

PLN-5001-001

DMS-100 FAMILY

# DMS SuperNode

## Technical Specification

BCS36 and up Standard 02.09 March 2000

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This equipment has been tested and found to comply with the limits for a Class A digital device pursuant to Part 15 of the FCC Rules, and the radio interference regulations of the Canadian Department of Communications. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at the user's own expense. Allowing this equipment to be operated in such a manner as to not provide for proper answer supervision is a violation of Part 68 of FCC Rules, Docket No. 89-114, 55FR46066

This equipment is capable of providing users with access to interstate providers of operator services through the use of equal access codes. Modifications by aggregators to alter these capabilities is a violation of the Telephone Operator Consumer Service Improvement Act of 1990 and Part 68 of the FCC Rules

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## About this document

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This document describes the technical specifications of the functional capabilities for the DMS-100 Family System with emphasis on the DMS SuperNode switching system. The capabilities described in this document represent the switch capabilities at a particular point in its evolution. The dynamic nature of the telecommunications industry will cause future product capabilities to exceed those represented in this current issue of the Technical Specification. For this reason, the DMS Family of switches and their capabilities are under continuous development and improvement.

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**Note 1:** Note that while this publication is entitled DMS SuperNode Technical Specification, its contents also include some references to the DMS-100 Family of switching systems and NT40 processors. This current document has the same organizational format as the *DMS-100 Family Technical Specification* (PLN-1001-001), which is available to Nortel Network's NT40 customers.

**Note 2:** Throughout this publication we referred to DMS-100 Family switching system. Within this context, we also include the DMS SuperNode.

This document describes the DMS SuperNode capabilities as outlined in these chapters:

### **Chapter 1: System capacity and performance**

Capacity models are used in this chapter to describe the capacity of the DMS SuperNode switching system. The capacities of the Central Processing Unit (CPU), from the DMS-100 F to the DMS SuperNode architectural evolution, its components and comparable Network and Peripheral Modules are discussed. In addition, the performance and service standards are described in detail.

### **Chapter 2: Engineering description**

This chapter describes the hardware and software of the DMS SuperNode and the DMS-100 F switches. The hardware description includes the basic

modules of the system as well as the four functional areas of the basic switching systems configuration. Software system are described in detail.

### **Chapter 3: Features**

This chapter describes the customer features that are available with the DMS-100 family switching systems. These features are described in this chapter as they relate to the features as set forth in the Bellcore LATA switching system generic requirements (LSSGR) Tr-Tsy 000064, Issue 1, June 1989. For ease of reference, the feature numbers used in the LSSGR are indicated next to the corresponding DMS-100 and DMS SuperNode features. Features that are provided by the DMS-100 family switch but are not listed in the LSSGR are included in this chapter and are given a number with the suffix "A." This number indicates the appropriate area that they would appear in the LSSGR and the "A" indicates that the described feature is in addition to the LSSGR requirements.

### **Chapter 4: Call processing**

Call processing is accomplished through a combination of call processing support and applications software. This combination provides a common software architecture that supports many different types of calls. The application of this architecture to specific types of calls is illustrated in this chapter through examples of the software that is required to process several representative types of calls.

### **Chapter 5: Signaling and interfaces**

The signaling descriptions in this chapter specify the supervisory, address, and other signals used in the DMS-100 family system of switches. This chapter also describes the interfaces used by the DMS-100 family switching system to interconnect with the outside world.

### **Chapter 6: Administration**

This chapter covers the administrative and operational aspects of the DMS-100 family system.

### **Chapter 7: Maintenance**

The MAP provides an interface between the DMS-100 family systems and the operating company personnel. The tasks performed at the MAP include general maintenance, administration, trunk testing, and line testing functions. This chapter describes the MAP and how it is used to perform these various functions.

### **Chapter 8: Transmission**

Analog and digital transmission specifications are described in this chapter. Network interface characteristics and clock synchronization are also discussed.



### **Chapter 9: Equipment**

This chapter describes the physical and environmental attributes of the DMS-100 family system.

### **Chapter 10: Power requirements**

The ac and dc power requirements of the DMS-100 family system are described in this chapter. Grounding arrangements are also discussed in this chapter.

### **Chapter 11: Documentation**

A variety of documents are available to support and maintain the DMS-100 family system of switches. These documents include practices, drawings, manuals, and a variety of other documents. This chapter describes the different documents that are available.

### **Chapter 12: List of terms and abbreviations**

This chapter lists the most used terms and abbreviations found throughout this document.

This issue of the DMS SuperNode Technical Specification supersedes and replaces all prior issues.

Additional copies of this document may be ordered by contacting your telephone operating company documentation coordinator or by calling the Nortel Networks Product Documentation department (include purchase order number) at the following toll-free number.

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# Chapter 1: System capacity and performance

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## Capacity overview

This section is intended to provide system personnel with processor capacity information and guidelines for the DMS-100 Family switches.

Interworkings of the processor must be understood before using capacity information and guidelines. The interworkings involve these functions: types of work performed, how time is allocated, and how changing conditions are handled.

The processor has 100 percent of real time available to execute tasks. These tasks are defined as being related to call processing processes or overhead processes. Overhead processes handle the overall system operations from system sanity to monitoring tools, whereas call processing systems deal with the handling of calls to the recording of billing information.

Overhead processes that perform similar or related functions are grouped into scheduler classes. These classes allocate a portion of processor real time based on their contribution to the overall switch performance. The classes associated with overhead processes are as follows:

- schedule
- maintenance
- system (pre-BCS28: System 7)
- system tools (pre-BCS28: System 6)
- guaranteed terminal (pre BCS28: guaranteed background)
- background
- idle (pre BCS28: System 0)
- audit (deferred background)
- guaranteed OM
- non-guaranteed OM
- network operation system file transfer

The call processing processes that perform similar or related functions are grouped into scheduler classes and input/output (I/O) interrupts. The classes and I/O interrupts are allocated a portion of processor real time based on the traffic demand on the switch. The classes and I/O interrupts associated with call processing processes are as follows:

- call processing
- high priority call processing
- deferrable call processing
- I/O interrupts

With the work for the processor divided into classes, allocation of processor real time must be set for each class. This document defines how time is allocated to the different classes and how time allocations fluctuate due to changing variables. Some of the variables are call types mixes, call processing occupancies, and engineering factors.

The engineering of real time utilized in the overhead classes of the processor are usually evaluated at three different grade-of-service levels at high day busy hour. These three grades are defined as:

- Twenty percent of attempts experience dial tone delay (DTD) or incoming start to dial delay (ISDD) greater than 3 sec.
- Eight percent of attempts experience DTD or ISDD > 3 sec.
- One and one-half percent of attempts experience DTD or ISDD > 3 sec.

<b>Table 1-1 Real-time allocations/Grades-of-service</b>		
<b>% DTS/ISDD</b>	<b>NT40 (40 Mhz) overhead/CP</b>	<b>DMS SuperNode overhead/CP</b>
1.5%	21.5% / 78.5%	18.0% / 82.0%
8.0%	18.9% / 81.1%	14.5% / 85.5%
20.0%	17.0% / 83.0%	14.0% / 86.0%

As the DMS-100 Family switch evolved over the years, the processor has been enhanced. The earliest processors are referred to as NT40 and the latest series of processors are called DMS SuperNode (SN). To date the NT40 has two versions, one with a 36 MHz clock and the other one with a 40 MHz clock. However, the DMS SuperNode currently has four versions: SN10, SN20, SN30, and SN40. One additional version is planned for 1992, SN50. The enhancements of the SN series range from faster clock speeds to new memory access techniques.

The results of the more efficient processors are the use of less processor real time required to handle call processing and overhead tasks. The table below

reflects the capacity increases provided by the enhanced processors compared to the NT40 (36 MHz).

<b>Table 1-2 Capacity increases</b>		
<b>Processor</b>	<b>Planned</b>	<b>Actual</b>
NT40 (36 MHz)	Base	Base
SN10	1.3 – 1.6	1.38
SN20	2.0 – 2.2	2.14
SN30	2.9 – 3.0	3.21
SN40	3.4 – 3.8	NA
SN50	5.0+	NA

Real time allocations for work on the different types of processors are provided in this section. NT40 (36 MHz), NT40 (40 MHz), and SN10 processor allocations are considered equal to each other and are referred to as the NT40 processor throughout this document. The SN20 and SN30 processor allocations are also considered equal to each other and are referred to as SN processor throughout this document.

## Real time allocation

### System operating software (SOS) scheduler

There are several hundred concurrent processes that perform a variety of functions. Processes that perform similar or related functions are grouped into scheduler classes. The SOS scheduler allocates processor real time to the processes using scheduler classes, along with priority of classes and timeslices for the classes.

A timeslice is expressed as a number of ticks (a clock interrupt every 6.25 ms for the NT40 and 12.5ms for the DMS SuperNode). When a process is created, it is assigned a timeslice.

### Processor real time allocations

Table 1-3 shows the typical real time usage by the classes under full call processing load (20% DTD > 3 sec.) on a fault free switch versus real time allocations (overhead allocations set to minimum values) guaranteed to the class by the switch if needed.

Note that the Scheduler class, the System class, and System Tool class are referred to as non-scheduled classes, meaning that they use real time that they need and are not allocated a set amount of real time at capacity. The values given for these classes under real time allocation of processor classes in Table 1-3 are typical real time usage at capacity.

<b>Table 1-3 Real-time allocation of processor classes</b>		
<b>Class name</b>	<b>Typical real time usage at capacity</b>	<b>Real time allocations at capacity</b>
Scheduler	3.0%	3.0 %
System/System tool	1.0%	1.0 %
Maintenance	3.0%	8.0 %
Background/Idle/Audits	4.0%	3.0 %
Guaranteed terminals (GTERM)	1.0%	2.0 %
GOM & NGOM	2.0%	3.0 %
NETMTC	0.0%	0.0 %
NOSFT	0.0%	0.0 %
AUXCP	0.0%	1.0 %
HPCP,CP,DEFCP,I/O	86.0%	79.0 %
Total real time	100%	100.0 %
<b>Note:</b> GOM = Guaranteed OM, NGOM = Non-guaranteed OM, NOSFT = Network operation system file transfer, AUXCP = Auxiliary call processing, HPCP = High priority call processing, CP = Call processing, DEFCP = Deferrable call processing.		

Table 1-3 shows that 86 percent of processor real time is available for call processing classes where as 14 percent of real time is given to overhead classes in a typical office. These allocations of processor real time to overhead classes versus call processing classes vary due to switch conditions and scheduler demands. As the switch conditions cause overhead requirements to increase, real time available for call processing will decrease. Therefore, if overhead requirements are higher than 14 percent of processor real time, the maximum call processing allocation will be less than 86 percent. This is because the overheads can use all their real time allocations if they need the real time to process the work.

Classes do not always use their full allocation of the fixed component, but if required, it is available to them. When extra fixed time allotments are available, they can be used by other classes.

Within the assignable component, the proposition of processor real time that the scheduler allocates to scheduler classes depend on several factors like:

The presence of certain applications programs, for example, NOSOFT.

The amount of processor real time required by maintenance, as demands for maintenance by the switch increase, the scheduler allocates more time for this class.

The scheduler class demands more assignable component of time when extra processor real time is available. This is because the scheduler is looking for work for the processor to perform.

The call processing classes use only the assignable component and can, if needed, use all of the assignable component of time. While the processor is running below its capacity, assignable time is available to all other classes in whatever amounts they require.

### **Overhead classes**

Overhead tasks have a complex interrelationship with each other and are application dependent. Real time allocation algorithm controls are implemented in the operating system scheduler to guarantee that each class receives a predefined minimum processor allocation of real time across all call processing occupancies. These allocations, for a typical plain ordinary telephone service (POTS) office, were obtained from modeling as well as load and volume testing in existing offices.

### **Scheduler class**

The scheduler controls the allocation of processor real time after I/O, clock, and scheduler interrupts have taken their share. Remaining real time is divided up between all the other classes. The scheduler allocation can range from 6 percent of NT40 (4 percent of SN) fixed time up to 35 percent of NT40 (35 percent of SN) fixed/assignable time based on call mix, call volume, and system critical maintenance. When real time requirements for call processing classes are low, the scheduler looks for additional activities to schedule into the processor, causing the scheduler to consume more processor real time. Conversely, as real time requirements for call processing increase, call processing classes give up control of the processor less often, which means less scheduling. The scheduler will run higher than 6 percent NT40 (4 percent SN) at maximum call processing occupancies in traffic operator position system (TOPS) and Meridian Digital Centrex (MDC) offices due to the handling of complicated I/O messages. The scheduler in these applications can run up to 18 percent.

### **System class and systemtool class**

System class and systemtool class are used for critical system operations. Both of these classes used as much processor real time as they require, meaning that the processor real time used by these classes is not restricted by the scheduler. In a typical office, these two classes combined use is less than 1 percent of NT40/SN processor real time at capacity. The 1 percent of real time is from the fixed component and any required value above 1 percent is taken from assignable component.

### **Maintenance class**

The scheduler allocates 2 percent of NT40 (1 percent of SN) processor real time to the maintenance class. Under normal operating conditions, this class only used the 2 percent of NT40 (1 percent of SN) fixed component. If maintenance requirements exceeds the minimum guaranteed time, the extra real time allotment is taken from the assignable component.

Any portion of real time allotment not used by maintenance class is available to other scheduler classes and is normally used by call processing classes. But on the other hand, any unused processor time allotted to the call processing classes is made available to maintenance.

Functions within this class include:

- dialtone speed recorder (DTSR)
- receiver attachment and delay recorder (RADR)
- network maintenance
- reloading new peripheral
- overhead for maintenance diagnostic processes
- device independent recording package (DIRP) audits

### **Guaranteed terminal (GTERM) class**

The office parameter `GUARANTEED_TERMINAL_CPU_SHARE` controls the percentage of processor real time that the scheduler allocates to Guaranteed Terminal class at capacity. This parameter has a range of 2 percent NT40 (2 percent SN) to 16 percent NT (16 percent SN), with a default value of 2 percent. The first 2 percent is part of the fixed component, and the rest is from the assignable component.

Any portion of the assignable component not used by `GUARANTEED TERMINAL` class is available to other classes and is normally used by call processing classes.

Functions within this class include: Log and MAP devices defined as guaranteed in Tables `TERMDEV` and `LOGDEV`.

`GUARANTEED TERMINAL` class runs before `SYSTEMTOOL` class, thus `GUARANTEED TERMINAL` can not be locked out by `SYSTEMTOOL` class.

### **Guaranteed operational measurements (GOM) class and non guaranteed operational measurements (NGOM) class**

Operational measurements (OM) data is gathered continually to monitor the performance of the switch. Examples of OM data include receiver and trunk usage and event counts. The OM system organizes the measurement data and manages data transfer to the display units and recording devices.



The scheduler guarantees 3 percent of NT40 (2 percent of SN) processor real time at capacity to the GOM and NGOM classes. The GOM class uses as much of this time as required (usually less than 1 percent), and the remainder of the time goes to the NGOM class. If any portion of this time is left over, it is made available to the BACKGROUND and AUDIT classes.

OM transfer process runs in GOM class and the sampling process runs in NGOM class.

### **Background (BGK) class and AUDIT class**

The scheduler guarantees 3 percent of NT40 (4 percent of SN) processor real time at capacity for BGK and AUDIT classes. BGK class is guaranteed 2.7 percent NT (3.7 percent SN) and AUDIT class is guaranteed 0.3 percent NT (0.3 percent SN). Any unused BGK class time is given to AUDIT class.

Any processor real time not used by the OM scheduler classes is made available to these two classes first.

Functions within BKG class include: most terminals, OM accumulation, line and trunk maintenance, and critical audits.

AUDIT class is for slow running audits and processes that do not require fast turn around time.

### **IDLE class**

IDLE class is provided time only if all the other classes have nothing to do. Therefore, at full load, IDLE gets 0 percent.

The idle process and call processing resource audit run in this class.

### **Network operating software file transfer (NOSFT) class**

NOSFT class, which is used by the processes communicating with a DNC, is limited to 3 percent of NT40 (3 percent of SN) processor real time (assignable time) at capacity. If a switch is not connected to a DNC then the 3 percent is provided to the call processing classes first.

Currently the processes for file transfer run in MAINTENANCE class instead of NOSFTG class. This means that NOSFT class will always be 0 percent and MAINTENANCE class allotments will increase when a DNC is connected to the switch.

:

- high priority call processing (HPCP)
- call processing (CP)
- deferrable call processing (DEFPCP)
- call processing-I/O Interrupts

They comprise a total maximum CPU call processing allocation (assignable component) of 183 percent NT40 (8 percent SN).

### **Call processing-I/O interrupts (I/O)**

I/O Interrupts handle interrupts from the peripheral modules, typically using 11 percent of NT40 (11 percent of SN) processor real time. The interrupts involve on-hook, off-hook, digits, flash, and so on.

### **High priority call processing (HPCP) class, call processing (CP) class, deferrable call processing (DEFCP) class**

The scheduler will give these classes up to 72 percent of NT40 (75 percent OF SN) processor real time at full load in an ideal POTS office with no engineering factors.

Functions within these classes are: call processing, AMA, call setup, translations, network connections, terminations, feature activations, AMA disk and I/O queue handling.

## **Planning and engineering**

The engineering of a DMS-100 Family switch (DMS SuperNode included) comprises a number of steps that must be accomplished in order to establish and manage the loading of the processor. Responsibility for this engineering of switch application belongs to both the telephone operating company and Nortel Networks. The telephone operating company forecasts the expected requirements for lines, trunks, features, and traffic rate. Then this information is entered into Nortel Networks' planning and provisioning tools to size the engineerable items for a specified level of performance. The combination of telephone company data and Nortel Networks' engineering rules produce an engineering application.

Engineerable items, such as PM capacity and software features, that could limit the maximum carried traffic for a switch must be identified. An office has physical limitations (lines, trunks, ports), by traffic types, or by both. Office limitations are tracked against office growth to ensure a well engineered switch.

### **Engineering factors**

Engineering factors listed in the following table must be considered when determining processor loading, because these factors affect the switch's overall call processing capacity. The factors influence the percent of real time allocated between overhead and call processing. Some of the factors like ACTIVITY tool are optional, but when activated will add to the minimum overhead requirements. Factors like average work time (AWT) and peaking are traffic characteristics that can also increase the overhead

requirements. As a result, these factors can decrease maximum call processing occupancy.

<b>Table 1-4 Processor engineering factors</b>		
<b>Factor</b>	<b>NT40</b>	<b>DMS SuperNode</b>
Activity Tool (OVERHEAD)	2.0%	1.0%
Activity Tool (CALL PROC)	2.0%	3.0%
Average Work Time	0.0 to 7.0%	0.0 to 4.0%
Maintenance	0.0 to 2.0%	0.0%
EADAS	2.0%	1.0%
SES	0.5%	0.3%
DNC/9600 BAUD	0.0 to 3.0%	0.0 to 1.5%
DNC/19200BAUD	0.0 to 0.5%	0.0 to 2.5%
Eng. Background	0.0 to 14.0%	0.0 to 7.0%
Peaking	2.0 to 14.0%	2.5%
CPUSTAT	1.0%	0.5%
SYNC	1.0%	1.0%
SMDI	Calculated	Calculated
AABS	Calculated	Calculated

The following information describes the engineering factors as shown in the above table:

#### **Activity tool factor**

The ACTIVITY tool is a measuring tool that allows Nortel Networks and the operating company personnel to accurately determine the performance of the switch. The processor activities which drive the measurement use approximately 4 percent of NT40 (4 percent of SN) processor real time. This 4% allocation is split between overhead which uses 2 percent NT40 (1 percent SN) and call processing which uses 2 percent NT40 (3 percent SN). processor real time is not required when the tool is inactive.

#### **Average work time (AWT) factor**

AWT is the average amount of central processor time spent processing each call. The level of messaging complexity associated with each call type will effect how much time is spent processing each call. For instance, the amount of messaging involved in processing a TOPS call type will be greater than a POTS call type. Depending on call mix and type, different offices will have different average work times. Increased AWT will increase the amount of time the processor spends treating call attempts in progress versus accepting new origination work.

Table 1-5 below shows AWT Factor percents used for the different AWT values at three different grade-of-service levels:

<b>Table 1-5 DMS SuperNode AWT factor percents</b>			
<b>AWT</b>	<b>1.5% DTD</b>	<b>8.0% DTD</b>	<b>20.0% DTD</b>
< 7.5ms	0.0%	0.0%	0.0%
7.5ms – 12.4MS	2.0%	1.0%	0.0%
12.5ms – 20.0ms	3.0%	1.0%	1.0%
> 20.0ms	4.0%	2.0%	1.5%

<b>Table 1-6 NT40 AWT factor percents</b>			
<b>AWT</b>	<b>1.5% DTD</b>	<b>8.0% DTD</b>	<b>20.0% DTD</b>
< 15.0ms	0.0%	0.0%	0.0%
15.0ms – 25.9ms	3.0%	1.0%	1.0%
26.0ms – 40.0ms	6.0%	2.0%	2.0%
> 40.0ms	7.0%	3.5%	3.0 %

### **Maintenance factor**

In a well maintained office during high traffic, the MAINTENANCE class should use only 2 percent of NT40 (1 percent of SN) processor real time at high traffic periods. If maintenance requirements tend to go above the 2 percent NT 40 (1 percent SN), this extra real time demand must be accounted for in the maintenance factor.

### **EADAS-DC and EASDAS-NM factors**

If the office is equipped with EADAS-DC (engineering administration data acquisition system—data collection) and/or EADAQS-NM (engineering administration data acquisition System—network management), then 2 percent of NT40 (1 percent of SN) processor real time is required.

If the office is not equipped, then 0 percent of processor real time is used for the engineering factor.

### **SES (service evaluation system) factor**

SES checks completion of a line/trunk call. It uses 0.5 percent of NT40 (0.3 percent of SN) processor real time when turned on. SES uses 0 percent of processor real time when inactive.

### **DNC 9600 baud and DNC 19200 baud factors**

The dynamic network control (DNC), depending on the specific application, has the ability to gather and store large quantities of data from several DMS switches simultaneously. The demand for real time depends on the rate of data transfer. Both engineering factors use 0 percent of processor real time when inactive.

Further information can be found in SEB 89-04-001, business network management (BNM) Impact on the DMS switches.

### **Engineerable background factor**

With engineerable background, the operating company has the ability to expand the maximum processor allocation for priority devices above 2 percent NT40 (2 percent SN) minimum allocation. This option allows the amount of processor allocation for priority devices to increase at the expense of call processing classes, if required.

The basic minimum 2 percent allocation for guaranteed background class allows for the following:

NT40—One priority device with 100 percent duty cycle or 2 percent per two priority devices with 50 percent duty cycle.

DMS SuperNode—Allow 1 percent per priority device with 100 percent duty cycle, or 1 percent per two priority devices with 50 percent duty cycle.

Any terminal requirements greater than above during periods of high call processing must be accounted for in engineerable background factor. As a guideline for additional terminal requirements the following applies:

NT40—Allow 2 percent per priority device with 100 percent duty cycle, or 2 percent per two priority devices with 50 percent duty cycle.

DMS SuperNode—Allow 1 percent per priority device with 100 percent duty cycle, or 1 percent per two priority devices with 50 percent duty cycle.

If the number of priority device requirements are below the basic minimum, then the engineering factor is 0 percent of processor real time.

### **Peaking factor**

Traffic peaking refers to a sudden increase in the amount of offered traffic versus the average traffic over a given time period. The grade-of-service level can be affected during periods of traffic peaks, for this reason traffic peaking should be considered when engineering the load level of the processor. Adding 2–4 percent NT40 (2.5 percent SN) for peaking is a safety margin to ensure desired grade-of-service is maintained at traffic peaks.

A study of over 50 field offices was conducted to determine the effects of peak traffic on grade-of-service. The conclusions of the study indicates that 95 percent of the offices had an average fifteen minute peaking over the office Busy Hour, requiring less than 2-4 percent of NT40 (2.5 percent of SN) real time in maximum high day loading to achieve the average 20 percent DTD > 3 second grade-of-service level criteria. Therefore, the NT40 2-4 percent (POTS-2 percent, MIC-3 percent, TOPS-4 percent, ACCESS TANDEM-4 percent) and SN 2.5 percent (all office types) compensation factors are considered to be conservative. If peaking is not required then the engineering factor is 0 percent of processor real time.

### **CUPSTAT factor**

The operational measurement, CUPSTAT outputs processor occupancy information in much the same way as the ACTIVITY tool. With CUPSTAT active during periods of maximum call processing, the NT40 CUPSTAT Factor is 11 percent (SN is 0.5).

Further information on CUPSTAT can be found in SEB 88-04-002, Enhanced CC real time Indicator.

### **SYNC factor**

In an access tandem office a call processing phenomenon referred to as harmonic effect can take place when a processor reaches 85 percent-90 percent of capacity. A feature called bleed (0-3) can be used to lessen the effect of this phenomenon. When bleed is set to maximum there is only a 1 percent NT40 (1 percent SN) impact on processor real time.

Further information on harmonic effect can be found in SEB 88-06-004, Access Tandem Harmonic Effect.

### **SMDI factor**

Simplified messaged desk interface (SDMI) messaging real time requirements must be calculated for each individual application. SEB 88-06-002, SMDI messaging capacity can be used, as it refers to performing these calculations.

### **AABS factor**

Automated alternate billing service (AABS) message handling process, called MPCFASTO, operates in the maintenance class. All the other AABS functionality operates in call processing processes. The impact of AABS on real time can be calculated using SEB 89-07-001, Automated Alternate Billing Service Performance Engineering Guidelines.

## **Call timings for DMS SuperNode (DMS-core)**

DMS-Core call timings for real time planning purposes and for a series of office models that are representative of general office configurations. New

call timing models were introduced in BCS32 to better represent the U.S marketplace as it is today.

DMS-core call timings are measured in a laboratory environment. The hardware and software in the laboratory is configured to emulate realistic switch parameters, and the call timings have been measured in the following configuration:

### **DMS-core call timings configurations**

CC	DMS-core series 20
20 MHz clock	In sync
DTSR	Unbound
LOGAMA	Off
AMA tape mounted	No
BELLCORE AMA	Yes
Data billed to disk	Yes
UTRs	Yes
SMDR	Off
TOPS EBAF	Phase 2
Data cache	On
Cache parity	On

Beginning with BCS32, universal tone receivers (UTRs) are on and automatic message accounting (AMA) is billed to disk. EBAF phase 2 is used on TOPS calls.

The call timings in this section are always reported in milliseconds and are considered to be within plus or minus 5 percent accuracy unless otherwise noted.

Call timings are categorized as follows:

- actual
- derived
- estimated

### **Actual call timings**

Actual call timings are those measured in the current BCS.

### **Derived call timings**

Derived call timings are used to determine the real time cost of specific features. These call timings are utilized as adjustments to base call types for capacity planning purposes. Timings followed by the letter “D” indicate derived call timings.



### **Estimated call timings**

Estimated call timings are determined by using current base measured call timings along with design estimates. These estimated call timings are considered to be accurate within plus or minus 15 percent accuracy. Timings followed by the letter “E” indicate estimated call timings.

A series of call type models representative of general office configurations are provided as well as a complete list of all call timings measured at each BCS interval.

An asterisk (\*) next to each call timing indicates as AMA record is included in the timing. A double asterisk (\*\*) next to the call type or timing indicates that the call type is included in the REAL::TIME capacity planning tool.

Finally, a listing of estimated call timings for various features and call types is provided. These features and call types have been included in the REAL::TIME tool for estimating future CPU capacity requirements.

The REAL::TIME capacity planning tool or timings provided should be used to estimate the CPU real time impact for various offices.

### **CPU call timing models**

The following is a series of office models that are representative of general office configurations in the U.S. marketplace. These models are introduced for the first time with BCS32 and will serve as a baseline for future BCS comparisons. Unlike call timing models utilized in the past, these models contain significant penetrations of custom calling, CLASS and business services.

Call timing models are defined as follows:

suburban	residential end office
urban	business end office
access tandem	tandem office
TOPS	combination of operator services and access tandem

Each call timing model is configured as discussed in the following paragraphs.

#### **Base model**

The base model contains the basic traffic mix of line-line, line-trunk, trunk-line and trunk-trunk calls.

#### **Feature model**

The feature model contains feature penetrations within the base model. Feature adjustments are applied as necessary to the base model. The actual

feature mix utilized with each model was determined through studies conducted in various field offices.

**Model summary**

The model summary provides the maximum call rate possible for each processor series. The average work time in milliseconds for each processor is also provided.

Actual office BCS impact for a specific traffic mix can be estimated by using the REAL::TIME capacity planning tool.

The DMS-core has a maximum call processing capacity of 86 percent. This percentage has been adjusted when necessary to allow for AWT. Table 1-7 below illustrates the percentage adjustment needed at various levels of AWT for each series of processor. For example, in the urban model, an AWT of 22.4 ms (Series 20) equates to a 1.5 percent adjustment to the maximum call processing of 86 percent.

<b>Table 1-7 DMS-core average work time (AWT) adjustments 20% grade of service</b>	
<b>AWT (average MS)</b>	<b>Call processing adjustments</b>
<b>Series 20 processor</b>	
< 12.6 ms	0%
12.6 ms to 20.0 ms	1%
>20.0 ms	1.5%
<b>Series 30 processor</b>	
< 8.7 ms	0%
8.7 ms to 13.3 ms	1%
>13.3 ms	1.5%
<b>Series 40 processor</b>	
< 7.2 ms	0%
7.2 ms to 11.1 ms	1%
> 11.1 ms	1.5%
<b>Series 50 processor</b>	
< 5.3 ms	0%
5.3 ms to 8.0 ms	1%

<b>Table 1-7</b>	
<b>DMS-core average work time (AWT) adjustments 20% grade of service</b>	
<b>AWT (average MS)</b>	<b>Call processing adjustments</b>
> 8.0 ms	1.5%
<b>Note:</b> Actual office BCS impact can be estimated by using the capacity prediction tool REAL::TIME	

<b>Table 1-8 Suburban model DMS-core series 20 processor</b>				
<b>Base model</b>		<b>BCS35 RTM weighted ms/CA</b>		
<b>Call type</b>	<b>Call description</b>	<b>Mix</b>	<b>Call</b>	<b>Time</b>
994	POTS 1FR-POTS 1FR	19.3%	0.1	1.949
995	POTS 1FR-EAS trunk (MF)	12.0%	8.0	0.960
402	POTS IFR-toll trunk (MF/FGD)	2.4%	17.5	0.420
577	POTS IFR-EAS trunk (SS7)	12.0%	11.1	1.332
1226	POTS 1FR-toll trunk (SS7/FGD)	2.4%	19.6	0.470
996	MF trunk-POTS 1FR	12.8%	7.1	0.909
580	SS7 trunk-POTS 1FR	12.8%	10.3	1.318
014	Line ineffective	18.0%	2.5	0.450
946	Trunk ineffective	3.0%	2.8	0.084
993	Partial dial	5.3%	3.7	0.196
<b>Feature model</b>		<b>Mix</b>	<b>Call</b>	<b>Time</b>
POTS Custom calling / orig.		4.8%	0.0	0.000
POTS Custom calling / term.		4.5%	0.3	0.013
Call waiting / term.		1.7%	50.3	0.858
3-Way calling / orig.		1.0%	69.5	0.669
Call forward / term.		1.3%	4.0	0.054
Speed calling / orig.		1.0%	-0.3	-0.003
Residential enhanced services CLASS / orig.		4.8%	2.1	0.101
Residential enhanced services CLASS / term.		4.5%	4.2	0.189
Automatic call back nodal delayed / orig.		0.5%	59.0	0.273
Automatic call back network delayed / orig.		0.7%	89.9	0.587
Customer originated trace / term.		1.1%	15.9	0.171
Automatic recall nodal immediate / term.		0.7%	7.3	0.048
Automatic recall network immediate / term.		0.9%	5.8	0.052
Calling number delivery block / orig.		1.4%	5.7	0.082
Selective call forward / term.		1.1%	8.1	0.087
Simplified message desk interface / term.		0.3%	15.4	0.041

<b>Table 1-9 Urban model DMS-core series 20 processor</b>				
<b>Base model</b>		<b>BCS35 RTM weighted ms/CA</b>		
<b>Call type</b>	<b>Call description</b>	<b>Mix</b>	<b>Call</b>	<b>Time</b>
888	MDC line–MDC line	17.1%	9.7	1.659
889	MDC line–EAS trunk (MF)	11.1%	10.0	1.110
883	MDC line–toll trunk (MF/FGD)	6.5%	18.2	1.183
578	MDC line–EAS trunk (SS7)	11.1%	13.7	1.521
1228	MDC line–toll trunk (SS7/FGD)	6.5%	21.4	1.391
854	MF trunk–MDC line	17.5%	7.0	1.225
581	SS7 trunk–MDC line	17.5%	10.3	1.803
805	Line ineffective	7.2%	2.9	0.209
946	Trunk ineffective	3.0%	2.8	0.084
858	Partial dial	2.5%	7.9	0.198
<b>Feature model</b>		<b>Mix</b>	<b>Call</b>	<b>Time</b>
	MDC Custom call calling / orig.	26.2%	0.0	0.000
	MDC Custom call calling / term.	26.1%	6.5	1.693
	Call waiting / term.	1.0%	46.1	0.480
	3-way calling / orig.	5.2%	53.4	2.793
	Speed calling / orig.	1.0%	2.1	0.022
	Call forward no answer / term	15.6%	15.9	2.485
	Ring again / orig.	1.0%	46.9	0.491
	Call pick-up / term.	5.2%	21.3	1.110
	Call hold / orig.	1.0%	66.0	0.690
	Call transfer / term.	5.2%	28.6	1.490
	MDC CLASS / orig.	2.6%	2.1	0.055
	MDC CLASS / term.	2.6%	4.2	0.109
	Automatic call back nodal / orig.	0.3%	59.0	0.202
	Automatic call back network / orig.	0.7%	89.9	0.631
	Customer originated trace / term.	0.2%	15.9	0.027
	Automatic recall nodal / term.	0.6%	7.3	0.042
	Automatic recall network / term.	1.2%	5.8	0.070
—continued—				

<b>Table 1-9</b>				
<b>Urban model DMS-core series 20 processor</b> (continued)				
<b>Base model</b>		<b>BCS35 RTM</b>	<b>weighted ms/CA</b>	
<b>Call type</b>	<b>Call description</b>	<b>Mix</b>	<b>Call</b>	<b>Time</b>
	Calling number delivery block / orig.	1.0%	5.7	0.060
	Selective call forward / term.	0.5%	8.1	0.042
	Simplified message desk interface / term.	5.2%	15.4	0.802
	Multiple appearance directory number / orig.	5.2%	6.2	0.324
	Multiple appearance directory number / term.	5.2%	16.1	0.839
	Electronic business set with display / orig.	5.2%	0.0	0.000
	Electronic business set with display / term.	5.2%	3.9	0.203
End				

<b>Table 1-10</b>				
<b>Access tandem model DMS-core series 20 processor</b>				
<b>Base model</b>		<b>BCS35 RTM</b>	<b>weighted ms/CA</b>	
<b>Call type</b>	<b>Call description</b>	<b>Mix</b>	<b>Call</b>	<b>Time</b>
998	MF TI trunk – MF IT trunk	23.0%	7.7	1.771
1232	SS7 IT trunk – SS7 ATC trunk	60.0%	12.5	7.500
1230	MF trunk – SS7 ATC trunk	5.0%	11.7	0.585
1231	SS7 IT trunk – MF ATC trunk	5.0%	10.3	0.515
1233	E800 SS7 trunk – MF trunk)	3.0%	21.0	0.630
1234	E800 SS7 trunk – SS7 trunk	4.0%	23.1	0.924

<b>Table 1-11</b>				
<b>TOPS SA/HOC/DA/AT model DMS-core series 20 processor</b>				
<b>Base model</b>		<b>BCS35 RTM</b>	<b>weighted ms/CA</b>	
<b>Call type</b>	<b>Call description</b>	<b>Mix</b>	<b>Call</b>	<b>Time</b>
824	SA mechanized calling card service	11.0%	42.8	4.708
1178	SA AABS call card number 0+	10.0%	44.1	4.410
326	SA automated coin toll service	10.0%	36.6	3.660
1151	SA 411 external ARU	9.0%	37.2	3.348
—continued—				

**Table 1-11**  
**TOPS SA/HOC/DA/AT model DMS-core series 20 processor** (continued)

Base model Call type	Call description	BCS35 RTM Mix	weighted ms/CA Call	Time
1163	SA intercept external ARU	3.0%	18.8	0.564
1149	HOC 411 external ARU	7.0%	15.9	1.113
1128	HOC non-coin 0-	10.5%	21.8	2.289
1137	HOC coin 0+	4.6%	23.1	1.063
1130	SA non-coin 0-	14.7%	38.3	5.630
1139	SA coin 0+	6.2%	51.5	3.193
1232	SS7 trunk – SS7 trunk	8.0%	12.5	1.000
998	MF trunk – MF trunk	6.0%	7.7	.462
End				

**Table 1-12**  
**TOPS ROC/DA/AT model DMS-core series 20 processor**

Base model Call type	Call description	BCS35 RTM Mix	weighted ms/CA Call	Time
724	ROC mechanized calling card service	9.0%	42.8	3.852
1177	ROC AABS call card number 0+	8.0%	44.1	3.528
503	ROC automated coin toll service	8.0%	36.6	2.928
1150	ROC 411 external ARU	12.0%	37.4	4.488
1162	ROC intercept external ARU	3.0%	18.8	.564
1129	ROC non-coin 0-	10.4%	40.7	4.233
1138	ROC coin 0+	4.6%	53.8	2.475
1232	SS7 trunk – SS7 trunk	25.0%	12.5	3.125
1234	E800 SS7 – SS7 trunk	4.0%	23.1	.924
998	MF trunk – MF trunk	16.0%	7.7	1.232

<b>Table 1-13 Call timing model summary</b>		<b>SR20</b>
<b>Suburban model summary</b>		
Maximum calls/hour @ 86%		274,000
Average work time		11.314 ms
<b>Urban model summary</b>		
Maximum calls/hour @ 84.5%		121,000
Average work time		25.042 ms
<b>Access tandem model summary</b>		
Maximum calls/hour @ 86%		260,000
Average work time		11.925 ms
<b>TOPS SA/HOC/DA/AT model</b>		
Maximum calls/hour @C 84.5%		97,000
Average work time		31.440 ms
<b>TOPS ROC/DA/AT model</b>		
Maximum calls/hour @ 84.5%		111,000
Average work time		27.349 ms

<b>Table 1-14 Line originations</b>		
<b>Call type</b>	<b>Call description</b>	<b>ms per C/A SN20</b>
947	POTS DP 1FR – POTS DTMF 1FR line	10.2
005	POTS DP 1FR – LAMA trunk	12.4*
014**	POTS DTMF 1FR – false start	2.5
994**	POTS DTMF 1FR line – POTS 1FR line	10.1
015	POTS DTMF 1MR line – POTS 1FR line	14.7*
859	POTS DTMF 1FR line – MDC DTMF line	11.4
1059	POTS DTMF 1FR line – EBS with display	16.0
1236	POTS DTMF 1FR line – MADN primary	19.1
995**	POTS DTMF 1FR line – EAS trunk	8.0
—continued—		



<b>Table 1-14</b>		
<b>Line originations</b> (continued)		
<b>Call type</b>	<b>Call description</b>	<b>ms per C/A SN20</b>
016**	POTS DTMF 1MR line – EAS trunk	13.7*
3031	POTS DTMF 1FR line w/LPIC – ATC trunk	17.0*
378**	FGC 1+10 digits – AT (PIC)	16.4*
401	FGC 1+7 digits – IC (OCS on, PIC)	18.8*
402**	FGC 1+10 digits – AT(OCS on, PIC)	18.8*
974	POTS DTMF 1MR line – using AT TO IC FGD trunk	17.9*
949	POTS DTMF 1FR line – operator trunk	11.5
308	POTS DTMF 1MR line – busy	9.9
993	POTS DTMF 1FR line – abandon/6 digits	5.0
948**	POTS DTMF 1FR line – busy DTMF 1FR	8.4
967	POTS DTMF 1FR line – MF operator trunk	11.5
963	POTS DTMF 1FR line – MF PBX DID trunk	8.5
966**	POTS DTMF 1FR line – BLDN announcement	9.2
019**	Coin DTMF – POTS 1FR line	18.1*
020	Coin DTMF – EAS trunk	17.0*
910	FGB coin DTMF – AT MF	18.9
954	Coin DTMF – direct to IC F GD	22.0*
982	Coin DTMF – operator trunk	16.7
908	Coin DTMF – trunk (1+800)	18.0*
018	Coin DTMF – busy	12.7
054	PBX DOD trunk – POTS 1FR line	9.4
055	PBX DOD trunk – LAMA trunk	11.5*
915	FGB DTMF PBX DOD – AT MF trunk	11.4
917	FGD DTMF PBX DOD – AT MF trunk	17.1*
988	OUTWATS – direct to IC FGB trunk	14.9*
918	FGC DTMF OUTWATS – AT MF trunk	16.5*
989	OUTWATS – direct to IC FGD	16.8*
309	OUTWATS (ENHANCED) – ATC trunk	17.2*
—continued—		

<b>Table 1-14</b>		
<b>Line originations</b> (continued)		
<b>Call type</b>	<b>Call description</b>	<b>ms per C/A SN20</b>
899	MDC OUTWATS (ENHANCED) – ATC trunk	24.9
805	MDC DTMF – false start	2.9
888**	MDC DTMF – MDC line	9.7
1109	MDC DTMF (with SMDR) – MDC line	14.5
889	MDC DTMF – EAS trunk	10.0
882	FGC DTMF MDC – AT MF	16.6*
883	FGC DTMF MDS – AT MF	18.2*
884	DTMF MDC intraLATA – MF toll trunk	14.0
886	E800 EAE0 DTMF MDC – IC trunk	27.0*
873	MDC DTMF – without display	11.0
1199**	MDC DTMF – EBS with display	13.6
1224	MDC DTMF – EBS with display MADN 3 secondary members	29.1
1239**	MDC DTMF – EBS with display MADN 4 secondary members	31.2
874	MDC DTMF – MDC MF trunk	14.5*
857 **	MDC DTMF second DT – POTS 1FR	11.1
858	MDC DTMF – abandon after two digits	7.9
850	Attendant – MDC DTMF line (SCG)	13.6
891	EBS with display – EBS with display	14.8
892	EBS with display – EAS trunk	11.5
893	EBS with display – LAMA trunk	15.1*
863	EBS without display – EBS without display	11.9
894	EBS with display – EBS without display	12.2
885	EBS with display FGD – AT MF	20.1*
875	EBS without display – DTMF FX trunk	10.7
862	EBS without display – MDC DTMF DTMF line (SCG)	10.8
861**	EBS without display – attendant	11.7
1198**	EBS with display – MDC line	11.1
—continued—		

<b>Table 1-14</b> <b>Line originations</b> (continued)		
<b>Call type</b>	<b>Call description</b>	<b>ms per C/A SN20</b>
1238**	EBS with display MADN 4 secondary – MDC line	17.3
	Data path line	18.9E
	Data path – non-LAMA (EAS)	19.5E
	Data path – LAMA	29.2E
<b>End</b>		

<b>Table 1-15</b> <b>POTS custom calling feature (CCF) types</b>	
3-way calling	(3WC)
Call waiting	(CWT)
Speed calling	(SC1)
Call forward	(CFW)
Teen service	

<b>Table 1-16</b> <b>POTS custom calling features (CCF)</b>		
<b>Call type</b>	<b>Call description</b>	<b>ms per C/A SN20</b>
1065	1FR line (all CCF assigned) – 1FR line	10.0
1066	1FR line (3WC activated) – 1FR line	93.9*
1067	1FR line (SC1 activated) – 1FR line	9.7
1070	1FR line – 1FR line (CFU assigned)	10.2
1072	1FR line – 1FR line (all CCF assigned)	10.4
1073	1FR line – 1FR line (CFU activated)	14.4
1074	1FR line – 1FR line (CWT activated)	75.5*
1105	1FR line – 1FR line (3WC, SC!, CWT assigned)	10.0
1225	1BR line – 1FR line (teen service activated)	10.4

**Table 1-17**  
**MDC custom calling feature (CCF) types**

3-way calling	(3WC)
Call waiting	(CWT)
Speed calling short list	(SC1)
Speed calling long list	(SC2)
Call forward busy	(CFB)
Call forward universal	(CFU)
Call forward don't answer	(CFD)
Call transfer	(CXR)
Call hold	(CH)
Ring again	(RA)
Call pick-up	(CPU)

**Table 1-18**  
**MDC custom calling features (CCF)**

Call type	Call description	ms per C/A SN20
1085	MDC line – MDC line	10.8
1086	MDC line – (3WC activated) – MDC line	79.4*
1087	MDC line (SC1 activated) – MDC line	12.9
1088	MDC line – (SC2 activated) – MDC line	12.9
1089	MDC line – (CH activated) – MDC line	81.2*
1107	MDC line (RA activated) – MDC line	56.6
1092	MDC line – MDC line (CFU assigned)	11.6
1095	MDC line – MDC line (CFB assigned)	11.5
1096	MDC line – MDC line (CFD assigned)	16.2
1099	MDC line – MDC line (all CCF assigned)	16.4
1100	MDC line – MDC line (CFU activated)	17.2
1101	MDC line – MDC line (CWT activated)	83.3*
1102	MDC line – MDC line (CFB activated)	17.3
1103	MDC line – MDC line (CFD activated)	32.1
1104	MDC line – MDC line (CXR activated)	60.2*

—continued—

<b>Table 1-18 MDC custom calling features (CCF)</b>		
<b>Call type</b>	<b>Call description</b>	<b>ms per C/A SN20</b>
1106	MDC line – MDC line (3WC, SC1, SC2, CWT, CH, CXR assigned)	10.2
1108	MDC line – MDC line (CPU activated)	32.3
<b>End</b>		

<b>Table 1-19 RES custom local area signaling service (CLASS) types</b>	
Automatic call back	(ACB)
Automatic recall	(AR)
Calling number delivery	(CND)
Calling name delivery	
Calling number delivery blocking	(CNDB)
Selective call rejection	(SCRJ)
Customer originated trace	(COT)
Usage sensitive billing	(USB)
Selective call	(SCFWD)
Selective call acceptance	(SCA)

<b>Table 1-20 RES custom local area signaling services (CLASS) (continued)</b>		
<b>Call type</b>	<b>Call description</b>	<b>ms per C/A SN20</b>
3033	RES – RES	11.8
3034	RES COIN – RES	15.1
1205	RES – RES (ACB, AR, CND, COT assigned originating and terminating)	14.6
1258	RES (ACB, AR, CND, COT assigned) – RES	12.2
1259	RES (ACB, AR, CND, COT assigned) – RES	14.3
1206	RES – RES (ACB intraNODAL activated)	71.2
1207	RES – RES (AR intraNODAL activated)	21.6
1208	RES (ACB network activated) – SS7 – RES	116.5*
<b>–continued–</b>		

<b>Table 1-20 RES custom local area signaling services (CLASS) (continued)</b>		
<b>Call type</b>	<b>Call description</b>	<b>ms per C/A SN20</b>
1209	RES (AR network activated) – SS7 – RES	32.7*
1210	RES – RES (SCRJ activated)	24.3*
1211	RES – RES (SCFWD activated)	35.1*
1212	RES – RES (SCA activated)	29.2*
1213	RES – RES (DR activated)	29.1*
1214	RES – RES (COT activated)	15.9
1215	RES (CNDB activated) – RES	17.9
1216	RES (CNDB activated, USB on) – RES	20.7*
1217	IFR line – RES (CNAMD activated)	37.2*
1218	IFR line – RES (CND activated)	27.0*
3032	IFR line – RES (SCWID activated)	64.8*
3030	SS7 EAS trunk – RES (BCLID activated)	11.4*
<b>End</b>		

**Table 1-21  
RES simplified message desk interface (SMDI) types**

SMDI call forward busy	(CFB)
SMDI call forward don't answer	(CFD)
SMDI call forward always	(CFA)

<b>Table 1-22 RES simplified message desk interface (SMDI)</b>		
<b>Call type</b>	<b>Call description</b>	<b>ms per C/A SN20</b>
1220	RES – SMDI (direct)	30.0
1221	POTS 1FR — RES SMDI (CFR)	37.0
1222	POTS 1FR – RES SMDI (CFD)	49.4
1223	POTS 1FR – SMDI (CFA)	36.8

<b>Table 1-23 Incoming trunk origination</b>		
<b>Call type</b>	<b>Call description</b>	<b>ms per C/A SN20</b>
997**	MF tandem INCAMA trunk – tandem trunk	5.9
996**	MF trunk – POTS 1FR line	7.1
998**	MF IT trunk – trunk	7.7
453	MF IC trunk – POTS 1FR line	13.2*
999**	MF trunk – busy	9.8*
031**	MF trunk – INWATS line	14.4*
879	MF trunk – EBS without display	9.0
946	MF trunk – abandon (no start signal)	2.8
854	MF POTS trunk – MDC DTMF line	8.3
046	MF INCAMA trunk – POTS 1FR line	11.7*
048	MF INCAMA trunk – trunk	10.5*
456	IC carrier trunk – trunk	11.3*
991	IC trunk – MF PBX DID (PX)	10.8*
455	IT trunk – IC carrier trunk	7.7
919	FGC MF incoming trunk – IC trunk	15.5*
920	FGD MF incoming trunk – IC trunk	16.9*
921	MF incoming trunk – tandem MF IT trunk	17.1*
855	MDC MF trunk – MDC DTMF line	8.1
856	MDC DTMF FX trunk – MDC DTMF line (SCG)	10.7
868	MDC MF trunk – attendant	9.4
958	MF PX DOD trunk DIG (PX) – direct to IC trunk	17.5*
959	MF PX DOD trunk DIG –using AT to IC trunk	15.6*
961	MF PX DOD trunk DIG – MF EAS trunk	8.3
986	DTMF PBX DOD (FX) trunk – operator trunk	10.7
987	MF PBX DOD trunk – operator trunk	10.3

<b>Table 1-24 E911 trunking</b>		
<b>Call type</b>	<b>Call description</b>	<b>ms per C/A SN20</b>
1201	FX trunk – E911 tandem	31.4
1202	E911 trunk – E911 tandem PSAP QRY	30.7
1203	E911 trunk – PSAP line with ORIGHOLD	55.4*
1204	E911 trunk – PSAP line with SBT – LDTPSAP	121.5

<b>Table 1-25 SS7 trunking</b>		
<b>Call type</b>	<b>Call description</b>	<b>ms per C/A SN20</b>
577**	DTMF POTS line – SS7 trunk EAS	12.4
1226	DTMF POTS line – SS7 trunk toll	19.6*
578**	DTMF MDC line – SS7 trunk EAS	13.7
1228	DTMF MDC line – SS7 trunk toll	21.4*
1219**	DTMF MDC line (with SMDR) – SS7 trunk	16.9
579	DTMF POTS line – SS7 EAS	16.1*
580**	SS7 trunk – DTMF POTS line	10.3
581	SS7 trunk – DTMF MDC line	10.3
1230	FGD MF trunk – SS7 trunk	11.7
1231	FGD SS7 trunk – MF trunk	10.3
1232**	FGD SS7 trunk – SS7 trunk	12.5
1233	FGD E800 SS7 trunk – MF trunk (database query)	21.0
1234	FGD E800 SS7 trunk – trunk	23.1
1235	FGB SS7 trunk – MF trunk	8.1

<b>Table 1-26 800 service</b>		
<b>Call type</b>	<b>Call description</b>	<b>ms per C/A SN20</b>
922	E800 DTMF 1FR – IC (DB query)	25.7*
924	E800 DTMF 1FR – IC (DB query)	25.1*
—continued—		



<b>Table 1-26</b> <b>800 service</b> (continued)		
<b>Call type</b>	<b>Call description</b>	<b>ms per C/A SN20</b>
928	E800 EAEO DTMF 1FR – AT (DB query)	26.4*
929**	E800 AT – IT (DB query)	22.9*
<b>End</b>		

<b>Table 1-27</b> <b>Call timing adjustments</b>	
<b>Call description</b>	<b>ms per C/A SN20</b>
Automatic message accounting	4.4D**
Originating MADN (1 primary; 4 secondary members)	6.2D
Terminating MADN (1 primary; 4 secondary members)	16.1D
Station message detail recording	3.2D**
MDC attendant console termination	0.7D
MDC attendant console origination	3.0D
UTR	-1.3D**
Alternate routing	0.6
Virtual facility group	0.8
Hunt group	1.0
Permanent signal	10.9D
EBS (P-phone)	3.9D**
ACD termination (line-line intra-office)	16.8D**
ACD termination (trunk-line)	12.3D**
ACD termination queue	8.2**
ACD with MIS	0.4D**
UCD termination	6.3D**
UCD termination queue	3.2D**
MDC second dial tone access	1.0D**

<b>Table 1-28 POTS feature activation</b>	
<b>Call description</b>	<b>ms per C/A SN20</b>
Call waiting (Ref. # 1074)	50.3D**
Three-way calling (Ref. # 1066)	69.5D**
Call forward (Ref. # 1073)	4.0D**
Speed calling Ref. # 1067)	-0.3D**

<b>Table 1-29 MDC feature activation</b>	
<b>Call description</b>	<b>ms per C/A SN20</b>
Call waiting (Ref. # 1101)	46.1D**
Three-way calling (Ref. # 1086)	53.4D**
Ring again (Ref. # 1107)	46.9D**
Call transfer (Ref. # 1104)	28.6D**
Call pickup (Ref. # 1108)	21.3D**
Call forward, no answer (Ref. # 1103)	15.9D**
Call forward, universal (Ref. # 1100)	7.5D**
Call forward, busy (Ref. # 1102)	7.6D**
Speed calling (Ref. #1087/1088)	2.1D**
Call hold (Ref. # 1089)	66.0D

<b>Table 1-30 CLASS feature activation</b>	
<b>Call description</b>	<b>ms per C/A SN20</b>
ACB intra-NODAL (Ref. # 1206) Delay	59.0D**
ACB – SS7 network (Ref. # 1208) Delay	59.6D
SI7 network – ACB (Ref. # 1208) Delay	29.8D**
AR intra-NODAL (Ref. # 1207) Immediate	7.3D**
AR – SS7 network (Ref # 1209) Immediate	5. 8D**
SS7 network – AR (Ref # 1209) Immediate	2.9D**
CND (Ref. # 1218)	1.3D**
—continued—	

<b>Table 1-30</b> <b>CLASS feature activation</b> (continued)	
<b>Call description</b>	<b>ms per C/A SN20</b>
CNAMD (Ref. # 1217)	11.5D**
CDNB	5.7D**
COT	15.9D**
Selective call rejection (SCRJ)	7.0D**
Selective call forward (SCFWD)	8.1D**
Distinctive ring	2.1D**
Selective call acceptance	2.2D**
Usage sensitive billing	2.8D
End	

<b>Table 1-31</b> <b>CLASS feature assignment</b>	
<b>Call description</b>	<b>ms per C/A SN20</b>
CLASS w/Outgoing memory (ACB)	1.1D**
CLASS w/Incoming memory (AR,COT,SCRJ,SCFWD,DRCW)	4.2D**

<b>Table 1-32</b> <b>Stand-alone TOPS configuration</b>		
<b>Call type</b>	<b>Call description</b>	<b>ms per C/A SN20</b>
316**	0-; OH; non-coin; information only, no outpulsing	24.1
314	0-; OH; non-coin; inter exchange carrier	42.8
315	0-; OH; non-coin; person paid; end office	38.1
513	0-; OH; non-coin; OVS; transfer IC; inter-LATA carrier	33.4
813	0-; OH; coin; person paid; end office; without rate step	51.4
819	0-; OH; person paid; end office; TICS	53.2
1142	0-; OH; non-coin; person paid; AMA; answer	61.5
824**	0+; M CCS; SS7 database; successful	42.8
327	0+; M CCS; no query database	33.9
—continued—		

<b>Table 1-32</b> <b>Stand-alone TOPS configuration</b> (continued)		
<b>Call type</b>	<b>Call description</b>	<b>ms per C/A SN20</b>
331	0+; OA; non-coin; station collect; end office	45.6
329	0+; OA; non-coin; station paid; end office	40.0
332	0+; OA; non-coin; person collect; end office	42.6
330**	0+; OA; non-coin; person paid; end office	39.9
509	0+; non-coin; inter-LATA carrier	17.3
814**	0+; OH; coin; person paid; end office; without rate step	49.7
818**	0+; OA; non-coin; person paid; end office; TICS	43.1
827	0+; OA; CCN; SS7 database; successful	57.0
828	0-; OA; BNS; SS7 database; verify collect	54.3
830	0+; OA; BNS; SS7 database; verify third number	79.8
326**	1+; ACTS; coin	36.6
321**	1+; CAMA; ONI; non-coin	25.5
322**	1+; ONI; successful validation	20.0
328**	1+; direct dialed; hotel; person paid	43.7
809	1+; OH; hotel; bill to room	41.9
815**	1+; direct dialed; coin; station paid; end office; without rate step	52.0
518	Queue search for CMA calls	29.8
520	Verify and connect	56.6
526**	Verify with scrambler	35.0
<b>End</b>		

<b>Table 1-33</b> <b>HOST OC TOPS configuration</b>		
<b>Call type</b>	<b>Call description</b>	<b>ms per SN20</b>
335**	0-; OH; non-coin; information only, no outpulsing	15.4
333	0-; OH; non-coin; interconnect carrier	23.1
334	0-; OH; non-coin; person paid; end office	21.6
—continued—		

**Table 1-33**  
**HOST OC TOPS configuration** (continued)

Call type	Call description	ms per SN20
531	0-; OH; non-coin; OVS; transfer IC; inter-LATA carrier	17.1
613	0-; OH; coin; person paid; end office without rate step	23.4
619	0-; OH; coin person paid; end office; TICS	23.7
1140	0-; OH; non-coin; person paid; AMA answer	36.2
340	0+; MCCS; no query database	2.6
488	0+; non-coin; station collect; end office	23.2
486	0+; OA; non-coin; station paid; end office	21.3
489	0+; OA; non-coin; person collect; end office	23.0
487**	0+; OA; non-coin; person paid; end office	21.4
614**	0+; OH; coin; person paid; end office; without rate step	22.7
618**	0+; OA; coin; person paid; end office; TCS	19.8
627	0+; OA; CCN; SS7 database; successful	25.3
628	0+; OA; BNS; SS7 database; verify collect	22.9
630	0+; OA; BNS; SS7 database; verify third number	39.4
341**	1+; CAMA; ONI; non-coin	12.7
342**	1+; ONI; successful validation	12.7
347**	1+; direct dial; hotel; person paid	23.4
609**	1+; OH; hotel; bill to room	20.3
615	1+; direct dial; coin; station paid; end office; without step rate	24.6
536**	Queue search for CAMA calls	14.6
538	Verify and connect	32.3
544**	Verify with scrambler	21.9
<b>End</b>		

<b>Table 1-34 Remote OC TOPS configuration</b>		
<b>Call type</b>	<b>Call description</b>	<b>ms per C/A SN20</b>
492**	0-; OH; non-coin; information only , no outpulsing	25.4
490	0-; OH; non-coin; interconnect carrier	45.5
491	0-; OH; non-coin; person paid; end office	41.0
549	0-; OH; non-coin; OVS; transfer IC; inter-LATA carrier	38.1
713	0-; OH: coin; person paid; end office without rate step	53.8
719	0-; OH; coin; person paid; end office; TICS	56.2
1141	0-; OH; non-coin; person paid; AMA answer	69.0
724**	0+; MCCS; SS7 database; successful	42.3
497	0+; MCCS; no query database	36.1
507	0+; OA; non-coin; station collect; end office	46.4
505	0+; OA; non-coin; station paid; end office	43.4
508	0+; OA; non-coin; person collect; end office	45.9
506**	0+; OA; non-coin; person paid; end office	43.4
545	0+; non-coin; inter-LATA carrier	18.1
714**	0+; non-coin; person paid; end office; without rate step	53.6
718	0+; OA; non-coin; person paid; end office; TICS	47.2
727	0+; OA; CCN; SS7 database; successful	61.8
728	0-; OA; BNS; SS7 database; verify collect	58.6
730	0+; OA; BNS; SS7 database; verify third number	84.1
503**	1+; ACTS; coin	36.6
498**	1+; CAMA; ONI; non-coin	28.6
499**	1+; ONI; successful validation	21.3
504**	1+; direct dial; hotel: person paid	47.9
709**	1+; OH; hotel; bill to room	44.3
715	1+; direct dial; coin; station paid; end office; without step rate	55.2
554**	Queue search for CAMA calls	30.7
-continued-		

<b>Table 1-34</b> <b>Remote OC TOPS configuration</b> (continued)		
<b>Call type</b>	<b>Call description</b>	<b>ms per C/A SN20</b>
556	Verify and connect	62.5
562**	Verify and scrambler	37.6
-continued-		

<b>Table 1-35</b> <b>Stand-alone TOPS MP configuration</b>		
<b>Call type</b>	<b>Call description</b>	<b>ms per C/A SN20</b>
1130	0-; OH; non-coin; person paid; end office	38.3
1136	0-; OH; coin; person paid; end office	49.0
1133	0+; OA; non-coin; person paid; end office	40.0
1139	0+; OA; coin; person paid; end office	51.5

<b>Table 1-36</b> <b>HOST OC TOPS MP configuration</b>		
<b>Call type</b>	<b>Call description</b>	<b>ms per SN20</b>
1128	0-; OH; non-coin; person paid; end office	21.8
1134	0-; OH; coin; person paid; end office	23.7
1131	0+; OA; non-coin; person paid; end office	21.6
1137	0+; OA; coin; person paid; end office	23.1

<b>Table 1-37</b> <b>Remote OC TOPS MP configuration</b>		
<b>Call type</b>	<b>Call description</b>	<b>ms per SN20</b>
1129	0-; OH; non-coin; person paid; end office	40.7
1135	0-; OH; person paid; end office	52.4
1132	0+; OA; non-coin; person paid; end office	43.4
1138	0+; OA; coin; person paid; end office	53.8

<b>Table 1-38 Stand-alone AABS configuration</b>		
<b>Call type</b>	<b>Call description</b>	<b>ms per SN20</b>
1172**	AABS; 0+; collect; non-coin; LIDB database; verify	53.6
1175**	AABS; 0+; bill third party; non-coin; LIDB database verify	65.7
1178**	AABS; 0+; call card number; non-coin; LIDB verify	44.1
1254	Operator hand off through VSN billed collect	74.3
1257	Operator hand off through VSN billed third party	82.0

<b>Table 1-39 HOST OC AABS configuration</b>		
<b>Call type</b>	<b>Call description</b>	<b>ms per C/A SN20</b>
1170	AABS; 0+; collect; non-coin; LIDB database; verify	0.0
1173	AABS; 0+; bill third party; non-coin; LIDB database verify	0.0
1176	AABS; 0+; calling card number; non-coin; LIDB verify	0.0
1252	Operator handout using VSN billed collect	34.2
1255	Operator handout using VSN billed third party	33.2

<b>Table 1-40 Remote OC AABS configuration</b>		
<b>Call type</b>	<b>Call description</b>	<b>ms per C/A SN20</b>
1171**	AABS; 0+; collect; non-coin; LIDB database; verify	53.6
1174**	AABS; 0+; bill third party; non-coin; LIDB database; verify	65.7
1177**	AABS; 0+; calling card number; non-coin; LIDB verify	44.1
1253	Operator hand out using VSN billed collect	74.0
1256	Operator hand out using VSN billed third party	79.6



<b>Table 1-41 Stand-alone TOPS MP configuration</b>		
<b>Call type</b>	<b>Call description</b>	<b>ms per C/A SN20</b>
1148	411; combined trunk and voice quote	33.9
1151	411; combined trunk and external ARU	37.2**
1154	411; DA trunk; external ARU; no ANI	34.7
1163	Intercept; intercept trunk; external ARU	18.8
1166	Intercept; intercept trunk; number not in database; voice quote	26.6**
1169	Intercept; intercept trunk; ONI; external ARU	35.5
1242	411; combined trunk; call completion; station paid	52.4**
1245	411; call completion; station paid AABS calling card	77.9
1248	411; call completion; station paid AABS collect	88.9
1251	411; call completion; station paid AABS bill third party	99.9

<b>Table 1-42 HOST OC TOPS MP configuration</b>		
<b>Call type</b>	<b>Call description</b>	<b>ms per C/A SN20</b>
1146	411; combined trunk and voice quote	18.0
1149	411; combined trunk and external ARU	15.9**
1152	411; DA trunk; external ARU; no ANI	17.9
1161	Intercept; intercept trunk; external ARU	0.0
1164	Intercept; intercept trunk; number not in database; voice quote	13.9**
1167	Intercept; intercept trunk; ONI; external ARU	14.9
1240	411; combined trunk; call completion; station paid	15.9**
1243	411; call completion; station paid AABS call card	17.2
1246	411; call completion; station paid AABS collect	19.3
1249	411; call completion; station paid AABS bill third party	20.6

<b>Table 1-43 Remote OC TOPS MP configuration</b>		
<b>Call type</b>	<b>Call description</b>	<b>ms per C/A SN20</b>
1147	411; combined trunk and voice quote	34.7
1150	411; combined trunk and external ARU	37.4**
1153	411; DA trunk; external ARU; no ANI	34.7
1162	Intercept; intercept trunk; external ARU	18.8
1165	Intercept; intercept trunk; number not in database voice quote	29.1**
1168	Intercept; intercept trunk; ONI; external ARU	36.4
1241	411; combined trunk; call completion; station paid	52.6**
1244	411; call completion; station paid AABS calling card	76.9
1247	411; call completion; station paid AABS collect	84.7
1250	411; call completion; station paid AABS bill third party	95.0

<b>Table 1-44 Stand-alone EAOSS</b>		
<b>Call type</b>	<b>Call description</b>	<b>ms per C/A SN20</b>
1115	0-; inter-LATA; dial pulse; non-coin; person paid	37.1
1124	0-; inter-LATA; DTMF; pre-subscription; coin; person paid	57.4
1112	0+; inter-LATA; DTMF; non-coin; person paid	39.9
1118	0+; inter-LATA; DTMF; pre-subscription; non-coin; person paid	43.7
1121	0+; inter-LATA; DTMF; 10XXX; non-coin; person paid	42.5
1127	1+; inter-LATA; dial pulse; 10XXX; CAMA; ANI failure	28.5

<b>Table 1-45 HOST OC EAOSS</b>		
<b>Call type</b>	<b>Call description</b>	<b>ms per C/A SN20</b>
1113	0-; inter-LATA; dial pulse; non-coin; person paid	21.4
1122	0-; inter-LATA; DTMF; pre-subscription; coin person paid	26.4
1110	0+; inter-LATA; DTMF; non-coin; person paid	20.9
1116	0+; inter-LATA; DTMF; pre-subscription; non-coin; person paid	20.0
1119	0+; inter-LATA; DTMF; 10XXX; non-coin; person paid	20.0
1125	1+; inter-LATA; dial pulse; 10XXX;; CAMA; ANI failure	12.7

<b>Table 1-46 Remote OC EAOSS</b>		
<b>Call type</b>	<b>Call description</b>	<b>ms per C/A SN20</b>
1114	0-; inter-LATA; dial pulse; non-coin; person paid	42.1
1123	0-; inter-LATA; DTMF; pre-subscription; coin; person paid	62.4
1111	0+; inter-LATA; DTMF; non-coin; person paid	42.2
1117	0+; inter-LATA; DTMF; pre-subscription; non-coin person paid	46.8
1120	0+; inter-LATA; DTMF; 10XXX; non-coin; person paid	47.8
1126	1+; inter-LATA; dial pulse; 10XXX; CAMA; ANI failure	32.4

## Engineering and planning

The engineering of a DMS SuperNode switch comprises a number of steps that must be accomplished in order to establish and manage the loading of the processor. Responsibility for this engineering of a switch application belongs to both the telephone operating company and Nortel Networks. The telephone operating company forecasts the expected requirements for lines, trunks, features and traffic rate. This information is entered into Nortel Network's planning and provisioning tools to size the engineerable items for a specified level of performance. The combination of data from the telephone company and Nortel Networks' engineering rules produce an engineering application.

Engineered items, such as peripheral module (PM) capacity and software features, that could limit the maximum carried traffic for a switch must be identified. The office may be limited physically (lines, trunks, ports), by traffic types, or by both. Office limitations are tracked against office growth to ensure a well engineered switch at all times.

### **Engineering factors**

Engineering factors must be considered when determining processor loading, because these factors affect the switch's overall call processing capacity. The factors influence the percentage of real time allocated between overhead and call processing. Some of the factors like the ACTIVITY tool are optional, but when activated will add to the minimum overhead requirements. Other factors like AWT and peaking are traffic characteristics that can also increase the overhead requirements. As a result, these factors can decrease maximum call processing occupancy.

Optional major features are those features that require additional CPU work to be considered with the overhead requirements. This feature requirement is in addition to the minimum overhead requirements. Therefore, with these features present and active in a switch, maximum call processing occupancy will be affected.

Some of the factors that impact upon maximum call processing:

- activity tool
- AWT
- maintenance
- EADAS (DC/NM)
- service evaluation system (SEB)
- DNC/9600 baud and DNC 19 200 baud
- traffic peaking
- CPUSTAT
- SYNC
- SMDI
- engineerable background

### **Grade of service**

There are traffic characteristics that affect the office grade of service at high processor occupancies. These characteristics can be categorized as traffic peaking and average work time per call. Traffic peaking and average CPU work time do not affect maximum call processing occupancies. High traffic peaking and large average CPU work times cause delays within the CPU which become larger at higher levels of call processing. Thus, more delays are experienced within the CPU as higher levels of call processing are

reached. This extra amount of delay is not related to, and does not affect the operation of the DMS switch.

To accommodate these delays, two grade-of-service compensation factors are used for engineering the maximum call processing to meet the HDBH grade of service of 20 percent DTD > 3 sec. There are two grade-of-service compensation factors:

- **Traffic peaking** – the variation of offered traffic versus the average traffic over a given time period. A 2 percent compensation factor is considered conservative and applicable to all office types.
- **Average CPU work time** – the average amount of CPU time that is spent on processing each call during the office busy hour. Different office types will have different average CPU work times. Increased average CPU work times increase the amount of time the CPU spends processing current call attempts before accepting new origination work. Thus, at a fixed CPU occupancy, higher average CPU work times will produce more delays compared to lower average CPU work times.

### **DMS SN grade of service analysis**

The central office must be managed over a wide span of different levels of traffic that will result in various grades of service levels. Nortel Networks provides tables to engineer the switch at 1.5 percent, 8.0 percent and 20 percent grade of service.

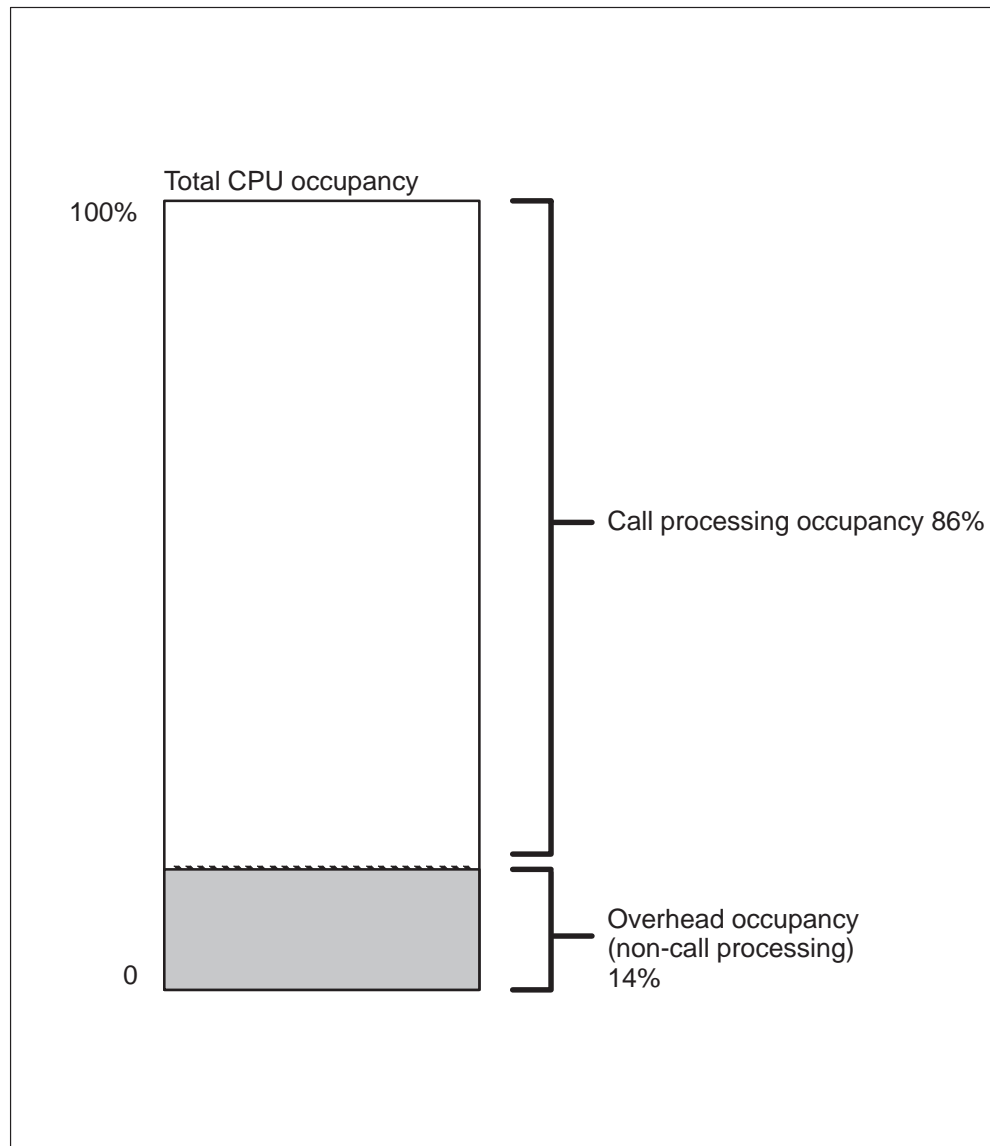
These call timing models were measured at Nortel Networks' facilities in a laboratory environment. However, the call timings described here are structured to emulate realistic switch parameters in a working telephone office.

### **Overhead occupancy**

The engineering of CPU real time used in the overhead classes of the CPU is important, since the maximum call processing occupancy accounts for non-deferrable priority processes such as task assignment, scheduling and system integrity. Deferrable functions, such as operations, administration and maintenance (OAM) and auditing routines are also included in the overhead occupancy. Overhead factors can cause the minimum total CPU allocation of 14 percent to be higher. Overhead has a complex interaction with call processing because as call processing increases, many overhead classes will collapse to their minimum levels. Therefore, effective capacity engineering of overhead requirements includes overhead requirements that are above the minimum values.

If the number of priority device requirements are below the basic minimum, then the engineering factor is 0 percent of processor real time.

**Figure 1-1**  
**Distribution of CPU occupancy (DMS SN)**



## Operating guidelines

The operating guidelines for establishing the loading levels for specific applications, at both the end and the beginning of the engineering design period, include a series of planning factors that the telephone operating company should take into consideration in the engineering process. The current maximum load recommendation for the DMS-100 Family is 86 percent of the total CPU time for local/toll/MDC offices and 86 percent of the total CPU time for TOPS offices, including a minimum of 14 percent for basic non-call processing overhead. Refer to Figure 1-1 for the distribution

of total CPU occupancy. Once the office is placed in service, the office call attempt busy hour can be monitored and the planned load can be increased according to the operating plan.

### **Engineering considerations – load level**

There are many considerations and decisions to be made when planning load levels for a processor. Some of the decisions are based on clear cut rules, but others are based on sound engineering judgements using guidelines.

The following are some of the key considerations that must be evaluated by the engineer before decisions can be made:

- 1 Determine the point on the load service curve that the processor will fall during both HDBH and ABS. Having the grade of service level during ABS too close to the exponential part of the load service curve may cause grade-of-service to be greatly reduced during HDBH. The higher the ratio of HDBH to ABS, the larger the buffer needed from the exponential part of the curve.
- 2 The high day call mix versus ABS call mix must be considered. Typical offices serving large business applications usually see very little variation in call mix from day to day, whereas the call mixes for POTS offices tend to change with traffic levels.
- 3 The engineering factor by percents used in deriving a processor's loading are considered conservative values. This is because all the major features will not be working concurrently or actively producing outputs every minute of the busy hour. Also priority devices would rarely have 100 percent duty cycles during busy hour.
- 4 In an initial office the data used to define office characteristic are predicted values, whereas in an in-service office data are measured values. Good engineering judgement must be used in determining the predicted values in order to ensure the switch meets the desired grade of service level during cutover. Once an office is placed in service, the office characteristics are measured and compared to predicted characteristics. If any of the prediction numbers differ from the measured, then the new verified numbers can be used for switch load planning.

### **Capacity prediction and verification tools**

#### **Prediction with REAL::TIME**

High day capacity can be reasonably predicted for a particular application by using the expected feature and call mix in conjunction with the measured CPU per call timings. With the number of features being introduced to the DMS-100 Family, the assessment of CPU use, both now and in the future, is of increasing importance.

Nortel Networks' PC program, **Real::Time** is used to predict CPU capacity. It is a stand-alone program that is available on floppy disk and can be used on an IBM or IBM-compatible personal computer. This program predicts CPU capacity to a fair degree of accuracy. Based on the total milliseconds required for an office configuration and the overheads desired, the capacity prediction technique determines what the percentage overhead and call processing occupancy (CPOCC) will be with the call mix overhead data that has been entered.

### **Verification tools**

Measurements within the DMS-100F and the SN switches can be used to verify actual office traffic. These tools are OMs and the traffic separation measurement system (TSMS). These measurements are used with the CPU capacity tool, **ACTIVITY**, to validate CPU predictions for each office configuration.

**Operational measurements** are used to determine system call mix, feature activations, and trouble conditions. The OMs reference measured call characteristics including overflows and blocked calls. This provides a delineation of capacity and trouble concerns. OMs, when used in conjunction with **ACTIVITY**, provide the capability to project system call capacity.

The **ACTIVITY** software provides an on-line real time indicator tool that monitors the system traffic count, CPU occupancy, and call the queuing time. The **ACTIVITY** feature provides assistance in these two areas:

- 1 evaluation of the current system configuration to assist in capacity planning
- 2 as a maintenance tool to determine if call processing is being efficiently handled

The measurements of call processing occupancy and grade of service from these tools verify the expected real time requirements. Since the **ACTIVITY** software takes direct measurements from the CPU scheduled and interrupt processes, it is the most comprehensive and accurate real time measurement.

### **MEMCALC – Calculates memory requirements**

**MEMCALC** is an engineering tool that utilizes software, data base information and actual switch parameters to calculate memory requirements. **MEMCALC** requires as inputs all software packages that will reside in the office's in-service BCS load as well as data based on end of design (EOD) quantities, or actual switch parameters. This tool is an integral part of memory provisioning and is available to customers as well as Nortel Networks. **MEMCALC** produces the memory required to satisfy the switch application only. It includes required memory allocator rounding rules as part of its output. An administrative spare, which includes a spare to account



for MEMCALC program accuracy, BCS dump and restore tools and normal day-to-day service order activity, is also required. Administrative spare is also added to the MEMCALC output and is included in the description of provisioning policies.

## **S/DMS SN – enhanced network (ENET) – Fiberworld**

The S/DMS SN is a new family of fiber-optic switching and transmission products that offers access to a full range of voice, data and video. The ENET is an integral part of the signaling and connectivity layers of the S/DMS SN layered architecture.

### **ENET**

The enhanced network is a single-stage, non-blocking, constant delay, junctorless time switch that supports narrow band services as well as services requiring bandwidth greater than 64 kb/sec (kb/s). With the constant delay and independence of the traffic load, ENET can support wideband services (n by 64 kb/s switching), such as video conference, image transfer, high speed FAX, and private-line backup. ENET simplifies the wire center while positioning it for future wideband services and is the vehicle of choice when simplifying a wire center by collapsing multiple switches into a single DMS SN.

### **Modular growth**

In the single-cabinet configuration, a fully duplicated ENET can expand from 4000 channels to 64 000 channels in 2000 channel increments in the peripheral-link paddle boards and 4000 channel increments for the first 32 000 channels and then 16 000 channel increments thereafter in the crosspoint cards. With the addition of a second cabinet, ENET capacity can be expanded to 128 000 channels in the said increments.

The new capabilities of the enhanced network, coupled with the HSI peripherals, will make possible new revenue-generating telecommunication services such as dialable wideband services (DS-1, fractional DS-1) that the telephone operating companies can tailor to meet their customers' needs. Also, the Enhanced Network, HSI peripherals, and integrated digital cross-connect features that support DS-, n x DS- and DS-1. These connections allow the consolidation into the S/DMS SN system of traditionally stand-alone network elements, such as multiplexers, digital signal cross-connect (DSX) bays and digital cross-connect systems.

### **FiberWorld connections**

The enhanced network and the S/DMS SN DMS-Bus are interconnected by the DS-512 fiber-optic links. The multiplexed connections between the enhanced network and other peripherals can use either DS-30 copper links or DS-512 fiber-optic links. However employed, the fiber-optic links are identical to the links between the DMS-core and the DMS-bus, making the

best use of the enhanced network's extraordinary capacity. Each fiber link carries 512 channels (511 for traffic and 1 for framing).

### **Simplified engineering**

As a junctorless, non-blocking switching matrix, ENET does not require complicated engineering. Unconstrained by traffic and load balancing, its provisioning is based only on peripheral link terminations. ENET provides the platform for circuit-switched, channel-switched or nailed-up digital service.

### **Shared technology with DMS-core and DMS-bus**

The enhanced network has its own internal 32-bit processor based on the Motorola MC68020 microprocessor, which is similar to that used in the S/DMS SN system. The common circuit packs used in both the S/DMS SN and ENET are the RTIF NT9X26AB and power converters NT9X30AA and NT9X31AA. Employing fiber-optic lines between the DMS-core and the DMS-bus makes the best use of the ENET's extraordinary capacity.

### **Reduced footprint**

ENET significantly reduces the central office footprint by housing up to 64 000 one-way duplicated channels in a single cabinet configuration, or 128 000 channels in two cabinets.

### **Switching plane selection**

Peripherals have access to both planes of the enhanced network, which operate in parallel and independently. The active plane is selected on a pre-connection basis.

### **Reliable high performance**

Enhanced network processors establish connections on command from DMS-core and maintain these connections until they receive a disconnect command. The fault-tolerant architecture of the enhanced network guarantees that all connections meet a rigorously low bit-error-rate standard ( $10^{-12}$ ). The enhanced network also monitors for link errors, performs loop-back testing and generates and checks test codes to enable pro-active treatment of conditions that might otherwise become service affecting. This advanced design permits straightforward diagnostics should a fault be detected on a connection path—the path between the input and output channels is always the same

### **Peripheral module termination capacity**

These are the peripheral modules (PMs) in the DMS-100 Family:

- Trunk Module (TM)
- Digital Carrier Module (DCM)
- Digital Trunk Controller (DTC)

- ISDN Digital Trunk Controller (DTCI)
- Message Switch and Buffer (MSB)
- Maintenance Trunk Module (MTM)
- Remote Line Module (RLM)
- Line Concentrating Module (LCM)
- ISDN Line Concentrating Module (LCMI, LCME)
- Remote Line Concentrating Module (RLCM)
- Line Group Controller (LGC)
- ISDN Line Group Controller (LGCI)
- Line Trunk Controller (LTC)
- ISDN Line Trunk Controller (LTCI)
- Outside Plant Module (OPM)
- Remote Switching Center (RSC)
- ISDN Remote Switching Center (RSCI)
- Subscriber Carrier Module—SCM-100R (DMS-1 Rural)
- Subscriber Carrier Module—SCM-100U (DMS-1 Urban)
- Subscriber Carrier Module—SCM-100S (DMS-1 SLC-96).

### **TM**

The TM provides an interface between external analog trunk facilities and the internal switching network. It converts incoming analog signals to digital signals and multiplexes them into a 2.56 Mb/s bit stream for transmission to the DMS-100 Family switching network. De-multiplexing and the digital to analog conversion are also provided for outgoing signals.

The trunk module interfaces a maximum of 30 analog trunk circuits to one 32-channel (30 VF, plus 1 signaling and plus 1 unused) speech link to each of the duplicate networks. The duplicate networks are referred to as plane-0 and plane-1. Many types of analog trunk circuit packs are available to interface to analog trunks. See Chapter 5 of this document for the most common types of analog trunks. No blocking exists in the TM.

### **DCM**

The DCM provides an interface between the DMS-100 Family switching network and digital trunk facilities. The DCM presents a standard interface between the primary digital carrier signal referred to as DS-1, which consists of 24 VF channels, time-multiplexed onto a 1.544-Mb/s bit stream, according to the DS-1 line signaling format. The DCM interfaces a maximum of five DS-1 links (5 by 24 = 120 VF channels), equipped with four 32 channel (30 VF plus one signaling plus one unused) speech links to each of the duplicate networks. No blocking exists in the DCM.

### **DTC**

The DTC interfaces between digital trunks carried over DS-1 links and the DS-30 links used internally in DMS-100 between the PMs and each plane of the duplicate network. The DTC interfaces a maximum of 20 DS-1 links with 16 DS-30 links to each of the duplicate networks. No concentration exists in the DTC.

### **DTCI**

The ISDN digital trunk controller (DTCI) adds support for primary rate interface (PRI) trunks to enhance the functionality of the DTC. An ISDN signaling processor (ISP) card is used to terminate the D-Channel associated with the PRI trunks.

### **MSB**

The MSB provides the CCIS signaling interface between the CCIS links and the DMS-100 Family switch. Two versions of the MSB are available: the MSB6 for CCIS applications, and the MSB7 for SS7 applications.

### **MTM**

The MTM provides facilities for housing and controlling receivers, test circuits, transmission test lines, communication links, and jack-ended trunks.

### **RLM**

The RLM provides the capability to remote the interface between analog line facilities and the internal switching system. It converts analog signals to digital and digital signals to analog and multiplexes the digital signals on DS-1 facilities to DCMs at the DMS-100 host office. The RLM provides concentration of 640 analog subscriber lines (20 terminal groups of 32 lines per group) to up to four DS-1 links. Although 640 is used as the nominal capacity of a remote line module, the first RLM at a particular site has a capacity of 608 lines. Subscribers connected to an RLM have the same features available to them as subscribers in the host office.

### **LCM**

The LCM provides an interface between analog line facilities and the internal switching system. It converts analog to digital and digital to analog signals and multiplexes the digital signals into a 2.56 MB/s rate for transmission to the LGC using DS-30A links. The LCM provides concentration of 640 analog subscriber lines to between 60 and 180 speech channels (2 to 6 DS-30A links) to the LGC. Six hundred thirty-nine (639) lines are available for subscriber use. One line is used for testing.

### **LCME**

A dual-unit peripheral module that terminates ISDN 2B1Q (two binary one quaternary) U-type (single slot) lines, ISDN S/T-type lines, and POTS lines, EBS lines, and datapath lines. The LCME also provides access to the ISDN

B-, D-, and M-channels. The LCME supports 480 POTS or EBS lines or 240 Datapath lines.

### **RLCM**

The RLCM is a remote LCM connected to a host LGC or RSC through a minimum of two, and a maximum of six, DS-1 links. During normal non-EAS operation, the RLCM will support all of the subscriber line features that are possible to assigning to lines at a host LCM.

### **LGC**

The LGC is designed to support the LCM and the family of remotes based on the LCM equipment. The LGC interfaces up to 16 DS-30 C-side ports spread over as many as 16 network modules. The 16 DS-30 C-side ports are accessible by 20 DS-30A P-side ports. Since the DTC and LGC employ a common architecture, it is possible to interface the 16 DS-30 C-side ports with a combination of DS-30A and DS-1 P-side ports up to a combined total of 20 P-side ports. When both DS-30A and DS-1 P-side ports are equipped, the module is designated as an LTC.

### **LGCI**

The ISDN line group controller (LGCI) adds support for the BRI lines to the functionality of the LGC. To do so, two new cards were introduced: the ISDN signaling processor (ISP) card and the D-channel handler (DCH) card. The DCH card terminates the D-channels from multiple ISDN loops. It provides the interface between the ISDN loops and both the packet andler (PH) and the ISDN signaling processor.

### **LTC**

The LTC is designed to support a subset of both LGC and DTC functions. The LTC interfaces to the DMS network through a minimum of three to a maximum of 16 DS-30 ports. These 16 DS-30 ports are accessible to a maximum of 20 DS-30A ports or 20 DS-1 ports. The DS-30A ports support LCMs. The DS-1 ports support digital carrier facilities, RLCMs, and RSCs.

### **LTCI**

The ISDN line trunk controller (LTCI) adds support for the BRI lines to the functionality of the LTC. It uses the same new hardware as the LGCI: the ISP and DCH cards. In the future the LTCI will support primary rate interface (PRI) trunks.

### **OPM**

The OPM is an RLCM housed in an environmentally controlled cabinet. Features and configurations of the OPM are the same as those for RLCM. Additionally, the OPM provides commercial ac power inlet, rectifiers, batteries, an environmental control system and equipment for the termination, protection and powering of associated DS-1 pairs.

### **RSC**

The RSC is an LGC based peripheral that is remotely connected to an LGC when supporting lines only and to an LTC when supporting lines and trunks. These connections are two–16 DS-1 C-side host links. A variable set of loopback channels are available for intra-calling. The RSC supports up to 20 links, which may be configured to provide various combinations of DS-30A links (LCMs, RMMs) and/or DS-1 links (RLCMs, OPMs, CDO trunking and PBX trunking). The RSC, when supporting lines only, has the ability to interface up to 5760 lines in low traffic applications (2.8 CCS/line).

### **RSCI**

The ISDN remote switching center (RSCI) adds support for BRI lines to the functionality of the RSC. It uses the same new hardware as the LGCI: the ISP and DCH cards. It supports ESA for both ISDN and non-ISDN lines. It does not support PRI trunking.

### **Subscriber carrier module-100R (SCM-100R)**

The subscriber carrier module-100R (SCM-100R) provides an integrated interface for up to six DMS-1 remote concentrator terminals (RCTs) to the DMS-100. Each RCT can support up to 256 lines and will use two or three DS-1 links depending upon protection switching provisioning.

### **Subscriber carrier module-100U (SCM-100U)**

The subscriber carrier module-100U (SCM-100U) provides an integrated interface between the DMS-100 Family host and DMS-1 Urban remote concentrator terminals. Each RCT will support up to 560 lines and will use from two to eight DS-1 links to the host DMS-100 Family.

### **Subscriber carrier module-100S (SCM-100S)**

The subscriber carrier module-100S (SCM-100S) provides an integrated digital interface between the DMS-100 Family host and AT&T SLC-96 digital loop carrier systems. SCM-100S supports mode I, mode II, and mode III SLC-96 remote terminals (RTs) and their protection switching span lines. Each SCM-100S has the capacity for 20 DS-1 links from RTs, thus it will support up to four mode I SLC RTs of five spans (four primary, one protection) each, or six mode II or mode III RTs of three spans (two primary, one protection) each.

## **DMS SN memory**

DMS SN has 10 card slots available for memory on its shelf. Unlike the NT40, there is no hard-partitioned separation of program store and data store. The memory is provisioned in a common pool. Also, there is no separate spare for fault detection built into a memory controller card. There are two different capacity memory cards available as follows:

- 6 Mbyte      NT9X14BB

- 24 Mbyte NT9X14DB
- 96 Mbyte NT9X14EA

The shelf can be equipped with all 6 Mbyte cards, all 24 Mbyte cards or a combination of the two. The physical capacity of the DMS SN memory shelf is 240 Mbytes.

**Note:** The maximum addressable store using a full complement of 24 Mbyte or 96 Mbyte circuit cards is detailed per processor as follows:

<b>Table 1-47</b>	
<b>Name of table</b>	
<b>SN CPU</b>	<b>Maximum addressable memory</b>
Series 20 NT9X13BC	200 Mbytes
Series 30 NT9X13GA	212 Mbytes
Series 40 NT9X13HB	212 Mbytes
Series 50 NT9X10AA	248 Mbytes (216-Mbyte shelf memory plus 32 Mbytes on-board processor memory)
Series 60 (NT9X10AA and NT9X14EA)	400 Mbytes

SN office image sizing is required by a system load module (SLM) loading.

The office image for a DMS SN can be loaded from a pre-programmed computer tape or SLM. The SLM is strongly recommended to load the large office images associated with SN configurations. Determination of the office image size and subsequent memory requirements on the SLM or magnetic tape is relatively simple formula:

Office Image size = program store in Mbytes + 0.5 by data store in Mbytes + .75 by 7 Mbytes.

(Where the 7 Mbytes is for the SN message Switch Image size.)

The physical capacities of the SLM I unit are 140 Mbyte hard drive (5 1/4-inch drive) and 60 Mbytes for the streaming cartridge tape, SLM II has a 600 Mbyte hard drive (5 1/4-inch) and 150 Mbyte streaming cartridge tape.



### **System load module**

The optional SLM is a mass storage system which is used to store office images from which a new load or stored images can be booted into the Computing Module (CM). The SLM is designed for the larger DMS-Core loads that exceed the 30 Mbyte limit of the current MTD. It is also used when a faster boot load and image dump rate is required.

The SLM is packaged into a single replaceable unit which consists of a 5 1/4-inch hard disk drive, a 1/4-inch streaming cartridge tape drive and a controller CP.

Originally, two sizes of SLM units (called SLM I and SLM II) were available for use with the DMS SN. SLM I has recently been discontinued, leaving only the SLM II unit for used with the DMS SN.

The SLM II provides greatly increased non-volatile mass storage capacity compared to the SLM I. This increased capacity is needed to support the increased number and size of the system image files on the DMS SN.

The SLM II has the following architecture – a single replaceable package consisting of a 5 1/4-in. hard disk drive, 1/4-in. streaming cartridge tape drive, and a controller CP.

The SLM II hard disk has a capacity of 600 Mbytes and the tape cartridge has a capacity of 150 Mbytes. Although currently an optional offering, it is recommended that all DMS SN offices provision a SLM II.

### **Memory sparing**

NT40 and DMS SN sparing philosophies differ. NT40 uses program store as well as data store and provides reliability spare of 256 k block of memory on the NT4X79AA memory controller card. This reliability spare can take the place of any 256 k block of memory from a 256 k word NT3X93AA or 1 M word NT4X80AA card that encounters a single fault. However, the SN must be provisioned for a reliability spare. The DMS SN memory is spread evenly over all cards on the memory shelf. There is no physical spare as such. Whenever a card is lost, the store allocator automatically reconfigures the memory over the remaining cards without service interruption. Because NT40 and SN have different control philosophies as well as sparing techniques, separate memory provisioning guidelines are required. In addition, an administrative spare is also required.



## Basic memory provisioning – NT40 and SN

The basic memory provisioning policy applies to both NT40 and SN in the following procedures:

- To calculate memory requirements, use the wired capacities of all lines, trunks and input/output (I/O) ports. Note that cards equipped I/O ports should be considered as wired. This includes all read only and Keyboard send receive printers and visual display units (VDUs).
- When processing extensions and/or authorized software updates, all existing software packages from the previous office image must be applied to the new load. Discrepancies between the previous office image and the current job feature data base (JFDB) should be resolved by the job engineer and the Nortel Networks marketing representative. DO NOT remove any feature package(s) from the office image or JFDB without prior written authorization from the marketing representative and the customer. After all discrepancies have been resolved, all records should be updated as required.
- The DMS SN Major Group Software Package, NTX960AA/AB, must be present in the job's JFDB listing in order to access SN MEMCALC. Conversely, NTX960AA/AB must be absent from the job's JFDB listing in order to access NT40 MEMCALC.

## DMS SN policy

This policy covers the guidelines for an all 6 Mbyte, an all 24 Mbyte, or a mixed memory card configuration. Note that 6 Mbyte only offices require at least a BCS24 software load, 24 Mbyte only offices require at least a BCS26 software load, and mixed memory offices require at least a BCS25 software load.

**Note 1:** BCS24 and BCS25 apply to the NT40 processor only.

**Note 2:** Only 96-Mbyte offices require at least BCS36. The 96 Mbyte memory cards cannot be mixed with any other memory card type (6 Mbyte or 24 Mbyte).

**This is important**—when 24 Mbyte cards are first added to a switch upgraded from BCS24, the BCS25 or later load must first be inserted before the cards may be added. This restriction may require that parameters or the feature set be down-sized to allow insertion of the BCS25 or later load with 6 Mbyte cards only.

A MEMCALC work-around is described in the EXCEPTION MEMORY POLICY:

A baseline has been established with BCS26 for all SN offices to include the Message Switch NT9X13DB and Computing Module NT9X13BC processor cards. These cards support all SN memory configurations. Customers not at

BCS26 level should contact their regional marketing representative for scheduling information.

It is strongly recommended that 24 Mb cards be utilized for all initial and extension offices for BCS26 and later loads. A current exception is the signaling transfer point (STP) office in which computing module (CM) memory will remain fairly constant, and may be served by all 6 Mb cards.

### **DMS SN exception memory policy**

Subsequent extensions or with a large initial load, a point may be reached whereby greater than a full complement of 6 Mb cards is required for an office (54 Mb total active and administrative spare memory, 6 Mbytes reliability spare memory). 24 Mb cards will be provided. Offices with greater than 54 Mb active (includes administrative spare) memory will increase from 54 to 60 Mb, as the sparing requirements detailed above require a separate 6 Mb and 24 Mb card for reliability spare. With 8 remaining slots for active memory, the Job Engineer and telephone operating company can determine the optimum amount of each type of card required.

Because of critical overhead and 8 Mb rounding, some blocks of memory on 6 Mb cards may not be utilized for allocated memory. Therefore, several possible mixed SN memory configurations are provided with the maximum, which is a full 24 Mb card complement. A full complement is 212 Mb active, 24 Mb spare, 4 Mb addressable overhead.

### **Monitoring and administration**

Telephone company engineers project usage, lines, trunks and features that are required in an office through an engineering period. This period is usually two to three years following an in-service date. These projections are based upon customer growth forecasts that the telephone company develops.

Operating company and Nortel Networks engineers provision memory for DMS-100F switches based upon the telephone company's projections. Using the Nortel Networks memory provisioning tool, MEMCALC, future BCS requirements are based upon Nortel Networks' forecast of the SN memory needed for these BCSs. The memory is provisioned in a DMS-100F switch based upon these two forecasts: Customer End of Design (EOD) parameters and the Nortel Networks memory program MEMCALC.

After the cutover of a new switch or a major addition to an existing switch, MEMCALC should be run using the actual switch parameters. The MEMCALC questionnaire references the necessary switch data to run the tool and the switch's outputs to MEMCALC input requirements. Some of this information may also be accessed using the MAP utility, using the BCSMON command—*BCSMON DUMP COUNT*.

## Performance standards

Performance standards establish the criteria used to engineer a DMS-100 Family switching system, including the determination of the quantity of various circuits required. The DMS-100 Family parameters involved are documented, and sensitivities are discussed in the following subsections.

## Basis for provisioning of engineered facilities

The DMS-100 Family traffic sensitive components are provisioned based on service criteria, traffic load level, and/or real time. The capacity tables and mathematical functions that form the basis for equipment provisioning give the traffic capacity (usage) or real time capacity (call attempts) that can be handled by the overall system as well as the traffic sensitive system component, while attaining a fixed service criterion during a given period of time. These are based on average busy season service objectives and 10 high day service objectives. In the two following examples, “hour” refers to any period of 60 contiguous minutes, and “month” refers to a service observing month which typically ends on the 20th to 22nd day of the calendar month:

- Average Busy Season method traffic data, typically expressed for local switching systems as CCS per main station, is collected and processed to determine the busiest hour for each of the switching system components that is to be engineered. The hour which has the highest average traffic for the three highest traffic months is designated the “busy hour.” The three months, not necessarily consecutive, that have the highest average traffic in the busy hour are termed the “busy season.” The busy hour traffic level averaged across the busy season is termed the “Average Busy Season Busy Hour (ABSBH) load.”
- In the Ten High Day (THD) method of engineering, the traffic data is processed to identify the ten highest traffic days of the year. The hour of the day that has the highest average traffic on these ten days is designated the “busy hour.” The ten day average traffic level for this busy hour (the same hour for all ten days) is termed the “ten high day busy hour load.” The one day among the same ten days that has the highest traffic during the busy hour is designated the “high day.” The traffic level in the busy hour of the high day is termed the “High Day Busy Hour (HDBH) load.” (There may be some other hour of the high day or another day of the year with a higher traffic level, but it would not be used as an engineering basis.) In the ten high day method, data is not included for extremely high traffic days which can be attributed to unusually severe weather or catastrophic events which are not expected to recur from year to year.

The busy hour ratios of 10 HDBH to ABSBH and HDBH to ABSBH for calls or traffic usage are specified by the operating company during the provisioning of engineering facilities.

### **Provisioning methodology**

DMS-100 Family overall and system component provisioning is based on three factors:

- 1 Termination—lines and trunks
- 2 Traffic criteria—usage and call attempts
- 3 Real time—call attempts and call processing time

#### **Termination**

By this method the provisioning is done on a termination appearance basis; the number of components to be provisioned depends on the number of terminations to be connected to these components and on the number of terminations that these components can allocate per module.

#### **Traffic criteria**

By this criteria the provisioning is done on a traffic capacity basis (usage and call attempts); the number of system components to be provisioned depends on the traffic offered by the terminations to be connected to these system components and on the traffic capacity that these system components can carry per module. This is a function of the method of operation based on blocking or delay criteria and the service standard required.

#### **Real time**

This provisioning criteria is accomplished on a total ms/hr capacity basis (call attempts and timings); the number of system components to be provisioned depends on the mix of traffic originating from or terminating to these system components and the ms capacity/hr that these system components can provide.

### **Service standards**

#### **Grade of service (GOS)**

The office GOS is defined as being a component of the office service quality, qualifying the normal office reaction to traffic variations in the ideal situation in which the office is completely trouble free. Therefore, to establish a standard basis of equipment provisioning, it is necessary to devise a measure of service to quantify the inconvenience suffered by the subscribers as a result of blocking or delay. The DMS-100 Family System applies a mixture of blocking (matching loss) and delay criteria.

#### **Blocking criteria (matching loss)**

Blocking occurs when a call arrives for service and all servers (peripheral and network paths or service circuits) are busy. The call attempt may be delayed until a server is idle or aborted, depending on the service discipline. Blocking delay greater than 0 (zero) is measured as the fraction of all calls attempted that are either lost or enter a queue.

There are four types of blocking or matching losses that occur in DMS-100 Family systems:

- 1 Tandem Matching Loss (TML) is defined as the failure to find a path through the network from a given incoming trunk to an outgoing trunk group, assuming that idle trunks exist within the group. In DMS-100 Family systems, TML occurs if no connection can be made with two trials. Only the unavailability of a path through the network contributes to the tandem matching loss.
- 2 Intra-Office Matching Loss (IAML) is defined as the failure to find a path through the network from a given originating speech link (30 voice channels) to a given idle terminating line. The terminating line is assumed to be accessible by more than one speech link. The IAML depends on the channel availability of the terminating line peripheral, and on the availability of a path through the network.
- 3 Incoming Matching Loss (IML) is defined as the failure to find a path through the network from a given incoming trunk to a given line, assuming that the line is idle. Access to the line through more than one speech link is implicitly assumed. The IML depends on the channel availability of the terminating line peripheral, and on the availability of a path through the network.
- 4 Outgoing Matching Loss (OML) is defined as the failure to find a path through the network from a given originating speech link (30 VF channels), or equivalent, to a given idle outgoing trunk.

### Matching loss grade of service

Only the availability of a path through the network contributes to the outgoing matching loss. The overall DMS-100 Family grades of service based on matching loss criteria are shown in Table 1-48:

<b>Table 1-48</b>		
<b>Matching loss grade of service</b>		
<b>Matching loss criteria</b>	<b>ABSBH</b>	<b>HDBH</b>
	<b>DMS-100 (local)</b>	
Intra-office matching loss (IAML)	2%	20%
Incoming matching loss (IML)	2%	20%
Outgoing matching loss (OML)	1%	20%
—continued—		

<b>Table 1-48</b>		
<b>Matching loss grade of service (continued)</b>		
<b>Matching loss criteria</b>	<b>ABSBH</b>	<b>HDBH</b>
	<b>DMS-200 (toll)</b>	
	<b>10 HDBH</b>	<b>HDBH</b>
Tandem matching loss (TML)	0.5%	2%
	<b>End</b>	

### Delay criteria

Delay occurs when a call finds all servers (typically service circuits) busy and the call is queued until it deflects or a server becomes idle. Delay is usually measured as the fraction of call attempts that are delayed more than the criteria indicates (delay >3 sec.). The two types of delay are dial tone delay and incoming start dial delay:

- 1 Incoming Start-to-Dial Delay (ISDD) – defined as the elapsed time from a “request-to-dial” from an incoming trunk to the return of a “start-to-dial.” The requirements are stated in terms of the probability that an incoming trunk requiring connection to an MF receiver experiences a delay of more than three seconds.
- 2 Dial Tone Delay (DTD) – defined as the elapsed time from a “request for service” (off-hook) to the return of a “start-to-dial.” The requirements are stated in terms of the probability that a customer line requiring connection to a Dial-Pulse (DP) or Dual Tone Multi-frequency (DTMF) receiver experiences a delay of more than three sec.

The overall DMS-100 Family grade of service based on delay criteria are shown in Table 1-49.

<b>Table 1-49</b>				
<b>Delay grades of service</b>				
<b>Delay criteria</b>	<b>DMS-100 (local)</b>		<b>(DMS-200 (toll))</b>	
	<b>ABSBH</b>	<b>HDBH</b>	<b>10 HDBH</b>	<b>HDBH</b>
Dial tone delay >3 sec	1.5%	20%	*	*
Incoming start-to-dial >3 sec (IR attachment delay)	1.5%	20%	8%	20%
<b>Note:</b> * Not applicable				

## Service circuits

In all cases, occupancy on individual groups of service circuits, such as receivers, tone circuits, conference circuits, or announcement circuits, is limited to 75 percent on an HDBH load level basis. The requirements are expected to be controlling requirements for large groups of service circuits. For smaller groups of service circuits, the following definitions provide the basis for service circuit delay and blocking requirements.

In general, the quantities of these system components are engineered to cause very little blocking or delay to customers and to cause minimal queuing (even under peak loads). Central processor usage per call does not increase substantially during peak load conditions. The service circuits grade of service based on blocking and delay criteria are shown in Table 1-50:

<b>Table 1-50</b>			
<b>Service circuits blocking and delay criteria grade of service</b>			
<b>Service circuit</b>	<b>Criteria</b>	<b>ABSBH</b>	<b>HDBH</b>
DTMF receiver	DTD > 0 sec	1%	5%
	DTD > 3 sec	0.1%	1%
MF receiver	DTD > 0 sec	1%	5%
	DTD > 3 sec	0.1%	51%
Announcement circuits	Blocking	1%	5%
Tone circuits	Blocking	1%	5%
Conference circuits	Blocking	0.1%	1%

**Note:** UTR receiver uses similar GOS as DTMF or MF receivers.

## Receivers

Service circuits in the DMS-100 Family system are common equipment units which include DTMF, MF Receivers, and Universal Tone Receivers (UTRs). The DTMF receiver is used to convert dual tone multi-frequency address signals from the customer to machine readable codes. The DTMF receiver connection is from a customer line (through an LCM/LGC) through the network, to a DTMF receiver on a TM or MTM.

The MF receiver is used to convert multi-frequency signaling over a trunk to a machine-readable code. The MF receiver connection is from an incoming trunk (through a digroup or a TM) through the network, to an MF receiver on a TM or MTM.

The UTR is used to collect and decode both DTMF and MF address signals and to report the decoded address digits to the central control by means of the peripheral signaling processor, and it eliminates the need to establish a



network path to a DTMF/MF receiver in an MTM. The UTR is located in the LGC, LTC, DTC, or RSC peripherals.

Two connection attempts will be made on randomly chosen DTMF/MF receivers (MTM mounted) if blocking occurs. The length of time taken to establish a connection to a receiver determines its delay criteria. To minimize blocking probability, the receivers are spread over the available TMs and MTMs.

### **Recorded announcement circuits**

The DMS-100 Family uses the Digital Recorded Announcement (DRA) system (refer to Chapter 4), which with the DMS-100 Family control capability can be engineered, on a per office basis, to provide the required number of announcements. The DMS-100 Family system uses a time switch broadcasting (TSB) process to distribute tones and recorded messages through the incoming time switch on the receive side (A) of the network module simultaneously to many users from a single source.

The incoming network speech channel can be connected (in a broadcast mode from each source) to all outgoing speech channels, within the same network incoming time switch (refer to Chapter 2 for definition). Hence, information from one originating source can be broadcast to any DMS network output, subject to the simultaneous connections discussed below.

The number of simultaneous connections in the DRA system is limited in order to reduce the possibility of time switch blocking. This maximum is normally specified in translations and should not exceed 30 percent of the number of call processes calculated per office application. From a traffic standpoint, each TSB source can be viewed as a trunk group in which the number of servers equals the above specified maximum number of connections.

The DRA uses standard announcements, available in English and French, which are pre-recorded (written) into programmable read only memory (PROM) by the manufacturing process. Random access memory (RAM) is used to store announcements recorded on location.

The DRA, like the existing analog system, uses time switch broadcasting to distribute announcements to multiple users. However, unlike the analog system, all announcements from the same DRA are confined to the same time switch (the one to which the MTM is connected).

In a given DRA system, all announcements will share a group of “trunk” circuits (channels) as determined by the DRA controller switch setting (8, 16, 24, or 30). The number of circuits required can be established as a function of the number of announcements, their traffic characteristics and announcement grade of service (GOS) objectives. The DRA provides



Special Information Tones (SIT) as defined by the AT&T Compatibility Bulletin No. 154.

### **Overload and abnormal conditions**

A DMS-100 Family switch is designed and configured with specific characteristics to handle a defined amount of traffic. If the designed load is exceeded, some of the traffic must be delayed. The exact effect depends on the nature of the overload. The design intent is that any part of the equipment that is offered more than its rated load should continue to operate at or near its rated capacity. The excess load should be delayed or blocked in an orderly manner and should not cause throughput degradation or outage.

#### **Types of overload**

Overload may be in any of four main areas:

- 1 shortage of tone receivers
- 2 shortage of speech paths
- 3 shortage of processing capacity in one or more peripherals
- 4 limits on global system capacity. The CPU as the focus of all switching activity in the DMS-100F and the processor in the SN effectively determines the ultimate system capacity and hence requires overload protection in order that the system does not experience throughput degradation or outage in the presence of excess load.

These four algorithms are used to achieve overload protection:

- 1 message throttling
- 2 progress message favoring
- 3 resource reservation
- 4 ineffective attempt elimination

### **Overload controls**

**Message throttling** is a technique employed in the DMS-100 Family to limit the number of incoming messages that the CPU or processor will accept in a clock tick, (that is, 6.25 ms). Basically, message throttling is realized by weighting incoming messages according to category (call processing, non-call processing) and ensuring that, during any clock tick, the weighted sum of incoming messages does not exceed a pre-defined threshold. Once the threshold is reached, I/O interrupts are disabled until the start of the next clock tick, at which time the process is repeated.

**Progress message favoring** ensures that calls in progress are given preferential treatment over new originations. It is realized by splitting call processing into two queues: origination and progress, and always serving the progress queue first.

Under high load, progress message favoring delays the number of originations accepted by the processor and this, in turn, limits the possibility of destructive processor overload. A side effect of this technique is that it practically guarantees that accepted calls will be successfully completed.

**Resource reservation** A variety of software resources are required in order to process call events. These resources are office engineered and hence, under overload, certain of these resources will exhaust. By design, resources exhaust on originations and not progress events and also by impacting originations. Shortage effectively serves as an overload control.

Typical examples of critical resources are Call Condense Blocks (CCBs) and call processing letters. One of the CCBs is obtained at the initiation of every call and released on call takedown but if no CCBs are available then no new call originations can be accepted. The call processing letters are used for both origination and progress messages but if these are unavailable call events can not be processed. To force shortages to affect only originations, a sufficient number of these letters are reserved solely for progress events. When the number of free letters is reduced to the reserved amount, origination events are no longer accepted.

**Ineffective attempt elimination** The primary goal of the processor under extreme load conditions is the successful termination of the maximum number of calls. As overload conditions persist, delays tend to develop in processing new call originations and this leads to an increase in pre-dial abandons. Handling abandoned calls lowers the overall capacity of the switch and hence, in order to achieve the highest successful termination rate, the processor discards an origination message without further processing if a second message has arrived for that specific call. This action is restricted to origination events which have been queued in the processor for greater than 0.5 sec, since delays of this order only occur during heavy overload conditions. With load shedding, origination calls in the processor for longer than three seconds are discarded, requiring the peripheral to regenerate the origination.

**Originations queuing in peripherals** During periods of overload, originations may be submitted to a DMS-100 Family peripheral at a rate greater than they are accepted by the processor. Treatment of the excess originations in the trunk peripheral depends on the trunk type. Trunks are put into a lockout state in the peripheral if originations are delayed for more than five seconds. The trunk will return to the idle state upon receipt of a clear forward signal. In the case of immediate dial trunks, dial pulses are collected by the peripheral before an attempt is made to submit any origination to the processor.

Line originations are queued within the line peripheral and, until the origination message has been sent to the central control and a suitable

response (namely, associate channel and provide dial tone order) has been received, further state changes on the line are ignored. Hence a subscriber remaining off-hook will eventually receive dial tone. If the subscriber has gone on-hook when the central control response is received, then the line peripheral dispatches a disconnect message to the central control which responds by returning the line to the idle state.

When the origination queue in the line peripheral overflows, the line originations are deferred. Subsequent line scans will cause originations to be placed in the queue as space becomes available. In the case of new peripherals, the originations are handled in the last in-first out (LIFO) manner rather than first in-first out (FIFO), and calls are handled in a pre-determined order:

- in progress
- terminations
- new originations

### **Multi-frequency (MF) tone receivers**

If no MF tone receivers (MTM mounted) are available, incoming calls may be delayed in a queue for up to five seconds. Calls overflowing the queue are placed in a “high and wet” list (lockout) until clear forward is received. Larger queue capacity is pointless, since sender time-out would occur before the call was served. Proper receiver provisioning will normally avoid this type of overload. Dial pulse calls do not require a common receiver but are handled entirely within the originating peripheral.

### **Dual tone multi-frequency (DTMF) receivers**

If no DTMF receivers are available, originating calls are delayed in a queue indefinitely. Calls overflowing the queue are re-originated (that is, processor primes the peripheral to wait for one second, returns the line to the idle scan list and subsequently produces an origination message if still off-hook). If an originating call in the queue goes on-hook it is removed from the queue. The length of the queue is equal to the number of DTMF receivers (MTM mounted) in the office.

### **Speech paths**

The DMS-100 Family digital switching network has a very low blocking factor and also allows the use of generous provisioning rules. Network overload is therefore unusual unless abnormal traffic patterns occur. If no speech path can be found after two path trials, the call is routed to tones. Digital tone generators are located in peripheral modules and tones are transmitted to trunks without using network paths.

## **Speed of service**

This subsection of the technical specification defines the time intervals allowed for performing certain call processing operations within the

DMS-100 Family switching system. The speed of these operations is considered critical to customer service and for effective interaction with other switching systems.

### **Definitions of supervisory signals**

The following is a definition of the Per Trunk Signaling (PTS) supervisory signals used in the DMS-100 Family to interact with other switching systems.

For each operation time, the definition is given in terms of the starting and ending points followed by the requirements. The value given for the mean is interpreted as the maximum allowable mean from the starting point to the ending point for that operation time. The operation time may not exceed the 95 percent level more than 5 percent of the time for two conditions:

- 1 Receipt of a PTS supervisory signal is said to occur when the state transition, which begins the signal, occurs at the E lead. The E and M lead trunks make use of separate leads for signaling. Ground and open states are used for off-hook and on-hook, respectively, on the E lead for signaling from the trunk facility to a trunk circuit. Battery and ground or battery and open states are used for off-hook and on-hook, respectively, on the M lead for signaling from a trunk circuit to the trunk facility.
- 2 Transmittal of a PTS supervisory signal is said to occur when the state transition, which begins the signal, occurs at the M lead.

### **Operation times applicable to PTS – SN/access tandem**

Operation times will be met at all engineered traffic loads.

#### **Address time (cross-office time)**

- starting point: end of address digit reception
- ending point: transmittal of connect signal
- mean: 200 ms
- 95 percent level: 360 ms

#### **Network path closure time**

- starting point: completion of outpulsing
- ending point: establishment of communication path through office
- mean: 100 ms
- 95 percent level: 180 ms
- maximum: 250 ms

#### **Answer time**

- starting point: receipt of answer signal
- ending point: transmittal of answer signal

- mean: 22 ms \*  
50 ms \* \*
- 95 percent level: 38 ms \*  
95 ms \* \*
- maximum: 50 ms \*  
not specified \* \*

\* trunk to trunk connection

\* \* trunk to line connection

#### **Re-answer time**

- starting point: receipt of re-answer signal
- ending point: transmittal of re-answer signal
- mean: 100 ms
- 95 percent level: 180 ms
- maximum: 250 ms

#### **Clear-forward time**

- starting point: receipt of clear-forward (disconnect) signal
- ending point: transmittal of clear-forward (disconnect) signal
- mean: 100 ms (plus incoming trunk disconnect timing)
- 95 percent level: 180 ms (plus incoming trunk disconnect timing)
- maximum: 250 ms (plus incoming trunk disconnect timing)

#### **Clear-back time**

- starting point: receipt of clear-back (hang-up) signal
- ending point: transmittal of clear-back (hang-up) signal
- mean: 100 ms
- 95 percent level: 180 ms
- maximum: 250 ms

#### **Release-guard time**

- starting point: timeout of guard timing
- ending point: idling of outgoing trunk
- mean: 100 ms
- 95 percent level: 180 ms
- maximum: 250 ms

**Forward-transfer time**

- receipt of forward-transfer (ring-forward) signal
- ending point: transmittal of forward-transfer (ring-forward) signal
- mean: 100 ms (plus incoming trunk ring-forward timing)
- 95 percent level: 200 ms (plus incoming trunk ring-forward timing)

**Seizure time**

- starting point: receipt of connect signal
- ending point: transmittal of start dial or end of wink-start signal
- minimum:               280    290
- mean:                    375    315
- 95 percent level:       560    420

**Immediate start time**

- starting point: receipt of connect signal
- ending point: capability of storing pulses for immediate dial operation
- minimum: 25 ms
- mean: 50 ms (plus seizure recognition time)
- maximum: 120 ms (plus seizure recognition time)

**Response time**

- starting point: receipt of start-dial or end of wink-start signal.  
(transmittal of connect signal in immediate dialing case)
- ending point: beginning of outpulsing
- mean: 100 ms (plus required delay)
- 95 percent level: 180 ms (plus required delay)
- maximum: 250 ms (plus required delay)

**Receiver release time**

- starting point: end of address digit reception
- ending point: idling of address signal receiver
- mean: 100 ms
- 95 percent level: 180 ms
- maximum: 250 ms

**Transmitter release time**

- starting point: completion of outpulsing
- ending point: idling of address signal transmitter
- mean: 100 ms

- 95 percent level: 180 ms
- maximum: 250 ms

**Operation times for automatic message accounting (AMA), centralized AMA (CAMA) and local AMA (LAMA)**

Charge answer time

- starting time: receipt of answer signal
- ending time: beginning of charging period
- mean: 60 ms
- 95 percent level: 110 ms
- maximum: 150 ms

Charge disconnect time

- starting point: receipt of clear forward
- ending point: end of charging period
- mean: 60 ms plus incoming trunk disconnect timing
- 95 percent level: 110 ms plus incoming trunk disconnect timing
- maximum: 150 ms plus incoming trunk disconnect timing

**Automatic number identification (ANI) request time**

- starting point: end of address digit reception
- ending point: transmittal of ANI-request signal
- mean: 170 ms
- 95 percent level: 390 ms

**Operator number identification (ONI) request time**

- starting point: end of address digit reception
- ending point: transmittal of CAMA-position-request signal
- mean: 100 ms
- 95 percent level: 180 ms
- maximum: 250 ms

**ONI connect time**

- starting time: receipt of seizure-acknowledgement signal from CAMA position
- ending time: establishment of communication path between CAMA position and calling customer
- mean: 100 ms
- 95 percent level: 180 ms

- maximum: 250 ms

#### **ONI disconnect time**

- starting point: receipt of either the calling number or the position-disconnect signal
- ending point: Idling of CAMA position
- mean: 100 ms
- 95 percent level: 180 ms
- maximum: 250 ms

#### **Mishandled calls**

The call completion rate for a DMS-100 Family system is equal to or greater than 99.99 percent (no more than one call in 10 000 mishandled). A mishandled call is a call attempt that arrives at an incoming port of the switching system but was mishandled due to a hardware and/or software error. Three results are expected:

- 1 mis-routing
- 2 premature release by the switching system
- 3 switching system transmission failure as detected by a continuous parity check

Calls that cannot be completed due to the unavailability of engineered equipment are not included in this definition unless the congestion is caused by a system or subsystem fault or error.

### **Reliability**

To ensure high reliability, all critical subsystems are duplicate. When faults are detected, the system software re-configures the hardware to minimize the effect on service.

The coverage of a duplicate subsystem is the proportion of the occurrence of simplex faults from which the subsystem can recover through the detection of the fault and the subsequent re-configuration to the standby module. The long-term attainable coverage for the DMS-100 Family and the DMS SN duplicate modules is 99.9 percent for the core equipment and 99 percent for peripherals.

#### **Hardware failure modes**

Table J lists the predicted DMS-100 Family and the DMS SN printed circuit pack (PCP) failure rates. Table 1-52 lists the predictions for hardware reliability performance.



**System failure**

A system failure is defined as any failure that results in a complete loss of call processing. Double faults and uncovered faults in the central control may result in a system failure.

**Subsystem failure**

Table J lists the predicted DMS-100 Family and the DMS SN PCP failure rates. Table 1-52 lists the predictions for hardware and reliability performance.

**System downtime**

The following estimated times for restarts and reloads assume a fault-free DMS-100 Family System, both hardware and software. In addition, it is assumed that the peripheral subsystem has not experienced a power outage prior to the restart.

**Unscheduled system downtime – SN**

The total DMS-100 Family system unscheduled downtime, due to hardware, software and procedural failure modes, is expected to be no more than two hours in 40 years.

For BCS30, the following timings have been recorded for a typical DMS SN equipped with a SR40 processor:

**Warm restart** The amount of time required for A1 Flashing is 102 sec, first login is 111 sec, and First Host Dialtone is approximately 102 sec.

**Cold restart** The amount of time required for A1 Flashing is 113 sec, first Login is 108 sec, and First Host Dialtone is approximately 116 sec.

**Reload restart (auto reload)** The amount of time required for A1 Flashing is 177 sec, First Host Dialtone is approximately 183 sec.

<b>Boot timings:</b>	Device	BCS30 RTM
	DDU (8 in., 203 mm)	14:48 min
	DDU (14 in., 356 mm)	21:35 min
	SLM Disk	2:33 min
	SLM Tape	12:29 min

*Note:* Timings for the SN categories were obtained from RTP FAST (First Application Systems Test) Laboratory.

**Unscheduled system downtime – NT40**

For BCS30, the following timings have been recorded for a typical DMS 100 with an NT40 processor:

**Note:** Timings for NT40 were obtained from RTP FAST (First Application Systems Test) Laboratory.

As of BCS29, the RTP FAST NT40 is a DMS-200 Access Tandem load. Therefore, the first and 100 percent dial tone are no longer applicable. Most of the recovery timings will be faster due to the amount of NTX packages and engineerable datafill.

<b>Warm restart</b>	Event	BCS30 RTM
	SOS	:31
	Logs Start	1:01
	A1 Flashing	2:33
	Perminct	2:14
	1st Login	3:04
	1st DDU Insv	2:14
	AMA Active	2:17
<b>Cold restart</b>	Event	BCS30 RTM
	SOS	:27
	Logs Start	:57
	A1 Flashing	2:56
	Perminct	2:40
	1st Login	3:03
	1st DDU Insv	2:31
	AMA Active	2:37
<b>Reload restart</b>	Event	BCS30 RTM
	SOS	:34
	Logs Start	1:13
	A1 Flashing	4:08
	Perminct	3:46
	1st Login	4:15
	1st DDU Insv	3:13
	AMA Active	4:15
<b>Boot timings</b>	Device	BCS30 RTM
	DDU (8 in., 203 mm)	4:36
	DDU (14 in., 356 mm)	6:33
	MTD	15:09

### **Scheduled system downtime**

Reloads from the system magnetic tape through the BCS process are used to update the DMS-100 Family software. The new software is loaded in the

inactive CPU, while the active CPU is still processing calls. The manual activity switch and the restart procedure are initiated. In a typical DMS-100 Family System, the system downtime (the period of time from the commencement of the activity switch until dial tone is returned on all line peripherals) is estimated to be less than 10 min.

## **DMS SN processing elements**

The DMS-Bus establishes a peer relationship among the processors of the DMS SN system and enables messaging between processors without the processor's intervention. This messaging capability becomes significant when network responsibilities are consolidated within a single network node.

The modular growth of the DMS allows economic provisioning of processing resources for all deployment size ranges. Initial systems can consolidate processing responsibilities to the resources of the DMS-Core. For larger systems in which the resources of the DMS-Core are reserved for essential call processing, any combination of the following new processing elements for the DMS SN system can be provisioned: The Application Processor, the File Processor and the Data Communications Processor.

The hardware architecture of both the Application and File Processor is the same as for the DMS-Core. The Application Processor can assume DMS-Core responsibilities not essential to call processing or can perform new tasks that are assigned to the node as a result of reduced overhead through integration, such as Enhanced Service Provider Access and Billing or Centrex Billing management.

The File Processor supports integrated database applications executed by the DMS-Core, the Application Processor, or an external system interfacing with the DMS SN system, such as an Operations Support System or a Node/Network Workstation. The Data Communications Processor (DCP) provides integrated access to the DMS SN system for CCS7 signaling links, maintenance and administration positions, external computing systems and Operations Support Systems.

The software that serves these new processing modules is of two types: one for basic maintenance and control of the modules, and one to service unique applications and database management systems that run on the modules. The applications software is in development. Descriptions of the maintenance and control software follow.

## **Multi-processing**

This package enables multiple processors to exist, be maintained and communicate within the DMS SN system by providing individual processor maintenance, link maintenance (processor to DMS-Bus), and overall node maintenance in a multi-processing environment.

### **File processor**

This package provides the maintenance and control software resident in the File Processor. The File Processor may be provisioned with up to 96 Mbytes of memory, used in most applications as a cache. A memory cache allows faster access than other storage, such as disk or tape.

The File Processor implements a hierarchical and relational database and adheres to Network File System (NFS) for remote file access by other processors within the system or external systems. File Processor can be equipped with up to six devices on a Small Computer Systems Interface (SCSI) bus. These storage devices can be 600 Mb disks or 300 Mb cartridge tape drives.

### **Data communication processor**

This package provides the maintenance and control software resident in the Data Communication Processor (DCP). The DCP, in conjunction with support circuitry, manages the first three protocol levels of the interfaced link; the signaling message's access to the rest of the node is managed by the LPP's Local Message Switch (LMS), which uses the same architecture as the DMS-Bus.

The Data Communications Processors are located in the LPP frame and support specific applications, such as CCS7 signaling link access through the Link Interface Unit (LIU7), an Ethernet LAN for communication (synchronous and asynchronous), servers that manage terminal, workstation and modem access and a BX.25 access.

### **Application processor base**

This package provides the maintenance and control software resident in the Application Processor. The Application Processor can assume DMS-Core non-essential call processing activities (such as terminal drivers, AMA formatting) or new responsibilities assigned to the node.

The Application Processor can support two different operating systems: the SOS proprietary operating system and an industry standard version of UNIX. The SOS operating system allows the Application Processor to run DMS-Core software without translation. The UNIX operating system allows designers to take advantage of commercially available tools and assists in the unique requirements of custom programming applications.

### **Link peripheral processor (LPP)**

The DMS SN-based Link Peripheral Processor (LPP) has been providing economical and reliable messaging for Nortel Networks' signaling transfer point—the MDS-STP—since late 1988. In support of the increasingly high volumes of Common Channel Signaling No. 7 (CCS7) services being deployed in today's network, Nortel Networks announces the availability of

the LIU7, a Data Communications Processor (DCP), for high-capacity DMS SN Service Switching Point (SSP) applications.

Key applications include providing enhanced message-handling capacity for the following:

- large CCS7 access tandems and
- very large end offices that support multiple CCS7 services and/or large volumes of CCS7 trunking

As the data communications processor for FiberWorld and the S/DMS SN program, the LPP is also scheduled to serve as a multipurpose cabinet to support a range of DCP interfaces to external data systems.

### LPP on DMS SN service switching point

This base package provides the platform for Link Peripheral Processor (LPP) applications on the DMS SN Service Switching Point (SSP) and includes the following feature packages:

- Local Message Switch on LPP
- SN Enhanced Messaging
- FBus – Link Interface Unit (LIU7) Base.

**Table 1-51**  
DMS SN and DMS-100 family PCP failure rates (continued)

Pack name	Pack location	Description	Predicted failure rate per million hours
NT0X10AA	MTM	Miscellaneous Scan Card	4.06
NT0X36AA	SUPRV PNL	Power Control & Alarm	1.29
NT0X36AB	SUPRV PNL	Power Control & Alarm	1.34
NT0X51AA	PDC	Fuse Alarm	0.08
NT0X51AB	PDC	Fuse Alarm	0.05
NT0X67AA	IOC	I/O Control Term	0.44
NT0X70AA	TM	Trunk Module Processor	1.91
NT0X89AA	ALARM	Data Link Control	0.07
NT0X89AB	ALARM	Data Link Control	0.05
NT0X91AA	FSP	Alarm & Converter Drive	0.48
NT0X91AB	FSP	Converter Drive	0.13
NT0X91AD	FSP	Converter Drive & Protection	0.52

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**Table 1-51**  
**DMS SN and DMS-100 family PCP failure rates** (continued)

Pack name	Pack location	Description	Predicted failure rate per million hours
NT0X91AE	FSP	Converter Drive & Protection	0.52
NT0X93AA	FAN	48V to 24V Fan Inverter	1.70
NT1X00AA	MTM	102 Test Trunk	2.15
NT1X00AB	MTM	102 Test Trunk	1.42
NT1X00AC	MTM/OAU	Receiver Off-hook Tone	1.56
NT1X31AA	MTM	Conference Circuit	4.00
NT1X33AA	CMC	CMC Processor Interface	3.51
NT1X33BA	CMC	CMC Processor Interface	1.81
NT1X34AA	CMC	CMC Outgoing Controller	4.64
NT1X34BA	CMC	CMC Outgoing Controller	4.59
NT1X35AA	CMC	CMC Incoming Controller	4.66
NT1X35BA	CMC	CMC Incoming Controller	4.60
NT1X36AA	CMC	CMC Peripheral Interface	5.62
NT1X36AB	CMC	CMC Peripheral Interface Timing	5.64
NT1X36BB	CMC	CMC Peripheral Interface	5.64
NT1X37AA	CMC	CMC Common Control	2.23
NT1X37BA	CMC	CMC Common Control	3.20
NT1X42AA	CPU	E2A Telemetry Service Interface	0.66
NT1X43AA	CPU	Processor Program Store Port	3.41
NT1X43AC	CPU	Processor Program Store Port	3.41
NT1X43BC	CPU	Processor Program Store Port	3.41
NT1X43BD	CPU	Processor Program Store Port	3.70
NT1X43CA	CPU	Processor Program Store Port	4.62
NT1X43DA	CPU	Processor 8MW Program Store Port	2.46
NT1X44AA	CPU	Processor Stack	6.86
NT1X44BA	CPU	Processor Stack	6.90
NT1X44BB	CPU	Processor Stack	6.63
—continued—			

**Table 1-51**  
**DMS SN and DMS-100 family PCP failure rates** (continued)

Pack name	Pack location	Description	Predicted failure rate per million hours
NT1X44DA	CPU	Processor Stack (4KW)	2.70
NT1X45AA	CPU	Processor A.L.F.	3.28
NT1X45BA	CPU	Processor A.L.F.	3.34
NT1X45BB	CPU	Processor A.L.F.	6.63
NT1X45DA	CPU	Processor A.L.F.	1.99
NT1X46AA	CPU	Processor ROM	8.16
NT1X46BA	CPU	Processor ROM	7.68
NT1X46BB	CPU	Processor ROM	9.04
NT1X46CA	CPU	Processor 8K ROM	6.36
NT1X46CB	CPU	Processor 8KW ROM	6.61
NT1X46CC	CPU	Processor 8KW ROM	6.37
NT1X46CD	CPU	Processor 8KW ROM	2.57
NT1X46DA	CPU	Processor 8KW ROM	2.54
NT1X47AA	CPU	Processor Timing & Control	3.33
NT1X47BA	CPU	Processor Timing & Control	3.58
NT1X47BB	CPU	Processor Timing & Control	3.17
NT1X47DA	CPU	Processor Timing & Control	2.77
NT1X48AA	CPU	Processor Maintenance	3.28
NT1X48BA	CPU	Processor Maintenance	3.58
NT1X48CA	CPU	Remote Control Processor Maintenance	6.05
NT1X48DA	CPU	Processor Maintenance	2.07
NT1X49BA	CPU	Unbalanced Data Port Extender	0.58
NT1X49DA	CPU	Unbalanced Data Port Extender	0.60
NT1X50AB	CPU	Balanced Data Port Extender	2.29
NT1X50BB	CPU	Balanced Data Port Extender	2.29
NT1X50DA	CPU	Balanced Data Port Extender	2.06
NT1X51AA	CPU	CMC Interface	2.11

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**Table 1-51**  
**DMS SN and DMS-100 family PCP failure rates** (continued)

Pack name	Pack location	Description	Predicted failure rate per million hours
NT1X51BA	CPU	CMC Interface	1.21
NT1X51DA	CPU	CMC Interface	1.51
NT1X52AA	CPU	Processor Termination	4.45
NT1X53AA	CC	4K ROM Extender	2.11
NT1X53BA	CPU	4K ROM Extender	1.99
NT1X53BB	CC	4K ROM Extender	7.75
NT1X54AA	MTM	Jack End Trunk	1.32
NT1X55AA	IOC	Disk Drive Controller	7.14
NT1X55AB	IOC	Disk Drive Controller	8.00
NT1X55DA	IOC	8-in. Disk Drive Controller	3.56
NT1X62AA	CMC	I/O Message Controller	6.43
NT1X62AB	CMC	I/O Message Controller	5.65
NT1X62BB	CMC	I/O Message Controller	6.27
NT1X62CA	CMC	I/O Message Controller	5.65
NT1X67AA	IOC	I/O Terminal Controller	6.06
NT1X67AB	IOC	I/O Terminal Controller	6.84
NT1X67BB	IOC	I/O Terminal Controller	6.84
NT1X67BC	IOC	I/O Terminal Controller	6.89
NT1X67BD	IOC	I/O Terminal Controller	4.07
NT1X67DB	CC	BIT Synchronous Data Link Controller	3.79
NT1X68AA	IOC	Magnetic Tape Interface	4.93
NT1X68AB	IOC	Nine-Track Tape Controller	5.08
NT1X68AC	IOC	Nine-Track Tape Controller	5.17
NT1X68BB	IOC	Nine-Track Tape Controller	5.08
NT1X68BC	IOC	Cook Nine-Track Controller	5.08
NT1X68BD	IOC	9-Track Tape Contr. (HP & Cook)	5.08
NT1X75AA	MTM	Digital Recorded Ann. Controller	2.49
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**Table 1-51**  
**DMS SN and DMS-100 family PCP failure rates** (continued)

Pack name	Pack location	Description	Predicted failure rate per million hours
NT1X75BA	MTM	Enhanced Digital Recorded Announcement Controller	2.76
NT1X76AA	MTM	DRA Standard Ann. (English)	15.24
NT1X76AB	MTM	DRA Standard Ann. (English)	12.06
NT1X76AE	MTM	DRA Standard Ann. (English)	4.18
NT1X76BA	MTM	DRA Standard Ann. (French)	14.08
NT1X76CA	MTM	Mech Credit Card Service From Memory	22.34
NT1X77AA	MTM	DRA Recorded Memory	3.82
NT1X78AA	IOC	Power Converter	3.84
NT1X79AA	MTM	DRA (Electrical Erasable Prom)	6.03
NT1X89AA	IOC	Multiprotocol Controller	7.09
NT1X90AA	MTM	Test Signal Generator	7.82
NT2X01AA	MTM	Automatic Identification of Outward Dialing Data Rec C25	6.73
NT2X02AA	RLM	Line Drawer I/F Card	1.57
NT2X03AA	RLM	Power Converter	1.01
NT2X05AA	RLM	Power Converter	4.43
NT2X05AB	RLM	Power Converter	5.20
NT2X05AC	RLM	Power Converter	4.57
NT2X06AB	NM, DCM	Power Converter	2.65
NT2X06BB	NM, DCM	Power Converter	2.05
NT2X07AB	NM, DCM	Power Converter	3.14
NT2X09AA	TM	Multi-Output Power Converter	3.33
NT2X10AA	MTM	Line Test Unit Analog Card	3.16
NT2X10AB	MTM	Line Test Unit Analog Card	3.49
NT2X11AA	MTM	Line Test Unit Digital Card	2.09
NT2X11AC	MTM/RMM	Line Test Unit Digital Card	2.05
NT2X15AA	FAN	Inverter Unit	1.11
—continued—			

**Table 1-51**  
**DMS SN and DMS-100 family PCP failure rates** (continued)

Pack name	Pack location	Description	Predicted failure rate per million hours
NT2X16AB	RLM	I/O Bus Interface	1.59
NT2X17AB	RLM	Type A With Cutover Line Card (20 dB)	0.77
NT2X17AC	RLM	Type A With Cutover Line Card (20 dB)	0.80
NT2X17AD	RLM	Type A With Cutover Line Card (20 dB)	0.80
NT2X18AC	RLM	Type B Line Card	2.42
NT2X18AD	RLM	Type B Line Card	1.97
NT2X18AE	RLM	Type B Line Card	1.80
NT2X20AB	RLM	Ringling Bus Multiplexer	0.83
NT2X21AA	RLM	Terminal Addressing Interface	3.14
NT2X21AC	RLM	Terminal Address I/F	3.83
NT2X22AA	RLM	Conn Mem/Trans Mux	3.32
NT2X22AB	RLM	Conn Mem/Trans Mux	4.74
NT2X23AA	RLM	Receive Mux	2.74
NT2X24AB	RLM	Signaling Processor	5.72
NT2X25AB	RLM	Signaling Processor I/F	3.84
NT2X26AA	RLM	Main Processor	8.25
NT2X26AB	RLM	Master Processor	11.26
NT2X27AA	RLM	Ringling Generator Interface	3.33
NT2X27AB	RLM	20Hz Ringling Generator	2.08
NT2X27AC	RLM	Ringling Generator Harmonic MF	3.55
NT2X27AD	RLM	Ringling Generator Synchronic MF	3.55
NT2X27AE	RLM	Ringling Generator Synchronic MF	3.55
NT2X32AA	DCM	DCM Processor	2.26
NT2X33AA	DCM	DCM Processor	4.25
NT2X33AB	DCM, RLM	DCM Processor	2.50
NT2X34AA	DCM, RLM	Peripheral Message Processor	1.80
NT2X35AA	DCM	DCM Line	3.55
—continued—			

**Table 1-51**  
**DMS SN and DMS-100 family PCP failure rates** (continued)

Pack name	Pack location	Description	Predicted failure rate per million hours
NT2X35AB	DCM	DCM Interface	1.17
NT2X36AA	DCM/RLM	Network Interface	6.57
NT2X36AB	DCM	Network Interface w/XPCM Suppress Cap	7.67
NT2X37AA	DCM	DCM Tone Supply	3.91
NT2X37AB	DCM	DCM Tone	2.18
NT2X38AA	DCM	DCM Signaling	4.55
NT2X38AB	DCM	DCM Signaling	4.31
NT2X38AC	DCM	DCM Signaling	4.46
NT2X38AD	DCM	DCM Signaling	4.31
NT2X41AA	MTM	Office Alarm Circuit #1	0.30
NT2X42AA	MTM	Office Alarm Circuit #2	0.53
NT2X43AB	MTM	Office Alarm	2.00
NT2X45AA	TM	Trunk Module Network Interface	4.83
NT2X45AB	TM	Trunk Module Network Interface	4.79
NT2X47AA	TM	Trans TST Modular Controller	7.22
NT2X47AB	TM	Trans Test Unit	8.17
NT2X47AC	TM	Trans Test Unit Controller	3.96
NT2X47AD	TM	Trans Test Unit Controller	4.42
NT2X47BA	TM	TTU Controller (A-Law)	8.23
NT2X48AA	TM	Digital 4 Channel MF Receiver	2.59
NT2X48AB	TM	Digital 4 Channel Receiver	2.79
NT2X50AB	TM	Minibar Driver	2.41
NT2X53AA	TM	TM/Control	1.61
NT2X55AA	MTM	SD Card II	0.77
NT2X56AA	MTM	TTM Digital Filter	4.52
NT2X56AB	MTM	TTM Digital Filter	1.69
NT2X56BA	MTM	Digital Filter (A-Law TTU)	4.89

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**Table 1-51**  
**DMS SN and DMS-100 family PCP failure rates** (continued)

Pack name	Pack location	Description	Predicted failure rate per million hours
NT2X57AA	MTM	SD Card I	2.56
NT2X57AB	MTM	Signal Distribution Card	2.51
NT2X59AA	TM	Group CODEC DMS-200	2.90
NT2X59AB	TM	Group CODEC DMS-300	5.00
NT2X63AA	MTM	M/F Receiver	2.12
NT2X65AA	TM	CAMA Position Signal Trunk	5.54
NT2X66AA	TM	CAMA Suspension & Calls Waiting	1.23
NT2X70AA	CPU, CMC	Power Converter	2.87
NT2X70AB	CPU, CMC	Power Converter	2.82
NT2X70AC	CPU, CMC	Power Converter	3.19
NT2X70AD	CPU, CMC	Power Converter	3.22
NT2X70BA	CPU, CMC	Power Converter	2.89
NT2X71AA	MTM	Transmission Termination Trunk	3.00
NT2X72AA	TM	4-Wire E&M, Type I Interface	5.85
NT2X72AB	TM	4-Wire E&M 600 Ohm Echo Sup.Control	5.94
NT2X72AC	TM	4-Wire E&M, Echo Control, low gain	5.93
NT2X75AA	MTM	Loop Around Test Line	1.92
NT2X77AA	TM	Compromise Bal. Network 900 Ohm	0.10
NT2X77AB	TM	Compromise Bal. Network 600 Ohm	0.11
NT2X77AC	TM	Compromise Bal. Network 900 Ohm Fix	0.55
NT2X77AD	TM	Compromise Bal. Network 600 Ohm Fix	0.06
NT2X78AA	TM	Trunk 4 Wire SF Signal	7.95
NT2X80AA	TM	Precision Bal. Network	0.10
NT2X81AA	TM	Trunk 2-Wire E&M 900 Ohm	2.15
NT2X81AB	TM	Trunk 2-Wire E&M 600 Ohm	5.53
NT2X82AA	TM	Trunk 2-Wire Incoming MF/DP	5.88
NT2X83AA	TM	Trunk 2-Wire Outgoing DP	6.56
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**Table 1-51**  
**DMS SN and DMS-100 family PCP failure rates** (continued)

Pack name	Pack location	Description	Predicted failure rate per million hours
NT2X85AA	TM	Recording Comp. Trk Hi-Lo Coin	3.96
NT2X86AA	TM	Toll Switch Trunk	3.64
NT2X88AA	TM	Trunk 4-Wire E&M 600 Ohms	2.52
NT2X90AA	MTM	Trunk LTD NE-14 or CALRS	4.27
NT2X90AB	MTM	Incoming/Outgoing Test Trunk	4.83
NT2X90AC	MTM	Incoming/Outgoing Test Trunk	4.90
NT2X90AD	MTM	Incoming/Outgoing Test Trunk	4.06
NT2X92AA	TM	2-Wire Outgoing, MF, RB	5.79
NT2X95AA	TM	2-Way PBX Trunk DID/DOD	2.45
NT2X96AA	TM	PCM Level Meter	4.29
NT2X98AA	TM	2-Wire Incoming MF/DP RB	4.78
NT3X02AA	TM	TOPS Controller	2.72
NT3X03AA	TM	TOPS Digital Signal Processor	1.54
NT3X04AA	TM	TOPS Digital Signal Processor	5.34
NT3X06AA	TM	2 W OTG TRK CCT AE/3CL	3.95
NT3X07AA	TM	2 W INC TRK CCT	6.39
NT3X08AA	MTM	ACTS – Digitone Service	5.48
NT3X09AA	TM	Remote Metallic Test Access	1.82
NT3X09BA	TM	Remote Metallic Test Access	4.07
NT3X13AA	CMC	Master Clock Generator	3.48
NT3X13BA	CMC	Master Clock Generator	3.43
NT3X14AA	CMC	Synchronizable Master Clock Counter	3.27
NT3X14BA	CMC	Synchronizable Master Clock Counter	3.27
NT3X14BB	CMC	Synchronizable Master Clock Counter	3.63
NT3X14BC	CMC	Synchronizable Clock Controller	2.09
NT3X15AA	CMC	Synchronizable Master Clock Counter	3.35
NT3X15AB	CMC	Synchronizable Master Clock Counter	3.65

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**Table 1-51**  
**DMS SN and DMS-100 family PCP failure rates** (continued)

Pack name	Pack location	Description	Predicted failure rate per million hours
NT3X15BA	CMC	Synchronizable Master Clock Counter	3.57
NT3X15BB	CMC	Synchronizable Master Clock Oscillator	2.73
NT3X15CA	CMC	Stratum 3 Synchronizable Master Clock	3.00
NT3X15DA	CMC	Stratum 2 Synchronizable Master Clock	3.01
NT3X16AA	CMC	Stratum 2 Oscillator	2.02
NT3X17AA	NM	Network Incoming Crosspoint	4.40
NT3X18AA	NM	Network Outgoing Crosspoint	4.46
NT3X19AA	NM	Network Speech Interface	4.81
NT3X20AA	NM	Network Test Access	2.72
NT3X21AA	NM	Network Bus Interface	1.11
NT3X22AA	NM	Network I/O/Interface	3.74
NT3X22AB	NM	Network I/O/Interface	5.61
NT3X23AA	NM	Network X-Point Controller	5.98
NT3X23AB	NM	Network Signaling Controller	5.10
NT3X24AA	NM	Network Clock	2.39
NT3X34AA	PS	Single Ended Memory Bus Terminator	0.66
NT3X35AB	PS	Differential Memory Bus Terminator	0.68
NT3X36AB	PS	Differential Bus Interface	1.94
NT3X36AC	PS	Differential Bus Interface	2.21
NT3X36BB	PS	Differential Memory Bus Interface	1.94
NT3X36BC	PS	Differential Memory Bus Interface and Terminator	2.21
NT3X37AA	PS	Single Ended Memory Bus Terminator	0.95
NT3X37AC	PS	Single Ended Memory Bus Interface	1.24
NT3X37BA	PS	Single Ended Memory Bus Interface	0.54
NT3X37BC	PS	Single Ended Memory Bus Interface and Terminator	0.81
NT3X38AA	PS	Memory Controller	4.36
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**Table 1-51**  
**DMS SN and DMS-100 family PCP failure rates** (continued)

Pack name	Pack location	Description	Predicted failure rate per million hours
NT3X39AA	PS	16K MOS Memory	14.26
NT3X40AA	CPU	64K MOS Memory	13.79
NT3X40BA	CPU	64K MOS Memory	13.80
NT3X42AA	CPU	LM Word Memory Control	3.48
NT3X42BA	CPU	LM Word Memory Control	3.39
NT3X4302	CPU	(IMW) Memory Back Panel Terminator	1.97
NT3X4303	CPU	Processor Back Panel Terminator	0.38
NT3X4304	CMC	CMC/IOC Back Panel Terminator	0.40
NT3X4307	PS	PS Controller Back Panel Terminator	0.49
NT3X4309	CCC	16 MW Memory BP Termination	0.63
NT3X47AA	RLM	RLM Message Controller	6.83
NT3X48AA	RLM	RLM T1 Line I/F	4.95
NT3X49AA	RLM	RLM Extension MEM	8.15
NT3X51AA	RLM	RLM Service Shelf Interface	2.99
NT3X65AA	DCM	Echo Suppressor	5.71
NT3X67AA	TM	6 Party Conference Circuit	1.78
NT3X68AA	TM	Perm Sig & Conf Tone Generator	0.85
NT3X68AB	TM	MF Dual Tone Generator	0.85
NT3X68AC	MTM	Call Waiting Tone Generator	0.85
NT3X70AA	NM	Network Crosspoint	2.66
NT3X71AA	NM	Network Test Code	1.28
NT3X72AA	NM	Network Serial Port Interface	3.91
NT3X72AB	NM	Network Serial Port Interface	3.61
NT3X73AA	NM	Network Serial to Parallel Formatter	3.66
NT3X74AA	NM	Network Control Processor (E-Core)	2.77
NT3X74AB	NM	Network Control Processor (E-Core)	2.46
NT3X74BA	NM	Network Control Processor (CP)	4.91

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**Table 1-51**  
**DMS SN and DMS-100 family PCP failure rates** (continued)

Pack name	Pack location	Description	Predicted failure rate per million hours
NT3X74BB	NM	Network Control Processor	5.56
NT3X75AA	NM	Network P-Side Message Processor	2.09
NT3X75BA	NM	Network P-Side Message Processor	2.97
NT3X76AA	NM	Network Clock	2.63
NT3X76AC	NM	Network Clock	5.25
NT3X82AA	MTM	OAU Dead System with Unique Audible	2.75
NT3X82AB	MTM	OAU Dead System with Common Aud.	2.25
NT3X83AA	MTM	OAU Alarm Transfer	3.05
NT3X84AA	MTM	OAU Alarm Sending	2.50
NT3X85AA	MTM	OAU Alarm Grouping	2.65
NT3X86AA	NM	Network Parallel to Serial Formatter	5.03
NT3X91AA	TM	Remote Office Test Line	2.71
NT3X93AA	PS	256K Memory	6.00
NT3X94AA	PS	4 MW Memory Controller	3.70
NT4X01BA	TOPS	TOPS B01 Control Board	7.67
NT4X01BB	TOPS	Blind Operator Interface	2.67
NT4X08AA	TOPS	Attendant Console Main Circuit Pack	5.70
NT4X21AA	TOPS	Main Set Circuit Pack (Basic)	3.35
NT4X21AB	TOPS	Main Set (Display)	4.68
NT4X21AC	TOPS	Button Add-On	4.02
NT4X21AD	TOPS	Handsfree Auto Answer	2.51
NT4X23AA	TOPSDTU	Digital Test Unit	11.93
NT4X25AA	TOPS	Data Unit Sync/Asyn LS, Variable	6.27
NT4X25AB	TOPS	Data Unit Sync/Asyn LS	1.14
NT4X25AD	TOPS	Data Unit Rack Mount LS	6.98
NT4X25AM	TOPS	COAX Eliminator CUI/F	7.72
NT4X25BA	TOPS	Dial/Key	5.60
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**Table 1-51**  
**DMS SN and DMS-100 family PCP failure rates** (continued)

Pack name	Pack location	Description	Predicted failure rate per million hours
NT4X25BB	TOPS	Switch Interface	0.92
NT4X25BC	TOPS	Low Speed Main PCB Assy.	4.44
NT4X25BE	TOPS	High Speed Main PCB Assy.	4.84
NT4X25BR	TOPS	Data Unit COAX PCB Assy.	5.51
NT4X25CH	TOPS	Low Speed Rack Mount Autoloop Back	4.79
NT4X26AA	TOPS	Subscriber Access Multiplexer (SAM)	4.45
NT4X26AB	TOPS	SAM-1A (TF)	7.67
NT4X30AA	TOPS	P1 Business Set (W78)	4.61
NT4X60AA	TOPS	TOPS Power Supply	2.16
NT4X60AB	TOPS	TOPS Power Supply	2.18
NT4X61AA	AOSS	Audio Control	2.79
NT4X62AA	AOSS	Data Control	3.81
NT4X63AB	AOSS	Keyboard Assembly	0.10
NT4X63AC	AOSS	Module Controller	3.08
NT4X63AD	AOSS	Display Unit	4.02
NT4X63AE	AOSS	Row and Column Control	1.39
NT4X63BD	AOSS	Display Controller	1.80
NT4X79AA	CCC	16 MW Memory Control	4.93
NT4X80AA	CCC	IMW Memory	8.46
NT5X25AA	TM	1 WY TRK OUTG GRD ST DP/DTMFOR INCM LP OR GRD ST 20Hz RG	6.94
NT5X29AB	MTM	Service Observing Circuit	4.80
NT5X29AC	MTM	Audio Answer Detect MF CKT	1.96
NT5X30AA	MTM	IOI Communication Test Line CKT	2.77
NT5X48AA	TOPS	480Hz & 620Hz Tone Generator (TOPS)	0.20
NT5X48AB	TOPS	Tone Amplifier (TOPS)	0.49
NT5X48AC	TOPS	Tone Monitor	0.38
NT5X49AA	TOPS	Converter CPNTA (TOPS)	1.07
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**Table 1-51**  
**DMS SN and DMS-100 family PCP failure rates** (continued)

Pack name	Pack location	Description	Predicted failure rate per million hours
NT5X5201	TM	Component Assembly	0.05
NT5X5202	TM	Component Assembly	0.09
NT5X67AA	DCM	DCM Cutover CKT	2.12
NT5X6901	MIS	Inactive System Timing	0.03
NT6X17AA	LCM	Standard Line CCT Type A with Cutover	1.20
NT6X17AB	LCM	Standard Line CCT Type A with Cutover (20 dB)	1.15
NT6X17AC	LCM	Standard Line CCT Type A with Cutover	0.57
NT6X18AA	LCM	Line Card Type B	0.78
NT6X18AB	LCM	Line Card Type B with +48V	0.87
NT6X19AA	LCM	Message Waiting Line Card	0.93
NT6X20AA	LCM	Message Waiting Converter Card	0.62
NT6X21AA	LCM	P-Phone Line Card 15 KFT	1.13
NT6X21AB	LCM	P-Phone Line Card 15 KFT	0.97
NT6X21AC	LCM	P-Phone Line Card 15 KFT	1.08
NT6X23AA	LCM	Converter	1.02
NT6X30AA	LCM	Ringing Generator	9.86
NT6X30AB	LCM	Ringing Generator CP	10.95
NT6X36AA	LCM	FSP Alarm	0.90
NT6X38AA	RLM	Ringing Control	10.21
NT6X40AA	LGC/DTC	DS-30 Network Interface	6.26
NT6X40AB	LGC/DTC	DS-30 Network Interface	5.94
NT6X40AC	LGC/DTC	DS-30 Network Interface	5.48
NT6X40BA	LGC/DTC	SCM DS-30 Interface CP	2.46
NT6X41AA	LGC/DTC	Speech Bus Formatter	5.12
NT6X42AA	LGC/DTC	Channel Supervision MSG	4.43
NT6X43AA	LGC/DTC	MSG Interface	3.59
NT6X44AA	LGC/DTC	Time Switch	3.42
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**Table 1-51**  
**DMS SN and DMS-100 family PCP failure rates** (continued)

Pack name	Pack location	Description	Predicted failure rate per million hours
NT6X44AB	LGC/DTC	Time Switch	3.72
NT6X44CA	LGC/DTC	Time Switch A/MU	4.17
NT6X45AA	LGC/DTC	LGC/DTC Processor	8.12
NT6X45AC	LGC/DTC	LGC/DTC Processor	4.39
NT6X45AE	LGC/DTC	LGC/DTC Processor	4.29
NT6X45AF	LGC/DTC	LGC/DTC Processor CP	5.02
NT6X45CA	LGC/DTC	SMS Processor CP	5.20
NT6X46AA	LGC/DTC	SP Memory Plus	12.58
NT6X46AB	LGC/DTC	SP Memory Plus	4.53
NT6X46AC	LGC/DTC	SP Memory Plus	3.15
NT6X46BA	LGC/DTC	SP Memory Plus	3.97
NT6X47AA	LGC/DTC	MP Memory	16.73
NT6X47AB	LGC/DTC	MP Memory Plus	8.74
NT6X48AA	LGC/DTC	DS-30 LCM Interface	4.18
NT6X49AA	LGC/DTC	DS-1 MUX Multiplexer	2.22
NT6X50AA	LCM	DS-1 Interface	3.84
NT6X51AA	LCM	LCM Processor	3.95
NT6X51AB	LCM	LCM Processor	8.21
NT6X52AA	LCM	Digroup Controller Card	7.07
NT6X53AA	LCM	Power Converter 5V/15V	3.99
NT6X54AA	LCM	Bus Interface	2.20
NT6X60AA	RLCM	Ringing Generator	9.98
NT6X65AA	MSB	CCIS Signaling Terminal	9.24
NT6X66AA	MSB	CCST Signaling Terminal	3.64
NT6X67AA	MSB	Signaling Terminal Buffer	0.62
NT6X68AA	MSB	Signaling Terminal Interface	1.09
NT6X68AB	MSB	Signaling Terminal Interface	1.94

—continued—

**Table 1-51**  
**DMS SN and DMS-100 family PCP failure rates** (continued)

Pack name	Pack location	Description	Predicted failure rate per million hours
NT6X68AC	MSB	Signaling Terminal Interface	1.45
NT6X68AD	MSB	Signaling Terminal Interface	1.47
NT6X69AA	MSB	CPP Message Protocol and Tone	4.25
NT6X69AB	MSB	CPP Message Protocol and Tone	4.88
NT6X70AA	MSB	CCIS Continuity Card	1.93
NT6X71AA	LCM	Data Line Card	1.14
NT6X71AB	LCM	Data Line Card	1.96
NT6X72AA	RCE	Host Link Formatter	4.03
NT6X73AA	RLCM	Link Control Card	4.98
NT6X74AA	RLCM	RMM Control Card	9.23
NT6X74AB	RLCM	RMM Control Card	3.72
NT6X75AA	RLCM	ESA Tone and Clock Card	1.90
NT6X76AA	LCM	Asynch Intrfc Ln Crd (AILC) (2 Slots)	0.68
NT6X79AA	CPC	Tone Generator	1.80
NT6X80AA	SCM	SCM Pad/Ring Card	2.05
NT6X80BA	SMR/SMS	SCM Pad/Ring Card	2.51
NT6X81AA	SCM	SCM A Bit/B Word	6.22
NT6X85AA	SCM	DS-1 I/F (SLC-96)	4.67
NT6X85AB	SCM	DSI I/F for SLC-96	4.65
NT6X86AA	SCM	A-Bit Message Card	3.64
NT6X92AA	TM	UTR	12.08
NT6X92BA	LGC/DTC	UTR	6.26
NT6X92BB	LGC/DTC	UTR	7.59
NT6X99AA	LCM	Tester Line Card	1.87
NT8X02AA	OPM	Battery Charger Controller	2.36
NT8X12AA	DSN	Network Port CP	5.79
NT8X13AA	DSN	Crosspoint CP	2.89
—continued—			

**Table 1-51**  
**DMS SN and DMS-100 family PCP failure rates** (continued)

Pack name	Pack location	Description	Predicted failure rate per million hours
NT8X14AA	DSN	Test Code CP	1.59
NT9X12AA	CM	CPU Port	12.67
NT9X12AB	CM	CPU Port	12.73
NT9X13BA	CCC	CPU CP	18.49
NT9X13BB	CCC	CPU (Static RAM) CP	18.48
NT9X13BC	CCC	CPU (Static RAM) CP	18.48
NT9X13CA	CCC	CPU Plus 4 Mb CP	12.10
NT9X13DA	CCC	CPU 16 CP	6.14
NT9X13DB	MS	CPU (16MHz)	16.02
NT9X14AA	CCC	Memory 4M CP	0.95
NT9X14BB	CCC	Memory 6M CP	8.00
NT9X15AA	CCC	Mapper CP	6.09
NT9X17AA	CCC	MS-4 Port CP	14.09
NT9X20AA	CCC	DS5 Paddle board CP	5.21
NT9X21AA	CCC	CM Bus Terminator Paddle board	1.39
NT9X23AA	CCC	DS30-4 Port Paddle board 4.13	2.67
NT9X23BA	MS	DS30 4 Port Paddle Brd (STP) CP	3.83
NT9X26AA	CCC	Remote Terminal Interface CP	2.54
NT9X27AA	CCC	CM Bus Extender	2.30
NT9X27BA	CCC	CM Bus Extender	0.79
NT9X30AA	CCC	+5 Volt Power Converter	1.84
NT9X31AA	CCC	-5 Volt Power Converter	2.27
NT9X32AA	MS	MS Load CP	1.10
—continued—			
NT9X44AA	CCC	System Load Unit	26.01
NT9X46AA	CCC	Parallel Port Interface Paddle board	0.69
NT9X47AA	CCC	+12 Volt Power Converter	1.84
<b>End</b>			

<b>Table 1-51</b> <b>DMS SN and DMS-100 family PCP failure rates</b> (continued)			
<b>Pack name</b>	<b>Pack location</b>	<b>Description</b>	<b>Predicted failure rate per million hours</b>
NT9X49CA	CCC	MS P-Bus Terminator 76	2.27
NT9X52AA	CCC	T-Bus Access CP	1.54
NT9X53AA	CCC	MS Clock CP	8.13
NT9X54AA	CCC	MS External Clock Interface	2.30
NT9X54AB	MS	Ext. Clock Interface (Stratum 212.5)	2.33
NT9X73AA	STP	LMS-FBUS Rate Adapter	10.34
NT9X74AA	STP	FBUS Repeater-Terminator	3.18
NT9X75AA	STP	CPU-FBUS Interface CP	10.80
NT9X76AA	STP	STP Signaling Terminal CP	9.58
NT9X78AA	STP	STP DS-0A Interface Paddle board	4.45
NT9X79AA	STP	FBUS Extension Paddle board	0.53
NT9X79BA	STP	FBUS Extension CP-Terminations	0.81
<b>End</b>			

<b>Table 1-52</b> <b>DMS SN reliability performance (hardware failures only)</b>	
<b>DMS-100 parameter</b>	<b>Predictions</b>
System downtime	0.35 minutes per year
24 digital trunk downtime due to hardware failures.	5.50 minutes per year
Single line downtime due to hardware failures.	4.20 minutes per year

**Table 1-52****DMS SN reliability performance (hardware failures only)**

<b>DMS-100 parameter</b>	<b>Predictions</b>
Probability of cutoff call	0.03 x 10 <sup>-5</sup> line to line (LCM) 0.03 x 10 <sup>-5</sup> line to trunk 0.03 x 10 <sup>-5</sup> trunk to trunk
Probability of Reliability Related	0.20 x 10 <sup>-4</sup> (L to L)
Ineffective Machine Attempts	0.20 x 10 <sup>-4</sup> (L to T)
P(RRIMA)	0.20 x 10 <sup>-4</sup> (T to T)

**Table 1-53****Assumptions**

- |   |  |
|---|--|
| 1 | The MTTR is three hours.   |
| 2 | The duplicated equipment coverage is 99.9% for peripheral equipment.   |
| 3 | 3-minute call-holding time is used for all cutoff call calculations.   |
| 4 | P(RRIMA) and "Probability of Cut-off Calls" have been calculated according to the equations in Appendices A and B. |





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## Chapter 2: Engineering description

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### DMS-100 family and DMS SuperNode

The DMS-100 switching system is based on a family concept to provide a wide range of digital switching and networking functions. DMS switches are characterized by their ability to meet new applications and reliability requirements by incorporating the newest Nortel Networks technology in their design. New technology in turn translates into greatly increased capability and reliability at reduced cost for the telephone operating companies.

The evolution of the DMS-100 Family is the result of modular design techniques currently used in the development of both software and hardware. Modularity may be thought of as the implementation of a complex system through a set of functional units (modules) connected by well-defined interfaces. As a result of precise module and interface design, the various related components can be connected, disconnected, modified, or improved without affecting the operation of other modules in the system or the system as a whole.

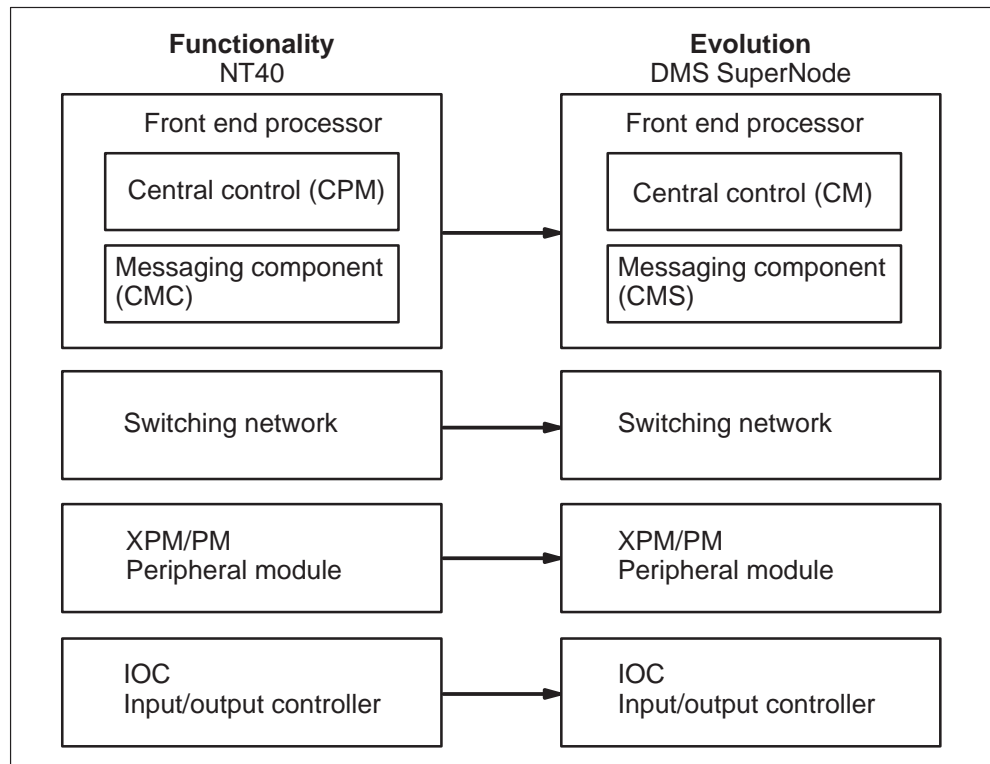
The evolution from the DMS-100 F based NT40 processor to the DMS SN makes possible these important technological improvements:

- increased processing and call-handling capacity
- reduced size of cabinets requires less housing space
- greatly improved reliability through technological improvements

### DMS-100 family hardware architecture

Both the NT40 and the DMS SN have the same functional elements: the control component, the messaging component, the Switching Network, the PMs and the I/O Controller. Figure 2-1 shows this evolutionary process in block diagram form.

**Figure 2-1**  
**From DMS-100F to DMS SN – architecture evolutionary description**



**Note:** The CPM and the CM hereafter will be referred to as Central Control, and the CMC and MS hereafter referred to as the Messaging Component.

**The control component** coordinates call processing, diagnostics, maintenance, user interface and including the actions of the Switching Network and the PMs.

The DMS SN control component is called DMS-core. The DMS-core consists of a duplicated Computing Module and a SLM.

Most of the control component software is portable, this means that software developed for the Central Control CPU NT40 can also be used on the DMS-core.

**The messaging component** routes messages within the DMS-100. There are also two generations of the messaging component:

- 1 In the NT40, it is the Central Message Controller (CMC).

- 2 In the DMS SN, it is called DMS-Bus. DMS-Bus consists of high throughput duplicated Message Switches (MS). The Message Switch is based on the DMS SN CPU; thus, it uses some of the same software as the CM and the Central Control Unit.

**The switching network** is a digital-switching matrix that interconnects the PMs, using time-division multiplexing. The Switching Network has duplicate network planes for reliability. The Switching Network components are microprocessor-controlled, digital-switching Network Modules (NM). The Switching Network can be connected either to the Central Message Controller or to the DMS-Bus.

There are two generations of the switching network. The first is the junctored network (J-Net) and the second is the enhanced network (E-Net). The NT40 can use only the J-Net while the DMS SN can use both the J-Net and the E-Net.

**The peripheral modules** (PM) provide an interface between the Switching Network and the outside plant, such as lines and trunks.

**The input/output controller** (IOC) provides an interface between the messaging component and input/output devices such as magnetic-tape drives, disk drives, data links, video display units and printers.

**The maintenance administrative position** (MAP) is a video display unit connected to the IOC which provides a man-machine interface for the DMS-100 and the DMS SN.

For reliability, both the NT40 and the DMS SN have duplicated control components that operate in synchronism and duplicated messaging component elements that operate in a load-sharing mode. Duplication offers hardware fault protection, as well as the ability to carry out office extensions and software updates without disrupting service.

### **Functional modularity**

A digital connection can be established among PMs under the direction of the control component. Once connected, the PMs can pass voice/data and Pulse Code Modulation (PCM) signals among themselves.

Hardware and functional modularity are most evident at the PM level of the system. The PMs connect both analog and digital voice and signaling transmission systems. Each PM also provides signal processing to convert data to a common digital format for transmission to another PM connected by the way of the Switching Network. The destination PM reconverts the common format to the one required by the facility with which it connects. The conversions involved are:

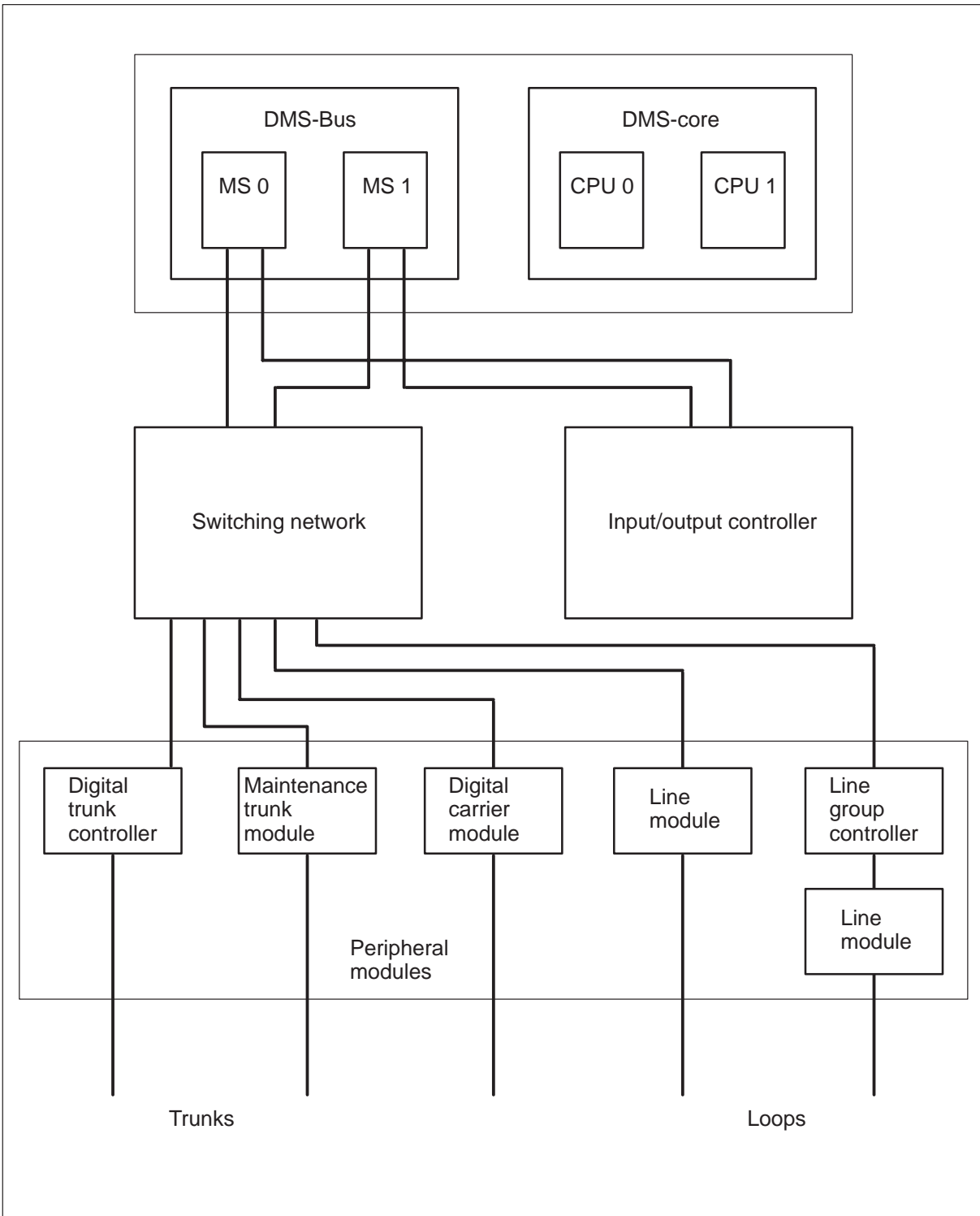
Hardware and functional modularity are most evident at the PM level of the system. The PMs connect both analog and digital voice and signaling transmission systems. Each PM also provides signal processing to convert data to a common digital format for transmission to another PM connected by the way of the Switching Network. The destination PM reconverts the common format to the one required by the facility with which it connects. The conversions involved are:

- analog-to-digital (A/D) – for conversion of voice-frequency analog signals to internal digital signals
- digital-to-analog (D/A) – for conversion of internal digital signals to analog voice frequency signals
- digital-to-digital (D/D), – conversion from internal to external formats on digital facilities (for example, DS-1 format used on a T1 digital carrier)

Functional modularity is graphically illustrated in Figure 2-2.

In addition to signal processing, the PMs also perform many of the common and real time consuming functions associated with a particular facility or terminal, such as terminal supervision and control. The term “terminal” as used here refers to both the interface circuit on a circuit card mounted in a PM unit and the device to which it is connected. Telephone sets, trunk circuits, video display units and data links are examples of devices mentioned here.

**Figure 2-2**  
**DMS SN functional view**



For example, Line Modules perform line supervision, digit reception and ringing functions. As a result, the control component needs only to determine call destination when all digits are received and to establish a call connection through the Switching Network. In other words, the control component coordinates the actions of the PMs; the PMs themselves provide the terminal-specific functions. Modularity and distribution of functions have resulted in a distributed processing system architecture.

### **Distributed processing architecture**

The DMS-100 Family of switches employ a distributed processing architecture that uses several different processors. Function and Technological evolution determine the choice of a particular processor.

- The DMS SN CM and Message Switch are programmed in PROTEL, a high-level language developed by Nortel Networks.
- The NT40 Central Control CPU uses a microprogrammable processor that is programmed in PROTEL.
- The PMs use a processor that is programmed in an 8085 assembly-level language.
- The XPMs use a processor that is programmed in PASCAL. XPM is a term applied to the PMs based on the Extended Multiprocessor System (XMS) also developed by Nortel Networks.

Although each has a different programming environment, these units communicate by means of a simple interface. Messages are sent over serial data links designated as DS-30, DS-512, and DS-1.

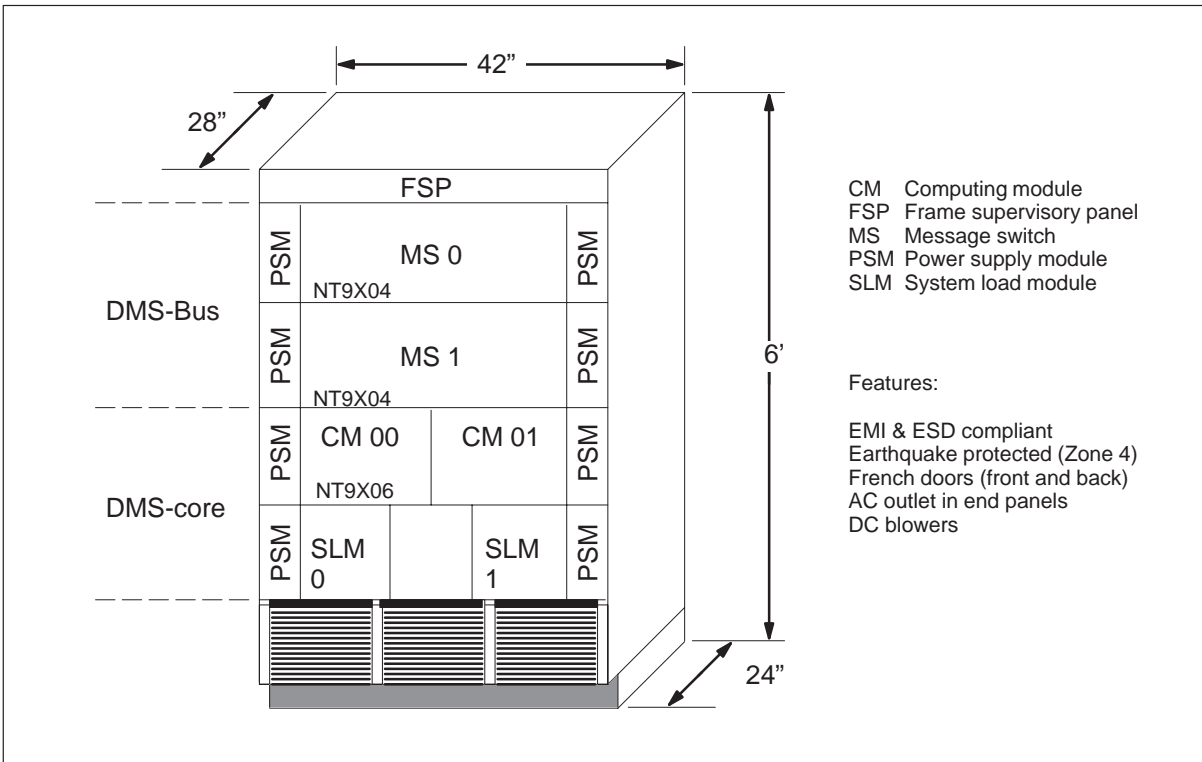
Under normal circumstances, the two CPUs operate in synchronism (that is, both are simultaneously executing the same instruction with the same data). Each has access to certain state information in the mate CPU; therefore, fault detection (for example, matching for loss of synchronism) can be carried out. In addition, this access provides inter-processor communication for system maintenance software.

The Input/Output Controller (IOC) connects a variety of input/output devices with the CPU using the Messaging Component links. These devices include VDU, printers, magnetic-tape drives, disk drives, and data links.

### **DMS SN cabinet**

High density component packaging resides within a six foot high cabinet that is thermal efficient, earthquake protected (Zone 4-NEBS), and Electromagnetic Interference (EMI) and EMI and Electro-Static Discharge (ESD) compliant. The various hardware utilities are packaged in the basic DMS SN cabinet as shown in Figure 2-3. All critical elements of DMS SN: the CM, SLM, and MS are duplicated for reliability and are shelf mounted.

**Figure 2-3**  
**DMS SN cabinet**



## Hardware architecture

The DMS SN hardware structure is based on a distributed processing architecture organized into four functional elements:

- DMS-Core and DMS-Bus (DMS SN)
- IOC
- Switching Network, made up of microprocessor-controlled, digital-switching NM that interconnect the PMs, using time-division multiplexing
- Microprocessor-controlled PM

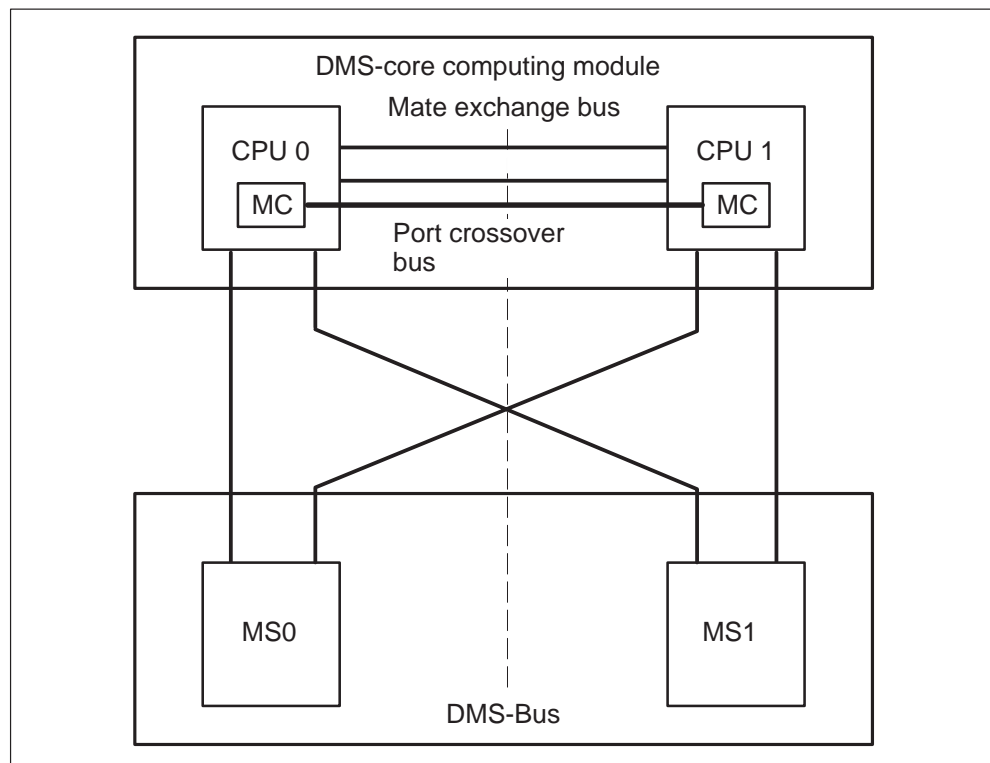
The DMS SN, is made up of two distinct entities: the CM and MS. Each of these components is duplicated for reliability. This configuration is illustrated in Figure 2-4. Duplication offers hardware fault protection, as well as the ability to carry out office extensions and software updates without disrupting service. However, duplication of these entities differ in this manner:

- CM CPUs operate in SyncMatch Mode. This allows uninterrupted control in the event of a fault.

- MS operate in a load-sharing mode. This means that both MSs are sharing the message flow and if one MS fails, the other assumes the full load capacity in the event of a failure.

This technique not only results in true redundancy of these two entities but also makes possible in the sharing of connections between themselves. Each CPU has a serial fiber optic connection to each MS. This direct connection between the two CMs is the Mate Exchange Bus which in turn makes possible a secondary connection between MCs using the port crossover bus. This ensures complete redundancy for the CM connections. Additional serial digital data links interconnect the messaging component (DMS-Bus) with the switching network and the PMs.

**Figure 2-4**  
**Block diagram DMS SN front end**



Serial digital data links interconnect the control component, the messaging component, the Switching Network, and the PMs. In addition, there are data links between the messaging component and the IOC.

## DMS SN

DMS SN consists of the DMS-core and the DMS-Bus.



These hardware components are interconnected by DS-512 links referred to as CMIC Links. DMS-Bus is connected to the Switching Network by way of DS-30 links.

The Reset Terminal, connected to the CM and MS are used to perform basic initialization and maintenance functions for the DMS-core and the DMS-Bus. The Reset Terminal is connected to the Reset Terminal Interface (RTIF) paddle board in the Computing Module and the Message Switch. The RTIF paddle board is connected to a USART (Universal Synchronous Asynchronous Receiver Transmitter) on the DMS SN CPU circuit pack.

### **DMS SN hardware components**

The DMS SN hardware components consist of circuit packs and paddle boards, interconnected by a two-sided back-panel; these components reside on shelves within a cabinet. A circuit pack is a multilayered, printed circuit board that plugs into the front of the backpanel. A paddle board is shorter than a circuit pack, but it employs similar technology. Paddle boards plug into the backpanel and typically provide auxiliary and interface functions.

### **DMS SN central processing unit**

The DMS SN Central Processing is a 32-bit microprocessor with a built-in instruction pre-fetcher and built-in instruction cache. The instruction cache is a fast on-chip memory that stores the most recently-executed instructions. The microprocessor is register oriented and uses an instruction set especially defined for it. The CPU also includes a Memory Access Unit (MAU) that provides the following functions:

- high-speed data cache to reduce processor-memory interaction
- memory access protection for up to 256 Mbytes of memory, in units of 64 kbytes (one page of memory)
- interface between CPU and memory
- parity checking

The instruction cache and data cache allow the CPU to operate with a greater throughput than is possible with only random memory access.

The CM and the MS use different versions of the CM. They differ only in the amount and type of memory provided. Both the CM and the MS use the Support Operating System (SOS). Each has its own CPU and which also uses additional software. Some software is used by the CM and the MS and is common to both, while some software is unique and is used only by one or the other. However, each maintains its own copy of the SOS plus all other common software and its own unique software. Each has its own clock for program-instruction sequencing and timing functions.

### **DMS SN memory**

DMS SN Memory consists of memory circuit packs. Identical memory circuit packs are used in both the CM and in the MS.

The memory consists of integrated Program Store and Data Store on the same bus. There are separate data and address buses, each 32 bits wide. Memory is byte addressable; thus, the logical address range is 4 Gbytes.

### **Memory access protocol**

Memory is partitioned into 64 kbyte pages. The function of each page of memory is defined by memory protection attributes in the MAU. Four types of memory protection attributes are provided in the DMS SN:

- 1 Write Protection
- 2 Program Only
- 3 Data Only
- 4 Supervisor Mod

Combinations of these attributes determine the characteristics of each page of memory as follows:

**Program store** has the Program Only attribute. Write protection in Program Store is implemented by means of a counter. Only the program loader and some debugging tools modify Program Store.

**Protected data store** has the Data Only and Write Protection attributes. Write protection can be disabled temporarily for all of DSPROT.

**Data store or program store reserved** for use by the Support Operating System (SOS) has the Supervisor Mode attribute, in addition to its other attributes.

**Data store** All other types of Data Store have the Data Only attribute.

**Unallocated memory** has the combination of Data Only, Program Only and Write Protection attributes.

Physically, memory is provided on memory circuit packs. There are three types of Memory circuit packs:

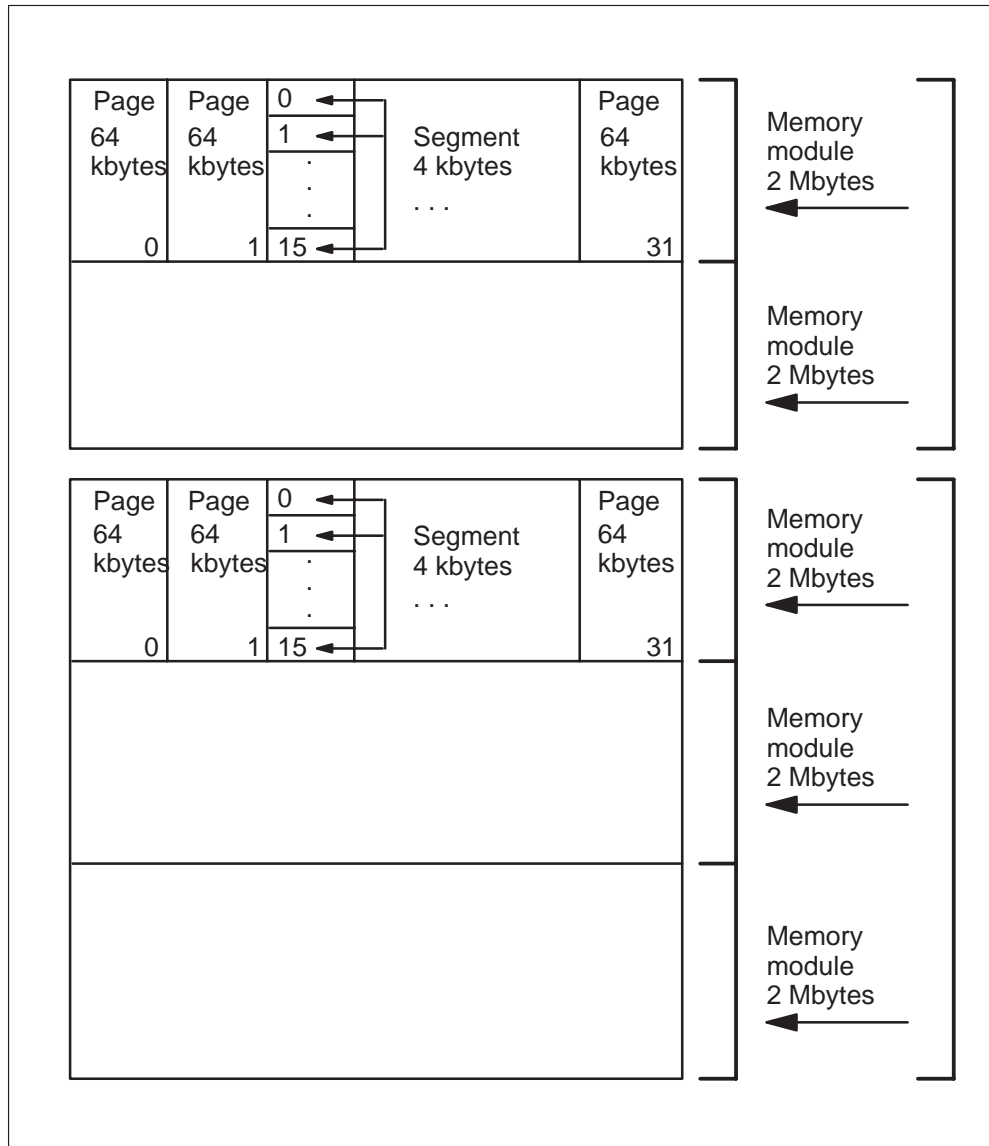
- 1 6 Mbytes of dynamic random-access memory (DRAM), is divided into three 2 Mbyte memory modules (NT9X14BB).
- 2 24 Mbytes of dynamic random-access memory (DRAM) is divided into three 8 Mbyte memory modules (NT9X14DB).

- 3 96 Mbytes of dynamic random-access memory (DRAM) is divided into three 32 Mbyte memory modules (NT9X14EA).

Each memory module, illustrated in Figure 2-5, has its own memory controller.

Memory is organized into 40 bit words: 32 data bits, seven error-correcting code bits and one parity bit. The error-correcting code bits provided the capability to correct single-bit errors and to detect multiple-bit errors. The error-detecting and error-correcting capabilities are implemented in the memory controller hardware.

**Figure 2-5**  
**Memory modules, pages and segments**



**DMS-core**

DMS-core, the control component of DMS SN, performs call processing and maintenance functions. DMS-Core consists of a CM and a System Load Module (SLM). The basis components of the CM are the Computing Module CPU, memory and the Message Controller. The CM is designed to provide increased processing and call-handling capacity as compared to the Central Control CPU of the NT40. The CM is fully duplicated operates in synchronism. Both Units resided on a single shelf, called the CM Shelf. One side of the CM Shelf contains CPU-0 and the other side contains CPU-1.

## Computing module operating modes

When the duplicated CPUs in the Computing Module are operating in synchronism, the controlling CPU is called “active,” and the mate is called “inactive.” When operating in the SyncMatch mode, both CPUs will be operating from one of the CPU’s clock.

<b>Table 2-1 Name of table</b>	
<b>Operating modes</b>	<b>Clock status</b>
When the operation goes into Sync:	The clock on the active CPU is used by both CPUs (unless the active CPU’s clock is faulty).
Scheduled SWACT are preformed during low traffic periods to ensure that both units are functioning (operating in Sync):	Clock does not move.
Operation in DPSync:	Each CPU uses it’s own clock.

## Computing module memory

When the dual CPUs in the CM are operating in synchronism, the memory is synchronized with the CPU and the error-correcting capability is software-disabled for faster operation. When the dual CPUs in the CM are not operating in synchronism, the memory is not synchronized with the other processor and the error-correcting capability is enabled.

Each CM can be equipped with up to ten memory circuit packs for a total of 240/400 Mbytes depending on the processor and memory used.

## Message controller

The Message Controller (MC) provides serial message links between the DMS-core and the DMS-Bus. Each MC consists of two CM Port circuit packs, each with an associated DS-512 Interface paddle board. Each CM Port circuit pack in conjunction with its associated DS-512 Interface paddle board provides the following functions:

- access to the CPU bus
- access to the mate CPU bus through the port cross-over bus
- generation of incoming message interrupts
- message buffering
- protocol handling - supports DS-30, DMSX and DMSY protocols
- parallel-to-serial and serial-to-parallel conversion

One of the two CM Port circuit packs in each MC is located on the CPU-0 side of the CM Shelf; the other one is located on the CPU-1 side. Port cross-over buses between the CM Port circuit packs allow the active CPU to have read/write access to all four ports. The inactive CPU has read-only access to all four ports when the dual CPUs in the CM are operated in synchronism. Each MC is connected to both Message Switches by the way of two DS-512 message links to each Message Switch.

The two DS-512 links associated with the active CPU are called primary links. the two DS-512 links associated with the inactive CPU are called secondary Links. If a primary link failure occurs, the MCs re-route messages over a secondary link by way of the port cross-over buses.

When the duplicated CPUs are operating in synchronism, the MCs route incoming messages to both CPUs by the way of the port cross-over buses. The MCs also synchronize the two incoming message interrupts to the CPs.

### **Message controller synchronization**

The CM Subsystem Clock paddle board generates the Transmit Frame Pulse required for CM Port circuit pack synchronization. One CM Subsystem Clock paddle board is located on the CPU-0 side; the other is located on the CPU-1 side of the CM Shelf. Each CM subsystem Clock paddle board provides the master clock and Transmit Frame Pulse to the two CM Port circuit packs located on the same side of the CM Shelf.

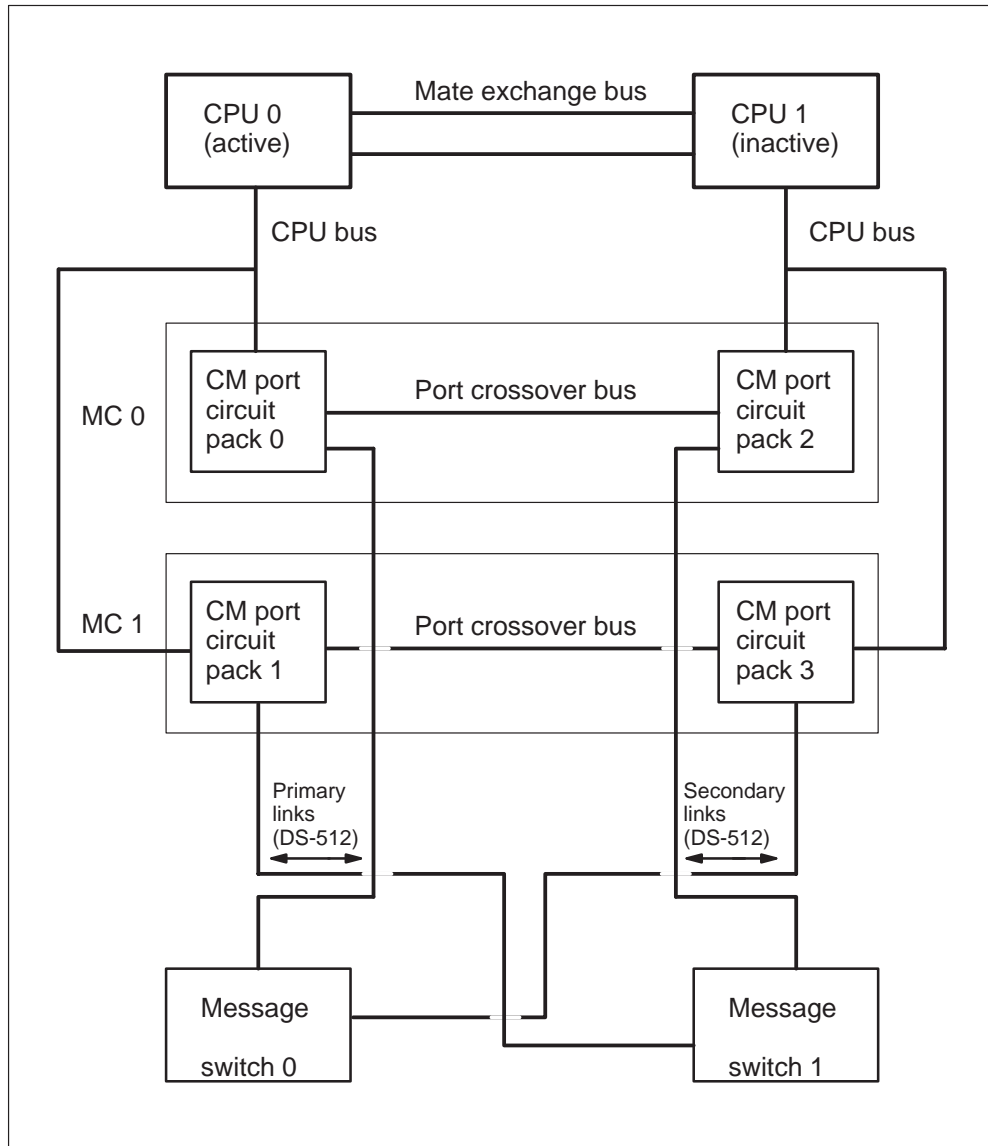
### **Error detection capability**

- 1 CM Memory – when the CMs are operating in synchronism, the memory is synchronized with the processors and the error-correcting capability is software-disabled for faster operation.

When the CM are not operating in synchronism, the memory is not synchronized with the other processor and the error-correcting capability is enabled.

- 2 DMS SN Memory – the DMS SN Memory has four kinds of memory protection. These are: 1) Write protection, 2) Program protection, 3) Data only, 4) Computing Module Memory
- 3 Message Switch and CPU – he CPU and Memory Subsystem configures and maintains the other subsystems. The Series 20 version of the DMS SN processor circuit pack is used in the MS CPU and contains four Mbytes of memory; All the software used by the MS resides on 6 Mbytes. Memory circuit pack and on the processor circuit pack. The MS error detection and error correction are always enabled.

**Figure 2-6**  
**Computing module CPUs, message controllers, message switches**



Each DS-512 Interface paddle board provides a Receive Frame Pulse (RFP) derived from its DS-512 link to one of the two MSs. The CM software selects one of the two DS-512 Interface paddle boards on each side of the CM shelf: the CM Subsystem Clock paddle board uses the RFP from the selected DS-512 Interface paddle board as the reference for Clock synchronization. The relationships between the CM Subsystem Clock paddle boards and the CM Port circuit packs are shown in Figure 2-6.

### **Time of day clock**

Each CM Port circuit pack contains a 48 bit timer that is used as a Time-of-Day (TOD) clock for the CM. Each CM Subsystem Clock paddle board provides the clocking signal for the two TOD clocks located on the same side of the CM shelf. The two TOD clocks in each pair always agree within a small tolerance. The CM maintenance software monitors the TOD clocks and keeps them in close agreement. The four TOD clocks provide an accurate and reliable TOD reference for the CM.

### **System load module**

The System Load Module (SLM) consists of a disk drive (150/600 Mbytes) and a tape cartridge (75/150/250 Mbytes) and it is used to download office images. The tape cartridge is operated in streaming mode. The SLM allows rapid installation of software loads, compared to a magnetic tape drive or a disk drive connected through the IOC. There are two SLMs, one connected to each of the duplicated CPUs in the Computing Module. A software load can be installed in either CPU from either SLM through the port cross-over buses.

### **DMS-bus**

The DMS-bus is the messaging component of the DMS SN and consists of duplicated MS that operate in a load sharing mode. The MS concentrates and distributes messages in the DMS-100. The MS is designed to provide a greater message traffic capacity and longer message length compared to the Central Message Controller (CMC). The MS provides the central clock source for the DMS-100 office. Each MS resides on a separate MS shelf.

On the peripheral side, the MS can be connected to both the DS-30 and DS-512 links, and can support DS-30, DMSX and DMSY protocols. When connected to DS-30 Links, the MS converts between DS-30 and encapsulated DS-30 message formats.

The MS can route messages using either a logical address or a physical address. Logical addresses are converted to physical addresses by component of the MS called the Mapper Subsystem.

The MS is built around two major internal buses:

**The processor bus (P-bus)** The Message Switch CPU uses the P-Bus to communicate with all other components of the MS. The P-Bus is used primarily for control and maintenance.



**The transaction bus (T-bus)** Messages are transmitted from port to port over the T-Bus. It is a synchronous bus operating at 4096 Mb/s. The T-bus is composed of these four buses:

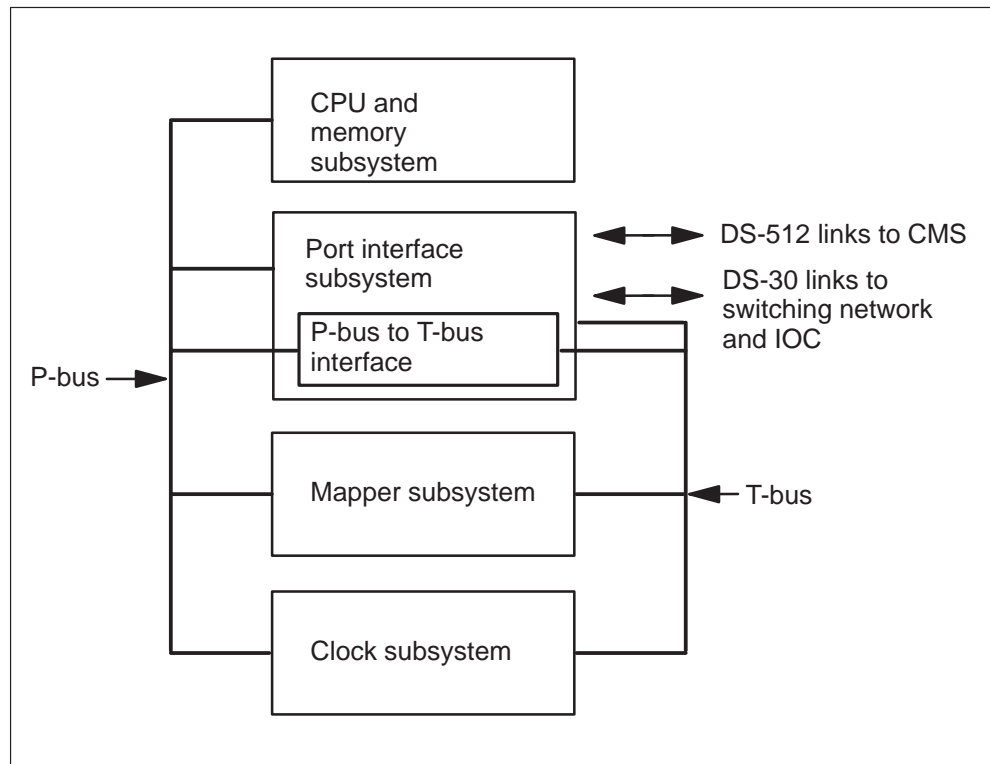
- 1 The address/data bus is a 32 bit-wide two-way bus carrying multiplexed address and data information. The addresses are the logical and physical destination addresses; the data consists of the messages to be rerouted. The net data rate is approximately 130 Mbytes/bits per second (32 by 4096 Mb/s). A 4 bit parity bus is associated with the address/data bus (one parity bit per address/data byte).
- 2 The control/status bus identifies the state of the address bus (for example, address cycle, data cycle, end-of-message cycle).
- 3 The access control bus implements a distributed arbitration algorithm to resolve T-bus access contention quickly and fairly.
- 4 The timing bus carries all the clock signals necessary for the operation of the T-bus and the Port Interface Subsystem.

The MS consists of the following subsystems:

- Processor and Memory subsystem
- Port Interface subsystem
- Mapper subsystem
- Clock subsystem

A functional view of the MS is illustrated in Figure 2-7.

**Figure 2-7**  
**A functional view of the message switch**



### **CPU and memory subsystem**

The processor and Memory Subsystem configures and maintains the other subsystems. One 6 MByte Memory circuit pack is required in the Message Switch; all the software used by the Message Switch resides in this Memory circuit pack and on the processor circuit pack. Error detection and error correction are always enabled for the Message Switch memory.

### **Port interface system**

The Port Interface Subsystem provides interfaces to DS-30 and DS-512 links, including protocol handling for DS-30, DMSX and DMSY protocols. The Port Interface Subsystem includes universal port cards called MS 4 Port circuit packs with associated paddle boards for DS-30 and DS-512 links. Each MS 4 Port circuit pack serves one to four ports and provides the following functions:

An interface to the T-bus allows the port to transmit and receive messages over the T-bus.

Protocol handlers for the DS-30 and DS-512 links; Port is programmed for one of three protocols: DS-30, DMSX or DMSY.

Buffers to temporarily store messages in transit between a DS-30 or DS-512 link and the T-bus. These buffers are required because of the different speeds of the T-bus (130 Mb/s) and the DS-30 and DS-512 links (2.56 to 32 Mb/s).

Each DS-30 link is associated with one MS port since all 32 channels on the link are associated with one Network Module (NM) or with one Input/Out Controller (IOC). Each DS-512 link connected to a CM is associated with one MS port since the link consists of one 32 Mb/s message channel.

The Port interface Subsystem provides the interface between the P-bus and the T-bus by means of the T-Bus Access circuit pack.

### **Mapper subsystem**

The Mapper Subsystem converts logical addresses to physical addresses and provides route status information.

Message switching is the MS operates in one of two modes:

- 1 Mapper Assist Mode

Logical addresses are converted to physical addresses by the Mapper Subsystem. Mapper assist mode is used when the physical address is set to a default value (all ones).

- 2 Mapper Bypass Mode

Physical addresses are used to route messages. The Mapper Subsystem is not used.

A logical address is a 16-bit destination node identifier; a physical address consists of a 7-bit MS 4-Port Circuit address and an 8-bit port number that identifies the port on the MS 4-Port circuit pack.

The Mapper Subsystem consists of a block of memory that contains mapper tables. For each logical address, the mapper tables provide a Primary Physical Address (PPA) and a Secondary Physical Address (SPA). The SPA is used if the PPA is not available. The mapper tables also indicate which MS 4 Port circuit packs and ports are not available due to hardware faults or maintenance actions.

The information in the mapper tables is supplied by DMS core after system initialization and after the I/O System routes have stabilized. The mapper tables are updated during operation to reflecting changes in route availability and additions and deletions of routes.

### **Clock subsystem**

The Clock subsystem provides the system clock source for the DMS-100 office and the MS subsystem clock source for the MS.

The system clock is provided by the System clock circuit pack (NT9X53AB). One Message Switch provides the master clock source for the DMS-100 office; the other Message Switch clock is synchronized to this master clock source. The System clock circuit pack may be synchronized to one of three sources:

- 1 the mate Message Switch clock
- 2 an external clock source within the DMS-100 office
- 3 any of the DS-1 links connected to a Digital Trunk Controller (DTC), Line Trunk Controller (LTC), or Digital Carrier Module (DCM) when the DMS-100 is operating in a digital network environment

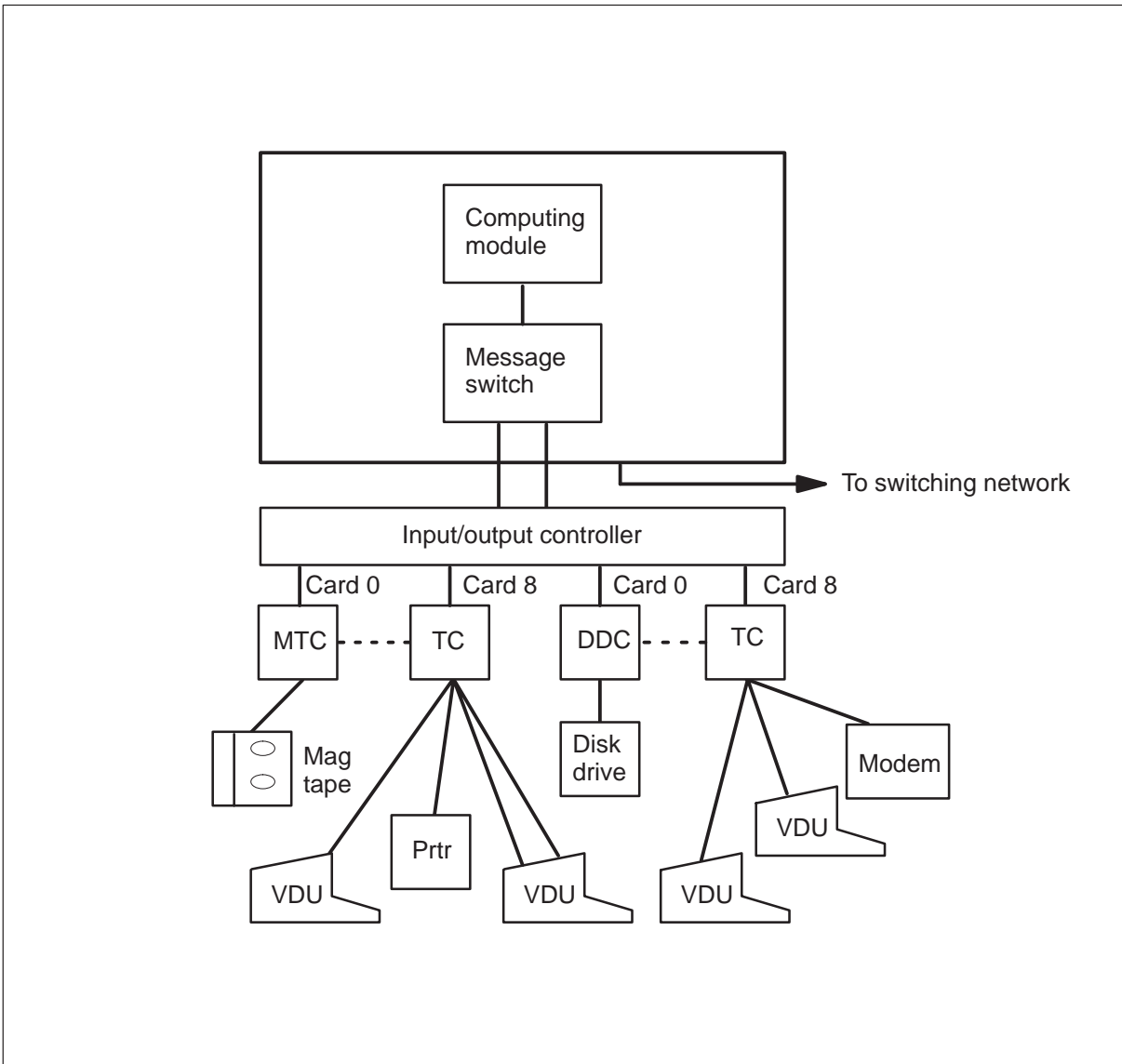
The System clock circuit pack also provides the MS subsystem clock needed for Port Interface Subsystem and T-bus operation.

### **Input/output controller**

The Input/Output Controller (IOC) connects a variety of input/output devices with the Central Control CPU by way of the message links to the messaging component. These devices include video display units (VDU), printers, magnetic-tape drives, disk drives and data links.

The IOC, together with the I/O Device Controller that connects with the particular device, perform the necessary conversion to DS-30 format for communication with the control component by way of the message links. Two DS-30 links connect to the IOC, one from each message component.

**Figure 2-8**  
**Simplified diagram of input/output controller**



### Input/output system

The PMs and the control component communicate with one another by means of messages sent over DS-30, DS-1 and DS-512 links. The messages can be PCM signals, or they can be control and information messages exchanged by the control component, the Switching Network and the PMs.

### Nodes - NMs, PMs, IOC

Any unit that can accept messages or originate them, or both, is termed a "node." Therefore, the control and messaging components, the NMs, the

PMs and the IOC are all nodes. In the DMS-100, the side of a node (or link) “facing” toward the Central Control processor is referred to as the “C side;” the side of a node (or link) facing toward the PMs is referred to as the “P side.” In DMS SN, the side of a node (or link) facing toward the DMS-Bus is referred to as the C Side: the side of a node (or link) facing away from the DMS-Bus is referred to as the P side. In both switching systems, messages going from the C side to the P side are called outgoing messages. Those coming from the P side to the C side are called incoming messages.

When installed, each NM, IOC and PM is assigned a unique node number by the system. Each terminal controlled by the node is assigned a unique number on the node. Therefore, every terminal (for example, line and trunk) on the system is identified internally by a unique “terminal identifier” made up of the node number and the terminal number on the node. This identifier may be thought of as the address of a terminal. The Central Control Processor software controls terminals by sending messages to the nodes on which they are located. These messages include the terminal identifier, as well as the data necessary for the particular action being performed.

Message link control is handled by the I/O System. This function is distributed among the nodes since each node must receive and send messages over its C side and P side message links. The I/O System uses routing and error control information as a message to ensure successful message transmission in the presence of link noise or in the event of transient or permanent hardware faults.

### **DS-30 interface**

The common interface between components of DMS-100 system is a serial data link with a bit-stream format. This format is termed “DS-30” and is composed of thirty two 10 bit channels within a 125 ms frame. The channels are numbered 0 to 31; channel 0 comes first in time.

*Note:* Framing is required so that both sending and receiving equipment can agree on channel and bit number.

### **DS-1 interface**

Certain PMs, such as the Remote Line Module, are located at a distance from the Switching Network, and make use of DS-1 transmission facilities to connect to it. Within the North American network, the standard for digital transmission is DS-1. The T1 digital carrier is an example of a digital transmission system that uses DS-1. DS-1 carries PCM signals in 193 bit frame (twenty four 8 bit channels plus a framing bit.)

### **DS-512**

The DS-512 format is the standard for internal optical fiber links on DMS SN. A DS-512 link is equivalent to 16 DS-30 links, multiplexed onto a

single optical fiber. One channel is used for link synchronization. DS-512 provides more bandwidth than DS-30, and allows greater packaging density.

DS-512 format is used on the link between DMS-core and DMS-bus. This link is a 32 Mb/s message channel. The distance specification of a DS-512 link is 250 meters. The DS-512 link is based on short-wavelength optical technology, using LEDs and multi-mode fiber.

## Switching network

The Switching Network can be connected either to the messaging component by way of the DS-30 links. The Switching network is illustrated in Figure 2-9.

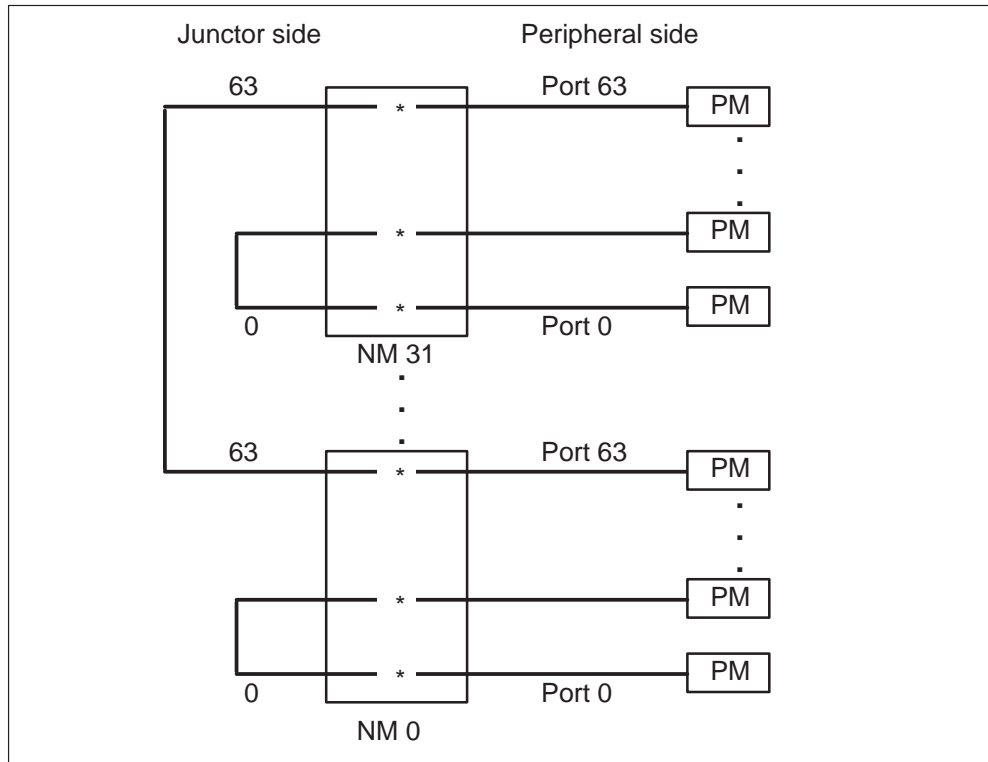
The Switching network switches Pulse Code Modulation (PCM) signals using time-division multiplexing. It performs the following tasks:

- Establishes a DS-30 channel between incoming and outgoing ports under command of the Central Control Processor (CCP) (that is, connects two PMs by way of switched DS-30 link).
- Provides signal processing (digital attenuation and gain) for PCM signals.
- Inserts outgoing control messages from the CCP into the DS-30 message channels to the PMs.
- Extracts incoming messages from the PM message links and forwards them to the control component.

The Switching Network consists of up to 32 NM. Each NM has up to 64 DS-30 incoming ports and 64 DS-30 outgoing ports. The incoming side is termed the “peripheral side,” because this side connects to the PM links (termed “speech links”). The outgoing side is termed the “juncture side,” since this side is used to interconnect the NMs by way of speech links called “junctors.” Thus, any NM peripheral-side port or channel may be connected to any other NM peripheral-side port or channel, thus establishing a DS-30 channel connection.

A NM consists of a time-division-multiplexed switching matrix controlled by a Network Module Controller (NMC). The NMC connects with the messaging component by way of DS-30 links. The NM determines which messages coming from the control component are Switching Network control messages, and which are messages destined for the connected PMs. It takes action on Switching Network control messages and forwards the PM control messages to the PMs. Messages from PMs to the CCP are forwarded by way of the messaging component.

**Figure 2-9**  
**Switching network configuration**

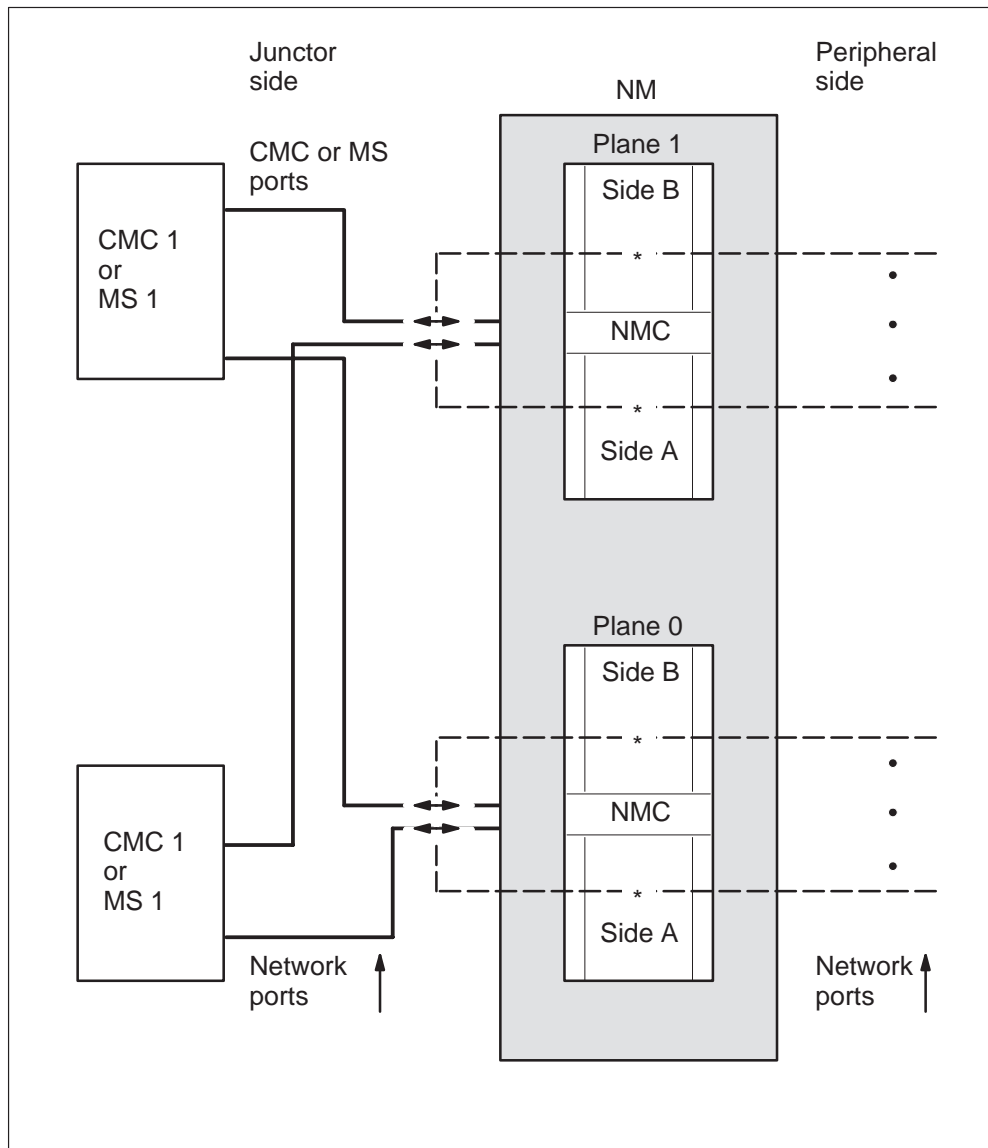


### Network module controllers

NMCs are duplicated and the mates are termed “Plane 0” and “Plane 1.” Refer to Figure 2-10. The NMCs operate in “duplex” mode. Each CMC and each Messaged Switch has two ports assigned to each NM: one for messages assigned to Plane 0 and one for messages assigned to Plane 1. Switching Network control messages are sent duplex from the control component to an NM. Thus both planes receive a connection message and both establish a connection. Therefore, PMs connected through the Switching Network have a duplicated path over which to communicate with the CCP. Figure 2-10 shows the Duplicated NMCs.



**Figure 2-10**  
**Duplicated network module controller**



Messages sent to PMs are sent simplex; each message traverses the messaging component-to-NM links and the NM-to-PM message link, as specified in the routing information carried in the message. If a message link fails, the following action occur:

- The link is taken out of service for maintenance.
- All messages are routed through the remaining good link.

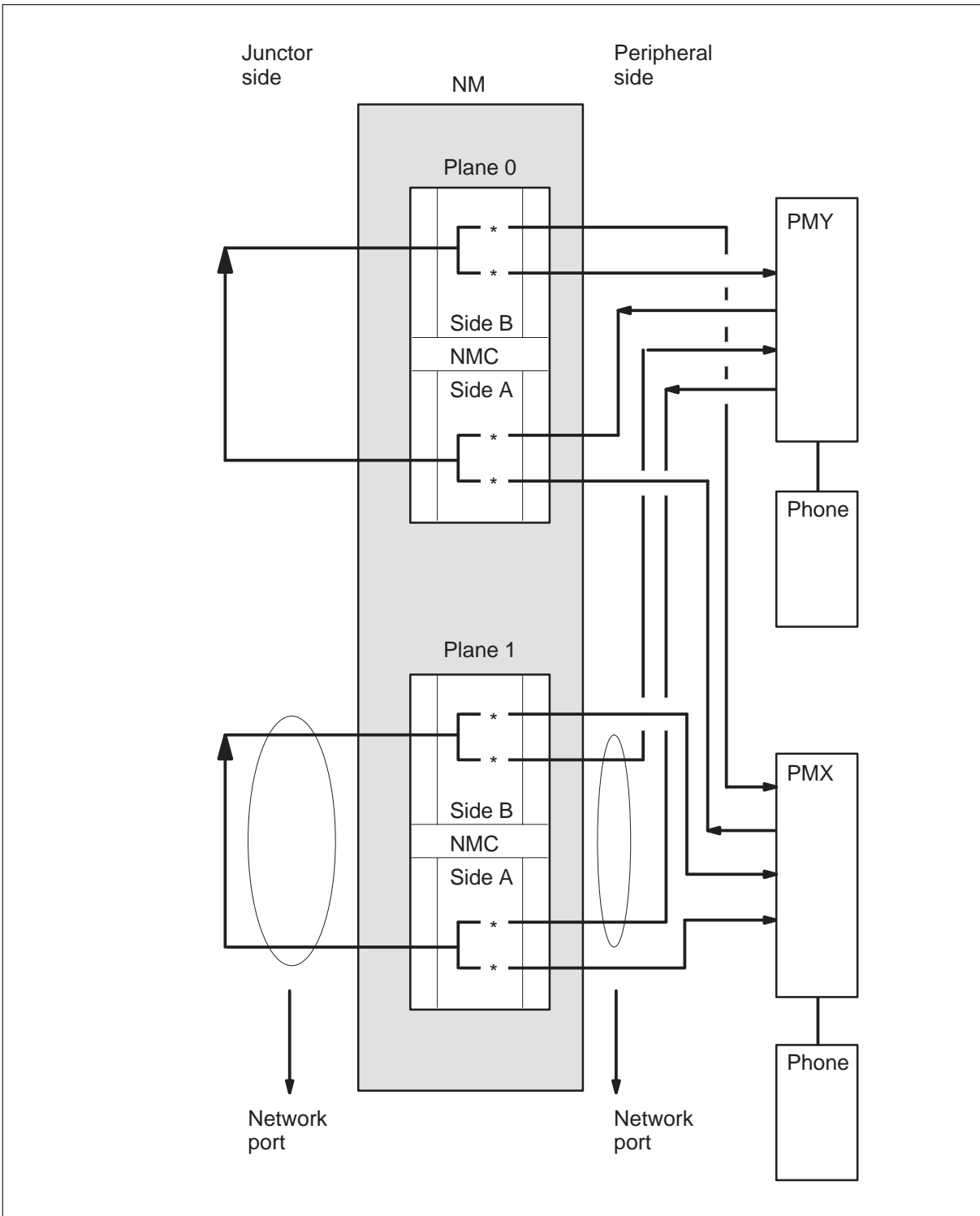
Since a NM path is uni-directional, two paths are required to establish a bi-directional channel. Thus, there are two “sides” to a plane designated as

Side A and B. Side A switches PCM signals from the peripheral side to the junctor side, while Side B switches PCM signals from the junctor side to the peripheral side.

The juncctors are DS-30 links providing NM interconnection and intra-connection. Juncctors carry 31 channels of speech, with one channel (channel 0) used for Switching Network DS-30 synchronization.

The designated grade-of-service (probability of blocking) of the Switching Network is achieved with traffic offered by 30 channels of DS-30 at the speech links. Thus, two channels of a speech link (channels 0 and 16) are available for other purposes. Channel 0 is made available for messaging and channel 16 for maintenance features. Channel 16 is also used by Inter-Peripheral Message Links (IPML).

**Figure 2-11**  
**Intra-network connection**



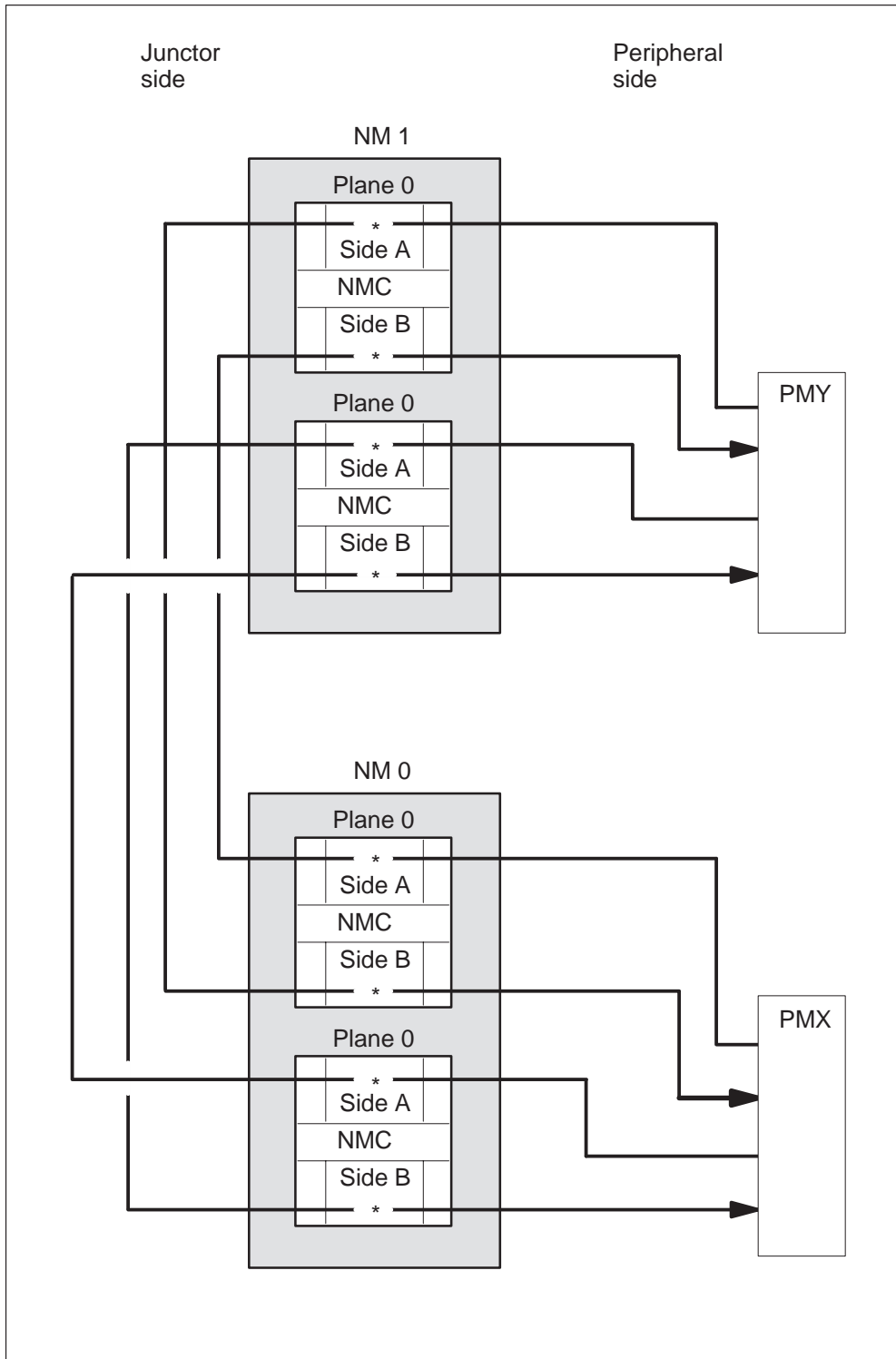
**Intra-network connection**

Two PMs on the same NM are intra-connected by a single junctor. The PMs have one (duplicated) link connected to both planes of the NM. In this case, the link carries both speech and messaging. As shown in Figure 2-11, the two PMs are connected by way of the Switching Network. Note that the illustrated connection represents both space and time since a link/channel on one PM is connected to a different link/channel on the other. In this case, only one Physical junctor is necessary since it can carry up to 31 channels. PCM signals from each PM are carried on the single junctor, but in different time-slots (channels).

**Inter-network connection**

The PM terminals to be connected are located on different NM's (refer to Figure 2-12).

**Figure 2-12**  
**Inter-network connection**



## Peripheral modules

### A system overview

Peripheral Modules (PM) perform the following tasks:

- PMs connect analog and digital facilities for conversion of data and signaling to and from internal DS-30 format.
- PMs transmit DS-30 Pulse Code Modulation (PCM) signals and data to other PMs connected through the Switching Network.
- Additional signal processing is provided by PMs through the use of service circuits (for example, Multi-frequency and Dual-Tone Multi-frequency receivers).
- PMs provide circuits for frequency and level measurements that are associated with the maintenance of switch hardware and facility transmission performance.
- PMs provide for subscriber or terminal signaling.
- Subscriber terminal signaling, such as busy tone and dial tone, multi-frequency digit outpulsing tones, and ringing current to telephone sets to subscriber loops is made possible by PMs.

PMs are microprocessor based; are produced in a variety of types to handle specific functions. All PM software is down-loadable from the control component, with the exception of a small amount that resides in read-only memory (ROM) and is necessary to control software down-loading. Each PM is connected to the Switching Network by DS-30 links that carry these transmissions:

- data for PCM signals
- messages to and from the CCP
- messages to and from PMs connected through the Switching Network

The connections through the Switching Network are duplicated. At least one (duplicated) DS-30 link is provided.

*Note:* A duplicated link means that there are two links, one to each Switching Network plane. Speech and signaling information is sent over both links, but only one link is active. If a fault occurs on the active link, the other link takes over.

### How peripheral modules function in the network

Most PM types can be connected to the Switching Network with more than one (duplicated) link—up to a maximum of 16. The number of links depends on the volume of traffic to the Switching Network; the volume of traffic the unit offers depends on the number of terminals that the unit controls and on the traffic offered by each terminal.

For PMs that control subscriber line circuits, concentration occurs between terminals and links to the Switching Network. This is the case because line traffic is low (typically 400 call seconds or 4 CCS), whereas a DS-30 link channel can carry 36 CCS. Concentration at LCM/LGC makes efficient use of link traffic capacities. The concentration is implemented by a time-division-multiplexed switching matrix. Trunk PMs (for example, Trunk Modules and DTCs) have no concentration since trunks operate at a high traffic level (up to 36 CCS).

Prior to sending a Switching Network connection control message, the central control processor informs each PM of the integrity value to be sent to the other PM to be received from the other PM. These values can be different. The control component selects integrity values on a per-connection basis. Therefore, each connection gets a different integrity value (by cycling through the existing 256 values, some of which are not allowed). Since there are delays in the completion of the various functions on call connection, the integrity byte allows each PM to verify that a connection has been established before proceeding with its call processing function.

The integrity digit is checked to ensure that a connection continues to exist for the duration of the call. Since a large amount of PM hardware and software is involved in the transmission of the integrity byte, the functioning of the PM is verified with integrity value continuity. In addition, since each call connection is assigned a different integrity value, software error occurring in the Switching Network path selection, which overwrites an existing connection, will be detected through a change in integrity value.

Since the Switching Network connection provides a duplicate path (plane 0 and plane 1), the Central Controller processor also tells the PMs which plane is the “preferred plane.” PMs transmit over both planes. However, they accept only PCM signals from the preferred plane, but this is different for each call (that is for each connection).

Since the Switching Network operates in “duplex” mode, that PMs have access to a duplicated link and a duplicated Switching Network plane. Upon loss of integrity or parity, a PM switches activity to the mate link and attempts to reestablish integrity with the other PM. A link or Switching Network hardware fault is recoverable since a duplicated path is available; therefore, there is no loss of connection. Loss of connection can be caused by logic errors or by PM hardware failures.

Control messages are carried over channel 0 on one (duplicated) speech link only. This link is commonly termed the message link. If a PM has more than one duplicated speech link to the Switching Network, this channel is unused on the remaining speech links. The control component sends and receives PM messages by the way of the message channel. The 8 bit speech/data portion provides a 64 kb/s channel. Bit 1 is not used since the messaged

protocol detects message errors by checksum or Cyclic Redundancy Check (CRC) coded comparison. Bit 0 is used for DS-30 frame synchronization.

Successive outgoing messages from the control component to the PMs use alternate routes, therefore, outgoing messaging are distributed over the routes. This mode of operation ensures equitable distribution of the message traffic load over all elements of the I/O System.

Incoming messages from the PMs are sent over the “preferred route” message link. The control component ensures that each PM has a preferred route in order to guarantee that the incoming message load is distributed over the I/O System.

## List of peripheral modules

The hardware and software configuration of the PMs depends on their function and geographical location. Some examples of PM types are:

- Line Module (LM)
- Trunk Module (TM)
- Maintenance Trunk Module (MTM)
- Office Alarm Unit (OAU)
- Digital Carrier Module (DCM)
- Remote Line Module (RLM)
- Remote Service Module (RSM)
- Line Concentrating Module (LCM)
- Line Group Controller (LGC)
- Digital Trunk Controller (DTC)
- Line Trunk Controller (LTC)
- Remote Line Concentrating Module (RLCM)
- Remote Cluster Controller (RCC)
- Signaling Terminal (ST) and Message Switch and Buffer (MSB)
- Subscriber Carrier Modules (SCM) of the following types
  - SCM-100R or Rural for the DMS-1
  - SCM-100S for the SLC-96
  - SCM-100U for the DMS-1U

## Description of peripheral modules

### Line module

A line module (LM) is connected to as many as 640 subscriber line and performs the following tasks:

- signal processing
- line supervision



- line ringing
- tone generation

A Time Division Multiplexer (TDM) provides for the concentration of lines (up to 640)—from one to six duplicated DS-30 speech links to LGC/Switching module. Speech signal processing converts analog speech signal processing converts analog speech signals into PCM speech signals in the internal DS-30 format.

LMs are paired so that a common control failure in one does not leave all 640 subscriber lines without serviced. If an LM fails, the mate LM Takes over all 640 lines.

A LM accommodates both Dial Pulse (DP) and Dual-Tone Multi-frequency (DTMF) signaling, this can be accomplished only with LGC/LMs back to MTMs.

- Dial Pulse signaling is processed by the LM as an extension of the line supervision function.
- DTMF signaling requires connecting the line to a service circuit known as a DTMF receiver. DTMF receivers are mounted in MTMs and accessed by means of each PM's Switching Network links and a Switching Network connection.

### **Trunk modules**

A trunk module (TM) connects as many as 30 analog trunks to Switching Network ports by means of a single duplicated speech/messaging link. Thirty channels accommodate PCM signals; channel 0 is used for messaging; channel 16 is not used. There is no Trunk-to-Switching Network port concentration.

### **Maintenance trunk module**

A maintenance trunk module (MTM) is a trunk module specifically designed to accommodate a variety of test and service circuits for signal processing. For example, DTMF receivers are located in MTMs, along with several kinds of transmission test circuits. These circuits perform frequency and level measurements associated with office and facility maintenance.

### **Office alarm unit**

An Office Alarm Unit (OAU) is also a TM with circuitry that allows it to connect with the office alarm system.

### **Digital carrier module**

A Digital Carrier Module (DCM) is connected to as many as five DS-1 spans, with up to four duplicated DS-30 links to the Switching Network (which is  $5 \text{ by } 24 = 4 \text{ by } 30 = 120$  channels). There is no concentration. Internally, an 8 bit DS-1 channel is carried in the data bits of the DS-30

channel; normally, A/B bit signaling is extracted and carried in the Channel Supervision Message (CSM). To control “slip,” elastic buffering is used to take care of bit-rate variations between the external DS-1 and internal DS-30. Usually, both derive their clock from a common source in a master-slave configuration.

### **Slip explanation**

Slip occurs when there is a change in the relative bit rates between two connected digital facilities (in this case, DS-30 and DS-1). Buffers are used to handle short term variations. However, if the changes are great enough, the buffer either overflows, or is empty when the next frame is to be transmitted. If overflow occurs, a buffered frame must be thrown away to make room for the next frame. If the buffer is empty, the last frame transmitted must be repeated to allow time for a new frame to arrive in the buffer. In either case, the results is impulse noise on voice connections, or errors in data transmission.

The CSM can be equipped to connect with a common external clock when the DMS-100 is operating in a digital network environment. The DCM uses an incoming reference DS-1 link to compare the external clock rate against that on the internal DS-30 speech links. Discrepancy messages are sent to the CCP, which adjusts the clocks in the Message Controller (from which the DS-30 clock signal is derived).

The DCM can be configured to connect with a RLM by way of DS-1 links. For these DS-1 links, normal DS-1 A/B bit signaling is disabled: signaling is done by a High-Level Data Link Control (HDLC) protocol on channel 1 of a DS-1 link. A second DS-1 link channel 1 is reserved as backup. The DCM handles the conversion to and from the HDLC for the CSM and PM control messages.

Each RLM has up to four DS-1 links that can terminate on a DCM. The DS-1 ports on a DCM that are not assigned to RLM service can terminate standard DS-1 links.

### **Remote line module**

A Remote Line Module (RLM) is a LM that can be located at a distance from the Switching Network. Each RLM is connected to a DCM by up to four DS-1 links. For reliability, each RLM is connected to a different DCM, and each DCM is connected to only one RLM. As with the Line Module, two RLMs are paired; if one RLM fails, the mate RLM takes over the lines.

The RLM pair may be equipped with an intra-calling capability because there may be a large community of interest. That is, an RLM serving a small community carries a significant number of calls that originate and terminate within that community. As a result, calls originating and terminating within

the RLM pair can be connected locally, rather than being switched under the direction of the control component.

### **Remote line concentrating module**

The Remote Line Concentrating Module (RLCM) is a LCM that can be located at a distance from the Switching Network. The RLCM is connected to a “host” PM by means of a DS-1 link using the DMSX protocol. The host PM can be a LTC or to a Remote Application. The RLCM can service up to 640 lines and can be up to 150 miles from the host PM. RLCMs may be equipped with Emergency Stand-Alone (ESA) capability. As with the LCM, the RLCM components are duplicated for reliability.

Like the RLM, the RLCM may be equipped with an intra-calling capability because a large community of interest may exist (that is, an RLCM serving small community carries a significant number of calls that originate and terminate within the community). As a result, call originating and terminating within the RLCM can be connected locally, rather than being switched under the direction of the control component.

### **Remote service module**

A Remote Service Module (RSM) is located at a RLM and houses DTMF receivers to replace those normally located at the Control Component site.

### **Line concentrating module**

The Line Concentrating Module (LCM), like the LM, supports analog lines and provides low-level functions (for example, line scanning and ringing). In addition, it supports advanced subscriber terminal equipment, such as the Business Set and Data Unit. Using advanced technology, the LCM is physically half the size of the LM and supersedes it.

A maximum of 640 lines can be connected to each LCM. Each LCM consists of two shelves, known as Line Concentrating Arrays (LCA). Each LCA consists of a Power Converter, Control Complex, and a maximum of five LCM drawers per shelf. Each LCM drawer contains up to 64 Line Circuit (LC) cards. There can be up to 320 lines connected to each LCA. The LCM layout is illustrated in Figure 2-13.

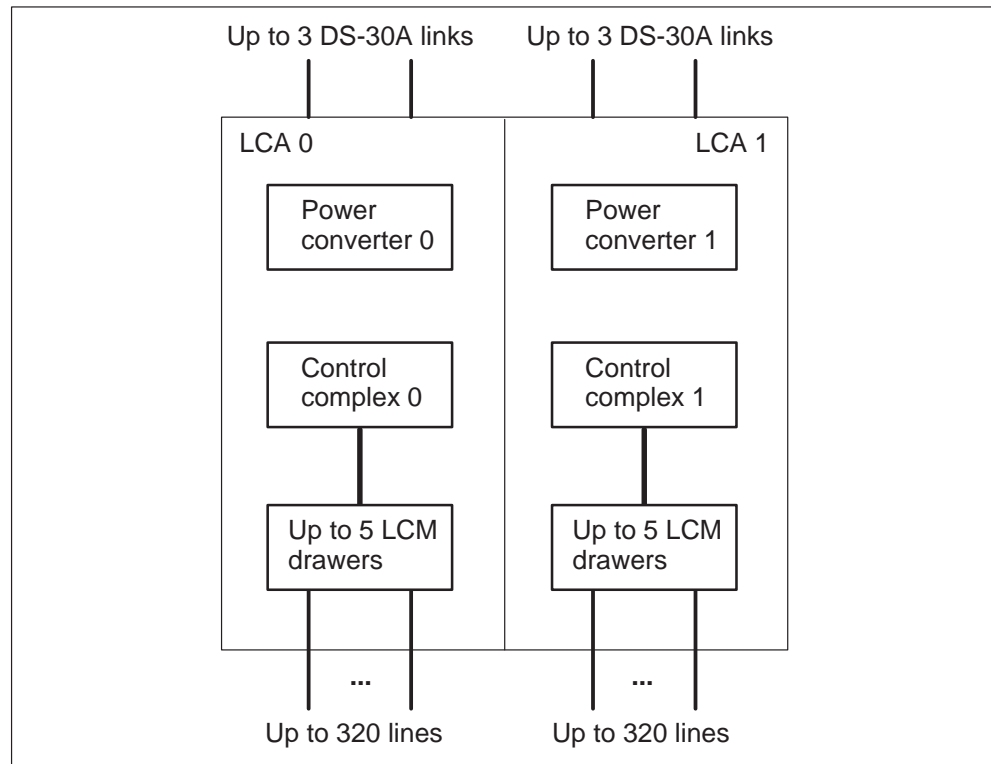
Unlike LMs, which connect directly to the Switching Network by way of DS-30 speech links, a group of LCMs connects to a LGC, a LTC, or a RCC, which in turn connects to the Switching Network. There are a maximum of three DS-30A links per LCA and a maximum of six DS-30A links per LCM.

For reliability, each LCA can take over the lines of the mate LCA. Duplication within the LCM is illustrated in Figure 2-14. The LCAs are connected by a serial data link that allows one LCA to check its data with the mate LCA. The data for each call in progress is sent to the mate LCA over this link. If a fault occurs in one LCA, the mate LCA can take over the

calls in progress. Each LCM drawer has duplicated links connecting it to both Control Complexes and each DS-30A link is connected to both Control Complexes as well. Therefore, if a Control Complex fails, the hardware signals the mate Control Complex, which then takes over the remaining 320 lines. There is no reduction in the number of links between Group Controller and the LCM, because the Control Complex has access to the failed Control Complex's LCM Drawers and DS-30A links.

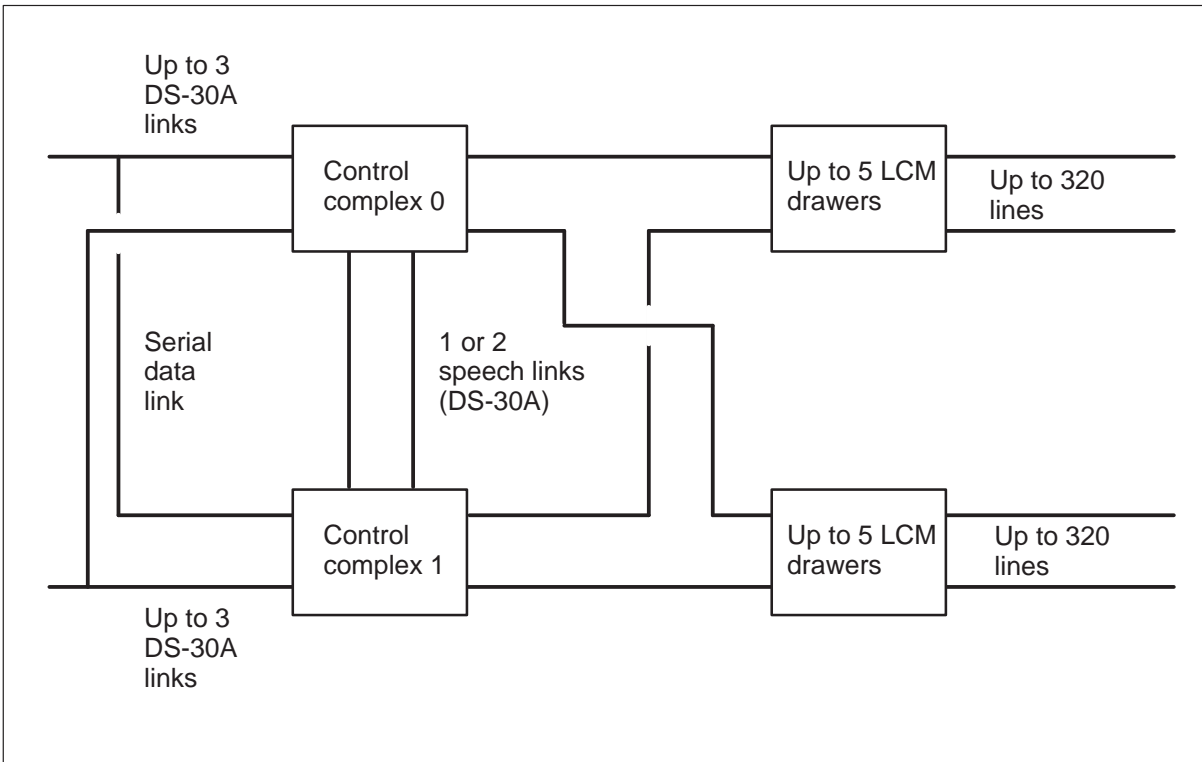
Between the two LCAs, there can be one or more speech links (DS-30A). If all DS-30A channels on an LCA are busy, but the mate LCA has free DS-30A Channels, a call originating on the Busy LCA can be routed over one of the inter-LCA speech links to a free DS-30A channel on the mate LCA. This capability provides access for all lines to all six DS-30A links for traffic engineering purposes.

**Figure 2-13**  
**Layout of a line concentrating module**



Each LCA has its own Ringing Voltage Generator. In the event of a failure, the mate LCA supplies the ringing voltage for both LCAs.

**Figure 2-14**  
**Duplication within the line concentration module**



### Line group controller

The Line Group Controller (LGC) is designed to support the LCM, as shown in Figure 2-15.

The LGC performs high-level functions, such as:

- call coordination
- provision of the different tones required

A LGC may be equipped with UTR. UTRs provide the same functions as the DTMP and Multi-frequency (MF) receivers located in MTMs.

From one to ten Concentrating Modules can be connected to each LGC; the number depends on the volume of traffic. Each LCM can have two to six connections (links) to the LGC. The LGC can have a maximum of 20 ports and 3 to 16 links to the Switching Network.

Between a LCM and its LGC is a DS-30A link, and the link control protocol is DMSX. The Link between each LGC and the Switching Network is a DS-30 Link.

As Figure 2-14 illustrates, there is usually some concentration of lines, depending on the engineering of the office. The concentration can occur in two places: in the LCM or in the LGC.

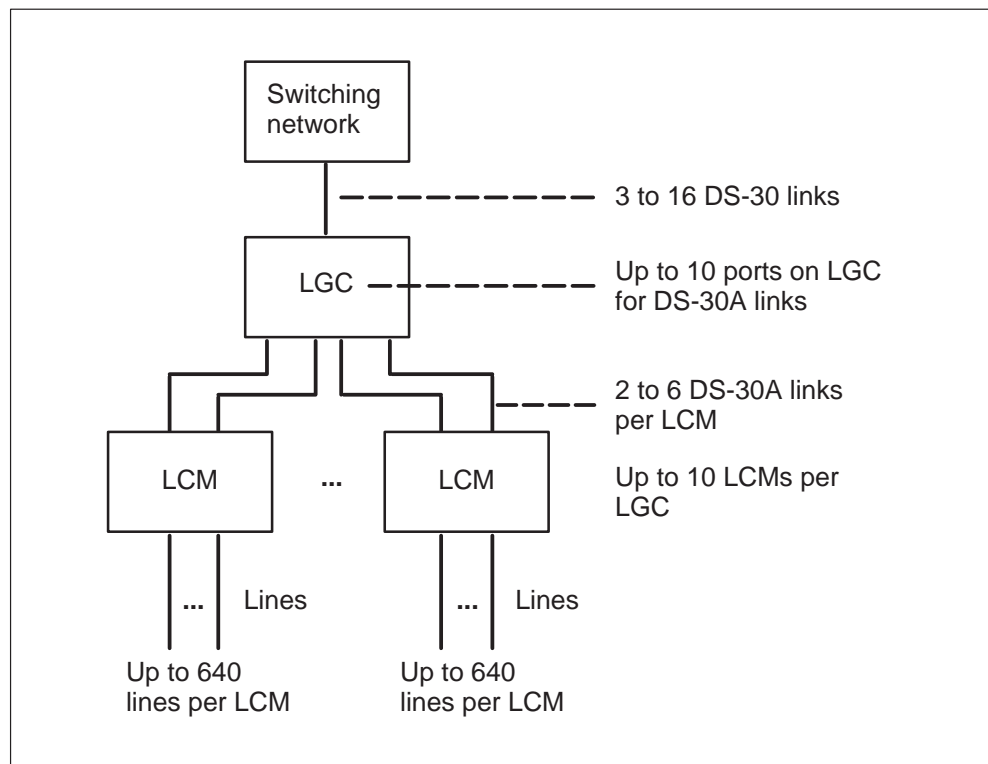
**Note: 1** Each LGC has a maximum of ten LCNs and, therefore, a maximum of 6400 (10 by 640) lines. The LGC has a maximum of 20 ports available for DS-30A links from the LCNs and, therefore, also has a maximum of 600 (20 by 30) speech links from the LCNs.

**Note: 2** There are up to 480 (16 by 30) speech links between the Switching Network and the LGC.

Line concentration can be lessened either by reducing the number of LCNs or the number of lines per LCM.

The LGC is divided into two units: each unit occupies one shelf and contains a control section, a power converter, DS-30 Interface Cards, and DS-30A Interface Cards. The LGC shelf layout is illustrated in Figure 2-16. The control section consists of two microprocessors: A Master Processor (MP) and a Signaling Processor (SP).

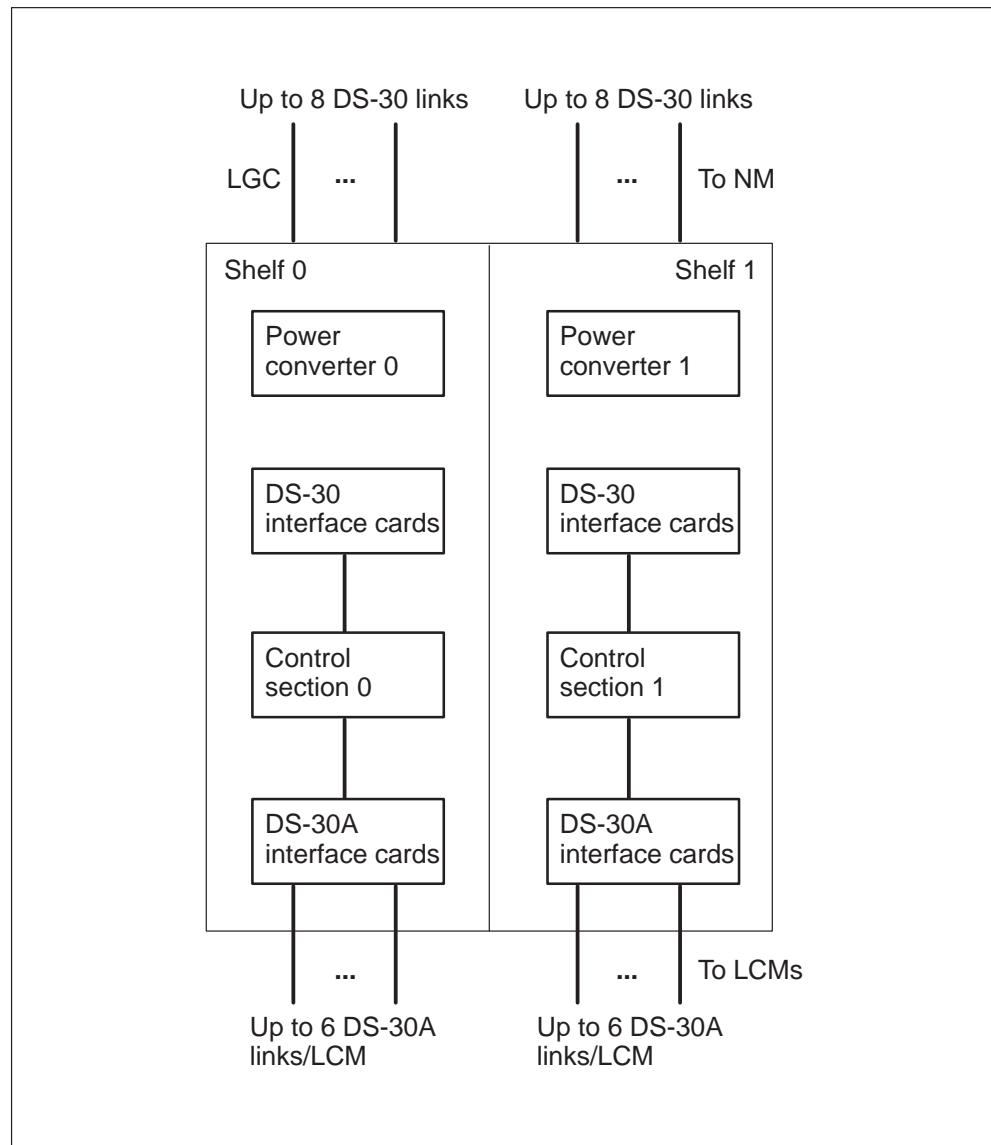
**Figure 2-15**  
**Line group controller and line concentrating module**



The MP provides the medium-level call processing functions associated with the LGC applications, such as:

- digit collection
- channel assignment
- function key interpretation
- interpretation of messages from the control component.

**Figure 2-16**  
**Line group controller and its shelves**



The SP provides the processing required to support the real-time critical functions of the LGC such as:

- message transmission and reception from the Switching Network and the PMs
- time switch control
- Channel Supervision Message reception and transmission

The SP and the MP each have their own memory cards as well. The control sections of the LGC are illustrated in Figure 2-17.

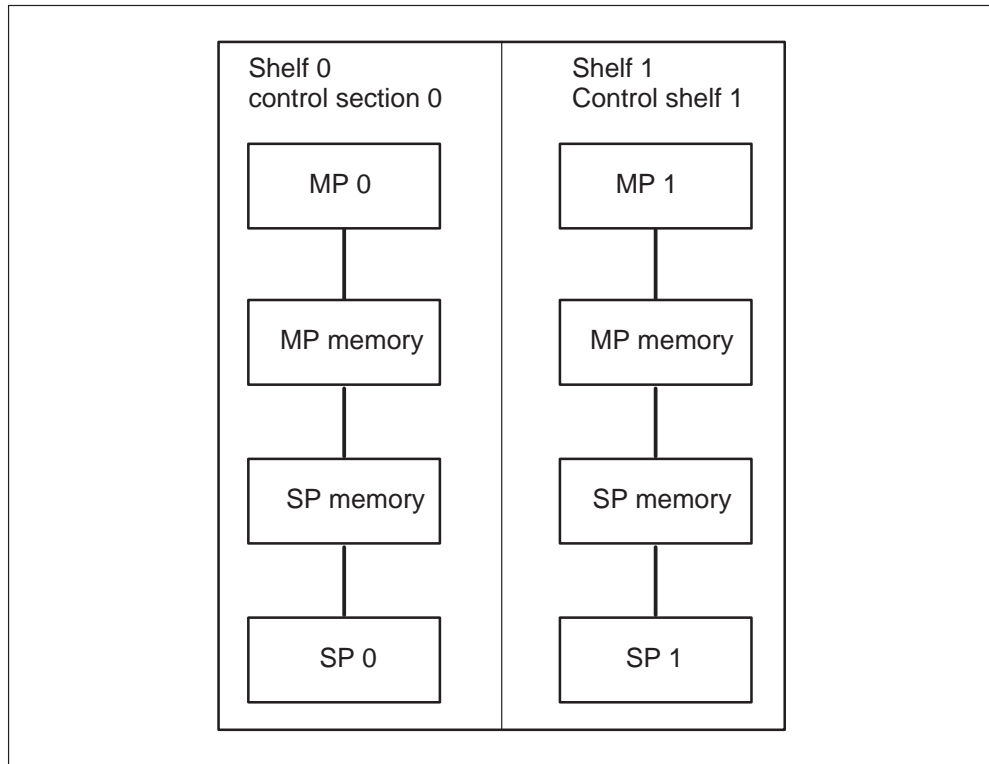
For reliability, one control section is active, and the other is in a standby mode. There is a 19.2 kb/s link between the two units. This link is used to transfer information from the active unit to the standby unit. The transfer is carried out so that the standby unit has enough data to continue operation if the active unit fails. The active unit checkpoints data from each call to the standby unit. A fault (hardware or software) causes the active unit to become inactive; the standby unit then assumes control of the LGC. Duplication within the LGC is illustrated in Figure 2-18.

The LGC is the basic peripheral group controller of the XPMs (the second generation of PMs). The derivatives of the LGC are:

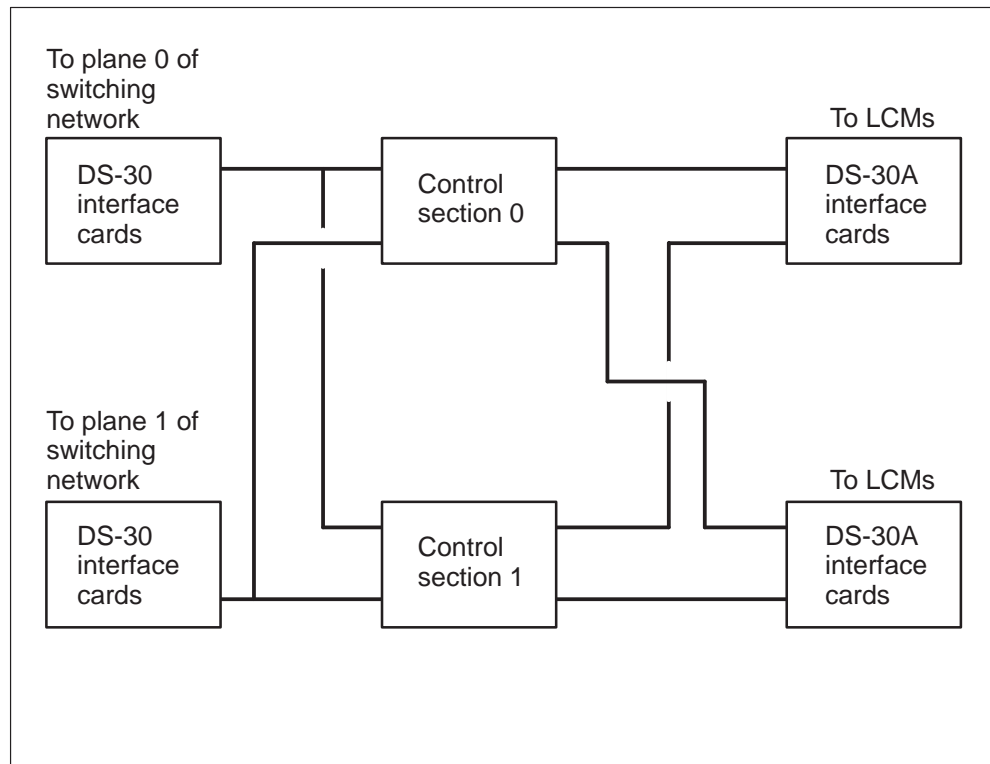
- The DTC supersedes the DCM.
- The LTC combines the functions of the LGC and the DTC for smaller offices.
- The Remote Cluster Controller is a large remote PM.



**Figure 2-17**  
**Line group controller – sections**



**Figure 2-18**  
**Duplication within the line group controller**



### Digital trunk controller

The DTC uses the same hardware as the LGC, with one exception: it has DS-1 Interface Cards instead of DS-30A Interface Cards. The DS-1 Interface Cards supports digital trunks used for inter-office trunking. There are 20 ports available on the DTC for digital trunks. The DTC provides A/B bit scanning capability.

The DTC can be equipped to connect with a common external clock when the DMS-100 is operating in a digital network environment. The DTC uses an incoming reference DS-1 link to compare the external clock rate against that on the internal DS-30 speech links. Discrepancy messages are sent to the control component, which adjusts the clocks in the Message Controller (from which the DS-30 clock signal is derived).

### Line trunk controller

The LTC combines the functions of the LGC and the DTC. The LTC is a LGC with a mixture of DS-30A Interface Cards (for links to LCMs) and DS-1 Interface Cards (for trunks). The LTC is designed to support the family of remotes based on the LCM (for example, the RLCM). Like the LGC, the LTC has 20 ports available. For example, there may be eight ports assigned

for trunks (DS-1 protocol) and 12 ports for lines (DS-30A protocol). The LTC provides A/B bit scanning capability.

LTC can be equipped to connect with a common external clock when the DSM-100 is operating in a digital network environment. The LTC uses an incoming reference DS-1 link to compare the external clock rate against that on the internal DS-30 speech links. Discrepancy messages are sent to the control component, which adjusts the clocks in the Central Message Controller (from which the DS-30 clock signal is derived).

### **Remote cluster controller**

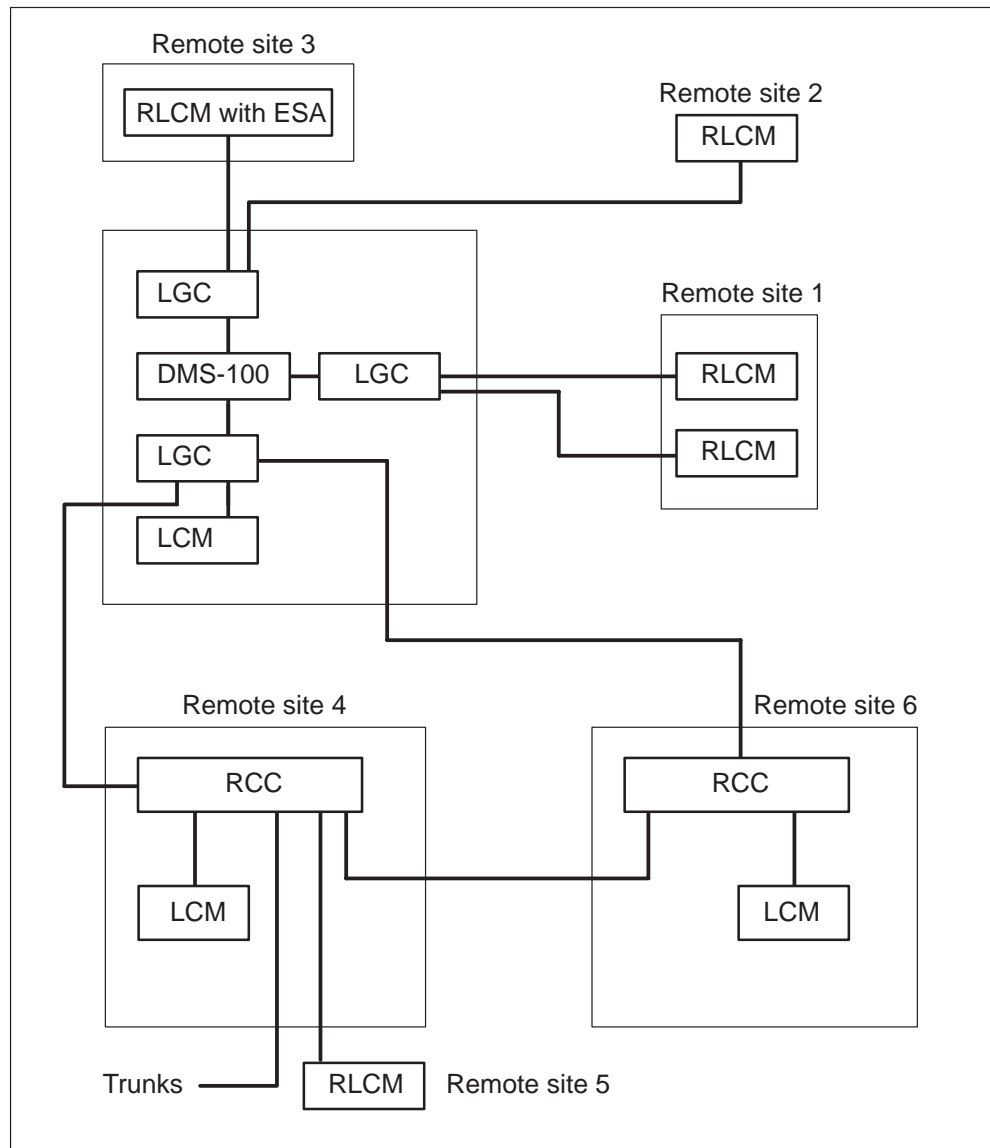
The Remote Cluster Controller (RCC) is a remote LTC. It can support Line Concentrating Modules, digital trunks, and RLCMs (that is, remotes off a remote). RCCs are connected to a LTC or to a DTC by means of DS-1 links. RCCs may be equipped with Emergency Stand-Alone (ESA).

Examples of remote PMs are illustrated in Figure 2-19 which show:

- 1 Remote Site 1 illustrates a site with two RLCMs.
- 2 Remote Site 2 illustrates a site with one RLCM.
- 3 Remote Site 3 illustrates a site with one RLCM that is equipped with ESA.
- 4 Remote Site 4 illustrates a site with one Remote Cluster Controller. This RCC supports an LCM, trunks, and a DS-1 link to Remote Site 6. This site is a Remote Switching Center (RSC).
- 5 Remote Site 5 is a remote off Remote Site 4, and contains one RLCM.
- 6 Remote Site 6 illustrates a site with one Remote Cluster Controller supporting an LCM and a DS-1 link to Remote Site 4. Remote site 6 is a Remote Switching Center (RSC).

Remote Sites 4 and 6 also illustrate how inter-RCC switching can occur between remote sites over DS-1 links.

**Figure 2-19**  
**Examples of remote peripheral modules**



## Signaling terminal and message switch and buffer

### Common channel signaling (CCS)

Common Channel Signaling (CCS) is a signaling method in which signaling information for a number of trunks is transmitted on a separate trunk. The trunk that carries signaling information is called a CCS signaling link; the trunks carrying voice and data are called CCS trunks. To provide an interface with a Common Channel Signaling environment and to operate within that environment, DMS-100 uses Signaling Terminal (ST) and a Message Switch and Buffer (MSB). The ST and the MSB provide a means

of associating the signaling information carried on the CCS signaling link with the voice and data carried on the CCS trunks.

The ST provides an interface to a serial data link. This serial data link is used to send and receive signals over the CCS signaling links.

The MSB is a packet switch that supports the ST. All CCS messages, incoming and outgoing, are routed through the MSB. The MSB sends or routes the signals (messages) received by the ST through the Switching Network to the DTC connected to the CCS trunk. Messages containing signaling information are sent from the component to the DTC connected to the CCS trunk; the messages are routed to the CCS signaling link through the MSB and the ST.

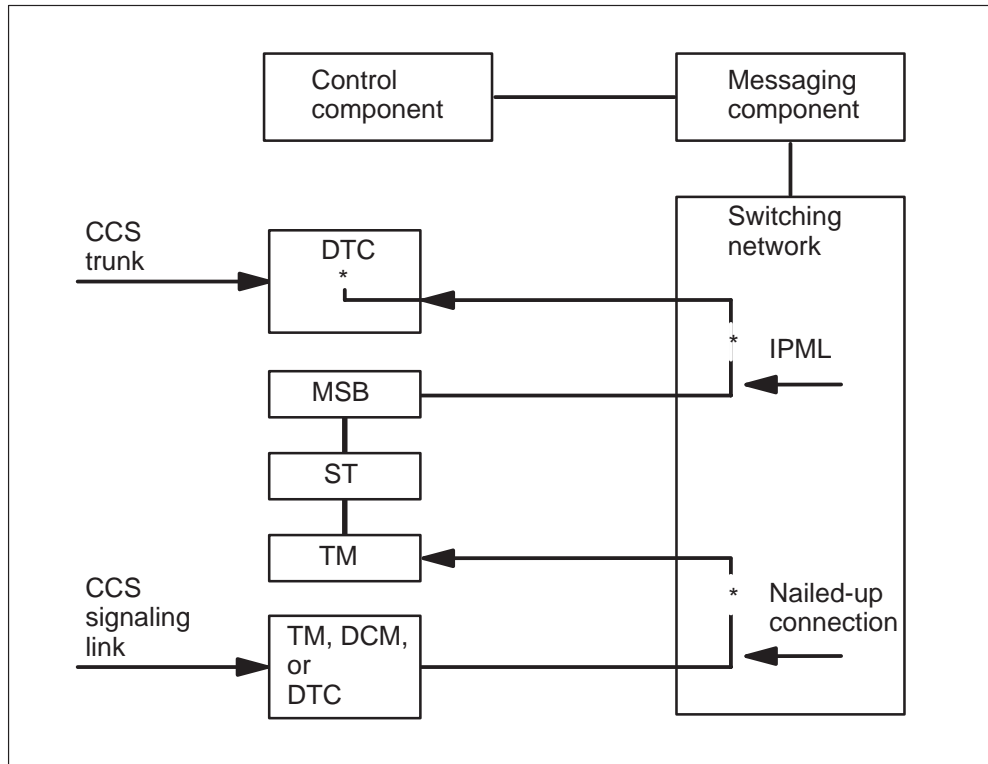
### **Common channel signaling – CCITT No. 6 and CCS7**

Two different protocols are used to implement Common Channel Signaling: CCITT No. 6 and CCS7. Different MSB and ST configurations are used to implement these two protocols:

- 1 The DMS-100 hardware configuration for CCITT No. 6 is illustrated in Figure 2-20. The CCITT No. 6 protocol involves the following steps:
  - a. CCS trunks carrying voice and data are connected to a DTC. The CCS signaling link carrying analog signals may be connected to a Trunk Module in the case of an analog trunk, or to a DCM or a DTC in the case of a digital trunk.
  - b. When the CCS signal (on the CCS signaling link) arrives at the TM, DCM or DTC, it is converted by the PM to a DS-30 signal and routed by way of a nailed-up (permanently assigned) connection in the Switching Network to a TM connected to an ST. The TM converts the DS-30 signal to an analog signal that is used as input to the ST.
  - c. The Signaling Terminal contains a modem that is used to extract the signal. The ST then passes the signal to the Message Switch and Buffer.
  - d. The MSB routes the signal through the Switching Network to the DTC on which the CCS trunk is located. The connection between the MSB and the DTC is called an Inter-Peripheral Message Link (IPML). An IPML is a nailed-up connection that is duplicated for reliability.
  - e. The DTC associates the signal with the appropriate CCS trunk and handles the call as if it had arrived on a trunk with Per Trunk Signaling.

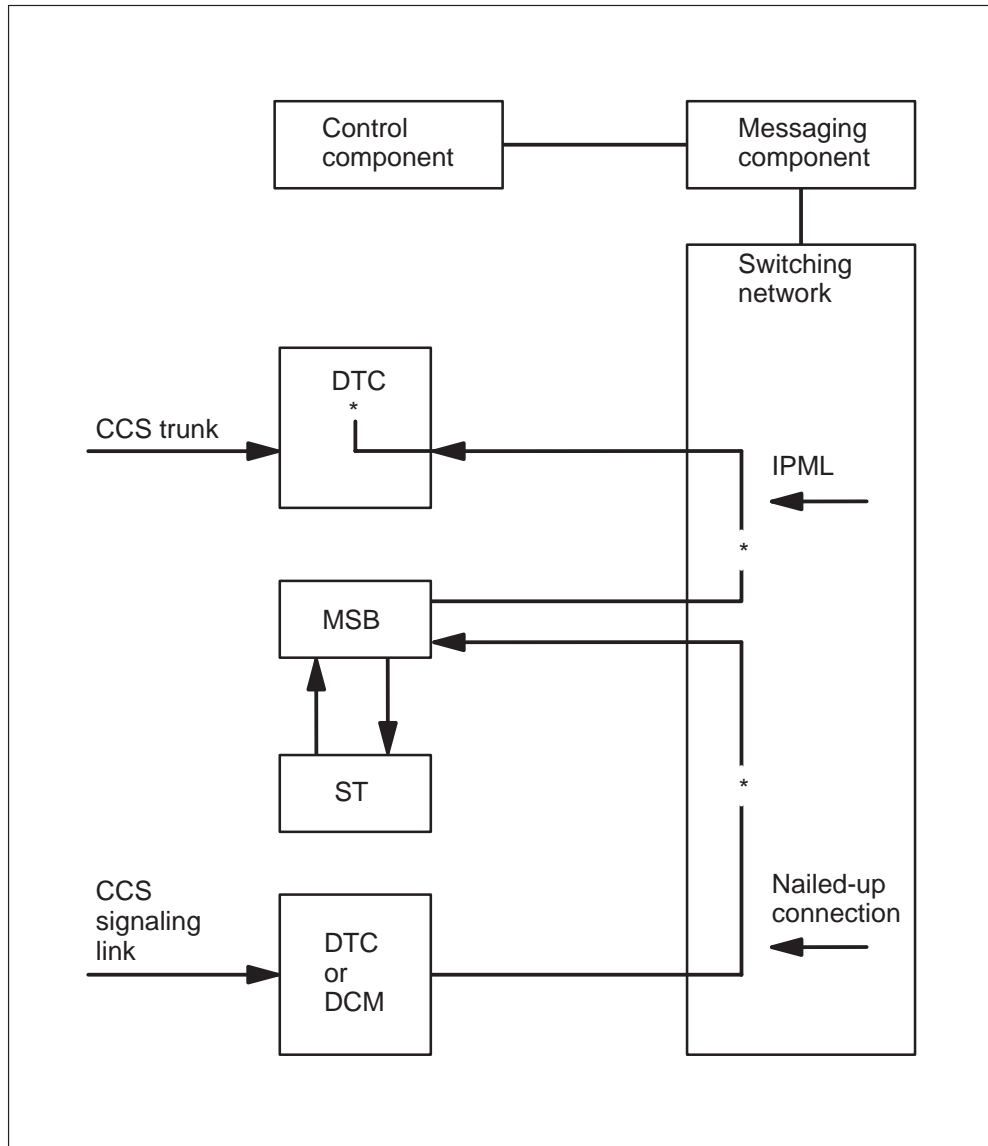
When the control component sends a message over the CCS signaling link, the message flow is in the opposite direction. Messages travel over all the links in both directions.

**Figure 2-20**  
**Hardware configuration for CCITT No. 6**



- 2 The DMS-100 hardware configuration for CCS7 is illustrated in Figure 2-21. This hardware configuration differs from CCITT No. 6 in two respects: the CCS7 signal is digital rather than analog and is routed directly to an MSB. The CCS7 protocol involves the following steps:
- The digital CCS signal (on the CCS signaling link) arrives at a DTC or a DCM and is routed by way of a nailed-up connection in the Switching Network to an MSB.
  - The MSB passes the CCS signal to an ST, where the signals are extracted. The ST then passes the signals back to the MSB.
  - The MSB routes the signal by way of an IPML to a DTC.
  - The DTC associates the signal with the appropriate CCS trunk and handles the call as if it had arrived on a trunk with Per Trunk Signaling.

**Figure 2-21**  
**Hardware configuration for CCS7**

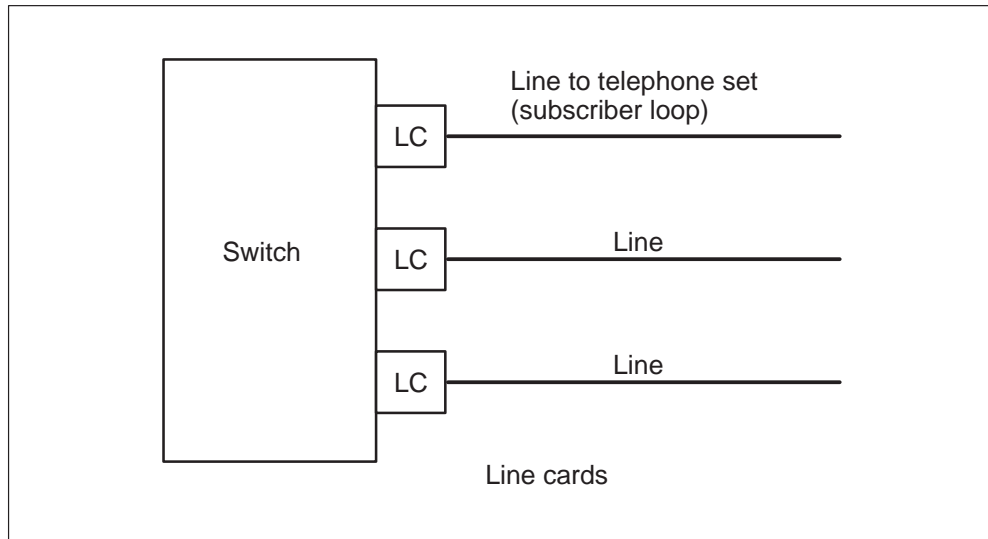


## Subscriber carrier module

### Traditional connections versus subscriber module connections

The traditional method of connection is illustrated in Figure 2-22. The line cost in this case is the cost of one line card, plus the cost of the Subscriber loop to the Subscriber telephone set.

**Figure 2-22**  
**Traditional connections**

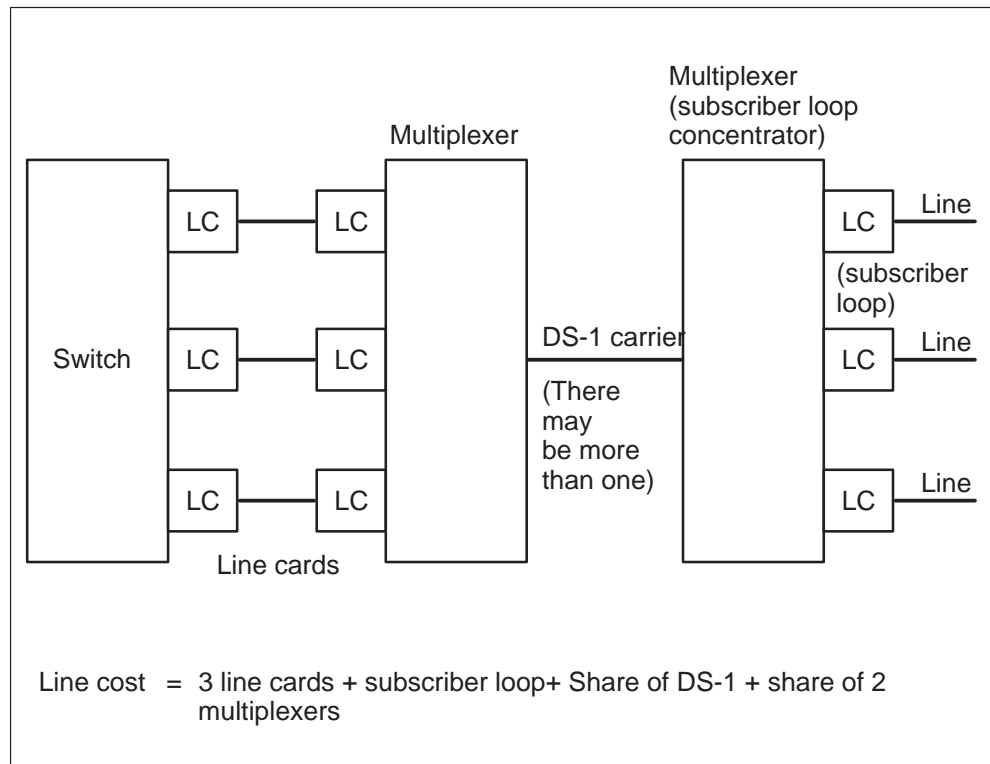


The traditional Subscriber Carrier (SC) places a multiplexer at the switch and another near the subscriber. The multiplexer located near the subscriber is called a Subscriber Loop Concentrator (SLC). The configuration of the traditional SC is illustrated in Figure 2-23. The multiplexers at the switch has line cards that are connected directly to the line cards of the switch. The multiplexers are connected by DS-1 carriers (possibly more than one). The multiplexer near the Subscriber contains line cards connected to the Subscriber lines. The line cost for the traditional Subscriber Carrier is: the cost of three line cards and the subscriber loop, plus a share of the DS-1 carrier cost, plus a share of the cost of the two multiplexers. Since the Subscriber loop is shorter than the Subscriber loop for the traditional method of connection, the total cost per line is lower.

The Subscriber Carrier Module (SCM) is an XPM designed to allow a digital interface between the DMS-100 and a SLC.



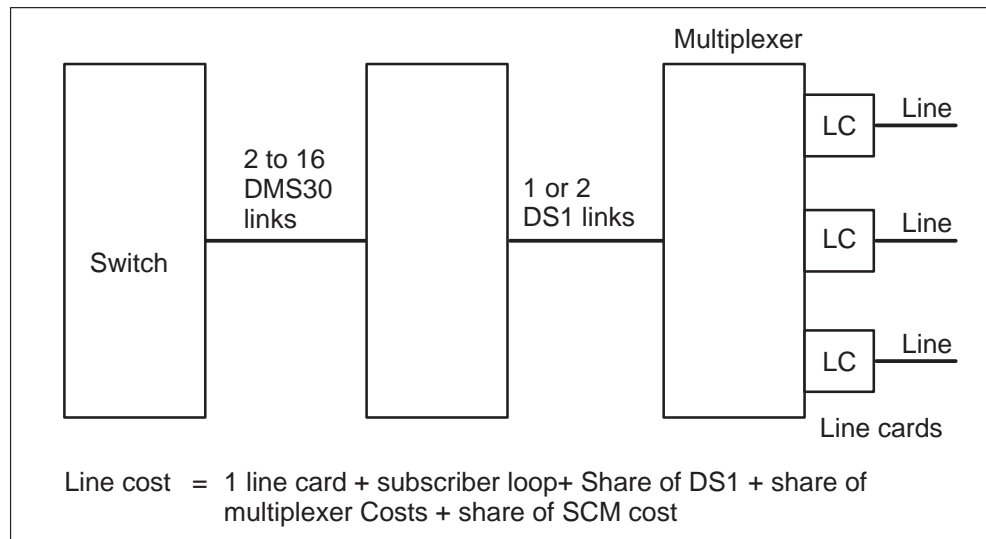
**Figure 2-23**  
**Traditional subscriber carrier**



There are three types of SCM, each of which connects with a different SLC:

- 1 the SCM-100R connects with the DSM-1
- 2 the SCM-100S connects with the SLC-96
- 3 the ISCM-100U connects with the DMS-1U

**Figure 2-24**  
**Subscriber carrier module**



An SCM is divided into two units. One unit is active and provides the necessary processing and control functions; the other unit is in standby mode and is able to take over call processing if a fault occurs in the active unit.

The SCM reduces the cost of the traditional SC: it replaces two of the three line cards and one multiplexer. The configuration of the SCM is illustrated in Figure 2-24. The line cost is the cost of one line card and the Subscriber loop, plus a share of the DS1 carrier cost, plus a share of the SCM cost.

### **Meridian business set (MBS) module**

The basic Meridian Business Set provides voice and “above voice band” signaling transmission over a two-wire line. Voice and signaling are frequency division multiplexed, with binary data transmitted by absence of an 8 kHz carrier. All feature activation is by this transmission.

### **The Meridian proprietary business set (NTX106AA)**

#### **Key short circular hunt**

This feature provides circular hunting across directory number appearances on MBSs and Electronic Business Sets (EBSs), ensuring that incoming calls to a short hunt group canvass the entire group before receiving an overflow treatment if an idle appearance is not found. This feature enhances the existing Short Hunt feature.

### **Meridian enhanced business set services (NTX878AC)**

#### **Group intercom all call**

This feature allows an MDC user to page up to 30 members in his/her designated Group Intercom (GIC) group. This functionality is extremely

useful in situations where common announcements need to be broadcast to several individuals (who are equipped with Meridian Business Sets) within the same GIC Group.

### **MADN cut-off on disconnect (COD)**

The optionally available Multiple Appearance Directory Number (MADN) Cut-Off on disconnect (COD) feature disallows the placing of a DN appearance on Hold unless other formerly bridged members have either pressed their release keys or gone on-hook. The new feature closely simulates a true key system operation.

The standard current MADN arrangement with bridging options permits a member to place his or her DN appearance on hold while additional MADN members are still actively bridged into the call.

## **Meridian enhanced business set (NTX878AD)**

### **MADN bridging—three-way call**

This feature enables a MADN Single Call Arrangement (SCA) with bridging options to establish a three-way call during a bridged state. Currently, a MADN SCA with bridging options cannot activate three-way calling during a bridged state.

### **Repeated alert for meridian business set (MBS)**

When a Meridian Business Set (MBS) is in an off-hook condition, this feature provides multiple alert tones to the user when another call arrives on a Directory Number or Intercom key.

Currently, when the MBS is in a busy condition, only a single alert tone is provided when another call is presented. MBS users who work in a noisy environment may miss the single tone and leave the call unanswered. This feature helps to ensure that all incoming calls are answered.

## **Meridian enhanced business set services (NTX878AD)**

### **Ring transfer key (MADN ring forward enhancement)**

This feature enhances the existing MADN Ring Forward (MRF) feature by providing the ability to use the Ring Transfer Key to turn off and on the audible ringing for numbers in the MADN group.

Ring transfer is a subset feature that controls all listed DNs and MADNs either to ring or not to ring, depending on current feature key status.

## **Meridian business set inspect key (NTXE40AB)**

### **Automatic inspection mode**

Currently, the MDC end user who has a display set must first depress a key (for example, Inspect Key) in order to update the display with information concerning calls that have been call-waited, group intercom calls, and calls

that are arriving to secondary directory numbers. The Automatic Inspect Mode feature changes the display status and provides pertinent call information upon call arrival at both idle and non-idle sets.

### **Meridian display communication (NTXE47AA)**

#### **Multiple executive message waiting keys per DN**

This feature enhances the basic Executive Message Waiting (EMW) feature to allow the assignment of more than one EMW key on a Meridian Business Set. One application of this enhancement is to designate voice mail to one key and a CENTREX message desk to another key on a business set, allowing the set user to distinguish messages from one or the other more easily.

### **MBS call forward universal per key (NTXE62AA)**

#### **Meridian business set call forwarding on a per key basis**

This feature allows each DN on a MBS to be forwarded to a different DN. Call Forward Per Key (CFK) is a variation of Call Forwarding Universal and Intragroup.

### **MBS interactive displays**

#### **MBS power feature—name programming**

With this feature, users of MBSs with display can program their own sets so that their names are directly associated with their individual directory numbers. This capability was previously administrable only through the SERVORD system.

To implement Name Programming, the user enters the characters (including alpha) by means of the regular twelve-key keypad, the power feature key, and designated softkeys. To guide and simplify the procedure, the display indicates prompts and other necessary information. Access to this feature is controlled through password recognition, and switch security is assured.

This feature also allows a technician to program names remotely, using any MBS at the customer's premises.

## Error handling

### Errors in a call process

Call process procedural messages are indicated in bold face type. The procedure **call\_error** handles errors that originate in the call process and that are detectable by call processing support or application software. The procedure **call\_error** produces a **SWERR** log entry and additional log entries that display the contents of the Call Condense Block (CCB), the Call Data Block (CDB) and any extension blocks involved in the call. The call process is terminated and re-started at its entry point, which is procedure **call\_process**. The call process cleans up the call in which the error occurred by performing the following steps:

- 1 Increments **number\_calls\_in\_recovery**; this is the number of running call processes involved in error recovery.
- 2 Invokes the idler procedure for each agent involved in the call.
- 3 Discards any Support Operating System (SOS) letters queued on the **cdb.cpmb.mailbox** and sets **cdb.cpmb.state cpmbidle**; if a CCB is linked to the CDB's, it sets **ccb.cptlgb.state** to unavailable.
- 4 Re-initializes and releases:
  - the CCB (**ccb.cptlgb.state** is set to **onfreeq**)
  - the Extended Call Condense Block (ECCB) if one is involved in the call
  - any extension blocks associated with the call
- 5 Clears any outstanding wake-up requests associated with the call.
- 6 Decrements **number\_calls\_in\_recovery**.

The call process then proceeds to process the next call processing transaction.

*Note:* The CCB is a data structure that contains information about a call in progress. The CDB is a data structure that is used during active call processing. Each call process has a permanently associated CDB.

### Traps

Traps occur when errors are detected by firmware or by SOS (for example, division by zero, stack overflow, stack underflow). The call process is killed, and a death message is sent to its daddy process. The Call Daddy Process then recreates the call process. When the call process begins to execute, it cleans up the call in which the trap occurred, as previously described.

**Note:** The Call Daddy Process has two responsibilities: 1) It creates other processes known as “child” processes. The child process is usually “owned.” 2) It receives death messages and decides whether or not to recreate the child process. For example, if a child process traps or fails because of an error (software or hardware), the daddy process is informed by means of a Support Operating System (SOS) message, called a “death message;” then the daddy process uses SOS utilities to clean up any resources that were associated with the child process. The concept of the daddy process represents a basic programming technique for the support OS. This technique automatically provides an appropriate action when the death of a process occurs.

There are two types of trap that occur in the SP and MP. Traps due to software-detected errors and traps due to hardware-detected errors.

Software traps include:

- 1 divide by zero
- 2 range checks
- 3 task errors (running out of space is an example).

Hardware traps include:

- 1 parity errors
- 2 bus errors
- 3 Memory Management Unit (MMU) errors

These traps are classified as recoverable or unrecoverable.

The designation of traps as recoverable and unrecoverable is a design decision. A task running out of task space is an example of a recoverable error. A parity error is an example of an unrecoverable error.

### **Task recovery**

See additional information in this section under, “Tasks.”

If a task identifies itself as recoverable to (Run Time Support System) RTSS and a recoverable error occurs, the task is restarted. If the task does not identify itself as recoverable, even a recoverable error will cause an XPM restart.

Associated with each trap is a trap handler. The trap handler is invoked by RTSS or by a hardware interrupt, depending on which one detects the trap. The trap handler is invoked by RTSS or by a hardware interrupt, depending on which one detects the trap. The trap handler looks at the fault data stored in the system stack to determine what caused the trap and which task it was

executing. The trap handler places the fault data in **mod\_com\_area** for debugging purposes.

If the task is identified as recoverable and the trap was recoverable, control is returned to the main procedure within the task; adjusting the stack pointer then clears the stack for the task. The STEAP is left as it was; therefore, all variables allocated by procedure new remain allocated.

### **Activity timer**

The activity timer is set by hardware to 1.5 sec and has a specific location on the address bus. The TIMER task resets the activity timer within 1.5 sec by reading this address. If the activity time-out occurs in an inactive unit, nothing happens.

### **Sanity timer**

The sanity timer is set by software and is currently set to 30 sec. The TIMER task must read a specific memory location within 30 sec; if it does not do so, the hardware causes a rest. On a reset, the unit returns to a WAI state and the complete load is sent to the unit again; if the sanity time-out occurs on the active unit, the reset also triggers an activity switch.

### **Error processors**

Error processors are invoked when call processing application software detects an error that does not originate in the call process itself (for example, an error originating in the PM). These errors do not cause the call process to be killed and recreated. Error processor are bound to the specific agents involved in the call, and their usual function is to take down the call and idle the agents involved.

## **Call processing applications software**

### **Structural description**

Call Processing Applications Software handles the functions that are specific to each type of call processing agent or to each type of call processing agent or to each type of call.

Most call processing applications are implemented in standard call processing applications architecture. Custom calling features that cannot be implemented easily in standard architecture are implemented in the Feature Processing Environment.

The standard call processing applications software has a hierarchical, layered structure. The elements of the structure are classes of procedures. Within a class, all of the procedures are functionally similar. Each procedure within a class is tailored to the logical and physical characteristics of a particular agent or type of call. All the procedures required to support call processing functions for a type of agent or type of call can be considered as aspect.

The general nature of the structure is the same for all calls, but the details of the structure depend on the agents involved and the type of call. At the top level of the hierarchy, the starter procedure controls the flow of the call, based on the message being processed, the call state and the type of agent or type of call.

The second level of the hierarchy consists of a set of processor procedures. Each processor controls an individual transaction or a set of closely related transactions. Processors are described later in this chapter in "Processors."

The remaining levels of the hierarchy are composed of function and supervisors. These procedures perform a variety of call processing tasks under the control of processors.

The procedures at each level of the hierarchy communicate results to the procedures at higher levels by means of return codes. procedures at all levels have read/write access to the contents of the CCB, the CDB, the Extended Call Condense Block (ECCB), and extension blocks.

Call processing applications software is table-driven, invoking the required procedures from procedure tables that are indexed by type of agent or by type of call.

Call processing procedure tables may be indexed by call processing call processing (CP) selector, by thread, or by cross thread:

**CP selectors** group agents by broad physical and logical characteristics (for example, lines, trunks, receivers). CP selectors are used to access procedures that involve only one agent. The CP selector is part of the Call Processing Identifier (CPID), which is derived from the Terminal Identifier (TID) of a terminal.

**Threads** of call processing agents distinguish their physical and logical characteristics more finely than CP selectors (for example, Dial Pulse [DP] line, DTMF) line, coin line, DP trunk, Multi-frequency [MF] trunk). The thread is part of the data stored for each agent in the call processing database. Threads are used to access procedures that involve only one agent.

**Crossthreads** are used to categorize connections (for example, line-to-line, line-to-trunk). The crossthread for each call is determined after the terminating agent is selected, based on the threads of the originating and terminating agents. Crossthreads are used to access procedures that involve both agents. Some thread and crossthread values are assigned to custom calling features and other special functions.



## Starters

Starter procedures from the first level of the call processing applications software hierarchy. Starters control the flow of the call from origination through to disconnect.

Starters are invoked by procedure **call\_process**. The starter associated with a particular agent is selected from a table of starter procedures indexed by the agent's CP selector.

The table of starter procedures is a table of gate procedures, defined in module **CPTABUI**. The selector for the starter gate is the agent's CP selector. A target procedure starter gate is the agent's CP selector. A target procedure is bound into the table of gate procedures for each value of the CP selector. CP selectors which are not in use have a nil procedure bound into the table.

The starter procedure selected for the agent invokes the appropriate processor, based on the message being processed, the call state and the thread or crossthread. The starter continues to execute until the call is completed or condensed and the returns control to procedure **call\_process**.

## Processors

Processors control individual transactions or sets of closely related transactions. Processor procedures are gated through a table of gate procedures defined in module **CPTABUI**. The selectors for the processor gate are the class of processor and the thread or crossthread. Processors reside at the second level of the call processing applications software hierarchy, except for cross processors, which reside at the third level. There are several classes of processor procedures:

**Setup processors** coordinate the setup phase of the call. The setup phase of the call includes all the transactions from origination through to signaling the terminating agent. In most cases, the setup processor calculates the cross-thread of the call from the matrix-to-crossthread table.

When the originating agent is a trunk, part of the usual function of the setup processor is performed by the originating allocator. The trunk originating allocator coordinates origination, digit collection and translation: the trunk setup processor coordinates the selection and signaling of the terminating agent. Setup processors are selected by the thread of the originating agent and are invoked by starters.

**Cross processors** establish the connection between the originating and terminating agents. If a receiver is involved in the call, the cross processor releases it. If a DTMF sender is required for outpulsing, the cross processor obtains a DTMF sender and sends messages to the Network Modules (NM) and Peripheral Modules (PM), directing them to connect a speech path between the originator and the DTMF sender through the NMs. Cross processors are selected by cross thread and are invoked by setup processors. Cross processors control only a portion of a transaction.

**Recall processors** process answer and flash messages. They record information for billing and route flash messages to custom calling features (for example, three-way calling, call waiting, and so forth). Recall processors are invoked by starters. They are selected by thread if only one agent is involved in the call, or by crossthread if two agents are involved.

**Disconnect processors** take down connections and complete the recording of billing information disconnect processors are invoked by starters. They are selected by thread if only one agent is involved in the call, or by crossthread if two agents are involved.

**Error processors** take down calls and idle the agents involved when errors occur. Error processors are invoked by starters. They are selected by thread if only one agent is involved in the call, or by cross thread if two agents are involved.

Processors continue to execute until control is transferred to another processor, or until the call is completed or condensed. Processor invoke functions and supervisors to perform their call processing tasks.

### Functions

Functions usually reside at the third or lower levels of the call processing applications software hierarchy. Functions are invoked by processors to perform a variety of call processing tasks. Functions are gated through tables of procedure variables defined in module **CPTABUI** and are selected by thread or CP selector. There are several classes of function procedures:

**Allocators** assign an agent to a call as the originator or terminator. The agent's data is copied from the database into the Call Condenser Block (CCB) for use by subsequent call processing procedures. When the originating agent is a trunk, the originating allocator resides at the second level of the hierarchy. The trunk originating allocator performs part of the function usually performed by a setup processor; it coordinates origination, digit collection and translation. Originating allocators are invoked by setup processors when the originator is a line, or by a starters when the originator is a trunk. Terminating allocators are invoked by cross processors. Originating allocators are selected by the thread of the originating agent and terminating allocators are selected by the thread of the terminating agent.

**Loaders** transfer the collected digits from the incoming message to the translation area of the CCB. Some loaders do simple pre-processing of digits messages. Loaders are invoked by setup processors when the originator is a line, and by the originating allocators when the originator is a trunk. Loaders are selected by the thread of the originating agent.

**Translators** analyze the translation database to determine the call's destination, based on the digits collected and the originator's attributes. Translators are invoked by setup processors when the originator is a line and by originating allocators when the originator is a trunk. Translators are selected by the thread of the originating agent.

**Identifiers** initiate recording of billing information. Identifiers are invoked by setup processors when the originator is a line. Identifiers are not used by standard trunks since billing is done at another office. Identifiers are selected by the thread of the originating agent.

**Routers** test the availability of agents and route calls, based on the results of translation. Routers are invoked by setup processors. Routing procedures are selected by a routing selector contained in the translation result.

**Terminators** select a terminating agent from a group of possible terminators (for example, trunk group, line hunt group, call forwarding) and put the thread of the terminating agent into **ccb.port2perm.thread**. Terminators are invoked by routers and are selected by the CP selector of the terminating agent.

**Outpulsers** compose and send messages to perform outpulsing on trunks. Outpulsers perform the function of signaling the terminating agent when the terminator is a trunk. Outpulsers are invoked by terminating allocators and are selected by the thread of the terminating agent.

**Idlers** idle agents when errors occur. Idlers are invoked by error processors, by the procedure **call\_error**, and when a trap occurs. Idlers are selected by the CP selector of the terminating agent.

**De-allocators** de-allocate agents from calls. De-allocators are invoked by disconnect processors and are selected by the thread of the agent being de-allocated.

**Spillers** compose and send messages to outpulse the calling number so that billing information can be recorded in the destination office. Spillers are invoked by recall processors and are selected by the thread of the terminating agent.

**Billers** perform special billing functions for message rate lines, coin lines, INWATS lines and PBX trunks. Billers are invoked by recall or disconnect processors, and are selected by the thread of the originating or terminating agent.

*Note:* Functions continue to execute until they return control to the invoking processor.

### **Supervisors**

Supervisors are invoked by cross processors to perform some of the functions associated with establishing the telephony connection and signaling the terminating agent. Supervisors compose and send messages, directing PMs to perform the following operations:

- 1 give audible ringback tone to the originator
- 2 if the terminator is a line, apply physical ringing to the terminator
- 3 transmit and detect integrity for the duration of a call
- 4 report on-hook or flash signals from the agents involved in a call; report answer signals also, if required

Supervisors are gated through a table of procedure variables defined in module **CPTABUI** and are selected by crossthread. Supervisors continue to execute until they return control to the invoking processor.

## **Firmware/software – DMS-100 family and DMS SN**

This section discusses the modularity of central control software, and describes the key features of the programming language as well as the major subsystems of the DMS-100 Family software. For this discussion, the DMS-100 Family firmware/software is broadly classified into two main categories.

**Central control firmware/software**

This consists of programs that perform a number of functions necessary for switch operation, plus tools for the implementation of these programs. The majority of these programs are written in a high-level language (PROTEL) and, after compilation and linking, are loaded into the program store of the switch. The data associated with the programs is stored in the switch data store. The code for three functions is implemented in firmware (ROM in CPU):

- 1 bootstrap loader
- 2 micro-code for the execution of machine instructions
- 3 applications not suitable for PROTEL (for example, some of the processor maintenance code)

**Peripheral firmware/software**

The DMS-100 Family system is a distributed processing system where the central control exercises high-level control of calls and system maintenance, and the repetitive, time consuming tasks such as scanning, control, and maintenance of telephony interfaces are delegated to the microprocessor-based peripheral modules. The functions assigned to the peripheral modules are performed by Telephony Peripheral Virtual Machine (TPVM) programs, referred to as peripheral software. The TPVM is a simulated computer which provides a high level mode of control of telephone calls and other tasks carried out in peripheral modules.

The TPVM is applicable to all peripherals with the exception of the LCM, OPM, and RLCM. These are directed by the LGC and do not require the flexibility inherent with TPVM.

The software that implements a TPVM in a peripheral module is stored in RAM and other than the LGC and DTC which are written in PASCAL, all are written in assembler language. Only a small loader is stored in PROMS and it constitutes the firmware of the various telephony peripherals.

**Modularity**

The DMS-100 Family software has a highly modular structure with narrow, well-defined interfaces among modules. The module interfaces are designed around basic operating system functions (scheduling tasks or store allocations), the basic call processing functions, the features required (Centrex or CAMA), and the hardware supported.

To minimize software administration, DMS-100 releases software periodically using a Batch Change Supplement (BCS) process where each BCS basically represents a committed set of features and software fixes. Within this framework, the production of an office load results only in the selection of those modules corresponding to the features requested for the particular office.

The selection of modules is designed to accommodate not only the type of office (toll or local), but also the features required (such as, MDC, CAMA, or common channel signaling), and the hardware supported (trunk types or digital carriers). In addition, the common library is designed to accommodate different versions of facilities, for example, single or triple entry billings, and “specials” that may be developed for specific customer requirements.

The modules in the common library can be classified into several layers that are used to build up an office. The main layers are the operating system, the call processing utilities, and the call processing options. The call processing options do not provide direct interfaces for other modules to call. They are specifically designed with no references to them, so that they can be independently selected as options for any given office. When loaded, they make themselves known to the rest of the system. The term “agency” is used for these call processing options. Typically an agency deals with a specific set of call processing features and the terminals (lines or trunks) to which they apply.

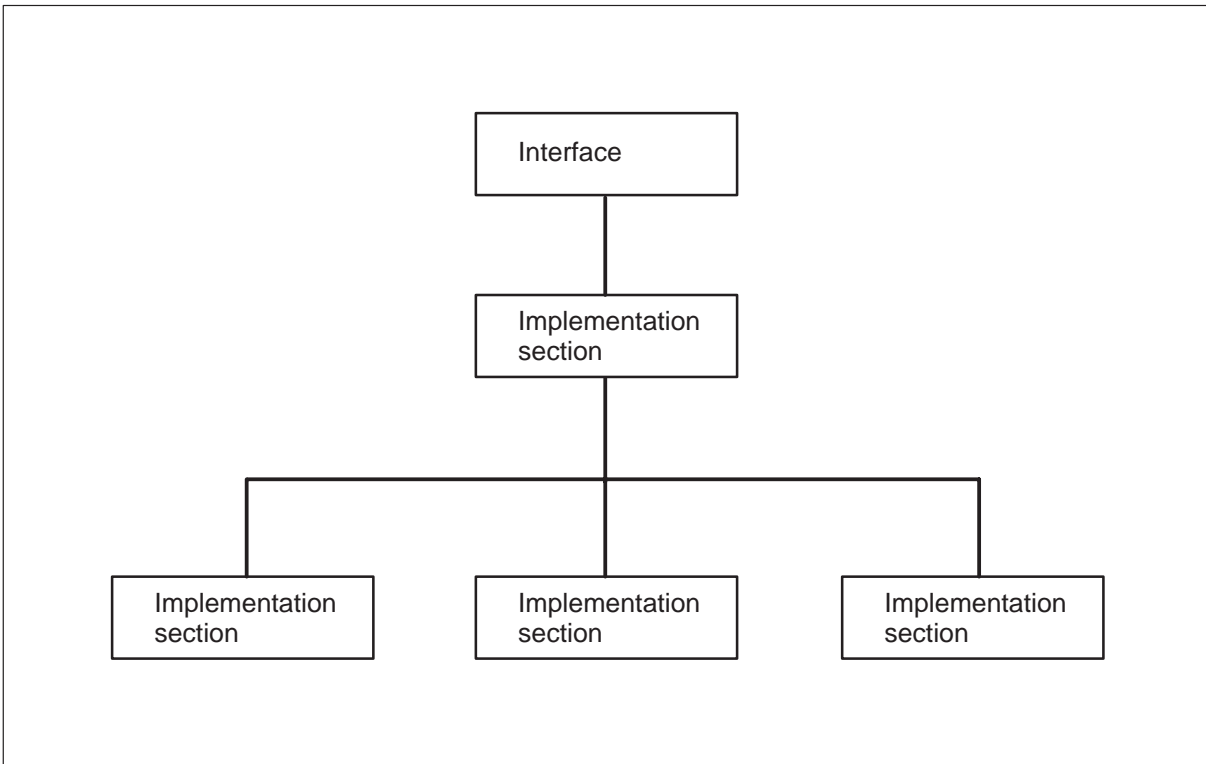
An agency includes both the code and the data tables used to specify the terminal service options, parameters, and status. An example of a module in the call processing utility layer is the network control module. This module provides the procedures to make or break a network connection between specified network channels. To use these functions, other modules call the appropriate procedure in the network control module interface. The algorithms and data structures used to select a free path and send the appropriate control messages out to the network peripheral processors are all contained within the network module.

If the selection algorithms or data structures are ever modified, the effects of such a change are strictly contained within the module and the only requirement is to implement the functions, as specified by the interface procedures. The switch operating system provides a basic layer that supports both the call processing utilities layer and the options.

A typical module consists of a procedural interface, and a number of implementation sections (see Figure 2-25). The implementation sections contain data declarations, code for procedures declared in the interface, and additional procedures. Interface procedures are available outside of the module but data and code declared in the implementation sections are private to the module and are not accessible from outside it. The interface and all implementation sections are separately compiled. The design process used for the DMS-100 Family software consists of two steps:

- 1 the subdivision of a problem into a number of modules, a specification of the interface of each module
- 2 the actual implementation and testing of each module

**Figure 2-25**  
**Internal structure of a module**



As part of the module specification, the interfaces are written in PROTEL language and compiled. Several modules, then, may be implemented in parallel. All uses of the pre-compiled interfaces are verified by the type checker as the implementation sections are coded and compiled. Separate tools for checking intermodule references are not required. The PROTEL module structure encourages a hierarchical, or layered, system structure, where high level modules (for example, call processing phases) make use of lower level modules (such as, the operating system nucleus).

## PROTEL

The DMS-100 Family software is written in the Procedure Oriented Type Enforcing Language (PROTEL). Any time-critical or maintenance operations not suited to PROTEL implementation are programmed directly in firmware. The DMS-100 Family object code is stack oriented, allowing an extremely compact object code to be generated by a relatively simple compiler, without the need for difficult global optimization. This approach has been proven on the Burroughs 5500 and 6500 computer systems, and on Nortel Networks' SL-1 digital business communications system. PROTEL is a block structured language which maps well onto the stack run-time environment. Procedure calls and array indexing (with run time checking of subscripts) are both fast operations implemented as single instructions.



Many of the features of PROTEL were borrowed from the languages PASCAL and ALGOL68, although the statement syntax may resemble PL/1. In addition, the module structuring technique, described above, has proven to be both a useful language feature and a valuable design tool.

There are five key features of PROTEL.

### **Block Structure**

All identifiers local to a procedure, or other block, are invisible from outside the block. Local variables are dynamically allocated on procedure entry and deallocated on procedure exit. This feature is efficiently supported by the stack architecture of the object machine. Potentially, all procedures are recursive or re-entrant.

### **Data Types**

PROTEL provides a few built-in data types (for example, numeric and symbolic ranges as in PASCAL) and also provides the capability to define more complex arrays and structure types. The AREA construct allows the definition of structures whose details are undefined in the top level software, but can be further refined (details filled in) in lower levels of software.

### **Control Structures**

PROTEL provides a flexible set of control structures which are compatible with the goals of structured programming. IF, CASE, and various iterating constructs are supported. The EXIT statement may be used to prematurely terminate a loop. The assignment statement and procedure call complete the list of executable statements. There is no GO TO statement.

### **Procedure Types**

Procedures are PROTEL data types, and like all other types, may be declared as variables or constants. A procedure constant corresponds to the procedure, function, or subroutine of most high level languages. A procedure variable may be bound, at run time, to a specific procedure constant.

In some cases, there may be several implementations of a module resident on a single DMS-100 Family office. In this case the proper implementation must be selected at run-time. This is done by declaring a table of procedure variables for any procedure in the module's interface, which are to be invoked in this way.

An example of this is the file system. A module is declared for each physical device type (for example, TTY or nine-track tape). Each device module supports the standard I/O system procedures; OPEN, CLOSE, GET and PUT. The correct module is selected at run-time by indexing a table of procedure variables with the new device type modules without having to modify the base software. This would not be true if the device selection were



done with a CASE statement. A similar technique is used to implement agencies that perform standard call processing and administrative functions on a variety of telephony terminals (for example, trunks and announcement machines).

### **Dynamic Arrays**

PROTEL arrays may be allocated at compile-time, or at run-time, under control of the programmer. Run-time (dynamic) allocation permits the size of data tables to be controlled by office parameters, and for existing tables to be extended on-line.

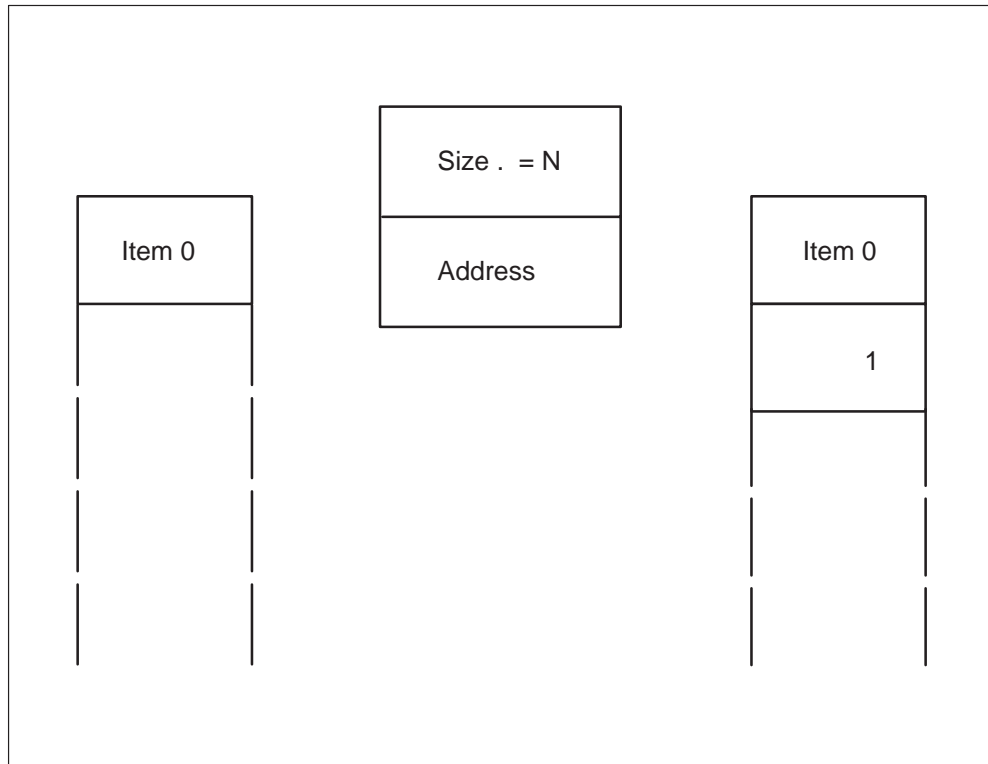
Fixed size arrays to be allocated at compile-time are defined by the type; TABLE (range) OF (element type). For example, a register to hold up to 16 digits may be declared:

```
DCL DIGIT REGISTER TABLE 0-15 OF DIGIT
```

Typically, call processing data tables vary in size from office to office. If all table sizes were specified at compile-time, the software would have to be recompiled each time a new office was delivered. This problem is avoided by allocating these tables at run-time. For example, a table of trunk data would be declared:

```
DCL TRUNKS DESC OF TRUNK DATA
```

The above declaration allocates a table descriptor, rather than the table itself. A descriptor consists of a size and table address, rather than the data itself. The difference between the TABLE and DESC is illustrated in Figure 2-26. The actual storage for TRUNKS is obtained, at run time, by a call on the operating system storage allocator. An additional advantage of the Dynamic Array technique is that tables may be re-allocated after an office has been put into operation. This permits office data tables to be extended on-line.

**Figure 2-26**  
**Descriptor**

## Major subsystems of DMS-100 Family software

The DMS-100 Family central control software consists of five major systems:

- 1 Support Operating System – manages the various hardware and software resources of the central control complex. In addition, it implements and controls the multi-tasking environment.
- 2 Database System – implements the data management functions in the switch. These include the facilities for Data Modification Orders (DMOs), pending order file, journaling, and dump/restore. It also implements facilities for presenting data to the users in a canonical form, thus allowing changes to be made to data structures without the need for a reverse compile of programs. The various database facilities are described in Chapter 5.
- 3 Call Processing Software – described in Chapter 4.
- 4 Fault Detection and System Recovery Software – performs the automatic detection, diagnosis and recovery of hardware and software faults. It also implements facilities for performing manual testing and maintenance of switch and facility hardware.

## 5 Audit Software

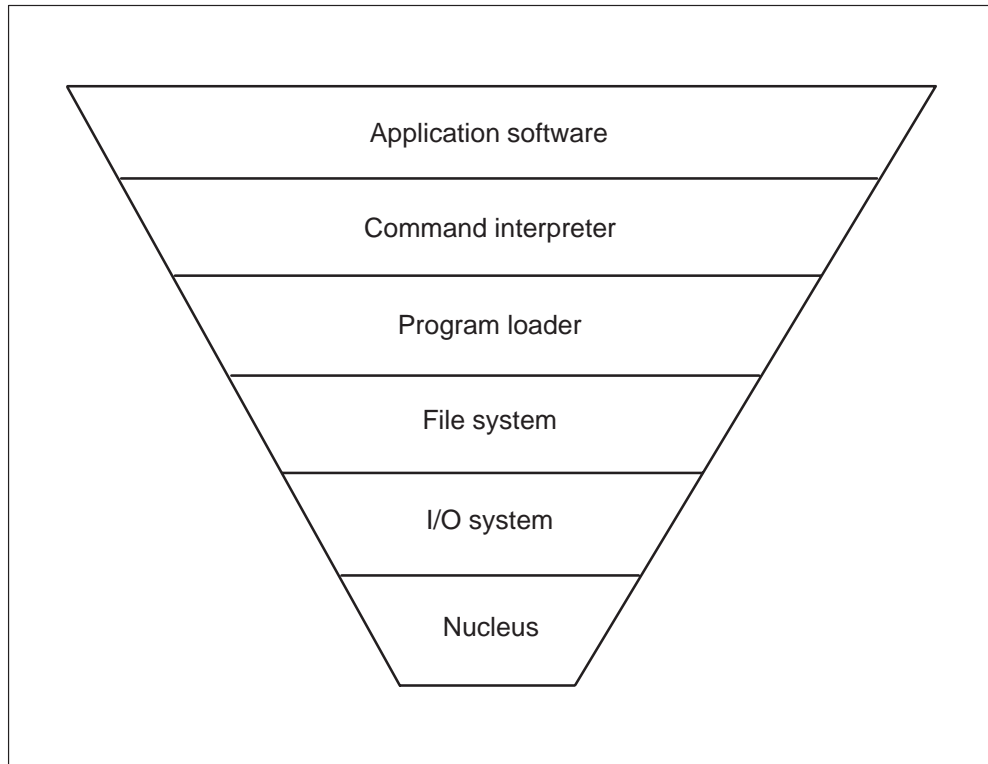
### **Support operating system**

In a modern software-controlled switch, there are a number of tasks to be performed in a concurrent fashion. These tasks include the setup of a number of calls at the same time, performing billing functions, enabling craftsmen to take control of equipment for testing, and handling an unending stream of trunk orders. In the DMS-100 Family system, the management of this multitasking environment is done by the Support Operating System (SOS). The SOS accomplishes this by supporting the execution of several programs by appropriately sharing the hardware resources (such as, CPU time or memory) among them according to their requirements.

SOS provides a mechanism called a process which is more precisely defined than a task. A process can be thought of as the execution of a program. The code of the program, spanning a number of PROTEL modules, defines what actions are to be performed and the flow of control through the code, and execution of these functions constitutes a process. At any given time, the state of the process is reflected in the point of execution in the program code and the value of the data manipulated by the program. This state of a process is remembered in a Process Control Block (PCB) associate with the process. It describes whether the process is running or waiting for an event. For waiting processes it has enough information to resume their execution from the state in which they suspended execution.

SOS is developed in the form of a layered structure (Figure 2-27). At the base we have the nucleus and above it we have other systems such as the log system, I/O system and file system. The reason for having the layered structure is to allow the more sophisticated facilities to make use of the more primitive. For example, once the ability to communicate with a terminal has been implemented in the I/O system, the file system procedures for reading or writing data may use this facility as a primitive without concern with the actual implementation of that function.

**Figure 2-27**  
**Support operating system (SOS)**



**Facilities provided by support operating system (SOS)**

Here are the various facilities provided by the SOS:

**Storage allocator** – provides facilities for allocating and de-allocating chunks of memory out of the program or data stores. On an allocation request by any user, the storage allocator allocates the requested amount of store from the available store using the first-fit method. On de-allocation, the storage is returned to available store thereby becoming available for reallocation on a first-fit basis again. In order to minimize the problem of store fragmentation, the storage allocator will merge the deallocated store areas if they are found to be contiguous. The store fragmentation is further minimized by requiring users to request store allocation/de-allocation in some integral units of store required for an entity.

**Directory system** – provides a mapping between character strings and unique integers in a certain range.

**Pool allocator** – provides facilities for allocating and de-allocating pools of storage out of which items of only a perspective type may be allocated. The use of a pool allocator reduces the memory overhead as compared to allocating individual items using the storage allocator. To minimize the blocking of processes requesting items from the same pool, the size of the pool is determined (by the user module and supplied to pool allocator as a parameter) on the basis of the type and usage of a particular resource to be allocated from the pool. However, if blocking may still occur, it is resolved by the usage of another facility in SOS, called the flag system which is described below.

**Scheduler** – responsible for sharing the CPU among all the processes in the system. This allocation is done on the basis of the priority assigned to each process, as well as the availability of processes to run as they wait for certain events and as these events take place.

**Timing facilities** – keeps track of the progress of real-time and is used to time running processes as well as processes waiting for timed events.

**Message system** – used for inter-process communication. Information is transferred by the sending process, posting the information (called a letter) on a mail box, and the receiving process retrieving the information from the mail box. The receiver is delayed appropriately should it attempt to retrieve a letter before it has been posted.

**Synchronization primitives** – used to regulate access to shared data by several processes to prevent the data from getting scrambled due to unregulated read and write attempts. They are also used to control the allocation and release of finite resources, in order to keep track of how many units of the resource are available at any given time.

**Log system** – when a software subsystem detects an event that it wants to report to the outside world, it may compose a report describing the event, and pass it to the log system which stores it in memory for later retrieval, or output it immediately to one or more output devices.

**I/O system** – contains facilities for sending messages to or receiving messages from various peripheral devices.

**File system** – supports standardized, device independent procedures for creating, opening and closing files for reading data from them or writing data to them. It is designed as a gate module containing various generic procedures for performing the above mentioned functions. The device dependent code for these functions is developed in the form of various agency modules which become bound to the module at run time.

**Command interpreter** – Command Interpreter (CI) of the operating system performs the input function for the man-machine interface to the switch (MAP). It provides a facility for reading and interpreting user commands and taking appropriate actions. It reads lines typed at a MAP, analyzes them, invokes command programs as needed, and evaluates the parameters required by these commands.

**Program loader** – used to load, modify, or unload programs and program increments.

**Flag system** – in DMS-100 Family systems, the use of exhaustible system resources, such as mailboxes, processes, MF receivers, and so forth., is controlled through the use of flags. A flag associated with a resource indicates the number of items of that resource are in use or in demand. Three facilities are provided by the flag system:

- time-outs to prevent blocking or deadlock
- non-busy waiting
- first-come-first-served service of waiting processes

### **DMS-100 family database system and software**

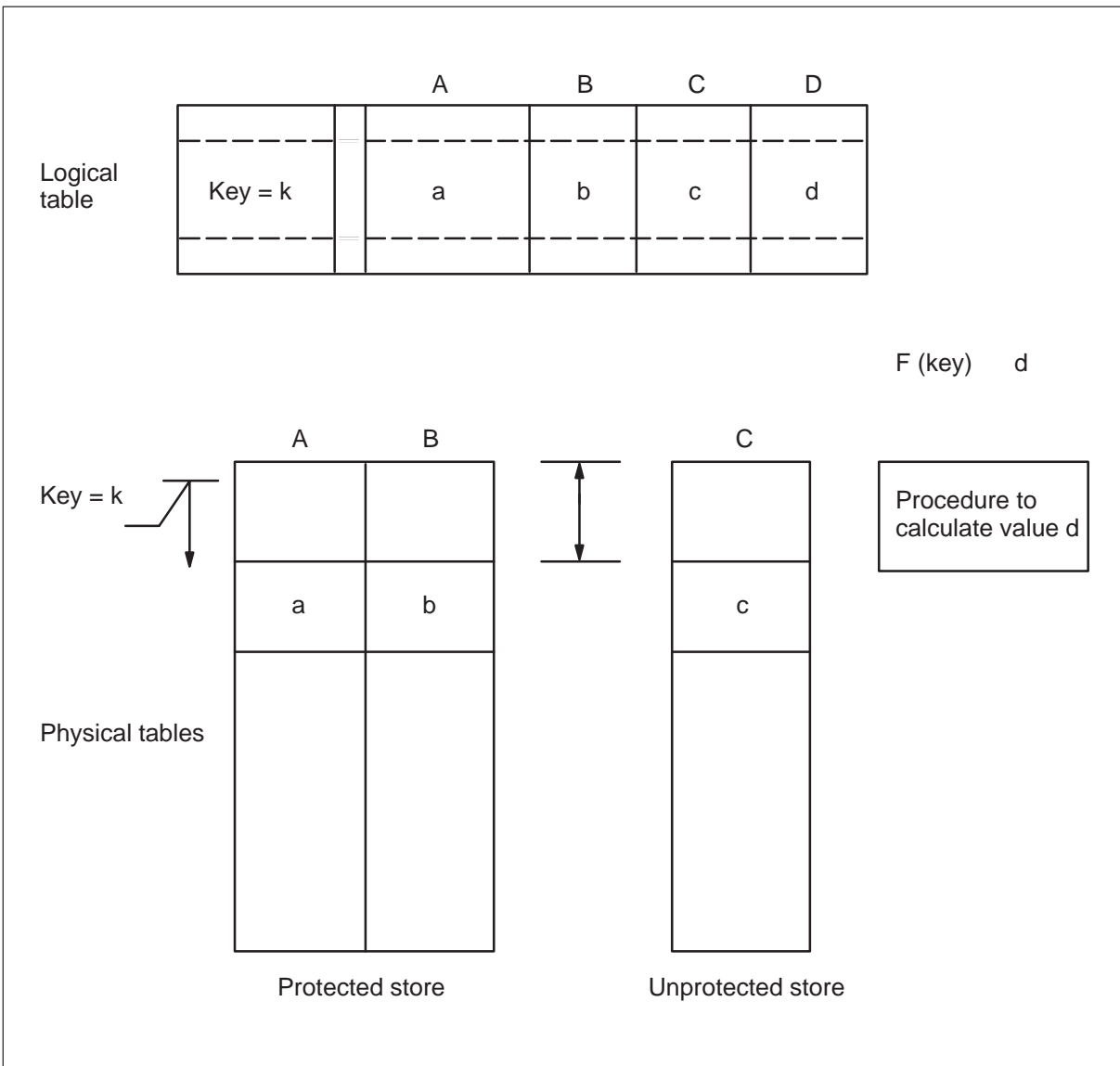
As the software undergoes extensions for new developments and changes, it is often necessary to alter the basic data structures used. The “hiding” of data structures inside modules allows such fundamental changes to be made without impacting other parts of the system. The interface to the module provides a set of functions that operate on the data structure, but the data structure itself is never accessible from outside the module.

When the new software is loaded onto an operational switching system, the current operational data must be extracted so that it can be used by the new software. This process is often achieved with a reverse compile, or bit shuffler program, which reformats the data from the old structure into the new structure. An alternative approach is to make use of the on-line service order facilities to dump the data into a file and later read it back into the new software load.

The first approach suffers from the need to prepare a special program for every data conversion. The alternative of using the service order facilities overcomes this problem, but requires all software to be compatible with a fixed external format used for service orders. Both approaches require that the service order facilities are modified at the same time that the data structures are altered for call processing. This simultaneous change of call processing and service order software is often more extensive than desirable, and prone to error.

The DMS-100 Family system defines all the data used by the software, in terms of a database schema or canonical form. The relational model has been used for this purpose, so that all data is viewed as a set of simple tables. These tables are independent of the actual physical data structures used by the call processing software (refer to Figure 2-28).

**Figure 2-28**  
**Logical and physical tables**



A data table is described in a single common manner, regardless of the fact that it may be implemented with lists, hash tables, bit maps or other techniques and that this implementation may change in future versions of the software. The data tables that describe the database are closely related to the

customer personnel's view of data in terms of customer service records and office configuration data. However, the data tables are nevertheless independent of the service order command language, office record print formats, and other operational features of the service order software.

In order to satisfy the various user requirements (both internal and external), four different data schemas are implemented in the DMS-100 Family database system:

**The physical schema** – corresponds to the actual physical structure of data. It is at a very low level and is described by descriptors, segmented store, or digitators.

**The internal schema** – corresponds to a view of the data in which various users can access the data in a common way through a single set of read/write procedures. The data, at this level, is seen as organized in the form of flat tables. Each row in the table consists of a number of fields, the first of which is an index. The index identifies a particular row in a table and provides sufficient information to determine the actual physical storage location of data. The main difference between this and the next level (the “logical schema”) is that the information about the relative order of rows (or tuples) in a table is not remembered at this level.

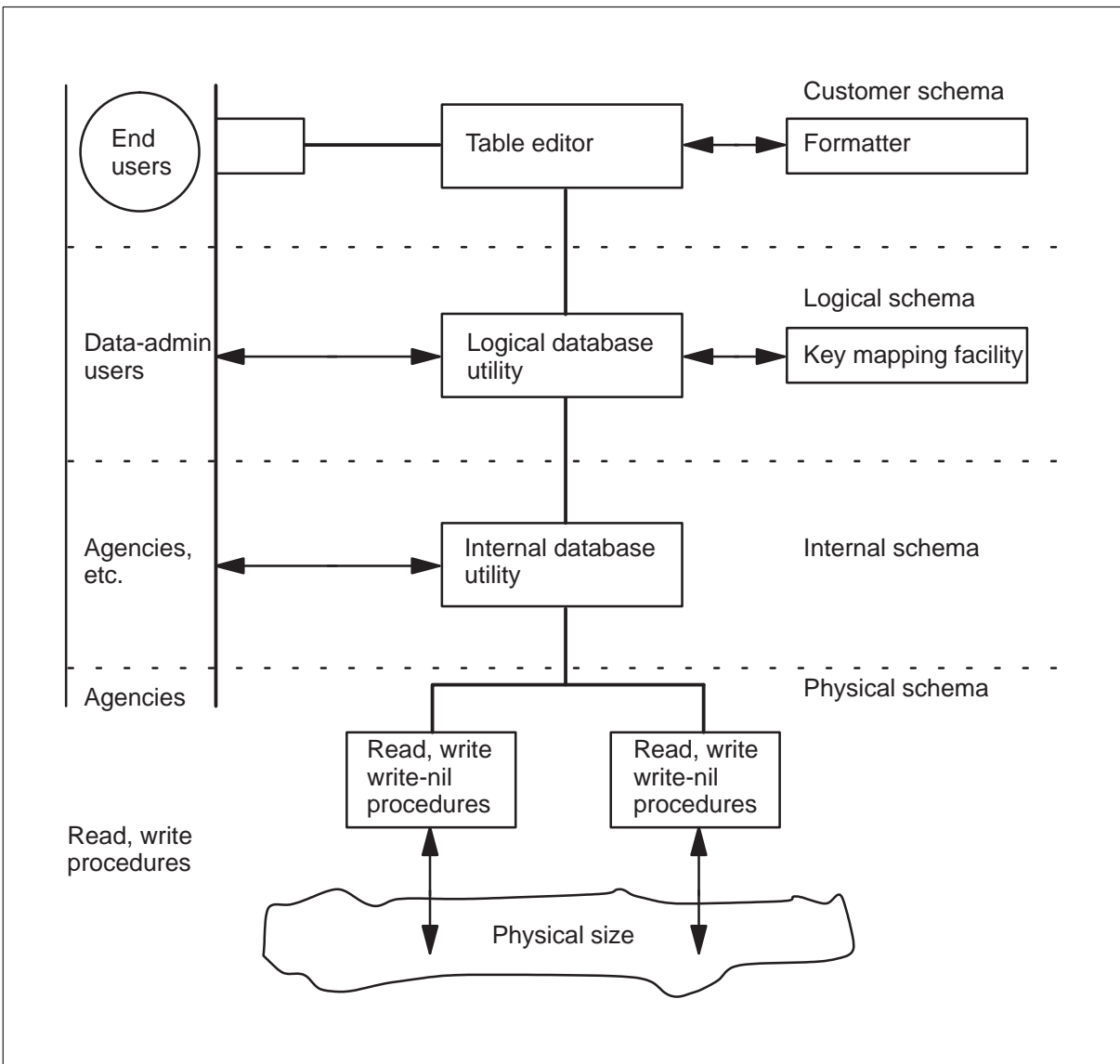
**The logical schema** – provides a higher-level view of data. The data at this level is presented to the users in a canonical form regardless of the actual internal storage mechanism used. The data is once again seen as residing in a number of rows, referred to as logical tuples, and a number of columns identifying fields of the tuples. The first field of the tuple is a key which uniquely identifies that tuple.

**The external** or customer schema – provides the end-user view of data. The data is represented in the character form, rather than the binary form used at the logical schema level. Users at this level are provided with a number of commands for making various queries as well as manipulating data.

Figure 2-29 shows the relationship of various software modules which together constitute the DMS-100 Family database system. As shown, these utilities build a layered structure whereby each level uses the facilities provided by the lower level.



**Figure 2-29**  
**DMS-100 database system**



Starting at the bottom of the figure, the time critical agencies access the data directly at the physical schema level. These agencies have complete knowledge of the actual structure of data, in fact these agencies have defined this set of data using the most efficient storage mechanisms they deemed fit in each case.

At the next higher level, an internal database utility is provided to serve as a procedural interface for user modules at this level. This module performs the mapping of data from the physical view of data to the internal view of the same. Any agency wishing to make its data known to the users at the

internal level defines the internal view, provides the read, write and write-nil-tuple procedures for mapping, and binds the same to the internal-database gate module.

At the logical schema level, a logical database utility is provided to perform mapping between the logical view of data and the internal view of data. It is at this level that the ordering information about the tuples is retained (key-mapping facility). Therefore, the requests such as “get the first tuple”, “delete the next tuple”, and so forth, can be serviced at this level.

At the highest level, the mapping between the external and the logical schemas is provided by the Table Editor. Also, a very powerful set of table-manipulation commands is implemented within the Table Editor. The “Formatter” is used to provide mapping between the external representation and the internal (or PROTEL) representation of data. Finally, there is the Data Dictionary module which supports a data dictionary embodying information about all the data types in the system.

### **I/O system software**

The DMS-100 Family I/O system software handles communication between all peripheral devices in the switch (such as, network modules, trunk modules, or tape drives) and software using those devices (call processing, maintenance, file system software). The I/O system is concerned only with the transmission of information between the CC and peripherals rather than with the information itself.

**CC to peripheral messages** – from time to time, some CC software sends an outgoing message to a device:

- 1 A call process telling a network module to establish a connection.
- 2 A Command Interpreter (CI) process sending a line of output to a terminal (through a device controller).
- 3 A maintenance subsystem requesting a trunk module to perform a self-diagnostic test.

The software in question composes the appropriate message and invokes the I/O system to transmit that message to a particular peripheral device referred to as a node. The I/O system selects a route to that node from its route-table, and then passes the message to a CMC, instructing it to send the message using the selected route.

If both CMCs are unavailable (when they are busy sending other messages), the output request is placed in a queue and the I/O system sends the message when a CMC becomes available.

The transmission across the CPU-CMC nodes is interrupt driven, that is, when the outgoing message buffer of a CMC is empty, it posts an interrupt for the CPU by setting an Outgoing Message Buffer Empty (OMBE) bit in a

four-bit interrupt register. The interrupt is handled by the CMC interrupt handler in the I/O system. The CMC interrupt handler would then release the next queued message into the outgoing message buffer of the CMC posting the interrupt.

From the CMC outwards, the transmission of messages between any two nodes is regulated by an appropriate “message protocol”. According to this message protocol, the sending node first of all transmits a control byte “May I Send” (MIS) to the receiving node. The latter responds to the sender’s MIS by sending it a control byte “SEND”. If received within a perspective time, the sender transmits the message followed by the checksum over all the bytes sent. The checksum is recalculated by the receiver and compared with the checksum actually received. If checksums agree, a Positive Acknowledgment (PACK) is returned to the sender, otherwise a Negative Acknowledgment (NACK) is sent back. The receipt of a first NACK by the sender results in it retrying the message. If a NACK is received a second time, the message is bounced back to the central control which would normally attempt to transmit using the other plane.

### **Peripheral to CC messages**

There are two occasions when the CC software will expect a message from a peripheral device:

- 1 a terminal controller informing a CI process that the output is completed
- 2 a trunk module reporting seizure on a trunk, or digits received on an incoming trunk, or results of a test.

The software in question informs the I/O system that it is expecting a message from a specific node. This is done by one of two methods:

- 1 supplying a procedure (an “input handler”) that the I/O system will call whenever it receives an incoming message
- 2 requesting that all incoming messages from the node be placed in SOS messages and sent to a particular mailbox.

When a CMC has an incoming message to pass to the CC, it once again posts an interrupt for the CPU by setting an Incoming Message Buffer Full (IMBF) bit in its interrupt register. The interrupt is once again handled by the CMC interrupt handler procedure in the I/O system:

- 1 Calls the input handler.
- 2 Places the message in a SOS mailbox .
- 3 Discards the message, if neither of the above alternatives was requested by the CC software

In addition to handling the transmission of incoming and outgoing messages, the I/O system performs six functions:

- 1 maintains node and link (communication paths between nodes) configurations
- 2 allocates message buffers
- 3 maintains available routes to each node
- 4 Handles message-transmission error reports generated by nodes. As part of a pre-specified message format, there is an error-byte reserved for recording any problems encountered by the message during its journey. The I/O system analyzes the error byte and invokes the appropriate maintenance subsystem to perform tests on the affected node/link.
- 5 times non first-time return-to-service attempts on nodes and links
- 6 audits node and link status, I/O routes, and CMC buffers

### **File system software**

Although the I/O system is very efficient, the processes using it must have their programs tailored to the requirements of the particular device they are talking to. For example, a process using the I/O system to read/write lines of text on a video display terminal would need considerable modification of its program if it had to read and write text on a magnetic tape. But quite often this is just what is required; it is necessary to switch its input or output between a number of different peripheral devices, for example, an error log program may be required either to send its output to a visual display unit or printer for immediate study, or to a magnetic tape or disk for later analysis.

To meet this requirement, the file system of SOS provides facilities that allow for the input and output of text or binary data on a wide range of computer peripherals such as visual display units, hard copy terminals, magnetic tapes, magnetic disks and line printers. Five operations are supported by the DMS-100 Family file system:

- 1 creating a new file on a specific device
- 2 opening an existing file
- 3 putting a record on a file
- 4 getting a record from a file
- 5 closing a previously opened file

The file system maintains information about all devices that are supported as well as all files in the system. As mentioned before, for each device the location of the physical file system procedure supporting it is kept. Each file has specific information in a file control block:

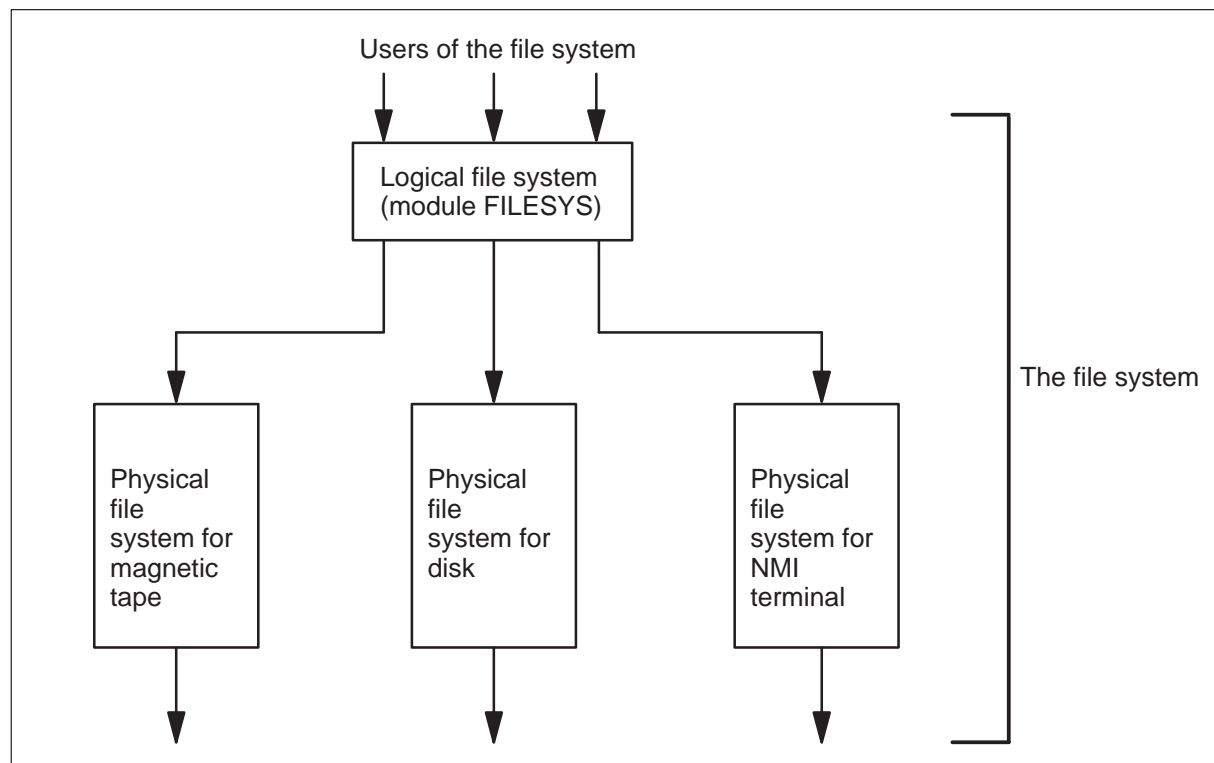
- 1 device type
- 2 file name
- 3 file ID

- 4 File Attributes
- 5 Access Attributes (specify whether access is sequential or random, and whether it is for reading or writing)

In addition to providing the ability to perform a file operation on any one of the devices supported, the structure of the file system allows for the addition of a new physical device to the system without having to make any changes to the logical physical system. The device dependent module for the new device is designed as an agency, compiled, linked and loaded into the switch. As soon as the new module is run, it calls on a special procedure in the gate (the logical file system), and passes it the addresses of the procedures for performing file operations on the new device. The logical file system records the new addresses in its table, and thereby enables itself to perform file operations on the newly added device.

The structure of the DMS-100 Family file system is shown in Figure 2-30. As shown, the file system is structured as a logical file system module that supports procedures for all the operations described above and which acts as a gate module to device dependant modules called the physical file system. The device dependent modules interact with the devices to perform the desired function.

**Figure 2-30**  
**Physical devices supported by the file system**



A file system operation required by a process is performed by calling a logical file system procedure and specifying the device or file ID as a parameter. Based on the device, an appropriate physical file system procedure is selected to perform the desired operation on the specified device.

Internally, the logical file system maintains a table of addresses of procedures in the various device dependent modules which it uses to select an appropriate physical file system procedure at run-time. These addresses are supplied to it by the device dependent modules at the time of their initialization.

### **Fault detection and system recovery**

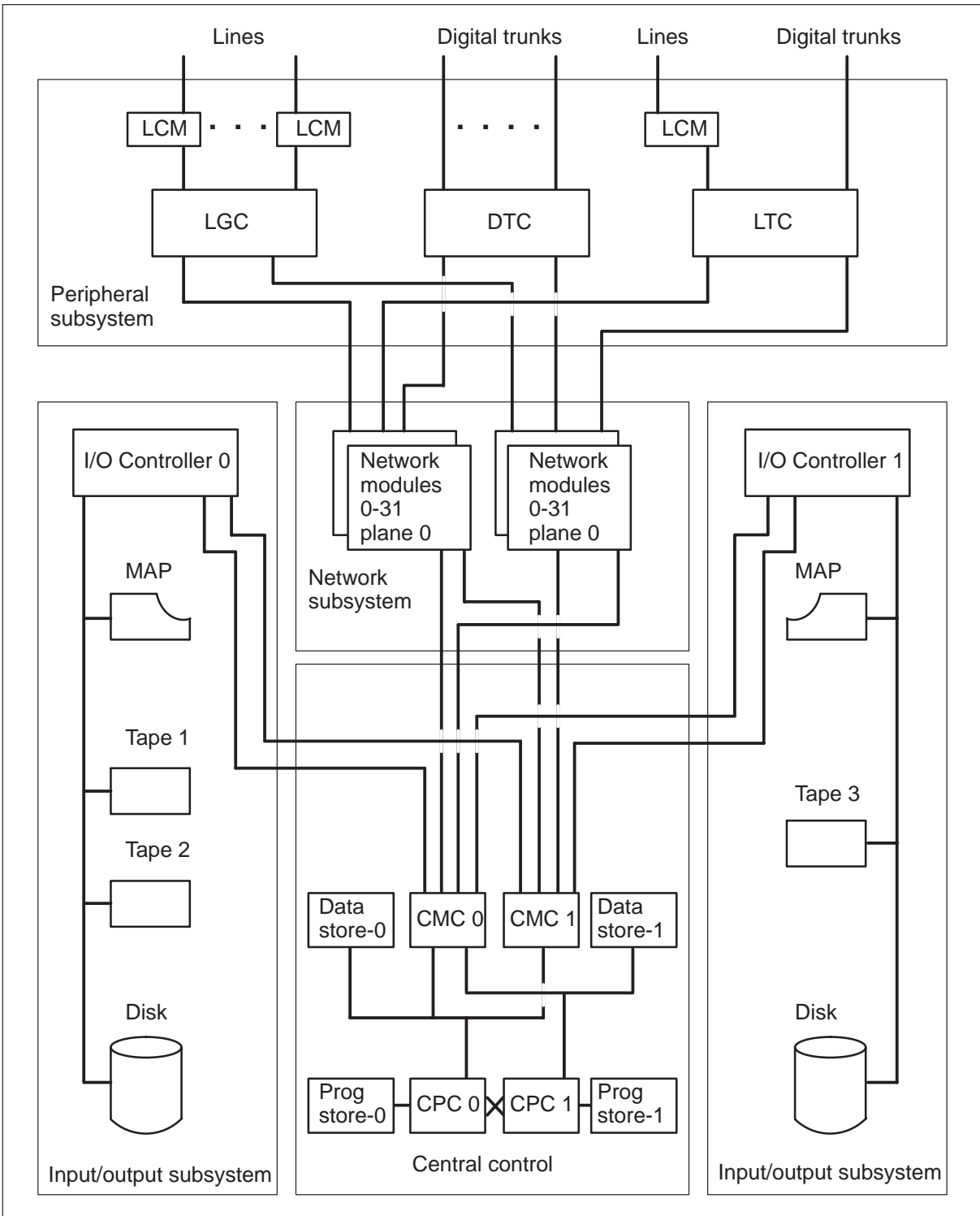
In order to carry the levels of traffic demanded of modern switching systems, the DMS-100 Family system employs an architecture that distributes the control functions for call processing to several control centers. To provide the reliability demanded of today's switching systems (working non-stop 24 hr. a day), these control centers are made of the most reliable components and arranged in a hierarchy with clearly defined responsibilities for fault detection and system recovery. Component redundancy has been applied to this structure in a selective, cost effective manner, both to the control centers themselves and the communication links between them, permitting faults in the system to be readily diagnosed.

### **The DMS-100 family components**

As shown in Figure 2-31, a DMS-100 NT40 system consists of four major subsystems:

- 1 central control (NT40)
- 2 switching network
- 3 input/output
- 4 peripheral modules

**Figure 2-31**  
**DMS-100 family (NT40) – major subsystems**



The Central Control (CC) has overall responsibility for the system sanity. Sanity of the CC itself is ensured by operating the duplicated CPUs in a matched mode; in this mode each CPU executes identical steps and compares its results with those of the other processor after every step. The CMCs operate in a load sharing mode and are checked for correct operation by the message protocol itself and by hardware and software mechanisms within the CPU.

The network subsystem, consisting of up to 32 network modules, is arranged in two identical planes to provide redundancy.

The peripheral module subsystem serves as the interface between the DMS-100 Family office and the lines and trunks served by the switch. The peripheral modules are connected to the network planes by a system of links that carry time multiplexed speech signals and control messages. The control message system enables the network and peripheral modules to carry out the central office switching functions as directed by the CC.

### **Redundancy**

In DMS-100 Family systems, the concept of redundancy has been applied in all major equipment areas: the CC, the network subsystems, and peripheral control sections have been fully duplicated. Redundant message paths between the modules have also been provided since faulty links would otherwise prevent the system from operating satisfactorily. Supporting this structure are hardware and software mechanisms (called the DMS-100 Family maintenance subsystems) that detect faults when they occur and manage the system reconfiguration and recovery.

Besides being fully duplicated, the modules in the CC contain numerous internal fault detection mechanisms to check every step of the CC's operation. The rest of the DMS-100 Family system depends on this secure control for reconfiguration and recovery from failures. Either of the duplicated network planes is capable of carrying the entire load of the switch in the event of a fault in one of them. Faults in the network switching matrix are detected by peripheral modules. The network message controllers are checked by both the peripheral modules and the CC.

The peripheral module control area is fully duplicated and functions in a "hot standby" mode of operation. Internal software mechanisms are used to detect faults. When a fault is detected in the control area of the peripheral (when the standby unit assumes control and becomes active) an activity switch is performed.

The fault tolerance of the control message system is achieved by providing redundant links. The message protocol automatically reroutes a message from a faulty link to a sound one when necessary. In addition, a unique



RESET message is provided to bring peripheral and network module controllers to a known initial state in the event of a failure.

### **Fault detection and management**

To manage the redundant topology of the overall system, each subsystem contains fault detection mechanisms to drive the software that reconfigures the system in the event of a failure. The CC uses matching between the processors and a trap system that detects faults independently in each processor. Each CPU matches its own results with those of its mate on the completion of each processor micro-cycle. Transmission of data port information between processors is provided by a mate communication bus carrying data with parity. For the matching operation to work, the two CPUs are tightly synchronized. Both processors select the same clock source, which ensures simultaneous completion of micro-cycles. In addition, each processor waits until the accesses to both stores have finished before proceeding to the next micro-cycle. This automatically takes into account delays introduced by asynchronous refreshing of the dynamic memories used in the stores.

If the matching logic in either processor detects a mismatch of results, it triggers a processor interrupt. This induces a branch to firmware that runs a self test sequence called a maze to check basic CPU operation. On successful completion of the maze, control is transferred from the firmware to software, which invokes the appropriate recovery procedures based on status information exchanged between the CPUs. This status is provided by a mate communication register and a Fault Indication Register (FIR), both of which can be read directly by the mate processor.

The fault indication register is a readout of the trap circuits that operate independently in each processor. These trap circuits detect faults attributable to parity, address range violations, op-code validity, timeouts, and so forth, and set flags in the FIR upon the detection of any such faults. A setting of any of the flags causes what is known as a trap-level interrupt and simultaneous capture of the addresses on both the program and data ports to aid fault diagnosis. Hardware faults that normally generate both mismatch and trap interrupts are handled by the mismatch mechanism. In matched operation, a trap interrupt generated without an accompanying mismatch interrupt indicates a software fault. Trap level processing is handled primarily by software that attempts to minimize the effect of the fault on overall system operation.

In addition to the fault tolerant facilities provided in the CPU, several features under software control are incorporated in the memory module to enhance memory integrity and fault tolerance. For example, the memory is subdivided into 16 kb blocks, each protected by a bit contained in a write-protect register within the memory controller. This bit acts as a key to each block and is accessible only to certain system operating procedures.

Because the memories contain the majority of the central control circuit packs, each CC memory module includes an extra memory card. This card may be configured by software to respond to the address space of any of the other cards in the module. With this technique a faulty memory module is automatically restored to operation by isolating the faulty card from the system and switching in the spare. The new memory card is updated from the mate's memory and the CC returns to matched operation.

The CMCs, like the CPUs and memories, are duplicated, but unlike the CPUs, they operate in a load-sharing mode and use fault detection techniques based on internally housed circuits. These monitor circuits consist mainly of timers and other logical checks to ensure that the protocol on each message is correctly followed. The detection of a fault sets flags in a register similar to the CPUs fault indicator registers and causes an interrupt to the CPUs.

Although redundant paths are available between the CC and any peripheral module, messages are sent on one route at a time. Should a failure occur, another route is tried only after the first attempt is completed and declared a failure. In order to ensure that all paths are exercised, the message routing software has a choice of two different routes to each node which are calculated to include all links and intermediate (that is, network) modules in the system. Furthermore, each module in the system has sufficient intelligence to determine whether a message sent to it obeys the protocol. If it doesn't, the module closes the port over which the message arrived. This action is taken on the assumption that the sending module developed a fault. The CC can diagnose the problem and still communicate with the module through the other good link.

### **Variations**

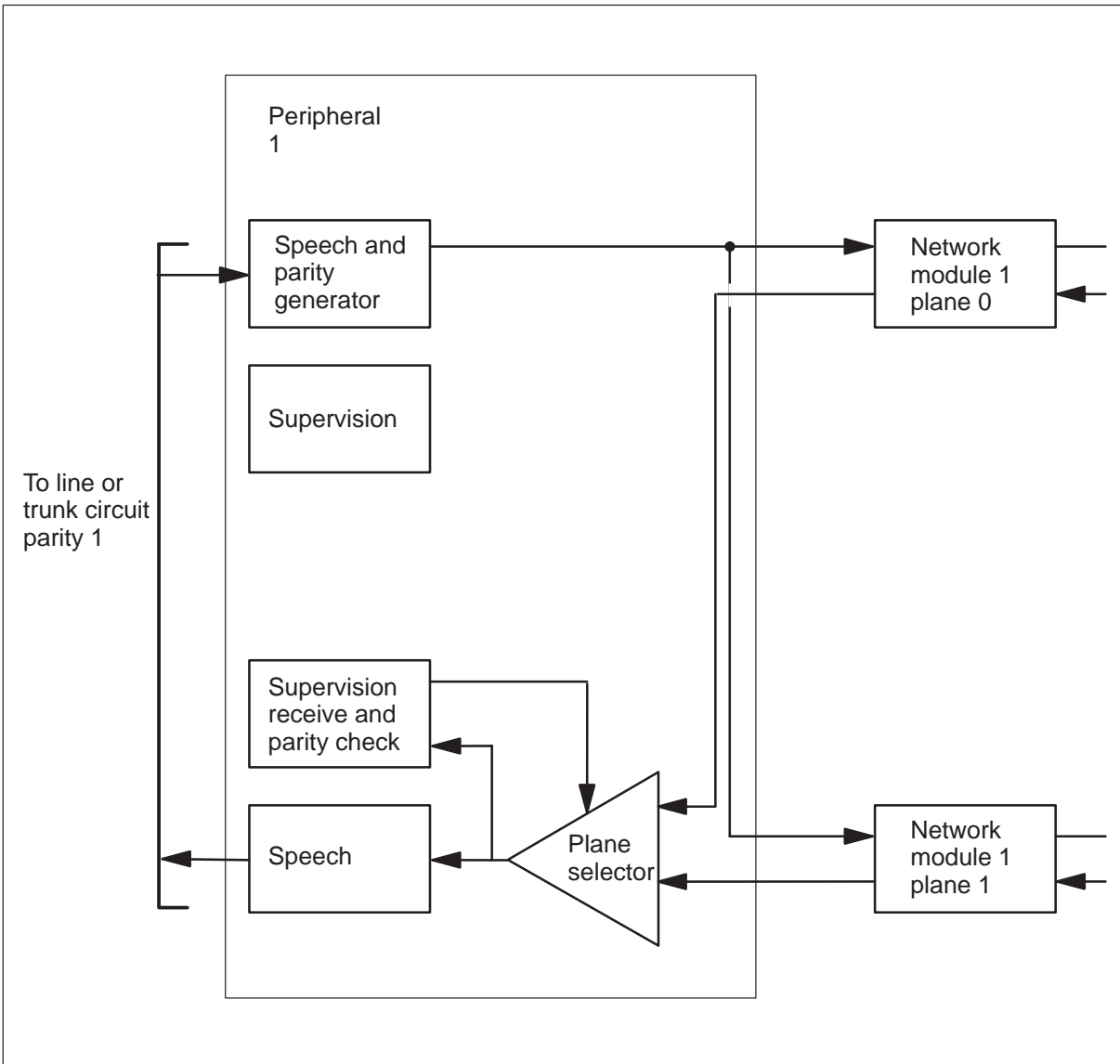
A variation of this link control strategy is required between the CMCs and CPUs. Although the two CPUs operate synchronously and therefore appear to the rest of the system as a single entity, only one CPU at a time is designated "active" and can actually send messages to the CMCs and hence to the system. Both CPUs always receive messages from the system. This mechanism of "activity" prevents an "insane" processor from corrupting the rest of the system by sending nonsense messages to it. An active processor is also capable of resetting its inactive mate when required. The activity state is determined by a single flip-flop that is cross-coupled between the CPUs; it is designed with a minimum of circuitry in order to reduce its own probability of failure. To facilitate system maintenance, a processor can manually be forced into the inactive state, provided that its mate is fault-free.

To ensure integrity of the communication between the CC and the operator environment, the I/O controllers use two fault detection mechanisms. One is the message system protocol, and the other is a system of self checks incorporated in the I/O and device controller firmware. It is possible that I/O

devices of a similar type may be assigned different functions. Should one fail, its function may be reassigned to another similar device. This can be done either automatically or manually, depending on the importance of its function. For example, toll billing tapes may be reassigned by software, certain display terminals may not.

The interdependence of network and peripheral fault detection mechanisms is shown in Figure 2-32, which identifies the modules associated with every call. The fault detection mechanism between modules is included in the data format of the speech links. Two additional bits appended to each 8-bit speech sample are assigned to channel supervision messages and parity. Although they provide fault coverage of link and network speech paths, they are generated and checked in the peripheral modules.

**Figure 2-32**  
**Network and peripheral fault detection**



As shown in Figure 2-32 the network planes are duplicated to facilitate fault recovery; outputs from both planes appear at each peripheral. Conversely, each peripheral feeds both planes simultaneously with the same signal. In the event of a fault in one of the network planes, the peripheral module that detects the fault simply elects to receive the call from the corresponding network module in the other plane.

Providing network plane selection on a per call basis offers a significant increase in the resilience of the system to multiple faults. Distributing the fault detection mechanisms to all the peripheral modules provides smooth

recovery from simple but far-reaching faults such as network power failures. A network module can support approximately 1900 calls at any one time, but if that module fails, each of the several peripheral modules connected to it is required to recover only their own calls. Operating independently, these peripheral modules reconfigure the system to use the remaining good network plane for the calls that require it. (It is the simultaneous transmission of speech and supervision signals on both planes that allow this reconfiguration of each call path). Once the reconfiguration has been accomplished and service restored, the peripheral modules then report the problem to the CC for maintenance.

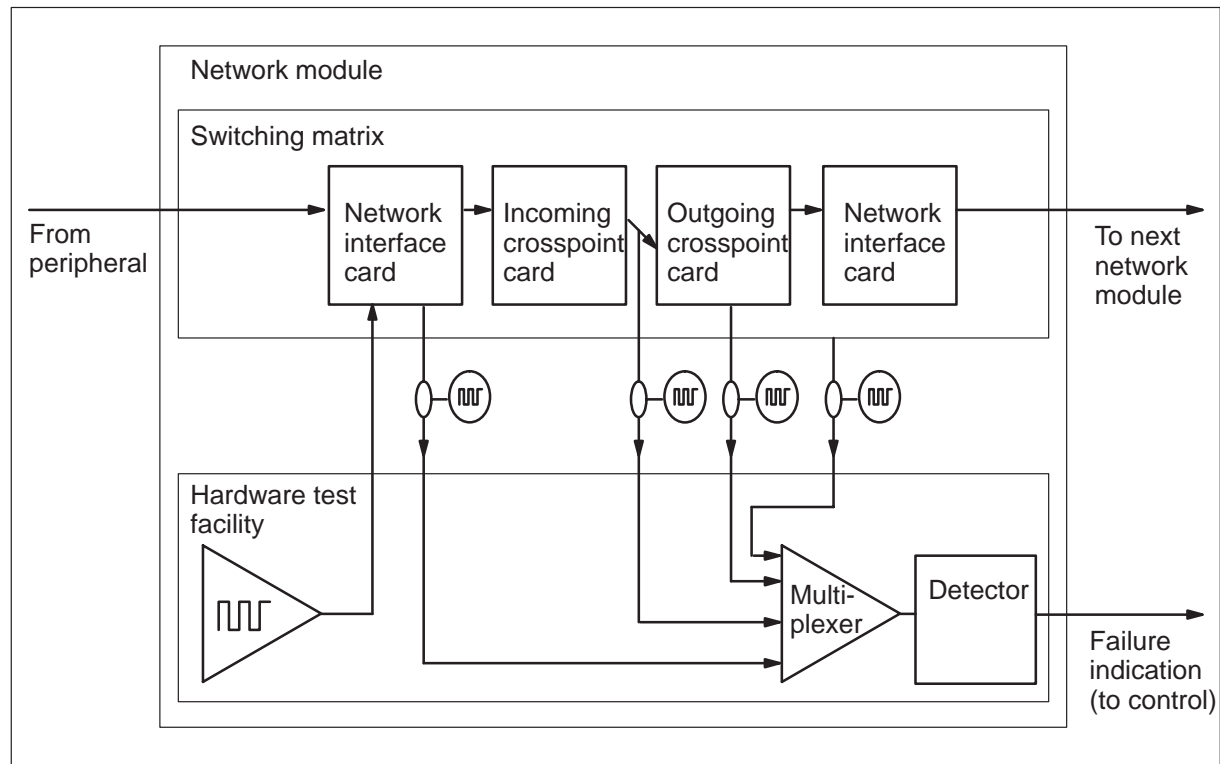
If any call encounters a failure in the second network plane, the peripheral that detected the failure would not switch back to the first plane. Instead, it would inform the CC call processing software that the path initially specified for the call could not be sustained.

In addition to detecting network faults, the parity and supervision mechanisms are also used to detect faults in links and in the peripheral modules themselves. In these instances it is the other peripheral associated with a call that reports a difficulty to the CC, which then takes appropriate action.

As well as relying on other modules for fault detection, every network and peripheral module includes basic fault detection and location mechanisms unique to itself. For example, all modules contain sanity timers, which are continually reset by correct cyclical operation of the controller. Should the controller software enter a tight loop for any reason, the timer expires and causes the controller to enter a reset state. This state is detected by the next module upstream towards the CC, which informs the central control of the reset condition. These sanity timers ensure that faulty peripheral and network modules can never become blind to messages arriving from the CC.

The fact that the peripheral and network controllers reside in a small number of circuit packs inherently simplifies the location of faults. In the network subsystem up to eight circuit packs may be involved in the speech path of a call, four in each module as shown in Figure 2-33. Faults detected during a call by the parity or supervision mechanisms can be pinpointed by a system-generated test code. This code is automatically inserted into the speech path and monitored at certain strategic points. An absent or incorrect code at any point identifies the fault location.

**Figure 2-33**  
**Network fault detection**



Should a peripheral module detect a fault on a speech path, internal tests to determine the location of the fault are conducted in each of the two network modules involved. A hardware facility built into each network module inserts a test code into the speech path in front of the network interface card, and monitors the signal after it passes through each of the four module cards involved. In this way a faulty card can be identified for subsequent repair.

### Message system integrity

The procedures to diagnose fault conditions and effect system recovery reside primarily in the CC. Between the CC and other subsystems redundant paths have been provided; each is equipped with a protocol that can manage fault detection and recovery within the message system itself.

The message protocol is designed to detect transmission and equipment failures and to permit the rerouting of messages around a failed module or link. Prior to transferring the message itself, the sender of the message initiates a handshake to ensure the receiver is in a condition to receive the message. On confirming that the receiver is ready, the sender forwards the message, which includes a checksum over the data and header fields. The receiver verifies the checksum and if it is incorrect, requests a re-transmission by returning a negative acknowledgement of the message. If

the second transmission attempt also fails, or if the receiver could not accept the message in the first place, the sender autonomously tries another route. If one is unavailable the sender sets an error byte in the message header and returns the message to the module from which it came.

### **System re-initialization**

System re-initialization or restarts are initiated whenever the internal checks built into the DMS-100 Family central control hardware and software determine that the system is behaving abnormally. These checks are extensive in nature and serve to maintain or restore a stable call processing environment. Six activities can cause system restarts:

- 1 traps in critical system programs
- 2 death of critical system process(es)
- 3 sanity time-out
- 4 operating system process queue empty
- 5 call data block queue corrupt
- 6 call condense block states inconsistent.

There are three types of system restarts:

- 1 Warm restart – the first level of restart and is entered for the less severe detected abnormalities. Calls being processed are cleared but existing connected calls are retained. Data such as network connection maps, billing data, and error logs are retained.
- 2 Cold restart – this level of restart is entered directly if the system detects an abnormality of a severe nature, or is entered after a second warm restart has failed to resume normal system operation within a three minute time interval. The second warm restart is initiated whenever the first fails to establish normal system operation, again within a three minute time interval. As with a warm restart, calls being processed are lost. In addition, since network connection maps are cleared and both lines and trunks are set to the idle state in Central Control on a cold restart, established calls may be disconnected due to the reuse of network paths or reuse of terminals as terminators in new calls before original calls disconnect. LOG system and AMA billing records are retained.
- 3 Reload restart – this re-initialization is used after a reload of an office image tape and can be either manually initiated or caused by an auto-reload. Office configuration and translation data are overwritten by the office image tape data. All dynamic data including error logs are cleared.

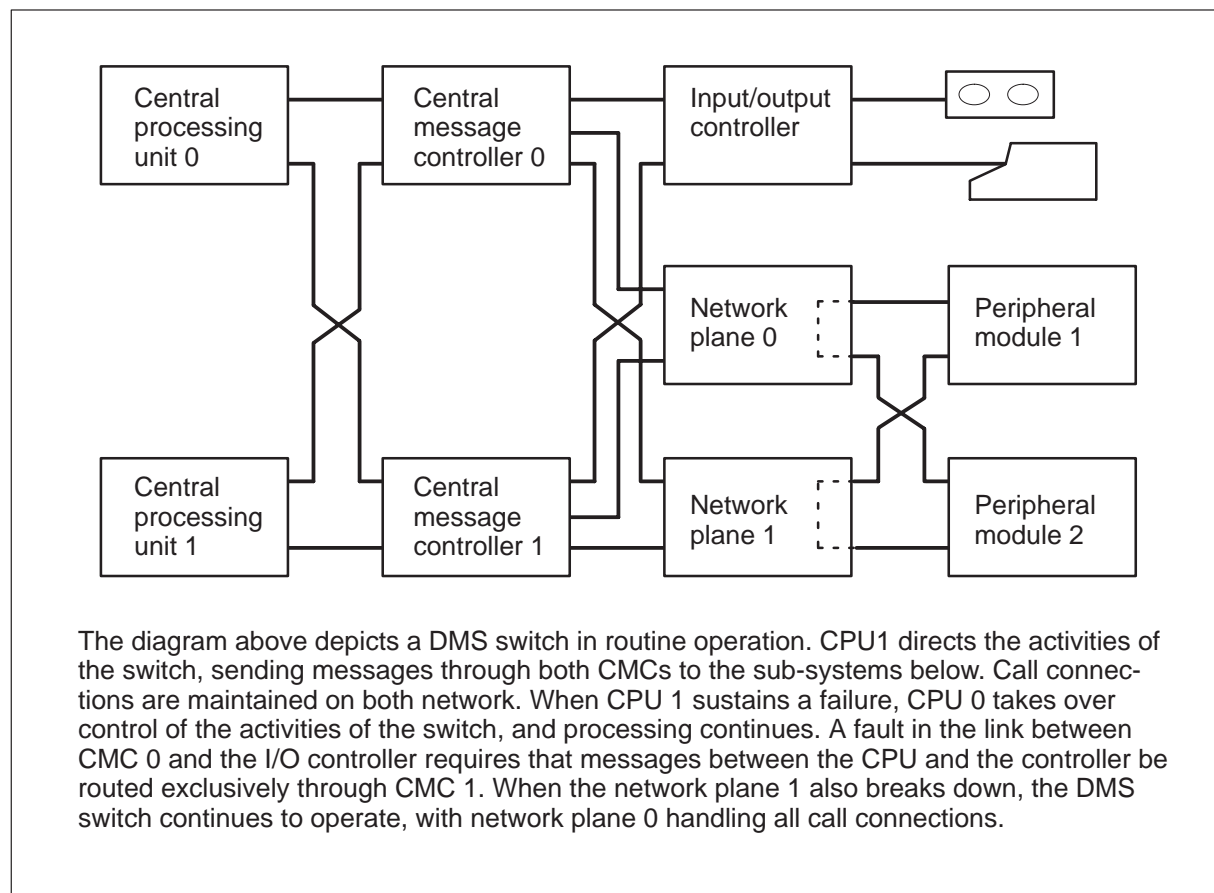
### Examples of system recovery

To illustrate the procedure of tracing a fault and re-configuring the system as necessary, a sequence of faults will now be applied to the simplified version shown in Figure 2-34. When a fault occurs, five basic steps are executed:

- 1 detection of the fault
- 2 reconfiguration to avoid use of the faulty element
- 3 diagnosis of the fault to a replaceable unit
- 4 replacement of the faulty unit
- 5 return of the previously faulty element to service

Throughout these events, normal system functions must continue unaffected.

**Figure 2-34**  
Example of system recovery (NT40)



The first fault considered is a failure in the arithmetic unit of CPU 1, the active processor in this example. The fault is detected by the matching logic between the two processors and this generates a mismatch interrupt when the faulty hardware is used. The two CPUs then automatically run through a



maze sequence located in microstore. CPU 0 successfully completes the maze, but CPU 1 fails and enters a firmware loop.

After completing the maze, CPU 0 attempts to communicate with CPU 1 but fails because CPU 1 is held in its loop. The activity switch timer that started when the mismatch occurred will time-out and force CPU 0 into the active state. Information for fault diagnosis is stored for subsequent action and switching control is returned to the interrupted software routine now running only in CPU 0.

Diagnosis is performed by a operating company personnel using the MAP to generate a circuit pack replacement list. Using this list, the faulty CPU is repaired and returned to service by MAP commands that re-synchronize the CC.

Link faults manifest themselves in various ways such as message time-outs, invalid control bytes and bad checksums. For this example (refer to Figure 2-34) a time-out waiting for a message handshake occurs on an incoming message. The I/O controller closes the link so that messages are no longer routed over it and then sets an error indication in the message that it sends over the alternate link.

When the message arrives at the CC, the appropriate maintenance software is informed of the link failure. It removes the link from service and informs the I/O routing software that this link is no longer usable. In addition, the CMC is told to stop scanning the link for incoming messages. Communication with the I/O controller and devices must now use the alternate link.

Immediately, and periodically thereafter, the CC tests the out-of-service link to see whether it can be returned to service. The CC begins this test by placing the link in a restricted maintenance state that allows only maintenance traffic to pass over the link. The test is then carried out by priming the I/O controller and CMC link control functions to accept such maintenance message. Proper setting of the route bits now ensures that the message travels over the link and be looped back by the receiving controller. The normal routing algorithms and automatic rerouting features of the system are therefore bypassed in this test. If such a test passes, the CMC, I/O controller, and operating system are informed that the link is again available for normal message traffic. In this fashion the system recovers from transient fault conditions.

If the fault is hard, the system will not be able to return the link to service and maintenance personnel informed through the MAP of the fault. Using MAP facilities, they identify and replace the faulty component and return it to service. Normal operations of the switch are unaffected by either the failure or the repair action.

With both a CPU and a CMC-1 I/O controller link out of service as shown in Figure 2-34, assume a connection memory failure in a network module occurs. As noted earlier, network connections are established in both planes but the peripheral modules select only one plane from which to receive the speech samples. Typically half the calls in progress are arbitrarily completed through the even plane and the remainder through the odd plane. When the connection memory failure occurs, the peripheral module detects the loss of the speech path by the message interruption on the supervision channel associated with the call. The peripheral immediately selects the other plane to receive speech for that call and generates a maintenance message to the CC, indicating the channel and link that are experiencing the problem. The call is sustained in the opposite plane and the subscriber remains unaware of the fault. When the fault message arrives in the CC, information on the bad connection is frozen in software, so that even if the call is disconnected, the connection can be diagnosed. The diagnosis is performed, using the test code mechanism previously described, to pin down the fault to a subsection of the network planes or interconnections.

Upon confirmation of the memory fault, the network module must be removed from service. All new calls are connected through the good plane and the message system is reconfigured accordingly.

The CC accomplishes this by updating the routing information, closing the CMC links to the affected network module and closing the peripheral links originating in that network module. At this point the detection and reconfiguration process is complete. The repair and return to service steps are again accomplished using the MAP. The same test procedures used in diagnosing the original problem are used to verify the repair. These examples demonstrate the ability of the DMS-100 Family switch to remain in operation during a period of major component faults.

## Audits

All major call processing resources are audited by the Call Processing Resource Audit Process. This process is a child process of the Call Processing Audit Daddy Process.

The Call Processing Resource Audit Process audits all queues of Call Condensed Blocks (CCB), Call Data Blocks (CDB), Expanded Call Condensed Blocks (ECCB), cpleters, and extension blocks. If a queue is found to be corrupt, one of the following two results occurs:

- 1 In the case of cpleters, extension blocks or ECCBs, the queue is rebuilt.
- 2 In the case of CCBs or SDBs, a warm restart is caused.

The call processing audit process also performs the following functions:

- 1 States of CCBs and contents of Terminal State Words (TSW) are checked for consistency. If errors are found, corrective action is taken if possible, and the errors are logged.
- 2 Any terminals whose origination messages have not been processed due to overload conditions are returned to the idle state.
- 3 Call processes stuck in a stopped state are re-created.
- 4 Calls that are condensed, on a ready queue, or suspended with no terminals linked are destroyed.
- 5 If the state of a **CCB** is **onreadyq1** or **onreadyq2** and the CCB is not on the appropriate ready queue, the call associated with the **CCB** is destroyed.
- 6 Any cpleters that are not attached to a **CCB** or on the *availcpleters* queue are returned to the *availcpleters* queue.

### Call processing agent audits

Call processing agents, such as trunks, lines and conference circuits, are audited by two other child processes of the Call Processing Audit Daddy process. These processes are the Call Processing Audit process and the Call Processing Audit Driver Child Process. Both of these processes run at the scheduler class, **nqbkclass**, at an interval determined by an office parameter called, **AUDIT\_INTERVAL**. Each type of agent that requires an audit provides its own audit procedure to be invoked by the Call Processing Audit Driver Child Process.

Receivers are also audited by two special processes:

- 1 The High-Frequency System Audit Process runs at scheduler class **nqbkclass** at an interval determined by the office parameter, **AUDIT\_INTERVAL**. This process invokes procedure **rcvr\_audit** to audit receiver states and queues. The High-Frequency System Audit Process is a child process of the System Audit Daddy Process.
- 2 The Receiver Fault Audit Process recovers receivers in the inconsistent states (for example, a receiver that was not released when a call was disconnected). This process runs at scheduler class **system6**, delaying for 30 sec after executing for two ticks. The Receiver Fault Audit Process is a child process of the General Daddy Process.

### Call processing resource audits

The Call Processing Resource Audit process runs at scheduler class **System 0**; it does not run when processes in other scheduler classes are running.

The maintenance software looks for and diagnoses the causes of hardware faults. If a failure is found, tasks are re-routed to compensate for failed equipment. Also, the maintenance software makes it possible to test,

reconfigure, and add or remove equipment from the DMS-100 Family System with little or no disruption of service. The “audit software”, on the other hand, detects and corrects the effects of software errors.

The state or condition of each of the DMS-100 Family hardware resources (memory, central message controller, or trunk modules) is represented by software data structures. In addition, there are data structures that do not directly represent hardware resources but are software resources in their own right. For example, the message passing system of the operating system employs data structures to represent mailboxes and letters.

In any software system the size of the DMS-100 Family, which contains several hundred thousand lines of PROTEL source code, some software errors may remain even after an extensive testing process. Sometimes discrepancies will arise between the actual state of a hardware resource and the state represented by its corresponding software data structure. Internal inconsistencies can also develop in independent software data structures such as mailboxes. These discrepancies can arise, for example, because of unforeseen dependencies in initialization sequences, because of inadequate checking for software error conditions (such as ignoring a return code after sending a message to process), and because of unforeseen or subtle hardware failure modes. In general, these errors can cause the gradual deterioration, or even the loss, of some of these software data structures and this will eventually affect the performance of the switching system. A software data structure that has deteriorated may become unable to represent the state of a hardware resource; in such a situation it could, for example, show a network speech channel as in use when in fact it is not. Independent software data structures, such as mailboxes, may simply become unavailable for use.

In conventional computer systems this situation is normally dealt with by a periodic restart or by reloading the computer, usually at least once a day. In telephony, however, this is not acceptable, and the DMS-100 Family audit software is used to make periodic checks on the data structures for integrity, reasonableness and, where appropriate, to see that they match the actual hardware states that they are meant to represent. Usually any discrepancy is logged and where possible, corrected. Where there are very serious, unrecoverable discrepancies the office alarm may be sounded. In extreme situations maintenance may cause a system restart and may eventually lead to reload of the system from tape.

There are four levels of audits:

- 1 audits of telephony equipment such as trunks, lines, DTMF receivers, and MF receivers
- 2 audits of call processing software resources: data structures that chart the progress of individual calls

- 3 audits of operating system software resources: mailboxes, letters, and memory
- 4 call completion audits.

### **Example of an audit in DMS-100 family systems**

The first three levels of audit—audits of telephony equipment, call processing software, and operating system software—check the correct operation or condition of the corresponding software data structures. The audit for MF receivers (a first level audit) illustrates the general principles of these audits.

Every few minutes the audit for MF receivers is invoked and applies a series of tests. For example, all receivers of a given type that are in the idle state ought to be on a queue of idle receivers. Thus a data structure describing the state of one receiver is checked to ensure that if that data structure represents the idle state it is also linked to the idle queue. Other audits are based on the idea of reasonableness. For example, if a receiver has been recorded as continuously busy (that is, associated with the same call) for more than a given amount of time, it is assumed that this is an error and the receiver is recovered, marked idle, and put back on the idle queue.

In addition to the test applied to individual receivers, there are also tests on groups of receivers. The queues of idle receivers are represented by linked lists. These lists are checked for integrity by following the whole queue to look for loops or breaks, and then checking to see whether each member in the list should really be in the list. If a defect in the queue is found, then the audit takes recovery action by rebuilding the whole queue.

In spite of the many levels of checking in individual parts of the system, there may still be undetected faults that prevent the correct operation of call processing. Because of this the call completion audit was designed. For this audit a crude “goodness” measure is constructed, based on the ratio of the number of calls successfully completed to the number of calls originated.

The numerical value of this ratio (maximum 100 percent), which is recomputed every few minutes, is tracked over several cycles. If it falls below a certain threshold an office minor alarm is sounded and a message is sent to the log. If it falls below a lower (critical) threshold an office major alarm is sounded. If this happens on several consecutive cycles a critical alarm is sounded and the system is automatically restarted.

### **Monitoring call processing activity**

Two useful monitoring tools are available through the MAP: levels CPSYS and ACTIVITY.

CPSYS displays the following information:

- 1 number of CCPs in use

- 2 number of call processes in use
- 3 total number of extension blocks in use
- 4 number of cletters in use
- 5 number of ECCBs in use
- 6 number of calls in each call state

ACTIVITY displays the following information:

System status as displayed at the MTC MAP level, consisting of the alarm and fault status for each maintenance subsystem (for example, control component, messaging component, NMs, PMs) at traffic levels which include these:

- 1 calls per hour
- 2 numbers of line and trunk originations during the sample period (1 min.)
- 3 call completion rate
- 4 percentage of calls terminating on tone or announcement

CPU occupancy, as distributed over the following:

- 1 call processing and I/O interrupt handling
- 2 scheduler processing
- 3 foreground processing (scheduler classes **system6** and **system7**)
- 4 maintenance processing (scheduler class **maintclass**)
- 5 non-guaranteed background processing (scheduler classes **system0**, **ngbkgclass**, and **defbkgclass**)
- 6 preferred background processing (scheduler classes **gbkgclass**, **gomclass**, **ngomclass**, and **nosftclass**)

Grade of service, which includes measurements of average and maximum delays for calls waiting on origination and progress queues, and for background processes waiting on the scheduler queues.

Round-trip messaging delays from the control component to a PM and back to the control component.

## Tasks

A task is defined by the syntax of the XPM PASCAL language and contains a body of code. A task program in execution; execution of a task starts at the beginning of the task body.

XPM PASCAL supports concurrences at the language level. the language allows the designer to define task types and to initiate multiple instances of these task types. This arrangement may be thought of as many machines executing the same sequence of instructions. In reality, there is only one

machine; its time is divided among the several running tasks by a task scheduler.

A task consists of several data structures:

- 1 The Task Control Block (TCB) contains a variety of information used by RTSS to control a task. The TCB contains:
  - data that defines the state of the task
  - control information.

The data that specifies the state of the task defines what the task was doing when it was last running. The data contains enough details to let the task resume execution when it is rescheduled. For example, this data would include a copy of machine registers, such as the instruction counter and the status register.

Task control information includes the following elements:

- task ID
  - priority of the task
  - pointers to link the TCB onto the scheduling queues
  - pointers to link the TCB onto a queue while waiting on events.
- 2 The Stack Heap (STEAP) allocates the memory for the task.
  - 3 The Stack evaluates expressions, allocates local variables and stores procedure return information.

Some hardware registers are used to access the procedure code, as well as the STEAP and Stack. These registers are unique and refer only to the currently running task.

The Inter-Process Communication (IPC) system provides a means of communicating between tasks.

### **Task creation and initialization**

A task is created by the INITIATE statement, which specifies:

- 1 the amount of task space required for the Stack and STEAP
- 2 the priority of the task for scheduling purposes

RTSS allocates a Task Control Block (TCB), assigns a task ID, allocates a task space (which includes a STEAP and a Stack), and places the TCB on the scheduling queue. By convention, most tasks in the XPMs are created in the initialization procedures.



### Task scheduling

Although it appears that there are several tasks executing concurrently on the XPM, there is in fact only one task executing at any given time. The processor time (for the SP and MP) is divided among several running tasks by a scheduler. The scheduler performs the following operations:

- 1 It decides which task to execute next.
- 2 It allocates processor time among the task that are waiting to be executed.
- 3 It provides task synchronization.

Because there may be many tasks competing for processor time, the scheduler uses a priority system to establish which task should have access to the processor next. Each task is assigned a priority when it is created. Tasks are assigned a priority from one to seven, with seven being the highest priority.

### Timer task

There is a TIMER task in both the SP and MP. The TIMER task is the only priority seven (the highest priority) task. A level three interrupt occurs every 10 milliseconds. The clock interrupt handler is located in RTSS. This interrupt handler performs the following functions:

- 1 It increments the internal clock. The clock kept as a number of ticks. It should be noted that an XPM clock tick (10 ms) is not the same as the control component clock tick (6.25 ms).
- 2 It checks the delay queues. A task can delay itself for a specified period of time.
- 3 It makes the TIMER task ready to run.
- 4 It invokes the scheduler, which is part of RTSS. Since the TIMER task is the only task at priority seven.

Application software that must run every 10 ms binds in procedure variables to the TIMER task at initialization time. The following are examples of application software that are bound in:

- 1 procedures to check the IPC queues
- 2 procedures to check the other processor (SP or MP) to see whether it requested an activity switch or a restart by setting flags in **mod\_com\_area**
- 3 MSR procedures
- 4 scanning of links from P-side nodes for incoming messages

There are two priority levels for procedures in the TIMER task:

- 1 critical procedures that always run



2 non-critical procedures that run if there is time

When the TIMER task is finished, it suspends itself. As a result, it is not run again until the next clock interrupt occurs.

## Scheduler

The scheduler is a mechanism for sharing the CPU among the various processes running on the machine. Each process is assigned a priority, an integer from zero to seven which indicates the relative importance of that process. Processes performing more important tasks such as call processing are assigned a higher priority and will be scheduled in preference to lower priority processes when a number of processes are found to be ready-to-run at the same time. For example, call processes run at priority-level five, and the CI processes controlling manual administration function, usually runs at priority-level two. When a process becomes ready it is entered at the tail of the queue corresponding to its priority. Whenever the scheduler is invoked, the process that is selected to run is at the head of the highest priority non-empty scheduling queue.

In order to avoid the lower priority processes being “locked out” under heavy load conditions, the processes are divided into two classes:

- The call processing and foreground processes (priorities five, six, and seven) which are assigned 90 percent of the scheduled CPU time.
- The background processes (priorities zero, one, two, three and four) which are assigned 10 percent of the scheduled CPU time.

The scheduler is invoked under one of three circumstances:

- The currently running process is suspended. This is the case when it must wait for something to happen, for example, the process for handling logons from users will suspend, and wait for the next login or logout action.
- The time slice of the currently running process is expired.
- A higher priority process has become ready-to-run.

On invocation, the scheduler performs three functions:

- saves some information about the process which has just been running
- selects which process to run next
- retrieves information about the process to be run and passes control to that process

## Timer

The timer is based on the CPU clock and is invoked every clock tick (6.25 ms). It is used to time running and suspended processes. The currently running process is timed by decrementing its time slice value every clock tick. When this value reaches zero, the process is placed at the end of its priority queue and the scheduler is invoked.

Timed processes, those waiting for a certain time interval to expire, are placed in a timer queue. The timer queues are examined every two clock

ticks for any processes that need to be woken up. If any such processes are found, they are placed in the appropriate scheduling queues.

### **The wake-up subsystem**

This part of SOS software gives processes the ability to detect the occurrence of a particular date and/or time, or to detect any changes to the date and/or time. A process does this by posting a wakeup or time-date change request with the wakeup subsystem. When the desired event occurs a message is sent to the process. A good example of the use of the wake-up system is an audit process wishing to wake up at a certain time and perform routine maintenance on part of the system or facility hardware.

### **Bootstrap loader**

The bootstrap loader is implemented in microcode and permanently located in the ROM card of the CPU. It is used to autonomously load program and data store from a bootstrap input device, for example, a magnetic tape.

Bootstrapping a DMS-100 Family office can occur in one of three modes:

- dead office
- active controlled
- autoloader mode

All three modes share the same set of firmware.

The dead office mode is used to load a non-functioning office. Operating company personnel activate the loader by means of manual control switches located on the CPU, for example, the thumbwheel, DACT and RESET. Progress reports identifying stages of initialization, such as, error codes and load completion, are made via the two-digit display also located on the CPU.

The active controlled mode is used in a normally functioning office. The active Central Control (CC) can process calls and, at the same time, control the bootstrap loader in the offline CC. The controlling and reporting procedures are implemented in the high level language PROTEL, and are resident in PS. Manual controls by operating company personnel and loader activity reports are via the normal office I/O facilities, for example, a designated MAP or teleprinter. One use of this mode is to load a new generic program into the offline CC while the active CC continues to run the office with the old generic.

The autoloader mode is similar to the dead office mode except that it is activated automatically when the system has made three attempts to switch machine activity and resume normal operation and all have proved unsuccessful. When activated, the autoloader proceeds to load the contents of an office image tape into PS and DS without manual intervention. This mode is particularly useful when an office is unattended.

### **Growth capability**

The DMS-100 Family software has been designed into well defined building blocks called modules. These modules include all the programs necessary for an operational system. In addition, provision is made for a group of optional modules containing the code and data necessary for implementing feature-dependent functions. This modular design not only produces a reliable product, but also provides flexibility for future growth to accommodate new features.

### **DMS-100 family peripheral software**

The DMS-100 Family system has been designed as a distributed system where the various peripherals perform the time consuming repetitive tasks (scanning and supervision of trunks, etc.) under the control of the main CPU. To provide a uniform vehicle for control of activities within peripheral modules, each peripheral module contains a simulated computer, the Telephony Peripheral Virtual Machine (TPVM). The architecture of this simulated computer and its instruction set provide a flexible, high level mode of control of telephone calls and other tasks carried out in peripheral modules.

Central control communicates with peripheral modules through messages. The messages from central control contain programs written in TPVM language identify the terminal on which the program is to be executed. The incoming messages to central control, on the other hand, are generally reports of events (for example, trunk seizure, digits dialed, integrity failure). A number of advantages are derived from the TPVM approach to DMS-100 Family software. A fairly important one is the containment of effect of change on software. A new feature will usually require only additions to software resident in central control; redesign of a peripheral module or the interface to take advantage of new technology will affect only software resident in the peripheral module.

### **Telephony peripheral virtual machine (TPVM)**

The TPVM provides the interface between the peripheral module and central control. Its architecture includes a stack processor with an instruction set that offers high level control of telephony peripherals. The instructions (or primitives) of a TPVM instruction set can be grouped into six major categories:

- stack
- communication
- terminal control
- call control
- maintenance
- exec

The stack instructions provide a means for performing logical and arithmetic operations on data in the stack and for moving data from a stack to other data areas of TPVM.

The communication instructions are used to compose messages and dispatch them to central control. These instructions also control the generation of messages to other peripheral modules over the supervision message channel, the reception of messages from other peripheral modules, and actions initiated upon reception of such messages.

Terminal control instructions control the hardware that connects the telephone lines and trunks to the switch. A high level mode of control is employed, which means that central control does not have to be concerned with the details of terminal control.

The call control instructions generally initiate control of a phase of a telephone call, for example, digit reception, or supervision of a talking connection. The maintenance instructions provide the means for maintenance of trunk interfaces, peripheral module hardware, and its interfaces to the DMS-100 Family network.

The “execs” are short TPVM programs stored directly in the peripheral module memory and can be called up as needed. For example, they can be invoked directly by central control messages or called up after the occurrence of certain call events in terminals to initiate needed action. The TPVM contains instructions to define and invoke these execs.

The TPVM instruction set is designed to optimize some of the conflicting tradeoffs in the design of peripheral modules, for instance, the need to minimize peripheral module memory while carrying a substantial part of call processing load, or the need to be flexible while attaining a high level of abstraction (that is, protecting central control from the need to concern itself with call details).

The software that implements a TPVM in a peripheral module is stored in Random Access Memory (RAM). Indeed, only a small loader program is stored in peripheral module PROMs (Programmable Read Only Memories). The TPVM programs are stored on magnetic tape and down-loaded from central control to the peripheral modules.

### **Peripheral processing**

Processing is carried out in a generally similar way in all the peripheral modules. For example, the DTC illustrates how peripheral processing takes place. Each DTC combines two peripheral processors: the Signaling Processor (SP) and the Master Processor (MP).

- the SP (through associated hardware interfaces) has four functions:
  - handling the I/O message protocol between the DTC and CC

- collection and comparison of all 480 Channel Supervision Messages (CSM)
- interfacing the A/B bits on the digital carrier and providing filtering of the A/B bits, timing of signaling and alarm states, digit collection and the transmission and timing of local alarms
- hardware monitoring and fault detection routines
- Master Processor – The MP implements the TPVM. In the TPVM, programs sent from the CC are interpreted and terminal processes executed. In addition, audits of terminal states and data are performed.

### **Meridian Digital Centrex (MDC)**

Meridian Digital Centrex is a powerful portfolio of business communication services offered through a full line of voice, data and ISDN terminals, resulting in the most cost-effective, productivity enhancing telecommunications system for the 1990s.

Through MDC, the business customer can access all of the MDC technologies, including analog lines, Meridian Business Set lines, Datapath lines, DMS Integrated Access Local Area Network (DIALAN) lines interwork. This interworking allows the telephone operating company to match the most cost-effective technology to the particular services desired by the customer. Capabilities within the MDC portfolio include:

- ISDN—offers integrated voice, circuit data and packet data over a single line.
- DMS Meridian Automatic Call Distribution (ACD)—provides superior call handling from the central office by efficiently distributing a large volume of incoming calls to a designated group of answering positions
- Meridian Network Centrex and Meridian Digital Centrex CLASS—transparently extends MDC features across the public network through the implementation of Common Channel Signaling No. 7.
- Business Network Management (BNM)—extends network management capabilities, station moves and changes and Station Message Detail Recording (SMDR) to the customer premises.

### **Integrated services digital network (ISDN)**

Integrated Services Digital Network (ISDN) is a set of standardized customer interfaces and signaling protocols for delivering digital circuit-switched voice/data and packet-switched data services. Standardizing these interfaces and implementing the standards in a multivendor environment has several advantages for the telephone operating companies and their customers.

#### **ISDN overview**

Voice and data communications have followed separate evolutionary paths. However, increasing demand for new telecommunication services coupled

with the complexity and the high cost of providing dedicated lines to each new service have created an urgent need for subscribers, as well as network providers, to develop services that can share the access to transmission lines. ISDN integrates single all-digital communications network that allows single-plug access to voice, data, text, network signaling, and image transmission. This access is the key feature of ISDN. The feasibility of ISDN is made possible through the process of digitization, in which all information is transported as 0 and 1 bits in the digital language of computers. Because all information is coded and transmitted in a uniform manner, that different services can share the same lines and network resources.

ISDN users have uniform access through standard interfaces which provide B- and D-channels. The B-channel is a 64 kb/s two-way information 'pipe' which can carry any digital information such as digitized voice or data. The D-channel is a channel used for controlling the B-channels and for supporting low-speed packet data.

ISDN users have uniform access to these standard interfaces:

- interface to customer premise equipment (CPE) such as computers, POTS, and facsimile machines through BRI
- interface to Centrex and Business Sets, digital Private Branch Exchanges (PBX), host computers, and Local Area Networks (LANS) through PRI
- trunk-side interface to the Public Switched Network (PSN) through Common Channel Signaling No. 7 (CCS7).
- access to local packet-data terminals and the Public Packet Switched Network (PPSN) through X.25 and X.75/X.57' packet services.
- Equal Access

### **National ISDN-1**

Progress toward a national ISDN standard took a major step forward in February, 1991, when the Corporation for Open Systems (COS) held the International ISDN Briefing in New York. COS members announced **National ISDN-1**. This will be the members commitment to develop a standards-based ISDN offering and market it across the nation early in 1992. Nortel Networks will deliver National ISDN-1 compliance with the BCS34 software release.

COS is a non-profit organization of switch manufacturers, Bell Operating Companies, computer and data-equipment manufacturers, and major ISDN users. It was formed to encourage the widespread deployment of a standards-based telecommunications network, ISDN, through switch vendor cooperation.

The National ISDN-1 announcement removes the barriers that have delayed ISDN deployment, unstable standards, proprietary implementations, and the



lack of a commercially viable set of calling features and services. National ISDN-1 standards agreement means that vendors are committing to a communications standards between ISDN switches so that vendors are committing to a communications standard between ISDN switches so that ISDN services can be extended over a wide area served by different central offices and multiple operating companies.

### **Calling features**

National ISDN-1 defines a set of calling features, such as Call Transfer, Call Forward, and Call Waiting. Nortel Networks meets many of these standards now and will meet most of the others by early 1992. In addition, Nortel Networks uses standards-compliant protocols to offer ISDN customers a set of value-added features that have yet to be defined by national standards bodies.

### **Interworking with non-ISDN lines**

There will always be a need for ISDN lines to interwork with non-ISDN, such as POTS, Meridian Digital Centrex, and 911 emergency lines. Some switch vendors require that ISDN lines be kept strictly separate on an 'ISDN island.' However, Nortel Networks' ISDN has always met the requirement that ISDN lines fully interwork with other kinds of lines.

## **Basic Rate Interface**

An ISDN BRI loop from a customer's premises has two B channels at 64 kb/s each plus one D channel at 16 kb/s totaling to 144 kb/s. This gives the user the capability of using three channels (commonly called 2B+D).

2B+D provides access for up to eight terminals and is configured as follows:

- B channels     The two B channels can be used for circuit switch voice and data or high-speed packet switched data. The two channels not only can be used for two separate calls but also independently and simultaneously for two connections pertaining to the same call. This would apply, for example, to a call between two voice/data terminals requiring separate connections for voice and data transmission.
  
- D-channels     One 16 kb/s channel carries signaling and control information for the B channels and may also be used to interleaf low-speed packet data with this information. By its ability to support low-bit-rate data in packet mode, this channel can serve the so-called telemetry services (that is, meter reading, alarm monitoring, and so on).

### **Primary rate interface**

Primary Rate Interface (PRI) carries  $nB+D$  channels over a digital DS1 facility (23B+D in North America and 30B+D) in Europe) and is used to



link private networking facilities such as PBXs, LANs, and host computers with a standardized architecture acting as the bridge between private switching equipment and the public network.

23B+D is configured just like the BRI with the following exceptions:

Access termination at the DMS is provided through ISDN Digital Trunk Controller (DTCI) and/or ISDN Line Trunk Controller (LTCI).

Since low-bit-rate data packet is not supported on the D channel, the D-channel is then relegated to call control signaling associated with the B-channels.

Although PRI is defined as 23B+D, one D-channel has the capability to provide signaling for up to 479 B channels, provided all DS1 facilities are located on the same ISDN Controller.

20 DS1s by 24 channels per DS1	= 480 channels
D-channel for call signaling	= -1 channel

Possible B channels	= $\frac{480}{1}$ B channels
---------------------	------------------------------

## ISDN benefits

### Integrated voice and data service

ISDN uses the customer's existing wire pair to deliver many new services simultaneously, such as digital voice, circuit-switched 64 kb/s data and packet-switched data. This powerful capability makes ISDN today's top choice in voice and data technology, when desk-to-desk data connectivity is equally as important as the telephone service.

### Out-of band signaling

Just as out of band CCS7 signaling increases the efficiency of inter-office communications, ISDN's D channel signaling handles call control activities between the switch and the customer more efficiently than POTS service.

### Lower CPE cost

National ISDN-1 (NI-1) standards will eventually lower the cost of ISDN CPE, because the equipment will be produced in greater volume by many different and competitive manufacturers.

### Wider choice of CPE

End users can choose from among a wide variety of NI-1 standard compliant ISDN equipment from different manufacturers, thus better matching purchases to customer needs.

### **Terminal portability**

NI-1 ISDN standards allow ISDN CPE from one manufacturer to operate on any ISDN switching system.

### **Standardized OAM**

Standardized line maintenance capabilities for ISDN will simplify training of maintenance personnel and work to reduce operational costs.

DMS-100 ISDN is built to these standard interfaces. As manufacturers of CPE and other switches follow suit, all ISDN CPE will be able to operate on any standards compliant ISDN switching node.

The BCS31 ISDN offering provides standards compliance for Layer 1 (2B1Q; TR-393) and layer 2 (TR-793). Layer 3 standards compliance with full terminal portability is provided by BCS34.

There are currently two different ISDN customer interfaces: BRI and PRI. ISDN is extended between switches by CCS7 trunk signaling.

A typical representation of an ISDN network is shown in Figure 2-35 ISDN access arrangements fit into any network environment:

### **BCS32 BRI enhancements**

*Note:* As of BCS 32, the Integrated Access Controller (IAC) peripheral is no longer supported as a controller for BRI or PRI ISDN. Beginning in BCS32, BRI and PRI ISDN must be supported by the LGCI, DTCl, or LTCl.

### **ISDN LCM Support for Additional Line Types**

Beginning with BCS32, the ISDN 2B1Q Line Concentrating Module (ISDN LCM) can support line cards for 2B1QU, ISDN T, POTS, Meridian and Electronic Business Sets, and Datapath Service. This additional support makes administration easier and lowers costs, because there are no single-service-type LCMs (feature package NTX750AB).

### **Networking Enhancements**

BCS32 adds additional TR-444 capabilities, such as mapping ISDN Q.931 signaling onto ISUP signaling and extending Low-Layer and High-Layer compatibility and Called and Calling Party Subaddress information between nodes (AG2002 and AG2211 in package NTX757AA). Refer to Figure 2-35.

### **Translational and Routing Enhancements**

BCS32 provides additional TR-448 compliance by extending the TR-448 ISDN routing and digit analysis capabilities to existing DMS-100 INWATS and Virtual Facility Group (VFG) translations. Also, this feature completes

TR-448 compliance by allowing a Bearer Capability to be datafilled against an incoming trunk group (AG2210 in package NTX767AA [end offices] and NTX768AA [Tandem Offices]).

### **BCS33 BRI enhancements**

#### **New call-coverage features**

BCS33 introduces a comprehensive set of Bellcore-standard features that allow ISDN set to be better used in call-coverage applications, including:

- Key Short Hunt for EKTS (AQ0733 in NTX754AA)
- Abbreviated/Delayed Ringing for EKTS (AQ0734 in NTX754AA)
- Call-Forward Programming by a Secondary MADN Member for EKTS (AQ0735 in NTX754AA)

#### **Inbound modem pooling**

This feature allows terminals in non-ISDN (for example, POTS) networks using voiceband modems to establish calls to ISDN circuit-switched data terminals. This capability further reduces the barrier between ISDN and non-ISDN and non-ISDN data applications by allowing lower speed but transparent access between two users. See the ISDN Inbound Modem Pooling feature AC0615 in package NTXN99AA.

#### **Dynamic Terminal Endpoint Identifiers (TEIs)**

This capability allows ISDN users to specify the Dynamic Terminal Endpoint Identifier (TEI) for their terminals. These features represent the first step toward ISDN terminal portability on the DMS-100 (delivered with BCS34 in feature AL2277 in the package NTX750AB).

### **BCS34 National ISDN-1 BRI enhancements**

#### **Flexible-calling enhancements**

BCS34 delivers these ISDN Flexible-Calling Features.

- ISDN Additional Functional Call-Notification Busy Limit (AQ0779 in NTX755AB).
- 6/30-Port Conferencing for Flexible Calling (AQ0736 in NTX755AB)
- Three-Way Call Chaining for ISDN Flexible Calling (AF3244 in NTX755AB)



- Data services.
  - X.25 packet mode terminals on B channel of BRI and D channel of BRI
  - Transparent circuit switched 64 kb/s data on B channel.
  - DMS PH fully integrated at BCS34 based on the LPP platform for National ISDN-1 compliance (NTXP47AA/NTXP75AA).
- Key activation and Dial Access Code activation for terminal access to ISDN circuit switched supplementary services.

### **Basic rate software packages**

The BRI is the basic subscriber loop, delivering two 64-kb/s B channels and one 16 kb/s D channel over a standard twisted pair loop. Each of the circuit-switched B channels can transmit voice or data simultaneously, while the D channel transmits call control messages and user packet data.

B channels packets are routed from the BRI interface and are routed through the network interface unit (NIU) to the X.25/X.75/X.75' link interface unit (XLIU). The B channel path is fully redundant from the enhanced line concentrating module (LCME).

D channels from the BRI interface are terminated at the D channel handler (DCH). From there, the DCH forwards the packet data to the XLIU on the Bd channel.

### **ISDN voice services**

DMS-100 is a complete business service that offers the largest number of productivity-enhancing voice features in the industry.

DMS-100 ISDN offers functional-signaling features in accordance with TR268 Bellcore standards. Now more than 200 standard features designed to Bellcore Technical Recommendations (TRs) have been implemented on DMS-100 ISDN lines. Standard ISDN allows local exchange carriers to offer a consistent grade of service to all customers, regardless of the serving switch and when fully implemented, standard ISDN will allow a wider choice of telephone and terminal vendors, because they will build their products to the same standards.

In an ISDN Meridian Digital Centrex group, BRI lines can be intermixed with business set lines, allowing the customer to provide each employee with the appropriate level of service at a cost effective rate. As the need for integrated voice and data grows, more ISDN lines can easily be added.

Table 2-2 summarizes the software packages required for various BRI services and required packages for the DMS PH (beyond the usual MDS packages required to access MDC features).

<b>Table 2-2 BRI software packaging</b>	
<b>Package name</b>	<b>Standard ISDN capabilities</b>
ISDN Basic Access (NTX750AB)	TR-393-ISDN Basic Access Digital Subscriber Line, Issue 1 TR-793-ISDN D-channel Exchange Access Signaling (Layer 2)
ISDN Advanced Signaling (NTX753AB)	TR-268-ISDN Basic Access Call Control, Issue TR-856-ISDN Hold Capability, Issue 1
Advanced Signaling (NTX753AB) (GA BCS35)	Information Request (TRs 847, 205, 850, 853, and 858) TR-847-Terminal initialization/SPID and FA protocols TR-850-BBG Dial Access Compliance TR-268-Terminal-portability Enhancements
ISDN Electronic Key Telephone Service (NTX754AA)	TR-205-ISDN Electronic Key Telephone Service Issue 1
ISDN Standard Supplementary Services (NTX755AA)	TR-858-Flexible Calling Issue 1
ISDN Standard Supplementary Services (NTX755AB) (GA BCS34)	TR-858-Flexible Calling Issue 1 TR-857-Additional Call Offering Issue 1
ISDN Standard Supplementary Services (NTX755AC) (GA BCS35)	Terminal portability for Bellcore TR Supplementary Services
ISDN User Part (ISUP) Interworking (NTX757AA)	TR-444-ISDN Access Using the ISDN User Part, Issue 1 TR-444 Compliance Phase 1 TR-444 ISUP-BRI Interworking Compliance Phase 2
ISDN Routing and Digit Analysis End Office (NTX767AA) and Tandem Office (NTX768AA)	TR-448-ISDN Routing and Digit Analysis Issue 1 TR-448 Compliance Phase 1 TR-448 ISDN Translation and Routing(NTX767AA)
TR-444 ISUP Interworking-Toll Office (NTX769AA) (GA BCS34)	TR-444 ISUP/BRI Interworking for Toll Office
MDC Message Waiting Service (NTX119AA)	Allows assignment of Message Waiting/Call Request to a feature key on a functional signaling set
ISDN Inbound Modem Pooling (NTXN99A) (GA BCS33)	Inbound Modem Pooling
DMS PH	<b>Required feature packages</b>
NIU Software Base NTXH77AA	Provides channelized access from the switched NIU software based network to the LPP packet processors.
—continued—	

<b>Table 2-2 BRI software packaging</b> (continued)	
<b>Package name</b>	<b>Standard ISDN capabilities</b>
DMS PH software base NTXP47AA	TR301.2 provides X.25, X.75 and X.75' packet processing for ISDN.
DMS PH Servord NTP75AA	Integrates the packet OA&M into the existing DMS Service Order process.
End	

### Free upgrade to Standard 2B1Q ISDN

Nortel Networks is offering telephone operating companies and their customers a free upgrade of non-standard AMI ISDN lines to standardized 2B1Q. There is also a replacement program for AMI equipment in inventory.

Until recently all switch manufacturers have implemented ISDN-like services using proprietary Alternate Mark Inversion (AMI) lines. However, this implementation does not meet the definition of standard ISDN, which requires a single customer interface for all switch and terminal vendors.

### The importance of 2B1Q

2B1Q (two binary, one quaternary) has been defined by the International Telephone and Telegraph Consultative Committee (CCITT), the American National Standards Institute (ANSI), and Bell Communications Research (Bellcore) as the new North American standard for the ISDN line between the customer premises and the central-office switch. The ISDN customer with 2B1Q lines will benefit from terminal portability, a greater choice of NT1 and terminal equipment and improved maintenance.

### The upgrade program

Those now using AMI-based ISDN must now upgrade to the 2B1Q lines or continue to use their non-standard AMI network. But because of Nortel Networks' commitment to ISDN standards, telephone operating companies and their customers served by DMS-100 ISDN switch will receive a free 2B1Q upgrade which includes:

- one-for-one free replacement of AMI ISDN line cards and Network Termination 1 (NT1) devices that are installed or in inventory by January 1, 1991
- free upgrade of AMI Line Concentrating Modules (LCMs) to handle wired capacity of ISDN lines installed and shipped by January 1, 1991
- free upgrade of NTX750AB central-office software package for 2B1Q capabilities



### **Upgrade eligibility**

The program is available beginning in BCS32 to any telephone operating company that:

- has AMI equipment deployed or in inventory before January 1, 1991
- has purchased BCS32 software (or later release)

### **Nortel Networks 2B1Q products**

NT 2B1Q products include the following:

- rackmount/wallmount and desktop NT1s with optional terminal powering and battery backup
- single-slot line cards
- high-capacity line drawers for the 480-line ISDN LCM

Nortel Networks' 2B1Q products fully complies with the American National Standards Institute (ANSI) and Bellcore requirements, and also conforms to the CCITT I-Series Recommendations.

### **Standardized maintenance improved**

2B1Q standards include powerful maintenance capabilities using the embedded operations channel (EOC), including layer-1 Performance Monitoring through Cyclic Redundancy Check (CRC). As standards for new maintenance capabilities emerge, existing equipment can be easily upgraded through software upgrades to comply with the new standards

### **Future feature upgrades**

Beginning with BCS33, new switch orders for ISDN applications or feature upgrades will be available only with standard Functional Call Control or Meridian Feature Transparency (MFT). MFT is an option that allows an ISDN line to use the complete set of Meridian Digital Centrex features. It allows a customer to migrate to ISDN while retaining MDC features—such as Automatic Call Distribution (ACD)—on selected lines.

### **Central office upgrade to standard ISDN**

To facilitate the migration from Stimulus to Functional Call Control, NT is offering free DMS-100 software upgrades to Standard Functional Call-Control Protocol with the purchase of the appropriate BCS software release. Functional Call-Control software has been available since BCS29 and has evolved to meet the functional standards as defined by TR-268 in BCS31. Beginning with BCS33, software package NTX750AC will provide only the Functional Call-Control Protocol and the MFT option.

Also in support of standard ISDN, NT continues to offer the free upgrade to Standard 2B1Q ISDN—announced April 16, 1990—to all central offices now using Alternate Mark Inversion (AMI) line coding. This offer includes



standard 2B1Q DMS-100 software, a one-for-one replacement of all AMI line cards and NT1s, and an upgrade of ISDN Line Concentrating Modules (LCMs) when the operating company purchases BCS32 or a later software release.

### **Free terminal upgrade to standard ISDN**

NT also provides an easy and efficient program to support the migration of standard Functional Call Control for its family of ISDN Business Sets.

The M5209T set currently supports both Stimulus and Functional Call Control. To migrate to Functional Call Control, a simple data modification is made in the DMS-100 central office, with few or no programming changes in the set at the customer's site. There are no firmware changes required in the set.

The M5317T set requires a firmware upgrade kit—available from NT free of charge. These kits contain all firmware and documentation required for the changeover, which is done in the field. With a simple data modification in the DMS-100 central office, either the customer or an operating-company technician can complete the changeover to Functional Call Code Control at the customer's site.

### **Implementing the transition from stimulus to functional**

The operating companies and their ISDN CPE providers will manage the timing of the transition for their customers. Any translation changes and customer-side visits to install firmware or to reprogram ISDN terminals shall be made by the telephone operating companies, the CPE provider, or the ISDN subscriber,

The transitions must be completed before a DMS-100 is upgraded to BCS38 (currently planned for release in 1994). Customers choosing to continue with the stimulus versions for the M5209T, M5317T, and earlier ISDN trial equipment—T2317 and Personal Computer Terminal Adapter (PCTA)—will be supported through BCS37 as they migrate to standard ISDN.

For technical information about these ISDN terminals, contact Nortel Networks' Terminals Technical Support in Nashville using the following toll-free number: 1-800-558-9936. Your Nortel Networks representative can give you more information about the free upgrade and ISDN Functional Call-Control applications.

### **Standardized 2B1Q-compliant products introduced**

With BCS31, Nortel Networks introduces a complete line of 2B1Q-compliant products, including the following:

- **network termination 1**—NTI devices with optional terminal powering and battery backup
- **single slot line cards**

- **high capacity line drawers**—Specifically for the 480-line ISDN Line Concentrating Module (LCM). The existing AMI LCM can be upgraded to 2B1Q.

All S/T-interface terminals, such as the Meridian M5317T and M5000T1 UTA, M5209T ISDN business sets, will operate on a 2B1Q lines and have access to all the ISDN MDC features available.

**2B1Q ISDN products** Line cards, line drawers, and NT1s using single-chip 2B1Q technology are currently available from Nortel Networks.

2B1Q is a foundation for standardized ISDN, and when implemented by other switch vendors, will allow any vendor's compliant customer-premises equipment (CPE) to connect to any compliant switch. It replaces switch vendor's present proprietary Alternate Mark Inversion (AMI) line-coding schemes. Nortel Networks will continue to support its currently installed AMI products.

**Improved, standardized maintenance** 2B1Q standards include new maintenance capabilities using the embedded operations channel (EOC), including layer 1 performance monitoring through Cyclic Redundancy Check (CRC). As new maintenance capabilities are standardized, existing equipment can be easily upgraded with software to comply with the new standards.

Because line maintenance capabilities for 2B1Q have been standardized, these procedures will simplify training of maintenance personnel and reduce operating costs. Operating companies will also be able to do network-wide maintenance from a centralized Operations System (OS).

### **Standard ISDN features and Meridian feature transparency (MFT)**

Subscribers to ISDN MDC will have access to a large set of standardized ISDN features. For customers with special feature requirements, Meridian Feature Transparency (MFT) is an ISDN line option that gives access to the familiar MDC feature set.

Nortel Networks recognized the need for flexibility and matches features to end-user requirements. Customers are helped in their migration from Meridian Digital Centrex to ISDN. To meet these needs, Nortel Networks offers the standards-based feature set and Meridian Feature Transparency (MFT) on DMS switching systems.

Standard ISDN will allow local exchange carriers to offer a consistent set of feature services to all customers, regardless of the serving switch. When fully implemented by switch and CPE vendors, it will allow a wider choice of telephone and terminal vendors because products will be built to the same standards.

Nortel Networks has lead the industry in implementing standard ISDN features on public switching systems. Currently over 200 standard features based on Bellcore Technical Recommendations (TRs) have been introduced on the DMS Family of switching systems.

**Terminal / feature flexibility** All T-interface terminals, such as the Meridian M5317T and M5209T ISDN Business Sets, will operate on a 2B1Q loop just as they did on an AMI loop. 2B1Q has no effect on feature access; 2B1Q lines have access to all the ISDN Meridian Digital Centrex features.

Nortel Networks recognized the need for flexibility and matches features to end-user requirements. Customers are helped in their migration from Meridian Digital Centrex to ISDN. To meet these needs, Nortel Networks offers the standards-based feature set and Meridian Feature Transparency (MFT) on DMS switching systems.

**Special feature needs** A customer may, for example, wish to assign some ISDN lines to the MFT option so that can function as Automatic Call Distribution (ACD) stations. (Bellcore has not at present standardized ACD features for ISDN lines),

With a simple translations change, customers can later migrate to standards-based ISDN features without changing ISDN terminals.

**Full interworking** The standards-based, pre-standards, and MFT feature options are assigned by datafill on a set-by-set basis. Sets assigned difference options fully interwork and can be mixed on the same loop and in the same customer group. ISDN data terminals will use the standard features, even if voice terminals are on the same loop and are assigned to the MFT option.

**No terminal management problems** MFT will not require tracking multiple terminal types because a single firmware version of ISDN Meridian Business Set will support both standards-based and MFT features. ISDN Meridian Business Sets will support both standards-based and MFT features. ISDN Meridian Business Sets manufactured before the availability of MFT features. ISDN Meridian Business Sets manufactured before the availability of MFT will be capable to be upgraded to support both MFT and standards based sets. Customers who would have hesitated because of feature availability can migrate to integrated voice and data with full feature transparency where required.

## **NT ISDN business sets/terminal adapter**

Nortel Networks continues to develop terminals to meet the needs of different market segments—from voice-only ISDN set to those with fully integrated voice and circuit/packet-switched data. All three ISDN sets will support National ISDN-1 beginning January 1, 1992.

**M5209T and M5317T ISDN Meridian Business Sets** The M5209T and M5317T ISDN Meridian Business Sets are designed to Nortel Networks' BRI Specification (NIS-5208-5 Issue 1.0), which is based on Bellcore functional-signaling standards. The MFT option will be supported on single-firmware versions of Nortel Networks' M5209T ISDN Business Set and M5317T ISDN Business set. These sets can be upgraded for MFT. The specific features delivered will depend on each individual set's design.

**M5317T Centrex ISDN SET** This set has twelve programmable line/feature keys, five context-sensitive Soft Keys, and an 80-character display, the largest of any Business Set. It will be available as the voice-only M5317T, or as the M5317TD with high-speed circuit-switched data at 19.2 kb/s

**M5209T Centrex ISDN Display Set** The M5209T ISDN Display Set has nine line/feature keys and a 48 character adjustable display. It is available as a voice-only set, or with either of two options—one for packet-switched data at up to 9.6 kb/s, another for selectable packet-or circuit-switched data (circuit data up to 19.2 kb/s).

**M5000TB1 ISDN Terminal Adapter** This new terminal adapter supports 2500-type telephones and allows a wide range of existing computers and data terminals to connect to an ISDN line. It supports many available communications-software products with flexibility and operational simplicity of a modem. It makes many non-ISDN data products compatible with an ISDN MDC line. This protects the end user's investment in voice and data equipment and allows wider deployment of ISDN lines.

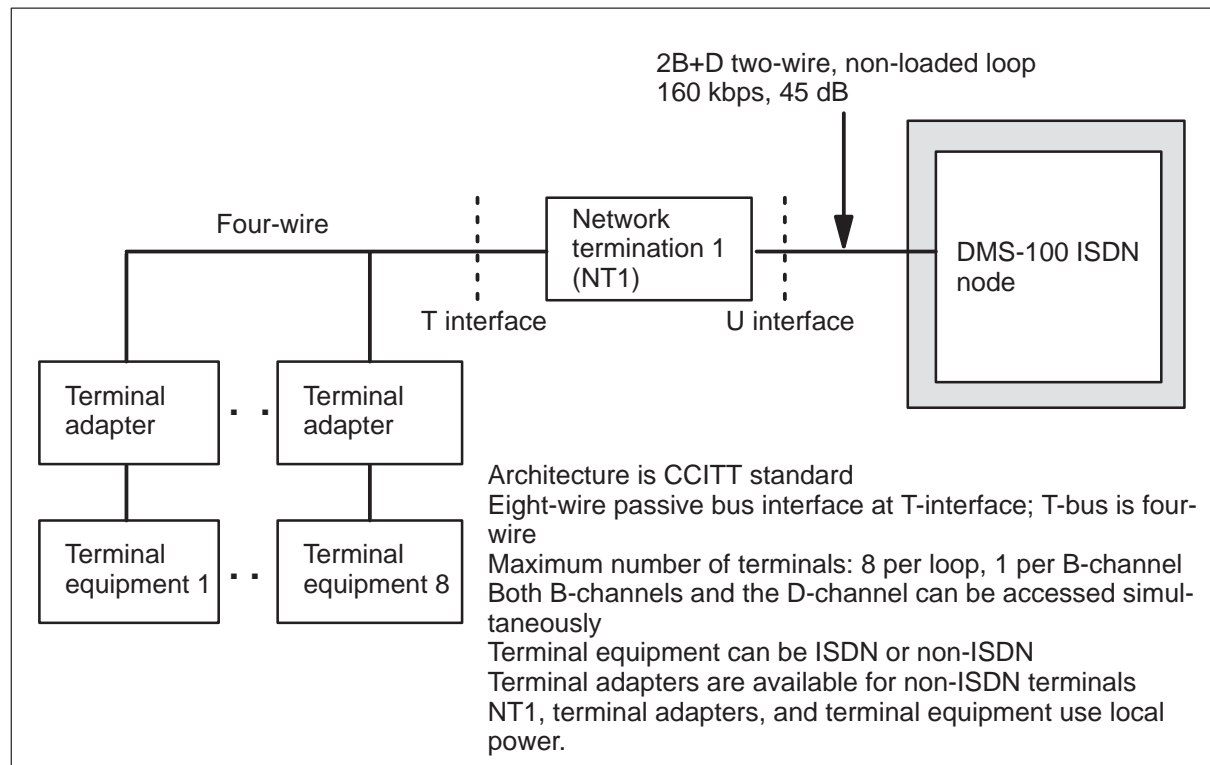
**M5000TD1** The M5000TD1 uses standardized functional signaling and the Hayes At Command Set enhanced for ISDN and supports both circuit and packet switched data. It connects to analog voice and data devices—such as 2500-type sets, modems, and Group III FAX machines—through an RJ-11 connection. Many ISDN Meridian Digital Centrex features—such as Conference Calling, Call forward, Call Transfer, Call Park, Call Pickup, and Speed Calling—are available to the 2500 set connected to the M5000TD1. The keypad of 2500 set can be used to set up calls for Group IV FAX machines and other data devices that do not have dialing capabilities.

## DMS-100 node implementation

### ISDN basic rate interface components

The architecture of the BRI to the DMS-100 node is shown in Figure 2-36. This architecture complies with CCITT recommendations.

**Figure 2-36**  
ISDN access (basic rate interface-network implementation)



The two basic access interfaces are the 'U' and 'T' interfaces.

The U interface has these characteristics:

- two 64 kb/s B channels and one 16 kb/s D channel (2B+D)
- one 8 kb/s C channel for loop maintenance, 8 kb/s for framing
- bit range of 160 kb/s
- echo Cancellation Hybrid technology
- loop attenuation of up to 45 dB at 80 kHz
- full duplex transmission on two wires
- standard 2B1Q U Interface (introduced in BCS31).

The 'T' interface has these characteristics:

- eight-wire passive bus connector of which four wires are used for the 'T' bus, with the remaining four wires allocated for future optional power transfer to ISDN telephones
- support of up to eight terminals, of which not more than two can be supported by the B channels
- support of the short passive-bus configuration, the extended passive-bus configuration, and the point-to-point configuration as per CCITT specifications
- 192 kb/s transmit and receive digital streams on the 'T' bus

Network Termination 1 (NT1) provides the network ('U') interface to the two wire subscriber loop, and the terminal 'T' interface to the four-wire multi-drop bus on the terminal side.

The NT1 provides functions equivalent to Layer 1 (physical) of the Open System Interconnect (OSI) Reference Model, whose functions are associated with proper physical and electrical termination of the network. The NT1 has six functions:

- transmission termination for 'U' and 'T' interface,
- layer 1 line maintenance functions and performance monitoring,
- encoding, timing, and synchronization,
- layer 1 multiplexing,
- T-Bus activation and deactivation
- interface termination to allow multi-drop terminals to gain access to common D-channel resources employing Layer 1 contention resolution.

The NT1 remains active at all times since the transmissions system is a live-loop system. Terminal Equipment (TE) is used to directly connect to the NT1 with terminating resistors at both the far and near ends of the loop.

Terminal Adaptors (TAs) are required for non-ISDN terminals to be converted to the 2B+D access at the 'T-Interface. The NT1, TA, and TE are powered individually from local sources or via 2B1Q U TI equipment.

The Basic Access (2B+D) Loop supports four applications:

- circuit switched voice over B channel
- clear 64 kb/s circuit switched data over B channel
- packet mode data services on dedicated provisioned B channels, which are provisioned at subscription time
- packet mode data services on D channel

Simultaneous connections can be made on all three channels of the 2B+D loops.

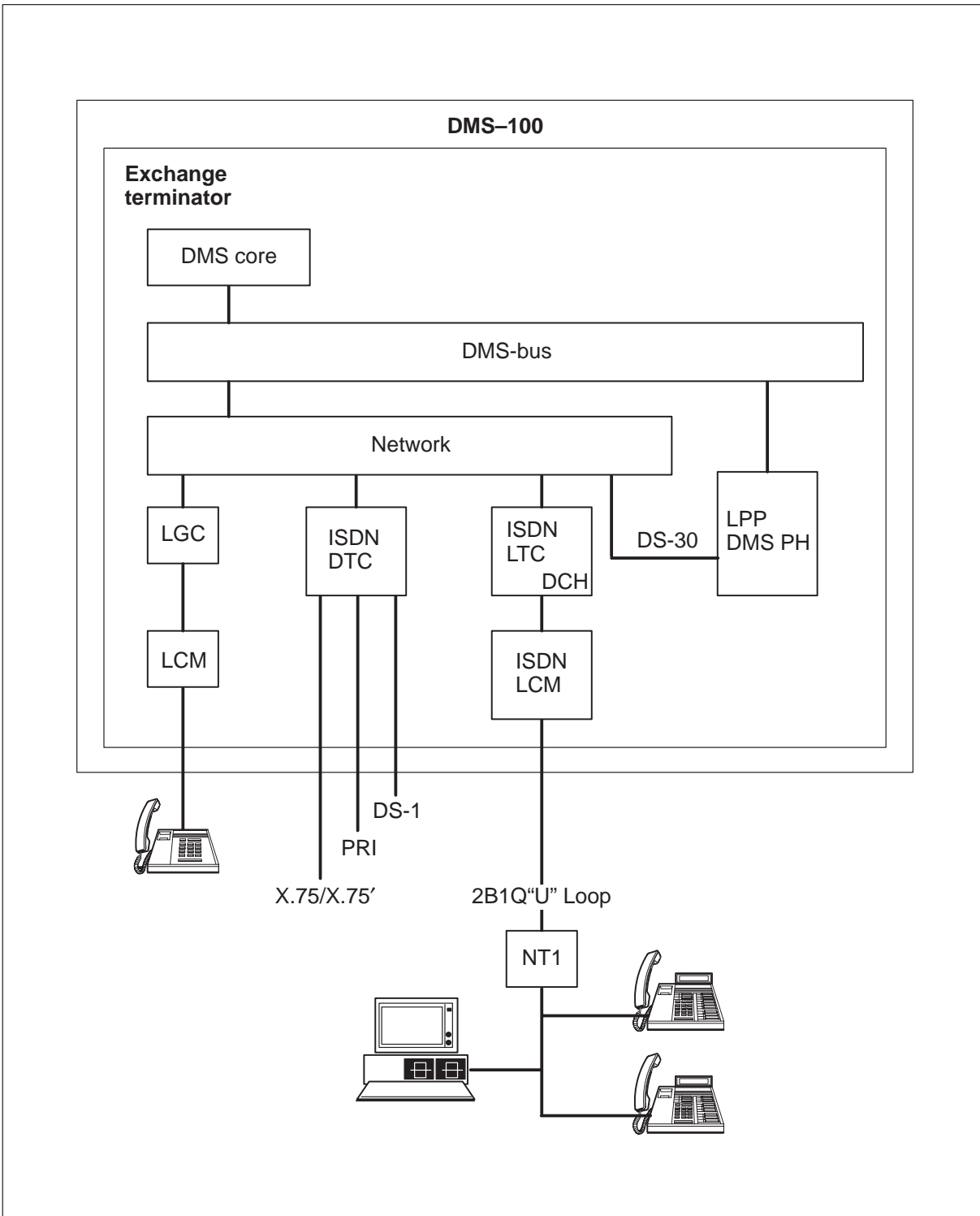
**Primary rate access**

Primary Rate Interface (PRI) provides 23B+D access to the ISDN central office from PRI-equipped CPE, such as PBX. The D channel is a 64-kb/s signaling channel; the B channels are 64 kb/s channels that can carry voice, circuit-switched data.

DMS-100 PRI terminates on a DS1 port on the ISDN DTC. Clear-channel transport at 64 kb/s is provided through the B8ZS coding scheme.

DMS-100 PRI hardware includes the ISDN DTC and ISDN LTC as illustrated in Figure 2-37. The first application contained PRI links interconnecting a DMS-100 central office and an SL-1 PBX. The application supports Calling Number Delivery, Direct Inward Dialing (DID)/Direct Outward Dialing (DOD), FX, WATS, TIE, Integrated Service Access (multiple call types supported by a single PRI), and Integrated Trunk Access. Additional supplementary services and enhanced networking features will be provided in later phases to integrate PBX and Centrex private networking.

Figure 2-37  
DMS-100 ISDN Architecture





The following set of network services, for which Primary Rate Access signaling has been defined, are intended for application between a DMS-100 central office switching system and a PBX such as the Meridan SL-1:

- two concurrent numbering plans that are available to address end users of the Basic Connection Service
  - North American Numbering Plan
  - Electronic Switched Network (ESN) Numbering Plan
- Basic Connection Service for B channel Connections
  - Voice and voiceband data
  - 64 kb/s unrestricted circuit-switched digital data
  - 56 kb/s circuit-switched digital data, rate adapted to 64 kb/s
- Calling Number Delivery
  - Delivery of calling number to and from the PBX
  - Privacy (A subscription option, available in BCS32, causes the Public Switched Telephone Network (PSTN) to withhold calling number from the PBX; in this case, the calling number will be delivered as seven asterisks [\*\*\*\*\*]. This default may be overridden on a per-call basis.)
- Call Redirection/Forwarding
  - Within PSTN and Private Network
  - Call Forward-Variable,- No Answer, Busy
- PSTN Equal Access
  - Interexchange carrier (IC) selection on a per-call basis (central-office [CO] user)
  - Default IC selection when IC not specified (CO user and PBX user)
- Special Number Services (0, 0-, 411, 911, 611, 1-800, and 1-900) that allow PBX users to access the PSTN.
- PSTN Route and Cost Selection Service
  - Integrated Services Access supports DID/DOD, Foreign Exchange (FX), IN/OUT WATS, and tie-trunk call types over a single PRA interface to the PSTN.
  - Private Network Overflow Service allows overflow from a given private network onto public-network facilities.

## DMS-100 ISDN node architecture

The ISDN node, as implemented on the DMS-100, has two major functional components, the Exchange Termination and the Packet Handler.

### Exchange termination

The Nortel Networks ISDN switch is an enhanced version of the DMS-100 digital circuit switch. Newly developed access peripheral modules and the integral D-channel handler provide ISDN basic rate access to the whole range of DMS features for circuit switched voice and data communications.

The DMS-100/ISDN switch is implemented through the ISDN version of the Line Concentrating Module (LCM), Basic Rate Interface (BRI) line card, and a Line Group Controller (LGC), with the added D-channel Handler (DCH), and ISDN Signal Processor (ISP) modules to provide D-channel handling capabilities. The new ISDN Line Concentrating Module (LCM) supports integrated user access to packet mode services, as well as access to DMS-100 based circuit mode service. These new peripherals thus become an integral part of the DMS-100 switch. Packaging of the ET is in standard DMS-100 frames.

There are six ISDN components:

- ISDN Line Card (ISDN-LC) – The ISDN-LC is plugged into a line drawer; the 2G1Q High DENSITY Line drawer has 60 slots and supports 60 2B1Q line cards per drawer.
- These functions are provided by the ISDN-LC:
  - loop interface
  - shaping network
  - sealing current
  - digital echo cancellation
  - voltage surge protection
  - automatic line build-out, equalization, automatic gain control, and bridge tap equalization
  - test access cut-off relays
  - scramble/descramble, frame synchronization
  - data clock
  - C-channel control
  - 2B1Q coding
- ISDN LCM
  - The ISDN LCM is an enhanced version of the current LCM, which allows for non-concentrating configurations.
  - eight line drawers per dual shelf ISDN LCM
  - maximum of 60 2B1Q lines per drawer are available in BCS31 for a total of 480 total lines
  - fully duplicated ISDN LCM control

- 4:1 Time Division Multiplex (TDM) on the D-channels for transmission over DS-0 channels of the DS-30A Speech Links
- ISDN Line Group Controller (ISDN LGC)
 

The ISDN LGC provides a non-concentrating switched path for B channels through to the DMS network and nailed-up connections for dedicated B channel access to the packet handler.

It is a two-shelf module for duplicated control. The ISDN LGC handles the D channel Layer 3 (Q.931) functions (the call control and signaling functions). The ISDN LGC performs the linking between the Q.931 and the internal DMS-100 call processing procedures for call control and feature access.

- D channel Handler (DCH)
 

The DCH supports Layer 2 (Q.921) functions on messages received from the D channel. The DCH splits the routing of received messages according to their service designation. D-channel messages received at the DCH with a service designation (SAPI=16) indicating user packet data will be routed via dedicated DS-1 links to the packet handler, which will perform the packet data Layer 3 functions. If the received messages have service designation (SAPI=0) indicating call control, the DCH will route the messages via internal links to the ISDN-signaling per-processor in the LGC for Layer 3 preprocessing and to Common Control Complex (CCC) for Layer 3 call processing.
- DMS Packet Handler (DMS PH) hardware
 

The X.25/X.75/X.75' link interface unit (XLIU) can coexist with other types of application specific unit (ASU) in the LPP. For a minimum DMS PH configuration, two XLIUs can be added to any LPP shelf that is already equipped with the network interface unit (NIU) pair.

### **DMS Packet Handler – product/system overview**

Prior to BCS34, packet services were provided by the DPN-based Packet Handler (DPN PH) which is connected to the DMS through DS1 links. The DMS Packet Handler (DMS PH) is being introduced to provide ISDN packet service for the DMS-100 ISDN as an integral component of DMS-100 Family and DMS SN switches.

This new LPP application delivers National ISDN-1 compliant ISDN B and D channel packet data. The LPP is a fully integrated DMS SN component currently being deployed in DMS central offices for CCS7 and other applications.

With BCS34, the DMS PH application will be introduced on the LPP. For offices using an LPP for CCS7 and other applications, the DMS PH is a cost-effective way to provide ISDN Packet services because it reduces

hardware requirements and simplifies network maintenance and administration.

### **National ISDN 1 compliant**

The DMS PH meets the requirements of National ISDN-1 and serves as the platform for compliance with later TR phases.

### **Bellcore TR compliant**

In the US marketplace, the DMS PH is an integral component of the DMS SN switch, capable of providing Bellcore TR compliant packet services. It is based on the LPP developed for CCS7 STP. The LPP is also being deployed for CCS7 SSP, for Ethernet interfaces, for Operation Support Services (OSS) interfaces and for Frame Relay Services. TR standards follows the guidelines with regard to required market functionality for National ISDN-1 (NI-1) 1992 and beyond.

**Totally integrated peripheral for TR compliance** The DMS PH integrates all ISDN OAM&P functions into the DMS-100 OAM&P system for packet switching services. The requirements of National ISDN-1 and later TRs for integrated OAM&P, OMs, and AMA billing will be fully supported on the LPP/DMS SN platform.

**Common platform** All LPP applications are based on a common DMS SuperNode platform, and share common engineering, administration, maintenance, and operations.

Because multiple applications use common hardware resources, the operating company's hardware investment is protected against obsolescence due to shifts in market demand for services.

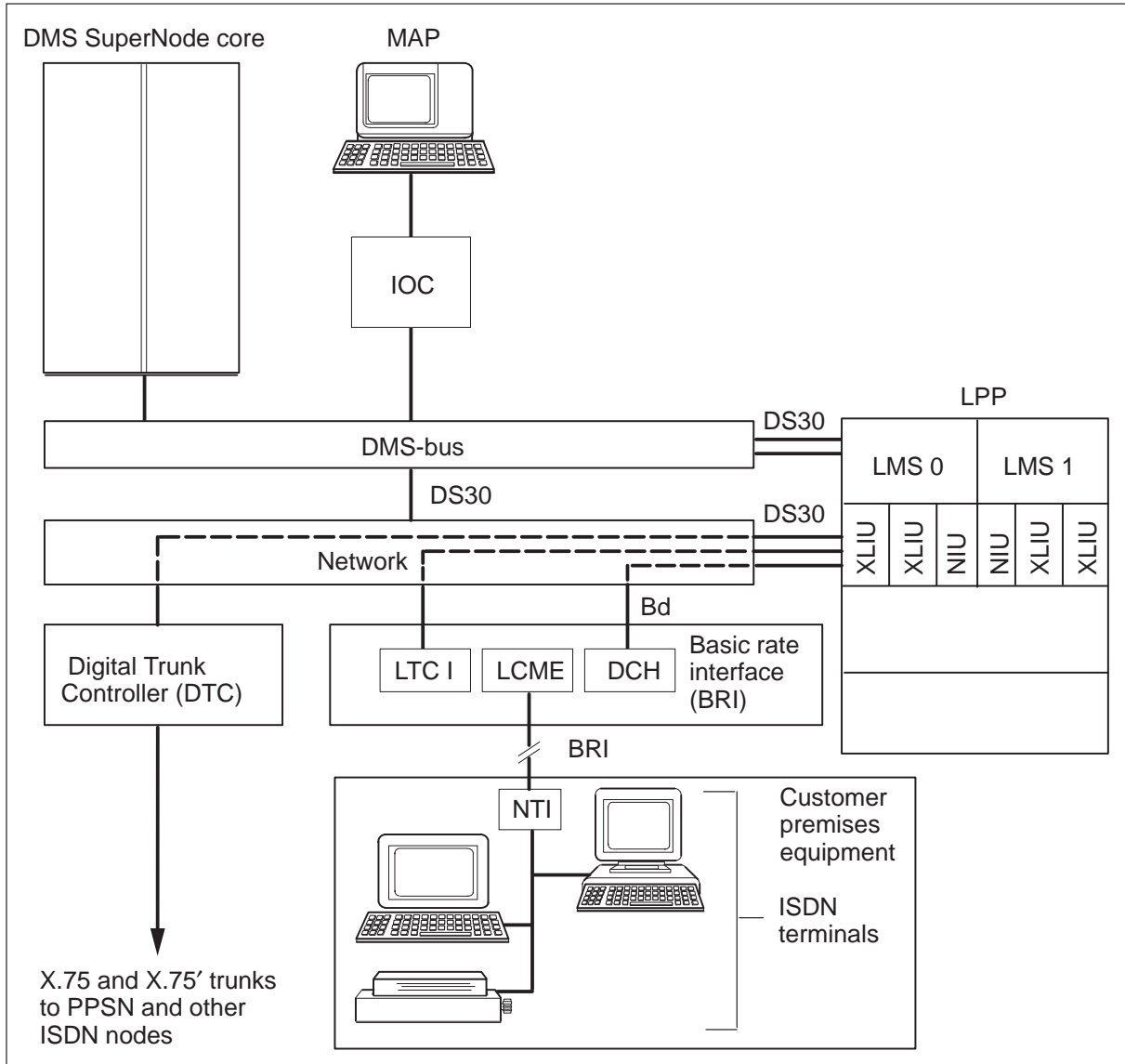
### **DMS Packet Handler on the LPP**

The DMS PH is based on the LPP platform. The LPP provides the protocol processors required for packet switching. It relies on common DMS operations, maintenance and provisioning systems to provide all the OAM functions. To provide for simplified and consistent call services, the DMS PH will rely on the Call Processor of the DMS-Core to provide functions such as Digit translation and Hunt Group processing.

Changing the service mix on the LPP is simple. The various LPP applications are activated by adding the appropriate link interface units and software. This gives the operating company maximum flexibility in deciding which services to deploy.

**Real-time impact** Packet-data transfer performed by the DMS PH has virtually no impact on the DMS-core because X.25 protocol processing is integrated into the LPP. The applications processors of the DMS PH supply full lower-level protocol support for X.25 and X.75/X.75'. The only impact to the DMS-Core is in the call setup, billing, and call teardown.

**Figure 2-38**  
DMS PH in DMS SuperNode



**DMS Packet Handler in the DMS SN**

Figure 2-39 above describes DMS PH as it resides in the DMS SN.

The DPN PH is based on the DPN AM/RM architecture. It is connected to the DMS switch through DS1 links. Integrated provisioning and maintenance is provided through an external workstation based OAM processor.

**DMS-Bus** The DMS-Bus is a hub for communication between system peripheral modules, devices and processors. For greater reliability, DMS-Bus consists of two message switches. Each message switch controls messaging and allows direct communication between multiple applications of the DMS SN, so they can communicate freely with each other.

**DMS SuperNode core** The DMS SN core is the main computing core of the DMS node. DMS core consists of two synchronized computing module planes that manage high level call processing functions.

**Digital Trunk Controller (DTC)** The DTC is the X.75 and X.75' interface to and from the DMS node. It can be used with either the standard DTC or the ISDN Digital Trunk Controller (DTCI).

**Link Peripheral Processor (LPP)** DMS PH is engineered as an application specific unit (ASU) in the LPP. The LPP based DMS PH provides:

- an internal frame bus to provide high messaging throughput
- separate packet processing and data traffic from switch control to ease congestion and engineering
- fully duplicated local message switches
- design for modular growth [three link interface shelves (LIS)]

The LPP processing components that contribute to DMS PH are:

- Local Message Switches (LMS)  
These are message switches that increase both the fan out of the actual message switch as well as intra DMS PH traffic.
- X.25X/X.75/X.75' Link Interface Unit (XLIU)  
The XLIU implements the DMS-100 (DMS PH) product. Up to 10 XLIUs may be provided per shelf (30 per LPP) to provide X.25 and X.75/X.75' protocol handlers. Refer to Figure 2-40 for an architectural view of the LIS shelf.
- Network Interface Unit (NIU)  
The NIU implements channelized access for the ASUs. One NIU is provided per shelf used for DMS PH to terminate DS30 links from the network (network module) and distribute data to XLIUs on the shelf.

One NIU occupies two link interfaced unit (LIU) slots to achieve a fully redundant configuration.

D channel packet traffic is statistically multiplexed and routed over dedicated DS-30 connections (along with provisioned B channel packet traffic) from the switched network to the LPP X.75/X.75'. Trunk traffic is routed to and from the trunk peripherals, allowing the existing digital voice network to interconnect ISDN nodes in a network. Because packet traffic is routed through the switched network, it operates from the OAM&P system of the DMS dual-plane switching matrix.

- provisioned B channel packet (switched directly through network to DMS PH)
- D channel packet is split off of call control in the DCH, statistically multiplexed over dedicated DS-30 connections from the network to the DMS PH.

### DMS Packet Handler hardware

The LPP itself consists of four shelves and comprises two major systems—the Application Specific Units (ASU) and the Local Message Switch (LMS). The ASUs are different types of link handlers and are the protocol-processing engines, such as the LIU7 for CCS7 and the Ethernet Interface Unit (EIU) for connections to 802.3 LANs and Ethernet gateways between the DMS SN and enhanced central-office OAM&P systems.

**Hardware dependencies** The DMS PH requires that the switch be a DMS SN equipped for National ISDN-1 and it is equipped with an LPP/LIM cabinet.

The DMS PH also requires that the DMS bus be equipped with 10 Mbyte of memory.

### Link Interface Unit (XLIU)

The IPF uses the Motorola 68030 processor, performs layer-3 X.25 and X.75/X.75' processing, and serves as the master processor for the HFP. The HFP also based on the Motorola 68030 processor-performs layer-2 LAPD and LAPB processing. OAM functions reside in the DMS-Core, which handles all provisioning data and operations-system (OS) interfaces. As is the case with CCS7 and other applications, the low level DMS PH functions are performed in the XLIU.

**Link Interface Unit (XLIU) cards** The XLIU is a three-card unit consisting of the following cards:

- NTEX22—integrated processor and Frame Bus Interface (IPF) for level 3 processing and F bus access
- NTFX10—High density line controller frame processor (HFP) for level 2 processing

- NTFX09—Channelizedbus Interface Paddle board (CIP) for channel bus (C-bus) access to provide a new High-Speed Data-Link Control Frame Processor (HFP) with redundant access to the channelized data

**Network Interface Unit** The NIU is a fully redundant, six-card unit consisting of two each of the following cards:

- NTEX25—Channel bus controller (CBC)
- NTEX22—Integrated processor and frame bus interface (IPF)
- NTEX28—Link paddle board (LPB) which supports four DS30 links for the DMS PH.

DMS PH services are available on LPPs utilizing the 2-slot link interface shelf (that is, the 36-ASU LPP package). Additional XLIUs can be added, one at a time, to a maximum of ten per shelf. This allows for a total of 30 XLIUs in one LPP. In this configuration, each each XLIU can terminate 512 X.25 D channel terminals, 31 X.25 B channel Ports or 31 X.75/75' trunks. X.25 LAP D and LAP B terminations can be combined on the same processor. Similarly X.75 and X.75' trunks may share the same processor, but may not reside with the X.25 terminations.

One NIU is to be provided per LPP shelf, occupying the two center slot positions on each. The middle slots are utilized to provide the proper power redundancy and to limit the inter-card cable lengths.





### **Transition from DPN to DMS packet handler**

The DMS Packet Handler and the DPN Packet Handler can coexist in the same DMS-100 switching system, and interwork over DS-1 connections through the network.

*Note:* DPN packet handler is being offered up to BCS33 for ISDN. Detailed information on the DPN packet handler is included in at the end of this chapter.

### **Real Time impact**

The LPP-based Packet Handler impacts the Computing Module (CM) real time. Preliminary per packet session timing is 22 ms regardless of number of packets transmitted or received. This timing includes call setup, call takedown and detailed billing.

### **DMS PH provisioning**

The DMS Packet Handler application is based on the LPP/LIM hardware platform. Two additional interface units are being introduced to handle the DMS Packet Handler feature. These units are the Network Interface Unit (NIU) and the X.25/X.75/X.75' Link Interface Unit (XLIU). Both of these units need to be provisioned on a new or existing 36-Link LPP/LIM Cabinet.

The X.25/X.75/X.75' Link Interface Unit (XLIU) provides interface to the X.25/X.75/X.75' protocols. The XLIU handles physical, data link, and network level protocol services. One (1) Link Interface Shelf (LIS) will support up to 10 XLIUs; up to a maximum of 30 XLIUs per LPP cabinet. All the XLIUs must be located in the same LPP cabinet.

Each XLIU should be provisioned using the following rule:

- traffic load of 160 data packets per second (60 percent processor utilization)
- maximum of 512 X.25 D channel terminals
- maximum of 31 channels where each channel can carry:
  - one (1) X.75/X.75' trunk, or
  - one (1) B channel port, or
  - up to 64 D channel terminals

The XLIU must be provisioned for either X.25 lines or X.75/X.75' trunks. For X.25 service, a mixture of B channel and D channel terminals can be provisioned on the same XLIU. Each B channel port consumes one of the 31 XLIU channels. D channel terminals can be statistically multiplexed at a ratio of up to 64 on each XLIU channel to the maximum of 512 per XLIU. Similarly, both X.75 and X.75' trunks can be terminated on the same XLIU,

one trunk for each XLIU channel. Traffic should be estimated on a per channel basis and then channel allocation may be done on a per XLIU basis.

The Network Interface Unit (NIU) allows the LPP to be connected to the switching network such that the the Application Specific Units (ASU) can have direct access to network channels. One NIU will support ten XLIUs. One Link Interface Shelf (LIS) will support one NIU; up to a maximum of three NIUs per LPP cabinet. However, the NIU can only mount on a LIS that has been equipped for Channel Bus (CBus). This is accomplished by equipping the LIS with the NT9X74DA, FBus Repeater CP. The NT9X72EA LIS Common CP Fill contains the NT9X74DA FBus Repeater CP. A Product Change Kit is available for field upgrades of already existing LIS configuration.

### **DMS PH software provisioning**

The DMS PH is being introduced in BCS34 to VO and limited availability offices, and will be generally available in BCS35. The DMS PH will require the following software packages:

- NTXD44—LPP Master Package (or NTXD87—Single shelf LPP Master Package)
- NTXF93—ISDN Provisioning SERVORD
- NTX750—ISDN Basic Access
- NTXH77—NIU Software Base
- NTXP47—DMS PH Software Base
- NTXP75—ISDN DMS PH SERVORD

Refer to SMSQUERY for the Software Interdependencies of the previous packages.

### **Memory provisioning**

Memory provisioning is impacted by the number of Call Condensed Blocks (CCBs) required for LPP-based packet services. Traditional calculation of CCB requirement does not apply to packet service. Initial view of CCB requirement for LPP-based packet service is recommended as 1000 CCBs per XLIU.

### **DPN packet handler**

Beginning with BCS34 ISDN packet services will be provided through a fully integrated component, the DMS PH. Until then, the DPN PH will be provided for ISDN Packet Services with DMS.

### **Migration of service from DPN PH to DMS PH**

In the future, the migration of existing packet lines will be supported by providing the following capabilities:

- Ability to move service data from the DPN PH to DMS PH

Only service data applicable to DMS PH services will be extracted from the DPN PH configuration. The goal is to minimize manual input and reduce the service interruption time. Permanent Virtual Circuits (PVC) and Closed User Groups (CUG) service data may require some additional provisioning.

- Migration is independent from the ISDN integrated OAM product  
The Integrated ISDN OAM feature packages are not required for the transition, or after all services have been moved to the DMS PH. The DMS PH will still be able to co-exist with the Integrated OAM feature if installed.

- Migration will be transparent to the subscriber.

The subscriber will not be required to modify the terminal characteristics or dialing procedures.

### **DPN bypasses the DMS network**

Access to circuit switched calls is provided over the B channels in ISDN. These B channels are connected through the LTCI/Network (the line and trunk controller for ISDN) as with standard telephone in existing DMS products. Packet switched calls, however, can be provided access over the B-channels as well as the D channels and are connected through the LTCI/DCH destined for the Packet Handler (DPN) totally bypassing the DMS Network.

### **DPN Digital Interworking Unit (DIU)**

The DPN based PH is equipped with a new module called the Digital Interworking Unit (DIU). The DMS-100 ET and the DIU of the PH are interconnected with a DS-1 digital transmission link using the B8ZS coding scheme for zero code suppression. This digital access path will enable the packet mode terminals to gain access to the packet switch network through the DMS-100.

To support the Basic Rate D channel packet mode services, the signaling and packet data are processed by the DCH, and the packet data is then multiplexed (64:1) over DS-0 channels of the DS-1 digital link channels to the Packet Switch.

The DPN PH has these components:

- Digital Interworking Unit (DIU)  
The DIU demultiplexes the DS-1 line from the DMS-100 ET into individual 64 kb/s serial streams for presentation to the Access Module.
- Access Module/Resource Module

The AM provides the protocols to support the user packet mode data. Protocols supported are LAPB for basic access B channel packet data and LAPD for basic access D channel packet data. The RM is the core packet switch of the packet handler. It establishes and maintains virtual circuits for the transfer of user packet mode data and provides X.75/X.75' protocol for interface to the PPSN.

The DPN PH is packaged in standard DPN cabinets. Actual frame configuration is determined by traffic considerations, and for the majority of initial applications, a single cabinet is sufficient.

### **ISDN packet mode services**

The DMS PH offers four ISDN packet mode services:

- D channel packet mode access for X.25 terminals using 1984 CCITT LAPD at the link level (Layer 2), and 1984 CCITT X.25 facilities at the packet level (Layer 3)
- B-channel packet mode access for X.25 terminals using 1984 CCITT LAPB at the link level, and 1984 CCITT X.25 facilities at the packet level
- interworking with PPSNs by way of X.75/X.75' or high speed DPN trunks
- rate adaptation through HDLC interframe flag stuffing as specified in X.31 for X.25/LAPD and SNA/SDLC terminals

The B channel access for packet mode terminals will be dedicated. The dedicated B channel access is similar in functionality to the dedicated X.25 or SDLC access to PPSNs.

ISDN is intended to provide access to various services supported not only by ISDN but also by the other in-place networks, such as PPSNs. The packet mode services offered by the DMS-100 Family ISDN switch include the support of packet mode terminals' access to and from the packet mode terminals (DTEs) on the PPSNs. The DMS-100 Family ISDN switch, as well as the packet switching products, will support the necessary enhancements to 1984 CCITT Rec. X.75 (Bellcore X.75') in order to allow effective ISDN-PPSN interworking.

### **BCS32—DMS SN advanced intelligent networking**

Nortel Networks' portfolio of Intelligent Networking (IN) products and services enables the telephone operating companies to define and produce a wide range of new business and residential services that meet increasingly challenging customer demands. Based on CCS7, IN enables the operating companies to maximize an important market advantage; the ability to add reliable, capacity and services to the public network.

The Advanced Intelligent Network (AIN) allows rapid and efficient service introduction through these new Nortel Networks services.

**Centralized services introduction** Allows services to be introduced on a network level, rather than on a node by node basis. Services function in the same manner, regardless of the node's manufacturer.

**Customized service creation** Enables operating companies to determine the services to be deployed on a own specific timeframe.

**Standard interfaces** Supports a multi-vendor environment.

Starting with BCS32, Nortel Networks introduces the software platform to support the Advanced Intelligent Network (AIN). Whereas previously implementations have been service dependent, that is designed specifically for a single offering such as the 800 Service. AIN is service independent, providing a base to implement a range of revenue-generating activities. Other key AIN goals are to create a service creation environment (SCE) that allows the operating company to initiate and control development of software that operates on any AIN compliant node. Using the network Service Control Point (SCP) to provide global network intelligence, the operating company can introduce and change services from an efficient central database.

Nortel Networks' CCS7 products delivers all these three key Intelligent Network elements:

- DMS-100 SSP (Service Switching Point)—a DMS-100F/DMS SuperNode switching system equipped with signaling capabilities can originate or terminate CCS7 messages and queries to network SCPs.
- DMS-STP (Signaling Transfer Point)—is a highly reliable DMS SuperNode based vehicle for routing messages through the CCS7 network and centralizing access to the network SCPs.
- DMS-SCP (Service Control Point)—is a centralized database that provides network intelligence for IN services. The DMS SCP is a central office compliant system that delivers the robustness and capacity of the DMS SN.

All three Nortel Networks IN nodes comply fully with North American and international standards, giving the operating company the flexibility to implement any individual Nortel Networks IN product in an existing multivendor network. In addition, Nortel Networks' CCS7 portfolio provides telephone operating companies with the substantial advantage of a shared DMS SN platform of common technology from which to implement advanced network services, minimizing costs through uniform training and spares requirements.

## DMS SuperNode integration

The DMS SN switching system allows the telephone operating company to integrate Intelligent Network functions that previously had been configured as stand-alone nodes. A single central office can be configured with any combination of SSP, STP and/or SCP functions. Within the DMS SN system these integrated configurations share substantial amounts of hardware and software, thus allowing the telephone operating company to implement new Intelligent Network services, resulting in a newer high degree of operating economy.

With BCS30, the LPP currently used for the DMS STP becomes available to provide high capacity messaging for SSP tandem offices or very large end offices that support multiple CCS7 services.

## Available services

The following currently available services exist in Nortel Networks' concept of Intelligent Networking:

**CCS7 trunk signaling** This implements intra- and interLATA trunking using out-of-band signaling to perform call set-up and takedown. CCS7-based Custom Local Area Signaling Services (CLASS) are also available, offering advanced custom calling features to residential subscribers and small business customers.

**800 service** This allows the operating companies to offer a competitive alternative to Interexchange Carrier (IEC)-provided INWATS capabilities. 800 Service was the first CCS7 offering delivered because of its new and large revenue potential for the operating companies. This services has been installed in more than 350 switches.

**Exchange alternate billing services** This creates software controlled, customized hybrid networks that combine elements from both the public network and private facilities.

**Private virtual networking (PVN )** This creates software controlled customized hybrid networks that combine elements from both the public network and private facilities.

IntraLATA CCS7 Trunk Signaling has been installed in over 200 sites. Through its use of out-of-band signaling, CCS7 Trunk Signaling offers the operating companies considerable OA&M savings over traditional multifrequency (MF) trunking. Furthermore, it is the transport platform for extending the other new Intelligent Networking services across the network. InterLATA CCS7 Trunk Signaling allows local and interexchange carrier connection to extend MDC/ISDN business services and CLASS residential features across LATA boundaries.



A companion Intelligent Network software is the Enhanced Maintenance package which reduces expenses and extends maintenance abilities by providing DS-OA loopback and Bit Error Rate Test (BERT) capabilities for the DMS-STP. The DMS-STP V.35 Subrate Links package enables the V.35 version of the LIU7 paddle board to administer CCS7 links at subrates of 2.4 kb/s through 19.2 kb/s.

### **DMS-100 service switching point (SSP)**

#### **For NT40 and DMS SuperNode**

DMS-100 SSP is a switching system which is available for NT40 or DMS SuperNode based. SSP is equipped with signaling capabilities that enable it to originate or terminate CCS7 messages and queries to network service control points (SCPs). Intelligent Networking services have been available on the DMS-100 SSP for some time. With the DMS SN Link Peripheral Processor, CCS7 messaging for the DMS-STP provides economical signaling for CCS7 access tandems or very high volume end offices that are able to support multiple CCS7 services

#### **Other currently available services**

The Signaling Transfer Point Base and STP Operations software packages provide basic STP functionality and including 18-digit Global Title Translation (GTT) capabilities with interface to the Switching Control Center System #2 (SCCS).

The DMS-STP interface to the Signaling Engineering and Administration System (SEAS) became generally available with BCS27. SEAS is the operating company operations support system (OSS) that reduces operating expenses by providing a single point from which to plan, provision, engineer and administer multiple nodes in a CCS7 network.

DMS-STP Gateway Screening paves the way for the end-to-end delivery of CCS7-based advanced network services by allowing operating companies to control access to their CCS7 databases and to protect against unauthorized use of other CCS7 facilities and services. This capability enables the secure interaction of CCS7 equipment owned by multiple telephone operating companies throughout the nation, permitting advanced features to be extended across local or regional boundaries.

### **DMS-STP (signaling transfer point)**

The DMS-STP, the DMS SuperNode signaling transfer point, is designed to provide efficient, economical and reliable message transfer among the nodes of a CCS7 network supporting revenue-generating advanced network applications such as 800 Service, calling card validation, Custom Local Area Signaling Services (CLASS), Meridian Network Centrex and ISDN networking.



Key advantages of DMS-STP:

- exceptional message throughput
- unique distributed architecture that allows 18 digit global title translation, as well as value added features such as gateway screening, to be implemented without significantly affecting the performance of the switch
- economical expansion through simple plug in provisioning and modular hardware
- DMS SN compatibility
- cost effective integration with other DMS SN applications, such as DMS-100 SSP, the DMS-200 SSP, DMS-SCP and integrated applications processors

DMS-STP has undergone Bellcore evaluation and verification office activities and is now generally available to telephone operating companies in the United States and to the international market.

### **DMS-STP/SEAS interface**

This package allows interface to the Signaling Engineering and Administration System (SEAS). SEAS is the operations support system that provides for the economical planning, provisioning, engineering and administration of multiple CCS7 network nodes from a single, centralized administrative center provided by the telephone operating company. DMS-STP traffic, routing and performance data can be sent to SEAS on a scheduled and/or on-demand basis to deliver the information needed for cost efficient management of the CCS7 network.

Supporting all relevant features in Bellcore's 1.1 SEAS release, the DMS-STP connects to the Signaling Engineering and Administration Center (SEAC) over BX.25 Links. The DMS-STP SEAS interface also increases the nodal power of the operating company's OAM capabilities by providing two new MAP levels that allow local or remote access to DMS-STP specific functions. From these MAP levels, operating company personnel can monitor and modify interactions between SEAS and The DMS-STP.

When SEAS capability is provisioned, the DMS-STP also requires the Multi-Protocol Controller (MPC) to accommodate the BX.25 interface to SEAS. To ensure reliability, one MPC should be provisioned in each of the DMS-STP's two I/O Controllers.

### **DMS-SCP (service control point)**

The DMS-SCP is Nortel Networks' DMS SN based service control point which provides the centralized database that delivers network intelligence for revenue generating Intelligent Network (IN) services. The key benefits of the DMS-SCP include:

- multivendor compatibility through compliance with Bellcore's AIN specifications
- full central office compliancy
- economical expansion through modular architecture
- reduced training and spares inventory costs through commonality with the DMS SN platform
- cost effective integration with other DMS SN applications, including the DMS-100 SSP and the DMS-STP

In addition to the DMS core and DMS bus, the DMS-SCP includes Link Peripheral Processors to provide interface and messaging to the CCS7 network and File Processors (FPs) to respond to database queries. The SCP FP uses Small Computer System Interface (SCSI) to access up to six storage devices to house the data to support IN services. These devices can be either 300 Mb tape drives or 600 Mb disks.

A file processor can process between 30 to 70 queries (depending on query size) and each DMS-SCP can support up to 30 FPs. This modular architecture enables the DMS-SCP to be cost effectively deployed to support initial IN applications and then economically grow in increments up to 1000 transactions/s as CCS7 requirements increase. Three FPs provide a capacity of 100 to 200 queries/s to address the most current query processing requirements. DMS-SCP is scheduled for U.S. verification office activities with BCS33.

### **InterLATA CCS7 trunk signaling**

Nortel Networks' implementation of CCS7 InterLATA Trunk Signaling conforms to the specifications in Bellcore Technical Reference document, TR-TSY-000394, entitled "Switching System Requirements for Interexchange Carrier Interconnection using Integrated Services Digital Network User Part (ISUP)."

Features of InterLATA CCS7 trunk signaling are:

- improved call setup times for interLATA calls, including 800 Service and Private Virtual Networking (PVN) calls
- expands ISDN service across LATA boundaries
- provides the platform for transparently extending MDC business services nationwide to multi location customers
- for residential customers, extends the reach of CLASS and CND, to Calling Number Delivery Blocking and Customer Originated Trace.

The new CCS7 capability is fully compatible with both the existing multifrequency (MF) trunks and intraLATA CCS7 networks. When two different signaling networks are interconnected, InterLATA CCS7 Trunk Signaling is typically deployed in a quasi-associated configuration to use the

gateway screening capabilities of a DMS-Signaling Transfer Point (DMS-STP). The DMS-100 can also provide direct associated signaling between switches.

### **Enhanced SSP/private virtual networking**

A Nortel Networks software feature enhances the base PVN package to provide the following additional capabilities:

**AIOD interworking** The DMS-100 F SSP accepts Automatic Identification of Outward Dialing (AIOD) signaling from a subtending PBX to insert the specific DN of the calling station into the PVN database query

**Priority line** Special users can have their line exempted from the Automatic Dial Gapping controls that are implemented during network overload.

**CCS7 trunk interworking** Allows the DMS-100 Family SSP to accept PVN calls incoming over CCS7 trunks and following the PVN database query, to route the call once again over CCS7 facilities.

**Access to Meridian Network Centrex (MNC) features** MNC/PVN interworking provides PVN access to Number Delivery, Name Delivery and Network Ring Again.

## **Introducing DMS SN SE**

The DMS SN SE is currently being introduced to provide a cost-effective small switch core platform, based upon the DMS SN/Enhanced Network (ENET) technology. This platform contains the proven functionality of the CM/SLM, DMS Bus, LIU functionality, the Network.

In reality, this is a DMS SN base switching system which will meet the needs of the small telephone end office. It offers newly modified control complex with growth potential from an initial installation of less than 2000 lines to 12 000 lines with expansion to 20 000 lines (including POTS, ISDN, PH, and a wide range of business services. However, analysis from our FAST laboratories, that the deployment in applications that exceed 13 000 lines (8000 trunks) should consider expansion to the standard DMS SN.

Basic DMS SN SE applications:

- standalone
- SSP/STP/SCP
- small STP
- cellular
- IEC

- toll
- PBX

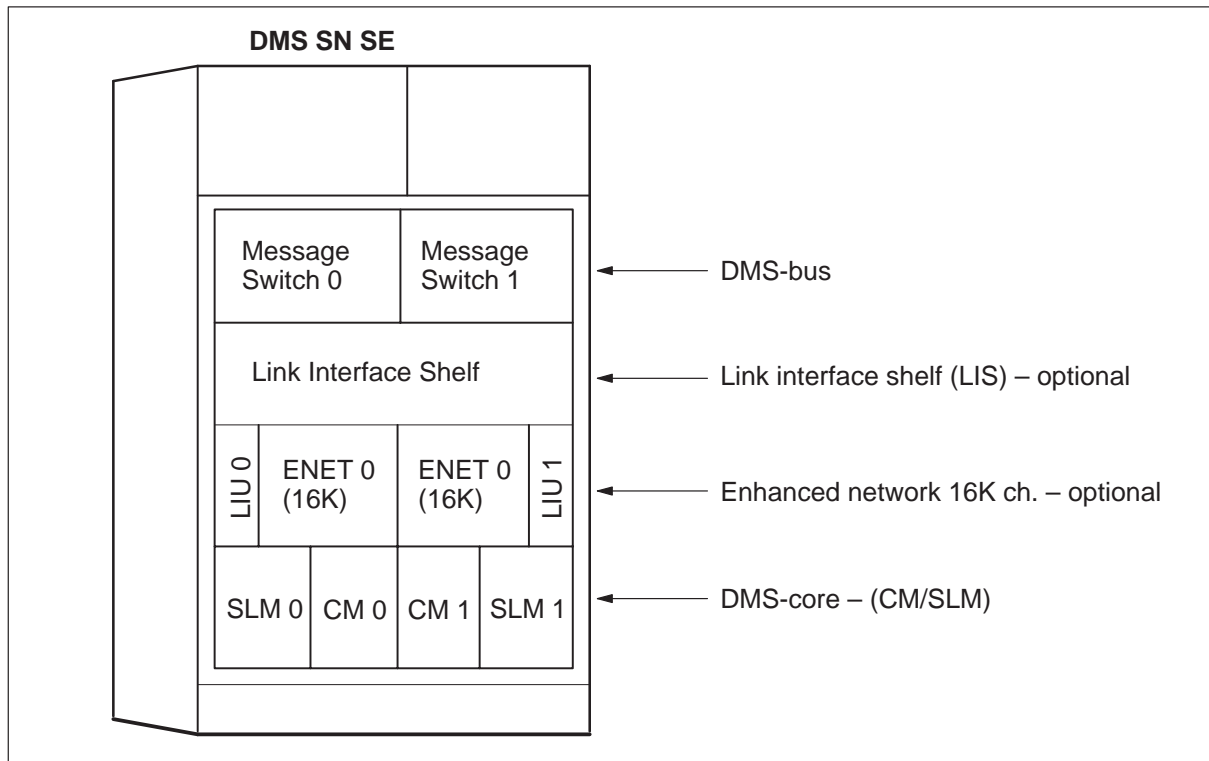
The DMS SN SE retains fully compatibility with the DMS SN's features and services, therefore, extending the application of the standard DMS SN, ENET and LPP technologies to lessor applications than previously considered economical.

**Product description**

DMS SN SE is designed to use the same Call Processing software that is currently being used as well as planned for a DMS-100 and DMS SN office.

The DMS SN SE compatibility is accomplished by using DMS SN type CMs running in sync mode, providing dual plane network, and providing "system level" interfaces the same as a full scale DMS SN. This architecture is basically a scaled-down DMS SN with "open bus" type of architecture.

**Figure 2-41**  
**DMS SN SE description**



**DMS-Bus**

- duplicated message switch on a single shelf
- seven MS slots per side (5 provisional)

**Link Interface Shelf (LIS) – Optional**

- support for additional 12 Interface Units within “Core” cabinet
- support Integrated PH for ISDN

**Enhanced Network 16k channel – Optional**

- duplicated, junctorless, non blocking network (for NX64 services)
- ENET cross points optimized for 16k channel network
- shelf supports two LIU7s for two SS7 links

**DMS Core (CM/SLM)**

- duplicated, synchronized CM
- Series 20 processor capabilities
- five memory card slots per side (24 M or 96 M at BSC35)
- new SLM 1A(340 M disk and 150 M tape drive)

**DMS SN SE hardware**

The following hardware will be available for the BCS34 release:

- Frame Assembly                      NT9X01MB
- Shelf Assemblies
  - NT9X0610                      Processor (CM)
  - NT9X44AC                      CSLM1A
  - NT9X13NA                      Processor (MS)
  - NT9X35FA                      4 k x 8k Crosspoint CP
  - NT9X13PA                      Processor (16 k ENET)
- Paddle Boards (PB)
  - NT9X62CA                      4 link SR512/Dual OOB Reset
  - NT9X69BA                      16 link DS30

The SE core will interface to the existing JNET/DSN networks or to its internal 16 k ENET.

The SE can optionally support a DMS SN standard LIS (Link Interface Shelf). The optional LIS provides up to twelve 2-slot LIUs and connects to the SE core via standard cooper F Bus.

The SE core can support up to 8 JNET network modules (16 k channels), plus up to 6 IOCs when configured for the LECL/IEC market. When configured for the MSL market, SE can support up to 10 JNET network modules and up to 10 IOCs.

The optional SE ENET shelf will support up to 16 k channels of ENET (duplicated) and two 2-slot LIUs.

### **SE software packages**

There is a minor differentiation between the DMS SN SE and the DMS SN in the base software packaging. This has been necessary to support the modified system maintenance and administration necessary for the modified core layout.

NTXD88 is the base master package which provides all the common and bilge software necessary to operate the DMS SN SE's SLM/CM and MS, with the Series 20 DMS SN processor and a SLM1A. It is functionally equivalent to the DMS SN Series 20's NTX960AC.

NTXQ53 is an optional package which enables the LIS shelf, and the LIU slots on the ENET shelf.

NTXC21 is an optional package which enables the 16 k ENET.

These packages provide a software platform equivalent to that of the DMS SN. On to this software platform, the DMS SN family's application packages can be added in the same way as they would to the DMS SN.

### **DMS SN growth potential**

The DMS SN SE provides applications with seamless growth, through provisioning options up to configurations matched to 16 k channels of Enhanced Network capacity.

This typically corresponds to end office applications of 20 000 lines at 5 ccs, and with trunking at 10 percent (or 12 000 trunks).

To allow adequate scope for growth the DMS SN SE is NOT recommended for initial deployment in applications supporting more than 13 000 lines.

Growth from 13 k to 20 k provides a growth budget of 4 percent p.a. compounded over 10 years (or 54 percent).

### **Transition for exceptional growth**

To protect the operating company's investment in the advent of exceptional unplanned growth, Nortel Networks will provide DMS SN SE to DMS SN MOP upgrades. The MOPs permit the replacement of the DMS SN SE modules with standard DMS SN modules.

It is anticipated that the 16 k channel Enhanced Network would be the first module to exhaust. To defer a complete replacement of core and network at the same time, replacement of the ENET 16 k with an external enhanced network would be carried out. This external ENET will have limited provisioning capability off the DMS SN SE's Message Switch. An application dependent provisioning capacity of up to 32 k channels could be anticipated. The next stage in the product's migration is the replacement of

the DMS SN SE's core with a standard DMS SN, and the conversion of the LIS to a fiberized LIS.

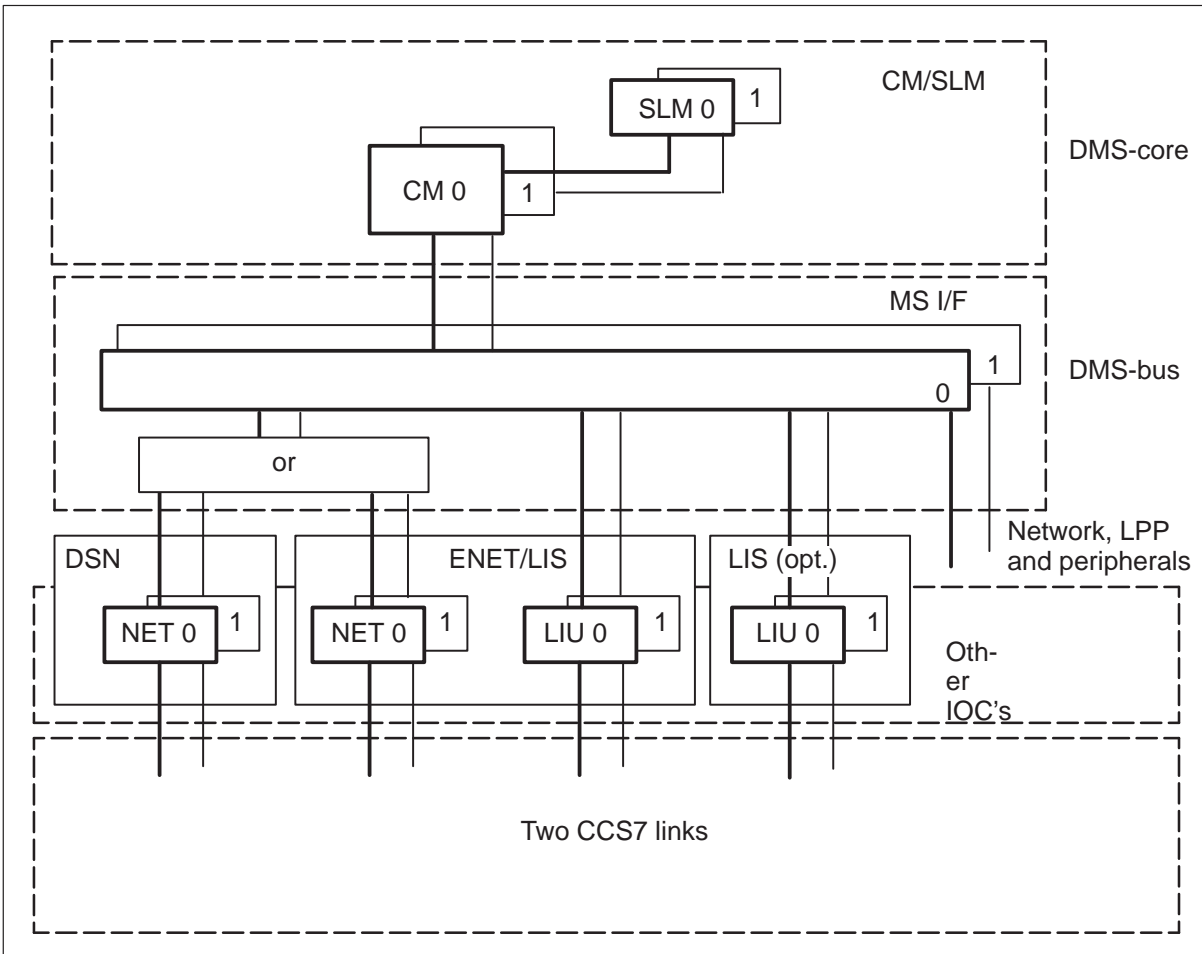
### **S/DMS SN SE – architectural integrity**

The DMS SN SE has not compromised on the issue of maintaining the integrity of and full compatibility with, the evolving S/DMS SN architecture. The SE maintains full compatibility with the evolving (FiberWorld version) S/DMS SN family product line—the FiberCenter, and the Nortel Networks' vision of FiberCenters.

Whether it is replacing COs or upgrading DMS switches, deployment of the DMS SNe SE prepares the network for future technologies associated with FiberWorld. S/DMS SN SE is compatible with Series III peripherals.

As a hybrid wire/fiber center, DMS SN SE allows the telephone operating companies to provide Dialable Wideband Service, integrated Digital Cross Connect, and future Wideband services.

**Figure 2-42**  
**Retains full SN architecture**



### DMS SN Series 50 BRISC processor

The DMS SN Series 50 processor is based on recent technological advances on Reduced Instruction Set Computing (RISC). BRISC is the Nortel Networks' version from BNR of Reduced Instruction Computing Set. Generally available in the 1992-93 time frame, the Series 50 processor is installed through a simple, non-service affecting upgrade of a few circuit packets replacements and a new software package. BRISC optimizes the RISC principle of using less computing instructions to increase processor throughput—this call processing technology effectively decreases the average time it takes to process a call.

BRISC maximizes call processing code execution performance with the implementation of several design innovations, including:

- Intelligent Prefetcher—this anticipates and accesses code before it is required by the processor



- Cache Memory—stores frequently used data on a high-speed memory device located on the processor memory board

The Series 50 BRISC processor powers the DMS SN system up to the following capacity:

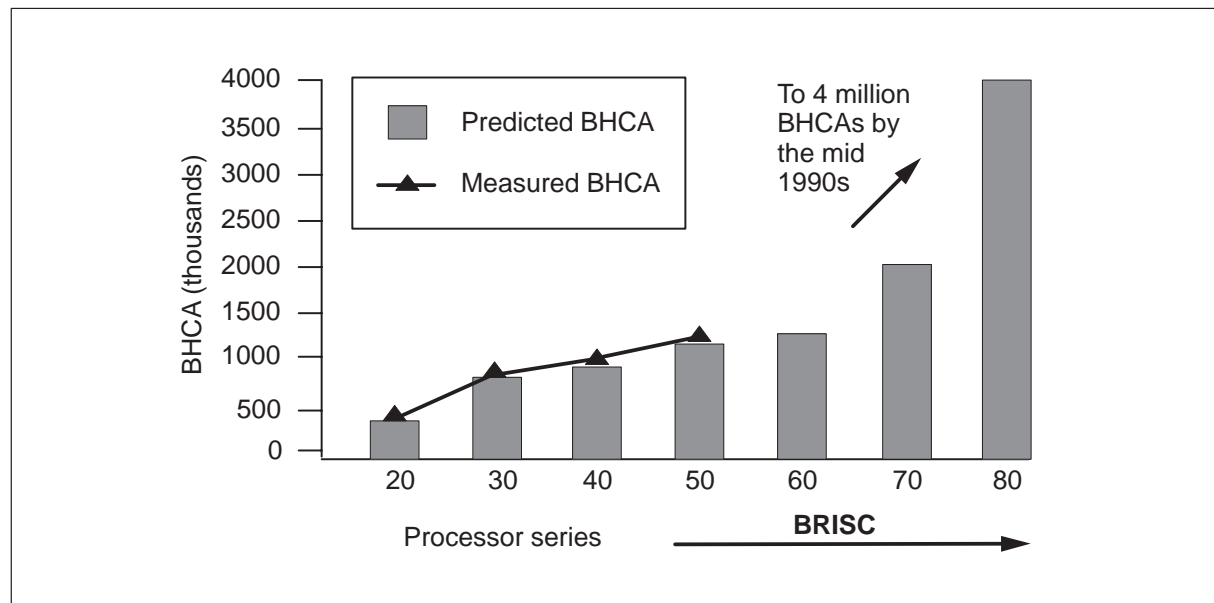
- 1.2 million Busy Hour Call Attempts (BHCA)
- 33 MHz clock
- 24 Mb memory pack
- burst mode memory

The complete portfolio of DMS SN processors comprises the Series 10, 20, 30, 40 and the first BRISC processor, Series 50. Nortel Networks places variety and processor choice to the decision of the telephone operating company. The appropriate amount of computing power, based on the capacity and feature requirements of individual offices, can be selected from the DMS SN processors.

### Evolution of the BRISC Processor

Each new DMS SN processors in the product line are laboratory and field tested and the results has consistently exceeded original capacity projections. Beginning with the Series 50 and during the 1990s, product innovation and evolution will produce dramatic growth in the DMS SN switching capacity.

**Figure 2-43**  
Capacity evolution of BRISC series processors



The projected results are possible due to DMS SN design strategy that uses commercially available components and computing processes ensuring that

the DMS SN system can evolve with the latest technical innovation in the computer industry.

### **BRISC Processor benefits**

The DMS SN Series 50 BRISC Processor offers these benefits:

*Increased capacity*—the Series 50 BRISC processor has more than twice the computing power of the Series 40 DMS SN processor. Increased computing power means increased call-handling capacity as well as the capability to offer additional features and services.

*Revenue opportunities*—revenue opportunities are expanded because the increased capacity of BRISC processing easily accommodates the addition of new subscribers and subscriber areas as well as the addition of advanced features and services to attract the established subscriber base.

*Protected investment*—because the addition of BRISC to the DMS SN system is a program of switch evolution, and not replacement, and because BRISC functionality is transparent to already installed application software, prior product investments are protected.

*Innovative planning*—the capacity reserves delivered by BRISC allow network providers to expand current concepts of central office planning and consider the consolidation of multiple wire centers into a single DMS SN system and offering remote learning and other multimedia centers.

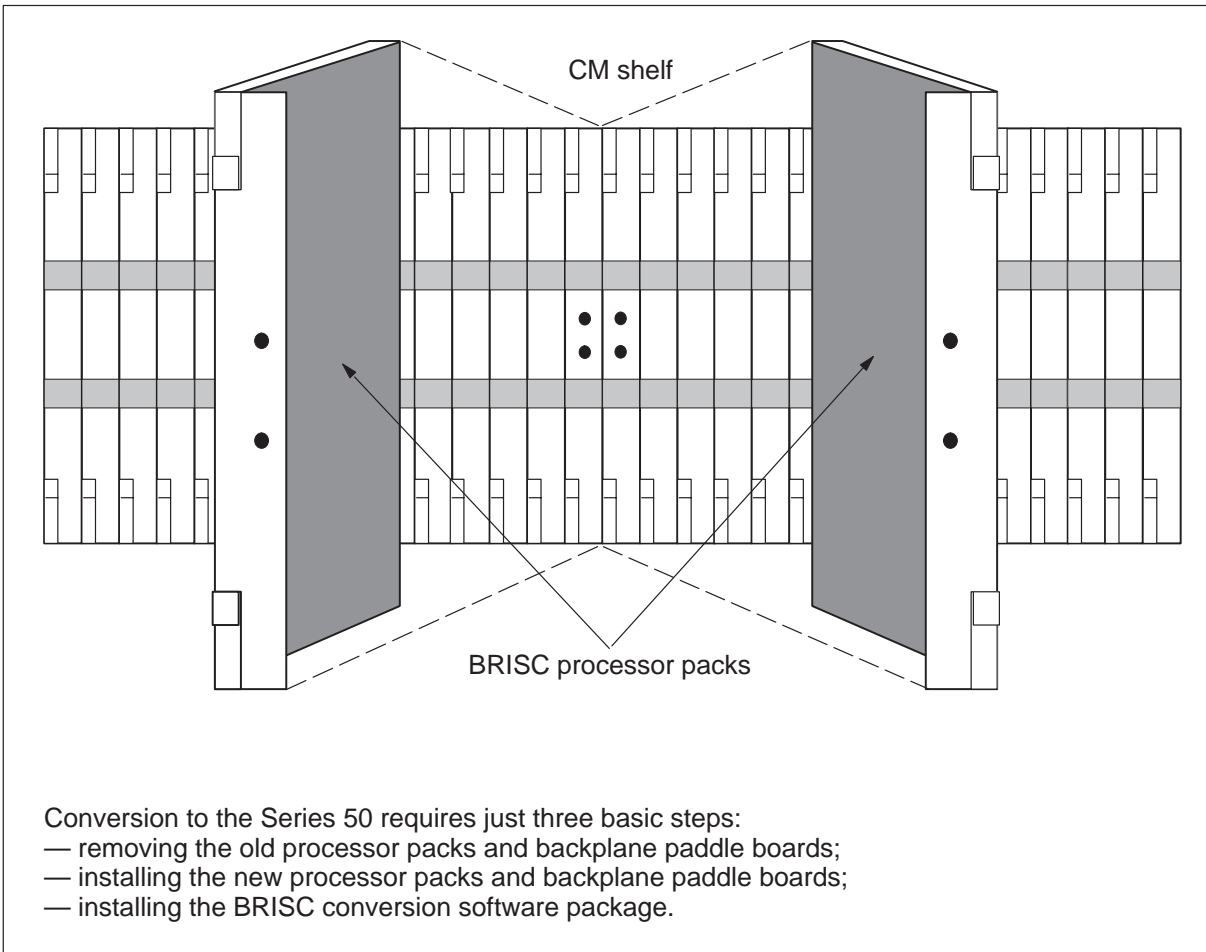
*Easy upgrades*—installation of the Series 50, as well as later BRISC processor upgrades, is accomplished with a simple change out of a few circuit packs in the DMS SN CM and the loading of a BRISC software package.

### **DMS SN conversion to BRISC**

Conversion to Series 50 BRISC processing the the DMS SN system is straightforward. It is accomplished by simply installing the following two circuit packs on each plane of the DMS core CM shelf. The following BRISC CPU feature cards are used in the conversion process:

- NT9X10AA—BRISC processor pack
- NT9X26DA—Remote terminal interface paddle board

**Figure 2-44**  
**Conversion of the Series 50 Processor**



Basic DMS-Core architecture remains unaltered by the procedure, and the changeover does not affect service to customers. The processor upgrade procedure is completed with the loading of a conversion software package. As more powerful BRISC processors become available in the future for the DMS SN system, processor upgrades will continue to require only an exchange of circuit packs combined with the installation of conversion software.

### **Series 50 Processor basics**

The Series 50, as well as future BRISC processors, is based on Motorola's Reduced Instruction Set Computing (RISC) set of microprocessors. Additional software protocols are designed by Nortel Networks to accommodate the particular requirements of large digital switching systems. The Series 50 is one of the first RISC technology based computing modules developed for use in telecommunications.

Basic RISC strategy is to access, process and transmit information efficiently and quickly. RISC does this by retrieving data from a nearby memory source before it is needed by the processor; using parallel code and data paths within the processor; and executing simple uniform instructions, most of which are completed within a single clock of the processor. This reduces the average time it takes to execute a computing task, which results in increased processor throughput.

### **BRISC hardware basics**

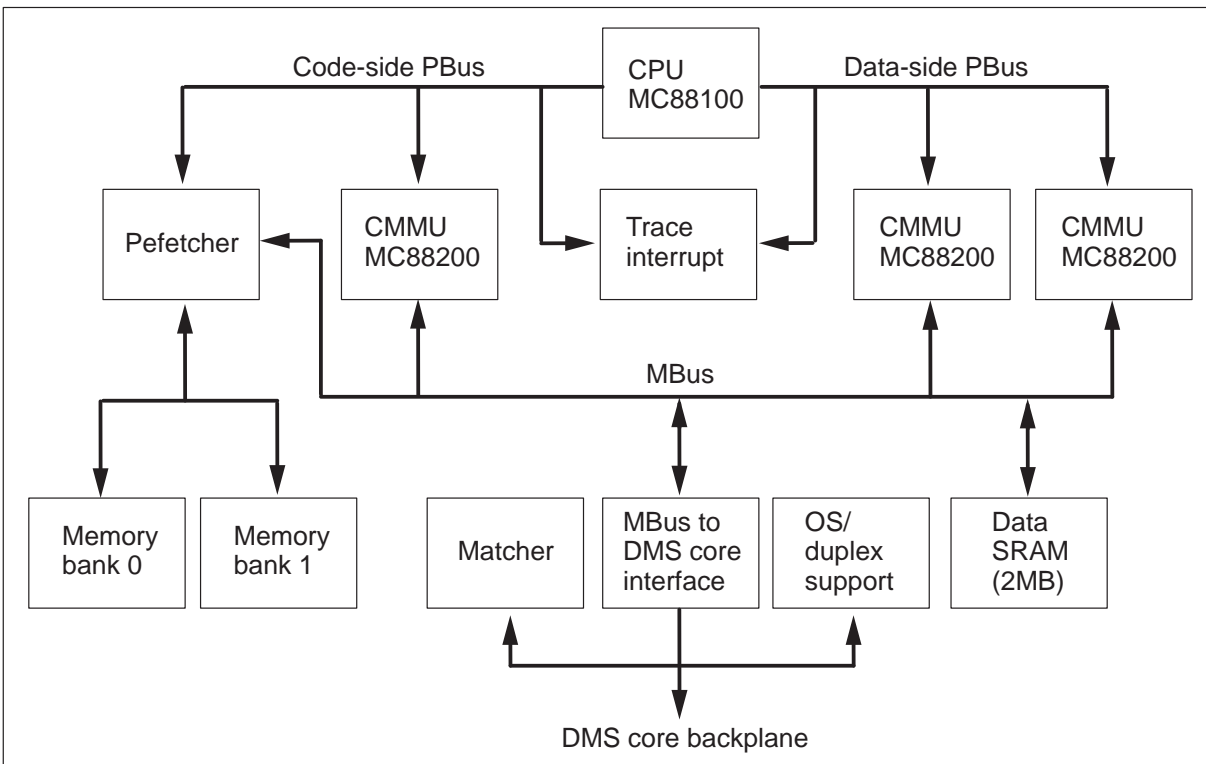
The Series 50 BRISC processor enhances the computing power of RISC and applies it to the particular requirements of digital switching technology with a series of Nortel Networks developed application-specific integrated circuits (ASICs), including the following:

- **Intelligent Prefetcher**—anticipates and retrieves code before it is required by the processor, stores the most frequently used data on a high-speed memory device (cache memory) located directly on the processor board.
- **Trace Interrupt Controller**—monitors and analyzes processor performance.
- **MBus-to-External Bus Interface**—bridges the busses that support the Motorola processor and the DMS-Core.

These unique hardware elements working together enable the Series 50 to capitalize on its own operational efficiencies. As calling traffic increases, the processor performs better, further decreasing call processing times. These functional innovations achieve significant improvements in call-handling capacity, and distinguish the Series 50 BRISC processor from other non-BRISC DMS SN processors.

The figure shown below is an architectural illustration of the Series 50 BRISC processor.

**Figure 2-45**  
**Series 50 BRISC architecture**



### Intelligent prefetcher

The prefetcher is a single-chip interface between the CPU and the Dynamic Random Access Memory (DRAM) array (Memory Banks 0 and 1), and performs several important functions. First, it acts as a controller, constantly refreshing the DRAM and performing error correction on its contents. Second, the prefetcher uses a data request and delivery technique called interleaving to compensate for the difference in operating speeds between the BRISC processor and the DRAM array. Most importantly, the prefetcher improves CPU performance by anticipating information, such as data address, that the processor will next require and then retrieving and delivering that information. Success in delivering this information is extremely high: 97 percent of the requested code arrives at the processor within a single clock period.

### Cache memory

The Series 50 prefetcher also includes cache memory in which prefetched code is stored for later access by the processor. Cache memory divides its instruction buffer into predictive part containing refetched instructions to be executed by the processor and a historical part containing recently used instructions that may be required again by the processor.

Cache memory allows the prefetcher to retrieve information before the processor requests it. To insure as quick a response as possible, cache memory is located within the prefetcher. Because the Series 50 has separate buses for code and data, separate code and data caches are used. This allows for concurrent fetching of code and data without one access slowing down the other.

### **Trace Interrupt Controller**

The BRISC processor also supports observation techniques that are controlled by a sophisticated ASIC called the Trace Interrupt Controller (TIC). The TIC interfaces with the processor directly, tracing software execution (such as memory accesses), logging the location of each event, and signaling when a problem or a specific set of conditions occurs. The TIC can also monitor and analyzes processor performance. The Motorola TIC is more accurate than existing timing tools, which do not interface directly with the processor.

### **MBus-to-External Bus Interface**

Nortel Networks' third new ASIC is a bridge between the buses that support the Series 50 processor and the DMS SN system's DMS Core. This ASIC, call the MBus-to-external bus interface (MEI), ensures that BRISC technology is backward compatible with existing DMS technology. The MEI allows the new processor to interface to circuitry that performs processor checking functions. It also supports the instant switching of system control to a fully redundant alternate processor and memory system. In the future, the MEI will provide even more efficient memory system protocols to support higher performance BRISC processors.

## **BRISC software basics**

BRISC software offers many improvements and efficiencies over non-BRISC processing, some of primary importance are:

- The software maintenance system monitors and controls prefetcher functions. For example, BRISC processor synchronization and its memories like other ASICs and hardware.
- The operating system handles BRISC processor fault handling and interrupt systems. This is the area of the DMS SN compiler that generates the machine code for the BRISC processor.

### **Software compiler**

The DMS SN compiler improves BRISC processor performance by capitalizing on the strengths of the microprocessor. Software machine code produced by the compiler has longer, more orderly sequences than previous machine code, with fewer branches, making the prefetcher more efficient in anticipating addresses required by the processor.

The new compiler also capitalizes on the microprocessor's large set of registers, such as; the internal ultra-fast memory devices, thus maximizing the BRISC machine code's use of these devices. Because registers respond faster than caches, they are used for the information that the CPU requires most. Efficient use of registers is critical to the optimum operation of the microprocessor.

### **Software diagnostics**

All software tests are performed on the inactive CPU, rather than on the active side. This practice prevents possible corruption of the active CPU. BRISC also provides a higher level of test coverage than previous processors because the test software is three times larger than existing non-BRISC diagnostics.

### **Series 50 engineering tools**

With the addition of the Series 50 processor to the DMS SN system, measuring and monitoring switch activity is easier, more accurate, and specific to the BRISC processing. A new method of calculating switch capacity called the Utilization Method has been developed, switch reporting tools and display screens have been modified and expanded, and real time management has been revised and updated for the Series 50.

### **The Utilization Method**

The Utilization Method has no effect on how the processor real time is schedule, but only on how this information is reported. The Utilization Method uses a measurement called COMPLEX, which represents the relative complexity of a switch's calling traffic mix as compared with a standard POTS traffic model, and expresses this mix as a percentage of the POTS model. This comparative method presents a more useful image of call rates and provides a consistent reference measurement of switch activity.

### **MAP screens**

Real time and switch capacity figures are reported on the various display screens of the MAP. Information fields of particular MAP screens, such as the call processing screen, are modified for BRISC-specific calculations, while some fields have been removed and others have been added. For example, a new call processing screen sub-command displays current settings of office parameters and other engineerable factors that affect call processing capacity.

### **Real time planning**

Real time planning and other engineering tools have been updated to reflect significant aspects of BRISC processing. The Real Time Summary Sheet now displays BRISC processor information as calculated using the Utilization Method. Due to the unique performance characteristics of the Series 50, in which BRISC processor real time decreases as calling traffic

increases, new grade-of-service criteria has been applied to the capacity planning process. Results show that the Series 50 guarantees improvements in grade-of-service, such as the percentage of dial-tone delay during peak traffic loads, far beyond current network performance standards.

### **BRISC Processor upgrade requirements / dependencies**

The BRISC Processor upgrade procedure upgrade is a simple one, however, other requirements and dependencies exist in the DMS SN system for the total system conversion from one processor series to another. The following master software packages are required for the installation of BRISC Series 50 DMS SN.

<b>Table 2-3 Master software packages required for installation of BRISC Series 50</b>			
<b>Conversion Hardware</b>	<b>Conversion Software</b>	<b>System Prerequisites</b>	<b>System Dependencies</b>
NT9X10AA BRISC processor pack	NTXD25AA Master Package	NT9X14DB 24 Mb memory package	NTX000AA Bilge
NT9X26DA RTIF paddle board		NT9X12AC CPU port pack	NTX001AA Common basic
		NT9X44AB System load module II	NTX940AA CM Bilge
			NTX941AA CM Common
			NTX942AA SN SLM
			NTXE54AA SLM II sw
			NTX950AA MS Bilge
			NTX951AA MS Common



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## Chapter 3: Features

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A definition of each feature as provided in the DMS-100 Family is given in the following text. For comparison purposes, the Bellcore LATA Switching Systems Generic Requirements (LSSGR), TR-TSY-000064, feature number is shown in the left column. These numbers correspond to the feature numbers in the June 1989 issue of the LSSGR. Feature numbers that are suffixed with an 'A' indicate features that are provided by the DMS-100 switch in addition to those listed in the LSSGR.

### **01-00-0000 Residence and business customer features**

#### **01-01-0000 Resident features**

##### **01-01-0100 Four- and eight-party line**

A four- or eight-party line is a line arranged to serve up to four or eight main stations. Ringing selectivity is dependent upon central office ringing arrangements in accordance with the multiparty ringing Feature 20-08-0000. Reverting calls between four- and eight-party customers sharing the same line are treated in accordance with the reverting call service (see Feature 20-10-0000.)

Identification of an originating subscriber on a four-party line may be provided on an Operator Number Identification (ONI) or Automatic Number Identification (ANI) basis. Eight party lines utilize ONI only.

##### **01-01-1000 Basic business group**

The basic business group features provide the basic capabilities for handling a group of lines associated with a single customer. Basic business group includes provision for special dialing arrangements, special restriction arrangements, and special announcement capability for the switch to recognize the association of the customer's lines as a group. These features are provided through the DMS-100 MDC feature package.

##### **01-01-1010 Business group line**

A business group line provides capabilities similar to an individual line but, in addition, is classed as a member of a group of business lines belonging to a single customer. This group identification is needed for several reasons:

- Calls between group members are accomplished through a special dialing plan that is shared by the group.

- Calls between group members using the special dialing plan can be billed differently from POTS calls using SMDR (see Feature 02-02-1110).
- Calls between group members through the special dialing plan have special traffic measurements.
- Calls incoming to the group or outgoing from the group through Direct Distance Dialing (DDD) have special traffic measurements.
- Private facilities can be shared by group members.
- Features can apply to calls incoming to the group, within the group, outgoing from the group, or any combination of these.
- Attendant consoles may be provided.

### **01-01-1020 Business group dialing plan**

Business group lines share a common group numbering plan:

- intercom dialing on a two- to seven-digit basis
- access to an attendant through the digit “zero”
- access to private facilities through a one- to seven-digit code
- re-definition of feature access codes from standard POTS codes
- overriding this special dialing plan by dialing access code (the digit “nine” usually) to gain access to the standard DDD numbering plan

### **01-01-1030 Critical interdigital timing for dialing plan**

This feature provides the ability to use conflicting variable length codes in a business group dialing plan. Example, both 323 and 3236 can be assigned as station extensions in the same business group. A “#” can be used as an end of dialing code to truncate the interdigital timing where an ambiguity exists.

### **01-01-1040 Intercom dialing**

Intercom dialing is provided in conjunction with the special dialing plan feature to permit lines with the business group feature to place calls to one another on a two- to seven-digit basis. Calls placed in this fashion are not subject to the DDD billing used in the local area. OMs and Traffic Separation Measuring System (TSMS) reports are available for each customer group. In addition, the SMDR feature is used to generate call detail records (see Feature 02-02-1110).

### **01-01-1045A Group intercom (GIC)**

With this feature, intercom groups of various sizes may be established within a MDC customer group. Intercom groups are available in four different sizes:

- up to 10 members—single-digit member numbers from 0 to 9
- up to 100 members—two-digit member numbers from 00 to 99
- up to 1000 members—three-digit member numbers from 000 to 999

- up to 10 000 members—four-digit member numbers from 0000 to 9999

To use GIC, the station user goes off-hook, receives dial tone and dials octothorpe (#) (or the octothorpe equivalent code) followed by the member number of the called party. The member number assigned to the station is independent of the station's regular directory number. A customer group can have more than one intercom group, however a station can only be a member of one intercom group. If the customer group has the SMDR feature, SMDR records may be produced for all GIC calls.

#### **01-01-1050 Customer access treatment code restrictions**

In the DMS-100 integrated business network, class-of-service restrictions can be used to control access to miscellaneous trunk groups and special services, such as tie, Foreign Exchange (FX) and Wide Area Telecommunications Service (WATS) trunks, CCS access line, paging, and dictation. A station is assigned a Network Class-of-Service (NCOS) that defines the trunk groups the station has dial access.

Access to station set features can also be controlled. This is achieved by allowing a station access only to these features supported by its line and customer group data.

#### **01-01-1060 Semi-restricted (originating and terminating)**

In the DMS-100 switch, originating and terminating restrictions are independent of one another in order to provide maximum flexibility. Originating restrictions are handled through NCOS which defines a set of capabilities / restrictions that allow / deny the routing of a call.

Terminating restrictions are handled in two ways:

- Denied Termination (DTM) which blocks all terminating calls
- Terminating Restriction Codes (TRC) which specify the station's ability to receive direct dialed calls and also its ability to receive calls through the attendant

A semi-restricted station is not allowed access to the public network except by way of the attendant.

#### **01-01-1070 Fully restricted (originating and terminating)**

A fully restricted station is not allowed access to the public network either through direct dialing or through the attendant. The methods outlined for handling semi-restricted service are used to accommodate this feature (see Feature 01-01-1060) .

#### **01-01-1080 Business group direct inward dialing (DID)**

With this service, an MDC station user may receive incoming calls without attendant intervention. This feature is a consequence of the direct appearance of the line at the serving switch.

**01-01-1090 Business group direct outward dialing (DOD)**

With this service, an MDC station user can place external calls to the exchange network without attendant intervention by dialing the DOD access code, receiving a second dial tone, then dialing the external number.

**01-01-1100 Business group automatic identified outward dialing (AIOD)**

This feature provides identification of the calling business group line (see Feature 01-01-1010) for AMA recording purposes. This feature is a consequence of the direct appearance of the line at the serving switch.

**01-01-1110 Class: distinctive ringing call waiting**

This is a call management feature which enables a subscriber to select a group of directory numbers from which incoming calls are identified at the called station by a distinctive ring or tone.

The Distinctive Ringing Call Waiting (DRCW) screening list may be modified by the operating company through service orders or by the subscriber using access and modification codes. The subscriber may query feature status, activate and deactivate the feature, review the directory number list, and add or delete entries from the list.

DRCW takes precedence over Three-Way Calling (3WC) and Call Forwarding Busy Line (CFBL).

Selective Call Rejection (SCR), Call Forwarding and Selective Call Forwarding (CF, SCF), and Make Set Busy (MSB) take precedence over DRCW.

DRCW alerting treatment may be applied to lines with teen service line, it cannot be applied to secondary directory numbers (SDN).

**01-01-1111A Distinctive ringing**

This feature permits an MDC customer to identify certain call types by applying a distinctive ringing cadence to calls terminating within the customer group. Distinctive ringing produces a different ringing cadence for intragroup and DID calls:

Calls to MDC stations to which distinctive ringing does not apply will cause a ringing cadence of two seconds on, four seconds off (repeated).

Calls to MDC stations to which distinctive ringing does apply will cause a ringing cadence of 1.5 sec. on, 0.5 sec. off, 0.5 seconds on, 3.5 sec. off (repeated).

Enhancements to the existing distinctive ringing capabilities (Generalized Distinctive Ringing) will increase the number of different ringing cadences to five. Association of the various ring patterns to a particular call type is determined through datafill. Five call types can be datafilled to receive Distinctive Ringing Cadences:

- Intragroup
- Intergroup
- MDC trunks “owned” by a customer group
- Group Intercom calls
- all others

#### **01-01-112A Distinctive call waiting**

The distinctive call waiting feature permits the called MDC station to determine whether an incoming waiting call is external or internal to the customer group by providing different tone cadences for the two situations. The different tones have unique applications:

- 1 If the waiting party is external to the busy station’s customer group, then a tone cadence consisting of two bursts separated by silence is applied. The lengths of the two bursts as well as the silent portion is specified as an office parameter and is applicable when the distinctive call waiting tone option is applied to the controller’s customer group.
- 2 If the waiting call is internal to the customer group, then the tone applied consists of a single burst, the length of which is also an office parameter.

As implied above, the distinctive call waiting tone feature is optional on a customer group basis. If this feature has not been applied as a feature to the controller’s customer group, then the “single burst” office parameter is used to determine the duration of call waiting tone. This statement applies only to MDC call waiting.

#### **01-01-1115 Distinctive alerting/call waiting indication**

This feature allows subscribers to be alerted with distinctive ringing or call waiting tones when calls are received from directory numbers (DNs) for which they have specified this treatment in their screening lists.

For any incoming calls from a DN on the list, the subscriber is alerted either by distinctive ringing ring cadence: short-long-short) or, if the incoming call is call waited, by distinctive call waiting tones (tone cadence: short-long-short).

The subscriber activates and deactivates the feature by dialing on DR/CW (Distinctive Ringing/Call Waiting access code. Through automatic announcements, the subscriber can receive a report on the status of the feature (that is, activated or deactivated, screened-for DNs, and so on).

Guided by prompts from the DMS switch, the subscriber can easily modify any of the currently specified feature information.

### **01-01-1120 Special intercept announcements**

A unique intercept announcement can be provided to each business customer group. These unique intercept announcements are applicable on three kinds of calls:

Attempting to terminate to nonworking Directory Numbers (DN) assigned to the business customer group.

Originated by business group members through the special dialing plan but to codes which are undefined.

Restricted from terminating to a group member or restricted from originating by group members due to various restriction arrangements, such as fully restricted service, semi-restricted service, code/toll restriction/diversion, and so on.

### **01-01-1130 Single-digit dialing**

MDC translators are provided to accommodate single digit translations for access to preselected groups of stations such as, Group Intercom Service (see Feature 01-01-1045), the attendant, or a particular group of facilities. Translation capabilities include the use of the asterisk (\*) and octothorpe (#) as leading control digits. Single digit station to station calling is not provided, as the DMS-100 switch uses a two to seven digit plan.

### **01-01-1140 Virtual facility groups (VFG)**

This MDC feature package provides the capability to simulate finite resources (lines or trunks) in software. The simulated resources are called VFG. The VFG's restrict the number of simultaneous active calls to the datafilled size (0-2047) of each VFG. Up to 8092 VFG's may be datafilled on each switch.

### **01-01-1141 Traffic expandable SFG**

### **01-01-1150 Usage resisters for business customer traffic**

(Planned for future release.)

### **01-01-1150A Flash translator**

This feature enables the operating company to define translations that interpret the digits dialed after an MDC station's switchhook flash. This is independent of the normal originating translations for that station (for example, the same digits to different routes depending on whether the line was flashed). This feature allows MDC users to customize their translation scheme with regard to flash features.

**01-01-2000 Multiline variety package (MVP)**

This feature permits a POTS type dial plan to be used by small business and multiline residence customers. The MVP intercom feature allows for abbreviated (station-to-station) dialing within the MVP group. MVP customers also have access to features such as call hold, call pickup, call transfer, conference, or call waiting. MVP intercom and other features are accessed by an MVP station dialing (\*) or (#) as the first digit to avoid interference with the POTS dialing plan.

**01-01-3000 Electronic key telephone service****01-01-3100 Electronic business set**

The Electronic Business Set operates with Nortel Networks' MDC to provide the user with pushbutton access to features and directory numbers. Flexibility in feature assignment is provided, the features and lines assigned to each button are programmable in the DMS-100 software.

The business set is operated over a two-wire (single-pair) non-loaded loop which is connected to a business set line card located in a DMS-100 host or a DMS-100 remote. Although the business set terminates on a single line, multiple DN's (each with its own feature set) can appear on the station. A DN can appear on (or be accessed from) more than one station. Status information is provided for each feature and DN appearance.

There are many business set features:

- Automatic Answer Back (AAB) — when implemented on a business set, allows any incoming call to be automatically answered after four seconds. The callers talk through a hands-free unit. When the calling party hangs up, the call is automatically disconnected.
- Automatic Dial (AUD) — allows a business set station user to call a frequently dialed number by depressing the assigned feature key. The user is permitted to change the assigned number stored against the feature key. The feature is assigned to the feature key through the service order system.
- Automatic Line (AUL)—AUL on a business set is a DN feature that may be assigned to individual DN appearances on a business set station, including the primary DN. When an off-hook is reported from a DN appearance to which AUL has been assigned, a connection is automatically established to a predetermined location.
- Busy Override—A user equipped with this feature may, upon encountering a busy signal, break into (override) the busy connection. Feature activation by depressing the Busy Override key results in both parties of the busy connection being notified (by a tone) of an impending override. Subsequently, a three-way call is established consisting of the activating station and the original (busy) parties. Subsequent depressing of the Busy Override key results in disconnection of the unwanted party.



- Call Back Queuing — an extension of Ring Again, which allows a user to make a ring again request on a busy trunk in addition to a busy line. The user may, upon hearing busy tone, reorder tone, or a no-circuits announcement, press the Ring Again key to make a call-back queuing request.
- Call Forward — allows a station user to have incoming calls automatically forwarded to a programmed telephone number. The user programs the number to which calls are to be forwarded by depressing the Call Forward key, dialing the destination number, and then depressing the Call Forward key again to complete the programming. The associated Call Forward LCD is ON while call forward is active.
- Call Park — allows a user to hold a call against a DN, from which it may be retrieved at any station by requesting call park retrieve and dialing the DN of the user who parked the call.
- Call Pickup — enables a station to answer calls incoming to another station in the same call pickup group. The feature is activated, after obtaining dial tone, by depressing the call pickup key.
- Call Waiting—If the user is engaged in a call on a given DN, and another call attempts to terminate on the same DN, the user is notified by the call waiting lamp flashing. The user then may, by depressing the Call Waiting key, autohold the original call and answer the waiting call, alternate between the two calls, or terminate one of them.
- End-to-End Signaling—While in the talking state, a subscriber may signal the far end by using the key pad. The digits are outpulsed forward in the standard DTMF format.
- Group Intercom — allows a customer to terminate on any member of a predesignated intercom group by using abbreviated dialing. This intercom group may have a maximum of 10 members (one digit dialing), 100 members (two digit dialing), or 1000 members (three digit dialing).
- Handsfree Unit — The business set may be equipped with the NT1L00AA Handsfree Unit, which allows operation of the set without use of the handset.
- Call Hold —A user who wished to hold an active call can do so by pressing the Hold key (manual operation) or by selecting another DN (auto-hold operation).
- Individual Business Line — allows a direct "dial 9" trunk to be associated with a DN appearance on the station set. This line will not have access to the features on the business set.
- Intercom — allows the user to establish a voice connection to the loudspeaker of a preselected station. Activation is accomplished by going off-hook and depressing the Intercom key to establish the voice connection. The receiving end may then establish a normal connection by going off hook and selecting the Intercom channel.



- Listen on Hold — Pressing the hold key while in the talking state puts a call on hold. The handset can then be replaced. Depressing the DN key with the handset on-hook connects the talking path to the speaker so that the subscriber can listen while on hold without the requirement of having a handsfree unit.
- Make Set Busy — By activating the Make Set Busy key, the station appears busy to all in-coming calls. The station user is still able to originate calls. The associated LCD will be ON while the feature is active.
- Malicious Call Hold — allows a station to activate a call hold and trace. This results in a printed report of the calling and called party numbers at the central office. The feature is activated by depressing the Malicious Call Hold key while engaged in the call.
- Multiple Appearance Directory Numbers — allows a multiple number of line appearances equipped with business sets to be associated with a single DN. Any line appearance can originate calls on the number, and all line appearances are alerted and can answer an incoming call. Two variations are available: Single Call Arrangement (SCA) and Multiple Call Arrangement (MCA). SCA limits the number of calls which can be set up on the group to one. MCA allows individual calls to be set up by each member of the group.
- MADN Hold (SCA) — allows an outside call to be transferred by the member of a MADN-SCA group receiving the call to another member of the MADN-SCA. The member receiving the call places the outside party on hold. Any other member of the MADN-SCA may then pick up the call by pressing the DN key.
- On-Hook Dialing — Depressing the DN key without lifting the handset causes dial tone to be returned to the speaker on the business set. The user can then dial the called number by any of the usual methods such as, dialing, speed calling, auto dialer keys, and ring again.
- Privacy Release — MADN-SCA normally has privacy associated with an active call, in that other members in the MADN group are denied access to the DN when it is in use. The station engaged in an active call may activate the Privacy Release key causing the DN LCDs on all members of the MADS group to wink. One other member may now enter the call by depressing the DN key (the DN LCDs at all stations go to the ON state), and, once entered, privacy is reestablished. The procedure can then be repeated to add other members to the connection, up to a maximum of 29 members plus the external party.

- Ring Again — Upon encountering a busy number, the station user may activate the Ring Again feature by depressing the Ring Again key and going on-hook. The user may originate and answer other calls, and will be notified by a buzzer tone or LCD wink when the busy end becomes free. To complete the Ring Again, the user selects an idle DN and depresses the Ring Again key. At this point, the previously busy end will be rung. A Ring Again request is canceled by pressing the Ring Again key while it is in an active, but not notification, state.
- Speed Calling — allows the station user to store numbers in a speed call list. Three types are available: speed call short list (SCS) with up to 10 entries; speed call long list (SCL) with up to 70 entries; and speed call user group (SCU) with up to 70 entries. To use Speed Calling, the user obtains dial tone, depresses the speed call key, and dials the one- or two-digit access code. The list of speed call numbers are reprogrammed by the speed call key.
- 3-Way Calling /Call Transfer —3-Way Calling allows the station user to establish a three way conference call. While actively engaged in a call, the user depresses the Conference key, dials the third party, and then connects all three parties by depressing the Conference key once again. Once the three parties are conferenced, the user may transfer the call by pressing the release key or hanging up. Prior to establishing the conference, the calling party may alternate between the called parties by pressing the DN and Conference keys.
- 6-Port Conference — allows a station user to establish a six way conference call. While actively engaged in a call, the user depresses the Conference key, dials the third party, and connects all three by depressing the Conference key again. This procedure is repeated to connect a 4th, 5th, or 6th party. Private consultation is the same as for 3-Way Calling above.
- 30-Port Conference — If the 30-port feature is assigned, the user may add additional 6 port conference bridges until a maximum of 30 conferees are attached.
- Automatic Line and MADN — allows a MADN - SCA/-MCA member to be assigned as an Automatic Line (AUL). In addition, it makes automatic lines compatible with many features and options that do not require initial dial tone.
- Short Hunt — Provides the capability for incoming calls to hunt over a set of DN appearances on a business set in search of an idle DN on which to terminate. The set of DN's can be either standard DN appearances or MADN's, and may include all, or a subset of, the DN appearances on the business set.

- **MADN and conference Interaction** — Allows various types of conference calls, including three-way calls, to interact with MADN hold. As an example, this feature will allow a conference call to be either answered or established by one party, placed on hold and picked up by another party. By using this feature, a secretary can answer or establish conference calls for a manager.

### **01-01-3110A Electronic business set display features**

This feature set provides the user of an electronic business set equipped with the optional 32 character alphanumeric liquid crystal display (LCD) with visual feedback during originating, terminating, programming and feature activation operations of the set. The display provides the user with such information as inter/intra customer group (within same switch) calling party information, called number echoing, feature activation, and so on.

- 1 **Called Number Display** —The display set echoes all input digits during call origination or feature programming. Dialed digits are echoed starting on the bottom line of the display. The upper line reflects the condition of the call.
- 2 **Calling Number Display** —When an incoming call arrives at the prime DN of a display set, information concerning the incoming call is displayed on the upper line of the display. The information displayed varies depending on the originator of the call:
  - For calls within the customer group, the caller's extension is displayed.
  - For calls outside the customer group but within the same switch, (\*\*\*\*\*) is displayed unless an intercustomer group display office parameter is set, in which case the calling party's DN is displayed.
  - For calls arriving on trunks within the same customer group, the abbreviated common language name (six characters) of the trunk group is displayed. If the intergroup office parameter is set, the outside MDC trunk CLLIs are also displayed.
  - For calls arriving from the attendant, the last eight characters of the CLLI for the attendant are displayed.
- 3 **Feature Display** — provides the user with visual feedback on user entered data and call information during the use of other MDC features.
- 4 **Query Time Key** — The business set with display may be equipped with a Query Time key which, when depressed, displays the current time and date in the format:

YY/MM/DD HH:MM

The time and date are displayed for 12 sec., after which the display reverts to its previous state.

## **01-02-0000 Features common to residence and business**

### **01-02-0100 Individual line**

An individual line is a line arranged to serve only one main station although additional stations may be connected to the line as extensions of the main station. Individual lines provide telephone service to residence and business customers. The system is capable of automatically identifying the directory number assigned to a line, based upon the originating appearance to the system. Service-related features such as manual originating, dial pulse dialing, or Dual Tone Multi-frequency (DTMF) dialing assigned to individual lines may vary from line to line within the DMS.

### **01-02-0200 Two-party line**

A two-party line is a line arranged to serve two main stations. Automatic identification of each party and individual ringing capabilities are provided. A two-party line may be used to provide telephone service to residence and business customers. Service related features may vary between parties sharing a two-party line.

Reverting calls between two-party customers sharing the same line are treated in accordance with the reverting call service feature (see Feature 20-10-0000).

### **01-02-0250 Teen service**

This feature provides the capability to assign multiple (DNs) to individual lines. Distinctive Ring patterns are applied to each DN. Distinctive call waiting tone is also provided.

### **01-02-0300 Line restriction services**

#### **01-02-0301 Manual line service**

Manual line service is a service-related feature that automatically requests operator assistance (or attendant assistance in the case of a business group) upon detection of an origination. Since all originations from lines with this service are routed to an operator or attendant, no dial tone is returned to the subscriber. This feature does not affect termination to a line.

#### **01-02-0302 Automatic line**

This feature provides automatic placement of a call to a preselected directory number upon detection of an origination. No dialing is required by the calling party to complete the call. The service may be used for intraoffice or interoffice calls. This feature does not affect termination to the line.

#### **01-02-0303 Warm line**

The Warm Line (WML) feature is basically a time delayed automatic line (see Feature 01-02-0302). If a subscriber with this feature goes off-hook and begins dialing within the time delay period, the call will proceed normally. However, if dialing is not started before the time delay period has elapsed,

the call is treated as an automatic line, whereby a call is automatically placed to a preselected directory number. (This preselected number may be changed by the subscriber at any time).

The time delay is specified on a per-line basis, and may range from 0 to 20 seconds. Subscribers with DIGITONE stations may avoid the time delay by keying the octothorpe to activate the automatic number outpulsing. Warm Line is not available to MDC Lines.

#### **01-02-0400 Free terminating service (FNT)**

With this feature, calls from a class of lines (for example, intraoffice) or from specified trunks to a line designated as a free terminating line are not billed. Intra-office calls are screened by the system to prevent charging of calls to lines with this feature. Interoffice calls completed to free terminating lines may require, depending upon the incoming trunk class, that answer supervision not be returned to the originating office.

Calls to the “official lines” of an operating company are an example of lines which may require free terminating line service.

#### **01-02-0500 Denied terminating service (DTM)**

DTM is a feature whereby the system denies call completions to a line. Plant maintenance calls can be connected to lines with this restriction.

#### **01-02-0550 Denied originating service (DOR)**

DOR is a feature whereby only the customer may receive calls. When a line with this option attempts to originate a call, the line is routed to treatment.

#### **01-02-0600 Code restriction and diversion**

Code restriction is a feature that blocks/allows call completion to customer specified codes for calls that originate in a business customer group. The codes can be from three to ten digits in length and are activated by the operating company. Calls to these codes are denied/allowed depending on the option chosen by the customer.

In a POTS environment, restriction of calls (from NPA/NXX translator) from certain originators is provided through class of service screening (see Chapter 4).

#### **01-02-0610 Toll restricted service**

Toll restricted line service is a feature that restricts the completion of originating calls to a limited area only.

More than one limited area of toll restriction may be provided for a central office.

### **01-02-0620 MDC – IBN-restricted code routing**

The IBN code restriction feature allows a customer to specify a collection of three- through 10 digit sequences that are to be restricted. The restrictions may apply to all of the customer's stations and access lines or the restrictions may apply to selected stations only. The restricted calls are routed to the attendant, an announcement or tone, on a customer group basis.

### **01-02-0650 Outgoing call screening**

See Feature 01-02-0600.

### **01-02-0710 Voice/data protection**

The DMS-100 MERIDIAN Business Services (MBS) offers two types of data protection. The first is the No Double Connect (NDC) option which may be assigned to individual lines within a customer group. When this option is assigned to a line, the DMS-100 prevents interruption or mutilation of data calls caused by the application of warning tones and voice energy associated with attendant camp-on, busy verification, busy override and call waiting. A line assigned NDC cannot use the call transfer or any of the conference features. This option prevents the user of such a line from providing access to data or to computers from other, possibly unauthorized lines. The NDC option is activated/deactivated through Data Modification Order (DMO). The second option uses the Station Activated Do Not Disturb (DND) feature (see Feature 01-02-0751).

### **01-02-0750 Do not disturb**

With this feature calls are protected from interruptions such as, call waiting tones, directed at the busy station and caused by MDC features with exception of attendant busy verification. The attendant busy verification feature will override the active DND on a station, however if the attendant merely attempts to call or to extend a call to the DND station the attendant will receive an alpha indication in the console display that the station is under DND; the call will not be interrupted. This feature can be activated/deactivated from the station set, and may be assigned on a per line basis to MDC lines equipped with 500/2500 sets, and also to individual directory number appearances on the electronic business set. When this feature is active on an idle line and an incoming call is diverted, a momentary splash of ringing (500 ms) will be applied to the line to serve as a reminder that the feature is activated (500/2500 sets only).

### **01-02-0752A Do not disturb**

The DND feature is assigned to MDC stations through service order and is activated/deactivated by the attendant or automatically at operating company specified intervals. This service is especially attractive for hospital applications. DND includes four capabilities:

- 1 Selected Single Station Diversion
- 2 Selected Group Station Diversion

- 3 All Station Diversion
- 4 Attendant Completion of Calls to Diverted Stations

While DND is activated, two conditions occur:

- 1 Busy tone is given to the caller if the call type is station-to-station.
- 2 Non station-to-station calls have four possible routes:
  - The appropriate attendant subgroup
  - A preassigned DN
  - A preassigned route
  - An announcement or tone.

### **01-02-0753A Make set busy**

The MSB feature may be assigned on a per line basis to MDC lines equipped with 500/2500 sets and also to individual directory number appearances on the electronic business set. It allows the user to make a line busy or available to incoming calls by dialing the make set busy activation/deactivation code. While MSB is active on a line, external incoming calls will be given the treatment specified in translations, and intragroup calls will receive busy tone. A variation of MSB, referred to as MSB-Intragroup (MSBI), will enable the user to make the directory number appear busy to intragroup (internal) calls only. External calls will not be blocked.

The MSB feature only affects terminating calls; the user will still be able to place outgoing calls.

### **01-02-0760A Selective call rejection**

Selective Call Rejection is a Custom Local Area Signaling Service (CLASS) feature that allows customers to block subsequent calls from a calling directory number after receiving an undesired call. The customer dials a code that places the last calling party's directory number on a list for rejection. Subsequent calls from the rejected party are intercepted and routed to treatment. Selective call rejection also gives customers the ability to enter additional directory numbers onto the list. Calls from these parties are also intercepted and routed to treatment.

CLASS features are based on Signaling System No. 7 and its ISDN User Part.

### **01-02-0800 Hunting features**

#### **01-02-0801 Series completion service**

Series completion is a feature whereby calls to a busy line are routed to another specified telephone number in the same switching office. More than two lines may be linked to form a series completion list.



Each member of a series completion list has a unique telephone number. A series completion list is not limited to sequential numbers. Calls attempted to a busy line within a series completion list will hunt for an idle line by advancing to the next number in the list until either an idle line is found or all lines are found busy. The originating call will be completed to the first line found idle in the series completion list. Busy tone or other termination treatment is returned only when all hunted lines are found busy.

This feature is not applicable for two-, four-, or eight-party lines. DMS-100 allows up to 8192 hunt groups and a maximum of 1024 lines per group.

In the DMS-100 switch, this feature is known as Directory Number Hunting (DNH).

#### **01-02-0802 Multiline hunt (MLH) service**

Multiline hunting is a feature whereby calls to a busy line are routed to other specified lines without assigning a telephone number to each line. A telephone number is assigned to the first line of a group of sequentially ordered lines that form a multiline hunt group. With this service, when the line associated with the dialed number is found busy, the system hunts only the lines sequentially following the line associated with the dialed number. The call is completed to the first line found idle. Busy tone or other termination treatment is returned only when all lines in the hunt group are found busy.

#### **01-02-0803 Circle hunting**

With this feature, the system tests all lines for busy, within the DNH hunt group regardless of the point of entry into the group, before returning busy tone. The hunt starts at the line terminal associated with the dialed number and continues to the last line in the DNH hunt group and then to the first line until the remaining lines in the DNH hunt group are tested.

#### **01-02-0804 Preferential multiline hunting**

Preferential hunting is a specialized hunt group capability that allows a separate unique hunt list to be assigned to any directory number within the hunt group. This hunt terminates in the regular or circular hunt list for the group if the preferential hunt is unsuccessful.

#### **01-02-0805 Uniform call distribution (UCD)**

The distributed line hunt option in DMS-100 can be assigned to multiline hunting groups to provide equal distribution of incoming calls over the group. With this option, hunting always commences at the subsequent line in the group to the last one that was used. This will ensure that calls are distributed equally throughout the group. DLH is available to POTS and MDC lines.



In addition to the basic capabilities of DLH, UCD is offered as a feature option on MDC lines. UCD allows for an even distribution of incoming calls to a Listed Directory Number (LDN) over a group of 500/2500 stations or electronic business sets. If all stations in the group are busy, new calls are queued and ringing tone is returned to the caller. If the predicted delay exceeds a customer preset threshold, a recorded announcement advising of the delay will be provided. When a station in the UCD group becomes idle, the first call in queue is offered to the station.

Each station in the UCD group has its own directory number. To be eligible to receive UCD calls (calls to the UCD listed DN), a UCD designated station must dial an activation code followed by the UCD directory number of the group to which they belong. Similarly, a feature deactivation code is required to remove the station from UCD operation.

#### **01-02-0806 Stop hunt key**

The stop hunt feature is available to customers who have multiline hunt service. A key at the customer's premises connected to the SPCS through a wire pair is associated, by the switching system, with a given line of the multiline hunt group. Customer activation of the key stops the hunt at the line associated with the key.

#### **01-02-0807 Queuing for multiline hunt groups**

This service allows for an even distribution of incoming calls to a LDN over a group of Unity or other 500-/2500-type sets. This group of stations is called a UCD group. Each station in the UCD group has its own directory number.

#### **01-02-0808 Delay announcement for queued calls on hunt group**

When one or more active stations in a UCD Group are idle, a queue of these agents is formed. As calls to the LDN come in, each call is directed to the first (longest idle) station in the agent queue. When all the answering agents are busy, the incoming calls are queued and the callers receive an audible ringback. When the delay interval exceeds the customer-specified delay threshold, a recorded announcement advising of the delay is provided. When a station becomes idle, the first call in the incoming call queue is sent to the idle station.

#### **01-02-0809 Make busy key**

This feature provides a method for making a group of lines busy to incoming calls. The feature is activated by operation of dedicated keys at the customer premises which inhibit the search for an idle line through a DMS-100 miscellaneous scan point. Incoming calls are given busy treatment such as, hunt forward, whenever the make busy key is activated, regardless of the busy/idle status of the stations(s). This feature is available only for hunt groups and not for UCD stations.

### **01-02-0810A Bridged night number (BNN)**

BNNs can be assigned to DNH, MLH and Distributed Line Hunting (DLH) groups. This feature permits the customer to advertise a different number for night service without requiring a third wire. For example, the customer may advertise that a different DN is to be dialed after 5:00 p.m. If the daytime DN is dialed, hunting as specified for the group will apply. If BNN is dialed, the BNN will be rung. Several BNNs can be assigned, on an individual line basis, to a main hunt group. If required, hunting can take place among the BNN. If the BNN form a hunt group, hunting is sequential unless option Circular Hunting (CIR) is assigned to the BNN group.

### **01-02-0900 Dial pulse dialing**

Dial pulse dialing is a feature that permits a customer to send pulsed DC address signals to the switching system. After line seizure, the system alerts the customer by dial tone of its readiness to receive the dialed address information. Dialed digit interpretation is provided by the system in accordance with the call processing feature arrangements for the central office. The system will ignore dual tone multifrequency (see Feature 01-02-1000) address signals from lines only provided with the dial pulse dialing feature (see Chapter 5).

### **01-02-1000 Dual-tone multifrequency (DTMF) dialing**

DTMF dialing is a feature that permits a customer to send dual tone multifrequency address signals to the switching system. After line seizure, the system alerts the customer by dial tone that it is ready to receive the dialed address information. Dialed digit interpretation is provided by the system in accordance with the call processing feature arrangements for the central office. Lines provided with the DTMF dialing feature are also permitted to use dial pulse dialing (see Chapter 5 B).

### **01-02-1051A Calling number delivery on MDC**

This CLASS feature permits forwarding of the calling party DN to the customer premise. Calls originating from outside the service area are displayed as all zeros. Calls with private DNs are not displayed, but are sent to the Customer Premise Equipment (CPE) as all ones. Customers have the ability to turn on and off number forwarding to their premises.

There are two ways in which customers can prevent their directory numbers from being forwarded to the called party. The first way is by using a service order to prevent the customer's DN from being forwarded to any called party. The second method is by dialing a privacy code to prevent the DN from being forwarded to the called party on the next call only.

CLASS features are based on Signaling System No. 7 and its ISDN User Part.

**01-02-1052A Customer originated trace on MDC**

This CLASS feature will provide a way to help customers combat nuisance calls. This feature allows a customer to trace the last call received. The customer's DN and the DN of the calling party are output to the operating company personnel. (The trace information could instead be routed to a law enforcement agency, if the necessary arrangement were made.)

CLASS features are based on Signaling System No. 7 and its ISDN User Part.

**01-02-1053A Calling number delivery blocking on MDC**

Calling Number Delivery Blocking (CNDB), a CLASS Phase 1 feature, permits the originating subscriber to block the display of the DN on a terminating subscriber's set to which the Calling Number Delivery (CND) feature has been assigned.

To block the delivery of the DN, the subscriber dials an activation code prior to placing the call. The feature is automatically deactivated when the subscriber hangs up. This feature can also be applied in reverse: the originating party can subscribe to permanent blocking of his/her number display. When this is the case, dialing the activation code causes the number to be displayed to the terminating subscriber.

**01-02-1100 Abbreviated Dialing Features****01-02-1101 Speed calling**

Speed calling is a feature that allows a customer to specify a list containing directory numbers, each associated with a unique abbreviated dialing code. On reception of a valid abbreviated dialing code from a line arranged with this feature, the system attempts to complete the call to the associated directory number.

A POTS subscriber may have a short and/or a long speed call list. The short list allows the user to assign called numbers (up to 24 digits) to codes "two" through "nine". The long list allows the user to assign called numbers to codes "20" through "49."

A business customer group subscriber may have a short and/or a long speed call list. The short list allows the user to assign designated numbers (up to 24 digits) to codes "zero" through "nine." The long list (which can consist of 30, 50, or 70 numbers) allows the user to assign designated numbers to codes "00" through "69" provided they do not conflict with codes used for other features.

The speed calling feature is available to individual lines, two-party lines, and individual members (some or all) of a multiline hunt group. For business customer group subscribers, speed calling lists assigned to individual lines may be shared by other lines at the customer's request.

The addresses in a speed calling list are placed in the list by direct input from the customer. In the case of POTS only, the customer speed calling lists are also accessible and modifiable by the operating company.

#### **01-02-1102 Customer changeable speed calling**

Customer changeable speed calling is a feature that provides the services described for the speed calling feature (see Feature 01-02-1101) and permits initial entry and changing of a speed calling list by direct input from the associated customer's line.

#### **01-02-1106 Business group speed calling (short list)**

A business customer subscriber group short list allows the user to assign ten designated numbers to codes zero through nine. The use of the speed calling short list is limited to speed calling individual.

#### **01-02-1106 Business Group Customer/Changeable Speed Calling (Long List)**

A business customer subscriber group long list allow the user to assign 30, 50 or 70 (maximum) stored numbers. Stored numbers are assigned speed calling location codes from 00 to 69. The long List group list are line designated as the controller and only the controller can add, delete or change numbers from the list. Any other member of the group is restricted to the use of the feature only and cannot change the contents of the list.

Changes to speed calling lists are made by overwriting an existing number.

#### **01-02-1200 Call waiting features**

##### **01-02-1201 Call waiting**

The call waiting feature allows a line in the talking state to be alerted by a call waiting tone when another call is attempting to complete to that line. The call waiting tone is only audible to the line with the call waiting feature activated. Audible ringing is returned to the originating line. The service also provides a hold feature that is activated by a switchhook flash. Consecutive flashes allow the customer, with the service activated, to alternately talk to the original party and the new calling party. If the customer with the service activated hangs up while one party is on hold, the customer with the service activated is automatically rung back, and upon answer is connected to the held party.

##### **01-02-1202 Call waiting originating (CWO)**

Call waiting originating is a service which applies call waiting service capabilities on a called line.

When an MDC line with the CWO feature calls a busy MDC line within the same customer group, the caller hears audible ringing, recorded announcement or music instead of busy tone while the called party is

informed through a special tone burst that a new call is attempting to reach him. The called party could then place his current call on hold and answer the calling party. If the called party goes on hook, the station will ring and on answer be connected to the calling party. Call waiting originating service essentially allows the customer to assign call waiting (terminating) service to a called party for the duration of a call. This service is restricted to MDC intraoffice/intragroup calls only.

#### **01-02-1203 Dial call waiting**

Dial call waiting permits a station user to impose call waiting on a busy station by dialing the call waiting feature activation code followed by the station DN. If the called station is busy, the caller will be call waited. While call waited, the originator will hear either audible ringback tone, recorded announcement or music. This feature is restricted to intraoffice/intragroup calls between MDC stations (500/2500 sets).

#### **01-02-1204 Cancel call waiting – POTS**

This feature will allow the POTS customer with call waiting service to inhibit the operation of call waiting for the duration of a single call. The customer dials the call waiting access code, obtains special dial tone, and places a call normally. Call waiting is disabled for the duration of the call and is automatically restored to the line upon disconnect by the subscriber. Calls incoming to a line which has deactivated call waiting are routed to treatment, such as tone or announcement.

#### **01-02-1205 Business group call waiting (BGCW)**

Business Group Call Waiting includes these four features: 01-02-1208, 01-02-1210, 01-02-1202 and 01-02-1203. With this feature, an incoming call encountering a busy station receives audible ringing, while the called, busy station receives a call waiting tone. The called, busy station can then acknowledge the incoming caller and place the existing caller on hold (and alternate between the callers) or can abandon one of the calls. The basic Call Waiting feature applies to attendant extended, Direct Inward Dialing (DID), Enhanced Private Switched Communication Service (EPSCS), and tie-trunk calls. An additional feature, Call Waiting, Intragroup, can be assigned to any line that has the basic Call Waiting feature.

#### **01-02-1208 Call waiting terminating**

Call Waiting Terminating (CWT) informs a busy subscriber in a business group, by the application of a call-waiting tone, that an additional call directed to the subscriber's line is present at the switch. The call-waiting tone is applied only once for a given additional call and only for the line to which the call is directed; the calling line receives audible ringing as if terminating to an idle line and the other party on the original connection receives no indication. The subscriber may accept the incoming call by either disconnecting from the existing call or executing a switch-hook flash.

### **01-02-1210 Call waiting-incoming only**

Two options are available to stations in a DMS-100 business customer group which are assigned the call waiting feature. The basic Call Waiting (CWT) feature will apply to all calls incoming to the customer group from the DDD world. As a further refinement, trunk groups incoming to the customer group (tie, CCSA, and so forth) may be designated as “external” for the purpose of invoking this feature. An additional feature, Call Waiting Intra-group (CWI), can be assigned to any station which is already assigned the basic call waiting feature. CWI allows call waiting on intragroup calls in addition to those allowed with CWT.

### **01-02-1240 Business group automatic callback**

Business Group Automatic Callback (BGAC) allows a calling party encountering a busy station on an intrabusiness group call to be notified when the called station becomes idle. (An intrabusiness group call is a call between two lines in the same business group that is dialed using the intercom dialing plan). If the caller responds appropriately to the notification, the the original call is attempted by the switch.

### **01-02-1241A MDC – station message waiting**

This feature provides notification to MDC station users that a message has been queued against their directory number. A message waiting lamp may be provisioned on the set for visual indication or, if the lamp is not provisioned, an audible indicator (for example, a stuttered dial tone) will inform the user that a message is waiting. The feature can be implemented by either using a message center (see Feature 03-02-0020) where unanswered or busy calls are diverted, or by using a message queuing capability without the use of a message center.

The message center application allows an incoming trunk call and/or an internal call to be automatically routed to the message center if the call is not answered or is busy at the original destination. The called station is provided with an audible or visual indication that a message is waiting, and can retrieve the message by directly accessing the message center.

The message queuing capability of the feature operates as follows: station A calls station B, and B is either busy or does not answer. A flashes the switchhook and dials the call request activate feature code. B, who is provided with an audible or visual indication that another station wishes to be called back, originates and dials the call request retrieval feature code, and A is automatically rung. Since multiple call requests are supported, retrievals will be served in the order of their arrival. Originating and terminating stations must be within the same DMS.



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### **01-02-1242A Voice messaging service**

In addition to the station message waiting (see Feature 01-02-1241) capabilities, the DMS-100 switch can provide an integrated interface to VMX, Inc.'s Voice Message Exchange (VMX). The VMX stores spoken messages that can be retrieved at a later time. Upon retrieval, the user hears the message in the sender's own voice. As a VMX user, the following voice messaging features and capabilities are available.

- A visual (message waiting lamp) or audible (stuttered dial tone) indication is given at the user's telephone when there are "unread" voice messages in the user's personal Voice Mailbox.
- Voice messages can be composed, reviewed, edited, erased, saved, and/or sent to another VMX user.
- Voice messages that are deposited in the user's mailbox can be redirected, together with any voice comments the user may want to add.
- Incoming calls to the user's telephone can be forwarded to the VMX for answering.
- A personal greeting can be composed by the user to greet callers when the user has call forwarded his telephone to the VMX.

Simplified Message Desk Interface (SMDI), a messaging interface designed to provide a universal connection to a variety of voice messaging machines, is planned.

### **01-02-1250 Automatic call back**

This CLASS feature will permit a customer, after reaching a busy station, to hang up and dial the activation code and the busy station directory number to activate automatic call back. When the busy station goes on-hook and the calling station is on-hook, the calling station will receive a distinctive ringing pattern. When answered, a call is automatically completed to the previous busy station.

CLASS features are based on Signaling System No. 7 and its ISDN user part.

### **01-02-1255A Ring again**

This feature allows an MDC station user to be automatically recalled when a previously called busy station becomes idle. When encountering a busy station, the caller flashes the switchhook, dials a code and goes on hook. When the busy station becomes idle it is automatically connected to the originator and rings his set. A distinctive ringing code is used.

This feature only applies if both the originating and terminating MDC stations are served by the same DMS-100. Both stations must belong to the same customer group.

### **01-02-1256A Last number redial**

The last number redial feature enables a subscriber to redial the last called number by dialing a single digit rather than the entire number. This feature is available in the MDC environment for both 500/2500 sets and electronic business sets.

### **01-02-1260A Automatic recall on MDC**

This CLASS feature will permit a customer to have a call automatically returned to the last calling party. If the customer's last calling party is busy when the recall attempt is made, the call is queued until both the customer and the last calling party are idle. When this occurs, the system will re-ring the customer. When the ringback is answered, the last calling party receives power ring, and when answered, the call is completed.

CLASS features are based on Signaling System No. 7 and its ISDN user part.

### **01-02-1265A Executive busy override (EBO)**

This feature allows a station to gain access to a busy station by flashing during busy tone and dialing a feature code. The EBO originator must be an MDC line, connected to busy tone, and assigned the EBO line option. The EBO terminator must be an MDC line in the same customer group as the originating line, in the talking state, connected to a line or trunk and not assigned the Executive Busy Override Exempted (EBX) option. EBO warning tone is provided to alert the terminator prior to establishment of a three-way connection.

### **01-02-1270A Distinctive ringing/call waiting on MDC**

This CLASS feature permits a customer to obtain a distinctive alerting/call waiting indication when called by a selected list of directory numbers. The selected list of directory numbers may be 7 or 10 digit DNs or may be a function of a group of stations belonging to one customer or may be geographic in preference by NPA/NXX. On an originating basis the customer may dial an access code prior to the called station so that the called party receives distinctive ringing or tone.

CLASS features are based on Signaling System No. 7 and its ISDN user part.

### **01-02-1300 Multiway calling service features**

#### **01-02-1301 Three-way calling (TWC)**

Three-way calling is a feature that allows a station in the talking state to add a third party to the call without operator assistance. To add a third party to the call, the three-way calling customer flashes the switchhook once to place the other party on hold, receives special (for example, stutter) dial tone, dials the third party's telephone number, and then flashes the switch hook again to



establish the three-way connection. The second switchhook flash may occur any time after the completion of dialing.

After the three-way connection has been established, the customer with the service activated may disconnect the last party added by a single switchhook flash. The customer with the service activated may terminate the three-way call by disconnecting. Should either of the other two parties hang up while the service-activating customer remains off-hook, the three-way call is returned to a two-party connection between the remaining parties.

### **01-02-1302 Recursive calling**

Recursive calling permits an individual line or a two-party customer to ring and establish a talking connection with the other extensions on that line.

### **01-02-1302A Three-way calling enhanced**

This feature enhances the basic 3WC service (Feature 01-02-1301) to include recursive 3WC capabilities. A noncontrolling party in an existing three-way call is allowed to flash and add another party, thus linking (chaining) two or more three-way conference bridges together.

### **01-02-1304 Usage-sensitive – three-way calling**

This feature will allow a subscriber to activate three way calling and be billed on a per usage basis. To activate the Usage Sensitive Three Way Calling feature, the customer goes off-hook, dials a service access code, receives recall dial tone, and places two calls in sequence as in normal 3WC.

### **01-02-1305 Add-on – transfer and conference calling**

Add-on Transfer and Conference Calling Features provide, to the user, the capabilities to handle more than one call at a time on a given line. The features included in this FSD provide the capability to hold a call and originate an additional call (Call Hold), the capability to form a three-way conference (for example, Three-Way Calling), the capability to redirect a call to another line (Call Transfer), and the capability to create a larger conference (Conference Calling-Six-Way Station Controlled).

### **01-02-1310 Add-on – consultation hold – incoming only**

Add-on is three-way calling excluding intragroup calls. When the call does not meet this criteria the flashes of three-way calling are ignored by the system.

As in three-way calling, the add-on feature allows “consultation- hold” whereby the incoming call prior to the third party add-on is retained in hold, and private consultation between the called and third party is in effect. A subsequent called party switchhook flash removes the hold and enables the three-way transmission path. Once the three-way connection is established, normal TWC operation is provided.

**01-02-1320 Call transfer individual – all calls**

A business customer group station user may transfer any established call to another station. The station user may make the transfer by hanging up or may utilize a switchhook flash to consult with the third party prior to transferring the call.

This assignable feature also includes three way calling.

**01-02-1321 Call transfer – internal only**

This service is a restricted form of the call transfer – all calls feature. It is available to members of an MDC customer group and restricts the allowable transferred-to-terminals to those which are also members of the customer group. The called party system interaction is similar to that during TWC except that when the party with the feature hangs up the incoming or outgoing call is transferred to the third party. The system will disconnect all parties when a transfer is attempted to any party outside the group.

**01-02-1322 Call transfer – individual – incoming only**

This is a variation of the call transfer feature which provides the capability to restrict a station's call transfer feature so that only calls from outside the customer group to the station may be transferred.

**01-02-1323 Call transfer – outside**

This service permits business group stations to transfer calls to stations outside of the business group when the original connection originates or terminates outside the business group or intrabusiness group. Call transfer on controlling party disconnect occurs only if at least one remaining terminal has received valid answer supervision and one terminal remaining on the call will guarantee control of supervision.

**01-02-1324 Call transfer – add-on to fully restricted station**

This feature allows a station user with three-way Conference/Call Transfer feature to transfer calls to restricted stations (that is, stations with the Denied Termination option assigned).

**01-02-1325 Call transfer – inter-centrex screening**

This service restricts transfer calls originating outside the business group only to extensions within the Centrex complex. See Feature 01-02-3000.

**01-02-1326 Dial transfer to tandem tie line**

The call transfer feature is compatible with tie lines. When the consultation hold function is invoked and dial tone is obtained, the station which normally has access to tie lines may dial a call through the tie line and after using the three-way calling feature, transfer the original call over the tie line.

**01-02-1330 Call transfer attendant**

A station user connected to an incoming call can recall the attendant, by either flashing the switchhook or flashing the switchhook and dialing 0, to transfer the call to another station line.

**01-02-1340 Conference calling – six-way station controlled**

This feature enables an MDC station user, after dialing a conference access code, to sequentially call up to five other parties and add them together to make up a six-way call. The procedure followed by the station user after dialing the access code consists of calling each party, consulting with them privately, and then adding them to the conference. To add additional parties, the originating station user flashes the switchhook, receives a distinctive dial tone, and dials the next potential conferee. The conferees can include lines within the customer group, lines belonging to other customer groups, and stations reached through trunks. A variation of this feature is planned for POTS subscribers.

**01-02-1341A Station controlled conference****01-02-1342A Conference calling – station controlled 30-party**

This feature enables an MDC station user to establish a conference call of up to 30 conferees without the assistance of the attendant. Seven feature variants exist, allowing the station (based on its feature assignment) to establish a conference consisting of 6, 10, 14, 18, 22, 26 or 30 parties. The conferees can include lines in the same conference group, lines belonging to other customer groups, and stations reached through trunks.

**01-02-1343A Conference calling – meet-me**

A station in a DMS-100 business customer group can arrange a meet-me conference consisting of up to six parties or up to 30 parties (customer group option) by obtaining the DN of a conference bridge from the attendant, if one has not been previously assigned to the station user. At the specified time of the conference, all conferees can then dial the directory number and be connected together in a conference.

**01-02-1344A Conference calling – preset**

This feature allows an MDC station, trunk or attendant console to establish a preset conference with up to 25 conferees by dialing a specific directory number and invoking simultaneous ringing of the pre-selected conference numbers. The conferees are specified in advance in a data table indexed by the conference DN. When the first conferee answers the conference begins. As others answer they too are added to the conference. The conference is terminated when all of the conferees have disconnect

### **01-02-1350 Call hold (CHD)**

Call Hold (CHD) allows an MDC station user with a 500/2500 set to put a call on hold by flashing the switchhook and then dialing a hold code, for example, 9. This frees the line to originate another call. Only one call per station line may be held at a time. The held call cannot be added to the other call; however, the user can toggle between the two calls. The original connection can be retrieved by dialing the hold code a second time. If the station user hangs up with a party on hold, the user will be rung back and reconnected to the held party when answered.

### **01-02-1352A Permanent hold (HLD)**

This feature allows an MDC station user with a 500/2500 set to hold one active call against its own directory number without attendant assistance. This is done by the station with the permanent hold option (HLD) flashing and dialing the permanent hold access code. The holding station may then go on-hook, but cannot perform other tasks such as originating a second call, etc. The held call may be retrieved from the same station by going off-hook. A reminder ring and recall options are available with this feature.

### **01-02-1400 Call forwarding features**

#### **01-02-1401 Call forwarding variable**

With this feature calls attempting to terminate to a line are redirected to another customer specified line served by the same office or by another office. The customer must activate and deactivate the forwarding function and specify the desired terminating address during each activation procedure. When activated, calls forwarded while the line is idle cause a short (approximately 0.5 sec.) ring on the forwarding line as a reminder that the service is active.

If the call from the calling party to the forwarding line is chargeable, the calling party is billed for that part of the call. If the forwarded leg of the call is chargeable, the forwarding line is billed for the forwarded leg of the call.

#### **01-02-1402 Remote call forwarding (RCF)**

With the RCF feature, all calls to a telephone number are always forwarded to a remote address. This service is similar to call forwarding service with these exceptions:

- 1 forwarding is always activated and not controlled by the customer
- 2 no local office terminal is associated with the dialed number from which forwarding occurs

The number of simultaneous calls which can be forwarded from a specific RCF directory number is definable up to a maximum of 512 through the DMO process.

RCF calls are billed on a per call basis. If the office is equipped with Local Automatic Message Accounting (LAMA), then regular LAMA billing procedures are used. If not, then the calls are routed over a separate Centralized Automatic Message Accounting (CAMA) trunk group which is used exclusively for RCF calls. The separate trunk group is provided to prevent calls encountering ANI failure being routed to the CAMA operator at the CAMA office.

#### **01-02-1403 Call forwarding – usage sensitive pricing**

This feature will allow subscribers to use call forwarding and be billed on a per usage basis rather than a flat rate monthly basis. The difference between subscribers who are flat rate users and those who have usage sensitive pricing is determined by the AMA billing record in conjunction with the telephone operating company downstream processor.

#### **01-02-1404 Call forwarding – busy line (CFB)**

When a DMS-100 business group station with the CFB feature is busy, terminating calls are automatically routed to a predefined station within the customer group.

Three options are available to stations with this feature:

- 1 All calls (DDD, tie trunk, intragroup calls) will be forwarded if the base station is busy.
- 2 Intragroup calls will receive busy. All other calls will be forwarded
- 3 External (outside the customer group) calls will receive busy. All other calls will be forwarded.

#### **01-02-1405 Call forwarding – busy line inhibit make busy**

This feature associates a new Make Busy feature key with a line that has Call Forward Busy (CFB) or Call Forward Busy Line (CFBL) service. When the key is activated, all incoming calls to the base station are always call forwarded, regardless of the busy idle status of the base station.

#### **01-02-1406 Call forwarding – busy line inhibit line busy**

This feature is implemented by service order and introduces the following two new line options – Inhibit Make Busy (IMB) and Inhibit Line Busy

#### **01-02-1407 Call forwarding – don't answer – all calls**

For a DMS-100 business customer group station with the Call Forwarding – Don't Answer feature, a terminating call is automatically routed to another designated station within the same customer group or to the attendant if the call is not answered within a prescribed time. The answer time-out interval (12 to 60 seconds) may be specified on a per line or per customer group basis.

Three options are available to stations with this feature:

- 1 All calls (for example, DDD, tie trunk, or intragroup calls) will be forwarded if the base station does not answer within the prescribed time.
- 2 Intra-group calls will continue to ring the idle station. All other calls will be forwarded.
- 3 External (outside the customer group) calls will continue to ring. Intra-group calls will be forwarded.

### **01-02-1408 Call forwarding over private facilities**

This feature is only applicable to centrex customers who possess call forwarding service and dial access to private facilities. Normally, during the activation of call forwarding, the desired rerouting directory number is specified during the activation procedure and the calls are placed and re-routed over the DDD network. If the centrex customer possesses private outgoing facilities such as FX lines, WATS, CCSA, etc., and has dial access to these facilities, this feature will permit the customer to use the private facilities during the call forwarding activation process. The customer dials the call forwarding activation code, followed by the private facility dial access code, followed by the desired directory number. This feature includes the optional capability for validation of the forward-to number.

The following validation options are offered on a customer group basis:

- Terminating Validation—Call completion results in activation with subsequent call forwarding of incoming calls being made over the private facilities. Failure of call completion requires a subsequent activation within two minutes in order to produce activation.
- Routeable Validation—The forward-to number is translated to validate routeability, no call is placed.
- No Validation—Forward-to number is not validated.

Billing of forwarded calls occurs as in normal call forwarding, however, there are no DDD charges associated with the forwarded leg since private facilities are used.

### **01-02-1409 Remote activation of call forwarding**

A customer subscribing to call forwarding may optionally obtain the remote activation feature, which will provide a dedicated DN per local switch that can be used for remote activation. Any customer may place a call to this remote activation directory number from any station. Calls to this number are answered with a tone or announcement. The caller then dials, through DTMF, their base DN followed by a security code. If the dialed DN and security code match and the customer subscribes to remote activation, confirmation tone followed by dial tone is returned. The customer subscribing to remote activation to call forwarding proceeds with the call



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forwarding activation/deactivation procedure as if at home. This capability is available to both POTS and MDC stations.

### **01-02-1410A Selective call forwarding on MDC**

This CLASS feature allows customers to have only those calls which are from selected parties forwarded. The Selective Call Forwarding (SCF) customer specifies the callers which are to receive special treatment by including their DNs on a screening list. If a call is received from a DN on the customers SCF screening list, the call is forwarded to the remote station.

CLASS features are based on Signaling System No. 7 and its ISDN User Part.

### **01-02-1420 Call forwarding – incoming only**

When a station assigned Call Forward, Busy is busy, all calls are forwarded to a predetermined station within the customer group. An option is available with this feature to prevent the forwarding of intragroup calls. Where a high proportion of incoming calls are of an intragroup origin, this option prevents the remote station from being flooded with calls. This applies where several stations have Call Forward, Busy or Call Forward, No Answer activated to the attendant station. When the base station does not answer an incoming call within the time prescribed by a customer group, the call is routed to either a remote station or the attendant station. An option is available with this feature to prevent the forwarding of intragroup calls to a remote station

### **01-02-1421 Call forwarding – within group only**

This feature is a modification of basic call forwarding service in that it validates, at the time that DMS-100 attempts to forward the call, that the DN to which the call is to be forwarded is an intra-group extension number. If this is not the case, the call is routed to treatment

### **01-02-1430 Call forwarding – busy line – incoming only**

This subset of the call forwarding – busy line feature (Feature 01-02-1404) permits forwarding of external (outside of the customer group) calls only. Intra-group calls which attempt to terminate to the busy station will receive busy treatment.

### **01-02-1440 Call forwarding – don't answer – incoming only**

This subset of the Call Forwarding – Don't Answer feature (Feature 01-02-1407) permits forwarding of external (outside of the customer group) calls only. Intragroup calls will continue to ring the idle line.

**01-02-1450 Call forwarding – sub-features**

Call Forwarding sub-features, (CF) provides its customers with the ability to redirect calls automatically from the customer's network address to another network address. Sub-features of CF provide, for example, redirection of calls when the user's address is busy or redirection of calls when the user does not answer. Sub-features of CF include:

- Call Forwarding Variable (CFV) (Feature 01-02-1401)
- Remote Call Forwarding (RCF) (Feature 01-02-1402)
- Call Forwarding – Usage Sensitive Pricing (USCF) (Feature 01-02-1403)
- Call Forwarding Busy Line (CFBL) (Feature 01-02-1404)
- Call Forwarding Busy Line – Inhibit Make Busy (CFBL) (Feature 01-02-1405)
- Call Forwarding Busy Line – Inhibit Line Busy (CFBLILB) (Feature 01-02-1406)
- Call Forwarding – Don't Answer (CFDA) (Feature 01-02-1407)
- Call Forwarding Over Private Facilities (CFPF) (Feature 01-02-1408)
- Call Forwarding – Incoming Only (CFIO) (Feature 01-02-1420)
- Call Forwarding Intragroup (CFIG) (Feature 01-02-1421)
- Call Forwarding – Busy Line – Incoming Only (CFBLIO) (Feature 01-02-1430)
- Call Forwarding – Don't Answer – Incoming Only (CFDAIO) (Feature 01-02-1440)
- Call Forwarding Variable – Basic Business Group (CFVBBG) (Feature 01-02-1451)

**01-02-1451 Call forwarding – variable – basic business group**

This feature provides business group customers with the ability to activate and deactivate a business group version of the Call Forwarding Variable (CFV) feature (see Feature 01-02-1401). This feature enables Meridian Digital Centrex Call Forwarding, Intragroup (CFI) to automatically validate the directory number entered as the forwarding DN when a MDC station activates CFU/CFI. The following validation options are offered only on a customer group basis:

- no validation of forward-to-DN (current option)
- validation of the correctness of the DN as a routeable number (routing option)
- validation by attempting to complete the call to the target station upon feature activation (terminating option).



**01-02-1452 Overflow registers for remote call forwarding**

Overflow registers are provided in the DMS-100 Family and are inherent in the Operational Measurement features.

**01-02-1500 Compatibility with radio and concentrator systems**

The DMS-100 is compatible with various radio and concentrator systems. Nortel Networks will, upon request, advise of the compatibility of a particular system being considered for application.

**01-02-1600 International direct distance dialing (IDDD)****01-02-1601 IDDD through an operator system**

This feature provides for routing and customer charging of IDDD calls through an operator system. The arrangement provides for direct dialing of station-to-station calls without operator assistance (except for calling party identification where required) for individual, two-, four-, and eight-party, and other customer line types. The arrangement also provides for coin calls and special toll calls, such as person-to-person calls, and calls where the domestic operator can request, in advance, overseas operator assistance.

IDDD calls routed through an operator system are billed through the operator system and require ANI. The calling number must be forwarded to the operator system through ONI when it cannot be done with ANI.

This feature is implemented through DMS-100 translations, primarily the pre-translator (see Chapter 4).

**01-02-1602 IDDD local billing control**

International direct distance dialing local billing control provides for customer dialing of station-to-station overseas calls without operator assistance. Customers dial 011 to indicate a direct dialed station-to-station call followed by a seven- to 12-digit international number consisting of a country code and a national number. Calls with invalid country codes are screened out. IDDD calls are routed to an international gateway. Billing information is recorded by LAMA or forwarded to an automatic message accounting center, depending on the billing methods used by the local office for domestic calls. Operator assisted international calls (prefixed by 01) and special international toll calls (prefixed by 010) are routed through (and billed by) the operator system.

**01-02-1700 Flat rate charge service**

Flat rate charge service is a feature that, for a fixed monthly charge, permits an unlimited number of completed calls from a local non-coin line to a group of specific destinations. The group of destinations is referred to as a flat rate area and is usually located within a geographic boundary surrounding the central office. Two or more flat rate areas may be specified for a central office with some destinations assigned to more than one flat rate

area. No charge recording is required for completed calls to destinations within the originator's flat rate area.

### **01-02-1800 Message rate charge service**

Message rate service is a feature which facilitates charging of local calls. Lines subscribing to this service are billed an amount proportional to the number of local calls. Toll calls are recorded for normal toll billing.

Message rate service is available in DMS-100 on an individual line basis by line class-of-service. Full detailed billing records are provided for local calls from message rate lines. Message rate service requires the DMS-100 to be equipped with LAMA.

Multi-Unit Message Rate (MUMR) service whereby a subscriber has access to several message rate areas or destination code groups is available for DMS-100. The group of destination codes is referred to as a message rate area and may include single message unit and multi-message unit destination codes. A message rate area may include several destination codes from the Home Numbering Plan Area (HNPA) and selected destination codes from Foreign Numbering Plan Areas (FNPA's) (see Chapter 6).

### **01-02-1900 Customer premises message registers**

This feature provides the capability to operate remotely a customer premises message register to visually display the accumulated number of calls originated from certain lines. Full detail billing records are provided for local calls from message rate lines. The number of message units assigned to each destination code within a message rate area is available to the system.

The customer can have the capability to reset the message rate register.

With the availability of the MUMR (Feature 01-02-1800) a customer premises message register may be arranged to display the accumulated number of message units expended on calls from that line.

### **01-02-2800 Call pickup features**

#### **01-02-2801 Call pickup**

An MDC station may answer a call which has been terminated to another station in its Call Pickup group. This is accomplished by dialing a pickup access code while the called station is being rung. If more than one station in the group is being rung, the order of pickup is dependent on the linking of the station numbers (it is circular).

The user must be idle prior to dialing the pickup code. If the station is busy, then the old call must be terminated or held (using the Call Hold Feature 01-02-1351) before the new call can be picked up.

**01-02-2802 Directed call pickup – barge-in (DCBI)**

The DCBI feature permits an MDC station to answer a call that is ringing any other line within the same customer group and served by the same DMS switch.

To answer a ringing set within the same group, the station dials the feature code followed by the extension number of the ringing line. If the called station has already answered the call by the time the instigating station has completed the pickup sequence, the instigating station will barge-in to the answered call and be connected into a three-way call. A warning tone may be applied to both parties of the existing call before the activating station is barged-in. Application of this tone is a customer group option. This feature is available to an MDC user with either a Dial Pulse/Dual Tone Multi-frequency (DP/DTMF) set or an electronic business set.

A terminating line option, directed call pickup barge-in exempt, blocks any attempt by another station with this feature to barge-in.

A terminating line option, directed call pickup exempt, blocks any attempt by another station to pick up a call by means of directed call pickup, either barge-in or non barge-in.

These options are station features; neither can be assigned to attendant consoles.

**01-02-2803 Directed call pickup without barge-in**

The Directed Call Pick-Up Non-Barge-In feature permits an MDC station to answer a call which is ringing any other line within the same customer group and served by the same DMS switch. This feature is available to an MDC user with either DP/DTMF set or electronic business set.

To answer a ringing set within the same customer group, the station dials the feature code assigned to directed call pickup followed by the extension number of the ringing line. If the line being picked up has already answered, the party dialing the pickup code is routed to reorder.

**01-02-2804 Trunk answer from any station**

With this feature, an incoming call to the listed directory number of a DMS-100 business customer group will ring one (or more) suitably located common audible device(s) when all attendant positions are unattended. Any customer group station, subject to class-of-service restrictions, may answer the call by going off-hook and dialing an answer code. The answering station may complete the call to another station in the customer group by means of call transfer.

**01-02-2900A Call park features**

### **01-02-2901A Station call park**

This feature allows an MDC station user to park a call against their own directory number. The parked call may then be retrieved from any station in the customer group by dialing a code and the directory number against which it is parked.

### **01-02-2902A Directed call park**

This feature provides the capability for an MDC station user to park an active call against a directory number other than his own. The user parks the call by dialing a feature activation code followed by the valid MDC directory number that the call is to be parked against. The call can then be retrieved from any station in the customer group by dialing the call park retrieval code and the directory number against which it is parked. An option of requiring a security code for retrieval of the parked call is provided.

### **01-02-3000 Centrex complex**

MDC stations in different customer groups may call each other using abbreviated dialing, in the same manner that callers in the same customer group may call each other by dialing two through five digits. The customer group dialing plans must be non-ambiguous, the same four-digit extension cannot appear in the different customer groups. In addition to this basic capability, the MDC customer group transparency feature provides the ability to associate multiple customer groups with a single common "complex". This feature will enable the operating company to define through datafill the degree of transparency in dialing and feature operation between various customer groups in the same switch. Each customer group can be transparent to other customer groups on the switch, transparent to some subset of the other customers, or non-transparent to other customer groups. Calls between customer groups which are defined as transparent to each other are treated as intragroup calls. Intra/inter-group distinctions in feature operation are enforced accordingly.

### **01-02-3010 Airport centrex service**

See Centrex Complex (Feature 01-02-3000).

### **01-02-3020 University dormitory service**

See Centrex Complex (Feature 01-02-3000).

### **01-02-3100 Main – satellite service**

When a business customer receives business group service at two or more separate switching systems in the same geographic area, but wishes to obtain the same service as if he/she were served by a single switch, main-satellite operation is provided. One of the business customer serving switches is designated as the main and all attendant services are provided from this location. The other serving switches are designated as satellites and all attendant functions are remoted to the main location. Only the main location

has a listed directory number and all Direct Inward Dialing (DID) calls are completed through the main. All the switches are interconnected through the tie trunks for intercom dialing between locations. A separate tie trunk group is used for attendant completed calls, DID calls, and dial 0 calls to the attendant, at the main. Switches serving as satellites should be able to route all requests for attendant service to the main location. Switches serving as the main should be able to recognize calls from tie trunks and flashes over the special tie trunk groups as requests for attendant assistance.

### **01-02-3200 Attendant service**

The Network Attendant service (NAS) feature enhances current Attendant Services by enabling the attendant to extend control over calls where the attendant and other callers are Connected to different switches but are in the same customer group.

### **01-02-3300 Release link operation**

(Planned for future release – BCS to be determined)

### **01-02-3400 LATA wide centrex**

(This feature planned for BCS33 release.)

This feature allows Extended Area Service (EAS) and Meridian Digital Centrex (MDC) types of traffic, each including multiple customer groups, to be served by one trunk group. The result is increased trunking efficiency and simplified provisioning and administration.

CCS7 shared trunking allows a trunk group to maintain the private or public network identity of each call while carrying multiple traffic types and multiple customer groups. The presence of the new CCS7 parameter called Multiswitch Business Group (MBG) gives each private call its own identity.

In addition to providing transparent support of many of the features associated with ISUJP MDC trunking, for MBG calls routed over POTS trunks, some of the customer features that are currently only supported over ISUP MDS trunks are also supported, including:

- Connected Number Display
- Connected Name Display
- Reason Display
- Network Ring Again

### **01-02-3500 Improved centrex industrial package**

### **01-02-3900A LATA wide centrex billing**

This feature enhances the service feature field (Table 12) of the Bellcore AMA Call Code 032 to include information relating to the number of

subscriber digits dialed. This provides the telephone operating company with a method of billing multi-location centrex users (within a LATA) who chose to utilize the Public Switched Network for their private inter-company communications.

In a LATA wide billing configuration, supported originators (MDC lines, attendant consoles, and virtual lines through Direct Inward System Access) are routed through a VFG which has been designated as a Tandem Tie Trunk (TDMTT) facility. The information contained in service feature field Call Code 032 serves as an indication that the TDMTT service is provided through the DDD network as opposed to private point-to-point tie line facilities.

### **01-02-4100 Customer owned premises wiring acceptance test (COPWAT)**

The Customer Owned Premises Wiring Acceptance Test (COPWAT) permits a telephone customer to make a dial tone and ringback test to verify that premises wiring from the Network Interfaces (NI) has been installed correctly. A rotary or DTMF dial telephone set that responds to 20 Hz ringing is used to make this test.

## **02-00-0000 Private facility access and services**

### **02-01-0000 Private facility access**

PVN allows Local Exchange Carriers (LECs) to provide business customers with Private Network functionality that uses any combination of public network and leased facilities through a cost effective customized network from his telephone operating company with access on a per call basis to any interexchange carrier (IEC) or private virtual network for interLATA needs.

In conformance with Bellcore specification TR-TSY-000402 (Issue 1, Nov. 1987), PVN service can be provisioned at a DMS-100 end office or a DMS-100/200 access tandem. The DMS-100 Family Service Switching Point (SSP) interconnects over a CCS7 network with a centralized PVN database at a Service Control Point (SCP) conforming to Bellcore specification TA-TSY-000460.

With PVN enhancements, the following additional features can be provisioned:

The DMS-100 Family SSP accepts Automatic Identification of Outward Dialing (AIOD) signaling from a subtending PBX and inserts the specific DN of the calling station into the PVN database query.

Special users can have their line exempted from the Automatic Call Gapping controls that are implemented during network overload.

CCS7 Trunk Interworking allows the DMS-100 Family SSP to accept PVN calls incoming over CCS7 facilities (see the CCS7 Trunking)

Access to Meridian Network Centrex (MNC) features MNC/PVN interworking provides PVN access to Number Delivery, Name Delivery and Network Ring Again.



### **02-01-0010 Foreign exchange (FX) lines**

An FX line terminates in a distant central office different from the one which would normally provide service to the customer. The customer pays monthly mileage charges for the distance between the normal serving office and the distant (foreign) exchange office to be served from. A customer originating a call on the foreign exchange line essentially draws dial tone from, and dials into the distant exchange and all calls are billed as if dialed from that distant central office. In the DMS-100, FX service may be provided over external facilities connected to an analog line card or may be provided using direct digital interface. 800 service is a terminating-only service that allows a subscriber to receive message calls originating within specified service areas, with the call charges billed to the called party instead of the calling party. The service is provided to one or more dedicated access lines. The 800 service billing information and appropriate service measurements are registered by the AMA recording arrangement serving the terminating exchange. See Chapter 4.

### **20 02-01-0021 800 Service – virtual facility group (VFG)**

With this feature, the number of simultaneous 800 service (see Feature 01-02-0020) calls is restricted by software VFG rather than by the physical size of a dedicated trunk group. This service is only applicable to MDC customers.

### **02-01-0022 Regulatory – two way WATS**

This feature provides Wide Area Telephone Service (WATS) capabilities to the residential environment. The capabilities provided are Enhanced Outward WATS (EOW), Enhanced Two Way WATS (ETW), Inward WATS (INW), Outward WATS (OWT) and Two Way WATS (2WW).

With this feature, the Enhanced WATS capability can be provided to the residential environment by adding the Enhanced WATS package.

### **02-01-0030 Outward Wide Area Telecommunication Service (OUTWATS)**

OUTWATS is provided over one or more dedicated access lines to the serving central office. The service allows customers to make calls to a certain zone(s) or band(s) on a direct dialing basis for a flat monthly charge or for a charge based on accumulated usage. Outward WATS lines can dial station-to-station calls directly to points within the selected band(s) or zone(s), or to reach a WATS operator for assistance.

### **02-01-0031 OUTWATS – virtual facility group (VFG)**

With this feature, the OUTWATS service as described in Feature 02-01-0030, is not provided by a dedicated trunk group. Instead, the OUTWATS traffic shares a trunk group with other outgoing traffic. The restriction on the number of simultaneous OUTWATS calls is achieved by a



virtual facility group, whereby the switching system keeps track in software of the number of simultaneous OUTWATS calls and routes to reorder the attempts that overflow the VFG size. This service is only applicable to MDC customers.

#### **02-01-0040 Tie facility access**

In the DMS-100 system dial access by stations and/or the attendant may be provided by cut-through or senderized operation. Digits dialed after the access code are received by the distant customer group switch and are treated as if they were originated by a station in the distant switch. Calls incoming over the tie trunk from the distant switch are interpreted in accordance with the customer group dialing plan.

#### **02-01-0110 Electronic tandem service (ETS) access**

When a customer subscribes to ETS at a distant switch, an MDC customer group served by the DMS-100 may desire access to that ETS. The access is provided using private facilities. Stations or the attendant in the MDC customer group dial the ETS access code and are cut through to the tie line connecting to the ETS switch. Further dial tone and digit collection are accomplished by the distant ETS switch according to the ETS dialing plan and features assigned to the tie line. The DMS MDC system recognizes seizure and performs digit collection and interpretation through the customer group dialing plan for calls terminating from the ETS through the tie lines.

#### **02-01-0120 Enhanced private switched communication service (EPSCS) access**

When a customer subscribes to EPSCS, the DMS-100 MDC system provides for the ability to terminate access lines to the EPSCS switch. These access lines provide for station and/or attendant origination capabilities and network call completion capabilities. The customer group stations dial the EPSCS access code and gain cut-through access to the EPSCS facilities using the dial access to private facilities feature (see Feature 02-01-0150). Second dial tone is provided from the distant EPSCS switch and the remaining dialed digits are passed or repeated through the local office to the EPSCS switch. The DMS-100 will recognize a seizure of the access line, collect digits, and interpret them through the customer group dialing plan for calls terminating from the EPSCS switch.

#### **02-01-0130 AIOD for EPSCS access**

(This feature is currently not planned.)

#### **02-01-0140 Common control switching arrangement (CCSA) access**

When the customer has subscribed to a CCSA service, a facility is subscribed which provides access to the CCSA network. The access line(s) provides the capability for stations of this customer to gain access to the

CCSA network and/or to receive calls from the CCSA network. Access to the network may be through the attendant, restricted to attendant access, or by the station on a dial-up basis (using the dial access to the private facility feature). When dial access is provided, it may be cut through or senderized. The station dials the access digits (usually the single digit '8') and after an optional second dial tone completes dialing per the CCSA numbering plan. The DMS-100 will recognize a seizure of the access line, collect digits, and interpret them through the customer group dialing plan for calls terminating from the CCSA switch.

#### **02-01-0150 Dial access to private facilities**

When a Centrex customer has private facilities, these may be directly terminated to various customer premise equipment such as a telephone, key set, or Private Branch Exchange (PBX). As an option the Centrex customer may choose to have the facility terminated at the central office and have access to the facility by dialing a unique access code per facility. Thus the customer may go off-hook, dial the appropriate access code, obtain a second dial tone and dial the call as if he/she were directly connected to the selected facility. The private facility may be accessed on a cut-through or senderized basis. In cut-through operation, the DMS-100 seizes the private facility upon recognition of the access code and passes or repeats customer dialed digits. In senderized operation the DMS-100 collects customer dialed digits; seizes the appropriate private facility and then output pulses the dialed digits.

#### **02-01-0160 Tandem tie facility dialing**

When a business has several business customer groups located in different switches and inter-connected by dial repeating tie facilities, the customer may request the MDC cut-through dialing feature. This feature is provided by the DMS serving the customer group which has tie lines to two or more different locations. This feature permits calls coming into the customer group to dial digits which are the access digits for another tie facility. Tandem tie facility dialing returns second dial tone to the distant switch and receives further digits which are tandemmed through this office to the second distant office selected by the access code dialed by the customer in the first distant office. This tandemming process may again be repeated in the next office based on the digits dialed by the originating party and the originating capabilities assigned to the tie line in each office.

#### **02-01-0190A Direct inward system access (DISA)**

The MDC DISA feature permits selected outside callers to dial from the switched network directly into the DMS-100 and gain access to network facilities without attendant assistance.

The caller dials a seven- or ten-digit-DISA directory number or an INWATS-DISA number which provides automatic answer. The caller then enters an authorization code and the called number.

**02-01-1000 Paging services****02-01-1010 Radio paging access**

This feature allows a subscriber to dial a directory number and alert a person on the move by an audible signal from a portable radio receiver associated with the dialed number.

The terminating office outpulses four DTMF digits on a trunk group connected to a control unit external to the switching system. The “thousand” numbers of the directory numbers are usually grouped in several number blocks. The incoming call is completed to the control unit which returns answer supervision and appropriate tones and announcements to the calling end.

**02-01-1020 Improved radio paging**

This feature simplifies and enhances Loudspeaker Paging for users of Attendant Consoles (ACs), Meridian Business Sets (MBSs), and 500/2500 sets by enabling the party being paged to respond by entering a simple answerback code and a one or two digit call-park index code (against which the call is parked) and allowing the paging party to talk to the party being paged (when required), before the final connection is established by the original caller. This feature permits MDC stations and attendants to access customer provided loudspeaker paging equipment. Access is provided for the following paging system configurations:

- single paging system/single zone
- single paging system/multiple zone
- multiple paging systems/single zone per system
- multiple paging systems/multiple zone per system

These configurations are accessed by dialing an appropriate access code, one for each paging system. Multizone systems are supported for DTMF outpulsing only.

**02-01-1040 Code calling access**

This feature permits MDC station users to access customer-provided code call equipment by dialing an access code (lxx) and a called party code. The called party code is transferred to the code call equipment, which in turn activates customer-provided visual/audible signaling devices to alert the called party. The called party can be connected to the calling party by dialing a code call pickup code from any unrestricted MDC station within the system.

**02-01-1050 Dictation access and control**

This feature provides access to and control of customer-owned dictating equipment by station users within a customer group.

A code is keyed to access the dictation recording equipment and control signals are sent by DTMF transmission lines over the voice path. Access to dictation equipment control is subject to originating class of service restriction.

### **02-01-1060 9.6 kb/s data switching**

Datapath provides circuit-switched digital data services for synchronous and asynchronous data up to a rate of 64 kb/s. It uses a standard, non-loaded, two-wire subscriber loop for distances up to 18 000 feet (5.4 km) on 22 gauge cable. It provides Datapath users with a list of features which includes auto dial, speed call, modem pooling, and ring again. Datapath links computers and computer terminals through public or private networks (see Chapter 10).

The implementation of Datapath presents the main advantages of dial-up and point-to-point systems as it provides access through the switched network as well as digital transmission. It offers other capabilities:

- use of existing subscriber loop (no coaxial cable) RS-232C or V.35 interfaces
- elimination of most fixed data configurations
- sharing of modems if needed to communicate with analog trunks or end user modems (modem pooling)
- efficient use of computer ports through queuing and hunting features of the DMS-100 Family
- use of selected DMS-100 Family system and station features

### **02-01-1070 Switched modem pooling**

Datapath uses the end-to-end Data Unit (DU) communications protocol to transmit and receive data over digital facilities. Modem pooling is used to effect data transmission between two DUs over an analog transmission path, or to allow a DU to communicate with an end user modem. As a supplement to the Datapath offering, modem pools are provisioned at the central office. These pools are engineered for a desired grade-of-service, alleviating the need for one modem per line.

Modem pooling allows the DU user to select a variety of modems with different speeds and/or options. The modem pools are stored, processed and manipulated by the Network Resources Selector System (NRS). The NRS tables are datafilled by the customer to meet the customer's needs.

## **02-02-0000 Private facility features**

### **02-02-0010 Customer control**

Customer Data Change (CDC) offers business users a command method of inputting station moves and changes. This capability is provided by a secure

partitioned access to the DMS-100 SERVORD, allowing customers access only to their own stations for all MDC features.

In Business Network Management (BNM) application, this feature allows the end user to control both packet and circuit switched ISDN terminals.

#### **02-02-0020 Customer station change rearrangement**

This feature allows customers to logon to the DMS-100 through dial-up or dedicated circuits and make changes to line data. The changes will only be allowed using the Service Order System (SERVORD). The end user will be allowed to:

- move station numbers
- put lines in/out of service
- add/delete line options
- query lines and DNs

#### **02-02-0030 Selective control of facilities**

This feature allows the customer to logon to the DMS and change the Network Class of Service (NCOS) assigned to their groups of lines, trunks and authorization codes. As the NCOS defines the privilege level of a particular originator, this feature permits the end user to control the dialing capabilities of the various parts of their customer group.

#### **02-02-0040A Customer testing of facilities**

This feature allows a business group customer to access the Trunk Test Position (TTP) level of the DMS-100 MAP for the purpose of testing that customer's own (private) trunk facilities. The user is restricted from testing any facilities on the DMS other than their own private trunks and are restricted from accessing any of the other DMS maintenance levels.

#### **02-02-0090A Business network management interface**

Business Network Management (BNM) provides enhanced network features to the users of DMS-MERIDIAN Digital Centrex service. The functionality provided gives the end user control over their Centrex network services from their own premises (see Chapter 5). Nortel Networks' Dynamic Network Control system (DNC) with BNM software interfaces with one or several DMS-100 MDC switches to provide such features as:

- Call Detail Information
- Traffic Reports
- Automatic Trunk Test Reports
- Network Status/Change
- Trunk Testing
- Killer Trunk Reports

- Station Moves/Changes

**02-02-0100A Tie trunk features**

A tie trunk, by definition, connects two business customer groups. The business customer groups may have a Central Office base service (Centrex-CO) or they may be served by a customer premises switch. Usually all the customer groups are branches of the same corporation. The tie line is a wire pair terminated on the switches serving the two customer groups which are interconnected. The tie line may be used for calls only in one direction or both directions.

**02-02-0200 Outgoing facility group queuing**

The DMS-100 trunk queuing package permits improved usage of facilities (both physical and virtual facility groups) in a private network by allowing the calls to be queued as described in Features 02-02-0201 through 02-02-0206. The package consists of an MDC queuing feature set and a MERIDIAN Switched Network (MSN) queuing feature set. The MDC and MSN feature sets are packaged together and are not available as separate offerings. All of the features of the package are available to MDC subscribers.

**02-02-0201 Deluxe queuing**

See Feature 02-02-0200.

**02-02-0202 Off-hook queuing (OHQ)**

The off-hook queuing feature allows the caller to remain off-hook and wait for a busy facility to become idle. Indication that the call has been placed in queue can be given to the caller by tone or announcement. The caller is held in the first level of queue for a specified time (up to 60 sec.). After this time, other options for completing the call (for example, more expensive route, second level queue) are attempted by the switch. Four levels of queue (maximum four minutes) may be provided.

**02-02-0203 On-hook queuing**

Call-back queuing (also known as on-hook queuing) provides a ring back to the on-hook calling line when a facility for which the call is queued becomes available. CBQ can be activated by the caller after receiving no circuit treatment, after receiving Expensive Route Warning Tone (ERWT) (see Feature 02-02-0360) or during the off-hook queue tone or announcement.

**02-02-0204 Post-queue routing**

The MDC trunk queuing package provides a mechanism for handling queued calls which have remained in queue the maximum interval allowed. The options are specified by datafill and include, but are not limited to, completion of the call over alternate facilities (for example, expensive routes) or routing the call to treatment.



**02-02-0205 Priority queuing**

In the DMS MDC trunk queuing package, distinctions are made between Off-Hook Queuing (see Feature 02-02-0202 ) and Call-Back Queuing (see Feature 02-02-0203). OHQ calls are always higher in priority than CBQ calls. In addition, OHQ calls are given a priority of either 0 or 1. Priority 1 (usually assigned to trunks) is higher than priority 0 (usually assigned to stations). CBQ has four priority levels: 0-3, level 0 is the lowest and level 3 is the highest. Each class of service assigned to a line has a CBQ Start Priority (CBQSP) assigned in datafill. The CBQSP specifies at which level in queue calls will initially be placed.

**02-02-0206 Service protection**

The MDC trunk queuing package provides for priority advancement to ensure at least a minimal level of service for low priority calls.

The placement of a station on a call-back queuing request is based on its CBQ starting priority (0-3). If a low priority call is still queued after a specified length of time, the stations request will be dequeued and requeued at the end of the next higher level. This will continue until the CBQ reaches the maximum priority specified by customer datafill.

**02-02-0300 Automatic flexible routing****02-02-0310 Automatic route selection (ARS)**

The ARS feature allows an outgoing call from a DMS-100 business customer group to be automatically completed by the customer's most preferred route available. If the primary route is busy, the ARS feature automatically tries alternate routes. The order of search is specified by the customer and is usually specified from the least cost route as the first choice to the most expensive route as the last choice.

Routing alternatives available to a specific station are dependent upon that station's NCOS which points to a translator which, in turn, points to a route list. ARS is based upon automatic alternate routing, but introduces the additional feature of call queuing.

**02-02-0320 Deluxe automatic route selection**

Deluxe ARS provides efficient use of off-network calls. A list of facility groups for a given destination is searched (for idle facility) in the order specified by the customer. The routing algorithm may be arranged to take into account time-of-day/day-of-the-week information in order to increase efficiency. Calls may be routed over private or public facility groups.

**02-02-0325A Time-of-day NCOS routing**

This feature provides the capability of mapping normal class of service values into new values based on the time of day, day of week, or day of year, as well as the capability for conditional routing based on Network Class of Service (NCOS). This feature applies whenever requirements call for a time-dependent NCOS; for example, a customer may wish to impose a more restrictive NCOS on calls made after normal business hours or on weekends.

Conditional routing based on NCOS allows for flexible screening of class of service values at the routing stage of the call. For example, calls with a more restrictive NCOS could be routed to treatment while calls with a less restrictive NCOS would be routed over a particular trunk group.

**02-02-0330 Automatic alternate routing**

Automatic route selection (see Feature 02-02-0310) and time-of-day routing (see Feature 02-02-0320) are applicable to both off-network and on-network calls.

**02-02-0331 Uniform numbering**

The simplified dialing feature allows a customer to adopt a destination code based dialing plan for the private network of which MDC is a part. The customer assigns a destination code to each point in the private network that can be reached by the customer's tandem tie trunk network.

This allows subscribers served by MDC to dial a fixed number of digits to reach a called party, regardless of the number of points in the connection. The dialing plan is similar to the DDD network where a subscriber dials; for example, NPA-NXX-XXXX.

Typically, the destination code is composed of an access code to identify access to the customer's private network plus a location code which identifies the end PBX. At the end of dialing, the DMS transforms the fixed length number dialed by the subscriber into a series of access codes and the extension number of the called party. These are then outputted in the appropriate format.

**02-02-0332 Off-network-to-on-network conversion**

The MSN Network Automatic Route Selection (NARS) feature provides least-cost routing to any on-net or off-net location using any suitable combination of on-net and off-net resources. The route taken is transparent to the user and not directly dependent on the digits dialed (see Feature 02-02-1300 for a description of MSN).

**02-02-0333 On-network-to-off-network conversion**

On-network-to-off network-conversion provides off-network routing of on-network calls when no on-network path is available (for example, because of failure or overload).



**02-02-0335A Random conditional routing**

This feature provides the capability to distribute calls over several lists of trunk groups on a percentage basis when the MDC Automatic Route Selection (ARS) feature is provided.

ARS completes calls on the first idle trunk in a route list. Through datafill, the operating company can specify how calls should be distributed over several route lists, with a certain percentage going to each list.

**02-02-0340 Facility restriction level (FRL)**

Facility Restriction Level (FRL) provides control of access to outgoing facility groups. Incoming facility groups and lines are assigned incoming permission levels. Outgoing facility groups are assigned outgoing permission levels. A particular call is eligible to use a given outgoing facility group provided that the permission level associated with the outgoing facility group does not exceed the permission level associated with the incoming facility group or line. The default FRL is an integer associated with a facility group to represent the permission level. (“Default” is prefixed to distinguish this FRL, which is normally associated with a facility group or line, from alternate FRLs resulting from application of a conversion table.) Default FRLs may also be associated with Traveling Class Marks (TCMs) and authorization codes.

**02-02-0341 Attendant control of trunk group access**

This feature permits the attendant to control access to outgoing trunk groups by the operation of corresponding keys.

As stated in Feature 02-02-0340, the DMS-100 implementation of calling privilege control is based on NCOS, LSC, and LSC flag values. Outgoing and two-way trunk groups to which LSC is applicable are also assigned an alternate LSC flag. When attendant control is activated, access to the controlled group will depend on the originators LSC corresponding to the alternate LSC flag. In this way a customer can selectively allow/deny access to a trunk group affected by attendant control. LSC can be associated with incoming trunks, stations and authorization codes.

**02-02-0350 Traveling class marks (TCM)**

The Traveling Class Marks (TCM) feature provides a mechanism for network class of service. Two switches providing private network service to a single customer may be interconnected over private facilities. In this situation, the origination switch may be arranged to signal more than just called-number information to the terminating switch (over the private facility). The TCM represents this additional information and consists of one or more digits appended to the called number. The purpose of the TCM is to allow the passage of class-of-service information through the private network and to influence call routing.

### **02-02-0360 Expensive route warning tone (ERWT)**

This feature provides a per-call method of controlling cost. The customer may designate certain route list elements as expensive for a given destination. When a call is to be routed over an expensive route list element, the caller hears ERWT. After ERWT is heard, the caller has three options:

- remain off-hook and allow the system to complete the call on an “expensive” route
- abandon the call by going on-hook
- activate CBQ (see Feature 02-02-0203). This places the call in queue for the “cheap” routes

### **02-02-0370 Tab manual/time-of-day routing control**

Provides customer control of routing algorithm. Allows manual or automatic changes of the active list of facility groups over which automatic flexible routing hunts to complete a given call.

See Feature 02-02-0010.

### **02-02-0380 Special calls**

The DMS is capable of providing basic uniform numbering (see Feature 02-02-0331) plus access to special dialing patterns such as 10XXX +, 1+, 0+, 011+ and N11. The special pattern must be preceded by the off-network access code (for example, 9).

### **02-02-0390 Seven-digit home numbering plan area (HNPA) dialing**

The DMS is capable of providing access to stations not on the customer network (but within the HNPA), without the need for 10 digit dialing. The dialed number must be preceded by the off-network access code (for example, 9).

### **02-02-0400A Network speed calling (NSC)**

This feature allows a customer to define a list of NSC numbers. The NSC list is defined by using the table editor level of the Maintenance and Administrative Position (MAP). The NSC list may be changed or added to only from the MAP. Each customer group may define up to 1000 NSC numbers which can be assigned, using the MAP, to on-net or off-net numbers. The NSC numbers have priority and restriction class marks available so that low priority users can have their calling class upgraded for pre-programmed business destinations.

The NSC feature is accessed by the system users by means of a dialed feature access code.

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**02-02-1000 Authorization/account codes****02-02-1010 Authorization code for automatic flexible routing (AFR)**

Authorization codes are a set of digits dialed by an MDC/MSN station user and serve the following purposes:

- Identify an authorized user of the network and exclude unauthorized users.
- Record an authorization code in the SMDR record for billing purposes, analysis, and so on.
- Assign a network class-of-service designation to a person rather than to a station or incoming trunk group. A network class-of-service is assigned to each authorization code.

Authorization codes can be from 2 to 14 digits in length and are composed of two parts:

- An authorization code, which can be from 2 to 10 digits. The authorization code portion is fixed in length on a per customer group basis.
- A security code, which can be from 0 to 4 digits length, on a per authorization code basis. In other words, a security code is optional on a per authorization code basis.

Security digits, where used, always follow the authorization code. Security digits are transparent to the user and serve to make authorization codes more secure by seemingly varying the total authorization code digit length for a customer group.

An authorization code entry does not give a user access to the 'world'. Authorization code entry gives the user, for this call only, a different NCOS. The NCOS specifies what Code Restriction Level (CRL), LSC, and so forth which will be applicable to any number the authorization code user subsequently dials.

Once a valid authorization code is input, the attributes of the authorization code, not those associated with the line or incoming trunk group, will prevail for this call.

**02-02-1020 Account codes for AFR**

This feature allows a business customer group customer to add an account number to his own MDC SMDR record for customer allocation of charges. The account code may be entered by the station user at any point during a call originated or terminated by the user. The SMDR record generated will list not only the call detail but also the dialed account code. The account code is specified by the customer and may range from 2-14 digits long;

however, within a customer group, the number of digits in the account code is fixed.

### **02-02-1030 Customer dialed account recording (CDAR)**

This feature allows a customer to add an account number to their own AMA record for customer allocation of charges on billable outward calls. The account code can be entered: prior to dialing the called number, after dialing the called number when prompted by a special dial tone, or during the talking stage of the call.

Customer Dialed Account Codes are also available through SMDR (see Feature 02-02-1020).

### **02-02-1100 Message detail recording**

#### **02-02-1110 Message detail recording (MDR)**

Message Detail Recording (MDR) provides recording the capability of transmitting MDR information to the operating company revenue accounting office (RAO) in the same data stream that is used to transmit AMA billing data. MDR data in the AMA stream allows MDR information from an integrated business network (IBN) customer group to be transmitted to the operating company in the same data recording stream used for AMA billing data.

Authorization codes are used to identify the user, excluding unauthorized users, assign a network class of service (NCOS) to a user rather than a station and record the authorization code in either a station message detailed recording or an AMA record for billing or analysis purposes.

#### **02-02-1115 Generic requirements for MDR access interfaces**

An access interface to a COSS permits the MDR customer to obtain MDR data directly from the switching system. This feature enables the switching system to establish a connection and to transmit the MDR data toward the MDR customer who obtains MDR data through the MDR-CP arrangement.

#### **02-02-1120 Message detail recording of private facility calls through revenue accounting office (MDR using RAO)**

The Message Detail Recording using Revenue Accounting Office (MDR using RAO) feature provides a capability for transmitting Message Detail Recording (MDR) data records to the operating company Revenue Accounting Office (RAO) in the same data stream that is used to transmit AMA billing data records for the switching system. As the RAO processes the received data stream, the MDR data records are separated from the billing data records and the MDR records are forwarded to the customer. The MDR record data is not used for charging purposes.

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In addition to the SMDR capabilities discussed above (see Feature 02-02-1110), MDC/MSN (private facility) detail recording in the Bellcore AMA format is also available. This feature expands the supported Bellcore AMA call codes to include:

- 021 (CCSA Sampling)
- 032 (Tandem Tie Trunks)
- 007 (WATS Station Message Detail)
- 011 (FX on AFR)
- 085 (Electronic Tandem Switched Call)

A complete listing of the Bellcore AMA call codes supported in the DMS-100 Family is provided in Chapter 5 of this document. Appropriate records will be flagged for SMDR segregation.

#### **02-02-1125 AMA data records for derivation of SMDR data at the revenue accounting office**

Station Message Detail Recording (SMDR) is a method of providing Message Detail Recording (MDR) data for a business customer. The MDR data is derived by the Revenue Accounting Office (RAO) through processing of the customer's billing records and from some records that are not normally used for billing purposes.

#### **02-02-1130 Automatic customer message outputting system (ACMOS)**

This feature provides an interface to a customer owned hotel/motel property management system from the SPCS in order to provide call data. ACMOS provides the capability to report all completed local message unit calls to the customer for immediate billing and to identify the calling and called lines on selected intercom calls.

#### **02-02-1200 Traffic data provision features**

##### **02-02-1210 Traffic data to customer**

The DMS-100 provides the capability to transfer Operational Measurements (OM) over a communications link to the Dynamic Network Control (DNC) system for the implementation of Business Network Management (see Feature 02-02-0090).

##### **02-02-1220 Customer polled traffic data**

This feature will permit the customer, using the DMS-100 DPP, to poll the DMS-100 and obtain a prestored set of traffic measurements relating to their private facilities, business group, or both.

##### **02-02-1230 Non-usage trunk scan**

In the DMS-100 the killer trunk feature is provided to detect faulty trunk circuits or facilities that are not detectable by normal call testing. The

characteristic for analysis is abnormally long or short holding times. Assignable registers on a trunk basis accumulate the attempts and connect duration on the trunk. Periodically a process runs through the registers and computes the average call holding time for each trunk instrumented.

Average Holding Time = accumulated usage/accumulated attempts

If this value is above the long holding time threshold (slow release) or below the short holding time threshold, a report is printed identifying the trunk. This feature will also identify trunks which are always busy (36CCS) or always idle (0CCS).

The killer trunk feature provides information for a selected set of trunk groups. Each trunk group CLLI is classified as being telephone company or customer owned. Depending on this classification, the KT data associated with a CLLI may be output through the office log system or through the DIRP file for later polling by a downstream processor.

#### **02-02-1240 Locked-up trunk scan**

See the non-usage trunk scan Feature 2-02-1230.

#### **02-02-1250 Automatic circuit assurance**

The Automatic Circuit Assurance (ACA) feature provides a business group customer with private facility status information. The switch compares the duration of each private facility call to a short holding time bound and to a long holding time bound. The switch records an ACA referral when the number of calls with a call duration less than the short holding time bound exceeds a short calls threshold or when a single call with a call duration exceeding the long holding time bound is detected. The switch sends the ACA referrals through an interface to the customer's premises.

#### **02-02-1260 Virtual facility group (VFG) usage data**

This feature provides a unique identification number for each individual "trunk" in a WATS simulated facility group and records the number on the AMA tape. The number will be used to provide per "trunk" usage data to customers. This feature applies to both INWATS and OUTWATS simulated facilities.

The operational measurements available per VFG are:

- VFGTOTAL—number of outgoing call attempts
- VFGBLCKD—number of outgoing call attempts which were unable to find an idle resource
- VFGLSCBL—number of outgoing call attempts which were blocked by screening code restrictions



- VFGTRU—indication of the amount of traffic using each VFG during the measurement interval. The usage will be accumulated using a 100-s scan rate. Every 100 s VFGTRU will be incremented one for each member in the VFG which is call processing busy.

### **02-02-1270 Management information system for automatic call distribution**

The Management Information System will provide selected agent/traffic measurements for a group of stations assigned as an Automatic Call Distribution group (see Feature 03-02-0060). Information available reflects queue status and agent performance, and can be used to adjust staffing levels, forecast force requirements, optimize attendant work schedules, and so forth. Queue and call volume data is collected and can be transmitted to the customer premise on a near real time basis.

### **02-02-1280 Bulk calling line identification**

This feature allows the telephone operating company to deliver key information about incoming calls to the premises of individuals or groups of subscribers for immediate use or for storage and later use. Available information—sent for all lines in a BCL ID group—includes the date and time the call was received, the calling and called directory numbers, the busy/idle status of the called line, and the calling line type (that is, unique/nonunique). The information is sent to the customer's printer, computer, or other customer premises equipment of an BCLID data link using CLASS Modem Resource (CMR) technology.

### **02-02-1290 Automatic route selection traffic measurements**

This feature allows operating companies to collect OMs on a per route basis as well as on a per customer group basis. The queuing OMs provided by this feature can be used as a measure of traffic on various routes.

### **02-02-1300 Electronic tandem switching (ETS)**

Nortel Networks' MSN features enable multi-location business customers to establish a private communications network consisting of a number of nodes. The nodes, which are accessible to each other through on-network links, also have access to the public network and to specialized carriers. In the DMS-100 context, MSN is an extension of the MDC environment.

The routing strategies used by MSN permit cost-effective use of available network resources, least-cost routing to any on-net or off-net location using any suitable combination of on-net or off-net resources is available. The route taken is transparent to the user and not directly dependent on the digits dialed.

### **02-02-1320 Improved electronic tandem service/network**

This feature package allows MDC subscribers to access IDDD by Automatic Route Selection (ARS) through the subscriber's private network. Enhanced

ARS also provides enhanced routing capabilities and allows the subscriber to regulate access to IDDD calls at any point within the private network.

### **02-03-0000 Private virtual network (PVN)**

PVN allows Local Exchange Carriers (LECs) to provide business customers with private network functionality that uses any combination of public network and leased facilities. Thus, the end user enjoys a cost-effective customized network from his telephone operating company with access on a per-call basis to any interexchange carrier (IEC) or private virtual network for his interLATA needs.

In conformance with Bellcore specification TR-TSY-000402 (Issue 1, Nov. 1987), PVN service can be provisioned at a DMS-100 end office or a DMS-200 access tandem.

## **03-00-0000 Attendant features**

### **03-01-1000 Operational features**

03-01-1010 Nondata Link Attendant Console

New Feature: NTX877AB AL0612 (BCS30) – Requires nondata link console such as the Conveyant Systems TeleDesk or AT&T 50B. MB50193.03/09.

In a business group, a particular station may be designated as an attendant by the customer. This station may assist other stations in the business customer group in making calls and may be designated to receive calls to the advertised or Listed Directory Number (LDN) for the whole group.

Business group stations may access the attendant by dialing the single Digit '0'. In order to speed call completion and aid in the identification of calls terminating to the attendant, the attendant may be provided with a special telephone called a console. The console may be used to terminate separate loops from the SPSCS to aid in segregating different types of calls terminating to the attendant (dial 0 calls may terminate separately from LDN calls or there may be several LDNs). The console usually has keys with lights and audible indicators to indicate to the attendant that calls are terminating. Likewise, private facilities may be terminated at the attendant console. When the console functions are entirely provided by customer premises gear, the console is of the nondata like type.

### **03-01-1020 Attendant console**

An attendant console may be provided for business services customers. The console will have a line peripheral interface using three tip and ring pairs onto three standard line circuits. One pair is used for voice and two are used for full duplex FSK data. The line cards can be located in either a DMS-100 host office or a DMS-100 remote.



Trunks and lines do not have direct terminations on attendant consoles; a virtual loop concept is used. An attendant is involved only for the length of time required to complete or otherwise dispose of a call. As soon as the attendant keys a destination number, which can be a station served by the DMS-100 switch, a station served by a PBX through tie trunks, or a number accessed using the public network, the attendant can release the call from the loop. The attendant can also hold the call on loop and make the console available for new calls while still receiving call status information.

DMS-100 console data permits multiple console operation. A maximum of 255 consoles per DMS-100 switch can be assigned (see Chapter 5).

### **03-01-1030 Attendant access to code calling**

This feature allows an attendant to access customer-provided code call equipment by dialing an access code and a called party code.

The called party code is transferred to the code call equipment, which activates customer-provided visual/audible signaling devices to alert the called party. The called party can be connected to the calling party by dialing a call pick up code from any unrestricted station within the system.

### **03-01-1040 Attendant conference**

An attendant is able to initiate a conference call of up to 30 parties (excludes attendant). The selection of a special conference attendant can be done from any station within the same customer group by dialing a particular access code.

### **03-01-1050 Attendant Camp-On (Non-Data Link Console)**

This feature allows 50B attendant consoles (non-data link) served by the DMS-100 switching system to extend incoming calls whether or not a private announcement of the call is required. If no private announcement is required, the attendant leaves the call in a “ring” state. However, to ensure that the call is handled properly, the attendant is provided with a timed reminder if the call remains unanswered. If answered, the call is automatically released from the console loop.

### **03-01-1060 Attendant camp-on**

This service feature allows calls incoming to an attendant console to be transferred to a busy station by the attendant. When the attendant uses the camp-on feature in transferring a call to a busy station, the busy station may receive an optional indication of camp-on tone (see Feature 03-01-1070) each time the attendant leaves the loop (release key, hold key, automatic hold). The call being transferred is held waiting and receives, as a customer group option, silence, an announcement or music while waiting for the busy station to answer the call. If the called customer hangs up the station rings, and if the user then goes off-hook, it is connected to the waiting party. If the called customer flashes, the third party is put on hold and the incoming call

is completed. The camped-on call may be routed back to the attendant if the busy station has not answered within a specified period of time (12-60 sec.). The attendant can then again camp-on the call.

### **03-01-1070 Indication of camp-on**

Camp-on tone is a customer group option associated with the attendant camp-on feature. When the attendant uses the camp-on feature in transfer ring a call to a busy station, the busy station receives an indication of camp-on tone. The tone consists of 440 Hz at -13 dBm and is applied for the duration (0 to 1500 ms) specified for the customer group.

### **03-01-1075A Attendant call park**

This feature allows an attendant to park calls against any directory number in the attendant's customer group. The parked call may be retrieved from any station, by the attendant parking it or by another attendant by dialing the feature access code for retrieval plus the DN against which the call is parked.

### **03-01-1080 Night service**

Night service routes calls normally directed to the attendant to preselected station lines within or outside the customer group when the regular consoles are not attended. The routing is provided to the customer on a fixed basis. Flexible night service allows attendant modification of the night routing.

### **03-01-1085A Attendant autodial**

This feature permits the attendant to dial frequently called numbers by depressing a single key. Each Autodial key can have only one number assigned to it at a time, but the console can have as many as 42 feature keys designated as Autodial (42 being the total numbers of feature keys on the console). Once a feature key has been designated as an Autodial key, it may be programmed either from the console or by filling the appropriate data tables from the MAP.

### **03-01-1090 Power failure transfer – attendant**

The MDC Attendant Console may be powered directly from the DMS-100 peripheral module in applications where the loop length is less than 600 feet (183 m). (Beyond this a local power supply is provided). An optional battery backup can also be supplied, providing continued service in the event of a customer premise power failure. If the battery backup is not provided, (in applications of greater than 600 ft. [183 m]), calls normally directed to the console may be transferred to the night service number in the event of a customer premise power failure.

### **03-01-1100 Attendant control of facilities**

The feature permits the attendant to control access by all stations to selected trunk groups and/or virtual facility groups by operating corresponding keys.

When such control is activated, calls to these facilities are routed to specified treatment on a customer group basis: route to the attendant, route to reorder tone, route to announcement.

### **03-01-1110 Dial through attendant**

This feature allows the attendant to select the facility and pass dial tone to an MDC station in the same customer group. The station user then dials the called number. This feature is usually used to override outgoing station restrictions.

### **03-01-1120 Attendant busy verification – stations**

This feature allows the attendant to verify the busy or idle state of lines within the customer group. When a station is busy, the attendant can break in on the busy connection. If the station is idle, the attendant can cause the station to be rung by depressing the signal source key.

### **03-01-1130 Attendant tie trunk busy verification**

This feature provides the attendant with the ability to gain access to a specific member of a busy trunk group for the purpose of verifying a busy condition. If the trunk is idle a momentary burst of tone will be returned to the attendant, and a call may be completed. When the trunk is busy the attendant, upon hearing busy tone, may elect to intervene (barge-in) into the connection and both parties involved in the busy connection will hear busy verification tone. The attendant cannot force release the connection but may request that the parties go on-hook.

### **03-01-1140 Attendant call through tests on tie trunks**

(Currently not planned for release.) NTX717AB can be provided for verification of trunks from a designated station.

### **03-01-1150 Attendant emergency override**

(This feature currently not planned.)

### **03-01-1160A Attendant activation/deactivation of call forwarding**

This feature allows attendants to query, activate, deactivate and program call forwarding for MDC stations equipped with the basic Call Forwarding (CFU) or Call Forwarding - within group only (CFI).

A console feature key must be assigned to a CFS. There are four attendant keying sequences:

To query current state – CFS + Station DN + CFS

To deactivate – CFS + Station DN + CFS + # + CFS

To activate – CFS + Station DN + CFS + \* + CFS

To program and – activate CFS + Station DN + CFS + \* + Call Forward DN + CFS

### **03-02-0000 Advanced features**

#### **03-02-0010 Attendant ID on incoming calls**

This feature provides for the identification, using Incoming Call Indication (ICI) lamps on the attendant console, of LDN calls directed toward different listed directory numbers.

#### **03-02-0015A Priority console alerting**

This feature allows an attendant to be alerted to a queued emergency call while the console is in any of the following states:

- idle
- active on any type of call
- position busy or night service
- programming a feature

Calls to emergency numbers can be datafilled to appear at an ICI key/lamp on the console. Each customer group equipped with this feature can have up to five emergency ICIs assigned. The attendant is alerted that the call is an emergency by the emergency ICI flashing. An optional audible indication is also available.

#### **03-02-0020 Message desk service**

This feature allows attendant consoles (up to 255) to be used as the message center for a number of MDC station users. The basic service consists of:

- automatic forwarding of calls from a station to the message center on a busy, don't answer and/or an all calls basis
- direct calling to the message center
- queuing and distribution of incoming calls to individual consoles at the message center
- display of call type, calling and called party identification at the console
- message waiting indication at the station

An outboard device is required for message entry and retrieval by the message center attendants.

In addition to the above capabilities, station message features are available to MDC users as described in Features 01-02-1241 and 01-02-1242.

#### **03-02-0030 Station billing on attendant handled calls**

Station billing on attendant handled calls for all AMA records, automatically replaces the attendant's billing number in the AMA record with the billing number of the "source" party. This is a business group option.

**03-02-0040 Trunk group busy indication**

The feature permits the display of trunk group and/or VFG status on the attendant console. The lamp state associated with a trunk group will be off if one or more trunks in the group is idle, or on if all trunks in the group are busy.

**03-02-0050 Call waiting lamps for attendant**

With this feature, the CALLS WAITING lamp turns on at all consoles with a headset jacked in whenever at least one call is waiting in a queue. The CALLS WAITING lamp will flash whenever calls are waiting in the queue for a period greater than or equal to a customer specified threshold.

**03-02-0060 Automatic call distribution**

Automatic Call Distribution (ACD) allows a large number of incoming calls to be answered by a cluster of individuals serving as an ACD group. Incoming calls are served on a first-in basis and distributed among members of the ACD group on a most-idle basis. The automatic call distribution group can also be equipped with supervisory positions that allow the supervisor to display queue status or monitor the current status of an agent.

In addition to basic call distribution capabilities, ACD is designed to meet end user needs for management reporting and load management. ACD extends the capabilities of the Uniform Call Distribution offering (01-02-0805) by providing management statistics on a per agent basis in addition to the usual per directory number statistics.

ACD is intended primarily for applications with 40 or more agents, and has a capacity for 4000 agents per system divided among 256 ACD groups. There can be up to 256 agents and supervisors per group, and one supervisor can serve 48 agents. ACD can serve multiple locations through host office and DMS remote lines.

**03-02-0070 Uniform call distribution from attendant queue**

This feature provides for a uniform distribution of calls from the attendant queue to a group of attendant consoles. As the consoles become idle, incoming calls are distributed on a first-in, first-out basis. All new call arrivals, including recalls to the attendant console, are placed in queue in the order of their arrival. While queued, audible ringback is provided to the caller by the DMS-100 except where ringing is provided by the originating office. Audible ringing will be provided until the call is answered or abandoned.

The length of the queue can be limited based on the maximum permissible time that a call can wait in the queue. Calls which will exceed the estimated time threshold are routed to either busy tone or announcement. The diversion threshold can range from four seconds to 17 min. in four-second increments, or be specified as infinite if desired.

The attendant can obtain a display of the call queue status by activation of the Display Queued Calls feature key, which indicates the number of calls queued to be answered and the time the oldest call in the queue has waited. This information can be displayed for the entire attendant subgroup or for a particular Incoming Call Identification (ICI) key.

#### **03-02-0090A Attendant console display**

The console display includes a 16 character alphanumeric display to assist the attendant in the handling of calls. The attendant console display can store up to 32 characters, but only 16 characters are displayed at one time. For some types of calls, the call information must be displayed in two stages. A display control function key is provided to handle the two stage display format. This display provides the attendant with information such as the calling station number for station to attendant (dial "0") calls, class of service, the trunk group number, held call information, queue status, and so forth.

### **04-00-0000 Customer switching system features**

#### **04-01-0000 Private branch exchange (PBX) line**

A Private Branch Exchange (PBX) is a central office line connected to a customer premises switching system and used as an originating, terminating, or two-way facility for calls to/ from stations served by the PBX.

#### **04-01-0100 PBX line interface features**

The PBX connection to the DMS-100 may be provided by way of line (Line Class Code PBM or PBX), analog trunk (trunk type P2), or digital trunk (trunk type PX). The features available for line access are shown in the Line Class Code (LCC) options compatibility tables included in Chapter 5. For features available for digital trunk access, refer to 297-2101-451, section 186. Analog trunk access features are found in 297-2101-451, section 617.

#### **04-02-0000 Direct inward dialing (DID)**

DID is a feature that allows an incoming call from the exchange network (not FX or WATS) to reach a specific PBX station line without attendant assistance. With DID, the central office seizes a DID trunk and outpulses the station line number to the PBX. If the called station's line is idle, and not restricted from receiving terminating calls, the PBX alerts the called station and returns audible ringing on the incoming connection. If the called station's line is busy, the PBX returns busy tone. If the called station is restricted from receiving terminating calls, the incoming call is routed to an announcement, reorder tone, or to the attendant by the PBX.

#### **04-03-0000 Automatic identified outward dialing (AIOD)**

AIOD provides a means of billing outgoing calls from a PBX to the individual PBX stations originating the call.

The telephone call from a PBX may appear to DMS on a PBX line or a PBX trunk. AIOD information relating to a telephone call on a particular PBX line or PBX trunk is provided over a separate data link between the PBX and the host DMS-100.

There may be one or more data links between the PBX and the host office active when standby data link configurations are available.

#### **04-04-0000 Toll diversion**

All attempted toll calls from a PBX line with the Toll Diversion Option (TDV) will cause a toll diversion signal to be sent from the DMS-100 to the PBX. The toll diversion signal can be either a battery reversal or an operating company specified wink (50 to 500 ms in 10 ms units). Upon receipt of the toll diversion signal the PBX takes the appropriate action (for example, route to attendant).

After sending the toll diversion signal, DMS-100 waits for an operating company defined period (nine to 1000 ms in 10-ms units) for a disconnect from the PBX. If the disconnect signal is not received, DMS-100 advances the call.

All toll calls or customer specified three digit codes can be diverted.

#### **04-05-0000 Routing of hotel/motel calls**

This feature provides the capability to route outgoing hotel/motel guest-line non-coin toll calls to an operator system and promptly receive an automatically computed record of the call charges. Hotel/motel guest-line calls can be routed from the serving central office to an operator system over a combined trunk group. In such case, calls from hotel/motel are identified by the information digit “6” in the ANI signal.



**04-06-0000 Outward calling features for PBX**

This customer feature allows a PBX (a customer premises switch) to take advantage of business group features relating to outgoing private facilities. Instead of terminating outgoing private facilities directly onto the PBX, the customer may instead terminate the outgoing facilities at the local switching system. The PBX is connected to the local automatic route selection and may also include authorization codes, outgoing trunk queuing, and so on. The PBX customer may therefore have their stations dial the outgoing private facility access code, have the PBX seize the special lines to the local switch, and have the local switch:

- 1 recognize the PBX seizure on these special lines as a request to use the private facilities
- 2 return dial tone directly to the PBX station
- 3 collect the digits associated with the called number
- 4 route the call over the appropriate private facility based on the particular outward calling features selected

The capability of the outward calling features extends sophisticated DMS-100 routing and control functions to a PBX which may not be able to provide such features by itself.

**04-07-0000 DTMF outpulsing to PBX**

With this feature, the central office uses DTMF (instead of dial pulse) address signaling to the PBX on DID calls (see Feature 04-02-0000).

**05-00-0000 Customer interfaces****05-01-0000 Loop signaling interfaces****05-01-0100 Analog asynchronous signaling data interface**

This feature provides the requirements for an analog, asynchronous, relatively low speed (300 to 1800 baud) data signaling interface between the SPCS and the customer premises equipment. The interface is intended to apply to existing customer loops and will allow full duplex data transmission during established call as well as when no call is present (regardless of whether the line is off-hook or on-hook). It may be used to transmit data such as the calling directory number from the SPCS to the called party.

**05-02-0000 Data line interfaces****05-02-0100 Dedicated inband analog signaling data interface**

This feature provides a full duplex data link for the exchange of information between a SPCS and terminal equipment located on the customer premises. The data link, which utilizes an analog signaling technique, terminates at the SPCS and the Customer Premises Terminal Equipment (CPTe) at a modem. Depending on the traffic generated by a particular customer, one of several specified data rates is chosen to accommodate the user's needs.



The purpose of this data link is to support those network services that require the exchange of information between the customer premises and the serving SPCS.

*Note:* The DMS-100 supports data interfaces of the speeds and types described, however, full definition of the requirements and interactions between the switch and the proposed Features (05-01-0100 and 05-02-0100) are not yet available.

### **05-02-0200 PBX separate channel analog signaling interface**

(Currently not planned for development.)

### **05-02-300 Suppressed ringing for telemetry services**

This feature provides the capability to establish connections to customer's lines for the purpose of telemetry services for information gathering, without applying power ringing. When it has been verified that the line is in an on-hook state, a connection is completed to provide access for various telemetry services such as meter reading, and so forth, without alerting the customer. All incoming calls to the customer's line should receive a busy tone when encountering a busy condition due to telemetry services.

### **05-02-0600A Datapath**

#### **05-02-0601A Datapath – low-speed data unit**

The LSDU is a microprocessor-based data set that uses Time Compression Multiplexing (TCM) technology to map data and signaling information between an RS-232 interface and a two-wire loop leading from the Data Unit to a Data Line Card located in the DMS-100. The TCM circuit provides a clear full duplex 64 kb/s data channel and an 8 kb/s signaling channel. The two-wire connection is supported up to a maximum distance of 3.4 miles (5.7 km) using 22/24 gauge wire or 2.7 miles (4.3 km) using 26 gauge wire. This part of the DMS-100 Datapath offering allows the customer to use the switched telephone network for data calls. In addition, two LSDUs may be connected "back-to-back" to provide a simple point-to-point data communications facility. The LSDU supports data rates at the RS-232 interface of 300 b/s to 19.2 kb/s asynchronous and 1.2 kb/s to 19.2 kb/s synchronous (see Chapter 6).

#### **05-02-0602A Datapath – high-speed data unit**

The HSDU is a microprocessor-based data set that uses TCM technology to map data and signaling information between a V.35 interface and a two-wire loop leading from the Data Unit to a Data Line Card located in the DMS-100. The TCM circuit provides a clear full duplex 64 kb/s data channel and an 8 kb/s signaling channel. The two-wire connection is supported up to a maximum distance of 3.4 miles (5.7 km) using 22/24 gauge wire or 2.7 miles (4.3 km) using 26 gauge wire. This part of the DMS-100 Datapath offering allows the customer to use the switched

telephone network for data calls. In addition, two HSDUs may be connected “back-to-back” to provide a simple point-to-point data communications facility. The HSDU supports data rates at the V.35 interface of 48, 56, and 64 kb/s synchronously (see Chapter 6).

#### **05-02-0603A Datapath – coax eliminator data unit system**

The function of the Coax Eliminator Data Unit system is to replace a dedicated 3270 type coax link with a two-wire loop, allowing for both back to back or DMS-100 circuit switched operation. To accomplish this, two separate data units (DUs) are provided: the Terminal Interface (TIF) to interface an IBM 3270 terminal, and the Control Unit Interface (CUIF) to interface an IBM 3274 control unit. Both of these DUs utilize Time Compression Multiplexing (TCM) technology to convert the coax interface to the two-wire loop. The TCM circuit provides a clear full duplex 64 kb/s data channel and an 8 kbps signaling channel. The 64 kb/s channel is used for sending IBM session information embedded within a HDLC protocol running synchronously at a rate of 56 kb/s. The 8 kb/s channel is used for messaging between the data unit and the DMS-100 switch.

#### **05-02-0605A Asynchronous interface module**

The Asynchronous Interface Module (AIM) is designed to serve the data switching needs of low speed (up to 19.2 kb/s) asynchronous ASCII terminal users who are interested in a more cost effective, but less powerful, alternative to the Low Speed Data Unit (see Feature 05-02-0601). Like the LSDU, the AIM is equipped with an industry standard RS-232C interface connection to the user’s data terminal equipment. The AIM converts the RS-232C signals to RS-422 signals, which are sent from the AIM to an Asynchronous Interface Line Card (AILC) located in the DMS-100.

The major differences between the use of the LSDU and the use of the AIM are:

- The RS-422 connection between the AIM and the DMS-100 is a four-wire connection, as opposed to the two-wire connection supported by the LSDU.
- The maximum distance from the AIM to the DMS-100 is 4000 ft. (1219 m). The maximum loop length of the LSDU is 18 000 ft. (5486 m).
- The AIM has no keypad, therefore all dialing and feature activation must be performed directly from the terminal keyboard.
- The AIM operates in asynchronous mode only.

#### **05-02-0606A Asynchronous interface line unit**

The Asynchronous Interface Line Unit (AILU) is an RS-232C to RS-422 cable line driver that can be used as an alternative to the AIM (05-02-0605) for interface to asynchronous ASCII terminal devices and the DMS-100 Asynchronous Interface Line Card (AILC). The AILU allows users of standard RS-232C data terminal equipment to operate in a full-duplex mode

at speeds of up to 19.2 kb/s. As with the AIM, all dialing and feature activation must be performed directly from the terminal keyboard.

#### **05-02-0607A IBM PC interface card**

The IBM PC Interface Card connects an IBM personal computer directly to the DMS-100 system. The PC Interface Card provides an RS-422 interface instead of the RS-232C interface normally found on these personal computers. This PC card performs a function similar to that of the AIM and uses the Asynchronous Interface Line Card to connect to the DMS-100.

A personal computer, using Nortel Networks' Personal Computer Interface Card, can be directly connected to the Asynchronous Interface Card through two-twisted pairs. The PC Interface Card is installed in the personal computer's backplane slot.

Standard Communications Software (for example, Crosstalk, Smartterm) can be used to transfer files between personal computers, or between a personal computer and a host computer. The card is asynchronous and allows a personal computer to communicate with an asynchronous host computer connected to the DMS-100 system up to a speed of 9.6 kb/s. (This speed is limited due to the communications speed limitation of the personal computers.) A personal computer using such a card can be located up to 4000 feet (1219 m) from the DMS-100 system.

The PC Interface Card users can take advantage of various DMS-100 system features, such as port contention/concentration and use of twisted-pair distribution. The PC Interface Card offers DMS-100 data call processing features such as Auto Dial, Speed Call, Ring Again, and so forth. These features are available for use directly from the personal computer keyboard without the use of a telephone.

#### **05-02-0608A DATAPATH loop extension**

The DATAPATH Loop Extension (DPX) channel unit is provided to extend the basic DATAPATH capabilities beyond the two-wire loop limit using T1 facilities. The DPX uses one DS-0 channel of a DS-1 digital carrier to transport digital information from the channel bank associated with a customer premise data unit to the DMS-100 switch. This is accomplished with the DATAPATH extension card which plugs into the Nortel Networks DE-4E channel bank. The card performs the functions of the data line card and provides the interface to the DS-1 channel terminating on the switch and to the data unit terminated on the loop from the channel bank. The DPX will only provide basic data transport without the usual DATAPATH convenience features such as Ring Again, modem pooling, and Speed Call.

**05-03-0000 Integrated services digital network (ISDN) basic access**

The ISDN basic access interface allows the simultaneous transmission of voice, circuit-switched data, and packet data over a single customer line connecting customer premises equipment and a DMS-100 Family system. The basic access allows the provision of two 64 kb/s B-channels, which may be used to carry voice, circuit-switched data, or packet data, and a 16 kb/s D-channel, which can carry signaling information and packet data. The ISDN basic access feature package will be provided through a controlled introduction over several BCS releases.

**05-04-0000 ISDN primary rate access**

The ISDN primary rate access will be implemented over a DS-1 rate (1.544 Mb/s) system using the 23 B + D format. Clear channel capability is provided for all channels, B and D. Primary rate access can be used to connect an ISDN PBX to a central office as well as to connect other service providers to a central office.

**05-04-1000 PBX separate – channel digital signaling interface**

This Primary Rate Interface feature provides the capability to network ISDN services between the DMS-100 and digital private branch exchange (PBX) equipment, such as the Nortel Networks SL-1. The PRI uses DS-1 facilities and provides 64 kb/s clear B channels that can be used to transport voice or data. Signaling is handled out-of-band on the PRI D channel.

**10-00-0000 Coin and charge-a-call features**

See Chapter 5.

**10-01-0000 Coin line – coin first**

Coin first coin service is a feature that requires deposit of a coin(s) before dial tone is returned and a call can be initiated. Deposit of the local initial rate and the station off-hook closes a conducting path from the ring terminal at the central office to ground at the coin station. The central office responds to this origination signal by returning dial tone.

**10-02-0000 Coin line – dial-tone-first**

Dial-tone-first coin service is a feature that provides dial tone without an initial coin deposit. On coin-paid local calls the deposit of initial rate must be made prior to the completion of dialing. The central office tests for the initial rate by connecting negative battery to the tip conductor. All other calls may be dialed without a coin deposit. Positive battery is connected to the ring conductor on calls to operator systems when the latter are in a coin deposit monitoring state.

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### **10-03-0000 Coin collect and return signaling**

Coins are collected or returned by the application of coin collect or coin return battery by the central office. Coins are collected at the end of all sent-paid charged calls and just prior to the end of the initial period on calls that go into overtime. The return of coins on free calls can be optionally made initially, or upon disconnect. Coin deposits are returned at disconnect on calls that cannot be completed as requested. If the central office cannot collect or return coins, a stuck coin trouble record is made identifying the station. An option is provided for using coin collect and return signals of opposite polarities (see Chapter 6).

#### **10-03-0010 Creation of AMA Records local MUMR 1 zone coin calls**

(This feature is planned for future release.)

Local Multi-Unit Message Rate (MUMR) service is provided for coin lines in this feature, which permits calls made from a coin station to be billed in AMA records with call codes 001 through 005. This feature also allows the DMS-100 system to prompt for the correct initial coin deposit and all overtime deposits based on the distance dialed for the call and the time of day or day of the week the call is made.

This feature requires additional recording capability in the DMS-100 switch Digital Recorded Announcement Modules (DRAMs) (NT-TBD), and a receiver to detect and decode the tones provided by the coin station to indicate the deposit and denomination of the coins (NT3X08AA).

### **10-04-0000 Coin with or without local overtime charging**

Coin service with local overtime charging provides operating company selectable timed initial and overtime periods. Coins are collected shortly before the end of each charging period. At the end of each period an overtime coin test is made by applying the appropriate battery polarity to the tip conductor. If a coin is present, timing for the next period commences. If no coin is present, an announcement is returned to instruct the customer to make an overtime deposit. Another coin test is performed after the announcement, and, if no coin is present, the call is terminated.

Coin service without local overtime charging permits unlimited conversation time on local calls at no charge beyond the initial coin deposit.

### **10-05-0000 Coin distance dialing with an operator system**

This feature permits the handling of customer dialed toll calls from coin stations. An operator (or the Automated Coin Toll [ACT] service equipment at an operator system) is connected to request and monitor the initial deposit, to notify the customer at the end of the initial period, request and monitor the initial deposit, to notify the customer at the end of the initial period, and

to request and monitor overtime deposits. The operator also provides assistance on “0 +”, seven and 10 digit special toll calls (collect, credit card, person-to-person, and so forth). The operator signals the central office to collect and return coins and to ring back the coin station on these types of calls.

#### **10-06-0000A Coin line – semi-post pay**

Dial tone is returned immediately upon off-hook condition at the coin station and dialing can commence prior to any coin deposit. Calls to operators or free numbers complete successfully with two-way conversation possible, and no coin deposit. All other calls are completed but transmission is blocked and calling party can not be heard until a coin deposit is made. No refund is possible.

#### **10-08-0000 Expanded inband signaling**

Expanded inband signaling allows the DMS-100 to receive expanded inband tones used by an operator system. The inband signal (MF tone transmission) is monitored by the DMS-100 for coin collect, coin return, operator attached, operator released and combined coin collect and operator released MF tones.

This feature also allows the DMS-100 to perform red box fraud prevention on specially equipped sets served from dial tone first lines. This is done by blocking the transmission of coin deposit tones fraudulently simulated by the user. The operator released signal enables the DTMF pad, thus allowing end-to-end DTMF signaling.

This feature also permits operator ringback on non-coin lines.

#### **10-09-0000 Improved public telephone service**

##### **10-09-0001 Local rate flexibility**

This feature provides the capability for the DMS-100 to process single and multi-message unit coin calls without routing them to an operator system or an operator. It provides for independent and variable initial overtime rates and timing of local coin calls. The initial and overtime rates and timing of MMU calls can be changed with time of day and day of week.

##### **10-09-0002 Coin box accounting for collection scheduling**

(This feature is planned for development but currently has not been targeted for release in a specific BCS.)

##### **10-09-0003 Coin box accounting for revenue allocation**

This feature allows the generation of an AMA record for all calls made from a coin line with a call code of 136. Thus, the operating company can track and account for all calls made, including the number dialed and the duration of each call, so that the billing requirements for private coin line companies and interexchange carriers can be reconciled accurately in order that the



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revenue levels of telephone operating company-owned coin stations can be verified. This feature will require a coin detection circuit pack (NT3XC08AA).

### **10-10-0000 Charge-a-call (coinless public telephone service)**

Charge-a-call permits the customer to make INWATS, directory assistance, 0- and 0+ non-sent-paid calls (credit card, third number, collect) with no coin deposits from a special public phone which has no coin handling capabilities. Charge-a-call calls are routed to the operator station and identified by the ANI information digit "7."

### **10-11-0000 Stuck coin administration**

Stuck coin administration permits the operating company to print out the directory number of coin lines with stuck coins at a repair service bureau or automatic line insulation test teletypewriter.

### **10-12-0000 Inband signaling**

Inband signaling is used by an operator system and cord boards on trunks handling coin calls. With this signaling method, an on-hook wink from the operator system requests the local office to connect an MF receiver and prepare to receive an inband signal. The inband signal (MF tone) requests the local office coin collect, coin return or ringback actions on the coin station (see Chapter 6).

### **10-13-0000 Coin line activity monitoring (CLAM)**

(Currently not planned for development).

## **15-00-0000 Public safety features**

### **15-01-0000 Basic emergency service (911)**

The basic 911 emergency service feature provides a three-digit universal telephone number (911) which gives the public a direct access to an emergency service bureau, usually without charge to the calling subscriber. The emergency service is one-way only, terminating to the service bureau. The emergency service bureau is usually located within a police department, although in some communities it is located in a fire department or in an independent agency serving as a communications center. A given local switching system may serve more than one emergency service bureau.

When the originating line and the emergency service bureau are served by the same switching system, the bureau has the capability of holding and disconnecting the connection, monitoring the supervisory state and reringing the originating station.

When the local switching system is in an area with Expanded Emergency Service (E911), served through a tandem switch, the emergency call is advanced to the tandem switch with calling line ANI.

### **15-02-0000A Enhanced (E911) emergency service**

The DMS-100/200 serving as an E911 tandem office will control routing of the call to the correct Public Safety Answering Point (PSAP) trunk and provide ANI for display at the PSAP answering position.

The E911 feature will allow each 911 call to be routed to a particular PSAP serving the calling telephone location in spite of conflicts between central office and municipal boundaries. It will provide for an ANI display of the calling telephone number at the answering position and will allow the primary PSAP attendant to transfer a 911 call to any one of a number of secondary PSAPs or to any telephone number. With E911 service, each 911 call will be routed over a dedicated trunk group from the originating central office to the tandem office.

### **15-03-0000 Tracing of terminating calls**

This feature provides identification of the calling number on intraoffice calls, or of the incoming trunk on incoming calls, for calls terminating to a specified directory number. When this feature is activated, the originating directory number or incoming trunk number, terminating directory number, and time and date are printed out for each call to the specified line.

### **15-04-0000 Outgoing call tracing**

This feature allows the tracing of nuisance calls to a specified directory number suspected of originating from a given local office. The tracing is activated upon entering the specified directory number. A printout of the originating directory number, outgoing trunk number or terminating number, and the time and date are generated for every call to the specified directory number.

### **15-05-0000 Tandem call trace**

This feature identifies an incoming trunk of a tandem call to a specified office directory number.

The feature is activated by entering the specified distant office directory number for tandem call trace. A TTY printout is generated for every call to the specified directory number. The printout contains the incoming and outgoing trunk numbers, the DN of the called party, and the time and date of the call.

### **15-06-0000 Trace of a call in progress**

This feature identifies the originating directory number or incoming trunk for a call in progress. The feature is activated by authorized personnel entering a request that includes the specific terminating directory number or trunk involved in the call. This feature is provided through the MAP and provides a real-time display of connected terminals.



**15-07-0000 Group alerting**

The DMS-100 is compatible with various outboard group alerting systems, such as Tellabs Model 291 and Wescom Model 931. When a particular group alerting system is planned for use with a DMS-100, Nortel Networks will, on request, advise on the compatibility of that particular unit.

In addition to the above capabilities, the Preset Conference Feature 01-02-1344 is available to MDC users.

**15-09-0000A call hold on malicious call trace**

The called party can hold the connection within the office on a malicious call by flashing the hookswitch and staying off-hook. An alarm and a log report (trace information) are generated in the DMS-100 upon receipt of the hookswitch flash.

If both the calling and called parties are terminated on the DMS-100, the entire connection will be held until the called party goes on-hook. If the call arrived on an incoming trunk and terminates within the DMS-100 office, the connection will be held back to the incoming trunk.

For lines equipped with three-way calling and call transfer the activation of the malicious call trace feature differs from that of ordinary lines in that a two-digit code (operating modifiable) is required after the hookswitch flash.

**20-00-0000 Miscellaneous local system features****20-01-0000 Loop range features**

See Chapter 5.

**20-01-0300 Compatibility with 1500 ohm loops**

The DMS-100 line circuit provides for 1900 ohm external resistance, including the subscriber's instrument, for standard customer lines. For coin lines, external resistance of up to 1500 ohms may be used.

**20-01-0400 2800 Ohm subscriber line service – selected lines**

The DMS-100 plan permits extending the conductor loop resistance of customer lines to 2800 ohms (outside plant) through an external per line range extension device (see Feature 20-01-0410).

**20-01-0410 Compatibility with external per-line range extension devices**

This feature applies to the arrangement whereby voice frequency gain, equalization, and signaling enhancement for subscriber lines exceeding 1500 ohm conductor loop (outside plant) resistance is obtained by wiring to range extension equipment installed on frames external to the switching system.

**20-01-0420 Integrated per-line range extension**

(This feature currently not planned for release.)

**20-01-0430 Concentrated range extension**

(This feature currently not planned for release.)

**20-01-0500 Integrated 2800 ohm subscriber line service**

(This feature currently not planned for release.)

**20-01-0600 Compatibility with dial long line circuits**

Dial long line circuits are circuits that are used to extend the range of customer loops. The range may be extended by repeating supervision and dial pulses from the customer to the central office and by repeating ringing from the central office to the customer. A variety of dial long line circuits may be required dependent upon their capabilities to provide necessary service features and for meeting transmission and range requirements associated with these services. When a particular dial long line circuit is planned for use with a DMS-100 system, Nortel Networks will, on request, advise on the compatibility of that particular circuit.

**20-02-0000 Pair gain interfaces**

**20-02-0100 Integrated pair gain interfaces**

An integrated Pair Gain System (PGS), in DMS-100 context, is a PGS that terminates directly into the serving switch over digital facilities without the need for central office (CO) terminal equipment. The functions of the CO terminal are integrated into the DMS-100. This arrangement allows the line on the pair gain system to meet the requirements of lines served by the CO dependent upon the capabilities of the remote terminal.

Integrated operation is available for the Nortel Networks DMS-1R and for the AT&T's SLC-96 and is planned for the Nortel Networks DMS-1U (see Chapter 2).

**20-02-0200 Compatibility with conventional (non-integrated) pair gain systems (PGS)**

A PGS is a device used to reduce the quantity of outside plant facilities needed to serve telephone customers in a local switch by multiplexing and/or concentrating N lines onto some smaller number of facilities. It is composed of three subsystems. A conventional PGS is a PGS whose central office equipment expands the outside plant facilities back to N analog line appearances independently of the local switching system used. When a particular PGS is planned for use with a DMS-100 system Nortel Networks will, on request, advise on the compatibility of that particular PGS.

- 1 terminal equipment located in the serving office
- 2 a remote terminal located outside of the serving office

3 outside plant facilities interconnecting the first two subsystems

### **20-02-1000 Integrated digital loop carrier (IDLC) systems**

*Note:* To successfully activate this feature, the operating company must have a peripheral module that is compatible with the DMS remote subscriber carrier.

An Integrated Digital Loop Carrier (IDLC) system is a composite system that consists of an intelligent Digital Loop Carrier (DLC), Remote Digital Terminal (RDT) and digital elements of the Message Telephone Service (MTS) switch, the Local Digital Switch (LDS). The distinguishing characteristic of IDLC systems from universal DLC systems is the absence of per customer access line equipment and/or analog to digital conversion at the interface to the LDS.

### **20-02-1100 Generic IDLC interface**

*Note:* To successfully activate this feature, the operating company must have a peripheral module that is compatible with the DMS remote subscriber carrier.

See Feature 20-02-1000.

### **20-02-2010 Bridged services on an IDLC system**

*Note:* To successfully activate this feature, the operating company must have a peripheral module that is compatible with the DMS remote subscriber carrier.

A necessary feature for an IDLC system is to provide bridged services when one or more lines are served on IDLC (see FSD 20-20-1000 for background information on IDLC systems). The elimination of the Subscriber Main Distributing Frame (SMDF) for lines terminated on IDLC eliminates the CO point of access when lines have been traditionally bridged, physically opened and electrically tested. Digital bridging is feature of LDS, necessitated by IDLC systems, that simulates standard CO bridging when at least one of the lines does not have a CO analog appearance.

### **20-02-2100 Operator systems interface for an IDLC system**

*Note:* To successfully activate this feature, the operating company must have a peripheral module that is compatible with the DMS remote subscriber carrier.

A LDS will have an interface to operations systems. The collection of LDS equipment, firmware and software needed to implement this interface is referred to as the Operations Interface Module (OIM). IDLC systems use the OIM of the local switching system to communicate with operations systems.

Because the local switching system's OIM needs added functionality to implement the IDLC system to operations system interface.

## **20-03-0000 Line signaling**

### **20-03-0100 Loop start line**

In a loop start line arrangement the central office supplies battery between the ring and the tip conductors. The central office detects a loop closure from the customer station as a seizure, after which it provides dial tone on the tip and ring conductors as a start dial signal.

### **20-03-0200 Ground start line**

In a ground start line arrangement the central office provides battery through a ground detector to the ring conductor and leaves the tip conductor open. The customer station or PBX seizes the line by applying a ground to the ring conductor. The central office responds by returning ground on the tip conductor and dial tone across the tip and ring as start dial signals. Upon detecting the tip ground from the central office, the customer station or PBX changes to loop closure for the off-hook state. Alerting the customer or PBX is done by connecting 20 Hz ringing to the ring conductor and ground to the tip conductor.

### **20-03-0300 Line – sleeve lead control**

Line sleeve lead control is a feature that, by means of a third wire, permits operation of a device in an equipment unit external to the switching system but directly associated with the line. The system is capable of identifying any line equipped with a sleeve lead and provides the functional operation of the sleeve lead in accordance with the application of the device associated with that line and/or detect a change of state of the sleeve lead.

## **20-04-0000 Emergency ringback**

Emergency ringback is a feature associated with basic 911 emergency service that is used to recall a customer's station immediately following disconnect from and at the request of an emergency bureau. The request for emergency recall is transmitted from the emergency bureau to the central office as either a regular flash (450 ms to 2 sec) or a fast flash (80 to 130 ms). In the latter case the fast flash option is used.

Ringback is implemented as follows:

- Single party on-hook – The line is rung in the normal manner with audible ringing being sent to the emergency bureau.
- Multi-party on-hook – For two-and four-party lines which can be identified (that is, ANI), only the calling party receives ringback. For greater than four party, and also in cases where the two or four-party line cannot be identified, the flash is ignored and the emergency bureau continues to receive hookswitch status tone.

- Single and multi-party off-hook – A one-to ten-second (data base settable) bursting of Receiver at Off-Hook (ROH) is sent to the calling party. The tone burst may be repeated by additional flashes and the talk path is reestablished after each burst.

An additional feature (timed ringback) is available to superimposed and frequency ring lines. This feature basically limits the ringback to a specified number of cycles (operating company defined).

### **20-05-0000 Two-digit translation on incoming trunks**

Two-digit translation on incoming trunks is a system-related feature that provides for address signaling from incoming trunks where one digit of a three-digit address is suppressed by the originating office. DMS-100 Family equipment is capable of determining the valid three-digit address from the digit(s) received and routing the call to its intended destination.

An example of this feature is a 411 (directory assistance) call where a step-by-step office would suppress the first digit and only send the second and third (11) digits of the intended address. The receiving office will recognize the received address as a valid 411 address and route the call to a directory assistance operator.

### **20-06-0000 Announcements**

#### **20-06-0100 Recorded announcement service (local)**

Recorded announcement service is a system-related feature that provides a verbal announcement to originating lines which have voluntarily requested access to a recorded announcement (time, weather, and so forth) or have been routed to an intercept announcement for calls that cannot be completed as dialed.

Calls routed to an announcement, in response to a voluntary customer request, receive charge treatment. Calls routed to an intercept announcement are not charged to a customer. Therefore, answer supervision is not returned to the originating office for interoffice calls routed to an intercept announcement (see Chapter 1).

#### **20-06-0500 Special information tones (SIT)**

SITs are machine detectable tone sequences that precede announcements given to uncompleted calls. SIT permits the automated analysis of call disposition.

In the DMS, SIT tones may be a maximum of 32, each composed of three different frequencies and durations as specified by CCITT.

#### **20-06-0600 Digital recorded announcement system (DRAM)**

DRAMs are utilized in the DMS-100 Family of switches. The DRAM provides recorded announcements, stored in digital format, which are

accessible on either a “barge-in” or “non barge-in” basis. A set of standard announcements are available on Programmable Read Only Memory (PROM) cards while others may be made on site by the operating company using RAM or Electronically Erasable Prom (EEPROM) cards.

The DRAM may be utilized for Local Recorded Announcements (Feature 20-06-0100), Special Information Tones (see Feature 20-06-0500), or custom applications such as Calling Number Announcement (see Feature 20-06-0601) and Mechanized Calling Card Service (MCCS), announcements in an operator services environment (refer to Chapter 1).

#### **20-06-0601A Calling number announcement (CNA)**

The CNA feature is offered as an alternative to the hardware Automatic Number Announcement (ANA) circuits. With CNA, the DMS DRA facilities are utilized to playback the calling number to a line or to a loudspeaker. This capability may be utilized by the operating company personnel for functions such as verification of service order/line transfer cross-connects and assignment records.

#### **20-07-0000 Ringing**

In the DMS-100, programmable ringing generators are supplied in each line concentrating equipment frame. Cadence of ringing (based on a six-second period), frequency and amplitude, and dc offsets of ringing voltages are programmable. ac/dc, superimposed, coded and frequency selective ringing schemes are supported (refer to Chapter 5).

#### **20-07-0100 Individual line ringing**

Individual line ringing requires the application of an ac/dc ringing signal to activate a ringer bridged across the line within the telephone set (refer to Chapter 5).

#### **20-07-0200 Two-party line ringing**

Two-party line ringing normally requires the application of an ac/dc ringing signal to activate a ringer from either the ring side of the line to ground within the telephone set for party one or the tip side of the line to ground for party two. This method of ringing is referred to as two-party full selective ringing (refer to Chapter 5).

#### **20-08-0000 Multiparty ringing**

Multiparty ringing is a system-related feature that provides each party of a four-, or eight-party line with a unique ringing alert signal or coded ringing. DMS-100 provides both ac/dc and superimposed ringing capabilities for ringing party line stations.

The system provides optional ringing methods that include fully selective ringing, semi-selective ringing, and coded ringing. Fully selective ringing



provides for ringing each station without ringing any other station sharing the line. A common ringing code is used for all parties. Semi-selective ringing provides for the simultaneous ringing of no more than two stations with a unique ringing code for each of the two stations. Coded ringing provides for the simultaneous ringing of no more than four stations with a unique ringing code for each station.

Fully selective or semi-selective ringing is available for four party lines. Semi-selective ringing is available for eight-party lines (refer to Chapter 5).

### **20-09-0000 Audible ringing tone**

Audible ringing is a system-related feature that provides a ringing tone to inform calling customers that the called destination is being alerted. The signal is applied as soon as possible upon connecting to the called line.

The audible ring tone signal is applied in a manner that does not permit an electrical voice connection between the calling and called lines before answer (refer to Chapter 5).

### **20-10-0000 Reverting call service**

When party A calls party B sharing the same cable pair, party A gets a recorded announcement or other treatment from the DMS-100 that instructs the party that the call is for someone on his line and that he should hang up and wait for his phone to stop ringing, then pick up his phone. The ringing is applied to both parties and, when answered, ringing is tripped and a connection is established. As an option party B may get a zip tone that alerts him that party A is calling (refer to Chapter 5).

#### **20-10-0100A Single party revertive calling (Intercom)**

This feature allows a single line subscriber to use their phone as an intercom. Feature function is as follows:

- Subscriber dials their own number and is connected to a recorded announcement.
- Subscriber goes on-hook and ringing voltage is applied to the line. Since the ringers of the main and extensions are tuned to the same frequency, all phones will ring.
- When the person at the extension goes off-hook, ringing will stop at all phones and the initiator of the call can go off-hook and engage in conversation.

### **20-11-0000 Bridge lifters**

Bridge lifters are devices that electrically or physically isolate bridged telephone pairs at the central office to reduce the transmission losses they produce. Saturable inductors, relays, and semi-conductor devices are sometimes used as bridge lifters. An example of a bridge lifter application might be a two-party line bridged at the central office. If only one party is

off hook, the on-hook party is bridged through an inductor that isolates the on hook loop at voice frequencies yet allows dc access. For this application, 20 Hz ringing signals will pass through the bridge lifter device. This example may not be applicable to all two-party lines.

#### **20-14-0000 Class-of-service**

Class-of-service is a feature that permits the system to identify service requirements for lines and inter-system facilities. Each line and inter-system facility terminating in a central office requires individual treatment based upon its electrical characteristics, privileges, restrictions, call processing features, charge treatment, routing, screening, and so forth. The information used to define these attributes is referred to as “class-of-service information” (refer to Chapter 4).

#### **20-16-0000 Nailed-up connections**

This feature provides an option whereby a permanent (nailed-up) trunk to trunk path through the DMS-100 network may be established. The connection is commonly used for special purposes, such as computer links, and can be made over analog or digital trunks. The nailed-up connection will handle both inband and standard supervision signals in both directions.

#### **20-18-0000 Subscriber loop echo return control**

This feature provides for limiting echo return from subscriber loops under software control (refer to Chapter 5).

#### **20-20-0000 Automatic number identification (ANI)**

This feature causes the local switching system to outpulse the calling customer’s station identity to a CAMA office, or other office requiring calling number information (refer to Chapter 4).

#### **20-20-0100 Flexible ANI information digit assignment**

This feature provides a telephone operating company with the ability to assign a specific Automatic Number Identification (ANI) information digit pair to a call base on the specific line calls of service and on the facility digit dialed. This permits identification of unique call types to operator systems for special handling of the calls.

#### **20-20-0110 Flexible ANI information digit assignment**

The flexible ANI information digit assignment feature permits the telephone company to associate ANI information digits to features by means of originating lineclass of service routing and screening translations or with a “simulated facility” group that can be associated with a class of service.

#### **20-21-0000 Software controlled connection loss**

To assure transmission stability in conformance with the network transmission requirements, interoffice calls may require the insertion of one



of several loss values (including zero loss), depending on the connection type and the interfacing facility (for example, toll connecting, direct interlocal, analog, digital). Usually these losses are fixed and traditionally provided on analog facilities external to the switching system.

This feature provides for the insertion, when required, of any of several possible loss levels (0 to 7 dB in 1 dB steps) at the subscriber loop port side. The determination of each loss level is under software control and is a function of the transmission loss requirements for the connection.

In addition, digital pads associated with the DMS-100 Switching Network (0 to 7 dB in 1 dB steps) are used to implement various connection losses. Loss inserted using network digital pad switching complements the subscriber loop port level adjustments mentioned above and is an additive (that is, connections invoking a line can have a total of 14 dB loss as viewed at the receive side of the line). The network pad values are software selected on a per call basis. Transmit and receive directions are handled independently. The pads can be automatically disabled in digital data connections.

#### **20-22-0000 Synchronization to incoming DS-1 facilities**

With the hierarchical synchronization plan used in the operating companies, a switching system derives its clock rate from an accurate frequency signal arriving from another office. With this feature, the DMS obtains the primary or backup reference signal for synchronization of its clock from the DS-1 signals of designated digital facilities (refer to Chapter 8).

#### **20-24-0000 InterLATA-Carrier/International – carrier interconnection feature group D (FGD)**

The DMS-100 equal access end office feature allows direct interconnection to InterLATA Carriers (ICs/International Carriers (INCs)) desiring to service non-overlapping exchanges known as Local Access Transport Areas (LATAs).

To access an IC/INC, the subscriber in the DMS-100 dials 10XXX + (0/1) + 7/10 digits or 10XXX + (011/01) + CC + NN where XXX serves to identify the specific carrier. If the subscriber designates a Primary Interexchange Carrier (PIC), he dials only 7/10 digits to access the IC or only dials the standard sequence to access the INC. The DMS-100 receives all of the dialed digits, determines the carrier and establishes a connection on an outgoing trunk. DMS-100 will output carrier selection digits (if required) and ANI, prior to completion of dialing, if specified in translations. Depending upon traffic between the DMS and IC/INC, a trunk connection can be either direct or through an Access Tandem (AT) to the appropriate IC/INC. An AMA record in equal access Bellcore format can be generated for both originating and terminating calls.

The DMS-100 Family offers the capability to receive or send only three winks on INC calls when the connecting switch is not capable of generating or interpreting the standard four wink signaling sequence (refer to Chapter 6).

#### **20-24-0010 Signaling on international carrier calls**

This feature provides information on equal access measurements for each carrier that connects to the AT. Measurements are made for each InterLATA carrier (IC) or International Carrier (INC).

#### **20-24-0020 Facility/service selective dialing, switching and signaling requirements**

This feature provides for processing calls that apply Facility/Service Selective (FSS) options. With FSS options, a subscriber can dial a Facility Code (FC) and/or a Service Code (SC) to assure that selection of a particular facility and/or service on domestic and international calls. The FSS dialing procedure and the associated switching and multifrequency signaling requirements necessary to define FSS call processing are specified. These new capabilities are intended for end office and access tandem systems located in the operating company LATA environment. Compatible signaling arrangements should be provided in connecting IC and INC switching equipment to permit transport of FSS calls beyond LATA interfaces.

#### **20-24-0000A LATA equal access system (LEAS)**

The LEAS feature will allow a DMS-200 Access Tandem to provide Equal Access-like service to nonconforming end offices. A call placed by a subscriber in the nonconforming office will be routed to the LEAS Access Tandem by way of an ANI trunk. The ANI spill will be used as the line identifier for interrogation of the internal LEAS database, which contains the per line Equal Access information required to process the call such as, PIC or Carrier Toll Denial.

The LEAS arrangement will use traditional signaling sequences to set up the call from the end office and either traditional or Equal Access Plan signaling for call set up to the IC.

#### **20-24-0030 Exchange access operator service system (EAOSS) signaling**

Exchange Access Operator Services System (EAOSS) signaling will be used between an Equal Access End Office (EAEO) and an AT associated with an Operator Services System (OSS) to combine traffic requiring the telephone company operator services system with other types of traffic on a single trunk group or a number of trunk groups. It will also be used between an EAEO/AT and an IC on calls requiring special functions such as coin control, ringback, and hold.

**20-24-0040 Presubscription indicator**

The presubscription indicator feature provides for the transmission of an indication to an IC/INC of whether or not the calling station is presubscribed to that carrier.

**20-24-0040A Presubscription reports**

This feature provides, upon request, a listing of POTS directory numbers and associated line equipment for each interLATA carrier assigned in the DMS-100 switch. Reports may be generated from a MAP for either:

- a single interLATA carrier
- all interLATA carriers
- a summary of one or more carriers
- carriers by Numbering Plan Area
- carrier by LATA

A total of the number of directory numbers assigned to the carrier by presubscription is provided at the end of each report. If necessary, the DMS may be queried for the total number of presubscribed directory numbers without invoking the directory number listing. The feature also permits a listing of all directory numbers that do not have a Primary InterLATA Carrier (PIC) assigned.

**20-24-0050 Feature group C (FGC)**

FGC is the traditional interface between the operating company and AT&T.

**20-24-0060 Integrated multiple access switched service (IMASS)**

This feature is planned for a future BCS release.

**20-24-0070 IC Interconnection multiple 10XXX code indication**

This feature is planned for a future BCS release.

**20-24-0080 Data collection by feature group and IC****20-24-0200 Feature group A (FGA)**

FGA provides interconnection to carriers as a line-side appearance. FGA calls terminate or originate at designated FGA lines serving a carrier. The FGA line is virtually indistinguishable from any other line served by the switch. The only substantial difference is that AMA records are generated for all calls terminating or originating at the FGA line. The address digits of the called line are sent directly to the carrier by the customer using DTMF signaling.

**20-24-0300 Feature group B (FGB)**

FGB provides for trunk-side interconnection to ICs and INCs. A uniform access code of 950-WXXX\* is used for FGB switching. One uniform access code for domestic communications, and another for international

communications are assigned to the IC, if required. The originating calls may be routed directly from the serving office to the IC or through a tandem switch. In either case, an AMA record is generated on all calls dialed 950-WXXX. The address digits of the called line are sent directly to the carrier by the customer, using DTMF signaling. Terminating calls are also AMA recorded and may be routed directly to the switch serving the called line or through a tandem switch. FGB may be provided in the DMS-100 independent of the provision of other forms of interconnection to ICs.

\* Where – W = 0/1  
          X = 0-9

**20-24-0400 Customer changeable primary carrier designation**

(This feature currently not planned for development.)

**20-24-0500 Feature group E (FGE)**

(This feature currently not planned for development.)

**20-24-0600 Feature group F (FGF)**

(This feature currently not planned for development.)

**20-25-0100 AMA capabilities for type 1, 2A and 2B**

This feature, Multifrequency (MF) Monitor for Type 2A Cellular Interconnect, improves billing procedure by allowing the access tandem to monitor the MF digit stream of Feature Group D calls from a cellular mobile carrier (CMC) in order to include calling and called numbers in Automatic Message Accounting records for compliance with Bellcore FSD 20-25-0100.

The signaling on Feature Group D calls from a CMC over a Type 2A interconnection to an IC is identical to that provided on connections from Equal Access End Offices. The access tandem receives the signal from the CMC, establishes the connection to the IC, and puts the connection through. The MF outputting, consisting of the calling and called numbers, then passes directly from the CMC to the IC normally undetected by the access tandem. This feature permits the DMS-200 access tandem to attach an MF monitor to collect the requisite digits.

**25-00-0000 Interoffice features**

**25-01-0000 Interoffice address signaling**

Refer to Chapter 5.

**25-01-0200 Revertive pulsing**

Revertive pulsing is a dc signaling type which consists of transmitting the pulses backward from the terminating office to the originating office. A start/seizure signal received on an incoming trunk causes this trunk to commence transmitting pulses back to the originating office. The originating

office counts the pulses and sends a stop signal to the terminating office to indicate end of selection. The terminating office stores the pulse count and the cycle repeats until all the selections are received. The terminating office then sends an incoming advance signal to indicate it has successfully received all the selections. The originating office should establish the talking path upon reception of this incoming advance signal.

The translation and routing systems used in the DMS-100 provide the capabilities required to support:

- incoming RP calls with low/high five
- outgoing RP calls with low/high five
- andem RP calls with low/high five

### **25-01-0300 Dial pulsing**

Dial pulsing is a feature that provides the capability of transmitting and receiving dc address signals between offices.

Dial pulse address signals are sent as trains of on-hook pulses with the number of pulses in the trains corresponding to the digit of the address. The trains of digit pulses are separated by longer off-hook intervals called inter-digital times. The time interval from the start of an on-hook pulse to the start of the next on-hook pulse in the same digit is the pulse period. The reciprocal of this period is the pulsing speed and it is expressed as pulses per second. The on-hook pulse duration is called the break time and the off-hook remainder of the period is called the make time. The break time, expressed as a percent of the period, is a characteristic or measure of the dial pulsing called percent break.

For reception of dial pulse addresses, the system recognizes dial pulse signals at a nominal rate of 10 pulses per second.

A dial pulse sending circuit output pulses at the nominal rate of 10 pulses per second and 60% break (refer to Chapter 5).

### **25-01-0400 Multifrequency pulsing**

Multifrequency pulsing is a feature that provides the capability of transmitting ac address signals between offices. Each address digit is transmitted as a pulsed pair of frequencies (from a set of six). Pulses are transmitted at a nominal rate of seven pulses per second (refer to Chapter 5).

### **25-01-1000 Common channel signaling**

The DMS-100 family of switches supports both Common Channel Interoffice Signaling No. 6 (CCIS 6) and Common Channel Signaling No. 7 (SS7). Both follow the same basic principle (separation of signaling and voice paths), but vary in their implementation. A description of Common

Channel Signaling (CCS) and its implementation in the DMS-100 Family of Switching Systems is provided in NTP 297-1001-137 (refer to Chapter 5).

### **25-01-1100 CCS exchange access interface**

This feature allows the local carriers equal access end office (EAEO) to establish interLATA connections for signaling contain carrier information to the AT by means of CCS7 signaling. This feature allows the local exchange carriers AT to transmit Feature Group D signaling containing carrier information between the EAEO and the IEC's switch by means of CCS7 signaling.

## **25-02-0000 Address pulsing control**

### **25-02-0100 Immediate start**

Immediate start (by-link) is a feature that provides inter-system address signaling between the DMS-100 Family system and a system that transmits and/or receives address signals without special address control signals. For the reception of digits from offices requiring immediate start, the system is prepared to recognize the first dial pulse promptly after the connect signal is received. For transmission of address information to an office requiring immediate start, the system delays outputting after sending the connect signal to assure that the distant office is ready.

The transmitting office verifies that battery and ground are of the proper polarity at the time of seizure. Failure to detect the proper condition results in a retry of the call on another trunk and a failure recorded (refer to Chapter 5).

### **25-02-0200 Wink start**

Wink start is a feature that provides control for address signaling between systems arranged with wink start as a special address control signal. The wink start signal is applicable to specified incoming, outgoing, and two-way trunks and is used to inform the calling office that the called office is prepared to receive address signals.

A wink start signal consists of a brief off-hook. If the calling office receives an off-hook signal of more than the expected wink duration on a two-way trunk, the signal will be interpreted as a glare condition. (A glare condition is the result of nearly simultaneous seizures of a two-way trunk at both ends.)

For wink start operation, the transmitting DMS-100 Family office will test for the detection of the brief off-hook as a signaling integrity check (refer to Chapter 5).

### **25-02-0300 Delay dial**

Delay dial is a feature that provides control for address signaling between systems arranged with delay dial as a special address control signal. The



delay dial signal is applicable to specified incoming, outgoing, and two-way trunks and is used to inform the calling office that the called office is prepared to receive address signals.

The delay dial state is an off-hook signal and the start dial signal is a change of state from off-hook to on-hook. The called office may have a delay dial trunk in the delay dial state (off-hook) prior to receiving a connect signal or it may place the trunk in the delay dial state upon reception of a connect signal.

For delay dial operation, the originating DMS-100 Family system will detect the on-hook to off-hook transition of the delay dial signal shortly after sending the connect signal. Receipt of the on-hook to off-hook condition is an indication of signaling integrity (refer to Chapter 5).

### **25-02-0400 Stop-go**

Stop-go is a feature that provides control of inter-system address signaling between a local switching system and an intertoll trunk that is arranged for stop-go signaling.

Stop-go operation is similar to delay dial except that the delay dial signal is sent during interdigital time after one or more digits have already been sent on an immediate start basis. The off hook transition constitutes a stop pulsing signal and the transition back to on-hook is the go signal. This operation is only required where a local switching system is establishing a call over a toll connecting trunk using an intertoll step-by-step system to a common control system that does not have immediate start capability or in certain tandem tie trunk networks. Dial pulsing is always used.

In the toll connecting application, the stop signal is generated first by the intertoll step-by-step system when it is about to seize a trunk to the called office. This stop signal is then extended by an overlapping delay dial signal from the called office until it is ready to receive dial pulses. The local switching system is capable of detecting the stop dial signal during interdigital time. After detecting the go signal the local switching system resumes outpulsing of the address digits. The local switching system is not required to generate stop-go signals (refer to Chapter 5).

### **25-03-0000 Call state supervisory signaling**

#### **25-03-0100 Loop signaling arrangements**

Signaling arrangements where dc supervisory, address and control signals are superimposed on the same conductors that are used for transmission are referred to as loop signaling arrangements. The following are supervisory states which are available for various loop signaling arrangements.

**25-03-0101 Reverse battery (RB)**

The trunk circuit at one end of a variety of loop signaling trunks applies battery and ground through suitable resistance to the tip and ring conductors. One polarity on the tip and ring leads is used for the on hook state and the reverse is used for the off hook state. The trunk circuit at one end of a variety of loop signaling trunks provides supervisory signaling by means of loop signaling states. On a loop signaling trunk, the on-hook state is an open infinite resistance across tip and ring. The off hook state is a relatively low resistance across tip and ring (refer to Chapter 5).

**25-03-0102 High-low**

The trunk circuit at one end of a variety of loop signaling trunks provides supervisory signaling by changing the impedance it applies across the tip and ring conductors. A high-low trunk indicates the on-hook state by a high resistance across tip and ring. The off-hook state is a relatively low resistance across the tip and ring.

**25-03-0200 E&M lead interfaces**

E&M lead trunks make use of separate leads for signaling. Either E&M leads or E, M, SG, and SB leads are used. Ground and open states are used for off-hook and on-hook, respectively, on the E lead for signaling from a trunk facility to a trunk circuit. Battery and ground or battery and open states are used for off-hook and on-hook, respectively, on the M lead for signaling from a trunk circuit to the trunk facility. The SG and SB leads may be used to supply the signaling ground and battery when a looped conductor arrangement is desired (refer to Chapter 5).

**25-04-0000 Intraoffice connecting arrangements**

An intraoffice connecting arrangement is provided to establish a connection between two customers served by the same switching system.

**25-05-0000 Incoming interoffice trunks****25-05-0100 Inter-end office – RB supervision, MF or DP**

A local incoming trunk with loop supervision is used to complete a call from a distant local office to a customer served by the home office. The home office uses reverse battery supervision toward the distant office. Either dial pulsing or MF signaling may be used (refer to Chapter 5).

**25-05-0200 Inter-end office – E&M lead supervision, MF or DP**

A local incoming trunk with E&M lead supervision is used to complete a call from a distant local office to a customer served by the home office. Supervision is handled over the E&M leads. Dial pulsing will be received on the E lead and MF signaling will be received over the transmission leads (refer to Chapter 5).



**25-05-0300 Tandem – RB supervision, MF or DP**

A tandem incoming trunk with loop supervision is used to complete a call from a distant office to a customer served by the home office or to another distant office. Reverse battery supervision is used toward the originating distant office (refer to Chapter 5).

**25-05-0400 Tandem – E&M lead supervision, MF or DP**

A tandem incoming trunk with E&M lead supervision is used to complete a call from a distant office to a customer served by the home office or to another distant office. Supervision is handled over the E&M leads. Dial pulsing will be received on the E lead and MF signaling will be received over the transmission leads (refer to Chapter 5).

**25-05-0500 Immediate start – RB supervision, DP**

An immediate start incoming trunk with loop supervision is used to complete a call from a distant non-common control step-by-step office to a customer served by the home office or to another distant office. Immediate dial operation is used with the incoming dial pulsing being either loop

or battery and ground pulsing. Reverse battery supervision is used toward the originating distant office (refer to Chapter 5).

**25-05-0600 Immediate start – E&M lead supervision, DP**

This immediate start incoming trunk is similar to the immediate start coming trunk with loop supervision, except the E&M lead supervision is used. Incoming dial pulsing is on the E lead (refer to Chapter 5).

**25-05-0700 Tandem connecting trunk**

Incoming tandem connecting trunks are used to complete calls from a tandem office to a customer served by the local switch office. Supervision and address signaling are handled as described above for the loop and E&M lead local incoming trunks.

**25-05-0800 Common channel signaling (CCS) incoming trunks**

Incoming CCS trunks are used to carry voice signals between offices, address and supervisory signals are exchanged over signaling links. The DMS-100 Family of switching systems supports both Common Channel Interoffice Signaling No. 6 (CCIS 6) and CCS No. 7 (SS7) trunking.

**25-05-0900 Switchboard or desk**

See Chapter 5.

**25-05-0901 Switchboard, distant building**

A variety of trunks are used to complete toll calls from switchboards in distant buildings to customers served by the office. Supervision may be high-low, reverse battery, or by E&M leads. Address signaling is by either

dial pulsing or MF signaling. Coin control signals are handled by inband MF signals. Re-ring is controlled either by wink or inband MF signals.

#### **25-05-0902 Terminating switchboard, same building**

When the 3CL switchboard is in the same building as the central office, trunks used to complete toll calls to customers served by the central office may use trunks using four conductors, in addition to those trunks used when the switchboard is in a distant building. The multiwire trunks use sleeve lead supervision and MF signaling.

#### **25-05-0903 Verification connections**

Verification service is a feature which permits operators to establish a connection to a customer's line to verify a busy condition. Operator access for verification is provided over dedicated facilities and special verification trunks which interconnect local offices and operator systems. In the local office the verification access is obtained using incoming "no-test" trunks and associated facilities. The facilities may connect directly to a manual switchboard or to a switched verification network accessed by remote operator systems. The trunks may use reverse battery loop or E&M lead supervision, with MF or dial pulse signaling. In DMS-100 the verification operator can both talk and listen over the established connection.

#### **25-05-0904 Operator's clearing**

Trunks are used to establish a connection to a 3CL switchboard when a customer does not complete dialing (partial dial), or the customer line is persistently off-hook (permanent signal).

#### **25-05-0905 Local test desk or cabinet access**

Test trunks are used to establish test connections from a local test desk or cabinet to a customer line through the local switching system. These connections are required for testing, maintenance, and busy verification. Access to both busy (no test) and idle (regular test) lines is available. The switching system provides a ringing source for these test facilities.

### **25-06-0000 Outgoing interoffice trunks**

Outgoing interoffice trunks are used to handle calls between two local offices or from a local office to a tandem office.

#### **25-06-0100 Loop supervision, MF or DP**

Outgoing loop trunks use loop or high-low supervision toward the distant office. Reverse battery supervision is returned from the distant office. Address signaling is by either dial pulsing or MF signaling (refer to Chapter 5).

**25-06-0200 E&M lead supervision, MF or DP**

Outgoing trunks may use E&M lead supervision. Address signaling may be by MF signaling over the transmission leads or dial pulsing on the M lead (refer to Chapter 5).

**25-06-0300 Directory assistance**

Directory assistance trunks are used to complete calls to operators when the customer has dialed the directory assistance number. These types of trunks may use reverse battery loop supervision or E&M lead supervision, and they may be used to or from centralized locations in distant buildings.

**25-06-0400 Common channel signaling (CCS) outgoing trunks**

Outgoing CCS trunks are used to carry voice signals between offices, address and supervisory signals are exchanged over signaling links. The DMS-100 Family of Switching systems supports both CCIS 6 and CCS No. 7 (SS7) trunking.

**25-06-0500 Switchboard or desk****25-06-0501 3CL-type operator switchboard interface**

One-way trunks may be provided to a 3CL switchboard in the same or in a distant building when a customer dials a “0” call for operator assistance. A class-of-service tone to identify the customer’s class of service may be used. Either reverse battery, high-low or E&M lead supervision analog trunks or DCM/DTCs may be used to a distant building. Sleeve lead supervision is used within the same building.

**25-06-0502 Direct trunk interface to IC operator system**

Trunks to IC Operator Systems are provided for “0”, “0+”, and “1+” calls. Both coin and noncoin stations may be served. High-low-reverse battery, or E&M lead supervision is used. Address signaling is by DP or MF signaling. Address signaling is followed by ANI. Multiwink, inband coin control and ringback signals are used. After address signaling, the connection can be released only after the operator system returns on-hook supervision.

**25-06-0503 Repair service bureau access**

This access provides a routing arrangement by which a customer dialing 611 or a designated seven-digit number is connected to a repair service bureau for the purpose of reporting trouble.

**25-06-0504 Access to local test desk**

Test trunks are provided to complete calls to a local test desk or other test equipment for test and maintenance purposes. These are used by craftpersons at the customer’s station (refer to Chapter 5).

Intercept trunks are used to complete calls to an operator or an announcement machine when the called number has been disconnected, has been changed, or is out of order.

**25-06-0505 Centralized intercept**

Intercept trunks are used to complete calls to an operator or an announcement system when the called number has been disconnected, has been changed, or is out of order.

**25-07-0000 Two-way trunks**

Refer to Chapter 5.

**25-07-0100 Interoffice (MF And DP)**

Two-way trunks may be used to provide the combined functions of the incoming and outgoing trunks already described. E&M lead supervision is used.

**25-07-0100 Improved glare treatment**

This feature is not planned at the present time

**25-07-0300 Switchboard and desk**

Two-way operator office trunks provide the capability to carry outgoing 1+, 0+, 0-, 01+ and 011+ calls to the toll office and incoming toll connecting and busy verification from the toll office.

**25-08-0000 Outgoing centralized automatic message accounting (CAMA) trunks**

When message billing is provided through a distant CAMA office (see feature 55-01-0300), dedicated CAMA trunks are used for the completion of DDD calls through the CAMA office. On CAMA calls, the calling number is outpulsed through ANI, or when necessary (for example, multiparty calls) identified by an operator (ONI). An operator system may be used for the CAMA function, in which case operator system trunks instead of CAMA trunks are used for completing DDD calls.

**25-09-0000 Direct ports to pulse code modulation (PCM) facilities**

Direct ports to PCM facilities provide for a direct connection from a switching network to a PCM digital terminal. The DMS-100 Family systems use a Digital Carrier Module DCM or DTC to provide this feature (refer to Chapter 5).

**25-09-0100 Direct ports to DS-1 facilities**

Direct ports to DS-1 facilities are provided for a direct connection from a switching network to a DS-1 digital terminal.

**25-09-0200 Direct ports to DS1C facilities**

(This feature currently not planned for development.)

**30-00-0000 Call processing features****30-01-0000 Overload control and protection of essential services**

Overload occurs when traffic is greater than what the switching system can carry, and cannot meet the service objectives. During periods of heavy overload and without adequate controls, the throughput of the switching system will degrade. Throughput of the switching system can be defined by the number of calls per unit time that progress to completion. This includes ringing, connection to tones or announcements, or outpulsing. It is the objective of overload control to maintain or maximize system throughput during heavy overload and to minimize adverse service effects to other switching systems and to the network.

Under very severe overload (during catastrophic conditions) it is necessary to make provision for the continuation of essential community services. This is accomplished by designating some lines as “essential,” and providing for priority treatment of originating attempts from these lines over other lines. This feature is manually enabled and disabled.

**30-01-0100 Automatic internal overload control**

The DMS-100 Family contains software measures to automatically safeguard efficiency when the offered load significantly exceeds capacity (refer to Chapter 1).

**30-01-0200 Essential service protection**

The purpose of this feature is to assure that lines designated by the operating company as “essential” receive priority originating service during periods of extreme overload. Each line in the DMS-100 is designated as either essential or non-essential.

When ESP is activated, those lines designated as essential will be given preferred service. Originations from these lines will be treated before all others. Non-essential lines will be given equitable service with the maximum throughput possible. ESP is activated or deactivated manually.

**30-02-0000 Customer line checks****30-02-0100 Power cross test**

This test is used to determine if any foreign voltages exist on a customer line.

**30-02-0200 Ringing continuity test**

This test is performed to ensure that no open circuit exists on a loop.

### **30-03-0000 Numbering plan**

The numbering plan is a feature that utilizes destination code numbering to provide a uniform method for identifying a main station in accordance with the North American numbering plan (Notes on the BOC IntraLATA network). A destination code consists of a three-digit NPA code, a three-digit central office code and a four-digit station number. A destination code is also referred to as a national number. All ten digits or, more commonly, the last seven digits of a destination code are referred to as a directory number or telephone number.

### **30-04-0000 Direct distance dialing (DDD)**

DDD is a feature that permits eligible customers to place calls without operator assistance by dialing a set of digits in accordance with the numbering plan (see Feature 30-03-0000).

### **30-05-0000 Permanent signal**

Permanent signal is a feature that tests for the reception of digits after dial tone has been returned to an originating line. If no digits are received within a limited time after the start of dial tone to the calling line, the line is considered to be in a permanent signal state (off hook) and permanent signal treatment is applied. Permanent signal timing is recommended as 16–24 sec, but longer intervals may be required for some applications. Permanent signal treatment consists of a sequence of steps including an announcement followed by receiver off hook tone to attempt to clear the condition (refer to Chapter 4).

### **30-06-0000 Digit interpretation**

Digit interpretation is a feature that provides for the recognition of the end of customer dialing and the recognition of dialed digits as prefixes, central office codes, NPA codes, and other types of dialed information. The digit interpretation rules applicable to a local system are office dependent in accordance with the feature arrangements provided (refer to Chapter 4).

### **30-07-0000 Digit interpretation timing**

#### **30-07-0100 Partial dial**

Partial dial timing is activated after each digit is received unless the system has determined that dialing is complete, critical interdigital timing is activated, or dialing is invalid. The partial dial timing interval is recommended to be 16–24 sec. Certain applications may require longer time intervals. A time-out after this interval indicates that the customer will be given partial dial treatment. Partial dial treatment consists of a series of steps including an announcement followed by receiver-off-hook tone (refer to Chapter 4).

**30-07-0200 Critical interdigital timing**

Critical interdigital timing is activated when the digits received could provide sufficient information to complete a call, but the possibility of receiving additional valid digits exists. For example, after the seventh digit of a ten-digit station call has been received, the system might assume that no digit will follow. However, one option allows a short period of time for the customer to continue dialing the eighth digit of a ten-digit call. This period of time is a critical interdigital timing interval and is approximately four seconds in duration. A time-out after the critical interdigital timing interval is treated as a completed dialing condition.

**30-07-0300 End of dial**

This feature allows the system to determine that dialing is complete and then process the call with a minimum of delay. A customer alternative to timing is the use of the # key on the DTMF (or equivalent) set to indicate the intended end of dialing. The system will in this case interpret the # signal from a DTMF (or equivalent) set to be the end of dial signal.

**30-08-0000 Screening**

Screening is a feature that determines the eligibility of a customer to complete a call as dialed based upon class-of-service information associated with the line. Prior to routing a call as dialed the system will screen the call and deny completion of all calls that are found to be ineligible due to class-of-service restrictions (refer to Chapter 4).

**30-09-0000 Routing**

Routing is a feature that determines the terminating line or trunk group based upon an analysis of the digits received, call history, and screening of a line where required (refer to Chapter 4).

**30-10-0000 Alternate routing**

The system will attempt to route a call to the trunk group assigned as the primary trunk group. If no trunk is available in that trunk group, the system will attempt to route the call in a predetermined sequence over each alternate trunk group assigned for the destination code requested (refer to Chapter 4).

**30-12-0000 Subscriber directory number dialing features**

These features relate to the subscriber dialing practices for calls in a given NPA. In the definitions under this feature set, the symbol "X" denotes any dialed decimal digit (0-9), "N" denotes digits two through eight, "P" denotes digits zero or one.

The first three digits of a seven-digit address or digits four through six of a 10-digit address are the office code. The first three digits of a 10 digit address are the NPA code. NPA codes are of the format NPX (excluding N11 codes). Office codes are preferably of the format NNX (which are



distinguishable from NPA codes). However, some NPAs have exhausted all NNX formats for office codes and had to resort to using office codes of the NPX format, thus giving rise to code ambiguities. Code ambiguities can be resolved by the prefix method or a critical (four seconds) inter digital time-out after the seventh digit, depending on the switching environment.

Subscriber dialing practices are usually uniform for a given NPA, and are governed by the constraints or capabilities of the exchanges in the NPA (common control or non-common control), and whether or not NPX formats are used for exchanges in the NPA.

### **30-12-0100 Prefix '1' for inter/intra NPA billable calls**

The DMS-100 translations permit the use of the prefix '1' for all billable (non-local) 7 and 10 digit calls. This scheme may be used to provide uniform dialing within an NPA with Step-by-Step (SXS) exchanges (which require the '1' prefix for routing to a serving CAMA office for billing). If an NPA with this dialing arrangement exhausts the NNX format and uses NPX formats for some office codes, then the code ambiguities can be resolved by the use of a critical (four second) interdigital time-out after the seventh digit. Valid call addresses for this arrangement are:

#### Non-ambiguous codes

- non billable: NNX-XXXX
- 7 digit billable: 1 + NNX-XXXX
- 10 digit billable: 1 + NPX-NXX-XXXX

#### Ambiguous codes

- non billable: NXX-XXXX
- 7 digit billable: 1 + NPX-XXXX (T > 4 sec.)
- 10 digit billable: 1 + NPX-NXX-XXXX (no critical time-out occurred after 7th digit)

### **30-12-0200 Prefix '1' for 10-digit calls**

The DMS-100 translations permits the use of a '1' prefix digit to indicate 10 digits follow ('1' plus seven digits will be routed to treatment). This arrangement is used in NPAs where all exchanges are common control and ambiguous NPX codes are in use (or planned to be used) for office codes. Codes allowed for this feature are: 1 + NPX-NXX-XXXX.

### **30-12-0300 No prefix required for 7- or 10-digit calls**

This translation arrangement provides for routing of 7 and 10 digit station calls dialed without a prefix. This scheme is adopted in NPAs where all exchanges are common control and there are no ambiguous office codes in the NPA. Features 30-12-0301 and 30-12-0302 are two examples of this feature.



**30-12-0301 Prefix '1' allowed on 10-digit calls only**

With this arrangement prefix '1' is allowed on all 10 digit calls. If less than 10-digits are dialed following the prefix, the call is routed to treatment. There are three codes allowed:

- 1 NNX-XXXX
- 2 NPX-NXX-XXXX
- 3 1 + NPX-NXX-XXXX

**30-12-0302 Prefix '1' allowed on 7- or 10-digit calls**

With this arrangement, the prefix '1' is not required, but is permitted, on any 7 or 10 digit call (including 7 digit calls within the same exchange). There are four codes allowed:

- 1 NNX-XXXX
- 2 NPX-NXX-XXXX
- 3 1 + NNX-XXXX
- 4 1 + NPX-NXX-XXXX.

**30-12-0305A Dialing arrangements for carrier access**

There are three general IC/INC access arrangements of specific interest from a dialing procedure standpoint. These are referred to as Feature Group A (FGA), Feature Group B (FGB), and Feature Group D (FGD).

Access plan	Dialing procedure	
Feature Group A	NXX-XXXX	+ 2nd dial tone + ID Code + called number
Feature Group B	(1 +) 950-PXXX	2nd dial tone + ID Code + called number
Feature Group D*	10XXX (+1) + 7/10 D	[(1 +) 7/10 D]
	10XXX + 0 + 7/10 D	[ 0 + 7/10 D]
	10XXX + 0 (#)	[10XXX + 0 (#) or (00 {#})]
	0 (#)	[ 0 (#) ]
	10XXX + 01 + CC + NN (#)	[01 + CC + NN (#) ]
	10XXX + 011 + CC + NN (#)	[01 + CC + NN (#) ]
	10XXX + #	[10XXX + #]

\*sequences in brackets [ ] are for calls using the PIC.

### **30-13-0000 Foreign area translation (six-digit translation)**

Foreign area translation is a feature that provides selective routing for 10-digit calls based upon the requested FNPA code and office code. This translation is only required for FNPA's which can be accessed by more than one route (refer to Chapter 4).

### **30-14-0000 Operator assistance – dial '0'**

Operator assistance in response to dialing a single digit '0' is a feature that routes a call directly to an operator for assistance (refer to Chapter 4).

### **30-15-0000 Dial '0' plus 7 or 10 digits**

When a '0' plus 7 or 10 digit call is recognized and dialing is determined to be complete with a valid destination code, the call is routed to an operator system. The 7 or 10 digits received are outpulsed to the operator system. The caller uses this dialing sequence to access an operator system when alternate billing (calling card) or operator assistance (person-to-person call) is desired.

### **30-16-0000 Service codes**

#### **30-16-0100 Service code N11**

Service code N11 is a feature that provides simplified dialing in order to complete calls to frequently called service facilities. Service codes are of the form N11, where N is any digit two through nine. When the system receives a valid service code, as specified by the operating company, dialing shall be considered complete and the call will be routed to the trunk group associated with the service requested. Although all service codes are not universally applied in all central offices, the typical application of service orders is as follows.

- Local directory assistance – 411
- Repair – 611
- Business office – 811
- Emergency – 911

### **30-17-0000 Interface to directory assistance system**

Directory assistance codes is a feature that routes calls to a local or FNPA directory assistance operator based upon the digits received. The option of charging for directory assistance calls is provided.

Directory assistance codes may vary in different areas. The system is capable of interpreting and routing any one, a subset of all, or all of the appropriate codes to a directory assistance facility.

- 411
- 1-411
- 555-1212

- 1-555-1212
- NPA-555-1212 (NPA = 3-digit NPA code)
- 1-NPA-555-1212 (NPA = 3-digit NPA code)
- 10XXX-555-1212
- 10XXX-1-555-1212
- 10XXX-NPA-555-1212
- 10XXX-1-NPA-555-1212

### **30-18-0000 Custom calling service access codes**

Custom calling service access codes is a feature that permits the system to provide custom calling services to the customer with a standardized set of two-digit codes following a service access code prefix \* or 11.

### **30-19-0000 inter-system address outpulsing (MF and DP)**

inter-system outpulsing is a feature that provides the forwarding of MF or DP address information from a from the DMS-100 Family system to a distant office. The system provides the following (see Features 30-19-0100 through 30-19-0400) minimum capabilities (customer dialed prefixes are not normally outpulsed).

#### **30-19-0100 Outpulse 2-15 digits MF and DP**

Outpulse the dialed number received (from 2 to a maximum of 15 digits) (refer to Chapter 4).

#### **30-19-0200 Delete digits (up to 15)**

Outpulse the dialed number with the first digit suppressed (on a maximum of 15 digits) (refer to Chapter 4).

#### **30-19-0300 Prefix digits (up to 11)**

Outpulse the dialed number received with one to eleven digits prefixed. The system can suppress up to a maximum of fifteen digits and then prefix up to eleven digits (refer to Chapter 4).

#### **30-19-0400 Outpulse seven digits for valid service codes**

A specified seven-digit number may be outpulsed upon receipt of a valid service code.

Provision is made for specifying the number of digits to be suppressed, prefixed, or both based upon each interoffice destination code.

### **30-20-0000 Reception of outpulsing from other systems**

The reception of outpulsing from other systems is a feature that permits the accumulation of MF or DP address information in order to locally terminate a call. The number of digits required for each application is dependent upon

the local office trunk group arrangement, the distant office outpulsing characteristics, and local office destination code assignments (refer to Chapter 3).

### **30-21-0000 Intercept routing for calls to blank, changed, disconnected, or unassigned directory numbers**

Intercept routing for calls to blank, changed, disconnected, or unassigned directory numbers is a feature that permits the system to alert calling customers (local or inter-system) to the reason why a call cannot be completed as dialed. In addition, where applicable, it is desirable that the calling customer be provided with the correct information required to complete the call without operator assistance. No charge is made for calls routed to intercept. Features 30-21-0100 through 30-21-0300 intercept treatments are provided for these type calls.

#### **30-21-0100 Announcement – local or remote**

Calls may be routed to local or remotely provided announcements.

#### **30-21-0200 Operator**

Calls may be routed to local or remotely located operators.

#### **30-21-0300 Interface to intercept system**

Trunk group type AI is provided to interface with an automatic intercept system. Calls which cannot be completed as dialed are assigned various treatments. Any treatment, through translations, can be routed to an AI trunk group.

### **30-23-0000 Remote switching units (RSUs)**

The DMS-100 Family offers remote switching with a family of remote modules of various sizes and capabilities. Subscribers served by these remotes are provided with the same grade-of-service and the same feature set as that available to subscribers served by the host. The remotes interface the controlling DMS-100 host office using DS-1 links and offer such options as intra-calling and Emergency Stand-Alone (ESA).

DMS-100 Family, DMS SN remotes are discussed in Chapter 2.

### **30-25-0000 Timed release disconnect**

An originating office causes a TRD if the calling party fails to disconnect within an operating company specified (160 ms to 40.8 sec) time after the called party has gone on hook. TRD timing is not performed by the local office on calls routed to operator systems.

### **30-26-0000 Tandem capability**

The tandem office feature provides the local switching system with the capability to serve as a tandem or local/tandem office. The tandem office is

an intermediate switching center primarily used to switch trunks between local or tandem offices and other local or tandem offices. Each local office in an area may have trunks to one or more tandem offices, but each tandem office does not necessarily have trunks to every central office in the area. In many cases, local offices are connected with each other by direct trunks that do not go through a tandem office. Tandem switching is a means of making economical use of trunks and switching equipment, where otherwise many small separate groups of trunks would be required to interconnect different offices in the same general area.

### **30-26-0100 Limited local tandem switching**

This feature provides only the capability for interconnecting an originating local office to a terminating local office.

### **30-26-0200 Local inter-tandem switching**

This feature provides, in addition to the capabilities of Feature 30-26-0100, the capability to interconnect local tandem offices and to connect the local office with another tandem office.

## **30-28-0000 CLASS – screening list editing**

This feature package provides the support capabilities necessary for the telephone operating company to administer the CLASS and CLASSPLUS features that use screening lists:

- Distinctive Ringing/Call Waiting (NTXA42AA)
- Selective Call Forwarding (NTXA95AA)
- Selective Call Rejection (NTXA96AA)
- Selective Call Acceptance (NTXA45AA)

Screening List Editing (SLE) allows the subscriber to program a list of directory numbers for one or more of these services as well as to activate and deactivate the service. With SLE, subscribers have keypad control over which incoming calls they wish to accept, reject, forward or be identified by distinctive ringing/call waiting tones. Up to 31 different list entries are allowed for each service.

The subscriber can activate/deactivate the screening list features, obtain feature status reports and create or modify the directory number screening lists. This package is a prerequisite for any of the screening list features. Additional DRAM hardware must be provisioned to support screening List Editing features.

## **31-00-0000 Data base services**

### **31-01-0000 Service switching point (SSP)**

This feature provides the DMS-100 Family Equal Access End Office or Access Tandem with 800 SSP functionality. The initial function of the SSP

is to process calls that require remote data base translations for 800 service calls. To accomplish this, the DMS-100 recognizes these calls, communicates with the data base, and then handles the calls in accordance with the data base instructions. This functionality assumes the implementation of SS7 in the BOC network.

**31-02-0000 BOC 800 Service**

(See Feature 31-01-0000)

**32-00-000 Data services****32-10-1000 Public switched digital service (PSDS)**

PSDS is a circuit switched digital transport capability that allows a subscriber to send data at 56 kb/s over the public switched network. PSDS may be deployed utilizing high-speed DATAPATH capabilities (see Feature 02-01-1060). Data units capable of interworking with AT&T's Circuit Switched Digital Capability (CSDC) are available.

**35-00-0000 System maintenance features****35-01-0000 Trouble Detection**

The DMS-100 uses a variety of methods for determining actual and potential hardware and software troubles.

**35-01-0100 Hardware redundancy**

Major system hardware is duplicated and/or arranged so that a failure in a major system function is detected rapidly, the cause of the failure identified, and if required, the system provides for the automatic substitution of a spare standby unit or bypass. With hardware redundancy, failure of a single hardware unit does not cause a major loss of system call processing.

**35-01-0200 Hardware checks**

Hardware troubles are detected by means such as redundantly encoded and checked programs and data, matching of the operation of duplicated units, and self-checking hardware. The fault detection facilities permit automatic corrective actions to be taken rapidly to maximize the system's ability to respond to real-time inputs or to provide adequate output information and reduce or eliminate the mutilation of calls being handled.

**35-01-0300 Software checks**

The DMS-100 uses various trouble detection strategies to detect troubles before service is impacted.

**35-01-0310 Continuous automatic tests**

Continuous tests detect troubles, such as continuous data transmission errors; two types of continuous tests, audits and sanity test, are described in Features 35-01-0311 through 35-01-0312.

**35-01-0311 Audit programs**

In DMS-100 Family systems extensive audit programs are provided to detect and correct data errors before they can propagate and lead to system outages or significant service degradations. Audit programs are run on a routine basis and are interlocked with normal call processing (refer to Chapter 1).

**35-01-0312 Sanity tests**

Basic checks are continuously made to ensure that the call processing program modules are cycling in proper sequence and on a timely basis. Emergency action software is capable of invoking actions to recover from fault conditions with a minimum degradation of system call processing capability (see Equal access recording in Chapter 6).

**35-01-0320 Per-call trouble detection**

Connections set up by the switching system are tested to detect troubles in equipment such as peripheral modules or network equipment elements associated with that connection.

**35-01-0321 Call processing data base trouble detection**

Troubles in the call processing data base resulting from syntactically correct but functionally incorrect entries (for example, incorrect routing translation table) are detected and reported by the switching system (for example, as abnormally high overflows or other call completion problems).

**35-01-0322 Call processing resource availability tests**

These tests detect the lack of currently available call processing software resources such as Call Condense Blocks (CCB) and Call Processing (CP) letters.

**35-01-0323 Ineffective attempt detection**

Calls that cannot be satisfactorily completed after two attempts will be routed to treatment. Each failure scores the appropriate equipment failure peg count (refer to Chapter 6).

**35-01-0324 Cut-off call trouble detection**

Operational measurements provide a count of all calls cut-off as a result of CPU restarts.

**35-01-0325 Path integrity test**

Connections set up through the network are tested before and during use by the DMS-100 internal integrity checking mechanism (refer to Chapter 1).

**35-01-0326 Network path privacy of communication test**

This test protects customer privacy of communication by checking for unwanted connections with other network paths (refer to Chapter 1).

**35-01-0327 Tip and ring polarity check test**

This test detects tip and ring polarity reversals in the switching system network.



**35-01-0330 Periodic automatic tests**

Periodic automatic tests are performed on standby units of a duplicated unit pair operating in an active-standby state, on units in a non-duplex redundancy scheme, and on server groups such as transmitters and receivers.

**35-01-0340 Semi-automatic trouble detection tests**

Individual automatic tests may be requested from a local, remote, or portable MAP and the results presented at that location or at a different location, if so requested.

**35-01-0350 Manual tests**

Certain testing requires manual assistance or intervention such as the periodic testing of the person/system interfaces or the ability to remove and restore power from an equipment unit. These tests are simplified and their number minimized to avoid procedural errors and reduce the training and continuing effort required of maintenance personnel.

**35-01-0360 Inhibit of trouble detection**

The use of manual tests is limited to the type of testing that requires manual assistance or intervention by the nature of the test (for example, testing of the person/machine interface).

**35-02-0000 Service recovery**

Service recovery capabilities are intended to recover the switching system from detected troubles, both internal and external, in order to protect service with minimal impact on customers. Service recovery includes automatic reconfiguration of major functional units such as processors, memories, and busses to obtain a working configuration.

Service recovery strategies protect stable calls first and transient calls second. Automatic service recovery strategies are preferred to manual strategies.

**35-02-0100 Fault recovery programs**

In the DMS-100 Family, the maintenance system is designed to detect and analyze faults, to take corrective action, and to alert the maintenance personnel. The maintenance system is subdivided into several subsystems, each of which is responsible for its own level of hardware. Each subsystem has specific responsibilities:

- routine testing
- fault detection
- fault analysis
- error reporting, diagnostic report, and/or subsystem status
- reporting

Isolation and recovery software locates the source of the fault, and reconfigures the system so that subsequent calls will not be affected. To ensure the integrity of the DMS-100 Family system software, hardware and software mechanisms are provided to continually verify its sanity. They include data table indexing range checks, audits of software structures, and sanity timer which guards against software or micro-program loop errors not otherwise detectable.

### **35-02-0200 Initializations**

The various levels of “loss of sanity” lead to different levels of initialization in the central control. The number of levels executed will depend on the severity of the problem. If, at the highest level, the system fails to initialize, an activity switch occurs and an attempt is made to initialize on the newly active machine, with a further activity switch if this too is unsuccessful. After three unsuccessful attempts to switch activity and resume normal operation the bootstrap loader is activated in the auto-load mode (refer to Chapter 1).

### **35-02-0300 Automatic service recovery and protection**

Automatic service recovery and protection features that do not require manual intervention are provided where trouble conditions affect service to a group of customers (refer to Chapter 1).

### **35-02-0310 Automatic treatment of errors**

A failure in DMS-100 Family Systems can be diagnosed as either a hard fault or a transient error. If a failure is diagnosed as a transient error, the event is entered in the log. If the threshold is exceeded, the status is changed on the MAP and a trouble record is output. The appropriate equipment failure register is scored.

### **35-02-0320 Automatic treatment of faults**

Equipment units with detected faults are automatically removed from service. The equipment experiencing fault conditions is removed from service as soon as the fault is detected provided system operation is not severely degraded (see OUTWATS zone support in Chapter 6).

### **35-02-0330 Equipment selection procedures**

Automatic equipment selection procedures are such that calls encountering a trouble have a reasonably high probability of completion on subsequent customer or system retries (see Local call detail recording in Chapters 3 and 6).

### **35-02-0340 Safeguards against taking good equipment out of service**

Safeguards are provided so that trouble conditions within the service recovery and protection facilities can be detected and the trouble isolated to

a minimum number of units. A trouble condition will not result in a large proportion of non-faulty equipment being taken out of service. Thresholds may be established (see OUTWATS zone support in Chapter 6).

### **35-02-0400 Manual service recovery**

Manually initiated system initializations and re-configurations supplement the automatic capabilities.

## **35-03-0000 Trouble notification**

Facilities and procedures are provided to alert persons to the existence and severity of a trouble condition. The notification provides adequate information for craftspersons, with minimal training, to verify and locate the trouble condition(s).

### **35-03-0100 Three-level alarm structure**

The office alarm subsystem reports system trouble conditions to office personnel located on-site or remotely (refer to Chapter 6). The severity of each trouble is indicated using different levels of urgency:

- critical alarm – The critical alarm indicates that a severe, service-affecting condition has occurred and that immediate corrective action is imperative, regardless of the time of day or the day of the week. An example of a critical alarm condition is a duplicated memory outage.
- major alarm – The major alarm may be a hardware alarm or a program alarm. It indicates a serious disruption of service to customers, or malfunctioning or failure of important circuits. These require immediate corrective action to restore or maintain system capability. Thus, a major alarm would justify the calling of a maintenance person at any time of the day or night to an unattended office. An example of a major alarm condition is when a trunk group has reached its out-of-service limit.
- minor alarm – This may be a hardware alarm or a program alarm. It indicates the existence of a trouble that does not have a serious effect on service to customers, or malfunctioning or failure of circuits that are not critical to system operation. An example of a minor alarm condition is when a trunk is removed from service and put on a high-and-wet list.

### **35-03-0200 Audible alarms**

The system provides the software and hardware for generating audible alarms. Unique alarms are used to distinguish different alarm levels (refer to Chapter 6).

### **35-03-0300 Visual alarm indicators**

Visual displays are provided to indicate the various types of alarms locally and at locations other than the maintenance control center in accordance with local practices (refer to Chapter 6).

### **35-03-0400 Output messages**

In addition to audible and visual alarms, output messages report alarmed maintenance information to the operating company personnel. Reference to paper based documents is not normally necessary to isolate the trouble and perform further tests.

### **35-03-0500 Trouble status indicators**

Trouble status indicators in the office include:

- system status indicators which display the status of the major units of equipment of the system
- state of health indicators which do not necessarily denote trouble but report such conditions as system load
- other visual indicators such as aisle pilots and exit alarm panels

### **35-03-0600 Office alarm subsystem**

The DMS-100 alarm system is designed to generate audible and visual indications of trouble conditions detected within the DMS or in associated equipment (refer to Chapter 6).

### **35-03-0700 Alarm inhibit**

Provision is made in the DMS-100 to selectively inhibit certain non-critical alarms in special situations where repeated alarms would mask valid alarms.

## **35-04-0000 Trouble verification**

The DMS-100 will take actions to verify that a trouble exists prior to providing a trouble indication. Additional testing may be invoked prior to initiation of repair to determine the continued existence of the problem and to verify that the trouble has been cleared. Thresholding is available for certain classes of troubles in order to avoid premature service recovery action and trouble notification.

## **35-05-0000 Trouble isolation**

Test hardware, software, and procedures are provided to locate a defective unit with no disruption of service once a trouble condition has been detected and verified.

### **35-05-0100 Trouble location procedure**

In order to facilitate the isolation of faults in DMS-100 Family systems, the maintenance and administration position is provided with a telescoping process to determine the smallest number of replaceable units which can be changed to restore system status to normal (refer to Chapter 6).

### **35-05-0200 Diagnostics**

These programs are provided to identify the failing element in a faulty unit to a relatively few quickly changeable spare parts (for example, a circuit

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pack or a plug-in module of apparatus). The simplicity and speed of repair is an essential component of the overall system objective. After a suspected failed part or parts have been replaced, diagnostic programs can be requested in order to determine if the trouble has been cleared or the unit is still faulty.

The output of the diagnostic tests of a faulty unit yields direct information as to the location of the failed replaceable elements. The diagnostic programs do not interfere with the normal call processing programs or system operation (refer to Chapter 6).

### **35-05-0300 Error analysis**

As described previously the DMS-100 Family systems distinguishes between faults and errors. Statistics on errors are kept and analyzed periodically and the results printed out. When errors exceed a threshold, which in many cases is customer changeable, the faulty equipment is automatically removed from service and appropriate messages are routed to the LOG and/or alarm system (see Features 35-02-0100 and 35-02-0310).

### **35-06-0000 Repair**

In DMS-100 Family Systems, all faults detected by diagnostics will dictate a repair procedure. To facilitate maintenance and administrative functions at the equipment location, each line or trunk module frame is equipped with an I/O port multiple for connection to a portable MAP or other ASCII compatible I/O terminal. An extensive range of interrogation and control functions are provided. For example, the status of a line or trunk can be displayed and it can be made maintenance busy. Since trunk circuits may be packaged two or more to a module circuit board, capability is provided to display the status of circuits on the board and also to simultaneously busy them out; that is, park make-busy until all idle.

In the DMS-100 Family equipment identification scheme, a dual identification code defines each equipment entity down to the card and circuit level, in terms of its function and location. These codes appear on each component in the packaging hierarchy (bay, shelf, card) and are also stored in the system data base. The significance of this feature to the maintenance personnel is that maintenance actions and equipment faults will be specified in system output by both location address and equipment function. As a result, repair time and the chance of human error will be greatly reduced.

Where practical, hardware change to line circuit cards or trunk circuit cards can be accomplished by an adjustment which does not require removal of the card. These adjustments are made by means of switches on the card.

It is not necessary to remove power from a peripheral equipment unit prior to removal or insertion of circuit packs. It may be necessary, however, to remove power from some other equipment units prior to removal or

insertion of circuit packs. Appropriate cautions are clearly identified and documented.

### **35-07-0000 Maintenance person switching system interfaces**

Refer to Data recording in Chapter 6.

#### **35-07-0100 Maintenance and administration position (MAP)**

The MAP provides an interface to assist in the fault recovery, isolation, and repair processes. The assignment of various maintenance and administrative functions to specific MAP units is specified by the operating company. A specific MAP unit may be assigned the capability to perform all functions if desired. Alternately specific MAP units may be assigned subsets of the total capability, or single functions (refer to Data recording in Chapter 6).

#### **35-07-0200 Switching system control and display interface**

The MAP VDU is the principle man-machine interface between the maintenance personnel and the DMS system. The VDU screen area available for system output is 80 characters wide by 24 lines long. In the maintenance mode, the screen is divided into a number of areas which are used for displaying various types of information:

- System status area (3 lines by 80 characters) indicates the alarm and/or operational status of the system, with immediate automatic updating of the current display.
- Work area (variable number of lines by 68 characters wide) provides:
  - descending levels of subsystem status
  - display of working data (posted trunk numbers and voltage and frequency levels applied and measured)
- Command menu display area (20 lines by 12 characters wide) defines the function which can be performed at the position at any given time.
- Command interpreter output area (variable number of lines by 68 characters wide) provides:
  - output of system reports (including error, action taken, and diagnostic messages) upon operator request
  - output defining specific components of the system
- Input echo area (1 line by 68 characters) provides an echoed statement of the most recent operator input command string.
- User identification and time (2 lines by 12 characters) provides the identification of the user logged into the MAP and the time of day.

Refer to Data recording in Chapter 6.

There are two other system visual displays:

- alarm display panel (refer to Chapter 6).

- CPU status indicators (refer to Chapter 1)

### **35-07-0210 Alarm release**

Audible alarms in the DMS-100 Family can be cancelled by the removal of the alarm condition or, if it is a system detected fault, by the operation of a key on the Alarm Control and Display Unit (ACD) located near the MAP. Subsequent audible alarms are not inhibited.

Alarm and status indications displayed at the MAP cannot be retired intentionally until the alarm condition is cleared (refer to Chapter 6).

### **35-07-0220 Alarms transfer**

This feature permits the transfer of major and minor alarm indications, for the system and its power plant, to a distant office. With the Switching Control Center System (SCCS) interface, alarms in the transferred mode will appear at the DMS office for a short period of time (spurt alarms) and then automatically retire (refer to Chapter 6).

### **35-07-0300 System maintenance input/output interface**

The MAP provides an interface between maintenance personnel and the DMS-100 Family of digital multiplex switching systems. The tasks performed at the MAP include general maintenance functions (error detection and diagnosis), administration functions (network management, customer data modification), and trunk testing functions.

The MAP is designed to operate as a single entity for small office applications, as well as a large system interface where a number of MAP units can operate concurrently. The basic components of the MAP include a VDU, with keyboard, a voice communications module, testing facilities and optional position furniture.

The VDU screen will display system output, and inputs to the DMS system are made through the VDU keyboard. Other devices such as printers can be used in conjunction with the VDU. Printers associated with the VDU will operate in parallel with it.

Compatible input/output devices or terminals may be used in addition to the standard MAP units for the various MAP functions (refer to Chapter 8).

### **35-07-0400 Extended maintenance interface (Beltline)**

Equipment frames provide jacks on the FSPs so that portable MAP units or equivalent, may be connected to the system. The configuration allows the device to transmit and receive input and output messages. The jacks are placed such that the portable MAP is located near the immediate vicinity of the equipment undergoing test or repair.



The frames with electronics are equipped with an FSP as standard equipment. In the case of double bay frames, each bay is equipped with the FSP.

### **35-08-0000 Remote maintenance**

This feature provides interfaces permitting full remote maintenance operation excluding repair requiring physical action on equipment. The feature allows, at the remote maintenance location, all MAP capabilities available at the switching system location. These capabilities include: I/O messages, visual and audible status indications and alarm conditions, equipment control, unit isolation, system reconfiguration and initialization, office data access and change, and control of ac, dc and transmission tests on trunks. These capabilities allow the craft at the remote maintenance location to operate, administer and maintain the switching system with the same effectiveness as at the switching system site.

### **35-08-0300 Interim defined central office interface (IDCI) to the switching control central system (SCCS)**

This feature provides for three logical channels from a Network Element (NE) to the SCCS that will enable remote surveillance of the NE from the SCC. With this interim generic interface, SCCS can provide a remote surveillance capability that is functionally equivalent to that provided for embedded SCCS interfaces that conform to 35-08-0100 and 35-08-0200 without requiring any SCCS NE-specific development.

### **35-09-0000 Maintenance measurements**

To assist in the determination of the grade of service provided to the customer and of the system switching performance, an extensive set of maintenance measurements is automatically kept by the system (refer to Chapter 5).

## **40-00-0000 Trunk, line and special service circuit test features**

### **40-00-1000 Trunk maintenance**

Means are provided to detect faulty incoming and outgoing trunks and service circuits, automatically and/or manually, to protect service from faulty trunks, to allow verification of a fault, and to allow isolation (refer to Chapter 6).

### **40-00-1200 Trunk and line control and display interface**

MAPs are provided to permit CO maintenance personnel to maintain trunks, lines, special service circuits and switching system service circuits (MF receivers, etc.). Each MAP may be designated as a TTP, an LTP, or a combined LTP/TTP (refer to Chapter 6).



**40-00-1300 Trunk and line maintenance I/O interface**

A trunk and line maintenance I/O interface is provided to permit the craftsperson to enter messages concerning trunks or lines and to receive appropriate output messages. This is done through a MAP designated as a trunk test position or line test positions. MAP units may be assigned as either TTP or LTP or both, as required by the operating company (refer to Chapter 6).

**40-00-1400 Supplementary trunk and line test position (TLWS)**

In larger offices, additional trunk test facilities may be required and one or more additional test positions may be added to the system to provide this capability. These positions provide the same set of features as provided at the above test positions.

**40-01-0000 Trunk test features at the trunk and line test position (TLWS)**

Refer to Chapter 6.

**40-01-0100 Diagnostic tests**

Outgoing trunks may be checked by placing program initiated and controlled test calls to test lines in the distant office and detecting the response signals received over the trunk. Incoming trunks can be tested for the ability to change state under manually initiated or system controlled process. Test results are reported on the appropriate MAP channel and when a failure results, trouble data isolates faulty components.

The system provides diagnostic data results which indicate the results of each failing test performed by a diagnostic program. A diagnostic test may be run several times on a specified trunk or service circuit through a single test request. Means are provided to allow a diagnostic test of an outgoing trunk to a specified type of far-end operational test line (synchronous or non-synchronous) or a permanent busy, instead of the normal diagnostic test.

**40-01-0200 Outpulsing tests**

The outpulsing test is a feature that provides the means to place a call and talk or listen over a specified outgoing trunk. It is possible to specify the digits to be outpulsed over the trunk and the supervision returned over the trunk is displayed at the test position.

**40-01-0300 Make busy/make idle control**

The make busy/make idle control feature provides the ability to make a specific trunk maintenance busy or idle by manual request.

**40-01-0400 DC voltmeter**

In the DMS-100 Family, internal diagnostics will detect faults that are caused by external dc type troubles. Further dc testing may be performed on

subscriber loops through a remote dc testing mechanism accessed using the MAP (refer to Chapter 6).

Metallic trunk access is provided on an optional basis by means of the SAS manufactured by Telecommunication Technology Incorporated (TTI). The SAS system has been integrated into the DMS-100 Family by means of custom-design of the MAP and cabling arrangements (refer to Chapter 6).

DMS-100 Family trunk circuits do not include metallic access to the facility conductor. VF access for transmission testing is obtained through the PCM coded path through the network. DC measurements are not possible through the network.

#### **40-01-0500 Transmission measurements**

##### **40-01-0501 Basic transmission measurements**

It is possible to send tone and measure received tone level and frequency in order to make possible two-way determination of the standard transmission parameters affecting voice communications: loss (level), C-message noise, C-notch noise, gain-slope, return loss. It is also possible to apply an ac open, an ac short, or a balance termination.

##### **40-01-0502 Enhanced transmission measurements**

It is possible, using external test equipment, to send tone and measure received tone level and frequency in order to make possible two-way determination of the standard transmission parameters affecting voice-band data communications: peak-to-average ratio, intermodulation, impulse noise, phase hits, gain hits, drop-outs, phase jitter, amplitude jitter, envelope delay distortion, and frequency shift.

##### **40-01-0600 Supervisory tests**

Upon request, the system will display the status of incoming supervision on trunks and allow control of the state of outgoing supervision.

##### **40-01-0700 Trunk circuit diagnostics**

The switching system provides trunk diagnostic results in response to manual requests.

##### **40-01-0800 Monitor**

Capability to monitor a line or trunk that is service busy is provided using an optional headset trunk.

##### **40-01-0900 Talk**

Capability is provided to set up a talk and listen connection, through a headset trunk to a specific idle trunk without outpulsing digits. Thus, a craftsman with the same capability at the far end of the trunk can talk and listen over the facility on a prearranged basis (refer to Chapter 6).

**40-01-1100 Test set connections**

It is possible to connect portable transmission and signaling test equipment to trunks at the test position. This is accomplished using jack-ended trunks and headset circuitry (refer to Chapter 6).

**40-02-0000 Remote trunk and line maintenance****40-02-0100 Remote trunk maintenance**

This feature provides the capability for receiving and executing trunk test access requests from remote work stations. These requests include supervisory, outpulsing and transmission tests and remove and restore of trunks from service, and setting up monitoring and talking connections (refer to Chapter 6).

**40-02-0200 Remote office test line (ROTL)**

An ROTL allows two-way transmission tests to be made automatically on trunks outgoing from the office containing the ROTL. These tests may be initiated from a remote location. It also allows interrogation of trunk or trunk group maintenance busy status from a remote location. ROTL is capable of operating with the Centralized Automatic Reporting On Trunks (CAROT) system or with a processor controlled capability which permits locally initiated semi-automatic ROTL tests (see Traffic separation measuring system (MSTS) in Chapter 6).

**40-02-0300 Remote line maintenance**

This feature enables a craftsperson at a remote location, using a connection to an incoming test trunk to access lines and verify status, and perform basic tests such as resistance, leakage and current measurements and ringing and coin control signals. This function may also be performed from a remote MAP (refer to Chapter 4 [NT2X90]).

**40-02-0301 Interfaces to local test desk and related systems**

A test trunk (NT2X90) is provided for compatibility between a local switch and existing maintenance systems such as the No. 14 Local Test Desk, the Bell System Mechanized Loop Test System (MLT), and the Switched Access Remote Test System (SARTS) phantom connector.

The switch provides a means for establishing a metallic connection between a line to be tested and any of the above external maintenance systems. These systems are equipped for testing using a standard test trunk circuit which uses sleeve lead signaling. The DMS-100 is also compatible with various other test desks and automated test systems. Nortel Networks will, upon request, advise on the compatibility of the particular desk or system being considered for application (refer to Chapter 4).

#### **40-03-0000 Local office test lines**

Test lines are provided for testing lines and incoming trunks from connecting offices. The transmission test lines listed in this Section may also be used for tandem applications but would then be accessed by a 10X code (see Operational measurements [OM] in Chapter 6).

#### **40-03-0100 100-type test line**

A 100-type test line provides a local office with equipment that first applies a precise (1004 Hz, 1 mW) tone for a timed period, then a balanced termination for transmission level and noise measurements. Line and trunk access are provided to the 100-type test line (see Operational measurements system components and organization in Chapter 6).

#### **40-03-0200 101-type test line**

A 101-type test line provides a communication line to a craft position (see Operational measurements system components and organization in Chapter 6).

#### **40-03-0300 102-type test line**

A 102-type test line applies a precise (1004 Hz at 1 mW) tone for approximately nine seconds on, one second off, in a repetitive sequence. Refer to Operational measurements system components and organization in Chapter 6.

#### **40-03-0500 105-type test line**

A 105-type test line, with responder provides for automatic two-way loss and noise measurements, plus gain slope, return loss, and noise in the presence of tone on trunks requiring transmission testing (see "Operational measurements system components and organization" in Chapter 6).

#### **40-03-0600 Synchronous test line**

A synchronous test line provides diagnostic tests of incoming trunk equipment. A total of six supervisor pulses are returned followed by a tone signal (see Operational measurements system components and organization in Chapter 6).

#### **40-03-0700 Non-synchronous test line**

A non-synchronous test line tests incoming trunk equipment. Supervisory pulses are repeated until disconnection takes place (see "Operational measurements system components and organization" in Chapter 6).

#### **40-03-0800 Permanent busy test line**

A permanent busy test line returns a permanent busy signal.

#### **40-03-1000 107-type test line**

(Currently not planned for release.)

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#### **40-04-0000 Outside plant test lines**

##### **40-04-0100 Dialable cable pair locator tone**

This feature provides the capability for a craftsperson to locate a specific tip and ring cable pair among a group of cables in any location. The craftsperson connects a phone to any tip and ring cable pair and dials a security access code of three to seven digits followed by the DN of the desired line. The DMS-100 Family switch connects an external tone supply to the desired line for a specified duration (refer to Chapter 6).

##### **40-04-0200 Coin station test line access**

DMS-100 Family provides metallic access to coin station test lines to allow testing by the craftsperson at a coin telephone station.

##### **40-04-0300 DTMF station test circuit**

This circuit provides the capability for an installer (or customer assisted by test desk personnel) to test the station ringer and directory number—line assignment in the central office. It is possible to test DTMF stations, including 12-button sets and repertory dialers such as the TOUCH-A-MATIC.

#### **40-08-0000 Automatic progression trunk and service circuit testing**

DMS-100 Family Systems provide automatic progression trunk and MF receiver testing which can be scheduled. The trunk and MF receiver tests are scheduled by means of the automatic trunk testing feature. Before automatic trunk and receiver testing can commence, scheduling information pertaining to the trunk group, and so forth, has to be input. Once all the data has been input, the ATT software will initiate the appropriate test. All circuits failing tests can be optionally removed from service and detailed trouble reports provided to highlight failures. Safeguards are provided to limit the number of circuits that can be removed from service due to failures (see "Network management" in Chapter 6).

#### **40-09-0000 Automatic line insulation tests (ALIT)**

In the DMS-100, the line insulation test will check the loop to determine if there is a foreign potential on the conductors. Pass/fail thresholds may be specified and the results routed as desired. This test may be scheduled and may also be performed routinely on line appearances in automatic sequence. The test may be requested to test a range of lines or all lines in the office. Upon request, a craftsperson may perform ALIT tests on a single specified line appearance (refer to Chapter 6).

#### **40-10-0000 Ground start line terminating loop check**

Each time that a call attempts to complete to a ground-start line the DMS-100 will check that the subscriber loop is open before terminating the call. If the loop is closed the call will be routed to re-order. This feature

prevents false charging and premature ringing trip under certain ground start line fault conditions.

#### **40-11-0000 Test incoming trunks in tandem or local state**

This feature is not required in DMS-100 Family Systems. There is no difference in trunk configuration for local terminating or tandem calls.

#### **40-12-0000 Automatic retest (Treatment) of permanent signals**

##### **40-12-0100 Lines**

In DMS-100, lines which are not cleared during initial permanent signal treatment are placed in a Permanent Signal (PS) lockout state. There is no limit to the number of lines which can be in the PS lockout state. A message identifying the line is output whenever it goes into the PS lockout state and a minor alarm together with a TTY (or equivalent) message will be output whenever the number of lines in the PS lockout state exceeds a certain threshold.

The line state changes from PS lockout to idle when an on hook is detected. A printout of lines in the PS lockout state can be requested by maintenance personnel (refer to Chapter 3).

##### **40-12-0200 Trunks (false seizures)**

Trunks causing incoming seizure with no subsequent signaling are removed from service, monitored for supervision, and restored to service when the seizure is removed.

#### **40-17-0000 Manual testing**

##### **40-17-0100 Manual test of line**

This feature provides a craftsperson at an appropriate MAP with line maintenance capabilities: to remove lines from service, to restore lines to service, to verify the status of lines, and with access to lines for basic test capabilities (resistance, leakage, and current measurements, ringing, and coin control signals).

##### **40-17-0200 Manual test of trunks**

This feature provides a craftsperson at an appropriate MAP with trunk maintenance capabilities: to remove trunks from service, to restore trunks to service, to verify trunk states, and with access to trunks for basic test capabilities (resistance, leakage and current measurements, supervisory tests, Voice Frequency (VF) parameter measurements (see "Network management" in Chapter 6).

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## **40-18-0000 Treatment of trunks with machine detected interoffice irregularities (MDII)**

### **40-18-0100 Removal from service of trunks with machine detected interoffice irregularities**

When this feature is activated, a trunk on which an unexpected stop dial signal or a stop dial time-out occurred is held off-hook and kept out of service. On occurrence, a message will identify the affected trunk. For service protection the number of trunks thus withheld from service may be limited. Trunk service activation is by a manual input command. This feature will assist in the location of wiring transpositions external to the switching system.

### **40-18-0200 Selective suppression of MDII messages**

This feature permits, when activated, suppression of MDII reports associated with ineffective call attempts on a message type basis.

### **40-18-0500 Call irregularities due to trunk failures**

#### **40-18-0501 Detection, reporting, automatic diagnostic and trunk removal safeguards**

The system makes four provisions for call irregularities due to trunk failure:

- Call attempts that use a trunk and fail to complete are detected, reported, and counted. (Calls are completed over other trunks if a failure persists.)
- The information reported includes all equipment involved in the connection, type of failure, and address information. A retry will be provided where required to meet blocking objectives.
- Diagnostic tests of suspected units are automatically initiated.

Refer to Chapters 3, 5, and 6.

#### **40-18-0502 Trunk error analysis**

The system provides error analysis of call irregularities due to trunk failure. Consecutive faults on a trunk cause a diagnostic to be invoked and if the trunk fails the diagnostic it is removed from service. Safeguards prevent automatic removal of an excessive number of trunks from any trunk group.

#### **40-18-0600 Identification of tip-ring reversals associated with spurious answer signals**

On demand, the system provides a report that identifies the loop supervision outgoing trunk on which an anomalous supervisory state (false answer) is detected at the end of outpulsing. This capability is applied to help locate a probable external source of malfunction.

## **40-19-0000 Demand listing of trunk numbers of a specified trunk group**

Upon request, the system will list all trunk assignments associated with the trunk group specified (see "Network management [VDU]" in Chapter 6).



**40-20-0000 Print the trunk out-of-service (TOS) list**

Upon request, all trunks in a specific state will be output based upon the sequential assignment of trunk groupings or trunk appearances (see "Network management [VDU]" in Chapter 6).

**40-21-0000 Diagnose the TOS list**

Upon MAP request, all trunks in a appropriate out-of-service-state may be diagnosed (see "Network management [VDU]" in Chapter 6).

**40-22-0000 Trunk group – remove from service (make busy)**

Upon request, the system places all idle (not traffic busy) trunks in a specified trunk group in the out-of-service locked out manual, or out-of-service disabled manual state requested. Traffic busy trunks are camped-on, and as they become idle, are also placed in the requested state.

This capability is available using standard MAP commands, or optionally through scan point activation.

**40-23-0000 Trunk group – restore to service (make idle)**

Upon request, the system provides the ability to restore to service in the idle state all trunks in a specified trunk group removed from service by use of the remove from service feature (see Feature 40-22-0000).

This capability is available using standard MAP commands, or optionally through scan point activation.

**40-24-0000 Transmission testing of trunk groups**

Upon MAP request, all trunks of a specified trunk group will be transmission tested (see "Network management [VDU]" in Chapter 6).

**40-27-0000 Line access to test position**

The system provides craftspersons with the ability to dial directly from a line to the test position. In the test state, all normal line tests are available.

**40-28-0000 Multiple trunk test capability**

The system provides the software capability to conduct tests on an engineered number of trunks in parallel (see "Network management [VDU]" in Chapter 6).

**40-29-0000 Trunk-to-trunk test connection**

This feature provides a capability for establishing and disconnecting stable connections between trunks or test circuits, in response to manual requests, for the purpose of special tests (see "Network management [VDU]" in Chapter 6).



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**40-30-0000 Plug-up lists for trouble intercept routing**

The system provides for a special case of permanent signal treatment for lines. Such lines, when in trouble, are placed in the plug-up state by input request. Calls to lines in this state are routed to a trouble intercept. When the line changes state (off- to on-hook or vice-versa) it is automatically restored to service.

**40-31-0000 Transmission level point adjustment**

The transmission level point adjustment feature provides for manual adjustment of the trunk test measurement level.

**40-32-0000 Carrier group alarm (CGA)**

The DMS-100 system provides the capability of detecting CGA for directly connected DS-1 systems.

A carrier link may be put out-of-service by the system when an alarm is raised and returned to service by the system when the alarm is dropped. However, if the alarms occur frequently, the carrier state may bounce between system-busy and in-service.

To control the number of system Return-To-Services (RTS), a system RTS counter exists for each carrier. The counter keeps track of the number of times the carrier is RTS'ed within the audit interval. The counter is incremented when the carrier is returned to service by the system and is reset in the next audit.

Should the counter value exceed the maintenance limit, a warning is raised in the MAP. Should the counter value exceed the out-of-service limit, a criterion for putting the carrier permanently out of service is said to be reached. Once a carrier is put permanently out of service, it will remain in this state until it is successfully RTS'ed by manual action.

**40-32-0100 Software carrier group alarm**

(Currently there are no plans for development)

**40-33-0100 In-service facility performance monitoring**

Capability should be provided to detect, on an in-service basis, digital transmission impairments such as coding violations, out of frames, and slips on all facilities terminating at the Digital Interface Unit within the switch, and to gather, store, and perform thresholding on all associated performance monitoring parameters as stated in FR-NWT-000475, OTGR: *Network Maintenance: Transport Surveillance*.

**45-00-0000 Administrative features****45-01-0000 Data base management – memory alteration**

See Chapter 5.

#### **45-01-0100 Assignments**

A means of specifying line/telephone numbers, trunks, routing, and charging assignments is available. A means of specifying the miscellaneous equipment assignments is also available.

#### **45-01-0200 Provision driven memory administration (PDMA)**

With this feature, DMOs may be activated immediately upon entry or placed in a POF in the system memory for activation at a later time. These DMO's are input using the File Editor and Table Editor command repertoire. The file editor is used to create the POF and the table editor DMO commands are stored within the newly created file. While in the POF, DMO's may be queried, changed, or deleted. They may also be activated individually or all at once with a single input command (refer to Chapter 5).

#### **45-01-0300 Initialization and growth**

A means is provided to initialize the data model and the contents of the data base, and for the data base to grow as additional equipment is added in the office.

#### **45-01-0400 Office records verification and statistics**

A means is provided to obtain office records and statistical summaries of the data base for many operating company functions, perform ad hoc requests for data in the data base, and audit a data base external to the central office with the data base contained in the central office.

#### **45-01-0500 Memory, backup and recovery**

A means is provided to restore from a second source a damaged data base to a consistent state (refer to Chapter 5).

#### **45-01-0600 Program alteration**

The DMS-100 Family System provides efficient means of altering system memory data for both emergency and routine situations.

#### **45-01-0700 Interface to centralized database management centers**

This feature allows the implementation of database management functions from centralized operations support centers external to the switching system, through remote MAPs.

#### **45-01-0800 Direct terminal interface for data change and verify**

This feature provides the capability to efficiently perform data change and verify functions locally and/or remotely without assistance from external operations support systems (refer to Chapter 5).

**45-01-0900 Data base integrity and security****45-01-0910 Data base integrity**

Measures are provided to protect the data base contents against invalid operation and its accidental alteration or obliteration.

**45-01-0920 Data base security**

A set of protection measures are provided to prevent unauthorized access to the data base to protect against disclosure, alteration or obliteration of its contents.

**45-02-0000 Monitoring of recent change area**

Recent change area is not provided in DMS-100 Family systems (see Feature 45-01-0200 for description on pending order file).

**45-03-0000 Delayed activation of recent change message**

Pending order file is provided in DMS-100 Family systems (see Feature 45-01-0200).

**45-04-0000 Printout of call forwarding entries**

This feature provides a printout that lists all lines with the call forwarding feature. The information contained on the printout includes the call forward state for each line, for example, I for inactive, A for active, or W for waiting.

**45-05-0000 Teletypewriter input/output**

Input/output capabilities for the DMS-100 Family are provided through MAP units. The units include cathode ray tube type output and keyboard input capabilities. Optional hard copy printers may also be equipped. Multiple MAP units are normally provided as required by the operating company.

Assignment of functions such as maintenance, traffic measurement, service order or line/trunk testing are flexible. Single or multiple functions may be assigned to particular MAP units or groups of units.

**45-06-0000 Automatic traffic measurements**

The system accumulates peg counts and usage data on lines, groups of lines, trunks, groups of trunks, service circuits, groups of service circuits, and call processing registers. Peg count and usage data are automatically output through locally or remotely located devices for the periods consisting of each quarter-hour, half-hour, and total day (refer to Chapter 5).

**45-06-0100 Types of measurements****45-06-0101 Event measurements**

Event measurements provide an accumulation of the number of times a specific system action occurs (refer to Chapter 5).

#### **45-06-0102 Usage measurements**

Usage is the duration of a specified condition, normally the busy condition of a server. (A server is a system component that performs operations required for the processing of a call.) It is collected, summed and accumulated over time intervals which are specified for the type of server (refer to Chapter 5).

#### **45-06-0103 Data base statistics**

Traffic data analysis requires that the switch be capable of reporting the number of members or groups associated with specific traffic data (for example, the number of trunks in a trunk group ). The statistics are available in response to a query.

#### **45-06-0200 Measurement applications**

See to Chapter 5.

#### **45-06-0201 Office totals**

Office total measurements provide a picture of the system as a total environment (primarily using type and number of call activities performed), and an indication of system quality in terms of number and type of incomplete activities.

#### **45-06-0202 Component measures**

Standard measurements are provided for each traffic sensitive system component. A traffic sensitive component is a group of servers that provide less than 100 percent switched capacity. This is a group of servers for which, when all are in use, the probability of another request for use exists. The term “component” includes hardware and, if appropriate, software server groups. The measurements are provided on a per group basis and reflect the sum of the individual servers in the group.

#### **45-06-0203 Network measures**

A system network is a set of common paths used to interconnect various system components required for call processing. The paths are formed by the use of switched link chains, which has the effect of providing wide access using limited servers. The network measures are event measures (for example, terminating calls) or usage measures (for example, service circuits usage) that relate to the performance of the network.

#### **45-06-0204 Subscriber measures**

By providing additional information on origination and termination attempt counts for each type of line and trunk, this feature enables telephone operating companies to obtain accurate measurements for input to the **Real::Time** tool. The **Real::Time** tool allows telephone operating company personnel to analyze and determine traffic performance for in-service DMS-100 Family switches.

**45-06-0205 Validity measures**

Information is provided with operational measurements which will allow the data user to judge the reliability of the data.

**45-06-0206 Division of revenue measures**

The Traffic Separations Measurements System (TSMS) in DMS-100 Family systems can be used for division of revenue purposes. This TSMS feature is based on United States Telephone Association (USTA)/Bell “essential traffic separations data—digital switching systems” (refer to Chapter 6).

**45-06-0207 Local point-to-point data collection**

(Currently not planned for release.)

**45-07-0000 Service measurements****45-07-0100 Customer access service measurements**

The measurements provided for this feature are initially very similar to those described for Feature 45-06-0000, automatic traffic measurements, and output as Feature 45-09-0000.

**45-07-0200 Maintenance service measurements**

Maintenance measurements provide data which may be used to evaluate equipment performance and the impact of troubles on customer service, and also to calculate an operating company defined performance index.

**45-08-0000 Service measurement on special studies**

In DMS-100, subscriber line usage registers can be assigned to measure usage on selected subscriber lines. Up to a maximum of 1140 lines can be measured in this manner. The measurements can be output using locally or remotely located devices.

**45-09-0000 Traffic measurement output**

The DMS-100 provides an interface with the Engineering and Administration Data Acquisition System (EADAS) for the output of accumulated traffic measurements. Traffic measurements output is also available through local or remote MAP channels.

In addition to the above capabilities, the DMS-100 is compatible with various remotely pollable devices. Use of these devices, together with their host computer system, permits traffic measurements to be received and analyzed remotely. Nortel Networks will, upon request, advise upon the compatibility of the particular vendor equipment being considered for use.

**45-09-0100 SPCS/OS interface-EDAS interface**

This feature provides the capability for polling of selected OM data by the EADAS/DC system over a data link using the BX.25 Issue 3A protocol.

This feature requires the Multi-Protocol Controller (MPC) BX.25 software package for teleprocessing capability (refer to Chapter 6).

#### **45-10-0000 Network administration center (NAC) I/O channel**

##### **45-10-0100 NAC verification of translation data**

A MAP may be provided to allow administrative personnel to query the translation data of the system (refer to Chapter 6).

##### **45-10-0200 System status information retrieval**

This feature enables the NAC to use the MAP efficiently:

- Query the switching system for office performance (for example, processor overload) and control status information,
- Receive the above information automatically on occurrence of status changes, and
- Change the control status for Essential Service Protection (Feature 30-01-0200).

##### **45-10-0300 Traffic data query capability**

This feature enables the NAC, through the MAP, to query the switching system for selected traffic data measurements, acting as a backup to normal data collection and critical network management controls (refer to Chapter 6).

#### **45-11-0000 Verification of traffic schedules**

The system will, upon request, produce an output of the traffic report from the previous collection interval (refer to Chapter 6).

#### **45-13-0000 Service evaluation interface**

##### **45-13-0100 Service analysis (SA)**

The Service Analysis (SA) feature is designed to appraise the quality of service provided by the operating company equipment and its personnel. This is accomplished by monitoring, on a random basis, subscriber dialed and operator assisted calls in order to obtain data that can be analyzed and evaluated. This data then provides information as to the quality and completeness of service offered to telephone users.

Service analysis is initiated and carried out by a service analyst who interacts with the DMS system. The analyst performs the SA functions by listening to calls and noting the events in a call as they occur. The events of interest in service analysis are machine (software) recognized and analyst detected events. All subjective information (events) pertaining to each call is contributed by the analyst, while non-subjective data and cumulative timing is done automatically by the DMS system. In addition, the analyst controls the number and types of calls that are to be analyzed.

Service analysis is performed from a service analysis position which consists of three analyst interfaces:

- a VDU and associated keyboard
- a receive-only voice channel (for example, monitor)
- a teleprinter

The DMS-100 is also compatible with various external service observation units. Nortel Networks will, on request, advise as to the compatibility of the particular vendor equipment being considered for use (refer to Chapter 6).

#### **45-13-0200 No. 2 service evaluation system (SES) interface**

No. 2 SES will provide an end-to-end measurement of network service quality for the general areas of connection availability and billing integrity. Specifically, this involves both Dial Line Service Evaluation (DLSE) and the Incoming Trunk Service Evaluation (ITSE) processes.

The interface is a direct processor to processor arrangement between the No. 2 SES and the DMS-100 system, whereby selected call attempts are passed through a dedicated full duplex link operating at 2400 baud in a synchronous mode using BX.25 protocol levels 1 and 2 (refer to Chapter 6).

#### **45-13-0300 Signal converter allotter**

The DMD interface to SES provides direct processor interface.

#### **45-15-0000 Black box fraud protection**

The DMS-100 system can detect false supervision conditions (such as pre-trip) and route the call to re-order.

#### **45-16-0000 Blue box fraud prevention**

A “blue box” is a call originating device that can be used to place a free or low cost multi-link fraudulent call through the network. The blue box fraud prevention feature (applicable to incoming CAMA trunks only) provides a means to detect such fraud attempts and to terminate these calls on detection (refer to Chapter 4).

#### **45-18-0000 Network traffic management (NTM)**

Network management is a set of real-time procedures aimed at optimizing network performance when the network is under stress due to adverse conditions. Network management features available in DMS-100 Family systems for both local and tandem applications provide and operate control and surveillance features that aid in maintaining the network’s integrity and security during overloads and failures.

Unlike internal switching system overload controls, which modify the internal call processing functions under overload to maximize the efficiency of the switching system, network management controls are aimed at



modifying and optimizing the flow of traffic in the entire network (refer to Chapter 6).

#### **45-18-0100 Automatic network traffic management (NTM) controls**

Automatic network management controls respond dynamically to switching office and trunk group congestion and failures. The application of automatically triggered controls to traffic destined for Hard To Reach (HTR) points permits these controls to be more effective than the older nonselective controls (refer to Chapter 4).

#### **45-18-0101 Dynamic overload control (DOC) receive and response**

The DOC receive and response feature is one of the components of the DOC system. It provides the ability to:

- receive DOC commands from connected congested switching systems using dedicated scan points
- respond to these commands with protective (traffic restricting) controls on trunk groups to the overloaded or failed switching system

Up to three levels of DOC (MC1, MC2, MC3) can be received for a given trunk group, to which the switching system responds with successively more stringent controls on traffic destined for the overloaded switching system.

The first level of DOC (MC1) typically controls traffic to hard-to-reach destination codes or alternate-routed traffic, whereas the second level of DOC (MC2) takes a more stringent control (for example, all traffic). The control responses are assigned manually by network managers, and can vary by trunk group. The response to the MC3 switching failure signal stops all traffic to the failed switching system, and may automatically direct some of this traffic to predesignated (prestored) reroute(s).

The DOC receive and response feature applies to both local and tandem switching systems (refer to Chapter 6).

#### **45-18-0102 Trunk reservation**

Trunk reservation is a dynamic control that responds to trunk congestion in the outgoing trunking field. It is triggered for a particular trunk group when less than a certain number of trunk circuits are idle in that group. Trunk reservation is a two-level control system where the first level indicates less trunk congestion than the second level. The first-level response is typically limited to control of traffic destined for hard-to-reach codes or alternate-routed traffic, whereas the second response level takes a more stringent control (for example, all traffic). The control responses are assigned manually by network managers according to established rules and can vary by trunk group.



Trunk reservation includes the function performed by Directional Reservation Equipment (DRE) and Protectional Reservation Equipment (PRE) (refer to Chapter 6).

#### **45-18-0103 Hard-to-reach codes**

This control is a refinement of code blocking. If traffic to a certain code point is determined to have a low probability of completion, the code is designated as HTR. These HTR codes, in conjunction with Selective Trunk Reservation (STR), allow a percentage of traffic to the HTR codes to be blocked based on the current occupancy of the trunk group (see 45-18-0102). Up to 256 codes of one to twelve digits can be designated as HTR. These HTR codes are entered through the DMS MAP (refer to Chapter 6).

#### **45-18-0104 DOC sensing and transmit**

The dynamic overload control system responds to machine congestion. It maximizes call completions by dynamically regulating the traffic in the network to levels that can be handled most efficiently. The DOC system has two components.

- sensing of machine congestion and transmission of control signals to connected switching systems
- responding to DOC signals received from overloaded systems

The DOC sensing and transmit feature provides the first of these two components, including the ability to:

- sense two levels of switching overload (MC1 and MC2) and one level of switching failure (MC3)
- transmit DOC commands to connected switching systems through dedicated signal distributor points

The DOC sensing and transmit feature is associated with both local and tandem switching. Refer to Chapter 6.

#### **45-18-0105 Automatic congestion control (ACC) system**

This feature is not planned for release at this time.

#### **45-18-0105A Selective incoming load control (SILC)**

This network management control serves as a substitute for DOC for connected offices that cannot or do not respond to IDOC control signals (for example, equal access InterLATA carriers). In the absence of DOC, SILC permits incoming and two-way trunk groups to limit incoming traffic according to preset rate/percentage values (refer to Chapter 6).

#### **45-18-0106 Automatic call gap (ACG) message**

### **45-18-0107 InterLATA carrier/international carrier interconnection**

#### **45-18-0200 Manual network management (NM) controls**

Manual network management controls supplement and augment automatic network management controls. Manual controls also provide more flexibility in coping with situations that require human judgment. Manual controls, such as reroutes, can be expansive in nature. Alternatively, they are protective by canceling or blocking traffic that cannot be completed. Manual controls are activated and deactivated at NMCs through the system which supports the operation of the NMC (refer to Chapter 6).

#### **45-18-0201 Code controls**

Manual code controls block traffic to destination codes that are hard or impossible to reach. This conserves network resources for other traffic. Code controls are most effective for controlling focused overload, a condition characterized by a surge of traffic from many parts of the network to a single office or destination code. In the DMS-100 Family system, network management controls can be either call blocking or call gapping controls (refer to Chapter 6).

#### **45-18-0202 Trunk group controls**

Manual trunk group controls are of two types: protective and expansive. Protective controls can be used to inhibit the spread of congestion in the network by restricting normal trunk group access and overflow. Protective trunk group controls include trunk group cancel and skip controls.

Expansive controls are used to exploit routing beyond the normal in-chain routes, when in-chain routes are busy or have failed, and there exists idle capacity in out-of-chain routes. The control which accomplishes this is called a reroute control (refer to Chapter 6).

#### **45-18-0203 Administration of hard-to-reach codes**

The administration of HTR codes allows them to be defined from network management center through MAP units. This provides the capability of manually entering HTR codes on the switching office's HTR control list for use with protective automatic and manual trunk group controls (refer to Chapter 6).

#### **45-18-0300 Network management surveillance data**

The Network Management MAP displays surveillance data, and is updated every minute to reflect changes in system performance data and the types of controls in effect (refer to Chapter 5). In addition to the NM MAP displays, surveillance data is available by way of EADAS/NM interface. The DMS-100 EADAS interactions are outlined in the following paragraph.

Every 30 seconds a discrete request message is received by the DMS. The DMS in turn responds with a set of discrete (on/off) indicators that reflect the current state of switching problems and NM controls. Every five minutes a data request is received which prompts the DMS to respond with register readings and five minute data that describes switching and trunk group performance, switching problems, and the results of NM control actions during the most recent five-minute interval.

#### **45-18-0400 Centralized network management**

It is necessary to provide network managers with real-time network surveillance data and manual controls. Network managers in NMCs are expected to intervene in problems for which automatic solutions would be excessively expensive and in problems requiring human judgment. These capabilities are available using remote MAP(s). They will also be available by way of the EADAS/NM interface after phase II of the EADAS/NM implementation (refer to Chapter 6).

#### **45-18-0401 Network management audits and alerts**

The DMS system maintains files of reference and status data that the NMC audits. When an audit request message is received, the DMS sends the contents of the files. Most of the information in the files is reference material (for example, trunk group data), but some information will be status and surveillance data (for example, control status).

#### **45-18-0402 Message administration**

The message administration feature comprises the functional interactions which take place between the DMS-100 and the Network Management Center (NMC). The messages communicated by the DMS include five-minute surveillance data, 30 sec. status discretets, and responses to audit requests. The DMS is capable of receiving and responding to data requests from the NMC. It will also be capable of receiving and responding to control command messages from the NMC.

#### **45-18-0403 Engineering and administrative data acquisition system/network management (EADAS/NM) interface**

The DMS-100 Family system interfacing capabilities provide access to the Engineering Administrative Data Acquisition System for Network Management (EADAS/NM). With this interface the Network Management Center (NMC) personnel can effectively monitor and control network performance.

The DMS interfaces to EADAS/NM through the EADAS Data collection (DC) system. Refer to Chapter 6. EADAS/DC provides a passage for data to be exchanged between the DMS and EADAS/NM. A two phase introduction of interface capabilities is planned.

Phase I includes.

- five minute OM data
- five minute OM data audits
- associated 30 sec. discretets

Phase II includes.

- additional OM data audits
- associated 30 sec. discretets
- additional 5 min. data
- network management controls

#### **45-18-0500 Backup network traffic management capabilities (NTMC)**

In the event of loss of contact with EADAS/NM, full Network Traffic Management capabilities are available by way of the Network Traffic Management MAP(s) located in the NTMC.

#### **45-19-0000 Trunks out-of-service for data changes**

Changing trunk data can affect call processing if the trunk is busy. This feature informs operating company personnel through a message if all trunks in a trunk group or subgroup are not out of service. Once all trunks are out of service, a data change can be made without affecting call processing.

#### **45-20-0000 Automated records**

The DMS-100 provides a number of administrative aids designed to provide the operating company a method of outputting system records (for example, circuit assignments, card assignments, and so on). These aids may be utilized to reduce the amount of require paper records.

### **46-10-0000 Frequency of service impairment**

#### **46-10-0100 Cutoff calls**

A cutoff call occurs when a stable call is terminated for some reason other than an on hook by one of the parties. A call that has progressed to final network cut-through is considered an established or stable call

In a switching system, cutoffs can be caused by hardware or software failures, procedural errors, or (in the case of time-division switching systems) digital signal impairments (that is, slips, misframes, and errors). The performance measure for cutoff calls is the proportion of cutoff calls to total calls based on a particular holding time (usually 3 min.).

#### **46-10-0200 Ineffective machine attempts**

An ineffective machine attempt is any valid bid for service that does not complete because of a system failure. The failure can be due to hardware,

software, or procedural error. A valid bid for service is defined as any originating or incoming call attempt that delivers the expected number of digits to the switching system. Mis-dialings or incomplete dialings caused by customers are not included in this definition. Calls that cannot be completed because of traffic congestion are also not included in this definition unless the congestion is caused by a system or subsystem fault or error.

#### **46-10-0300 Line failure rate**

Line failure rate is the frequency of outages a customer line experiences due to switching system and subsystem malfunctions. Problems that occur in the station or wiring, outside plant, or loop electronics are excluded. The line failure rate may be expressed in FITS (1 failure in 109 hrs. = 1 FIT) or in failures/yr.

#### **46-10-0400 Trunk failure rate**

Trunk failure rate is the frequency of outages a trunk experiences due to switching system and subsystem malfunctions. It may be expressed in FITS (1 failure in 109 hrs = 1 FIT) or in failures/yr.

#### **46-10-0500 System failure rate**

The system failure rate is the frequency of entire system outages. Allowable system failure rate is a function of duration of failure. See total system downtime (46-20-0500) for the definition of a system outages.

### **46-20-0000 Downtime for line, trunks, and system**

#### **46-20-0100 Individual line downtime**

Individual downtime is the time during which the customer is out of service as a result of system failures. This does not include the time out of service due to congestion, unless the congestion is due to a switching system failure. A customer's line is considered out of service if either originating or terminating capability is lost for more than 30 sec, or if stable calls cannot be maintained for periods greater than 30 sec. Individual line downtime is measured as the expected long-term average time out of service per line in minutes per year.

#### **46-20-0200 Individual trunk downtime**

Individual trunk downtime is the time that a given trunk is out of service as a result of a system or subsystem failure. Like individual line downtime (46-20-0100), it is the expected long-term average time out of service per trunk in minutes per year.

#### **46-20-0300 Downtime for integrated digital termination**

Digital multiplexer functions may be integrated into a digital switching system. Some failure modes may disable all trunks served by one termination. The objective, which includes failures due to hardware,

software, or procedural errors, is designed to limit the average outage duration due to failures affecting groups of 24 or more trunks.

#### **46-20-0400 Partial system downtime**

Partial system downtime is the weighted time out of service for switching system failures that put a number of lines out of service simultaneously. Failures that cause total outages are excluded from the calculations, as are failures that cause only single line outages.

#### **46-20-0500 Total system downtime**

Total system downtime is the duration of a total system outage. A total system outage occurs when a failure results in loss of functionality of the entire system. It is measured as the expected long-term average time out of service in minutes per year for all outages greater than 30 sec.

During the recovery from a total system outage, the downtime contribution to total system downtime is weighted by the fraction of terminations affected during each recovery interval, similar to partial system downtime (46-20-0400).

#### **46-20-0600 System operations capability**

##### **46-20-0601 Manual initiation of emergency recovery**

Control is the capability to initiate emergency recovery and reconfiguration actions manually. Control is considered to be lost if any of these actions cannot be initiated. Loss of control can be expressed in minutes per year.

##### **46-20-0602 Visibility of fault**

Visibility is the ability of the system to give a specific indication of any fault that has been detected. The fault should appear on the switching system control and display interface (35-07-0200); it is not sufficient for a fault to be reported only by an alarm or a log message. Visibility is considered lost if an indication of any single fault that would otherwise be reported is not given to the operating company personnel. Loss of visibility may be expressed in minutes per year.

##### **46-20-0603 Manual request for diagnostic**

Diagnostic capability is the capability to initiate trouble verification and isolation routines manually. Diagnostic capability is considered lost if initiation of any one of these routines cannot be requested. Loss of Diagnostic capability can be expressed in minutes per year.

#### **46-30-0000 Service life**

Switching systems represent substantial capital investments on the part of a telephone company. Because of this cost, and the difficulty and expense associated with their replacement, a telephone company expects that switching system will be designed to operate with stable or improving



reliability throughout their service life. The actual service life of a system expected by a telephone company will depend on several factors. For LATA switching systems, service life would not normally be expected to be fewer than 25 years.

This general reliability service life requirement does not take precedence if more rigorous service life are established for individual component types (for example, optoelectric devices where distributional service life requirements may be applicable).

#### **46-40-0000 Reliability of remote switching units**

This describes the applicability of other reliability features to Remote Switching Units (RSUs) (30-23-0000). RSUs can be separated into two categories based on their ability to survive a failure of the host or host-remote link. To perform reliability analyses, an RSU should be considered a “separate entity remote” if the remote provides full or partial stand-alone capability in the event of a host failure or a failure of the host-remote link. To perform reliability analyses, an RSU should be considered a “separate entity remote” if the remote provides full or partial stand-alone capability in the event of a host failure or a failure of the host-remote link. Note that the application of the remote unit determines whether the unit effectively functions as a central office by serving a community of interest. If the system serves very few, or diversely located customers, it would not normally be considered a separate entity remote.

A remote unit that does not satisfy the definition of a separate entity remote should be considered as a component of the functional equipment included in the reliability analysis of the house system.

### **50-00-0000 Cutover and growth features**

#### **50-01-0000 On-line growth procedures and tests**

The system provides the capability of adding, changing or removing equipment to an existing operational system with no degradation of system service. This capability applies to major functional equipment, peripheral equipment and minor functional equipment. Test facilities are provided during the above operations (refer to Chapter 7).

#### **50-02-0000 Automatic board-to-board testing**

Board-to-board testing is performed prior to the transfer of a number of customer lines from one switching office (or offices) to another. There are two distinct applications for this feature. The first application is office cutovers where one office is replacing another office (or offices). The second is an area transfer between two offices.

Board-to-board testing ensures that the connections of transferred lines to the new office are correct with respect to the existing connections of these lines to the old office (or offices).

Automatic board-to-board testing utilizes the program capabilities of the system in order to perform board-to-board testing in an automatic manner without disturbance to the customer's lines either in the idle or busy state (refer to Chapter 7).

## **55-00-0000 Billing and comptrollers features**

### **55-01-0000 Automatic message accounting (AMA)**

AMA is a set of features that provides billing information concerning the control, collection and recording of calls charged and other pertinent information as a record for the call billing process. AMA has major subsets, local (LAMA) and centralized (CAMA) and AMA teleprocessing. Each of these arrangements are described in the following paragraphs (see Features 55-01-0100 through 55-01-0400 and Chapter 6).

#### **55-01-0100 Local automatic message accounting (LAMA)**

LAMA is a billing feature that provides local control, collection and recording of billing information and other pertinent information on magnetic tape. Specific billing details such as calling customer's telephone number, called customer's telephone number, time of answer, time of disconnect, and billing class-of-service are detected and recorded accurately for individual and two party lines.

#### **55-01-0300 Connection to centralized automatic message accounting (CAMA) offices**

CAMA is a feature provided by a distant switching system for the control, collection, and recording of billing information and other pertinent information from local offices. Interface between the switching system and the CAMA system requires dedicated trunks and trunk groups. The switching system is capable of outputting all called number digits and the calling line directory number digits of lines arranged for ANI. Calls routed to the CAMA system from lines that are not arranged for ANI are referred to as calls requiring ONI.

ANI type calls require unique identification to be outputted from the local switching system. Calls routed to the CAMA facility which encounter ANI failures within the local switching system prior to outputting also require unique identification. Two CAMA formats are available with the DMS-200 system.



**55-01-0400 AMA teleprocessing**

Remote polling of AMA data is available to host collectors using a version of CCITT X.25 protocol. Polling may be through dial-up or dedicated connections. Polling is available with either disk or magnetic tape operation.

DMS-100 also provides an interface to a host AMATPS collector using the DPP described in Chapters 2 and 6.

**55-02-0000 AMA recording for special studies**

Distinguishing marks are provided in the affected AMA records of calls involved in each of the types of special studies in this part.

**55-02-0100 AMA recording for service evaluation**

(Currently not planned for release.)

**55-02-0200 Complaint observing**

Complaint observing is used, typically, for customers who question their telephone bills. Individual customer lines identified by the switching system for complaint observing can have complete AMA details recorded for all AMA attempts and completions originating from these lines. Each AMA record is uniquely marked.

**55-02-0300 Traffic sampling**

The traffic sampling feature provides information on the flow of calls through TOPS. Three software registers provide a “1 to N” fraction for weekday, Saturday and Sunday. 1 of N calls are flagged on the AMA tape. If an AMA entry would not normally be required, it will be made with a Traffic Sample, no charge indication for the purpose of sampling. The flagged calls on the AMA tape will form a data base for downstream statistical analysis for the following functions:

- operator services work volume
- division of revenue procedures
- customer checking acceptance analysis
- engineering studies

**55-02-0400 Subscriber line usage**

Customer line usage studies are used to determine measured service tariffs and to determine tariff effects. Lines marked for this study can have detailed AMA records produced for all attempts and completions, whether or not the calls would ordinarily be AMA calls. Each AMA record is uniquely marked.

**55-03-0000 Billing services**

The features in this part are typical billing services that may be provided.

### **55-03-0100 Class-of-service – billing**

The class-of-service, or charge class, controls a call's charging and billing treatment. Each line is assigned a class-of-service, except that a line may not be assigned to a class-of-service corresponding to a service not offered by the office. Typical classes of service are as follows:

- FLAT—(refer to Feature 01-02-1700)
- MESSAGE RATE—(refer to Feature 01-02-1800)
- COIN SERVICE—(refer to Features 10-01-0000 through 10-02-0000)
- OUTWATS BILLING—(refer to Feature 02-01-003)
- INWATS BILLING—(refer to Feature 02-01-0020)

### **55-03-0200 AMA detailed record on timed message unit (MU) calls and untimed**

This feature provides the capability to record,(when required by changeable office data parameters), the called number and/or message billing index on message rate calls (refer to Chapter 5).

### **55-03-0300 Calling area assignments**

Allowable calling areas are defined for the various service classes to which customer lines may be assigned. These areas are flat rate, message rate, local coin, and OUTWATS areas. In addition, tandem calls are recognizable. This also applies to IDDD calls

### **55-03-0400 Bill to another number in the same switching system**

Bill to another number in the same switching system is a feature that provides for billing to a special billing number instead of the directory number of the originating line. The special billing number must be a valid directory number within the central office of the originating line, but it is not required that a physical line or station be associated with the special billing number.

### **55-03-0500 Directory assistance charging**

The capability of charging for directory assistance calls may be provided.

### **55-03-0510 AMA recording of '555' calls**

This feature provides call codes that are assigned (based upon translation of the dialed digits) to Bellcore format AMA records. These call codes are; Non Directory Assistance 555 (Call Code 088) and call codes 800 through 999 whose meaning can be defined by the telephone operating company.

### **55-03-0600 Free calls**

Subscriber calls originating at a local office to certain destinations generate billing records which prevent charging (free calls). Examples of possible free calls are calls to service codes (for example, 411, 555). Calls to NPA directory assistance bureaus (NPA-555-XXX) do not require special AMA

records; they are currently not billed because of Revenue Accounting Office (RAO) screening of the called number. Other calls, such as calls to assistance operators (0, 0+) are billed on the basis of records generated in other operator services systems, and no billing record is generated at the originating local office. Calls to lines in the same office with free terminating class-of-service do not generate a billing record. Provision is made to construct uniquely marked AMA records for free calls when required.

#### **55-03-0700 AMA recording of customer evoked vertical services**

The capability should be provided to indicate in the billing record when a customer initiates a special service request, such as adding on a third party or activating the call forwarding service. This capability is required to provide usage-sensitive custom calling (for example, Features 01-02-1304 and 01-02-1403).

#### **55-05-0000 Usage sensitive billing option on normally flat rate features**

The capability should be provided for billing certain flat rate features on a usage-sensitive basis. Examples of these features are: speed calling, call forwarding and three-way calling.

#### **55-06-0000 Verification of billing number assignments**

This feature provides the capability to verify through an input message, single or multiple assignments of billing numbers to directory numbers or terminal numbers.

#### **55-07-0000 Billing records of WATS calls**

Provides AMA records for WATS calls, including the WATS band number and calling number.

#### **55-08-0000 AMA reel mounting protection and automatic positioning**

AMA check programs prevent improper mounting of reels and eliminate the possibility of improper positioning of the beginning-of-tape mark by the operating company personnel. The mark will be positioned automatically after a new reel of tape has been mounted on the AMA transport.

### **60-00-0000 Tandem features**

**Tandem office (DMS-200)** Tandem offices are the switching entities in the long distance trunking network through which any DDD telephone may be reached if a direct trunk is unavailable.

**Combined office (DMS-100/200)** A single switching system which is capable of providing more than one of the fundamental switching functions (for example, end office, tandem) is called a combined office. On a given call such an office may serve either of these functions.

### **60-01-0000 Access tandem office trunks**

Trunk names differ to some degree among various standard references. The nomenclature and two letter codes, by traffic use, utilized herein are known as “common language” codes.

The trunks discussed herein are known by the same names regardless of whether they appear on a system that performs only the tandem office function or other class of office functions (local or tandem) as well. In the following paragraphs, the assigned codes by traffic use are shown in parentheses. A few of the trunks discussed in this section do not yet have common language codes assigned to them.

A variety of trunks that may appear on a tandem switching system depending on specific features provided in the office:

- Tandem connecting
  - DDD Access (DD)
  - Centralized Automatic Message Accounting (CA)
  - Operator Services System (OS)
  - Tandem Completing (TC)
  - Two-Way Operator Office (OO)
  - Two-Way Tandem Connecting (not coded)
- Inter-tandem
  - Primary inter-tandem (IT)
  - Emergency Access (not coded)
  - Regular Access (not coded)
  - Operator System Verification (not coded)
- Secondary inter-tandem
  - Special Operator Service Traffic (SOST)
  - Operator Assistance (OA) and Leave Word (LW)
  - Residual (not coded)
  - Delayed Call (DC)
- Auxiliary service
  - Rate and Route (RR)
  - Rate-Quote (not coded)
  - Directory Assistance (IN) (DA)
  - Time (TI) and Weather (WE)
- Special service trunks
  - Direct Inward Dialing (DI)
  - NWATS (WI)

- Miscellaneous trunks
  - CAMA – Operator (CP)
  - Data Processing systems (not coded)
  - Trouble Reporting (not coded)

#### **60-01-0100 Tandem connecting trunks**

Tandem connecting trunks are trunks between an end office and a tandem office. The trunks may be one-way local to tandem, or one-way tandem to local or two-way (refer to Chapter 5).

#### **60-01-0101 DDD access (DD) trunks**

DDD access trunks are one-way trunks from a end office to a tandem office carrying noncoin interLATA traffic. The recording and timing of the call is done at the end office and operator assistance is never required.

#### **60-01-0102 Centralized automatic message accounting trunks**

CAMA trunks are one-way trunks from an end office to a tandem office carrying non-coin tandem traffic. The recording and timing of the call are done at the tandem office. ANI is normally used for the identification of the directory number of the calling party. Certain kinds of calls, such as those from a multiparty line or those encountering an ANI failure in the end office, require identification by a CAMA operator at the tandem office who obtains the directory number verbally ONI. A CAMA trunk may serve a local office not equipped with ANI in which case ONI applies on all calls.

#### **60-01-0103 Operator services system (OS) trunks**

Operator services system trunks are one-way trunks extending from a end office to an operator system and then to a tandem office. These trunks carry dial assistance, special tandem, coin and non-coin traffic. The tandem office is an outlet to the DDD network for long haul calls and also for short haul calls to an end office in the same tandem center area. The operator system does the call rating and charge recording functions. The operator collects coins, redirects the call (if necessary), initiates charge timing and does other necessary operator functions.

In some sparsely populated locations, an operator system, instead of the tandem office, serves as the CAMA office. The 1+ noncoin traffic may be combined with special tandem traffic on a separate trunk group, the trunks at the tandem office are identical to trunks and are so coded.

#### **60-01-0104 Tandem completing (TC) trunks**

Tandem completing trunks are one-way outgoing trunks from a tandem office to an end office. In some literature they are called tandem switching trunks and in other literature they are called tributary trunks.

**60-01-0105 Two-way operator office (OO) trunks**

These trunks are also known as Combined Operator – Office Trunks (COOT). A small Community Dial Office (CDO) usually does not have a switchboard in the same building and may not have access to an operator system. The “O” operator and cord switchboard are, in general, located some distance away, in the tandem building which houses the area’s tandem switching system. A two-way trunk (OO) group is established, giving the CDO customers dial “O” access to the operator and giving the operator direct tandem completing access to the CDO, without going through the tandem switching system. Usually the tandem-switching system is also given one-way access to the (OO) trunk group which is used to complete traffic to the CDO. Operation is the same as for regular one-way tandem completing trunks from the switching system, except for the exchange of busy signals with the tandem switchboard.

**60-01-0106 Two-way tandem connecting trunks**

Most tandem connecting trunks today are one-way; either incoming to the tandem office (DDD access) or outgoing from the tandem office (tandem completing). Two-way tandem connecting trunks combine DDD access and tandem completing trunk functions. Long haul two-way tandem connecting trunks are known as End Office Tandem (EOT) trunks.

**60-01-0200 inter-tandem trunks**

In addition to the trunks that connect any end office through tandem office with any other end office through tandem office, the term “inter-tandem” has recently been extended to cover other types of trunks such as emergency access trunk operator system verification trunks, and regular access trunk since their transmission characteristics are identical to inter-tandem.

**60-01-0201 Primary inter-tandem (IT) trunks**

A primary inter-tandem trunk is a trunk that connects any end office or tandem office with any other end office or tandem office. The trunks may be one- or two-way.

**60-01-0202 Emergency access trunks**

(Currently not planned for release. Not applicable.)

**60-01-0203 Regular access trunks**

(Currently not planned for release. Not applicable.)

**60-01-0204 Operator system verification trunks**

An operator system verification trunk is a one-way trunk from an operator system to a tandem office. It has been classified as an inter-tandem trunk. The difference between an operator system verification trunk and a delayed call trunk is that the delayed call trunk is limited to the secondary inter-tandem category. The verification trunk is used by an operator system

operator to reach, through the tandem office, either a tandem connecting or an inter-tandem trunk dedicated for verification service. Over these dedicated trunks an operator system operator can verify the busy or idle status of a called line in a prearranged selection of nearby or distant end office.

### **60-01-0300 Secondary inter-tandem trunks**

Transmission literature categorizes trunks from the tandem switch to their associated switchboard (or operator system) to the tandem switch as secondary inter-tandem since their transmission characteristics are similar to inter-tandem trunks but not identical in every respect. Secondary inter-tandem trunks are subdivided as discussed in the following sections.

### **60-01-0301 Special operator service traffic (SOST) trunks**

SOST trunks are trunks from a switchboard to a tandem office and are used for originating outward traffic and for the completion of assistance and leave-word traffic where an operator system is not available. Residual traffic received from operators is also completed by switchboard operators using SOST trunks.

### **60-01-0302 Operator assistance (OA) and leave-word (LW) trunks**

Trunks in this category connect a tandem office to an assistance operator or to a leave-word operator at a cord switchboard. Both types of operators are reached only by operators at their own tandem center or by operators at some distant tandem center. These leave-word and assistance operators assist other operators, at switchboards or at an operator system who may be at a distant location or in the same area, in such functions as verification of line busy, completion of calls to mobile or marine stations and the completion of calls originated earlier by a customer in the tandem center where the leave-word operator is located. leave-word and assistance operators may advance the call through the tandem office using SOST trunks, tandem switching trunks, or operator- office trunks directly to an end office.

“Operator assistance” and “leave-word” trunks also exist between a tandem system and an operator system and are used when this traffic is handled by an operator system’s operator. Operator assistance and leave-word trunks associated with an operator system are joined at the operating system through their respective trunk circuits to the equivalent of SOST trunks. These trunks are used by an operator system operator to complete “operator assistance” and “leave-word” traffic through the tandem office. An operator system operator, unlike a cord switchboard operator, does not have direct access to tandem switching trunks or to operator-office trunks.

### **60-01-0303 Residual trunks**

The operator system operators handle most types of calls without the assistance of another operator. The category of calls that the operator is not equipped to handle are called “residual calls,” and these are advanced by the



operator system operator through the associated tandem office to a operator at switchboard called the SOST board or equivalent. This operator then advances the call (through a SOST trunk) as appropriate. Marine, mobile, and conference calls are typical.

#### **60-01-0304 Delayed call (DC) trunks**

An operator system's operator uses a delayed call trunk to reach both the calling and called parties by setting up two separate connections through the tandem office. The called and calling parties are joined at the operator system through the delayed call trunk circuit which has two trunk appearances on the tandem office. The tandem office treats the delayed call trunk as two separate and distinct incoming trunks.

#### **60-01-0400 Auxiliary service trunks**

Some trunks associated with a tandem switching office are not used to advance a call to another office. These include:

- rate and route trunks
- rate quote trunks
- directory assistance trunks
- time and weather trunks

#### **60-01-0401 Rate and route trunks**

Rate and route trunks are one-way trunks from a tandem office to operators at cord switchboards or desks. Originating operators place calls to these operators to obtain dialing instructions (area code, and so forth), and charging rates for operator-assisted calls to infrequently called localities. After obtaining the needed information, the originating operator releases the connection to these special operators and then places the outgoing call in a normal manner.

#### **60-01-0402 Rate-quote trunks**

Rate-quote trunks are one-way trunks from a tandem office to an external rate-quote audio response system. Calls are placed to these systems by originating operators needing charging rates for operator-assisted calls to infrequently called localities. The external system returns an audio response to the operator keyed request.

#### **60-01-0403 Directory assistance trunks (IN) (DA)**

These are one-way trunks between a tandem office and an automatic call distribution system through which directory assistance operators are reached. There may be either one group of trunks or two groups of trunks, one IN for tandem assistance and one DA for local assistance when these latter calls are routed to the tandem office to reach the ACD.



**60-01-0404 Time and weather trunks (TI and WE)**

These are one-way outgoing trunks from a tandem office to external centralized announcement locations. In some areas separate trunk groups are established; in other areas a common group is established and digits are pulsed to the central location. At the central location, translation of the digits determines the announcement to be given.

**60-01-0500 Special service trunks****60-01-0501 Direct inward dialing (DID)**

DID permits dialing a DDD or local call directly to a PBX extension. This reduces the number of attendants and positions that a large business customer has to provide to handle incoming calls.

DID trunks to PBXs directly from tandem offices give load relief to end offices with large PBX customers.

**60-01-0502 800 service trunks**

Inward Wide Area Telephone Service (INWATS) is a special service that allows a customer to receive and pay for telephone calls that have been placed without charge to the calling party. INWATS customer lines have historically been assigned to an end office, but for large ACD customers with INWATS service, substantial system savings in both trunk and local office switch facilities can be realized by terminating the INWATS customer trunk directly on a tandem office rather than on a local office. The term “trunk” rather than “line” has been agreed to when a tandem office is involved.

**60-01-0600 Miscellaneous trunks**

This category comprises trunks provided for traffic administration, plant maintenance and administrative purposes, or trunks that do not fall within other specified categories.

**60-01-0601 CAMA operator trunks**

CAMA operator trunks are required at a tandem office to connect to an operator on CAMA billed calls requiring ONI of the calling number. In an existing tandem switching system, this operator service is provided through access to CAMA switchboards, an operator system or operator switchboards. Two concurrent connection paths are required between the local/tandem office and the operator position. One path is to be used for talking (requesting and providing the calling number), and the other for signaling, MF outpulsing the calling number, to the local/tandem office for CAMA recording.

### **60-01-0603 Trouble reporting trunks**

Trouble reporting trunks are one-way trunks from a tandem office to a computer. They are used by operators to record trouble reports by pulsing coded information through the tandem office to the computer.

## **60-02-0000 Call processing features**

### **60-02-0100 Trunk-to-trunk test connections**

This is the capability of setting up or disconnecting stable connections between various trunks and service or test circuits either in response to manual requests (made through MAP) or as a part of the switching function. These connections meet the established tandem transmission requirements.

### **60-02-0200 Three-digit translation**

Three-digit translation in conjunction with an address length count for the complete thousand “XXX” combinations (refer to Chapter 4). Included are three translations:

- 200 “0/1XX” TTC codes, Operator Codes (Op Cs)
- 800 “NXX” CO and other special purpose codes
- 800 “NXX” Area Codes (ACs)

### **60-02-0201 0/1XX Terminating tandem center and operator codes**

This is the ability to translate the two hundred 3 digit codes of the form 0/1XX made available to operators or generated by the machine for certain tandem calls to modify routing or call-handling logic. Examples of these codes are TTC and operator codes, and machine generated codes used for routing such calls as INWATS and international calls.

### **60-02-0202 NXX Central office and special purpose codes**

This is the ability to translate the 800 NXX codes comprising central office codes, special purpose codes such as 555 for tandem directory assistance and 844 for time, and service codes such as 411 and 911.

### **60-02-0203 NXX area codes**

This is the ability to translate the area codes which are currently of the form N 0/1X but are to be expanded to the form NXX by the turn of the century.

### **60-02-0300 Six-digit translation**

This is the ability to make a six-digit translation for NPAs in conjunction with an address length count. This is required when a Foreign NPA (FNPA) can be reached by more than one route. There are also situations where six-digit translation applies to a central office code and subsequent digits as well as to tandem center codes and subsequent digits (refer to Chapter 4).

**60-02-0400 Digit deletion**

This is the ability to delete 1 to 15 digits before outputting them to the next office (refer to Chapter 4).

**60-02-0500 Digit prefixing**

This is the ability to prefix digits to the incoming address starting from the most significant digit position of the incoming code format. Prefixed digits consist of decimal values only (refer to Chapter 4).

**60-02-0600 Code conversion**

This is the ability to substitute for some or all of the routing digits received. This feature provides flexibility of meeting numbering plan requirements by furnishing routing digits for certain systems in the network. For example, an established step-by-step train may require routing digits which differ from those provided by the seven-digit numbering plan. This is a combination of digit deletion and digit prefixing since the conversion is limited to leading digits (refer to Chapter 4).

**60-02-0700 Route advance logic**

This is the ability to determine the alternative routing choices based on the received digits and incoming trunk information. The route advance logic is able to determine at least seven alternative routes where each route may have alternative choices of trunk subgroups. The route advance logic is expandable (refer to Chapter 4).

**60-02-0800 International direct distance dialing (IDDD) via function**

The IDDD – via function provides for an appropriate trunk-to-trunk connection after the translation of the “011XXX” digits which are received during the first stage of pulsing on IDDD calls. After transmission of the 011XXX digits, there is no delay in readiness to detect delay dial from a gateway office ahead (refer to Chapter 4).

**60-02-0900 Capability for satellite connections**

Long haul trunks may, in certain circumstances, be derived in part from satellite transmission facilities. When this is done, echo control arrangements, either split suppressors or split cancellers, must be provided at each trunk end or at an alternative location closer to the end of the connection. It is assumed that not more than one satellite in synchronous orbit will be used for one trunk.

**60-02-1000 Recorded announcement service**

Recorded announcement service is a system related feature which provides various verbal announcements for connection to incoming trunks whenever appropriate conditions are encountered. An incoming trunk will be connected to an announcement channel whenever vacant code, partial dial,

equipment busy, blockage or disaster conditions are encountered. The messages are structured to explain the condition to the customer and cause a change in subsequent attempts as applicable. Calls routed to these announcements will not return answer supervision to the originating office. Announcements are provided on a non barge-in basis (refer to Chapter 1).

#### **60-02-1100 Overlap outpulsing**

DMS-100 provides for overlap outpulsing in the following cases:

- DP or DGT line to DP trunk
- DP trunk to DP trunk (non-CAMA, operator service system)

#### **60-02-1200 Vacant code screening**

This is the capability to establish a connection to an announcement trunk at the operating company's option, for all unassigned numbering plan area and central office codes (refer to Chapter 4).

#### **60-02-1300 Trunk class screening**

This is the capability to restrict incoming trunk groups from certain dialing patterns (refer to Chapter 4).

#### **60-02-1400 CAMA unauthorized code screening**

This is the capability to restrict incoming CAMA trunk groups from certain dialing patterns (refer to Chapter 4).

#### **60-02-1500 CAMA for adjacent NPAs**

The tandem system provides the capability of handling calls by CAMA, from the CAMA HNPA plus up to four adjacent NPAs.

### **60-03-0000 Tandem signaling**

#### **60-03-0100 Common channel signaling (CCS) signaling**

Common Channel Interoffice Signaling (CCIS) employs data links, distinct from the voice paths, to transfer information between systems in the Stored Program Controlled (SPC) network. The information transferred consists of supervisory and address signals, as well as supplementary information. Tandem CCIS will integrate tandem offices into the SPC network.

A program is underway to introduce SS7 into the DMS-100 Family of switches. SS7 is a form of common channel signaling, based on CCITT #7 (used in international applications), and is optimized for use in North American signaling networks to provide interoffice trunk signaling as well as transaction oriented signaling for database query applications (refer to Chapter 5).

#### **60-03-0200 Interoffice trunk signaling**

Signaling between tandem exchanges is essentially the same as between local exchanges. Additional signals associated with operator systems are

used on tandem exchanges. They are ring forward, an on-hook wink used by an operator system to recall an operator in the forward direction, and double ring forward used by an operator system to signal a cordboard that the originating station has disconnected. Dual tone multifrequency signals and coin signals are not used between tandem exchanges.

## **60-04-0000 Line and trunk test features**

### **60-04-0100 Test lines**

See Chapter 7.

### **60-04-0101 All 10X-type test lines used on end offices**

#### **60-04-0102 103-type test line**

This provides for overall tests of the supervisory and signaling features of conventional inter-tandem trunks.

#### **60-04-0103 104-type test line**

This provides a test termination for two-way loss measurements and one-way noise checking. The termination can be used to test trunks outgoing from offices equipped with manual testboards or with certain automatic equipment.

#### **60-04-0104 108-type test line**

The 108 test line provides far end loop-around termination to which a near-end Echo Suppression Measuring Set (ESMS) is connected for the purpose of testing Echo Suppressors (ES).

#### **60-04-0105 109-type test line**

DMS-200 is compatible with the AT&T 109 Test Line J93020.

### **60-04-0200 Multiple trunk test capability**

Technicians at trunk and line work stations and centralized trunk test units are able to perform tests simultaneously on several trunks, using MAP facilities (refer to Chapter 7).

### **60-04-0400 Through balance test facilities**

(Currently not planned for release. Not applicable.)

### **60-04-0500 Selection of transmission test levels (TLP2, TLP3)**

For trunks which can operate in either a local or tandem mode, the switch recognizes both local and tandem test line calls and adjusts trunk circuit loss appropriately.

#### **60-04-0600 FX line for ROTL in tandem offices**

ROTL access is provided using dialable subscriber lines in a two line hunt group. The lines are connected to a local office while the ROTL can be physically located in offices of all class. After the connection is established and the ROTL is ready to proceed with the test, the ROTL will communicate with the DMS for trunk selection through the test port and scan/distribute points.

#### **60-04-0700 Two-way trunk maintenance**

Two provisions are made for two-way trunks :

- block outgoing calls but accept incoming calls
- block calls in both directions.

#### **60-04-0800 Quick 'go or no-go' trunk test**

The system provides an automatic, quick "go or no-go" type trunk test.

#### **60-04-0900 Voice path assurance (VPA) test**

The tandem switching system provides the capability for making a VPA test for CCIS and SS7 trunks (refer to Chapter 5).

### **60-05-0000 Network management features**

Network management is a set of real-time procedures aimed at optimizing network performance when the network is under stress due to adverse conditions. Network management provides and operates control and surveillance features that aid in maintaining the network's integrity and security during overloads and failures.

Unlike internal switching system overload controls, which modify the internal call processing functions under overload to maximize the efficiency of the switching system, network management controls are aimed at modifying and optimizing the flow of traffic in the entire network.

#### **60-05-0100 Automatic network management controls**

Automatic network management controls respond dynamically to switching office and trunk group congestion and failures. The application of automatically triggered controls to traffic destined for HTR points permits these controls to be more effective than the older non-selective controls (refer to Chapter 6).

#### **60-05-0101 DOC sensing and transmit**

See Feature 45-18-0104.

#### **60-05-0102 Trunk reservation**

See Feature 45-18-0102.

**60-05-0103 Hard to reach codes**

See Feature 45-18-0103.

**60-05-0104 Dynamic overload control (DOC) receive and response**

See Feature 45-18-0101.

**60-05-0105 Automatic out-of-chain routing**

This is the capability to route calls to a number of out-of-chain trunk groups after all in-chain trunk groups have been found busy (refer to Chapter 6).

**60-05-0106A Selective incoming load control**

See Feature 45-18-0105.

**60-05-0200 Manual network management controls**

See Feature 45-18-0200.

**60-05-0201 Code controls**

See Feature 45-18-0201.

**60-05-0202 Trunk group controls**

See Feature 45-18-0202.

**60-05-0203 Administration of HTR codes**

See Feature 45-18-0203.

**60-05-0300 Network management surveillance data**

See Feature 45-18-0300.

**60-05-0400 Centralized network management**

See Feature 45-18-0400.

**60-05-0401 NM audits and alerts**

See Feature 45-18-0401.

**60-05-0402 Message administration**

See Feature 45-18-0402.

**60-05-0500 Backup network management capabilities**

See Feature 45-18-0500.

**60-05-0600 Trunk directionalization**

This feature allows the network manager to make a two-way trunk or trunk group busy to outgoing traffic while still handling incoming traffic (refer to Chapter 6).



## **60-06-0000 Billing**

### **60-06-0100 Tandem CAMA Billing Through Automatic Message Accounting Service Arrangement**

This feature provides for tandem billing from end offices on an ANI and ONI basis. The CAMA billing information is registered by the AMA recording arrangement serving the exchange (see Feature 55-01-0000 and Chapter 6).

### **60-06-0110 CAMA suspension**

This feature permits operators handling CAMA-ONI calls to vacate their positions during emergency conditions without causing service interruption. This feature is operated by a key and has the capability of being located at either the chief operators position or the maintenance center. Appropriate audible and visual signals are provided. Safeguards are provided so that trouble conditions cannot falsely cause the CAMA suspension to be put into effect (refer to Chapter 6).

## **60-07-0000 800 Service function – originating screening office**

This feature allows a tandem office to access a remote data base after a three digit 800 translation and determines if a specific 800 service (INWATS) call can be completed, and if it can be completed, the 10 digit formatted DDD number to which the call can be forwarded. CCIS direct signaling messages are used to communicate between the NCP and the OSO.

800 Service is a feature set based on SSP capability (TR-TSY-000024) that allows either a tandem or an end-office to access a remote data base SCP) to determine routing and Interexchange Carrier information to allow processing of an 800 call. Messaging between the SSP and SCP is by SS7 signaling.

## **60-08-0000 Direct inward dialing (DID)**

For a local/tandem office, this feature has two applications:

- serving PBXs using the same NXX codes as the local switching system, as described in Feature 04-02-0000
- routing DID calls to large PBXs with NXX codes of subtending local offices, over direct trunks from the local/tandem office to the PBXs.

## **60-09-0000 DDD service observing**

The service observing feature provides for the acquisition of terminating traffic data for the purpose of evaluating the switching system and its subtending network. The type of service observing provided for tandem switching systems is known as DDD incoming trunk observing. Its purpose is to evaluate the network completion performance of calls arriving from the outside world and terminating in the area served by the tandem switching system (see Feature 45-13-0100).



**60-10-0000 Echo control****60-10-0100 Echo suppressor control**

This is the ability to disable back-to-back split echo suppressors whenever a switched connection causes such an association on the same tandem switching system.

**60-10-0200 Echo canceller**

Internal echo cancellers are available on the DMS-250 and DMS-300. They are also available using external equipment on the DMS-100 system.

**60-11-0000 Access to automatic call distributor (ACD)**

This is the capability to complete Inward WATS (INWATS) and Directory Assistance (DA) calls directly to ACD systems (ACDS). Both four-wire loop and four-wire E&M lead interfaces are used. Also, wink signaling is used to obtain a positive call signal toward the ACD so that a call signal cannot be generated by a carrier failure. In addition to reaching attendants at the ACD, arrangements are available for access to test lines. These arrangements are dependent upon the type of ACD to which the calls are being completed.

**60-11-0100 Access to ACDS for INWATS**

In combination with ACDSHOW, Load Management enables senior supervisors to quickly reconfigure the structure and operational parameters of a Meridian ACD group to maximize the number of calls served or to alleviate work overloads.

**60-11-0200 Access to ACDS For directory assistance (DA)**

Load Management command set has been enhanced to include the following additional capabilities:

- Reassign an ACD directory number to another ACD group
- Change the audio group assigned to an ACD group.
- Change the recorded-announcement threshold for an ACD group.
- Display the announcement CLLI used by an audio group in Table Audio.
- Display the name of the audio group associated with an ACD group.

Load Management allows the above parameters to be reconfigured by the end user without intervention by telephone operating company personnel.

All data changes are recorded on an auxiliary device to preserve the ACD configuration in the event of switch failure.

### **60-15-0000 Local tandem synchronization**

The DMS-100 Family of switches provide the synchronous clock system configurations necessary to support the network synchronization objectives for Stratum levels I, II, and III (refer to Chapter 8).

### **60-16-0000 Traffic measurements (tandem)**

A local/tandem office requires traffic measurements supplementary to those required by a local exchange system. These additional measurements fall into four categories:

- additional office totals
- division of revenue measurements
- network management measurements
- measurements related to CAMA operation (refer to Chapter 6)

### **60-17-0000 Plant measurements**

Requirements for registration and integrity are the same as for local switching systems. Additional base, service and performance measurements are provided to permit separation between local and tandem functions of the switching system (refer to Chapter 6).

### **60-18-0000 Administration**

#### **60-18-0100 Recent change states**

The DMS-100 Family data modification system provides a pending order file. With this feature, DMOs may be activated immediately upon entry or placed in a POF in the system memory for activation at a later time. These DMOs are input using the file editor and table editor command repertoire. The file editor is used to create the POF and the table editor DMO commands are stored within the newly created file. While in the POF, DMO's may be queried, changed, or deleted. They may also be activated individually or all at once with a single input command (see Feature 45-01-0200 and Chapter 6).

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## Chapter 4: Call processing

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DMS-100 Family system call processing is accomplished through a combination of call processing support and applications software. The support software provides a general architecture for implementing all types of call processing tasks. The applications software handles the call processing functions that are specific to each type of call.

This common software architecture supports many different types of calls. The application of this architecture to specific types of calls is illustrated in this section through examples of the software required to process several representative types of calls. For call type connections described in this section, the Remote Line Module (RLM), Line Concentrating Module (LCM), and Line Group Controller (LGC) are collectively referred to as line peripherals. The Trunk Module (TM), the Digital Carrier Module (DCM), and the Digital Trunk Controller (DTC) are known as trunk peripherals.

### Terminology

The terminology used to explain the call process is in terms of the representative sample of call types:

Starter	Starter procedures are used by the call process to access other call processing application software. Examples of starters are line starter, trunk starter, and the CAMA position starter.
Setup Processors	Setup Processors are used to coordinate the selection of a terminating line or trunk.
Cross Processors	Cross Processors are used to establish the initial connection between the originating and terminating parties.
Recall Processors	Recall Processors are used to handle billing and feature implementation.
Disconnect Processors	Disconnect Processors are used to take down a call upon disconnect by one of the parties involved in the call.
Error Processors	Error Processors are used to take down a call upon hardware or software fault detection.

Allocator	Allocators are used to assign a line or trunk to a call as an originator or terminator.
Collectors	Collectors are used to build messages to collect digits.
Translators	Translators are used to coordinate the translation of dialed digits.
Terminators	Terminators are used to select a terminating line or trunk from a group of possible terminators.
Outpulsers	Outpulsers are used to build messages to perform outpulsing on trunks.
Idlers	Idlers are used to idle a line or trunk in case of abnormal call processing behavior.
Loaders	Loaders transfer address signaling digits from peripheral messages to the call condense blocks.
Identifiers	Identifiers determine the number to be billed for the call.
Billers and Call Detail Recorders	These are used to implement billing and recording procedures.
Call Process	<p>A call process (CP) is used to execute the DMS-100 Family system call processing software. It consists of a process control block, call data block, and a call condense block. A process control block is used by the operating system. A call data block is the work area used to hold call data while the process is running. A call condense block is the data area which records the state of the call and the identity of the calling parties.</p> <p>These blocks are associated with a call in order to handle an incoming message from a peripheral. Once the message has been handled, the process control block and CDB are released, leaving only the CCB linked to the call. The CCB is released upon call completion.</p>
I/O system Software	The I/O system software handles the transmission and reception of data (for example, messages) to and from the Peripheral Modules (PMs).

## Call processing types

### Trunk-to-trunk connection

Figure 4-1 illustrates two events of a trunk-to-trunk connection:

- the message flow between the peripheral modules and the CC
- the interaction, in general terms, between the various software modules within the CC

When an incoming seizure is detected on a trunk, a message is sent to the CC (1).

The I/O system associates a process with the originating trunk and sends the origination message to it (2).

When the process is scheduled, the trunk starter is invoked (3).

The allocator for the originating trunk is called (4). A collector is then called to arrange for digit collection (5). For an originating MF trunk, this involves obtaining and connecting an MF receiver or Universal Tone Receiver (UTR) to the originator (6).

A message is sent to the originating trunk peripheral instructing it to send a start dial signal to the far end office (7).

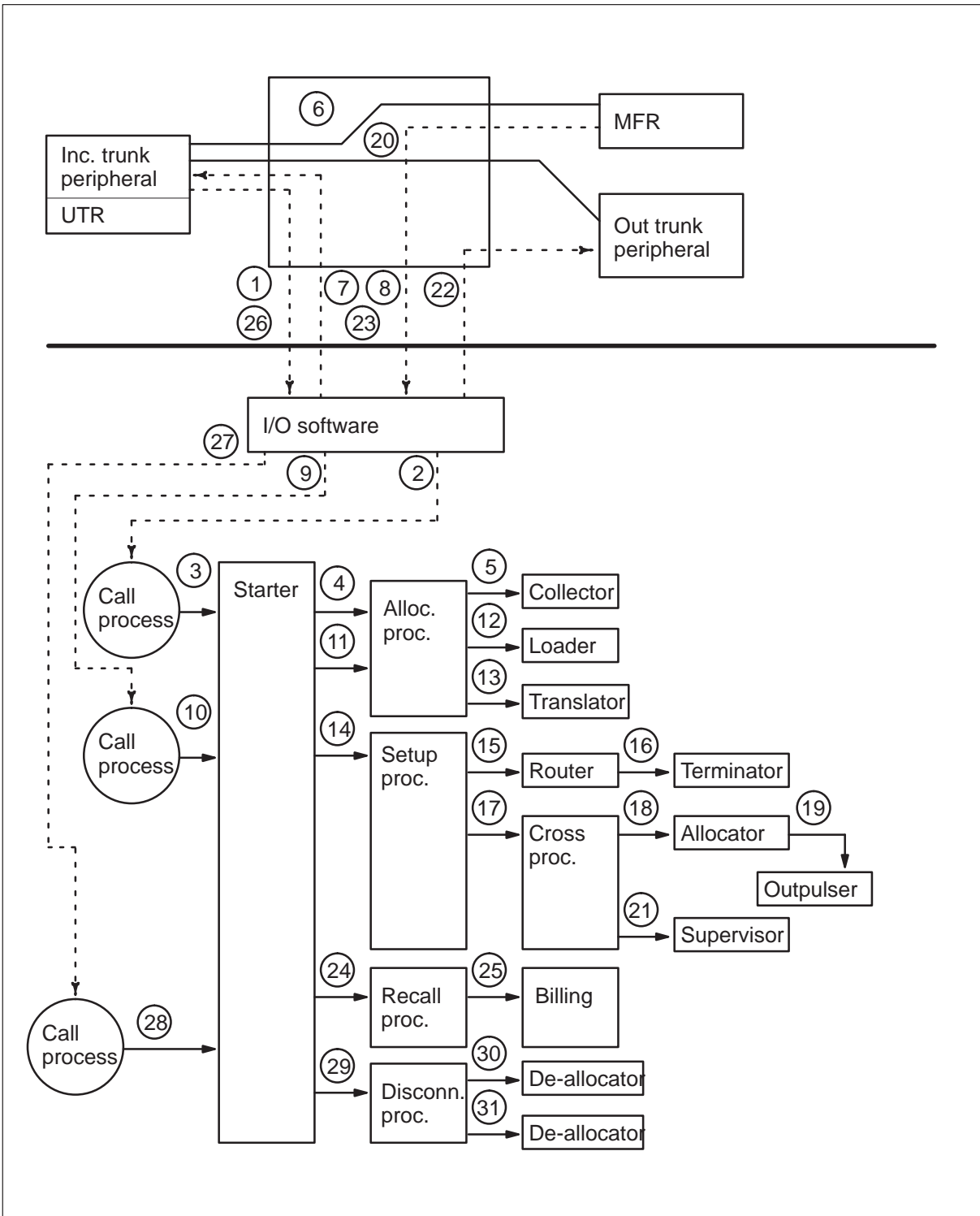
The call is condensed (for example, the call process and call data block previously associated with the call are freed).

The digits are collected using the MF receiver or UTR and sent to the CC (8).

A process is associated with the call and the digits message is sent (9):

- The loader is entered through the line starter and allocator and the digits are loaded into the call condense block (10), (11), (12).
- The appropriate translator is invoked (13) and the digits interpreted to obtain a route.

**Figure 4-1**  
Trunk-to-trunk connection



The trunk setup processor is then entered through the trunk starter (14):

- The connection (6) between the originating trunk peripheral and the MF receiver or UTR is taken down.
- The route result obtained from digit translation is passed to the router (15). The router uses the a terminator procedure to select the outgoing trunk group (16).
- The cross processor for the parties involved in the call is determined and invoked (17).
  - The allocator for the outgoing trunk group is called and a trunk in the specified trunk group is selected (18).
  - The number of digits to be outpulsed to the far end office is determined using an outpulser procedure (19).
  - A network connection is reserved and set up between the incoming and outgoing trunk peripherals (20).
  - The supervisor for the parties involved in the call is determined and invoked (21).
  - A message is sent to the outgoing trunk peripheral instructing it to send a seizure to the far end office, send the necessary digits, and set up the supervision (22).
  - A message is sent to the incoming trunk peripheral instructing it to set up supervision (23).

### **The call is condensed**

The appropriate recall processor (24) is determined and invoked. The call billing, if required, is handled by the appropriate billing function (25).

- When a disconnect is detected by the incoming trunk peripheral, a message is sent to the CC (26).
- A process is associated with the call and a clear forward message sent to it (27).
- The appropriate disconnect processor for the parties involved in the call is determined and invoked through the trunk starter (28) and (29). The de-allocators for the incoming and outgoing trunks are determined and invoked (30) and (31).
- The call process is then idled and any other system resources associated with the call are freed.

### **Trunk-to-line connection**

The trunk-to-line connection includes the message flow between the peripheral modules and the CC and the interaction between the various software modules within the CC.

- When an incoming seizure is detected on a trunk, a message is sent to the CC (1).

- The I/O system associates a process with the originating trunk and sends the origination message to it (2).
- When the process is scheduled, the trunk starter is invoked (3).
- The allocator for the originating trunk is called (4).
- A collector is then called to arrange for digit collection (5).
- For an originating MF trunk this involves obtaining and connecting an MF receiver or UTR to the originator (6).
- A message is sent to the originating trunk peripheral instructing it to send a start dial signal to the far end office (7).
- The call is condensed (for example, the call process and call data block previously associated with the call are freed).
- The digits are collected using the MF receiver or UTR and sent to the CC (8).

A process is associated with the call and the digits message sent to it (9):

- The loader is entered through the allocator and line starter and the digits are loaded into a call condense block (10), (11), (12).
- The appropriate translator is invoked (13) and the digits translated to obtain a route.

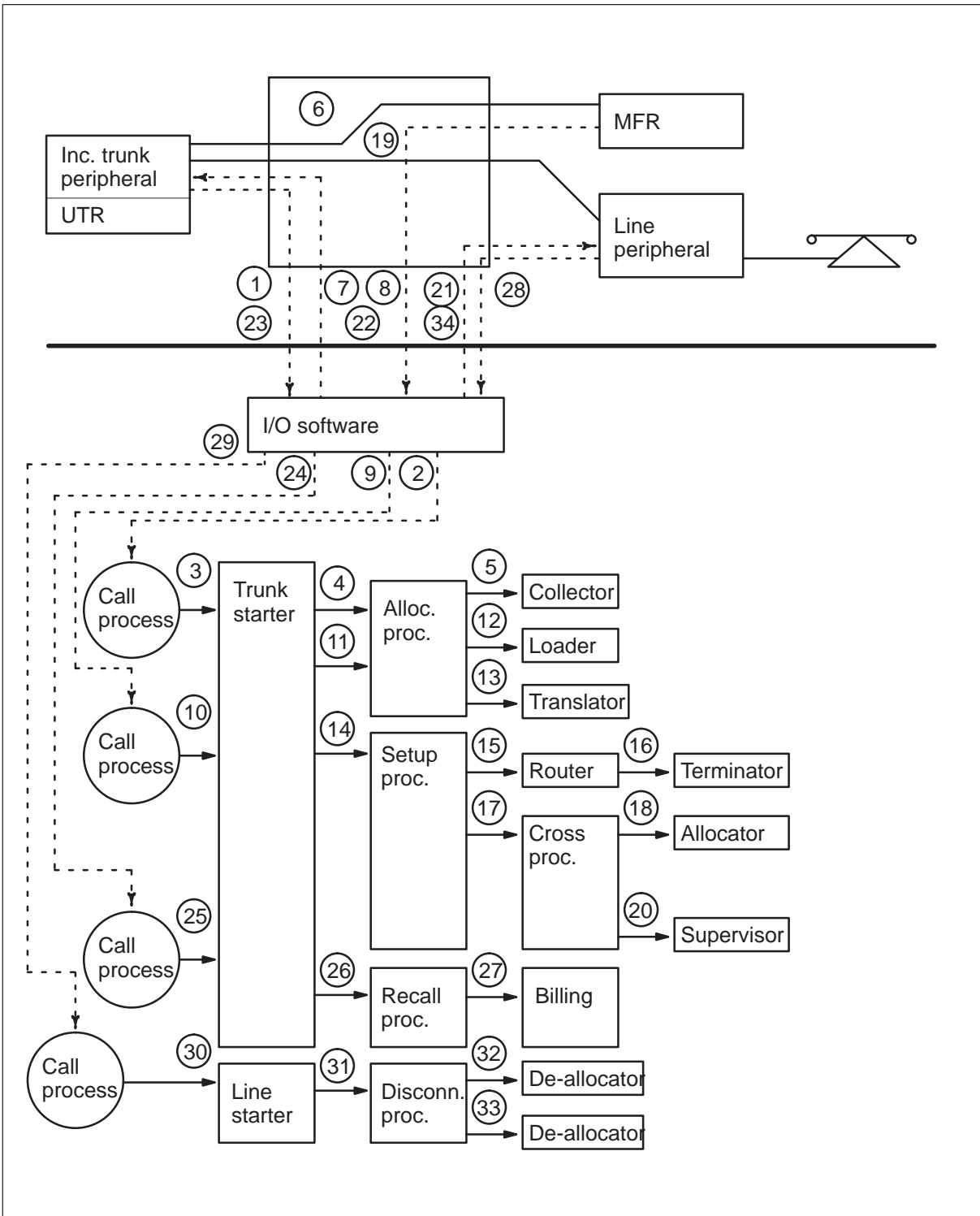
The trunk setup processor is then entered using the trunk starter (14):

- The connection (6) between the originating trunk peripheral and the MF receiver or UTR is taken down.
- The route result obtained from digit translation is passed to the router (15). The router uses a terminator procedure to determine the terminating party (in this case a line) (16).
- The cross processor for the parties involved in the call is determined and invoked (17).
  - The allocator for the terminating line is called on the line associated with the call (18).
  - A network connection is reserved and set up between the incoming trunk peripheral and terminating line peripheral (19).
  - The supervisor for the parties involved in the call is determined and invoked (20).
  - A message is sent to the terminating line peripheral instructing it to set up called supervision on the line (21).
  - A message is sent to the incoming trunk peripheral instructing it to set up supervision (22).

A process is associated with the call and the answer message sent to it (24).



**Figure 4-2**  
**Trunk-to-line connection**



### **The call is condensed**

When the called party answers, a message is sent to the CC (23).

The appropriate recall processor (26) is determined and invoked using the trunk starter (25). The call billing, if required, is handled by the appropriate biller function procedure (27).

### **The call is condensed**

Steps 23 through 27 are omitted on basic calls. An answer message is not sent unless the call is billed or unless it is required by a specific feature.

- When an on-hook is detected on the terminating line, the line peripheral sends a message to the CC (28).
- A process is associated with the call and an exit message sent to it (29). The appropriate disconnect processor for the parties involved in the call is determined and invoked using the line starter (30) and (31). The de-allocators for the incoming trunk (32) and terminating line (33) are determined and invoked.
- An idle terminal message is sent to the line peripheral (34). The trunk auto-idles.
- The call process is then idled and any other system resources associated with the call are freed.
- If the trunk disconnects first, the incoming trunk peripheral sends a message to the CC.
- A process is associated with the call and a clear forward message sent to it.
- The disconnect processor is determined and invoked through the trunk starter. The de-allocator for the trunk is called. The trunk auto-idles.

### **The call is condensed**

- When the line goes on-hook, the line peripheral sends a message to the CC.
- A process is associated with the call and an exit message is sent to it.
- The disconnect processor for the line is determined and invoked. The de-allocator for the line is called.
- An idle-terminal message is sent to the line peripheral.
- The call process is then idled and any other system resources associated with the call are freed.
- If the line does not go on-hook after a set period of time, a message is sent to the CC and the line goes to lockout. This involves resetting the line supervision to scan for on-hook only and freeing the call process, call data block, and call condense block. When the line goes on-hook, another message is sent to the CC. A call process, call data block, and call condense block are allocated to idle the line and are then freed.

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### Line-to-trunk connection

The dial pulse or DTMF line-to-trunk connection, illustrated in Figure 4-3, is described in terms of two events:

- The message flow between the peripheral modules and the CC
- The interaction, in general terms, between the various software modules within the CC
- When an off-hook is detected on a line, a message is sent to the CC (1).
- The I/O system associates a process with the originating line and sends the origination message to it (2).
- When the process is scheduled, the line starter is invoked (3).

The line setup processor is called (4):

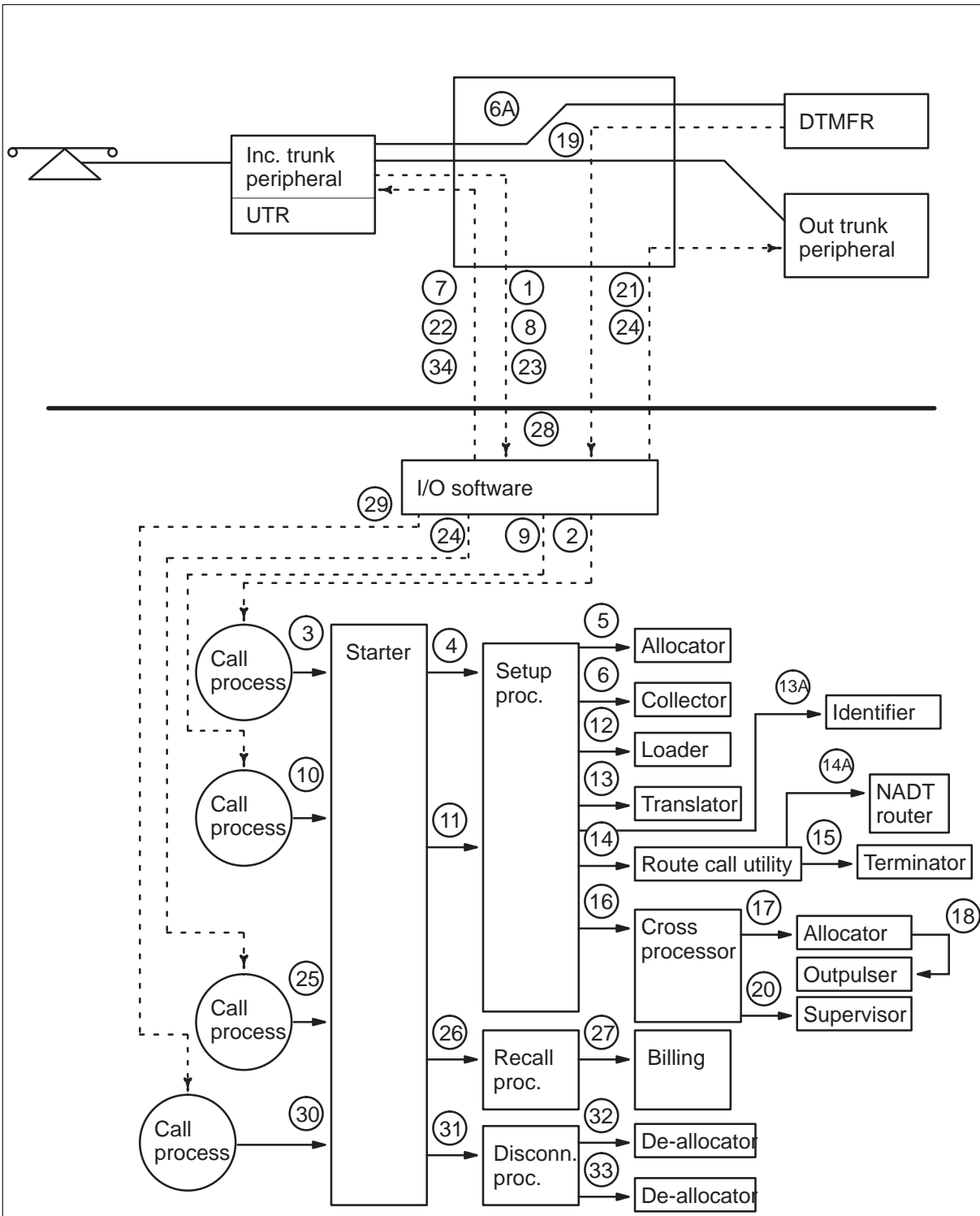
- The allocator for the originating line is called (5).
- A collector is then called (6) to arrange for digit collection. For an originating DTMF line this involves obtaining and connecting a DTMF receiver or UTR to the originator (6a).
- A collect digits message is dispatched to the originating line peripheral (7).
- The call is condensed, for example, the call process and call data block previously associated with the call are freed.
- The digits are collected by the line peripheral if the call is DP, or uses a UTR to receive DTMF. The digits are then sent to the CC (8).
- A process is associated with the call and the digits message sent to it (9).

The setup processor is re-entered through the line starter (10) and (11):

- The digits are loaded into the call condense block using a loader procedure (12).
- The appropriate translator is invoked (13) and the digits interpreted to obtain a route.
- The identifier is invoked (13a) to determine if a billing record of the call is required.
- For a DTMF line the connection (6a) between the originating line peripheral and the DTMF receiver or UTR is taken down.
- The route result obtained from digit translation is then passed to the route call utility (14).
- The route call utility invokes the North American Digit Translator (NADT) router (14a). The route call utility then uses a terminator procedure to select the outgoing trunk group (15).
- The cross processor for the parties involved in the call is determined and invoked (16):

- The allocator for the outgoing trunk group is called (17) and a trunk in the specified trunk group is selected.
- The digits to send to the far-end office are determined using an outpulser procedure (18).
- A network connection is reserved and set up between the originating line peripheral and the outgoing trunk peripheral (19).
- The supervisor for the parties involved in the call is determined and invoked (20).
- A message is sent to the outgoing trunk peripheral instructing it to set up supervision on the outgoing trunk, to send a seizure to the far-end office, and then to send the necessary digits (21).
- A message is sent to the originating line peripheral instructing it to set up calling supervision on the originating line (22).

**Figure 4-3**  
**Line-to-trunk connection**



**The call is condensed**

- When an answer signal is detected, a message is sent to the CC (23).
- A process is associated with the call and an answer message sent to it (24).
- The appropriate recall processor is determined and invoked using the line starter (25) and (26). The call billing, if required, is handled by the appropriate billing procedure (27).

**The call is condensed**

*Note:* Steps 23 through 27 may be omitted for the reasons stated in the Trunk-to-trunk connection section.

- When an on-hook is detected on the originating line peripheral, a message is sent to the CC (28).
- A process is associated with the call and an exit message sent to it (29).
- The appropriate disconnect processor for the parties involved in the call is determined and invoked (30) and (31). The de-allocators for the originating line and outgoing trunk are determined and invoked (32) and (33).
- An idle terminal message is sent to the line peripheral (34). (The trunk auto-idles.)
- The call process is then idled and any other system resources associated with the call are freed.
- If the trunk disconnects first, the outgoing trunk peripheral sends a message to the CC.
- If the trunk does time release disconnect (TRD) timing, the line will report exit to the CC only after TRD timing.
- A process is associated with the call and a clear-forward message sent to it.
- The disconnect processor is determined and invoked through the trunk starter. The de-allocator for the trunk is called.

**The call is condensed**

- When the line goes on-hook, the line peripheral sends a message to the CC.
- A process is associated with the call and an exit message sent to it.
- The disconnect processor for the line is determined and invoked. The de-allocator for the line is called.
- An idle-terminal message is sent to the line peripheral.
- The call process is then idled and any other system resources associated with the call are freed.

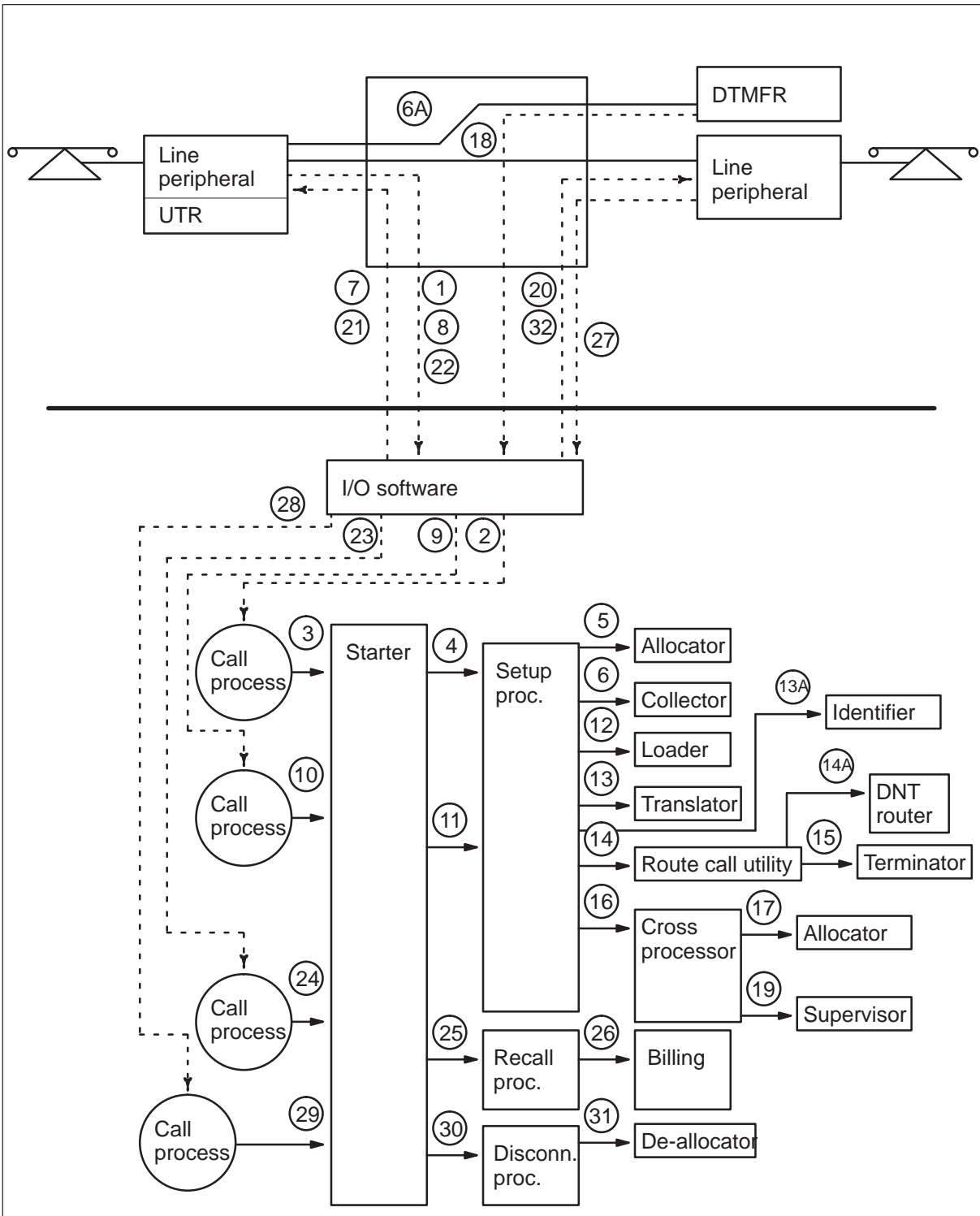
- If the line does not go on-hook after a set period of time, a message is sent to the CC and the line goes to lockout. This involves resetting the line supervision to scan for on-hook only and freeing the call process, call data block, and call condense block. When the line goes on hook, another message is sent to the CC. A call process, call data block, and call condense block are allocated to idle the line and are then freed.

### **Line-to-line connection**

The dial pulse or DTMF line-to-line connection, as illustrated in Figure 4-4, is described in terms of two events:

- The message flow between the peripheral modules and the CC
- The interaction, in general terms, between the various software modules within the CC.
- When an off-hook is detected on a line, a message is sent to the CC (1).
- The I/O system associates a process with the originating line and sends the origination message to it (2).
- When the process is scheduled, the line starter is invoked (3).

**Figure 4-4**  
**Lint-to-line connection**





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The line setup processor is called (4):

- The allocator for the originating line is called (5).
- A collector is called (6) to arrange for digit collection. For an originating DTMF line this requires obtaining and connecting a DTMF receiver or UTR to the originator (6a).
- A collect digits message is dispatched to the originating line peripheral (7).
- The call is condensed, for example, the call process and call data block previously associated with the call are freed.
- The digits are collected by the line peripheral if the call is DP, or uses a UTR to receive DTMF. The digits are then sent to the CC (8). A process is associated with the call and the digits message sent to it (9).

The setup processor is re-entered through the line starter (10) and (11):

- The digits are loaded into the call condense block through a loader procedure (12).
- The appropriate translator is invoked (13) and the digits interpreted to obtain a route.
- The identifier is invoked (13a) to determine if a billing record of the call is required.
- For a DTMF line the connection (6a) between the originating line peripheral and the DTMF receiver or UTR is taken down. Translation information is passed on to the route call utility (14).
- The route call utility then calls the Directory Number Translator (DNT) router (14a).
- The route call utility uses a terminator procedure (15) to determine the terminating party, in this case another line.
- The cross processor for the parties involved in the call is determined and invoked (16).
  - The allocator for the terminating line is called (17).
  - A network connection is reserved and set up between the originating and terminating line peripherals (18).
  - The supervisor for the parties involved in the call is determined and invoked (19).
  - A message is sent to the terminating line peripheral instructing it to set up called supervision on the terminating line (20).
  - A message is sent to the originating line peripheral instructing it to set up calling supervision on the originating line (21).

### **The call is condensed**

- When the called party answers, a message is sent to the CC (22). A process is associated with the call and the answer message sent to it (23).

- The line recall processor is entered through the line starter (24) and (25). The call billing, if required, is handled by the appropriate biller procedure (26).

**The call is condensed.**

*Note:* Steps 22 through 26 may be omitted for the reasons stated in Chapter 5.

- When an on-hook is detected, the line peripheral sends a message to the CC (27).
- A process is associated with the call and the exit message sent to it (28).

The appropriate disconnect processor for the lines involved in the call is determined and invoked (29) and (30):

- The de-allocator for the line which has gone on-hook is called (31).
- An idle-terminal message is sent to the line peripheral (32).

**The call is condensed**

- This sequence, Steps 27 through 32, is repeated when the other line goes on-hook.
- The call process is then idled and any other system resources associated with the call are freed.
- If the other line does not go on-hook after a set period of time, a message is sent to the CC and the line goes to lockout. This involves resetting the line supervision to scan for on-hook only and freeing the call process, call data block, and call condense block. When the line goes on-hook, another message is sent to the CC.
- A call process, call data block, and call condense block are allocated to idle the line, and are then freed.

**Intra-RLM or remote line concentrating module call**

The following differences between an intra-RLM or Remote Line Concentrating Module (RLCM) call and a standard DP or DTMF line-to-line call are highlighted.

An intra-RLM or RLCM call proceeds in an identical fashion to a standard line-to-line call up to the point that the router has determined the terminating line. The call processing then differs from a standard call as shown in Steps 16 through 21:

- Step 16. The cross-processor checks to determine that both parties are served by the same RLM. Assuming that neither line has custom calling features which preclude use of an Intra-RLM or RLCM call, a flag is set.
- Step 17. The allocator checks to see if the flag permitting an intra-RLM or RLCM call is set. Assuming this to be the case, an intra-RLM or RLCM connection known as a logical connection is chosen for the two subscriber lines involved in the call.
- Step 18. This step is essentially omitted. Network software will not attempt to reserve and set up a connection if a logical connection has already been chosen.
- Step 19. As per standard call.
- Step 20. The message sent to the terminating line peripheral also contains connection details for the intra-RLM or RLCM call.
- Step 21. The message sent to the originating line peripheral also contains connection details for the intra-RLM or RLCM call.

The call then continues in an identical manner to a standard line-to-line call.

### **MERIDIAN digital centrex line-to-line connection**

The MDC DP or DTMF line-to-line connection, as illustrated Figure 4-5, is described by two events:

- The message flows between the peripheral modules and the CC.
- The interaction, in general terms, between the various software modules within the CC.
- When an off-hook condition is detected on a line, a message is sent to the CC (1).
- The I/O software system associates a process with the originating line and sends the origination message to the process (2).
- When the process is scheduled, the line starter is invoked (3).

The appropriate setup processor is called (4):

- An allocator for the originating line is selected and invoked (5).
- A collector (6) is called to arrange for digit collection. For an originating DTMF line this involves obtaining and connecting a DTMF receiver or UTR to the originator (6a).
- A collect digits message is sent to the line peripheral associated with the originating station (7).
- The call is condensed for example, the call process and call data block previously associated with the call are freed.
- The digits are collected by the line peripheral if the call is DP, or uses a UTR to receive DTMF. The digits are then sent to the CC (8).

- A process is associated with the call and the digits message is sent to the process (9).

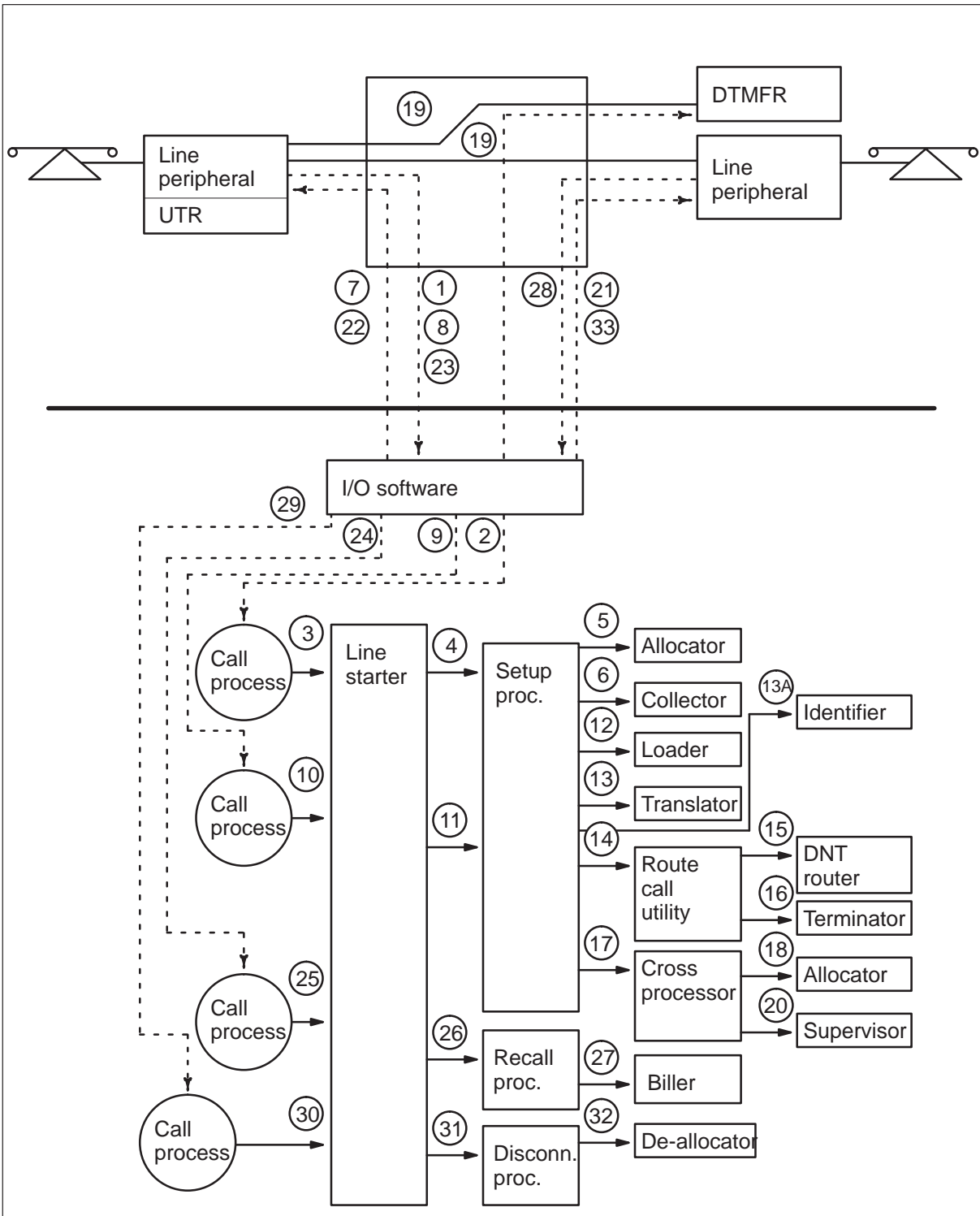
The setup processor is re-entered through the line starter (10) and (11):

- The digits are loaded into the CCB using a loader procedure (12).
- The IBN translator is called (13) and the digits are interpreted to obtain a route.
- For a DTMF line the connection (6a) between the originating line peripheral and the DTMF receiver or UTR is taken down.
- Verification is performed by the identifier (13a) to determine if Station Message Detail Recording (SMDR) is required.

Translation information is passed on to the route call utility (14) which then selects the appropriate router in the following manner:

- Calls translated into a call processing identification code, for example, calls to an attendant or a recorded announcement, are sent to a nil router. A new route is not required. For these calls, control is returned directly to the route call utility and an appropriate terminator is selected (see Item 16).
- Calls translated into a route identification code and terminating at a line served by the DMS-100 Family system are directed to the Directory Number Translator (DNT) router (15).
- The route call utility selects an appropriate terminator (16).

**Figure 4-5**  
**MDC line-to-line**



The cross-processor for the lines involved in the call is determined and invoked (17):

- The allocator for the terminating line is invoked (18).
- A network connection is reserved and is set up between the originating and terminating line peripherals (19).
- The supervisor for the lines involved in the call is determined and invoked (20).
- A message is sent to the terminating line peripheral instructing it to set up called supervision on the terminating line (21).
- A message is sent to the originating line peripheral instructing it to set up calling supervision on the originating line (22).

### **The call is condensed**

#### **Console-to-line connection – console origination**

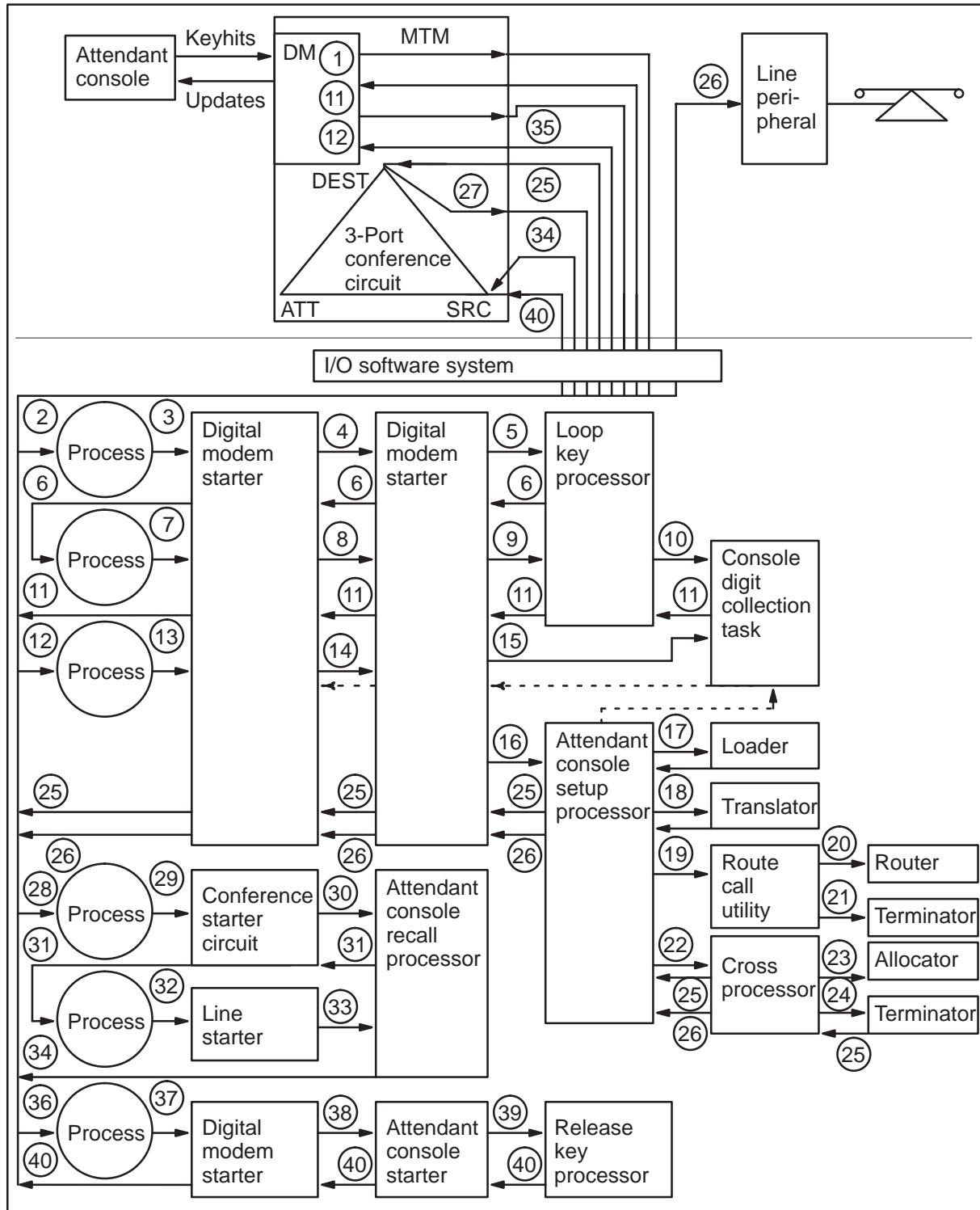
- The call originating to an attendant console and terminating on an MDC line process is shown in Figure 4-6. This includes the message flow between the peripheral modules and the CC, and the interaction of the various CC software modules.
- When the attendant presses an idle loop key, a message indicating that a key has been pressed (a keyhit) is sent to the CC through a digital modem (1). The digital modem is located in a Maintenance Trunk Module (MTM) of the DMS-100 Family system.
- The I/O software system associates a process with the call and sends the keyhit message to the process (2).
- When the process is scheduled, the digital modem starter is invoked (3).
- When the called party answers, a message is sent to the CC (23).
- A process is associated with the call and the answer message is sent to the process (24).
- The recall processor is invoked using the line starter (25) and (26). Call billing or SMDR, if required, is handled by the appropriate billing processor (27).
- When an on-hook condition is detected, the line peripheral sends a message to the CC (28).
- A process is associated with the call and the exit message is sent to the process (29).
- The line starter is invoked (30).
- The appropriate disconnect processor is determined and invoked (31). The de-allocator for the line which has gone on-hook is called (32).
- An idle terminal message is sent to the line peripheral containing the line that went on-hook (33).

- The sequence of Steps 28 through 33 is repeated when the remaining line goes on-hook.
- The call process is then idled and any other system resources associated with the call are freed.
- If the remaining line does not go on-hook within a set period of time, a message is sent to the CC and the line goes to a lockout condition. This involves resetting the line supervision to scan for an on-hook condition only and freeing the call process, the call data block, and the call condense block. When the line goes on-hook, another message is sent to the CC. A call process, call data block, and call condense block are allocated to idle the line and are then freed.
- The digital modem starter calls the attendant console starter (4).

Since the key pressed is a loop key, the loop key processor is invoked (5):

- Unlike lines, attendant console hardware (digital modem, 3-port conference, data input-output lines) are permanently linked to a CCB called the home CCB. The loop key processor obtains a new CCB and passes the loop key message to that new CCB.
- The loop key processor disassociates the digital modem from the home CCB, links the digital modem to the new CCB and sends the loop key message to that new CCB.

**Figure 4-6**  
**Console to line connection**





**The call is condensed**

- A new process is immediately invoked (6) and the loop key processor is reentered through the digital modem starter (7) and the attendant console starter (8) and (9). The loop key processor invokes a console digit collection task (10) and the task sends a collect digits message to the console (11).

**The call is condensed**

- When digits are returned from the console (12), the I/O software system associates a process to the digits message and sends the digits to that process.
- When the process is scheduled, the console digit collection task is reentered through the digital modem starter (13) and the attendant console starter (14) and (15). The digit collection task removes digits from the message and places them in an attendant console digit register.
- The attendant console setup processor is invoked (16). The attendant console setup processor invokes the attendant console loader (17) and the digits are loaded into a digit register.

The IBN translator is invoked (18):

- The digits are interpreted to obtain a route.
- The digits message from the console may contain one or more digits depending on the speed at which the digits are keyed. If either the loader or the translator determines that more digits are required, control is returned to the attendant console setup processor, the dashed lines on Figure 4-6, the attendant console processor invokes the digit collection task and the call is condensed. When more digits arrive, the call resumes at step 12.
- Translation information is passed on to the route call utility (19) which then selects the appropriate router (20).
- The router determines a route based on translation information.
- The route call utility selects an appropriate terminator (21).

The thread for the terminating line is obtained. The appropriate cross-processor is invoked (22):

- The allocator for the terminating line is invoked (23).
- The terminating line is connected through the network to the DEST (Destination) side of a 3-port conference circuit.
- The supervisor for the line and the 3-port conference circuit involved in the call is determined and invoked (24).
- A message is sent to the DEST side of the 3-port conference circuit instructing it to set up calling supervision (25).

- A message is sent to the terminating line peripheral instructing it to set up called supervision on the terminating line (26).

#### **The call is condensed**

- When the called party answers, the DEST side of the 3-port conference circuit reports an answer message to the CC (27).
- A process is associated with the call and the answer message is sent to the process (28).
- The conference circuit starter is invoked (29).
- The conference circuit starter calls the attendant console recall processor (30). The recall processor which is running on the home CCB sends the answer message to the correct CCB console.

#### **The call is condensed (31)**

- When a new process is invoked, the attendant recall processor is reentered through the appropriate line starter for the terminating line (32) and (33).

The attendant console recall processor performs six tasks:

- Idles the DEST side of the 3 port conference circuit.
- Frees the network connection from the DEST to the called line.
- Obtains and makes a new network connection from the called line to the SRC (source) side of the 3 port conference circuit.
- Transfers the terminating line from the DEST side of the 3 port conference circuit to the SRC side in anticipation of possible extension of the call.
- Sends supervision to the SRC side of the 3 port conference circuit (34) and to the called line.
- Provides appropriate lamp and display update information for the console.
- The call is condensed. Suppose that the attendant presses a release key thereby ending the call. A release key message is sent to the CC (35).
- A process is associated with the call and the release key message is sent to the process (36).

When the process is scheduled, the release key processor is invoked through the digital modem starter (37) and the attendant console starter (38) and (39). The release key processor has five functions:

- Provides appropriate information to update the lamps and the display of the console
- Re-links the CCB of the modem to the home CCB
- Sends the terminating line to lockout
- Frees the network connection between the SRC and the attendant

- Sends idle supervision to the SRC side of the conference bridge (40).

### **Console-to-line connection – console extension**

The call originating on an MDC line and initially terminating on an attendant console is then extended by the attendant to another MDC line. The call is described by the message flow between the peripheral modules and the CC and by the interaction between the various CC software modules

The initial sequence in origination of the call from an MDC line is described in Steps 1 through 17 of the MDC line-to-line connection section on page 4-17. Figure 4-7 illustrates Steps 18 through 40.

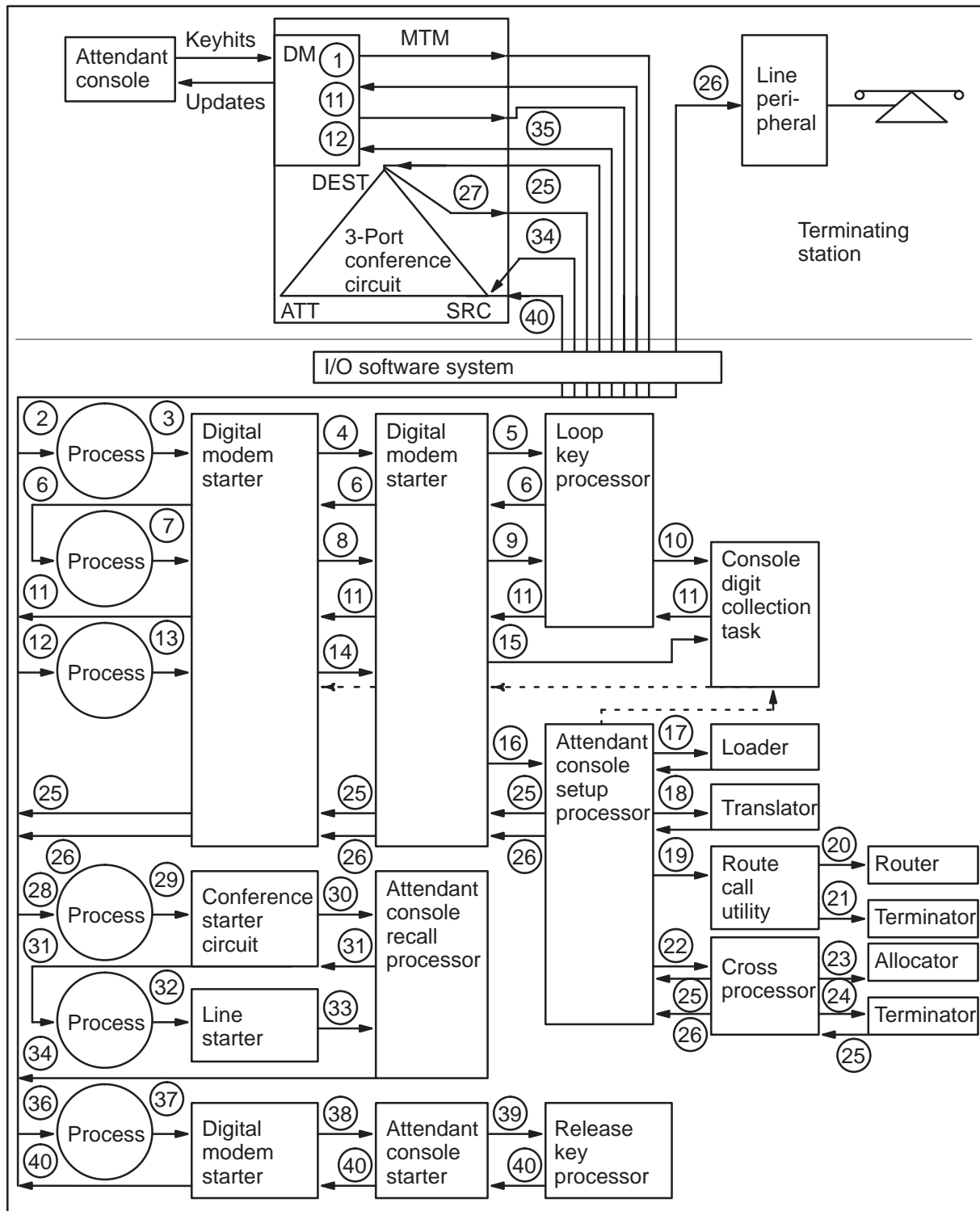
The attendant console cross-processor is invoked (19):

- A check is performed to ensure that the call can be added to the lineup (queue) of calls waiting for answer by console attendants.
- The appropriate console supervisor is selected.
- A message is sent to the originating line peripheral instructing it to set up single-ended supervision on the originating line (20).
- An extension block is attached to the CCB. The call is then placed in the queue of calls destined for consoles of the appropriate subgroup.
- The route call utility selects the MDC attendant console terminator (18).

### **The call is condensed**

- The call is presented to an idle loop on the most idle console when a console becomes available.
- To answer a call, the attendant presses the loop key for the loop on which the call is being presented or an Incoming Call Identification (ICL) key whose associated lamp is lit.
- When the attendant presses a key, a message indicating that a key has been pressed is sent to the CC through a digital modem (21). The digital modem is located in a MTM of the DMS-100 Family system.
- The I/O software system associates a process with the call and sends the keyhit message to the process (22).
- When the process is scheduled, the digital modem starter is invoked (23).
- The digital modem starter calls the attendant console starter (24).

**Figure 4-7**  
**Console-to-line connection – attendant extension**



The loop key processor is invoked (25):

- The call presented is removed from the queue of waiting calls
- Network connections are reserved between the Source (SRC) of a 3-port conference circuit and the originating line
- Unlike lines, attendant console hardware, digital modem, 3-port conference, and data input-output lines are permanently linked to a CCB called the home CCB
- The loop key processor disassociates the digital modem from the home CCB, links the digital modem to the CCB of the originating call, and sends the loop key message to that CCB.

### **The call is condensed (26)**

When a process becomes available, the loop key processor is re-entered through the digital modem starter (27) and the attendant console starter (28) and (29).

- The loop key is now attached to the CCB of the originating call
- Network connections reserved previously are now established
- A message is sent to SRC of the 3-port conference circuit instructing it to set up talking supervision on the line to conference port connection (30).

### **The call is condensed**

- The attendant and the calling party on the originating IBN line now speak.
- To extend the call to another IBN line, the attendant keys in the digits for the destination.
- The digits are sent to the CC (31).
- The I/O software system associates a process to the call and sends the digits message to that process (32).
- When the process is scheduled, a digit collection task is invoked through the digital modem starter (33) and the attendant console starter (33) and (35).
- The digital modem task removes digits from the message and places them into a digit register.
- The attendant console setup processor is called (36).
- An appropriate loader is invoked (40) and the digits are loaded into a digits register.
- The IBN translator is invoked (38). The digits are translated to obtain a route.
- Translation information is passed on to the route call utility (39) which then selects the appropriate router (40).
- The route call utility selects an appropriate terminator (41).

- 
- The appropriate cross-processor is invoked (42):
  - The allocator for the terminating line is invoked (43).
  - A network connection is reserved between the terminating line and the DEST side of the 3 port conference circuit.
  - The supervisor for the line involved in the call is determined and invoked (44).
  - A message is sent to the terminating Line Peripheral (LP) instructing it to set up calling supervision on the terminating line (43).

#### **The call is condensed**

- When the called party answers, the DEST side of the 3 port conference circuit reports an off-hook to the CC (44).
- A process is associated with the call and the answer message is sent to the process (45).
- The conference circuit starter is invoked (46).
- The conference circuit starter calls the attendant console recall processor (47). The recall processor sends the off-hook message to the correct CCB console.

#### **The call is condensed (48)**

When a new process is invoked, the attendant recall processor is reentered through the appropriate line starter for the terminating line (49) and (50).

The attendant recall processor performs two activities:

- sends supervision to the DEST side of the conference circuit (51) and to the called line
- provides appropriate lamp and display update information for the console

#### **The call is condensed**

- To be released from the call, the attendant presses the release key associated with the active loop on the console.
- When the attendant presses the release key, a release key message is sent to the CC (52).
- A process is associated with the call and the release key message is sent to the process (53).

The release key processor is invoked through the digital modem starter (54) and the attendant console starter (55) and (56):

- The SRC and DEST ports of the 3 port conference circuit are idled.
- Lamp updates are sent to the console in order to turn off the SRC lamp, turn off the DEST lamp, and turn on the Release (RLS) lamp (57).

- A direct network connection is established between the originating and terminating MDC lines and the attendant console is disconnected.
- Messages are sent to the originating and terminating line peripheral instructing them to set up call supervision for the new call connection (58) and (59).
- The extension block is removed from the call.
- The digital modem is disassociated from the CCB of the call and is returned to the home CCB.
- The attendant console is placed in the queue of idle consoles.

**The call is condensed**

Subsequent disconnect and take-down of the call for the originating and terminating lines is described in MDC Line-to-Line Connection.

**Call processing components**

Call processing components for the DMS-100 Family system are described in this section. Refer to Chapter 5-1 for ac and dc signaling timings and electrical compatibilities.

**Seizure**

The DMS-100 Family system can detect a seizure in any of five main signaling categories:

- analog per-trunk signaling
- digital per-trunk signaling
- Common Channel Interoffice Signaling
- signaling system No. 7
- analog per-line signaling

**Analog per-trunk signaling**

The DMS-100 Family system provides a large number of trunk interfaces which are electrically compatible with different ac and dc signaling systems. The correct application and detection of the appropriate electrical signal representing signaling information, is a characteristic of an interface circuit. In general, the signaling information is controlled directly by the peripheral processor in the TM and indirectly by the CC. The OFF-HOOK condition, which can be represented by an ac or dc signal, is detected by dedicated hardware on the trunk interface circuit. The condition is translated into a logic state which will be scanned by the peripheral processor. A seizure is recognized and reported to the CC after it has persisted for a pre-determined period of time. Therefore, an OFF-HOOK signal which does not meet the electrical parameters or does not persist for longer than the recognition period will not result in a seizure. The seizure signal which is passed to the CC through the internal message system will cause a call process to be



allocated to the call and subsequently results in the appropriate call processing software being invoked.

### **Digital per-trunk signaling**

The DMS-100 Family system supports digital trunks only at DS-1 rates in 24 channel format. The supervision signal is encoded in the A and B bits in the T1 format. The interface is provided by the digital line interface circuit which is located in the DCM or DTC. The digital line circuit provides frame synchronization and signal extraction from the A and B bits. An incoming OFF-HOOK signal is recognized as a seizure signal after validation by the peripheral processor in the DCM or DTC. The seizure message will initiate the call processing sequence as described in the seizure section.

### **Common Channel Interoffice Signaling and Signaling System No. 7**

The DMS-200 toll system supports Common Channel Interoffice Signaling (CCIS) and Signaling System No. 7 (SS7). The DMS-100 Family system local system supports only SS7. The seizure of a CCIS or SS7 circuit is detected in the Initial Address Message (IAM) received over the CCIS or SS7 signaling links. The IAM message is routed by the Message Switch and Buffer (MSB) to the DTC where the corresponding trunk is connected. The message is processed and checked for reasonableness by the DTC which then reports the seizure to the CC.

### **Analog per-line signaling**

The DMS-100 Family system locally supports two types of analog line circuits which are electrically compatible with dc line signaling systems. The OFF-HOOK condition, represented by a dc signal, is detected by dedicated hardware in the line circuit. The condition is translated into a logic state which is scanned by the peripheral processor. A seizure is recognized and reported to the CC after it has persisted for a pre-determined period of time. The seizure signal which is passed to the CC through the internal message system causes a call process to be allocated to the call processing software being invoked.

### **Dial tone speed**

For LM based line peripherals, dial tone speed measurements are made on 1800 test calls per site, 900 DP and 900 DTMF, generated each hour by the system. A site is defined as being either the base DMS-100 Family system or a cluster of one or more RLMs. Every four seconds, independent of experienced dial tone delay, the CC selects two line modules and issues commands which cause one to generate a dial pulse origination and the other to generate a DTMF origination. The line modules are selected on a fixed cyclic basis in order to obtain full system coverage.

On receipt of the command, the line module marks a 'dummy' line as being off-hook and zeroes a call timer. Subsequently, the regular line scan process



detects the off hook condition and generates an origination message which is forwarded to the CC.

On arrival at the CC, the origination message follows regular call processing procedures and the CC responds with an associate channel message. This message arriving at the line module results in the call timer being read and its value being reported to the CC.

The CC then frees any resources associated with the call and increments a peg counter if the value of the call timer exceeds 3 sec, for example, if the dial tone delay exceeds 3 sec. The peg counter is output with the regularly scheduled operational measurements.

For LGC based peripherals, dial tone speed measurements are based upon timing of actual calls. All originations are timed from first detection of the origination attempt in the line concentrating module to dial tone being returned.

The DTSR records the results from the host site. Results for remote sites are shown in the OM group site.

### **Digit reception and analysis**

The DMS-100 Family system had the capability to detect address signals over a line or trunk.

#### **Dial pulse digit reception – trunk**

Dial Pulses (DP) are essentially interrupted on/off hook signals which are scanned and timed by the peripheral processor. The digit timing, inter-digit timing and signal time-outs are performed by the peripheral processor in accordance with the timing period primed by the CC. When a DP trunk circuit is returned to the idle state, the peripheral processor is primed by the CC to detect the next seizure and to collect a pre-determined number of DP digits as defined in the incoming trunk group translation data during translations engineering. The peripheral processor will report to the CC after the first batch of digits is received. The call process allocated to the call will instruct the peripheral processor to collect more digits if appropriate. Any time-out conditions will be reported to the call process.

#### **Multifrequency digit reception – trunk**

Multifrequency (MF) digit reception is provided by the MF receivers provisioned on a pool basis. A network path will be established between the trunk circuit and the receiver under the control of the CC. The MF receiver will perform the timing and signal power level validation for the MF signals. The call process allocated to the call will determine the MF receiver requirement from the incoming seizure and the trunk subgroup data related to the trunk circuit. If one is needed, an idle receiver will be seized and a network path will be established between the trunk and the receiver. As the

network path is established, the two terminals (trunk and receiver) will also be instructed to transmit and to detect a code sent through the network. The detection of the code is an indication of a correctly established network path and this operation is called network path integrity check. The detection and transmission of the integrity code is also part of the peripheral processor function. When Universal Tone Receivers (UTRs) are provisioned in the DTC, a network path to a receiver pool is not required.

The peripheral processor at the incoming trunk circuit will apply the appropriate start dial signal in the backward direction when the network connection has been established. The type of start dial signal required is a trunk sub-group data attribute. The incoming peripheral processor is primed to apply the appropriate start dial signal when the connection is made.

The MF digits will be reported to the call process when the ST digit is detected. Signal time-out or other failure conditions will also be reported to the call process. The network path will be taken down and the receiver returned to idle after digit collection is completed.

#### **CCIS and SS7 digit reception – trunks**

The CCIS and SS7 IAM message containing address information is received by the MSB6 or MSB7 respectively. The MSB sends the address information to the DTC where the digits are collected and checked before being sent to the call processor for final destination determination.

#### **DP digit reception – lines**

The ON/OFF hook signals are scanned and timed by the peripheral processor(s) located in the line peripheral(s). The digit timing, inter-digit timing, and signal time-outs are performed by the peripheral processor in accordance with a digit collection algorithm primed by the CC. In general, the digit collection algorithm minimizes the number of digit reports made by the peripheral processor and, typically, a seven digit local call results in a single digit message to the CC.

#### **DTMF digit reception – lines**

The DTMF digit reception function is provided by the DTMF receivers provisioned on a pool basis. A network path will be established between the line circuit and the receiver under the control of the CC. The DTMF receiver will perform the timing and signal power level validation for the DTMF signals. The call process allocated to the call will determine the DTMF receiver requirement from the incoming seizure and the data related to the line. If one is needed, an idle receiver will be seized and a network path will be established between the line and the receiver. As the network path is established, the two terminals (line and receiver) will also be instructed to transmit and to detect a code sent through the network. The detection of the code is an indication of a correctly established network path. This operation is called network path integrity check. The peripheral processor(s) serving

the line circuit will apply dial tone to the line when the network connection has been established. When UTRs are provisioned in the LGC or LTC, that receiver will perform the functions of the DTMF receiver and will not require a network path to a receiver pool. As each digit is received by the DTMF receiver it is passed to the line peripheral processor through a network connection. The digit collection algorithm, described in this section, is then used to control the reporting of digits to the CC.

Once all digits have been received, the network path is taken down and the DTMF receiver is returned to idle.

### **Revertive pulsing**

Revertive Pulsing (RP) dc signaling is provided on DTCs and LTCs. Incoming office brush and office group selections are converted in the CC through translation tables. Incoming brush, incoming group and final brush are converted to digits by the peripheral processor. The final tens and final units will remain as received. Five or seven digits will be received by the CC.

### **Digit translation**

As illustrated in Figure 4-8, the digit translation function in the DMS-100 Family system is performed by several operations:

- pre-translation
- NPA/NXX translation
- FNPA translation
- INWATS translation
- local call area screening
- class-of-service screening
- international country code translation
- directory number translation
- route selection and digit manipulation
- outgoing trunk selection
- EA translation

### **Pre-translation**

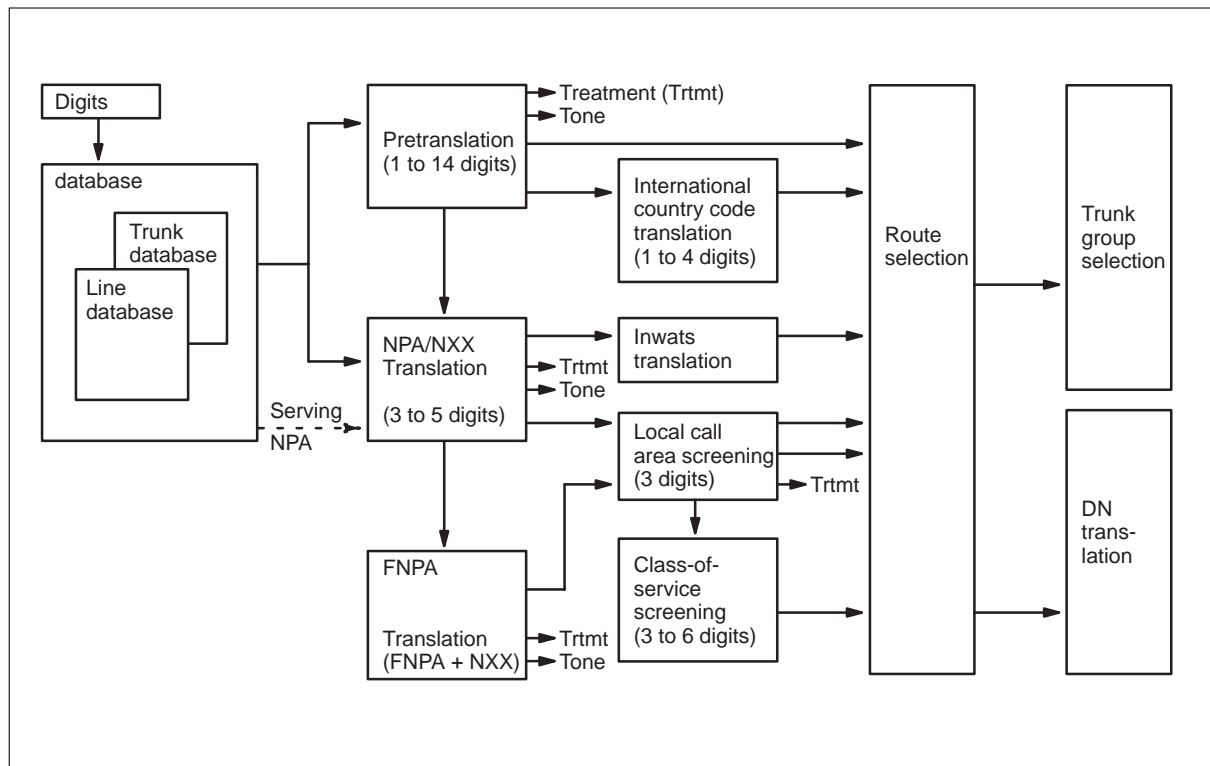
The principal function of this operation in the DMS-100 Family system is to route calls on the basis of one or more (maximum of 18) leading digits. pre-translation can result in a treatment, tone, route to another office, or it can advance translation logic to perform North American or international country code translation.

Pre-translation can be used to implement the translation domain feature, by assigning one pretranslator (maximum of 1023 in BCS30 and above

pre-translators are available) during the engineering of office data translation. The same address digits received on different lines or incoming trunk groups in the DMS-100 Family system can be translated with different pre-translators to connect to different lines or outgoing routes. The pre-translator can be effectively used to screen the calls on the basis of a few leading digits at an early point in the translation process, thereby providing real time savings in call processing.

An indication of whether pre-translation is required appears in the data for the particular line or trunk group on which the digits are received. There can be up to 1023 in BCS31 and above pre-translators provided in the system, each of which can be associated with any particular group of terminals.

**Figure 4-8**  
**DMS-100 family digit translation**



**NPA/NXX translation**

This operation in the DMS-100 Family system involves translation on the basis of the leading three to six digits and is the basis of the North American translation process. This is either the first step (if no pre-translation is required for the line or trunk group on which digits are received) or a second step (after the pre-translation indicates, based on the leading digits, that the North American translation is required) in digit translation.

The NPA/NXX translation has the capability of translating the possible thousand 3-digit combinations for each of the sixteen served NPAs that can be assigned to a system. Furthermore, the three-digit codes can be expanded to four, five, or six digits. The NPA/NXX translator can be used to translate FNPA codes; HNPA codes; INWATS codes of type 800, 00X, 1XB, 08B; NXX codes; operator or toll maintenance codes: 1XX, 11XX, 11XXX; service codes; Terminating Toll Center codes (TTC) of the type 0XX; and vacant codes.

Based on the ABC digits received, the NPA/NXX translator may result in a treatment, tone, route to an operator or maintenance trunk, route to another office (local or toll), route to a line in the same office, or else advance the translation logic to perform a six digit FNPA translation or an INWATS originating or terminating translation.

The DMS-100 Family system permits codes N O/I X and NNX to be used interchangeable by unblocking the E digit.

### **Foreign numbering plan area translation**

One of the outcomes of NPA/NXX translation is to present digits received to the Foreign Numbering Plan Area (FNPA) translation process for a six-digit (NPA+NXX) translation of a 10 digit call. This would be the case when the ABC digits represent a valid FNPA code requiring the switching office to perform a six-digit translation prior to routing the call into the FNPA domain.

The FNPA translator has the capability to perform six-digit translation on any number of FNPA codes. For a given FNPA, it can translate on the basis of a range of NXX digits or specific NXX digits, the various subsets of NXX. The outcome of FNPA translation is a treatment, tone, or a route to a terminating office.

### **INWATS translation – DMS-200**

INWATS NPA/NNX translation is performed by the 800 database.

### **Local call area screening**

Local Call Area Screening is available in a DMS-100 Family system office for lines directly served by the local office and also for incoming CAMA trunk groups if the local originating office is incapable of screening local codes, or if the operating company policy is to perform local call area screening in the local toll system in preference to the local system.

The function of local call area screening is to determine from the digits received whether a call is destined for a point within a local calling area or not. If so, then the route determined in the NPA/NXX translator may be modified in the light of an action specified in the local call area screening data. The DMS-100 Family system can accommodate up to 255 local call

area screening tables. Any of these tables can be associated with any particular line or trunk group

### **Class-of-service screening**

This function is provided in a DMS-100 Family system office for lines directly served by the local DMS-100 Family system office and for incoming trunk groups if the local switching unit is incapable of class-of-service screening, or if the operating company policy is to perform this function in the local-toll system in preference to the local system. The DMS-100 Family system provides screening for up to 255 classes of service.

The function of class-of-service screening is to permit the redirection of calls (from NPA/NXX translator) from certain types of originators.

The class-of-service screening can also be used to implement the translation domain feature. This feature is used to translate the same address digits on lines or incoming trunk groups to yield different lines or outgoing routes. Three-or-six digit translation is performed on the incoming digits (NPA+NXX) by appropriately assigning the class-of-service screening tables during the engineering of office translation data.

### **International country code translation**

Preliminary screening for international calls is performed in the pre-translator. The international country code translator performs translation on one to four leading digits representing a true or pseudo country code. The translation involves validating the number of digits received and routing the call to a treatment, an operator position, or an international switching center.

### **Directory number translation**

This function is performed whenever the local DMS-100 Family system determines that the received digits correspond to a directory number in this office. Directory number translation translates a given directory number into one of three forms:

- a specific line appearance
- a hunt group identifier
- a route list

### **Meridian digital centrex digit translations**

Digit translation operations applicable to DMS-100 Family system equipped with MDC service are dependent on the number and type of digits presented to the IBN translators. MDC stations have access to other stations within the same customer group (using 2 to 7 digit station number) or access to stations outside the customer group either through the trunks and/or special services or through the public telephone network. Calls external to the customer group are accommodated using special access codes.

---

**Station-to-station intragroup calling** Figure 4-9 illustrates MDC station-to-station digit translation. There are six digit translation operations/functions applicable to a station-to-station call:

- MDC database
- customer group data
- Network Class-of-Service (NCOS) data
- NCOS preliminary translator
- NCOS feature translator
- customer group translator

**IBN database, lines and trunks** The IBN database supplies both customer group and NCOS index for the originating station. NCOS is how originating restrictions are applied and basically defines a set of capabilities and restrictions that allow or deny the routing of a call.

**Customer group data** Customer Group Data CUSTHEAD TABLE CUSTNAME FIELD LANGUAGE pointers to the customer group translator, the customer group feature translator and the NCOS data applicable to that particular group.

**NCOS data** NCOS data for the originating station is accessed through the pointer obtained from the customer group together with the NCOS index obtained from the IBN line, trunk, or NPA database. Each entry includes two pointers: one to the NCOS preliminary translator and the other to the NCOS feature translator.

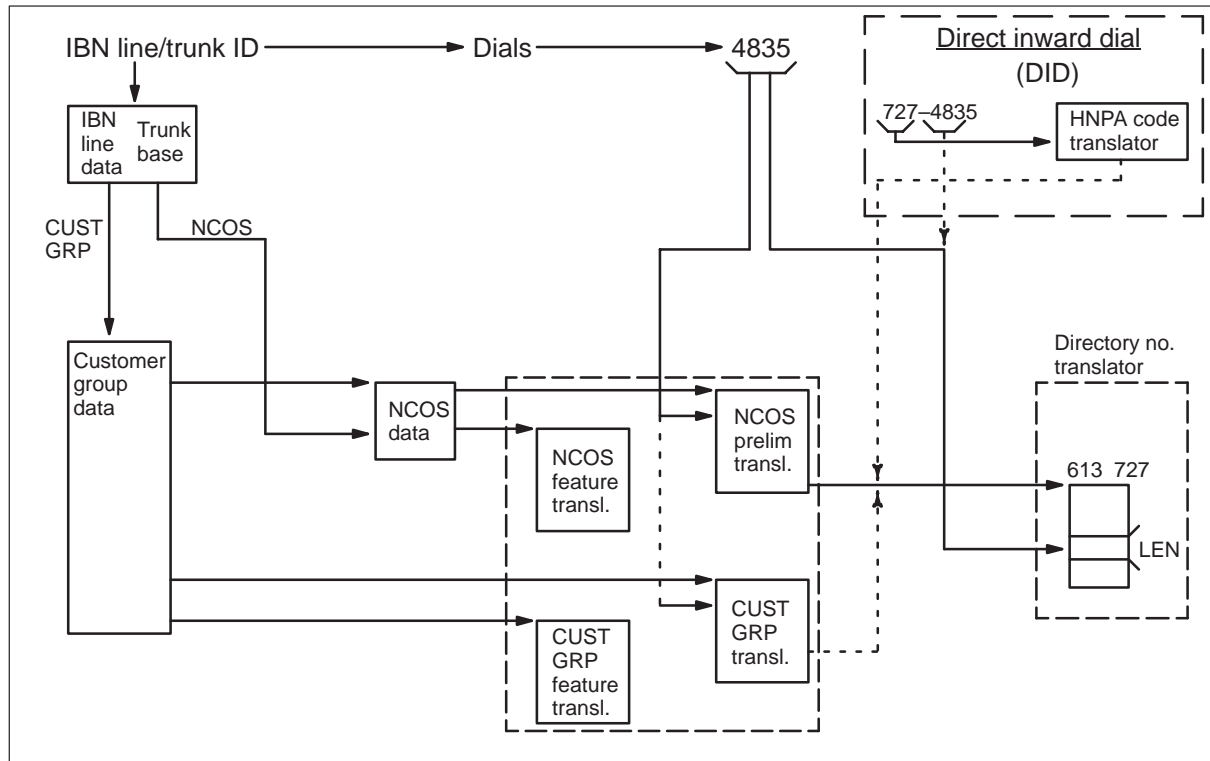
**NCOS preliminary translator** The NCOS preliminary translator determines what, if any, special treatment is applicable to the originator based on the dialed digits and the originators NCOS. It is used, for example, to provide different routing, authorization or account code treatment from that indicated in the customer group translator. If no special treatment is indicated, digit translation defaults to the customer group translator.

**NCOS feature translator** The NCOS feature translator is accessed on receipt of digits preceded by a special feature access digit, the asterisk (\*). The asterisk is either explicitly dialed or internally substituted by the customer group translator, for example, the asterisk is substituted for 11. This translator determines if the dialed feature access code is applicable to this particular NCOS. If not, it defaults to the customer group feature translator.



**Customer group translators** The customer group translator basically provides a translation result for the particular set of digits dialed. Typically, it results in the call being routed to a specific line appearance (digits correspond to a station within the group), a route (digits represent tie trunk access code), or treatment (digits not valid for this particular group).

**Figure 4-9**  
**IBN digit translation station-to-station**



**Customer group feature translator** As with the NCOS feature translator, the customer group feature translator is accessed on receipt of digits preceded by an asterisk (\*) or its equivalent. Each customer group has its own associated set of features and each station within the group has access to them unless precluded by one or more of the methods outlined previously. Access codes preceded by an \* and not 'recognized' by the customer group feature translator represent possible attempts at utilizing the speed calling feature and are referred to the speed calling list assuming this feature is provided.



**Station-to-direct outward dialing calling** The digit translation operations/functions applicable to a station-to-direct outward dialing (DOD) call are listed in the Digit translation section, along with the standard POTS translators. The latter are invoked whenever the appropriate DOD access digit(s) are recognized by the IBN translators.

**EA digit translations** The digit translation function in the DMS-100 Family system equipped with equal access software is an enhancement to those operations explained previously. Equal access translations are performed utilizing five additional operations:

- local access and transport area screening
- assignment of primary InterLATA carrier
- EA pre-translation
- EA route selection and digit manipulation
- EA trunking

**Carrier identification** Carrier identification defines each carrier to the DMS-100 Family system, along with the characteristics of each carrier.

The actual carrier name as it will be known to the DMS-100 Family system is spelled out, as well as the Carrier Access Code (CAC) associated with the spelled out name. Further, the type access allocated to the carrier is defined. An access may be one of the following types: transition plan, interim plan, or EA Plan (EAP), known as Feature Group D. This operation determines the types of traffic each carrier is authorized to process such as intraLATA, interLATA, international, intrastate, and interstate. Further, this operation will identify if the carrier accommodates or requires overlap carrier selection (sometimes called EA overlap outpulsing), Abbreviated Dialing 1 (AD1), and ANI. This operation also defines the disposition of “0” calls made to the carrier.

This operation determines whether a long or short terminating access record should be made. Also, this operation will determine if toll denial should be applied to a carrier.

**LATA screening** The purpose of LATA screening is to define the LATAs, on a subscriber basis, that are served by the DMS-100 Family system. This operation defines all NPANXX codes within the LATA as inter- or intra-state as well as Intra or InterLATA.

**Assignment of primary interLATA carrier** This translation allows each subscriber to be assigned a Primary InterLATA Carrier (PIC). With a PIC assigned, the subscriber may dial interLATA calls without the CAC and complete using the pre-subscribed carrier facilities. This operation also indicates if the subscriber can override the assigned PIC by dialing a CAC.

**EA pre-translation** EA pre-translation operates in essential the same manner as pre-translation described in the Line-to-trunk connection section. In addition, EA pre-translation provides the capability to pre-translate twice: first for the CAC (10XXX or 950 YXXX) and then for a second prefix such as 0 or 1 on a carrier basis.

### **Route selection and digit manipulation**

After passage through the digit translation process, the translation result is handed over to a route selection process which initiates the final disposition of the call. The route selection process determines either an entry point to DN translations or a route list consisting of up to 32 routes. If all routes are busy, the call is routed to all circuits busy treatment.

A route list is associated with each office code for the Home Numbering Plan Area (HNPA) 3 digit translation, with each FNPA 3 digit translation and with each FNPA office code combination 6 digit translation. More than one destination code may be associated with each route list.

Each NPA, home and foreign, may be equipped for a maximum of 1024 route references.

More than 45 000 route lists may be equipped in DMS-100 Family.

A maximum of 2048 trunk groups may be equipped in DMS-100 Family. Trunks in the same trunk group may be distributed over available TMs, DCMs and DTCs. Similarly service circuits may be distributed over available TMs and MTMs subject to compatibility rules.

When the route selected is an outgoing or 2 way intertoll group, standard digit manipulation can be performed by the system and need not be specified in the route and standard digit manipulation is performed:

- Where the ABC digits are equal to the connecting NPA, the ABC digits will be deleted from the digits outpulsed.
- Where the ABC digits dialed are equal to the connecting NPA and DEF digits are equal to the TTC code, the ABCDEF digits will be deleted from the digits outpulsed.
- Where a call within the HNPA is alternate routed through a FNPA, the area code of HNPA is prefixed to the digits being outpulsed to the FNPA.
- Where the served NPA is equal to the connecting NPA, and ABC digits are equal to the TTC code, the ABC digits are deleted.

**Non-standard digit manipulation** If non-standard digit manipulation is required, the digits to be deleted and digits to be prefixed can be specified for each route. If a route requires digit conversion, it can also be specified for the route. Information, such as requirements of cancellation of charge on DDD calls, can also be specified for any route.

**EA route selection and digit manipulation** This process is essentially the same as route selection and digit manipulation described in the Line-to-line connection section. Routes can be chosen on a conditional basis within a route list, including testing for a characteristic of the call, for example, domestic or international bound calls. In operator services EA environment, ports have the capability to test for one of eight characteristics:

- EA Coin
- EA HOTEL
- EA Restricted Billing Lines
- EA CAMA Calls
- EA ANI Fail (OPR Assist Calls)
- EA ANI Fail (Non-OPR Assist Calls)
- EA ONI (1+ calls)
- EA ONI (OPR assist Calls).

Routing can also be determined in this operation based on one or more call characteristics. Certain characteristics are used to make routing decisions by the DMS-100 Family system:

- call type operator assist
- call type direct dial
- international call
- domestic call
- Inter/IntraLATA
- inter/intraState
- carrier
- station class

This operation also has the capability to manipulate digits to conform to all EA requirements for both one-and two-stage outpulsing. After the digits are dialed and all characteristics determined, the DMS-100 Family system builds the digit stream for one- or two-stage equal outpulsing according to the appropriate format. The following outpulsing digits are determined by digits dialed and other call characteristics known to the DMS-100 Family system about the call. The outpulsing digits are placed in the outpulsing stream:

- INX (International Operator Assisted [OA])
- INX (International Direct Dial [DD])
- XXX (CAC)
- 01R (International World Zone 1)
- 022 (Identifies Traffic Type and/or Class)

## Call completion

**Outgoing trunk selection** One result of the route selection process is a route list providing a maximum of 32 routes to the destination of the call. The outgoing trunk selection process sequences down the route list looking for an idle trunk in one of the routes (trunk group) in the list. If all routes in the list are busy (no idle trunk found in the first and any of the alternate routes), the call is routed to a treatment. If, on the other hand, there are a number of idle trunks available, a trunk at the head of a queue of idle trunks is always selected for seizure. Four trunk selection methods are available in DMS-100 Family system switches:

- Most Idle Trunks are added to the tail of the queue as they are idled
- Least Idle Trunks are added to the head of the queue as they are idled
- Sequential Trunks are selected from those idle in the sequence specified in translations
- Circular Trunks are selected from the first idle one found, starting after the most recently released (MRR) trunk in the group

Should glare occur, the DMS-100 Family system provides a mechanism for identifying and resolving it. Glare is deemed to have occurred if a start-dial signal is not received by the seizing office within a pre-specified time after the initial seizure signal. This is resolved by marking the 2 way trunk groups as yield to glare in a controlled DMS-100 Family system office and as do not yield to glare in the controlling office. Based on this designation, the call processing software may instruct the peripheral module to remove the seizure signal controlled office, connect a receiver for the incoming call and then forward the start pulsing signal when ready to receive digits. On the other hand, if it is a controlling office, it is expected to wait for another 500 ms for a start dial signal failing which the incoming call is accepted by dropping the seizure signal. Refer to Chapter 4 for timing parameters.

The DMS-100 Family system may be arranged through trunk group assignment to switch through satellite transmission facilities and to associate with either full or split echo suppressors.

**EA trunking** This operation is essentially the same as outgoing trunk selection. Trunking between the carrier and the DMS-100 Family system allows for a carrier terminating record to be made. Trunking between the DMS-100 Family system and the carrier may be incoming, outgoing or two way. EA trunking will define whether the carrier is to receive ANI spill as well as one of three signaling types:

- bell with single ANI ID digit
- bell with double ANI ID digits
- EA Plan ANI spill

**Termination to lines** If DN translation results in a specific line appearance, the line status, as seen from a software viewpoint in the CC, is determined. Assuming the line is idle, the call proceeds to the ringing phase, otherwise busy tone is returned to the originating subscriber.

If DN translation results in a hunt group identifier, a hunt group termination process sequences through the hunt group searching for an idle line. Assuming an idle line is found the call proceeds to the ringing phase, otherwise a busy tone or another pre-defined hunt group overflow treatment is returned to the originating subscriber. Refer to Chapter 3, DMS-100 Family system feature 01-02-0800, for hunting feature descriptions.

**INWATS termination to lines** INWATS service is available to both POTS and MDC subscribers and, in both cases, a hunt group must be formed to accommodate the feature. If the INWATS service is required for a single line, a single line hunt group is formed.

For POTS subscribers, four billing registers are associated with INWATS service:

- number of attempts on the group
- number of overflows on the group
- connect peg counts on a per member basis
- accumulated usage on a per member basis

The information in these registers is available only on a query basis. POTS INWATS calls may also be recorded on magnetic tape if the system is equipped with LAMA.

In an MDC environment, billing registers are not provided and INWATS service is only possible if the office is equipped with LAMA. In addition, since INWATS MDC calls may terminate on an attendant console, the console must be equipped with an appropriate Incoming Call Indicator (ICI).

In order to control the number of simultaneous MDC INWATS calls, a virtual facility group concept is used. The number of terminations to an INWATS DN is limited to the number of virtual circuits to that DN. Operational measurements are provided on the virtual group for total call attempts and overflow attempts.

### Digit outpulsing

After translation, an outgoing trunk group and then a trunk within that group will be selected to complete the call. The outgoing trunk circuit will be seized and the appropriate seizure signal will be applied by the terminal. The application of the seizure signal will be under the control of the call processor and the peripheral processor associated with the outgoing trunk. The seizure forward process is complimentary to the incoming seizure. After the outgoing seizure, subsequent digit outpulsing will be performed in one of six ways:

- DP digit
- MF digit
- CCIS for DMS-200
- SS7
- DTMF
- Revertive Pulsing

**DP digit outpulsing** The system translation utility, which is a call processing module designed to provide a specific telephony function, will determine digits to be outpulsed on the seized outgoing trunk circuit. The call process will update the call status and assemble an internal message containing the appropriate signal protocol instruction and the digit information. The message will then be dispatched to the associated peripheral processor through the internal message system. The DP signal which is in the form of an interrupted supervision signal will be applied by the dedicated hardware located on each trunk interface circuit. The application and timing of the signaling hardware is controlled by the peripheral processor through logic signal distribution points on the interface circuit.

DP pulsing over digital trunks is performed in a similar manner except that the signal is applied using the A bit.

**MF digit outpulsing** For the DMS-100-Family system, MF pulsing is performed by the peripheral processor in accordance with the outpulsing message sent by the call process. After the outgoing trunk seizure, the peripheral processor will scan and detect the appropriate start dial signal before pulsing commences. The tone generator can generate up to 32 tones including the 15 composite MF tones.

Each PP located in trunk peripherals has an integral capability to generate and apply signaling tones. The tone generator is implemented digitally and is accessible by all trunk circuits in a module simultaneously.

**CCIS and SS7 outpulsing** There is no explicit outpulsing function in CCIS and SS7 as in per-trunk signaling. Internally, the outgoing digit information is derived and assembled in a similar manner to per-trunk signaling. The seizure and digit message will be routed to the DTC. The signaling information is then encoded in CCIS or SS7 IAM message and forwarded over an active signaling link. Refer to Chapter 3 for a description of CCIS and SS7 hardware.

**DTMF digit outpulsing** DTMF digit outpulsing is accommodated using a service circuit located in a TM or MTM. Once the CC has established a path between an idle DTMF transmitter and the outgoing trunk, a message containing the digits to be outpulsed is sent to the peripheral processor serving the DTMF transmitter. Upon completion of outpulsing, the DTMF transmitter is released and a path between the originator and outgoing trunk is established. In addition, DTMF outpulsing is available for trunk circuits on DTCs, RSCs, and LTCs without attaching a service circuit. DTMF tones are generated by the DTC or LTC.

**Revertive pulsing** Routing tables provide the selection code for each route. The thousands and hundreds digits are converted by the peripheral processor to incoming brush, incoming group, and final brush selections. Five or seven digits are sent to the peripheral processor by the CC.

## Call supervision

The recognition of signaling information and progression of a call in the DMS-100 Family system was described in these paragraphs. Calls that cannot be completed due to congestion or other failure conditions are processed or routed according to specified treatments. As a call progresses through the call sequence, the call state is updated by the call process associated with the call.

Once a network path between the originating and terminating terminals has been chosen, messages are sent to the network to establish the path, and to both the originating and terminating peripherals to establish the correct supervision for the call. The messages sent to the peripherals are dependent on the type of call as determined by CC software.

For the duration of the network connection, an integrity check mechanism is employed to ensure that the network path between the originating and terminating terminals is secure. The integrity check mechanism also has the ability to propagate supervision signals between the originating and terminating terminals via the DMS-100 Family system network.

Ac/dc supervision signal is translated into a logic state. The encoded supervision information is appended to the PCM voice signal by the peripheral processor and is monitored by another peripheral processor at the



other side of the switching network. The type of supervision which is propagated between the two terminals includes answer, clear forward, clear back, and disconnect signal. The scanning of supervision is performed by the peripheral processor function with a scan period of 5 ms. The distortion and delay in the propagation of supervision signal is limited only by the 5-ms scan rate.

**Answer supervision** Answer supervision is a backward signal which is detected at the terminating line or outgoing trunk and is always propagated to the peripheral processor associated with the originating line or incoming trunk circuit. For trunk-to-trunk calls the reception of the propagated answer signal will initiate the call duration timing for charging purposes or will result in an answer signal being applied at the incoming trunk circuit.

For line-to-line calls, reception of the propagated answer signal will result in the removal of audible ring back and other actions, such as initiation of call duration timing, as appropriate.

**Outgoing trunk disconnect signal – clear back** An outgoing trunk disconnect signal is an on-hook condition detected at the outgoing trunk after answer has been received. In the case where the incoming circuit is a CAMA trunk, the return to idle operation at both terminals is delayed until a clear forward signal is detected or until expiration of the disconnect timing delay. If the incoming circuit is not a CAMA trunk and the disconnect signal is repeated at the incoming circuit in the back direction, the return to idle operation is delayed until reception of a clear forward signal on the incoming trunk. Refer to Chapter 4 for additional information.

**Incoming trunk disconnect signal – clear forward** A clear forward signal for trunk-to-trunk calls detected at an incoming trunk will terminate the call duration timing. The signal is also propagated and repeated in the forward direction. Furthermore, both associated peripheral processors will also initiate the idling of the trunk circuit. The incoming signal processor will assemble all internal disconnect messages indicating the appropriate call timing information and the idle trunk state of both trunk circuits.

**Disconnect signal lines** A line disconnect signal is an on-hook condition detected at a line, either originating or terminating, after an answer signal has been received. For line-to-line calls, a disconnect signal is propagated to the other line involved in the call. If that line does not go on-hook within 10 seconds, disconnect treatment, as specified by the operating company, is applied.

## Billing

The billing function in the DMS-100 Family system is performed jointly by the call processing and AMA system software. The call processing system



receives the called and calling numbers, connects the called party to the calling party, times the call, and passes pertinent information to the AMA system for billing purposes. The AMA system analyzes the information passed to it by the call processing system, formats it into a suitable AMA format and writes it to a billing file.

The AMA system is described in this section including the details of call processing as to the detection of seizure, reception of called digits, digit translation, and routing of called digits.

**ANI reception – DMS-200** If a seizure is recognized on an incoming CAMA trunk as belonging to an ANI trunk group from a Class 5 office, that part of trunk group data, the DMS-200 CAMA office will, after receiving the called digits, transmit an off-hook towards the local office, as a start signal for outpulsing the ANI information. The far end office is expected to transmit the calling number digits in response to the above signal.

If the first calling number digit is not received by the DMS-200 in a specified time interval, or if one of the subsequent digits is not received during the specified interdigital time interval, or if the information digit received with the ANI spill denotes an ANI failure, the call is handled similar to a call on a ONI trunk. Refer to Chapter 5 for additional information.

If no irregularities are detected during the reception of ANI spill, the peripheral, in which the MF receiver is located, passes on the calling number digits to the call process in the CC. The calling number is validated for a correct NXX code and recorded in a call block. This call block is used by the call process to record pertinent billing information. The called number is used by the call process to determine the routing of the call and in connecting the selected outgoing trunk, via the network, to the incoming trunk. The peripherals connected to the two trunks are primed to report to the call process any change in the state of the two trunks.

If the calling party disconnects before an off-hook answer signal is received from the called party, the call process records in its call block “the time difference between the initial seizure of the incoming trunk and the reception of the clear forward signal from the calling end” as the elapsed time for the event. It also records that the calling end abandoned the call before the answer signal was received from the called end. The operating company determines whether a billing entry will be made for this event.

If an answer signal is received from the called end by the DMS-200, it is timed for answer filter time Minimum Chargeable Duration (MCD) which is specified during translation engineering. This signal must persist for at least the specified MCD to be considered as a valid answer signal.

In the case of the calling party disconnect (clear forward signal received prior to or during called party disconnect timing) the conversation time is calculated as the time difference between the reception of clear forward signal from the calling end and the reception of the answer signal from the called end.

If the called party disconnects first (clear back signal received) the conversation time is calculated as the time difference between the reception of the answer signal and either the reception of clear forward or the expiration of the disconnect timing delay.

All the events discussed above, are recorded by the DMS-200 call process in the call block. After a clear forward signal is received, or after the expiration of the called party disconnect timing delay, the billing information is passed to an AMA process and the call process then takes down the call. Consequently, all resources associated with the call process, namely trunks and call block, are idled.

**ANI fail or ONI CAMA DMS-200** If, after requesting for ANI, an ANI fail indication is received from the far end office, the DMS-200 call processing software routes the call to a CAMA position for calling number identification. The CAMA position operator gets the calling number from the caller and keys it into the DMS-200 office. If any keying errors are encountered, the operator is signaled to reset and reenter the calling number.

Once the calling number has been received by the call process, it handles the ANI fail call in a fashion identical to the processing of ANI successful call. If a call is incoming to DMS-200 office on an ONI trunk group, the call process routes it to a CAMA position which, in turn, requests the calling number and keypulses it into the DMS-200. The processing of the call from this point on is the same as that of an ANI call.

**ANI – local** A DMS-100 Family system acting as a local office, may elect to perform its own billing function (the office is equipped with LAMA) or have its billing performed remotely using CAMA or operator services system trunks (the office is non-LAMA).

**Local automatic message accounting** Once the DMS-100 Family system LAMA has determined that the call is billable, it obtains the calling number (performs an ANI function) and stores it in the call block. In most cases, obtaining the calling number involves referencing the data associated with the line appearance. For two- or multi-party lines, a party identification test must be made before the calling number can be determined. If no problems are encountered, the call is then established in the normal manner. The peripherals are connected to the two terminals being primed to report any changes of state on the terminals to the call processor in the CC.

If the calling party disconnects before an off-hook answer signal is received from the called party, the call process records in its call block “the time difference between the point at which the call was determined to be billable and the reception of the disconnect signal from the calling end” as the elapsed time for the event. It also records that the calling end abandoned the call before the answer signal was received from the called end. Whether a billing entry will be made for this event or not, is a operating company settable condition.

If an answer signal is received from the called end by the DMS-100 Family system, it is timed for answer filter time, or Minimum Chargeable Duration (MCD), which is specified during translation engineering. This signal must persist for at least the specified MCD to be considered as a valid answer signal.

In the case of the calling party disconnect prior to or during called party disconnect timing, the conversation time is calculated as the time difference between the reception of the disconnect signal from the calling end and the reception of the answer signal from the called end.

If the called party disconnects first (clear back signal received), the conversation time calculated as the time difference between the reception of the answer signal and either the reception of calling party disconnect or expiration of the disconnect timing delay.

After a calling party disconnect is received (or after expiration of the called party disconnect timing delay) the billing information is passed to the AMA process and the call process then takes down the call. Consequently, all resources associated with the call process, such as lines, trunks, and call blocks, are idled.

All the events discussed above, are recorded by the DMS-100 Family system call process in the call block.

**ANI fail or ONI LAMA office – DMS-100** If the DMS-100 Family system fails to determine the calling party number (ANI function fails), or if the line is marked as ONI, the DMS-100 Family system routes the call to a position trunk, an outgoing CAMA trunk, or an operator services system trunk.

The operator obtains the calling number from the subscriber and keys it into the DMS-100 Family system. If keying errors are encountered, the operator is signaled to reset and reenter the calling number. Once the calling number has been received by the call process, the call proceeds identically to a standard LAMA call in which the ANI function was successful.

The latter case is identical to non-LAMA, however, the responsibility for billing the call has been passed to the CAMA or operator services system office.

**Non-LAMA** Once the DMS-100 Family system office has determined that the call is billable, it obtains the calling number. Since billing is performed remotely, with CAMA or operator services system, the DMS-100 Family system selects and seizes an appropriate outgoing trunk, outpulses the called number, and waits for the ANI request from the distant office. If the ANI request is received within five seconds, the DMS-100 Family system outpulses the calling number preceded by the appropriate information digit. If the ANI request is not received within five seconds, the DMS-100 Family system logs a trunk trouble and a second attempt is made on a different trunk. If the second attempt fails, the DMS-100 Family system again logs a trunk trouble and provides re-order treatment to the line.

If the line is marked as ONI, or if the ANI function fails, only the appropriate information digit is sent over the CAMA or operator services system trunk in response to the ANI request.

### **Treatment of irregularities**

The various irregularities described here are detected at different points in the DMS-100 Family system call processing logic. In order to treat these irregularities in a systematic way, a number of treatment groups have been defined in the system. Any irregularity detected during call processing is mapped to one of the pre-defined treatment groups. Next, the mapping between a treatment group and a tone or an announcement, specified by the operating company, is used to provide an indication to the caller at the originating end. The irregularities detected by the DMS-100 Family system are described in the following. Chapter 5 provides additional information on DMS-100 Family system call treatments and irregularities.

#### **Permanent signal time-out**

**Lines** The line peripheral module is primed by the CC to time the interval between the start of dial tone and the reception of the first digit. Failure to receive a digit within a specified time, operating company settable in the range of 1 to 40 sec, results in operating company specified permanent signal treatment.

The permanent signal treatment is specified via a DMS-100 Family system route list. Typically the treatment would involve routing to an announcement, then to Receiver Off-Hook (ROH) tone, then to re-order and finally to Permanent Signal (PS) lockout. If the subscriber goes on-hook anywhere in the sequence his line is returned to the idle state.

**Trunks** The trunk peripheral is primed by the CC to time the interval between the transmission of a start dial signal and the receipt of the first digit from the far end. If the first digit is not received during this time, operating company settable to between 2 and 30 sec, a permanent signal time-out is said to occur. The peripheral, as primed by CC, reports this event to the CC. On receiving the report, the call processing software connects the far end to a tone or announcement specified by the operating company for the treatment group.

This treatment is applied in two additional situations:

- On an MF intertoll trunk, a receiver error message is received from the peripheral
- On an DP intertoll trunk, a received digit is greater than 10.

The permanent signal treatment is specified via a DMS-100 Family system route list. Typically, the treatment would involve routing to an announcement, then to Receiver Off-Hook (ROH) tone, then to re-order and finally to Permanent Signal (PS) lockout. If the subscriber goes on-hook anywhere in the sequence, the line is returned to the idle state.

### **Partial dial time-out**

**Trunks** As primed by the CC, the trunk peripheral times the interval between reception of each digit, excluding the first, and if a digit not received during this period. When this time period is settable by the operating company in the range of 2 to 30 sec, a partial dial time-out is said to occur. On receiving a report of this event from the trunk peripheral, the call processing software will connect the far end to a tone or an announcement specified for the partial dial time-out treatment group. This treatment is also given in three other situations:

- The MF start signal is not detected for calls on an incoming CAMA trunk or an MF intertoll trunk
- The MF ST is received for calls on an incoming CAMA trunk but the called number is invalid
- A call on DP intertoll trunk when translation needs more digits but none are available.

**Lines** As primed by the CC, the line peripheral times the interval between the reception of each digit. Failure to receive a digit within a specified time, operating company settable in the range of 1 to 40 sec. results in a partial dial treatment being given to the line.

### **Transmitter time-out – blocked calls**

**Delay dial signaling – one-way trunks** As primed by the CC call processing software, a trunk peripheral times the interval between the seizure of an outgoing trunk and the receipt of a delay dial signal from the other end. If the delay signal is not received within a pre-specified time after the seizure, the peripheral reports the time-out to the CC. On receiving the above report, the call processing software hunts for another idle trunk in that group, or other trunk groups, in the selected route list. If a trunk is found idle, a seizure is sent to the distant office and timing for the receipt of the delay dial signal is started. If the delay dial signal is not received during a pre-specified time, or the delay dial signal is received but the start dial signal is not received during its pre-specified time-out interval, a call is routed to a reorder treatment. Based on the mapping of reorder treatment, the call processing software will apply the appropriate tone or operating company specified announcement to the far end.

**Wink start signaling – one-way trunks** As primed by the CC, the trunk peripheral expects to receive the wink signal edges within a certain pre-specified times, failing which, it reports to the CC on the occurrence of the time-out. The call processing software in the CC hunts for another idle trunk as described in this section, and should the wink not be correctly received during the pre-specified times, the call is routed to a start dial signal time-out treatment again.

**Delay dial signaling – two-way trunks** Second trial and treatment procedures for two-way trunks are the same as those for one-way trunks, except if the start dial signal is not received within the proper time interval, glare is said to occur. Refer to Chapter 5 for the detection and resolution of glare.

**Wink start signaling – two-way trunks** Second trial and treatment procedures for two-way wink start trunks are the same as for one-way wink start trunks, except that if the trailing edge of a wink is not received within the proper time interval, glare is said to occur.



## Unexpected stop

**MF signaling** The trunk peripheral as primed by the CC call processing software will look for unexpected stops, stop dial signal, during MF outpulsing as an extended interdigital interval between the tens and units digits on intertoll, toll connecting, and local trunks. This interdigital or tone off timing will be extended by 70 ms to look for an unexpected stop condition. Upon detection of a stop dial signal from the called end during this interval, the trunk peripheral will report this condition to the CC. On receiving the above report, the call processing software will maintain the outgoing trunk in a busy state and hunt for another idle trunk in the same trunk group in which the false stop occurred. If this condition occurs on the second trial, the call processing software will apply the appropriate tone or announcement, operating company specified, over the incoming trunk to the originating office.

**DP signaling** The DMS-100 Family system will detect unexpected stop on outgoing DP trunks in two cases:

- a second stop is received during a stop-go operation
- a stop is received on DP outgoing trunks not requiring stop-go operation.

Upon detection of a stop dial signal from the called end during outpulsing, the peripherals will report this condition to the CC. The same procedure is employed here as in this chapter for routing to treatment. Unexpected stops after the start of the units digit will not be detected.

**Vacant code treatment** If at any step in the translation process an error is detected, such as an unassigned office code, area code or country code the call is routed to a vacant code which may then be mapped to a suitable announcement as specified by the operating company during system installation.

**More or fewer digits received than expected** If the number of digits received is more than the maximum or fewer than the minimum expected, the DMS-100 Family system digit translation process gives a treatment to the call. A tone or announcement can be associated with the treatment and applied to the far end.

**MF reception receiver unavailability** If a MF receiver is not available, the DMS-100 Family system will not send a start dial signal to the calling office. This will cause the latter to time-out. The same is true of operator trunks because the operator will abandon the call if a receiver-attached signal is not received from the DMS-100 Family system office in a specified time. No treatment is given to calls due to non-availability of MF receivers.

**Network congestion – trunk blocking** In case of a network congestion, for example, all attempts at finding a path from an incoming trunk to the selected outgoing trunk fail, DMS-100 Family system routes the call to a treatment.

### Minor irregularities

**Mutilated digits – MF pulsing** When mutilated digits are received by the peripheral in which the MF receiver is located. It reports this fact to the CC. The call processing software treats it as a partial dial situation and applies a tone or an announcement to the far end office.

**Misplaced start** On receiving digits from the peripheral, the call processing software verifies if the ST digit is in the correct position. If it is not, the call is routed to a partial dial treatment and a tone or an announcement associated with the treatment is applied to the far end.

**False KP** When call processing software detects a false keypulsing (KP) digit, it routes the call to a partial dial treatment and a tone or an announcement associated with the treatment is applied to the far end.

**Extra pulse** If, on verification of digits, the call processing software detects that a digit is greater than 10, it routes the call to a permanent signal treatment.

**Other pulsing error** Any pulsing error, assuming ST is received, other than those described in this section, is routed to a partial dial treatment in the DMS-100 Family system.

**Stuck sender** The stuck sender feature provides the means to identify and access outgoing trunks from the DMS-100 Family system that are encountering outpulsing problems. When the feature is initiated and an outpulsing problem occurs, the outgoing trunk to the distant office is retained and is identified on the TTP through a visual message.

**INWATS check failure – DMS-200** As in the case of other treatment groups, the unauthorized treatment can be associated with a tone or an announcement. Three checks are made on INWATS originating or terminating calls during the INWATS translation process:

- When 800+NX2-XXXX digits are received from outside the state, the NX2 codes being reserved for intrastate calls, the call is routed to an unauthorized INWATS calls treatment.
- When the interstate 800+NNX-XXXX code is received for an intrastate call, the call is routed to the unauthorized INWATS call treatment.



- When an INWATS terminating call originated from a band that is farther away, the terminator that has paid for it is routed to the unauthorized INWATS call treatment.

### AMA irregularities

**ANI reception irregularities – DMS-200** On receipt of the called number, DMS-200 returns a sustained off-hook to the local office as the ANI request. The calling MF transmission is expected in the form:

$$KP - I - 7D - ST$$

where:

I is the information digit (0-7)

and

7D is the calling number (7 digits)

On completion of ANI reception, the digits of the calling number are checked for validity and billing treatment. If any irregularity in the calling number, such as failure to receive digits in a pre-specified time, receipt of KP-I only, mutilated digits, extra digits or less digits, or receipt of KP or ST in the improper position is recognized, the call is routed to a CAMA operator position for ONI.

**Automatic Message Accounting operator irregularities** AMA operator impulsing may result in errors, for example, one or more than two frequencies for a digit, extra digits, or insufficient digits. Upon recognition of the above irregularities, the DMS-100 Family system sends the operator a reorder signal to the AMA operator position. The operator will respond by sending a reset signal back to the DMS-100 Family system office. In response to the reset signal, the DMS-100 Family system removes the reorder signal and resets itself for receipt of all address digits.

The number of times a reorder signal may be sent to an AMA position is defined by the operating company and has a maximum of ten reorders.

**Invalid calling party code** On receiving the calling party number from the AMA position, the call processing software checks the digits for valid office code as well as ensuring that the calling party number is not the same as the called party number. If the calling office code (NNX) is found to be invalid, a reorder signal is transmitted to the AMA position which indicates to the operator that she should send a reset signal to the office and then reenters the calling number. An operator is allowed a maximum of ten attempts for reentering the calling number, as defined by the operating company.

**Home numbering plan area intercept** When the translation process receives home NPA and HNPA dialing is not permitted, it routes the call to the home NPA intercept treatment. An appropriate announcement is applied to the far end when this occurs.

**Misdirected CAMA call** This treatment is used for routing of local calls, when the local originating office is incapable of screening local codes, which attempt to but are not permitted to switch via the toll network or when the prefix digit 0 or 1 is dialed in error on a local call and dialing of prefix digits on local calls not permitted.

**No circuit intertoll** This is the treatment to which an incoming or 2 way intertoll call is routed when all trunks associated with the outgoing trunk group are busy. Once again, an appropriate announcement can be associated with the treatment.

**No service circuit** Unless CAMA suspension is activated, a call on an incoming CAMA trunk is routed to this treatment and to a tone or announcement when there is a time-out waiting for a CAMA operator.

**Blue box fraud prevention** Blue box fraud depends upon an in-band signaling link being present in an end-to-end call connection. This signaling link is released by the calling party using the blue box before or after the called subscriber answers. The signaling link is then re-seized by the calling party and a new destination directory number outpulsed MF using the blue box. This operation, except for the wink start or delay dial signal, is transparent to the offices preceding the in-band signaling link.

In order to detect this type of fraud, the DMS-200 will detect a second proceed-to-send signal from the incoming SF unit at the distant office (a signal having a nominal duration of 200 ms greater than 75 ms and less than 2 sec). Upon detection of the second proceed-to-send signal, the DMS-200 will connect a MF receiver to the incoming CAMA trunk, for a period of 30 sec. If digits are not received within this time, the receiver will disconnect. If digits are received within this 30 s period, the second number is entered on tape along with an identifying code.

At this point the call may be dropped, or allowed to proceed, the operating company having the necessary data to correctly bill the call.

There is no danger of the fraudulent call proceeding after time-out of the DMS-200 MF receiver, as the MF receiver at the distant office will time out after 25 sec. If this occurs, the caller must reinstate the call and the detection process is repeated.

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## Tones and announcements

**Tones** The DMS-100 Family system allows an operating company to describe particular information about each tone:

- tone pattern (on/off sequence)
- segment time of the tone pattern in 10 ms intervals
- type of tone (high or low)
- time-out after which the tone will be withdrawn
- the maximum number of simultaneous connections allowed

Through translations, the DMS-100 Family system determines the type of tone and connects the calling facility to the appropriate tone. Next, the DMS-100 Family system supervises the calling facility for disconnect and upon receipt, disconnects the calling facility from the tone.

**Announcements** The DMS-100 Family system offers both analog and digital recorded announcement facilities. Three categories of information can be specified for each announcement:

- maximum number of simultaneous connections that can be made to a single announcement
- Time taken for one announcement cycle per announcement channel
- number of times the complete announcement will be heard before the call is advanced to the next tone or announcement

Refer to Chapter 2 for additional information.

**Analog recorded announcement equipment** The recorded announcement machine used in the DMS-100 Family system is supplied by AUDICHRON and is housed in the Recorded Announcement Module (RM) mounted on the miscellaneous equipment frame. Recorded messages are accessed via RM mounted play-back amplifiers and 4 wire E&M trunks housed in TMs. The speech channels incoming to a network from each of these trunks can be connected in broadcast mode to all outgoing speech channels within the same network subgroup.

The RM is available in four configurations:

- 6 tracks strapped for 6.5-sec. message
- 12 tracks strapped for 6.5 sec. message
- 6 tracks strapped for 13.5 sec. message
- 12 tracks strapped for 13.5-sec. message

The DMS-100 Family system allows for combining from one to eight, 6.5- or 13.5 sec. announcement channels to provide longer announcements. The DMS-100 also has capability of different language requirements.

**Digital recorded announcement unit** The Digital Recorded Announcement Unit (DRA) unit is micro-processor controlled system which uses Metal Oxide Semiconductor (MOS) memory, ROM, and RAM as the recording media for recorded announcement messages.

The ROM card is used to store seven standard prerecorded announcements while each RAM card is used for on-site recording of up to 32 sec. of speech. There are a maximum of eight memory cards in the DRA for a total of 1 Mbyte of memory.

The DRA unit plugs into a standard MTM and up to 30 channels can be accommodated per MTM with each channel carrying a different announcement. Announcements are assigned to a channel under control of the ANNMEMS data table. Broadcasting is used throughout the network from a single input to distribute a given announcement to trunks and lines. This reduces the number of speech line channels required for announcements. If additional announcements are required, additional DRA units may be added.

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# Chapter 5: Signaling and interfaces

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## Interfaces

DMS-100 Family communications are facilitated through analog, digital, or a combination of analog and digital interfaces. These interfaces communicate with the DMS-100 Family network using multiplex loops operating at 2.56 Mb/s:

- analog interfaces are used for providing intersystem services, such as E&M trunks. They are mounted in Trunk Module (TM) shelves.
- analog interfaces are also used to interface subscriber telephone equipment. These are the line circuits and are mounted in the Line Concentrating Module (LCM) shelves at the host office or at a remote site.
- digital interfaces provide direct access to the digital system or equipment at the DS-1 line rate (1.544 Mb/s). They are mounted in Digital Trunk controller (DTC) or Digital Carrier Module (DCM) shelves.
- ISDN interfaces

## Peripheral equipment pack requirements

### Common characteristics

These are the common characteristics for DMS-100 frequency ac induction:

- Supervision and signaling functions are under firmware control.
- Common signaling tones are generated digitally.
- Common signaling tones generated digitally and internally.
- Automatic switchover takes place between network planes in case of a network failure for reliability.
- Digital and analog loop back features are provided to facilitate maintenance for maintenance aid.
- Trunk circuits are transformer coupled to transmission facilities for isolation and impedance matching.
- Minimum insulation resistance is 10 k $\Omega$  for residential lines and 30 k $\Omega$  for trunks and coin lines.
- Longitudinal balance

- Ground potential variation:  $\pm 3$  volts

### **Protective characteristic requirements**

DMS-100 Family circuits are capable of maintaining normal service while dissipating 40 mA for both conductors. Currents levels between 40 mA and 350 mA create neither a fire or electrical shock hazard, although the circuit may fail. DMS-100 Family circuits are capable of withstanding longitudinal or metallic transients of 600 V (rms) for 5 sec. without creating either a fire or electrical shock hazard, although the circuit may fail.

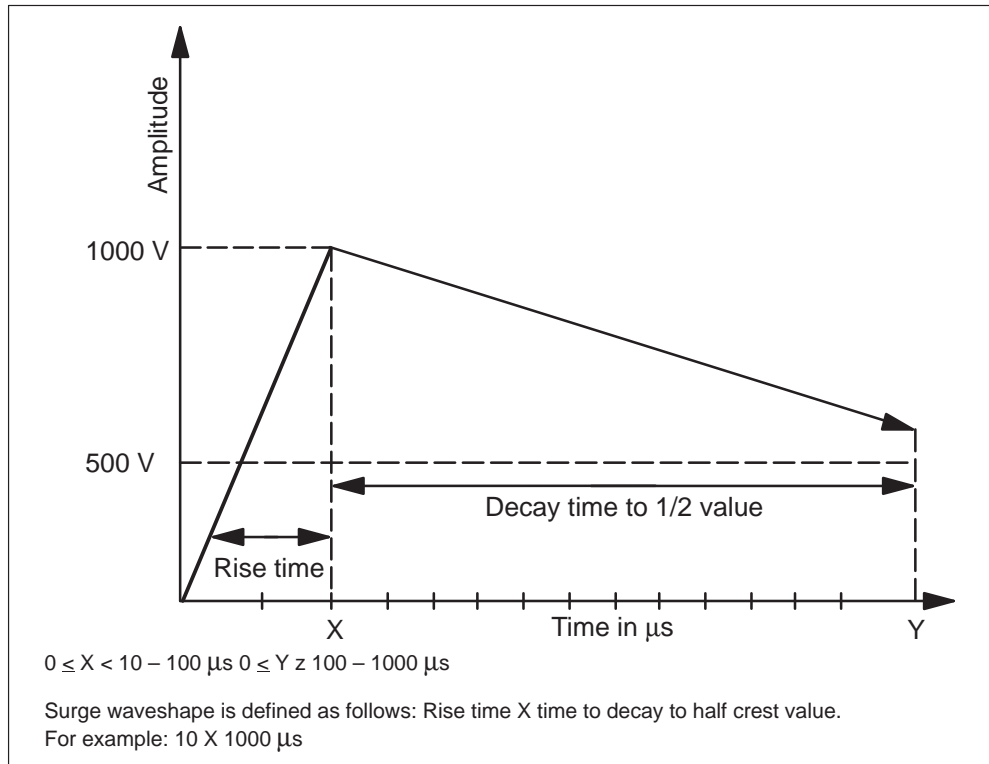
DMS-100 Family circuits withstand 700 V (rms), with a source resistance of 100  $\Omega$  for 183 ms, and automatically restore:

- High-voltage surge – DMS-100 Family circuits can withstand, without damage, a standard lightning surge waveform of 1000 V peak, 10  $\mu$ s rise time x 1000  $\mu$ s decay time (see Figure 5-1).
- Dielectric strength – High longitudinal impedance circuits—1000 Vdc, applied for 1 minute to tip, ring, and ground terminals, in any combination, will not result in damage.

Low longitudinal impedance circuits—Breakdown shall not occur (less than 10ma flowing) when 100 V (rms) of 60 Hz or 1400 Vdc is applied for one minute between terminals and dead-metal parts (exposed non-ground surfaces) or to other terminals that are not conductivity connected. This requirement applies to conductivity connected terminals after protective devices or fuse type elements have operated.

Typical outside plant protection used with the DMS-100 Family system is a 3-mil, 350-V carbon block that is provided by the operating company.

**Figure 5-1**  
**Surge waveshape**



### Analog trunk interface

Analog trunk circuits exchange control messages with the Trunk Module (TM), transmit near end signaling to far end, receive far end signaling, and process Voice Frequency (VF) signals. Several analog trunk circuits are currently available with the DMS-100 Family:

<b>Table 5-1</b> <b>Analog trunk interface</b>	
<b>Trunk circuit</b>	<b>Description</b>
NT2X72AA/AC	Four-wire incoming, outgoing or two-way, DI, DP or MF, E&M trunk circuit.
NT2X78AA*	Four-wire integrated SF, MF trunk circuit.
NT2X81AA/AB	Two-wire incoming, outgoing or two-way, Type DI, DP or MF, E&M trunk circuit.
NT2X82AA	Two-wire incoming, loop, reverse battery, DP or MF trunk circuit.
—continued—	

<b>Table 5-1 Analog trunk interface(continued)</b>	
<b>Trunk circuit</b>	<b>Description</b>
NT2X83AA	Two-wire outgoing, loop, reverse battery, DP or MF trunk circuit.
NT2X88AA	Four-wire incoming, outgoing or two-way, Type II, DP or MF, E&M.
NT2X92AA	Two-wire outgoing, loop, reverse battery, MF trunk circuit.
NT1X54AA	Four-wire jack ended trunk circuit.
NT2X65AA	Centralized Automatic Message Accounting (CAMA) position signaling circuit.
NT2X66AA	CAMA suspension and calls waiting circuit, loop or E&M.
NT2X90AC	Incoming or outgoing test trunk, two-wire with S-lead DP, MF, DTMF (DMS-100).
NT2X90AD	Incoming or outgoing test trunk, two-wire with S-lead, DP, MF, DTMF (DMS-100).
NT2X95AA	Two-way DID/DOD PBX loop trunk. MF, DP (DMS-100).
NT2X98AA	Two-way incoming trunk with S-lead control. Reverse battery, DP, MF.
NT3X06	Outgoing trunk to co-located 3CL switchboard with S-lead supervision. MF, DP, coin, non-coin.
NT3X07	Incoming trunk from co-located 3CL switchboard MF, non-coin only.
NT5X30AA	101 communication test line circuit.
<b>Note:</b> *This trunk circuit is not required for the Bell operating companies and, therefore, trunk specifications are not provided. Signaling, for this trunk, consists of sending or removing an SF tone (2600 Hz) and detecting the presence or absence of the SF tone (2600 Hz) for the on-hook and off-hook states.	
<b>End</b>	

The trunk circuits are contained on printed circuit packs with either one or two circuits per pack depending on the circuit type. The printed circuit packs are connectorized and plug into TMs.

The TM provides the interface between analog trunk circuits and the digital multiplex circuits of the DMS-100 Family. The TM converts analog trunk speech and signaling information to or from a 2.56-Mb/s stream. Trunk modules provided with DMS-100 Family are two wire (TM2), four-wire (TM4), or eight-wire (TM8) and the corresponding leads (two, four or eight wires) are cabled to the distributing frame. Trunk circuit packs, a shown in



Tables 5-2 and 5-3, are typically inserted into a trunk module that supports the minimum number of leads required by the trunk. However, since the design of the trunk module is universal, trunk circuit packs may also be inserted into a higher designated TM.

**Table 5-2**  
**Summary of trunk features**

DMS trunk circuit	*Trunk function	Appli-cation			Super-vision	Pulsing control				Pulsing				**Balancing network				**Balancing network				Impedance Ohms	Remarks	
		In	Out	2-way		Wink	Delay dial	Immediate dial	Stop go	DP loop	DP bat/gro	MF	DP E&M	NT2X77AA	NT2X77AB	NT2X77AC	NT2X77AD	NT2X80AA	Coin ring					
																			IB	MW	IB			MW
NT2X88AA	AN, CA, DD, IT, SP, TC, TT, VR	X			4 W E&M Type 11	X	X	X			X	X						X	X	X	X	600		
			X			X	X	X	X			X	X						X	X	X			X
				X		X	X				X	X								X	X			X
NT2X92AA	IN, TC		X		2 W loop reverse battery	X	X	X	X		X		X		X							Reverse make busy		
NT1X54AA	MAP				None																900	Network accessed connects to external test equipment		
NT2X65AA	CP			X	Hi-lo and control leads						X		X		X						600	Key ckt receives MF requires associated Ca TRK or POS ckt		
NT2X66AA	CAMA SUSP CAMA CW			X	E&M or loop																600	Interfaces with 5095868-01 and 5095872-01		
NT5X30AA	MAP	X			2 W loop gro start			X	X			X	X								900			
				X									X	X										
<p><b>Note:</b> * See abbreviations, ** see networks.</p>																								

5-6 Signaling and interfaces

**Table 5-3**  
**Summary of trunk features**

DMS trunk circuit	*Trunk function	Applica-tion			Super- vision	Pulsing control				Pulsing				**Balancing network				**Balancing network					Impedance Ohms	Remarks	
		In	Out	2-way		Wink	Delay dial	Immediate dial	Stop go	DP loop	DP bat/gro	MF	DP E&M	NT2X77AA	NT2X77AB	NT2X77AC	NT2X77AD	NT2X80AA	Coin ring						
																			IB	MW	IB	MW			Other
NT2X72AA	AN, CA, DD, IT, OO, SP, TC, TT, VR	X			4 W E&M Type DI	X	X	X			X	X						X	X	X	X	600	Without echo suppressor control (analog)		
			X			X	X	X	X			X	X						X	X	X			X	
NT2X72AC		X		X			X	X	X			X	X							X	X	X	X	600	Transmission level for carrier equip
			X			X	X	X	X			X	X							X	X	X	X		
NT2X81AA	CA, DD, In, IT, SP, TC, OO, VR	X			2 W E&M Type DI	X	X	X			X	X	X			X	X	X	X	X	X	900	Reverse make busy		
			X			X	X	X	X			X	X	X	X			X	X	X	X			X	
NT2X81AB		X				2 W E&M Type DI	X	X	X			X	X		X			X	X	X	X	X	X	600	Reverse make busy
		X		X	X		X			X	X		X			X	X	X	X	X	X				
NT2X82AA	CA, DD	X			2 W loop reverse battery	X	X	X		X	X	X			X	X						900	Make busy under control signal from TM		
NT2X83AA	IN, TC		X		2 W loop reverse battery	X	X	X	X		X	X			X	X		X				900	Reverse make busy		

**Note:** \* See abbreviations, \*\* see networks.

<b>Table 5-4 Abbreviations and networks</b>				
<b>Abbreviations</b>			<b>Networks</b>	
			<b>Codes</b>	<b>Description</b>
AN	Announcement	NT2X77AA	900 $\Omega$ +2.15 $\mu$ F + NBOC + NBOR	
CA	CAMA	NT2X77AB	600 $\Omega$ +2.15 $\mu$ F + NBOC + NBOR	
CP	CAMA position	NT2X77AC	900 $\Omega$ +2.15 $\mu$ F + NBOC	
CW	Calls waiting	NT2X80AA	H88 precision network	
DD	DDD access			
IN	Informantion			
IT	Intertoll			
MAP	Manitenance and administration position			
NBOC	Network build-out capacitors			
NBOR	Network build-out resistors			
OO	Two-way operator office			
SP	Traffic service position			
TC	Toll completing			
TT	Toll tandem			
VR	Verification			
4W	Four-wire			
2W	Two-wire			

### **Trunks with loop supervision**

DMS-100 Family provides one way, two wire loop reverse battery trunks. Supervisory or address signaling consists of superimposing and/or detecting DC states on the same trunk conductors that are used for voice transmission. The DMS-100 Family also provides a two-way loop DID/DOD trunk for PBX applications.

Additionally, there are trunks to interface with 3CL switchboards and test equipment of the #14 Local Test Desk (LTD) signaling scheme using S-lead control. Trunk circuit signaling states, electrical characteristics, working limits, and features are specified in subsequent sections.

**Working limits** The trunk sensitivities to the incoming steady signal and pulsing dc signal states are specified by the working limits provided for each trunk. Trunk circuits will function properly under the specified working limits.

Working limits are listed on the appropriate trunk General Specification (GS) document. Three working limits are common to reverse battery trunks:

- Battery Voltage

Nominal	Voltage Range
-48 Vdc	-42.75 Vdc to -55.8 Vdc
- insulation resistance – 30 000  $\Omega$  minimum
- ground potential difference –  $\pm 10$  V

**Trunk features** Features that are applicable to a particular trunk will be provided in the appropriate section. These features are common to DMS-100 Family reverse battery trunks:

- Terminating set – The circuits incorporate a 2W/4W terminating set which provides an interface between the two-wire facility and the four wire trunk circuits. Balancing of the terminating set is provided as a plug in option.
- Level adjustments – Level adjustments are provided in both receive and transmit directions in 0.25 dB steps over a range of 0 to 15.75 dB. Fixed pads are switched in or out by miniature switches, to obtain the required loss or gain.
- Test circuit – A test circuit to check the signaling, supervisory, and VF circuits is provided on each trunk. Operation of the test trunk relay, through the TM and Trunk Logic Circuit (TLC), isolates the trunk circuit from the transmission facility, allowing the trunk circuit to be tested internally. The test relay also implements the loop-around feature.

- Balance networks – Optional plug-in networks are available for balancing the terminating set. The selection of the balance network required depends on the type of trunk facility loading. Table 5-2 specifies balance network codes available.
- Impedance – Trunk impedance is  $900 \Omega + 2.15 \mu\text{F}$ .
- Reversal option – Tip and ring reversal option is only provided for NT2X90AB.

Two trunk circuits are accommodated per circuit pack. The printed circuit packs are connectorized and plug into two-wire, four-wire or eight-wire trunk modules (TM2, TM4, or TM8) except as noted for individual trunks.

**Two-wire incoming, loop, reverse battery, DP or MF, trunk circuit NT2X82AA**

- Signaling and supervision  
Far-end open and closure (on hook, off hook) signals are detected by the trunk loop detector. During pulsing B/G, the far end provides aiding resistance battery and ground, with respect to the incoming trunk, in place of the off hook signal. Near-end signaling by the incoming trunk consists of battery and ground reversals:

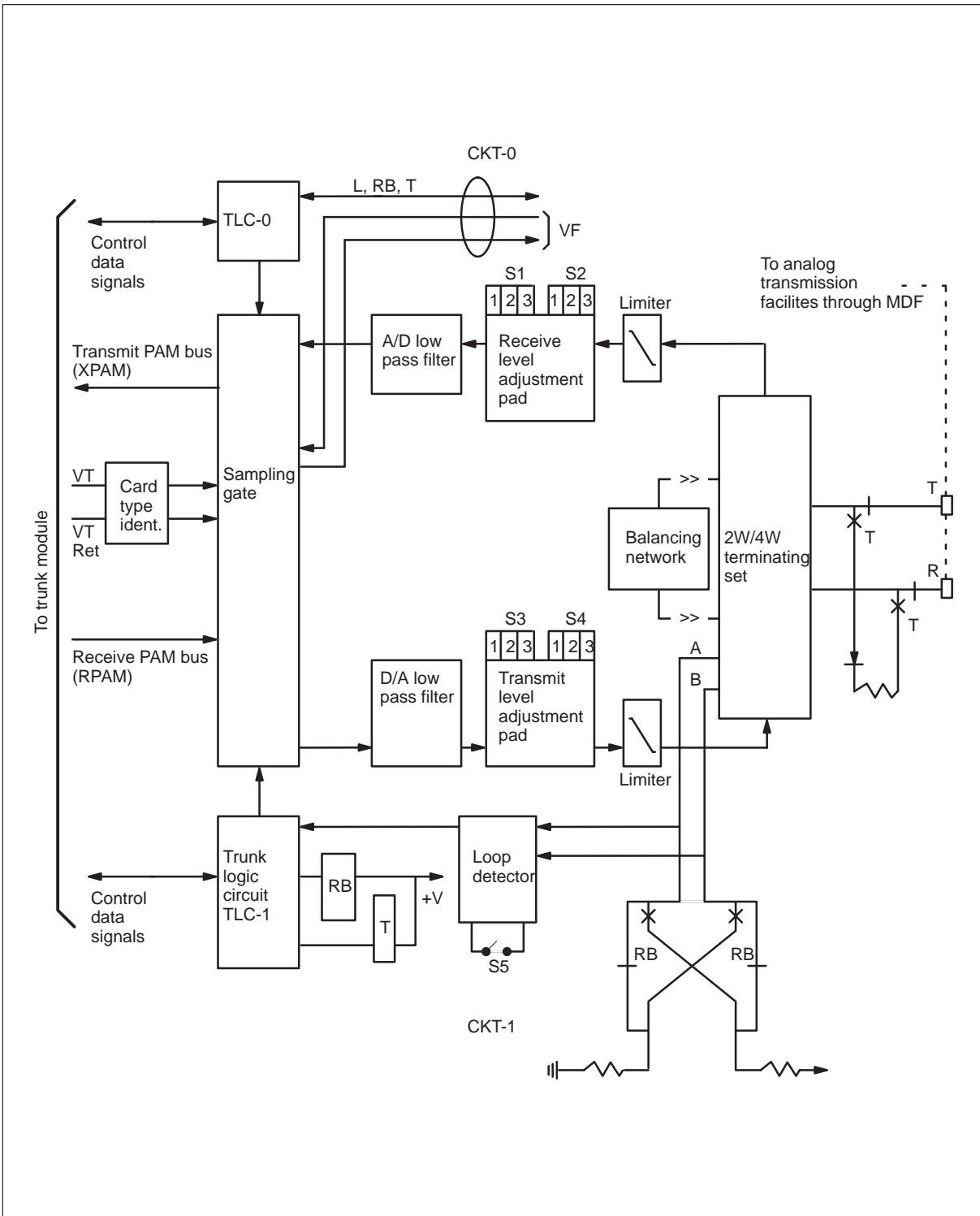
State	Tip lead	Ring lead
On-hook	Ground	-48 V
Off-hook	-48 V	Ground

The incoming trunk circuit supplies battery and ground through matched resistances of 446 ohms (nominal). During tip and ring reversal, when the electrical state is undefined, the transition period is 7 ms or less. Signal states are given in Table 5-5 and Figure 5-2.

State	System	T	R
Idle trunk	Far end	Open	Open
	DMS	Grd	-48 V
Incoming seizure	Far end	Loop closure	
	DMS	Grd	-48 V
Start dial	Far end	Loop closure	
—continued—			

<b>Table 5-5</b>			
<b>Signal states: NT2X2AA, NT2X95AA incoming (continued)</b>			
<b>State</b>	<b>System</b>	<b>T</b>	<b>R</b>
Reorder	DMS	-48 to Grd	Grd to -48
	Far end	Loop closure	
Impulsing MF	DMS	-48 V	Grd
	Far end	MF signal loop closure	
Impulsing DP	DMS	Grd	-48 V
	Far end	Open/close loop	
ANI request (INC CAMA)	DMS	Grd	-48 V
	Far end	Loop closure	
Disconnect far end	DMS	-48 V	Grd
	Far end	Open	Open
Disconnect DMS	DMS	-48 V	Grd
	Far end	Loop closure	
Idle trunk	DMS	Grd	-48 V
	Far end	Open	Open
Remote make busy	DMS	Grd	-48 V
	Far end	Open	Open
	DMS	-48 V	Grd
<b>Note:</b> 120 IPM L.T.			
<b>End</b>			

**Figure 5-2**  
**Incoming loop reverse battery trunk circuit card (NT2X82AA)**



**Working limits**

- Supervision – Maximum external circuit resistance: 4500  $\Omega$   
The trunk circuit will recognize as on-hook, bridge resistances:

<b>Loop option</b>	<b>Bridge resistance</b>
Short	6490 $\Omega$ minute
Long	18.7 k $\Omega$ minute

*Note:* The bridge resistance includes the outgoing circuit bridge with a 30K ohm leakage between trunk conductors.

- DP Pulsing external circuit resistance

<b>Loop option</b>	<b>Bridge resistance</b>
Short	0 to 2000 $\Omega$
Long	2000 to 4500 $\Omega$

In both short and long loop options, the incoming trunk circuit supplies battery and ground through matched resistances of less than 453  $\Omega$ . Only the loop detector sensitivity is changed for the short/long loop options. The battery limits (–42.75 V to –55.8 V) are the same for both dial pulsing and supervision specifications.

- Transmission

Receive level range	+6 dBm to –9 dBm for DTS output
Transmit level range	–9 dBm to +6 dBm for DTS input

The levels refer to those at the T&R leads. The amount of usable gain depends on the return loss that can be achieved on a particular transmission facility.

**Trunk features** Three features are provided by the incoming trunk NT2X82AA:

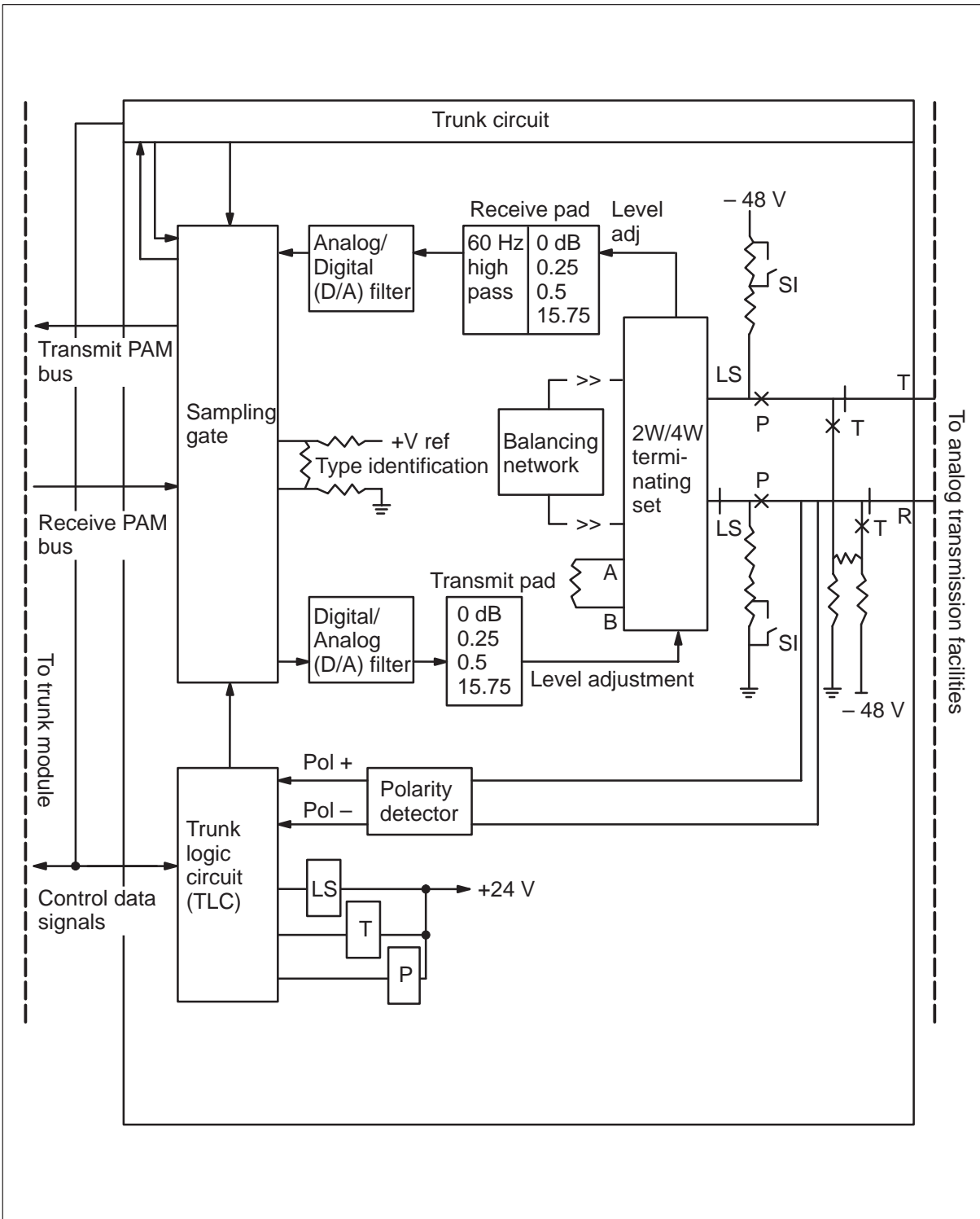
- Reverse make busy – Under a command initiated at the MAP, the incoming trunk circuit will return an off-hook towards the far end outgoing trunk. The off hook is applied while the trunk is idle.
- Detector sensitivity – The loop detector sensitivity is switch-selectable for short or long loop operation. The trunk working limits specify the associated limits for dial pulsing.
- Pulsing – The incoming trunk will accept DP or MF pulsing. Dial pulsing may be loop or battery and ground.



**Two-wire outgoing, loop, reverse battery, DP or MF, trunk circuit, NT2X83AA**

- Signaling and supervision – On trunk seizure, an off-hook (loop closure) is provided toward the far end. When B/G pulsing is used, the off-hook is replaced by the resistance battery and ground on tip and ring respectively (see Figure 5-3). Far end signaling, consisting of battery and ground reversals, is detected by the loop polarity detector.

**Figure 5-3**  
**Block diagram outgoing reverse battery trunk circuit card (NT2X83AA)**



The outgoing trunk circuit has certain outgoing states:

State	Tip and ring condition
On-hook	Open (greater than 100 k $\Omega$ )
Off-hook supervision	Bridged by less than 500 ohms (446 $\Omega$ nominal)

Pulsing Options:

Receiving or Repeating Circuit Requirement	Maximum External Circuit Loop Resistance	Battery and Ground (B/G) Feed Resistance	Position of Switches S1 and S2
--	--	--	--------------------------------

*SXS systems*

Loop pulsing	0 – 1200	653/653	off
BG pulsing	1200 – 2000	200/200	on

*Common control systems*

Loop pulsing	0 – 2000	653/653	off
BG pulsing	2000 – 4500	200/200	on

A network consisting of 620  $\Omega$  in series with 2200 pF is provided across the pulsing contacts. The undefined state during B/G pulsing is less than 1 ms. During transfer from B/G to loop or loop to B/G, the transition state is 7 ms or less.

When the outgoing trunk is used for MF applications, the transition period, or undefined state, is less than 1 ms. The outgoing trunk does not provide an idle circuit termination across the tip and ring leads when idle. Signal states are shown in Table 5-6.

### Working limits

- supervision – maximum external circuit resistance: 4500  $\Omega$
- transmission
  - receive level range +6 dBm to –9 dBm for DTS output
  - transmit level range –9 dBm to +6 dBm for DTS input

<b>Table 5-6 Signal states NT2X83AA, NT2X92AA, NT2X95AA incoming</b>			
<b>State</b>	<b>System</b>	<b>T</b>	<b>R</b>
Idle trunk	Far end	-48 V	Grd
	DMS	Open	Open
Outgoing seizure	Far end	Grd	-48 V
	DMS	Loop closure	
Start dial	Far end	-48 to Grd	Grd to -48
	DMS	Loop closure	
Outpulsing MF	Far end	Grd	-48 V
	DMS	MF signal loop closure	
Outpulsing MF battery/grd	Far end	Grd	-48 V
	DMS	Open/close -48	Open/close grd
Far end answer	Far end	-48 V	Grd
	DMS	Loop closure	
Disconnect DMS	Far end	-48 V	Grd
	DMS	Open	Open
Disconnect far end	Far end	Grd	-48 V
	DMS	Loop closure	
Idle trunk	Far end	Grd	-48 V
	DMS	Open	Open
Remote make busy	Far end	-48 V	Grd
	DMS	Open	Open

The levels refer to those at the T and R leads. The amount of usable gain depends on the return loss that can be achieved on a particular transmission facility.

**Trunk features** Three features are provided by the outgoing trunk circuit NT2X83AA:

- Pulsing – This trunk features B/G or MF pulsing.
- Reverse make busy – This trunk will be made busy if, in the idle state, an off-hook is received from the far end incoming trunk. The trunk is automatically restored to service when on-hook supervision is applied at the far end.

- Pulsing options – Switches located on the trunk card allow for manual selection of the B/G pulsing option, short or long loop as required.

**Two-wire outgoing, loop, reverse battery, MF trunk circuit, NT2X92AA**

- Signaling and supervision – On trunk seizure, an off-hook (loop closure) is provided toward the far end incoming trunk. Far end signaling, consisting of battery and ground reversals, is detected by the loop polarity detector.

On trunk seizure, an off-hook (loop closure) is provided toward the far end incoming trunk. Far end signaling, consisting of battery and ground reversals, is detected by the loop polarity detector.

At the outgoing trunk circuit, the outgoing states are as follows:

<b>State</b>	<b>Tip and ring condition</b>
on hook	open (greater than 100 kΩ)
off-hook (supervision)	bridged by less than 500 Ω (446 nominal)

Outgoing trunks NT2X83AA and NT2X92AA differ in pulsing options: NT2X92AA supports MF pulsing only, while NT2X83AA supports B/G and MF pulsing. During the transition from on-hook to off hook or off hook to on hook, the undefined state is less than 7 ms. The outgoing trunk does not provide an idle circuit termination across the tip and ring leads when idle. Signal states are given in Table 5-7, with the exception that B/G pulsing is not applicable.

**Working limits** The levels refer to those at the T and R leads. The amount of usable gain depends on the return loss that can be achieved on a particular transmission facility.

- supervision – maximum external circuit resistance: 4500 Ω
- transmission –
 

receive level range	+6 dBm to -9 dBm for DTS output
transmit level range	-9 dBm to +6 dBm for DTS input

**Trunk features** Two features are provided by the outgoing trunk circuit NT2X92AA:

- pulsing – The trunk circuit features MF pulsing only.
- reverse make busy – The trunk is automatically restored to service when on-hook supervision is applied at the far end.

**Two-wire incoming, loop, reverse battery, DP or MF, trunk circuit, sleeve lead control, NT2X98AA**

- Signaling and supervision – Far end open and closure (on-hook, off-hook) signals are detected by the trunk loop detector. During pulsing (B/G), the far end provides aiding resistance battery and ground, with respect to the incoming trunk, in place of the off-hook signal.

Near end signaling by the incoming trunk consists of battery and ground reversals:

State	Tip lead	Ring lead
on-hook	ground	–48 V
off-hook	–48 V	ground

The incoming trunk supplies battery and ground through matched resistances of 446  $\Omega$  (nominal). When the electrical state is undefined, during tip and ring reversal, the transition period is 7 ms or less. Signal states are shown in Table 5-7.

<b>Table 5-7 Signal states NT2X98AA</b>					
State	System	T	R	N	G
Idle trunk	Far end	Open	Open	–48 V	Grd
	DMS	Grd	–48 V	Open	Open
Incoming seizure	Far end	Loop closure		–48 V	Gnd
	DMS	Grd	–48 V	Sleeve closure	
Start dial	Far end	Loop closure		–48 V	Gnd
	DMS	–48 to Grd	Grd to –48	Sleeve closure	
Reorder	Far end	Loop closure		–48 V	Grd
	DMS	–48 V	Grd	Sleeve closure	
Impulsing MF	Far end	MF signal loop closure		–48 V	Grd
	DMS	Grd	–48 V	Sleeve closure	
Impulsing DP	Far end	Open/close loop		–48 V	Gnd
	DMS	Grd	–48 V	Sleeve closure	
ANI request (INC CAMA)	Far end	Loop closure		–48 V	Gnd
	DMS	–48 V	Grd	Sleeve closure	
—continued—					

<b>Table 5-7</b> <b>Signal states NT2X98AA</b> (continued)					
<b>State</b>	<b>System</b>	<b>T</b>	<b>R</b>	<b>N</b>	<b>G</b>
Disconnect far end	Far end	Open	Open	-48 V	Gnd
	DMS	-48 V	Grd	Sleeve closure	
Disconnect DMS	Far end	Loop closure		-48 V	Gnd
	DMS	Grd	-48 V	Open	Open
Idle trunk	Far end	Open	Open	-48 V	Gnd
	DMS	Grd	-48 V	Open	Open
Remote make busy	Far end	Open	Open	-48 V	Grd
	DMS	-48 V	Grd	Sleeve closure	
<b>Note 1</b> 120 IPM L.T.					
<b>Note 2</b> N&G leads form the S-lead control					
<b>Note 3</b> Conditions for S-lead assume connection from DMS-100 S D 32524					
End					

**Working limits** The levels refer to those at the T and R leads. The amount of usable gain depends on the return loss that can be achieved on a particular transmission facility.

- Supervision – maximum external circuit resistance loop: 1500 Ω  
sleeve: 200 Ω

The trunk circuit will recognize as on-hook, bridge resistance greater than 3840 Ω.

**Note:** The bridge resistance includes the outgoing circuit bridge with a 30-kΩ leakage trunk conductors.

—DP pulsing 1500 Ω – The incoming trunk circuit supplies battery and ground through matched resistances of less than 453 Ω. The battery limits (-42.75 to -55.8 Vdc) are the same for both dial pulsing and supervision specifications.

—Ground potential difference – sleeve lead +2 Vdc

—Transmission

receive level range                      0 dBm for DTS output

transmit level range                      -1 dBm for DTS input

—Connecting circuits required

Step by step (SXS) selector	SD30200
Auxiliary outgoing (AUX O/G) trunk (TRK)	SD32524

**Trunk features** Three features are also provided by the incoming trunk NT2X98AA:

- Reverse make busy – Under a command initiated at the MAP the incoming trunk circuit will return an off-hook towards the far end out-going trunk. The off-hook is applied while the trunk is idle.
- Forced calling – party disconnect with sleeve lead control.
- Pulsing – The incoming trunk will accept DP or MF pulsing. Dial pulsing may be loop or Battery and Ground (B/G).

**Two-way DID/DOD loop trunk, reverse battery, DP, DTMF  
NT2X95AA – DMS-100  
Signaling and supervision**

- Outgoing – On trunk seizure, an off-hook (loop closure) is provided toward the far end. When B/G pulsing is used, the off-hook is replaced by the resistance battery and ground on tip and ring respectively. Far end signaling, consisting of battery and ground reversals, is detected by the loop polarity detector.

At the outgoing trunk circuit, there are two outgoing states:

<b>State</b>	<b>Tip and ring condition</b>
On-Hook	Open (greater than 100 k $\Omega$ )
On-Hook	Open (greater than 100 k $\Omega$ )
On-Hook	Open (greater than 100 k $\Omega$ )
Off-Hook (supervision)	Bridged by less than 500 $\Omega$ (446 $\Omega$ nominal)

For B/G pulsing, the outgoing trunk provides battery and ground through matched resistances:

<b>State</b>	<b>Tip/ring resistors</b>
Off-hook (B/G pulsing short loop)	653/653 $\Omega$
Off-hook (B/G pulsing long loop)	200/200 $\Omega$



A network consisting of 620 Ω in series with 2200 pF is provided across the pulsing contacts. The undefined state during B/G pulsing is less than 1 ms. During transfer from B/G to loop or loop to B/G, the transition state is 7 ms or less.

When the outgoing trunk is used for MF applications, the transition period, or undefined state, is less than 1 ms. The outgoing trunk does not provide an idle circuit termination across the tip and ring leads when idle.

Signaling states are found in Table 5-7, except remote make busy, which is not allowed.

- Incoming – Far end open and closure (on-hook,off-hook) signals are detected by the trunk loop detector. During pulsing (B/G), the far end provides aiding resistance battery and ground, with respect to the incoming trunk, in place of the off-hook signal.

Near end signaling by the incoming trunk consists of battery and ground reversals as follows:

State	Tip lead	Ring lead
On-Hook	Ground	-48 V
Off-Hook	-48 V	Ground

The incoming trunk circuit supplies ground through matched resistances of 446 Ω nominal. During tip and ring reversal, the transaction period during which the electrical state is undefined, is 7 ms or less.

Signaling states are shown in Table 5-5 except remote make busy.

**Working limits**

- Supervision (INC/OG) – Maximum external circuit resistance 4500 Ω
- Incoming mode only – The trunk circuit will recognize as on-hook, bridge resistance as follows:

Loop option	Bridge resistance
Short	6490 Ω min
Long	18.7 kΩ min

*Note:* The bridge resistance includes the outgoing circuit bridge with a 30-kΩ leakage between trunk conductors.

- DP Pulsing External circuit resistance

Short loop option	0 to 2000 $\Omega$
Long loop option	2000 to 4500 $\Omega$

In both short and long loop options, the incoming trunk circuit supplies battery and ground through matched resistances of less than 453  $\Omega$ . Only the loop detector sensitivity is changed for the short/long loop options. The battery limits (–42.75 to –55.8 V) are the same for both dial pulsing and supervision specifications.

- Transmission  
Receive level range            +6 dBm to –9 dBm for DTS output  
Transmit level range            –9 dBm to +6 dBm for DTS input

The levels refer to those at the T and R leads. The amount of usable gain depends on the return loss that can be achieved on a particular transmission facility.

**Trunk functions** The following features are provided by the two-way DID/DOD trunk.

- Pulsing – This trunk supports B/G or DTMF pulsing in both incoming and outgoing modes.
- Pulsing option – In incoming mode, switches located on the trunk card allow for manual selection of B/G pulsing option, short or long loop as required.
- Transmission pads – The trunk features both manual and automatic selection of transmission pads. Each Printed Circuit Board (PCB) accommodates one trunk circuit.

#### **Trunks with E&M lead supervision**

DMS-100 Family trunk circuits use Type DI and Type II E&M lead signaling interface arrangements. The E&M lead interfaces are separate from the transmission path, although they may be associated with the same carrier channel that carries the transmission path.

**Working limits** The E&M trunk circuits have common working limits. Working limits associated with E&M lead interfaces are provided in the appropriate trunk working limits.

- Battery voltage  

Nominal	Voltage range
–48V	–42.75 V to –55.8 V
- Insulation resistance            30 000  $\Omega$  minimum

- Earth potential difference  $\pm 10$  V

**Trunk features** Features that are common to DMS-100 Family E&M trunk circuits are given below. Features that are applicable to a particular trunk will be provided in the appropriate section that describes the particular trunk circuit.

Trunk circuits receive or send DP or MF.

- Pulsing – Trunk circuits receive or send DP or MF.
- Test circuit – A test circuit designed to check the signaling, supervisory and VF circuits is provided. Operation of the test relay isolates the trunk circuit from the transmission and signaling facilities, allowing the trunk circuit to be tested internally.
- Reverse make busy – This outgoing trunk will be made busy if, in the idle state, an off-hook is received from the terminating end. The trunk will be restored to service when an on-hook is received.

This outgoing trunk will be made busy if, in the idle state, an off-hook is received from the terminating end. The trunk will be restored to service when an on-hook is received.

Two trunk circuits are accommodated per circuit pack. The printed circuit pack is connectorized and plugs into an eight-wire Trunk Module (TM8).

### Type DI interface

Type DI is a modified E&M lead Type I interface. The battery supply to the M lead for the off-hook state is applied through a 510  $\Omega$  current limit resistor instead of the traditional 13 A resistance lamp. The allowed M lead current during the off-hook state is 60 mA continuous maximum. During the on-hook state a local ground is provided on the M lead. A diode, 800 V 1 A, connected from the M lead to local ground provides surge or transient suppression.

The E lead detector will detect an open for the on-hook state and a ground for the off hook state. The E-lead sensor is non-inductive. The maximum resistance on the E lead for supervision is 1000 ohms.

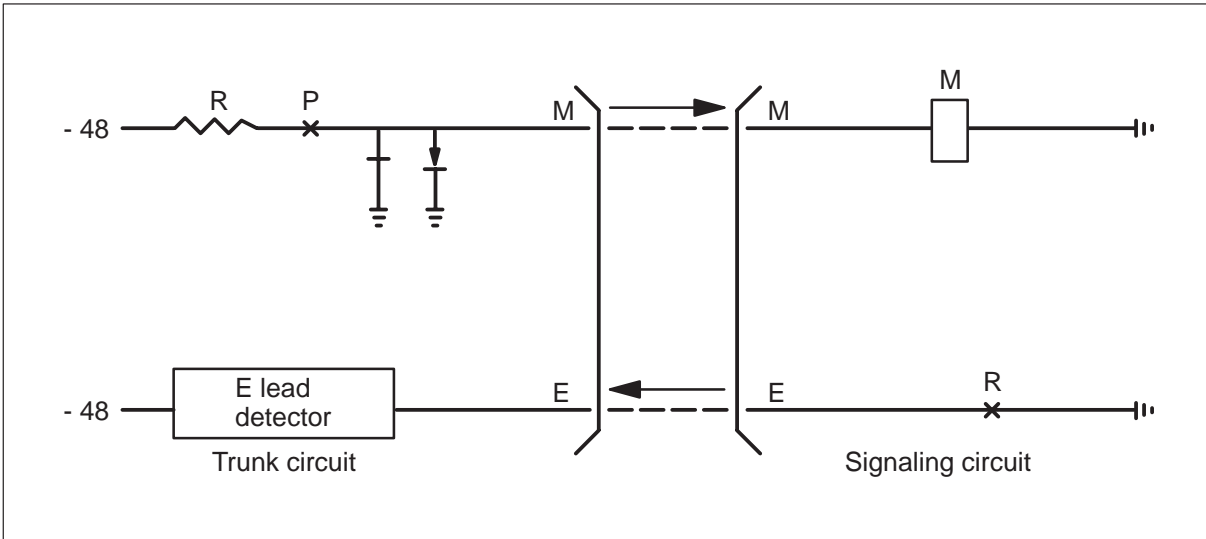
The -48V source used in the E-lead detector circuitry is current limited by a resistor to less than 12 mA. During on hook, -48 V appears on the E lead. A 20 k $\Omega$  ground on the E lead will be detected as an on-hook state.

- Supervision
  - E lead 1000  $\Omega$  maximum external resistance
  - M lead 350  $\Omega$  minimum external resistance
- Pulsing

M lead 200  $\Omega$  minimum external resistance

Type DI interface is illustrated in Figure 5-4.

**Figure 5-4**  
Type D interface



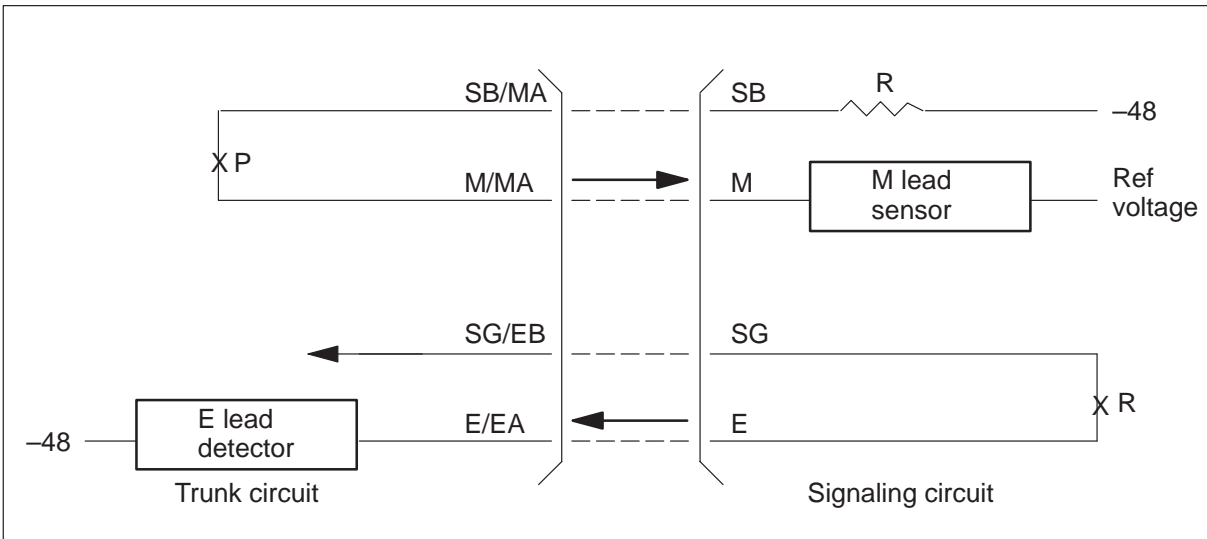
### Type II interface

Signaling from the trunk circuit to the signaling facility consists of opens and closures across the M and SB leads. A dc closure across the leads is provided for off-hook and an open for on-hook. The signaling facility should supply the nominal  $-48$  V to the SB lead through a current-limiting device. In the off-hook state, the potential drop from the M lead to the SB lead will not exceed 2 V. The relay contact in the M and SB path can handle a maximum of 2 A of switching current. In the on-hook state, the M-lead current will not exceed 0.1 mA when the M lead is grounded and  $-48$  V applied to the SB lead. Surge suppression-devices are not used across the M and SB leads.

The trunk circuit receives, from the signaling facility, opens and closures across the E and SG leads for on-hook and off-hook respectively. The E lead detector is non-inductive.

A  $-48$  V source (nominal) is used in the E lead detector circuitry and the E-lead current is limited by a resistor to less than 12 mA. During on-hook, the E lead voltage is  $-48$  V. The E-lead detector allows the E and SG leads to be up to 250  $\Omega$  each. A 20-k $\Omega$  ground on the E lead will be detected as an on-hook state. Type II interface is illustrated in Figure 5-5.

**Figure 5-5**  
Type II interface



**Four-wire incoming, outgoing or two-way, type DI, DP or MF, E&M trunk circuit, NT2X72AA/AC**

- Signaling and supervision – This trunk uses the Type DI E&M lead interface signaling arrangement. Signaling from the trunk circuit to the trunk facility is over the M lead using a nominal –48 V for off-hook and ground for on-hook.

Signaling from the facility is over the E lead using an open for on-hook and a ground for off-hook. The transition from on-hook to off-hook or off-hook to on-hook is less than 1 ms. Signal states are given in Table 5-8.

<b>Table 5-8</b> Signal states NT2X27AA/AC, NT2X81AA/AB type DI interface			
State	System	E	M
<b>Outgoing call</b>			
Idle trunk	Far (transmit)	–48 V	Grd
	End (receive)	Open	Grd
	DMS (transmit)	–48 V	Grd
	(receive)	Open	Grd
Outgoing seizure	Far (transmit)	–48 V	Grd
—continued—			

<b>Table 5-8</b>			
<b>Signal states NT2X27AA/AC, NT2X81AA/AB type DI interface (continued)</b>			
<b>State</b>	<b>System</b>	<b>E</b>	<b>M</b>
Start dial	End (receive)	Open	Grd
	DMS (transmit)	-48 V	-48 V
	(receive)	Open	Grd
	Far (transmit)	-48 V	(A) -48 V
	End		(B) Grd
	(Receive)	Grd	Grd
	DMS (transmit)	-48 V	-48 V
Outpulsing MF	(receive)	(A) Grd	Grd
		(B) Open	
	Far (transmit)	-48 V	Grd
	End (receive)	Grd	Grd
DP outpulsing	DMS (transmit)	-48 V	-48 V
	(receive)	Open	Grd
	Far (transmit)	-48 V	Grd
	End (receive)	Open/Grd	Grd
Called end answer	DMS (transmit)	-48 V	-48 V/Grd
	(receive)	Open	Grd
	Far (transmit)	-48 V	-48 V
	End (receive)	Grd	Grd
Disconnect DMS	DMS (transmit)	-48 V	-48 V
	(receive)	Grd	Grd
	Far (transmit)	-48 V	-48 V
	End (receive)	Open	Grd
Disconnect far end	DMS (transmit)	-48 V	Grd
	(receive)	Grd	Grd
	Far (transmit)	-48 V	-48 V
	End (receive)	Grd	Grd
	DMS (transmit)	-48 V	Grd

—continued—

<b>Table 5-8</b> <b>Signal states NT2X27AA/AC, NT2X81AA/AB type DI interface</b> (continued)			
State	System	E	M
Idle trunk	(receive)	Grd	Grd
	Far (transmit)	-48 V	Grd
	End (receive)	Open	Grd
	DMS (transmit)	-48 V	Grd
	(receive)	Open	Grd
<b>Incoming call</b>			
Incoming seizure	Far (transmit)	-48 V	-48 V
	End (receive)	Open	Grd
	DMS (transmit)	-48 V	Grd
	(receive)	Grd	Grd
Start dial	Far (transmit)	-48 V	-48 V
	End (receive)	(A) Grd (B) Open	Grd
	DMS (transmit)	-48 V	(A) -48 V (B) Grd
	(receive)	Grd	Grd
	Far (transmit)	-48 V	-48 V
Impulsing MF	End (receive)	Open	Grd
	DMS (transmit)	-48 V	Grd
	(receive)	Grd	Grd
Impulsing DP	Far (transmit)	-48 V	-48 V/Grd
	End (receive)	Open	Grd
	DMS (transmit)	-48 V	Grd
	(receive)	Grd/Open	Grd
	Far (transmit)	-48 V	-48 V
ANI request (I/C CAMA)	End (receive)	Grd	Grd
	DMS (transmit)	-48 V	-48 V

—continued—





-3 dBm to -18 dBm for DTS input  
(NT2X72AC)

The levels refer to those at the T and R leads. The amount of usable gain depends upon the return loss that can be achieved in a particular transmission facility.

**Trunk features** Four features are also provided by NT2X72AA/AC.

- Impedance – trunk impedance is 600  $\Omega$ .
- Level adjustments – Level adjustments are provided in both receive and transmit directions in 0.25 dB steps over a range of 0 to 15.75 dB. Fixed pads are switched in or out, by miniature switches, to obtain the required loss or gain.
- Carrier interface – The NT2X72AC trunk circuit transmission levels allow interfacing with carrier equipment.
- E&M lead interface – Trunk circuits feature Type DI interface.

**Two-wire incoming, outgoing or two-way, type DI, DP or MF, E&M trunk circuit, NT2X81AA/AB**

- Signaling and supervision – The E&M lead interface signaling arrangements, as well as signaling, are identical to NT2X72AA/AC . Signal states are given in Table 5-8 and Figure 5-6.

**Working limits**

- Supervision
  - E lead      1000  $\Omega$  max. external resistance
  - M lead      350  $\Omega$  max. external resistance (or 60mA max. current)
- DP pulsing
  - M lead      2000  $\Omega$  min. external resistance (or 25mA max. current)
- Transmission – The levels refer to those at the T and R leads. The amount of usable gain depends upon the return loss that can be achieved on a particular transmission facility.
- **NT2X81AA**

Nominal transmit level	0 dBm for DTS input
Nominal receive level	0 dBm for DTS output
- **NT2X81AB**

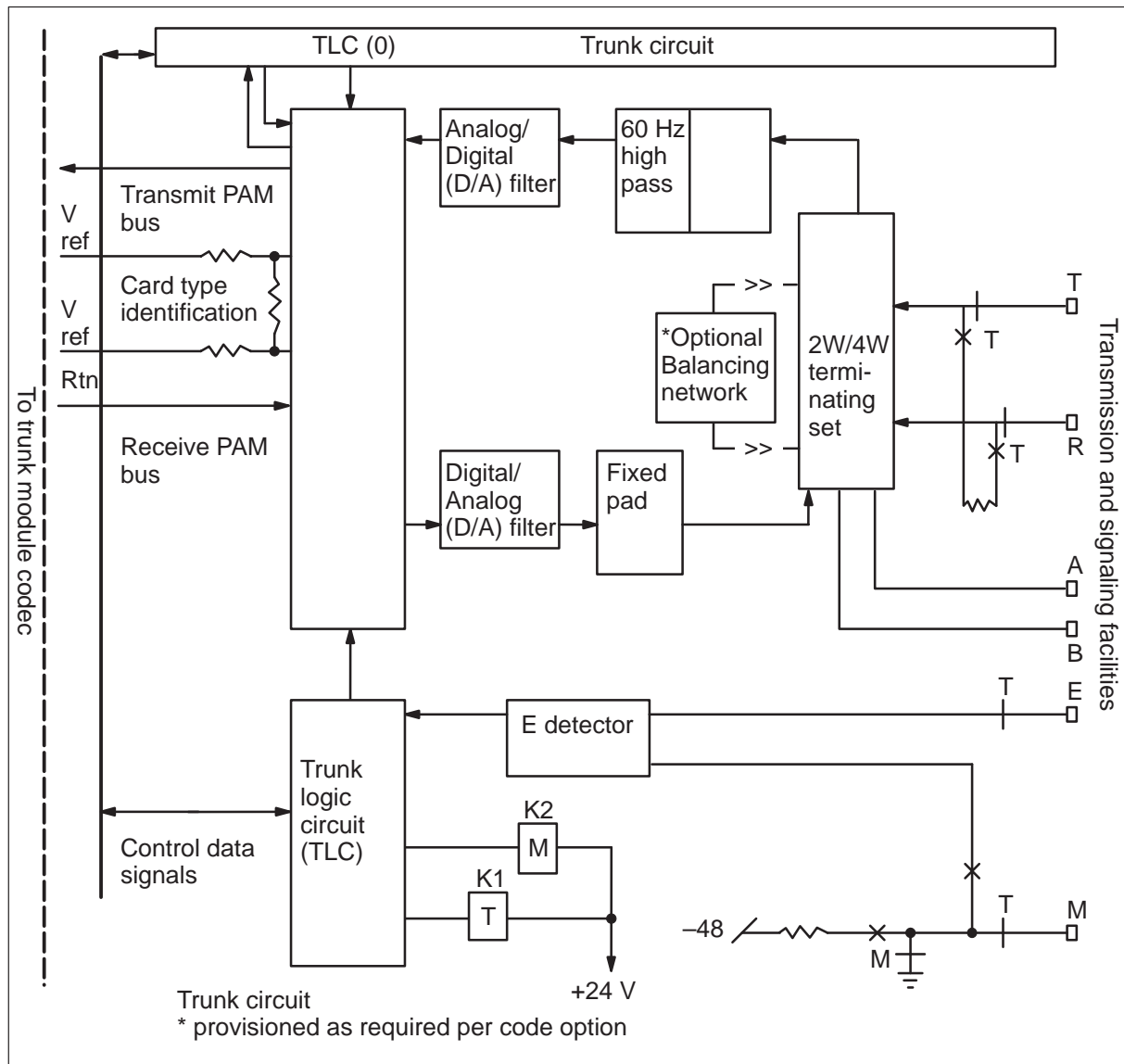
Nominal transmit level	-3 dBm for DTS input
Nominal receive level	-3 dBm for DTS output

**Trunk features** NT2X81AA/AB also provides five trunk features:

- Terminating set – The trunk circuit incorporates a two-wire to four-wire terminating set, which provides an interface between the two-wire facility and the four-wire trunk circuits.
- Impedance – Trunk impedance is as follows:

<b>NT2X81AA</b>	900 ohm + 2.15 uF
<b>NT2X81AB</b>	00 ohm + 2.15 uF
- Transmission – Fixed transmission levels are provided in both receive and transmit directions for NT2X81AA and NT2X81AB.
- Balance networks – Optional plug-in balance networks are available for balancing the two-wire to four-wire terminating set. Table 5-2 specifies the balance networks available.
- E&M lead interface – Type DI interface is provided.

**Figure 5-6**  
**2-wire E and M type DI trunk circuit card (NT2X81AA)**

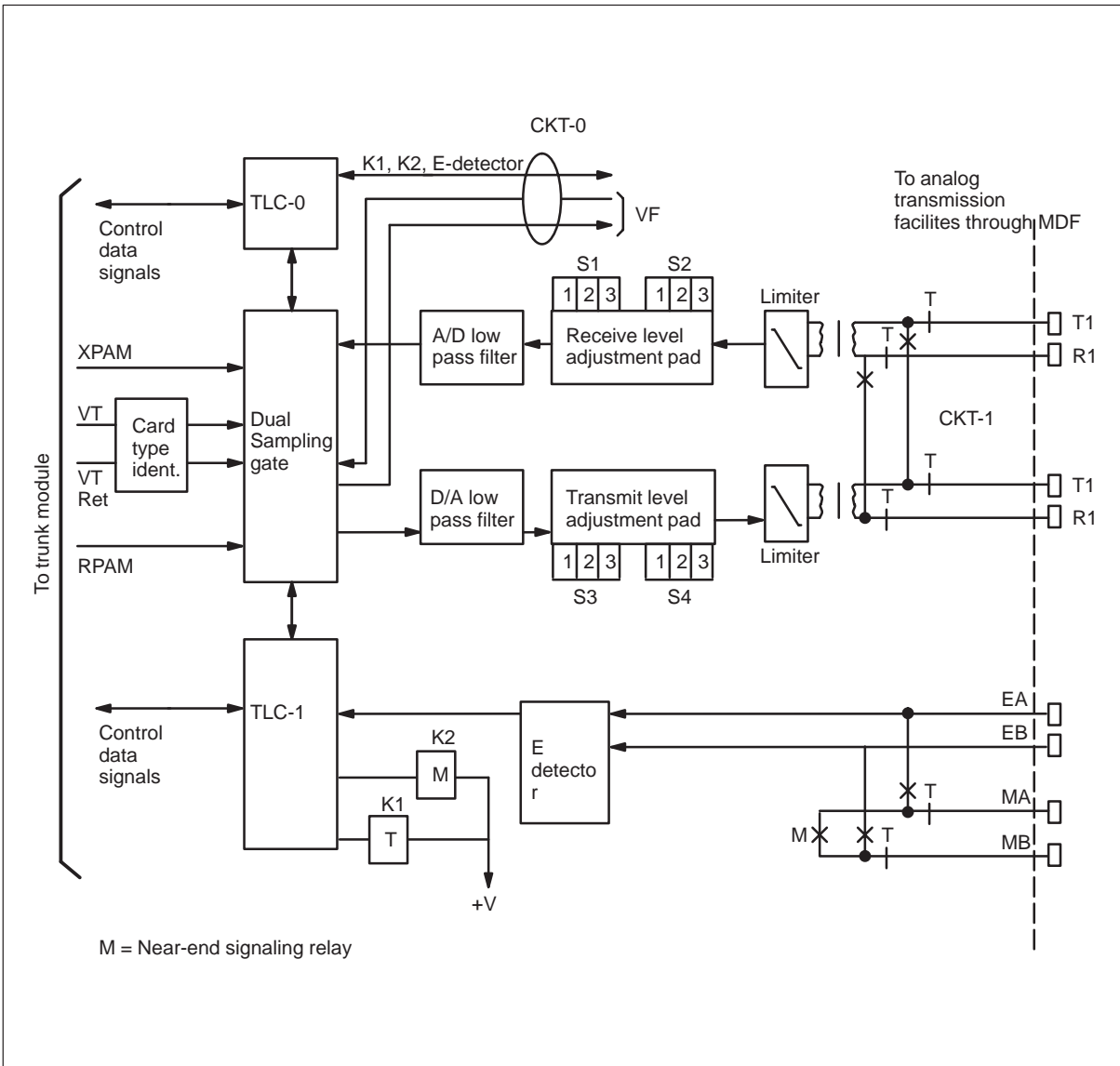


**Four-wire, incoming, outgoing or two-way, type II, DP or MF, E&M trunk circuit, NT2X88AA**

- Signaling and supervision – This trunk circuit uses Type II E&M lead interfaces (see Figure 5-7). On-hook and off-hook signals are transmitted to the signaling facilities as opens and closures across the M and SB leads.

On-hook and off-hook signals are received from the signaling facilities as opens and closures across the E and SG leads. Signal states are given in Table 5-9.

**Figure 5-7**  
**4-wire, 2-way E and M trunk circuit (type II) (NT2X88AA)**



### Working limits

- Supervision
  - E lead – 500  $\Omega$ , maximum external conductor resistance or total E and SG lead resistance.
  - M lead – Limitation on the M lead will be found in the connecting circuit.
- Pulsing Range
  - MF – Limited by the voice band transmission characteristics.

—DP – Limited by supervision range.

- Transmission
  - Receive Level Range –12 dBm to +3 dBm for DTS output
  - Transmit Level Range –6 dBm to +9 dBm for DTS input

The levels refer to those at the T and R leads. The amount of usable gain depends on the return loss that can be achieved on a particular transmission facility.

**Trunk features** NT2X88AA also provides the following trunk features:

- Impedance – Trunk impedance is 600 Ω and 2.15 μF
- Level Adjustments – Level adjustments are provided in both receive and transmit directions in 0.25 dB steps over a range of 0 to 15.75 dB. Fixed pads are switched in or out, by miniature switches, to obtain the required loss or gain.
- E&M Interface – NT2X88AA features Type II E&M lead interface.

NT2X88AA and NT2X72AA/AC differ in the type of E&M lead interface provided. NT2X72AA features Type DI interface while NT2X88AA features type II interface. Trunk circuit NT2X72AC also provides transmission levels for direct carrier applications.

<b>Table 5-9 Signal states NT2X88AA type II interface</b>					
<b>State</b>	<b>System</b>	<b>E/EA</b>	<b>SG/EB</b>	<b>M/MA</b>	<b>SB/MB</b>
<b>Outgoing call</b>					
Idle trunk	Far (transmit)	–48 V		Grd	
	End (receive)	Open		Grd	
	DMS (transmit)	–48 V	Grd	Open	Open
	(Receive)	Open	Open	Grd	–48 V
Outgoing seizure	Far (transmit)	–48 V		Grd	
	End (receive)	Grd		Grd	
	DMS (transmit)	–48 V	Grd	Closure	
	(Receive)	Open	Open	Grd	–48 V
Start dial	Far (transmit)	–48 V		(A) – 48 V	
	End			(B) Grd	
	(Receive)	Grd		Grd	
—continued—					

<b>Table 5-9</b>					
<b>Signal states NT2X88AA type II interface</b> (continued)					
<b>State</b>	<b>System</b>	<b>E/EA</b>	<b>SG/EB</b>	<b>M/MA</b>	<b>SB/MB</b>
Outpulsing MF*	DMS (transmit)	-48 V	Grd	Closure	
	(Receive)	(A) Closure		Grd	-48 V
		(B) Open	Open		
	Far (transmit)	-48 V		Grd	
DP outpulsing	End				
	(Receive)	Grd		Grd	
	DMS (transmit)	-48 V	Grd	Closure	
	(Receive)	Open	Open	Grd	-48 V
Called end answers	Far (transmit)	-48 V		Grd	
	End (receive)	Open/Grd		Grd	
	DMS (transmit)	-48 V	Grd	Closure/Open	
	(Receive)	Open	Open	Grd	-48 V
Disconnect DMS	Far (transmit)	-48 V		- 48 V	
	End (receive)	Grd		Grd	
	DMS (transmit)	-48 V	Grd	Closure	
	(Receive)			Grd	-48 V
Disconnect far end	Far (transmit)	-48 V		- 48 V	
	End (receive)	Grd		Grd	
	DMS (transmit)	-48 V	Grd	Open	Open
	(Receive)	Closure		Grd	-48 V
Idle trunk	Far (transmit)	-48 V		Grd	
	End (receive)	Grd		Grd	
	DMS (transmit)	-48 V	Grd	Closure	
	(Receive)	Open	Open	Grd	-48 V
	Far (transmit)	-48 V		Grd	
	End (receive)	Open		Grd	
	DMS (transmit)	-48 V	Grd	Open	Open
	(Receive)	Open	Open	Grd	-48 V

—continued—

<b>Table 5-9</b>					
<b>Signal states NT2X88AA type II interface</b> (continued)					
<b>State</b>	<b>System</b>	<b>E/EA</b>	<b>SG/EB</b>	<b>M/MA</b>	<b>SB/MB</b>
<b>Incoming call</b>					
Incoming seizure	Far (transmit)	-48 V		-48 V	
	End (receive)	Open		Grd	
	DMS (transmit)	-48 V	Grd	Open	Open
	(Receive)	Closure		Grd	-48 V
Start dial	Far (transmit)	-48 V		-48 V	
	End (receive)	(A) Grd (B) Open		Grd	
	DMS (transmit)	-48 V	Grd	(A) Closure (B) Open	Open
	(Receive)	Closure		Grd	-48 V
Impulsing MF*	Far (transmit)	-48 V		-48 V	
	End				
	(Receive)	Open		Grd	
	DMS (transmit)	-48 V	Grd	Open	Open
Impulsing DP	(Receive)	Closure		Grd	-48 V
	Far (transmit)	-48 V		-48 V/Grd	
	End (receive)	Open		Grd	
	DMS (transmit)	-48 V	Grd	Open	Open
ANI request (I/C CAMA)	(Receive)	Closure/Open		Grd	-48 V
	Far (transmit)	-48 V		-48 V	
	End (receive)	Grd		Grd	
	DMS (transmit)	-48 V	Grd	Closure	
Disconnect DMS	(Receive)	Closure		Grd	-48 V
	Far (transmit)	-48 V		-48 V	
	End (receive)	Open		Grd	
	DMS (transmit)	-48 V	Grd	Open	Open
	(Receive)	Closure		Grd	-48 V
—continued—					

<b>Table 5-9</b> <b>Signal states NT2X88AA type II interface</b> (continued)					
<b>State</b>	<b>System</b>	<b>E/EA</b>	<b>SG/EB</b>	<b>M/MA</b>	<b>SB/MB</b>
Disconnect far end	Far (transmit)	-48 V		Grd	
	End (receive)	Grd		Grd	
	DMS (transmit)	-48 V	Grd	Closure	
	(Receive)	Open	Open	Grd	-48 V
Idle trunk	Far (transmit)	-48 V		Grd	
	End (receive)	Open		Grd	
	DMS (transmit)	-48 V	Grd	Open	Open
	(Receive)	Open	Open	Grd	-48 V
<b>Note:</b> * MF signals are received on T & R leads.					
End					

### Trunks to centralized automatic message accounting (CAMA) position

The CAMA position signaling circuit and associated outgoing CAMA trunk or CAMA position circuit provide two VF channels as well as the signaling and supervision necessary for operator-identified CAMA service for the DMS-100 Family.

The CAMA suspension and calls waiting circuits provides signals which indicate levels of calls waiting and detects far end Abandoned Switchboard (AS). When the AS function is activated, calls normally requiring operator identification are completed without charge.

**Working limits** The following working limits are common to the CAMA position signaling circuit and CAMA suspension and calls waiting circuits:

- battery voltage

Nominal	Voltage Range
-48 V	-42.75 V to -55.8 V
- insulation resistance 30 000  $\Omega$
- earth potential difference  $\pm 10$  V

### Trunk features

Trunk features are described in the following paragraphs.



**CAMA position signaling circuit, NT2X65AA** Each CAMA position signaling circuit incorporates a talk and key circuit. The talk circuit incorporates a VF channel as well as signaling and supervision leads. The key circuit provides the interface for the VF channel which receives MF signals from CAMA positions (see Figure 5-8).

- Signaling and Supervision

Battery and ground is supplied through matched resistances of 446  $\Omega$  nominal (453 maximum), to the tip (TL) and ring (RL) leads respectively. Far end CAMA position available for service is detected by the resistance battery detector which detects -48V resistance battery on the P lead.

On seizure, leads OI and S, Operator Number Identification (ONI) or leads IF and S, Automatic Number Identification (ANI Fail) are grounded. Far end position seizure is detected as a low-resistance (1000 ohms or less) tip and ring bridge. Far end disconnect is a high resistance tip (TL) and ring (RL) bridge of 30 k $\Omega$  minimum.

Near end reorder signal is transmitted to the associated CAMA trunk as a tip and ring reversal. On disconnect the CAMA position signaling circuit removes ground from leads OI and S or leads IF and S.

The CAMA position signaling circuit interfaces with the connecting circuits (see d) on the local side. The connecting circuit in turn interfaces with switchboards or far end trunk facilities. The signal states for the connecting circuit, the outgoing CAMA trunk, are given in Table 5-10.

**Working limits**

- Supervision

Maximum external circuit resistance      1000  $\Omega$

(P) lead

- Transmission

Receive level range                              -9 dBm to +6 dBm for DTS output  
(Talk circuit)

Transmit level range                              +6 dBm to -9 dBm for DTS input  
(Talk circuit)

Receive level range                              -3 dBm to -18 dBm for DTS output  
(Key circuit)

The levels refer to those at the T and R leads. The amount of usable gain depends on the return loss that can be achieved on a particular transmission facility.

**Trunk features** The CAMA position signaling circuit has two features:

- Impedance

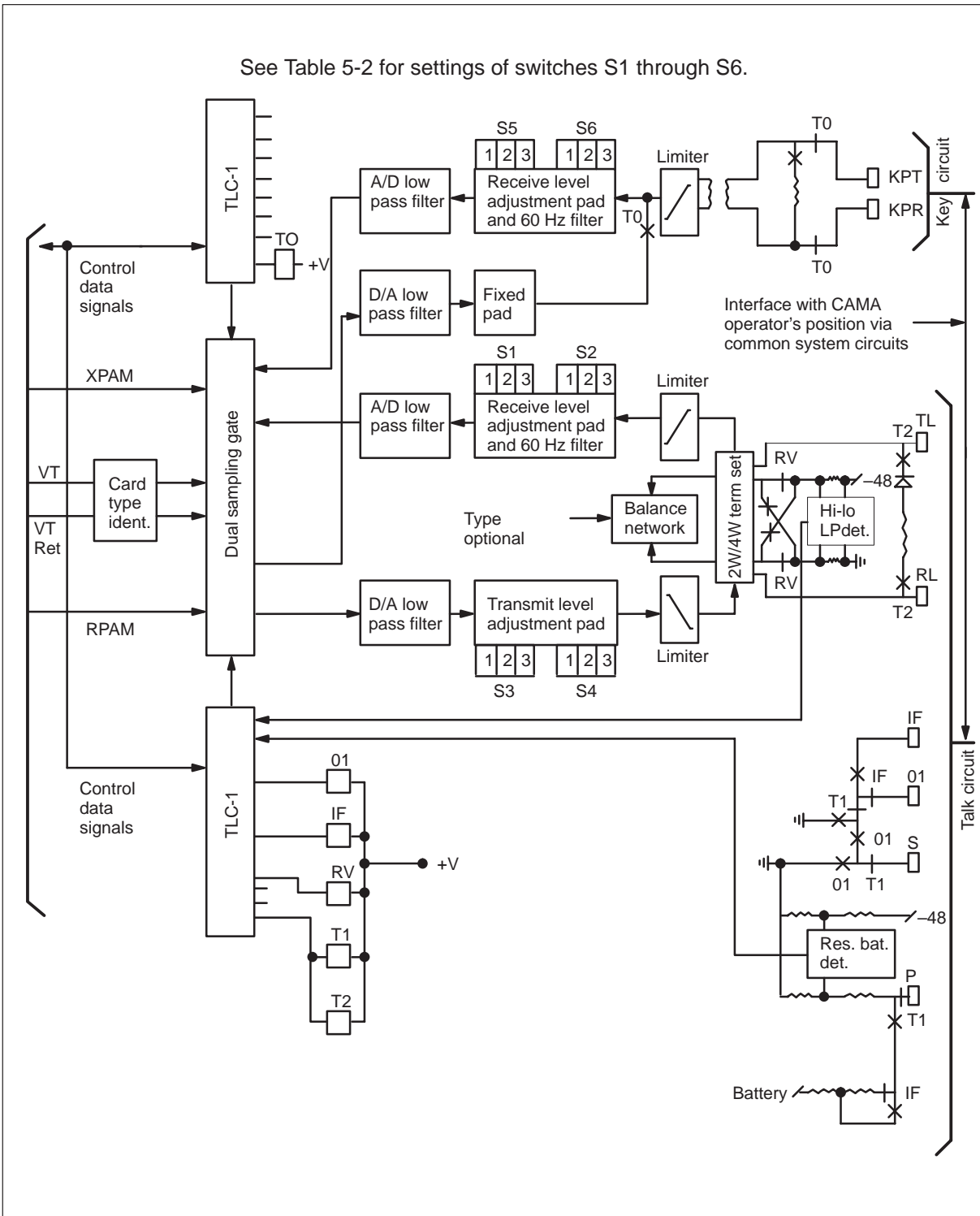
Talk circuit:  $600 \Omega + 2.15 \mu\text{F}$

Key circuit:  $600 \Omega$

- Terminating set

The talk circuit incorporates a two-wire to four-wire terminating set which provides an interface between the two-wire VF talking circuit and the four-wire TM circuit.

**Figure 5-8**  
**CAMA position signaling circuit (NT2X65AA)**



<b>Table 5-10 Signaling states – outgoing CAMA to CAMA position</b>						
<b>State</b>	<b>System</b>	<b>E&amp;M Talk</b>	<b>KP</b>	<b>Loop Talk</b>	<b>KP</b>	
CA position not in service	Far end	On-hook	Off-hook	On-hook	On-hook	
	DMS	On-hook	On-hook	On-hook	Off-hook	
CA position occupied	Far end	On-hook	On-hook	On-hook	Off-hook	
	DMS	On-hook	On-hook	On-hook	On-hook	
CA position seized	Far end	On-hook	On-hook	On-hook	Off-hook	
	DMS	Off-hook	On-hook	On-hook	Off-hook	
CA position busy	Far end	On-hook	Off-hook	On-hook	On-hook	
	DMS	Off-hook	On-hook	On-hook	Off-hook	
Call type signals	Far end	On-hook	Off-hook	On-hook	On-hook	
	DMS	Zip tones*	On-hook	Zip tones*	Off-hook	
Sender attached	Far end	On-hook	Off-hook	On-hook	On-hook	
	DMS	Off-hook	Off-hook	Off-hook	Off-hook	
CA position attached	Far end	Off-hook	Off-hook	Off-hook	On-hook	
	DMS	Off-hook	Off-hook	Off-hook	Off-hook	
Call number signals (MF)	Far end	Off-hook	MF signals	Off-hook	MF signals	
	DMS	Off-hook	Off-hook	Off-hook	Off-hook	
Reorder	Far end	Off-hook	Off-hook	Off-hook	On-hook	
	DMS	Off-hook	On-hook	On-hook	Off-hook	
Reset	Far end	Off-hook	Reset tones	Off-hook	Reset tones	
	DMS	Off-hook	On-hook	On-hook	Off-hook	
Release near end	Far end	Off-hook	Off-hook	Off-hook	On-hook	
	DMS	On-hook	On-hook	On-hook	On-hook	
Release far end	Far end	On-hook	On-hook	On-hook	Of-hook	

—continued—

<b>Table 5-10</b> <b>Signaling states – outgoing CAMA to CAMA position</b> (continued)					
State	System	E&M Talk	KP	Loop Talk	KP
	DMS	On-hook	On-hook	On-hook	On-hook
<b>Note 1</b>	*ZIP tones: (480 Hz)	ANI fail ONI	0.420 to 1.380 second on 0.050 to 0.175 second on 0.050 to 0.175 second off 0.050 to 0.175 second on		
<b>Note 2</b>	Resettone: 700 + 1700 Hz 68 ± ms min				
End					

**Test circuit** Operation of the test relay isolates leads KPT and KPR from the external facility and allows the key circuit to be tested internally. A test circuit is also provided to check the signaling, supervision, and VF circuits associated with the talk circuit. The test relays, when operated, isolate leads TL, RL, IF, OI, S, and P from the associated trunks.

**Balance networks** Optional plug-in networks are available for balancing the terminating set (talk circuit). Table 5-2 specifies balance network codes available.

**Level adjustments** Level adjustments are provided in both receive and transmit directions in 0.25-dB steps over a range of 0 to 15.75 dB. Fixed pads are switched in or out, by means of miniature switches, to obtain the required amount of loss or gain. One CAMA position signaling circuit (talk and key circuit) is accommodated per circuit pack, which is connectorized and plugs into an eight-wire Trunk Module (TM8).

**Connecting circuits** The CAMA position signaling circuit interfaces with the following circuits.

- SD96481-01            Outgoing Trunk to CAMA position (remote application)
- SD95853-01            CAMA position circuit (same building application)
- NT5X74AA            Universal CAMA position circuit
- NT5X75AA            Aux, CAMA position circuit, E&M
- NT5X75AB            Aux, CAMA position circuit, loop
- NT5X52AA            High tone source

### **CAMA suspension and calls waiting circuit, loop or E&M, NT2X66AA CAMA suspension**

When the AS key is operated at the CAMA switchboard an AS signal is transmitted to the CAMA suspension circuit. When the AS signal is detected, CAMA calls normally requiring operator identification will be completed without charge (see Figure 5-9).

**Calls waiting** This circuit transmits, to the far end connecting circuit, signals that represent the level of CAMA calls waiting in DMS-100 Family.

- Signaling & Supervision – CAMA Suspension  
—E&M Option

When the far end AS key is normal, the far end signals on-hook (open) on leads E1 and E2. An on-hook signal (ground) is provided on leads M1 and M2 toward the far end by the CAMA suspension circuit.

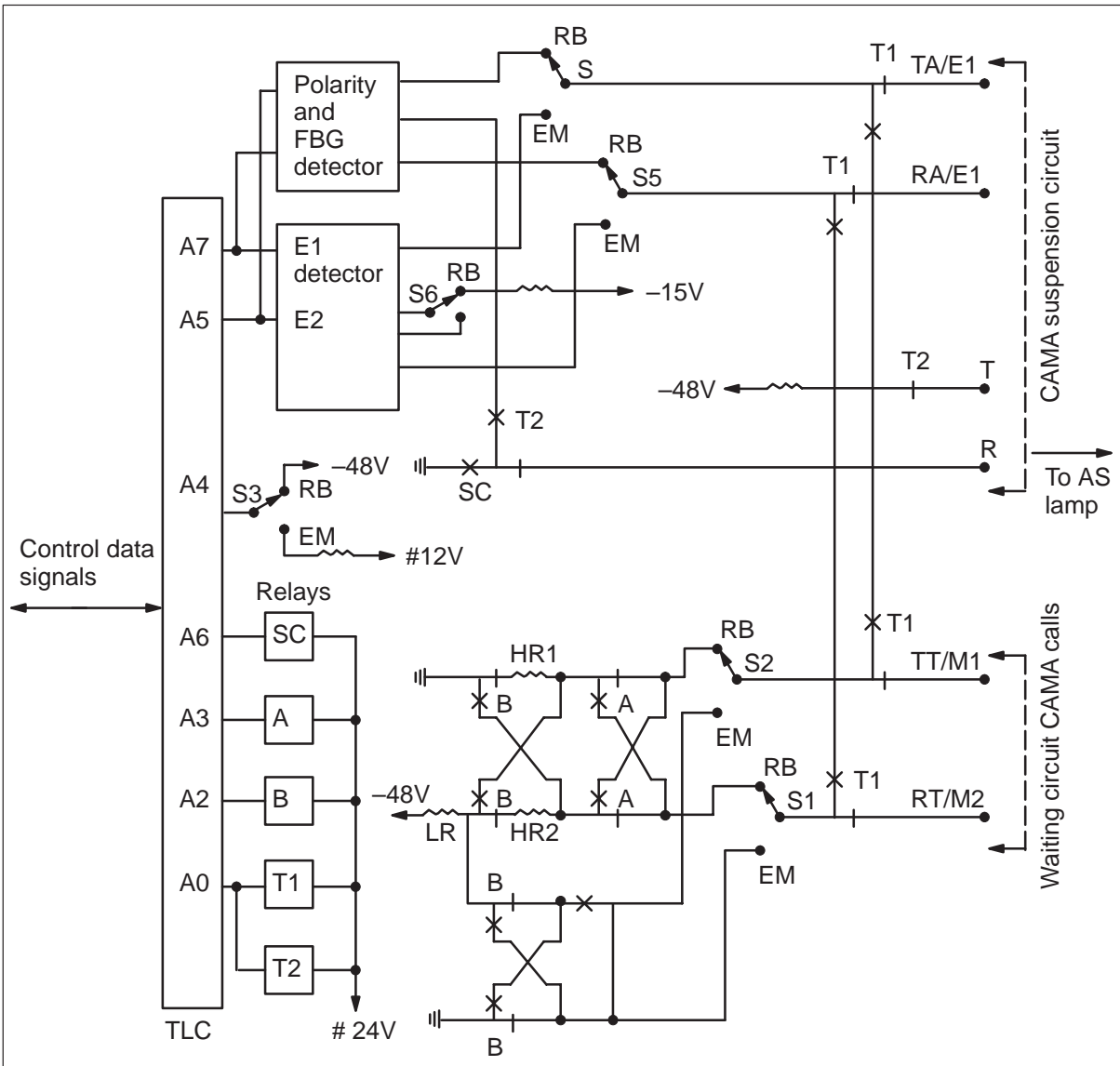
When the AS key at the switchboard is operated, the far end sends an off-hook (ground) on both leads E1 and E2. The CAMA suspension circuit, upon detecting the off-hook AS signal, sends a 30 IPM off-hook and on-hook signal to the far end on leads M1 and M2. The off-hook signal (on leads M1 and M2) is a low-resistance battery (200  $\Omega$ ). The signals on the M1 and M2 leads indicate to the far end that the AS signal has been received.

The E1 and E2 lead conditions are also checked for a fault condition. A ground appearing on one lead with the other lead open is detected as an alarm condition by DMS-100 Family. The signal states are shown in Table 5-11.

<b>Circuit state</b>	<b>F lead state</b>		<b>Calls waiting lamp state</b>	<b>CAMA SWBD condition</b>
	<b>E1</b>	<b>E2</b>		
Normal	Open	Open	Not applicable	As key not operated
AS	Grd	Grd	G + WH + R Flashing at 30 IPM	As key operated
FBG	Grd	Grd	Not applicable	E2 Ground E1 Open
—continued—				

<b>Table 5-11</b>				
<b>CAMA suspension signal states</b> (continued)				
<b>Circuit state</b>	<b>F lead state</b>		<b>Calls waiting lamp state</b>	<b>CAMA SWBD condition</b>
	<b>E1</b>	<b>E2</b>		
Open	Grd	Open	Not applicable	E1 open E2 Ground
<b>Note 1</b> Legend:				
Relay states: 0 = Not operated; 1 = Operated Lamp states: G = green, WH = white, R = red Circuit states: AS = Abandon switchboard; FBG = Foreign battery or ground				
<b>End</b>				

**Figure 5-9**  
**CAMA call waiting and suspension circuit (NT2X66AA)**



—Reverse Battery Option – When the far end AS key is normal, the far end signals  $-48\text{ V}$  on lead TA and  $+48\text{ V}$  (floating source) on lead RA. The CAMA suspension circuit provides a resistance ( $402\text{-}\Omega$ ) battery ( $-48\text{V}$ ) on lead T and an open on lead R.

When the AS key at the switchboard is operated, the far end reverses the battery polarity on leads TA and RA. Upon detecting this AS signal, this circuit provides a  $30\text{-IPM}$  ground on lead R as an acknowledgement to the far end that the AS signal has been received.



The signals present on the TA and RA leads are monitored by the Foreign Battery or Ground (FBG) detector. If a foreign battery or ground or an open is detected by the FBG detector, a signal is sent to the TM and consequently an alarm condition is initiated. CAMA calls are not suspended when this alarm condition occurs. The signal states are given in Table 5-12.

<b>Table 5-12 CAMA suspension interface – reverse battery option</b>							
<b>Circuit state</b>	<b>Polarity detected on leads</b>				<b>SC</b>	<b>AS</b>	<b>Far end CAMA SWBD condition</b>
	<b>TA</b>	<b>RA</b>	<b>T</b>	<b>Open</b>	<b>relay state</b>	<b>lamp state</b>	
Normal	48-V floating source - +		-48 V	Open	0	Ext	AS key not operated
AS	48-V floating source - +		-48 V	Gnd	0 & 1 or 30 IPM	Lit	AS key operated
FBG	Any fixed potential  Gnd Gnd or -V -V		-48 V	Open	0	Ext	FBG condition on leads TA and RA
Open	Open	Open	-48 V	Open	0	Ext	Open condition on leads TA and RA
<p><b>Note 1</b> Legend:                      Relay states: 0 = Not operated; 1 = Operated                      Lamp states: Ext = Extinguished                      Circuit states: AS = Abandon switchboard; FBG = Foreign battery or ground</p> <p><b>Note 2</b> See Table 5-11 for the CAMA suspension signaling state.</p>							

- Signaling – Calls Waiting
  - E&M Option – Near end signaling to far end consists of sending ground on leads TT/M1 and RT/M2 when no CAMA calls are waiting in the DMS-100 Family switch. When CAMA calls are waiting in the DMS-100 Family switch, low resistance (200 Ω) battery or local ground is transmitted on the M1 and M2 leads. Table 5-13 provides the signaling states, the output signals provided on leads TT/M1 and TT/M2 as well as the corresponding states of the far end CAMA calls waiting lamps.

<b>Table 5-13 Call waiting interface</b>							
<b>Signaling states</b>	<b>Relay states</b>		<b>Outputs to CAMA SWBD</b>				<b>CAMA SWBD calls waiting lamp states</b>
	<b>A</b>	<b>B</b>	<b>RB option TT</b>	<b>RT</b>	<b>E&amp;M Option M1</b>	<b>M2</b>	
Idle	0	0	HG	HB	Gnd	Gnd	
X calls waiting	1	0	HB	HG	LB	Gnd	G on
Y calls waiting	1	1	Gnd	LB	Grd	LB	G + WH on
Z calls waiting	0	1	LB	Gnd	LB	LB	G + WH + R on
CAMA suspension	0	0			LB	LB	G + WH + R on
	0	O + 1 at 30 IPM					G, WH, R flashing at 30 IPM
	0	0			Grd	Grd	G + WH + off

**Note 1** Relay states: 0 = Not operated, 1 = Operated; Lamps: G = Green, WH = White, R = Red; Calls waiting thresholds:  $X = 0 < X < X \text{ max}$ ,  $Y = X \text{ mas} < Y < Y \text{ max}$ ,  $Z = Y \text{ max} < Z$ ; Outputs: HG = High resistance ground; HB = High resistance battery, Grd = Ground, LB = Low resistance battery, IPM = Impulses per minute.

**Note 2** Calls waiting thresholds are specified in office data records

—Reverse Battery Option – When there are no CAMA calls waiting in DMS-100 Family, a high resistance (1500- $\Omega$ ) ground is transmitted on lead TT/M1 and a high resistance (1500- $\Omega$ ) battery on lead RT/M2. When CAMA calls are waiting for service in the DMS-100 Family, signals transmitted on the TT/M1 and RT/M2 consist of:

—HG	High resistance ground	1500 $\Omega$
—HB	High resistance battery	1500 $\Omega$
—LB	Low resistance battery	200 $\Omega$
—GND	Ground	local ground

The signaling states, the output signals on leads TT/M2 and RT/M2, and the corresponding states of the far end CAMA calls waiting lamps are given in Table 5-13.

**Working limits** Maximum external circuit resistance

- E&M option 4220  $\Omega$
- Reverse battery option 6020  $\Omega$

A 20 k $\Omega$  ground on leads E1 and E2 (E&M option) is detected as an on-hook state.

**Trunk features**

- Signaling and supervision – RB or E&M selectable by switch setting.
- Test circuit – Operation of the test relay isolates leads TA/E1, RA/E2, TT/M1, and RT/M2 from the external trunk facility allowing the signaling and supervisory functions of the circuit to be checked. One CAMA suspension and calls waiting circuit is accommodated per circuit pack, which plugs into an eight wire Trunk Module (TM8).

**Connecting circuits** This circuit interfaces directly with the common systems circuits SD95868-01 and SD95872-01. When the E&M option is specified, the CAMA suspension and calls waiting circuit appears as two E&M channels.

**Test trunks**

Test trunks are provided for maintenance purposes. This section provides the working limits, electrical characteristics, signaling and supervision, and the features of these trunks.

**Working limits – battery voltage**

Nominal	Voltage range
–48 V	–42.75 V to –55.8 V

**Trunk features** A test circuit to check the signaling, supervisory, and VF circuits is provided on each trunk. Operation of the test relay, using the TM and TLC, isolates the trunk circuit from the transmission facility, allowing the trunk circuit to be tested internally.

**Four-wire jack-ended trunk circuit, NT1X54AA** This trunk circuit provides a means to test trunks from the Maintenance and Administration Position (MAP) using portable analog test equipment (see Figure 5-10).

- Signaling and supervision – This trunk circuit connects to 600-Ω input/output impedance instruments (AC) only and, therefore, DC signaling states are not applicable.

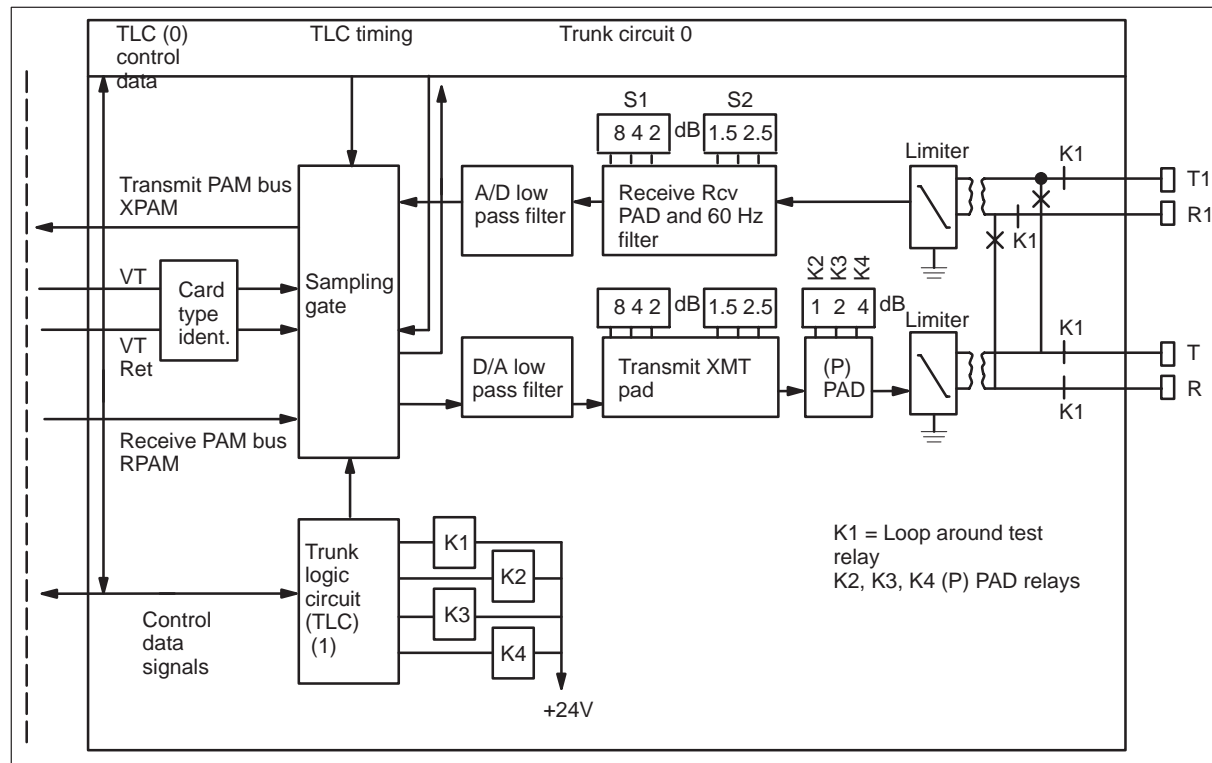
**Working limits**

- Transmission levels
 

Maximum transmit level with transmit switches S3, S4 set to “out” and “P” pads set to 0 dB.	+9 dBm for DTS input
Transmit level range with “P” pads set to 0 dB.	+9 dBm to –6 dBm for DTS input
Minimum receive level	–12 dBm for DTS output

Receive level range	-12 dBm to +3 dBm for DTS input
“P” Pad range	0 to 7 dB in 1 dB steps
• Facility cable – NEB808A	
Cable recommended	0.02 μF/1000 ft (305 m)
Maximum cable length	2500 ft (760 m)

**Figure 5-10**  
4-wire, jack-ended trunk card (NT1X54AA)



The maximum cable length limit restricts the attenuation distortion which results from the cable, to be within the bounds of -0.1 dB and +0.25 dB for the frequency range of 300 Hz to 3000 Hz. In addition, it limits the error introduced by the cable in return loss measurements to 0.5 dB or less.

**Trunk features**

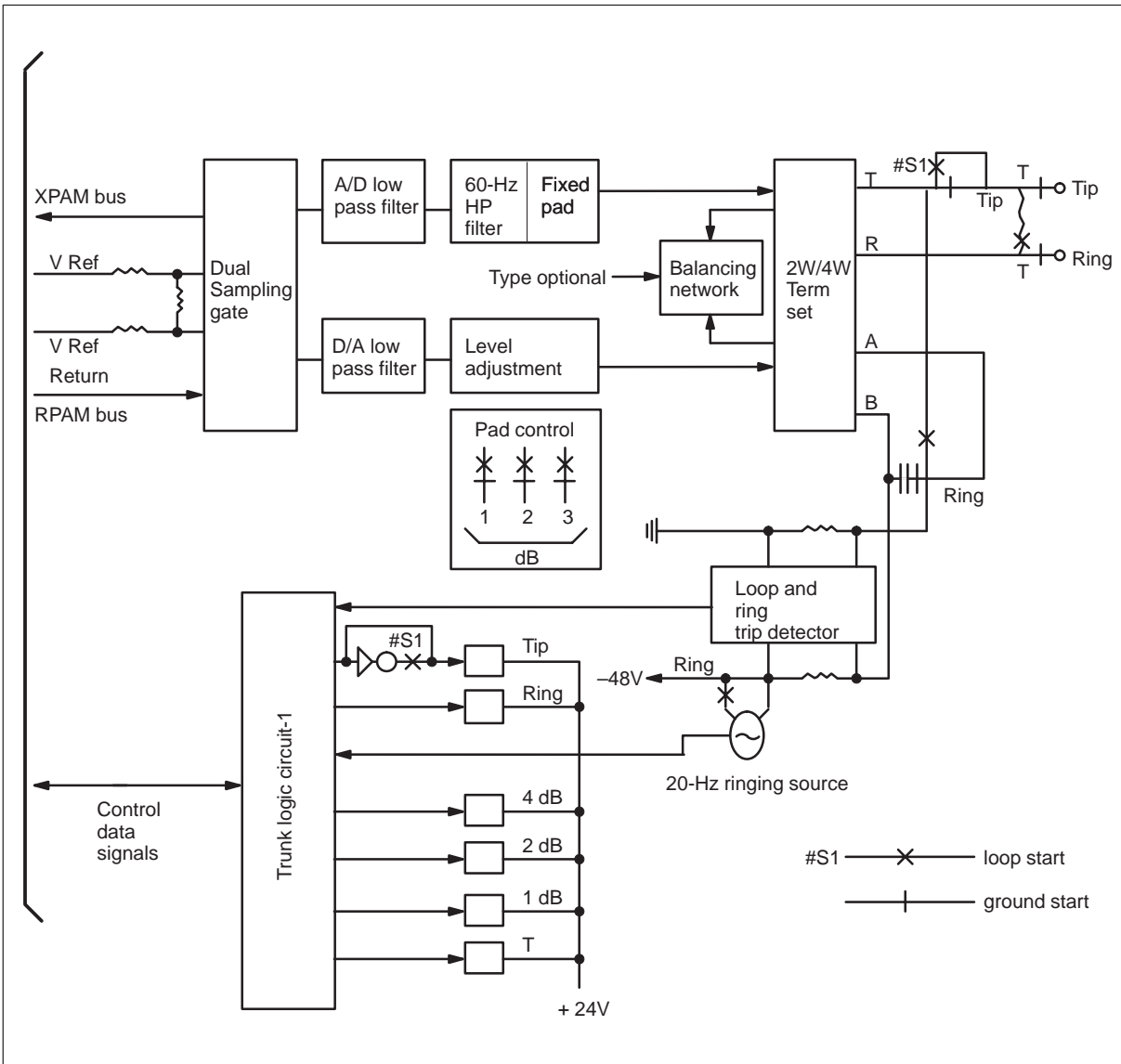
- Impedance – Trunk impedance is 600 Ω and 2.15 μF.
- Level Adjustments – Level adjustments are provided in both receive and transmit directions in 0.25 dB steps over a range of 0 to 15.75 dB. Fixed pads are switched in or out, by miniature switches, to obtain the required loss or gain.

- Software Controlled Pads – Three software-selectable “P” pads (4, 2, 1 dB) are included in the transmit direction to compensate various level points and produce the Actual Measured Loss (AML) for any trunk under test. These pads are connected when the circuit relays are operated by the switching system software. The selection of these pads is in accordance with the fixed-loss plan. Two trunk circuits are accommodated per circuit pack, which is connectorized and plugs into a four-wire or eight-wire Trunk Module (TM4 or TM8).

**101 communications test line, NT5X30AA**

This circuit provides a two-wire voice and signaling interface between the DMS-100 Family switch and the connecting 1A2, or equivalent, key telephone equipment, 500-type telephone set or connecting dial long line circuits. The key telephone equipment or telephone set is usually located at the MAP or a Trunk Test Position (TTP). The circuit is used for originating or terminating 101 trunk applications (see Figure 5-11).

**Figure 5-11**  
**101 communications test line circuit (NT5X30AA)**



- **Signaling and Supervision** – The 101 communications test line may be used as one-way terminating (outgoing) or one-way originating (incoming). Loop or ground start operation is switch-selectable. The ground start option is used for terminating applications and the loop start option for originating.

- Terminating – When the circuit is idle, the tip lead is open and the ring lead is at  $-48\text{ V}$ , which is supplied through a resistance of  $446\ \Omega$  nominal ( $453\ \Omega$  maximum). On seizure, this circuit provides resistance ground ( $446\ \Omega$  nominal,  $453\ \Omega$  maximum) on the tip lead and 20 Hz ringing (ac/dc, 65 V rms), on the ring lead. The 20 Hz ringing is obtained from the built-in ringing supply.

An off-hook loop closure from the far end trips the ringing, and this circuit restores the tip lead to  $-48\text{ V}$  dc (through resistance of  $446\ \Omega$ ). This circuit recognizes an external tip and ring bridge of  $3160\ \Omega \pm 1\%$  or greater as an on-hook.

- Originating – When used for originating applications, this circuit provides battery and ground, to the ring and tip leads respectively, through matched resistances of  $446\ \Omega$  nominal ( $453\ \Omega$  maximum). Far end on hook and off-hook (open and closure) signals are detected by the loop detector. An external tip and ring bridge resistance of  $3160\ \Omega \pm 1\%$  or greater is recognized by this circuit as an on hook.

### Working limits

- Battery Voltage

Nominal

$-48\text{ V}$

Voltage Range

$-42.75\text{ V}$  to  $-55.8\text{ V}$

- Insulation resistance

30 k $\Omega$  minimum

- Ground potential difference

$\pm 10\text{ V}$

- Supervision

Maximum external circuit resistance

700  $\Omega$

Maximum conductor loop resistance  
(DP pulsing)

500  $\Omega$

- Ringing Load

Ringing bridge impedance

7 k $\Omega$  min. at 20 Hz

Ringing bridge resistance on-hook

30 k $\Omega$  minimum

- Impedance – Trunk impedance is  $900\ \Omega + 2.15\ \mu\text{F}$ .

- Transmission

Transmit level range

$-6\text{ dBm}$  to  $+1\text{ dBm}$  for DTS  
input (software selectable)

Receive level range

0 dBm for DTS output

The levels refer to those at the T and R leads. The amount of usable gain depends upon the return loss that can be achieved on a particular transmission facility.

### Operating modes

- Local Mode – In local mode operation, the connecting equipment, 1A2 key telephone equipment or 500-type telephone set, is located within an external conductor loop resistance range of 500  $\Omega$  or less. In this operating mode, the 101 communications test line provides direct compatibility with:
  - a single 500-type (or equivalent) telephone set with one bridged C4A ringer, or 1A2 (or equivalent) key telephone equipment.
  - Operation with multiple loop telephone sets (that is, Logic 10/20) requires the use of external key telephone equipment that provides the lamp control, line hold, and ringing function.
- Remote Mode – When connecting equipment is beyond the 500- $\Omega$  external conductor loop resistance range, the remote mode of operation (on a loop basis) is achieved by using Dial Long Line (DLL) circuits in the central office. This mode of operation requires the use of a ground start DLL circuit (QVF12A/C) and an associated external 20-Hz ringing supply to repeat the ringing towards the station equipment.

When the connecting equipment is beyond the loop limits imposed by loop signaling and DLL circuits, a carrier equipped with Foreign Exchange (FX) channel units may be employed. The channel units must be capable of ground start operation with a forward disconnect feature. This feature is required to allow the release of a “hold” condition at the remote location. Opening the tip lead removes the “hold” condition applied by the key equipment and allows re-ringing the station.

### Trunk features

- Terminating set – The circuit incorporates a two-wire/four-wire terminating set which provides an interface between the two-wire facility and the four-wire trunk circuits. Balancing of the terminating set is provided as a plug-in option.
- Trunk impedance – 900  $\Omega$  + 2.15  $\mu$ F
- Test Circuit – A test circuit to check the signaling, supervisory, and VF circuits is provided on each trunk. Operation of the test relay, using the TM and TLC, isolates the trunk circuit from the transmission facility, allowing the trunk circuit to be tested internally.
- Balance Network – Optional plug-in networks are available for balancing the terminating set. Table 5-14 specifies balance network codes available.



- Ringing Supply – The circuit features a built in 20-Hz ringing supply. Each circuit pack accommodates one circuit. The circuit pack is connectorized and may be plugged into a two-wire, four-wire or eight-wire Trunk Module (TM2, TM4, or TM8).

**Typical connecting circuits**

- Local mode operation:  
One 500-type telephone set, or  
1A2 key telephone equipment (QUN10B plug-in unit)
- Remote mode operation:  
QVF12A/C DLL Circuit  
DE-3 FX Channel Unit QPP371

<b>Table 5-14 Multifrequency codes</b>				
<b>Frequencies (Hz)</b>	<b>Signaling Digit and control</b>	<b>Inband</b>	<b>CCITT system 5</b>	<b>TSPS</b>
700, 900	1			
700, 1100	2	Coin collect		
700, 1300	4			
700, 1500	7			
700, 1700		Ringback	Code 11	ST3P
900, 1100	3			
900, 1300	5			
900, 1500	8	Oper. released		
900, 1700			Code 12	STP
1100, 1300	6			
1100, 1500	9			
1100, 1700	KP	Coin return	KP 1	
1300, 1500	0	Oper. attached		
—continued—				

<b>Table 5-14</b> <b>Multifrequency codes</b> (continued)				
<b>Frequencies (Hz)</b>	<b>Signaling Digit and control</b>	<b>Inband</b>	<b>CCITT system 5</b>	<b>TSPS</b>
1300, 1700			KP 2	ST2P
1500, 1700	ST	Coin collect Oper. released		
End				

### **Incoming/outgoing test trunk, two-wire with S-lead, DP, MF, DTMF NT2X90AC – DMS-100**

This trunk provides the interface for loop test equipment of the #14 LTD, Mechanized Loop Tester (MLT), Loop Reporting System (LRS) types. This trunk also provides access for operator verification call VER90.

Signaling is provided on the T&R as well as on the sleeve lead.

The trunk interfaces the subscriber loops and DMS-100 line circuits through the metallic test access.

- **Signaling and Supervision**

—incoming mode – Test equipment provides low resistance across T and R and high negative current ( $20 < I < 100$ ) mA for seizure of trunk. Pulsing may be MF, DTMF, or DP (loop). These are recognized by the appropriate detector.

Current sensors are provided on the S lead for detecting positive/negative high and low currents. At the end of dialing, low negative current ( $3 < I < 20$ ) ma is supplied on the S lead. Subsequent conditions on the S lead may be the zero current condition ( $0 < I < 3$ ) ma. This tells the DMS-100 that access towards the central office side of the line-under-test is required.

This trunk provides battery and ground through matched resistors of less than  $453 \Omega$  ( $446 \Omega$  nominal). Near end signaling by the incoming trunk consists of battery and ground reversal as follows:

<b>State</b>	<b>Tip Lead</b>	<b>Ring Lead</b>
On-hook	ground	– 48 V
Off-hook	– 48 V	round

The above states may be reversed by means of manually-selectable switches on the pack. During tip and ring reversal the transition period, during which the electrical state is undefined, is 7 ms or less.

Signaling states are shown in Table 5-15.

- Outgoing mode – In the outgoing mode, service calls, for example, 511 or 711, are routed to a test position. This pack seizes a trunk on the test position by putting a 200  $\Omega$  ground on the S lead. The test position answers by applying a low-resistance bridge across tip and ring. Test position may now signal the DMS-100 in the same manner as if the telephone making the call to the test position had been posted as indicated in A.1 (incoming mode).

<b>Table 5-15</b>				
<b>Signaling states test trunk NT2X90AC</b>				
<b>Signaling state</b>	<b>System</b>	<b>T</b>	<b>R</b>	<b>S</b>
<b>Incoming call</b>				
Idle	Test eqpt.	Open	Open	Open
	DMS	Gnd	–48 V	Open
Seizure	Test eqpt.	Loop closure		H.R. battery
	DMS	Gnd	–48 V	L.R. ground
Start dial	Test eqpt.	Loop closure		H.R. battery
	DMS	–48 V	Gnd	L.R. ground
Dial	Test eqpt.	Loop closure		H.R. battery
	DMS	–48 V	Gnd	L.R. ground
Impulsing MF/DTMf	Test eqpt.	MF/DTMF on loop		L.R. battery
	DMS	–48 V	Gnd	L.R. ground
Impulsing OP	Test eqpt.	Open/closure loop		L.R. battery
	DMS	–48 V	Gnd	L.R. ground
End-of-dial	Test eqpt.	Loop closure		H.R. battery
	DMS	–48 V	Gnd	L.R. ground
(1) Idle line	Test eqpt.	Loop closure (out-access)		H.R. battery
	DMS	–48 V	Gnd	L.R. ground
	(a) Test eqpt.	Loop closure (in-access)		Open
	DMS	–48 V	Gnd	L.R. ground
	(b) Test eqpt.	Open	Open	L.R. battery
	DMS	–48 V	Gnd	L.R. ground
	Test eqpt.	Gnd	–48 V	Open
—continued—				

<b>Table 5-15</b>					
<b>Signaling states test trunk NT2X90AC</b> (continued)					
<b>Signaling state</b>	<b>System</b>	<b>T</b>	<b>R</b>	<b>S</b>	
(Idle)	DMS	Open	Open	Open	
(2) Busy line	Test eqpt.	Loop closure		H.R. battery	
	DMS	Battery	Battery		
				L.R. ground	
			DC-monitor	L.R. battery	
	(a) Test eqpt.	Open	Open	L.R. battery	
	DMS	-48 V	Gnd	L.R. ground	
	DMS	Gnd	-48 V	Open	
	Test eqpt.	Open	Open	Open	
	(3) line in lockout	Test eqpt.	Loop closure		H.R. battery
		DMS	Battery	Battery	L.R. ground
(a) Test eqpt.		Loop closure		*Open (min. 6 sec)	
DMS		-48 V	Gnd	L.R. ground * Permanent signal release (PSR)	
(b) Test eqpt.		Loop closure (out-access)		H.R. battery	
DMS				L.R. ground	
(c) Test eqpt.		Open	Open	L.R. battery	
DMS		-48 V	Gnd	L.R. ground	
DMS		Gnd	-48 V	Open	
(Idle)		Test eqpt.	Open	Open	Open
<b>Outgoing call</b>					
	Idle	Test eqpt.	Open	Open	
	DMS	Gnd	-48 V	Open	
Seizure	Test eqpt.	Open	Open	Open	
	DMS	Gnd	-48 V	L.R. ground	
Answer	Test eqpt.	Loop closure		H.R. battery	
—continued—					

<b>Table 5-15</b>				
<b>Signaling states test trunk NT2X90AC</b> (continued)				
<b>Signaling state</b>	<b>System</b>	<b>T</b>	<b>R</b>	<b>S</b>
	DMS	-48 V	Gnd	L.R. ground
<p><b>Note 1</b> Out-Access. In this mode all tests may be applied on the line side towards the subscriber set.</p> <p><b>Note 2</b> In-Access. In this mode normal in-testing towards CO side may be applied. Dial one may be monitored also. Avoid high voltage applications in this mode.</p> <p><b>Note 3</b> DC-Monitor. In this mode dc access is granted to the craftsperson. Line id type may be measured and voice monitored. Avoid further testing.</p>				
End				

**Working limits**

- Supervision – Maximum external circuit resistance on T/R 4500 Ω on S 1500 Ω.

The trunk circuit will recognize as on-hook, bridge resistances as follows:

<b>Loop option (T/R)</b>	<b>Bridge resistance</b>
Short	6490 Ω min.
Long	18.7 kΩ min.

*Note:* The bridge resistance includes the outgoing circuit bridge with a 30-kΩ leakage between trunk conductors.

- DP pulsing

<b>Loop option</b>	<b>External circuit resistance</b>
Short	0 to 2000 Ω
Long	2000 to 4500 Ω

In both short and long loop options, the incoming trunk circuit supplies battery and ground through matched resistances of less than 453 Ω. Only the loop detector sensitivity is changed for the short/long loop options. The battery limits (-42.75 to -55.8 V) are the same for both dial pulsing and supervision specifications.

- Transmission

Receive level range	+6 dBm to -9 dBm for DTS output
Transmit level range	-9 dBm to +6 dBm for DTS input

The levels refer to those at the T&R leads. The amount of usable gain depends on the return loss that can be achieved on a particular transmission facility.

**Features** The following features are also provided by the trunk.

- Reversal option – Tip and ring reversal can be provided by manually-selected switches on the pack.
- Detector sensitivity – The loop detector sensitivity is switch-selectable for short or long loop operation. The trunk working limits specify the associated limits for dial pulsing.
- Pulsing – The incoming trunk will accept MF, DTMF, or DP (loop) pulsing.
- Current sensing – Detectors are provided for sensing positive/negative high and low currents. Thresholds are defined in A(1) incoming.
- Ground – Internal or external S lead ground may be provided by means of manually selectable switches on the pack.
- Circuits per pack – One trunk circuit per pack is provided.
- DTMF testing – High impedance monitoring provided when DTMF pads are being tested.

**Incoming/outgoing test trunk, two-wire with S-lead, DP, DTMF, MF 2X90AD**

The 2X90AD performs all the services currently supported by the NT2X90AB and NT2X90AC and is used to test lines served by digitally integrated loop carrier systems. The first of these type systems to be interfaced is the AT&T SLC-96 when integrated using the DMS-100 Subscriber Carrier Module (SCM-100S). Other test trunks, such as the NT2X90AB and NT2X90AC, can exist in the same DMS-100 but cannot be used to test integrated pair gain lines. The NT2X90AD can test all non-test restricted lines on the DMS-100. Tests may be performed from trunk versions of MLT, MLT2, and LTD (see Figure 5-12).

The test trunk is associated with an applique circuit driven by a Signal Distributor (SD) circuit pack (NT2X57AA). The SD circuit pack operates relays on the applique circuit causing different voltages to be sent to the test equipment. Tones generated by the NT2X90AD circuit pack accompany the voltages, and both tones and voltages indicate the results of tests conducted on subscriber carrier line circuit packs.

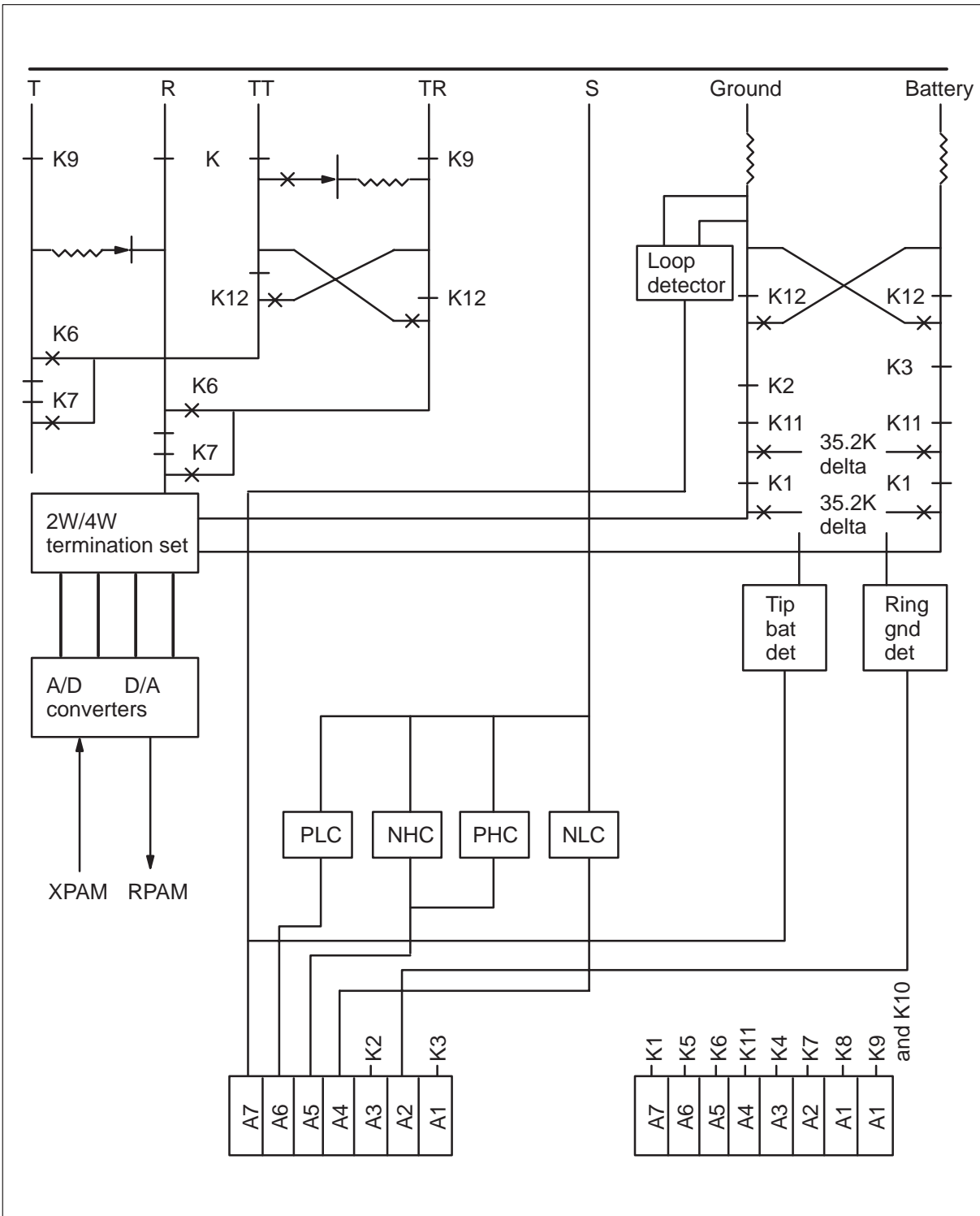
Indication is provided to the operator if the dialed number is busy, not in service, the test pair is in use, or if there is a major alarm on the Remote Terminal (RT). If none of these conditions are present, the DMS-100 connects the metallic test pair to the subscriber loop and the RT test circuit pack associated with the line being tested. The DMS-100 executes the channel test for the line circuit pack.

At the request of the operator the DMS-100 will report the following results:

- Bad channel is indicated by a grounded tip and 75 V from ring to ground.
- Good channel for single-party service is indicated by a high tone burst with tip grounded and -48 V from ring to ground.
- Good channel for multi-party service is indicated by two high tone bursts with -48 V from tip to ground and a grounded ring.
- Good channel for coin service is indicated by three high tone bursts with a grounded ring and 75 V from tip to ground.
- No channel test executed is indicated by a grounded ring and tip.

The test sequence is terminated by the MLT operator at the MLT or LTD.

**Figure 5-12**  
**Incoming/outgoing test trunk (2X90AD)**





## Digital trunk interface – DCM and DTC

DMS-100 Family can be directly connected to a channel bank or another digital office through a DS-1 digital carrier system. The DCM interfaces five 24 channel, 1.544 Mb/s, DS-1 carrier systems with four 32 channel (30 voice, 2 signaling and control), 2.56 Mb/s duplicated speech links (ports) to the DMS-100 Family digital network. A DCM consists of a maximum of 13 printed circuit packs.

The DTC interfaces twenty 24 channel 1.544 Mb/s DS-1 carrier system with sixteen 32 channel (30 voice, 2 signaling and control), 2.56 Mb/s duplicated speech links (ports) to the DMS-100 Family digital network. A DTC is a dual shelf peripheral with each shelf consisting of a maximum of 20 printed circuit packs.

### Packaging and power

A fully equipped DCM consists of six common control and DMS-100 Family network interface cards, one power converter board and five DS-1 line cards. A minimum equipped DCM requires all of the common cards but only one DS-1 line card. On the DMS-100 Family network side, the four network ports in each plane interface through a single network card. The line cards and the network card are interconnected through a speech bus, consisting of four paths in each direction, with one path assigned to each network port.

A fully equipped DTC consists of two shelves with common equipment to provide for hot standby operation in the event of failure of common control of one of the shelves. Each shelf contains 14 common control and DMS-100 Family network interface circuit packs, one power converter board and five DS-1 interface packs. Each DS-1 interface pack accommodates two DS-1 spans. In order to interface to the DMS-100 network, each shelf contains two interface packs, each providing eight ports to the network. Each port is duplicated into planes 0 and 1 of the DMS-100 network. Each incoming DS-1 channel is mapped to a network port.

### DS-1 Type interface specifications

#### Output specifications

Line rate	1.544 Mb/s phase locked to office clock
Line code	bipolar
Pulse amplitude	$\pm 2.4$ V to $\pm 3.6$ V

Unbalanced in height of negative and positive pulse	$\pm 0.3$ V
Half amplitude width	$324 \pm 30$ ns
Overshoot at Trailing Edge of Pulse	20 to 40 percent of pulse height with delay to 10 percent or less of base line to peak value with 400 ns
Minimum density	Normally 1 in 8, nor more than 15 consecutive zeroes

### Input specifications

Line rate	1.544 Mb/s $\pm$ 200 b/s
Line code	Bipolar
Amplitude	$\pm 1.5$ to $\pm 3.6$ V
Input impedance	100 $\Omega$ nominal

**Cable equalization** The 1.544 Mb/s line side can accommodate a maximum of 750 ft (229 m) of ABAY cabling (22 gauge) to a standard DS-1 type office repeater bay. The wiring from the DTC or DCM shelf to the office repeater bay is shielded 22 gauge cable. Three types of line equalizers are provided as part of the interface to accommodate the various cable lengths used, as shown in Table 5-16. The appropriate equalizer is selected by manual operation of option switches on the carrier interface card NT2X35AA or NT6X50AA/AB.

<b>Table 5-16 Cable equalization range</b>	
<b>Distance (feet)</b>	<b>Equalizer type</b>
0 – 150	1
151 – 450	2
451 – 750	3

**Operational characteristics**

**Channel bank type usage** Normally, the DMS-100 Family only interfaces with channel banks in which the transmitted signal can be slaved to the receiver clock. Interfacing with a non-synchronized channel bank would give approximately one frame slip every two seconds under worst-case conditions. Only synchronized channel banks are recommended for use with the DTC or DCM. This means all D 3 types and, depending on the manufacturer, some D 2 types are suitable.

**Channel units** The DTC or DCM will emulate and are far-end compatible with the following DS-1 trunk level signaling channel units:

- dial pulse originating (DPO)
- dial pulse terminating (DPT)
- sleeve dial pulse originating (SDPO)
- four wire E&M
- two wire E&M
- two wire DX
- four wire DX

The DTC and DCM will also emulate and are far end compatible with two line level signaling channel units:

- foreign exchange (office end) (FXO)
- foreign exchange (subscriber end) (FXS)

**Time slot organization** Each of the 24 time slots on a carrier is associated with a particular trunk on the channel bank or DCM (in a digital office) connected to that carrier. Since there is no blocking in the DCM, each trunk or each time slot of a carrier is assigned on a per call basis to a specific one of the 30 DMS-100 Family speech time slots on the network side.

The peripheral ports of a DTC are provided as 20 DS-1 ports with each group of five mapping, through a fixed map, to a group of four DS-30 network ports. Mapping is such that when all peripheral ports are provided, all channels on all network ports are used. When not fully equipped with DS-1 interfaces, the mapping allows for an even spread of DS-1 traffic over the available network ports within the 120-channel group.

**Control interface specification** Changes in A and B bits incoming from each of the 24 carrier trunks into a DTC or DCM are converted into messages in time slot 0. These messages contain the trunk address and the status of the associated A and B bits.

The NT6X50AB uses channel “2” in the ESF mode for Facilities Data Link (FDL) data.

The A and B bits transmitted on the carrier are controlled in two different ways by the supervision and signaling cards in the DCM of the DMS-100 Family System. Before outpulsing on a particular trunk, a message is sent to the DCM in time slot 0 to put the trunk into an outpulsing mode. In this mode, the A and B bits for that trunk are controlled by the data from the signaling card and the CCC. After outpulsing, the DCM puts the trunk back in normal supervision mode. In this mode, A and B bits are changed by messages arriving in time slot 0.

**Framing** The maximum average reframe time is less than 50 ms (this is the average time to reframe when the maximum number of bit positions must be examined for the framing pattern).

**Idle channel transmission** For each channel which is idle, the DTC or DCM will transmit a 01111111 pattern.

**Delay** The transmission delay caused by the buffering of bytes in the DTC or DCM will not be more than three frames (375 ms). The average delay will not be more than two frames (250 ms).

### **Local alarms**

A local carrier alarm is raised during any of four conditions:

- The DTC or DCM has lost frame synchronization on the received DS-1 signal for a sufficient amount of time.
- The number of frame synchronization losses in a 24 hour period has reached the out-of-service limit.
- The carrier slip rate has reached the out-of-service limit.
- The carrier bipolar violations rate has reached the out-of-service limit.

During a local alarm, the trunks on the DTC or DCM are taken out of service and the channel bank or digital office at the end of the DS-1 line is informed through zeroes in the second bit of all channels of the transmitted signal. At the end of the alarm state, the trunks are returned to service and the second bit in all channels is no longer forced to 0.

**Loss-of-frame synchronization** Immediately upon detecting loss of frame synchronization on an incoming DS-1 line, the DTC or DCM informs the DMS-100 Family CCC. After loss of synchronization, the NT6X50AB DS-1 I/F maintains the signaling bits in the last valid state until the DS-1 synchronization is restored. While in the alarm state, the DTC or DCM must recover and remain in frame synchronization for a continuous ten-second period for the CCC to end the alarm. A count of the total number of times a DCM loses and regains frame synchronization in a 24 hr period is also kept.

Maintenance and out-of-service limits are specified by the operating company on a per-DTC or DCM basis; 17 frame losses in 24 hr is suggested as the maintenance limit and 511 in 24 hr is suggested as the out-of-service limit. If the maintenance limit is reached, a Teletype message is printed. If the out-of-service limit is reached, the DCM is put into a local alarm until the trunks have been manually restored to service.

**Slip monitoring** The DCM sends one message to central control every time a frame slip occurs on the received T-1 facility. Maintenance and out-of-service limits are specified by the operating company on a per-office basis. In DMS-100, four slips per 24 hr are suggested as the maintenance limit and 255 slips per 24 hr as the out-of-service limit.

If the maintenance limit is reached, a log message is output. If the out-of-service limit is reached, trunks on the T-1 facility are put into a system busy state and must be manually restored to service.

**Bipolar violation monitoring** The DTC or DCM sends one message to DMS-100 Family CCC for every 1025 bipolar violations up to a maximum of one message every 384 ms. This maximum message rate corresponds to a violation rate greater than  $10^{-3}$  violations/bit. Maintenance and out-of-service limits are specified by the telephone company on a per-DCM basis. The limits allowed are  $10^{-3}$ ,  $10^{-4}$ ,  $10^{-5}$  and  $10^{-6}$  violations/bit.

If the maintenance limit is exceeded, a Teletype message is printed. If the out-of-service limit is exceeded, the DCM is put into a local alarm condition until the trunks have been manually restored to service.

### Remote alarms

When the DTC or DCM detects zeroes in the second bit of all channels of the received DS-1 signal for  $600 \pm 24$  ms, it informs the DMS-100 Family CCC through a signaling message. The CCC immediately declares a remote alarm and takes all trunks on the DCM out-of-service. While in the alarm state, if the DCM detects at least fifteen 1s in the second bits of the channels in three consecutive 48 ms periods, DMS-100 Family CCC is informed, the alarm condition ends, and the trunks are returned to service.

### Line circuits

The Line Circuit (LC) card is the final interface between the subscriber's loop and the digital circuitry in the network and central control. Various type line cards, each containing one line circuit, are available for use in the LCM. The card types are interchangeable and can be mixed within line drawers to meet the office provisioning requirements. The line card types currently available are listed below.

- Type A (6X17)—basic line card, suitable for most applications

- Type B (6X18)—has additional circuitry to provide features such as loop start/ground start option, coin features, etc.
- Type C (6X21)—interface for the MERIDIAN Business Set
- Type D (6X71)—interface for the DATAPATH Data Unit
- Type E (6X19)—interface for a subscriber set with a message waiting lamp and single party features
- Asynchronous interface 2.56 Line Card (6X76)—interface between a four-wire, RS-422 line, and the 2.56 Mb/s digital bit stream of the DMS-100.

Detailed information pertaining to each of the listed line cards is provided in the *Hardware Description Manual*, 297-1001-805.

### Line circuit functions

Where applicable, the line circuit provides these functions:

- office battery to the loop
- transmission of ringing and tones
- transmission of coin voltages
- speech coding and decoding
- test access
- loop loss control
- loop balance
- 60 Hz filtering
- loop supervision

**Office battery** Office battery is supplied to the loop on the ring lead through a 220  $\Omega$  resistance and ground on the tip side by way of another 220  $\Omega$  resistance.

**Ring** Ringing is generated in the programmable duplicated ringing generator within the Line Concentrating Equipment (LCE) bay which contains up to two LCMs. The ringing multiplexer in each LCM supplies ringing to the line cards through the ring bus.

The ringing load of both LCMs is shared by the two ringing generators. If one fails, the other assumes the full ringing load of both LCMs.

**Tones** Tones are generated by firmware controlled cards within the line group controller. Under command from a processor, the appropriate tone is transmitted to the loop through the line circuit (see Tables 5-17 and 5-18).

<b>Table 5-17 Precise tone plan</b>				
	<b>Individual frequency level</b>			
<b>Tone</b>	<b>350 Hz</b>	<b>440 Hz</b>	<b>480 Hz</b>	<b>620 Hz</b>
Call interrupt		-13 dBm <sup>1</sup>		
High tone			-17 dBm <sup>1</sup>	
Dial tone	-13 dBm	-13 dBm		
Audible ringing		-19 dBm	-19 dBm <sup>2</sup>	
Low tone			-24 dBm	-24 dBm
Variation				
Frequency	0			
Amplitude				
<b>Note 1</b> Not available in DCM.				
<b>Note 2</b> Dial tone is required for NT5X30AA 101 communications test line.				

<b>Table 5-18 Additional DMS-100 family tones</b>		
<b>Name</b>	<b>Frequency</b>	<b>Temporal pattern</b>
Busy verification	440	2 sec burst, followed by 0.5 sec burst every 15 sec.
Call waiting	440	Two 500 ms bursts separated by 10 sec.
Camp on off-hook queue	440	Single 500 ms burst
Tone expensive route	440	Single 1 sec. burst
warning	440	Three 250 ms bursts each separated by 250 ms.
Zip tone:		
ONI call	480	0.1 sec on, 0.1 sec off, 2 times
ANI failure	480	0.1 sec on, 0.1 sec off, 1 time
Conference lock	480	Single 1 sec burst
—continued—		

<b>Table 5-18</b>		
<b>Additional DMS-100 family tones</b> (continued)		
<b>Name</b>	<b>Frequency</b>	<b>Temporal pattern</b>
Conference tone	350 + 440	0.1 sec on, 0.1 sec off, 0.3 sec on;
Dial tone	350 + 440	Steady on
Recall dial tone	350 + 440	3 burst (.1 sec on, .1 sec off)
Authorization code	350 + 440	then steady on
Account code prompt	350 + 440	3 burst (.1 sec on, .1 sec off)
Prompt		then steady on
Conference leave	350 + 440	3 burst (.1 sec on, .1 sec off)
		then steady on
		Single 1 sec burst
Line busy	480 + 620	0.5 sec on, 0.5 sec off; repeating
Reorder	480 + 620	0.25 sec on, 0.25 sec off; repeating
Ring again/call back	480 + 620	0.25 sec on, 0.25 sec off; repeating
queue offer tone	480 + 620	
station ringer test:		
Ring party	480 + 620	Steady tone
Tip party	480 + 620	0.25 sec on, 0.25 sec off; repeating
Audible ringing	440 + 480	2 sec on, 4 sec off; repeating
Conference join	440 + 480	Single 1 sec burst
Receiver off-hook	1404 + 2406 2452 + 2604	0.1 sec on, 0.1 sec off; repeating
End		

**Coin voltage** Coin collect and coin return voltages are generated by the LCM ringing generator card and fed to the loop through the line circuit. The NT2X03AA (LM) and the NT6X23AA (LCM) provide +48 V for various coin functions. The voltages are used in conjunction with the type “B” line circuit and are provided on a per drawer basis as required.

**Speech coding and decoding** Speech is converted from an analog form to a digital form and vice-versa by the CODEC circuit on the line card. A filter limits the bandwidth to 3400 Hz. Speech sampling is done at an 8 kHz rate.

**Test access** A relay on the line card allows testing to be performed on the loop as well as towards the central office equipment side (see Line circuits for additional information).

**Loop loss control** To meet the fixed loss plan, pads under software control are switched in. This permits up to 7dB of loss in 1dB steps to be inserted in the outgoing speech path (D/A). Pad values are inserted under software control in the originating line circuit for the type of calls:



Connecting office type	Pad value
Intra-office	0 dB
Co-located SXS	1 dB
End-Office-Local	3 dB
Toll Analog	5 dB
Toll Digital	6 dB
End-Office-Toll	6 dB

**Loop balance** In order to match the cable type and loading on the line, loop balance networks can be selected on the line circuit under software control.

For loaded lines, the balance network selected is 1650  $\Omega$  in parallel with 5 nF. For non-loaded lines, the network is 800  $\Omega$  in parallel with 50 nF.

**Balance network testing (type A, B, and E line cards)** Loops are automatically classified as loaded or non-loaded and a corresponding balance network in the line circuit is used for each type. This system reduces the amount of mismatch to minimize echo on the loop. If, however, the return loss is less than a certain value, the echo is unacceptable for intra-office calls so the DMS-100 machine causes a 2 dB loss pad within the line circuit to be used for intra-office calls. The off-hook balance network test also determines if a loss pad is required to increase return loss above a certain level.

Under certain circumstances a balance network test will reconfigure the balance network or loss pad or both in the line circuit. When a line circuit has been changed, the tuple for that line circuit in the Line Circuit Inventory Table (LNINV) is updated as required to reflect the change.

To preserve the results of the more extensive and accurate off-hook balance network test, the value of the Manual Override bit (MNO) for the tuple of each line thus tested is set to Y (yes) in data table LNINV. This Y value prevents the on-hook balance network test from updating the tuple.

**On-hook balance network test (type A, B, and E line cards)** The on-hook balance network test is performed at the LTPM level, the LTPLTA level, or the ALT level. No log reports are generated as a result of this test at any level.

The on-hook balance network test is normally run automatically without manual intervention under operating company set schedules. This is done on the ALT level.

The on-hook balance network test is used to determine whether a loop is a loaded or non-loaded type and to display the result on the Visual Display Unit (VDU) if the test is manually invoked. The loop type is displayed both before testing and after. This test will also change the balance network in the line circuit connected to the loops tested and update the data table (LNINV) for the tuple of this line circuit if required, unless the changes have been inhibited.

**Off-hook balance network test (type A, B, and E line cards)** The off-hook balance network test is performed at the LTPLTA level. The off-hook balance network test is used to determine whether a loop is a loaded or non-loaded type and display the result on the VDU.

This test will also change the balance network in the line circuit connected to the loop tested and update the data table LNINV for the tuple of this line circuit if required. This test is more accurate than the on-hook balance network test. See Interoffice transmission testing in Chapter 7 for line testing facilities.

**60 Hz filtering** The transmit side (A/D) of the line circuit provides for 60 Hz AC induction filtering. Longitudinal induction of up to 20 mA per conductor can be tolerated by the line circuit. In a line connection the response at 60 Hz is at least 20 dB down from the reference frequency level.

**Loop supervision** The loop supervision circuitry monitors the line for on-hook/off-hook status. This information is passed to the appropriate peripheral processor and action is taken accordingly. This circuitry is also used to detect the changes in state of the loop that occur during DP dialing.

### Dialing

A station can have dialing option DP or DTMF. For DTMF the tones are received by the line circuit and transmitted to the DTMF receiver for digit detection and recognition. For DP information, see Line circuits.

### Line test circuits

The test circuits within the line card are activated by coded control signals. Depending on the code, signals are either sent to the relay drivers which operate the Test Access relay (TA) or the Cut-off relay (CO), or used to activate test circuits within the line circuit chip itself (see Figures 5-13 through 5-17).

**Test access** The Test Access (TA) relay on the line card provides metallic contact with the subscriber's analog line and the VF transformer. With TA and CO relays operated, contacts of TA are closed and those of CO are open, thus isolating the subscriber loop from the LC card, and enabling subscriber loop tests to be applied using the TA to the T and R leads. With the TA relay only operated, the TA provides bridged monitor access to the subscriber's T and R leads and the VF transformer.

**Cutover control** The Cut-Off relay (CO) also provides a facility for software-controlled cutover. For cutover, the cutover hold line is grounded using a common cutover circuit in the Line Drawer (LD). Once operated, sufficient current flows through the CO relay from the cutover hold line so that all operated CO relays in the line cards remain operated. This opens the CO contacts, thus isolating the tip and ring leads of the addressed line circuit from their connections to the MDF. At cutover time, the ground on the cutover hold line is removed, opening the hold current path for all CO relays in the line drawer. Any CO relay which has previously been set to the cut-off state will then be released. This simultaneously connects the tip and ring leads of any selected number of LC cards to their associated MDF connections.

**Analog loop-around** With only the relay CO operated, the T and R leads are isolated and the VF transformer is unbalanced. This causes VF signals on the "receive" path to appear on the "transmit" path with almost zero loss. The analog loop-around consists of a VF signal in digital form from a test signal generator.

After conversion to analog, the test signal crosses to the "transmit" path, is converted back to digital, and returns to the test equipment. By comparison of the input and output signals, the condition of the "transmit" and "receive" circuits can be tested.

**Digital loop-around** A special four-bit test pattern is transmitted and received through an established digital path to check the integrity of the digital connection in the line circuit.

**Metallic test access** The NT3X09 Metallic Test Access (MTA) circuit pack is used to provide a metallic DC connection between test circuits and line circuits on the DMS-100 Family peripherals. Two versions of the card are available; NT3X09AA with a 4x8 relay matrix, and the NT3X09BA with a 8x8 relay matrix. A larger matrix size can be obtained by joining together multiple circuit packs.

The MTA circuit pack occupies one slot in a Maintenance Trunk Module (MTM) or a Remote Service Module (RSM). One trunk appearance to the trunk controller is required for relay matrix control and 12 or 16 tip and ring

appearance, (AA and AB version respectively) are required for horizontal and vertical relay matrix connections.

The NT3X09 serves as a replacement for the 2X46AB Minibar switch and NT2X50 driver card currently being used for Metallic Test Access. The circuit pack will be provided for initial jobs and for growth to existing NT2X46AB/NT2X50 arrangements.

### **Line circuit types**

Various type line cards, each containing one line circuit, are available for use in the LCM. The card types are interchangeable and can be mixed within line drawers to meet the office provisioning requirements. Detailed information pertaining to each of the listed line cards is provided in the General Specifications (GS) documentation associated with the particular line circuit. Seven line card types are currently available:

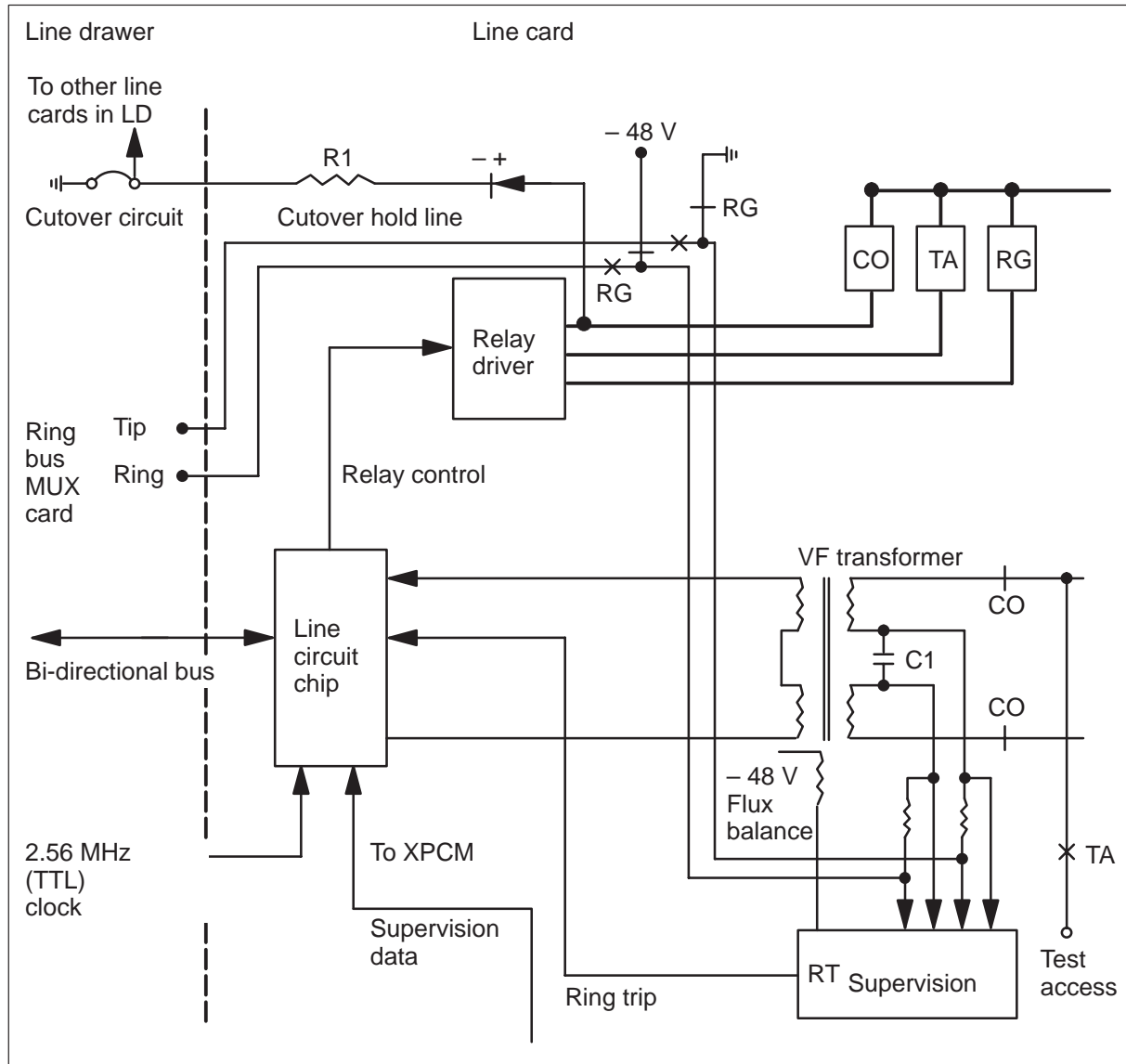
- Type A (6X17)—basic line card, suitable for most applications
- Type B (6X18)—has additional circuitry to provide features such as loop start/ground start option, or coin features
- Type C (6X21)—interface for the Meridian Business Set
- Type D (6X71)—interface for the Datapath Data Unit
- Type E (6X19)—interface for a subscriber set with a message waiting lamp and single party features
- Asynchronous interface line card (6X76)—interface between a four-wire, RS-422 line, and the 2.56 Mb/s digital bit stream of the DMS-100.

### **Line circuit diagram**

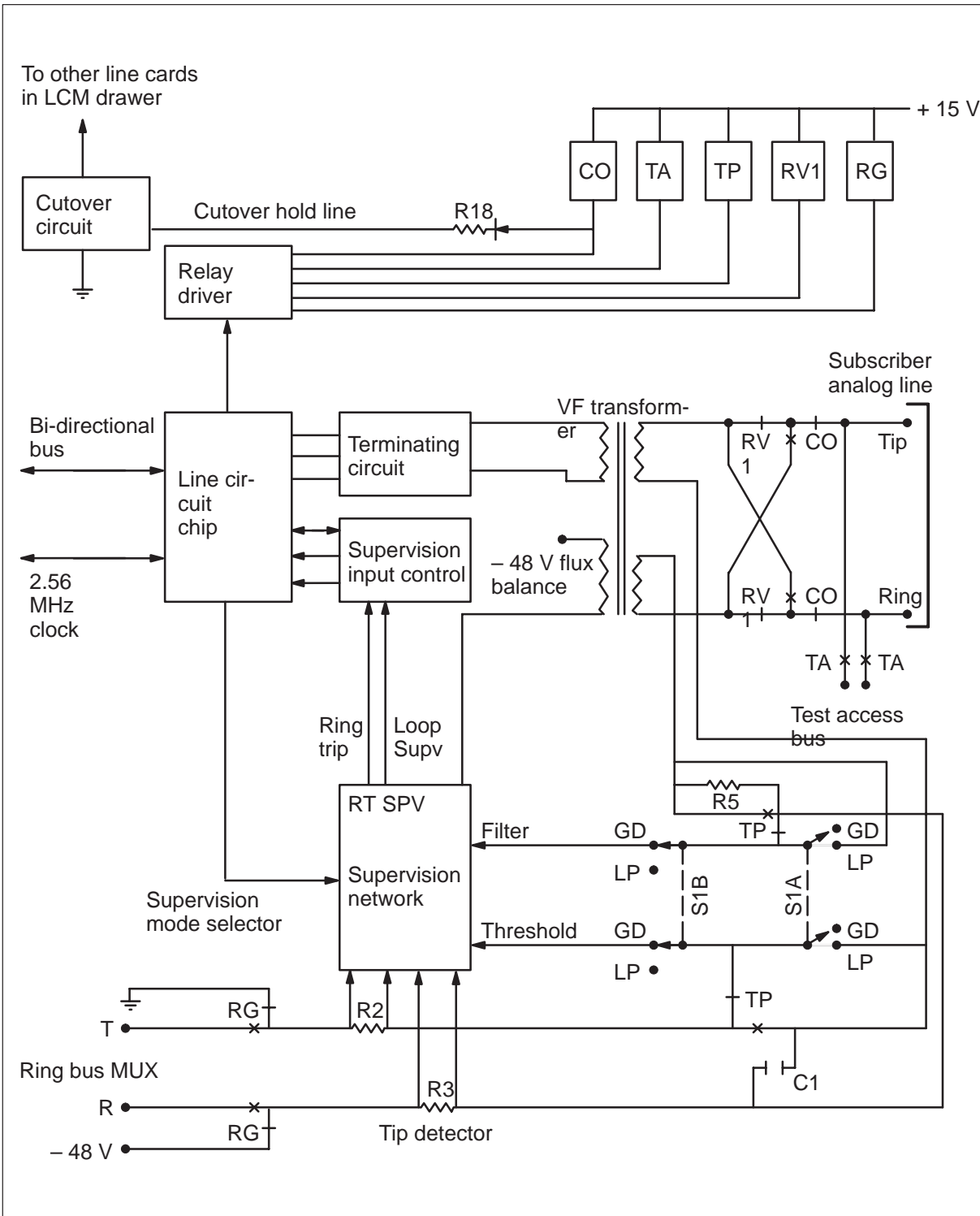
Block diagrams are shown for these line cards:

- Type A           Figure 5-13
- Type B           Figure 5-14 and Figure 5-15
- Type C           Figure 5-16
- Type E           Figure 5-17

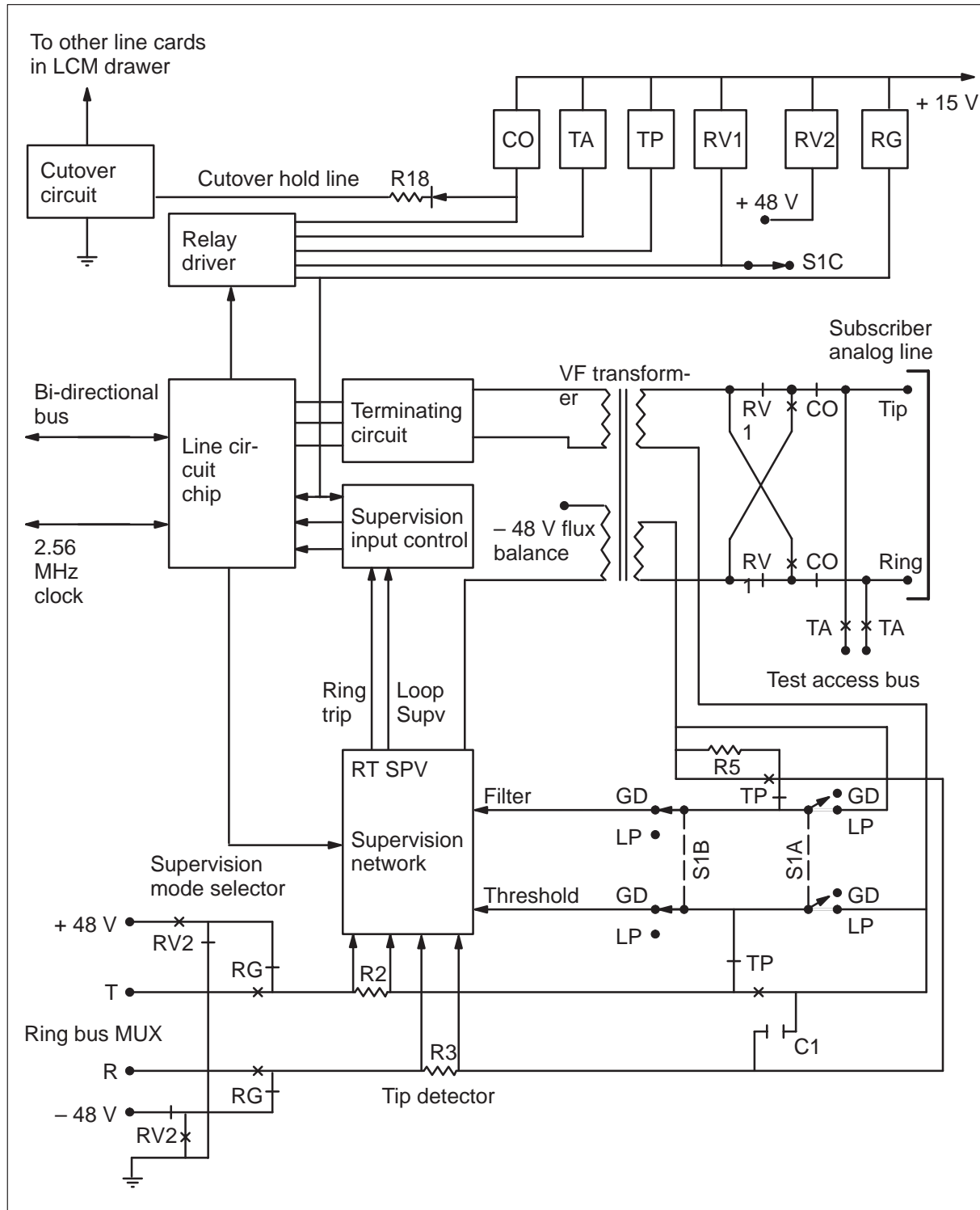
**Figure 5-13**  
**Simplified block diagram, standard line card type A**



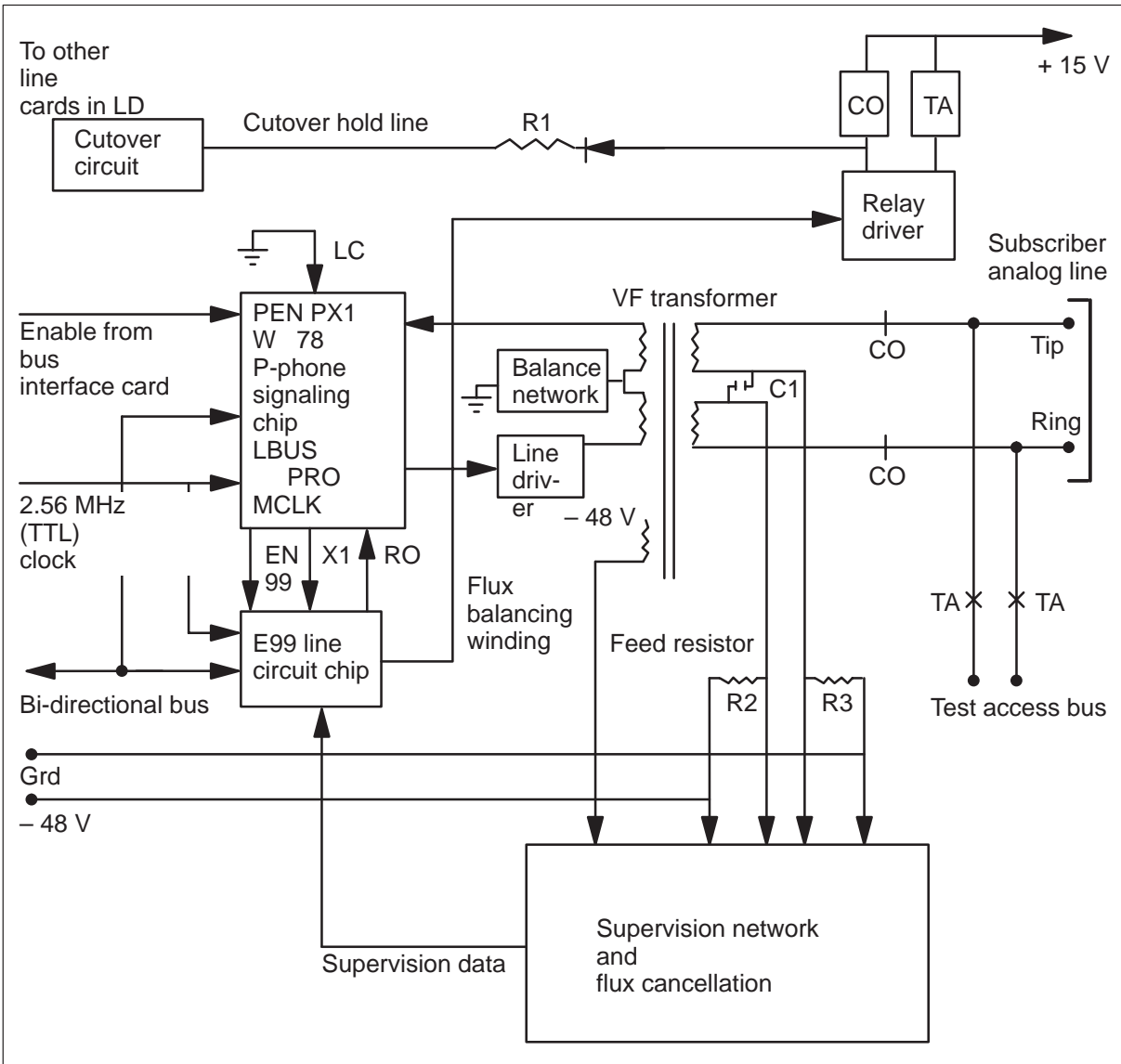
**Figure 5-14**  
**Block diagram, line card type B (NT6X18AA)**



**Figure 5-15**  
**Block diagram line card type B with + 48 V (NT6X18AB)**

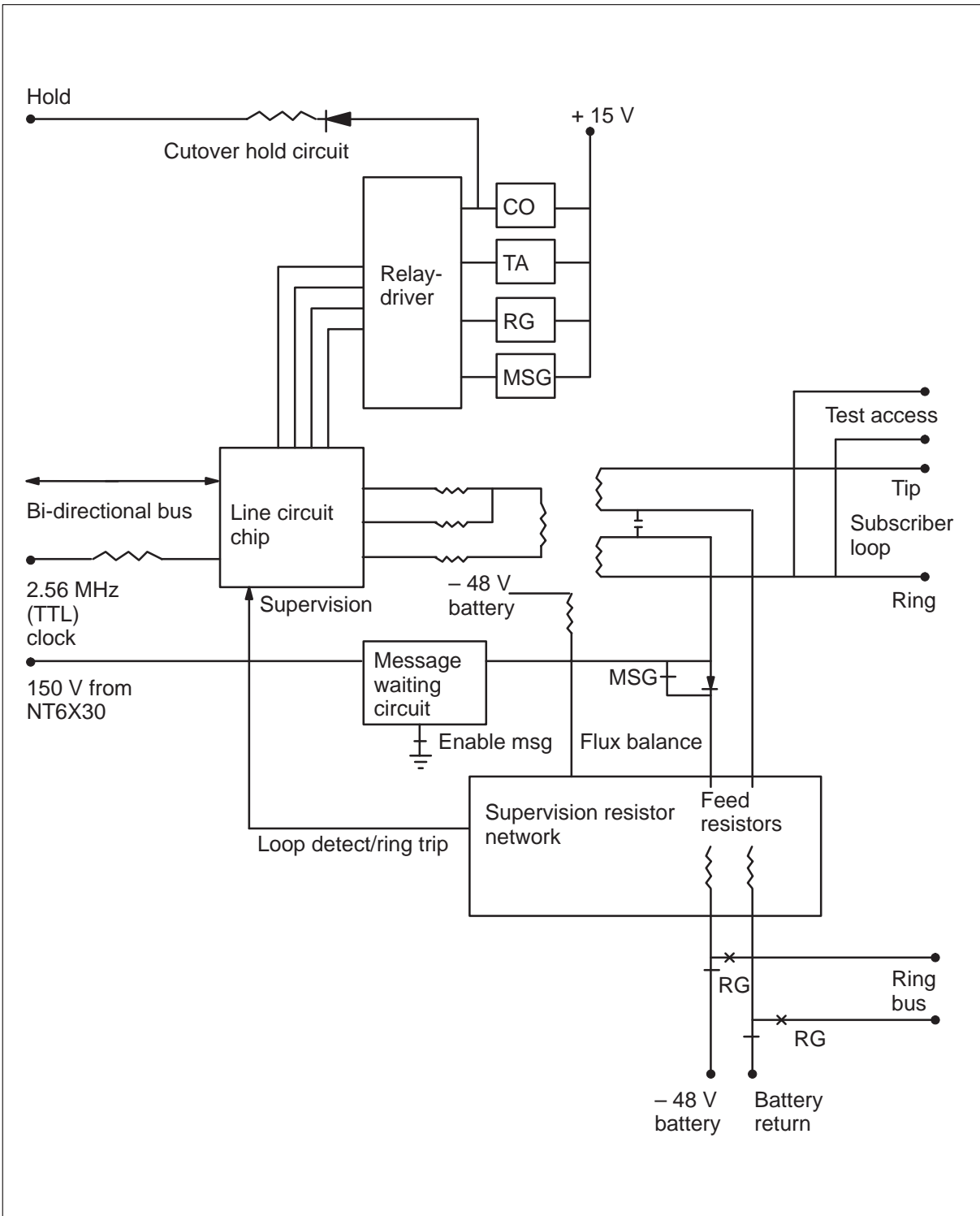


**Figure 5-16**  
**Simplified block diagram business set line card type C (NT6X21AC)**





**Figure 5-17**  
**Block diagram, line card type E (NT6X19AB)**



**Line circuit transmission**

The transmission parameters for line circuits are described in Chapter 7.

**Line circuit power requirements**

In the idle condition the power required is shown for each pack type.

Type A	2X17AB, AD	175 mW
Type B	2X18AD, AE	190 mW
Type A	6X17AC	165 mW
Type B	6X18AA, AB	190 mW

**Line circuit feature compatibility**

Tables 5-19, 5-20, and 5-21 list feature and line class compatibility information.

**Table 5-19**  
**Line functions**

	Ringing type	Circuit pack code					
		ANI	2X17AB, AD	2X18AB, AE	6X17AC	2X18AA, AB	6X19AB
Single party	20 Hz ac/dc bridged or ring to ground	NA	X	X	X	X	X
	MF bridged or ring to ground <sup>1, 2</sup>	NA	X	X	X	X	X
2-party	20 Hz ac/dc divided	YES	<sup>3</sup>	X		X	
	MF divided <sup>1, 2</sup>	YES	X	X		X	
	MF bridged <sup>1, 2</sup>	NO	X	X	X	X	
4-party	20 Hz ac/dc divided, coded (4-party semi-selective)	NO		X		X	
	20 Hz ac/dc bridged coded	NO		X		X	
	20 Hz superimposed, divided (4-party fully-selective)	YES		X		X	
	MF divided <sup>1, 2</sup>	YES		X		X	
	Mf bridged <sup>1, 2</sup>	NO		X		X	
8-party	20 Hz ac/dc divided, coded	NO	X	X	X	X	
	MF divided <sup>1, 2</sup>	NO		X		X	
	20 Hz superimposed, divided, coded (8-party semi-selective)	NO		X		X	
<p><b>Note 1</b> Only 4 frequencies within an FM group are provided.</p> <p><b>Note 2</b> MF ringing may be one of the following groups:                      Harmonic – 16 2/3, 25, 33 1/3, 50, 66 2/3, Hz;                      Synchronomic – 20, 30, 42, 54, 60, Hz                      Decimonic – 20, 30, 40, 50, 60, Hz.</p> <p><b>Note 3</b> May be used for Bell Canada only.</p>		<p>Legend: X – available                      NA – not applicable</p>					

**Table 5-20**  
**Line functions**

Business		Notes	2X17AB, AD	2X18AD, AE	6X17AC	6X18AA, AB	6X19AB	6X21AC	6X71AA	
PBX and PABX	Loop start		X	X	X	X	X			
	Ground start			X		X				
	Toll diversion	Indication provided by reverse battery		X		X				
	Hotel motel	Indication provided by reverse battery to PBX message registers		X		X				
		Lights message waiting lamp						5		
WAT & TWX			X	X	X	X	X			
Business set	DMS-100 business set	Also provides for low speed data						4		
Data	Datapath data unit	High and low speed data							X	
<p><b>Note 4</b> Uses above band ask for signaling  <b>Note 5</b> In conjunction with NT6X20AA</p>										

**Table 5-21**  
**Line functions**

Coin		2X18AD	2X18AE	6X18AA	6X18AB
Prepay dial tone first (loop start)	Rotary dial	X	X	X	X
	Digital +48 V on ring fraud prevention	8			8
	Digital -48 V T/R reversal fraud prevention	7,8	6,7	6,7	6,7
	Digitone no fraud prevention	X	X	X	X
Prepay coin first (ground start)	Rotary dial	X	X	X	X
	Digital +48 V on ring fraud prevention	8			8
	Digital -48 V T/R reversal fraud prevention	6,7	6,7	6,7	6,7
	Digitone no fraud prevention	X	X	X	X
Semi-post pay		X	X	X	X

**Note 6** When no ground is provided in the coin station, a 900 Ω limit applies  
**Note 7** This feature disables the touch-tone pad in the coin station by providing a tip/ring reversal on operator connection.s  
**Note 8** This method provides +48 on the ring and ground on the tip during a reversal condition to disable the touch-tone pad in the coin station. Requires use of +48 V converter

**Remotes interface**

The DMS-100 Family host switching system interfaces with its remotes using host peripherals and DS-1 signaling links at the host, and mate DS-1 signaling links in the remote. A DCM supports an RLM. Either an LGC or an LTC can support a Remote Line Concentrating Module (RLCM) a Remote Switching Center (RSC), or an Outside Plant Module (OPM).

The host located DTC provides DS-1 signaling interface to the Large Business Remote (LBR). An LGC or LTC located in the LBR supports the RSC and RLCM/OPM in remote off remote configurations. Interface specifications are described in Digital trunk interface—DMC and DTC.

**Meridian digital centrex attendant console**

The attendant console is a compact microprocessor driven cordless unit designed to be easily mounted on a desk or table top. These are the console main components:

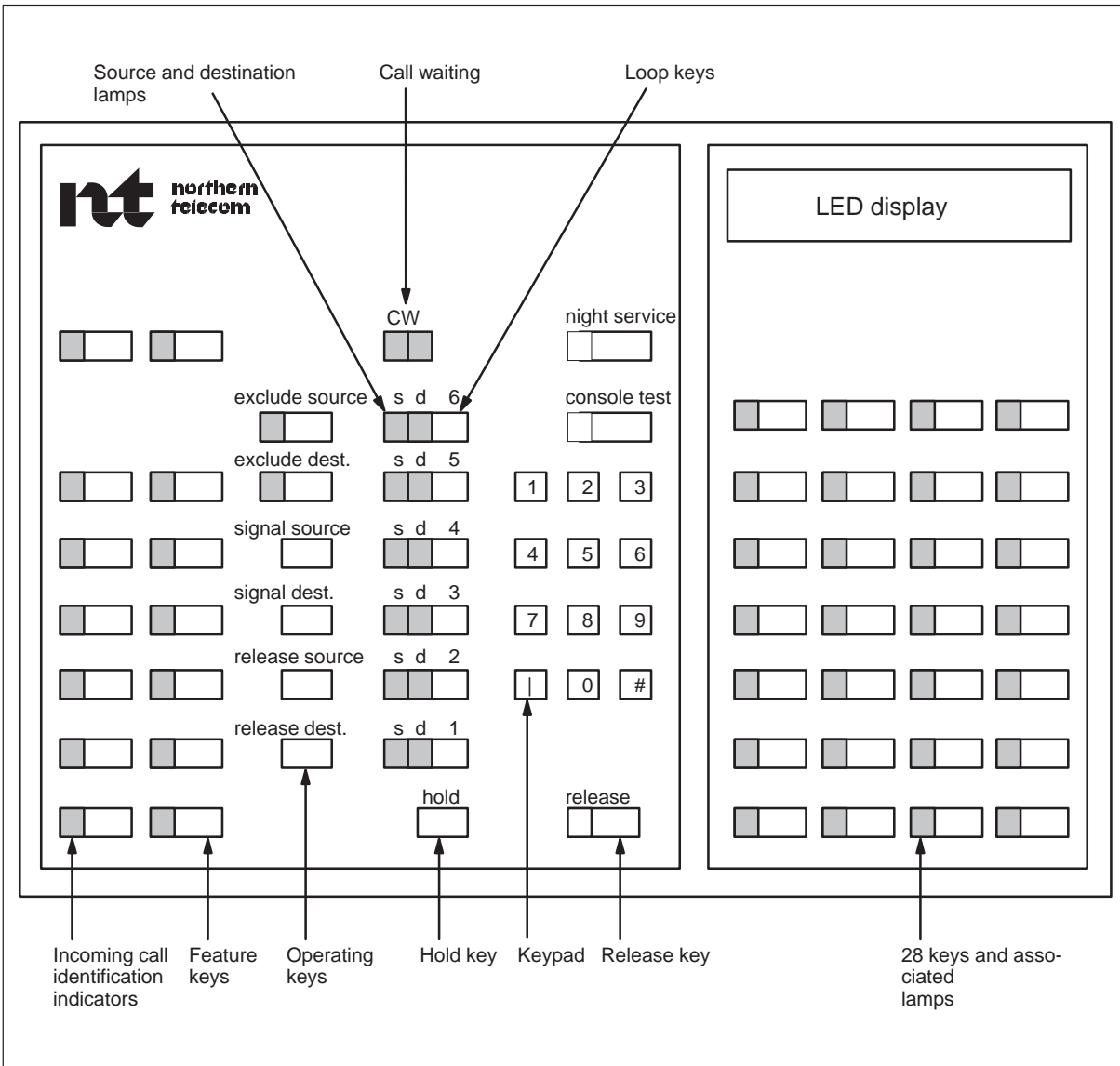
- 12 button key pad
- 6 loop keys with associated source and destination lamps
- 10 standard keys, 6 standard lamps

- 42 optionally assigned keys and lamps
- 2 headset/handset jacks, one on each side of the console loudspeaker
- 2 volume controls, one for headsets and one for handset
- 16 character alphanumeric display
- Indicator lamps using LEDs
- Hold key

**Console layout**

Figure 5-18 illustrates the attendant console layout.

**Figure 5-18**  
**Attendant console faceplate**



The attendant console is a compact, aesthetically pleasing unit designed to provide simple, efficient operation and minimum attendant work time. The entire unit measures 13 1/4" wide by 12" deep by 3 1/2" high (336 mm by 305 mm by 89 mm). Keys are designed for ease of access, provide positive tactile response to the user and are spaced to minimize keying errors.

The console faceplate is functionally divided into three distinct areas. The central portion contains 26 fixed function keys with associated lamp displays where applicable and are assigned as shown in the table below. The left side of the faceplate mounts 16 key/lamp combinations which are, with the

exception of two keys (console test and night service) universally assignable to any feature or function required.

The right hand panel of the console faceplate provides for a maximum of 28 additional feature keys and a 16 character alphanumeric display. All keys are universally assignable to any feature or function required. The display is 16 characters and provides information such as calling line, called line, class-of-service, and trunk group name. A display control function key can be assigned to handle two-stage display formats for a total of 32 characters, if 16 characters are insufficient.

In addition, the console is equipped with two headset/handset jacks (one on each side), a loudspeaker, and volume controls for both headset/handsets and the loudspeaker. The console can be locally powered either from the DMS switch (-48 V) or remotely powered using power supplies.

### **Console interface**

Attendant console interface to DMS-100 is shown in Figure 5-19.

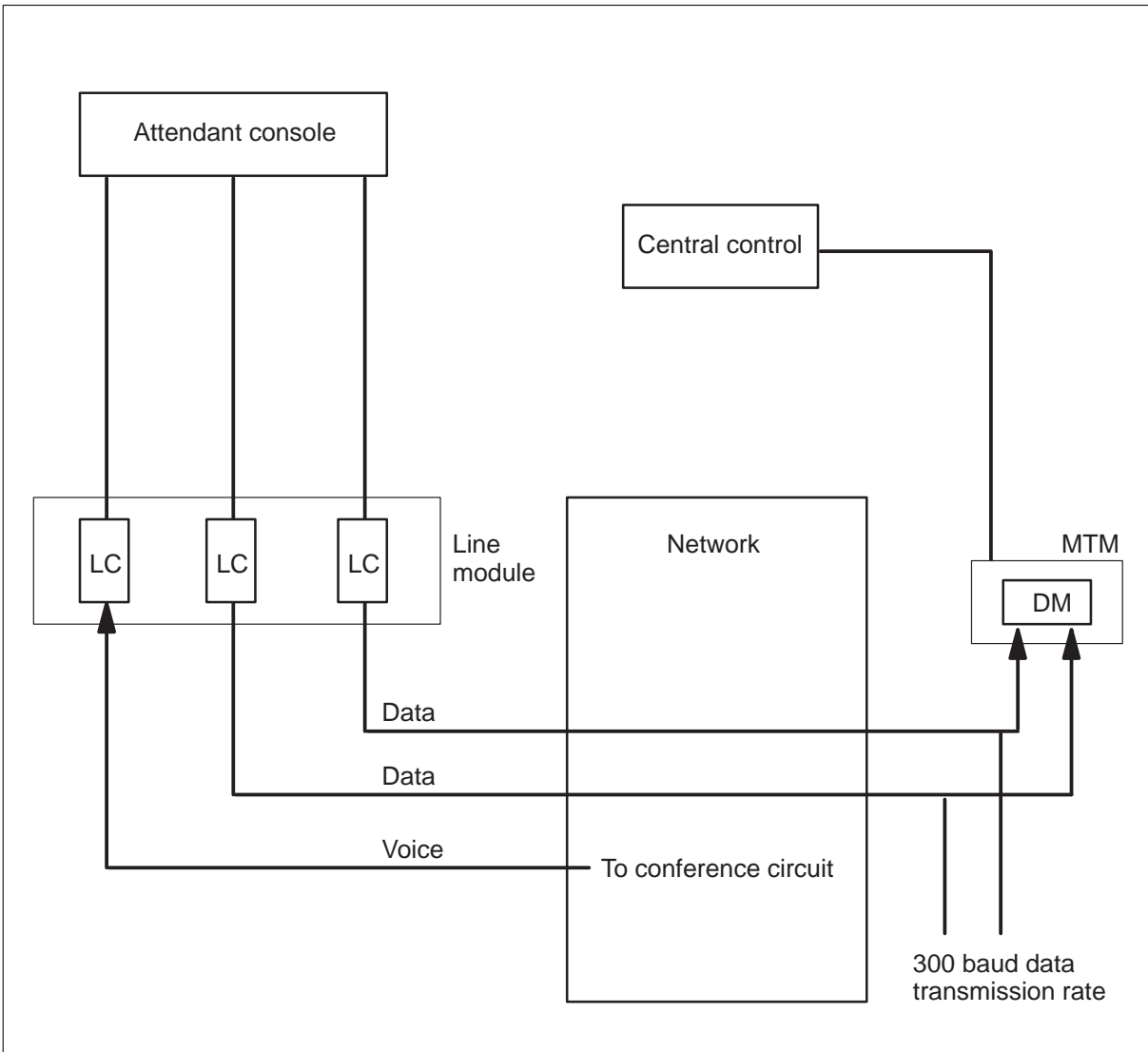
Connection between the console and the system is through a cable with three associated line appearances on the DMS-100 machine. One pair is required for voice, one pair for data transmission from the console to DMS-100, and one pair for data from the DMS-100 to the console.

While the console has six loop appearances, only one call may be processed by the attendant at a time. As a result, only one voice pair is required, with DMS-100 establishing the appropriate network connections to switch calls directed to the console to the voice pair when requested by the attendant through operation of the appropriate LOOP or Incoming Call Indication (ICI) key.

The data transmit pair is used to convey console keying information to the DMS-100 central control. Many of the keys on the attendant console exist only as addresses to the DMS-100 machine. A state change of a console key is transmitted to central control and the database is searched to determine the action required by DMS-100 as a result of the state change at that address. This provides great flexibility in that a key may be reassigned to a different function through an appropriate change to the system data base.



**Figure 5-19**  
**Attendant console system configuration**



The data receive pair provides the console microprocessor with the the information necessary to update console displays as a result of state changed in calls being served or waiting in the attendant queue.

The digital modem is used to receive keying information from the console in FSK format, and assemble this data in logical groupings of ASCII characters for transmission to the DMS-100 central control. In the reverse direction, messages are received from central control in ASCII and converted to FSK for transmission to the console.

A three-port conference circuit is dedicated to each console to bridge calling/called parties and the attendant as required, and eliminates the multiplicity of network connections which would otherwise be necessary. When attendant functions have been completed, the calling and called parties are joined over a regular network connection, and the conference circuit is released.

<b>Table 5-22 Typical console key assignments</b>	
<b>Key</b>	<b>Function</b>
12 button dial pad	These keys are used for digit entry. The asterisk (*) key is used to insert pauses for speed call programming. The octothorpe (#), when used, indicates an end of keying sequence.
LOOP	These six keys are used to answer, originate, and complete calls. Each LOOP key has an associated Source (SRC) and Destination (DEST) lamp to reflect calling and called party states during attendant handling. Calls are presented on loops on a first-idle-loop basis.
CW (Calls Waiting) Lamp	CW is a lamp with no associated key. It is OFF when no calls are waiting in the attendant queue, ON when one or more calls are waiting and flashes at 60 impulses per minute (IPM) when the number of calls waiting exceeds a specified threshold.
RLS (Release)	This key is used to release calls from the loop. Operation of this key makes the loop idle and makes the position available to receive new calls. The RLS lamp is OFF when the console is busy and ON when the console is idle.
HOLD	The HOLD key has no associated lamp. When operated, the attendant continues to receive call status information through the SRC and DEST lamps for the loop, but the attendant position is available to receive new calls.
RELEASE SRC (Release Source)	This key has no associated lamp. It is used to release a calling party.
RELEASE DEST (Release Destination)	This key has no associated lamp. It is used to release a called party, release from a busy reorder signal, or correct a keying error when dialing the destination.
—continued—	

<b>Table 5-22</b> <b>Typical console key assignments</b> (continued)	
Key	Function
SIGNAL SRC and sides of SIGNAL DEST	These keys are used to signal a party on the source and keys destination the loop respectively. The signal can be momentarily on-hook to another office or office or ringing for a local station.
EXCLUDE SRC and EXCLUDE DEST	These keys are used to temporarily exclude a calling or a called party to permit the attendant to talk privately with the other party. The lamp associated with each key is OFF when a party is not excluded and ON when a party is excluded.
NIGHT SERVICE	The key is used to invoke night service.
ASSIGNABLE KEYS	The following are examples of assignable keys.
CONSOLE TEST	This key, in combination with other keys, will perform various tests on the console.
ICI (Incoming Call Indication)	ICI lamps indicate the types of calls (by trunk class) being presented on the attendant loops, either in conjunction with or in isolation of the alphanumeric display. One ICI key/lamp assignment is required for each trunk class appearing on the console.
	The ICI keys are used to override the first-in/first-out call selection sequence presented on the attendant loops. If local operating policies dictate that certain call types are to be answered in preference to others, depressing the appropriate ICI key will present the first call of that type to the attendant for answer.
TGB (Trunk Group Busy)	The TGB lamps indicate the busy/idle status of each trunk group access control. Station access to a particular trunk group is denied when the associated TGB key is activated by the attendant.
SPEED CALL	This key is used to activate or program speed calling. Several of these keys may appear on a console depending on the number of speed call lists to which the attendant has access.
ACCOUNT	The ACCOUNT key is used to input and account code to the automatic message accounting equipment for outgoing calls processed through the attendant.
—continued—	

<b>Table 5-22</b> <b>Typical console key assignments</b> (continued)	
<b>Key</b>	<b>Function</b>
CONFERENCE	The CONFERENCE key allows the attendant to establish multiport conference calls.
BUSY VERIFY (Lines)	This key permits the attendant to verify the busy/idle status of a particular line.
BUSY VERIFY (Trunks)	This key permits the attendant to verify the busy/idle status of trunks.
POS BY (Position Busy)	Operation of the POS BY makes key console unavailable for handling calls.
<b>End</b>	

### **Electronic business set**

The Electronic Business Set operates with MDC. It provides subscribers with pushbutton access to a host of business features. The key software allows the set to be customized with features:

- Auto answer back
- Auto dial
- Automatic line
- Basic call display
- Busy override
- Call-back queuing
- Call forward
- Call hold
- Call park
- Call pickup
- Call transfer
- Call waiting
- Code access to features
- Display called number
- Display calling number
- Display key
- End-to-end signaling
- Feature display
- Group intercom
- Individual business line

- Intercom
- Listen-on-hold
- Make set busy
- Malicious call hold
- Message waiting
- Multiple Appearance Directory Number (MADN)
- On-hook dialing
- Privacy release
- Query time key
- Ring again
- 6- and 30-port conference
- Speed calling
- Three-way conference

There are nine assignable keys, eight of which have Liquid Crystal Display (LCD) indicators. The electronic business set is equipped with a standard 12 button keypad and four feature key configurations:

- Volume up
- Volume down
- Hold
- Release

A hands-free speakerphone and a 20 key/16 LCD add-on module are available. Up to three add-on modules may be attached to the right side of the business set, providing up to 69 keys that can be programmed with any combination of features and directory numbers. The business set is also available with an optional 32 character display. The display, made up of two 16-character lines centered above the keypad, is controlled by an internal microprocessor and shows information such as called number, calling number, date, and time.

The business set operates over a two-wire (single pair) unloaded loop connected to a business set line card (NT6X21AC) located in either a DMS-100 IBN host office or a DMS-100 remote. Each business set line card supports a single loop.

### **Intersystem DC signaling**

This section specifies the supervisory, address, and other signals that are received or generated at the interface between DMS-100 Family and the trunk facilities to other switching systems or switchboards. The interface circuitry of DMS-100 Family is a trunk circuit. Trunk features are also provided where applicable.

Intersystem DC signaling is accomplished through the use of two electrical states designated as on-hook and off-hook. These states designate the two signaling conditions of a trunk. If a trunk is idle, it signals an on-hook toward each end. Seizure of a trunk at the near end initiates an off-hook signal which is transmitted to the distant end. A distant end off-hook transmitted to the near end constitutes a seizure, answer, delay dial, reverse make busy, or ANI request signal. A transition state occurs during state changes from on-hook/off-hook to off-hook/on-hook. This transition state is specified for loop and E&M trunks.

### **Trunk seizure**

A seizure signal (sustained off-hook) is transmitted toward the called end of a trunk following its seizure by the calling office. This seizure signal continues until the connection is released. The transmitted or received seizure signals depend on the trunk type:

- received seizure (off-hook)
  - loop closure (loop trunk)
  - receiving ground on the E lead (Type DI E&M)
  - closure between E and SG leads (Type II E&M)

### **Immediate dial operation**

On calls from/to a non-common control step-by-step office, the address signaling will be by dial pulsing on an immediate dial basis. DMS-100 Family trunks can be assigned for immediate dial operation. There are two timing requirements:

- Incoming Call – DMS-100 Family is ready to receive digits typically within 90 ms including seizure recognition time.
- Outgoing Call – DMS-100 Family inhibits outpulsing for a period of 150 ms. This is a standard office parameter value. It can be set to the required operating company value in 10 ms steps, within the given limits, at the time of initial input or at extension time.

### **Wink start operation**

Wink start signal is a timed off-hook signal and is sent by the called office to the calling office upon recognition of the incoming seizure as soon as the system is ready to receive address signals. The off hook to on-hook transition at the end of the wink is considered as a start-dial signal by the

calling office. The DMS-100 Family has certain timing specifications for the wink-start operation.

**Minimum pause before send**

Wink (DP)	100 ms
Transmitted Wink	10 ms – 2550 ms
Receiving Pre-Wink Time	5120 ms maximum
Received Wink	100 to 350 ms (≥ 350 ms is glare on two-way trunks)
Pause Before Start Outpulse	80 ms

DMS-100 Family is ready to receive digits within 20 ms after sending the wink start (off-hook to on hook transition) signal.

**Delay dial operation**

Delay dial operation is similar to wink start operation, except that the leading edge (on-hook to off-hook transition) is returned immediately upon receiving the seizure signal. In some cases, the called office may be at off-hook state while idle.

DMS-100 Family outgoing trunks can operate with Class 5 office incoming trunks which are either off-hook or on-hook when idle. The required idle state can be selected by means of trunk data table entry. The timing requirements are specified below.

**Minimum Pause Before Send Delay**

Dial (DP)	100 ms
Transmitted Delay Dial	150 ms
Receiving Pre-Delay Dial Time	320 ms – 5120 ms
Received Delay Dial	100 to 5120 ms (≥ 5120 ms is glare on two-way trunks)
Pause Before Start Outpulse	80 ms

DMS-100 Family is ready to receive digits within 20 ms after sending the delay dial (off hook to on-hook transition) signal.

### **Integrity checking**

A signal integrity check is made during the initial call setup from the DMS-100 Family to another switching system. It is associated with detection, identification and recording of trunk/facility troubles. Two types of signaling integrity check are provided:

- checking the correct signaling response from the distance office for the trunks with delay dial or wink start
- checking the circuit continuity and correct polarity on the tip and ring for the trunks with loop supervision

### **Glare resolution**

Glare is the condition that occurs when a two-way trunk is seized from both ends at about the same time. On outgoing calls (two-way E&M lead trunks) to common control systems, upon forwarding the seizure signal, DMS-100 Family waits for the start dial signal (wink or delay dial) from the far end. If a start dial signal is not received by the seizing office within a specified time a glare condition is detected.

If the DMS-100 Family office is specified (operating company specifiable) as the “controlled end”, DMS-100 Family office will disengage from this blocking condition and permit the “controlling end” to proceed with the call attempt. The original outgoing call will be retried on another trunk.

If the DMS-100 Family office is specified as the controlling office, it waits (maximum 5120 ms) for the incoming off-hook state to change to on-hook. Then it starts to outpulse in the normal manner. If on hook is not detected after 5120 ms, DMS-100 Family drops its seizure signal, accepts the incoming call and selects an alternate trunk for the outgoing call.

To minimize this undesired condition on two-way trunks, in the DMS-100 Family, opposite order trunk selection (hunting) feature is provided. With this feature, two-way trunks will be selected (hunted) according to the manner which is specified by the operating company. Four trunk selection (hunting) options can be specified by the operating company:

- most idle
- least idle
- sequential
- circular

The option selected by the operating company is dependent upon the way the trunks are selected by the interfacing switcher. Thus simultaneous seizures from both ends are normally minimized unless only one idle trunk remains in the group.



### Stop-go operation

On calls to an office that is not equipped for immediate dial through an intertoll step-by-step tandem office, the stop-go method of operation is required. The stop signal is a timed off-hook signal and is returned to the originating office from the tandem office within the dial pulse interdigital interval to stop the outpulsing until the supervisory condition returns to on-hook (go signal).

DMS-100 Family intertoll trunks can be assigned for stop-go operation. Up to 3 stops may be specified per trunk group. Maximum timing requirement to receive the go signal is 4 sec. Invalid stop or a go time-out will route incoming trunk to sender retrieval.

### Dial pulsing

With dial pulse operation, the numerical value of each address digit is represented by the number of on-hook pulses. DMS-100 Family dial pulse reception and transmission feature is software controlled. No service circuit is associated with these functions.

Transmitted pulses (off-hook/on-hook) depends upon the trunk types:

- loop closure/open (loop trunk)
- applying battery/ground on the M lead (Type DI E&M)
- closure/open between M and SB leads (Type II E&M)

Outgoing Dial Pulse Characteristics

- speed  $10 \pm 0.2$  pps
- % break  $60 \pm 2$
- interdigital time 70 to 1000 ms (operating company specifiable).

Received pulses (off-hook/on-hook) depend upon the trunk types:

- loop closure/open (loop trunk)
- receiving ground/open on the E lead (Type DI E&M)
- closure/open between E and SG leads (Type II E&M)

Dial pulse receiving capability:

- speed 7.5 to 12 pps
- % break 25 ms minimum
- interdigital time 2 to 30 sec maximum (operating company specifiable).

### Revertive pulsing

Address signals are sent from the terminating office to the originating office—hence the name revertive pulsing—as trains of on-hook signals with the number of pulses in the train corresponding to the digit of the address.

Transmission of the revertive pulses is controlled by the originating office through seizure/start signals and stop signals. The stop signal is sent when the originating office determines that the number of pulses in the train corresponds to the address digits that it wanted the terminating office to send. Transmission starts/resumes when the terminating office receives a seizure/start signal.

### **Answer**

Answer signal is a sustained off-hook signal received from the called office after completion of address signaling. An off-hook signal from the called office that lasts for at least the answer timing interval will be considered to be a valid answer signal by the DMS-100 Family. AT&T offices are engineered for a 2080 ms answer timing interval.

On a non-CAMA call, the answer signal will be propagated to the originating office. Establishment of the connection and network integrity check ensure that the answer signal will not be propagated to the originating office for at least 100 ms after end of incoming ST signal. On a CAMA call, the ANI request signal is returned to the originating office as the off-hook signal.

### **Disconnect**

Disconnect is an on-hook signal with duration exceeding a prescribed time limit. Typically, it is initiated by the calling or called party at the end of the call.

### **CAMA call**

DMS-100 Family has specific timing requirements for the disconnect signal:

#### **Normal Disconnect – Non-CAMA call**

DMS-100 Family will recognize as disconnect, an on-hook signal from the originating trunk that persists for greater than 160 ms, or an on-hook signal from the called party that persists beyond the CAMA called party disconnect timing interval. AT&T offices are engineered for 11.04 sec. timing interval.

#### **Normal Disconnect**

DMS-100 Family will recognize as disconnect signal, any on-hook signal from the originating trunk that persists for greater than 160 ms.

### **Intercept**

Standard DMS-100 Family trunks (loop or E&M) may be used to provide regular intercept service.

## Wink signals

**Ring forward** Ring forward is a momentary on-hook signal sent toward the called end on an established connection. On non-CAMA calls, DMS-100 Family will recognize as ring forward any on-hook that lasts more than 50 ms and less the 140 ms. Following recognition of a ring forward, it is regenerated on the outgoing trunk as a 70–130 ms on hook signal.

Two successive ring forward signals will be recognized by DMS-100 Family, if the off-hook period which separates them is at least 50 ms long. The trailing edges of the two received winks must be separated by at least 175 ms to ensure a minimum of 50 ms off hook between the winks on the outgoing trunks. On CAMA calls, momentary on-hook signals shorter than disconnect timing are not re-transmitted on the outgoing trunk.

**Ringback and coin control** Ringback and coin control are momentary on-hook signals sent toward the calling end on an established connection. On non-CAMA calls, on hook signals are passed through the switch with a duration distortion of  $\pm 20$  ms maximum. On CAMA calls, momentary on-hook signals shorter than called party disconnect timing are not re-transmitted on the incoming trunk.

## Reverse make busy

Reverse make busy signal is a continuous off-hook supervision received from the terminating end of an outgoing trunk while it is idle. DMS-100 Family outgoing trunks (E&M and loop) are capable of being made busy when they receive off-hook supervision from the distant office.

## ANI request

ANI request signal is a steady off-hook signal sent on CAMA calls to the originating office after the called number is received. This is the request for the ANI outputting of the calling number.

DMS-100 Family CAMA office will not return the ANI request signal for at least 160 ms following the recognition of the interdigital timing interval after the last dial pulse is received, when the called number is received in DP. In the case of MF digit reception, ANI request signal will be returned after recognition of ST signal trailing edge. For operator number identification, an off-hook signal is sent back even though ANI data is not expected.

## Hits

Hits are momentary on-hook or off-hook changes in the received supervisory state which do not persist long enough to be recognized as a valid and legitimate information or supervisory signals. Signals of duration shorter than the following times will be considered as hits by DMS-100 Family:

<b>Trunk State</b>	<b>Time</b>
Idle incoming trunk (expecting a seizure)	60 ms
Outgoing trunk expecting a wink or delay dial	40 ms
Dial pulse reception	20 ms for TM 9 ms for DCM/DTC
Outgoing trunk expecting an answer signal:	
• CAMA call	40 ms
• Non-CAMA call	No filtering
Talk:	
• Incoming CAMA (expecting a disconnect)	190 ms
• Incoming non-CAMA (expecting a disconnect or ring forward)	40 ms
• Outgoing trunk/CAMA call (expecting a disconnect)	40 ms
• Outgoing trunk/non-CAMA call	No filtering

### **Transients**

Transients are defined as short duration changes in signaling state. The types of transients and the immunity of the DMS-100 Family to them are explained below.

**Split and preliminary pulses** Pulses or gaps with intervals of less than 5 ms are ignored, regardless of when they occur.

**Contact chatter** The short pulses generated due to the contact chatter will be ignored if the duration of the pulses is less than 5 ms.

**on-hook pulse after digit ends** An on-hook pulse, during interdigital time, with duration less than 20 ms for TMs and 9 ms for DCMs/DTC will be ignored.

**on-hook pulse upon answer** An on-hook signal received by the incoming trunk for less than the disconnect timing interval or ring forward timing interval will be ignored.

**off-hook pulse on disconnect** If on-hook is of sufficient duration to initiate disconnect, any subsequent off-hook received from the DMS switch is ignored until the guard interval has elapsed. If the signal remains after the guard interval, a trunk seizure is recognized.

**Intersystem AC signaling**

This section describes the requirements for the generation and recognition of AC signals and tones.

**Multifrequency signaling**

In Multifrequency (MF) signaling, combinations of two, and only two, of six frequencies in the voice band are used to represent the address digits and some special control or information signals. These frequencies are 700, 900, 1100, 1300, 1500, and 1700 Hz. Their 15 possible combinations and usages are given in Table 5-14.

**Transmit Requirements**

Nominal frequencies	700, 900, 1100, 1300, 1500, 1700 Hz
Frequency tolerance	$\pm 1.5\%$ of nominal
Output level	MF output power per frequency is $-6$ dBmO (or $-9$ dBm when measured at the DF)
Signal length and intervals:	
KP signal length	$100 \pm 10$ ms
Other MF signals	$70 \pm 5$ ms (70 ms nominal)
Interdigital interval	$70 \pm 5$ ms (70 ms nominal)
Twist	Power level difference between any two frequencies $\leq 1$ db
Phase delay	The two frequencies of each code start and end within 1 ms of each other
Intermodulation products	The total power of extraneous signal components is at least 30 dB below the power level of either frequency of the code (C-weighted)
Predial delay	Outpulsing starts approximately 70 ms after detection of start dialing on-hook signal

During tone-off periods, transmitted power at any MF frequency will not exceed  $-58$  dBm0.

**Receive Requirements**

Nominal frequencies	700, 900, 1100, 1300, 1500, 1700 Hz
Frequency tolerance	$\pm 1.5\% + 10$ Hz of nominal

Input level range                      0 to -22 dBm per frequency (signals with levels below -30 dBm per frequency will not be accepted)

**Signal length and intervals**

KP signal length                      55 ms minimum

Other MF signals                      30 ms minimum (two tones present)

Interdigital interval                      25 ms minimum (no signal frequency component above -30 dBm)

Tone interruptions                      Up to 10 ms will be bridged, after the minimum length signal has been received

Twist                                      Power level difference between any two frequencies  $\leq 6$  dB

Phase Delay                              For a valid MF signal, its two frequencies have to arrive within 6 ms of each other

Signal to Noise Ratio                       $\geq 20$  dB at the input to the MF or UTR receiver

The receiver will accept up to 10 p/s. The receiver checks for the presence of two, and only two, valid frequency components in each pulse. If a pulse fails to meet this requirement the call is routed to treatment. Digits received before a KP signal (on a call) will be ignored by the DMS-100 Family software, except for CAMA operator providing the ONI function. In this ONI case KP is not required from the operator.

If two or more consecutive KP signals are received during the signaling, these will be recognized as invalid digits and the call routed to treatment. Any KP signal received in other than the correct position is considered invalid and the call will be routed to a treatment.

**MF Address Signaling** Multifrequency signaling may be used to transfer the called number, calling number (when the call is to a CAMA office), and other information from the originating office to the terminating office. On incoming calls to DMS-100 Family, upon recognition of the seizure signal, DMS-100 Family sends the start dial signal to the originating office. The originating office, after receiving the start dial signal, should outpulse the called number using the appropriate signaling format. DMS-100 Family supports LATA Switching System Generic Requirements (LSSGR) pulsing format.

**Automatic number identification** Refer to Chapter 3 for additional information.

**Reception at CAMA office** On a CAMA call, calling number information is required. After the called number has been received, the CAMA office returns a steady off-hook signal toward the local office (not before the ST signal in MF pulsing). This off-hook signal (ANI request signal) is the start signal for outpulsing the calling number (ANI information) which is always sent by MF signals in the appropriate format.

DMS-200 CAMA office timing requirements for the ANI information reception:

- ANI Seizure Timing: 2 to 30 sec. (operating company defined)
- ANI Partial Dial Timing: 2 to 30 sec. (operating company defined)

**Transmission from local office** If billing is performed remotely on a call (CAMA or Operator System) the DMS-100 selects and seizes an appropriate outgoing trunk, outpulses the called number and waits for the ANI request from the distant office. If the ANI request is received within 5 sec., the DMS-100 outpulses the calling number preceded by the appropriate information digit. If the ANI request is not received within 5 sec., the DMS-100 logs a trunk trouble and a second attempt is made on a different trunk.

If the second attempt fails, the DMS-100 again logs a trunk trouble and provides reorder treatment to the line. If the line is marked as ONI, or if the ANI function fails, only the appropriate information digit is sent over the CAMA, Operator System trunk in response to the ANI request.

**Inband coin control and ringback** Multifrequency signals are used for inband signaling to control coin and ringback. A single appropriate code (see Table 5-14) is transmitted for each kind of control, toward the originating office, for a duration of at least 900 ms.

## Tones

**Precise tone plan** Four pure tones of 350, 440, 480, and 620 Hz are assigned singly or in pairs to represent standard audible tone signals in the precise tone plan (see Table 5-17). These signals are used to inform the customer or operator of the progress or disposition of a call. In DMS-100 Family, audible tone signals are produced digitally. Loss of commercial AC power does not cause tone interruptions.

**Receiver-off-hook (ROH) tone** The ROH tone is used to alert an off-hook customer receiving permanent signal treatment to return the telephone handset to on-hook. In the DMS, ROH is a combination of four frequencies: 1400, 2050, 2450, and 2600 Hz, with equal tone-on and tone-off (100ms) at -6.25 dBm per frequency. Unlike the other DMS tones (busy, dial, or no circuit) which are supplied directly from the peripheral modules, the ROH tone is provided from a service circuit housed in the MTM.

**Class-of-service tones** Class-of-service tones are used at switchboards to indicate the class of service of the calling subscribers when more than one class, such as coin or non-coin, is served by the trunk group:

Class-of-Service	Nominal Frequency	Nominal Level	Temporal Pattern
1	no tone		
2	480+620Hz	-24 dBm per freq.	500 ms on
3	480 Hz	-24 dBm per freq.	500 ms on

**Revertive ringing** Revertive ringing is ringing applied to the calling line side in the event of revertive calling of a two party or a multiparty line. This revertive ringing is used to indicate to the calling party when they may lift their receiver and start a conversation, for example, when they hear the ring trip.

In the case of a two party line, normal ringing (two seconds on, four seconds off) is used to ring both the calling and called party. For multiparty lines, two cases must be considered:

- calling and called parties on the same side of the line. In this case, both the calling and called parties have the coded ringing of the called party.
- calling and called parties on opposite sides of the line. In this case, the called party (fully selective system) or the called side (semi-selective system) hears the coded ringing and revertive ringing (a 0.5 sec. on, 5.5 sec. off cycle) is applied to the calling side.

**Call identity signals (zip tones)** The CAMA office sends call identity signals (zip tones) to the far end CAMA position to indicate if the call is normally operator identified (ONI) or if the call is the result of an ANI failure. DMS-200 CAMA office indicates two conditions:

- The ONI call by two pulses of 480 Hz tone, each 50 to 175 ms long and separated by 50 to 175 ms.



- The ANI failure by a single pulse of 480 Hz tone 420 to 1380 ms long.

If a reset tone (700 + 1700 Hz) is received from the far end, DMS-200 CAMA office will be prepared to receive the calling number again.

**Milliwatt test tone** The milliwatt test tone is used for trunk maintenance purposes. DMS-100 Family milliwatt test tone is produced digitally and controlled by software.

**Test Tone:**

Frequency 1004 Hz  $\pm$  0.02 Hz

Level 0 dBm0  $\pm$  0.01 dB

**Common channel signaling**

Two forms of Common Channel Signaling are supported in the DMS-100 Family of Switches. These two systems are identified as Common Channel Interoffice Signaling No. 6 (CCIS6) and Signaling System No. 7 (SS7). Both systems follow the same basic principle (separation of signaling and voice paths), but vary in their implementation. CCIS6 is applicable to DMS-200 offices only, due to the nature of the CCIS signaling formats. SS7, however, may be applied in the DMS-100 as well as DMS-200 systems due to the more flexible nature of the SS7 protocol. Detailed descriptive information pertaining to Common Channel Signaling and its implementation in the DMS-100 Family of Switches is provided in, 297-1001-137.

**Common Channel Interoffice Signaling No. 6**

The CCIS6 capability of the DMS-200 is for application as a Switching Office (SO) connected to the AT&T CCIS network through Signal Transfer Points (STPs). The DMS-200 implementation uses the quasi-associated mode of operation and is compatible with the AT&T CCIS network as defined in AT&T Technical Advisory No. 14. As the DMS-200 is intended to support SOs connecting to the CCIS network through STPs only the Access link (“A” link) and Extension link (“E” link) capabilities are provided. The version of CCIS adopted for use in the DMS includes both the banded and the direct signaling capabilities.

**Signal routing** The CCIS6 signaling network provides four alternate routes between SOs for signaling messages. These routes form two levels of redundancy in the event of a failure of a route. The first level is a signaling layer consisting of two signaling links or linksets. The second level is provided by two transmission links to each signaling link.

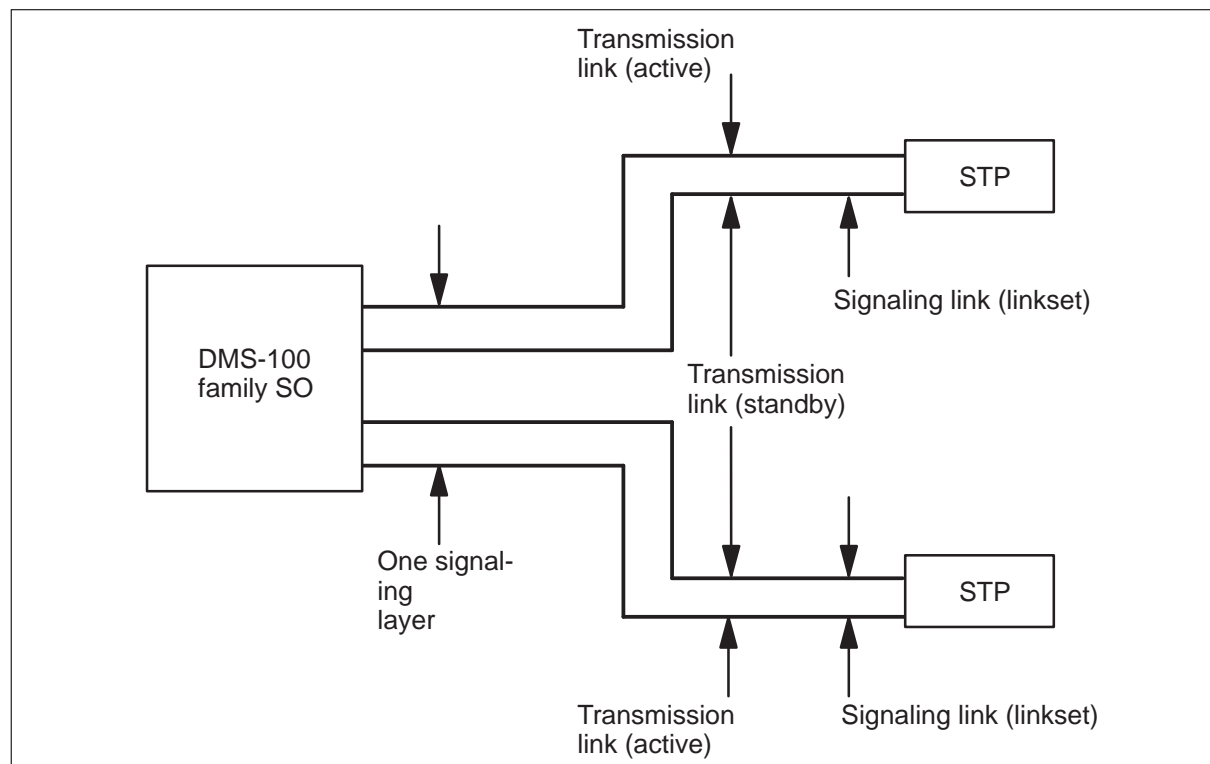
Selection of a route through the signaling network is made by the originating SO using one of two methods depending on the type of signaling used. The

first method, used for call processing, is banded signaling which relies on a preassigned route. The other, used for data base queries, is direct signaling which relies on a destination address and does not require a preassigned route.

### Signaling layers

A Signaling Layer (Layer) is an arrangement of routing paths, as shown in Figure 5-20. The redundant arrangement is provided by a pair of linksets connected to two STPs within the signaling network. The signaling load is equally divided between these linksets although either linkset is capable of handling the total load. This load sharing provides the first level of redundancy. In the event of a failure of a linkset the mate linkset takes over and handles the load of both linksets without a reduction in service. A layer is capable of handling signaling messages for up to 2000 voice trunks shared between the two linksets. The sharing is carried out by a fixed method, the messages associated with odd numbered voice trunks are carried by one linkset and the messages associated with even numbered trunks are carried by the other linkset.

**Figure 5-20**  
**DMS-100 family interface with CCIS6**



### Banded signaling

Banded signaling is an addressing scheme that relates a signaling message to voice transmission on a particular trunk. The signaling message contains a label which is the address of the trunk carrying the voice transmission that is associated with the signaling message. The label consists of two fields, the band number and the circuit number. The 9 bit band number identifies a group of up to sixteen voice trunks. Each trunk within the group of sixteen voice trunks is identified by an additional 4 bit code (circuit number). Each band number designates a group containing a maximum of sixteen voice trunks, but if a group contains more than sixteen trunks it will use more than one band. This technique reduces translation memory requirements and simplifies translation at an STP.

### Direct signaling

Direct signaling is a method of routing data messages through the CCIS6 signaling network using destination addresses that are not restricted to pre-assigned signaling links (no band or circuit number). As DS messages do not relate to particular trunks they can be injected into the CCIS6 signaling network from any signaling point.

DS messages may have one of two address formats: a six digit code, or a number within the range 0–32727. The six digit code is used for addresses using standard Numbering Plan Area (NPA) numbers. The number format is used for functions that the operating company has defined. The six-digit code enables the system to access Incoming Wide Area Telephone Service (INWATS) and Mechanized Calling Card Service (MCCS) data bases.

**Signal protocol** The CCIS6 signal protocol uses a full-duplex synchronous data link as defined in AT&T Technical Advisory, TA14. The bit rate on the signaling link is 2400 b/s, with bits in synchronism between any two SP. Bits are assembled into multiple signal units to form CCIS6 signaling messages. Each signal unit has a fixed length of 28 bits; 20 for signaling information and eight bits for error detection.

Signal units are transmitted in blocks of twelve. CCIS6 messages may consist of single signal units (lone signal units (LSU)), or they may be assembled from a number of signal units. A multi signal unit message (MUM) consists of an initial signal unit (ISU) and a number of subsequent signal units (SSU). Whenever the link is idle a synchronization signal unit (SYU) is transmitted, thus maintaining synchronism of the data on the signaling link.

Each call processing message is accompanied by a label to identify the band and circuit. Messages are categorized into a number of types:

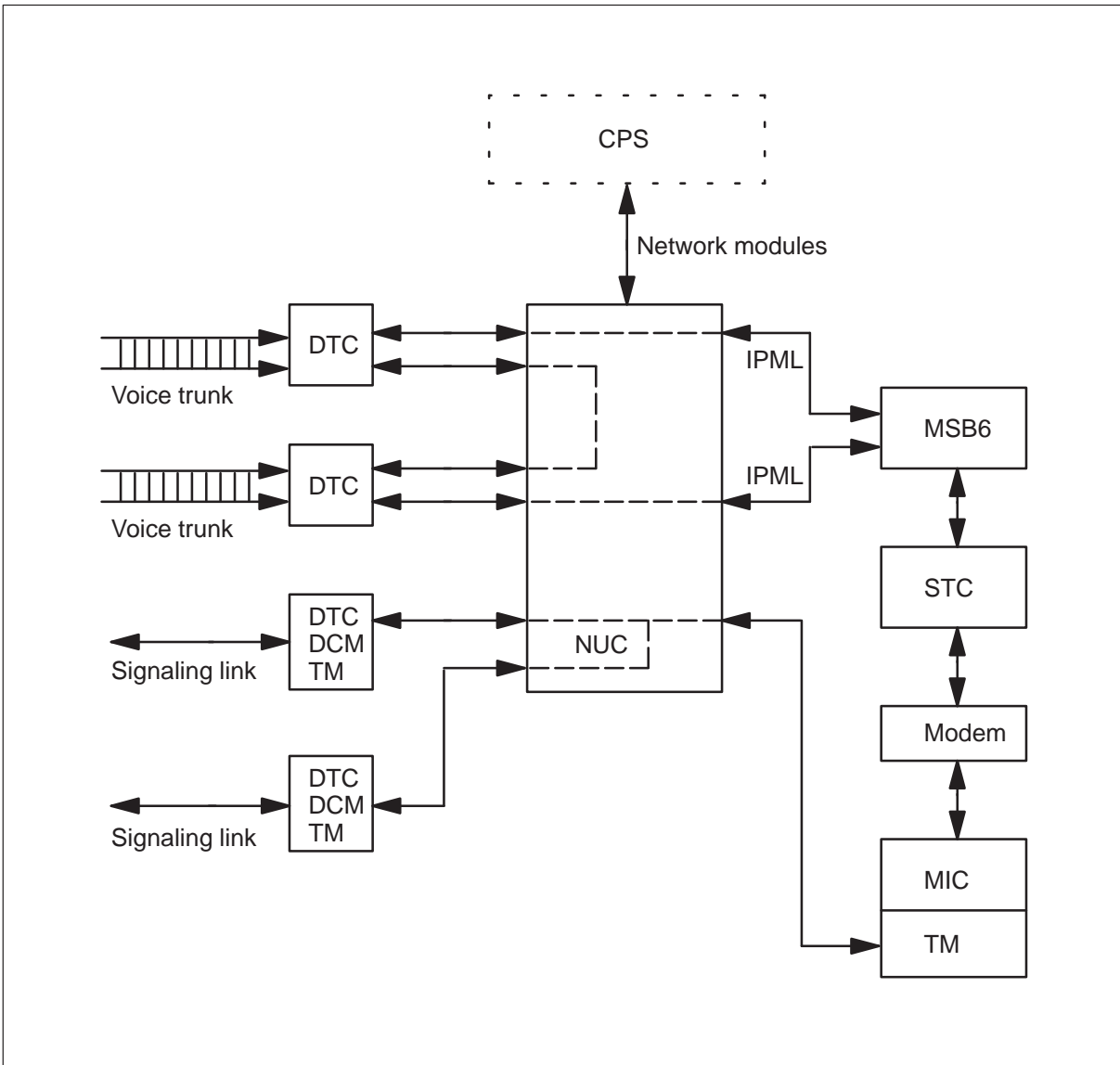
- **Telephone:** Pertain to a particular call. They include address messages, routing messages, and messages related to the completion of a call.

- **Trunk related:** Pertain to a particular trunk. They include messages that are used to test a trunk.
- **Trunk Network Management:** Contain information pertinent to the condition of the trunk groups or switching equipment. They include overload control messages.
- **Network maintenance:** Relate only to bands of trunks and affect only the trunk state information. They include reset-band messages and trunk query messages.
- **Signaling network management:** Contains information pertinent to the condition of the signaling links. They include Transfer Prohibited (TFP), Transfer Restricted (TFR), Transfer Allowed (TFA), and link failure messages.
- **Signaling link management:** Control the proper functioning of the signaling system. They include synchronization, activation, and changeover procedures.
- **Special:** Are miscellaneous messages that do not fit into the previously mentioned types. An example of this type is direct signaling messages.

Full details and definitions of messages are given in AT&T Technical Advisories, TA 14 and TA 37.

**DMS-100 hardware and software functions** A simplified diagram of the minimum configuration to implement CCIS6 is shown in Figure 5-21. Note that Call Processing Software (CPS) is identified by a box with dotted lines.

**Figure 5-21**  
**Block diagram of minimum CCIS6 configuration**



**Call Processing Software**

The call processing functions and trunk network management functions are divided, with the high level functions being the responsibility of the CPS and the low level functions being the responsibility of the software in the DTC and Message Switching Buffer (MSB6).

In addition to implementing the call processing procedures, the CPS carries out related functions:

- manual and automatic changeover control as part of signaling network management
- human-machine interface as part of signaling link management
- defines and sets up the DTC to MSB6 network connection (IPML)
- inform signal message handling of connections
- control of the various inventories, such as the Signaling Terminal (ST) inventory and MSB6 inventory
  - Message Switching Buffer

The MSB6 consists of two units operating in a warm/standby mode to provide redundancy. Each unit consists of two processors, the signaling processor and the master processor. The signaling processor performs two functions:

- receiving messages from the DTC interfacing the voice trunks
- sending messages to the DTC interfacing the voice trunks

The master processor performs five functions:

- polling ST for incoming messages
- selecting ST for outgoing messages
- selecting DTC for incoming messages
- managing signaling message handling routing data
- relaying commands to the appropriate ST

### **Signaling terminal**

The ST consists of the STC, its associated modem, and the Modem Interface Card (MIC) located in a TM forming the input to the transmission links. The STC is a single card module housing two micro-processors, the data link processor and the Master processor. The data link processor controls the modem interface, signal unit (SU) reception and error checking of the signaling messages. The Master processor implements the synchronization procedures, constricts SU, performs some low level management functions.

The modem modulates the analog transmission into a digital bit stream, and demodulates the digital bit stream into an analog transmission. The modem is a standard commercial unit operating at 2400 b/s. Each modem is hard wired to its STC, is dedicated to CCIS6, and is located in an MSB6 frame. The MIC in its host TM is the interface between the modem and network module.

**Transmission link**

The transmission link (TL) is the physical path to the CCIS6 network. It is implemented by a standard PM, the type of PM being dependent on whether it is an analog or digital facility. Because TL are connections to a CCIS6 network they are dedicated to signaling and are not able to transmit or receive voice traffic.

- Digital Trunk Controller

**Digital Trunk Controller**

CCIS6 voice trunks terminate on a DTC. The DTC performs three level 4 functions:

- sends messages to the MSB6
- implements continuity checks on the voice trunk
- implements reasonableness of message sequence checks

**Nailed-up connections**

Nailed-up connections (NUC) are dedicated paths through the network system connecting the MIC host TM and the transmission link. They are setup by software in accordance with the contents of a system table. NUC survive system cold and warm restarts.

**Inter peripheral message links**

The inter peripheral message links (IPML) are standard speech-type connections through the network for use as direct messaging between the MSB6 and the DTC. The IPML is duplicated so that all single faults can be bypassed.

Each IPML consists of a pair of network connections between an MSB6 and a DTC. Each network connection is called an Inter-Peripheral Connection (IPC). The IPC that form an IPML are set up on different network modules to reduce the possibility of a link failure. Messages are transmitted on the active IPC and message scanning on the inactive IPC, so that in the event of a fault in the active IPC, the other IPC is able to take over.

**CCIS trunks**

CCIS trunks carry voice traffic only. They are standard digital trunks that are dedicated to CCIS6. They cannot be used for any other type of call unless the switch is reconfigured.

**Signaling System No. 7**

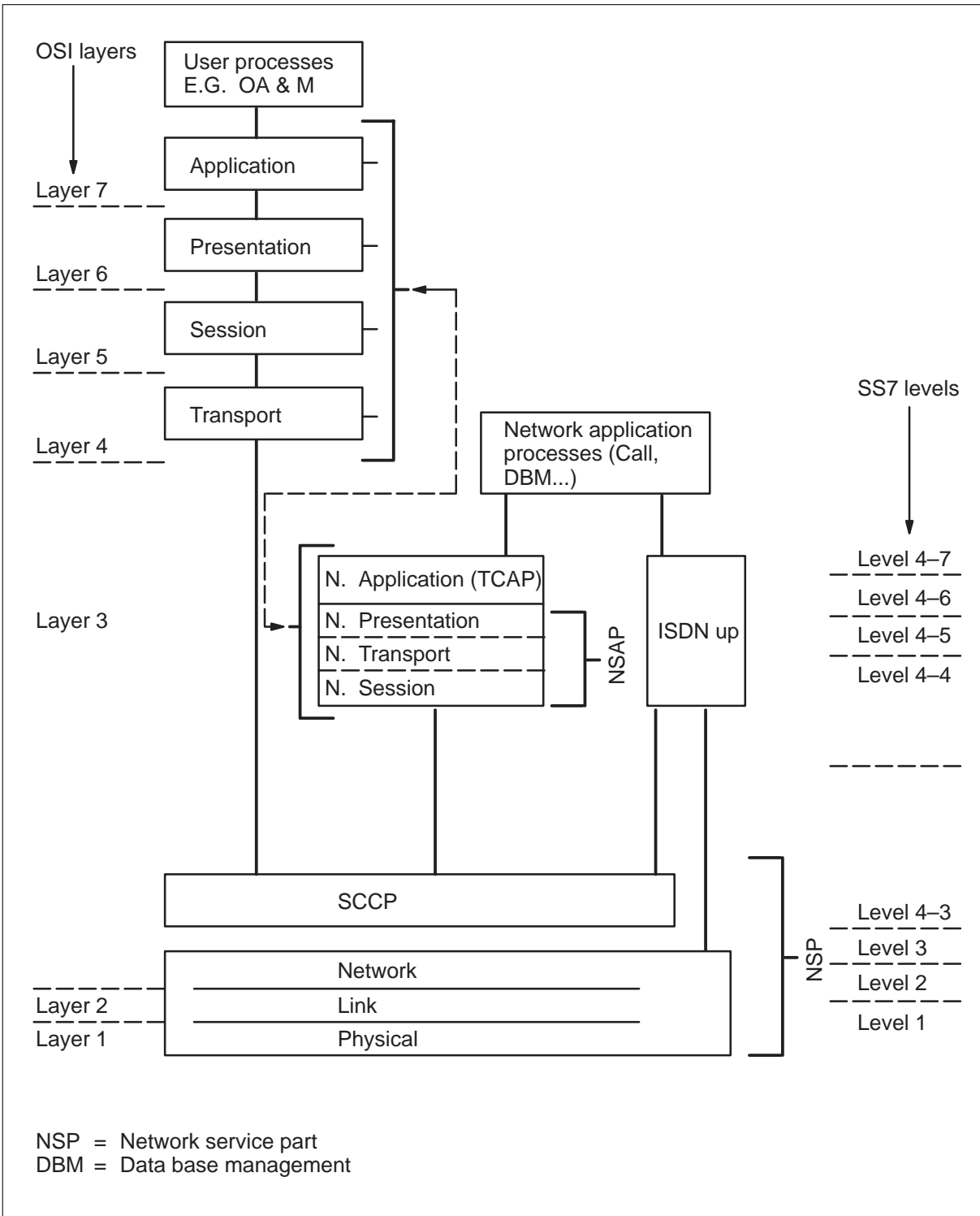
The DMS-100 Family SS7 is designed in accordance with the Exchange Carrier Standard Association T1X1 recommendations for SS7 for the U.S. and its implementation is in compliance with Bellcore's Technical Reference TR-NPL-000246. Both Transaction (data base query—TR-TSY-000024

Service Switching Point) and Trunk Signaling (call set up—TR-TSY-000317 IntraLATA Calling) capabilities are provided.

The DMS-100 Family implementation uses a four level structure which relates to the seven layer Open System Interconnection (OSI) reference model as shown in Figure 5-22. Levels 1, 2 and 3 together are called the Message Transfer Part (MTP). The overall function of the Message Transfer Part is to serve as a connectionless transport system providing transfer of signaling messages between the locations of communicating user or application functions. OSI layers 1 and 2 directly correspond with SS7 levels 1 and 2; layer 3 (the OSI network layer) is subdivided into two layers which correspond to levels 3 and 4 respectively. Level 4 is constructed to allow sublayering which provides functional partitioning for uses such as the Signaling Connection Control Part (SCCP) and the Transaction Capabilities Application Part (TCAP).



**Figure 5-22**  
**Comparison of SS7 levels with the OSI model**



### **SS7 signaling modes**

The SS7 signaling network has two modes of operation. The first is called associated, and refers to the connection of signaling links directly from one switching office to another. The second is called quasi-associated, and refers to the connection of signaling links to a STP. The signaling messages are sent through the STP for routing to the appropriate connecting switching office:

### **Routesets**

A routeset contains all of the routes between two switching offices. In the SS7 system there can be up to four routes in a routeset, two for the primary routes that loadshare the signaling traffic, and the remainder for the backup routes. If only one or two routes are used in a routeset they operate as primary routes, and the system has no routes in the quasi-associated mode.

Each route utilizes only one linkset to convey call processing traffic between the switching office. If a route is faulty (overloaded or the linkset is faulty), DMS routeset management transfers the traffic to the other route that is loadsharing. If this route subsequently fails then all traffic is transferred to the backup routes (if there are any available). Maintenance personnel are alerted of a route failure with a major alarm and a corresponding notification at the MAP. If all of the routes in a routeset are not capable of carrying traffic, then routeset management initiates a critical alarm alerting personnel of a complete breakdown of communication between the two switching office. When the routeset is once more able to carry traffic the traffic is restored to the primary routes as before.

### **Linksets**

A linkset defines the collection of links between two adjacent signaling points. Linksets can contain up to 16 links to provide a number of levels of redundancy. Linksets are configured (by system tables) into either a loadsharing mode or a dedicated mode. Note that linksets are separate from routesets and do not have to share the same operating mode.

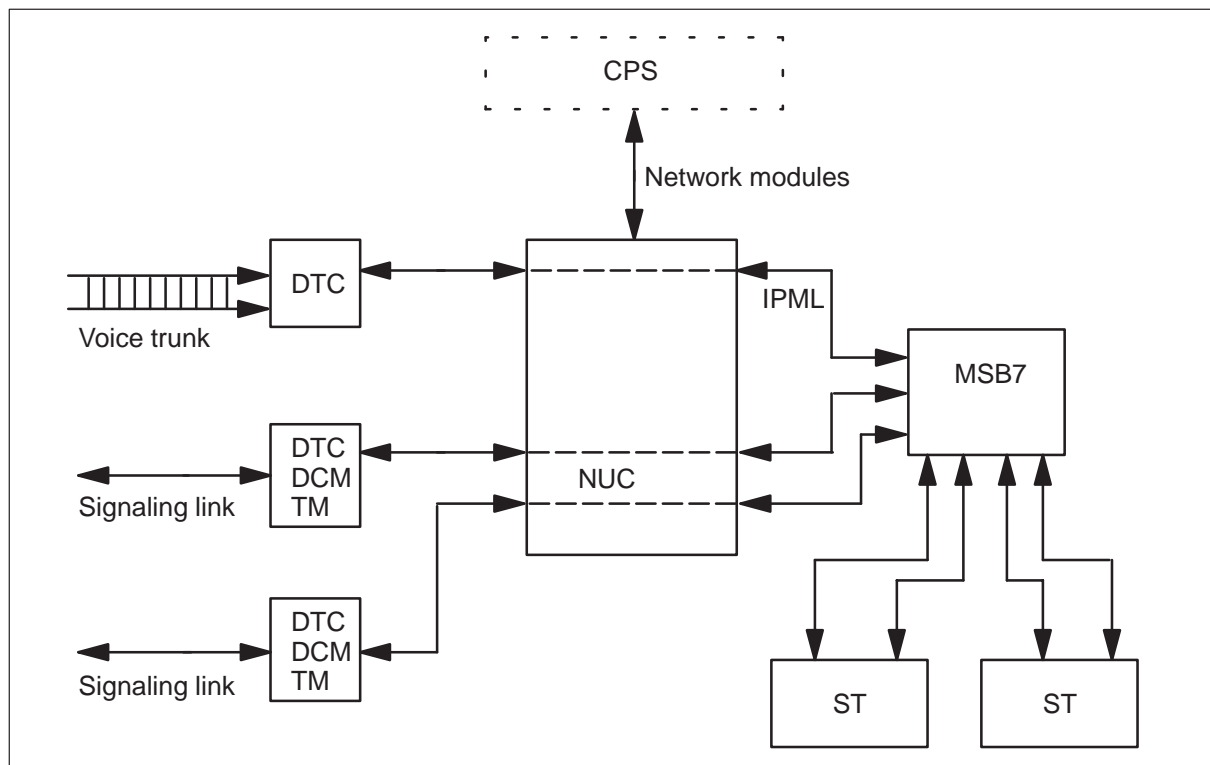
### **DMS-100 hardware and software functions**

SS7 is implemented in the DMS-100 Family of Switches by a number of Peripheral Modules (PM) controlled by the Call Processing Software (CPS). A simplified diagram of the DMS-100 implementation is shown in Figure 5-23. There are six software and hardware modules:

- Call Processing Software (CPS) carries out high level switching functions applicable to processing a call. It allocates resources, and directs the DTC to implement the low level call processing functions.
- Message Switching Buffer (MSB7) handles the level 3 functions such as signaling message handling and parts of signaling network management functions related to the signaling links.

- ST performs the functions of level 2: error checking procedures and the implementation of signaling link protocol.
- DTC implements software that performs lower level call processing functions, and to interface the voice trunk group.
- Nailed-Up Connections (NUC) are the network connections between the ST and the transmission link, they are made during initial program input, and are considered permanent as they are not broken by call processing software.
- Inter-Peripheral Message Links (IPML) are the network connections between the MSB and the DTC that are selected by system software. The IPML is duplicated to provide redundancy in the event of a failure.

**Figure 5-23**  
**Block diagram of minimum SS7 configuration**



### Variable timing parameters

#### Time and trunk

Variable timing parameters are provided in the DMS-100 Family of Switches. A detailed listing of the available parameters, their range, and default values is provided in 297-1001-455. A brief overview of the parameter table types is presented here:

- Standard Office Parameter Table

The Standard Office Parameter Table (OFCSTD) lists the office parameters which have a standard value. The default values satisfy most requirements, however the parameters can be changed by the operating company at the time of initial translation input or at extension time by submitting the appropriate forms and parameter values to Nortel Networks. At all other times the operating company will have to send a request to Nortel Networks to change the value of any of the standard parameters. Standard Office Parameter tables include timing of four events:

- Pre-dial Delay
- MF Inter-digital Timing
- Work Timings
- Pre ANI spill delay

#### **Engineered office parameter table**

The engineered office parameter table (OFCENG) lists the office parameters whose values are defined by the operating company and do not normally require changing before the end of the engineered interval. The value of the parameters in this table are submitted to Nortel Networks by the operating company on the appropriate forms at the time of the initial input or at extension time. At all other times, the operating company can change the value of these parameters with the use of non-resident procedures. The engineered office parameter table includes timing of events such as Permanent signal timing, partial dial timing, and ring timeout.

#### **Variable office parameters table**

The variable office parameter table (OFCVAR) lists the office parameters whose values are defined by the operating company and which can be changed by the operating company using the table editor process. The values of the parameters in this table are submitted to Nortel Networks by the operating company, on the appropriate forms, at the time of initial translation input. At all other times the operating company can change the value of these parameters with the table editor. The Variable Office Parameter Table includes timing of events such as per line cut off on disconnect timing, distinctive CWT tone duration, initial and overtime period for local coin overtime feature.

#### **CAMA position parameters**

Timing parameters may be specified. Values that are not specified are set to initialized values:

##### **Maximum queue time before operational measurements**

Time in seconds that call can wait in queue before pegging an operational measurement.

Value: 1 to 255 sec. (unit-s)

Initialized: 5 s

### **Maximum queue time before treatment**

Time in seconds that a call can remain in queue after pegging on operational measurements before it is routed to treatment.

Value: 29 to 255 sec.

Initialized: 175 s

### **Maximum seize before eorder**

Time in seconds that a call is allowed to wait for a seized position to report.

Value: 2 to 255 sec.

Initialized: 180 s

### **Guard time**

Time in seconds that a call will remain on the position after the DMS-100 Family system has received the seventh (last) digit of the calling number.

Value: 0 to 2 sec.

Initialized: 1 s

### **Minimum idle MF receiver**

The time in units of 160 millisecc. a receiver will remain attached to the position after operator disconnect.

Value: 4 to 40 sec. (160-ms intervals)

Initialized: 40 s

### **Maximum reorder**

The number of times an individual call will be allowed to present a reorder signal to one position.

Value: 0 to 10 sec.

Initialized: 2 s

**Line timing parameters**

Three parameters are specified by the operating company. They may be changed using the table editor process or by the non-resident process.

- Revertive Ring: This parameter may allow conditional or unconditional revertive ring or disallow revertive ring.
- Number of Digits: This parameter determines the number of digits collected by the line peripheral for a directory number before reporting. (Variable from 5 digits to 15 digits in 1-digit units)
- Overlap Carrier Selection: This parameter causes the peripheral to perform digit collection for equal access overlap carrier selection

**Analog customer line signaling**

Office battery for DMS-100 Family is nominally  $-48$  Vdc, with a normal range of  $-48.0$  Vdc to  $-53.5$  Vdc. In extreme conditions, and for short term only, the voltage can vary from  $-44.75$  V to  $-55.8$  V, measured at the MDF.

**DMS-100 supervisory states**

**Idle line** For loop-start lines, the subscriber line interface in the CO provides balanced  $220\ \Omega$  dc resistance in each of the tip and ring lead towards the line. At the CO, a high impedance balanced detector is provided across the feed resistors for sensing loop current.

Office battery, through one resistor, is applied on the ring. Ground, through the other resistor, is applied on the tip. Balanced components provide for 20 mA per conductor immunity to 60 Hz longitudinal AC induction.

For ground-start lines, office battery, through a  $1040\text{-}\Omega$  resistance in the subscriber line circuit is applied through current sensing circuitry to the ring side of the line. The tip side is open. Immunity to 60 H induction is limited to 20 mA.

**During dialing** The DMS-100 Family line circuit provides for detection of dc loop currents between 9 mA and 18 mA. This provides for  $1900\text{-}\Omega$  external resistance, non-coin, including subscriber's instrument. Under extreme battery conditions, for a  $1900\text{-}\Omega$  loop, the system will supply a minimum of 18.1 mA loop current. For coin lines, external resistance up to  $1500\ \Omega$  may be used.

**During talking** For DTMF or coin signaling from the station during the talking state, the limits given in Analog customer line signaling apply.

**Open intervals during call processing** During the addressing or while receiving rotary-dial or DTMF dialing information, DMS-100 does not produce an open in either the tip or ring leads. No open condition on the tip or ring is produced after addressing or during call processing. As a telephone operating company option an open battery signal on disconnect (Cutoff on Disconnect) may be applied to either the originating or terminating agent in a call. The Cutoff on Disconnect (COD) signal option may be applied on a per line or per office basis. The duration of the open battery signal is variable:

- Office option: 500 ms to 10 s in 10 ms increments
- Line option: 100 ms to 2.55 min in 10 ms increments

In situation where both the office option (Global Cutoff on Disconnect) and the line option (COD) are specified, the line option takes precedence. For coin lines, coin present test is done during a 500-ms period. The coin collect/return function is applied for one second.

**Detection of customer line supervisory states**

**During seizure, dialing, ring trip, talking** For loop-start lines, DMS-100 line interface will recognize loop closure with a maximum external range, including the subscriber set, of 1900 Ω. Within this range, a loop closure will be recognized as an off-hook during seizure, dialing, ring-trip, or talking.

For ground-start lines, a ring conductor closure to ground with a maximum resistance of 2020 Ω and having an earth potential difference up to 3 V is detected as a seizure signal.

After seizure ground start lines will recognize an off hook for external loops up to 1900 Ω including the telephone instrument. For coin lines, the equivalent figure is 1500 Ω.

**During hold** After the network connection has been established, the DMS-100 will hold the connection with a maximum external resistance of 1900 Ω.

**During disconnect** DMS-100 will recognize an on-hook disconnect state, if the external circuit resistance of the customer loop exceeds 5760 Ω:

<b>External Resistance</b>	<b>Line Supervision</b>
Under 1900 Ω	Hold
1900 to 5760 Ω	Hold or Disconnect
Over 5760 Ω	Disconnect

**Disconnect timing and disconnect sequences** Refer to Intersystem DC signaling for a description of disconnect and other on-hook signals.

### **Tests made during call-processing**

**Tip-party identification** DMS-100 makes the tip-party test by applying office battery through a resistor to the tip and ring shorted together. A current sensor detects the presence of a threshold-set current flow. External resistance with a maximum value of 4680  $\Omega$  will give an off-hook indication to identify the tip-party. This is done with up to 3 V ground potential difference.

The tip-party test is conducted for 500 ms. The tests are performed upon origination and completion of dialing.

### **Handling of abnormal line conditions**

**Open interval at permanent-signal time-out** Lines that remain permanently off-hook after office disconnect or lines that are left in the off-normal state after a service request are given an open interval that is applied as a first operation in processing permanent signals. The open interval is telephone company settable in the range of 500 ms to 10 sec. The recommended value is 800 ms.

### **Address detection**

DMS-100 terminates the voice path as specified in Envelope delay distortion on page 8-6, and if the station does not have “deny origination” option assigned to it, the originating station will receive dial tone when DMS-100 is ready to receive digits. On ground-start lines dial tone will be transmitted after the DMS-100 recognizes an origination and the tip side at the CO becomes grounded.

DMS-100 is capable of receiving dial pulses from dial pulse lines and DTMF lines. Stations that have the DTMF option assigned to them will be able to rotary dial or DTMF pulse to DMS-100.

**Rotary dial pulse detection** DMS-100 has the capability of detecting dial pulses with pulsing speeds between 7.5 and 12 p/s with telephone dial breaks between 58 and 67.5 percent measured at the MDF. The dial pulse receiver can recognize interdigital times as short as 110 ms.

### **Dual-tone multifrequency (DTMF) signal detection**

DTMF dialing signals are pulses of two simultaneous sinusoids, one from a low group of four frequencies and one from a high group of three frequencies which correspond to the characters shown in Table 5-23.



<b>Table 5-23 DTMF signal detection</b>					
		<b>Nominal high group frequencies (Hz)</b>			
<b>Signal</b>		<b>1209</b>	<b>1336</b>	<b>1477</b>	<b>1633</b>
Nominal low	697	1	2	3	A
Group frequencies	770	4	5	6	B
(Hz)	852	7	8	9	C
	941	*	0	#	D

The fourth frequency in the high group, 1633 Hz, is reserved for further use. This frequency, combined with the four low-group frequencies will provide the four additional characters, A, B, C, and D.

The DTMF telephone station oscillator is supplied a negative battery connected to the ring of the line during the time pulses can be expected to be initiated, if no polarity guard is provided.

**DTMF reception**

The DTMF receiver or UTR in DMS-100 will not interfere with the reception of dial pulses or other DC signals. When receiving DTMF digits the line impedance termination of 900 Ω + 2.16 μF satisfies the voice grade transmission parameters.

The DTMF receiver or UTR meets the criteria shown in Table 5-24.

<b>Table 5-24 DTMF/UTR reception parameters</b>		
<b>Parameter</b>	<b>Will accept digits</b>	<b>Will reject digits</b>
Frequency tolerance	± 1.5% (each freq)	± 4.0% both frequencies simultaneously
Signal duration	≥ 40 ms ON	≤ 23 ms On
-continued-		

<b>Table 5-24</b> <b>DTMF/UTR reception parameters</b> (continued)			
<b>Parameter</b>		<b>Will accept digits</b>	<b>Will reject digits</b>
Input level	DTMF	0 to -24 dBm (per freq)	$\leq -32$ dBm (per freq)
	UTR	0 to -25 dBm (per freq)	$\leq -34$ dBm (per freq)
Twist		-8 to +4 dB (high to low)	$\geq 19$ dB (high to low)
-continued-			

Frequency tolerance between 1.5 percent and 4.0% percent of each frequency may or may not register as a valid frequency.

Input levels between -24 dBm and -34 dBm per frequency may or may not register as a valid level. The input levels range for UTR is from -25 dBm to -55 dBm/freq.

Twist levels between -8 dB and -19 dB also between +4 dB and +19 dB high frequency to low frequency may or may not register as acceptable twist.

### **Tolerance to echo**

The DTMF and UTR receiver will operate accurately during the presence of signal echoes which are delayed to 20 ms and reduce in level by at least 10 dB with respect to the incident signal.

### **Registration in the presence of dial tone**

The DTMF receiver will accept digits in the presence of dial tone with frequency being  $350 + 440 \text{ Hz} \pm 0.5\%$  and level of -13 dBm, +3 dB for each frequency.

The UTR (6X92BB) will accept digits in the presence of dial tone with frequency being  $350 + 440 \text{ Hz} \pm 0.5\%$  at a level of -16.5 dBm per frequency present at the receiver.

### **Noise requirements**

The DMS-100 DTMF receiver complies with the noise specifications as given in AT&T Technical Advisory, TA 12.

## Ringling

**Ringling source** The ringling source consists of an ac ringling generator supply that effectively produces AC superimposed on DC. The ringling source also provides a synchronization signal to ensure that ringling voltage is removed at the ac voltage zero crossing.

During the silent period office battery supply (–48 V nominal) is applied on the ring-side of the line. For other than four-party selective or eight-party semi-selective, the ac ringling voltage is superimposed on a –48V battery.

The ringling generator can be programmed to operate in fixed steps between 16 2/3 Hz and 66 2/3 Hz, depending on the application. For frequency selective ringling, the output voltage is programmed between 90 V and 155 V (rms) depending on the frequency selected. For normal single-party lines, the ringling frequency is 20 Hz  $\pm$  1/3 Hz at a voltage level of 86 V (rms) nominal.

The ringling waveform is sinusoidal with peak-to-rms voltage ratio between 1.35 and 1.45. The ringling cycle has a normal duration of 6 sec. with several on-off options. A prime option provides two sec. on and four sec. off except for revertive ringling, which is 1.84 sec. on and 4.16 sec. off. Options of 1.95 on and 4.05 off are also available.

The ringling range, including the telephone set, has two values:

- 3 bridged or 6 ringlers to ground—1900  $\Omega$
- 5 bridged or 8 ringlers to ground—1300  $\Omega$

**Individual, coin, PBX lines** To ring these lines, the ringling source is applied on the ring lead and ground is applied to the tip lead.

**Two-party lines** The ring-party is rung as described for individual line. The tip-party is rung with the ringling source applied to the tip conductor and ground applied to the ring.

**Four-party selective ringling** The four parties are identified as R–, T–, R+, T+. To ring the R– or T– party, ringling superimposed on negative battery is applied respectively to the ring or tip of the line with the other conductor grounded.

Similarly, to ring the R+ or T+ party ringling superimposed on positive battery is applied respectively to the ring or tip of the line with the other conductor grounded. Type A line cards should not be used for multi-party ringling.

**Ten-party coded ringing lines (divided code ringing)** Ringing voltage is applied to the ring conductor to ring the five ring-parties and to the tip for the five tip-parties with the other conductor grounded. The parties on each side of the line hear ringing for all parties on that side of the line but distinguish between them by the ringing code. The codes vary as to the number of rings during the ringing cycle of 6 sec. The ringing spurts during the ringing cycle vary from 0.5 sec. to 2 sec. Eight-party coded ringing can be accommodated in the scheme with four parties assigned to the tip and four parties on the ring.

**Four-party semi-selective lines** These lines are rung as for eight-party code ringing lines except that only two ringing codes are used for each side of the line:

- 2 sec. on, 4 sec. off
- 1 sec. on, 0.5 off, 0.5 on 4 sec. off

**Eight-party semi-selective lines** These lines are rung as for four-party selective ringing, that is, with ringing superimposed on +40 V, with two ringing codes to distinguish between the two lines being rung on the same side of the line. The ringing codes are the same as for four-party semi-selective lines.

**Reverting call** When party A calls party B sharing the same cable pair, party A gets a recorded announcement or other treatment from DMS-100 that instructs the party that the call is for someone on his line and that he should hang up and wait for his phone to stop ringing and then pick up his phone. The ringing is applied to both parties, and when answered ringing is tripped, as an option party B may get a zip tone that alerts him that party A is calling. Connection is established. A further option will provide the capability to assign one of two announcements by line class code. Separate announcements may be applied to two party lines and multi-party lines (more than two parties).

**Audible ring tone** This tone is sent to the calling party when the called party is alerted by means of ringing voltage being applied to his line. The tone has a duty cycle of two seconds on, four seconds off. It is not necessarily synchronized to the duty cycle of the called party ringing voltage. The frequency of the tone is 440 + 480 Hz each  $\pm 0.5\%$  at a level of  $-19 \text{ dBm} \pm 3 \text{ dB}$  for each frequency.

### Ring trip

When the called party goes off-hook, DMS-100 recognizes the change-of-state and removes ringing voltage from the line. It also removes audible ring tone from the calling party line.

**Coin lines**

DMS-100 can accommodate prepay, dial-tone-first or semi-post-pay coin lines.

**Line circuits** DMS-100 type “B” line circuits can be selected for ground-start or loop start modes. This will provide the required conditions for coin- first or dial-tone first telephone lines. Line circuit specifications are described in Line circuits on page 5–65.

**Initial rate deposit test** At the coin-first telephone, when the initial rate has been deposited, the ring is grounded. The ground-start line circuit detects this ground. At the dial-tone-first station, the initial rate deposit is verified after seven digits have been dialed.

**Battery polarity dial-tone-first telephone** DMS-100 provides either for battery reversal or for +48 V application on the ring, for restoration of the totalizer in the coin box while an operator is attached. Battery is provided on the ring and ground on the tip.

**Coin disposal signals** Coin disposal signals of +130 V may be applied in a simplex mode, for example, on one lead for a period of one second. Coin collect is typically +130 V and coin return is –130 V.

**Stuck coin test** DMS-100 performs per call tests for coin presence after each coin collect or coin return action. If the coin presence test indicates a stuck coin, the coin collect/return action will be repeated followed by a second coin presence test. If a stuck coin is indicated, a message is sent to the system log file (line 112). The message gives the time of the failure and the LEN and directory number for the coin line.

**Message waiting feature** The Type E line circuit (NT6X19AB) provides the appropriate circuitry to flash a neon lamp in a message waiting telephone. There are specific lamp interface specifications:

- Open circuit voltage: –144 V to –159 V (from ring to tip)
- Lamp current: 0.9 mA to 1.2 mA
- Flash rate: 75 IPM, nominal
- Duty cycle: 38%, nominal

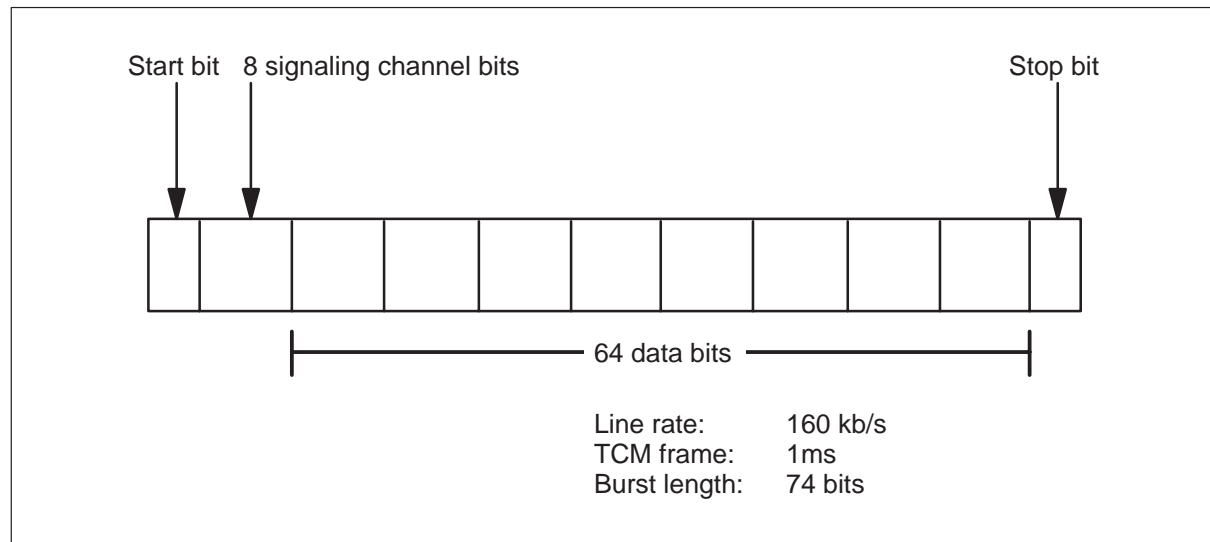
**Digital customer line signaling****Datapath signaling rates, data rates and protocols**

Refer to Chapter 2 for a description on Datapath and its applications.

**Time compression multiplexing** The Datapath two-wire interface uses Time Compression Multiplexing (TCM) to transfer bidirectional digital signals at an effective data rate of 72 kb/s full duplex. The 72 kb/s rate is configured as an 8 kb/s signaling channel plus a 64 kb/s data channel. As shown in Figure 5-24, TCM transfers both the signaling and the data information across this interface by time interleaving bursts of data in the transmit and the receive directions.

- Line Rate: 160 kb/s
- TCM Frame: 1 ms
- Burst Length 74 bits

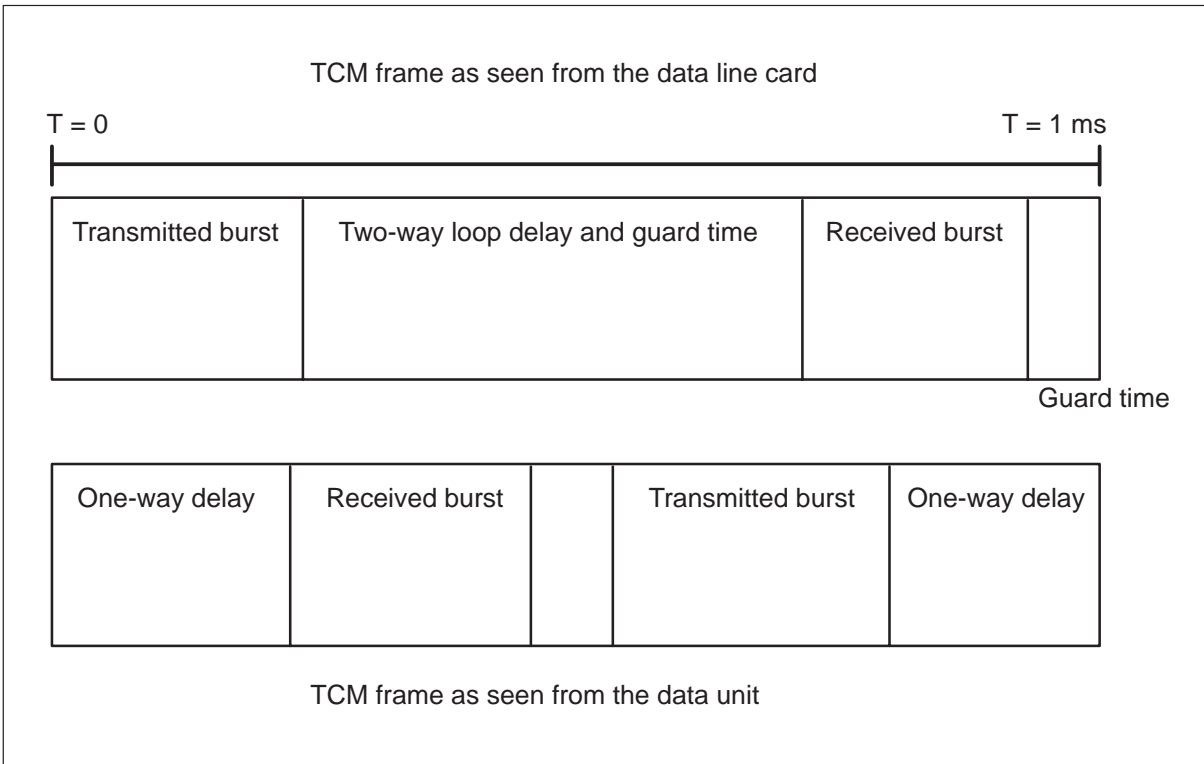
**Figure 5-24**  
**Time compression multiplex**



The line rate for TCM transmission is 160 kb/s. TCM is based on a one millisecond time frame with each frame containing two bursts of data. The first burst of data is sent from the Data Line Card (DLC) (master) to the Data Unit (DU) (slave); the second from the DU to the DLC. The format of these two bursts is identical; the loop burst format is illustrated in Figure 5-25.

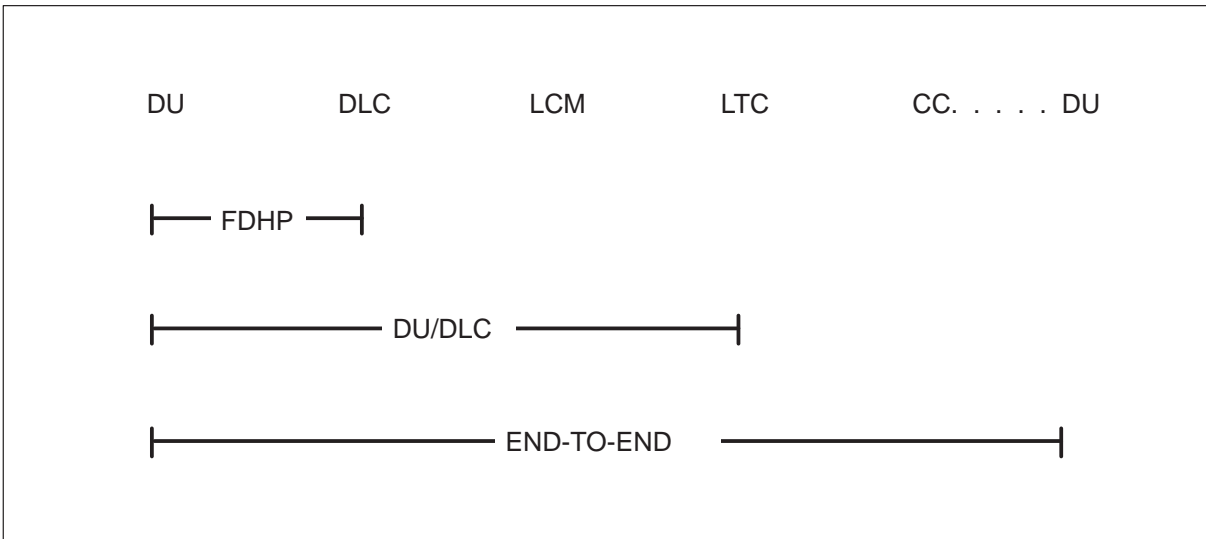
The first TCM burst, transmitted by the DLC, is timed according to a master clock on the DLC side of the interface. The master clock controls the transmission of bursts at one millisecond intervals. The second TCM burst, transmitted by the DU, is timed with timing information derived from the TCM burst received from the DLC. The figure below illustrates the transmission and the reception of a TCM frame.

**Figure 5-25**  
**TCM burst formats**



**Protocols** In this section, three protocols are briefly described. They are the Full Duplex Handshaking Protocol (FDHP) link level protocol, the DU/LTC communication protocol, and the End-to-End DU communication protocol. Figure 5-26 shows the components using each of these protocols.

**Figure 5-26**  
**TCM formats**



### **Full duplex handshaking protocol (FDHP) – link level protocol**

FDHP is the transport protocol used to send and receive messages. The messages that it transports over the 8-kb/s signaling channel are encoded according to the DU/LTC message protocol.

FDHP is a byte-oriented envelope protocol that provides three services:

- error detection using checksum
- error correction using re-transmission
- flow control

In the implementation of FDHP, the TCM circuit provides the one ms interrupt that drives the state machine.

To transmit a single message (two bytes) and the checksum twice requires six signaling bytes. Both the data and the handshaking control information are designed to communicate in a full duplex mode. Every byte transmitted contains three types of information:

- transmit state           (2 bits)
- receive state           (2 bits)
- data nibble              (4 bits)

The checksum is determined by a serial addition of each of the four data nibbles that form a message. Each data nibble is added to the sum as it is received or transmitted.



If the transmitter receives a Negative Acknowledgement (NACK), it must re-transmit the last group of four nibbles and the checksum. The receiver can indicate a busy condition at any time by entering the NACK state. If this occurs during data transmission, the information is re-transmitted when the receiver sends a Clear to Send (CTS) message.

### **DU/LTC communication protocol – message protocol**

Communication between the DU and the LGC or LTC is required for call origination and termination as well as for the maintenance and testing of the loop. The 8 kb/s full duplex signaling channel is used to exchange messages between the DU and the LTC. The messages consist of 8 bit control commands that are contained within a 16 bit message envelope protocol. Therefore, both the incoming and the outgoing messages transported on the signaling channel consist of 16 bits that divide into two bytes. The transport protocol is defined by FDHP as seen earlier.

Some examples of DMS to DU messages are commands to operate the feature key lamps, to enable/disable the connection of the speaker or to control loopback testing. An example of DU to DMS messages are commands to initiate DMS action as a result of a keystroke: DN key for call origination, resource key for connection to a resource (modem) or release key for termination of a call. Other examples are the DMS command to request that the data rate be sent and the DU command to reply with the data rate status.

### **End-to-end DU communication protocol – user and signaling**

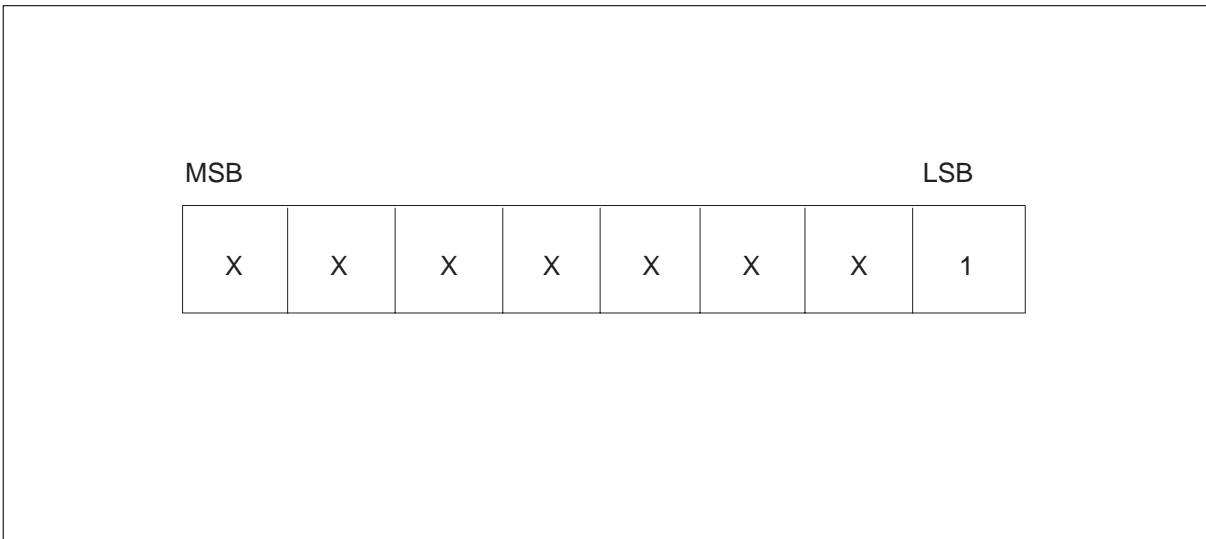
**data** The 64-kb/s full duplex data channel is used for the exchange of data between DU. This data channel rate is reduced to an end-to-end data rate of 56 kb/s. This is due to requirements of T1 transmission facility and DS-1 format.

Since T1 recovers the receive clock from the received data, a reasonable number of level transitions per unit time is required on the circuit. To allow independence between the multiplexed channels, a constraint of at least one bit equal to one per byte is imposed to all bytes transmitted over the 64 kb/s channel.

DS-1 achieves end-to-end signaling by periodically “robbing” the Least Significant Bit (LSB) of each channel. It overwrites LSB with a value that indicates an on-hook/off-hook status or dialing information. There is a general format for all transmitted bytes:

On the data channel, there are two basic data formats: the data byte and the signaling byte. In both formats, the least significant bit is set to a binary 1. The next bit is the data/signaling separator bit. It identifies the data formats: 0 for a data byte and 1 for a signaling byte. The remaining six bits are the information bits.

**Figure 5-27**  
**Channel bits**



The data byte divides into three subtypes:

- Ds6 Synchronous User Data (19.2 kb/s or less)
- DL Asynchronous User Data lower nibble
- DH Asynchronous User Data upper nibble

The transmission of a byte of asynchronous user data is accomplished by transmitting a DL data byte followed by a DH data byte. They are always transmitted as a pair.

The signaling byte divides into two subtypes:

- Sd DTE signaling containing EIA control signals
- Sg General signal selector. It precedes a pair of DL-DH bytes that contain signaling information.

There are two signaling formats:

- Data Byte Types
  - Ds6 Synchronous (19.2 kb/s or less) XXXXXX01
  - DL Asynchronous (lower nibble) XXXX0101
  - DH Asynchronous (upper nibble) XXXX1101
- Signaling Byte Types
  - Sd DTE signaling containing EIA control signals XXXXX011

- Sg      General signal selector.                      XXXXX111  
 It precedes a pair of DL-DH bytes  
 that contain signaling information.

### **Electronic business set signaling and loop conditions**

The Electronic Business Set utilizes ASK signaling over an unloaded loop. Both the analog voice signals and feature control signaling information are carried simultaneously on a single pair of wires using two separate frequency bands. Voice is carried over the standard 300–4000 Hz band, while the signaling information is carried on an 8000 Hz signaling channel. Any loading on the loop suppresses the 8000 Hz signaling.

The Business Set line card (NT6X21AB) receives and interprets the Business Set signaling information. The NT6X21AB is supported by the LCM, RLCM, OPM, and RSC. Refer to *Business Set, General Description, Installation and Maintenance, 297-2011-200* for installation procedures.

### **DID trunks**

Analog DID trunks may be loop or E&M trunks from the normal DMS-100 portfolio of trunks. The signaling is given in Chapter 4. Digital DID trunk service is also available through the DTC/DCM (PX trunk type).

### **Toll diversion signal**

All attempted toll calls from a PBX line or trunk with the Toll Diversion Option (TDV) will cause a toll diversion signal to be sent from the DMS-100 to the PBX. The toll diversion signal can be either a battery reversal or an operating company specified wink (50 to 500 ms in 10 ms units). Upon receipt of the toll diversion signal, the PBX takes the appropriate action, such as, route to attendant.

After sending the toll diversion signal, DMS-100 waits for an operating company defined period (0 to 1000 ms in 10-ms units) for a disconnect from the PBX. If the disconnect signal is not received, DMS-100 advances the call. All toll calls or customer specified three-digit codes can be diverted.

This feature is available as an option.

### **Miscellaneous scan and signal distributor points**

Scan and Signal Distributor (SD) points are used to interface external miscellaneous circuits. Scan points (NT0X10) are used to detect changes of state in external equipment. They may be used to detect ground, battery or loop closure condition. Battery is assumed to be 52 Vdc nominal and the external resistance must be less than 6980  $\Omega$ .

SD points are used to pass changes of state to external circuits. SD points (NT2X57) may pass internal ground, external battery, or loop closure using a relay contact under software control. The voltage on the external

connection must not exceed 100 V and the current must be less than one ampere.

Scan points are used in conjunction with line hunting groups for the stop hunt and random make busy features. They are also used in conjunction with external and operating company defined alarms (see Chapter 6). ROTL (Chapter 6), DOC (Chapter 5), and ABBT (Chapter 6) also use scan points.

SD points are used in conjunction with group alerting, remote message registers, hunt group overflow registers, and alarm sending. DOC, ROTL and ABBT also use SD points.

**Table 5-25**  
**Line class codes**

<b>Code</b>	<b>Description</b>
1 FR	Individual Flat Rate, Residence and Business
2 FR	Two-Party Flat Rate, Residence and Business
4 FR	Four-Party Flat Rate, Residence and Business
8 FR	Eight-Party Flat Rate, Residence and Business
10FR	Ten-Party Flat Rate, Residence and Business
1MR	Individual Message Rate
2WW	Two Way WATS
CCF	Coin, Coin First (prepay)
CDF	Coin, Free Dialing
CSD	Circuit-Switched Digital Data Service (CSDDS)
CSP	Coin, Semi Postpay
DATA	Data Unit
DISP	Proprietary Business Set with Display
IBN	Integrated Business Network
INW	INWATS
OWT	OUTWATS
PBM	PBX Message Rate
PBX	PBX Flat Rate
PSET	Proprietary Business Network
TWX	Teletypewriter Exchange
-continued-	

<b>Table 5-25 Line class codes</b>	
<b>Code</b>	<b>Description</b>
ZMD	Zero Minus Denied
ZMZPA	Zero Minus Zero Plus Allowed
<b>Note:</b> See <i>Local Customer Data Schema</i> , 297-2101-451, Section 114 for further information concerning LCC.	
End	

<b>Table 5-26 Line service options</b>	
<b>Option</b>	<b>Description</b>
3WC	Three Way Calling
AAB	Auto Answer Back
ACD	Automatic Call Distribution
ACDNR	Automatic Call Distribution Not Ready
AIOD	Automatic Identification of Outward Dialing
ASL	Agent Status Lamp
ATC	Automatic Time and Charges
AUD	Automatic Dial
AUL	Automatic Line
BNN	Bridged Night Number
CAG	Call Agent
CBE	Deny External Calls to Forwarded By Call Forward Busy
CBI	Exclude Intragroup Calls from CFB-IBN
CCSA	Common Channel Switching Arrangement
CDC	Customer Data Change
CDE	Deny External Calls to Forwarded By Call Forward No Answer
CDI	Exclude Intragroup Calls from CFD-IBN
CDR	Call Detail Recording (see Note 2)
CD0-CD9	Circle Digits 0-9
-continued-	

**Table 5-26****Line service options** (continued)

<b>Option</b>	<b>Description</b>
CFB	Call Forwarding Busy-IBN
CFD	Call Forwarding Don't Answer-IBN
CFDVT	Call Forward Don't Answer Variable Timer
CFI	Call Forwarding Intragroup-IBN
CFU	Call Forwarding Universal-IBN
CFW	Call Forwarding
CHD	Call Hold
CIR	Circular Hunt
CLF	Calling Line Identification with Flash
CLI	Calling Line Identification
CNF	Station Controlled Conference
COD	Cutoff on Disconnect
CPH	Called Party Hold
CPU	Call Pickup-IBN
CSDO	Circuit Switched Digital Data Service
CTD	Carrier Toll Denied
CUG	Closed User Group
CWD	Dial Call Waiting
CWI	Call Waiting Intragroup-IBN
CWO	Call Waiting Originating
CWT	Call Waiting
CWX	Call Waiting Exempt
CXR	Call Transfer
DCBI	Directed Call Pickup Barge-In
DCBX	Directed Call Pickup Barge-In Exempt
DCF	Denied Call Forwarding
DCKP	Directed Call Park
DCPU	Directed Call Pickup Non Barge-In
-continued-	

<b>Table 5-26</b>	
<b>Line service options</b> (continued)	
<b>Option</b>	<b>Description</b>
DCPX	Directed Call Pickup Exempt
DGT	DIGITONE
DIN	Denied Incoming Calls-IBN
DISCTO	Disconnect Time Out
DLH	Distributed Line Hunt
DND	Do Not Disturb
DNH	Directory Number Hunt
DOR	Denied Origination
DPR	Data Profile
DTM	Denied Termination
EBO	Executive Busy Override, Originator
EBX	Executive Busy Override, Exempted
ELN	Essential Line
EMK	Emergency Key
ESL	Emergency Service
ESP	Essential Service Protection
EXT	Assign Add-On Sets to P-Phone
FIG	Flash Ignore
FNT	Free Number Terminating
FRO	Fire Reporting System (origination and termination)
FRS	Fire Reporting System (termination only)
FSR	Frequency Selective Ringing
GIC	Group Intercom
GND	Ground Start (see Note 1)
HLD	Permanent Hold
HOT	Hotel (see Note 2)
ICM	Intercom (business set)
INT	Intercom (single-party revertive calling)
-continued-	

**Table 5-26****Line service options** (continued)

<b>Option</b>	<b>Description</b>
ITD	Interlata Toll Denied
KSH	Key Short Hunt (business set)
LCDR	Local Call Detail Recording
LNR	Last Number Redial
LOD	Line Hunt Overflow to a DN
LOR	Line Hunt Overflow to a Route
MAN	Manual Line
MCH	Malicious Call Hold
MDN	Multiple Call Hold
MLH	Multiple Hunt
MSB	Make Set Busy
MSBI	Make Set Busy Intragroup
MWT	Message Waiting
NDC	No Double Connect
NLT	No Line Insulation Test
NOH	No Receiver-off-hook Tone
NRS	Network Resource Selector
OBS	Observe Agent
OFR	Overflow Register (hardware)
OFS	Overflow Register (software)
ONI	Operator Number Identification
PBL	Private Business Line
PIC	Primary Inter/IntraLATA Carrier
PILOT	Pilot Billing
PLP	Plug-up (trouble intercept) (see note 6)
PRK	Call Park
PRL	Privacy Release
QTD	Query Time and Date
-continued-	



<b>Table 5-26</b>	
<b>Line service options</b> (continued)	
<b>Option</b>	<b>Description</b>
RAG	Ring Again (IBN)
RCVD	Billing to the Digits Received by the Terminating Office
RMB	Random Make Busy
RMP	Remote Meter Pulsing
RMR	Remote Message Register-Reversal
RMS	Remote Message Register-SD Point
RMT	Remote Message Register for Toll Calls
RSP	Restricted Sent Paid
RSUS	Requested Suspension
SC1	Speed Calling-Short List
SC2	Speed Calling-Long List
SCL	Speed Calling Long List-IBN
SCS	Speed Calling Short List-IBN
SCU	Speed Calling User-IBN
SDY	Study
SEC	Security
SHU	Stop Hunt
SLU	Subscriber Line Usage (see Note 4)
SMDR	Station Message Detail Recording
SNR	Stored Number Redial
SPB	Special Billing
SUPR	Supervisor
SUS	Suspended Service (see Note 4)
TDN	Toll Denial
TDV	Toll Diversion
TERM	Billing to the Directory of the Line on which the Call Terminated
TES	Toll Essential
TRMBOPT	Terminator Billing Option
-continued-	

<b>Table 5-26</b>	
<b>Line service options</b> (continued)	
<b>Option</b>	<b>Description</b>
UCD	Uniform Call Distribution
WML	Warm Line
<p><b>Note 1</b> GND has a read-only function. GND is set in data table LNINV (see <i>Local Customer Data Schema</i>, 297-2101-451, Section 1/123). The service order can on check for consistency and report to the user.</p> <p><b>Note 2</b> HOT, hotel line arranged for long distance dialing, is set in data table LINEATTR (see <i>Local Customer Data Schema</i>, 297-2101-451, Section 1/114). HOT is used with service orders to select a line with the appropriate attribute index.</p> <p><b>Note 3</b> Can be set only by the SO input command PLP.</p> <p><b>Note 4</b> Can be set only by the SO input command SUS.</p> <p><b>Note 5</b> For a complete explanation of the Subscriber Line Usage (SLU) Feature and instructions for implementation refer to <i>Operational Measurements</i>, 297-1001-114.</p> <p><b>Note 6</b> Additional information on line service options is contained in <i>Local Customer Data Schema</i>, 297-2101-451, Sections 1/117, 1/124, and 1/125. Options specific to IBN are described in 297-2001-103N.</p>	
—continued—	

<b>Table 5-27</b>	
<b>LCC – options compatibility</b>	
<b>LCC</b>	<b>Compatible options</b>
CCF	CLF CLI COD CTD DGT DOR DTM ELN FNT FSR GND LCDR MAN MTR NLT PIC PLP RCD RSP RSUS SDY SLU SUS TDN TES
CDF	CLF CLI COD CTD DGT DOR DTM ELN FNT FSR LCDR MAN MTR NLT PIC PLP RCD RSP RSUS SDY SLU SUS TDN TES
CFD	ATC AUL COD CTD CWT DGT DOR DTM ELN FIG FRO FRS FSR GND INT LCDR MTR NDC NLT NOH ONI PIC RMR RMS RSP RSUS SCI SC2 SDY SLU SPB SUS TES WML 3WC
CSD	ATC AUL CIR CLI COD CSDO CTD DGT DNH DOR DTM ELN FIG FNT GND LOD LOR MTR NDC NLT NOH OFR OFS PIC PILOT PLP RCVD RMB RSUS SDY SHU SLU SPB SUS TERM TES WML
—continued—	

<b>Table 5-27</b>	
<b>LCC – options compatibility</b> (continued)	
<b>LCC</b>	<b>Compatible options</b>
CSP	CLF CLI COD CTD DGT DOR DTM ELN FNT FSR GND MAN MTR NLT PIC PLP RSP RSUS SDY SLU SUS TDN TES
DATA	AUD AUL BNN CBE CBI CDC CDE CDI CFB CFD CFI CFU CIR CLI CUG CWX DCF DIN DISCTO DLH DND DNH DOR DPR DTM ELN FNT LCDR LNR LOD LOR MLH MSB MSBI NDC NOH NRS OFR OFS RAG RMB RSUS SCL SCS SCU SDY SEC SHU SLU SMDR SPB SUS TES
IBN	ATC AUL AVT BNN CBE CBI CCSA CDC CDE CDI CFB CFD CFDVT CFI CFU CHD CIR CLF CLI CNF COD CPU CWD CWO CWT CWX CXR DCBI DCBX DCF DCPK DCPU DCPX DGT DIN DLH DND DNH DOR DTM EBO EBX ELN FIG FNT FRS GIC GND HLD HOT LCDR LNR LOD LOR MDN MLH MSB MSBI MWT NDC NLT NOH OFR OFS ONI PILOT PLP PRK PRL RAG RCVD RMB RSUS SCL SCU SDY SEC SHU SLU SMDR SPB SUS TERM TES TRMBOPT UCD 3WC
INW	ATC CIR CLF CLI COD CTD DGT DLH DNH DOR DTM FIG FRO FRS FSR GND MLH MTR NDC NLT NOH OFR OFS PIC PILOT PLP RCVD RMB RSUS SDY SHU SLU SPB SUS TERM
OWT	AIOD ATC COD CTD DGT DOR DTM ELN FIG GND LCDR MTR NDC NLT NOH ONI PIC RSP RSUS SC1 SC2 SDY SLU SPB SUS TES
PBM	AIOD ATC BNN CIR CLI COD CPH CTD DGT DLH DNH DOR DTM ELN FIG FNT FRO FRS GND HOT LCDR LOD LOR MAN MLH MTR NDC NLT NOH OFR OFS ONI PIC PILOT PLP RCVD RMB RMP RMR RMS RMT RSP RSUS SDY SHU SLU SPB SUS TDN TDV TERM TES TRMBOPT
PBX	AIOD ATC BNN CFW CIR CLI COD CPH CTD DGT DLH DNH DOR DTM ELN FIG FNT FRO FRS GND HOT LCDR LOD LOR MAN MLH MTR NDC NLT NOH OFR OFS ONI PIC PILOT PLP RCVD RMB RMP RMR RMS RMT RSP RSUS SDY SHU SLU SPB SUS TDN TDV TERM TES TRMBOPT
PDATA	AUD AUL BNN CFB CFD CFU CIR CLI DISCTO DLH DNH DOR DPR DTM ELN FNT LCDR LNR LOD LOR MCH MLH MSB NDC NOH OFR OFS RMB RSUS SCS SCL SDY SHU SLU SPB SUS TES
—continued—	

<b>Table 5-27</b>	
<b>LCC – options compatibility</b> (continued)	
<b>LCC</b>	<b>Compatible options</b>
PSET	AAB ACD ACDNR ASL ATC AUD AVT BNN CAG CBE CBI CDC CDE CDI CFB CFD CFI CFU CIR CLI CNF CPU CWI CWT CXR DCBI DCBX DCF DCPK DCPU DCPX DIN DLH DND DNH DOR DQS DISP DTM EBO EBX ELN EXT FNT GIC ICM KSH LCDR LNR LOD MCH MDN MLH MSB MSBI MWT NDC NGTSRVCE NOH OBS ONI PBL PLP PRK PRL QTD RAG RMB RSP RSUS SCL SCS SCU SDY SEC SHU SLU SMDR SPB SUPR SUS TES 3WC
TWX	ATC CIR CLF CLI COD CTD DGT DLH DNH DOR DTM ELN FNT FSR GND LOD LOR MLH MTR NDC NLT OFR OFS PIC PILOT PLP RCVD RMB RSP RSUS SDY SHU SLU SPB SUS TDN TERM TES
ZMB	ATC CFW CLF CLI COD CTD CWT DGT DOR DTM ELN FIG FNT FRO FRS FSR GND HOT LCDR MTR NDC NLT NOH PIC PLP RMB RSP RSUS SC1 SC2 SDY SHU SLU SPB SUS TDN TES WML 3WL
ZMZPA	ATC CFW CLF CLI COD CTD CWT DGT DOR DTM ELN FIG FNT FRO FRS FSR GND HOT LCDR MTR NDC NLT NOH PIC PLP RMB RSP RSUS SC1 SC2 SDY SHU SLU SPB SUS TDN TES WML 3WL
1FR	ATC AUL BNN CFW CIR CLF CLI COD CTD CWT DGT DLH DNH DOR DTM ELN ESL FIG FNT FRO FRS FSR GND HOT INT LCDR LOD LOR MAN MLH MTR NDC NLT NOH OFR OFS ONI PIC PILOT PLP RCVD RMB RMP RMR RMS RSP RSUS SC1 SC2 SDY SHU SLU SPB SUS TDN TERM TES TRMBOPT WML 3WL
1MR	ATC AUL BNN CFW CIR CLF CLI COD CTD CWT DGT DLH DNH DOR DTM ELN FIG FNT FRO FRS FSR GND HOT INT LCDR LOD LOR MAN MLH MTR NDC NLT NOH OFR OFS ONI PIC PILOT PLP RCVD RMB RMP RMR RMS RSP RSUS SC1 SC2 SDY SHU SLU SPB SUS TDN TERM TES TRMBOPT WML 3WL
2FR	CLI CTD DGT DOR DTM FRO FRS FSR LCDR MTR NLT ONI PIC PLP RSUS SC1 SC2 SDY SLU SPB SUS TDN 3WC
4FR	CLI CTD DGT DOR DTM FRO FRS FSR LCDR MTR NLT ONI PIC PLP RSUS SLU SUS
8FR	CD0 CD1 CD2 CD3 CD4 CD5 CD6 CD7 CD8 CD9 CLI CTD DGT DOR DTM FRO FRS FSR MTR NLT PIC PLP RSUS SDY SLU SUS
—continued—	

<b>Table 5-27</b> <b>LCC – options compatibility</b> (continued)	
<b>LCC</b>	<b>Compatible options</b>
10FR	CD0 CD1 CD2 CD3 CD4 CD5 CD6 CD7 CD8 CD9 CLI CTD DGT DOR DTM FRO FRS FSR MTR NLT PIC PLP RSUS SDY SLU SUS
2WW	AIOD ATC CIR CLF CLI COD CTD DGT DLH DNH DOR DTM ELN FIG FRO FRS GND LCDR MLH MTR NDC NLT NOH OFR OFS ONI PIC PILOT PLP RCVD RMB RSP RSUS SC1 SC2 SDY SHU SLU SPB SUS TERM TES WML
<b>Note:</b> PSET is the LCC used for Business Sets. The DISP option is added to the line for Display Business Sets.	
End	

<b>Table 5-28</b> <b>Options – options incompatibility</b>	
<b>Option</b>	<b>Incompatible with options</b>
3WC	AUL CSDO FIG MAN NDC NOH
CD3	CD4 CD5 CD6 CD7 CD8 CD9 CD0 CD1 CD2 CSDO
CD4	CD5 CD6 CD7 CD8 CD9 CD0 CD1 CD2 CD3 CSDO
CD5	CD6 CD7 CD8 CD9 CD0 CD1 CD2 CD3 CD4 CSDO
CD6	CD7 CD8 CD9 CD0 CD1 CD2 CD3 CD4 CD5 CSDO
CD7	CD8 CD9 CD0 CD1 CD2 CD3 CD4 CD5 CD6 CSDO
CD8	CD9 CD0 CD1 CD2 CD3 CD4 CD5 CD6 CD7 CSDO
CD9	CD0 CD1 CD2 CD3 CD4 CD5 CD6 CD7 CD8 CSDO
CFB	BNN DTM FNT HOT TRMBOPT MLH DLH DNH
CFD	BNN DTM FNT HOT TRMBOPT DLH MLH DNH
CFVDT	BNN DLH DNH DTM FNT HOT MLH TRMBOPT
CFI	CFU BNN DOR DTM FNT HOT ONI PLP CSDO TRMBOPT
CFU	CFI BNN DOR DTM FNT HOT ONI PLP CSDO TRMBOPT
CFW	AUL BNN FNT HOT MAN ONI PLP TRMBOPT
CHD	DOR DTM FIG NDC
CIR	CWT DLH MLH CWI CWX
CLF	ESL FIG PLP
–continued–	

<b>Table 5-28</b>	
<b>Options – options incompatibility</b> (continued)	
<b>Option</b>	<b>Incompatible with options</b>
CLI	PBL
CNF	DOR FIG NDC PLP
COD	Compatible With All Line Options
CPH	FIG CSDO
CPU	BNN DOR DTM HOT
CSDO	BNN CCSA CDO CD9 ESL HOT LCR CFI CFU CPH RMT MAN ONI RMR RMS RSP SC1 SC2 TDN TDV 3WC CTD
CTD	AUL CSDO TDN TDV
CUG	Compatible With All Line Options
CWD	AUL DOR FIG CWO
CWI	BNN CIR DLH DNH DTM FIG LOD LOR MLH HOT NDC OFR OFS RMB SHU CWX
CWO	DOR CWD
CWT	BNN CIR DLH DNH DTM FIG LOD LOR MLH OFR OFS RMB SHU NDC CFB CBI CBE CWX
CWX	BNN CIR CWI CWT DLH DNH DTM FIG LOD LOR MLH NDC OFR OFS RMB SHU
CXR	AUL DOR FIG NDC NOH
DCBI	AUL DOR DCPU
DCBX	DTM NDC DCPX
DCF	Compatible With All Line Options
DCPK	AUL DOR DTM FIG
DCPX	AUL DOR DCBI
DGT	AUL MAN
DIN	BNN DTM HOT PBL
DISCTO	Compatible With All Line Options
DISP	Compatible With All Line Options
DLH	CIR CWY DNH MLH SHU CWI RAG MDN UCD CWX CBE CBI CDE CDI CFB CFD CFDVT KSH
DND	DTM PBL MDN
–continued–	

<b>Table 5-28</b>	
<b>Options – options incompatibility (continued)</b>	
<b>Option</b>	<b>Incompatible with options</b>
DNH	CWT DLH MLH CWI MDN UCD CWX CBE CBI CDE CDI CFB CFD CFDVT KSH
DOR	CXR MSB SCS SCL SCU CPU CFU CFI RAG PRK HLD CNF SMD DCPU DCBI MWT CWO CWD CHD LNR MSBI
DQS	Compatible With All Line Options
DTM	CWT AVT CBI CDI CFB CFD CFI CFU CWI DND DIN EBX HLD PRK RAG MSB CPU MDN UCD TRMBOPT DCPX DCBX MWT CBE CDE CWX CHD MSBI DCPK CFDVT
EBO	FIG
EBX	DTM
LN	Compatible With All Line Options
ESL	RSP CSDO CLF
FIG	CLF CWT 3WC CPH CXR CNF CWD CWX CHD CWI EBO HLD PRK RAG MWT DCPK
FNT	CFW CBE CDE CBI CDI CFB CFD CFI CFU CFDVT
FRO	FRS MAN RMS
FRS	FRO
FSR	Compatible With All Line Options
GIC	PLP MDN KSH
GND	Compatible With All Line Options
HLD	FIG DOR DTM NDC
HOT	AUL CFW CSDO MAN RSP TDV CBE CDE CBI CDI CFB CFD CFI CFU CPU CWI DIN SCL SCS SCU CFDVT
ICM	KSH
INT	Compatible With All Line Options
ITD	AUL TDV TES CSDO RSP CPU RMT
KSH	ACD DLH DNH GIC ICM MLH PBL
LCDR	CCSA CSDO MAN ONI
LNR	AUL DOR
LOD	CWT LOR CWI CWX
LOR	CWT LOR CWI CWX
-continued-	

<b>Table 5-28</b>	
<b>Options – options incompatibility</b> (continued)	
<b>Option</b>	<b>Incompatible with options</b>
MAN	AUL LCDR CFW CSDO DGT FRO HOT RMS RSP SC1 SC2 SPB WML 3WC CCSA
MCH	Compatible With All Line Options
MDN	PBL DLH DNH MLH RMB SHU DND UCD GIC AAB
MLH	CIR CSDO CWT DLH DNH CWI RAG MDN UCD CWX CBE CBI CDE CDI CFB CFDVT KSH
MSB	DTM DOR MSBI
MSBI	DOR DTM MSB
MTR	Compatible With All Line Options
MWT	DOR DTM FIG
NDC	3WC CHD CWT CWI CXR CNF DCBX CWX HLD PRK
NGTSRVE	Compatible With All Line Options
NLT	Compatible With All Line Options
NOH	3WC CXR
NRS	Compatible With All Line Options
OBS	Compatible With All Line Options
OFR	CWT CWX CWI
OFS	CWT CWX CWI
ONI	AUL CCSA LCDR CFW CSDO RSP SPB CFU CFI
PBL	MDN CLI DIN DND RMB RSUS SHU SLU SPB SDY BNN KSH SEC
PIC	Compatible With All Line Options
PILOT	Compatible With All Line Options
PLP	BNN CFW CLF CFI GIC CFU CNF PRK
PRK	DOR DTM FIG NDC
RAG	BNN DLH DOR DTM MLH FIG
RCD	Compatible With All Line Options
RCVD	Compatible With All Line Options
RMB	CWT PBL MDN UCD CWX CWI
RMP	Compatible With All Line Options
–continued–	



<b>Table 5-28</b>	
<b>Options – options incompatibility (continued)</b>	
<b>Option</b>	<b>Incompatible with options</b>
RMR	CSDO
RMS	CSDO FRO MAN
RMT	TDN TDV CSDO
RSP	CSDO ESL HOT MAN ONI TDN TDV
RSUS	PBL
SC1	AUL CSDO MAN
SC2	AUL CSDO MAN
SCL	AUL BNN DOR HOT SCU
SCS	AUL BNN DOR HOT
SCU	AUL BNN DOR HOT SCL
SDY	PBL
SEC	PBL
SHU	CWT DLH CWX MDN PBL UCD CWI
SLU	PBL
SMDR	DOR
SPB	BNN MAN ONI PBL
SUS	Compatible With All Line Options
TDN	AUL CSDO RSP TDV TEST RMT TES CTD
TDV	AUL CSDO HOT RSP TDN TES RMT ITD RSP
TERM	Compatible With All Line Options
TES	TDN TDV ITD
TRMBOPT	CFW DTM CFU CFI CFB CBI CFD CDI CBE CDE
UCD	AUL BNN DLH DNH DTM MLH RMB SHU MDN
WML	AUL AMN
-continued-	



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## Chapter 6: Administration

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This section describes the administrative and operational aspects of DMS-100 Family switching systems:

- Data Recording
- Automatic Message Accounting (AMA) System
- Operational Measurements (OM)
- Network Management
- Data Base Management
- Data Base Facilities and Structures
- Service Analysis
- Multiunit Message Rate Services (MUMR)
- Fraud Prevention Features

All administrative functions in DMS-100 Family switching systems are carried out from a MAP. One or several MAPs can be profiled to serve all the administrative functions, or a dedicated MAP can be configured to serve one specific administrative function depending on operating company needs.

A complete description of a MAP position can be found in Chapter 7.

### Data recording

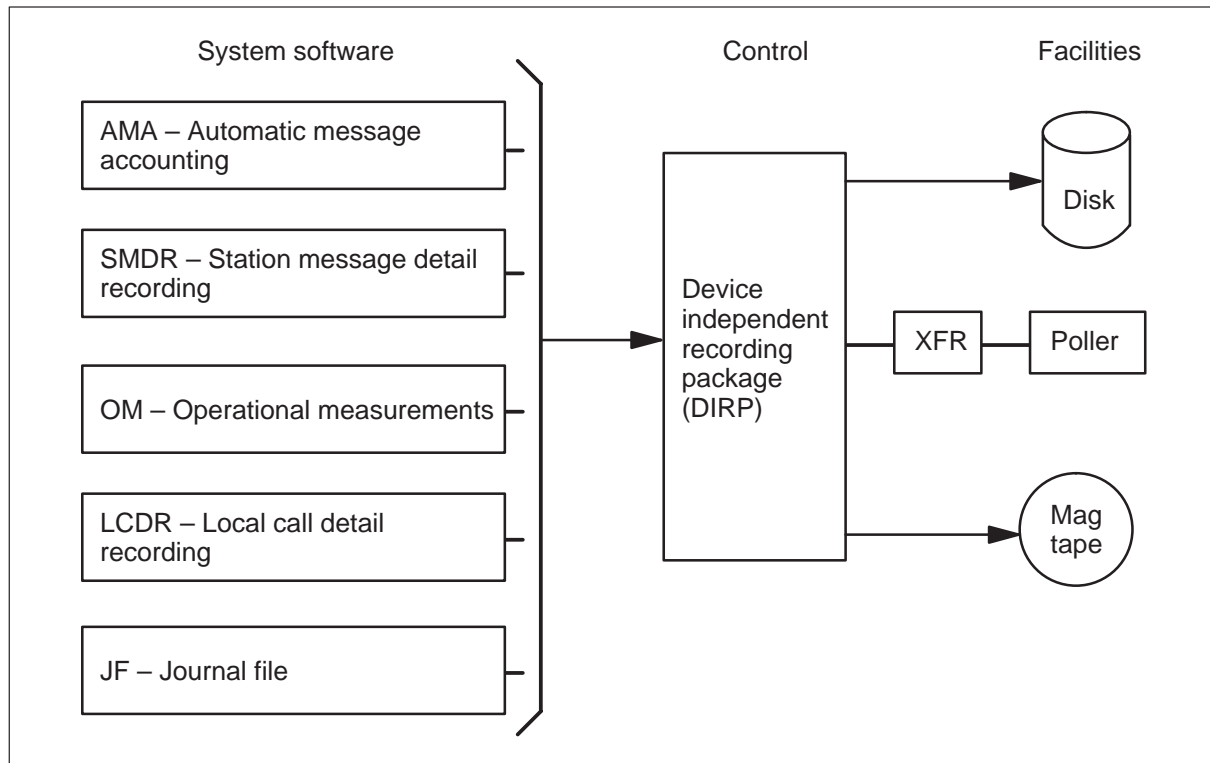
Data for AMA, SMDR, OM, and Journal File (JF) and others can be automatically recorded on either nine-track magnetic tape or Winchester type disk drives. The management of data traffic to and from the hardware devices is performed by a software subsystem called DIRP.

Each DMS-100 installation is configured for automatic data recording using two data tables: DIRPSSYS and DIRPPPOOL. The DIRPSSYS data table provides a list of recognized subsystems, such as AMA, OM, and JF, which record their data on either tape or disk files. This data table also provides additional operational information such as the number of open files and the alarm conditions for each subsystem. The DIRPPPOOL data table defines the groups of recording devices, the type of devices (tape or disk), and the recording volume identifications.

The system performs three scheduled software audits. The device audit checks the physical recording device every five minutes to verify that it is ready to receive data. The subsystem audit verifies the integrity of the device files and their configurations every 60 min. With disk operation, the disk daily audit performs a detailed audit of all disk files, verifying their status and updating the same as required. The tape daily audit performs the tasks, such as checking for free tapes and rewinding parallel tape files. Both tapes and disk audits run at 3:11 every morning.

Under normal operation, the subsystem files are maintained in the “open” state, ready to accept data. If two or more files are assigned to a specific subsystem, then active and standby status is assigned to the files, and periodic rotation of recording duty occurs. A maximum of three standby files can be specified for any subsystem. In addition to the active and standby files, a parallel file can be set up as a backup to record all data output by a subsystem. For more information (see 297-1001-312 and Figure 6-1).

**Figure 6-1**  
**Data recording**



## Magnetic tape

The characteristics of the recording format for magnetic tapes are covered by 297-1001-118, and are outlined in this section. Magnetic tapes can be used by DMS-100 Family switching systems to store data for seven applications:

- AMA
- OM
- Office Image (for system backup)
- Trouble Diagnostic Data
- Call Detail Recording (CDR) records for local calls
- Customer Data Modification (CDM)
- Office Data Modification

### Magnetic tape recording characteristics

The DMS-100/200 AMA recording system accepts magnetic tapes with these characteristics:

- tracks: nine-track format
- recording density: 1600 characters per inch (cpi) [bytes per inch (bpi)]
- recording technique: phase-encoded
- tape character (byte): eight bits of data plus one parity bit (odd parity)
- block size (physical block): between 18 and 2048 tape characters arranged in accordance with the American National Standards Institute (ANSI) recording format for magnetic tape.

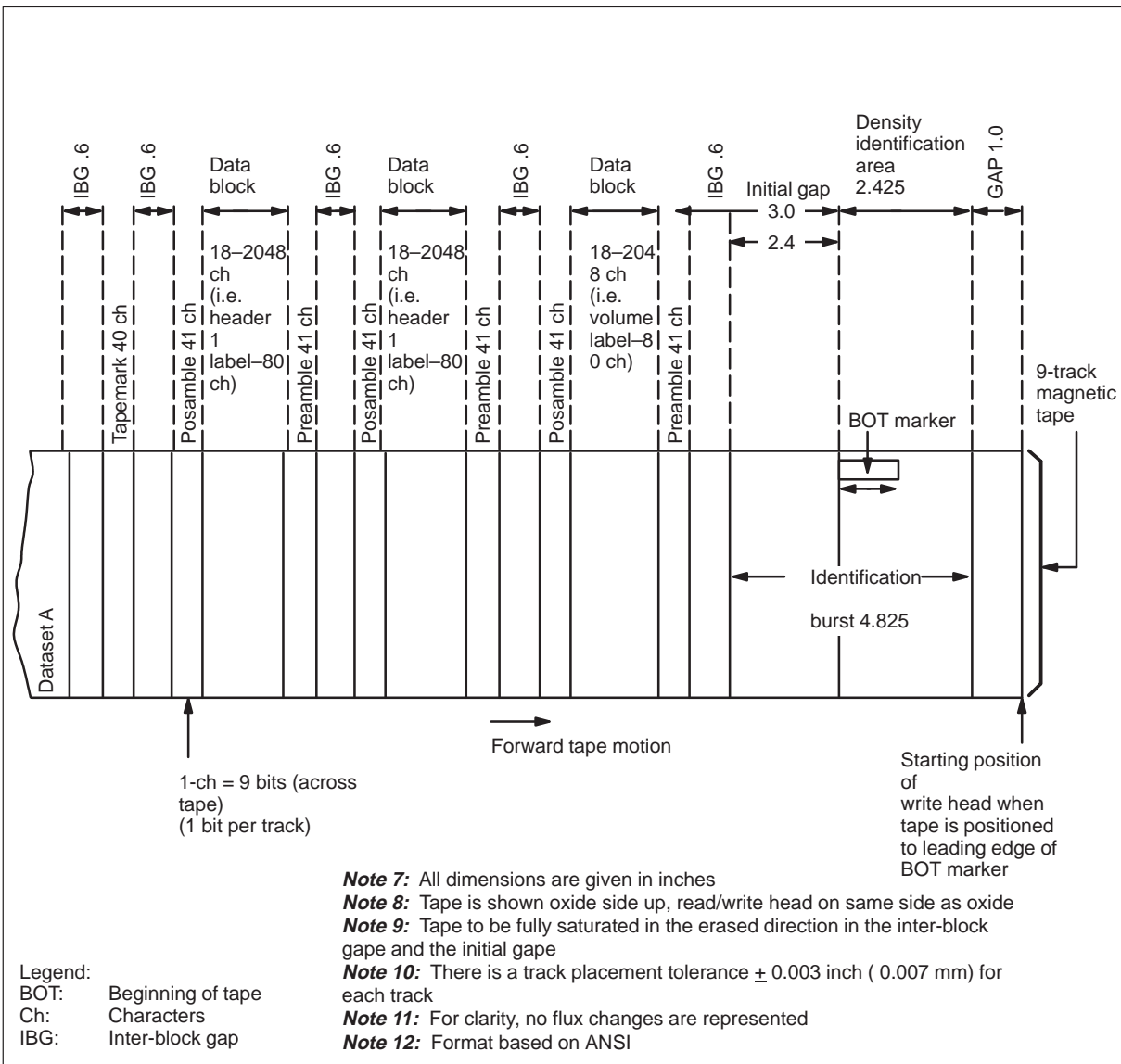
**Block arrangement** The DMS-100 machine accepts a nine-track tape recording using phase encoding, at a density of 1600 cpi or bpi, with odd parity. Data is recorded on tape with the ANSI recording format. This format consists of a density identification area, an initial gap, preambles, blocks of data of variable length, postambles, and strategically placed interblock gaps and tape marks:

- **BOT (Beginning of Tape) Marker:** A BOT marker is a reflective strip which marks the beginning of the permissible recording area. The tape is positioned by the system at the leading edge of the BOT marker after being manually loaded.
- **Identification Burst (Density Identification Area):** An identification burst is a pattern of flux changes on one track only and identifies the tape as being phase-encoded when it is loaded onto a dual-density tape drive.
- **Initial Gap:** An initial gap is the portion of the tape which is between the trailing edge of the BOT marker and the first block of data (volume label).

- **Interblock gap (IBG):** An interblock gap is a portion of the tape which has no flux changes. An interblock gap is 0.6 in. (1.5 cm) long. It separates the identification burst, blocks of data and tapemarks.
- **Preamble:** A preamble precedes the actual data in a block. It consists of a sequence of 40 zeros in each track followed by a binary one in each of these same tracks. The zeros synchronize clocks, and the binary ones signal the beginning of the data.
- **Block:** A block is a group of related data of between 18 to 2048 tape characters. A block can contain one or more records.
- **Postamble:** A postamble follows the actual data in a block and is a sequence consisting of a binary one in each track followed by 40 zeros in each of these same tracks. It is a mirror-image of the preamble.
- **Tape Mark:** A tape mark is a special control block having a pattern of flux changes in six out of nine tracks and is 40 characters long. It separates data sets from label groups.
- **Data Set:** A data set can contain one or more records which are organized into blocks in various formats, as described in 297-1001-118.
- **EOT (End of Tape) Marker (not shown in Figure 6-2):** An EOT marker is a reflective strip located about 25 ft. (7.6 m) from the end of the tape. It indicates the end of the normal permissible recording area. In some instances, (that is, the block being written), data may be written beyond the marker. Emergency transfer entry occurs when the EOT marker is detected. See 297-1001-119 for a description of tape transfer and entry.

The functions for various parts of the recording format are shown in Figure 6-2.

**Figure 6-2**  
**Magnetic tape recording format**



**Volume organization** Data can be stored on tape as:

- a single data set on a single volume
- a single data set on multiple volumes
- multiple data sets on a single volume
- multiple data sets on multiple volumes

### **IBM standard labels**

The volumes (and the data sets of file(s) they contain) are identified by labels as a basis for efficient processing. DMS-100 Family systems use IBM Standard Labels (See OS/VS Tape Labels) for this purpose.

The IBM standard label that identifies the volume and its owner is the Volume Label (VOL1).

The IBM standard labels identify and describe the data set:

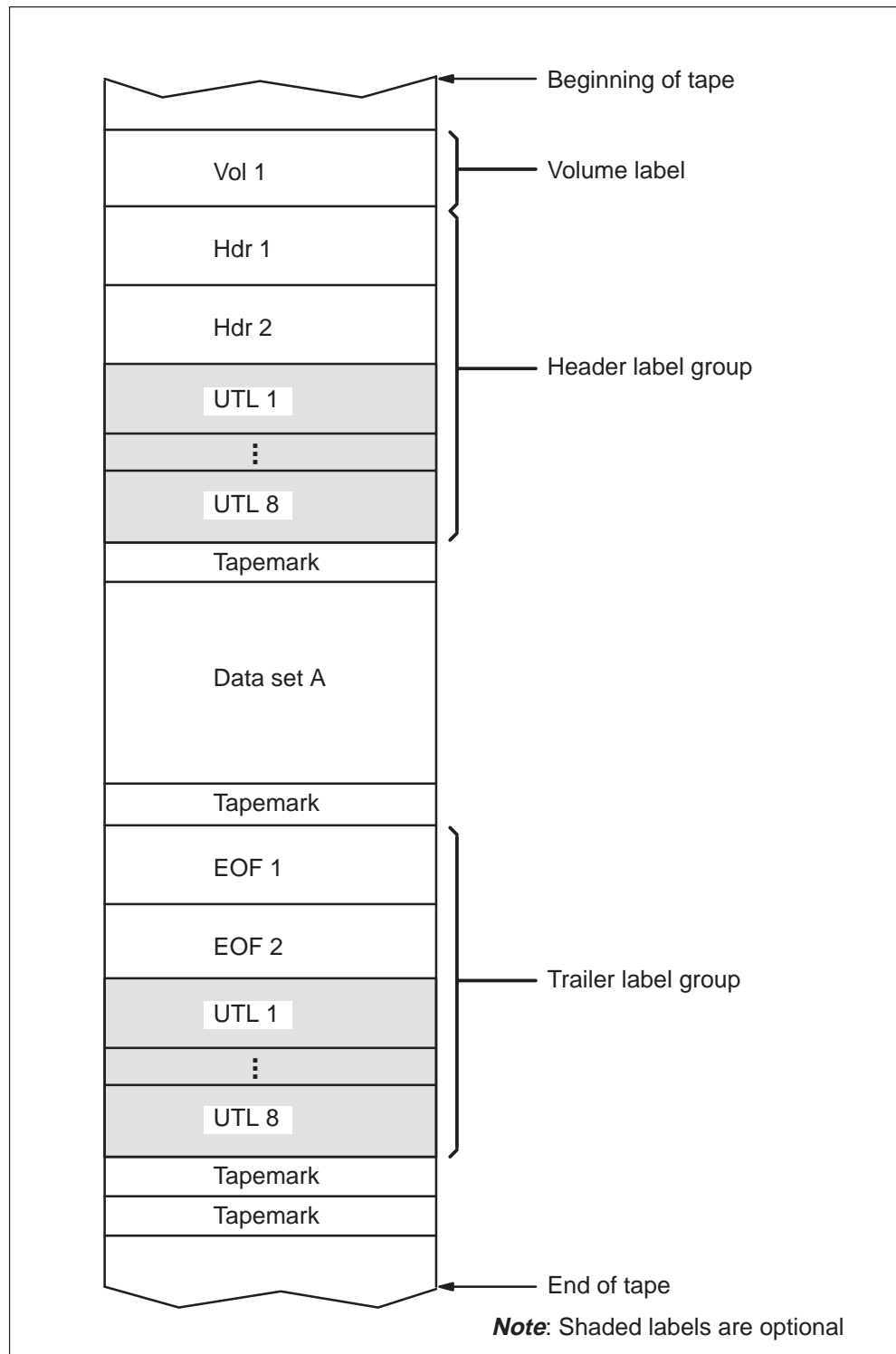
- Header Labels (HDR1, HDR2)
- User Header Labels (UHL1) (Bellcore AMA format)
- Trailer Labels (EOF1, EOF2)
- User Trailer Labels (UTL1) (Bellcore AMA format)

As shown in Figures 6-3 and 6-4, these labels are referred to collectively as the header label group or the trailer label group.

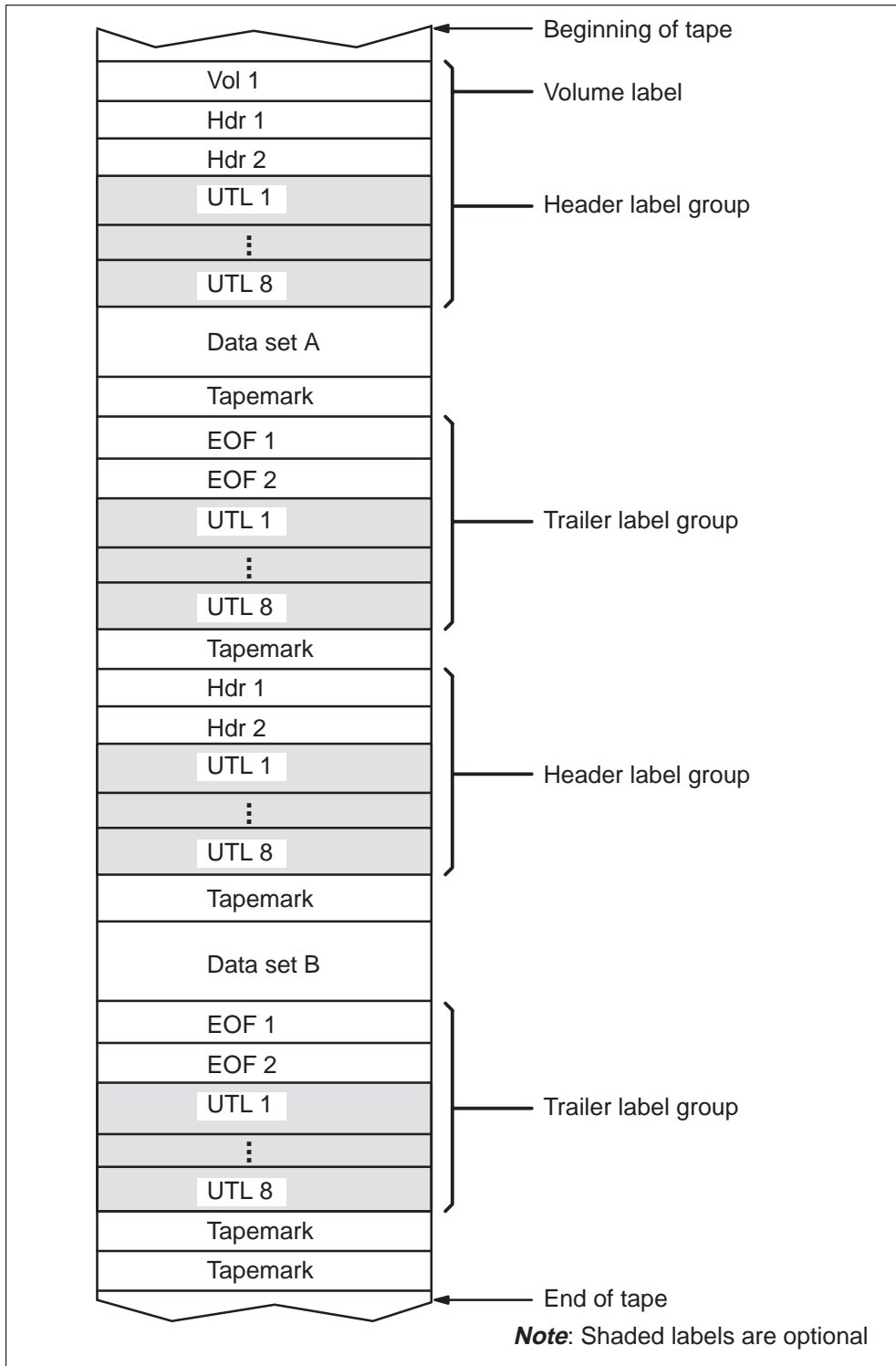
The tape mark, which acts as a delimiter or separator, follows both label groups, (header and trailer) and each data set. Two tape marks follow the trailer label group to indicate that the end of the last data set on the volume has been reached.



**Figure 6-3**  
**Label organization for a single data set on a single volume**



**Figure 6-4**  
**Label organization for multiple data sets on a single volume**



**Coding of IBM standard labels** All labels are recorded in Extended Binary-Coded Decimal Interchange Code (EBCDIC) and written as 80-byte (80 tape characters) blocks. The first four bytes always correspond to the label identifier itself (for example, VOL1 or HDR1). The contents of the remaining 76 bytes of each block differ according to the label, as covered by 297-1001-118.

**Volume label (VOL1)** The volume label is the first record on the volume and is identified by VOL1. It contains the volume serial number and the name of the volume owner.

**Header label 1 (HDR1)** The (data set) header label 1 precedes the data set and is identified by HDR1:

- data set name
- data set serial number
- data set volume sequence number (for single data set/multiple volume situations)
- data set sequence number (for multiple data sets/single volume situations)
- generation number (for generation data set groups)
- version number (for generation data set groups)
- creation date
- expiration date
- data security code
- block count
- system code

**Header label 2 (HDR2)** The (data set) header label 2 immediately follows the HDR1 label and is identified by HDR2:

- record format of the data set
- block length
- record length
- tape density
- system ID
- tape recording technique
- block attribute

**User header labels (Bellcore AMA format)** Optionally, a maximum of eight user header labels can appear immediately following HDR and are identified by UHL1 to UHL8. These labels contain user-assigned information about the data set.

**End-of-file label (EOF1)** The end-of-file label 1 follows the data set indicating that the end of the data set has been reached. It is identified by EOF1 and contains identical information to the HDR1 label, except for the label identifier and the block count.

**End-of-file label 2 (EOF2)** The end-of-file label 2 immediately follows EOF1 and is identified by EOF2. It contains identical information to the HDR2 label, except for the label identifier.

**User trailer labels (Bellcore AMA format) (UTL)** Optionally, a maximum of eight user trailer labels can appear immediately following EOF2, and are identified by UTL1 to UTL8. These labels contain user-assigned information about the data set.

### **Data set logical record formats**

A data set is composed of a number of logical records which are organized into fixed or variable-length blocks with the former being most used for DMS-100 Family system data sets.

Blocking is the process of grouping a number of logical records as a physical block. A block is made up of the data records between the inter-block gaps and may be 18 to 2048 tape characters (bytes) long. Blocking allows efficient use of storage space by reducing the number of interblock gaps in the data set. Blocking also reduces processing time because fewer input/output operations are required to process entire blocks of records when the records fit into the fixed length format applies. When a variable length record exceeds the physical block size, it will be written into the next block.

The OM and LOG datasets are encoded in EBCDIC (with the character set as defined by the IBM standard PN print train for 1403 and 1404 printers). The NT standard AMA and Bellcore AMA data sets are encoded in Binary Coded Decimal (BCD) four-bit code, the details of which are found in 297-1001-119. In the Bellcore format, the AMA data is recorded in signed packed decimal with hexadecimal identifiers.

## **Disk**

Disk Drive Units (DDUs) for DMS-100 are 14 inch Winchester type drives which have capacities of 300 Mbytes.

In a disk office, the DDU replaces the Magnetic Tape Drive (MTD) as the primary mass storage device. A minimum of one MTD is retained to enable physical transportation of data to and from the office.

Disk drives are typically configured for these files:

- AMA billing

- OMs
- office image – backup
- peripheral software loads
- JF
- Pending Order File (POF)
- non-resident programs
- user files

Refer to 297-1001-526.

The DDU consists of a disk drive and a NT1X78 power converter card installed on a dedicated shelf on an I/O Equipment (IOE) frame. Associated with each DDU is a NT1X55 disk drive controller card which occupies one card slot of the IOC shelf, and which interfaces with the DDU and IOC.

**Disk files** Storage space on a disk is allotted on the basis of volumes and files. Once the volumes are defined they are considered as separate entities by the system. After files are created within the volumes, the data is stored wherever space is available within the confines of the volume. This is a system task and is transparent to the user.

Each data file is a collection of segments within a volume with each segment representing 512 blocks of 1 k DIRP bytes each. The block is the smallest DIRP addressable unit (also equals 256 2 k DIRP blocks) and constitutes a disk sector.

**AMA and OM recording** The storage of AMA and OM data on disk can be very cost effective. The primary advantage of disk over tape is the reduction of the number of recording devices, for example, from four to six MTUs per office, to the one MTU-two disk combination. This advantage is gained through the random access characteristics of disk which enables the storing and accessing of many separate files simultaneously on one drive (see 297-1001-312).

Depending on the size of the AMA and OM files, (and drives and volumes allowed to DIRP) it is possible to store many days of AMA data, OM data, journal file, as well as the office image on one disk, while the other one can be the duplicate backup. On a daily basis, the most recent AMA file can then be image copied to tape, and transported to the processing center. The maximum DIRP backup is 24 volumes of 64 Mb each for a total of 1563 Mb/stream.

Security features provided primarily for AMA files include dual recording of data, sanity checks of file deletion commands, and activation of alarms, if a disk space minimum threshold is reached.

**Office image – backup** The disk can also be used for office image storage and bootstrap loading. With the recommended dual disk configuration, one or more office images can be stored on both disks. Since data transfer speed from disk is much faster than from tape, loading and dumping of the office image will be faster. Peripheral Module loads can also be stored on the same disk.

Normally the office images are set up as a particular disk volume as an archive or a set of images with the most recent being available for backup (current image file). Multiple images may be stored on disk and/or tape, with a route list defining the order in which the images are accessed.

**Journal file (JF)** This file contains records of all DMOs entered, allowing automatic re-activation if data tables are inadvertently destroyed. Even though this file is not large, it is normally active, therefore requiring a dedicated tape drive. Disk residence frees up the tape drive, and allows instant activation in an emergency (refer to 297-1001-127).

**Pending order file (POF)** The POF is used to store service orders, rating changes and office configuration changes for later activation. Although this file is normally small, occasional block-cut change procedures may require a much increased storage capability. Disk resident POF allows larger volumes of DMOs to be entered further in advance of their scheduled implementation (refer to 297-1001-126.)

**Non-resident programs and user files** As well as storing non-resident maintenance programs, the disk can be utilized to store other programs and data of a non time-critical nature. This further facilitates remote maintenance and administration of offices, and reduces the requirements for memory cards.

## Data polling

### Remote data polling of OM and/or AMA information

The remote data polling system permits the telephone company to transfer OM, AMA, and JF DIRP data of a DMS-100 family office to a data processing center. This data is stored on a disk or a magnetic tape and, through the DIRP, the data is made available to the remote data polling system which transmits it to the data center. The data is transferred using a version of the CCITT X.25 for data communication protocol.

Dedicated cards can be established separately or jointly for OM and AMA polling. The DMS-100 interface consists of an NT1X89 Multi-Protocol control card and an EIA RS-232-C interface to a modem.

When setting up the connection through the data packet switching network the data network (DNA) address of the host collector is verified by

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comparing it to the authorized list of users in data table XFERADDR (refer to 297-1001-451, "Section 045 Data Transferal System"). If the address matches, access is made available.

The inventory of data record files to which the host collector has access are listed in data table DIRPHOLD. Here the files are listed by type (such as, originating subsystem AMA, or OM), file name, and location (volume serial number). While file management is normally automatic, manual override is available. Files that have been requested and processed are denoted "aging" and await automatic expiration and erasure (refer to 297-1001-524.)

### **Automatic message accounting teleprocessing system (AMATPS)**

The AMATPS is an automatic AMA data management system designed for use with Bellcore AMA data in a DMS-100 office. The AMATPS transfers the Bellcore AMA data from the DMS-100 to the Host Office Collector (HOC) automatically, eliminating the need for manual transfer of AMA tapes to the Revenue Accounting Office (RAO). The AMATPS consists of the DMS-100 DIRP, the DPP unit, and the regional HOC. The HOC is a data collecting computer that collects AMA data from the central office within its region and compiles that data onto tapes that are used by the RAO for computing customer billing. The HOC uses BX.25 protocol and polls the billing data over a data link on a remote basis.

The technical requirements document for the interface is TR-TSY-000385, issued in July, 1986. This document designates the operating companies specification for an interface between the AMA transmitter and collector. Generic requirements are explained in the Technical Advisory TA-TSY-000385.

DIRP is a DMS-100 data recording management system which manages the flow of AMA data from the switch to the DPP unit. A detailed description of DIRP is found in 297-1001-312. The AMATPS interface receives data from the DPP which is an AMA data collector and storage device, and an AMA transmitter (AMAT) that conforms to Bellcore AMA transmission requirements. The DPP performs the AMAT functions independently of the DMS-100, thereby off-loading AMAT functions from the DMS-100 central control complex (CCC). The DPP receives Bellcore AMA data from DMS-100 DIRP and stores the data on its own internal disk. Redundancy is used throughout the DPP to prevent loss of the AMA data. DPP appears logically and physically to DMS as a standard tape interface.

Selectable data baud rates of 1200, 2400, 4800, and 9600 and 56 kb/s transmission capability are available.

### **AMA tape dump utility**

An optional non-resident utility is available for the purpose of providing a display or hardcopy of the contents of AMA files produced in a Local AMA (LAMA) or Centralized AMA (CAMA) office.

AMADUMP format filename

where: format = BC for Bellcore format

NT for NT format

filename is the name of the AMA datafile from a mounted and listed AMA tape or disk.

By issuing the proper commands from a MAP terminal, the contents of the AMA tape may be printed out with respect to two parameters:

- specific blocks or groups of blocks
- specific call entries which satisfy certain data patterns or time constraints

Refer to 297-1001-119.

*Note:* This utility cannot be used in conjunction with the DPP.

## **AMA system**

The AMA system collects the call billing data and automatically records it through DIRP. Periodically the AMA datasets are sent to the operating company's data processing center for data stripping. The data stripped from these AMA datasets provides the information necessary for customer billing and/or call analysis as required.

The DMS-100 Family supports both NT standard AMA format and Bellcore AMA format (which represents a universal standard within the Bell Operating Companies). Both formats support LAMA, CAMA, LCDR and TOPS. SMDR (for MDC) uses only the NT standard AMA format. Bellcore format supports Equal Access (Feature Groups A, B, C, D and operator systems). The NT AMA format supports Feature Groups A, B, and C.

In general, Bellcore format is implemented in accordance with Section 9 of the LATA Switching System Generic Requirements (LSSGR) dated July 1987. New requirements for this format capability should be verified with Nortel Networks before such capability is planned for a specific application.

AMA data recording can be made to either magnetic tape or disk. The mechanism used in establishing the desired configuration is a software subsystem called DIRP. This is outlined in Chapter 5 and is covered in 297-1001-312.

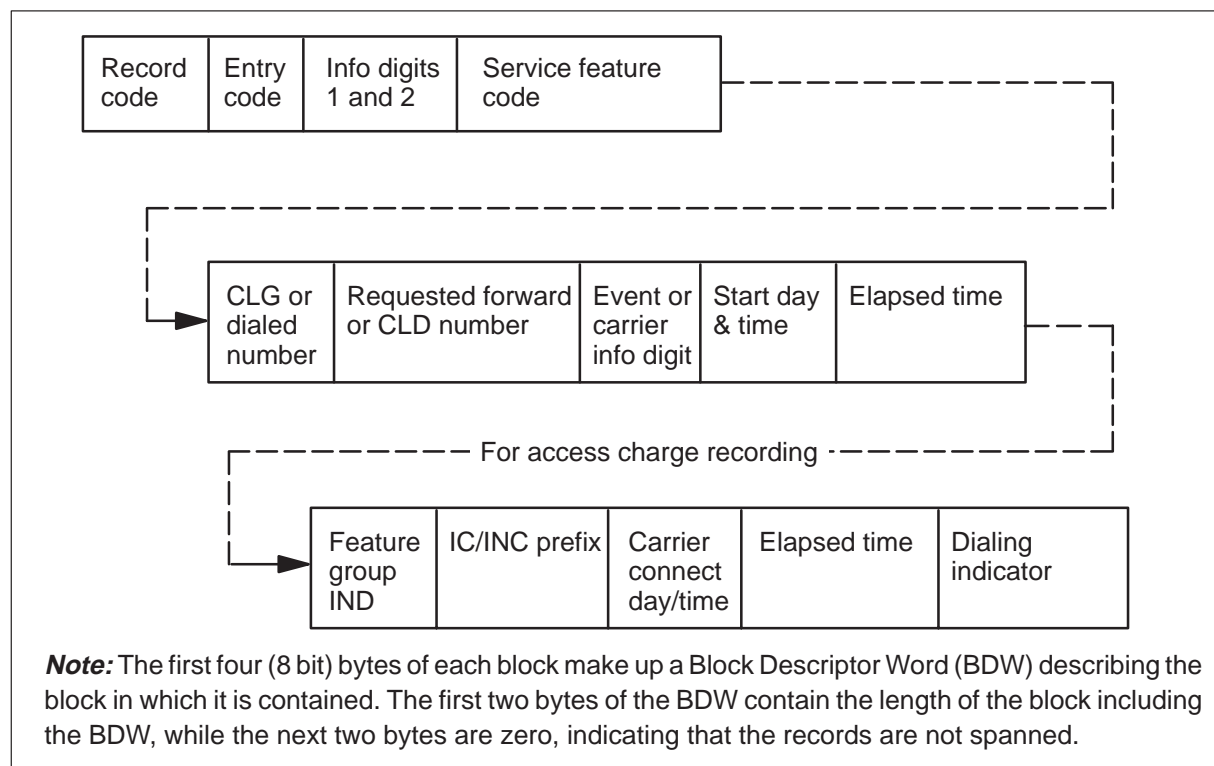


The AMA recording system can accommodate a number of simultaneous calls requiring AMA recording as defined by the number of call condense blocks provisioned by the operating company and specified in the office parameter table, plus the number of recording units.

### Bellcore AMA format

This section describes the Bellcore AMA format used for LAMA and CAMA operations. This format is necessary in equal access offices. It is outlined in the December 1984 Section 8.1 of the LSSGR and is used by the regional operating companies. Bellcore AMA records are variable blocked (see Figure 6-5). Variable blocked recording provides for records of variable length, each describing its own characteristics, packed into variable length blocks—but, do not exceed 2048 bytes. The Bellcore AMA format is described in detail in 297-1001-119.

**Figure 6-5**  
**AMA call record format (not applicable to Bellcore AMA)**



### Call types

The various call codes and associated structure codes supported by the DMS-100 Family are listed in Table 6-1. The call code defines the type of call or statistic being recorded (for example, call code 110 indicates that the record is for an interLATA station paid call). The listing shown in Table 6-1 is subject to change as new requirements are introduced.

<b>Table 6-1 Call codes and structure codes supported by DMS-100</b>						
<b>Call types</b>	<b>Call codes</b>	<b>High runner</b>	<b>Answer</b>	<b>Unanswer</b>	<b>Long duration</b>	<b>Other conditions</b>
Detailed Message Rate, Timed, MBI	001	00502	00020	00021	00120	
Message Rate, Timed, MBI	002	00503	00015	00016	00115	
Detailed Message Rate, Untimed, MBI	003	00504	00024	00087	N/A	
Message Rate, Untimed, MBI	004		00019	00086	N/A	
Detailed Message Rate, Timed, No MBI	005		00001	00002	00101	
Station Paid	006	00500	00001	00002	00101	
OUTWATS (Station Billing Number)	007	00501	00020	00021	00120	
INWATS	008		00079	00080	00179	
Directory Assistance (411)	009		00028	00068	00128	
FX, Automatic Flexible Routing	011	00500	00001	00002	00101	
Common Control Switching Arrangement (CCSA) Sampling	021		00001	00002	00101	
Conference Trunk Usage	026					00076
Call Forwarding Activation/Deactivation	031					00096
Tandem Tie Trunk	032		00025	00026	00125	
Directory Assistance (555)	033		00028	00068	00128	00126
Signaling Irregularities	034					00002
SLUS, Terminating Entry	036		00079	00080	00179	
SLUS, Overflow Counts	037					09003
Local Coin	041		00001	00002	00101	
Time Change	042					09000

—continued—

<b>Table 6-1</b>						
<b>Call codes and structure codes supported by DMS-100 (continued)</b>						
<b>Call types</b>	<b>Call codes</b>	<b>High runner</b>	<b>Answer</b>	<b>Unanswer</b>	<b>Long duration</b>	<b>Other conditions</b>
Flat Rate	067		00001	00002	00101	
OUTWATS (Billing Number)	068	00501	00020	00021	00120	
INWATS Overflow Count	071					09003
Circuit Switched Digital Capability	072		00190	00191	00194	
Free Call	074		00001	00002	00101	
Electronic Tandem Switched Call	085		00001	00002	00101	
Non-DA-555 Directory Assistance	088	00500	00001			
Sensor Tracer	090					09046 09049
Sensor / RAO Tracer	092					09013 09014
InterLATA Station Paid	110		00625	00625	00627	
InterLATA WATS, Station Detail	111		00629	00629	00633	
InterLATA WATS Billing Number	114		00637	00637	00641	
InterLATA CSDC	117		00645	00645	00647	
Terminating Access Record	119		00653	00653	00654	
Terminating Access Record (Shortened Format)	119		00664	00664	00665	
Originating LATA Overflow Counts (Output Hourly)	120					00655
Terminating DATAPATH		12	00656		00656	00657
Originating FGA	131		00079	00080	00179	
Originating FGB	134		00625	00625	00627	
Terminating FGB	135		00653	00653	00654	

—continued—

<b>Table 6-1</b>						
<b>Call codes and structure codes supported by DMS-100</b> (continued)						
<b>Call types</b>	<b>Call codes</b>	<b>High runner</b>	<b>Answer</b>	<b>Unanswer</b>	<b>Long duration</b>	<b>Other conditions</b>
16 Number Service Calls	141		00360		00362	00363 00361
Telephone Co. Number Service Calls	142		00364	00368	00360	00365 00367 00369
Generic Call Codes	800		00001	00002	00101	
	801		00001	00002	00101	
	802		00001	00002	00101	
	803		00001	00002	00101	
	804		00001	00002	00101	
	805		00001	00002	00101	
<b>Note:</b> When the Trunk Network Number (TNN) is appended to a record that would record in a 0XXXX structure without the TNN, the most significant digit of the structure code is a 1.						
End						

### Structure codes

The structure code is a six character field which defines a set of data fields within the record, with characters one through five containing the structure code, and the sixth character being the sign character. An example of structure code 00001, one of the structure codes associated with call type 006 (station paid call), is shown in Table 6-2. Table 6-3 shows structure code 09046 sensor tracer record. The most significant character of the structure code is an option indicator. The DMS-100 Family provides two options:

- 0 = The record does not contain a trunk network number (TNN).
- 1 = The record contains a TNN.

Each dataset record (both call and statistical) contains an initial byte of two hexadecimal characters (referred to as hexadecimal identifiers) followed by a number of fields containing, in order, structure code, call code, sensor type, sensor identification, recording office type, recording office identification, and the billing or statistical data needed for the defined record.

### Trunk or line identifier

The LSSGR term for trunk or line identifier is, Switch Supervisory Unit Number (SSU) Recording. Whenever the trunk or line identifier is to be recorded, an eight-character extension record for the SSU field is appended to the structure record that would otherwise be recorded.

BCD Chars	Meaning
-----------	---------

1-7	trunk or line identifier
8	SIGN (#C)

The most significant digit of the structure code indicates when the trunk or line identifier is appended to a record. In DMS-100, up to 2048 trunk groups and 2048 trunks are allowed with external numbers in the range 0000 to 9999. The internal representation of a trunk is converted to binary which fits into seven characters and is recorded on the AMA file as the trunk identifier. A similar encoding is provided for lines.

In order to facilitate trunk or line localization, DMS-100 provides a command which converts a seven-character trunk or line ID, input from a MAP keyboard, back into a group number and trunk number or Line Equipment Number (LEN), and displayed on the MAP screen.

When enabled, trunk and/or line number recording refer to the terminating parts of a call.

This structure code may be used when the following call codes are recorded:

Call code recorded	Call type
005	Detailed Message Rate, Time, No MBI
006	Station Paid
021	CCSA Sampling
041	Local Coin
067	Flat Rate
074	Free Call
011	FX, Automatic Flexible Routing
085	Electronic Tandem Switched Call
088	Non-DA-555 Directory Assistance and all "generic call codes."

Table 6-2 Structure code 00001		
Information	Table number	Number of characters
Station paid call		
Call Type	1	4

<b>Table 6-2</b>		
<b>Structure code 00001 (continued)</b>		
<b>Information</b>	<b>Table number</b>	<b>Number of characters</b>
Switch/Sensor Type	2	4
Switch/Sensor Identification	3	8
Recording Office Type	4	4
Recording Office Identification	5	8
Date	6	6
Timing Indicator	7	6
Study Indicator	8	8
Answer	9	2
Service Observed, Traffic Sampled	10	2
Operator Action	11	2
Service Feature	12	4
Originating NPA	13	4
Originating Number	14	8
Overseas Indicator	15	2
Terminating NPA	16	6
Terminating Number	17	8
Connect Time	18	8
Elapsed Time	19	10
<b>Note:</b> See LSSGR Section 8.1 for tables.		
<b>End</b>		

<b>Table 6-3 Structure code 09046</b>		
<b>Information</b>	<b>Table number</b>	<b>Number of characters</b>
Call Type	1	4
Sensor Type	2	4
Sensor ID	3	8
Recording Office Type	4	4
Recording Office ID	5	8
Date	6	6
Time	18	8
Recorder Generic Issue	B.3	6
Type of Tracer	40	4
Bad Tracer Indicator	C.147	2
ATORIGS – Call Originations	B.5	10
AMINPROG – AMA Calls Currently in Talking State	B.3	6
ATTRMT – Billable Calls After Digit Reception	B.5	10
ATNOTRMT – Non-billable Calls After Digit Reception	B.5	10
ATANS – Answered AMA Calls	B.5	10
ATRCSTPD – Station Paid Records	B.5	10
ATLTSTPD – Lost Records	B.3	6
ATEDSTPD – Estimated Disconnect	B.3	6
ATNASTPD – Lost Answer Message	B.3	6
ATRC411 – Directory Assistance 411 Records	B.5	10
ATLT411 – Lost Record	B.3	6
ATED41 – Estimated Disconnect	B.3	6
ATNA411 – Lost Answer Message	B.3	6
ATRC555 – Directory Assistance 555-1212 Records	B.5	10
ATLT555 – Lost Records	B.3	6
ATED555 – Estimated Disconnect	B.3	6
ATNA555 – Lost Answer Message	B.3	6

—continued—

<b>Table 6-3</b> <b>Structure code 09046</b> (continued)		
<b>Information</b>	<b>Table number</b>	<b>Number of characters</b>
ATRCTRCR – Tracer Records	B.3	6
ATLTTRCR – Lost Records	B.3	6
ATRCOTHR – Study Records	B.3	6
ATLTOTHR – Lost Study Records	B.3	6
ATEDOTHR – Estimated Disconnect	B.3	6
ATNAOTHR – Lost Answer Message	B.3	6
ATRCLONG – Long Duration Call Records	B.2	4
ATLTLONG – Lost Records	B.2	4
<b>Note 1:</b> Call code for this record is 090, call type is sensor tracer		
<b>Note 2:</b> Type of tracer for this record is 037		
<b>Note 3:</b> See LSSGR Section 8.1 for tables.		
End		

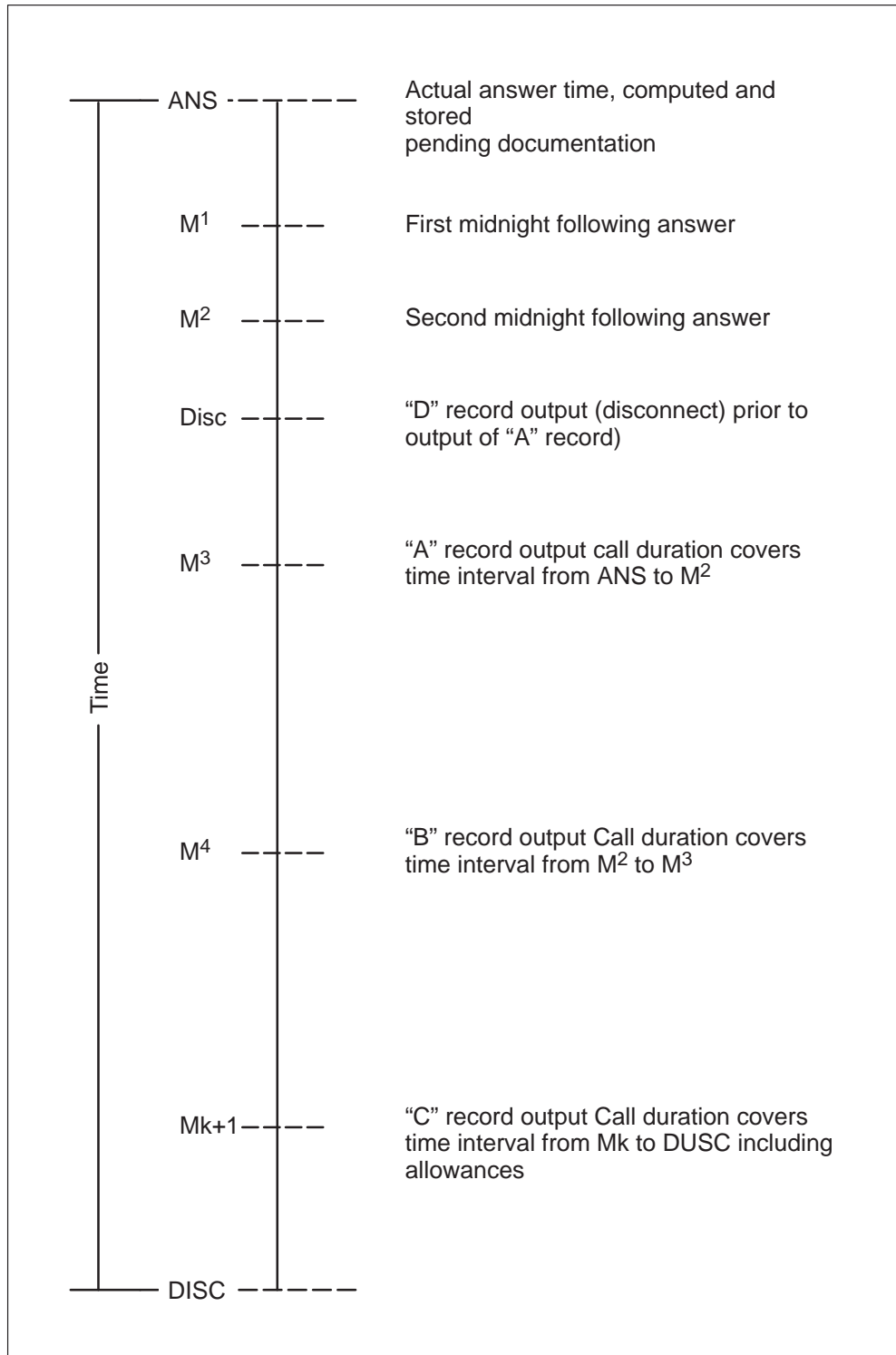
### Long duration calls

Long duration calls are defined as those AMA calls that remain connected through two successive midnights. On all such calls the call assembly process may output up to three record types indicating the beginning, continuation or end of a long duration call. The continuation records are output daily as long as the call is in the connect state.

Referring to Figure 6-6, if a call originates on day one, and continues to midnight of day two, it is recognized as a long duration call. If the call is still connected at midnight of day three, a record (Record “A”) is output, and marked using a character in the timing indicator as the beginning of a long duration call. The elapsed time field contains the elapsed time from answer until the second midnight. The actual time of day answer is retained pending disconnect.



**Figure 6-6**  
**Bellcore AMA long duration call analysis**



If the call is still connected at midnight of day four, a record (Record “B”) indicating the continuation of long duration call is output. The “B” record elapsed time field should normally contain 24 hr; however, it may contain a different time due to a possible change to the time-of-day clock made by operating company personnel. This elapsed time accounts for the period from midnight of day two until midnight of day three. For each subsequent midnight that the call is still connected another “B” record is output.

After disconnect occurs, the elapsed time not already accounted for in previously output “A” and “B” records is computed, and is output in a “C” record. The “C” record includes the time of day and date of disconnect. The original answer time and date appear in all three records. If disconnect occurs after the second midnight but before the “A” record is output on the third midnight, a single call record is output containing the total elapsed time. This long duration single call record is flagged with the character field and is known as a “D” record.

#### **Treatment of calls with no disconnect message**

If a warm restart has occurred since reception of the answer message, the difference between answer and restart times is computed and recorded as call duration. If several restarts have occurred, the time of the first one following the answer is used. Since the disconnect time is mutilated, the call record is flagged by the “charge guard” timing indicator to indicate that allowances have been made to ensure that no overbilling occurs when using the elapsed time fields, or that at least the minimum chargeable duration is billed.

If no restart has occurred, the record is output with the elapsed time set to zero and is flagged as a “single time line” record.

#### **Activation and deactivation of recording options**

The DMS-100 Family provides operator commands to control the AMA recording options using the AMAOPTS data table:

- record all unanswered calls
- record 411 directory assistance call
- record 555-1212 directory assistance calls
- include trunk identification number in all AMA records
- record coin calls
- record toll number terminating calls
- record high revenue calls only
- include line identification number in all AMA records
- record OUTWATS records
- record complaint observed records

- record line usage study

The table provides automatic activation and deactivation dates and times. The capability is provided to modify activation or deactivation times defined previously and to command an immediate activation or deactivation.

A daily log report indicates the current status of each recording option.

Refer to 297-1001-451, Section 057 for a complete set of AMA options.

### **Adjustment interval**

The adjustment interval is defined as the duration of a call for which the measured duration would be in error by one second due to clock system inaccuracy.

In the DMS-100 Family, the periodic signals used to measure call durations are derived from the office clock oscillator and have the same accuracy.

The oscillator accuracy is  $10^{-11}$  when synchronized to the BOC reference frequency. If the oscillator is allowed to free run for a long period of time, its accuracy is kept within  $\pm 1.6 \times 10^{-8}$  (synchronization Stratum 2 requirement) by periodic adjustments. The AMA adjustment interval therefore exceeds two years under usual operating conditions.

### **Call duration**

For most calls, the duration of a call is determined in the peripheral, without reference to the time-of-day clock. The determination of the elapsed time is therefore not affected by time-of-day changes.

For all calls of less than six hours in duration, the call duration is accurate to within +0 to –1 sec. of true call duration.

### **Call duration allowance**

A fixed call duration allowance (500 ms) is subtracted from the measured call duration to ensure no overcharging.

### **Timing precision**

All times are recorded with 100-ms precision in Bellcore format and 1000-ms precision in Nortel Networks format.

## **Standard NT AMA format**

This section describes the Nortel Networks standard AMA format used in local and local/toll switching systems. It is not to be confused with the Bellcore AMA format. The Bellcore AMA format is described in detail in 297-1001-119 (see also Bellcore AMA format on page 6–15)

### **DIRP files**

Each AMA dataset contains call record information in data files. The data files consist of blocks containing up to 2048 bytes of information.

### **Timing**

The timing of answer, and of called party disconnect, is specifiable in initial translations. The operating company can modify the timing values using office parameter tables.

### **Limitations and warnings**

Any of three errors in AMA recording can occur when a CPU activity switch (out of sync) occurs:

- wrong tape drive assignment
- rolled-back block count
- rolled-back date and time in the block-header entry

Out-of-sync processing is an abnormal condition which rarely occurs in active service. On an out-of-sync CPU activity switch, the newly-active CPU has out-of-date information stored in its memory.

### **Data collection and encoding**

The data blocks in AMA are recorded in fixed format (refer to 297-1001-119 for format description).

The encoding technique used in assembling the call data is also described in 297-1001-119.

AMA format is a single entry format. The system captures all relevant call details and, at call completion, the call information is mapped into the output format and stored in the AMA buffer. The encoding technique used in assembling the call data is BCD. EBCDIC encoding for the call data for the NT Standard AMA format is optionally available.

Maximum block size supported by the DMS-100 Family file system is 2048 bytes. A record is not allowed to span blocks. If a record does not fit in the current block, the current block is written out on the tape and the record is inserted in the next block. If necessary, padding by filler character (HEX A'), is used to conform to the fixed recording format supported by the DMS-100 Family file system.

*Note:* A DIRP block is 2048 bytes, a disk block is 1024 bytes.

**Figure 6-7**  
**NT AMA format call record types**

DDD CAMA	Record code	Entry code	Info digits 1,2	Service feature number	Calling number	Called number	Event info. digits	Answer time				Conversion time sec.				
	F0							Day in year	Hour	Min	Sec					
TOPS domestic	Record code	Entry code	Info digits 1,2	Service feature number	Calling number	Called number	Event info. digits	Answer time				Conversion time sec.	Operator number	Team no.	Info digits 3,4,5,6	TOPS orig. type
	F1							Day in year	Hour	Min	Sec					
DDD CAMA	Record code	Entry code	Info digits 1,2	Service feature number	Calling number	Called number	Event info. digits	Answer time				Conversion time sec.				
	F2							Day in year	Hour	Min	Sec					
TOPS overseas	Record code	Entry code	Info digits 1,2	Service feature number	Calling number	Called number	Event info. digits	Answer time				Conversion time sec.	Operator number	Team no.	Info digits 3,4,5,6	TOPS orig. type
	F3							Day in year	Hour	Min	Sec					
DDD LAMA CDR or INWATS	Record code	Entry code	Info digits 1,2	Service feature number	Calling number	Called number	Event info. digits	Answer time				Conversion time sec.				
	See note 3							Day in year	Hour	Min	Sec					
DDD CAMA	Record code	Entry code	Info digits 1,2	Service feature number	Calling number	Called number	Event info. digits	Answer time				Conversion time sec.				
	F6							Day in year	Hour	Min	Sec					

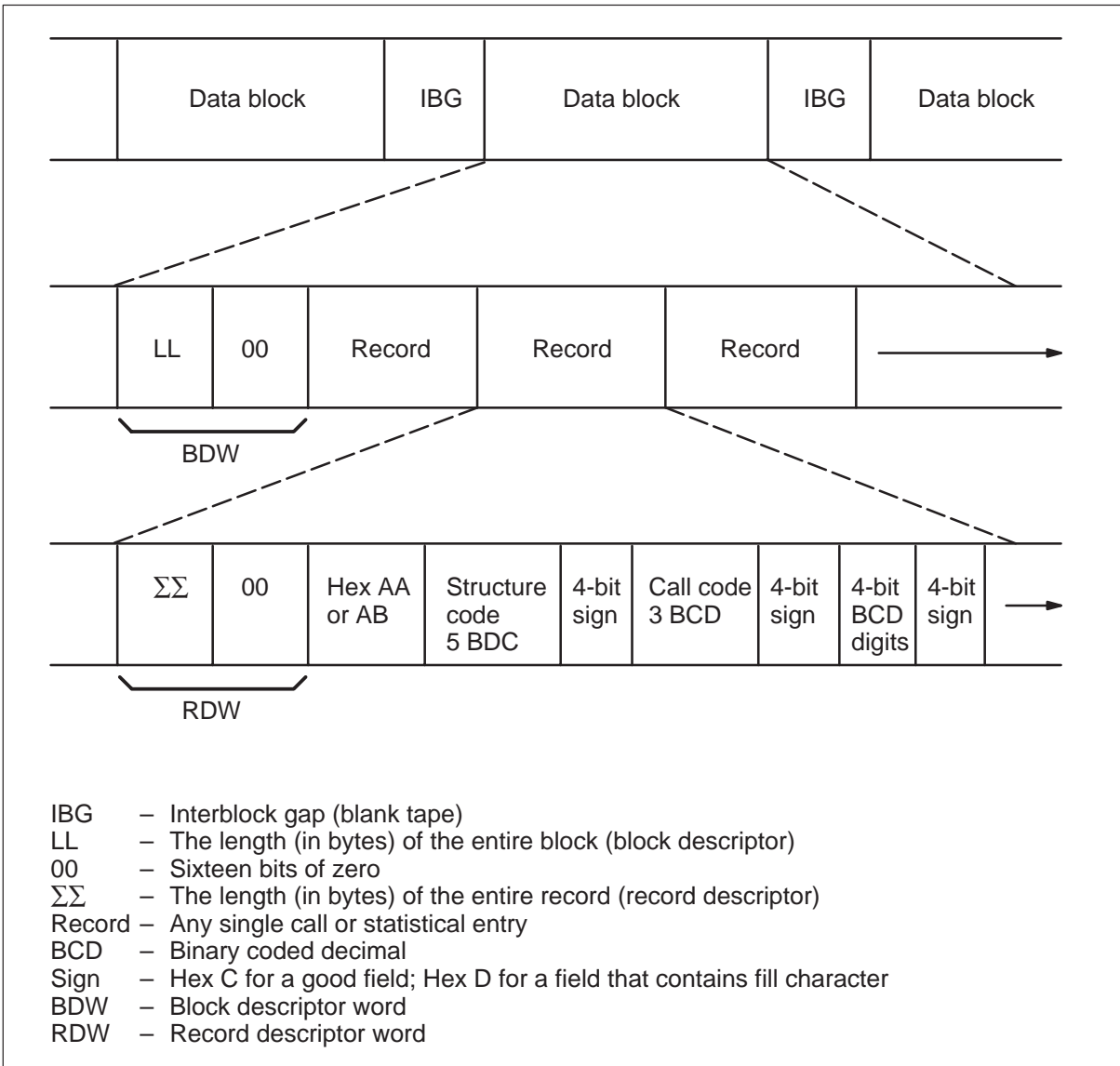
**Note:** Record codes—DDD LAMA=F4  
 —INWATS=F5  
 —CDR=F4

### Record types – structures

The various record structures are described in 297-1001-119, and are summarized in Tables 6-4 and 6-5.

Figure 6-7 shows the NT AMA call record types, and Table 6-6 shows the content by record type. Figure 6-8 shows the Bellcore AMA data set structure, and Table A shows the Bellcore call codes and structure codes supported by the DMS-100 Family.

**Figure 6-8**  
**Bellcore AMA data set structure (not applicable to NT format)**



<b>Table 6-4</b> <b>NT AMA format – structure codes</b>		
Block Headers	C1C1	Call Record
	C2C2	Data Record
—continued—		

**Table 6-4**  
**NT AMA format – structure codes** (continued)

Extension Records (TOPS)	E0	Special Billing
	E1	Hotel
	E2	Charge
	E4	Charge Adjust
	EE	AMA
Call Records	BO	Originating Access Charge Recording
	B1	Terminating Access Charge Recording
	F0	CAMA DDD
	F1	TOPS Assisted DDD
	F2	CAMA DDO
	F3	TOPS Assisted DDO
	F4	LAMA DDD and LCDR
	F5	INWATS
File Transfer Record	FA	INC Non-emergency
	FB	C/G Non-emergency
	FC	INC Emergency
Restart Record	FD	
Clock Change Record	FE	
	40	CLLI Translation Record
<b>End</b>		

<b>Table 6-5 AMA data file structure (NT format)</b>	
<b>Record type</b>	<b>File/record content</b>
BLOCK HEADER RECORD	Record Code Date/Time Block Count Office ID
CALL RECORD	Record Code Entry Code Information Digit Service Feature Digits Calling Number Called Number Event Information Digit Answer Date/Time Conversation Time TOPS Additive
EXTENSION CALL RECORD	Special Billing Hotel Charge Charge Adjust
CLOCK CHANGE RECORD	Record Code Old: Date/Time New: Date/Time
RESTART RECORD	Record Code Type of Restart Date/Time
FILE ROTATION RECORD	Record Code Transfer Date/Time



<b>Table 6-6 NT AMA format call record content</b>											
<b>Field name</b>	<b>Associated with record codes</b>										<b>Number of BCD characters</b>
	<b>B0</b>	<b>B1</b>	<b>F0</b>	<b>F1</b>	<b>F2</b>	<b>F3</b>	<b>F4</b>	<b>F5</b>	<b>F6</b>	<b>F8</b>	
Record Code (F0,F1,F2,F3,F4,F6)	X	X	X	X	X	X	X	X	X	X	2
Entry Code	X	X	X	X	X	X	X	X	X	X	2
Information Digits (1 and 2)	X	X	X	X	X	X	X	X	X	X	2
Feature Code	X	X	X	X	X	X	X	X	X	X	2
Calling Number:	X		X	X	X	X	X	X	X	X	10
Called Number:	X	X	X	X	X	X	X	X	X	X	10
Extra DDO Digits					X	X			X		5
Requested or Forward Number										X	15
Information Digit	X	X	X	X	X	X	X	X	X		1
Carrier Event Information	X	X									8
Start Day	X	X	X	X	X	X	X	X	X	X	3
Start Time	X	X	X	X	X	X	X	X	X	X	6
Elapsed Time	X	X	X	X	X	X	X	X	X	X	6
TOPS and AOSS											
Operator Number:				X		X				X	4
Team Number:				X		X				X	2
Information Digits 3, 4				X		X				X	2
Information Digits 5,6				X		X					2
Origination Type:				X		X				X	2
Filler HEX A					X	X			X		1
Access Charge Recording: (see note)											
Feature Group Indicator	X	X									1
IC/INC Prefix	X	X									4
Carrier Connect Day	X	X									3
Carrier Connect Time	X	X									6
Elapsed Time	X	X									6

—continued—

<b>Table 6-6</b>											
<b>NT AMA format call record content</b> (continued)											
<b>Field name</b>	<b>Associated with record codes</b>								<b>Number of BCD characters</b>		
	<b>B0</b>	<b>B1</b>	<b>F0</b>	<b>F1</b>	<b>F2</b>	<b>F3</b>	<b>F4</b>	<b>F5</b>	<b>F6</b>	<b>F8</b>	
Dialing Indicator	X										1
BCD Characters/Record	70	54	44	56	50	62	44	44	50	46	
Record Code	Record Type										
B0	Originating Access Charge Record										
B1	Terminating Access Charge Record										
F0	DDD CAMA										
F1	DDD TOPS Assisted										
F2	DDO CAMA										
F3	DDO TOPS Assisted										
F4	DDD LAMA and LCDR										
F5	INWATS and TERMBOPT										
F6	DDO LAMA										
F8	AOSS										
<b>Note:</b> Feature Group B only.											
End											

### Trunk identifier on AMA dataset (optional feature)

This feature allows the operating company to record the incoming and outgoing trunk identifiers along with the usual billing information presently provided by the AMA system.

Activation of the feature is through the OFCPARMS table (if the feature is present). The entry `AMA_EXTENSION_ENTRY` when set to “y” will result in an extension entry being generated for each billing. This extension entry contains the numerical identifiers for the trunk circuits involved in the call.

### Call types (entry codes)

Table 6-7 summarizes the call types supported by the DMS-100 Family for LAMA, CAMA, TOPS, and MDC.

### Special call type features

**Call analysis** Figure 6-9 indicates the sequence of events which may occur during the processing of an AMA call. An AMA call produces a single entry on tape.

**Uncompleted calls**

Operating company personnel may request, through the designated MAP or other Input/Output (I/O) terminal, the recording of uncompleted calls (Table OFCPARMS, Entry NO\_ANS\_CALLS\_ONTAPE). The entry is triggered by the disconnect of uncompleted call attempts and permits testing of the AMA system on a periodic basis or coincident with initial installations and extensions. It also provides data for possible Direct Distance Dialing (DDD) network and supervision troubles, fraud detection, and special studies required from time to time. Uncompleted calls, when recorded, are identified by event information digit 2.

**Figure 6-9**  
AMA call analysis

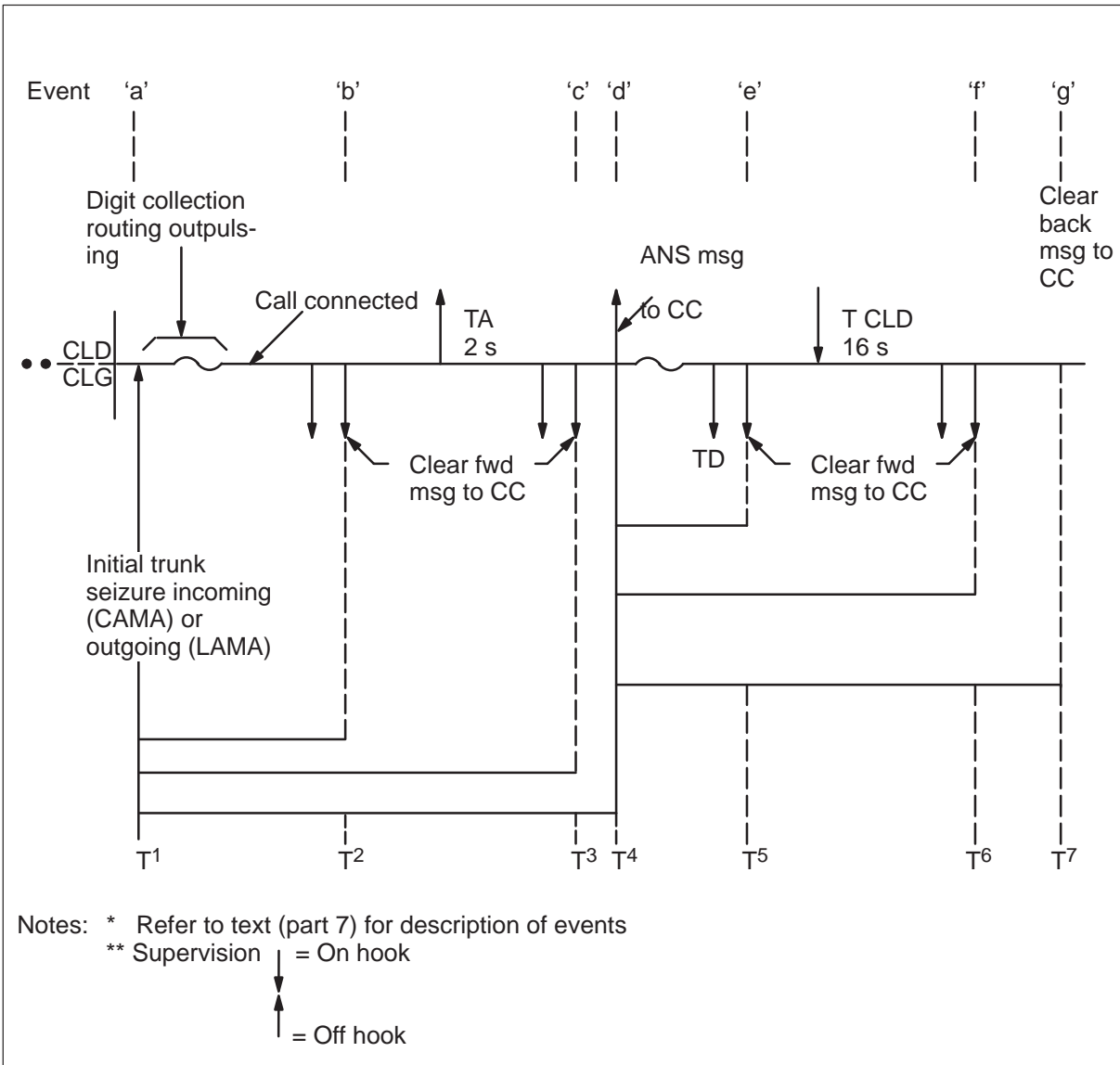


Table 6-7 NT AMA call types	
Entry code	Call type
00	Station Paid DDD
01	Station Paid LCDR
—continued—	

<b>Table 6-7 NT AMA call types (continued)</b>	
<b>Entry code</b>	<b>Call type</b>
02-07	Reserved for Special Features
08	TWX
09	Data
10-15	Reserved for Special Features
16	Timed Message Rate
17	Untimed Message Rate
18	Detailed Message Rate
19	Conference Trunk Usage
20	Station Paid Operator Assisted
21	Station Collect
22	Station Special Calling
23	Person Paid
24	Person Collect
25	Person Special Calling
26	Auto Collect
27	Station Special Called
28	Person Special Called
29	Person Call Back (PCB)
30	PCB Special Billing
31-39	Not Used
40*	Station Paid DDO
41-55*	For Special Features
56	Not Used
57	Not Used
58-59	Reserved for Possible Future Use
60*	Station Paid Operator Assisted
61*	Station Collect
62*	Station Special Calling
—continued—	

<b>Table 6-7</b>	
<b>NT AMA call types (continued)</b>	
<b>Entry code</b>	<b>Call type</b>
63*	Person Paid
64*	Person Collect
65*	Person Special Calling
66*	Not Used
67*	Station Special Called
68*	Person Special Called
70*	PCB Special Billing
71-79	Not Used
80	INWATS – Measured Time
81-83	Reserved for Possible Future Use
84-89	Not Used
90	Used by LAMA Initial Extension Entry
91-95	Not Used
96	Unspecified (default)
97	Cancelled Call (Domestic)
98	Cancelled Call (Overseas)
99	AMA Test Call
<b>Note:</b> * Indicates International Dialing	
<b>End</b>	

### Station message detail recording (SMDR)

SMDR is used with the MDC feature to record station originated calls on the basis of the access codes dialed. This is a single entry format recording (NT standard AMA format) and is independent of AMA billing which is primarily concerned with toll call billing.

Similar to AMA recording, the desired tape or disk facility is selected using the DIRP feature. (See Data recording and 297-1001-312.) Data table IBNXLA can be set to have SMDR record billable calls:

- DDD
- international Direct Distance Dialing (IDDD) (011+)
- operator assisted (0+, 01+)

- operator handled (0-)
- local directory assistance

### Supplementary SMDR data collections

All other data fields associated with SMDR are supplementary to the main purpose of SMDR and are added on the basis of special requirements for each feature. In each case, setting the associated field in the appropriate customer data schema table causes a SMDR record to be made when a call uses the feature.

Four supplementary SMDR records are available:

- Trunk Group Originations – These records are activated through the TRKGRP table. If the Call Detail Recording (CDR) field in this table is set to “Y” all originations by the associated IBN Trunk group are recorded in SMDR format. This enables calls (for example, INWATS) on a dedicated trunk group to be recorded.
- Line Data – These records are activated through the IBN line table IBNLINES. If the OPTLIST field contains SMDR, then all originations by the associated line are recorded in SMDR format.
- Attendant Consoles – These records are activated through the attendant console table ATTCONS. If the CDR field is set to ‘Y’, then all originations by the associated console are recorded in SMDR format.
- Customer Groups

Four features are activated to produce SMDR records when the appropriate entry is made in the OPTIONS field of the CUSTGRP Table:

Feature	Entry
For no-answer trunks, calls are considered answered if both parties are still connected after the answer timing allowance has exceeded the value entered in this field.	ANSTIM
Produce a Digits-As-Outpulsed (DAO) extension record if the digits-as-outpulsed are different from the digits-as-dialed.	RAO
Make SMDR records of no-answer calls (otherwise only answered calls are recorded).	RNA
Record all incoming and outgoing tie trunk or FX line calls. This is part of the Network Evaluation, Reporting and Verification (NERVE) feature	NERVE

**Office parameters**

Office parameters in data tables OFCOPT, OFCVAR and OFCENG are described in 297-1001-455.

**Table OFCOPT**

- AMA\_EXTENSION – Enables the CLI records to be dumped.
- SMDR\_OFFICE – Enables SMDR records to be produced if SMDR software is present.

**Table OFCVAR**

- SMDR\_LOG\_RPT – Specifies whether SMDR billing information is to be printed in AMA log reports AMAB150 or AMAB151 (see 297-1001-510 or 297-1001-840).

**Table OFCENG**

- NO\_OF\_SMDR\_REC\_UNITS – Sets the number of recording units required.
- INWATS\_ON\_AMA – Provides for AMA recording of INWATS calls.

**SMDR record types – structures**

In addition to the record structures shown in Table 6-6, the SMDR uses the call types as shown in the Table 6-8.

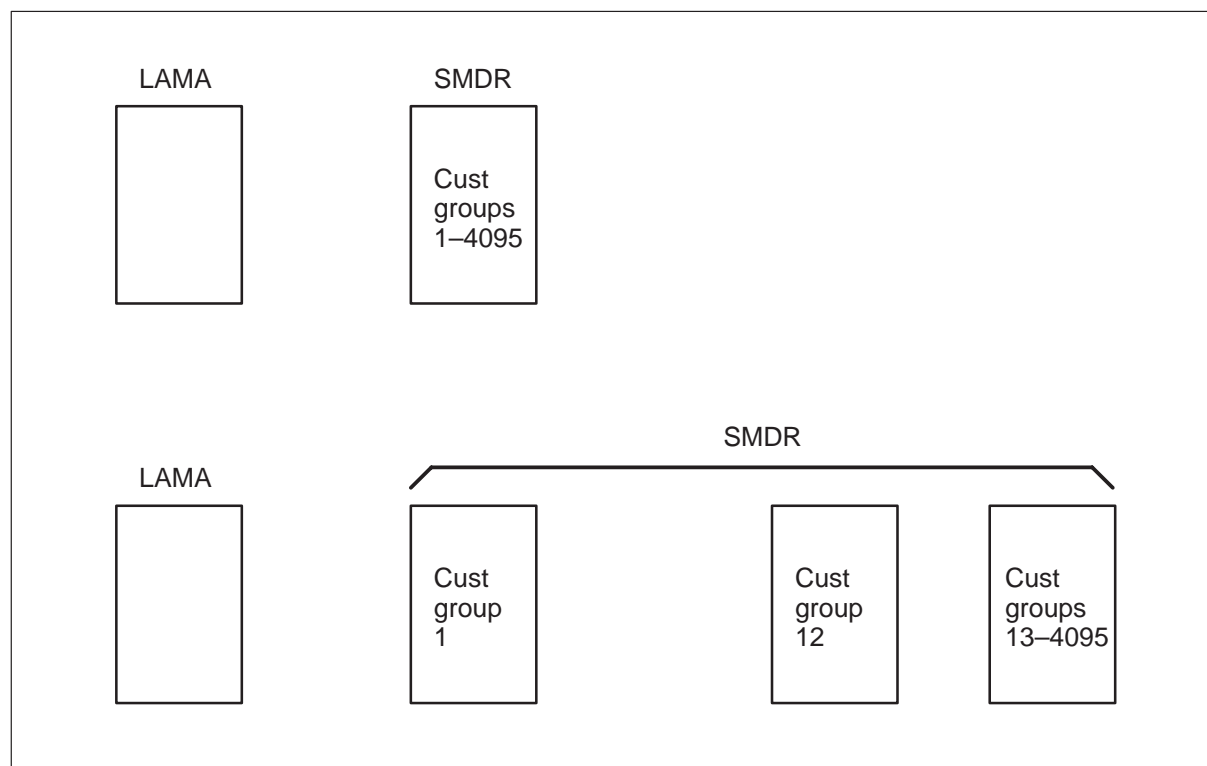
<b>Table 6-8 SMDR structure codes</b>			
Call Records	D1	SMDR	Short Format
	D2	NERVE*	Short Format
	D3	SMDR	Long Format
	D4	NERVE*	Long Format
Extension Records	D5	Digits as outpulsed	
	D6	Account / Authorization Code	
<b>Note:</b> * Network Evaluation Reporting and Verification (NERVE)			



### SMDR files

SMDR can have separate SMDR record files for up to twelve customer groups, with the remaining customer groups 13 to 4095 on a common SMDR record file. This optional arrangement is shown in Figure 6-10.

**Figure 6-10**  
SMDR – customer group records



### Local call detail recording (LCDR)

LCDR recording is a feature which facilitates charging of local calls. Lines assigned to this service may be billed an amount proportional to the conversation time for all local calls. Toll calls are handled in the normal way through the AMA system. There are five main points of the feature:

- The feature serves as LAMA extension in Class 5 operation.
- The service is available on an individual line basis as covered by 297-2101-451, Section 124, and 297-1001-451 Section 029.
- The service coexists with flat rate, message rate, and Private Branch Exchange (PBX) (refer to 297-2101-310).
- Local and toll calls are recorded on the same AMA file.
- Available with both NT and Bellcore AMA formats.

### **Equal access (EA) recording**

**Equal Access is supported by the Bellcore AMA format only;** it is not available in the Nortel Networks AMA format.

The EAP provides InterLATA Carriers (ICs) and International Carriers (INCs) access to LATAs. The INCs may interconnect directly to the LATA or may use the services of an IC for call transport. Detailed billing records are made on a per call basis in both the originating and terminating LATAs. Connections can be direct to EAEOs or connection through AT switches serving a given LATA.

In general, areas served by the operating companies are divided into non-overlapping LATAs made up of contiguous wire center areas. A LATA generally corresponds to an area that includes a Standard Metropolitan Statistical Area (SMSA) or a Standard Consolidated Statistical Area (SCSA). A local switching entity and any associated remote switching units will not serve more than one LATA.

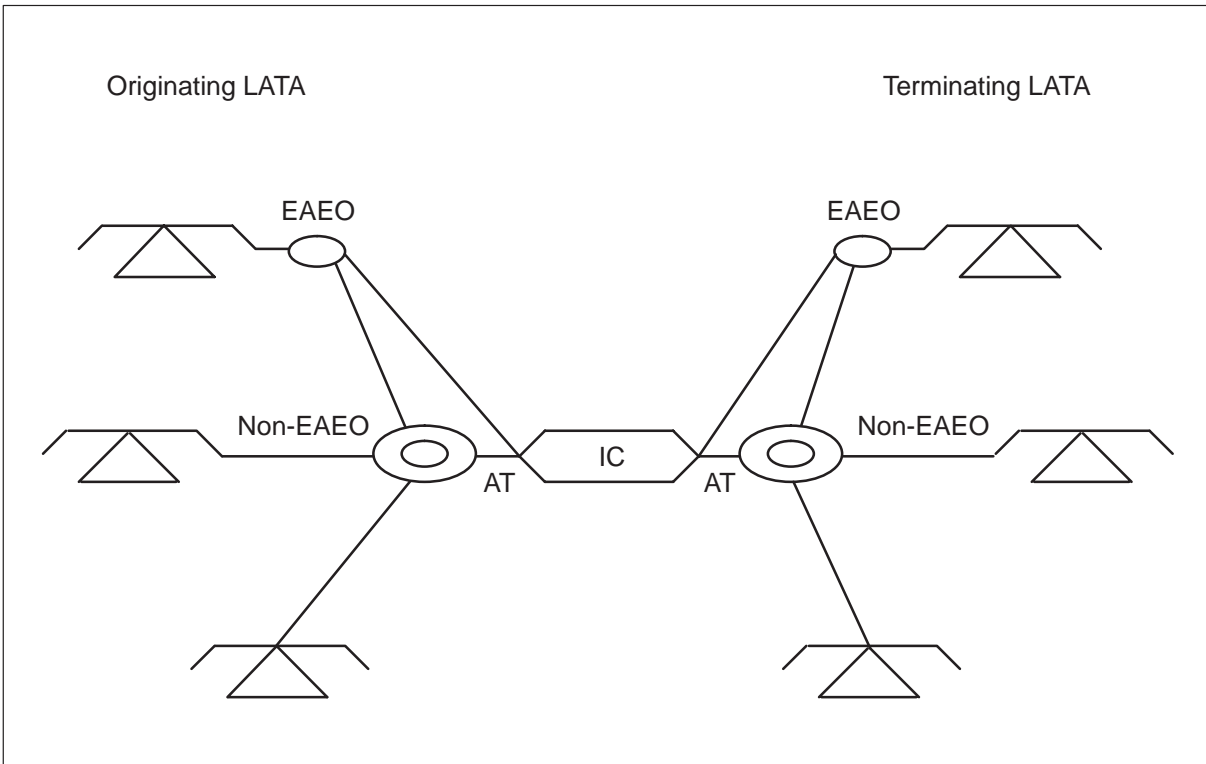
Traffic within a LATA will be served by an intraLATA carrier, while traffic between LATAs will be served by interLATA carriers. An interLATA carrier can also obtain regulatory approval to serve intraLATA traffic (that is, DNs within the LATA) but will receive such traffic only when the caller selects the carrier specifically by dialing the appropriate prefix (10XXX). Each IC wishing to deliver traffic to/from a particular LATA will interconnect to the end offices by direct trunking and/or through an (AT) switch or switches in that LATA. If there is more than one AT in a LATA, each end office will connect to only one AT. An IC does not have to provide connections to all ATs in a LATA, that is, they can serve less than an entire LATA.

IC calls entering a LATA should terminate to DNs in that LATA.

An IC desiring to serve a LATA will specify one or more Points of Presence (POP) within the LATA for connection of its facilities with those of the BOC. The BOC will provide access to/from the LATA through one or more EAEOs and/or ATs (see Figure 6-11). An EAEO will provide access only to co-located stations. An AT may provide access to any co-located stations as well as subtending end offices (for example, where IC direct trunks from an EAEO may route interLATA traffic directly to an AT). An AT would also serve EAEO traffic where there are no direct trunks from an IC to the EAEO in question.

An ICs traffic may share trunks from the EAEO to the AT with other IC traffic as well as with intraLATA traffic; that is, there need not be dedicated trunks for a particular IC from the EAEO to the AT. Trunks between the AT and the IC or between the EAEO and the IC will, of course, be dedicated to that IC.

**Figure 6-11**  
**IC interconnection**



### **Billing overview**

ICs and INCs will be assessed usage sensitive access charges based on the call records recorded in the EAP.

A telephone operating company may perform billing functions for the interLATA services of any interLATA carrier. Billing can include: recording, RAO entry, rating, bill rendering, collection, and treatment.

The form of the originating interLATA records combines the information normally recorded to bill the customer (for example, information recorded for a station paid, OUTWATS, or other type of call) with information which can be used to determine access charges to the IC/INC.

### **Billing data collection**

Per call billing records will be generated by each LATA for all IC/INC calls originating from or terminating to that LATA; this includes calls routed to an operator service facility and test calls made by an IC/INC to a LATA. The specification of which office generates the AMA records and when the recording of AMA information begins is defined in the following subsections.

**Originating LATA** The AMA information should be generated by the office that supplies dial tone to the calling party. An AMA record should be made for all calls which progress to the stage where the first wink is received from the IC/INC. The time at which the first wink is received from the IC/INC is referred to as the carrier connect time for the originating LATA.

**Terminating LATA** The terminating AMA access record should be generated by the office where the call enters the LATA. A per call access record should be made for all calls which progress to the stage where an AMA register is seized or a call record is put on the call (that is, the first possible time after the trunk has been seized to the office where the call enters the LATA). The time at which the AMA register is seized or a call record is put on the call is referred to as carrier connect time for the terminating LATA.

### **User/system interactions**

**InterLATA carriers** A customer may designate a single InterLATA carrier as a Primary Interexchange Carrier (PIC). Although customer designation of a PIC is not mandatory, such a designation is necessary within the switch if the customer is to be permitted to use 7/10 digit dialing as it exists today. This designation is accomplished by service order. However, to make a 0-call using the PIC, the customer must dial 00, or 10XXX + 0 (#). Calls dialed 0 (#) are routed to the telephone operating company operator system.

Each IC/INC will be assigned a 10XXX code to be used by customers when placing calls through a carrier other than their pre-subscribed carrier.

A customer may pre-subscribe to an INC instead of an IC. In this case, the INC is known as the primary interchange carrier.

A carrier that is represented by a single 10XXX code can carry both domestic and international traffic. A customer, who has designated such a carrier (known as the consolidated carrier) as the PIC, will be able to dial all calls through that carrier without a 10XXX prefix.

Customers who have designated as their PIC a carrier handling only traffic directed to points outside the continental United States should dial calls to points within the continental United States with the 10XXX prefix.

In order for a non-Centrex customer to place an interLATA call through an IC other than the PIC, the customer uses specific dialing instructions:

- Non-operator-assisted-call. 10XXX (+1) + 7/10 digits.
- Operator-assisted call. 10XXX + 0 + 7/10 digits.
- 0-call. 10XXX + 0 (#). 0 (#) calls (calls dialed without the 10XXX prefix) are routed to the telephone operating company operator system.

- Cut-through. 10XXX + # (Required for PIC calls as well).

The 7/10 digits should conform to the format of the North American Numbering Plan (NANP). For a pre-subscribed customer, all interLATA calls dialed without a 10XXX prefix (on a 1+ or 0+ 7/10-digit basis) should be routed to the PIC designated by the customer. If the customer is not indicated within the switch as pre-subscribed to an IC/INC, these calls should be routed to an announcement. All interLATA calls dialed by that customer within a 10XXX prefix should be routed to the IC represented by the XXX code (including the PIC if the XXX dialed corresponds to that carrier).

An IC may also obtain regulatory approval to receive intraLATA calls. In this case, however, even a customer who has pre-subscribed to that carrier should dial the carrier's 10XXX prefix to complete an intraLATA call through that carrier. Such calls should be treated the same as interLATA calls. If the IC is not approved to handle intraLATA calls, they are routed through the telephone operating company.

**International carriers** A non-Centrex customer wishing to use the facilities of an INC dials one of five sequences:

- 10XXX + 011 + CC + NN (#) [011 + CC + NN (#)].
- 10XXX + 01 + CC + NN (#) [01 + CC + NN (#)].
- 10XXX + 0 (#). 0 (#) calls (i.e., dialed without the 10XXX prefix) are routed to the telephone operating company operator.
- 10XXX + # (# alone is not allowed).
- For calls directed to stations within world zone 1, but outside the continental United States, two sequences should be used:
  - 10XXX (+1) + 10 digits [(1 +) 10 digits]
  - 10XXX + 0 + 10 digits [0 + 10 digits]

**Note:** (Sequences in brackets [ ] are for calls through the PIC):

In these dialing sequences, XXX is the INC identifier, CC is the Country Code, NN is the National Number, and # is an end of dialing indicator. A carrier serving both domestic and international traffic may do so using a single 10XXX code (the carrier may be a consolidated carrier). The CC + NN is handled in the same fashion as an IDDD call to determine end of dialing and invalid codes. The CC + NN may be 7 to 12 digits long. 022 is the standard prefix for IDDD calls and 01 is the standard prefix for operator assisted international calls.

### **OUTWATS zone support**

This feature enables the DMS-100 Family to support thirteen OUTWATS zones: 0-9, A, B, and C. These zones are defined by the operating company in Table OWATZONE and grouped together according to Table ZONEORDR. AMA recording capability with both Nortel Networks and Bellcore formats is provided.

### **Operational measurements (OM)**

The OM system in the DMS-100 Family Systems provides the operating company with performance data for the system. Included in the data is information on system performance, the grade of service being offered, connecting facilities, and performance and traffic levels of various elements internal and external to the system. The measurement update and print schedules are operating company defined, to provide the necessary flexibility to satisfy a wide variation of operating company requirements.

### **Operational measurements system components and organization**

The OM system monitors certain events in DMS-100 Family Systems and enters the results into registers in the data store. Events are entered either individually every time an event occurs, or scanned (sampled) at regular intervals regardless of the time of occurrence of an event. Events measured individually are referred to as peg counts, while sampled measurements (states) used to determine the degree of usage of the system hardware and software resources are called "usage counts." The low (slow) scan is based on 100 seconds per period and high (fast) scan is based on 10 sec per period.

A table of active measurements, with its associated holding and accumulating register, is called a measurement group. All measurements in the group have the same table name. Each table name is assigned a class definition, that is, ACTIVE or HOLDING, indicating its status in the total OM system. The group and class names are used to identify the OM in the header sections of OM output reports and as parameters of command.

### **Data collection**

The OM data in the active registers is useful only if related to the specific period of time during which it was collected. OM data cannot be directly copied from the active tables to an output process (tape, printer, accumulation) because of the likelihood that another count may occur during the copying process, thus introducing an unknown time period and causing an inaccurate output.

Data is transferred (copied) from the active registers to a duplicate set of registers classed as holding registers. Data copying from active to holding registers normally occurs at 15 or 30 min. periods (or optionally at 5-, 10-, 15-, 20- or 30-min. periods), depending on the type of OM counts and the active registers cleared to begin new counts for the next period.

The last three 5-min. period counts are stored in three sets of holding registers and the last four 15-min. period counts are stored in four sets of holding registers.

Copying to output processes is performed from the holding registers, with a controlled time period on which to base subsequent data manipulation. The holding registers isolate the output processes from the active OM data inputs, lessening the urgency and priority of the output copying processes. The contents of the holding registers are available for display or distribution using the file system. The file system allocates the OM data output to the appropriate devices, such as, teletypewriter (TTY) or Visual Display Unit (VDU), or through DIRP for recording on disk or tape.

### **Data accumulation**

When it is necessary to accumulate data over longer periods than the basic period used for transfer of data from active to holding registers, additional sets of registers (classed as accumulating registers, with a specific start and stop time), are provided. The data from the holding registers is copied onto the accumulating register at times for periods scheduled by the OM management tables. Each set of holding or accumulating registers having the same time characteristics is referred to as a measurement class (measurement schedule).

The data accumulation process adds the contents of the holding class registers to the accumulating class registers just prior to the next data collection. The accumulated data is available until the end of the accumulating period. The contents of the holding registers are also made available, through the DMS-100, to associated devices such as the magnetic tape unit or printer.

At the end of the accumulating period (scheduled by the OM management tables), the total contents of the accumulating registers are distributed to selected output devices, such as a printer, or recorded on tape or disk for downstream organizations. After distribution of accumulated data, the registers are reset to start the next accumulating period.



**Batch change supplement monitoring (BCSMON)** Replaced by DMSMON.

**DMS monitoring (DMSMON)** DMSMON replaces BCSMON. DMSMON was initially developed to compare the performance of a new software release with a previous version in the office. DMSMON is a useful analysis tool in determining office performance and highlighting potential problem areas in the switch.

The DMSMON utility is accessed from the CI (command interpreter) level of the MAP by entering the command DMSMON. The DMSMONCI command DBLOCKS is then used to display the digit block counts.

The DMSMONCI command DUMPALL will display information about patches, restarts, memory usage, switch downtime, high watermark values, and counts of logs, traps, software errors, and mismatches.

If needed, reports on the configuration of PMs, the types and numbers of memory cards, and counts of hardware and other fixed items can be obtained.

The best source of information for DMSMON can be found in NTP 297-1001-318.

### **OM management tables**

The data acquired and entered into the OM data tables is managed by four “management” tables which control the acquisition, collection, accumulation and distribution functions of the OM systems. The OM management tables are named OMTAPE (for both tape and disk), OMACC, OMPRT, and OMGRPORD

Access to the four OM management tables, for purposes of display and/or modification, is through the VDU, or other I/O device such as TTY. The VDU is part of the MAP and interfaces with the OM tables through the Command Interpreter (CI) or the table editor.

Commands to the OM system are entered using the CI from the VDU keyboard, and responses to the commands are displayed on the VDU screen. Authorized personnel can modify some fields of the OM management table using the table editor commands and procedures.

The following description briefly covers the general principles of operation of the OM management tables and the related office parameters:

**OMTAPE** This table contains values governing the measurement class, timing and other parameters required when performing a data copy process between a holding register and a designated tape, disk or any device supported by DIRP.



**OMACC** This table contains values governing the timing of data copying between holding registers and designated measurement classes of accumulating registers. The commands OMCLASS (defining a new measurement class), OMACCTAB (used to add or delete information on a measurement class), and OMDUMP (used to display the groups and fields belonging to a particular class), are used in conjunction with OMACC.

**OMPRT** This table contains values governing the measurements class, timing and other parameters required when performing a data copy process from a holding or accumulating register to an output printer. Output to a printer is generated by using the facilities of the DMS-100 Family logging, routing and reporting subsystem. The logging mechanism collects output reports from all parts of the system, which are filed in order of a log report number. OM reports are contained in the log OMPR, each report being associated with specific printing devices. The key to table OMPRT relates each row (tuple) to the log report number of the desired output in the log OMPR. When the other values (measurement group, class, timing, and so forth) are entered into OMPRT, the output report is automatically routed, through the routing and reporting subsystem, to the associated printer at the scheduled times triggered by the key reference to the log report number.

**OMGRPORD** This table provides the operating company with the capability to define the order of the OM group output within each OM accumulating class by datafilling tables OMPRT and OMTAPE.

### Data structure of OM format

OM data consists of a set of uniquely named registers. Some registers are provisioned on a per office basis. For example, a single register would represent the total number of input/output system errors. The register is called IOSYERR. Other registers are provisioned on a multiple basis. An example would be the incoming call attempts for trunk groups, named InCaTot. This register is provisioned one per trunk group and thus the InCaTot stack is indexed by trunk group number.

An example of a typical grouping is the group of registers associated with trunk group measurements. These registers are grouped in a tabular structure, named TRK, which is illustrated in the table below. The columns (fields) Common Language Location Identifier (CLLI) and Trunk Direction (TrkDir) are not OM registers, but contain key and information values associated with the TRK table structure. Each of the other fields, such as Incoming Call Attempts or InCaTot, represents one of the OM registers in the group and contains OM data. As shown in Table 6-9, each row (tuple) represents one trunk group.

<b>Table 6-9</b>						
<b>Structure of typical OM data table</b>						
<b>Trk (table name)</b>						
(Key field) MBU	Trk	Ncct	InCa	Pre	Tru	SBU
CLLI	Dir		Tot	RteAb		
<b>Note:</b> One row (tuple) per trunk group						

### NT standard format structure

The OM file structure consists of office parameter records containing definitions of the records in the data section of the OM files, and data records containing the actual counts of OM events in the holding or accumulating registers. Each record contains one line of information which varies in length depending on the type of record. The records are written in numerical sequence as variable-length-blocked. Each record is assigned a sequence number in the range 00000 to 65535.

### OM scheduled output reports

The scheduled output records of the OM system can be routed to the appropriate printing devices by the log system of the DMS-100 Family to produce the printed output reports. The output can be scheduled by the OMPRT table on an auto (normally 15 or 30 or optionally at 5, 10, 15, 20, or 30 min.), half hourly, daily, weekly or monthly basis. Each entry in OMPRT schedules a different output report. The output records are filed in the OM log table (OMPR) in the sequence of report number (for example, OMPR200 or OMPR201).

OM reports can be output to disk or tape, or polled by compatible collectors.

An example of the Digital Trunk Controller (DTC) and Trunk Module (TM) reports in machine printout format is shown in Figure 6-12. The numeric data values are printed after the header labels for the report.

**Figure 6-12**  
**DTC and TM reports**

PM2 (DTC)			
CLASS: ACTIVE			
START: 1986/08/07 09:30:00 THUR; STOP: 1986/08/07 09:39:47 THUR;			
SLOWSAMPLES: 5 ; FASTSAMPLES 57 ;			
KEY (PM2_OMTYPE)			
INFO (PM2_OMINFO)			
PM2ERR	PM2FLT	PM2INITS	PM2LOAD
PM2USB	PM2UMBU	PM2MSBU	PM2MMBU
PM2CXFR	PM2ECXFR	PM2CCTSB	PM2CCTMB
PM2CCTFL	PM2CCTER		
TM			
CLASS: ACTIVE			
START: 1986/08/07 09:30:00 THUR; STOP: 1986/08/07 09:40:47 THUR;			
SLOWSAMPLES: 6 ; FASTSAMPLES: 63 ;			
TMERR	TMFLT	TMSBU	TMMBU
TMCCTDG	TMCCTFL	TMMBP	TMSBP
TMMBTCO	TMSBTCO	TMCCTOP	

### OM demand output reports

DMS-100 Family systems provide output reports at any time, for all the operational measurements. These reports are routed to the appropriate printing devices. Demand output reports are requested by means of the input command "OMSHOW" and requesting the table, such as, TRK, and the class, such as, holding or active. An example of the AMA demand report is shown in Figure 6-13. The numeric data values are printed after the header labels for the report.

**Figure 6-13**  
**AMA demand report**

```
OMSHOW AMA HOLDING

AMA
START: 1986/08/07 09:00:00 THUR; STOP 1986/08/07 09:10:23 THUR;
SLOW SAMPLES      6; FAST SAMPLES      61;

AMAENT      AMAENT2      AMAEMTR      AMAFREE
AMAROUTE
```

### **Measurement blocks**

The OM system in DMS-100 Family systems provide the operating company with performance data for the switch. The general requirements of the operational measurements are divided into categories which include accuracy, integrity, security, documentation, report format, and report input and output capabilities.

#### **Measurement accuracy**

The design objective of the DMS-100 Family operational measurements system is to register peg counts for 100 percent of all detected events. Measurements that overflow are detected by the system and pegged by the “overflow” registers provided.

#### **Measurement integrity**

Measurements stored within the switching system are protected from inappropriate modifications by the switching system. The operational measurements are not reset by warm or cold system restarts.

#### **Measurement security**

The design of the DMS-100 Family operational measurements system ensures that the measurements stored within the switching system are protected from manual modification.

#### **Measurement documentation**

A partial list of operational measurement tables provided in DMS-100 Family switches is outlined in Table 6-10.

### Measurement format

Measurement data is output to VDUs and printers in decimal digits.

### Measurement report input and output capabilities

The measurement reports can be available at the local or remote locations. Reports in DMS-100 Family systems are provided on a scheduled or demand basis.

### Measurement groups

Operational measurements are provided in DMS-100 Family switches. Detailed information concerning operational measurements is provided in 297-1001-114. For certain OM tables, a key is provided which identifies an index for the table. (Keys are identified under the appropriate tables in the detailed documentation).

All the usage counts are identified by LOSCAN (low/slow scan, 100 sec.) or HISCAN (high/fast scan, 10 sec.). Some operational measurements apply only to DMS-100, others to DMS-200 while the rest are common to the DMS-100 Family of switches. Table 6-10 lists the various OM tables available in DMS-100 Family systems.

<b>Table 6-10 OM tables available in DMS-100 family systems</b>	
<b>Table</b>	<b>Description</b>
AMA	Automatic Message Accounting
ANN	Recorded Announcements Table
BLUEBOX	Bluebox Fraud Detection Table
CARR	Digital Carrier Equipment
CBK	Code Block Table
CF3P	Conference Circuits (3 Ports)
CMC	Central Message Controller
CP	Call Processing
CPU	Central Processing Unit
CSL	I/O Consoles (Any I/O Device)
DTC	Digital Trunk Controller
DDU	Disk Drive Unit File and Maintenance Work
DTSR	Dial Tone Speed Table
ESUP	Echo Suppressor (Digital)
—continued—	

<b>Table 6-10</b>	
<b>OM tables available in DMS-100 family systems (continued)</b>	
<b>Table</b>	<b>Description</b>
EXT	Extension Block OM
IOC	Input-Output Controller
IOSYS	Input-Output System
LM	Line Module (Maintenance)
LMD	Line Module (Traffic)
LOGS	Log System
MACHACT	Machine Activity Table
MTU	Magnetic Tape Unit
NMC	Network Message Controller
OFZ	Office Traffic
ONI	CAMA-ONI Positions
PRP	Preroute Point Table
RADR	Receiver Attachment Delay Reorder
RCVR	Receiver Service Circuits
RRTE	Re-Route Feature
SITE	Remote Line Module (RLM) Site OM Table
STN	Special Tones Table
TFCANA	Traffic Analysis Table
TM	Trunk Module
TONES	Tones Group Table
TRK	Trunk Group Table
TRTMT1,2	Call Treatment Table 1 or 2.
TS	Time Switch Table
LATAKLA	Equal Access Local Access and Transport Area Translation Table
OCCNAME	Equal Access List of Other Common Carrier Names
OFRT	Office Route Table
CUSTHEAD	IBN Customer Group Parameters & Options Per Group
—continued—	

<b>Table 6-10</b> <b>OM tables available in DMS-100 family systems</b> (continued)	
<b>Table</b>	<b>Description</b>
CUSTCONS	IBN Attendant Console Options Per Customer Group
CUSTSTN	IBN Station Options Assigned to Each Customer Group
CUSTSMR	SMDR Options (IBN) Per Customer Group
End	

### **OM selective output – group totals (LMD, TRK, CARR, SLU)**

This feature allows the OM system to generate totals for each register across all tuples of these tables. This provides a summary of the data in the OM periodic reports and a broad picture at the MAP of the system activity. It enables the operating company to place thresholds on the rate of increase of registers across all tuples.

### **Traffic separation measuring system (TSMS)**

The DMS-100 Family Traffic Separation Measurement System (TSMS) feature provides a means by which switched traffic may be separated on a point-to-point basis. The components of a call which are measured and separated are the setup time, the point-to-point attempt peg count, and the point-to-point connect time. In addition, a further breakdown according to call type is provided for originating components of the switch, and facility resources may be apportioned among the various source points (destinations).

These measurements are collected in OM peg count and usage registers where they are available for long term accumulation and/or output to devices specified by the operating company. This collected data can then be used to support tariffing of the various service offerings as well as revenue settlements with the connecting companies for the joint provision of services such as toll or EAS.

TSMS handles a variety of sources, destinations, and call types:

- **Source:**
  - A line or group of lines
  - A trunk group or group of trunk groups
- **Destination:**
  - A line or group of lines
  - A trunk group or group of trunk groups
  - An announcement or group of announcements
  - A tone or group of tones





terminal then the difference in time from origination to connection is calculated and added to the setup usage register at that STSxDTS intersection.

Setup time is calculated to the nearest second for addition to the setup usage register. The data unit is therefore Call-Seconds (CS):

- **Connect Usage:** Connect usage is accumulated by the OM usage scan. On call connection (that is, at the attempt peg point), the state of the call is set such that the usage scan will begin accumulating usage at the STSxDTS intersection. Calls which alternate route after connection (because of seize-fail or out-fail) will contribute connect usage at each of their connected STSxDTS intersections. The connect-usage is collected only after the setup usage has been collected on that call.

The OM usage scan is scheduled every 100 sec. Therefore, the connect usage data unit is Centum (Hundred) Call Seconds (CCS).

### Source traffic separation numbers

Source Traffic Separation Numbers (STSN) are assigned to trunk groups and to subscriber lines. The same numbers serve as Destination Traffic Separation Numbers (DTSN) for these destination types.

For trunk groups, the STSN/DTSN is assigned in the TRKGRP table field TRAFSNO. TRAFSNO has a range 0–127 with 0 as the default value. The same TRAFSNO may be assigned to more than one trunk group (such as, a group of trunk groups).

For lines, the line attribute table LINEATTR field TRAFSNO (range 0–127, default = 0) is used for STSN/DTSN.

The LINEATTR table is built before line service orders take place. Line service orders do not use the index to the LINEATTR table but rather use a key composed on the directory number, Line Class Code (LCC), Line Treatment Group (LTG), and HOT flag, if applicable. The LTG is generally used for rate center designation and is therefore closely related to the TS number. Prompting for LTG during the service order is enabled by setting the field SO\_PROMPT\_FOR\_LTG = Y in table OFCVAR.

The range of LTG is 0–63. Use of the LTG to develop more than one level of traffic separation will tend to use up available LTGs.

Intra-module traffic can be separated by assigning different line-attribute numbers to each different set of lines. The procedure is similar to that used for providing separation by site.

### Destination traffic separation numbers (DTSN)

There are five DTSN assignments:

- a line or group of lines

- a trunk group or group of trunk groups
- an announcement or group of announcements
- a tone or group of tones
- certain generic destinations

The DTSN for a line or trunk has, inherently, the same value as its STSN, since both values are assigned in the same data field in Table LINEATTR, for lines, or table TRKGRP, for 2W trunk groups.

For announcements, the Table ANNS, field TRAFSNO (range 0–127) is used for DTSN assignment. More than one announcement group may have the same DTSN number.

For tones, the Table TONES, field TRAFSNO (range 0–127) is used for DTSN assignment. More than one tone group may have the same DTSN number.

For special tones, the table STN field TRAFSNO (range 0–127) is used for DTSN assignment. More than one tone group may have the same DTSN number. Refer to 297-1001-451 for information on the ANNS TONES and STN tables.

Certain destinations have been given preassigned and unalterable DTSNs. These generic DTSNs have been assigned within the range 0 to 8 and should not be used in any of the DMO modifiable tables. We also recommend that DTSN 9 be left unassigned to allow for future generic destination.

These are the currently defined generic destinations:

• Default	=	DEFDTS	=	0
• Lockout	=	LKDTS	=	1
• Test Lines	=	TLDTS	=	2
• Position (CAMA/TOPS)	=	POSDTS	=	3
• Call Forwarding Admin.	=	CFDTS	=	4
• Speed Calling Admin.	=	SCDTS	=	5
• Revertive Calling	=	RVDTS	=	6
• False Start	=	FSDTS	=	7
• Partial Dial Abandon	=	PDADTS	=	8
• Spare (for future use)	=		=	9

Generic DTSNs from 4 to 6 are only applicable on a local or local/toll office; in other offices they are available for user assignment. If an office does not have TOPS/CAMA, DTSN 3 can also be assigned to some other destinations. Destination number 9 can be left out for future generic destination.

The “Default” Generic Disposition number (DEFDTS) will be used whenever the DTSN is not filled in for a destination. Destinations which are not to be included in the traffic separation measurements should be filled with the operating company-defined datafill (STSN).

### Custom calling features

**Call forwarding** A generic TSN is provided for the call forwarding administration function (CFDTS = 4). When the administrative function is entered by dialing the access code (72 for activation, 73 for deactivation) and attempt peg increments the STSxCFDTS intersection. The setup usage continues to accumulate while the subscriber is updating and/or activating his call forwarding number. It is added to the STSxCFDTS intersection when the activation call is initiated or when the call is not initiated (deactivation of busy activation). It is added when the administration update is complete.

The activation call made to the call-forwarding directory number is considered separately and an attempt peg, setup usage, and connect usage is accumulated at the appropriate STSxDTS intersection for that call. There is no setup usage since it has been absorbed at the STSxCFDTS intersection.

If the activation call results in treatment (for example, invalid-DN), an attempt peg is made at the STSxTreatmentDTS intersection.

For busy activation or call forward deactivation, when the administrative update is complete, the subscriber is connected to a confirmation-tone for a fixed time, followed by a silent-tone. The STSxConfirmationDTS intersections are pegged and the connect usage collected. There is no setup usage collection at these intersections.

*Note:* There is no connect usage at the STSxCFDTS intersection. The administration usage is all collected by the setup usage and the connect registers will always be zero in value.

Forwarded calls may be switched on a 1+ basis (call type = DD). However, since the call type dimension of the TS matrix is applicable only to originating traffic, incoming calls so forwarded will continue to be pegged and accumulated on a call type = NP basis.

**Call waiting (CW)** Lines with the call waiting feature will be handled logically as if the subscriber has two lines. Thus, the initial call will contribute an attempt peg, setup usage, and connect usage at the STSxDTS intersection. A second call arriving at the busy line will similarly attempt peg, setup usage and connect usage accumulate at the appropriate STSxDTS intersection. The connect usage starts when the second call informs the called party of its presence. A third call would be routed to a busy tone and does not enter the picture (it contributes to the STSxBusyDTS intersection).

**Speed calling (SC)** A generic TSN is provided for the speed calling administration function (SCDTS = 5). When the administrative function is entered by dialing the access code (74 or 75), an attempt peg is made at the STSxSCDTS intersection. The setup usage is added to the STSxSCDTS intersection when the administration update is complete. There is no connect usage collected at the STSxSCDTS intersection.

When the administrative update is complete, the subscriber is connected to a confirmation-tone for a fixed time, attempt peg, and connect usage at the appropriate STSxtreatmentDTS intersection.

Screening of the speed calling directory number is performed before the administrative update is made. Should a treatment (vacant-code) result from the screening (such as, invalid-DN or international number) the setup usage is collected at the STSxSCDTS intersection. An attempt peg and connect usage is collected at the STSxTreatment-DTS intersection. There is no setup usage collected at the STSxTreatment-DTS intersection.

**Three-way calling (TWC)** Three-way calling featured subscribers are measured as if they have two lines. Each origination is treated as a new call and the attempt peg, setup usage, and connect usage are collected as with a normal call. While the three parties are involved, whether in private consult or conference mode, connect usage is accumulated at the two STSxDTS intersections.

Attempt at adding a third party which results in routing to treatment (tone/announcement) will cause attempt peg, setup usage and connect usage at the appropriate STSxTreatmentDTS intersection.

### **Revertive calling (RC)**

With revertive calling, the calling subscriber is routed to a recorded announcement and, when he/she goes on-hook the called party is rung. When the called party answers, ringing is removed. For party lines with frequency-ringing, the called party is then connected to an announcement/tone for a fixed time. Party lines with coded or superimposed ringing have no such connection. Conversation is initiated when the calling party goes off-hook.

This feature is treated as two/three calls: the first from calling party to announcement/tone, another from called party to announcement/tone (if applicable), and finally the called/calling party connection.

There is a specific sequence of data collection:

- 1 Upon selection and connection to a recorded announcement, an attempt peg and setup usage are accumulated at the calling STS and the recorded announcement DTS intersection. Connect usage is initiated.

- 2 Connect usage is accumulated by the 100 sec. OM usage scan while the calling party is connected to the recorded announcement.
- 3 When the calling party goes on-hook, the recorded announcement connection is released and connect usage halted at that intersection. Called party ringing commences. This virtual connection to the called party results in an attempt peg at the calling STS and generic DTSN (Reverted call Destination Time Separation [RVDTS]). Connect usage scanning is initiated and is accumulated at the same virtual intersection.
- 4 For coded or superimposed ringing lines, connect usage continues while ringing and, when the called party answers, through the duration of the conversation. Connect usage ceases when either the calling or called party goes on-hook.

For frequency ringing lines, the called subscriber is connected momentarily to an announcement/tone which generates an attempt and connect usage at the called TSN and an announcement/tone destination TSN.

Depending upon the particular situation, two/three attempt pegs will be made and one setup usage and two/three connect usages. The attempts are not additive while the setup and connect usages should be added in order to get the total usage for the call.

### **CAMA and TOPS positions**

Calls which require operator intervention are connected momentarily to either a CAMA (for Operator Number Identification [ONI]) or TOPS (for ONI, operator handling) position. The amount of time a call is at, or queuing for, a TOPS or CAMA position, but without forward connection, is considered (along with dialing time) as setup time. The initial routing attempt will absorb this as setup usage at the STS to DTS intersection. There is no difference between the gathering of peg and usage for these calls and calls not requiring CAMA or TOPS.

Traffic separation of the CAMA or TOPS resource is to be obtained from ONI and TOPS operational measurements, from general office pegs and usages.

In order to provide some separation of unproductive CAMA or TOPS position attempts, a generic destination for CAMA and TOPS has been provided—POS DTS. This destination will accumulate attempt pegs and setup usage on calls which abandon while at, or queuing for, a CAMA or TOPS position but without forward connection. Thus the STSxPOS DTS intersection will accumulate attempt and setup usage but no connect usage.

Unique situations which arise on TOPS calls are handled individually:

- Several destinations may be reached and subsequently released by the TOPS operator before connection to the final destination is made. For example, this can occur if the operator terminates on a vacant-code.

In these situations the setup usage is accumulated at the STSx(any-intermediate)DTS intersection. An attempt peg and connect usage is also accumulated at the same intersection.

When progressing to the next intersection the connect usage is stopped. The setup usage is initiated again (with a new time-stamp) for the next STSxDTS intersection.

- A call which was previously handled by a TOPS operator and released can later be recalled to the same or another operator.

Since no new forward connection is possible on a recalled call, it will continue to accumulate usage at the previous STSxDTS intersection. However, while the call is waiting for or at an operator position, the usage will accumulate in the setup rather than the connect usage register. If conversation resumes after the recall, accumulation of the connect usage will also resume.

- A TOPS operator may originate a call by first calling the terminating subscriber and then calling back the originating subscriber. The originator and the terminator are then connected together. In some cases both the originator and the terminator may be on out-going trunks.

Since traffic separation does not provide for measurements at DTSxDTS intersections, calls which are originated by the TOPS operator will use the generic POSDTS number as their STSN. The TS data will be collected at the POSDTSxDTS intersection.

- A call may just terminate at the TOPS operator position. The situation is quite normal where a subscriber calls an operator for information only, and then hangs up. The call is never routed to an outgoing destination. In these cases the STSxPOSDTS intersection is used to accumulate attempt peg and setup usage. No connect usage is collected.

### **Overlapped outpulsing or overlap carrier (equal access) selection**

Overlapped outpulsing or overlap carrier selection is handled much the same as normal non-overlapped traffic. As soon as enough information is available to route the call, an attempt peg and setup usage are accumulated at the STSxDTS intersection. Connect usage accumulation is initiated. This occurs before all digits are collected. No matter what happens from this point, sufficient information for routing is available and an outgoing route occupied.

**Remote call forwarding (RCF)**

Remote call forwarding is handled as a basic tandem trunk call.

**Test lines**

Certain test lines are software implemented and do not have trunk groups associated with them and therefore no assignable DTSN. The generic destination TLDTs is used to separate this terminating test line traffic. There are five test lines designations:

- Synchronous/Asynchronous
- Station Ringer
- Silent Switchman
- 103
- 104

**PDAB/PDTP calls**

Calls which fail the called number integrity (dial tone time-out, inter-digit time-out) are defined as Partial Dial Time-out (PDTP). Calls which are abandoned prior to called number routing analysis (false start, partial dial abandon) are defined as Partial Dial Abandon (PDAB). There are four conditions for PDAB and PDTP calls:

- False Start.– False start is the case when a line is off-hook (origination is detected in the central control) and is then on-hook without dialing any digits before dial tone time-out. Short off-hooks (noise/glitches) which do not exceed the peripheral off-hook filter time will not contribute in any measurement.
- Partial Dial Abandon – Partial dial abandon is the case when a line is off-hook and is then on-hook after dialing at least one digit. This has to happen before all digits are dialed and before interdigit time-out.
- Dial Tone Time-out – Dial tone time-out is the case when a line is off-hook until dial tone time-out without dialing any digits. The call is then routed to a treatment.
- Interdigit Time-out. Interdigit time-out is the case when a line is off-hook and before a complete set of digits are dialed but time-out between dialing digits occurs. The call is then routed to tone/announcement treatment.

The basic requirements for PDAB/PDTP traffic separation measurements are to measure and distinguish the above categories. Only the locally originated partial dial traffic will be measured (DMS-100 lines, remote (RSC or RLCM) lines and PBX trunks). These measurements are not applicable to incoming traffic or trunks.



Category (3) or (4) type of traffic (PDTO) will cause attempt peg, setup usage and connect usage at STS X Treatment DTS intersection. They can be separated by assigning different DTSN to the treatments.

Different generic DTSN is provided for categories (1) or (2) type of traffic (PDAB): FSDTS = 7, PDADTS = 8. A false start call will cause attempt peg and setup usage at STS X FSDTS intersection. A partial dial abandon call will cause attempt peg and setup usage at STS X PDADTS intersection. There is no connect usage collection for PDAB traffic (categories 1 and 2).

In the case of three-way calling, false start and partial dial abandon traffic will be treated as one type, and will cause attempt peg and setup usage at STS X PDADTS intersection. There is no connect usage for this case.

For overlapped outpulsing or overlap carrier selection traffic, attempt peg, and setup usage will be collected at STS X DTS intersection as soon as enough digits are available to route the call. No attempt peg and setup usage will be made at STS X PDADTS intersection even if the call is subsequently abandoned (category [2]). However PDTO traffic will cause attempt peg and connect usage at STS X Treatment DTS intersection if there is interdigit time-out (category 4).

### **Traffic separation OM register assignment**

OM registers are used to accumulate pegs and usages for particular combinations of STS, DTS and call type. The assignment of OM registers to the intersections of the TS measurement matrix is done through the table TFANINT. This table takes as its index the two TSNs (STS and DTS) and allows the assignment of register numbers along the third dimension of the matrix (for example, the call type).

Since call type is only applicable for originating traffic, trunk (incoming) sources must use the same register number for all call types. The only exception to this is for PBX trunks, where separation data by call type can be collected. The call type used for separation is determined by translations for each call.

PDAB calls are abandoned prior to called number routing analysis, call type cannot be distinguished, the same register number should be assigned for all call types.

Each field is uniquely defined in table TFANINT:

- **INDX** Two part key: STSN (0-127) DTSN (0-127)
- **DDREGNO** Register number assigned to DD call-type traffic
- **OAREGNO** Register number assigned to OA call-type traffic
- **NPREGNO** Register number assigned to NP call-type traffic



The range of the OM register in table TFANINT is 0–2047. The same register number can be assigned for different call-types in cases where the user is not interested in separation by call-type.

The basic (default) offering restricts the operating company to a maximum range for STSN and DTSN of (0–15) giving a table indexing range (0–255) and a register number range 0–255).

The assignment of an OM register number actually assigns six OM registers to the TS matrix intersection: two for attempt peg, two for setup usage and two for connect usage. This group of registers is called TFCANA and the index into the group is the assigned OM register number. Refer to 297-1001-114 for general information on DMS-100 Family OMs.

*Note:* Setup usage and connect usage are optional.

The TFCANA group consists of six fields:

- 1 TFANPEG Number of attempts at a combination of incoming and outgoing TSNs.
- 2 TFANPEG2 Overflow count on TFANPEG.
- 3 TFANSU Total setup usage at a combination of incoming and outgoing TSNs. This time is in actual call-seconds and should be divided by 100 to convert it to CCS.
- 4 TFANSU2 Overflow count on TFANSU.
- 5 TFANCU Total connect usage at a combination of incoming and outgoing TSNs. This usage is in CCS units. Connect usage is collected only after we have collected the setup usage at that intersection.
- 6 TFANCU2 Overflow count on TFANCU

Since the measurements each have two sixteen-bit registers, they can accumulate up to 4 294 967 295 pegs or maximum usage. This will be adequate for the largest TSN groupings to be used in DMS-100 Family offices.

The operating company should assign a non-zero don't-care OM-register number to the don't\_care STSN X don't\_care DTSN intersection in order to collect all the TS data that is not required. Do not dump them into the default OM-register (0). This will allow the operating company to check for default traffic easily.

Note that the unit for setup usage is CS and for connect usage is CCS.

The TFCANA group of registers may be output to the LOG system or to any DIRP device (through OMDUMP/OMTAPE).

**Traffic separation default register (TSDR) Log**

TSDR log report informs the TSMS user about the calls which are accumulating traffic data into the default TSMS OM register (0). The report will allow the operating company to make sure that the default traffic is almost nil and to identify the source/destination and the type of call which is contributing to the default/trash OM register.

Information included in this report is as follows:

- The type of event (PEG, SETUP-USAGE or CONNECT-USAGE)
- The call type determined by translations (DD, OA or NP)
- The originator/source (trunk or line). In the case of TOPS\_Position (POSDTS = 3), the generic originator will not have any source in the log.
- The Source Traffic Separation Number (STSN).
- The terminator/destination (trunk, line, ANNS, tone, or position). The generic terminators will not have any destination in the log.
- The Destination Traffic Separation Number (DTSN).

This log report is controlled by an OFCPARM (in table OFCENG):

'TFAN\_DEFAULT\_REG\_LOG TFAN\_RTP N N N', where N N N are the field parameters for event types corresponding to TSPEG, TSSETUP and TSCONNECT respectively.

A report will be provided for the event\_type only if the corresponding field parameter is set to Y.

**TSMS customer tables**

**Office parameters** Four office parameters may be available to the user, depending upon whether the particular feature packages are available or not. These parameters are in tables OFCOPT and OFCSTD.

**Table OFCOPT** Parameter TFAN\_ENHANCED\_FEATURE = Y or N informs whether the TSMS is present or not. If this parameter is equal to N, there are 16x16 intersection points (maximum STS number = 15 and maximum DTS number = 15).

**Table OFCENG** When TFAN\_ENHANCED\_FEATURE = Y, three fields must be defined in table OFCENG:

- TFAN\_IN\_MAX\_NUMBER  
This is the maximum STS number which can be used in the separation measurements for sources. The valid range of this parameter is: (\*size\_15, size\_31, size\_63, size\_127\*). The default is 'size\_15'.

- **TFAN\_OUT\_MAX\_NUMBER**  
This is the maximum DTS number which can be used in the separation measurements for destinations. The valid range of this parameter is: (\*size\_15, size\_31, size\_63, size\_127\*). The default is 'size\_15'.
- **NO\_TFAN\_OM\_REGISTERS**  
This is the maximum number which can be used in the separation measurements for destinations. The valid range of this parameter is from 1 to 2048. The default number of OM registers is set to 225.

All three OFCENG parameters can be changed by the customer in coordination with NTI.

**Table TFANINT** This table allows the user to define the intersection points and assign the OM-register numbers at each intersection. Each intersection point is defined by two TSNs (a source TS and a destination TS). At every intersection three OM register numbers can be assigned for measurements according to the call type.

Since call type is only applicable for originating traffic, trunk (incoming) sources must use the same register number for all call types. The only exception to this is for PBX trunks, where separation data by call-type can be collected. The call type used for separation is determined by translations for each call.

The fields in table TFANINT have a unique definition:

- **INDX** Two part key: STSN (0-127) DTSN (0-127)
- **DDREGNO** Register number (0-2047) assigned to DD Call-Type traffic
- **OAREGNO** Register number (0-2047) assigned to OA Call-Type traffic
- **NPREGNO** Register number (0-2047) assigned to NP Call-Type (or all other) traffic

The range of the OM register in table TFANINT is 0-2047. The maximum number of intersections (or tuples) in table TFANINT is controlled by the size specified in table SYSDATA for TFANINT. This size, which ranges from 0 to 2047, should be set after the number of entries in table TFANINT is known. A COLD restart is required to allocate the data-store for TFANINT.

The assignment of an OM register number actually assigns six OM registers to the TS matrix intersection: two for attempt peg, two for setup usage and two for connect usage. This group of registers is called TFCANA and the index into the group is the assigned OM register number. The setup usage and connect usage are optional.

Intersections which are not defined in table TFANINT accumulate their data in the default (=0) OM register.

### **TSMS MMI commands and responses**

**TSMS OM registers** The TSMS operational measurements are contained within the TFCANA OM group. Query access to these measurements is available through the OMSHOW CI command of the OM system. Refer to 297-1001-518 for further explanation on this command.

There is a specific format of this command for TFCANA:

```
OMSHOW TFCANA <valid-class>          ( from OM register number )  
                                         ( to OM register number )
```

The use of OMSHOW allows a quick look at the measurement data.

However, for comprehensive measurements the data should be scheduled for output to DIRP to a storage device (tape or disk) for handling by down-stream processing (see 297-1001-312 and Figure 6-1 for DIRP operation).

**TSMS office data** To assist the TSMS user, further information is available by the TSMS CI-increment TFAN. Various commands are available to the user to assist in consolidating the intersection-points, OM-register, and the traffic separation numbers assigned to different sources and destinations.

The TFAN CI-mode can be entered by the CI command: TFAN. A query on TFAN will inform the user of all the various commands available at the TFAN level. A query on each command in the TFAN level will provide further information on the use of these commands.

The output from these commands along with the customer tables, TRKGRP, LINEATTR, TONES, STN, ANNS, and TFANINT, will provide enough information to evaluate and process the traffic separation data.

Four TFAN commands are available with the basic TSMS feature:

**QUERYTS** This command will display all the sources and destinations which have the user specified Traffic Separation (TS) number. TS number information is displayed for trunk groups, line attributes, tones, and announcements. If optional parameter ALL is specified, the command will continue with the rest of the TS numbers starting from the specified TS number.

**QUERYCLLI** This command will display the CLLI and the TSN assigned to the CLLI in the trunk group. If ALL is entered, then all trunk CLLIs are displayed with their TS numbers.

**QUERYREG** This TFAN command will display the intersections to which the given TSMS OM registers have been assigned. Displays are generated only for assigned registers. The information displayed includes the register number and the STSN and DTSN of each intersection assigned to that register number. If optional parameter ALL is entered, the command will display all of the registers starting from the value of the first parameter.

**QUERYINT** This command will display the source and destination TS numbers assigned to each intersection. These may include trunk groups, line attributes, tones, and announcements. The output is in the ascending order of the Source and Destination Traffic Separation numbers.

### **TSMS data to OM tape**

In order to assist the down stream processing of traffic separation data, all the TS source and destination data can be dumped on to the OM tape along with the TS data. The TS source and destination information are collected from table TFANINT, TRKGRP, LINEATTR, TONES, ANNS, or STN.

This dump facility is contained on a non-resident tape and has to be loaded before using. The OM tape used for dumping must have been formatted and mounted.

**TSNDMP output** The file structure of the TSN data will be similar to that of the OM tape (see 297-1001-117N). It will consist of four types of records:

- JH – Header record for TSN data
- JG – Group record type for TSN data table
- JK – TSN key and date record
- JE – End record

### **TSMS output**

**TSMS OM registers log report** The output to the log system for the TFCANA group of registers is scheduled through OMPRT through DMO. This is the standard method of scheduling OM to the log system (see 297-1001-518).

As shown in Figure 6-14, the TSMS feature provides output of (TFANPEG, TFANPEG2) to the log system.

**Figure 6-14**  
**Output registers**

```

OMPR200 SEP02 10:00:00 7499 INFO OM REPORT

CLASS: HOLDING
START: 1986/09/16 09:30:00 TUES; STOP: 1986/09/16 10:00:00 TUES;
SLOWSAMPLES:      18 ; FASTSAMPLES:  180 ;

TFCANA           TFANPEG           TFANPEG2

0                1077                0
1                 27                0
2                 301                1
3                  ,                ,
4                  ,                ,
5                  ,                ,
,                  ,                ,
,                  ,                ,
,                  ,                ,

```

With the usage measurement option, the setup (TFANSU, TFANSU2) and connect (TFANCU, TFANCU2) usage registers are provided (see Figure 6-15). The setup usage is in actual CS and the connect usage is in CCS.

**Figure 6-15**  
**Usage registers**

```

OMPR200 SEP02 10:00:00 7499 INFO OM REPORT

CLASS: HOLDING
START: 1986/09/16 09:30:00 TUES; STOP: 986/09/16 10:00:00 TUES;
SLOWSAMPLES 18 ; FASTSAMPLES: 180 ;

TFCANA  TFANPEG  TFANPEG2  TFANSU  TFANSU2  TFANCU  TFANCU2

0        1077    0          1930    0        10770   0
1         27     0           41     0         30      0
2        301     1        52970    1        6584   0
,         ,     ,           ,     ,         ,      ,
,         ,     ,           ,     ,         ,      ,

```

### **TSMS summary report**

The TSMS summary report is optional.

The main difference between this report and the standard output of the TFCANA group through the OMPRT table is summation of register data and multiple column output.

The pegs/usages and their associated overflows (TFANPEG and TFANPEG2) are summed for single number output. Setup usage is converted to CCS from call seconds (nearest CCS). The setup and connect usages may be added together for single columns at the end of each report.

The values in the output report are calculated by these formulas:

- PEGS = TFANPEG2 x 2E-16 + TFANPEG
- SET\_U = (TFANSU2 x 2E-16 + TFANSU) / 100
- CON\_U = TFANCU2 x 2E-16 + TFANCU
- SUM\_U = CON\_U + SET\_TU

Dependent on the page line length selected, this compression of data will result in multiple column output with resulting decrease in the number of lines of output.

This report, TFCANA, is scheduled using table OMREPORT:

L\_LEN (S/L) Line\_Length (short/long)  
 SET\_U (Y/N) Setup Usage (yes/no)  
 CON\_U (Y/N) Connect Usage (yes/no)  
 SUM\_U (Y/N) Setup and Connect usage summed (yes/no)

TABLE: OMREPORT

SCHEDNO	ACTIVE	WHEN	CLASS	DATA
2	Y AUTO	HOLDING	TFCANA	S Y Y Y
3	Y AUTO	HOLDING	TFCANA	L N N Y

Reports scheduled according to the settings in Table OMREPORT have a specific format:

Output format : S Y Y Y

OMRS002 10:00:00 8293 INFO OM PERIODIC REPORT

REPORT NAME: TFCANA REASON: SCHEDULED

CLASS: HOLDING

START: 1986/09/16 09:30:00 TUES; STOP: 1986/09/16 10:00:00 TUES;

SLOWSAMPLES: 18 ; FASTSAMPLES: 180 ;

ELAPSED TIME 00/00 00:30:00

```

DATA:    L_LEN                = S
SET-U    = Y
CON_U    = Y
SUM_U    = Y

```

```

-----
REGNO    PEGS                SET_U          CON_U          SUM_U
0        1077                19          10770         10789
1         27                 0           30            30
2       65837                1185        6584          7769
'        '                  '           '             '
'        '                  '           '             '
'        '                  '           '             '
TOTALS:  1274328            23118       74225         97343

```

END OF REPORT

### Equal access – TSMS features

When the equal access TSMS feature is required, there is a new table used similar to TFANINT called OCCTSINT. This new table has as its key a carrier separation number and destination number, and instead of separating calls by type (DD< NP< OA), calls are separated into four categories:

- 1 IntraLATA – Intrastate (LDSRA)
- 2 IntraLATA – Interstate (LDIRA)
- 3 InterLATA – Intrastate (LDSER)
- 4 InterLATA – Interstate (LDIER)

The data used to determine state and LATA attributes needed to peg the appropriate OM register can be found in table LATA\_XLA. (Refer to 297-1001-451, Section 075, for details).

Each category contains an OM register number but this number indexes into a new OM group called EATSMS. This new group is required because the TSMS data for DD, OA, and NP calls is not mutually exclusive of the four new fields. In other words, when the call is a DD call it could also be an InterLATA-Interstate call. Since this is the case, if the same OM registers were used, it might become very confusing because the data would not only represent the DD call, but also represent the InterLATA-Interstate call. Therefore EATSMS captures information on the traffic sent to carriers, while TSMS captures traffic information for the office as a whole. The equal access TSMS feature is a categorization of outgoing equal access trunk traffic.

The TSMS system, as it currently functions, will continue to work independently of the equal access TSMS. TSMS traffic will still be separated by source and destination number based on the type of each call,



but EATSMS equal access traffic will be separated by carrier and destination based on the LATA/state categories for each call.

Table OCCTSINT (see 297-1001-451, Section 053) will be similar to TFANINT because it will have as its key, two separation numbers. The traffic separation numbers used to index table TFANINT are in the data stored for trunk groups in table TRKGRP, for the announcements in table ANNS, for the tones in table TONES, and for the special tones in table STN.

Table OCCINFO will now be expanded to include a traffic separation number for each carrier, OCCSEPNO. For more information, refer to 297-1001-451, Section 076.

### **MDC – TSMS features**

This set of features is an incorporation of regular TSMS pegging, usage, and report facilities with MDC software. The primary purpose is to allow traffic separation measurements to be made on calls originating from or terminating a specific Network Class-of-Service (NCOS) within a specific customer group.

### **Engineering administrative data acquisition system (EADAS)**

EADAS is a centralized data acquisition system that collects traffic data from a number of central office switching systems by way of a BX.25 data link. This link also can provide access for EADAS/network management capabilities.

EADAS is a minicomputer-based system that collects and processes data at half hour, one hour, and 24-hour intervals. Both peg count and usage data measurements are collected for processing.

EADAS/DC generates near real time reports on network terminals located at various operations centers and records data on magnetic tapes for distribution to downstream users for further analysis. It is a front-end collector for the Total Network Data System (TDNS) of Operations Systems (OSs).

The data link between the DMS-100 Family and EADAS is a single dedicated synchronous 2400 baud data link with three BX.25 Permanent Virtual Circuits (PVCs). PVC is a user facility having a permanent association exists between two units of data terminal equipment which is identical to the data transfer phase of a virtual call. No call setup or clearing procedure is necessary.

### **Engineering administrative data acquisition system/data collection (EADAS/DC)**

The DMS-100 transfers specified OM data to the EADAS/DC system. Thirty-minute, hourly, and 24-hour data is supported.

BX.25 issue 3A protocol is used by the DMS-100 for data transferral. The multiprotocol controller (MPC) card serves as the switch hardware interface card to a modem for teleprocessing this data to EADAS/DC.

### **Engineering administrative data acquisition system/network management (EADAS/NM)**

The DMS-100 interfaces to the Engineering Administrative Data Acquisition System for Network Management (EADAS/NM) through the EADAS/Data Collection system. This provides near real-time network performance monitoring on a centralized basis, and centralized network control and administrative capabilities

The DMS-100 provides four capabilities to EADAS/NM:

- 1 Five-minute OM data
- 2 30-second discretets
- 3 Various audits
- 4 Network management controls

BX.25 issue 3A protocol is used by the DMS-100 for data and message transfer. For more information, see Feature 45-18-0403 in Chapter 3.

### **Service evaluation system No. 2 (SES No. 2)**

DMS-100 will interface with Service Evaluation System No. 2. SES No. 2 supports the Service Evaluation Center (SEC) which provides management with an assessment of network service quality. The DMS-100 Family/SES No. 2 interface consists of an Incoming Trunk Service Evaluation (ITSE) capability and/or a Dial Line Service Evaluation (DLSE) capability.

ITSE can be performed on telephone calls entering a telephone operating company network from an interexchange-carrier point of presence to an access tandem. A major purpose of ITSE is to ensure that all interexchange carriers are provided equal facilities by the telephone operating company.

DLSE can be performed on telephone calls originating on the line side of a switch within the telephone operating company network. The purpose of DLSE is to ensure that the switch under evaluation is providing acceptable telephone service levels to the public.

The Call Classification Terminal (CCT) of the No. 2 SES requests a call for evaluation over the data link. The DMS-100 Family switch selects an appropriate call and bridges that call to the CCT over a listen-only voice link. The DMS-100 Family switch provides call details over the data link. The CCT listens to the bridged call and analyzes the call based on what is heard and the call details provided by the DMS-100 Family switch. Based on this analysis, a final call disposition is determined by the CCT. Call disposition includes five possibilities:

- 1 Call Complete
- 2 Busy Tone Received
- 3 No Answer
- 4 Blockages
- 5 Network Error

### **Network operations system (NOS) interface**

The Network Operations System (NOS) employs flexible modular technology for interconnecting DMS-100 Family switching system network operations support systems and NOS for improved network operation, administration, and maintenance control.

NOS utilizes a high level, seven-layer communications protocol called Network Operations Protocol (NOP), which meets the new industry standard for Open System Interconnection (OSI). It is also compatible with International Telegraph & Telephone Consultative Committee (CCITT) signaling standards.

This protocol provides for transferring information over an X.25 NOP communication link from a DMS-100 office to the network operations system for evaluation. Types of data which may be transported include AMA, OM, Automatic Trunk Testing (ATT), and Killer Trunk (KT).

The NOS interface uses the X.25 NOP as a standard interface for transaction and file transfer of data between the DMS Family of switching systems, NOS, transmission equipment, and network operations support systems.

NOP is designed to offer network-wide control of operation, administration, and maintenance applications for greater productivity, flexibility, quality, and reduction in operation expenses. Its seven layer structure is based on CCITT standards, which correspond with the open system interconnection (OSI) reference model. This protocol eliminates the need for one protocol per OAM function, one protocol per carriage type, and one protocol per network equipment type. NOP is designed to support a variety of data, including maintenance and testing, customer control, transport services, network surveillance, and operation and administration functions.

## Network management (NWM)

The DMS-100 Family provides a wide range of NWM features to ensure the optimum use of available facilities in the face of abnormal loads and equipment or facility failures. Overload conditions, where the demand for service exceeds the ability of the trunk groups or the common control equipment to provide satisfactory service, are handled by network management by the immediate application of controls to isolate and contain the overload. Where a control is recommended only in a particular member of the DMS-100 Family, it is indicated by identifying that family member in the subsection title.

### Network management (VDU)

The NWM MAP is the main interface to the DMS-100 Family system and can be local or remote. This MAP is used for office maintenance and can also be used as the network management position when the function is remotod, providing that the appropriate levels and menus of the NWM functions are accessed. Four network management and system functions are performed from the VDU:

- 1 Display continuous system status information, in a fixed format, which provides the network manager with an overall impression of the “health” or status of the DMS-100 Family office. This display is updated every minute. Display temporary status information by entering commands from the menu.
- 2 Display a menu of assorted network management commands.
- 3 Determine what NWM action is required to clear or alleviate an overflow condition.
- 4 Output threshold data and network management operational measurements.

Continuous status information is displayed for five conditions:

- 1 Indication of the type(s) of active NWM controls in the DMS-100 Family office.
- 2 The total number of incoming seizures in the office.
- 3 The percentage of test calls which are not satisfying receiver attachment delay recorder time limits.
- 4 The percentage of CPU real-time usage.
- 5 The time of the last re-initialization within the previous 30-minute period.

The two types of temporary status displays available, trunk group and control, are used for monitoring purposes and observing the effect of active NWM controls. These displays remain on the VDU until they are erased or replaced by others through NWM command input.

The trunk group status display provides the identity of trunk groups, the number of calls offered, the number and percentage of calls overflowing, attempts per circuit per hour, connections per circuit per hour, the measure of traffic usage, the number of calls deflected and the name of any active control on the trunk group.

The control status displays are divided into four categories or levels. These levels are called the group, code, route and automatic controls. All of these levels display the different controls (available on a particular level) which are active in the DMS-100 Family and their total number.

The menus of commands available to the network manager are distributed among the different levels of displays provided. Any command display on any particular level may be entered.

The network manager may at any time display operational measurement data on the VDU by accessing the DMS-100 Family operational measurement system. Network management in the DMS-100 Family employs a teleprinter which is primarily used for scheduled hard-copy printout of NWM and OM reports. The VDU and printer may be located remotely.

### **Status board lamp display**

The status board provides the network manager with a lamp display, through Signal Distributor (SD) points, of the status of selected trunk groups (normally toll). Lamps are illuminated when all trunks in a group are busy. A maximum of 32 trunk groups can be associated with a single SD point which operates only when all groups are in the busy state. A maximum of 1792 SD points can be provisioned. The trunk groups can be outgoing or two-way groups.

The status board lamp display is updated periodically at an office settable interval. Data table Office Engineered Parameter (OFCENG) field name Network Management Trunk Group Busy Lamp Update (NWMTGBLU) is used when changes to the interval are required. The interval is in units of ten seconds with a default value of two minutes.

The status board can be located locally or remotely. A purchased telemetry unit may be used to remote the status board to other buildings.

### **Network management controls**

Several network management controls are currently available in DMS-100 Family.

#### **Directional reservation equipment (DRE) (DMS-200)**

DRE is a control (applied to two-way trunk groups) that gives priority to completing traffic by reserving a number of idle trunks in a group for this

completing traffic. Originating traffic is skip-routed, it overflows to the next group.

DRE is applied in steps or levels to indicate the amount of control desired. These levels are directly associated with the number of trunks to be reserved in a trunk group. Levels are in the range of 1 to 63 trunks.

Whenever DRE is in effect (active), it skip-routes originating traffic when the number of idle trunks in the group is less than or equal to the level value. In this way the idle trunks are reserved for completing traffic which has already penetrated the network.

Once DRE is enabled and the level setting is reached, 100 percent of all traffic, direct and alternate, offered to the two-way group will be skip-routed. The rerouting will continue until the number of idle trunks in the group increases past the trigger (level) point.

### **Protective reservation equipment (PRE) (DMS-200)**

PRE is a control that is similar to DRE, but PRE acts only on Alternate-Routed (AR) traffic offered to the two-way or one-way outgoing trunk group. Direct routed traffic is allowed full access. Once PRE is enabled and the level setting is reached, 100 percent of the AR traffic to the two-way home final is skip-routed unless a final route is involved in which case an NCA condition results.

### **Cancel to (CanT)**

CanT is a control that limits traffic attempts over selected one-way outgoing or two-way trunk groups and routes these attempts to a specified announcement. This control cancels a preset percentage of the traffic offered to a particular trunk group. The percentage level can be set in the range 1 to 100 percent in 1 percent steps. If any percentage of direct routed traffic is affected, then 100 percent of alternate-routed traffic is affected. Traffic that is affected by cancel to can be routed to one of three announcements:

- 1 No Circuit Available (NCA)
- 2 Emergency Announcement 1 (EA1)
- 3 Emergency Announcement 2 (EA2)

### **Skip control (SKIP)**

This control re-routes a percentage of alternate and direct routed traffic offered to an outgoing trunk group by skipping over the specified group to the next trunk group in the routing chain. The control percentage level settings ranges from 1 to 100 percent. If any percentage of direct routed traffic is affected, then 100 percent of alternate-routed traffic is affected.





- NXX Non-Area Code (NAC)
- XXX Country Code (CCODE)
- 10XXX Prefix Code (PFX)
- NPA-NXX ACODE + NAC
- NXX-XXXX subscriber number
- NPA-NXX-XXXX ACODE+ subscriber number

Provision for blocking more than one serving NPA is provided. A maximum of 256 code block controls of any combination of code types, such as AC, NAC, CC, PFX, and digits can be set.

### Preroute peg count (PRP)

This control provides the network manager with a tool for studying traffic levels to various destination codes and thus provides an indication when possible Code Blocking (CBK) controls would require activation. The PRP control pegs all calls to a specified destination code (CC, AC or NAC) but blocks none. PRP is activated or deactivated using the MAP (code control).

### Hard to reach flag (HTRF) (DMS-200)

HTRF is a code control that allows NWM to flag certain codes as hard-to-reach (HTR). The codes are checked at the time that a trunk is selected and a percentage of traffic is blocked or an NWM control is active on that trunk group. STR and HTR Levels (see 297-1001-453).

	Level 1	Level 2
HTR-Direct-route-Traffic	Blocked % *	Blocked 75%
HTR-Alternate-route Traffic	Blocked % *	Blocked 100%
Other-Direct-route Traffic	not applied	Blocked % *
Other-Alternate-route Traffic	not applied	Blocked 100%

\* Value can be 0 – 100%

### Reroute control (RRTE)

The RRTE allows a percentage of traffic to be deflected from a designated trunk group route to a different trunk group route in the routing chain. The percentage level setting can be in the range of 1 to 100 percent.

A maximum of 256 reroute numbers may be constructed in data table REROUTE. Each reroute number can, in-turn, point (through subtable NWMRROUT) to a maximum of 16 combinations of routes and control percentage level settings. Only one of these combinations can be active at



any one time. Multiple re-routes can exist on different trunk groups simultaneously.

The initial datafill and any subsequent changes that may be required for the above two tables is a DMO function performed using the table editor. The network manager can temporarily override the percentage default value set in subtable NWMRROUT by invoking the appropriate NWM command.

### **Flexible reroute**

The flexible reroute control is a percentage based reroute which may be activated at the MAP. It may have single or multiple vias. Up to sixteen reroute controls with up to seven multiple vias are allowed. Flexible re-routes are counted against the number of manual trunk group controls allowed in the switch at any one time. Five options are supported in the Flexible Reroute command:

- 1 regular/immediate reroute
- 2 direct routed/alternate routed traffic
- 3 hard to reach traffic/all traffic
- 4 equal access traffic/non-equal access traffic/all traffic
- 5 cancel in chain return

### **Automatic out-of-chain reroute (AOCR) (DMS-200)**

The AOCR feature provides extended routing of calls that overflow their in-chain finals. This extended routing is allowed only if idle capacity exists in the potential out-of-chain route. This feature activates a specified reroute if the overflow rate on a given trunk group exceeds a threshold while the overflow rate on the second group does not exceed another threshold.

A maximum of 64 AOCR can be set up in data table NWMAOCR. If any other type of NWM control is on a group, AOCR is not applied. If any other auto control is already on, it is overridden by AOCR.

### **Dynamic overload control (DOC)**

There are two types of DOCs provided in the DMS-100 Family: internal and DOC. The application of controls in response to an external signal is Remote DOC, while the generation of signals because of an internally detected overload is known as internal DOC. Remote DOC is also known as Pre-planned (PPLN) Controls in the DMS-100 Family.

**Internal dynamic overload control (IDOC)** The purpose of IDOC is to reduce the load offered to the controlling office by requesting selected subtending or contiguous offices to implement a pre-defined set of routing controls. IDOC is a signal that is generated and transmitted by the controlling office in response to internally detected overload indicators.

When the controlling DMS-100 Family determines that it is approaching a state of congestion such as, overload, it transmits a continuous control signal to its selected office(s). To initiate this control signal, a Signal Distributor (SD) point is enabled. The SD point is extended to facilities to the appropriate office(s). If CCIS is available in the office the appropriate CCIS Selective Dynamic Overload Control (SDOC) message will be sent to the STP.

The controlling DMS-100 Family switching system has the ability to apply three IDOC signal level filters. The thresholds of the signal levels and the period of their application are controlled by entries in the IDOC data tables (NWMIDOC and NWMSD). The level (1-3) is selected by an entry in field IDOCLEV of table NWMIDOC.

Level one is applied when the number of incoming Multifrequency (MF) calls waiting for a receiver exceeds the On-Threshold (ONTHLD) value for ONFILTER time, as set in table NWMIDOC. This level is deactivated if it is less than the value set for Off-Threshold (OFFTHLD) (less than ONTHLD) for OFFFILTER time, as set in table NWMIDOC. The decision to apply or remove the IDOC level is made every minute.

Level two is applied independently of IDOC level 1 and is active if the percentage of time devoted to call processing by the CPU of the DMS-100 Family switch is greater than ONTHLD for ONFILTER time. This level is deactivated when the call-processing CPU usage is less than OFFTHLD for OFFFILTER time. The decision to apply or remove IDOC level 2 is made every minute.

Level three is applied when the system has lost call-processing capability.

The SD points which transmit control signals reflecting the status of the IDOC levels are assigned by entries in table NWMSD. Some SD points are wired to the status board lamp assembly, which then provides indicators of the length of the MF receiver waiting queue, and CPU occupancy.

### **Pre-planned number control (PPLN)**

The PPLN feature applies remote DOC in response to an external signal from another office. This feature consists of preplanned controls that are activated by either scan points, reception of SDOC CCIS messages or through the NWM VDU.

Scan points may be activated by external ground, loop, or battery. In each case the external resistance must be less than 6980 ohms; battery required is 52 volts.

A maximum of 256 pre-plans can be remotely activated over 256 scan points. These values are set by office parameters NWMPPLN and NWMSC respectively. Each pre-plan can implement one of the seven trunk group controls over a series of trunk groups (maximum 32 trunk groups). The seven trunk group controls have an activation order:

- |   |      |                                   |
|---|------|-----------------------------------|
| 1 | IRR  | Immediate Reroute                 |
| 2 | DRE  | Directional Reservation Equipment |
| 3 | PRE  | Protective Reservation Equipment  |
| 4 | CANT | Cancel To                         |
| 5 | SKIP | Skip                              |
| 6 | STR  | Selective Trunk Reservation       |
| 7 | HUNT | (Regular Translations)            |
| 8 | RR   | Regular Reroute                   |
| 9 | CANF | Cancel From                       |

When a specific pre-plan is assigned to either DRE or PRE, up to 63 trunks may be reserved.

### **Selective incoming load control (SILC)**

SILC is a substitute for the IDOC control for connected offices that cannot or do not respond to IDOC signals (such as Equal Access [EA] interLATA carriers). When SILC controls are activated, selected incoming calls are blocked to reduce the amount of traffic that is accepted by the switch.

There are two thresholds for SILC controls similar to the thresholds for IDOC levels 1 and 2 (referred to as MC1 and MC2). Each threshold has two modes of call blocking, but only one mode may be used at a time:

- 1 Blocking by a preset percentage of incoming calls
- 2 Blocking by a preset gap between incoming calls (call gapping).

When incoming call gap control is used, a minimum time duration is guaranteed between calls that are accepted by the switch. All calls arriving before the gap has expired are blocked. When both SILC levels 1 and 2 are active, the level 2 control is used. The individual controls for level 1 and level 2 may be activated (enabled or disabled) for the whole NWM system through the auto and group control levels at the MAP.

When SILC is applied on specified trunk groups, there are two results:

- 1 The percentage setting randomly blocks a number of calls
- 2 The gap setting blocks all calls attempting to connect during the gapping time interval.

(Call gapping time interval can be set from 0 to 360 sec. in increments of one second for SILC level 1 or 2. The next level of call gapping time interval will be from 0 to 600 sec. in increments of 0.1 sec.).

When calls are blocked, there are three results:

- 1 Trunk states are temporarily set to lockout
- 2 The trunk sends a start dial signal wink
- 3 A 120 Impulse Per Minute (IPM) tone is sent on the trunk after the start dial signal.

The start dial signal prevents senders from being held in connecting offices. The 120 IPM tone warns the calling party that the call is not completed, which in turn results in less holding time on network resources during congestion and reduces the number of trunk troubles resulting from the blocked call.

### **Receiver attachment delay recorder (RADR)**

The RADR feature is not directly associated with any NWM control and is controlled by a data table. RADR is a process by which test calls originations are generated for the purpose of timing the interval period from the time of the original request for attachment to a MF receiver, to the actual time of connection.

The RADR feature records peg counts of the actual number of test calls, the number of test calls delayed more than three seconds (lower threshold) and the number of test calls delayed more than seven seconds (average threshold). These peg counts are provided in operational measurements system table RADR, and the thresholds are customer settable.

The data table (RADR) contains fields whose values can be set by the table editor to suit the measurement requirements. RADR threshold settings (lower or upper) can be set from 0 to 20 sec. in 1 sec. intervals.

### **Mass calling**

Mass calling is applied or removed using the NWM MAP. This control provides the network manager with a means of limiting the traffic offered to specific directory numbers whenever an excessive number of calls are routed to them (such as in a radio talk show or call-in contest) The mass calling number can be in the same, or in another switching system.

---

The DMS-100 Family System controls service to the mass calling number in two ways:

- 1 Code Blocking. Blocks a percentage of code point traffic on a called-digits basis. The percentage of blocking can be established by the operating company, and entered through the MAP (code control). Up to 256 code points can be specified. Peg counts are provided on a per-code point basis for calls which are blocked.
- 2 Selective Trunk Reservation. A specified number of trunks from an existing group are reserved for mass-calling. The reserved group of trunks serves as a separate group with its own routing chain for routing calls to mass-calling numbers only. Mass-calling numbers are assigned a unique NXX or NXX-X code. Standard trunk group measurements are taken on the new mass-calling group.

### **Line load control (LLC) (DMS-100)**

The Line Load Control (LLC) for DMS-100 is a separate feature which is not part of the NWM group of controls, but can be manually activated or deactivated from the MAP. The LLC feature is a means of limiting the amount of traffic handled by a DMS-100 Family office, by allowing only specially designated lines to originate calls. LLC has no effect on terminating calls.

All lines connected to a DMS-100 switch are designated, on service-order authority, as essential or non-essential by entries in the OPTLIST field of the LENLINES data table. The Essential Line (ELN) designation is available to: single party lines (1FR), coin lines (CCF, CSP, CDP), and two-party lines (2FR). When LLC is activated, only those lines designated as essential are allowed to originate calls.

A non-essential line is routed to lockout when it originates. Essential service protection provides service to non-essential lines while providing priority service to essential lines. When LLC is deactivated, all lines in the lockout state are returned to service.

### **Essential service protection (ESP) (DMS-100)**

When traffic reaches extreme levels, ESP guarantees a standard grade of service to lines marked as essential. It is controlled by a manual command from the MAP or equivalent. When ESP is not in effect, these lines will receive the same grade of service as all other lines. Once ESP has been put into effect, the system provides equitable service to all non-essential lines, with the maximum throughput possible. When ESP is enabled, essential lines are given preferred service. Originations from these lines will be handled before all others.

ESP can be queried to determine its status (on/off). The information printed will also identify the user performing the enable or disable operation.

### Toll network protection (TNP) (DMS-100)

Toll Network Protection (TNP) is a separate feature which is not part of the NWM group of controls but can be applied from the NWM MAP. The TNP feature, when applied, limits outgoing toll calls (operator assisted or direct dial) from lines which have been designated as Toll-Essential Service (TES). These lines must be assigned by service orders.

A line is designated as TES by an entry in the OPTLIST field of the LENLINES data table. All lines designated as TES must also be designated as an essential line (ELN), see Line Load Control. When TNP is activated by command from the MAP, only those lines designated TES are allowed access to the toll network, all other lines are denied.

### Network management displays

The status of the network is displayed on the screen of the MAP VDU and in levels, where the top-level display gives an overall picture of the whole network and the lower-level display reflects the status of the various NWM controls. The network manager can select a desired level by entering the appropriate command from the menu, and then telescope from the higher to lower levels.

#### Network management level display

The NWM level display is outlined in Figure 6-16. The first three lines of the VDU display provide a general view of the traffic-handling capability of the DMS-100 Family. This display appears at the top of the telescoping levels available to the network manager. The next lower line displays the variable information and is up-dated every minute to reflect the constantly changing traffic load, and controls applied or removed by the network manager. The individual display fields and ranges in values are as follows:

Display field	Ranges	Description
CTRL	G, C, R A, or . a, or .	G = Group Control(s) (Grpctrl) active C = Code Control(s) (Codectrl) active R = Route Control(s) (Rtctrl) active A = Automatic Control(s) (Autoctrl) active a = Automatic Control(s) disabled . = Inactive control
ITS	0-9999	Displays the number of incoming trunk seizures including "abandons" and "failures" that occurred in the last minute.
RADR	0-99%	Displays the percentage of test calls within the last minute whose delay time was greater than the lower RADR threshold value.

Display field	Ranges	Description					
CPU	0-99%	Displays the percentage of time within the last minute that the central processing unit was executing call-processing or higher priority tasks.					
INIT	Hours-0-23 Minutes 0-59	This field indicates the time of the last office re-initialization (warm or cold start, reload) when re-initialization has occurred within the last 30 minutes. If not then entry reads "00".					
IDOC	3, 2, 1 or .	This field indicates if IDOC is active or Inactive. Active 3, 2, or 1 = Level of IDOC Inactive = .					
FS	0-99	This field displays the number of final trunk groups in an overflow condition.					
	SCLLI	Short Common Language Location Identifier (CLLI) Adjacent to FS, this field displays the CLLI identities of up to six final trunk groups associated with FS. If more than six are in the overflow condition, the most recent are displayed.					
Ctrl	ITS	RADR	CPU	lnit	IDOC	CS	FS
GCR	XXXX	XX%	XX%	hh:mm	XXX	X	XX

**Figure 6-16**  
**NWM level display**

```
      NWM
0    Quit          /
1
2
3
4    Display____ /
5    ___Finals___ /
6    ___Groups___ /
7
8
9
10
11
12
13
14   Page         /
15   AutoCtrl    /
16   GrpCtrl     /
17   CodeCtrl   /
18   RteCtrl    /
      USER ID
      hh:mm
```

### Detailed network management levels

In each telescoping level of network management, different interactive responses are output by the system immediately after entering a menu command. From the top NWM level display, six menu levels can be accessed by the telescoping process:

- 1 Display Finals
- 2 Display Groups
- 3 Autoctrl
- 4 Grpctrl
- 5 Codectl
- 6 Rtectrl

**Display finals/groups** Display finals displays the traffic-related peg count and usage data and the group controls that are active for all final trunk groups in the office. Display groups display is similar to Display finals but the trunk groups are selected individually by the network manager.

Figure 6-17 outlines the top NWM level display finals trunk group data for finals and groups under the following headers.



---

<b>Display header</b>	<b>Description</b>
Ofrd	OFFERED. This field displays the peg count of those calls allowed access to the final trunk group. The peg count includes those calls deflected by network management.
Ovf	OVERFLOW. This field displays the peg count and percentage (%) of calls overflowing from trunk group. The percentage calculation does not include those calls deflected by NWM.
ACH	ATTEMPTS PER CIRCUIT PER HOUR. This field displays the outgoing call attempts per circuit per hour in the trunk group.
CCH	CONNECTIONS PER CIRCUIT PER HOUR. This field displays the number of outgoing connections per circuit per hour in a final trunk group.
ICCH	INCOMING CONNECTIONS PER CIRCUIT PER HOUR. This field display is similar to CCH but pegs the incoming connections.
CCS	HUNDRED CALL SECONDS PER HOUR. This field displays the traffic usage on a trunk group. Both incoming and outgoing usage is included.
Defl	DEFLECTED. This field displays the number of calls deflected from a trunk group by any of the following controls: DRE, .PRE, SKIP or CanT.
Ctrl	CONTROL. This field displays the identity of up to three controls which are active on a trunk group. Possible controls are DRE, PRE, Cant, CanF. An * asterisk following the third control identifier indicates that more than three controls are active.
SCLLI	SHORT COMMON LANGUAGE LOCATION IDENTIFIER. Displays the final or selected SCLLI such as, TORO1.
CLLI	FULL COMMON LANGUAGE LOCATION IDENTIFIER.

**Figure 6-17**  
**Display finals commands**

```

Ctrl      ITS   RADR  CPU   Init  IDOC Cs DCR  Fs   sclli1 sclli4
GCRA      XXXX  XX%   XX%   hh.mm XXX  X  XXXX XX  sclli2 sclli5
                                                sclli3 sclli6

NWM      Display Groups RALNC030214
0  Quit_  /Finals
2      /SCLLI CLLI      Ofrd  Ovfl      ACH  CCH  ICCH  CCS  Defl
3      /RAL214 RALNC030214 234   40   17%   35   28   20   135  17
4  Display_ /      Ctrls:
5  _Finals_ /
6  _Groups_ /
7      /
8      /
9      /
10 DCRMOCH_ /
11      /
12      /
13 IntCCtrl /
14 Page    /
15 AutoCtrl /
16 GrpCtrl /
17 CodeCtrl /
18 RteCtrl /

Note: IntCCtrl (menu item 13) is present in DMS-200 or DMS-300 offices only.

```

**Auto controls** The auto control level is accessed from the top NWM level by the input command Autoctrl. Figure 6-18 outlines the NWM AutoCtrl level display. It displays the automatic controls that are active or disabled. The types of automatic controls available are:

- IDOC Internal Dynamic Overload Control (1-3)
- PPLN Preplan Number Control (0-255)
- AOCC Automatic Out-of-Chain Reroutes (0-63)
- SILC Selective Incoming Load Control (level 1 or 2)
- SDOC Selective Dynamic Overload Control (1-3)

**Figure 6-18**  
**AUTOCTRL menu and example display**

```

Ctrl  ITS   RADR   CPU   Init   IDOC   Cs DCR   Fs   sclli1  sclli4
GCRA  XXXX   XX%   XX%  hh.mm  XXX   X  XXXX  XX   sclli2  sclli5
                                           sclli3  sclli6

      AutoCtrl      AutoCtrl
0  Quit_           /
2
3           /      Active      321      0      0      0
4  List_           /      Disabled  31      0      0      0
5  Apply_          /
6  Remove_         /
7  Disable_        /      AUTOCTRL:
8  Enable_         /
9  _IDOC_          /
10 _PPln_          /
11 _AOCR_          /
12
13 _SDOC_          /
14 Page           /
15
16
17
18

```

**Group controls** The group controls level is accessed from the top NWM level by the input command GrpCtrl. The commands in this menu enable the network manager to list, apply, or remove any of the group controls on selected trunk groups.

Figure 6-19 outlines the NWM Grpctrl level display. Group controls are available in the DMS-100 Family:

- DRE
- PRE
- CanT
- Skip
- CanF
- STR
- ITB
- SILC
- TASI (DMS-300)

Group controls can be applied to any trunk group as required by the network manager by telescoping to the appropriate control menu. Once a group control has been activated, it is displayed on NWM level display.

**Figure 6-19**  
**GRPCTRL menu and example display**

```

Ctrl  ITS      RADR      CPU  Init  IDOC  Cs  DCR  Fs  sclli1 sclli4
GCRA  XXXX     XX%      XX%  hh.mm XXX  X  XXXX  XX  sclli2 sclli5
                                           sclli3 sclli6

      GrpCtrl      GrpCtrl      Selected Group: RAL214  RALNC030214  IC
0  Quit      /      DRE PRE  CanT CanF Skip ITB  STR  FRR  TASI
2      /      32 25   11 17  9  7  41  0  70
3      /
4  List_    /      GRPCTRL:
5  Apply_   /
6  Remove_  /
7  _DRE_    /
8  _PRE_    /
9  _CANT_   /
10 _CANF_   /
11 _SKIP_   /
12 _ITB_    /
13 _STR_    /
14 _FRR_    /
15 _TASI_   /
16 Page     /
17 Select_  /
18          /

```

**Note:** TASI (menu item 15) is activated only on a DMS-300 with feature package NTX308AA. Similarly, the heading TASI appears only on a DMS-300 switch; the value represents the number of active controls. DMS-300 has TASI instead of STR.

**Code control** The code control level is accessed from the top NWM level by the input command CodeCtrl. The commands in this menu enable the network manager to list, apply, or remove any of the code controls.

Figure 6-20 outlines the NWM codectl level. Three code controls are provided in DMS-100 Family:

- 1 Code Block (CBK . . . )
- 2 Preroute Peg (PRP . . . )
- 3 Hard To Reach Flag (HTRF . . . )

There are four types of code control:

- 1 Country Code (CC)
- 2 Area Code (AC)
- 3 Non-Area Code (NAC)
- 4 Prefix (PFX)

Code controls can be applied to any of the above codes as required by the network manager by telescoping to the appropriate code menu. Once a code control has been activated, it can be displayed on the NWM level display.

**Figure 6-20**  
**CODECTRL menu and display with header definitions**

```

Ctrl  ITS    RADR    CPU  Init    IDOC Cs  DCR  Fs  sclli1  sclli4
GCRA  XXXX    XX%    XX%  hh.mm   XXX  X   XXX  XX  sclli2  sclli5
                                           sclli3  sclli6

CodeCtrl          CodeCtrl
0 Quit_          /          CBkC  CBkA  CBkN  CBkP  PRPC  PRPA  PRPN  PRPP
2                /          25   12   65   10   8    15   20   10
3                /
4 List_          /
5 Apply_         /
6 Remove_       /          HTRFC  HTRFA  HTRFN  HTRFP
7 _CBk_         /          2     7     20    10
8 _PRP_         /
9 _HTRF_        /
10 _PCT_        /          CODECTRL:
11 _GAP_        /
12 _CCODE_      /
13 _ACODE_      /
14 _NAC_        /
15 Page         /
16              /
17 _PFX_        /
18              /

```

**Note 1:** The suffixes of the header CodeCtrl represent:

C Country Code (CCODE)

- A Area Core (ACODE)
- N Non-Area Code (NAC)
- P Prefix Code (PFX).

**Note 2:** PFX (menu item 17) and the headers with suffix P are present only for EA offices with NTX060BA.

**Note 3:** The sum of the field values for CBK and PRP:

$$CBK + PRP = 256 \text{ maximum}$$

**Route control** The route control level is accessed from the NWM level by the input command "RteCtrl." This command displays the data concerning the reroutes which are currently active. Figure 6-21 outlines the "RteCtrl" level.

**Figure 6-21**  
RTECTRL menu and display

```

Ctrl  ITS      RADR CPU   Init  IDOC  Cs DCR Fs   sclli1 sclli4
GCRA  XXXX      XX% XX%   hh.mm XXX  X  XXXX XX sclli2 sclli5
                                           sclli3 sclli6

    RteCtrl          RteCtrl
0  Quit_            /      Rrte
2                               /      nnnn
3                               /
4  List_            /      RTECTRL:
5  Apply_           /
6  Remove_          /
7  _Rrte_           /
8                               /
9                               /
10                              /
11                              /
12                              /
13                              /
14  Page            /
15                              /
16                              /
17                              /
18                              /
    
```

## Administration of manual controls

The DMS-100 Family provides the capability of accepting manual control inputs from the network management personnel through the MAP designated for this function either locally or remotely.

### Activation of manual controls

In the DMS-100 Family, when any network management control has to be implemented, the appropriate NWM level is entered by means of the telescoping process. Once the appropriate level has been entered, the relevant information regarding the control has to be input such as, trunk group CLLI, control type, code type, or announcement type.

When the control information has been input, the control is activated and the MAP displays the appropriate control. Typical displays provided for various control types are outlined in Figures 6-18, 6-19, 6-20, and 6-21. In addition to the MAP display, any control activated or deactivated is reported by system log (hardcopy) report provided to the network manager.

In each telescoping level of the NWM MAP position, the system responses are output by the system immediately after entering a menu command. These responses indicate, in text format, either the acceptance or rejection of the input command. The following is a typical input required for the Autoctrl control level (see 297-1001-453).

### Autoctrl Level:

The commands in this menu enable the network manager to apply automatic controls manually.

The APPLY command format:

```
APPLY    ctrl    index [fsccli]
```

where:

ctrl = Type of Automatic Control.

IDOC – Internal Dynamic Overload Control

PPLN – Preplan Number Control

AOCR – Automatic Out-of-Chain Reroute

SILC – Selective Incoming Load Control

SDOC – Selective Dynamic Overload Control

index = Index to type of Automatic Control

IDOC – 1-3

PPLN – 0-255

AOCR – 0-63

SILC – Level 1022

SDOC – 1-3

*Note:* The brackets [ ] indicate that the enclosed parameters are optional.

### Compound control deactivation

The DMS-100 Family provides the network manager the capability of deactivating all presently activated manual controls. All controls are deactivated by the command, "REMOVE." Typical examples for various controls are:

- Code Control – The REMOVE command removes the specified control and parameter from the specific code or from ALL codes of the specified code type. The REMOVE command format for code control is:

```
REMOVE ctrl blocktype type [code [snpa/sts  
ALL] ALL]
```

where:

ctrl = CBK (Code Blocking), HTRF, PRP

blocktype = PCT or GAP (for CBK only)

type = CC, AC, NAC, or PFX

code = 1 to 15 digits

ALL = All codes specified by ctrl

snpa/sts = Serving NPA code

ALL = All snpa/sts specified by ctrl

*Note:* The brackets [ ] indicate that the enclosed parameters are optional.

- Group Control – The REMOVE command removes the specified control from all trunk groups or if ALL is not entered, from the trunk group selected for the control. The REMOVE command format for group control is:



REMOVE                  ctrl                  ALL

where:

ctrl =                  type of group control, DRE, PRE, CanT, CanF, Skip, ITB, STR, or SILC.

- Route Control – The REMOVE command removes the active route control defined by the parameter RrtNo, or all active reroute numbers. Any controls that have been deactivated are no longer displayed on the NWM MAP. Also this is logged in the log system and an output report provided. The REMOVE command format for route control is:

REMOVE      rrte      [rrt no  
   ALL]

**Note:** The brackets [ ] indicate that the enclosed parameters are optional.

### Enable and disable commands

In addition to the APPLY and REMOVE commands, ENABLE and DISABLE may also be used only at AUTOCTRL. There are two command formats:

ENABLE                  cntrl                  Index [fsccli]  
   ALL

DISABLE                  cntrl                  Index [fsccli]  
   ALL

ENABLE allows the DMS-100 to automatically activate/deactivate the control.

DISABLE prevents the DMS-100 from automatically activating/deactivating the control. The control can still be manually activated/deactivated.

### Limits in number of manually controlled groups

DMS-100 Family provides the capability of implementing manual controls simultaneously on all the existing trunk groups in the office. Certain controls are limited, SILC activated on only 256 trunk groups, and automatic out-of-chain routing is restricted to 64 groups.

### Derivation of control percentages

In the DMS-100 Family, when a percentage of traffic has to be blocked or re-routed by the various controls, it is entered as an input parameter for the required control. The percentage level provided in DMS-100 Family ranges from one to 100 in steps of 1 percent.

### Traffic counts

In the DMS-100 Family, certain OM tables are of particular interest to the network manager. Summary reports of these measurements can be directed to a network management output device (usually a teleprinter) at intervals scheduled by the network management personnel on an auto (normally 15 or 30 min. or optionally at 5, 10, 15, 20 or 30 min.), half hourly, hourly, daily, weekly or monthly basis.

These are some of the reports provided for network management in the operational measurements:

- Code Blocking Reports (CBK)
- Reroute Report (RRTE)
- Receiver Attachment Delay Report (RADR)
- Preroute Peg Count Reports (PRP)
- Trunk group report (TRK)

The following example details the information provided by the CBK OM table.

Field name	Description	Register provision
CBKKEY	Key to the Code Block Table code type: AC for Area Code CC for Country Code NAC for Non-Area Code PFX for PREFIX  Digit – register: The code to block serving number plan area	1 per Code
CBKLVL	Information Field. The code blocking level in percent.	1 per Code
CBKANN	Information Field. The announcement or tone to which calls may be rerouted.	1 per Code
CBKCNT	Peg count of the number of calls blocked by the control	1 per Code

### Status output

The network manager can list the various controls implemented in the DMS-100 Family. The information is a typical display on the network management MAP for the various controls (see 297-1001-453.)

### Grpctrl Level

The LIST command displays a list of trunk groups which have the specified control in effect on them.



where: LLC ON = locks out all lines which have not been designated as essential (ELN) in the OPTLIST field of table LENLINES.

If LLC ON is entered twice, the second entry has no effect.

A log message \*\*\* LLC100 is originated when LLC ON is entered, and a critical alarm is set.

where: LLC OFF = restores originating service to non-essential lines previously locked out by LLC ON, and originates log message LLC101, indicating that LLC is deactivated. The critical alarm is replaced by a no-alarm condition.

### **Toll network protection (TNP) MMI (DMS-100)**

TNP features are applied or removed by a non-menu command. The TNP command format is:

TNP            ON  
                 OFF

where: TNP ON = denies access to the toll network to all lines which have not been designated as Toll Essential Service (TES) and ELN in the OPTLIST field of table LENLINES.

TNP ON generates a log message \*\*\*EXT108 with alarm name ON, and sets a critical EXT alarm.

where: TNP OFF = restores access to those lines previously denied access by TNP ON. Another log message EXT108 with alarm name OFF is generated, and the critical alarm is retired.

The following responses to TNP commands appear on the MAP:

<b>Command</b>	<b>Response</b>
TNP ON	“OK”
TNP OFF	“OK”
TNP	“TOLL NETWORK PROTECTION IS ON” or “TOLL NETWORK PROTECTION IS OFF”
Q TNP	Displays the syntax of the TNP command

---

## Database management

The database management in DMS-100 Family provides the tools and capabilities which enable the user to modify office data resident in memory. The following defines the various database management and administration features available in the DMS-100 Family switching system.

### Memory alteration

The DMS-100 Family incorporates a flexible and efficient means of altering the contents of memory (program parameters and office data update).

### Office data modification

Office data modification may be used to add, change, or delete routine related office data, office parameters and trunk data in local and remote locations. In the DMS-100 Family system, office data updates are termed as DMOs. MDC customers can have the capability to modify LENSs, DNSs, or features assigned to lines in their customer group only by the use of the customer station rearrangement feature.

**TTY/(VDU) entry for immediate activation** The data modification facility permits fast and accurate input of DMOs and provides readily understandable machine output. All data modification programs are resident in DMS-100 Family systems, and as such, no special procedures need be followed for loading or execution.

The data modification system is data table oriented. The Table Editor (TE) provides a number of table oriented commands for use by maintenance and administrative personnel in executing DMOs.

DMOs are entered by typing in table editor commands and the associated parameters using the keyboard of a teleprinter or VDU, which may be a designated MAP or a dedicated DMO I/O terminal. The MAP may be located either locally or remotely.

Extensive use is made of validity and error checks and system safeguards to avoid functional input errors which may cause a loss of or translation data integrity. Failure to pass the checks will abort the order (command) and output an error message to the operator. This error message is in sufficient detail to identify clearly the reason for failure. Diagnostic messages and/or related data are output on the TTY or VDU screen.

### TTY/VDU entry in pending order file (POF) for delayed activation

DMOs may be activated immediately or placed in a Pending Order File (POF) in the DMS data store for activation at a later time.

The pending order file has four capabilities:

- 1 Manual request of the pending order file dump (such as, listing by total file, due date, or unique identifier).
- 2 Automatic reminder output message of pending orders prior to the due date.
- 3 Manual activation (by either total file, due date or unique identifier).
- 4 Orders may be activated singly or collectively.

If delayed activation is desired, the DMO input process has three information requirements:

- 1 The due date is the day at which those DMOs in the POF should be executed.
- 2 A unique identifier provides a means of labeling DMOs in each POF.
- 3 The prompt period provides the user the means to have an automatic message generated of POF identifiers any number of days prior to the due date. In this way all identifiers (and thus the associated DMO) can be checked prior to activation. While in the pending order file, DMOs may be queried, changed or deleted.

**Batch data modification** DMS-100 Family systems are able to accept DMOs presented through an input file. This feature may be used for any number of DMOs and permits the rapid loading of changes into the machine. Data changes can be submitted to NTI, which will in turn produce a data file on a magnetic tape. The operating company can also create their own data files with either the system file editor or the table editor. These data files can be verified before activation and reside on any device.

### **Memory reload**

It is possible to reload the system's memory completely and rapidly using both local and remote controls utilizing automatic and manual recovery, by use of bootstrapping. See Chapter 2 for bootstrap loader description.

### **Teletypewriter (TTY) input/output**

The MAP provides an interface between the maintenance personnel and DMS-100 Family systems. The tasks performed at the MAP include general maintenance functions (error detection and diagnosis), administration functions (network management, customer data modification, and so forth), and trunk and line testing functions. The basic components of the MAP include a VDU, with keyboard, a voice communication module, testing facilities and position furniture.

Printers and TTYs are used in conjunction with the VDU for maintenance, traffic counts, service orders, and trunk testing. Hard copies of critical status indicators and plant and traffic data are available from the TTYs whenever requested. The VDUs and TTYs can be located locally or remotely as per

operating company requirements. See Chapter 7 for MAP, and Chapter 9 for compatible units.

### **Automatic traffic and engineering measurements**

See Operational measurement for operational measurements.

### **Division of revenue peg counts**

See Traffic separation measuring system.

### **Memory verification**

In DMS-100 Family systems, Data Store (DS) is divided into protected store and unprotected store. The protected store contains critical system data (such as, addresses of procedures in program store or constants), office data (hardware configuration) and all the translation data. The unprotected memory or store contains transient data or per-call type information. The transient or per-call data includes items such as called number or channel numbers, which are removed from store once the call is finished.

The DMS-100 Family switching system can make an on-line comparison of all the data stored in protected memory with a backup magnetic tape. If any mismatches between the backup tape and memory occur, the addresses and contents of memory at those addresses are printed out on an input/output device. The system has an input message capability to print out on an input/output device all the protected memory addresses and contents of memory stored at those addresses.

### **Routing of output messages**

Output messages in DMS-100 Family systems can be dedicated to an output terminal, assignable by the operating company with a backup terminal in case the primary terminal fails. Also, all output messages in response to an input message are output on the terminal that the input message was entered on.

### **Trunks out-of-service for data changes**

The DMS-100 Family system software checks that the corresponding trunks are busied out before accepting data changes affecting trunk operation. If they are not, the data modification command will be rejected by the system.

### **Database facilities and structures**

The database software provides six facilities for defining, accessing, and modifying system data:

- 1 **Table Editor:** The table editor facility provides a man-machine interface to system data.

- 2 **Dump/Restore:** This is a process carried out by Nortel Networks when an office is to receive new software. It entails dumping a copy of the office data to tape, dropping sync, loading the inactive side with the new software and then using the batch DMO methods to restore the data tables on the inactive side. Activity is then switched and the machine is then running on the new software.
- 3 **Pending Order File:** The Pending Order File (POF) provides facilities for storing data modification orders and for retrieving them at a specified time for execution.
- 4 **Journal File:** The Journal File (JF) provides facilities for recording DMO on tape or disk so that data tables can be restored if the switch should fail and require a system reload.
- 5 Operating company personnel are allowed access to commands and tables at the MAP being used.
- 6 MDC customers can be allowed access for modification of data associated with their customer group through customer station rearrangement or customer network change features.

### **Table editor (TE)**

The DMS-100 Family table editor consists of a set of commands which enable the user to modify existing office data tables. The table editor commands are entered by typing in commands using the keyboard of a teleprinter or a VDU. The results of the commands are displayed on the TPR or the VDU screen.

The table editor can work with the Command Interpreter (CI) process to facilitate the modification of system data. Certain commands in the table editor are designed specially for parameter substitution in table editor "execs." (see 297-1001-310.)

The POF facility is an integral part of the table editor providing a facility for storing (within the CPU memory) table editor commands as files. These files are manually activated on an individual or collective basis. The contents of any of these files may be queried, changed, or deleted by the system file editor (see 297-1001-126).

An extension of the table editor is provided with DMS-100 systems (local) only. The extension provides a set of capabilities for database changes related to subscriber lines called service orders (see 297-2101-310.)

### **Table editor functions**

The table editor commands allow the user to perform the following functions:

- add, delete or change tuples or fields within a table or subtable
- list one or more tuples of a table or subtable



- move the cursor to display any tuple within a table or subtable
- display specified valid field values
- search for tuples containing specified field value
- verify table alterations before activating them
- modify subtables of the table being edited. Figure 6-22 shows the relationship between the table and a typical subtable. The subtable is accessed by addressing a field which contains a subtable pointer instead of data.
- ability to create pending files from within the table editor
- display the number of tuples used in a table
- ability to alter data when the CPUs are out of synchronization

### **Data table structure**

The data associated with the hardware and software subsystems of DMS-100 Family Switches are stored in tables. A table consists of rows (horizontal) and columns (vertical). The rows are referred to as tuples and the columns identify fields of tuples.

Figure 6-22 shows the structure of a typical table, containing 1 through N tuples and 1 through N fields. The fields in a table (or subtable) have five properties:

- 1 Each field has a unique identifier called a field name or field number, by which the field may be accessed.
- 2 Each field name consists of a maximum eight-character string.
- 3 Each field name has an associated field number. Field names are numbered consecutively, beginning with 1 for as many field names as there are in a tuple.
- 4 The contents of a field may contain one or more elements of data.
- 5 The contents of a field may contain data expressed in the form of numerics or alpha-numeric strings. It may also contain pointers to subtables.



**Input prompter**

The prompter in table editor has two input modes: prompting and non-prompting.

**Prompting mode**

- The name of the required field or parameter is displayed.
- The user must then input syntactically correct data for the field entirely on the current line.
- If the input data was not correct, an error message is printed and the field or parameter must be re-entered
- After two syntax errors on the same field, the valid syntax range is displayed.
- While in the prompt mode, the user may enter “ABORT” which has the effect of killing the command.

**Non-prompting mode** All commands are initially in the non-prompting mode. The required parameters are presumed to be on the current line. The system processes one parameter at a time until it either runs out of input or encounters an input error. At that time, the system goes into the prompt mode looking for the missing or invalid parameter. Any input line in either mode can be continued to the next line by placing a “+” at the end of the line.

**Description of table editor commands**

The table editor commands consist of two or more alphabetic characters followed, in most cases, by parameters. When the table editor is ready to accept a command, it displays the prompt character at the start of a new line on the terminal.

There are three basic categories of commands in the table editor: primitive, conditional, and compound. The commands covered in each category are shown in Table 6-11.

Primitive commands such as LIST, ADD, DELETE, TOP, and BOTTOM, are the basic commands used to manipulate the tables.

Conditional commands are used as field value test and logical commands as follows.

**Table 6-11**  
**Table editor commands**

Primitives	ABORT DELeTe FORMAT LAST PREV RETurn VERIFY	ADD DISPLAY HEADING LOCate QUIT SUBtable	ASSIGN EXTend HELP NEXT TABLE	CHANGE FIRST INFORM OVerride REPlace
Conditional	AND LE	EQ LT	GE NE	GT OR
Compound	BOTtom POSition	COUNT RANge	DOWn TOP	LIST UP
Pending Subsystem	ENDpof	POF	PUTpof	

Commands for testing field values:

```

field_name      condition field_value
                or
field_number    condition field_value

```

Commands of this form apply the specified condition to the field against the field value and return a Boolean indicating the result of the comparison:

- EQ (equality) – all field types
- NE (not equal) – all field types
- GT (greater than) – numeric
- GE (greater or equal) – numeric
- LT (less than) – numeric
- LE (less than or equal) – numeric

Logical Commands:

```
Boolean_result logop Boolean_result
```

These commands apply the indicated logical operation (logop) to their left and right parameters and return a Boolean indicating the logical result:

```

AND
OR

```

Compound commands are primitives which can optionally have a conditional second part, such as, list all (FIELD 2 EQ “XXX”). For further details see NTP 297-1001-310.

**Service orders (DMS-100 local only)**

Service order activity is necessary whenever subscribers, service features, and options are added or deleted. This section describes how the applicable information is entered into the DMS-100 system. Further details are in 297-2101-310. MDC customers can be allowed access to change data associated with lines in their customer group.

The line data query system is used to determine the status, working or unassigned, of directory numbers and line equipment numbers associated with lines. This information can be used in the preparation of service orders. Service order and query data consists of numerical data and mnemonics based on English-language telephony terms. Failure to pass internal validity checks results in the output of concise English-language error messages.

The service order and query subsystem comprises a set of executive DMO routines designed to permit fast and accurate manipulation of customer data. Knowledge of the DMS-100 data table structure and table editor commands is not a prerequisite for user.

Service orders and query commands are entered into DMS-100 by typing in mnemonics and numerical data using the keyboard of a teleprinter or visual display unit which may be part of a designated MAP or a dedicated DMO I/O terminal. The mnemonics used with service orders and query commands are either standard English-language telephony terms or their derivations and abbreviations.

Full validity checks are performed by the DMS-100 for service order data entered. Failure to pass these checks results in rejection of the data and the output of concise English-language error messages designed to clearly identify the cause(s) for rejection.

An error made while typing in data may be corrected by backspacing to the point where the error was made, using the delete or rub-out key, and entering the correct data. Following completion of a service order input, a display of the entire service order as entered permits human verification of data accuracy and completeness before final activation.

**Service order input commands** The type of service order or query is identified to DMS-100, by the first input command. The remainder of the service order data may be entered together with the input command as a string of data (no-prompt mode). Some of the service order input commands are summarized in Table 6-12.

<b>Table 6-12 Service order commands</b>		
<b>Command</b>	<b>Usage</b>	<b>Applicable to</b>
NEW	Establish service	Individual (non-hunt) line and establishes services for party lines P-Phone & Data Unit
OUT	Remove service	Individual line pilot of hunt group P-Phone & Data Unit
ADO	Add options to lines or add existing lines to a DNH group. Add features to P-Phone keys	Individual line DNH group member Pilot of hunt group P-Phones
DEO	Delete options from lines.	Individual line DNH group member Pilot of hunt group
	Delete features from P-Phone keys	P-Phones
EST	Establish a hunt group	Hunt group with members having common options
ADD	Add line(s) to a hunt group	Hunt group members
DEL	Delete line(s) from a hunt group	Hunt group members except pilot
ABNN	Add bridged night number(s)	Hunt group members
DBNN	Delete bridged night number(s)	Hunt group members
BULK	Verify or update (execute) from a batch of service orders in bulk	All service order types
DEOH	Delete options	MLH/DLH group members
SUS	Suspend service	Individual line Pilot (to suspend hunt group)
RES	Restore service (from suspension or plug-up)	Individual line Pilot (to restore hunt group)
PLP	Plug-up (place on trouble intercept)	Individual line Pilot of hunt group DNH group member
CDN	Change directory number	All DNs of a hunt group except the pilot DNs
CLN	Change line equipment number	All lines except party lines
CICP	Change intercept type	All unassigned DNs
—continued—		

<b>Table 6-12</b> <b>Service order commands</b> (continued)		
<b>Command</b>	<b>Usage</b>	<b>Applicable to</b>
QDN	Query Directory Number	Queries all information about hardware and software associated with a directory number
QLEN	Query Line Equipment Number	Obtains a printout of line data related to a specific line equipment number (LEN)
<b>End</b>		

**Service order format** Service order commands have a basic format:

- **A Command Identifier:** a service order command name
- **A Service Order Number:** a unique identifier for the service order to be entered. This is used for pending orders. The default value with no time stamp causes immediate activation.
- **A Set of Parameters:** the parameters required depend on the initial service order command and, for a given parameter, the response given to the immediately preceding parameter.
- **An Order Terminator:** usually a Carriage Return (CR) is required to indicate the service order is complete after all required parameters have been entered.
- **Statement of the Order Entered:** the system prints out a statement of the order it has received and requests confirmation that the entry is to be made, rejected, or edited.
- **Confirmation of Order:** a “Y” is entered to indicate to the system that the service order as entered is to be processed.
- **Error Statement:** if the system detects errors in the commands entered, such as incompatibility between parameters, the order is rejected and the reason for rejection is printed out. The user can edit or reject the entry.

#### **General rules for service orders**

- **Identification and Mode of Entry:** The type of service order or query is identified to the system by the command identifier. From this point, the remainder of the order can be entered in either the prompt mode or the no-prompt mode.
- **Prompt Mode:** In the prompt mode, the service order or query is entered item by item, following requests by the system.
- **No-Prompt Mode:** In the no-prompt mode, the service order or query is entered as a string of data immediately following the service order input command, each item separated by spaces.

- **Correction of Errors:** An error made while entering data can be corrected by backspacing to the point where the error was made, or using the delete or rub-out key and entering the correct data.
- **Dummy Character:** The \$ character is used to indicate the end of a list at any point in a service order entry, or when no entry is applicable. In the no-prompt mode, the \$ character is used to request the system to use a default value for a command parameter.
- **Continuation Character:** In the no-prompt mode, if there is insufficient space to complete an order in one line, a + character preceded by a space and followed by a carriage return is used to close off the line and the remaining data is entered on the next line.
- **Maximum Number of Characters:** In the no-prompt mode, the maximum input is 500 characters including spaces. If the 500-character limit is reached before a service order is completely entered, the system reverts to the prompt mode for entry of the remaining data.
- **Error in No-prompt Entry:** In the no-prompt mode, if a required entry is omitted or not entered in the proper order, or erroneous data is entered, the system reverts to the prompt mode, starting from the last correct entry.
- **Emergency Entry of Orders:** Service orders are normally entered when the two CPUs are operating in a synchronous mode. If the system is operating without the two CPUs in synchronism, the user is advised by a printout before the system accepts the order. In this case the user has the choice to abandon (enter character N) or proceed (enter character Y).

**Entering service orders** To enter the service order environment, the user must enter the SERVORD command. The SERVORD command may be input from any level (CI, table editor, or MAP).

To determine the parameters required for a service order command, a user can enter a Q character followed by a space, followed by the command concerned. The system prints out the parameters required.

All parameters are printed out as prompts when SO are entered in the prompt mode. If the range of entries for a specific prompt is not known, the entering an erroneous value twice will cause the correct range of values for that parameter to be displayed. The user can then select one of the correct values, enter it and then carry on to the next parameter.

If a service order is entered without a SONUMBER, that is, the internal default value is used, it can be accepted by the system for immediate activation. If the due date portion of the SONUMBER is later than the current system clock date, the service order is entered into the pending order file for activation at a later date.



**No-prompt mode service order** If all parameters and their entry sequence for a service order are known, a user simply logs on at a valid service order input device, enters the applicable service order command, a space, a \$ character or a SO number and due date, a space, all parameters in sequence and separated by spaces, and closes the entry with a CR. The \$ character must be used to indicate the ends of lists within an order, for example, to indicate all options have been entered.

When the carriage return is entered to indicate the completion of the order, the system prints out the order as entered and requests confirmation, rejection, or edit. If a Y is entered to indicate confirmation, the system either processes the order or rejects it and prints out the reason(s) for rejection, for example, incompatibility between options entered.

**Prompt mode service order** To enter a service order in the prompt mode, a user needs to know only the values of all parameters. The procedure then is to log on at a valid input device and enter a valid service order command followed by a carriage return; the system then prompts for the next input. If errors are made by entering invalid parameters, the system prompts for the correct information. The entry is terminated with a CR.

If a carriage return is entered in response to the SONUMBER prompt, the system uses a default value for SONUMBER which includes the current date as due date.

**Emergency activation** Service orders are normally entered when the two central processing units are running in a synchronous mode. If it becomes absolutely necessary to enter a service order when the central control is operating with a single CPU, operating company personnel can override the system restriction and emergency-activate the service order. Customer data entered during CPU transitions should be verified by query commands when synchronous operation has been re-established.

**Pending order file (POF)** If the due date entered as part of the SONUMBER is a future date, the service order is automatically entered into a POF.

**Journal file (JF)** When the (optional) DMS-100 Family JF is provided, a copy of each service order or DMO can be stored in the JF (on disk or tape) whenever the service order or DMO is successfully activated.

**Service order example** New 1FR Service with options establish individual line, flat rate service with DIGITONE dialing. The line is part of line treatment group one. The directory number is 362-1495 and the line equipment number is 0000231. The office has no service order echoing facilities at the MDF.

- Input in prompt mode

```
NEW
SONUMBER:   NOW 85 8 7 AM
DN:
3621495
LCC:
1FR
LATANAME:
NILLATA
LTG:
1
LEN:
HOST 00 0 02 31
OPTION:
DGT
OPTION:
$
COMMAND AS ENTERED
NEW NOW 85 8 7 AM 3621495 1FR NILLATA 1 HOST 00 0 02 31 ( DGT ) $
```

- Input in no-prompt mode

```
NEW $ 3621495 1FR NILLATA 1 00 0 02 31 DGT $
COMMAND AS ENTERED:
NEW NOW 85 8 7 AM 3621495 1FR NILLATA 1 HOST 00 0 02 31 ( DGT ) $
```

**Customer data change (CDC)** The CDC feature permits DMS-100 business services customers to access and modify their own office data from Nortel Networks approved ASCII terminals on a dial-up basis. Full DMS-100 Maintenance and Administration Positions (MAPs) are not provided to end users. Security in the DMS for these end user accesses can be provided through the Enhanced Security Package I feature set. These virtual PBX feature packages partition subscriber and office data in the DMS for multiple end customers.

To implement the Customer Data Change features, the telephone operating company defines, through a number of new data tables, the specific subscriber and/or office data that each end customer is allowed to view and/or modify, as well as the method by which they are permitted to access their data.

The CDC software includes Customer Service Change using SERVORD, Customer Network Data Changes, and Customer Network Manipulation.

**Customer service change using SERVORD** This feature permits specified users in an MDC customer group to access the DMS-100 Service Order (SERVORD) system in order to modify some line-related data. This feature also allows a customer to reserve line equipment numbers (LENS) for later use.

**Customer network data changes** This feature expands the SERVORD capabilities, enabling users in a customer group to view and modify certain translation and routing parameters.

**Customer network manipulation (CNM)** This feature further extends the end user's capabilities by providing access to the Table Editor level of the DMS-100 data modification system.

The primary purpose of this feature is to allow the telephone operating company to provide a large customer with the means to control Alternate Route Selection (ARS) patterns for their customer groups, and to control other network characteristics by doing their own datafill.

The telephone operating company is able to provide end user access to the Table Editor level of the DMS-100 data modification system through this feature. It also provides a new Table Editor, the Partitioned Table Editor (PTE), specifically designed for end user manipulation of data tables.

Like the Table Editor, the PTE consists of a set of commands that enable the user to create or modify office data tables. The PTE commands allow the user to display, add, delete, or change tuples or fields within a table or subtable. In addition, the PTE provides security of data by preventing a user from viewing or modifying another user's data.

CNM provides three functions to the telephone operating company:

- 1 define access rights to various tables and subtables for end users,
- 2 define access rights to various PTE functions for end users, and
- 3 maintain log reports of commands used in the PTE

### **Equal access pre-subscription reports**

This feature provides a listing of POTS directory numbers and associated line equipment for every interLATA carrier assigned in the DMS-100 switch.

These pre-subscription reports provide the telephone operating company with the capability to verify a subscriber's pre-subscription of an interLATA (long distance) carrier. These reports, by directory numbers from a MAP, provide detailed information:

- a single interLATA carrier
- all interLATA carriers
- a summary of one or more carriers
- carriers by Numbering Plan Area (NPA)
- carriers by LATA

A total of the number of directory numbers assigned to the carrier by pre-subscription is provided at the end of each interLATA carrier report. If necessary, the DMS may be queried for the total number of pre-subscribed directory numbers without invoking the directory number listing. This feature also permits a listing of all directory numbers that do not have a primary interLATA carrier assigned.

#### **Administration for subscriber module SLC-96 (SMS)**

SMS provides integrated administration and supports a majority of the features currently available with the SLC-96 remote terminal and DMS-100 switch. Service order changes and line data inputs are made at the MAP.

Line class codes and line options assignable to POTS DMS-100 lines are assignable to SMS/ SLC-96 lines.

The capability to trace calls is expanded to include calls originating from and terminating to SCM-100S/SLC-96 lines. Data printed out for the calling line include the location code of the SLC-96, identifying the calling line.

Line Load Control (LLC) is assigned to SMS/SLC-96 lines for essential subscribers, such as fire departments and police stations. Operator verification of SMS/SLC-96 lines is supported. A switch operator can monitor lines or converse on lines from the Traffic Operator Position System (TOPS) or equivalent position.

Operational Measurements (OMs) and traffic data are provided for the SMS and SLC-96. Call originations from and termination to SMS/SLC-96 lines are included in the Traffic Separations Measurement System (TSMS). Registers for Subscriber Line Usage (SLU) and message rate are assignable to SMS/SLC-96 lines. The MAP provides the capability to query and display the switch status data of special service circuits, such as complete cross-connect information and the assigned circuit paths.

## Dump/restore

This is a process carried out by Nortel Networks when an office is to receive a software upgrade, a Batch Change Supplement (BCS). The process consists of five sequential steps.

- 1 With the two CPUs in sync, a copy of the data in the tables is dumped to tape.
- 2 The CPUs are split, sync is dropped and the inactive side is loaded with the new software. This is a no-data image.
- 3 Using a facility called MATE10, communication is established with the inactive CPU.
- 4 The data files on the tape are transmitted to the inactive CPU and the data tables are restored using batch DMO procedures.
- 5 Activity is then switched and the office is running on the new software.

## Pending order file (POF)

The POF is a collection of service orders and DMOs which are not due on the day they are collated. The POF facility provides a method of verifying and executing the POF data files. A prompt facility can send a reminder message to the log device indicating that a particular file of pending orders is now due (see 297-1001-126.)

There are two methods of creating and starting POFs. One is for the service order system, the other is used through the table editor.

**POF – service order system created** To create a POF using the service order system the service order clerk enters a service order number and the date of activation. The DMOs generated by the service order are stored in a special table called DMOTAB. The prompt message information is stored in another table called NPENDING. Both of these tables are accessible through the table editor and are stored in the DMS memory. Editing of a POF created through the service order system requires deletion of the tuples in DMUTAB and NPENDING that have the service order number as a key, and re-adding the POF through the service order system.

**POF – table editor created** Creation of a POF through the table editor allows the user more flexibility. The user enters the “POF” mode after entering the table for which he wants to create the DMOs. DMOs in “POF” mode are not entered directly in the table but rather sent to a user-specified file on a user-specified device. Error checking is performed on the DMOs before they are added to the file. When the user has finished entering DMOs, he leaves “POF” mode or quits the table. Both actions will close the file just created. Editing of DMO files is accomplished by use of the system file editor.

A prompt message is not automatically created for DMO files as it is for service order POFs. The prompt can be manually created for DMO files using the "CREATE" command in the PENDING subsystem. "CREATE" places an entry in table NPENDING, and a log message is output at the requested time.

DMO files can also be created using the file editor, or they could be created off-line to the DMS-100 and then loaded into the DMS-100 (as a DMS-type file) using tape, data link, and so forth. This last is the recommended method of applying batch data changes to the DMS. Two resident modules are provided to use with DMO files: DMOVER which verifies the validity of data files (especially useful for files created off-line), and DMOPRO which verifies and processes the data files (actually inputs the data).

**Pending subsystem** This is accessed from the CI by entering the command "PENDING." The prompt string will change to "POF" until the "LEAVE" command is input.

While in the PENDING mode the user can "ACTIVATE" or "DISPLAY" one, all, or a group (specified by date and time) of POFs. To examine a POF the user looks at table "DMOTAB" for service order POFs, or prints or edits the user defined file if the POF is in the DMO format.

### **Journal file (JF)**

Only those DMOs that have been activated and deemed valid are entered into the journal file and these are identified by means of a unique JF identification (ID) number which is assigned automatically by the journal file system. These ID numbers are only resident on the journal file but are output to the user in the form of a confirmation message when the associated DMO or service order is activated and stored on the JF. (The message is output to the device from which the database change is initiated.) (see 297-1001-127.)

### **JF intermediate storage mechanism**

Once valid service orders and DMOs are activated they are stored in a buffer area in the DMS-100 family core memory that is provided for those journal file records that are to be recorded on tape. When full, the buffers are transferred to the journal file. These buffers reside in protected store and thus survive restarts (or cold starts).

### **JF tape service order/DMO organization**

The ID numbers (and their associated data updates) residing on the JF file are not necessarily in any sequential order since several users can be activating different data table changes concurrently. When DMO are performed, only one JF record ID number is output for the entire service order even though several data tables can be updated. This is due to the fact that service orders are executive routine driven (to update numerous tables

simultaneously). Internally on the JF tape, however, the individual data table changes (the number of changes being dependant on the service order executive routine) are recorded as individual entities, each of which retain the identical JF record ID number. When DMOs are effected, one record ID number is output for every data table (tuple) change initiated.

### **Starting and maintaining a JF**

If a JF can be kept on tape or disk, the access is through the DIRP subsystem. If the office does not have disk, then the usual place for the JF is at the end of the backup image tape. As both the backup image and the JF must be mounted at the same time this not only saves a tape drive, it also positions the tape at the JF after the system has reloaded. This allows immediate application of the JF. If the CPUs are not in sync, then JF updates are inhibited from the table editor and from service orders. There is an override capability.

The JF is stopped, (and DMOs as well), before a new backup image of the system is to be taken. Once the new image of the system is to be taken and is in position on the reserved tape drive then a new JF is started at the end of the new image tape. If the office has disk, then both the image and the JF are on disk so the position does not matter. The old JF must be transferred to an archive tape or disk which will contain all old JFs cataloged by JF name which contains the creation date.

The user manipulates the JF with five commands:

- 1 START – starts a new JF
- 2 STOP – stops a JF
- 3 RESTART – reopen and continue a JF
- 4 STATUS – reports state of JF
- 5 APPL – execute the DMOs in the JF

*Note:* APPLY can be used only after a system reload and before a new JF START is done.

### **Remote memory administration system (RMAS)**

The Remote Memory Administration System (RMAS) centralizes and mechanizes the recent change and data modification routines for DMS users. RMAS will serve as a direct interface to the service order system, over dial-up or dedicated facilities, for lines only. RMAS will also be designed to have database query capability.

RMAS uses an ASCII link that is asynchronous and full duplex. The baud rate is user selectable at 110, 300, or 1200 baud. Parity is selectable as odd, even or non. Access to DMS is achieved by way of one of its I/O ports.



## **Service analysis (SA) (observing)**

Service Analysis (SA), available on the MAP associated with the DMS-100 Family, is described in 297-1001-471. Service Analysis is an observation system that is used to appraise the quality of service provided by the telephone company. Service to be measured is based on call classifications such as Direct Distance Dialing (DDD) outgoing and Direct Dial Overseas. Calls are selected on a random basis to obtain the data for evaluation.

In the DMS-100 Family, the service analysis function is carried out at the SA position, which provides a voice and data link to the system by the system analyst who listens to the calls and notes events as they occur. The analyst used two sources of information, analyst detected events and machine detected events, to determine whether the customer is receiving good service from the equipment and/or the personnel involved in the call.

### **Call progress data – automatically detected**

Following seizure, call progress events detected by the processor are automatically displayed in coded format on the VDU, along with the time of occurrence of each event in elapsed seconds following seizure. This call data will include: (Note: The analyst may, at any time, obtain a display of the elapsed time into the call.)

- digits of the called number
- seizure of an outgoing trunk
- identification of type of special trunk seized
- forward supervision from the called end
- disconnect of the incoming trunk
- disconnect of the outgoing trunk
- call type routed to announcement
- called party answer
- call connected through the switch
- called digits received
- called number information
- called party disconnect
- calling number information
- calling party disconnect
- slash for special feature
- service analysis is unable to follow the call
- the originator has gone to lockout and the analysis is stopped
- the origination of a subsequent attempt during local dial analysis
- receiver attached for MF trunk



- Tone applied to the originator

### **Call progress data – analyst detected**

Call progress events which are identifiable only as audible signals on the voice channel will be detected aurally by the analyst. Upon detecting each such event, the analyst will depress a key as indicated in the menu, thereby signaling to the DMS-100 Family system processor the specific event which occurred at that time. The processor then responds to this signal by displaying the event and its elapsed time on the VDU in coded format. This call data has six components:

- 1 No Circuit Signal
- 2 Reorder Signal
- 3 No-Such-Number Signal
- 4 Recorded Announcement
- 5 Called Station Verbal Answer
- 6 Other Operator Answer

### **Service analysis increased sample rate**

This feature enhances service analysis by allowing the system to sample a maximum of nine calls simultaneously. This increases the screening process and reduces the delays caused by searching for appropriate calls to monitor.

### **Multi-unit message rate services (MUMR)**

This feature enables the operating company to charge calls on a basis of service provided. The rate for each Multiunit Message Rate (MUMR) call is based on a Message Billing Index (MBI), which can be included in the AMA record to simplify downstream processing. Screening tables are used to associate NPA and office codes with MBIs, and the operating company can assign MBIs to corresponding rate bands in its tariffs. The MBIs provide all destination related information required to bill the call. The billing information is collected by the LAMA system in the Bellcore AMA format. The called number can be omitted from the LAMA record. Omitting the called number from billing data is referred to as batch billing.

An option enables the operating company to forward charge pulses to hotel/motel PBXs on a per-office basis. The charge pulses are used for guest billing of non-toll calls. The number of pulses sent during a call varies with call duration, tariff, and surcharge. Charge pulses can also be designated for initial and overtime periods.

## **Fraud prevention features**

### **DIGITONE pad disabling**

This feature is necessary on calls from coin lines equipped with DIGITONE (push button) pads to the operator. On these types of coin phones, the

DIGITONE pads can be used to simulate coin signals. To prevent this type of fraud, coin sets have been designed so that the pads may be disabled. With this feature, DMS-100 automatically supplies +48 volts DC from the 6X23AA pack through the line card to disable the pad when the operator answers.

### **Blue box fraud prevention**

“Blue box” fraud prevention depends upon an in-band signaling link (SF) being present in an end-to-end call connection. This signaling link is released by the calling party using a blue box before or after the called subscriber answers. The signaling link is then re-seized by the calling party and a new destination directory number is outpulsed (MF) using the blue box. This operation, except for the wink start or delay dial signal, is transparent to the offices preceding the in-band signaling link.

In order to detect this type of fraud, the DMS-100 Family Office detects a second proceed-to-send signal from the incoming SF unit at the distant office, a signal having a nominal duration of 200 ms. (greater than 75 ms and less than 2 sec.). Upon detection of the second proceed to send signal, DMS will connect an MF receiver to the incoming CAMA trunk for a period of 30 sec. If digits are not received within this 30-sec. period, the second number is entered on tape, together with an identifying code.

At this point the call may be dropped or allowed to proceed because the operating company has the necessary data to correctly bill the call. There is no danger of the fraudulent call proceeding after time-out of the DMS MF receiver, as the MF receiver at the distant office will time-out after 25 sec. If this occurs, the fraudulent call must be redialed, in which case the detection is repeated.

This feature interfaces only with incoming CAMA trunks. Future enhancements will include other trunk types.

### **Purple box wire tap**

The purple box wire tap fraud depends upon the calling party being able to maintain the connection to the called party after the called party has gone on-hook. To prevent this type of fraud DMS will employ both timed called party clear and calling party clear connection release on normal (non-operator) types of call.

### **Calling line identification**

This feature is used to detect possible fraudulent or malicious call. With this feature, the line will be marked, at the subscriber’s request, in the line feature table.

When this feature is given to a subscriber, details of all calls, local or toll, terminated on that subscriber line will be recorded on the DMS log system

and output to a printer. Details recorded include: directory number of calling parties (if in the same office, or incoming trunk number if in different office), and date and time.

In cases where the call is made from a station calling a CLI number in another office, a search will be made through a list of CLI numbers stored in the CLIDN Table. This CLI number is a 7/10 digit number and is associated with outpulse digits and the trunk groups over which the CLI number is routed. When a match is found, call details are recorded on the DMS log system and output to a printer. Call details are provided for two call types:

- 1 Trunk-to-Trunk (Tandem) calls
  - incoming trunk number
  - outgoing trunk number
  - DN of called party
  - date and time
- 2 Line-to-Trunk calls
  - DN of calling party
  - outgoing trunk number
  - DN of called party
  - date and time

If calling DN cannot be identified, the number will be replaced by originating equipment number and ring and tip identification, if available.

### **Call hold on malicious call trace**

The Malicious Call Hold (MCH) is a feature which can be used by the operating company to hold the connection back to the malicious or fraudulent caller. The feature works differently on ordinary and custom calling service lines.

- ordinary lines – The called party can hold the connection within the office on a malicious call by flashing the switch hook and staying off-hook. An alarm and a log report are generated in the DMS-100 office upon receipt of the switchhook flash.

If both the calling and called parties are terminated on the DMS-100, the entire connection will then be held until the called party goes on-hook.

If the call arrived on an incoming trunk and terminates within the DMS-100 office, the connection will be held back to the incoming trunk. Malicious call hold feature is implemented by assigning the CLF feature in the line feature table.

- custom calling service lines = For custom calling service lines, the called party can request malicious call hold by flashing the switchhook. Upon receiving a special dial tone, the subscriber then dials a special 2 digit access code (operating company modifiable). This special code will in turn activate the Malicious Call Hold (MCH) feature. A log report is generated, an alarm is sounded and the path is held.

The talkpath is restored after MCH has been activated. The system will ignore further switchhook flashing from the terminator after activation of the malicious call hold feature. In this fashion, malicious call hold, three-way call, and call transfer features can co-exist for custom calling service lines.

The log report is modified so as to include additional information. If the calling party is a line, then its associated directory number and line equipment number will be printed. If the calling party is a trunk, then its associated CLLI\_NAME + CKT# (trunk common language name plus number in incoming trunk group) will be printed. (Line 125 and 126 logs will be used.)

- Call Waiting (CW) – A subscriber, having both the CW and MCH features, receives a call waiting indication and flashes the switchhook to answer the new call. If this new call happens to be malicious, the subscriber will not be able to activate malicious call hold, because flashing the switchhook will connect the subscriber to the original party.  
Currently call waiting overrides calling line flash, three-way call, and call transfer feature. However, a subscriber can have all features turned on.
- Three-Way Conference/Call Transfer (TWC/CT) – A subscriber, having both the TWC/CT and MCH features, may be able to activate either feature on a terminating call by flashing, receiving special dial tone and dialing either the special 2 digit access code to activate MCH or the regular 7 or 10 digit number to add the third party.  
For a line that has the malicious call hold feature but does not have the privilege of three-way call or call transfer, activation of MCH would be the same as in the current system. In other words, a switchhook flash from subscriber is sufficient enough to activate malicious call hold without dialing the special 2 digit access code.
- Calling Line Identification (CLI) – For lines that do not require a minor alarm sounded on call completion and that also have the malicious call hold capability, operating company personnel can assign both CLI and calling line flash (CLF) features to the lines.

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## Chapter 7: Maintenance

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Maintenance procedures documented in this Section relate to both DMS-100 and DMS SuperNode. Where DMS SuperNode procedures differ or require special consideration, this is indicated in the text. Generally, reference to DMS-100 Family is meant to also include DMS SuperNode.

### **Maintenance and administration position system**

The Maintenance and Administration Position (MAP) provides an interface between the DMS-100 Family System and operating company personnel. Tasks performed at the MAP include general maintenance functions for error detection and diagnosis; administration functions for network management, and customer data modifications; trunk testing functions; and line testing functions. The MAP, located locally or remotely, operates as a single entity for small office applications as well as a large system interface where a number of MAP units operate concurrently.

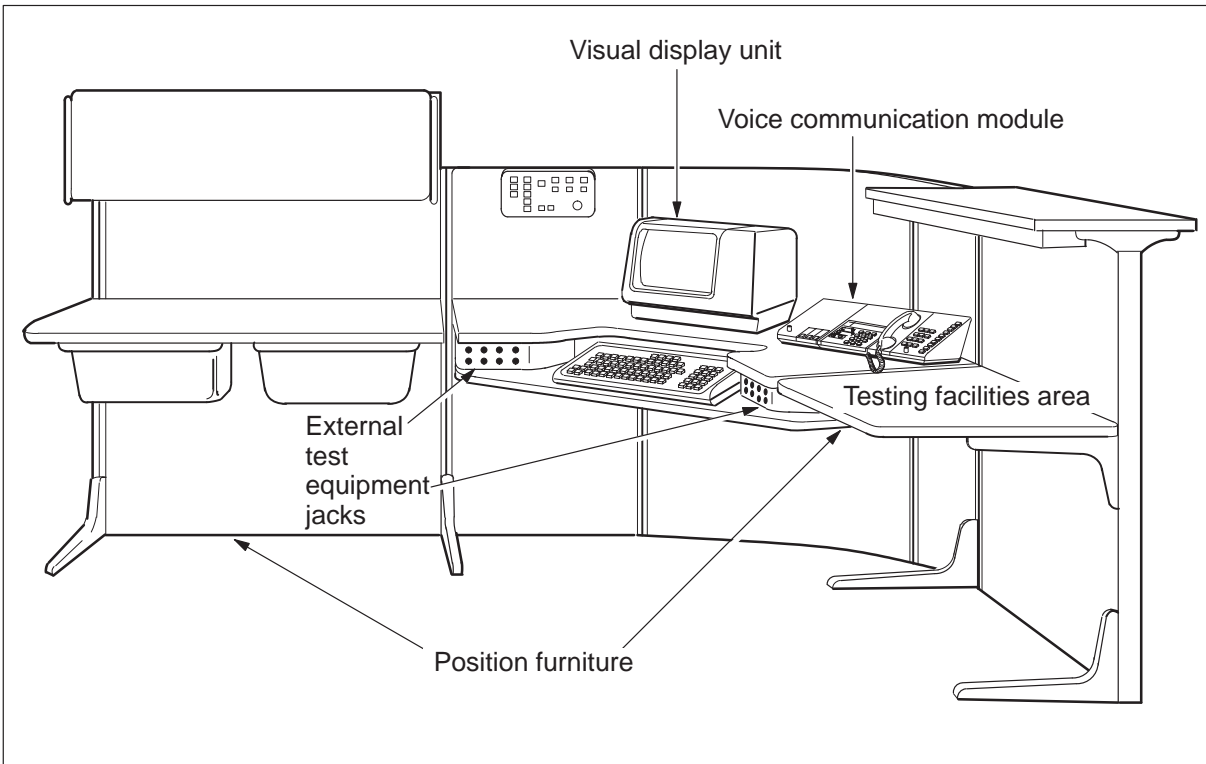
The number of MAP positions connected to a DMS-100 Family System is specified by the operating company. The maximum number the system can accommodate is a function of other Input/Output (I/O) devices equipped on the system. This capacity is not a practical constraint; any normal configuration has termination capacity for over 100 MAP teletypewriters (TTYs) wires and printers also may be used for data entry and retrieval, such as, customer data modifications, network management and Operational Measurement (OM) reports, and log reports. MAP assignments are recorded in protected data store memory and preserved on office image tapes to ensure these assignments are not lost in the event of system restarts.

In addition, a dedicated MAP, located in position zero of Table TERMDEV, is identically equipped in all systems. This MAP is commonly referred to as the operator position. Dedicated Emergency Technical Assistance and Support (ETAS) terminal definition, also is provided through remote dial-up.

### **MAP components**

The basic components of the MAP include a Visual Display Unit (VDU) with keyboard, a voice communications module, with system test interfaces, and optional position furniture. Other devices such as printers are used in conjunction with the VDU depending on operating company procedures. Figure 7-1 illustrates the MAP.

**Figure 7-1**  
**Maintenance and administration position**



### **Visual display unit with keyboard**

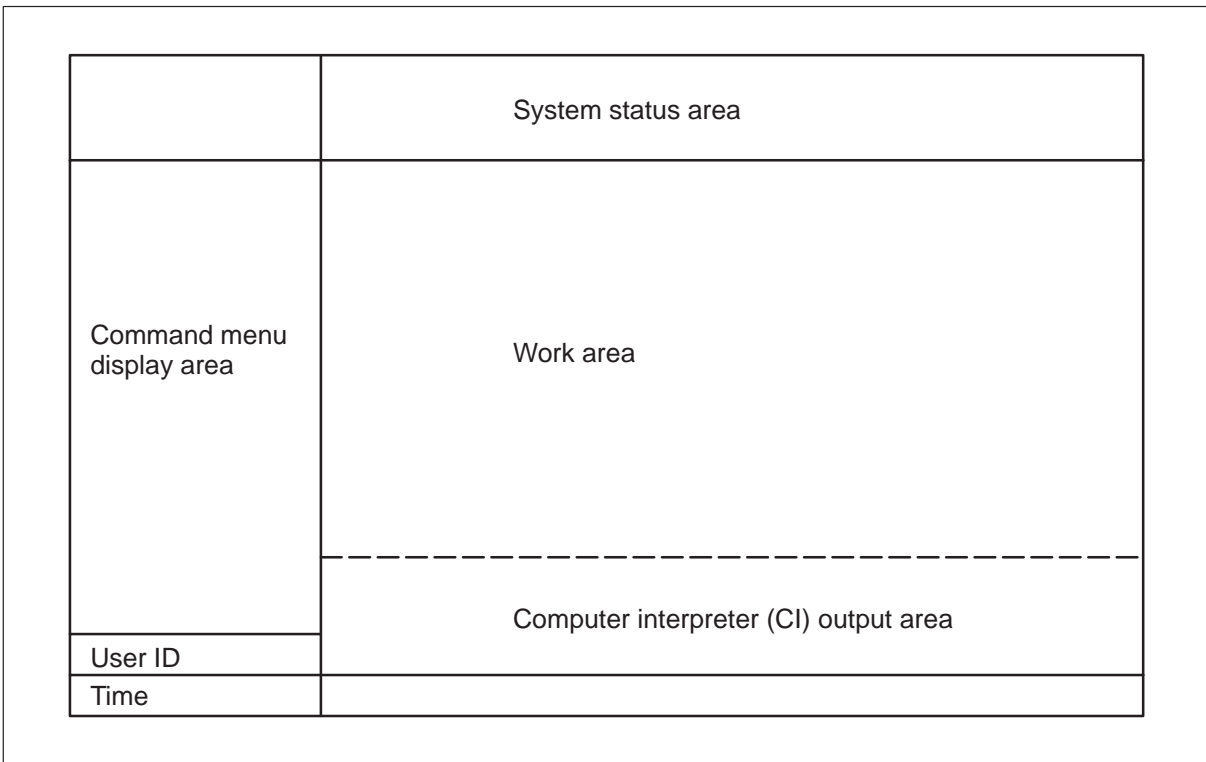
The VDU is the primary person/machine interface between maintenance and administration personnel and a DMS-100 Family System. In the maintenance mode, the screen is divided into a number of areas which display the six types of information:

- 1 System Status Area Indicates alarm and/or operational status of the system with immediate automatic updating of current display.
- 2 Work Area – Displays descending levels of subsystem status, to include working data, such as, frequency levels applied to and measured on posted trunks.
- 3 Command Menu – Defines functions performed at the MAP at any time. For lines that do not require a minor alarm sounded on call completion and that also have the malicious call hold capability, operating company personnel can assign both CLI and calling line flash (CLF) features to the lines.
- 4 CI Output Area – Lists system report output, to include error, action taken, and diagnostic messages, upon operator request. Also displays system responses to commands input by operator.

- 5 Input Echo Area – Provides echoed statement of most recent command string input by operator.
- 6 User ID and Time of Day – Identifies user and displays time of day.

Using the VDU and the keyboard, operating company personnel can examine the system, on several levels of detail, using the telescoping process provided in the DMS-100 Family System. At each menu level, system options for action by the operator are displayed. The results of an action appear on the VDU. With an optional hardware interface, the operator can recall the last three commands entered, using line editing functions. A printer can be configured with the VDU to provide a permanent copy of output reports or copy stored on disk, tape or alternate MAPs. The VDU and printer accept and display upper or lower case characters. Figure 7-2 illustrates the VDU screen.

**Figure 7-2**  
**Visual display unit screen**



### **Voice communications module**

The voice communications module is based on a LOGIC 20 or equivalent key telephone set. It provides a means of communication with other maintenance personnel in the same or distant offices, to include the monitoring of trunks and lines, and the testing of peripherals. An autodialer and a hands-free unit are optional. Four types of communication circuits are provided:

- 1 101 test line
- 2 communication lines
- 3 headset circuit
- 4 key telephone set

Four, 4-wire jack appearances are provided at the MAP when it is used as a line or trunk test position. One of these appearances is used for operating company determined purposes, such as connecting to a VF patch bay. The others connect to jack-ended trunks through which access, through the switching network, is gained to any line or trunk in the office. Portable test equipment is plugged into these jacks to perform various tests. For monitor functions and jack-ended trunk applications, dedicated circuits are located with the DMS-100 Family System. Facilities are required for connection to the MAP. TTYs are used in DMS-100 Family System for data entry and retrieval. These TTYs can be on-site or remotely located, operating at speeds of 300, 1200, or 2400 baud. TTYs are used to implement trunk and line work orders and network management controls, initiate diagnostics, and receive log messages, OM reports, and network management reports. TTY reports include report number, time, report trouble, and related data.

### **Furniture**

The optional MAP furniture is a modular system providing table surfaces which are positioned for either standing or sitting use. The furniture, consisting of tables and shelf units, is assembled in various configurations to provide work space and documentation storage for administrative or maintenance functions, and to mount the VDU, jack field, and communications module.

### **MAP interface to the DMS-100 family system**

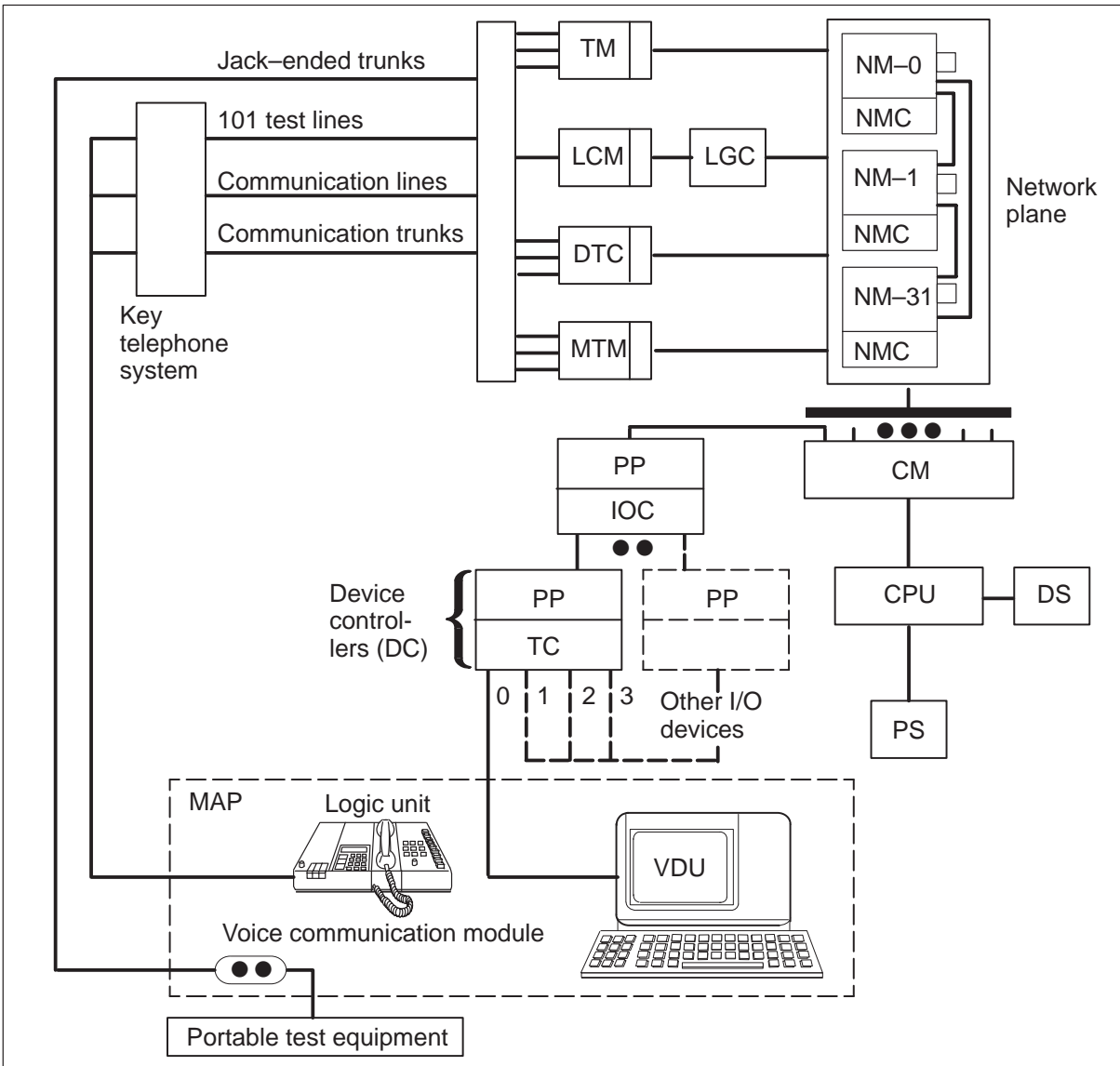
The VDU is connected to the system through a Device Controller. Up to four VDUs may be connected to a single device controller. For remote positions located at a distance greater than 1200 ft., modems are required. The VDU can operate at 300, 1200, 2400, or 4800 baud. A 300, 1200, 2400, or 4800 baud modem also can be configured to permit dialing into the DMS-100 Family System from remote MAPs. Device controller restrictions limit the total baud rate to 4800 for a complete device controller.



**MAP interface components**

Two communication trunks, used to originate calls, are associated with every MAP used for trunk testing. The T101 test lines are terminating type trunks, connected in parallel to every MAP used for trunk testing. Communication trunks, 101 test lines, local talk lines and communications lines terminate at the logic telephone set. Jack-ended trunks are hardwired directly to the jacks located on the position furniture. Each MAP used for trunk and line testing functions, and general maintenance functions, has three jack-ended trunks. Each trunk is associated with two jacks, one for the transmit side and one for the receive side. These jacks are provided for portable test equipment. Figure 7-3 illustrates the MAP in relation to the DMS-100 Family System.

**Figure 7-3**  
**Relationship of MAP to DMS-100 family system**



The DMS-100 Family System Network Operating Protocol (NOP) features active displays and detailed information for the craftperson monitoring activity from the MAP. The bit synchronous data link controller, NT1X67DB, is required if Station Message Detail Recording (SMDR) data files are to be transferred over a communications link to the Network Operations System (NOS). The MAP level for NOP feature provides a new MAP level to the DMS craftperson, showing the communication status relative to interaction between the DMS and NOS. In addition to NT1X67DB hardware, NTX427AA, and NTX560AA software packages are required to implement this feature.

## Operation of the MAP

### **Accessing the DMS-100 family system**

To gain access to the DMS-100 Family System, the user inputs a series of commands on the VDU keyboard. The commands and associated responses are displayed on the VDU screen. These responses can be requests for further information from the user or contain the information requested by the user. The user logs onto the system by typing in a user ID and a password. Once user validity has been acknowledged, the user specifies access to the maintenance system. The system operational status is then displayed.

**Automatic dial-back** The DMS-100 Family System can be optionally arranged for automatic answer and dial-back. With this arrangement the user will dial and then login with the prescribed user ID, password, and terminal number. This number is an automatic dialback ID which may be a valid telephone number of up to ten digits or a predefined index number. In either case, the automatic dial-back identifiers are listed in Table DIALBACK.

After the number is input by the user, the line is disconnected and the table is referenced to validate the terminal number. If valid, then automatic dialback is made to the telephone number packed against the terminal ID. If the login attempt is invalid, it is recorded in an audit file. Automatic dialback is implemented with the Companion CTS212AH smart modem. Offices at BCS 19 or above can use the RIXON 212A intelligent modem for automatic callback.

**Security features** The DMS-100 Family System offers command screening, password control, access control, audit trail, and automatic logout of dial-up lines on an optional basis.

**Command screening** The command screening feature allows the system to do extensive screening of user commands prior to execution. Command screening can be applied to any user, terminal, or both. DMS-100 Family System users and terminals will be assigned single or multiple privilege command classes from 0-31, for example, up to 32, depending on the functions of the user or terminal. To ensure system security, all commands will initially default to an operating company defined class until privilege classes are assigned.

**Password control** The optional password control feature will disable all current automatic logon procedures for the DMS-100 Family System and secure the system against unauthorized users. Users and passwords must be identified to the system prior to logging on. No user will be able to display or change the password of another. Passwords will be encoded and scrambled, however, the decoding algorithm will not reside in the system. The operating company will select the parameters for the number of characters in each password and determine the effective time interval before a password must be changed by the user. Password expiration warnings and a predesignated number of logon attempts before permanent lockout from the system is part of this feature. As an added security measure, the system will prompt the user for the current password when a password change is attempted.

**Access control** This feature allows control of user access to a DMS-100 Family System by controlling login access to consoles. Consoles may selectively enable or disable logins. These consoles may be automatically disabled on login failure when a time limit is set for logon sequence completion. A time limit which specifies the maximum time an enabled console may be left unused also may be set and various access and security related events will be logged. The login sequence is made more secure by pushing the password display during logon, prior to entry on hard copy devices, and erasing the password display from the VDU screen right after entry.

Offices at BCS 18 or above can generate log reports when users modify or attempt to modify the customer data tables. Presently, the access to the customer data table is controlled by the privilege class assigned to the table. When the user attempts to access a table, the privilege class is compared to the privilege class of the table. If privilege classes match, access to the table is granted. An enhancement to the security table allows the telephone operating company to monitor both the user and the tables being accessed. When this feature is activated, all completed or aborted attempts to access a table are recorded in a log report. This feature is activated or deactivated on a per table basis by authorized personnel.

**Audit trail** This feature provides control of user access and traces illegal entry attempts through the creation of an audit file of user entries:

- valid user logins and logouts
- invalid login attempts, for example, wrong or expired password or user ID
- forceout of users
- change of password
- addition of a userid using PERMIT, where userid is identified

- deletion of userid using UNPERMIT; where user must know password for user ID
- use of the PRIVCLAS command to change command sets
- privilege violation on table access
- valid use of selected commands
- privilege violation of selected commands

There will be space allocated to keep 1000 security reports. These security reports will be secure. Viewing and manipulating these reports will be restricted. Additionally, the operating company will be able to specify alarm levels to flag these reports.

**Automatic logout of dial-up lines** Automatic logout of dial-up lines allows users to be automatically logged out. The connection is dropped when a facility open condition is detected. Optionally, the terminal may be disconnected.

### Alarms

Audible and visual alarms are provided in the system to alert maintenance personnel of trouble conditions. Faults are classified according to the severity of the problem. Alarm categories include critical, major, or minor alarms.

Whenever a failure is detected in a DMS-100 Family System, system status information displayed on the screen is updated immediately to indicate the fault. In addition, an alarm status indication is displayed below the system status information. All critical and major alarms are indicated by an audible alarm and the appearance of the alarm status indication, \*C\* for critical and M for major. Audible alarms can be silenced through the command SIL input at the keyboard. A blank space below a system status fault indication denotes a minor alarm. Dead-system alarms cannot be silenced by software command, only by operation of the audible alarm reset switch.

### Isolation of faults

To facilitate the isolation of faults in the DMS-100 Family System, the MAP has a telescoping feature. Telescoping is the following of a branching process to determine the smallest replaceable unit which should be changed to restore system status to normal. The status data at any telescoping level being displayed is continuously updated to reflect the current status without the need to request an update. Supplementary data, within a particular level or a lower level, is requested for displays by inputting the appropriate commands in one of three ways. Each command line is followed by a carriage return:

- the menu number associated with command code
- the command, entered character by character, as displayed in the menu

- command code strings, separated by semicolons, descend through menu layers to circumvent the telescoping process.

The highest level of status reporting is Level 1 system status. The information displayed on the first three lines of the MAP screen. The first line consists of abbreviated maintenance subsystem headers:

- DMS-100 Family
  - CC Central Control
  - CMC Central Message Controller
  - IOD Input/Output Devices
  - Net Network Modules
  - PM Peripheral Modules
  - CCS Common Channel Signaling
  - Lns Lines-Local Offices Only
  - Trks Trunks
  - Ext External Alarms
- DMS SuperNode
  - CM Computing Module
  - MS Message Switch
  - CC Central Control
  - CMS Central Message Controller
  - IOD Input/Output Device
  - Net Network Modules
  - XPM Extended Peripheral Modules
  - CCS7 Common Channel Signaling
  - Lns Lines-Local Offices Only
  - Trks Trunks
  - Ext External Alarms

The second line contains status information for the particular subsystem. Information, displayed at any time for any subsystem, is the most severe abnormal condition in that subsystem. Normal status is indicated by a period (.). Fault conditions are indicated by acronyms, mnemonics, or numerals determined by subsystem requirements. The third line contains alarm status information. A Level 2 status or subsystem status indication consists of specific data on a subsystem's components. The information ranges from quantitative values in numerical form showing numbers of nonfunctioning elements to single letters showing qualitative status and/or alarm condition. The Level 2 command menu varies with the subsystem chosen. There are two types of commands available at this level. Commands may be associated with accessing lower level status levels, resulting in a Level 3 status. In

addition, action commands may be used for alterations to functional elements.

Some subsystems must be considered at lower levels to determine faulty components. To achieve this, a third (and fourth level for detailed status) level of status and its associated menu are provided. When the lowest level of status for any particular system is reached, the identity of the faulty element may be displayed in the CI output area of the screen.

To initiate tests from the MAP, the appropriate subsystem menus have to be accessed. Tests on trunks, analog or digital, and service circuits are initiated after the appropriate circuits have been posted at the Trunk Test Position (TTP) level. Tests on lines are performed after the line has been posted at the Line Test Position (LTP) level. Tests on the central control complex and the networks are initiated after requesting the diagnostics be run on the appropriate equipment.

When any unit is removed from service, the LOG system is updated to reflect this change. For example, if a trunk is made busy and removed from service, the trunk log subsystem will be updated and an output message provided at the TTP or printer assigned to the LOG system.

To assist personnel in isolating faults, Performance Oriented Practices (POPs) are provided for reference. A troubleshooting procedure is associated with each subsystem trouble indication displayed in the system status area of the VDU. An index is provided which identifies by procedure number the trouble-shooting procedure to be followed. The procedure specifies the steps to be taken to isolate the fault to a single element. These procedures also assist personnel in removing faulty equipment units from service.

Figure 7-4 illustrates Level 1, the highest level of system status reporting. Figure 7-5 illustrates the subsystem status of the CC, in which all CC units are in the normal condition, CC-0 is ACTIVE (ACT) and CC-1 is INACTIVE (INACT).

**Figure 7-4**  
**Level 1 system status**

CC	CMC	IOD	Net	PM	CCS	Lns	Trks	Ext
.	.	.	.	.	.	.	.	.
	Mtc	/						
0	Quit	/						
2		/						
3		/						
6		/						
7		/						
8		/						
9	CC	/						
10	CMC	/						
11	IOD	/						
12	Net	/						
13	PM	/						
14	CCS	/						
15	LNS	/						
16	Trks	/						
17	Ext	/						
18		/						
User	ID							
TIME	hh:mm							

**Note:** Figures for illustrative purposes only. Position of headings and data are approximate.

### Babbling diagnostic

The major babbling diagnostic failure flag provides an indication of devices which send interrupt messages to the CC at an excessively high rate. The DMS-100 Family System provides for detection and handling of babbling nodes. A counter and three threshold levels are maintained for the failure type, and an alarm condition occurs when one or more of the failure counters exceed one of the threshold levels.

Babbling enhancements after BCS 20 provide the ability to take babbling nodes out of service as they occur. A more sensitive low rate babbling detection mechanism will be implemented to enable a minor babbling diagnostic failure flag to be set along with alarm indication. In addition, the log ICMO identified babbling nodes on the TTY assigned to output system logs.



**Babblers line handler** The babbling line handler software package can diagnose the line card and loop of a line that has been reported as a babbling line in the peripheral. The line card will be removed from service, and placed in the cut state to prevent system degradation. For BCS 22 and above, an audit will revisit each babbling line and return it to service if babbling has ceased. Prior to BCS 22, manual action is required to restore the line card. The babblers queue size has been set at 128 elements.

**Figure 7-5**  
**Level 2 CC subsystem status example**

CC	CMC	IOD	Net	PM	CCS	Lns	Trks	Ext
.	.	.	.	.	.	.	.	.
CC	Stat	/	CC	Stat				----Link----
0	Quit	/	Stat	Sync	CPU	PS	DS	CMC 0 CMC 1 CCMnt
2		/	CC 0	Act	.	.	.	.
3		/	CC 1	Inact	.	.	.	.
4	Mtch	/						
5	Ramcpy	/						
6	Tst-	/						
7	Bsy-	/						
8	RTS-	/						
9	RMC-	/						
10	-CPU	/						
11	-Link-	/						
12	RexTst	/						
13	SwAct	/						
14	Sync	/						
15	DpSync	/						
16	CCMNT	/						
17	PS-	/						
18	DS-	/						
	user id							
	TIME	hh:mm						

### MAP software support

The MAP units are software driven from the DMS-100 Family System. Included in the software is a LOG system, which provides information storage and retrieval for system-related messages or reports. During operation, reports are generated by the DMS-100 Family System software and sent to the LOG system.

In the LOG system, these reports are categorized into a number of report classes according to the subsystem which generated the report. The LOG system stores these reports in several LOG buffers. There is one LOG buffer for each subsystem. Each subsystem has a number of basic report types

associated with it. Each output report is associated with a given report type and consists of a fixed format and variable data.

Optionally, on the basis of information stored in the LOG system, the reports are routed to MAPs or other output devices associated with specified classes of users. These output messages have a sequence number which can be printed in the order of alarm severity, critical, major, minor.

## **DMS-100 family system maintenance**

### **Maintenance capabilities**

DMS-100 Family Systems include a complete maintenance system composed of four components:

- 1 hardware fault detection capabilities
- 2 diagnostic programs which identify and isolate faulty hardware units
- 3 a software defensive programming strategy augmented with audit capabilities
- 4 alarm and MAP facilities for communication with the maintenance staff

Of necessity, these components are very specifically structured and imbedded within the DMS-100 Family System design. Enumeration of all the capabilities available through the maintenance system is not possible without a full and detailed analysis of this design. A complete listing of externally observable maintenance actions, together with the system responses, is available for maintenance operations guidance, through the Nortel Networks Practices (NTPs) in the -500 Series, for example,, 297-1001-500. In addition to these documents, a maintenance and administration manual is available from Nortel Networks, detailing focused maintenance operations designed for use in a central maintenance center. Various software packages also are available to aid in central maintenance operations, such as, focused maintenance and SPMs. For additional information, refer to Chapter 2.

### **Overview of maintenance actions**

The MAP is the focal point of DMS-100 Family System maintenance. In most cases, trouble or faults within the system will be automatically detected by internal facilities and an appropriate report filed in the LOG system. Audible alarms will be activated if appropriate. The LOG messages associated with CO alarms will have a priority-of-action flag associated with them, consistent with the urgency of the alarm. It is intended that major alarm messages indicate trouble conditions in the CO which require resolution by a operating company personnel.

The maintenance mode of the MAP provides a number of displays or levels. Each level presents detail, in increasing depth, on certain hardware and

offers a menu of commands. Access to each level is arranged in the same hierarchy as the system hardware.

The first level provides the overall status of each major subsystem. Each successive level provides greater detail and commands which enable the operator to telescope into the system. When the level of the fault is reached, maintenance personnel are alerted by a series of status displays.

Throughout the maintenance mode, the status of each subsystem is displayed at the top of the MAP screen. Whenever the system detects a failure, the status display changes to identify the failed subsystem and to show the severity of the failure. To obtain more information about the fault, the maintenance personnel change levels by entering a command corresponding to the failed subsystem. Depending on the subsystem entered, the display may immediately identify the faulty unit, or a detailed level may be entered to identify the exact location. Diagnostics may then be run to pinpoint the failure and corrective action taken.

DMS-100 Family Systems provide efficient and reliable facilities and procedures to verify trouble conditions. The Performance Oriented Practices (POP) are designed to provide support to the maintenance personnel for performing their tasks rapidly, accurately, and efficiently. The POP concept supports the task itself rather than a particular hardware or software item. A POP is a programmed document designed to direct the user, in a step-by-step fashion, from a stimulus, such as an alarm or a trouble report, through all operations necessary to successfully complete the task initiated by the stimulus.

The document is of significant depth to support the inexperienced user, but structured to permit the experienced user to bypass detailed instructions for operations that can be done from memory. The POP procedures outline any precautions that must be taken when testing any circuits or units.

Admonishments are reminders to help the user perform the task safely, with minimum service interruption, and avoidance of equipment damage. There are three possible types of admonishments used in the POP:

- 1 **DANGER** Personnel injury
- 2 **CAUTION** Service interruption
- 3 **WARNING** Equipment damage

In general, trouble verification will be done by the maintenance staff by causing the appropriate system diagnostic to be run using a MAP input command. The diagnostic output will indicate any Printed Circuit Pack(PCP) replacement required for repair of the trouble. For normal testing and verification on DMS-100 Family System equipment, two-person tests are not required. After repair, the diagnostic should be run again and, if the run is successful, a MAP input command can be issued to restore the unit to service.

**Real-time activity indicator – DMS-100 F**

Real-time activity software is an online real-time indicator tool which allows operating companies to monitor a system's traffic count, CPU occupancy, and call queuing time. This monitoring tool is invoked from the MAP where the activity command appears in the maintenance level menu (MTC). Once activity has been invoked, a MAP display provides a series of measurements which includes call attempt pegs, CPU occupancies, and processing queues. The system logs can be activated to provide 15 one minute snapshots of percentage of completions, CPU occupancy, and average queue delays. Four activity menu commands are used to control the start/stop of both the visual monitoring and the activity logs.

**Circuit selection procedures – DMS-100 F**

Selection algorithms for circuit groups, such as trunk groups, can be specified by the operating company:

- Most Idle – Trunks are added to the tail of the queue as they become idle.
- Least Idle – Trunks are added to the head of the queue as they become idle.
- Sequential – Trunks are selected from those idle in the sequence specified in translation.
- Circular – The trunk selected is the first idle trunk found in a search starting after the most recently released trunk in a trunk group.

**Sanity tests – DMS-100 F**

Sanity tests are provided in the DMS-100 Family System to ensure the integrity of the system software. The self-checking logic of the maintenance system uses four timers, one of which is the sanity timer. This timer runs continuously in both CPUs and is reset by the operating system. Failure to reset will cause the timer to fire, which causes a TRAP interrupt and, at the same time, enables the Activity Switch Timer (AST). If, for some reason, the TRAP is not served, the AST will fire and an activity switch will occur. The sanity timer guards against software or micro-program loop errors not detected by the TRAP system. Refer to Chapter 2 for additional information.

**Calls encountering trouble – DMS-100 F**

The objective of the DMS-100 Family System recovery system is to minimize service interruption. Calls encountering trouble are handled in two ways:

- 1 Attempted to be completed satisfactorily without the customer being made aware that a trouble exists. For example, when problems occur during path setup through the switching network, a retry is attempted without customer knowledge.

- 2 Calls that cannot be completed due to internal or external trouble conditions are routed to operating company-defined treatments such as tones, for example, 120 IPM or recorded announcements.

## Error handling – DMS SuperNode

### Recoverable and unrecoverable errors – DMS SuperNode

There are two types of trap that occur in the SP and MP: Traps due to software-detected errors and traps due to hardware-detected errors.

- 1 software traps include:
  - divide by zero
  - range checks
  - task errors ( running out of space) is an example of a task error).
- 2 hardware traps include:
  - parity errors
  - bus errors
  - Memory Management Unit (MMU) errors

These traps are classified as recoverable or unrecoverable. The designation of traps as recoverable and unrecoverable is a design decision. A task running out of task space is an example of a recoverable error. A parity error is an example of an unrecoverable error. All unrecoverable errors cause restarts.

### Task recovery – DMS SuperNode

If a task identifies itself as recoverable to Run Time Support System (RTSS) and a recoverable error occurs, the task is restarted. If the task does not identify itself as recoverable, even a recoverable error causes an XPM restart.

Associated with each trap is a trap handler. The trap handler is invoked by RTSS or by a hardware interrupt, depending on which one detects the trap. The trap handler looks at the fault data stored in the system stack to determine what caused the trap and which task was executing. The trap handler places the fault data in **mod\_com\_area** for debugging purposes.

If the task is identified as recoverable and the trap was recoverable, control is return to the main procedure within the task; adjusting the stack pointer then clears the Stack for the task. The STEAP is left as it was; therefore, all variables allocated by procedure new remain allocated.

### Activity timer – DMS SuperNode

The activity timer is set by hardware to 1.5 sec. and has a specific location on the address bus. The TIMER task resets the activity timer within 1.5 sec. by reading this address. If an activity time-out occurs in the active unit, the

unit gives up activity and the unit is reset. If the activity time-out occurs in an inactive unit, nothing happens.

### **Sanity timer – DMS SuperNode**

The sanity timer is set by software and is currently set to 30 sec. The TIMER task must read a specific memory location within 30 sec.; if it does not do so, the hardware causes a reset. On a reset, the unit returns to a Who Am I (WAI) state and the complete load is sent to the unit again; if the sanity time-out occurs on the active unit, the reset also triggers an activity switch.

## **Safeguards**

The DMS-100 Family System provides safeguards, daily scheduled CPU changeovers, routine diagnostics, per-call tests, and other background tests, where trouble conditions within the service recovery and protection facilities can be detected before service is affected.

Further safeguards are provided to prevent an inadvertent degradation of service due to improper data commands or actions. Any data changes implemented in the system are checked for validity and format and tested. In addition, the system provides input terminal restrictions which can restrict data changes to be implemented through the appropriate terminals.

Through MAP commands, units of the system may be removed from service. For duplicated units, that is, CPUs, CMCs, and networks, if one of the duplicated units is already busied out or inactive, and a command is input to busy or make the mate unit inactive, the system will provide a warning message and no action is taken to busy the unit. In the case of unduplicated units, such as, TM, DCM, and MTM, the system provides warning messages if circuits are service busy, and requires command validation before the unit is removed from service.

The DMS-100 System safeguards are provided to ensure that when a number of trunks in a trunk group are busied out either by the system or maintenance personnel, alarm conditions are provided on the MAP. Alarm conditions are classified as critical, major, and minor, dependent on the percentage of trunks busied in a trunk group. Once the percentage threshold is exceeded, the appropriate alarm is triggered for the affected trunk group. The threshold percentage information, from 0-100%, is defined by the OC in CLLI maintenance tables for all trunk groups.

The Automatic Trunk Testing (ATT) feature provides a safeguard to ensure that optionally no more than 25 or 50% of the trunks in a trunk group are removed from service if a failure condition is encountered the Automatic Line Testing (ALT) feature provides a means for testing lines or groups of lines automatically on a scheduled basis. Lines failing any of the tests are not removed from service, but may be posted at the line test position for further action. If the number of line test failures exceed operating company

defined thresholds, appropriate alarms will be generated. Separate thresholds may be set for diagnostic failures and permanent signal lockout. Most of the circuit packs in the system use a key and slot arrangement which restricts the appropriate cards to be installed in the proper shelf position.

### **DMS-100 family diagnostic system**

The DMS-100 Family System includes diagnostic programs for fault verification and resolution for all DMS-100 Family System equipment. A diagnostic program which may be manually or automatically invoked is used to locate faults in the functional subsystem. If a no fault condition is found, a report indicating that position id is posted to the MAP position which requested the diagnostic. In addition, appropriate peg count registers are incremented to indicate the relative occurrence of transient errors versus hard faults for automatically invoked diagnostics. Refer to Chapter 5 for additional information on peg counters.

In the DMS-100 Family System, a fault is a detectable trouble condition that can be reproduced at will by the system or by external means. An error is a detectable trouble condition that cannot be reproduced at will by the system or by external means. Typical software errors are referred to as SWERR. If a fault is found, the faulty unit is automatically removed from service and appropriate messages routed to the LOG system and/or the alarm system. By using the Return-To-Service (RTS) command, the faulty equipment can be returned to the active state. In the DMS-100 Family System, equipment experiencing correctable errors is not removed from service automatically unless an excessive error rate is experienced. When diagnostic programs cannot isolate the trouble to a single circuit pack, a list is generated which indicates circuit packs in the order of probability for causing the trouble. The design objective for the diagnostic system resolution is to automatically isolate a single PCP fault:

- 75% of the reported troubles are isolated to four or fewer PCPs
- At least 90% of the reported troubles are isolated to seven or fewer PCPs

Diagnostic output data provides the necessary replacement PCP code and the physical location down to the specific PCP card slot.

Manual interaction with the diagnostic/test system is through the MAP system. One properly trained maintenance person can perform these tests. Once the faulty unit has been replaced, the maintenance personnel initiate another diagnostic run to ensure that the unit is functional. This can be done from a portable MAP located in the vicinity of the fault, if the portable MAP has been provided. Once the unit passes the diagnostic test, it can be returned to service using the MAP.



## System alarms

The DMS-100 Family System alarm system performs three functions:

- 1 Generates audible and visual indications as a result of trouble conditions detected within the DMS-100 Family System, or in associated equipment
- 2 Provides a hardware-generated dead system alarm to alert maintenance personnel when the DMS-100 Family System software is not functioning
- 3 Provides manual facilities for alarm conditions.
  - Silencing audible alarms
  - Transferring alarms to a remote monitoring location
  - Grouping the alarms of the DMS-100 Family System with those of other systems on other floors
  - Transferring alarms from an unattended trunk or line test center to the main DMS-100 Family System alarm system.

There are normally two NT3X82 dead system alarm packs in the office. These alarms are wired to ensure any loss of communication between both of these packs and the CPU is required to generate the dead system alarm. Here the DS relays on both packs, normally held by software, are released, thus generating an audible and visual critical alarm, which indicates a dead system. The signals usually are cross-connected at the Distributing Frame (DF) and can be picked up by engineered telemetry equipment.

In addition, there is an NT3X84 alarm sending circuit pack in the office. When the DS relays in the NT3X82 packs are released, a ground is extended to the DS relay on the alarm-sending pack which causes it to operate. This action starts the dead system tone generator, 480 Hz, and activates a logic circuit which will select and seize an idle E&M trunk from two regular operator trunks. These trunks and the pack interface are cross-connected at the DF. The 480 Hz tone is then connected to the seized trunk. If neither trunk is idle Trunk 1 is automatically seized, the tone is connected to it and the M lead is pulsed at 60 IPM. Switches in the trunk selector logic circuit can be set to accommodate either Type I or Type II E&M signaling.

### Alarm system operation

Alarm and control inputs detected by the alarm system hardware are interfaced with the alarm system software through scan points. These scan points detect inputs generated by hardwired alarm contacts in the DMS-100 Family System hardware, by the operation of manual control switches, or by the alarm circuits of miscellaneous equipment associated with the DMS-100 Family System.

Alarm and control inputs are generated by the software of the other nine maintenance subsystems which complete the DMS-100 Family maintenance system are designated system inputs. Each maintenance subsystem controls



its own alarm status display in the system status area of the VDU at the MAP. The alarm system software checks for changes in the alarm status of these subsystems every five seconds and updates the audible and visual alarm indications accordingly. This software responds to alarm or control inputs by operating or releasing appropriate Signal Distribution (SD) points in alarm system hardware and to initiate or terminate the corresponding audible and visual alarm, or control function.

### **Alarm classes**

Trouble conditions are assigned to an alarm class by the maintenance subsystem which detects the trouble. The alarm classes, in decreasing order of severity, are critical, major, and minor. Critical alarms are reported within two seconds of occurrence. Major alarms are reported within 30 sec. of occurrence. Minor alarm trouble notification is reported within two minutes of the occurrence of the trouble. All alarms displayed at the MAP are entered in the LOG system and output reports routed to the appropriate printers.

### **Audible alarms**

Audible alarms are activated either on-site or transferred by the remote alarm transfer circuit to a remote monitoring location. On-site audible signaling devices are mounted on two different audible alarm panels, the main audible alarm panel and an optional audible alarm panel, for the Trunk Test Center (TTC) and/or the Line Test Center (LTC).

Up to two main audible alarm panels may be supplied per office depending on office size and configuration. For example, an additional audible alarm panel for the power plant if located on another floor. The audible alarm panels may be either wall or column mounted.

The main audible alarm panel provides the signaling devices. The TTC audible alarm panel also provides a TTC chime which signals an incoming call on a 101 communication test line.

- Critical Bell – Loud bell which can signal dead system alarm, critical system equipment failure, critical power plant failure, or critical system or power plant failure in another system if alarm grouping is in effect.
- Major Chime – Loud tone bar struck at 60 ipm which signals a major system failure, major power plant failure, frame supervisory panel alarm on any equipment aisle, or major equipment failure in another system if alarm grouping is in effect.
- Alarm Battery Subset – Loud telephone ringer, two bells with resonators, which signals four major alarms:
  - alarm battery supply failure at a Power Distribution Center (PDC)
  - battery failure at the Office Alarm Unit (OAU) or the associated MTM

- failure of an internal supply circuit at the OAU or MTM (+130V supply or 20 Hz ac ringing supply)
- loss of communication between the central control and the OAU or MTM.
- Minor Alarm Subset – Loud telephone ringer, two bells without resonators, which signals a minor system equipment failure, minor power plant failure, minor equipment failure in another system if alarm grouping is in effect, or an incoming call on a 101 communication test line at the TTC if night alarm transfer is in effect.

### **Alarm control and display panel**

The Alarm Control and Display panel (ACD) is located at the MAP for operational convenience. Mounted on the ACD are lamps which display the type and class of alarms and switches which provide manual control of alarm system facilities. Table 7-1 illustrates ACD alarm conditions.

### **Alarm display panel**

The alarm display panel is a multiple of the ACD which has all of the manual control switches removed except for the audible alarm reset switch. The functions of the lamps and the single switch on the alarm display panel are the same as those on the ACD. A maximum of two panels can be provided. The alarm display panel can be placed within the same building in a remote location. On a per-job basis, a purchased telemetry unit, such as Datalok No. 9, may be used to remote the alarm display panel functions to other buildings.

### **Exit alarm panel**

An exit alarm panel is located near the main exit door of each DMS-100 Family System floor in a multi-floored office. A maximum of four exit alarm panels multiplied together can be provided per DMS-100 Family System. These panels direct maintenance personnel to the area or floor of the office where an alarm condition has been detected. They also provide remote controls for the night alarm transfer and alarm grouping circuits.

### **Equipment aisle visual alarms**

Each equipment aisle in the DMS-100 Family System is equipped with end aisle pilot lamps which light to red if a fault is detected by any Frame Supervisory Panel (FSP) in the aisle. Each FSP in the aisle is equipped with a frame fail lamp which lights to indicate which frame in the aisle generated the alarm.

### **Dead system alarm**

The dead system alarm is generated by alarm system hardware to indicate a loss of call processing ability in the DMS-100 Family System. When a dead system condition occurs, the dead system alarm hardware alerts operating

company personnel by sounding the critical alarm bell and lighting the critical system lamp on the ACD.

**No call processing alarm** This feature provides a more sensitive dead system alarm. The regular dead system alarm causes messages to be sent to the Office Alarm Unit (OAU). The OAU recognizes when these messages are absent and raises a critical alarm whenever messages are lost.

The enhanced dead system alarm is similar to the regular version except that the OAU makes calls into the CC. These call attempts are made every five seconds and, if after twenty seconds the CC has not answered, the OAU raises a critical alarm. The CC also counts the number of calls made and, if no calls are noticed in twenty seconds, the CC raises a critical alarm in the EXT level of the MAP.

<b>Table 7-1 ACD alarm conditions</b>		
<b>Designation</b>	<b>Device</b>	<b>Function</b>
Critical System	Lamp (red)	Signals a critical system failure
Major System	Lamp (amber)	Signals a major system failure
Minor System	Lamp (white)	Signals a minor system failure
Major Other System	Lamp (yellow)	Signals a critical or major alarm in another system
Minor Other System	Lamp (green)	Signals a minor alarm in another area
Power Dist Center ABS	Lamp (red)	Signals an alarm battery supply failure at a PDC
Office Alarm Unit	Lamp (amber)	Signals an alarm system hardware failure
Critical Power Plant	Lamp (red)	Signals a critical DMS power plant failure
Major Power Plant	Lamp (amber)	Signals a major DMS power plant failure
Minor Power Plant	Lamp (white)	Signals a minor DMS power plant failure
Power Dist Center	Lamp (amber)	Signals an office battery supply failure at a PDC
Night Alarm Transfer	Switch (locking)	Initiates TTC Night Alarm Transfer
	Lamp (white)	Signals TTC Night Alarm Transfer is in effect

<b>Table 7-1 ACD alarm conditions</b>		
<b>Designation</b>	<b>Device</b>	<b>Function</b>
Alarm Grouping	Switch (locking) Lamp (white)	Initiates Alarm Grouping Signals Alarm Grouping is in effect
Alarm Transfer	Switch (non-locking)  Lamp (white)	Initiates or cancels Remote Alarm Transfer  Signals Remote Alarm Transfer is in effect
Audible Alarm Reset	Switch (non-locking)	Silences audible alarms
Lamp Test	Switch (non-locking)	Momentarily lights all lamps on the ACD and on any ACD multiples

### **Audible alarm reset**

The audible alarm reset switch on the ACD provides a hardware facility for silencing audible alarms. Audible alarms can be silenced by the SIL command, input at the MAP console, or by the momentary operation of the non-locking audible alarm reset switch at the ACD. The dead system audible alarm cannot be silenced by software command.

### **Trunk test center alarms**

The Trunk Test Center (TTC) is the area of a DMS-100 Family System where Trunk Test Positions (TTPs) are located. The alarm system software detects the trunk group alarm conditions, and initiates the corresponding audible and visual alarms.

There are two alarm conditions specifically associated with the TTC; an incoming call on a 101 communication test line and a trunk group out-of-service alarm. Audible signaling devices for these alarms are mounted on the TTC audible alarm panel. An incoming 101 call sounds the TTC chime. The trunk group alarm is a system alarm detected by the software of the trunk maintenance subsystem. Depending on the number of trunks out of service, for example, system busy and manual busy, within one trunk group, a minor, major, or a critical system alarm is generated.

### **TTC night alarm transfer**

When the TTC area is unattended, the night alarm transfer circuit provides the facility to transfer the TTC alarms to the main office alarm system. With night alarm transfer in effect, incoming calls to 101 test lines at the TTP generate a minor system alarm instead of sounding the TTC chime.

**Line test center alarms**

The Line Test Center (LTC) is the area of a DMS-100 Family System where line test positions are located. Alarms will be generated when the quantity of line failures reaches or exceeds the operating company-defined threshold value.

The threshold for each type may be set independently. The alarm class displayed will be the more severe one of the two types. For alarm purposes two fault types, diagnostic failures and permanent signal partial dial conditions, are used. Diagnostic failures indicate that a line has failed a manual short or extended diagnostic test, an automatic short or extended diagnostic test, or a system-invoked extended diagnostic test occurs.

**Remote alarm transfer**

The remote alarm transfer circuit allows the transfer of major and minor alarm indications, for the system and its power plant, to a remote alarm-receiving circuit in a distant office. This permits the local office to be unattended. Since the remote alarm-receiving circuit monitors only major and minor alarm classes, for example, major and minor, critical alarms are transferred to the remote location as majors. If alarm grouping is in effect, alarms originating on preceding and succeeding floors are also transferred to the remote location. The transfer circuit communicates with the remote alarm-receiving circuit in the distant office over two leads using either -130V or +130V supplies for signaling.

**Alarm grouping**

The alarm grouping circuit provides the capability to group alarms originating in the DMS-100 Family System with those originating on preceding (lower) and succeeding (upper) floors which have compatible office alarm systems.

**Alarm circuit power detection**

In the DMS-100 Family System, loss of alarm circuitry power is detected. The office alarm system contains alarm circuits to indicate a failure in the supply that powers the alarm circuits themselves. A failure in the fuses that supply the alarm circuits causes an audible alarm to be sounded.

**External alarms**

The external alarm maintenance subsystem monitors the alarm circuits of any equipment outside the DMS-100 Family System, such as, door alarms, fire alarms, and other miscellaneous building alarms, through the operation of DMS Scan Points (SC).

**Operating company defined alarm capabilities**

The DMS-100 Family Systems can accommodate up to 7168 operating company assignable scan points. The Signal Distributor (SDs) points are only limited by the number of MTMs that can be added to a DMS office.

Software facilities are available to permit very flexible operating company designed logic arrangements between the SCs and SDs. Detection of an SC change of state can cause multiple SD operations. Multiple SCs can control a single SD. The operating company designed logic is defined through the MAP using the alarm scan table and the alarm signal distributor table. Refer to Chapter 4 for additional information on SC and SDs.

**Alarm sending and checking system**

The Alarm Sending and Checking System (ASCS) is a software feature compatible with the DMS-100 Family System office alarm system. When activated, the feature provides a facility for sending an indication of an alarm condition occurring in the DMS office over a trunk to a remote operator position. If the receiving operator is at a TOPS position, an ANI-8 information digit, spilled over the trunk, is translated to an alarm indication on the video screen. The operator uses the TOPS facility to access further information. When the trunk termination is a regular operator position, upon answer of the call a tone is generated across the trunk indicating that the originating office has encountered an alarm condition. The operator then dials a DN allocated to the ASCS checking facility, and hears a specific tone from the office indicating the severity of the alarm condition. The tones and directory numbers used for ASCS, as well as certain parameters associated with the feature, are operating company assigned. Typical tone assignment is as follows:

<b>Tone</b>	<b>Meaning</b>
Continuous high tone low tone, or ringback tone,	Initially received by the operator indicating the existence of an alarm condition in the originating office.

When the appropriate ASCS DN is dialed, the class of the alarm is indicated by the tone control received:

<b>Tone</b>	<b>Meaning</b>
No tone	CRITICAL alarm
Busy tone	MAJOR alarm
Code 1 ringback tone	MINOR alarm
Code 2 ringback tone	No alarm

ASCS has the capability of repeating the alarm indicating call if the alarm condition is not corrected, or if its severity has worsened since the checking call was made. When the office is left unattended, the ASCS feature is activated by operation of the alarm transfer switch on the alarm control and display panel or by using a command from the MAP.

### **MAP alarm level screening feature**

This feature expands the capabilities of customer screening at the TTP to allow customized trunk group alarms to be shown at the customer's terminal. The calculation of alarm levels for display at the customer's premises is based solely on that customer's trunk groups only. This calculation does not include other trunks in the office.

## **CCIS signaling maintenance – DMS-200**

CCIS signaling link and trunk testing and maintenance procedures comply with AT&T "Technical Advisory No. 14," Chapters 10 and 11.

### **Visual displays and audible alarms**

Information related to the operation and performance of the DMS-200 CCIS system can be obtained using the MAP and hard copy output.

**Dynamic status display** The dynamic status display gives a nearly instantaneous view of the DMS-200 CCIS system. Operating personnel can monitor the status of the signaling layer on the MAP. The information display includes the Voice Frequency Link (VFL) used when a signaling link forms, the synchronization state of a signaling link, and the transfer state of a signaling link.

The synchronization state of a signaling link can be indicated in any of five ways:

- 1 No Sync – Not synchronized
- 2 E Prov – Emergency proving period
- 3 N Prov – In normal proving period
- 4 Sync – Synchronized and passed all proving period
- 5 1 Fail – Unidirectional failure

The transfer state of a signaling link can be indicated in any of three ways:

- |     |   |
|-----|---|
| TFP | Transfer prohibited signals have been received on one or more bands on this signaling link.   |
| TFR | No transfer prohibited signal has been received on any band on this signaling link but transfer restricted signals have been received on one or more bands. |



TFA        Neither transfer prohibited nor transfer restricted signals have been received.

### Queries

Detailed information on the DMS-200 CCIS system not shown on the dynamic status display is available through queries. CCIS query information permits the query of the transfer state of a particular band in any signaling layer and the alarm conditions of the CCIS system. A transfer state can be prohibited, restricted, or allowed.

### Logs and alarms

All significant events of interest to operating personnel are logged. All serious conditions affecting the signaling capability of the CCIS system are indicated in appropriate alarm levels:

- Logged events
  - connect/disconnect of a signaling terminal to a voice frequency link
  - find/lose sync
  - pass/fail different emergency proving
  - transfer prohibited/transfer restricted/transfer allowed receive
  - link failure in a layer
  - total signaling failure in layer
  - signaling terminal failure
  - changeover signal receive
  - manual changeover signal sent/receive
  - Manual voice frequency link transfer signal sent/receive
  - test standby voice frequency link signal sent/receive.
- Alarm conditions
  - failure of signaling layer
  - failure of signaling link
  - reception of transfer prohibited signal
  - failure of signaling terminals and signaling terminal or link interface cards.

### Performance counts and reports

Performance counts and reports are provided through the DMS-200 Operational Measurements system as described in Chapter 5. For CCIS measurements, three types of registers are provided:

- 1 registers for peg count
  - Initial Address Messages transmitted on a signaling link
  - IAMs received on a signaling link



- 
- answer messages received on a signaling link
  - total messages transmitted on a signaling link excluding re-transmission SYU, ACU, and faulty link information
  - messages received on a signaling link excluding re-transmission SYU, ACU, and faulty link transmission
  - re-transmitted messages on a signaling link
  - SUs transmitted on a signaling link
  - MUMs transmitted and the number of MUMs received on a signaling link
  - signaling units received in error on a signaling link
  - message queue overflows on a signaling link
  - block re-synchronizations attempted on a signaling link, where re-sync has 350 ms to succeed after pegging this counter
  - occurrences that signaling rate drift compensation was performed on a signaling link
  - automatic transfers to a reserved VFL
  - manual transfers to a reserved VFL
  - link initializations
  - emergency restarts on a signaling layer.
- 2 registers for usage count
- a signaling link outage as a result of system-made busy
  - a signaling link outage as a result of maintenance-made busy
  - total signaling terminal outage as a result of system-made busy
  - total signaling terminals outage as a result of maintenance-made busy.
- 3 registers for quantity
- block synchronization attempts on a signaling link where block synchronization procedure is initiated on initial line startup, after block re-synchronize failure, or as part of returning repaired equipment to service
  - ST or modems in the office.

### Switching equipment

Operating personnel can run diagnostics on all equipment used in the CCIS system. Signaling terminals, as all other DMS-200 subsystems, are audited periodically to ensure their sanity. The DMS-200 CCIS signaling terminal has a built-in pseudo-random generator and detector which can be used to monitor the transmitted pseudo-random bit pattern looped back at different points in the system. The monitor function is initiated under the control of the CPU during diagnostic and fault isolation.

### **Voice frequency link**

Maintenance personnel can access transfer links at the TTP so that DMS-200 internal transmission tests can be performed on the VFL links. In addition, external equipment can also be connected to the VFL using the TTP jacks.

### **Station ringer test**

The Station Ringer Test (SRT) consists of tests performed on the station equipment, usually a residential telephone station or a coin station, by a person at that station with no involvement with operating company personnel at the CO.

### **Capabilities**

The DMS-100 provides a SRT, which performs a dial test, off-hook ground test, and on-hook ground test. The following is the sequence of subtests that are performed, when applicable. The SRT may be ended after either Subtest A or B has been performed:

- Subtest A DP digit collection/DP station
- Subtest B DIGITONE digit collection/DTMF station
- Subtest C coin return/coin station
- Subtest D party identification and ground checks

The dial pulse digit collection subtest collects digits received and compares them with known dialed digits. The DIGITONE digit collection subtest collects all digits during dial tone to verify that any initial digit would break dial tone on a normal call. In a coin station, the coin return subtest operates the coin control mechanism to verify correct operation.

### **Implementation**

The SRT uses the following hardware:

- MTA connected to the LM containing the linecard connected to the loop of the station being tested
- LTU connected to the MTA used
- line card
- A DTMF receiver (if station is DIGITONE)

The SRT can be accessed by dialing one of the following number formats, from the station to be tested. There is a concurrent eligibility for 10 digit number formats:

- **seven digit number** – where three digit access code is followed by the last four digits of the DN for the station that is being tested or where a two digit access code is followed by the last five digits of the DN for the station that is being tested.

- **ten digit number** – where a three digit access code is followed by the seven digit DN of the station that is being tested.
- **thirteen digit number** – where a three digit access code is followed by the NPA and the seven digit DN of the station that is being tested.
- **concurrent eligibility of 10 or 13-digit number** – If this option is adopted there is a delay of a few seconds when no NPA is used, so that the LCD can be assured that no additional digits are forthcoming. Seven-digit number can be made available concurrently with ten, thirteen, or concurrent eligibility.

A dial tone returned to the station signals that the SRT is ready for use; a reorder tone signals that the SRT is not ready for use. The SRT times out after 3.5 min. if the test sequence is not acted on. (The Electronic Business Set (EBS) line is automatically returned to the state IDL seven minutes after the start of the test.) After accessing the SRT, the tester conducts tests that are applicable according to 297-2101-516. The sequence of tests for both POTS and MERIDIAN Digital Centrex (MDC) lines is described in this manual, including SRT on the EBS and data set.

### User defined command files

DMS-100 Family System include a facility to permit MAP users to create, file, and execute sets of MAP input commands. This programmable capability provides a powerful means whereby an operating company or individual craftperson can construct custom test sequences. These test sequences could be standardized by the operating company for company-wide use if desired. Conversely, individual test sequences could be used for particular offices should there be special outside plant or other problems in that office. During rearrangement activities, the desired test sequence could be planned in advance and then executed singly or repetitively as appropriate. This capability is used by opening and naming a file using the EDIT program. Any valid sequence of MAP commands may then be entered into the file. The file may be saved in main system memory or on magnetic tape. Available maintenance MAP commands are described in this section.

The sequence of commands stored in the custom file may then be executed any time by accessing the file and issuing a single MAP command.

### Switching control center system

The major functions of the DMS-Switching Control Center System (SCCS) interface provide the operating companies with four capabilities:

- 1 obtain log information from the DMS
- 2 prepare reports that track the quality of DMS operation

- 3 transmit information required by other support systems associated with the SCCS, such as T-carrier administration and network switching center systems
- 4 perform remote maintenance.

The DMS-100 Family System/SCCS interface enables telephone operating companies to perform remote maintenance and surveillance from a centralized location. This results in the ability to perform maintenance activities, trouble analysis, and emergency recovery of DMS-100 Family System switches remotely. Remote control of these functions provides economics in operation and improved response time.

The DMS-100 Family System/SCCS interface consists of two main areas and components. The first is remote maintenance consisting of two input/output channels for maintenance and system log reports. The second is remote surveillance consisting of the E2A telemetry interface.

#### **Remote maintenance I/O interface**

The remote maintenance I/O interface to the No. 2 SCCS transmits interactive commands and responses on the maintenance channel, and messages on the logging channel. The output message log format has been adapted on an optional basis for the No. 2 SCCS interface.

Generally, the I/O interface for remote maintenance consists of one primary MAP channel and one primary logging channel configured in the dedicated mode, with one or more I/O devices configured in the dial-up mode for backup. Modems that operate over four-wire, full-duplex facilities are provided by the operating company. An outboard modem-switching device with secure dial-up capabilities may be provided by the telephone company to allow connection from the SCCS to a secondary MAP I/O device and modem dial-up facilities. In such cases, two Foreign Exchange (FX) circuits from an adjoining exchange would be required. The modem-switching device can convert the two 2 wire line connections to one 4 wire facility at the modem.

#### **Remote surveillance and control telemetry interface**

This feature provides an NT1X48CA maintenance card and an NT1X42AA serial conversion card in the DMS-100 CPU shelf, and support software. With this feature, full control over CPU switch and thumbwheel functions is extended to the SCCS for maintenance and recovery operations.

These control functions are accompanied by comprehensive status indicators sent to the SCCS by the telemetry serial interface. The remote surveillance and control elementary interface uses a serial interface and SD functions for the discrete contact closure interface.

The discrete contact closure interface, as provided by way of loop closures on SD points, allows the SCC to receive alarms from the DMS-100 Family System switch. SD cards, with 14 SD points per card, are used for the interface and are provisioned in quantities that meet the telephone company's specified SCCS requirements. The SD points are activated as required by standard software translation tables.

The telemetry interface functions independently of the DMS-100 Family System switch and the SCCS minicomputer. Telemetry interface status flags are routinely audited and reported by way of the MAP and system logs as appropriate. The CC status will provide a report of errors on the particular CPU for Remote Maintenance Center (RMC) sanity set (Rsan), RMC manually disabled (Rman), and RMC protocol failure (Rpro).

### **SCCS-E2A Telemetry Alarm Indications**

- 1 CKT Limit
- 2 Critical
- 3 Major
- 4 Minor
- 5 System Emergency
- 6 CC
- 7 CMC
- 8 Network
- 9 Peripheral
- 10 Remote
- 11 I/O
- 12 Bldg/Power
- 13 AMA
- 14 Bldg Inhibit
- 15 Traffic
- 16 System Normal

### **Dialable cable locator tone**

This feature provides the capability for a craftperson to locate a specific tip and ring cable pair among a group of cables in any location. The craftperson connects a phone to any tip and ring cable and dials a security access code of three to seven digits followed by the DN of the desired line. The DMS-100 Family System switch connects an external tone supply to the desired line for a specified duration. The tone supply is connected by way of a MAINT type trunk which is datafilled in Table TRKGRP. The craftperson then uses a special probe, designed to accept the frequency of the applied tone, and

locates the desired cable pair. The tone generator and probe are not Nortel Networks products and, as such, are supplied by the operating company.

### **Silent switchman feature**

The silent switchman feature enables a craftperson to test the outside plant without the need of a second person in the office to open the cable pair. It is accessed using a three-digit code dialed from the customer station. Ten seconds of busy tone are given, and then the line is cut off for a period of up to 255 sec., (data modification order modifiable), to allow testing on an open circuit. If the line is still off-hook when the cut-off relay is released, the line re-originate and receives dial tone. The silent switchman feature does not require any hardware at the terminating end. Routing is accomplished much like the synch-nonsynch test line which makes use of a fixed CLLI group. Silent switchman is not supported for RCS (SLC-96) lines.

### **Dialable short circuit**

This feature provides single person access and testing through the use of a variable length access code (three to seven digits) that may be dialed from a line. The DMS places a short across the tip and ring of a specified line for up to six minutes (variable), with a three minute default. The short is removed at the end of the timeout. If the condition of the line prevents dialing, the test may be initiated from a different line by dialing the access code and the seven-digit DN of the desired line. By providing this feature, the telephone operating company reduces the total manpower required for cable testing.

## **DMS SuperNode – XPM**

XPM is the term applied to the Peripheral Modules (PM) based on the Extended Multiprocessor System (XMS) developed by Nortel Networks. The XPMs use the Motorola 68000 microprocessor. All XPMs have a common hardware and software base and a common run time environment.

### **XPM Hardware configuration**

Each XPM is divided into two units. Each unit occupies one shelf and contains the following hardware components:

- DS30 Interface cards (on the C-side)
- control section
- DS30A or DS1 Interface cards (on P-side)
- power converter
- spare slots

## Interface cards

**DS30 interface cards** These cards are on the C-side of the XPM. There are four DS30 Interface Cards, two on each shelf. The two cards on shelf 0 are connected to plane 0 of the Network Module (NM). The two cards on shelf 1 are connected to plane 1 of the NM. The speech links are duplicated over both planes. There are eight ports per card (numbered 0 through 7, or 8 through 15); as a result, there are 16 ports (0 through 15) connected to both planes of the NM. Each DS30 Interface Card is connected to both control sections for reliability. As a result, both control sections have access to all 16 ports on both planes.

**Control sections** For reliability, the XPM contains two control sections, one in each unit (or shelf). Only one unit is active at any one time. Each control section contains the following hardware components, all of which (with the exception of the Master Processor) are on the Signaling Processor address bus. Each control section contains these hardware components:

- 1 **Signal Processor (SP)**—provides the processing required to support real-time critical functions of the XPM.
- 2 **Master Processor (MP)**—provides call processing functions associated with the XPM applications.
- 3 **Formatter card**—contains the logic required to select speech links from either plane of the NM and the logic for the XPM shelf clock.
- 4 **CSM Interface card**—contains the required logic for CSM extraction and insertion, for parity and integrity checking.
- 5 **Message Interface card or the Message Protocol Circuit**—contains the interface to both NM and P-side message channels.
- 6 **A/B Bit Interface and Time Switch card**—contains the logic for A/B extraction and insertion. The time switch enables any C-side channel to connect to any P-side channel.

**DS30A and/or DS1 interface cards** The DS30A Interface cards and DS1 Interface cards are on the P-side of the XPM. The XPM may be equipped with DS30A Interface cards, or DS1 Interface cards, or a combination of the two. However, there can be no more than 20 ports on the P-side of the XPM.

Each DS30A Interface card is duplicated for reliability and has ten P-side ports. The duplicated cards are connected to the same DS30A link, but not to the same control section. The DS30A Interface cards on shelf 0 are connected to control section 0; the DS30A Interface cards on shelf 1 are connected to control section 1. For example, if the XPM has been equipped with four DS30A Interface cards and no DS1 Interface cards, there will be two active cards on the active unit (shelf), for a total of 20 ports. The other two cards (on the mate shelf) are duplicates of the active cards.



**Power converter** The XPM contains two power converters, one in each unit. The XPM Power Converter supplies the shelf voltages required by the XPM. Each converter can supply power to both shelves if the other fails.

**Spare slots** There are five spare (empty) card slots in each XPM unit (shelf). The spare slots provide room for future expansion. Three of these slots have access to the SP address bus and the parallel speech bus. The remaining two spare slots do not have access to either bus.

### **XPM hardware components and shelf layout**

The following table lists the XPM hardware components with their corresponding card numbers:

<b>Hardware Component</b>	<b>Card Number</b>
DS1 Interface Card	6X50
DS30A Interface Card	6X48
Master Processor	6X45
Master Processor	6X47
Signaling Processor	6X45
Signaling Processor Memory	6X46
A/B Bit Interface and Time Switch Card	6X44
Message Interface Card	6X43
Message Protocol Circuit	6X69
Tone Generator Circuit	6X79
CSM Interface Card	6X42
Formatter Card	6X41
DS30 Interface Card	6X40
Power Converter	2X70

### **XPM reliability strategies**

The XPM is divided into two units (0 and 1) for reliability. There is one active unit and one standby unit. The active unit is responsible for call processing, while the standby unit is ready to take over if a fault occurs in the active unit. This mode of operation is known as “hot standby.”



The control sections in the XPM are connected by a Universal Synchronous Asynchronous Receiver Transmitter (USART). This USART is called the Inter-Module Communication (IMC) link. There are two pairs of USARTs: one pair connects that SPs, the other pair connects the MPs. Only the USART connecting the two SPs is used. This USART is used to transfer information from the active unit to the standby unit, thus enabling the standby unit to assume control if a fault occurs in the active unit.

The USART is used to transfer information about call processing and maintenance. The call processing information is transferred only when the connection has been made and the call has reached the talking stage. The maintenance information (for example, that a link is busy) is transferred as it is detected by the active unit.

XPMs are responsible for detecting faults. The SP and the MP run audits on each of the components in the XPM, looking for faults. For example, audits to check the parity of Pulse Code Modulation (PCM) signals, or to check CSM integrity.

## Interoffice transmission testing

The purpose of the DMS-100 Family System test lines is to facilitate various manual and automatic tests to distant toll and local offices without human intervention at the called offices. Several test line terminators are available in the DMS-100 Family System:

- N100, S100, T100      Quiet or balanced termination
- T101                      Communication Test Line
- T102                      Milliwatt Test Line
- T103                      Supervisory and Signaling Test Line
- T104                      Transmission Test Line
- T105                      Transmission Measuring Test Line (terminating)
- T108                      Echo Suppression Test Line (terminating only)
- T109                      Echo Canceler Test Line, (terminating only)
- TSYN                      Synchronous Test Line
- TNSS                      Non-Synchronous Test Line

In addition to the ability to direct tests to the test lines above, DMS-100 Family System provides Remote Office Test Line (ROTL) interface for the Centralized Automatic Reporting On Trunks (CAROT) System. The interoffice transmission tests noted here also are performed by the DMS-100 Family System:

- TEM                      E&M Lead Test
- TRP2                      Repeat Two Test
- TLPA                      Loop Around Test

- ERL Echo Return Loss
- SRL Singing Return Loss (TCLC Short Circuit Test Line)
- TCLC Short Circuit Test Line
- TOTC Open Circuit Test Line

### **Test line tests and test termination**

#### **NI00, SI00, T100 test line**

The 100 test line, which is also known as a quiet or balanced termination, is used for noise and loss measurements. The 100 test line test can be invoked manually through the TTP or automatically through automatic trunk testing. There are three versions of the 100 test line test; S100, N100, and T100. The S100 provides a quiet termination for noise measurements only. The N100, a more recent version of the test, also includes a milliwatt test (a T102 test line) and can be used for far-to-near loss measurements. The T100 is used when the equipment at the terminating office is unknown. When the T100 test line is performed, a two-second time-out is introduced to detect the presence or absence of a milliwatt tone. If the T100 test detects the milliwatt tone, it executes the N100 version of the test; otherwise, the S100 version is initiated. If the version of the distant office test line is known, then that version of the test line can be performed directly, and thus the two-second delay per trunk of the T100 test line test is eliminated.

The DMS-100 Family System provides N100 and S100 quiet termination.

#### **T101 test line**

The T101 test line is used to establish two-way communications between the test position and any trunk incoming to the system.

The connection to the T101 test line is established through the switching network. To transfer from the voice mode to the test mode, a MAP must be available in the manual trunk test level. In this level, two commands are available which allow transfer of the connection:

- 1 Call Transfer (CALLTRF) transfers connection to TTP, making it available for maintenance functions.
- 2 Headset (HSET) returns trunk in the control position on the TTP to the communication module for voice access.

Capability is provided to direct a T101 call to a designated TTP, for example, a 101XX call will be routed to the TTP designated XX. If the TTP is busy, the call will be offered to any free TTP. Tests to a distant office code 101 test line are directed from the MAP position. Refer to 297-1001-516 for additional information.

**T102 test line**

The purpose of the T102 test line, also known as a milliwatt test line, is to apply a 1004 Hz test tone towards the originating office to facilitate simple one-way manual or automatic transmission loss measurements. The test tone is applied for a timed duration of nine-seconds during which an off-hook answer signal is provided. Then an on-hook signal followed by a quiet termination is transmitted to the originating end until the connection is released by the originating end.

The test sequence of the T102 test line is compatible with that described in “Notes on the Network”. Operation of the test line is given in NTP 297-1001-516. Seven-digit access is available for the T102 test line, as well as T102 access. The DMS Family System directs manual and automatic tests to the milliwatt test line.

**T103 test line**

The T103 test line is used for the overall testing of supervisory and signaling features on intertoll trunks. The test is performed to the far end to check overall supervisory and signaling features of the trunk. If the test fails or if a false tone signal is detected, the test is abandoned and the condition indicated. The tone checks are performed by the tone detector of the Transmission Test Trunk (TTT) provided in the DMS-100 Family System. The tone detector is able to detect and recognize all the supervisory signals that may be encountered (ringing, announcement, milliwatt, test progress tone, busy, and reorder tones). The DMS Family System provides the T103 test line termination for use in toll offices.

**T104 test line**

The T104 test line is used for two-way transmission loss measurements, far-to-near noise measurements, and near-to-far noise checks. Near-to-far noise checks are given only as an indication if the far-end preset value is exceeded. The T104 test line, normally used in testing toll trunks, is optional. This test line is normally not provided in local offices.

**T105 transmission measuring test line – terminating**

When a T105 test line at a far-end office is called and seized, timing functions are initiated and an off-hook supervisory signal and test progress tone are returned to the originating office. If the respondent is idle, the test line is connected to the respondent and test progress tone is removed. Transmission tests are then initiated. In the DMS-100 Family System, T105 test line terminating capability can be added by ordering the T105 far end software feature.

### **T108 test line**

The T108 test line provides far-end loop-around terminations to which a near-end echo suppression measuring set is connected for the purpose of testing echo suppressors.

### **T109 echo canceler test line**

The AT&T T109 echo canceler test line J93020CE-1 can be engineered into the DMS-100 Family System.

### **TSYN – synchronous test line**

The synchronous test line test (TSYN) provides for testing ringing, tripping and supervisory functions, and marginal testing of the supervisory and tripping functions of the local interoffice and toll-connecting trunks. The DMS-100 Family System provides the synchronous test line termination. It conforms with the responses defined in the “Notes on the Network”.

### **TNSYN – non-synchronous test line**

The non-synchronous test line test (TNSYN) provides an operational test for rapid testing of ringing, tripping, and supervisory functions of local interoffice and toll-connecting trunks. The DMS-100 Family System provides the non-synchronous test line termination. It conforms with the responses defined in the notes on the network.

## **Interoffice tests**

### **TEM – E&M lead test**

The DMS-100 Family System E&M lead, the designation for trunk and signaling type used, test (TEM) provides a rapid continuity, signaling and pulsing test to a distant office. The test sequence consists of a connection to the distant office test line and ends when the answer off-hook signal is received.

### **TRP2 – repeat two test**

The DMS Family repeat two test (TRP2) ensures that a trunk circuit in the distant office disconnects properly within the allocated time when the connection in the originating office is taken down. The test consists of two tests made in rapid succession on the same trunk circuit. The first test is the standard operational test line test, for example, T103, followed by an E&M lead test. If the distant office fails to disconnect after the first test, a 120 IPM signal is returned in the second test. The test is directed to an operating company pre-arranged termination. Normally this is a T103 test line when testing into a toll office, and synchronous or non-synchronous test line when testing into a local office.

### **TLPA – loop-around test**

The loop-around test (TLPA) enables two-way transmission tests to be performed on trunks to an end office without the requirement for manual

intervention at the end office. Tests using this test line are carried out either manually from a TTP or through the ATT system.

Initially, a 102TLT milliwatt test is carried out on two trunks to determine the far-near loss of each trunk. The two trunks are then connected in the loop-around test configuration. The terminating TLPA has two ports and each port is accessed by a separate access code. A milliwatt signal is transmitted over one trunk, through the TLPA, back to the originating office over the second trunk, and measured. The near-far loss of one trunk is determined by deducting the known far-near loss of the other trunk from the total loss. The TLPA test is repeated with the two trunk roles reversed.

The loop-around test is implemented according to “Notes on the Network”. A band pass filter is provided for transmission in both directions to prevent fraudulent talking. The filter frequency is 960–1200 Hz  $\pm$  16 Hz.

### **Centralized automatic reporting on trunk interface**

The ROTL capability is an essential part of the centralized automatic trunk testing system. The main purpose of this system is to perform transmission as well as signaling tests on trunk circuits over a wide area, that is, trunks connecting different offices in that area. An example of such a centralized system is the Centralized Automatic Reporting On Trunks (CAROT).

In order to perform the maintenance testing over a specific circuit, suitable equipment is connected at one end to initiate and control the test sequence while responding test equipment is connected at the far end. The test results are communicated to the CAROT centralized processor on the completion of each test.

In DMS-100 Family System implementation, the ROTL feature is provided by the Nortel Networks Digital Test Head/Remote Office Test Line (DTH/ROTL) with suitable interface to DMS-100 Family System. The controlling end is called the ROTL and provides the capability to communicate with the CAROT centralized processor in a predetermined format:

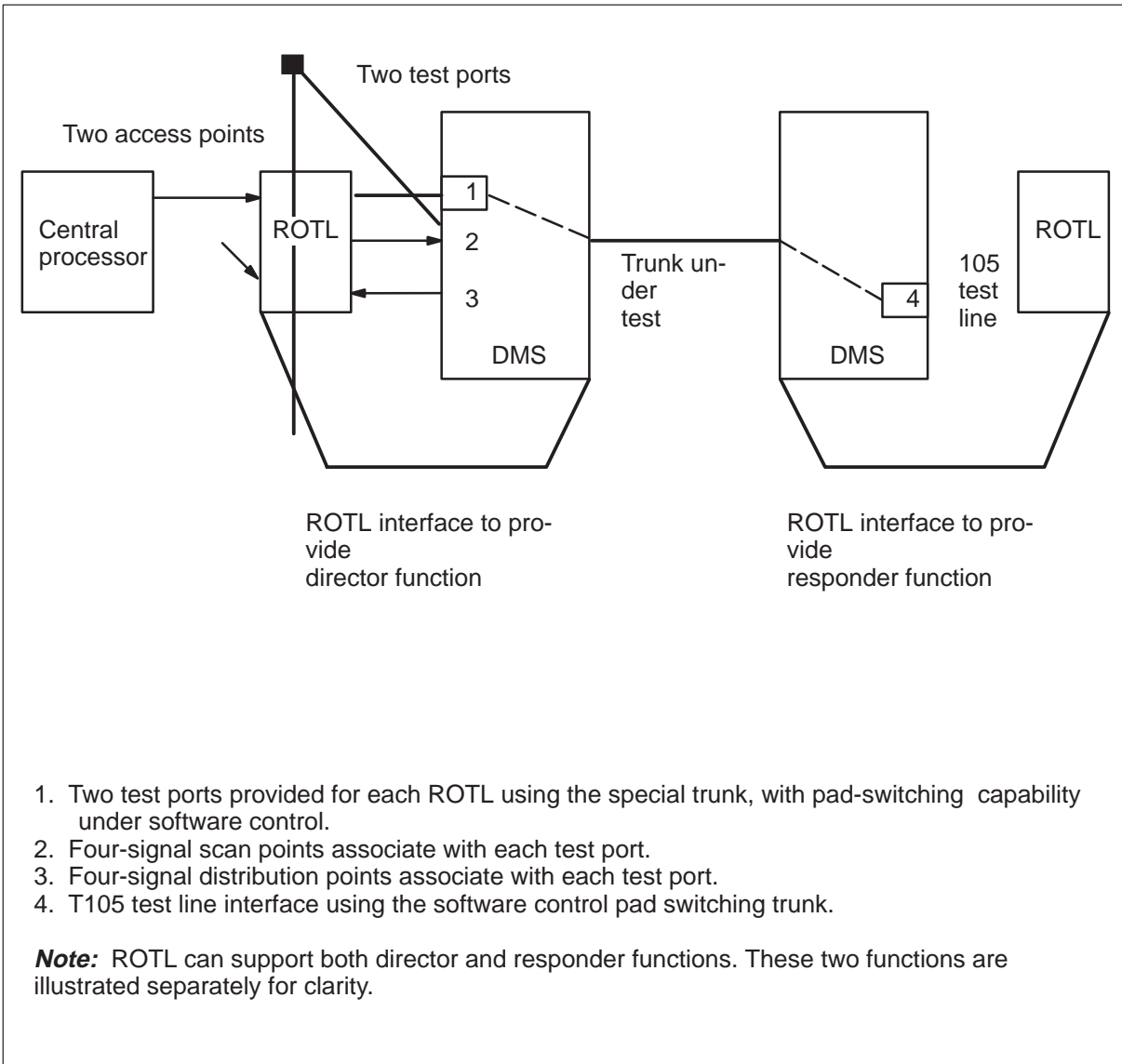
- make direct/indirect connection to the circuit to be tested
- initiate and perform the requested test(s)
- report the measured result to the CAROT central processor
- perform the respondent function as a terminating T105 test line (optional)

### **ROTL access**

The access of ROTL from the CAROT central processor is through dialable subscriber lines in two line hunt groups. The access lines may be connected to any Class 5 office while the ROTL is physically located in the DMS-100 Family System office. After the connection is established and the ROTL is

ready to proceed with the test, the ROTL communicates with DMS-100 Family System for trunk selection through the test port and scan/distributor points as described later. Figure 7-6 illustrates the ROTL test configuration.

**Figure 7-6**  
**ROTL test configuration**



### ROTL test port

The ROTL test port interface with the DMS-100 Family System is provided by a four-wire E&M type II circuit with 600- $\Omega$  impedance and wink start capability. The ROTL seizes a test port when it is ready to process the test request from the CAROT central processor. A MF receiver is attached upon seizure of the test port. Wink start signal is returned when the MF receiver is

attached. Appropriate control signals, in the form of “test progress tones”, are applied/removed from ROTL using the access line to the CAROT central processor until both ROTL and the switch are ready to receive the test instructions in the form of MF digits called priming digits. The priming digits include trunk selection information and the test instruction. The DMS-100 Family System primarily captures the trunk selection information and connects the selected trunk to the test port. The requested tests are performed by the ROTL internal hardware after the connection is established by the switching system. The system also seizes and outpulses on the selected trunk with the digits indicated in the priming information from the CAROT central processor. The outpulsed digits result in the attachment of proper terminating test equipment at the far end.

### Scan and signal distributor points

There are four scan points and four signal distributor points associated with each test port. The DMS-100 Family System and ROTL make use of the scan and signal distributor points to acknowledge and control the test sequence.

### Alarm status

DMS-100 Family System are capable of recognizing and indicating an alarm condition from the ROTL. The recognition is through a single scan point and results in a minor alarm at the system.

### T105 test line

The ROTL unit can be optionally equipped with up to six T105 test lines. The T105 test lines interface to the DMS-100 Family System using trunks such as the ones used for the test ports. If only the far end 105 test line and respondent feature is required, then only additional Nortel Networks software and hardware is required for a DMS-100 system.

**105 testline ERL/SRL** The Echo Return Loss (ERL) and Singing Return Loss (SRL) measure the return loss of a band-limited white noise signal over a trunk circuit. This feature adds 6 originating and 6 terminating tests to the T105 test line. The hardware required for this feature is NT2X47AD Transmission Test Unit (TTU). Table 7-2 outlines each test added in this feature.

<b>Table 7-2 T105 tests</b>			
<b>Test ID</b>	<b>Mnemonic</b>	<b>Test description</b>	<b>MF digit(s)</b>
31	SHISC	Singing Return Loss High Self-Check	A, 1
32	SRLHI	Singing Return Loss High	A, 2
—continued—			

<b>Table 7-2</b>			
<b>T105 tests</b> (continued)			
<b>Test ID</b>	<b>Mnemonic</b>	<b>Test description</b>	<b>MF digit(s)</b>
28	SRLLO	Singing Return Loss Low	8
38	SRLSC	Singing Return Loss Low Self-Check	A, 8
2B	ERL	Echo Return Loss	C
3B	ERLSC	Echo Return Loss Self-Check	A, C
<b>End</b>			

**Adding ERL and SRL capability to ATMS** When the originating office is a DMS-100 Family System Switch, this feature enhances the T105 tests to include Echo Return Loss (ERL) and Singing Return Loss (SRL). The hardware required for this feature is the NT2X47AD (TTU).

### Reporting of results

The DMS-100 Family System is only responsible for trunk selection, outpulsing of requested digits, and control of the transmission pads on the ROTL test port interface trunks. All other measurement functions, including reporting of results, are performed by the respondent, ROTL, and the central processor of the APC unit, using in-band signals, and are therefore transparent to the DMS-100 Family System.

### Types of tests

Six tests are supported through the ROTL interface:

- 1 T100 test line
- 2 T102 test line
- 3 T103 test line
- 4 T105 test line
  - Terminal balance (Toll)
  - Gain/slope frequency
  - C-notched noise
- 5 non-synchronous test line
- 6 synchronous test line

Current plans are to incorporate terminal balance, gain/slope frequency and C-notched noise tests in the T105 test line as described in AT&T "Technical Advisory No. 17," November 1981.



### **ROTL maintenance**

The ROTL system can be maintained without any maintenance software being incorporated into the DMS-100 Family System. A ROTL diagnostic package interacts with local maintenance personnel using a data terminal for which an optional jack access is provided using EIA RS232C interface. The capability of remote access of the diagnostic package over the Direct Distance Dial (DDD) network is provided. The remote terminal can request specific diagnostic tests to be executed and have the results sent back for display purposes.

Alignment of transmission measuring equipment within the ROTL system is performed on a manual basis using portable test equipment for which access is provided.

The ROTL system closes the alarm sense point contacts to indicate to the DMS-100 Family System when a major alarm condition, such as loss of power, exists. A visual indication of the major alarm is also provided by the ROTL system equipment. A primary power ON visual indication is provided to indicate that the ROTL system is receiving dc power.

## **Trunk test facilities and features**

### **Trunk test facilities at the maintenance center**

The Trunk Test Position (TTP) is used in the trunk maintenance center of a DMS-100 Family System office for manual and automatic testing of trunks and their associated facilities to the distant office. The TTP is basically a MAP equipped with the VDU, a communications module, jack field and optional associated furniture as described in this section.

The TTP functions may be performed from a remote MAP. Functions requiring external test equipment or monitoring may only be performed if the jack-ended trunks and headset circuit are extended to the remote location.

The test equipment required for the TTP test functions is internal to the DMS-100 Family System and is not dedicated to any specific TTP. The trunk test equipment is mounted on the Maintenance Trunk Module (MTM). It is selected from a common pool of test equipment when required by the TTP. When a test function has been completed, the test equipment is returned to the common pool.

The test equipment available in the common pool consists of a Milliwatt supply and a Transmission Test Trunk. The milliwatt supply provides a standard milliwatt source at 1004 Hz. The Transmission Test Trunk (TTT), which consists of a Pulse Code Modulation (PCM) level meter card and a test signal generator card, is used in four ways:

- 1 loss measuring device indicates frequency and level

- 2 noise measuring device, C-message weighting
- 3 tone detector identifies supervisory signals
- 4 frequency generator, adjustable frequency and level

The PCM Level Meter (PLM) card contains circuitry for measuring the level and frequency of PCM samples representing analog voice frequencies or tones. The PLM card contains a level meter and a frequency meter which are activated by control signals from the MTM at the appropriate time for the channel under test.

The DMS-100 Family System provides the capability of measuring and applying the level of a nominal 400 Hz, 1 KHz, or 2800 Hz. The actual frequency range accommodated by the DMS-100 Family System is 4-3996 Hz with level of range +3 dBm0 to -60 dBm0. In addition to this, various test line tests, such as, open circuit, short circuit, and balance, are provided by the DMS-100 Family System.

### **TTP general description**

The TTP provides maintenance personnel with the ability to perform maintenance test functions on trunk circuits and their associated facilities to the distant office.

There are six types of trunk circuits:

- 1 incoming trunks
- 2 outgoing trunks
- 3 two-way trunks
- 4 receivers
- 5 test equipment
- 6 miscellaneous circuits

In order to perform any maintenance functions on trunk circuits, access to the TTP level is required. The TTP level is accessed by telescoping through the Maintenance (MTC) and Trunks (TRKS) levels of the maintenance subsystems. Once the TTP level is accessed, any of the functions, through the menu commands, are entered from this level.

The system status display for the TTP level indicates, for example under the TRKS subsystem, the trunk status of the DMS-100 Family System. The overall status of the TRKS subsystem is reflected by status codes and alarm codes. Figure 7-7 illustrates the system status display and the maintenance menu. Figure 7-8 illustrates the trunk level display menu. In DMS-100 Family System, trunk and trunk group information can be displayed on the TTP by entering the trunk group status level. Figure 7-9 illustrates the trunk group status display menu, Figure 7-10 illustrates the trunks status display and menu.

**Figure 7-7**  
**System status display and maintenance menu**

CM	MS	IOD	Net	PM	CCS	Lns	Trks	Ext
.	.	.	.	.	.	26GC	.	.
	Mtc	/				*C*		
0	Quit	/						
2	ACTIVITY	/						
3		/						
4		/						
5		/						
6		/						
7		/						
8		/						
9	CC	/						
10	CMC	/						
11	IOD	/						
12	Net	/						
13	PM	/						
14	CCS	/						
15	LNS	/						
16	Trks	/						
17	EXT	/						
18		/						
	User ID							
	TIME hh:mm							

**Figure 7-8**  
**Trunk level display and menu**

CM	MS	IOD	Net	PM	CCS	Lns	Trks	Ext
.	.	.	.	.	.	.	26GC	.
Trks	/						*C*	
0 Quit	/							
2 Stat	/							
3 TTP	/							
4 ATT	/							
5	/							
6 CARRIER	/							
7 TRKS TRBL	/							
8	/							
9	/							
10	/							
11	/							
12	/							
13	/							
14	/							
15	/							
16	/							
17	/							
18	/							
User I								
TIME hh:mm								

**Figure 7-9**  
**Trunk group status display and menu**

CM	MS	IOD	Net	PM	CCS	Lns	Trks	Ext			
.	.	.	.	.	.	.	26GC	.			
							*C*				
	STATTKERP /			TWOWY		ITG	OTG	MISC			
0	Quit /			5GC		10GC	11GC	.			
2	DispGrp_ /										
3	NextGrp /	ITEM	TYPE	A	COMLANG	TOT	SB	MB	EX	%OS	
4	HCpyGrp_ /										
5	Item_ /	0	IC	SB	HULLPQ1077X0	20	2	1	0	15	
6	/	1	IC	.	TRLPQ0201T1	25	0	0	0	0	
7	/										
8	/										
9	/										
10	/										
11	/										
12	/										
13	/										
14	/										
15	/										
16	/										
17	/										
18	/										
	User ID										
	hh:mm										

**Figure 7-10**  
**Trunks status display and menu**

```

CM      MS      IOD      Net      PM      CCS      Lns      Trks      Ext
.      .      .      .      .      .      .      2GC      .
                                     *C*

  STATTRKS      /      TWOWY      ITG      OTG      MISC
0  Quit      /      2GC      .
2  DispTrk_    /
3  NextTrk /
4  HCpyTrk_    /      ITEM  TYPE  A  COMLANG      TOT  SB  MB  EX  %OS
5  SelGrp_     /
6  DisAlm_     /PM      NO  TRMNL  CKTNO  STATE  PM  NO  TRMNL  CKTNO  STATE
7  PrtAlm_     /TM8      1   3      1   INB   TM8  0   24   2   INB
8              /TM8      2   1      3   INB
9              /
10             /
11             /
12             /
13             /
14             /
15             /
16             /
17             /
18             /

User ID
hh:mm
    
```

The following information is displayed for the trunk group status level:

Display headings	Information displayed
TYPE	Type of trunk group: 2W, IC, 0G, or MISC.
A	Most serious alarm state present in the trunk group: GC, GM, G, SB, EX, MB, or • (period).
COMLANG	Common Language Location Identifier (CLLI) which identifies the far end of the trunk group. Presented in the format: aaaabbxxyyz.  where: aaaa = place/town bb = province/state xx = building yyy = traffic unit z = suffix
TOT	Total number of trunks in the group.
SB	Number of trunks that are system-busy.
MB	Number of trunks that are maintenance-busy.

<b>Display headings</b>	<b>Information displayed</b>
EX	Number of trunks that are external-busy, that is, busy as a result of external, carrier, or failure, TM failure.
%OS	Percentage of trunks out of service, that is, not available for call processing.
<b>Code displayed</b>	<b>Meaning</b>
GC	Group Critical alarm. The number of trunks in the EX, Manual Busy (MB), and System Busy (SB) states exceeds an operating company established level.
GM	Group Major alarm. The number of trunks in EX, MB, and SB states exceeds an operating company established level, but not the critical alarm level.
G	Group Minor alarm. The number of trunks in EX, MB, and SB states exceeds operating company established level, but not the major alarm level.
•	A period. No trunks are out of service.

In the case of individual trunks in a trunk group, the following is displayed for the trunk status, as illustrated in Figure 7-10.

<b>Status code</b>	<b>Trunk state</b>	<b>Description</b>
CFL	Carrier Fail	Trunk removed from service because of failure of associated outside facility.
CPB	Call Processing Busy	Trunk currently carrying traffic, that is, part of call-carrying connection, service-busy.
CPD	Call Processing Deload	Trunk carrying traffic, but another entity, for example, maintenance, has requested to be informed when Call Processing (CP) releases trunk.
DEL	Deload	Trunk previously CPD, now released by CP; requestor is now being informed that trunk is now available.
IDL	Idle	Trunk in service and available to any process.
INB	Installation Busy	Trunk is installed but not yet in service, for example, not tested.
INI	Initialized	Intermediate state to which all previously CPB circuits are set following a system restart.

Status code	Trunk state	Description
LO	Lockout	Trunk under continuous seizure from far office without digits being received; system continues scanning and sets circuit idle when seizure ceases.
MB	Maintenance Busy	Trunk removed from service by maintenance personnel; can be returned only by maintenance person.
NEQ	Not Equipped	Trunk hardware not provided.
NMB	Network Management Busy	Trunk removed from service through automatic manual network management action.
PMB	Peripheral Module Busy	Trunk not available to traffic because the associated PM is out of service.
RES	Restricted Idle	Two-way trunk with restricted availability to traffic, for example, outgoing side not available.
RMB	Remote Make Busy	Trunk with incoming side removed from service either by far end or by near end which informs far end.
SB	System Busy	Trunk removed from service by system maintenance which performs periodic tests, for example, to detect intermittent conditions, until trunk is either restored to service or set MB.
SZD	Seized	Indicates a trunk has maintenance or system process ongoing.

As illustrated in Figure 7-8, the TRKS level display layout is similar to the system status display except for the different command menu. Using the command menu and the telescoping process, two functions are accomplished and information is obtained from the TTP in the DMS-100 Family System:

- 1 Query:
  - trunk group status
  - Individual trunk status
- 2 Enter:
  - TTP monitor level
  - TTP manual level
  - TTP automatic trunk testing level
  - CARRIER menu level for regular DS-1 spans
  - CCS menu level



Once the appropriate level for the TTP is displayed, maintenance action for trunks is requested by invoking the appropriate command. Typically, the following information is displayed for the circuit under test in the TTP status menu and display, as illustrated in Figure 7-11:

- circuit type
- trunk or DTC module name and number
- trunk group CLLI
- trunk state
- supervision
- type of test equipment connected
- type of distant office termination
- level meter reading
- test results

**Figure 7-11**  
**TTP status and menu display**

```

CM      MS      IOD      Net      PM      CCS      Lns      Trks      Ext
.       .       .       .       .       .       .       1MB      .

      TTP      /POST 127 DELQ D 4 A16 BUSYQ A 59 DIG
0 Quit      /TTP 14
2 Post_     /CKT TYPE PM NO COM LANG STA S R DOT TE RESULT
3 Seize_    /2WY MF TM2 125 22 TOROONO523H1 7001SZD..DIG
4           /
5 Bsy_     /A-SZ SEL MB
6 RTS_     /
7 Tst_     /TL TEST SET
8          /
9          /
10 CktLoc  /
11 Hold    /
12 Next_   /
13 Rls     - /
14 Ckt_    /
15 Trans1Vf_ /
16 StkSdr_ /
17 Pads_   /
18 Level_  /
User ID
hh:mm

```

### TTP control

Each TTP displays up to four controlled connections at any one time. One control position and three hold positions are available. The connections set up on any of these positions are displayed on the VDU.

Before any maintenance action on a circuit can be performed, it must first be identified to the TTP. This identification is achieved by posting the circuit using the command POST. The POST command does not affect the posted circuit(s) in any way, it only makes them known to the TTP position. The circuits may be posted individually or in groups and can be identified for posting by specified state such as, busy or idle, CLLI trunk group name, peripheral module type and number, or various other designations. The first circuit of the posted set is always automatically placed in the TTP control position.

Man Machine Interface (MMI) maintenance action commands will normally be executed only on the circuit in the control position. If the ALL option is available, it will execute the command on all posted circuits when selected. If maintenance functions are being performed on a circuit in the control position and there is a requirement to temporarily suspend the process, the circuit can be placed in one of three hold positions. MMI actions that are still active on the control circuit are retained while the circuit is in the hold position. If none are required to be retained, the circuit state may be observed while it is in the hold position. To allow MMI alterations or changes to the circuit in hold, it must be transferred into the control position for maintenance action.

When a circuit is idled from the control position then all the test equipment associated with it is also idled and the circuit under test is returned to its previous state or to the state indicated. When a TTP is idled the connection under the TTP control position is released. Connections that are in the hold positions, if any, are held for a maximum two hour period after which time these held connections are also released.

### **TTP circuit posting and seizing**

Before any maintenance action on any trunk is performed, the trunk must first be identified to the TTP. This is accomplished by posting the trunk using the command POST. A trunk that is posted is not removed from service and therefore may be seized by call processing at any time prior to the initialization of a maintenance function or after a maintenance function is completed.

To prevent interruptions during maintenance functions, it is required that the trunk be seized (using the command SEIZE) after posting it using the TTP. By seizing the trunk, it is removed from service and not available for call processing. All maintenance functions will therefore be completed without interruptions. The SEIZE command does not result in any external action.

The SEIZE command seizes the circuit under the TTP control position or it will automatically seize circuits when these are transferred from the posted set to the control position. The automatic seize feature seizes a circuit if it is available, for example, if it is idle or in one of the maintenance states. If the

circuit is service busy, it is marked for maintenance action (the circuit is placed under the deloaded state).

When the service-busy circuit becomes idle, it is available for maintenance but not for call processing. The deloaded circuit is kept out of service until it is transferred into the control position, at which time it is seized. A maximum of four circuits can be in the seized state at one time: one in each of the three HOLD positions, and one in the CONTROL position.

### **TTP features**

Any trunk that requires maintenance action must first be identified to the TTP:

- CLI
- PM ID
- busy queue
- circuit state

Trunks are selected and identified to the TTP:

- individually
- state
- range
- group
- PM

**Trunk seizure** The trunk seizure feature seizes the circuit in the control position or automatically seizes the circuit from the POSTED set when it is placed into the control position. Circuits that are seized are not available for call processing.

**Removing trunks from service** The Removing Trunks from Service (BSY) command is used to change the state of a circuit in the control position, or optionally, all the circuits in the posted set, to one of the available maintenance, that is, out-of-service, states. Idle and out-of-service circuit states will be changed immediately. Service-busy, that is, Call Processing Busy (CPB) circuit states, however, are changed only when their previous action is completed. CPB circuits are deloaded, and when their present action is completed they are set to the indicated state. Circuits which are not seized when the BSY command is entered, change their state to the indicated state immediately. However, circuits which are seized change to the indicated state only when they are released from the control position.

**Returning trunks to service** The Returning Trunks to Service (RTS) command is used to change the state of a circuit in the control position, or optionally, all the circuits in the posted set, to the Idle (IDL), Restricted Idle (RES), or the Initialized (INI) state. Only the circuits in the Manual Busy (MB) state will be returned to the requested state. Therefore, to return to service those circuits that are in a different state other than MB requires that these be set to the MB state first.

**Diagnostic test** The diagnostic test (TST) provides a complete test of the trunk card. This test ensures that the circuitry located on the card and its transmission path are functioning properly. Any faults detected are indicated through the VDU. The actual testing of the trunk is performed by the diagnostic test sequence. This is a typical diagnostic sequence for a two-way, four-wire E&M trunk:

- Place the trunk into its correct hardware idle state.
- Check that a card is plugged into the TM in question.
- Operate the test relay and check that the circuit responds correctly.
- Perform a functional test by operating and releasing SD points and analyzing the scan results.
- Transmission test the circuit in its looped-around mode (test relay operated) by sending a frequency at a specific level and measuring the loss..
- Return the trunk to its idle hardware state

If the trunk passes or fails the diagnostic, the appropriate message is displayed at the TTP. Various test line tests, (T102, T103) can also be invoked from the TTP for posted trunks and results provided on the TTP. Tests can be repeated on the same trunk as required by the maintenance craftsperson. Typical examples of output reports provided for a T102 test pass and fail condition are outlined here.

```
TRK 125 NOV 21      23:59:59      3250 PASS  TL102 PASSED
      OTWAON002T0    7001
      EML = 5.0dB     F - N DEV = 1.0dB

TRK 126 NOV 2      23:59:59      7251 FAIL  TL102 FAILED
      OTWA0N002T0    7001
      TSTEQ = TTT 1   REASON = Q2 LIMIT EXCEEDED
      EML = 6.0dB     F - N DEV = 5.4dB
```

**Test line test** The Test Line Test (TST < TLCODE >) is a test to the distant office test line. Test line tests can be performed from the TTP:

- T100 Test line (balance/noise)
- T101 Test line (communications)

- T102 Test line (milliwatt)
- T103 Test line (operational)
- T104 Test line (transmission)
- T105 Test line
- synchronous test line
- non-synchronous test line
- loop-around test line
- E&M (designation for trunk signaling used)
- repeat two test, such as, disconnect and immediate reseizure
- echo return loss
- singing return loss

**Trunk location** The trunk location feature (CKTLOC) displays the physical card location of the circuit (analog or digital) which is posted in the control position at the TTP. The physical card location information provided consists of floor, row, frame position, frame name, frame number, shelf position, and card number.

Transmission data from the data base is also displayed. For analog trunks, the circuit number and transmission data for the trunk sharing the circuit pack of the posted trunk is also displayed.

**Force release** – The Force Release (FRLS) feature provides the means to release an existing connection and remove the circuit from service (set it to the MB state).

**Call transfer** The call transfer (CALLTRF) feature allows maintenance personnel to transfer connections from a 101 communication test line to the headset and to move the call processing linked circuit to the control position of TTP. The 101 circuit is idled and saved in the POST set.

**Trunk monitoring** The monitor menu commands of the TTP (MONPOST, MONLINK, MONTALK) provide access to service-busy connections for monitoring purposes, such as, listening, talking, or both. Monitoring requires circuits in the DMS-100 Family System dedicated to the monitoring MAP.

When the monitor display is entered, the MONPOST function is automatically associated with the circuit in the control position, if it is not seized. The monitor connection is established only when the circuit is in the call processing busy state, which implies another circuit is linked to it. A monitoring connection is released when the call processing connection is

released and is re-established when a new call-processing connection is set up.

A monitor function is cancelled for any of five conditions:

- 1 The TTP monitor display is exited.
- 2 A monitor-held connection is transferred to the control position, but not in MONITOR level.
- 3 The command RLS is entered for a monitor connection.
- 4 A command that requires circuit in control position to be seized is entered.
- 5 The circuit in the control position is released for any reason.

The trunk monitoring commands provide three capabilities:

- 1 MONPOST – Sets up a connection between the headset of the TTP communications module and the trunk in the control position. This enables a user to listen to the incoming transmission of the posted trunk. The trunk in the control position must be in a call processing busy state.
- 2 MONLINK – Sets up a connection between the headset of the TTP communication module and the circuit that is linked to the trunk in the control position. This enables a user to listen to the incoming transmission of the linked circuit. The trunk in the control position must be in a call processing busy state.
- 3 MONTALK – A command of the TTP provides a three-party conference between the trunk in the control position, the trunk linked to it, and the headset of the TTP. The connections are set up through a three-port conference circuit. A monitor connection, for MONPOST/MONLINK, must be established before the MONTALK command is entered. Success or failure to establish a three-way conference connection is readily displayed on the TTP.

The Stuck Sender (STKSDR) feature provides the means to monitor and identify trunks that are encountering outpulsing problems, for example, stuck senders. Problems are identified through the VDU. When an outpulsing trouble is encountered, the connection is held to the distant office and the trouble indicated.

**Outpulsing** An outpulsing (OP) feature provides a means of establishing a connection to a distant office by outpulsing a given called number through a trunk in the control position. The called number is from 1 to 14 digits or the test line code, for example, T100.

Talking and listening capability is provided by means of the headset trunk by connecting it to the circuit in the control position. The supervision returned over the trunk is displayed on the TTP.

**On-off hook signaling** The On-Off Hook (ONOFFHK) signaling feature provides a means of sending on or off-hook signals to the distant office. If the command request is initiated and an on-hook is presently being sent, it is changed to an off-hook signal and vice-versa. The sub-menu SGNL command must be invoked from the MAP or TTP before the ONOFFHK command of that sub-menu can be used on the circuit in that MAP or TTP control position.

**Ring-back/ring-forward** The Ring-Back/Ring-Forward (RNGBF) feature provides a means of sending a ring-forward or ring-back signal to the distant office. Ring-back is a 100 + 20-ms on-hook signal. The sub-menu SGNL command must be invoked from the MAP or TTP before the RNGBF command of that sub-menu can be used on the circuit in that MAP or TTP control position.

**Automatic test repetition** A trunk test can be repeated automatically for a specified number of times by means of a repeat (REPEAT) command.

**Translation verification** The Translation Verification (TRNSLVF) feature provides a means to verify the trunk group translations for any number received, for example, directory numbers, test codes, and so forth, on a trunk posted in the control position. Translation is displayed for the entire route list for the trunk group and number under test.

### Circuit identification

Trunks can be posted individually, or in groups using POST. These trunks are identified by a circuit designation such as terminal ID, that is, DCM 7 CKT 2, circuit state (SB or MB), CLLI IE YNTWOH781GT, or a busy queue.

When diagnostics are initiated automatically on trunks by the system, reports are generated in the LOG system. Trunk identification is generally designated by the CLLI and the circuit number:

```
TRK      130      NOV21      23:59:59      3259  PASS
TLI00    PASSED                    YNTWOH781GT  7001
```

### DC voltmeter

In the DMS-100 Family System switched access to analog trunk circuits is provided on an optional basis by means of the Switched Access System (SAS) manufactured by Telecommunication Technology Incorporated (TTI). The SAS has been integrated into the system by means of custom design of the MAP and cabling arrangements.

When a trunk is posted on the TTP by means of the SAS operation, the trunk can be split to either the switch or the facility and the tip and ring conductors presented to the dc voltmeter mounted on the custom MAP.

### **Trunk failure treatment**

The DMS-100 Family System log system provides the capability of suppressing specified report(s) within a given log. Typically trunk reports can be suppressed:

SUPPRESS Log name – report number

where:

log name = TRK (trunk)

Report number = 101 – 130 (type of report)

### **Focused trunk maintenance**

Focused trunk maintenance for trunks offers the ability to reposition maintenance personnel onto the MAP away from log terminal trunk fault processing. Focused trunk maintenance provides this ability through alarm thresholding and failure information buffering. This provides better interaction with alarms to effect repair.

Alarms are generated when troubles, identified by software, exceed a customer-defined threshold. The customer designates thresholds for minor, major and critical alarms as a percentage of the successful call attempt, value N. The DMS increases the failure count for each failure and decreases it for each N calls completed successfully.

When a failure count exceeds the threshold, an alarm level is generated and a 15-min. wake-up period is invoked. The alarm level may not decrease during this period except by being manually reset. The package continues processing messages during this stage, and if a higher level condition develops, a new wake-up process begins.

With focused maintenance, the buffering of failures is handled by two buffers, designated the upper and lower buffers. A pair of these buffers exists for each trunk group in the office. The upper buffer contains ten records of the worst members of a group (those failing more than once). The lower buffer records up to five members that have failed only once. Separate sets of buffers, one for call processing activity and another for maintenance activity, are available.

The activation of focused maintenance deactivates log messages generated to report failures. Any fault that would have generated a log message is processed through the buffers to ensure that the latest data is available to



help direct maintenance actions. Customers can reactivate the generation of log messages as desired by temporarily activating the specific messages.

Commands available at the MAP provide for display of the buffers and of the groups having active alarms. Other commands permit suppression and resumption of specific trouble reports and review of the trouble designation list. A new post command automatically creates a post set of all buffered members for appropriate testing and fault resolution action.

Focused maintenance improves maintenance response by thresholding the alarms and buffering failure information for reference by way of the MAP levels as required. The focusing of maintenance activity to the MAP and away from logs improves maintenance efficiency and actions, because the maintenance personnel are not responding to every minor problem, and are able to move easily between the alarm reporting and maintenance action required to isolate and clear the fault.

### **Automatic trunk test facilities**

The DMS-100 Family System Automatic Trunk Testing (ATT) feature provides automatic test line testing for outgoing trunks and the outgoing portion of two-way trunks and diagnostic tests on any group or circuits that can be identified by CLLI. Various test line and diagnostic tests are provided to maintain these trunks by monitoring the quality of trunk signaling and transmission.

There is no test equipment associated directly with ATT. All required test equipment is obtained from a common pool and, when no longer needed by ATT, is returned to the common pool.

ATT works on a trunk group basis. Tests are basically scheduled by specifying the trunk group to be tested, the test to be performed (test line or diagnostic), and the frequency at which the test is to be run on the group—more than one test can be specified per group. When a trunk group is under test, ATT steps through the group attempting to run the requested test on each trunk in succession. The maximum number of groups to be tested simultaneously can be set manually to a maximum of 15. In practice, this number would be limited, for example, by the amount of test equipment available.

The ATT logs reports to inform the craftperson of its progress and the results of its trunk tests. The types of logs to be output are under manual control. A summary report is logged at the end of testing a trunk group.

Trunks may be removed from service if found to be faulty by ATT. If this option is requested, an upper limit of 25% or 50% must be set for the number of trunks from the group to be removed from service.

Although group test scheduling will primarily be exercised through table control, groups may be scheduled on a one-shot basis using the ATT MAP level by telescoping through the MTC and TRKS levels of the MAP. This level provides additional commands and displays to monitor and control the running of ATT. The maintenance personnel have three ways of monitoring and controlling ATT: table control, TTP, and log system.

### **Table control**

Two tables are essential to the running of the ATT. All general ATT scheduling is done through the ATTSCHED table. The ATTOPTNS table specifies the ATT control data that does not pertain to specific trunk groups.

ATT also refers to other resident tables. These are: TSTLCONT, CLLIMITCE, and subtable DIAGDATA.

The ATTSCHED table contains the following information:

- CLI of trunk group to be tested
- type of test performed
- specific test entry to be scheduled identified
- frequency of test: hourly, daily, weekly, monthly
- maximum time for test in 10 min. units (00–60 range).

The ATTOPTNS table contains the following information:

- class of test
- the type of log reports to be generated
- deviation limits from the Expected Measured Loss (EML) designated Q1 (for maintenance limit) and Q2 (for immediate action)
- minimum amount of time to wait for busy trunks to become available
- to retest a trunk that has failed a test
- to remove from service a trunk that has failed a test
- the maximum number of trunks from a group that can be removed from service for testing

Two other tables play effective parts in the processing of scheduled tests, the Immediate Test (IMTST) and Manual (MANUAL) tables. The IMTST table contains a list of tests waiting to be completed. This list is updated every 10 min. The MANUAL table contains a list of tests to be made as entered by means of TESTREQ command from ATT MAP level.

IMTST and MANUAL contents will be destroyed if a restart occurs. Thus, a restart will abort an ATT test sequence in progress. The ATT data in other tables is not affected. ATT testing that is scheduled to begin after the restart completion will proceed normally.

**ATT MAP level**

The basic tool for monitoring the running of the ATT is a VDU at the ATT MAP Level. A continuous display updated dynamically, and three sets of supplementary information, are provided. The continuous display shows the current status of ATT:

- simultaneous tests that were run
- entries made in the MANUAL testing table
- Common Language Location Identifier (trunk groups under test)
- trunk groups waiting for test equipment
- trunk groups where testing is suspended while waiting for available trunk groups

The items shown should also include:

- whether ATT is running or halted
- a summary table, both automatic and manual, for number of trunk groups in IMTST table

The supplementary displays contain lists of information as selected by menu commands. Only one type of display appears at any time and the information therein depends on the selections desired. Possible lists are as follows:

- tests entered in the ATTSCHED table that have been stopped
- entries from the IMTST table
- a combination of entries from the ATTSCHED and MANUAL tables having a specified CLI and optionally a specified test
- entries from the MANUAL table

In addition to monitoring the ATT, the ATT level is used to manually control scheduled tests. This facility allows a group of trunks to be scheduled on a one-shot basis by entering the appropriate commands. Commands are also provided to allow ATT to be stopped and started from the TTP.

**LOG system** ATT LOG reports inform the craftperson of its activity. As ATT steps through the scheduled trunk groups executing the specified tests it enters reports in the ATT LOG. By scanning this LOG, the operating company personnel follows the progress of ATT in detail. The ATT LOG is accessible through the general LOG system. When testing a trunk group, the following reports will be logged:

- A START LOG, summarizing the testing information for the trunk group
- all trunk test failures, to include operational test failure, transmission Q2 exceptions, test line protocol
- all trunks that are skipped as they were unavailable for testing; this is optional for manual requests

- a SUMMARY LOG, summarizing the test results
- test equipment selected by ATT for the group test
- reference trunk selected

Depending on the option selected, the Q1 exceptions and the test passes will be logged. If group testing is terminated abnormally, the reason will be reported.

A number of different report formats are used for the ATT LOGS; most of the LOG information is self-explanatory. An example of a typical log report is outlined here.

ATT100            This format is employed to report a test pass for an operational type of test (T103, TR2S, TRR2L, TE\_M, TSYN, TNSS, DIAG). The basic information given is the trunk name and the test. A sample LOG is:

```
ATT100 JAN01 16:02:00 6298 TST CKT ODCMBX1 10
DIAG                                                    PASS
```

### **Call irregularities due to trunk failures**

DMS-100 Family System provide automatic call testing of irregularities which may occur during the processing of a call:

- integrity check failure for continuity
- false supervision
- unexpected stop-go
- reversed trunk
- glare/no glare

Actions are provided for call irregularities due to trunk failure:

- Call attempts using a trunk but fail to complete are detected, reported, and pegged in OM.
- Trouble report identifies particular trunk involved with all pertinent data, that is, equipment, type of failure; for network blocking, a retry is initiated.
- Detection of possible trunk failure results in diagnostic test on the suspect trunk.
- Peg counts provided in the OM for various trunk failures; circuit failing diagnostic test may be removed automatically from service and designated system-made busy.
- Call irregularity data is provided in the OM and LOG system. All data is made available to an I/O channel in format suitable for downstream processing.

---

## Cutover and growth features

This section deals with the methods and strategies used in performing extensions or equipment growths in the DMS-100 Family System and are based on two criteria:

- 1 minimum interruption to the peripheral working equipment, such as, trunks
- 2 essential parts of control equipment are duplicated (central control complex and digital networks) which provide the capability to work one side of the system and process calls on other side.

### On-line growth procedures and tests

#### Procedures for trunk growth and testing

The addition of trunks, service circuits, and test circuits in the DMS-100 Family System to an existing TM or DTC module, or the addition of a new TM or DTC, to an existing trunk equipment bay, will not disrupt the system, service, or cause any deterioration in the grade of service.

All growth equipment or trunks are placed into the inactive level. In this state, they will not be accessed either by call processing programs or automatic diagnostics. This inactive level is accessed by proper commands from the MAP. Another set of commands will be required to move equipment from the inactive level into the active on-line level. Each TM has 15 slots for a total of 30 trunks circuits.

The growth or extension of equipment has no effect on a working DMS-100 Family System as long as the extended equipment remains in the inactive level mode. However, once the extended equipment is integrated into the system, it will be governed by the normal fault recovery programs, since there will be no differentiation between existing or extended equipment.

#### Procedures for data store and network module extension

The procedures used to extend the CC are generally similar to those used for adding trunk circuits. Detailed methods of procedures are available but not included here.

Because the CC is fully duplicated, the DMS-100 Family System can be reconfigured into two halves for extension. The new equipment is physically installed and cabled. It is marked inactive in software. One-half of the machine handles the total traffic using the old configuration. The second half is configured to include the new equipment, and test it. Once the new equipment is properly tested and integrated on the inactive machine side, the half which has been extended is activated and the unextended side made inactive. The procedure is now repeated. On completion both halves are extended and duplicated operation can resume.

Assignment of both new and old peripherals to new and old network modules is simplified by the use of the speech link connecting frame. This frame is used to cross-connect the 30-channel voice links from peripheral modules to network ports. To simplify the process, connectorized patch cords are used.

### **Procedures for line growth and testing**

The addition of line cards in the DMS-100 Family System to existing line concentrating modules, or the addition of new line concentrating modules, will not disrupt the system or service, or cause any deterioration in the grade of service. If a line drawer is to be added to an in-service line concentrating module, it is not necessary to remove power from the LCM. The drawer is plugged in and then the fuse is inserted into the fuse panel, providing power to the drawer.

Detailed procedures are available and will not be included here. The concept is basically the same as that covered under trunk growth described in this section. Growth equipment is placed in the software state of inactive or Installation Busy (INB) until it is ready to go into service.

### **Implementation of growth**

The procedures outlined in these paragraphs are designed to cause no interruption of working equipment or call processing. The duplicated network in DMS-100 Family Systems permits increasing the network size without impacting call processing and simplifies the growth task itself. Associated with growth is the concept of two-stage provisioning versus conventional provisioning.

With the conventional approach, all the switching equipment is engineered, ordered and installed for the engineered interval simultaneously. A two-stage provisioning method is suggested for DMS-100 Family Systems. The basic CPUs and the central message controllers shelves are not engineered or extended, since they are installed on the initial job for the ultimate capacity of the office.

Provisioning of the network and peripheral equipment components, and the program and data stores, constitutes stage one. The equipment frames will be engineered and installed for the job interval, based on requirements established by the operating company. The associated modules, including shelf backplanes, control cards, and so on, will be provided and installed simultaneously as part of this stage.

The second stage is the provisioning of items such as analog trunk and digital trunk plug-in cards. These are purchased and installed by the operating company as required and supplied by Nortel Networks on a plug-in-provisioning basis. This means that the office will be engineered for the initial and growth requirement but equipped for the initial requirement

only. The net result is that various plug-in cards are not purchased until required for service rather than at the beginning of an engineering interval.

### Pre-turnover trunk testing

DMS-100 Family Systems have the capability to pre-test trunks prior to the in-service date. When negotiated with the installation agencies, this capability may be used before turnover while the processor is functioning. Figure 7-12 illustrates Digital Carrier Module connections (DCMPAC).

### Analog trunk pre-testing

The TTP in DMS-100 Family Systems performs all the pre-cutover analog trunk testing prior to in-service date with CPU functioning. “Trunk Test Facilities and Features” in this section describes the tests performed using a TTP.

### Digital trunk pre-testing

**Digital carrier module** A MAP display level is available for the Digital Module Connections (DCM) pre-testing and cutover procedure. The display is entered from the DS1STAT level display and menu from the TTP. Figure 7-13 illustrates the digital carrier module subsystem display hierarchy. Figure 7-14 illustrates the digital carrier module status and menu display.

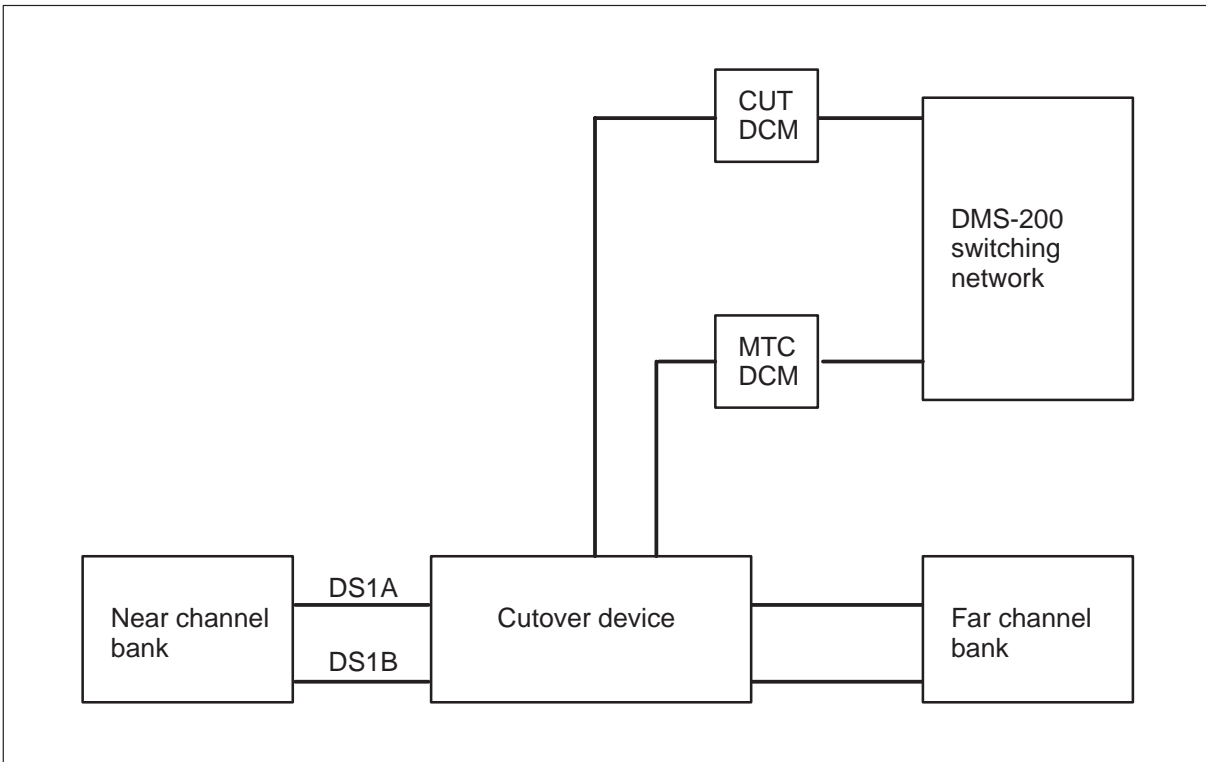
DCM pre-testing and cutover is a process that allows a DCM to be pre-tested before it is cut into service. The DCM is cut into an existing 24-channel DS-1 path fully transparent to both ends. An individual channel can be busied, tested, and returned to service without affecting the operation of the remaining 23 channels. The cutover device is inserted in the existing path of two DS-1s (DS-1A, DS-1B), typically between two channel banks. The cutover device contains two software-controlled relays which are operated to complete the path from the near channel bank through the two DCMs to the far channel bank. One of the DCMs is under test, referred to as the CUT DCM, and the other is the test facility, referred to as the MTC DCM.

Three modes of operation are possible during the procedure:

- Initial mode                      Direct transparent connections exist between the near and far channel banks.
- Pre-test mode                      Transparent connections exist from the near channel bank, through the CUT and MTC DCM, to the far channel bank.
- Cutover mode                      The MTC DCM is cut out and 24 channels from the near channel bank appear as normal trunks on the CUT DCM.



**Figure 7-12**  
**Digital carrier module connections**



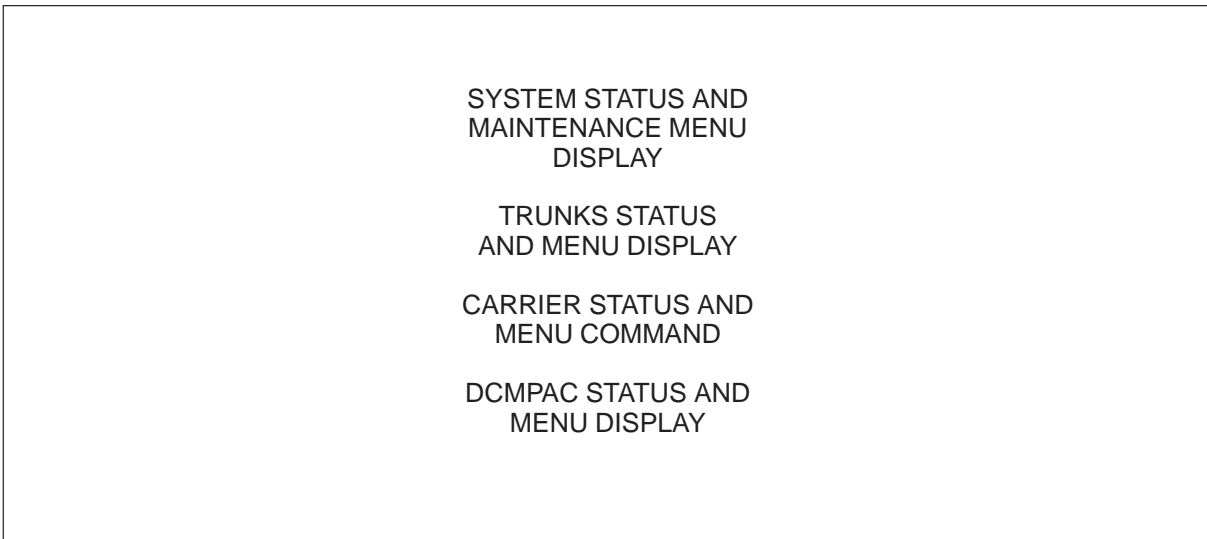
Twenty-four DS-1 connections are first made between the CUT DCM and MTC DCM. The pretest relay is then operated to make a path through the new configuration, transparent to both ends. The pair of DS-1 connections are now in the pre-test mode.

Each of the 24 connections are dropped, one at a time, to enable testing of the associated channel without affecting the remainder of the DS-1. When testing of a selected channel is completed, it is reconnected through the switching network and another channel connected for testing. In this manner all 24 channels of a DS-1 are tested.

When testing has been completed on all 24 channels of the two DS-1s the relays are cut back to the original configuration, initial mode, or into cutover mode where the MTC DCM is cut out.



**Figure 7-13**  
**Digital carrier module subsystem display hierarchy**



**Figure 7-14**  
**Digital carrier module status and menu display**

```

CM          MS          IOD  Net  Ins   Trks   Ext

  DCOMPAC
0 Quit      /
2 Select_   /
3 _Ref      /
4 _CutDCM_ /
5 _MtcDCM  /
6 _NxtFail /
7 SDPoint  /
8 ScanPt_  /
9 _Loc_     /
10 Pretest / USER 1 DCE CKT POINT LOCATION PT NAILED UP SCAN PT MODE
11 Cutover / REF CUT 31 0 SD MTM 0 14 0 CCNN DISC ACTIVE PRETEST
12 RmvAssoc/ 4 MTC 99 4 SCAN MTM 1 14 3 23 1
13 Connect_ /
14 Disconn_ /
15 List_    /
16 Clear_   /
17 User     /
18         /

      USER ID
      hh:mm

Reference      0 Mode_INITIAL_none pending
CUT DCM        0 0 MTC DCM
SD point       MTM 4 10 0
Scan PT        MTM 4 11 0
Disc           1 2 3 4 5 6 7 8 9 10 11 12
13 14 15 16 17 18 19 20 21 22 23 24

There are 0 pairs with pending failures.
There are 2 users logged in DCOMPAC.

```

**Digital trunk controller** This feature provides a process to allow testing of carrier facilities on a Digital Trunk Controller (DTC) prior to cutting it into service. Carrier Pretest and Cutover (CARPAC) is a CC nonresident software subsystem that allows fully transparent cutting of a new peripheral into an existing carrier path.

Individual channels on a carrier can be busied, tested by the far end craftperson, and put back into service without affecting the remaining channels. With the completion of testing, the carrier can be cutover to the DMS for service. Although up to 80 carrier pairs may be associated in data,

it is very important that no more than 20 carrier pairs be in a pretest mode to ensure proper handling of integrity failures and carrier alarms.

This feature uses a stand-alone pretest and cutover unit, which consists of an NT5X68 control card and up to 12 circuit cutover packs (NT5X67). Scan points and SD points are also required for monitoring and control.

### **Automatic board-to-board testing**

This section outlines the equipment and procedures required to perform Automatic Board-to-Board Testing (ABBT) and cutover where DMS-100 Family Systems have been installed to replace various types of electro-mechanical switches. This replacement involves the physical transfer of lines from the older switching system to the new digital system. To accomplish this transfer without interrupting service to the subscribers, the one-to-one correspondence between the two systems is verified, prior to cutover, by comparing the original subscribers' numbers with the physical locations of the corresponding line equipment assigned to those subscribers in the new system.

Pre-cutover testing is performed automatically by the portable ABBT set (NT5X73AA). Result codes are output by the ABBT set, indicating the state of correspondence of each line. The cutover and ABBT procedures are controlled by software programs which are loaded into the DMS-100 Family System at the appropriate time, and permit relevant commands to be entered by the personnel performing the cutover. The programs are unloaded when no longer required. The loading, running, and unloading of the cutover and ABBT programs is performed by MMI sequences using the MAP. Provision is made for testing of subscriber lines contained in hunt groups and not assigned individual directory numbers. Detailed instructions for ABBT are provided in NTP 297-1001-522.

Between one and eight automatic board-to-board test sets can be simultaneously used by the DMS-100 Family System. A corresponding number of connections is required in the switching system being replaced. A capability of performing testing for 10 000 lines during an eight hour shift is provided by this capability. Each ABBT unit requires a test connector or equivalent in the old switching office that is being replaced.

### **ABBT equipment**

**Basic principles** Board-to-board testing is carried out just prior to cutover from the old switching system to the new DMS-100 Family System. At this stage, customer lines appear on both systems. However, service is still provided from the old one. Call terminations are not provided by the DMS-100 Family System because software data identifying the lines is in the cut-off state. Board-to-board testing verifies that the software translation tables and physical cross-connections match existing conditions in the old system.

When a test is initiated, a specific sequence of events occurs:

- 1 The DMS-100 Family System selects the line associated with the designated Directory Number (DN) and connects the line to the ABBT test circuit through its Metallic Test Access (MTA) unit and DF.
- 2 The DN is outpulsed to the old switch by the outgoing trunk circuit (NT2X83), through the ABBT test circuit, an interface circuit to match the old office circuits, and a test access trunk to the line in the old switch. The interface circuits vary, depending on the type of old office.
- 3 Tests are performed by activating relays in the ABBT through signal distribution points, and the results are obtained through scan points in the DMS-100 switch.
- 4 The test results are printed out as required.

The test arrangement is capable of checking for five conditions:

- 1 proper assignment of new line equipment
- 2 continuity of new lines
- 3 absence of jumper reversals at the DF
- 4 tip and ring affiliations of party lines
- 5 loop-start and ground-start assignments in the line data tables

ABBT can also be performed where the old office is to be replaced by a Remote Switching Center (RSC) or Remote Line Concentrating Modules (RLCMs). ABBT is controlled by a remote host DMS-100 Family System, new office, through a Line Group Controller (LGC), and DS-1 carrier links. The ABBT equipment can be located at the host site if the remote office is within metallic range.

**ABBT portable test set** ABBT is performed by one or more NT5X73 automatic board-to-board test sets and appropriate software. These are used where DMS-100 Family Systems are installed to replace certain types of switches:

<b>Company</b>	<b>Type</b>
Western Electric	SXS, No. 1 Crossbar, No. 5 Crossbar, No. 1 ESS, No. 2 ESS, No. 3ESS
Automatic Electric	SXS, C1-EAX, No. 1 EAX, Leich TPL
ITT	A1 Pentaconda, IOC Metaconda, DSS-1210
North Electric	NX-1D,.NX-2A
Stromberg-Carlson	X-Y
Nortel Networks	SXS, No. 5 Crossbar, SP-1, No. 1 ESS, DMS-10, SA-1, SF-1, DMS-100 (for extensions)
US Instrument	Motorswitch
Federal Telephone	SXS
Nippon Electric	23BA, ND-20, NEAX-61 (KA-1)

The ABBT set is a portable unit, supplied with a set of five cables. Each cable is fitted with connectors at the ABBT end and leads for wire-wrap connections at the DF end. Keys and lamps located on the front panel of the ABBT set are used to monitor the functions of the unit.

**Equipment requirements** As illustrated in Figure 7-15, the general cabling arrangement for ABBT is connected using cables A through D to the DF for the DMS-100 system. Interface between the ABBT and the new switching system is provided by the following circuit cards and units in the TM or MTM. All hardware needed to perform ABBT must be in place and operational before the test sequence is begun.

- outgoing trunk circuit card NT2X83
- SP 5, scan card NT0X10
- SD points (10) SD Card NT2X57
- MTA unit NT2X46

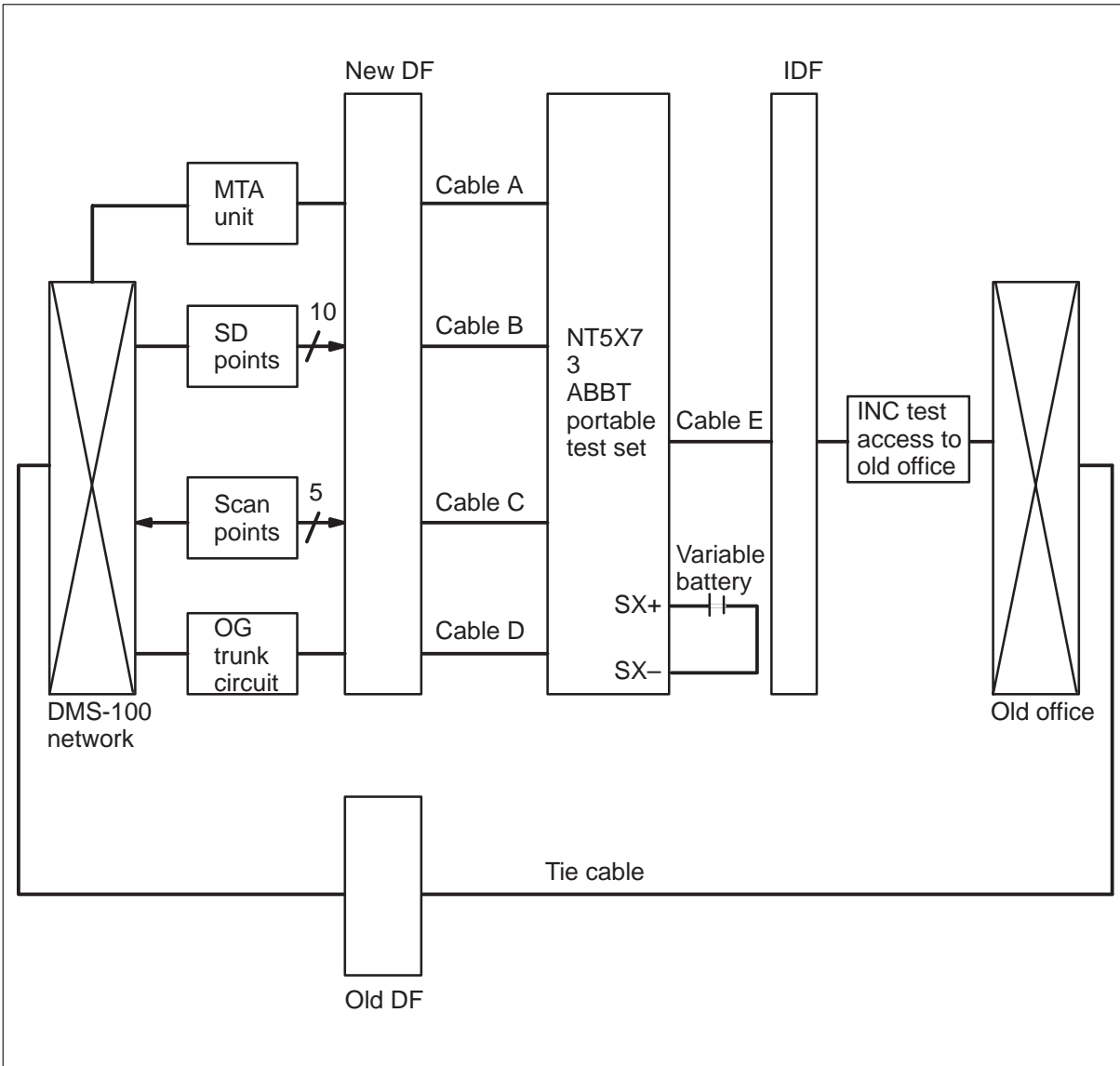
#### **Pre-cutover procedures**

Prior to cutover, all necessary hardware and connections for the particular office must be in place and operational before proceeding further.

During the ABBT sequence, all other testing activity in the old office is curtailed, so that access to old line appearances is not blocked. Also, the test access trunk to the old office should be dedicated to ABBT. During ABBT,

access to this trunk by operating company test personnel **must be prohibited.**

**Figure 7-15**  
**General cabling arrangement for ABBT**



**Strapping cutover hold relay** Before the actual transfer of service, subscriber's lines appear on both the old and new switching system, with service provided by the old one. This condition is possible by holding the cut-off relay in each LC of the new office in the operated state, using a cutover hold line to its associated Line Drawer (LD). This isolates the tip and ring leads of each LC from the MDF.

The cut-off relays are held in the operated state by a ground connection, applied through a common cutover circuit in each LD. This circuit can be either a strap connecting the hold line to ground or the contacts of a HOLD relay, located on the ringing multiplexer card in the LD. Sufficient current flows through the cut-off relay through the cutover hold line so that it is energized but not operated. When the appropriate control code is applied to the LC, the cut-off relay on the line card operates, thus opening the cut-off relay contacts. This isolates the tip and ring leads to the MDF from the line card circuit. When the cutover control code is removed, the current through the cutover hold line is sufficient to hold the cut-off relay in the operated state. At cutover time, the cut-off relay on the line card is deactivated, and the cutover circuit in each LD is de-energized, thus connecting the tip and ring leads of the line to its associated line card circuit. The cut-off and HOLD relays are operated at the appropriate times by the cutover software program LMCUT.

LMCUT is a non-resident program which must be loaded into the DMS-100 Family System before it can be used. Once LMCUT is loaded, access is provided to a repertoire of commands which control the operation of the cut-off relays, and provide a test of voltages present at tip and ring leads of the LC. The LD and LC are part of the Line Concentrating Equipment (LCE) or Remote Line Concentrating Module (RLCM) frame. It is possible, using the LMCUT software commands at the MAP, to operate or release the cut-off relay individually on each line card in a specific drawer.

If the cut-off relays are to be operated for an extended period, it is recommended that the ground strap (NT2X1914) be installed on each LD for greater reliability of cutoff during switch testing. The ground strap is to the plugs to which the control cables for the drawers are connected at the back of the LCE or RLCM frame. Once the strap is applied, the cutover program can be turned off to facilitate testing.

The ground strap holds the cut-off relays permanently, until it is physically removed, or power is removed, or an LC card is pulled out and reinserted. If power failure occurs or an LC is reinserted, an LMCUT command must be used to reoperate the cut-off relays. Just prior to cutover, the LM cut software should be reactivated and the ground straps removed. At cutover, deactivating LM cut will place the lines in service.

### **ABBT procedures**

Before starting the ABBT procedures, the hardware requirements must be in place and operational, and the pre-cutover procedures must be completed. Control of the ABBT sequence is exercised by a non-resident software program.

Once the program is loaded into the system, access is provided to a repertoire of commands which define the test parameters, execute the test

sequence and display the test results. In DMS-100, the user interface for ABBT is designed to simplify the operating company personnel's task. For example, commands and appropriate prompts are available to START, STOP and CONTINUE the test sequences, to SHOW, that is, display, the test results and to DEFINE the various parameters associated with the ABBT test sequences. The DEFINE command permits the user to subdivide the inputs into subsets and allows changing of individual subsets without the the directory number ranges to be tested. DEFINE OUTPFILE is used to route the test results to an appropriate output device.

## Line test facilities

The Line Test Position (LTP) is used in the line maintenance center of a DMS-100 Family System office for manual and automatic testing of subscriber lines. The LTP is basically a MAP equipped with the visual display unit, a communications module, jack field, and optional associated furniture as described in this section. The LTP functions may be performed from a remote MAP; however, functions requiring external test equipment or monitoring may only be performed if the jack-ended trunks and headset circuit are extended to the remote location.

The test equipment required for the LTP test functions is internal to the DMS-100 Family System and is not dedicated to any specific LTP. The trunk test equipment is mounted on the MTM. It is selected from a common pool of test equipment when required by the LTP. When a test function has been completed, the test equipment is returned to the common pool.

## Hardware

Specific hardware is used for line testing.

- line test position
- line test unit
- transmission test unit
- transmission test trunk
- jack-ended trunk
- external test equipment
- metallic test access
- printer
- T101 communications test line
- I/O test trunk

### Line test position

The Line Test Position (LTP) is a MAP consisting of four items:

- 1 VDU
- 2 furniture



- 3 voice communications module
- 4 test jacks

**Line test unit**

The Line Test Unit (LTU) consists of two circuit packs located in an MTM. This unit is connected to a selected line circuit under test through the MTA unit.

**Transmission test unit**

The Transmission Test Unit (TTU) consists of two circuit packs located in an MTM. This unit is connected to a selected line circuit through the internal digital network.

**Transmission test trunk**

The Transmission Test Trunk (TTT) consists of two circuit packs located in an MTM. This unit is connected to a selected line circuit through the internal digital network.

**Jack-ended trunk**

Jack-ended trunks are manufactured with two trunks per circuit pack and are located in a TM or an MTM. A jack-ended trunk is connected to a pair of jacks normally located at the LTP. The jack-ended trunk interfaces special test equipment at the LTP with a selected line circuit under test through the internal digital network.

**External test equipment**

External test equipment includes any special test equipment not regularly used at the LTP and connected to the line card through the test jacks. The return loss measuring set and the impulse noise measuring set are examples of external test equipment.

**Metallic test access**

The Metallic Test Access (MTA) is a small matrix used to provide a dc path between certain test equipment and the line circuit under test through the LCM test access bus. The LTU and the No. 14 test desk are examples of test equipment which use the MTA. The MTA is located on a miscellaneous frame. It is cabled directly to the LCM and connected to the test equipment through the DF.

In offices at BCS-20 or later, the NT3X09BA, metallic test access driver card is available which replaces the Minibar switch and driver. The NT3X09BA occupies one slot in the MTM, Remote Service Module (RSM), or Remote Maintenance Module (RMM). It provides one trunk appearance to the trunk controller for matrix control, and provides 16 tip and ring appearances for the horizontal and vertical connections. The 3X09BA metallic test access switch feature provides the ability to set a crosspoint, or

release all crosspoints for the NT3X09BA MTA driver card and card diagnostics.

### **Printer**

The printer is used to obtain the results of ALT. This unit, not part of the LTP, can be located in the same DMS-100 Family System office or remotely. It is also used in conjunction with manual line testing if a hard copy record is required.

### **I/O test trunk**

The I/O test trunk is a 2X90 card mounted in an eight-wire trunk module (TM8) at a host office, in a Remote Maintenance Module (RMM) at an RLCM, or in a Remote Service Module (RSM) at an RLM. It provides a DMS interface with non-DMS local testing equipment. This enables maintenance personnel who operate the non-DMS test equipment to access subscriber lines through the MTA.

- No. 14 local test trunk
- No. 3 local test cabinet
- Mechanized loop testing system (MLT 1 and MLT 2)

### **Communication test line**

The 101 communication test line uses a 5X30 card mounted in a TM. It interfaces the NM and the LTP, and is used at the communication module to originate voice contact with a subscriber.

### **Line test descriptions**

These line tests can be performed manually:

- short diagnostic
- extended diagnostic
- line insulation
- on-hook balance network
- off-hook balance network
- loss
- noise
- line
- dc voltage
- ac voltage
- resistance
- capacitance
- coin

---

The following tests also can be performed for ALT:

- short diagnostic
- extended diagnostic
- line insulation
- on-hook balance network

### **Short diagnostic test**

The short diagnostic test is only performed on the ALT level. This test routinely checks most of the DMS-100 Family System line circuit for correct operation. Specifically, the Pulse Code Modulation (PCM) path to and from the line card as well as the analog path of the VF transformer are checked. Under this test routine, the following subtests are performed:

- trans-hybrid loss test
- attenuation pads in the line card
- notch & weighted noise test
- ring supervision

### **Extended diagnostic test**

The extended diagnostic test routine checks virtually all of the line circuit for correct operation. This test routine is more comprehensive than the short diagnostic test with the following subtests being performed, as appropriate for particular line cards:

- transhybrid loss
- attenuation pad
- noise
- loop signal at keyset (business set only)
- flux cancellation
- loop detector
- two-party ANI (DMS-1 RCT only)
- equalization current detector (business set only)
- buffer full flag (business set only)
- reversal relay (POTS only)
- +48 V reversal relay (DIGITONE fraud prevention)
- ground start relay
- ground start detector
- cutoff relay
- subscriber loop
- ringing and supervision (POTS only)

- test access relay

### Line states

Each line circuit has a state assigned to it:

CPB	The call processing busy state is assigned to a line circuit that is in use by a subscriber. Call processing is taking place.
CPD	The call processing deload state is assigned to a line circuit that is presently in use by a subscriber. That request, to place the line in the deloaded (DEL) state, is pending and will be acted upon as soon as the subscriber is no longer using the line circuit. Call processing is taking place.
CUT	The cutoff state is assigned to a line circuit by the LTP operator. The cut-off relay is operated and the subscriber line loop is not connected to the line circuit.
DEL	The deloaded state is temporarily assigned to a line circuit after the call process has ended in a line circuit that was in the CPD state. Call processing cannot take place.
IDL	The idle state is assigned to a line circuit which is not serving a subscriber but is available to do so. This is the normal state for a line circuit that is not CPB. Calls may be originated from or terminated on a line circuit in this state.
INB	The installation busy state is assigned to a line circuit which does not have complete data associated with it, only the card type. There is no a directory number associated with it and call processing cannot take place. However, certain tests can be performed.
LMB	The line module busy state is assigned to a line circuit when the LCM, in which the line circuit is located, is busy or otherwise unable to control the line circuits it contains. Call processing cannot take place.
LO	The lockout state is assigned to a line circuit to take a line out of service. Call processing cannot take place. Manual action is required to change the state.
NEQ	The not-equipped state is assigned to a valid LEN which does not have the required data in table LNINV associated with it. There may or may not be a line circuit card in the slot of the line drawer for that particular LEN. Call processing cannot take place.
PLO	The Permanent Signal Partial Dial (PSPD) lock-out state is assigned to a line when a PSPD condition exists. Call processing cannot take place until the condition no longer exists and the DMS machine restores the line to the idle (IDL) state.

### LTP general description

The Line Circuit (LNS) level display is illustrated in Figure 7-16. Essentially, this layout is similar to the system status display except for the different command menu. Using the command menu and the telescoping process, the following functions are accomplished and information is obtained from the LTP:

- LTPLTA level
- LTP manual level
- ALT level

**Figure 7-16**  
**Line circuit level**

```

CM                MS  IOD      Net      PM      CCS      Lns      Trks      Ext
.                 .    .        .         .         .         .         PS DF    .
                                     M

      Lns          /
0 Quit_          /
2                /
3 LTP            /
4 ALT            /
5 LNSTRBL       /
6                /
7                /
8                /
9                /
10               /
11               /
12               /
13               /
14               /
15               /
16               /
17               /
18               /
OPERATOR
Time 06:18 >

```

Once the appropriate level for manual line testing is displayed, maintenance action for lines is requested by invoking the appropriate command. As illustrated in Figure 7-17, the following information is displayed from the Line Test Position (LTP):

- line class code
- seizure indicator
- party
- LEN

- DN
- state
- terminating equipment
- LTA connector mode
- site, if remote, is provided

**Figure 7-17**  
**Line test position level**

```

CM          MS      IOD      Net      PM      CCS      Lns      Trks      Ext
.           .       .        .        .        .        .       .        .
                M
    LTP      /
0  Quit_    / POST 2      DELQ 3      BUSYQ 1      PREFIX 621
2  POST_    /
3           / LCC PTY RNG  HOST      LEN      DN      STA S LTA  TE  RESULT
4  LTPMan   / 1FR      14 1      13 01 621 7348 IDL
5  BUSY_    /
6  RTS_     /
7  Diagn_   /
8  Tstring  /
9  AlmStat_ /
10 CktLoc   /
11 Hold     /
12 NextH_   / LNCARD DIAG FAILS CURRENT 22 THRSHLDS MIN 10 MAJ 20 CRIT 30
13 NextP_   /
14 IBNCON   /      PSPD      CURRENT 3 THRSHLDS MIN 10 MAJ 20 CRIT 30
15 CSDDS    /
16 LTPLTA   /
17 LCO_     /
18 Prefix_  /
    OPERATOR
Time 06:20 >

```

**Manual line testing features**

Menu commands are available at the LTP level and define the available features.

## Posting line (POST)

```

D dn [dn...]
L      [site] len
      dwr

H dn
S state
BQ
Dq
DTSR [site] frame, unit
DF
      [ D
      F
      S
      N ]
      [ VOICE
      DATA ]
LF
      [ VOLTSFAIL
      RESFAIL
      LASTFAIL ]
M dn
TE group name, group number

G site [ ALL
      FROM start element
      [TO finish element]
      MEMBER group number ]

SLTD [site] frame, unit
MP [site]
SHOWER

```

Posts a line or set of lines to the LTP as follows:

D	Posts lines associated with a maximum of five directory numbers.
dn	Is a seven-digit directory number without spaces between any digits. If a prefix has been entered, the quantity of directory number digits varies in accordance with the conditions stated in Note 1, and the entry rules are altered as in Note 2.
L	Posts a line circuit, line drawer, or an LSG.

site	The short CLLI for the remote or host site. The default value is the host site CLLI.
len	Is a seven-digit line equipment number for a line circuit, entered as nn n nn nn. The first two digits identify the frame, the next one the unit, the next two the drawer or LSG, and the last two identify the circuit.
dwr	Is a five-digit line drawer number, entered in the same way as the parameter LEN but excluding the last two (circuit) digits. The digit identifiers are the same as those for LEN.
H	Posts all lines that are associated with a directory number in a hunt group.
S	Posts all lines by their state.
state	One of the codes listed in line states, as described in this section.
BQ	Posts all lines in the busy queue.
DQ	Posts all lines in the deloaded queue.
PRINT	Causes the LEN and DN of all lines in the posted set to be displayed.
DF	Posts all lines that have failed a line card diagnostic.
D	Posts all lines that have failed the long diagnostic; REPLACE CARD is the required action.
F	Posts all lines that have failed the long diagnostic; CHECK FACILITY is the required action.
S	Posts all lines that have failed the short diagnostic.
N	Posts all lines that have passed the short diagnostic, but need to pass the extended diagnostic to clear the diagnostic failure that was detected.
DATA	Posts all data lines that have failed diagnostics.
VOICE	Posts all voice lines that have failed diagnostics.
LF	Posts all lines that have failed an ALT insulation test.
VOLTFAIL	Posts all lines that failed the EMF test.
RESFAIL	Posts all lines that have exceeded the Band O threshold once, and exceeded the Band 1 threshold on three previous occasions (Note 3).
LASTFAIL	Posts the last line that has failed an ALT line insulation test.
DTSR	Posts all dial tone speed recording circuits that are associated with a specified line frame and unit.
frame	Is a one or two digit line frame number that forms part of the LEN (Note 4).



unit	Is a single digit line frame unit number that forms part of the LEN.
M	Posts all lines that are associated with a Multiple Address Directory Number (MADN) group, using one directory number from the group.
SLTD	Posts subscriber line test digital equipment so that it can be accessed for DMS-1 RCT lines maintenance.
MP	Posts modem pool data lines.
SHOWER	Posts all lines that are in the shower queue to a maximum of 32 lines.

**Note 1:** The sum of the quantity of prefix digits and the quantity of DN digits must be at least seven. If the quantity exceeds seven, the DN digits will overwrite the rightmost prefix digits on this occasion only.

**Note 2:** When DN digits begin with 0, they must be entered within single quotation marks if prefix digits have been set.

**Note 3:** The Band 0 threshold is 40 k $\Omega$ ; the Band 1 threshold is 200 k $\Omega$ . The thresholds are displayed in hundreds of  $\Omega$ .

**Note 4:** The system recognizes an omitted digit as zero, thereby permitting the frame number to be entered as a single digit for frames 0 to 9.

### Accessing LTP manual level

This command is used to telescope the display to the LTP Manual Level (LTPMAN) position.

**Removing a line from service** The Removing a Line From Service (BUSY) command is used to change the state of the line in the control position to a specified state. Optionally, the BUSY command may be used to change the states of all the lines in the posted set, including the one in the control position, to a specified state. Only lines in the following states will be changed: INB, IDL, ALL, or MB.

**Returning line to service** The Returning Line to Service (RTS) command is used to change the state of the line in the control position, or optionally the complete set of posted lines, including the one in the control position, from the MB state to the IDL state. This command only acts on lines in the MB state.

**Diagnostic testing** The diagnostic testing (DIAGN) command is used to perform an extended diagnostic test on the line in the control position and display the results on the VDU screen. This command only acts on lines in the IDL or MB states.

**Query or change alarm thresholds** The alarm status (ALMSTAT) command is used without parameters to query and display the quantity, by type, of alarms in the LNS subsystem. This command is used with parameters to alter the alarm thresholds.

**Display details of a line** The circuit locate (CKTLOC) command is used to display the location identifier of the line circuit in the control position. Site, floor, row, bay, shelf, slot and equipment stock number are displayed. Also, characteristics of the line circuit under test are displayed.

**Place lines on hold** The place lines on hold (HOLD) command is used to move the line in the control position to the first available of the three hold positions, and to move a line from the posted set, if there are any, into the control position.

**Retrieve a held line** Retrieve a held line (NEXTH) moves the line in a HOLD position to the control position or replaces the line in the control position with a line in a hold position; and exchanges, saves, or drops the replaced line from LTP control.

**Accessing the next posted line** Accessing the next posted line (NEXTTP) places the line in the control position with a line from the posted set of lines. The replaced line (previously in control position) is dropped from the LTP control unless the parameter command SAVE is used.

**Access line test position line test access level**

Access to the line test position line test access level (LTPLTA) command is used to telescope the display to the LTPLTA level.

**Control cut-off relay in line card** The control cut-off relay in line card (LCO) command is used to operate or release the cut-off relay of the line circuit of the line in the control position. Optionally, this is used to operate or release the cut-off relays of all the lines in the posted set.

**Prefix digits to an LTP** The prefix digits to an LTP (PREFIX) command is used without parameter command to clear the LTP display of prefix digits. The PREFIX command is used with parameter to set or change prefix digits. One to seven digits, being the right-hand digits of a directory number, may be used as the parameter.

**Posting the next drawer** The posting the next drawer (NEXTD) command is used to post the next set of 32 lines which is one half of all the lines in a line drawer of a LCM of the currently posted set.

**Force release a line connection** The force release a line connection (FORCRLS) forcibly disconnects a line circuit from the test equipment or any other circuit and changes its state to MB.

**Measure loss on a line** The measure loss on a line (LOSS) command is used to measure the insertion loss of a test tone sent by maintenance personnel from the subscriber end of the loop to the line circuit which has been posted and is in the control position. This command only acts on lines in the IDL or MB states.

**Measure noise on a line** The measure noise on a line (NOISE) command is used to measure the C-message weighted circuit noise on the loop of the line circuit in the control position. This command only acts on lines in the IDL or MB states.

**Send tone on a line** The send tone on a line (TONEGEN) command is used to send a tone out on the loop side of the line card in the control position.

**Connect jack to a line** The connect jack to a line (JACK) command is used to connect one of the three jack ended trunks to the line in the control position.

**Perform a balance network test on a line** The perform a balance network test on a line (BALNET) command is used to perform an on-hook balance network test on the loop connected to the line circuit in the control position. If required, and if allowed, this test adjusts the balance network, or the loss pad, or both, in the line circuit and alters the data in the line circuit inventory table (LNINV) to reflect any change.

**Release test equipment from a line** The release test equipment from a line (RLSCONN) command is used to release the test equipment connected to the line in the control position.

**Monitor a line** The monitor a line (MONLTA) command is used to monitor any activity on the subscriber line without detection.

**Monitor and talk over a line** The monitor and talk over a line (TALKLTA) command is used to monitor any activity on the subscriber line. The craftperson at the LTP can talk to, and be heard by, the person at the subscriber station. Optimally, this command can connect talk battery so that a tester can converse with the subscriber when the cut-off relay is operated.

**Originate a call from the LTP** The originate a call from the LTP (ORIG) command is used without a parameter to connect either an on-hook or an off-hook termination to T and R of the line circuit in the control position through the test access relay. A monitor or talk connection, using either the MONLTA or TALKLTA command, must be established before this command is performed. The ORIG command is used with a parameter to send from one to eleven dial pulse digits into the loop side of the line circuit in the control position through the test access relay.

**Perform a line test on a line** The perform a line test on a line (LNTST) command is used to perform voltage, resistance, and capacitance tests on the line in the control position.

**Measure DC voltage on a line** The measure dc voltage on a line (Vdc) command is used to perform a dc voltage measurement on the line in the control position.

**Measure AC voltage on a line** The measure ac voltage on a line (Vac) command is used to perform an ac voltage measurement on the line in the control position.

**Measure resistance on a line** The measure resistance on a line (RES) command is used to perform a resistance measurement on the line in the control position. Resistance may be measured between any pair of points among T, R and ground.

**Measure capacitance on a line** The measure capacitance on a line (CAP) command is used to perform a capacitance measurement on the line in the control position. Capacitance may be measured between any pair of points among T, R, or ground.

**Operate the line test access relay on a line** The Line Test Access (LTA) command is used to change the mode of connection of the Line LTA to the line card in the control position, or used to release the connection of the LTA from the line card in the control position. The two modes are: test into line card and loop facility, or test into loop facility only.

**Perform coin station test** The perform coin station test (COIN) command is used to send a 130 V pulse of voltage out on the loop to operate either the coin collect (+130V) or coin return (-130V) mechanism in the coin station.

**Send ringing to a line** The send ringing to a line (RING) command is used to place ringing voltage on the loop of the line circuit posted in the control position. When the RING is input without a parameter, the ring code used will be according to data filled in LENLINES under field RINGCODE for the tuple of the DN and PTY currently displayed in the control position. If, in the case of other than a single-party line, it is desired to ring a party the DN of which is not posted in the control position, the command is used with a parameter. The parameter used governs the ring code which will be used. The ring code will be according to the data filled in LENLINES, under the field RINGCODE, for the tuple of the PTY as input as the parameter with the command.

**Perform DIGITONE pad or dial test** The perform digitone pad or dial test (DGTTST) command is used to test the DIGITONE pad or dial on the subscriber station. A talk connection, using the TALKLTA command, must be established before this test is requested. Someone at the subscriber station must key or dial the required digit sequence in response to dial tone being sent to the subscriber station by this test.

**Ringing test** This ringing test (TSTRING) command is used to perform a ringing relay test on the posted line card. Since it invokes a test which sends ringing out on the loop, a confirmation is required before the test is started. Test indicates that ringing is functioning properly, voltage is detected on ring lead before ringing applied, or no voltage is detected on ring lead after voltage applied.

**Display general reports of extended diagnostic failures** The display general reports of extended diagnostic failures (LDGR) command is used to condition the LTP and the log system to display general reports of extended diagnostic test failure records.

**Display detailed reports of extended diagnostic failures** The display detailed reports of extended diagnostic failures (LDDR) command is used to condition the LTP and the log system to display detailed reports of failure responses to extended diagnostic testing.

### **MDC console testing**

The IBNCON command is used to request the system status display and the menu of commands for testing an MDC console. This command is in the LTP level of commands associated with a line test position when the DMS office has associated MDC attendant consoles. For further details on MDC attendant console testing refer to NTP 297-2101-516. Some of the unique menu commands in the MDC console testing level are as follows:

SELECT	Allows selection of a specific MDC console.
DIAGNOSE	Followed by another command, or menu, initiates specific test on selected MDC console and on its voice or data loops. Test results displayed beneath the display of the selected MDC console on the line test position's CRT.
PREV DM	Displays location identity of the digital modem allocated to the MDC console under test.
Q CON LINE	Displays details concerning the voice and data lines connected to the MDC console under test.
Q CUST GRP	Displays customer group and sub-group identification data corresponding to a specified MDC consoles line.
Q SEATED	Checks if headset or handset is plugged into the jack of MDC console seized for testing.
FRLS	Causes MDC console selected for testing be forcibly released from CPB state and placed in MB state.

### **Focused line maintenance**

The focused maintenance software package offers the ability to reposition maintenance personnel onto the MAP away from log terminals for line processing. Focused line maintenance provides this ability through alarm thresholding and failure information buffering. This provides better interaction with alarms to effect repair. With focused maintenance, the buffering of failures is handled by two buffers, designated the upper and lower buffers. A pair of these buffers exists for each line concentrating device in the office. This feature functions similarly to the focused trunk maintenance feature described in "Trunk Test Facilities at the Maintenance Center."

### **Automatic line testing**

Automatic Line Testing (ALT) is usually performed on a scheduled basis; operating company involvement is limited to the initial scheduling. Normally ALT is run on a large group of host or remote lines during a low traffic period. ALT identifies line faults so that they can be cleared before they become service affecting, and before subscriber reports are originated. Lines which fail to meet established standards of quality are identified to the operating company by posting the failures at the Line Test Position (LTP) and by output reports generated from the ALT log subsystem. The line failures that are identified in this way are then manually tested and corrected.

All test equipment that is required for ALT is internal to the DMS-100 Family System. Therefore, any MAP can be used to schedule ALT. For example, a MAP configured as an LTP may be used to schedule ALT.

### Concurrent testing

The ALT level command, ALTUSERS, in the line maintenance subsystem (LNS), displays the identification of all users that have tests pending or tests in progress, and the type of tests that each has specified. When each user defines the lines to be tested and the type of test to be run, the system organizes the tests to be run simultaneously. A test type, in association with a specific user, is called a test process. These lines, which are scheduled for a test process, comprise a group. The following factors are considered in establishing a group:

- Type of test equipment required
- Quantity of test equipment available
- Time required to conduct the tests
- Time available to conduct the test
- Quantity of lines scheduled for testing

When a test process is completed, test equipment used is released and is assigned to a test process from the same or another user. In this way, different test types may be run concurrently for optimum use of the test equipment. When a test process with specified BEGIN and END times completes before the end time, another cycle of testing is started if the test equipment is not required for another test process.

The maximum quantity for a test process that can be created in a switch is determined by a parameter in the OFCENG table, as described in NTP 297-1001-455. When the quantity of test processes that are defined exceeds the maximum parameter, a message is displayed during the definition activity to warn the originator that a test may not be performed.

### Test process interruption

ALT is a test process that seizes an MTA vertical for lengthy periods, preventing other testers from using the vertical. For this reason ALT is classified as an interruptible process so that test activity can be suspended while an interrupting process seizes the vertical. When the interrupting process is completed, it releases the MTA vertical and ALT resumes testing.

### ALT INTERRUPTING PROCESSES

Process	Interrupt ALT
Board-to-Board Test	No
System Diagnostic	No
Automatic Line Test	No
Ring Generator Test	No



Line Cutover	No
Operator Verification	Yes
Manual Diagnostic (LTP)	Yes
Station Ringer Test	No
Foreign Potential Test	No
Automatic Electric Co. Test Desk	Yes
Local Test Desk	Yes
Mechanized Loop Test	Yes

If an interrupting process attempts to seize an MTA vertical that is busy with an uninterruptable process, it waits a maximum of 40 sec. to seize the vertical when it becomes free. If the vertical is still busy after 40 sec., the interrupting process proceeds with the remainder of its schedule. Only one process can wait for a busy vertical to become free. Additional processes are denied attempts to wait, and they resume their schedule.

### Tests

Four types of tests are performed at the ALT sub-levels, such as ALT SDIAG, ALT DIAG, ALT LIT and ALT BAL. The tests and their codes in the ALT menu are noted here. One or more of these tests may be performed on a group of lines.

Test	Code
Short diagnostic	SDIAG
Extended diagnostic	DIAG
Line insulation test	LIT
On-hook balance network test	BAL

### Line insulation test prevention on PABX

Most loops which are connected to Private Automatic Branch Exchanges (PABX) are not meaningfully tested by the ALT Line Insulation Test (LIT) due to a possible voltage or other condition imposed on the loop by the PABX. To prevent the test being conducted on these loops, the option NLT is specified in the line assignment table LENLINES for each line on which LIT is not to be performed.

### Test duration

Each of the four ALT tests has performance time requirements:



<b>ALT Tests</b>	<b>Approximate Seconds</b>
Short diagnostic	7
Extended diagnostic	20-40
Line insulation test	6-8
On-hook balance network	5

The time required to complete the Line Insulation Test (LIT) is reduced if all the subtests are not performed. The test times which are given are the average per line when a large group of lines is tested. They include both a portion of the time that is used to configure the test equipment for testing the group of lines, and the time used in testing one line. The time required to test one line individually is greater because test equipment must be configured beforehand.

### **Automatic line testing commands**

The automatic line test level is accessed from the Line Maintenance Subsystem (LMS) level with the command ALT being entered at the MAP or LTP position.

#### **Define an automatic line test**

An automatic line test command (DEFINE) is used to specify an ALT on a group of lines.

SDIAG	short diagnostics are to be performed.
DIAG	extended diagnostics are to be performed.
LIT	line insulation tests are to be performed.
BAL	on-hook balance network tests are to be performed.
site	site name used when the central office is equipped with a remote LCD.
len	seven-digit Line Equipment Number (LEN) that identifies the location of the line circuit in memory.
scope	specifies the range of lines that are to be tested and schedules the test. It consists of parameters: C, count; ELEN; B, time; E, time; DAYS, days.
	where:
C	specifies that the lines to be tested are defined by quantity (count) and lines to follow
count	quantity of lines to be tested
ELEN	site and LEN of the last, end line to be tested and defined

	B	beginning time of the test is to be defined; beginning time is to follow
	time	time to begin or end the test
	E	specifies ending time of the test to be defined; ending time is to follow
	DAYS	specifies that the testing days are to be defined. The testing days are to follow.
	days	are the days in which the tests are to be performed (Y) and the days on which they are not to be performed (N), starting at Monday and ending at Sunday.
littest		specifies the LIT tests that are to be performed. It consists of parameters: EMF, TG, RG, TR, ALL. where:
	EMF	specifies that a subscriber loop is to be tested and any foreign ac or dc voltages are to be measured between the tip conductor and ground and between the ring conductor and ground.
	TG	resistance between the tip conductor of the subscriber loop and ground is to be measured.
	RG	resistance between the ring conductor of the subscriber loop and ground is to be measured.
	TR	resistance between the tip and ring conductors of the subscriber loop is to be measured.
	ALL	EMF, TG, RG and TR line insulation tests are to be performed on the subscriber loop, as well as capacitance tests between the loop conductors.
testlimits		specifies the resistance and voltage thresholds for LIT. It consists of parameters: RES, BAND 0, BAND 1, dc, ac, VOLTS, CAP, MF. where:
	RES	specifies that the limits of the resistance bands are to be defined.
	Band 0	is the most critical threshold resistance, in hundreds of ohms, between the tip conductor and ground, the ring conductor and ground, and between the tip and ring conductors of the subscriber loop.

Range: 1 to 7500

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Band 1	is the least critical threshold resistance, in hundreds of ohms, between the tip conductor and ground, between the ring conductor and ground, and between the tip and ring conductors of the subscriber loop.
	Range: 1 to 7500
dc	specifies that the dc voltage threshold value is to be defined. The voltage threshold is to follow.
ac	specifies that the ac voltage threshold value is to be defined. The voltage threshold is to follow.
volts	is the voltage threshold.
	Range: 1 through 140
CAP	specifies that the capacitance threshold value is to be defined. The capacitance threshold is to follow.
mf	is the capacitance threshold in units of .001 microfarads.

**Note 1:** The parameter SITE is omitted when the office is not equipped with a remote.

**Note 2:** ALT tests can be defined from an LTP for one site only. The currently defined tests must be cancelled if a different site is to be defined.

**Note 3:** The command DEFINE will adopt default values so that omitting the parameter LEN causes the first two line equipment numbers in the office to be tested.

**Note 4:** When an LIT test is defined, and no tests are specified, the currently defined tests are run; otherwise the parameter ALL is the default value.

**Note 5:** A redefinition of the parameter LITTESTS cancels all previously defined values. When any of the test limits are not specified, the current values are used; otherwise the following default values are used:

BAND 0	= 400 (40 000 $\Omega$ )
BAND 1	= 2000 (200 000 $\Omega$ )
dc VOLTS	= +2 to -2
ac VOLTS	= 2
CAP MF	= 400 (0.4 $\mu$ F)

**Note 7:** The parameter TIME is expressed in the format hhmm, where hh is in the range 00 to 23 and mm is in the range 00 to 59.

**Note 8:** If tests on all defined lines are completed before the specified test ending time, testing restarts and repeats as often as time allows.

**Note 9:** When a process will not run, FL STRT is displayed under the label DAYS.

### **Display the status of ALT**

The display the status of ALT (STATUS) command is used to update the display of the status of any ALT level test.

### **Stop a specific ALT**

The stop a specific ALT (CANCEL) command is used to halt a test and display a summary of the results of the halted test.

### **Activate**

The activate (RUN) command is used to start a test by changing the status of that test from define to active. This status change is effected immediately or at the scheduled begin time.

### **Display all ALT users**

The display all ALT users (ALTUSERS) command is used to display the user name of all users who have an automatic line test in progress or who are scheduled to conduct systematic line tests.

### **Automatic retest of ALT failures**

The automatic retest of ALT failures feature enhances the ALT facility by automatically retesting and logging line failures. In addition, STOP and RESTART commands have been added for the user to stop and then continue a test.

**Automatic retest of ALT failures for scheduled testing** With this feature, ALT will ignore the passed lines that have been tested and repeat the test starting from the first failed line. Only when all the lines pass or when all the failing lines have been retested twice will ALT retest from the first line of the set. In all cases, ALT will terminate the testing when the end time arrives.

**Automatic retest of ALT failures for non-scheduled testing** The current non-scheduled ALT will test each line in the posted set only once. With this feature, ALT will terminate the testing only when all the lines pass or when the failing lines have been retested twice. As in the scheduled ALT, the passed line will be ignored in the retest. The non-scheduled ALT differs from the scheduled ALT in that the non-scheduled ALT does not retest the whole set of lines.

## Subscriber module SLC-96 maintenance

The Subscriber Module SLC-96 is a peripheral module based on LGC and DTC architecture. The SMS provides a digital interface between a DMS-100 Family System digital switch and the remote terminal of the SLC-96 digital loop carrier system. Integrated into the DMS-100 Family System, the three elements would be comprised of the RT, the SMS, and T1 carrier links between the two. Maintenance for SMS and SLC-96 is fully integrated in the DMS switch. The SMS and SLC-96 DS-1 lines and subscriber loops, except special channel units, can all be tested through maintenance procedures:

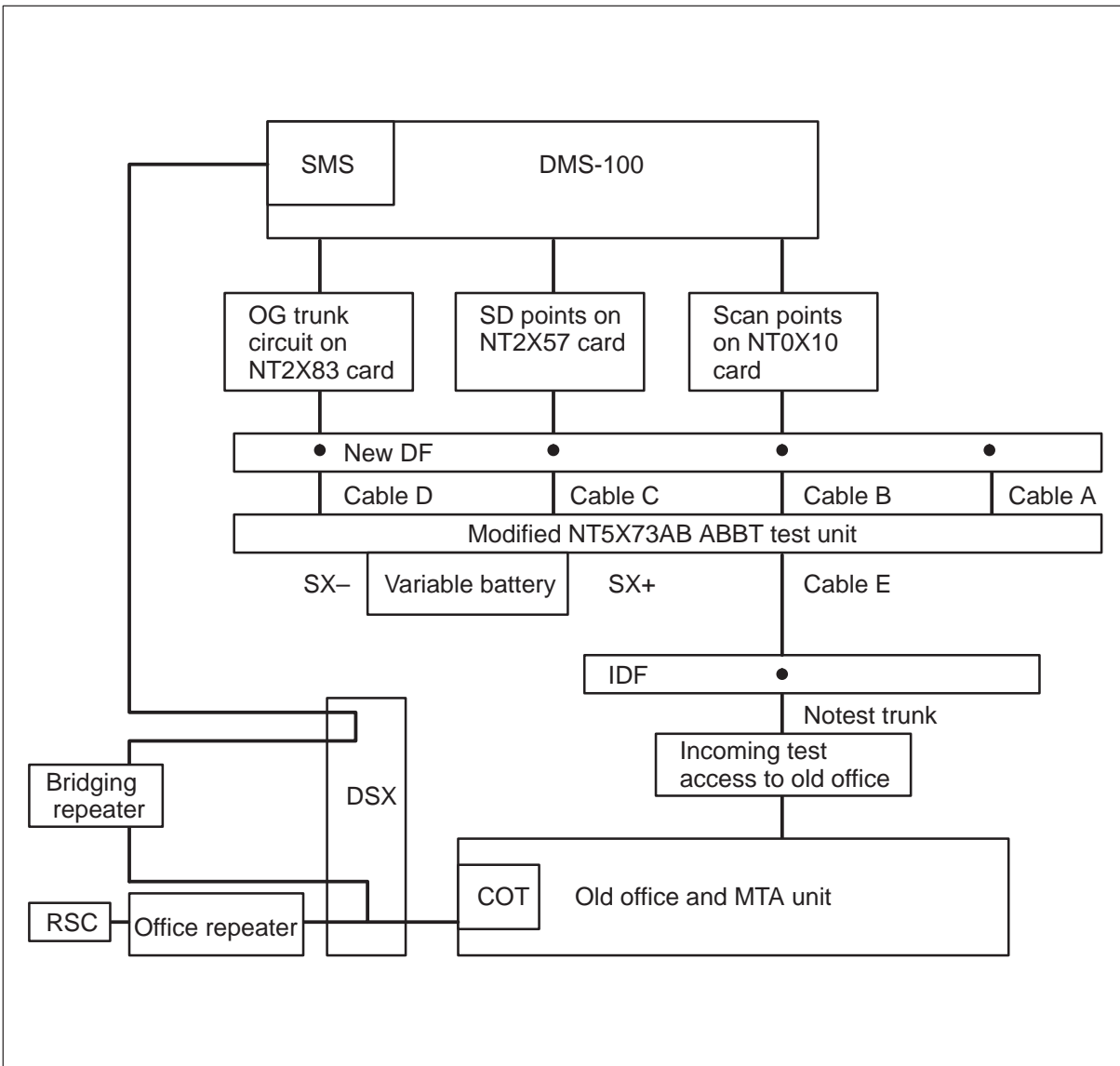
- Carrier channel unit testing is part of an integrated maintenance package.
  - Addition of SMS to the CARRMTC table
  - Support for the SMS at the CARRIER level of the MAP
  - Audits for DS-1 lines attached to an SMS
  - Generation of logs and operational measurements for DS-1 lines
- Digital board to board testing to support the cutover of lines from nonintegrated systems is supported. Figure 7-18 illustrates ABBT connections for SLC-96 subscriber lines.
- Digital loopback and VF loopback at the RCS is supported.
- Testing and Diagnostics of the SMS-RCS system can be performed from the MAP position.
- Subscriber loops are tested using a metallic process, with a metallic test pair accessing the subscriber loops at one end and, at the other end, terminating on a metallic test access network. Subscriber loops are tested through the MAP or from remote test desks, such as the MLT or the #14 Local Test Desk (LTD). Remote test equipment connects to the metallic test access circuit through an applique circuit, NT2X90AD Test trunk, and MTA.
- SMS provides integrated administration and supports a majority of the features currently available with the SLC-96 remote terminal and DMS-100 switch.
- Nailed-up specials maintenance is a planned enhancement for the SMS.
- RCS alarms are integrated into the DMS-100 Family System alarm system and are monitored and controlled by DMS-100 software.

Reasons for all alarms are included as part of the Man-Machine Interface (MMI). Programmable power and miscellaneous alarms with assignable severity levels are a useful enhancement to the standard alarms.

- The station ringer test is supported for RCS lines.

- The Maintenance and Table Control for the Nailed-up Specials feature implements the audits and log reports associated with nailed-up peripheral side (p-side) to p-side DSO cross-connections. The nailed-up feature enables a craftsperson to set up or take down the connection between two terminals on the same SMS.

**Figure 7-18**  
**ABBT connections for SLC-96 subscriber lines**



**Subscriber carrier module rural (SMR) and urban (SMU)**

The Subscriber Carrier Module Rural (SMR) provides a DMS-100 or DMS-100/200 customer with integrated access to a Digital Multiplexing Switch-1 Rural (DMS-1R) on a direct digital basis. When the DMS

Switching system is equipped with Custom Local Area Signaling Service (CLASS) the Number Display (CND) is automatically extended to subscribers served by the DMS-1 Urban. DMS-1R and DSM-1U are Nortel Networks pair gain devices for service on a direct digital Basis.

The Subscribed Carrier Module Urban (SCM-100U) with Calling Number Delivery (CND) performs many of the same basic functions as the SCM-100R, however, with many more addition features, such as enhanced services (EPOTS), for Custom Local Area Signaling Services (CLASS) for Remote Switching Centers (RSC) and TR-008 digital loop carrier such as the SLC-96. These new features reduce the cost of delivering special services. These features provide the ability to:

- access the Maintenance and Administration Position (MAP)
- handle new alarm information
- provision new line card inventory data
- download inventory

### **Integrated maintenance**

The loopback path of all circuit packs, maintenance relays, and loop and ANI detectors at the SMR are regularly tested. An equivalent loopback is retained by the DMS-1R to check its operation.

Alarms, power alarms and maintenance indications are displayed on the MAP terminal. SMR internal diagnostic software will indicate the location and type of faulty circuit packs in the SMR and the DMS-1R. Service order changes and line data information are also accommodated by way of input to the MAP.

The SMR conducts its own routine maintenance and operation checks, identifying malfunctions and circuit pack failures. Any failure will automatically enable a diagnostic check to determine the failed circuit pack. The location and type of faulty circuit packs are indicated on the MAP.

### **DS-1 line maintenance**

If a DS-1 link between a DMS-1R and the SMR fails, either channel reassignment or protection switching will prevent the possibility of interruption in subscriber service. Link failures can be induced by diagnostic personnel, and protection switching can be manually initiated for testing during low traffic periods.

### **DS-30 line failure**

Multiple network links on connections by way of duplicated DS-30 links with traffic reassignment absorb DS-1 link or circuit pack failure, preventing service interruption.

### **SMR control module**

If the SMR control module should fail, the mate shelf will take control of the faulty shelf's traffic. This mate shelf maintains full control of the links until the failure is corrected.

### **Subscriber loop testing**

The DMS-1R has the optional capability of connecting any subscriber loop to a test head mounted in the DMS-1R. The SMR allows operation of this test head from a DMS-100 Line Test Position (LTP). The control and display of digital subscriber loop test information is by way of the DMS-100 MAP and/or the LTP. The PP Digital Test Head (SLT-D) consists of a QPP423 circuit pack mounted in the DMS-1R.

The DMS-1R provides Line Test Access (LTA) capability to connect any subscriber's loop to a metallic pair that is returned to the central office. The SMR allows connection of this pair to a testing facility by way of the host incoming test trunk. Testing includes subscriber line In/Out testing as well as busy monitoring.

### **DMS-1R maintenance**

Alarms and maintenance indications on each DMS-1R are routinely scanned by the SMR. Alarm conditions are displayed on the MAP terminal.

Memory audits, Peripheral Module call failures, and DMS-1R maintenance diagnostics are provided by way of the host LTU.

Diagnostics for DMS-1R line cards by way of the alarms and system audits are also part of SMR maintenance.

### **System maintenance**

SMR system maintenance is the same as LTC system maintenance with two exceptions.

- 1 The SCM A-bit/B-word and Ring/Pad tests are two new diagnostics that are run when TST or RTS is chosen from the posted SMR menu. These diagnostics are provided for two new SMR circuit packs, the A-bit/B-word and Ring/Pad circuit packs.
- 2 An SMR communicates with a DMS-1R by sending B-word commands over a DS-1 link. Replies to these commands are expected from the DMS-1R. If a reply is not received, the B-word hardware will timeout. An SMR keeps a count of B-word timeouts per DS-1 link, and sends an unsolicited message to the CC, indicating that the DMS-1R is not communicating on that link. When more than ten B-word unsolicited timeout messages arrive at the CC in a five minute period, the link is removed from service.



## DMS-1R lines maintenance

Line circuits, subscriber loops, and stations are tested under the lines maintenance (LNS) subsystem. Station testing is performed either under the LNS subsystem at a MAP or, in the cases of the Silent Switchman (SSMAN) and Station Ringer (SR) tests, from a station. Lines are tested manually and automatically. Stations are tested manually.

### Manual line tests

Manual Line Tests are performed by the switch operator of line circuits, loops, and stations. Line circuits and loops are tested individually with results displayed to the switch operator at a visual display unit. Lines are tested manually as part of routine maintenance or when either a customer report is generated or an ALT failure occurs.

Manual line testing is performed at the Line Test Position level using any of the four levels of the line maintenance subsystem: ALT, LTP, LTP Manual (LTPMAN), and LTP Line Test Access (LTPLTA). Manual line testing covers several tests:

- short diagnostic
- ac voltage
- extended diagnostic
- resistance
- line insulation
- capacitance
- loss
- coin
- line
- digit
- noise
- ring
- originate
- station ringer
- dc voltage

### Automatic line tests

Automatic line tests are performed on line circuits and loops, usually on a scheduled basis, without switch operator involvement other than for initial scheduling. ALT in a DMS-100 office is performed under the LNS subsystem and includes testing both line circuits and the attached loops. Lines that fail to meet certain standards of quality are identified to the switch operator by posting the failures at the LTP or by output reports generated by

the ALT log subsystem. The failures thus identified are then tested manually and corrected.

Three tests are performed automatically for line testing. These can also be performed manually:

- short diagnostic
- extended diagnostic
- line insulation

### **Station tests**

Station Test results are displayed at the VDU except for the Station Ringer and Silent Switchman tests, which are returned to the station.

**Silent switchman test** The DMS-100 does not support the Silent Switchman test for DMS-1R lines since it requires placing the subscriber loop in cutoff. Since this interferes with ringing, subscriber loop cutoff, hence Silent Switchman, is not supported. Attempting to run this test causes a re-order tone to be returned to the DMS-1R line.

**Station ringer test** The Station Ringer Test is supported for DMS-1R lines. Since it is difficult to attach test equipment to a DMS-1R line during normal traffic periods, the Station Ringer test is changed for DMS-1R lines so that it never returns the 60 IPM low tone low resistance to ground after the off-hook ground test.

### **DMS-1 line test using line test access**

This feature extends DMS-100 line tests to lines in DMS-1Rs equipped with the LTA card accessing MTA.

## **Remote line concentrating module maintenance**

The Remote Line Concentrating Module (RLCM) maintenance serves as an interface between remotely located subscriber lines and a DMS-100 host. A single RLCM provides services, including MERIDIAN Business Services and DATAPATH for up to 640 lines over two to six DS-1 links to the host.

The design of the RLCM is based on the LCM in the host office. This ensures commonality of hardware and features, and allows for total integration of RLCM maintenance and administration into the host office. Integration results in cost savings which a single all-inclusive system provides. Both the maintenance and administrative functions are performed by way of MAP positions located at either the host or the remote site. MAP positions at the remote site communicate with the host through dedicated lines external to the RLCM, or by way of dial-up lines through the RLCM.

Fault detection and tracing can be performed to the circuit card level. Detection is accomplished through continuous self-monitoring of the system, routine audits, and both automatic and manual diagnostic loopbacks.

### **Line testing metallic access**

Line tests may be performed at the MAP position, or alternately from external systems such as the MLT 1/2 or the #3 LTC. DMS line testing at the MAP position requires provisioning of the following:

- remote line maintenance
- line test unit
- remote metallic test access
- I/O test trunk

### **DS-1 link maintenance**

Both the RLCM and LGC host monitor the DS-1 links and report error conditions to the host CC:

- bipolar violations
- frame slips
- loss of frame
- message channel loss

The error conditions are compared to operating company specified system limits and, if on a particular link the limits are exceeded, the link is removed from service. In the extreme case of total loss of communication with the host DMS, the RLCM enters the Emergency Stand Alone (ESA) state if the ESA option is provisioned.

## **Outside plant module maintenance**

The Outside Plant Module (OPM) maintenance is an RLCM which has been repackaged in a weatherproof cabinet, including environmental equipment and standby power equipment.

In addition to the standard RLCM maintenance functions described in this section, the OPM has a unique maintenance feature set which controls and monitors the Power and Environmental System (PES) of the OPM cabinet.

### **OPM maintenance and administration**

Maintenance and administration of the OPM are integrated into the host DMS. These functions are performed at the MAP, which can be located at the host or at a remote site. Fault detection for the following are performed through continuous self-monitoring of the system, routine audits, and automatic and manual diagnostic loopbacks:

- LCM and line cards

- RMM and service circuit cards
- ESA functions
- DS-1 line interface functions

Some parts of the OPM, including the host-directed DS-1 spans and the environmental control system, require routine manual maintenance.

### **OPM maintenance software**

The power and environmental aspects of the OPM are displayed and manipulated at the Outside Plant Module Power and Environmental System (OPMPES) MAP level which is accessed by way of the PM MAP level.

### **OPM environmental-controlled cabinet**

The OPM's environmentally-controlled cabinet allows it to be deployed in a wide range of environments. Conditions in the main compartment are maintained by the Environmental Control Unit, which includes heaters, ventilation fans, dampers, air intake ports and sensors. The end-access compartment does not require environmental regulation. The OPM is designed to operate within the following ambient temperature ranges:

- Continuous operation                       $-40^{\circ}\text{F}$  ( $-40^{\circ}\text{C}$ ) to  $+113^{\circ}\text{F}$  ( $45^{\circ}\text{C}$ )
- Short term (72 hours continuous or 15 days maximum per year)     $-58^{\circ}\text{F}$  ( $-50^{\circ}\text{C}$ ) to  $+122^{\circ}\text{F}$  ( $50^{\circ}\text{C}$ )
- Maximum rate of change                      3 cycles of  $1.8^{\circ}\text{F}$  ( $1^{\circ}\text{C}$ ) per minute

o maintain adherence to the rate-of-change requirement, opening of the main compartment at low temperatures may require raising and preheating of a tent, as follows:

- Below  $-4^{\circ}\text{F}$  ( $-20^{\circ}\text{C}$ ) outside ambient, a preheated tent to at least  $32^{\circ}\text{F}$  is recommended. This assumes that ac power is on and that heaters are operational.
- Between  $-4^{\circ}\text{F}$  ( $-20^{\circ}\text{C}$ ) and  $-14^{\circ}\text{F}$  ( $-10^{\circ}\text{C}$ ), no tent is required if doors are opened for minor routine maintenance—that is, with the doors remaining open for no longer than 10 to 15 minutes. This assumes no rain, snow, etc.
- Between  $-14^{\circ}\text{F}$  ( $-10^{\circ}\text{C}$ ) and  $32^{\circ}\text{F}$ , doors may be open up to one-half hour without a tent.

The maximum internal operating temperature is  $158^{\circ}\text{F}$  ( $70^{\circ}\text{C}$ ), at specified ambient temperature.

The OPM is designed to operate, with the doors closed, during conditions up to and including the following precipitation situations:

- 5 minutes of rainfall at a rate of 12 in. (30.5 cm) per hour.
- 10 minutes of rainfall at a rate of 5 in. (12.7cm) per hour.

- 5 min. of rainfall at a rate of 5 in. (12.7 cm) per hour followed by winds of 40.3 miles (65 km) per hour for an additional 15 minutes.

Continuous humidity should be from 5–99% relative humidity, 39.75 mmHG (5.3 kPa) vapor pressure at a temperature of 95°F (35°C).

Electrical Protection is provided to isolate OPM equipment from excessive power-line surges caused by lightning or power system faults. Protection against electrostatic discharge and electromagnetic interference is also provided. Additional grounding schemes are available for sites that are susceptible to lightning strikes. Further information on OPM grounding can be found in NTP 297-2101-200.

### **Battery maintenance**

Every six months, the battery strings should be given a physical and electrical inspection. Remote control of battery string switching allows three activities:

- 1 removing a battery string pair from either the load bus or the charge bus
- 2 placing a battery string pair onto the load bus
- 3 placing a battery string pair onto the charge bus

Busy, return-to-service, test, and off-line functions for the circuits are used to control battery string switching and detect alarm/state condition of an OPMPEs. Automation of scheduled battery rotation (a four day cycle) is supported in the normal and post ac failure mode, effective with BCS 28 and above.

Effective with BCS31 and above, automation of scheduled battery rotation/testing on a 28-day cycle is supported in the normal and post ac failure mode. Also supported are remote measurement of load bus voltage, charge bus voltage and battery string voltage.

### **Power alarms**

Alarm detection and automatic battery switching on certain types of alarm conditions are an integral part of the OPM maintenance package. There are also craftperson failsafes designed into the package for prevention of battery string switching when certain condition such as rectifier failure are detected.

### **Log reports**

Log reports are output to reflect the changing events or failures encountered in the OPMPEs system. PES100 PES117 are associated with OPM maintenance.

### **Audits**

There are hourly audits on the OPMPEs for periodic verification of the condition of the OPMPEs as viewed in software. If a mismatch between

software and hardware is detected, the audit restores the hardware to the current condition of the software and generates a log message indicating this.

### Alarms

Overall condition is the combination of alarms and circuit states reflecting the overall condition of the OPMPEs. All alarm changes detected and changes of state of the circuits will cause a condition change. The priority and causes for each condition are described as follows:

RED: one or more serious problems detected. This will cause a major alarm at the PM level if no other PM alarms.

#### Detectable Alarms

ac	failure
FL0	detected
FL1	detected
CL0	detected
CL1	detected
EHT	detected
ELT	detected
FSP	detected
FRNT	door open
SIDE	door open

AMBER: One or more potentially serious problems and no serious problem at this time; when more than one equipped battery string pair is not on the load bus. Causes a minor alarm on the PM level if no other PM alarms.

#### Detectable Alarms

#### Card States

BCCF0 detected	Peripheral Made Busy
BCCF1 detected	System Busy, Man Busy
ECU detected	In-service

The following three alarms will be available for the BCS31 CC load:

	HBTdetected	
	P/S Post AC failure mode (short)	
	P/E Post AC failure mode (Extended)	
GREEN:	No problems	
	<b>Detectable Alarms</b>	<b>Card States</b>
	None	In-service
OFFL:	Both Battery Charge Controller Driver (BCCDVR) and Power and Environmental System Alarm (PESALRM) cards offline. This does not affect the PM OFFL count.	
	<b>Detectable Alarms</b>	<b>Card States</b>
	Ignored	Offline
Control/ Monitor Circuit Cards:	<b>Detectable Alarms</b>	<b>Card States</b>
	BCCDVR	Battery Charger Controller Driver card

## Remote switching center maintenance

The largest member of the remote family is the Remote Switching Center (RSC). It is comprised of a Remote Cluster Controller (RCC), one or two Remote Maintenance Modules (RMMs), and up to nine LCMs. The RSC uses hardware that is common to that of the DMS-100 Family System host office. The RCC is based on the LGC. The LCMs associated with the RSC use the same line cards as in the host office.

### Basic RSC maintenance

Basic maintenance support for the RSC includes:

- low-level types
- office data management
- MAP
- I/O system
- messaging
- maintenance aspects
- speech aspect
- bst/rts/offline
- loading

- tests/audits
- SWACT
- DS-1 maintenance
- P-side modes

### **SWACT**

The RSC provides the capability for warm SWACT in the RCC so that established calls are preserved in an activity switch between mate units. Messaging between the RSC and the CC passes through the Channel Supervision Messaging (CSM) hardware of the LGC. The CSM hardware of the LGC keeps the Master Processor (MP) of the LGC aware of connection data in the RSC. This awareness allows CSM to survive SWACT of the LGC, it allows warm SWACT of the LGC.

### **DS-1 maintenance**

DS-1 maintenance on p-side ports of an RCC is identical to that provided for an LGC. However, an RCC has DS-1 maintenance on its control side links, which interface as remote links with DS-1 maintenance of the peripheral side of the host.

### **P-side modes**

P-side modes allow maintenance on DS-1 links connected to the control side of the RCC. Most functions provided are similar to those currently available in DS-1 maintenance for peripheral side DS-1 links. The functions are called by the CC, either by itself or in response to MAP maintenance commands. The maintenance functions provide four capabilities:

- 1 enable/disable monitoring of DS-1 circuit physical presence
- 2 enable/disable maintenance monitoring of DS-1 circuits
  - monitoring slips within elastic maintenance store of a DS-1 circuit
  - counting all occurrences of lost frame pulse
  - monitoring levels of bipolar violations
  - monitoring remote alarm indicator
  - monitoring local alarm
- 3 access the counters and status of DS-1 circuits
- 4 monitor the DS-1 link of an inactive unit

### **Remote maintenance module**

The RMM is a shelf module derived from the MTM:

- a single control card
- an optional group codec card
- two power converters



- up to 14 service circuit cards

A maximum of two RMMs may be provisioned at an RSC site, each occupying one shelf in the RSC bay. At least one RMM is recommended at each RSC site to perform diagnostic tests. Service circuit cards include scan, signal distribution, metallic access, metallic network, and line test unit.

The RMM contains its own processor that performs scanning of the service circuits, test trunks, and alarm service circuit packs. The major differences between the MTM and the RMM are as follows:

- MTM DS-30 ports are replaced with DS-30A ports, which allows connection of the RMM to DS-30S links from the RCC
- MTM input/output protocol is replaced with DMS-X protocol. This enhances the reliability of the RMM by rendering it less vulnerable to noisy DS-1 link message corruption

The RMM is supported as a separate node off the peripheral side of the RCC. It is treated, for messaging and maintenance, as a stand-alone peripheral. RCC peripheral side links 0 and 1 are dedicated to the RMM. These two links cannot be datafilled otherwise.

### **RSC equipment maintenance**

The maintenance of all RSC modules is integrated into DMS peripheral module maintenance performed at the MAP:

- LCMs, including their line cards and ringing systems
- RMMs and associated service circuits
- RSC control equipment and associated interfaces to LCMs, RMMs, and DS-1 links

The RSC MAP level looks like the LGC level with a few differences based on the RSC remote location and the C-side DS-1 links. All commands available to the LGC are available to the RSC with the addition of ESA commands.

### **Automatic line tests/metallic line testing**

The RMM line test service circuits are used by the ALT diagnostic. RMMs operate with ALT as ALT is currently implemented. No changes or additional commands are required.

The ALT diagnostic is performed at the lines (LNS) level of the MAP. It allows automatic testing of line circuit packs and attached subscriber loops. Four tests are available under ALT:

- 1 short diagnostic
- 2 extended diagnostic
- 3 line insulation test

#### 4 On-hook balance network test

##### **Manual line tests**

Manual line tests are performed by the switch operator on line circuits, loops, and stations. Line circuits and loops are tested individually. The results of the test are displayed to the switch operator, immediately after testing, at a VDU. Lines are tested manually as part of routine maintenance, or when either a customer report is generated or ALT failure occurs.

Manual line testing is performed at the LTP level using any of the four levels of the LNS subsystem: ALT, LTP, LTP Manual (LTPMAN ), and LTP Line Test Access (LTPLTA).

##### **Station testing**

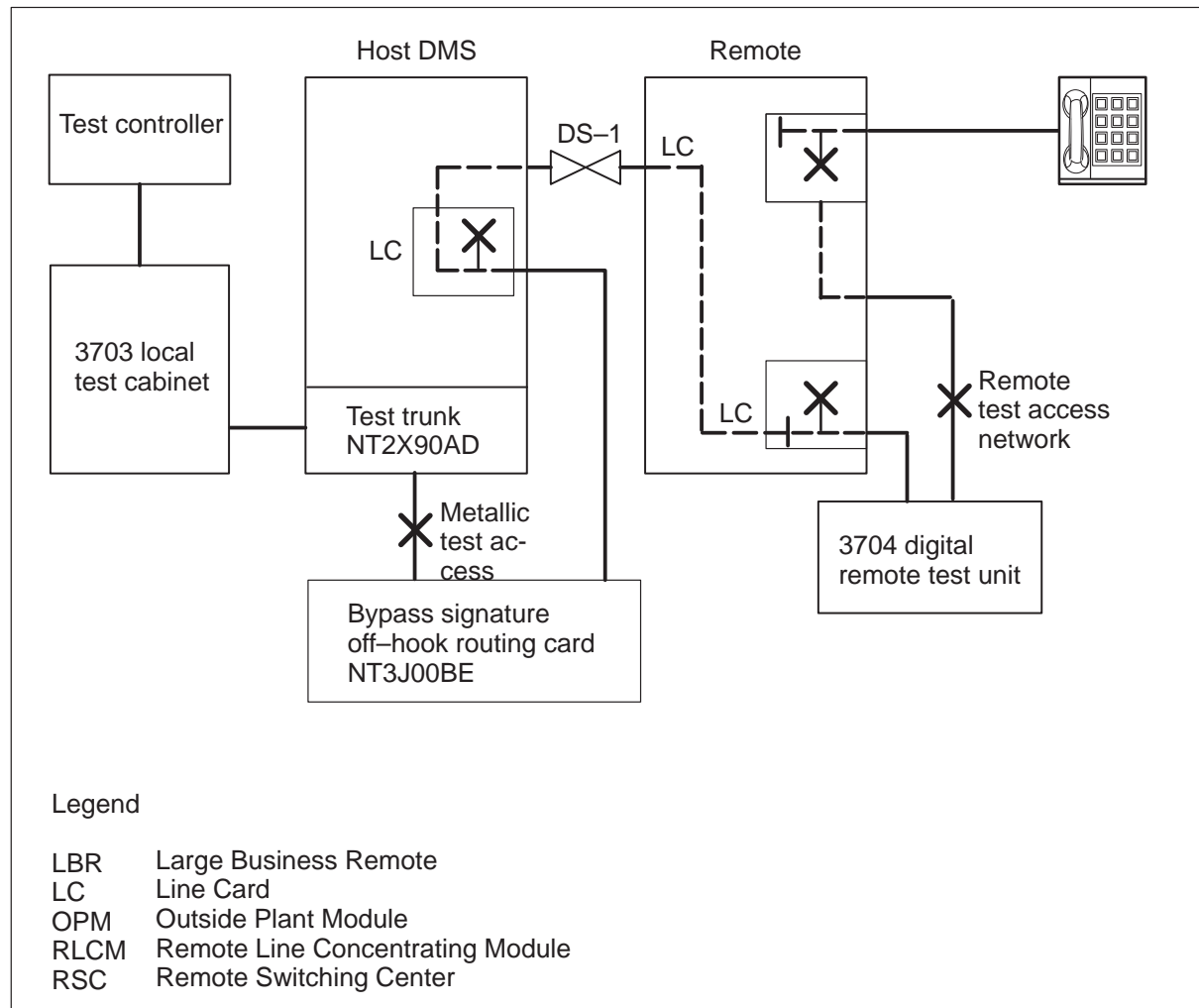
Station testing helps determine if a station is functioning properly while connected to a loop and line circuit combination. Station testing is performed either under the LNS subsystem at a MAP or, for the Silent Switchman (SSMAN) and Station Ringer (SR) tests, from a station. Stations are tested manually. Station test results are displayed at the VDU except for the SSMAN and SR tests, which are returned to the station.

#### **Digital remote test unit for DMS-100 remotes**

The Digital Remote Test Unit (DRTU) model 3704 is a remotely located measurement device for testing lines off DMS-100 Family System remotes located beyond 3-k $\Omega$  cable resistance. The 3704 is controlled by Nortel Networks's Centralized Automatic Loop Reporting System (CALRS) or 3703 Locate Test Cabinet (LTC).

Automatic line access and testing is provided by the DRTU method at any distance from the central office with no copper pair requirement and without the need to recalibrate for each remote. Signaling and measurement data between host and remote are transmitted completely by ac signaling type protocol by way of the DS-1 span. Figure 7-19 illustrates the DRTU Test Configuration.

**Figure 7-19**  
**DRTU test configuration**



## DATAPATH testing

Datapath consists of four elements:

- DU Data units to transmit and receive data
- Modem Pool Equipment configuration to interface digital and analog facilities used for data transmission
- Loop facility Connecting path from a DU and a data line card (DLC)
- Trunk facility Connecting path between DLCs, MPs if necessary, for DLCs in different switches.

## DATAPATH maintenance

DATAPATH components are maintained by accessing the LTPMAN level of the MAP to connect test equipment and facilities to them. When the

connections are completed, the components can be tested using MAP commands in the same manner that other lines are tested.

### **Data unit**

All maintenance features of the Data Unit (DU) are integrated into the DMS-100 common maintenance software. Various tests can be accessed from the MAP to detect, isolate, and identify facility failures or faults. The DU is equipped with a pushbutton switch in faceplate that activates the unit's self-test feature. It also provides loopbacks at the TCM tip and ring, and at the RS232-C interfaces.

When an LCM finds a DU that does not respond to messages, it initiates a series of diagnostics to determine whether the fault lies within itself, the Bus Interface Card (BIC), or the line card. If the diagnostics indicate that the fault lies with the line card, and the diagnostic failure flag is not set against it, a LINE 204 line card fault log report is output. The line is then flagged as being suspect, and may be scheduled for an extended diagnostic.

### **Modem pooling**

There is no maintenance and testing facility dedicated to Modem Pooling (MP). Additionally, operational measurements associated with modem pooling exist.

### **Loop facility**

Means of testing the data transmission for continuity and error rate at the customer's site is provided by data looparound. Once a user dials the looparound access code, the DU transmit path is connected to its receive path in the DMS-100.

Data looparound is assigned an access code in the IBNXLA table. A data unit network class of service (DU NCOS) and translator name are assigned in the NCOS table.

Data looparound is initiated from the DU using the normal call origination procedure. As soon as the access code is entered, looparound is activated and the Connect lamp lights solid. If the line is posted at the MAP, it shows as being connected to itself. There is no time limit; once activated, data is looped around until the RLS key is pressed or the DTR lead of the DTE is set to low.

If data looparound cannot be activated, reorder tone is returned over the DU speaker. This happens when a feature data block cannot be allocated, or when the call is blocked in the network.

**Trunk facility**

The end-to-end protocol used by DATAPATH to receive and transmit data may only be processed over digital facilities. The transmission capabilities of the DMS provide the means to ensure digital connectivity. Some conditions are imposed on the connections to ensure data transmission:

- end-to-end digital connections must be provided
- digital pads must be switched out or set to zero
- echo suppressors or cancellers must not be used

**Audits**

The DATAPATH audit consists of a check of the DU/DLC synchronization status. It searches for DUs that are in the CPB state but are not synchronized with their DLC. Such calls are disconnected and a log report is generated.

**Bit error rate testing**

Bit Error Rate Testing (BERT) can be performed by accessing the LTPMAN level of the MAP.

**BERT MAP commands**

Three commands at the LTPMAN level are used for DATAPATH maintenance. They allow the connection of external test equipment to a DU for BERT on that unit, as well as the monitoring of any data call on the DMS-100. These commands are EQUIP, CONNECT, and LOOPBK:

- EQUIP – Reserves a MONITOR(S) and a TEST line for use at the LTPMAN levels of the MAP. This is used in conjunction with the CONNECT command.
- CONNECT – Connects a specified line to the currently posted line with the option of simultaneous MONITOR connections.
- LOOPBK – Loopback activates one of the loopback points of the currently posted line. This causes the data transmitted from the switch to be sent back to the switch for testing purposes.

**Integrated bit error rate testing**

Integrated Bit Error Rate Testing (IBERT) provides an alternative internal method of testing DATAPATH loops versus the external test equipment method. Firmware (NT6X99AA) located in the line concentrating module, in conjunction with a unique software feature, provides this capability.

**DATAPATH coax eliminator**

This feature provides the firmware for the data unit when switching IBM 3274 or 3278 terminals in the centrex or PBX environment. The same maintenance procedures apply as do for other data units in the DATAPATH system, as described in these paragraphs.

## **DATAPATH loop extension (DPX) maintenance**

### **DATAPATH loop extension (DPX)**

DATAPATH Loop Extension (DPX) is an economical method of extending DATAPATH services to end users who have small line sizes that are located beyond the reach of central office DATAPATH loops. DPX uses Nortel Network's DE-4E channel banks to provide up to 48 lines extended up to 150 miles, allowing telephone operating companies to expand their serving area.

### **DPX testing**

DPX maintenance is integrated with DMS maintenance capabilities, including the MAP. All normal DATAPATH loopbacks are functional with DPX, and additional loopbacks are provided to complete fault isolation. A BERT feature on the DMS will allow complete Bit Error Rate (BER) testing. In addition, each DPX channel unit has a self-test capability.

Maintenance messages between the DMS-100 and the DPX are accomplished by means of an in-band maintenance protocol. These messages allow the DPX to support the following functions:

- BERT
- Diagnostics, DPX, DLC, and DU self test.

### **DPX/DE-4E alarms**

The DE-4E detects long periods of signal loss on the received DS-1 bit stream, and provides a Carrier Group Alarm (CGA) indication to the DPX card. When this CGA indication is received, the DPX terminates any calls in progress and does not initiate any calls until the alarm is cleared.

## **Distributed processing peripheral**

The Distributed Processing Peripheral (DPP) is a peripheral designed to provide teleprocessing capabilities for selected downstream processing systems. It has a full range of maintenance and record formatting capabilities.

### **DPP maintenance and administration**

The DPP is a fully integrated DMS-100 Family System peripheral, and is maintained and administered from the MAP position. Maintenance links from I/O controller ports to the DPP allow alarms, log messages, and commands to be transferred from the DMS-100 Family System CPU to the DPP. These links operate by means of redundant ports with crossover capability and duplicated I/O controller access capability. One port functions actively, while the other acts as a standby providing system security.

### **DPP MAP interface**

DPP maintenance and administration can be performed from any DMS MAP connected to the switch. The MAP interface provides an extensive command set which allows the craftperson to communicate with the DPP. Due to the sensitivity of AMA data, only one MAP user is allowed in MAP level DPP at a time.

Reports regarding statistical data in the DPP are available on demand to the user from any DMS-100 Family System MAP. DPP program down-loading from the DMS-100 Family System CPU can be initiated from the MAP or requested by the DPP.

If both maintenance links are inoperative, an emergency administrative terminal may be plugged directly into the DPP using an RS-232 C Protocol.

### **DPP testing**

The DPP continually runs diagnostic tests to check its own functionality. These diagnostics are transparent to normal operation of the DPP, and are nondestructive in nature to the operation of the DPP. Diagnostic testing is performed against the processors, the controllers, and the major memory areas using the MAP. Information indicating test failure is transferred to the user.

### **Alarms**

Minor, major, and critical alarms are generated within the DPP:

- processors
- memory area
- I/O controllers
- ports
- fans
- power
- clock
- unscheduled machine-caused switchover

Three trigger points are associated with defined levels of storage on the disk for primary AMA records:

- 1 70 percent for minor alarm
- 2 90 percent for major alarm
- 3 100 percent for critical alarm

## **Multiprotocol controller (MPC)**

The Multiprotocol Controller (MPC) is a general purpose data communications package that allows data communications between a DMS-100 and another computer, such as between a central office billing

computer and another DMS-100, using various supported data communication protocols.

The MPC is designed to support two applications and protocols:

- DMS-100 applications that require a data network interface, such as a packet network. The MPC application interface allows logical connections with remote systems to appear as operations upon a file, which is an access method generic to all I/O devices. The first such application to be supported is the Engineering Administrative Data Acquisition System (EADAS).
- Different data communications protocols that may be required by applications. The first such protocol supported is BX.25, Issue 3.

### **MPC maintenance**

There is a specific Man-Machine Interface (MMI) module associated with the MPC subsystem and, as such, the MPC MAP level display indicates the status of the DMS equipped MPC. In a subdisplay, the status of the ports on each MPC is indicated.

This feature generates a log report for each state transition the MPC undergoes. There are specific alarm levels associated with these state transitions:

- unequipped
- offline
- Man\_busy
- System\_busy
- OK

### **Voice message exchange (VMX)**

The DMS-100 Voice Message Exchange (VMX) interface software package provides an integrated interface to VMX, Inc.'s Voice Message Exchange. The VMX stores spoken messages that can be retrieved at a later time.

### **VMX alarm interface**

The VMX alarm interface is a VMX hardware option that enables VMX alarms to be integrated with the DMS-100 alarm indications. The VMX alarm interface unit is interfaced to the host DMS-100 through the Alarm Scanner circuit pack (NT0X10) in a maintenance trunk module. When this option is equipped, alarms that are generated by the VMX are reflected as alarms on the host, with the exception of an ac power loss on the VMX. If this option is not equipped, alarm messages are read at the VMX printer.

Sending of alarms to the DMS-100 can be enabled or disabled at any time by changing the position of the ENABLE/DISABLE switch on the interface unit. Refer to Chapter 8 for additional information.



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## Synchronization

Chapter 8 of this document provides additional information on DMS-100 Family System synchronization.

### Synchronization maintenance

The status of the synchronizable clock system is displayed at the MAP, and includes the:

- status of active and standby clocks
- status of primary and alternate timing links
- slip count on timing links.

Commands available at the MAP include:

- switch clock activity
- synchronize active clock to primary timing link
- switch timing links
- synchronize standby clock to active clock
- adjust clock frequency
- drop synchronization

In the unlikely event that a fault condition occurs, an alarm indication is raised. The system is scanned approximately every 13 sec., and if a fault condition exists an indication appears at the MAP display and/or a log output report is generated. In general, when an alarm condition occurs, the display (and possible audible and visual alarms) persists until a clock test is run and the test passes. The alarms generated in all synchronous clock configuration are power, phase, tuning as required, and heater (Stratum I only).

## End user testing of trunks (EUTT)

The End User Testing of Trunks (EUTT) feature package provides MDC end users with the capability to do their own trunk maintenance and testing. Access to the TTP level of the DMS-100 Family System maintenance and administration system is provided to the end user by means of a Nortel Networks approved workstation, usually a dial-up ASCII terminal.

### EUTT software features

The EUTT software includes four features:

- 1 Customer screening at the TTP
- 2 MAP alarm level screening
- 3 Killer trunk report separation
- 4 Automatic TTR

### **Customer screening at the trunk test position**

This feature, which is the base feature for the EUTT software package, enables telephone operating companies to supply their centrex customers with access to the TTP level of the DMS-100 MAP in order to allow end user maintenance of trunk facilities.

This feature provides a secure method for partitioning the office trunk data and screening the TTP access terminals to allow a particular end user to access only those trunks that are “owned” by that customer. Common trunks, for example, DDD, remain under the supervision of the telephone operating company.

Customer screening at the TTP blanks out all DMS-100 top-level alarms for non-telephone operating company users. In addition, whenever a non-telephone operating company user alters the state or the pending state of a trunk, a log report is produced. This log report identifies the trunk, the new trunk state, and the new pending state. Operating company users continue to receive top-level alarms as usual.

### **MAP alarm level screening**

This feature allows end users to receive top-level trunk group alarms on their remote terminals. The top-level alarm alerts the user to a problem with the trunks subsystem. All other subsystem top-level alarms remain unavailable to end users.

The top-level trunks subsystem alarm display for a particular end customer is based only on the trunks that are “owned” by that customer. It is not possible for an end customer to receive alarms that apply to trunk groups or trunks owned by other end customers.

The MAP alarm level screening feature also allows end users to access the trunk group status and trunk status levels of the DMS-100 maintenance and administration system, so that troubled trunk groups and individual trunks can be identified for corrective action.

### **Killer trunk report separation**

This feature permits the transfer of scheduled killer trunk log reports to a Device Independent Recording Package (DIRP) file for polling by a downstream processing device. It is implemented in conjunction with Network Operations System (NOS) applications.

### **Automatic trunk test reporting**

This feature enables the DMS to store ATT results in disk files, and then transfer those files to the NOS over a data link. Partitioning of the ATT data is on a customer group basis. Retrieval of only the ATT data for a particular customer group is supported.

### **Command security**

End users are permitted to log on to a trunk test position as usual; however, the telephone operating company controls the commands that each user is allowed to use.

Each DMS system is equipped with standard security features that allow the telephone operating company to screen commands by terminal and by user. With the standard security features, the user is permitted to use any commands unless specifically restricted by the telephone operating company.

The Enhanced Security Package I feature set is required for implementation of EUTT, as this software package prevents the end user from accessing any commands other than those specifically allowed by the telephone operating company.

### **Customer access to trunks**

Two methods are available to the telephone operating company for providing end user access to the TTP level of the DMS-100 Maintenance and Administration System.

When an end user logs on to the trunk test position, the user can be required to select the MTC level from the MAPCI menu. The user is then allowed access only to the TTP and TRK levels of the MAP.

Alternatively, the telephone operating company can set up the logon profile such that the user is automatically logged on to the TTP level of the MAP. The POST, CKT, and STKSDR commands identify, to the TTP, trunks for TTP maintenance actions. For EUTT, each of these commands has been altered to ensure that only trunks that are owned by the user attempting to perform the maintenance action are identified.

To initiate trunk testing, the end user enters the POST command and specifies a particular trunk(s). The POST command checks for trunk group ownership. If the user does not own the trunk(s), the user cannot proceed with trunk testing.

### **Network testing and maintenance**

Expansion of the Focused Maintenance software package provides for diagnostics on the DMS-100 Family System network similar to those on trunks and lines described in this section. Four distinctive functions, as described below, are provided.

### **Network circuit pack diagnostics**

This feature provides the ability to completely test each DMS network circuit pack for functionality. The testing checks control areas, and channels every path through the circuit pack as may apply to that circuit pack. The testing covers existing packs as noted here. Integration of other network circuit pack arrangements, either upgrades or enhancements, into this diagnostic is projected.

- DS-30 serial port interface card
- junctor serial port interface card
- serial-to-parallel formatter card
- crosspoint card
- parallel-to serial formatter card

### **Network path diagnostic**

This feature provides the ability to repeatedly test a specific network path as identified by the NET102 message from the DMS. This permits verification of a problem with the path, and that the repair process was completed correctly.

### **Scheduled testing of DMS network fabric**

This feature provides automatic testing of the DMS-100 network fabric on a scheduled basis, similar to the automatic trunk testing feature of the DMS. The access and selection of this process will be from the MAPCI level of input rather than from a menu level.

Warning messages indicating improper activation is given to assist in preventing inadvertent activation that would cause traffic degradation. The testing shall be normally activated during low traffic periods and on network units that are in a precut state. The results of the testing will be provided on demand, and will indicate those network path entities that failed the testing sequence. The test systematically evaluates every path and channel available between every input port on a network unit to every other output port on that same network unit. This type of test, although time consuming, ensures that the network is capable of handling traffic under most conditions.

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## Chapter 8: Transmission

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The DMS-100 Family switching system is specified for application as a Class 5 or higher office in the existing North American (digital and analog) network. The DMS-100 Family functions in both fixed loss plan and via net loss plan environments.

### Transmission test level point

The standard transmission level point (TLP) in the DMS-100 system is 0 dB. The standard TLP in the DMS-200 system is a -3 dB TLP at the center of the switch. These are the reference points for a transmission plan using the test signal generated by the DMS.

The DMS-100 does not provide a digital reference point.

### Analog connection transmission specifications

Unless otherwise mentioned, specifications are stated in terms of Main Distribution Frame (MDF) to MDF measurements, with nominal impedance terminations. For these performance limits to apply, the cabling from peripheral modules to the MDF should be restricted to 75 ft (22.86 m)  $\pm$  75 ft (22.68 m) of 26 gauge cable. In other cases, allowances must be made for the office cabling in evaluating transmission performance.

Care must be taken to eliminate feedback as a source of measurement error between 2-wire interfaces, for example, disabling the bitstream in the direction of transmission opposite to the direction under test.

Unless specified otherwise, when an input signal is required for measurement purposes, the signal power level should be 0 dBm0.

### Transmission specifications

The following transmission specifications are met, with the switching equipment installed in a switching center, during any one maintenance interval. The limits apply to 95% of connections unless indicated otherwise. The transmission specifications for connections between interfaces assume no digital pads in the switching network (see Transmission pads). Should digital pads exist, additional allowances must be made. The limits of the analog parameters are specified herein assuming a full 8 bit u255 PCM conversion. These transmission specifications apply over the normal

operating environmental range of 50° F through 86° F, relative humidity of 20 to 55 percent, and office power in the range -42.75 Vdc to -55.8 Vdc with -48 Vdc nominal voltage.

Unless otherwise specified, these definitions apply:

- Line Interface (LI) is the analog interfaces as described in Chapter 5.
- Line Interface (LI) are also analog line interfaces at remote locations connected by a digital host link.
- Trunk Interface (TI) are 2-wire (2W) and 4-wire (4W) analog trunk circuit interfaces as described in Chapter 5.
- Digital Interface (DI) is as described in Chapter 5.
- Connections between interfaces designated “from interface A to interface B” also mean “from interface B to interface A”.

### Digital test sequence

The repetitive transmission of the sequence of digital codes in a given connection will be decoded at a properly aligned analog circuit output as a 0 dBm0 1000 Hz (nominal) sinusoidal test signal (see Table 8-1).

Word no.	Bit position							
	1	2	3	4	5	6	7	8
1	0	0	0	1	1	1	1	0
2	0	0	0	0	1	0	1	1
3	0	0	0	0	1	0	1	1
4	0	0	0	1	1	1	1	0
5	1	0	0	1	1	1	1	0
6	1	0	0	0	1	0	1	1
7	1	0	0	0	1	0	1	1
8	1	0	0	1	1	1	1	0

This repetitive sequence of 8 digits is defined as the Digital Test Sequence (DTS). The set of codes listed above is used only in specifications. It is not used as a test signal in the DMS-100 Family systems as it contains patterns that could erroneously simulate T1 carrier framing patterns.

### Test tone-digital reference signal

The Test Tone as derived from the Digital Reference Signal (DRS) is a 1004 Hz tone at a level of 0 dBm0 and is used in the system for maintenance purposes.

### Equipment transmission levels – (1004 Hz)

#### Line interfaces

The nominal loss of an analog-to-digital (A/D) path is 0.0 dB.

The nominal loss of a digital-to-analog (D/A) path is 0.0 dB (Type A, B, E) and 3.5 db (Type C).

The loss control of a D/A path is 0.0 db to 7.0 db in 1 db steps. Loss is implemented with analog pads under software control. An example of pad loss is shown in Table 8-2.

<b>Type of Connection</b>	<b>Type A, B, E Loss (dB)</b>	<b>Type C Loss (dB)</b>
Intraoffice	0	
3.5	1	
Interoffice (co-located)		
3.5	2	
Intraoffice special application	3 4	3.5
—		
Interoffice (local)	5	5.5
Unused	6	6.5
—	7	—

#### Trunk interfaces

Analog trunk circuit interfaces in DMS-100 Family systems incorporate either a fixed or variable pad in order to introduce the loss level required for application in the transmission plan. The loss range of 0–15.75 dB is manually adjustable in 0.25 dB steps to allow for compensation of cable losses and/or Via Net Loss (VNL). DMS-100 family trunk circuit interfaces have nominal transmission levels/ranges as described in Chapter 5. Trunk interfaces with variable gain can be controlled to within  $\pm 0.125$  dB of its nominal loss by means of the adjustable pad.

### Connection loss

Connection loss at 1004 Hz is shown in Table 8-3.

<b>Table 8-3 Connection loss</b>		
<b>Connection Type</b>	<b>Connection loss (1) (1004 Hz)</b>	
	<b>Average Loss (dB) (Note 2)</b>	<b>Variability (dB) (Note 3)</b>
L1//2WT1//4WT1 to L1//2WT1//4WT1	≤ 0.6	± 0.5
L1//2WT1//4WT1 to D1	≤ 0.35	± 0.3
<b>Note 1</b> Allowances must be made for nominal interface losses other than 0 dB.		
<b>Note 2</b> Average loss is equal to or greater than 0 dB.		
<b>Note 3</b> Variability from average loss.		

### Inband attenuation distortion

With input as specified to properly established connections, the output is shown in Table 8-4.

<b>Table 8-4 Frequency response limits (dB) relative to level at 1004 Hz reference frequency</b>			
<b>Connection type</b>	<b>Frequency (Hz)</b>	<b>Minimum loss (dB)</b>	<b>Maximum loss (dB)</b>
L1 to L1	60	20	–
	200	0	4.0
	300	–0.5	1.0
	3000	–0.5	1.0
	3200	–0.5	1.5
	3400	0	3.0
L1//2 WT1 TO 2 WT1	60	20	–
	200	0	4.0
	300	–0.5	1.2 (Note 2)
	450	–0.5	1.0
	3000	–0.5	1.0
	3200	–0.5	1.5
	3400	0	3.0
<b>End</b>			



<b>Table 8-4</b> <b>Frequency response limits (dB) relative to level at 1004 Hz reference frequency</b> (continued)			
<b>Connection type</b>	<b>Frequency (Hz)</b>	<b>Minimum loss (dB)</b>	<b>Maximum loss (dB)</b>
L1//2 WT1 TO 4 WT1	60	20	–
	200	0	4.0
	300	–0.4	0.8 (Note 2)
	450	–0.4	0.65
	3000	–0.4	0.65
	3200	–0.4	1.5
4 WT1 TO 4 WT1	60	20	–
	200	0	3.0
	300	–0.3	0.3
	3000	–0.3	0.3
	3200	–0.3	1.5
	3400	0	3.0
<p><b>Note 1</b> Use linear interpolation to obtain limits at frequencies between those given (+ indicates more loss, – indicates less loss).</p> <p><b>Note 2</b> Increase maximum loss by 0.4 dB at 300 Hz for each 600-Ω 2WT interface in the connection.</p>			
End			

### Level tracking

The linearity of each transmission path through the DMS-100 Family is such that for a 1004-Hz sine wave signal, the output of the input levels, as shown in Table 8-5, tracks the output of a 0 dBm0 input signal.

<b>Table 8-5</b> <b>Transmission levels</b>		
	<b>1004 Hz input</b>	<b>Max. deviation from insertion loss at 0 dBm0 at input signal level</b>
L1//2WT1//4WT1	+3 to –37 dBm0	± 0.5 dB
to	–37 to –50 dBm0	± 1.0 dB
L1//2WT1//4WT1		

### Absolute delay

Measured at 1500 Hz, the absolute envelope delay (round trip) of analog-to-analog connections has a mean value equal to or less than 2.1 ms, with 95% of the connections not exceeding 2.7 ms. Delay due to remote links is not included.

### Envelope delay distortion

Envelope delay distortion, with reference to the lowest absolute envelope delay, is shown in Table 8-6.

<b>Table 8-6</b>		
<b>Maximum envelope delay distortion in microseconds</b>		
<b>Frequency (Hz)</b>	<b>L1//2WT1 to L1//2WT1</b>	<b>4WT1-TO-4WT1</b>
400	700	500
600	500	350
800	350	200
1004	190	140
1150	150	110
2300	150	110
2600	190	140
2800	350	200
3000	500	350
3200	700	500

### Return losses and impedances

#### Input impedances

The Interface equipment port nominal input impedance is shown in Table 8-7.

<b>Table 8-7</b>	
<b>Input impedance</b>	
<b>Equipment Port</b>	<b>Impedance</b>
4WT1	600 $\Omega$
2WT1(1)	600 $\Omega$ in series with 2.16 $\mu\text{F}$ 900 $\Omega$ in series with 2.16 $\mu\text{F}$
L1	900 $\Omega$ in series with 2.16 $\mu\text{F}$
<b>Note:</b> See Analog trunk interface on page 5-3 for individual trunk interface descriptions.	

#### Input return loss

The return loss of the interface port(s) when measured against the appropriate impedance will meet the limits shown in Table 8-8.

<b>Table 8-8 Input return loss</b>		
<b>Interface type</b>	<b>Frequency range (Hz)</b>	<b>Minimum return loss (dB)</b>
L1	ERL(1)	20
	SRL(2)	14
2WT1 (single-core) (5)	ERL(1)	20
	SRL(2)	14
2WT1 (two-core) (5)	ERL(1)	26
	SRL(2)	20
4WT1	ERL(1)	30
	SRL(2)	24

**Note 3** Echo Return Loss (ERL) is the ratio in decibels of the weighted average of transmitted power to the weighted average of reflected power at all frequencies in the echo range (560 to 1965 Hz).

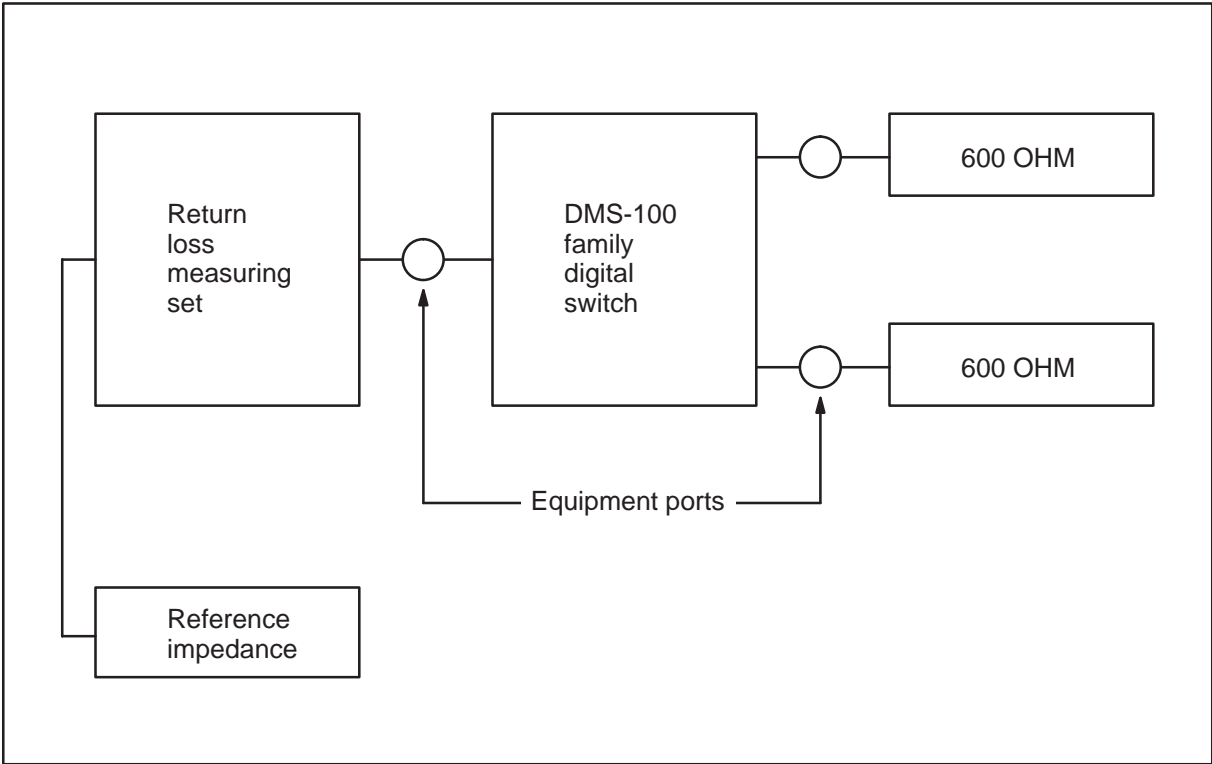
**Note 4** Singing Return Loss (SRL) is the ratio in decibels of the weighted average of transmitted power to the weighted average of reflected power at all frequencies in a frequency band. The most probable singing bands are low (260 to 500 Hz) and high (2200 to 3400 Hz). SRL is considered the lowest of these two bands.

**Note 5** System measurements should be made with interfaces connected to a digital quiet termination or equivalent which is a device capable of generating a digital sequence that will produce, when ideally decoded, a signal not greater than 15 dB<sub>BrnC0</sub> (see Figure 8-1 for 2-wire and Figure 8-2 for 4-wire measuring arrangements).

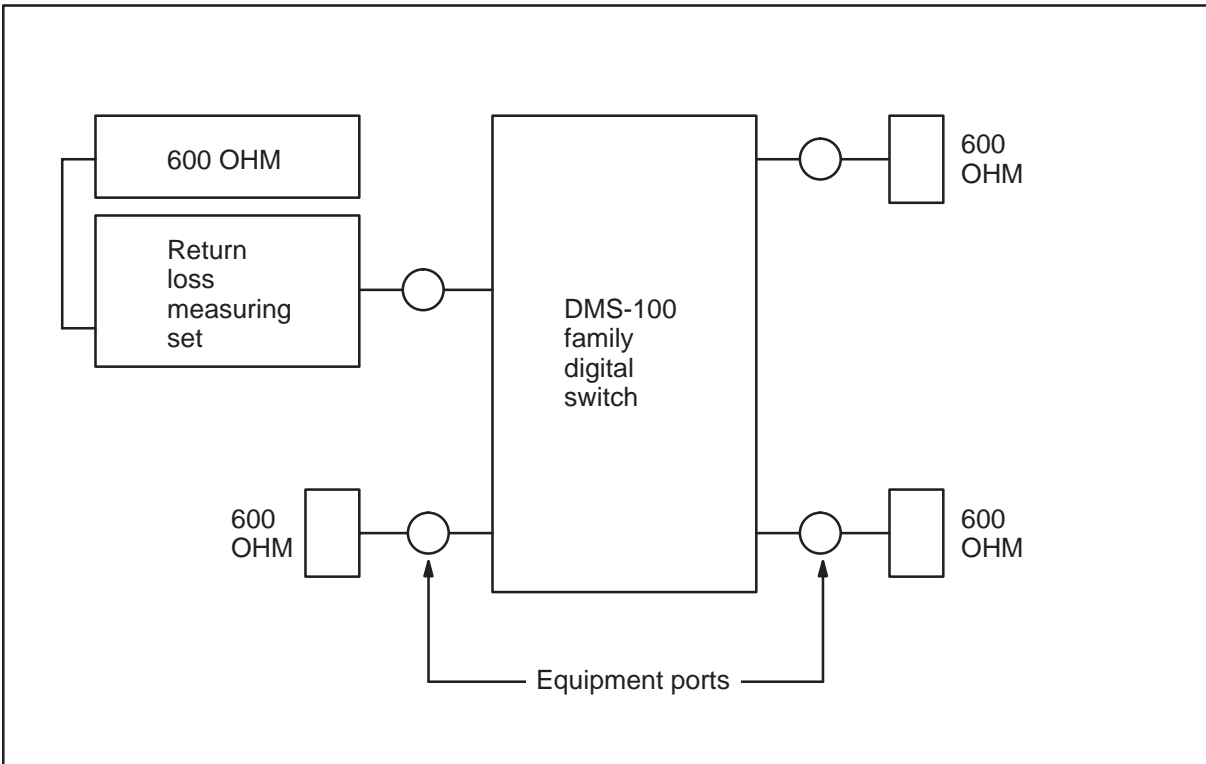
**Note 6** A measuring set conforming to IEEE Standard 743-1984 or its equivalent should be used when performing the above weighted return loss measurements.

**Note 7** Single-core and two-core hybrid types of 2-wire to 4-wire conversion units used in trunk interfaces.

**Figure 8-1**  
**Input impedance return loss test (2-wire)**



**Figure 8-2**  
**Input impedance return loss test (4-wire)**



### Balance return loss of 2-wire interfaces

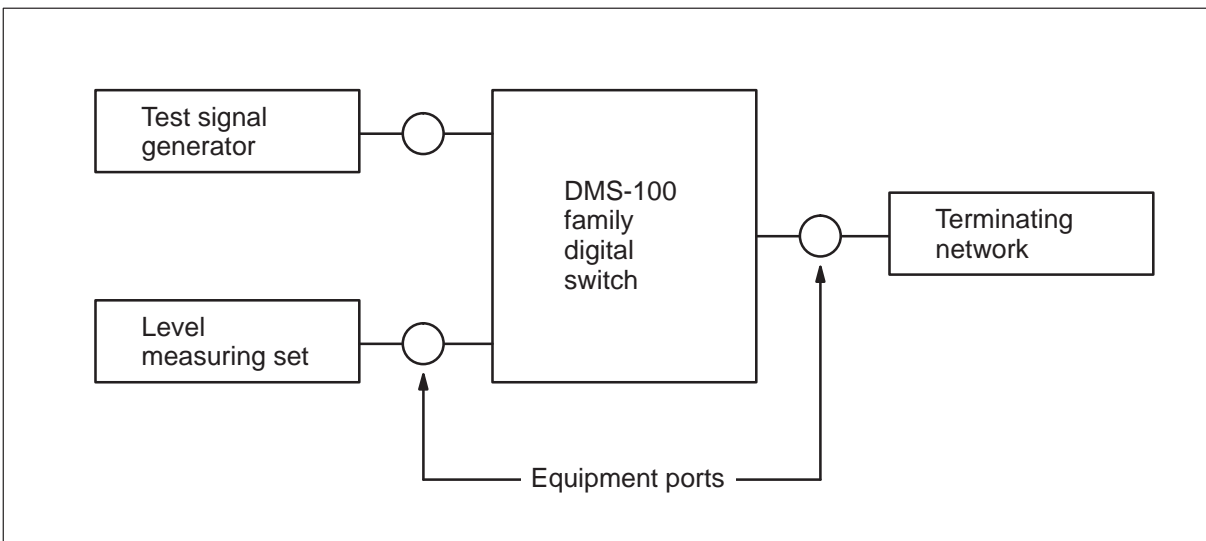
Hybrid balance (transhybrid loss) is measured against a termination of  $600\ \Omega$  plus  $2.16\ \mu\text{F}$  or  $900\ \Omega$  plus  $2.16\ \mu\text{F}$ , as appropriate for 2-wire trunk circuit interfaces (see Table 8-9).

<b>Table 8-9</b> <b>Balance return loss</b>		
<b>Interface type</b>	<b>Frequency (1) range (Hz)</b>	<b>Minimum balance return loss (dB)</b>
L1 (2)	ERL	21
	SRL	16
2WT1 (2,3) (single-core)	ERL	21
	SRL	16
End		

<b>Table 8-9</b> <b>Balance return loss</b> (continued)		
<b>Interface type</b>	<b>Frequency (1) range (Hz)</b>	<b>Minimum balance return loss (dB)</b>
2WT1	ERL	30
(3,4) (two-core)	SRL	25
<p><b>Note 1</b> See Chapter 7 for a description of ERL and SRL.</p> <p><b>Note 2</b> Adjustments must be made when nominal A/D and D/A path losses are other than 0 dB.</p> <p><b>Note 3</b> Terminate 2-wire port in equivalent balance network impedance. (See Chapter 4 for a description of balance networks for trunk circuit interfaces.)</p> <p><b>Note 4</b> Limited gain capability available.</p>		
End		

Line circuit interfaces are measured against a reference termination of  $800\ \Omega$  in parallel with  $0.05\ \mu\text{F}$  (non-loaded network) or  $1650\ \Omega$  in parallel with  $0.005\ \mu\text{F}$  (loaded network), as appropriate (see Figure 8-3). A  $100\ \Omega$  resistor should be placed in series with each capacitor.

**Figure 8-3**  
**Trans-hybrid measurement for ERL and SRL**



### Single frequency distortion

With a signal in the frequency range of 0 to 12 kHz, at a level of 0 dBm<sub>0</sub>, is applied to the input of any analog to analog type connection, the measurement at the output of any frequency other than the applied signal will be equal to or less than -28 dBm<sub>0</sub>.

**Intermodulation distortion**

Measured in accordance with the 4-tone test method of composite input level of -13 dBm0, connections will equal or exceed the values shown in Table 8-10.

<b>Table 8-10 Distortion limits</b>				
<b>Connection Type</b>	<b>dB Below received power</b>			
	<b>R2(1) ≥ 95%</b>	<b>Min</b>	<b>R3(2) ≥ 95%</b>	<b>Min</b>
Line//2WT1 to Line//2WT1	44	43	45	44
4WT1 to 4WT1	46	45	48	47
LINE//2WT1 to 4WT1	44	43	45	44
<b>Note 5</b> R2 = Average power in the 503 to 537 Hz and 2223 to 2257 Hz bands.				
<b>Note 6</b> R3 = Total power in the 1877 to 1923 Hz band.				

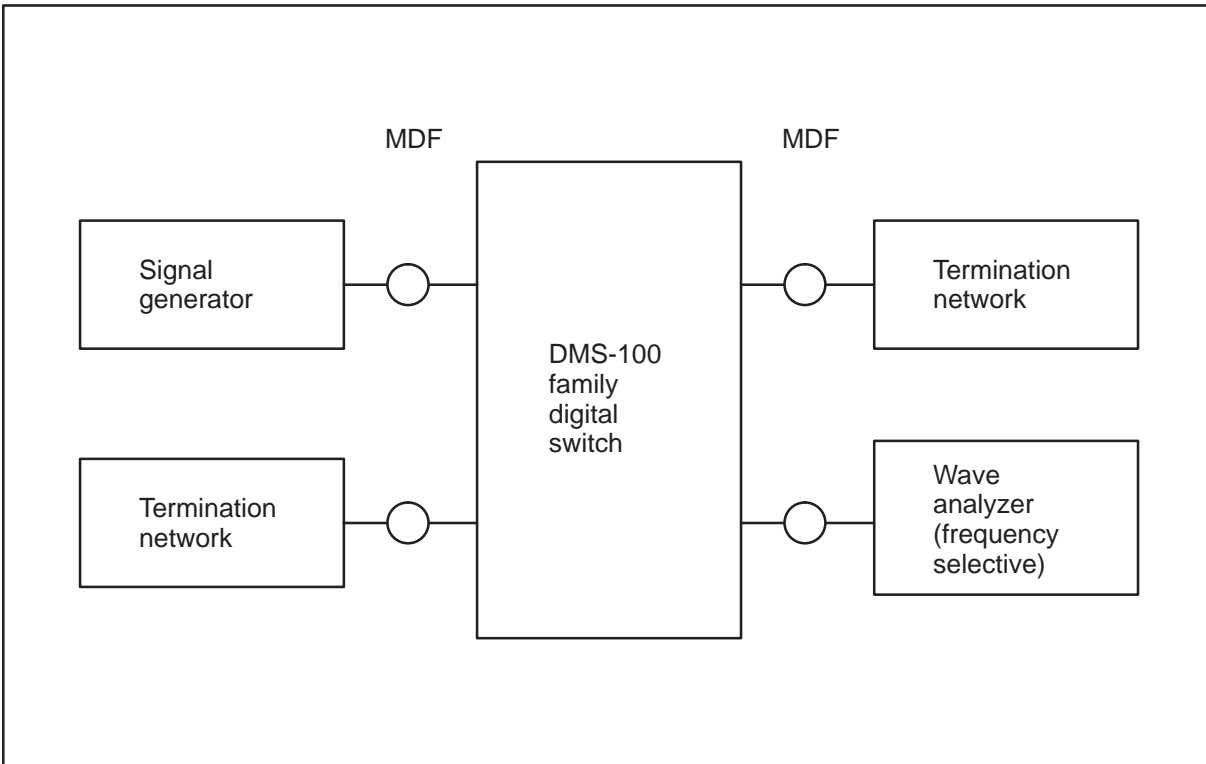
The 4-tone test method involves the transmission of four equal level tones (856, 863, 1374, & 1385 Hz) at a given composite level.

**Linear crosstalk coupling loss**

Crosstalk is specified as equal level crosstalk over the frequency range 200 to 3400 Hz at a test tone level of 0 dBm0 on properly established connections. Inputs and outputs of the circuits under test are terminated in their nominal impedance (see Figure 8-4).

Crosstalk attenuation between any two connections is ≥ 70 dB, C-message weighted.

**Figure 8-4**  
**Linear crosstalk coupling loss measurement**



### Idle channel noise

With the input terminated in the nominal impedance, the noise measured at the output is  $\leq 20$  dB<sub>rnCO</sub> for trunk-to-trunk connections and for 95 percent of the line-to-line connections for the line circuit types A, B, and E. Type C (6X21) will measure  $\leq 23$  dB<sub>rnC</sub> at the output.

### Quantization distortion

When a sine wave signal of 1004 Hz is applied to the circuit input, the ratio of the signal to total distortion power, measured C-message weighted at the circuit output (C-notched noise measurement) is shown in Table 8-11.

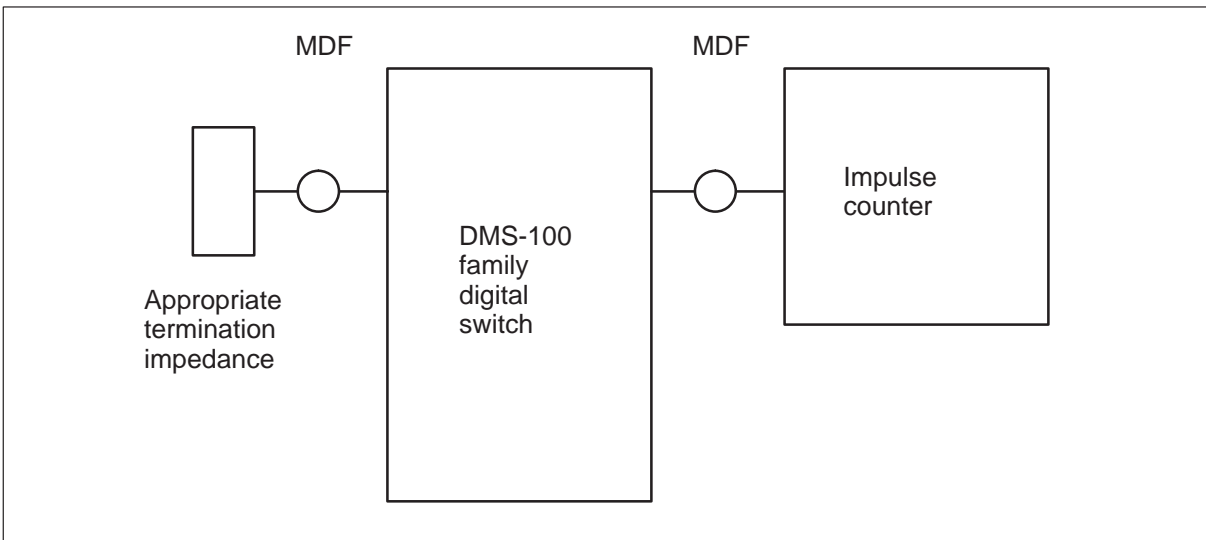


<b>Table 8-11 Total distortion limits</b>	
<b>Input level at 1004 Hz</b>	<b>S - D ratio (db)</b>
	<b>L1//2Wt1//4WT1 to L1//2WT1//4WT1</b>
0 to -30 dBm0	≥ 33
-40 dBm0	≥ 27
-45 dBm0	≥ 22

### Impulse noise

At least 50% of each connection category will register not more than 10 counts in 30 min at a threshold level of not greater than 42 dBmC0, during a normal business day, when using an NE-6F impulse counter or equivalent (see Figure 8-5).

**Figure 8-5**  
Impulse noise measurement



### Longitudinal balance – IEEE test method

When lines and trunks are measured according to IEEE STANDARD 455-1985, the longitudinal balance performance is shown in Table 8-12.

<b>Table 8-12 Longitudinal balance performance</b>				
<b>Line and 2-wire trunk circuits</b>	<b>Min. balance 95% of connections</b>	<b>Average balance</b>	<b>4-wire trunk circuits</b>	<b>Minimum balance</b>
204 Hz	≥ 58 dB	≥ 63 dB	204 Hz	≥ 86 dB
504 Hz	≥ 58 dB	≥ 63 dB	1004 Hz	≥ 80 dB
1004 Hz	≥ 58 dB	≥ 63 dB	3004 Hz	≥ 78 dB
3004 Hz	≥ 53 dB	≥ 58 dB		

## Digital connection transmission specifications

### Digital carrier module and digital trunk controller transmission specifications

The Digital Carrier Module (DCM) provides digital speech and signaling interfaces between up to five, 24-channel, DS-1 carrier systems, at 1.544 Mb/s and four, 32-channel, 2.56 Mb/s, duplicated links (ports) to the DMS-100 digital network.

The Digital Trunk Controller (DTC) provides digital speech and signaling interfaces between up to twenty, 24-channel, DS-1 carrier systems at 1.544 Mb/s and up to sixteen, 32-channel, 2.56 Mb/s, duplicated links (ports) to the DMS-100 digital network.

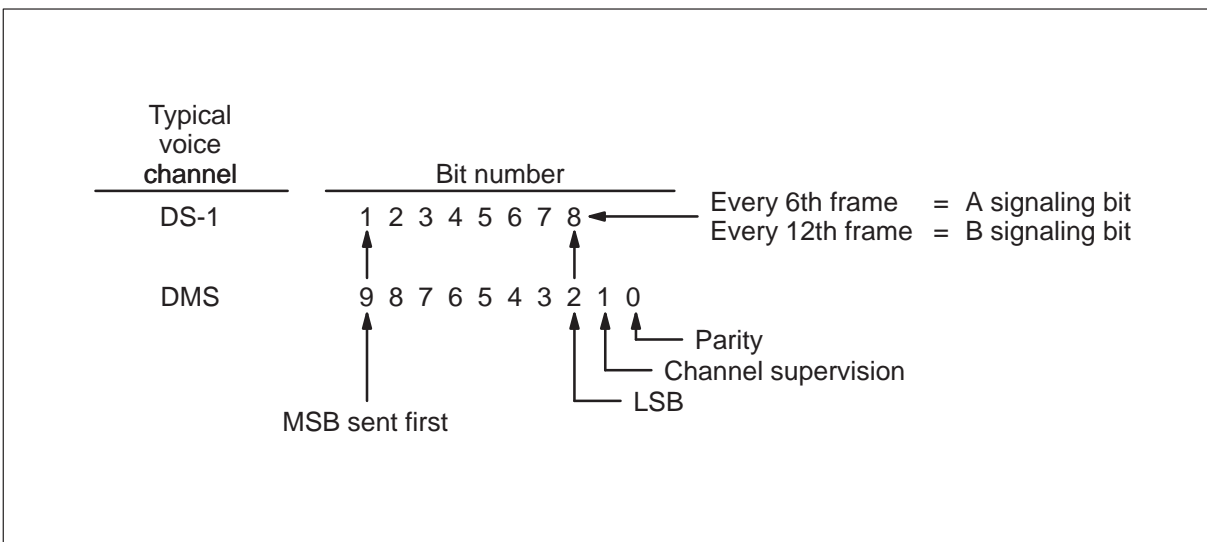
DCM and DTC transmission features are shown in Table 8-13 and in Figure 8-6.

<b>Table 8-13 DS1 carrier interface characteristics</b> (continued)	
Rate:	
input:	1.544 Mb/s ± 200 b/s
output:	1.544 Mb/s, phase-locked to the office clock
Structure:	24 channels per frame, 8 bits per channel.
—continued—	

<b>Table 8-13</b>	
<b>DS1 carrier interface characteristics</b> (continued)	
DE2, DE3 Signal Structure Compatible Data Format:	Bits numbered 1 to 8, bit 1 transmitted first.
Idle Code:	0 1 1 1 1 1 1 1 (Bit 1 = 0)
Channels:	Channels numbered 1 to 24, channel 1 transmitted first.
Ports:	DCM - Ports numbered 0 through 4. DTC - Ports numbered 0 through 19.
Frame:	193 bits per frame. 192 speech bits (24 x 8). Framing on 193rd bit.
Signaling:	A and B bits (bit 8 in each speech channel). The A-bit is every 6th frame in 12-frame master frame. The B-bit is every 12th frame.
Code:	Bipolar (50% duty cycle)
DS1 Receiver Input Signal:	$\pm 1.5V$ to $\pm 3.6V$
DS1 Transmitter:	Output pulse height $\pm 2.4V$ $\pm 3.6V$ at input to equalizer  Pos/Neg unbalance: $\pm 0.3V$  Half-amplitude width: $352 \pm 50$ ns  Unbalance in width of Pos/Neg Pulse: $\pm 15$ ns.  Overshoot at trailing edge: 20 to 45% of pulse height with decay to 10% or less of peak value within 400 ns.  Minimum density: average not less than one pulse in eight, no more than 15 consecutive zeros.
Transformer Interwinding Isolation:	500V DC minimum.
Bit Mapping DS1 to DMS:	Refer to Table 7-1.
—continued—	

<b>Table 8-13</b> <b>DS1 carrier interface characteristics</b> (continued)	
Channel and Port Mapping:	DCM - Refer to Figure 7-6. DTC - Distributed over equipped network ports.
Digital Tones:	Refer to Chapter 4.
End	

**Figure 8-6**  
**Mapping DS1 to DMS**



**Figure 8-7**  
**Channel and port translation**

DMS channels	DMS ports				
	0	1	2	3	
0	-	-	-	-	Channel 0 used for signaling
1	0 - 1	1 - 1	2 - 1	3 - 1	
2	4 - 1	0 - 2	1 - 2	2 - 1	
3	3 - 2	4 - 2	0 - 3	1 - 3	
4	2 - 3	3 - 3	4 - 3	0 - 4	
5	1 - 4	2 - 4	3 - 4	4 - 4	
6	0 - 5	1 - 5	2 - 5	3 - 5	
7	4 - 5	0 - 6	1 - 6	2 - 6	
8	3 - 6	4 - 6	0 - 7	1 - 7	
9	2 - 7	3 - 7	4 - 7	0 - 8	
10	1 - 8	2 - 8	3 - 8	4 - 8	
11	0 - 9	1 - 9	2 - 9	3 - 9	
12	4 - 9	0 - 10	1 - 10	2 - 10	
13	3 - 10	4 - 10	0 - 11	1 - 11	
14	2 - 11	3 - 11	4 - 11	0 - 12	
15	1 - 12	2 - 12	3 - 12	4 - 12	
16	-	-	-	-	Channel 16 not used for speech
17	0 - 13	1 - 13	2 - 13	3 - 13	
18	4 - 13	0 - 14	1 - 14	2 - 14	
19	3 - 14	4 - 14	0 - 15	1 - 15	
20	2 - 15	3 - 15	4 - 15	0 - 16	
21	1 - 16	2 - 16	3 - 16	4 - 16	
22	0 - 17	1 - 17	2 - 17	3 - 17	
23	4 - 17	0 - 18	1 - 18	2 - 18	
24	3 - 18	4 - 18	0 - 19	1 - 19	
25	2 - 19	3 - 19	4 - 19	0 - 20	
26	1 - 20	2 - 20	3 - 20	4 - 20	
27	0 - 21	1 - 21	2 - 21	3 - 21	
28	4 - 21	0 - 22	1 - 22	2 - 22	
29	3 - 22	4 - 22	0 - 23	1 - 23	
30	2 - 23	3 - 23	4 - 23	0 - 24	
31	1 - 24	2 - 24	3 - 24	4 - 24	

DS-1 ports and channels

Example DMS port 0, channel 31 is mapped into DS-1 port 1, channel 24.

<b>Table 8-14 Network interface characteristics</b>	
Rate:	2.56 Mb/s
Structure:	32 channels per frame, 10 bits per channel
Data Format:	Bits numbered 9 to 0, bit 9 transmitted first
Channels:	Channels numbered 0 to 31, channel 0 transmitted first.
Ports:	DCM - Ports numbered 0 to 3, plane 0 and plane 1 DTC - Ports numbered 0 to 15, plane 0 and plane 1
Frame:	Frame bit-0, of channel-0
Signaling:	Message channel — port 0, channel 0, bits 9 to 2, bit 9 is most significant, bit 1 not used
Code:	Bi-phase with frame pulse violation once per frame
Receiver sensitivity:	0.25V peak-to-peak
Driver output:	2.4V $\pm$ 0.1V peak-to-peak
Rise Time:	50 ns, minimum
Line Impedance:	100 $\Omega$
Transformer interwinding isolation:	500 V (dc), minimum

### Digital trunk to digital trunk echo path delay

The echo path delay is the total of the “go” and “return” transit time delays of a signal through an office connection path.

For digital trunk to digital trunk connections, the average echo path delay is less than or equal to 1.0 ms and 99% of connections have a delay less than or equal to 1.4 ms.

### Transmission pads

To assure transmission stability in conformance with the network transmission requirements, interoffice calls may require the insertion of one of several loss values (including zero loss) depending on the connection type and the interfacing facility (for example, toll connecting, direct interlocal, analog, or digital). Typically, these losses are fixed and are provided on analog facilities external to the switching system.

DMS-100 Family systems provide for the insertion, when required, of any of several possible loss levels at the subscriber loop port side. The determination of each loss level is under software control and is a function of the transmission loss requirements for the connection.

In addition, digital pads associated with the DMS-100 Family switching network will be used to implement various connection losses. Network digital pad switching will complement the subscriber loop port level adjustments mentioned above. The network pad values will be software selected on a per call basis. Transmit and receive directions may be handled independently for certain predetermined applications.

Digital pad values range from 0 to 7 dB in 1 dB steps.

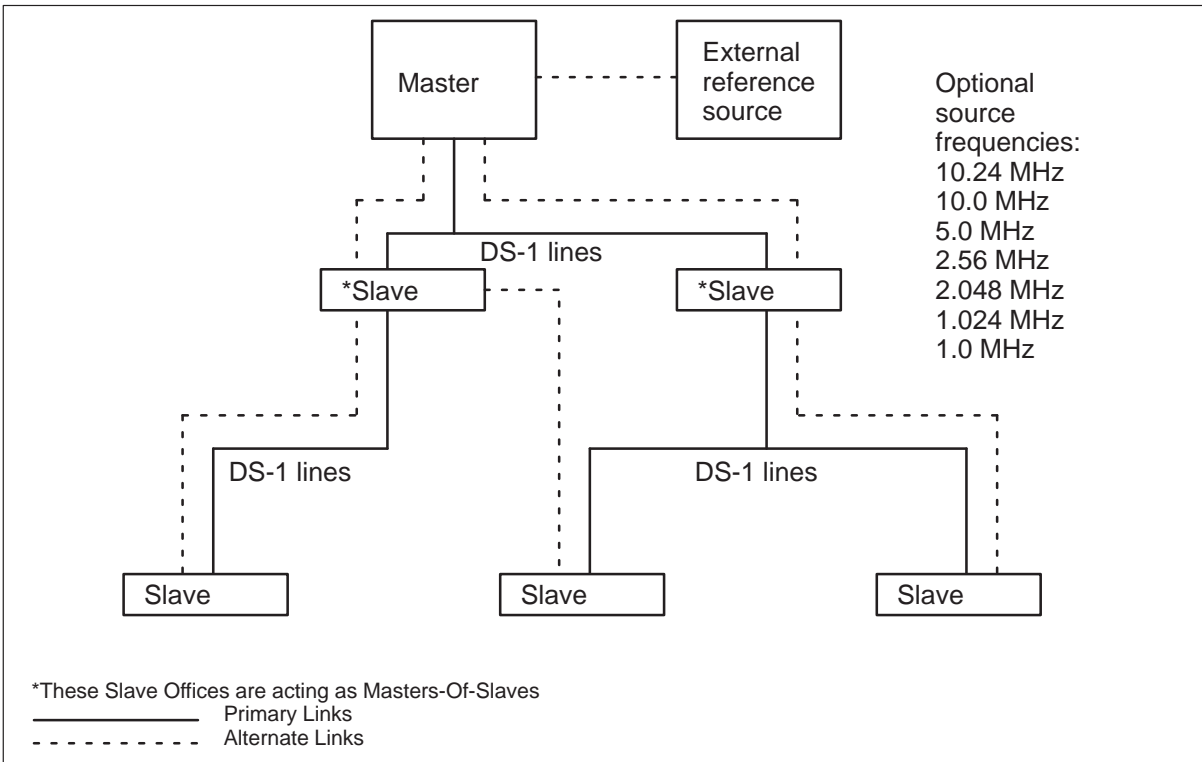
Means are provided to automatically disable any pads in digital data connections.

Refer to Equipment transmission levels - (1004 Hz) for details on peripheral circuit levels.

### **Clock synchronization**

The DMS-100 Family of switches is synchronized using the “Preselected Alternate Master/Slave” (PAMS) method. The PAMS method of synchronization is a variation of the Master/Slave concept. In the PAMS arrangement, each slave node is slaved directly through one DS-1 input to one other node at an equal or higher level in the timing hierarchy. However, in the event of a failure of this primary link, a switchover is performed at a preselected alternate source of an equal or higher level in the timing hierarchy. There are three possible synchronous clock system configurations in the DMS-100 Family (see Figure 8-8).

**Figure 8-8**  
**Synchronous clock system outline of possible configurations**



**Note 1:** Master-Internal Office. The free-running oscillator in one of the Central Message Controllers (CMC) is used as the network master clock. The inactive clock is synchronized to the free-running clock so that a smooth switch occurs between clocks.

**Note 2:** Master-External Office. This office is equipped to synchronize to an analog reference clock. This analog clock may come either from a source external to the office or from atomic clocks located in the office.

**Note 3:** Slave Office. The CMC clocks in this type of office are slaved to the clock in a master office, or to another slave office above it in the network hierarchy, by clock signals carried over one of two assigned DS-1 timing links.

The DMS-100 Family has four clocks available to support various applications: Stratum 1, Stratum 2, Stratum 3, and the DMS-100 standard synchronized clock.

The basic hardware components in the DMS-100 Family synchronous clock system are the DS-1 line card and a programmable clock circuit card.



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DS-1 line cards are mounted in DTC and DCM and two DS-1 lines, the primary and the alternate, are typically assigned to the clock system for reliability.

### **Standard synchronized clock**

The clock hardware consists of an NT3X14BA synchronous master clock counter card and an NT3X15BB synchronous master clock card. These cards are mounted in the CMC shelf. Each office has two sets of clock circuit cards: one in each CMC to operate as active and standby sources.

The synchronous master clock card receives power from the associated shelf. This circuit pack contains on-board regulators to produce the stable voltages required by clock hardware components.

Backplane wiring options on the NT3X15BB synchronous master clock allow a master office, which is operating with an external reference oscillator, to synchronize to signals of 10.24, 10.0, 5.0, 2.56, 2.048, 1.024, or 1.0 MHz, with a sine wave nominally +2.5 Vac and 50- $\Omega$  impedance.

### **Stratum 1 synchronization**

The DMS-200 uses the master external office configuration to achieve Stratum 1 level accuracy, by interfacing with a cesium clock reference mounted in a Master Reference Frequency Frame (MRFF).

The MRFF has two configurations:

- The NT5X23AA consists of two in-service cesium clocks, each being independently powered and connected to its respective CMC clock circuit. A third non in-service cesium reference is provided as a spare.
- The NT5X23AB consists of a two-clock system as described above without provision for a spare.

Each cesium clock reference is connected to its associated CMC clock by a maximum 200 feet (60.96 m) of 50- $\Omega$  coaxial cable and control wiring. The control wiring allows the DMS-200 to provide indications of trouble on the MRFF equipment and allows the DMS-200 to operate status lamps (active, standby and spare) on the MRFF display and alarm circuit packs, NT5X24AA, which are provided for each reference clock and are located on the MRFF.

### **Stratum 2 synchronization**

Stratum 2 level synchronization for a DMS-200 is provided by using the master external or slave configuration and an oscillator that meets the performance criteria for a Stratum 2 clock.

The Stratum 2 Synchronized Clock Master Oscillator, NT3X16AA, is a Voltage Controlled Crystal Oscillator (VCXO). The NT3X16AA is located on a Stratum 2 Oscillator Shelf, NT3X95AA, which is installed in an

NT0X43 Input/Output Equipment (IOE) frame. There are two clock modules in the shelf, one for each CMC. The NT3X16AA, located in the IOE frame is connected to its associated Synchronized Master Clock, NT3X15DA, by a maximum of 200 feet (60.96 m) of 50- $\Omega$  coaxial cable and control wiring.

The Stratum 2 hardware mounted in the CMC consists of a Synchronized Master Clock Controller (NT3X14BC) and a Stratum 2 Master Oscillator Clock (NT3X15DA).

### **Stratum 3 synchronization**

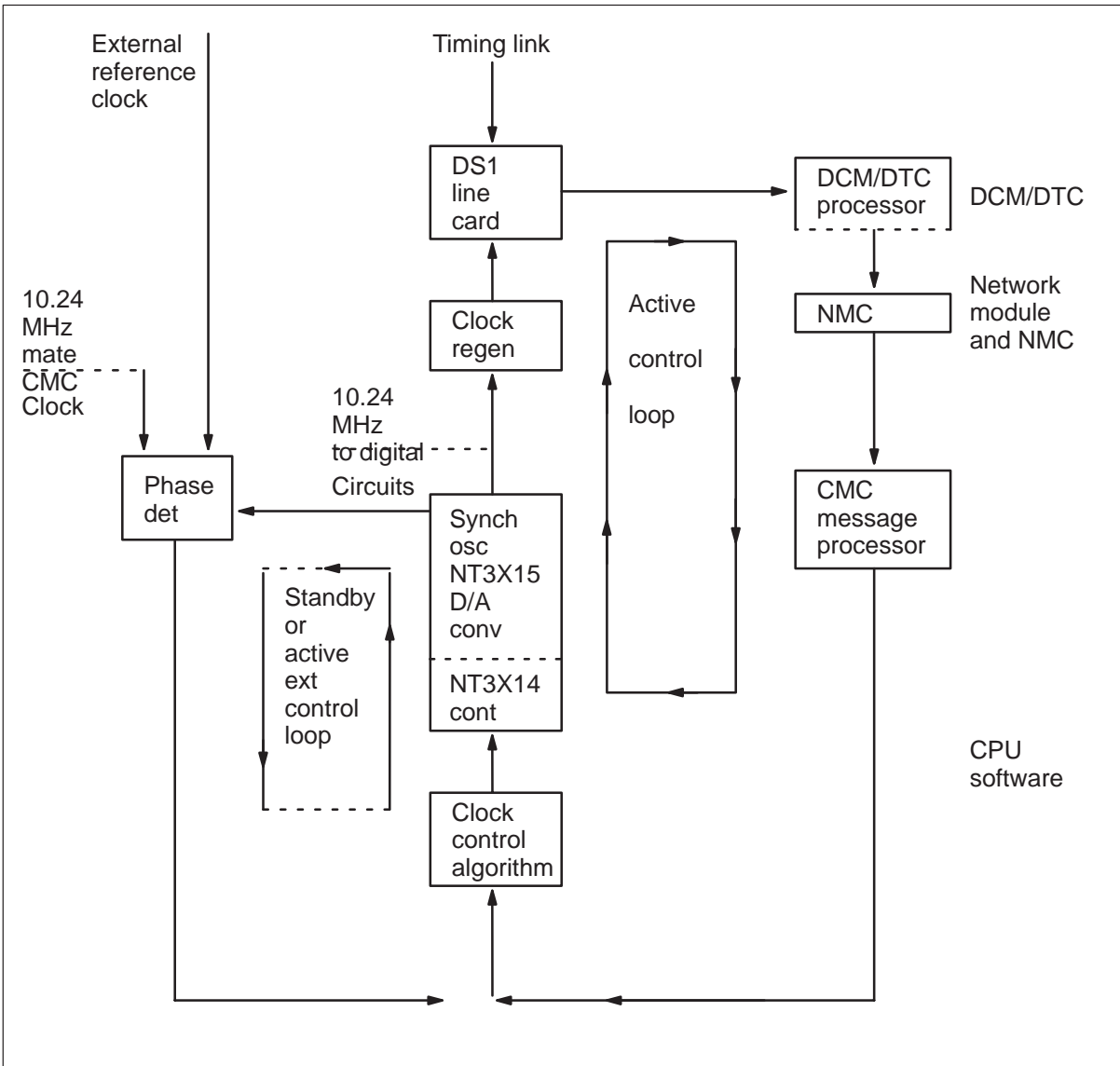
Stratum 3 synchronization in the DMS-100 uses the slave configuration with a clock that meets Stratum 3 performance criteria.

The VCXO for Stratum 3 is located on the NT3X15CA, Stratum 3 synchronized clock master oscillator, housed on the CMC shelf. The synchronized master clock counter, NT3X14BA, is housed in the same location.

### **Synchronization loop**

The simplified block diagram in Figure 7-8 illustrates one-half of a duplicated system. The main components, such as the control loop for the active clock and its standby loop, are identified and their locations shown within the DMS-100 Family office.

**Figure 8-9**  
**Synchronous clock system (simplified block diagram)**



A distributed phase-lock loop is formed by the clock oscillator whose output is distributed among all hardware modules in the DMS-100 family office, a digital phase comparator in the DCM or DTC common equipment, the DMS-100 family internal message system, and the control algorithm in the CPU which controls the clock oscillator frequency through a digital-to-analog converter.

The incoming master clock signal received over the timing link is compared in the DS-1 line card with the local clock signal. The firmware in the DCM or DTC samples the phase differences between the two signals and reports to

the synchronous clock software through the message system of the DMS-100 family, the DCM or DTC message processor, the Network Message Controller (NMC), and the CMC message processor.

In addition to checking for phase differences, the DS-1 line card also detects and reports slips, bipolar violations, and lost synchronization.

The DCM or DTC collects phase comparison samples at 400 ms intervals. After 32 samples are collected (12.8 s), a phase report is sent to the CC. The phase report contains the 32 samples and information on slips.

In the CC control algorithm, the 32 phase values are normalized and summed. The resulting average phase sample is integrated with 30-bit resolution. Then, the integrator output is added to the average phase sample multiplied by a coefficient. The 30-bit word is truncated (to match the resolution of the digital-to-analog converter in the NT3X15 synchronous master clock card) and is sent to the NT3X14 controller. The control word is updated after each phase report (every 12.8 sec).

The D/A converter supplies a DC voltage to control the frequency of the Voltage-Controlled Crystal Oscillator (VCXO) on the associated oscillator circuit pack.

The Stratum 2 and standard clocks employ an ovenized crystal oscillator while the Stratum 3 uses a temperature compensated oscillator. The D/A converter allows the oscillators to be precisely adjusted:

- Standard Synchronized Clock  
 $1 \times 10^{-9}$
- Stratum 2 Clock  
 $1 \times 10^{-11}$
- Stratum 3 Clock  
 $7.5 \times 10^{-9}$ .

The output of the VCXO assembly is a 10.24-MHz square wave to the various digital circuits in the system.

The phase detector in the standby control loop comprises two counters which allow the oscillator frequency to be compared with other sources, such as the clock signal from the mate CMC, or from an external reference clock when in the master-external operation configuration. When used with an external reference source, failure of such a source can be detected by the Central Control (CC) and clock activity is switched to use the mate CMC oscillator as the office clock.

**Slip rate**

When two offices are synchronized, no slips should occur on the DS-1 lines between these two offices. Should synchronization be lost due to the failure of all timing links between a master and a slave office, the slave enters a free-run mode. The time to the first slip is dependent upon the buffer fill at the time the free-run mode is entered. A buffer of two frames is used. The Stratum 2 and Stratum 3 clocks comply with the slip rate of objectives outlined in Bellcore Technical Advisory TA-NPL-000436. The standard synchronized clock ensures less than 1 slip in 10 hrs after being in the free-run mode for 72 hrs.

**Frequency capture width**

When in a slave mode, a clock must be capable of synchronizing to a master which is offset from the correct frequency by its maximum or minimum allowed frequency. The DMS-100 is capable of synchronizing to a master that has three offsets ( $\Delta F/F$ ):

- Standard Synchronized Clock  
 $\pm 7.5 \times 10^{-7}$
- Stratum 2 Clock  
 $+ 1.6 \times 10^{-8}$
- Stratum 3 Clock  
 $\pm 4.6 \times 10^{-6}$

**Free-running mode frequency drift**

When an oscillator is operating in the hold-over state in the free run mode, the oscillator will experience a slow change in frequency due to aging of the crystal. This frequency change ( $\Delta F/F$ ) has three parameters:

- Standard Synchronized Clock  
 $\pm 2 \times 10^{-10}/\text{DAY}$  (Note 1)
- Stratum 2 Clock  
 $+ 1 \times 10^{-10}/\text{DAY}$
- Stratum 3 Clock  
 $\pm 3.7 \times 10^{-7}$  (Note 2)

**Note 1:** After 90 days of continuous operation,  $\pm 3 \times 10^{-10}$  until that time has elapsed.

**Note 2:** The Stratum 3 clock is a temperature compensated oscillator. The frequency change shown includes changes due to temperature as well as aging.

While operating in the free-running mode, the clock frequency can be manually adjusted by specifying, via MAP input command, a number of steps to be added or subtracted from the D/A control word (see Sanity timer - DMS SuperNode, for typical frequency step size).

### **Error rate**

Under specified operating conditions, the error rate of an internal DCM-to-DCM or DTC-to-DTC connection is less than  $1 \times 10^{-9}$ .

### **Compression law**

The compression law used in the DMS-100 family is a linear approximation to a  $\mu = 255$  law as shown in CCITT G. 711 Tables.

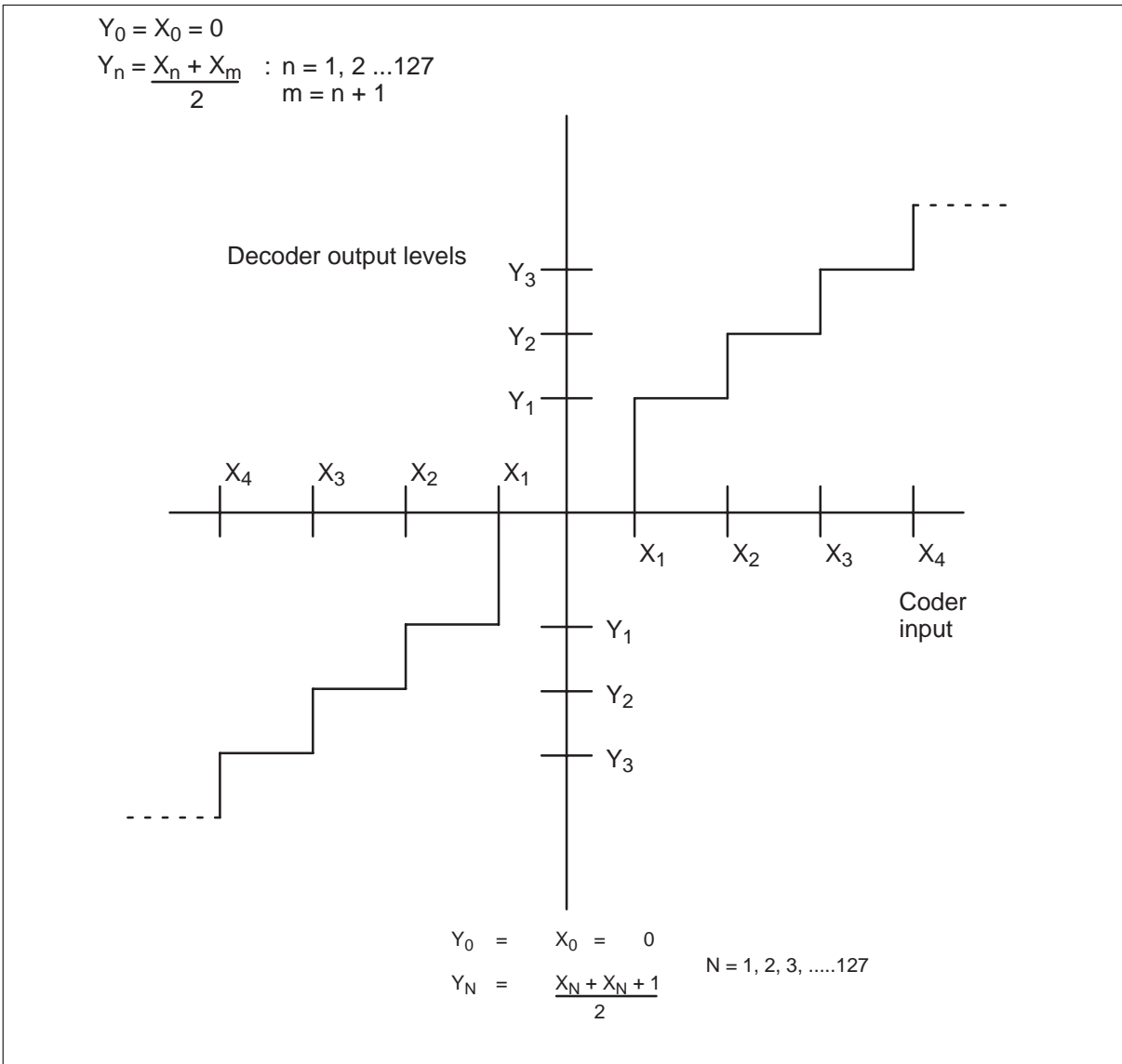
The characteristics, decision levels, and code assignments described in the following sections include the effect of compression and expansion.

### **CODEC transfer characteristics**

The relationship between encoder decision levels and the decoder output levels is defined by specifying the CODEC transfer characteristic.

Figure 8-10 shows the transfer characteristics for 8-bit Pulse Code Modulation (PCM) words. The output levels ( $Y_n$ ) are always midway between the decision levels ( $X_n$ ) (this can be termed a “decision level assignment” CODEC). The output levels are shown in Figure 8-10.

**Figure 8-10**  
**CODEC transfer characteristic information frame**



### Decision levels

The relative magnitudes of the decision levels are shown in Table 8-15. The decision levels are placed symmetrically about zero.

The maximum decision level magnitude, has been normalized to 8159 so that all level magnitudes may be represented by integer values. The magnitude of the peak value of a +3 dBm0, 1 kHz single-frequency signal is slightly less than that of the largest decision level.

<b>Table 8-15 CODEC decision levels</b>	
<b>Level number <math>n</math></b>	<b>Level magnitude <math>X_n</math></b>
0	0
$1 \leq n \leq 16$	$2n - 1$
$17 \leq n \leq 32$	$4n - 33$
$33 \leq n \leq 48$	$8n - 161$
$49 \leq n \leq 64$	$16n - 545$
$65 \leq n \leq 80$	$32n - 1569$
$81 \leq n \leq 96$	$64n - 4129$
$97 \leq n \leq 112$	$128n - 10273$
$113 \leq n \leq 128$	$256n - 2409$



## Chapter 9: Equipment

### Physical

The DMS-100 Family system hardware is packaged into single- or double-bay frames equipped with appropriate shelves. Bays are identified by their primary function. Shelves and drawers are identified by their specific function.

Table 9-1 identifies the DMS-100 Family frames or bays with their corresponding shelves and drawers.

<b>Table 9-1 DMS-100 family bays and corresponding shelves/drawers</b>	
<b>Bays</b>	<b>Shelves/drawers</b>
CCC — Central Control Complex (Duplicated)	CPU — Central Processing Unit
	CMC — Central Message Controller
	PS — Program Store
	DS — Data Store
	FSP — Frame Supervisory Panel
	CU — Cooling Unit
DCE — Digital Carrier	DCM — Digital Carrier Module Equipment (4 max)
	FSP — Frame Supervisory Panel
DNI — Digital Network Interconnecting (Duplicated) (or DNIC)	NJC — Network Junctor Connector Panel 16 (21 max)
	—continued—

<b>Table 9-1</b> <b>DMS-100 family bays and corresponding shelves/drawers</b> (continued)	
<b>Bays</b>	<b>Shelves/drawers</b>
DSNE — Double Shelf Network Equipment	NET0 — Network Plane 0
	NET1 — Network Plane 1
	FSP — Frame Supervisory Panel
	CU — Cooling Unit
DTE — Digital Trunk Equipment	DTC — Digital Trunk Controller
	LTC — Line Trunk Controller
	LGC — Line Group Controller
	FSP — Frame Supervisory Panel
	CU — Cooling Unit
IOE — Input/Output Equipment	MTD — Magnetic Tape Drive
	DDU — Disk Drive Unit
	FSP — Frame Supervisory Panel
	IOC — I/O Controller
	DPP — Distributed Processing Peripheral
	BMC II — Billing Media Converter (SH 18, 51)
	ROS — Stratum II Shelf
LCE — Line Concentrating Equipment	LCA — Line Concentrating Array
	FSP — Frame Supervisory Panel
LGE — Line Group Equipment	LGC — Line Group Controller (2 max)
	LTC — Line Trunk Controller
	DTC — Digital Trunk Controller
	FSP — Frame Supervisory Panel
	CU — Cooling Unit

—continued—

<b>Table 9-1</b>	
<b>DMS-100 family bays and corresponding shelves/drawers (continued)</b>	
<b>Bays</b>	<b>Shelves/drawers</b>
LTE — Line Trunk Equipment	LTC — Line Trunk Controller (2 max)
	DTC — Digital Trunk Controller
	FSP — Frame Supervisory Panel
	CU — Cooling Unit
MEX — Memory Extension (Duplicated)	DS — Data Store
	FSP — Frame Supervisory Panel
	CU — Cooling Unit (Optional)
MIS — Miscellaneous	XXX — For miscellaneous equipment shelves such as data sets, alarm circuits, etc.
	FSP — Frame Supervisory Panel
MS6E — Message Switching 6 Equipment	DSM — Modem Assembly Modified
	STA6 — Signal Term Array 6 Shelf
	MSB6 — MSB6 Module
	CU — Cooling Inverter Unit
	INV — Inverter Unit
	FSP — Frame Supervisory Panel
MS7E — Message Switching 7 Equipment	ST7 — Signaling terminal for SS7
	MSB7 — Message Switch and Buffer
	STA7 — Signaling Terminal Array
	ST7G — Signaling Terminal Shelf
	FSP — Frame Supervisory Panel
	CU — Cooling Unit
MSS — Maintenance Spare Storage	XXX — For storage of spare circuit packs
—continued—	

<b>Table 9-1</b> <b>DMS-100 family bays and corresponding shelves/drawers</b> (continued)	
<b>Bays</b>	<b>Shelves/drawers</b>
NETC — Network Frame Planes Combined (Duplicated networks)	NCO — Network Crosspoint Plane 0
	NCI — Network Crosspoint Plane 1
	NI — Network Interface Planes 0 & 1
	FSP — Frame Supervisory Panel
	CU — Cooling Unit
PDC — Power Distribution Center	FPA — Fuse Panel “A” Feed (5 max)
	FPB — Fuse Panel “B” Feed (5 max)
	FSP — Frame Supervisory Panel
	GP — Ground Panel (top or bottom feed)
	FP — Filter Panel
RCE — Remote Controller Equipment	RCC — Remote Cluster Controller Module
	RMM — Remote Maintenance Module (2 max)
	FSP — Frame Supervisory Panel
	CU — Cooling Unit
RCME — Remote Control & Maintenance Equipment	RMM — Remote Maintenance Module
	HIE — Host Interface Equipment Shelf
	FSP — Frame Supervisory Panel
RLM — Remote Line Module	RLC — Remote Line Module Controller
	LD — Line Drawer
	FSP — Frame Supervisory Panel
—continued—	

<b>Table 9-1</b>	
<b>DMS-100 family bays and corresponding shelves/drawers (continued)</b>	
<b>Bays</b>	<b>Shelves/drawers</b>
RLCM — Remote Line Concentrating Module	HIE — Host Interface Equipment
	LCM — Line Concentrating Module
RME — Remote Miscellaneous Equipment	RMM — Remote Maintenance Module
	FSP — Frame Supervisory Panel
	FPA — Fuse Panel “A” Feed
	FPB — Fuse Panel “B” Feed
	FSP — PDC FSP
	FSP — MISC FSP
	XXX — For Miscellaneous Equipment Shelves
RSE — Remote Service Equipment	FP — Filter Panel
	RSM — Remote Service Module
	FSP — Frame Supervisory Panel
	XXX — Miscellaneous Equipment Shelves
SLC — Speech Link Connecting (or SLCC)	PSL — Peripheral Speech Link Connecting
	NSL — Network Speech Link Connecting
SME — Subscriber Module Equipment	SMR — Subscriber Carrier Module
	CU — Cooling Inverter Unit
	FSP — Frame Supervisory Panel
—continued—	

<b>Table 9-1</b> <b>DMS-100 family bays and corresponding shelves/drawers</b> (continued)	
<b>Bays</b>	<b>Shelves/drawers</b>
TME — Trunk Module Equipment	TM8, 4, 2 — Trunk Module 8-, 4-, 2-wire (see Chapter 4)
	MTM — Maintenance Trunk Module
	FSP — Frame Supervisory Panel
	AXU — Office Alarm X-Connect
<b>Note:</b> Maximum of 5 Trunk Modules per frame only if:	
	a) All are TMs
	b) 0 4 are TMs and 1 is an MTM
	c) 1 is an MTM and another is an AXU. Maximum of 4 Trunk Modules for all other combinations.
<b>End</b>	

A DMS-100 Family system usually has one or more Maintenance and Administration Positions (MAP) equipped with a Visual Display Unit (VDU), Logic series keyset, jacks, and an optional printer.

All frames, with the exception of Speech Link Connecting (SLC), Digital Network Interconnecting (DNI), Maintenance Spare Storage (MSS), and Maintenance Storage Cabinet (MSC) are equipped with a Frame Supervisory Panel (FSP) designed specifically for the control and monitoring of the equipment in the frame.

A multiple fan unit is designed for use in the central control and network frames which require forced-air cooling. The cooling unit mounts at the bottom of the frame, occupying a single shelf space. Fan failure detection is provided. With the exception of the fan cooled LGE, LTE, MS6E, MS7E, RCE, SME, and DTE, the peripheral equipment is convection cooled.

Internal DMS-100 Family system cabling is totally implemented with connectorized cable using 26 AWG twisted pairs. Cabling to the MDF uses standard cables connectorized at the DMS-100 Family side, and either connectorized or loose at the MDF side depending upon the DF block used. Cable distances between the network and peripheral modules are limited to a 750 ft (228.6 m) maximum; between network and central message controller they are limited to a 200 ft (60.96 m) maximum. Power distribution cables are not connectorized. It is not possible to reverse or incorrectly mate the two halves of a biased connector. Also, all connectors have adequate space between adjacent connectors or other units to allow a firm grasp on the associated plug for removal.

A common type of shelf, with the exceptions shown in Table 9-2, is used for mounting printed circuit cards throughout the DMS-100 Family system. There are 24 in. (610 mm) of usable space between the side plates of the shelf. The common shelf has these dimensions: height 14 in. (356 mm), width 25 in. (635 mm), and depth 12.5 in. (318 mm).

<b>Shelf</b>	<b>Inches</b>	<b>Millimeters</b>
Frame Supervisory Panel (FSP)	5.0	127
Metallic Test Access (MTA)	7.0	178
Inverter (INV)	5.0	127
Recorded Announcement Module (6 channels)	13.0	330
Recorded Announcement Module (12 channels)	21.0	533
Magnetic Tape Drive (MTD), DPP, BMC, Stratum II ROS	28.0	711
Peripheral Speech Link Connecting Panel	3.5	89
Network Speech Link Connecting Panel	3.5	89
DNI Panels	3.5	89

All printed circuit boards measure 12.5 in. (317 mm) high and 10 in. (254 mm) deep except miscellaneous alarm Printed Circuit Boards (PCBs) (which are about half the height), first generation line circuit PCBs (which are 4 inches [102 mm] by 4 in. [102 mm]), and second generation line circuit PCBs (which are 3 in. [76 mm] by 3.5 in. [89 mm]). All PCBs with the exception of the line circuit have face plates of suitable widths. Both single and double sided PCBs are used.

Circuit pack extenders are provided for PCBs that can tolerate the additional time delays imposed. Extenders can swivel through a 180-degree arc. Circuit pack extenders are not provided for all units, such as high-speed logic circuits, that cannot tolerate extra distance.

The alignment guides for installing circuit packs in a shelf or drawer allow for considerable misalignment while attempting to seat a circuit pack without causing equipment damage. Wherever possible, quick-fasten devices (rather than bolts or screws) are used for all replaceable units.

The heads of fastening devices for all mounted units are accessible with a standard screwdriver.

## Equipment Frames and Cabinets

A single-bay frame has been designed and used throughout the DMS-100 Family system. In some cases (for example, CCC), two bays are fixed together to form a double-bay frame.

Frame structure members do not impede normal maintenance access or removal of frame component modules or subassemblies.

EMI hardware, mounting hardware, cabling hardware, and rear panels are provided for a given bay configuration and are normally shipped loose. This equipment is provided in addition to the basic framework.

### Equipment frame dimensions

All NT40 based DMS-100 Family equipment frames use an identical framework assembly with specific dimensions:

Depth:	18 in. (457 mm)	
Width:	27 in. (686 mm)	
Height:	Framework only	84.0 in. (2.13 m)
	Overframe Cable Duct	10.0 in. (254 mm)
	Cross-Aisle Cable Duct	7.1 in. (180 mm)
	Subtotal	101.1 in. or 8'5" ± 1" (2.6 m ± 25 mm)
	Ladder Type Cable Rack	12.0 in. (304 mm)
	(Top is 9' 4" (2.8 m from floor)	
	Total	113.1 in. (2.9 m)

Recommended clear ceiling height is 132 in. (11 ft). Minimum clear ceiling height is 120 in. (10 ft).

The level above the 101.1 in. or 8' 5" (2.6 m) is reserved for the ladder type cable rack which is normally used for cabling to the Distributing Frame (DF), transmission systems, and power distribution.

The DMS SuperNode equipment frame has specific dimensions:

Depth:	24 in. (610 mm)
Width:	42 in. (1.1 m)
Height:	72 in. (1.8 m)

### Cabinet Dimensions

The DMS-100 Family cabinets each have a height of 72 in. (1829 mm) and have the following width/depth combinations:

20.88 in. (530 mm)/ 28 in. (711 mm)
28.46 in. (723 mm)/ 28 in. (711 mm)
41.88 in. (1064 mm)/ 28 in. (711 mm)



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### Equipment frame lineups

Frames intended for use in lineups comply with six requirements:

- Frames are designed to allow side-by-side assembly into straight lineups. A nominal clearance of 1/16 in. (1.6 mm) is to be provided between adjacent frames.
- No part of any frame, structure, or equipment normally attached to the frame extends horizontally beyond the base of the frame.
- All frames in a lineup are of the same depth. The front edges of all frames are in line.
- All frames are provided with means for attachment to a concrete floor. This includes provision for relocation of such means of attachment if interference occurs with the reinforcing rods in the concrete floor. Note that with some earthquake reinforcement arrangements this flexibility is not available.
- Means are provided to level and plumb all frames and to compensate for variations in floor flatness:
  - floor levelness
  - Maximum deviation from the elevation established for the floor must not exceed plus or minus one inch over the entire floor area and the maximum difference in elevation between the high and low points in any building bay must not exceed 3/4 in. (19 mm).
  - floor flatness
  - Maximum deviation from a true straight edge 8 ft (2 m) in length placed anywhere on the floor must not exceed 1/4 in. (6.4 mm).
- Except as otherwise noted, full frame lineups will be located to provide straight cross aisles. The width of cross aisles will be such that movement of equipment frames during installation is not restricted.

### Equipment cabinet loading

The floor loading of a DMS-100 Family Cabinet does not exceed 115 lb/sq. ft. (4.86 kN/sq. m), averaged over the equipment footprint and allowable aisle area/s. An allowance of up to 25 lb/sq. ft. (1.06 kN/sq. m) can be included to allow for attached overhead cable distribution systems. An allowance of 10 lb/sq. ft. (0.423 kN/sq. m) can be included for personnel and transient loads. Hence, the total floor loading does not exceed 150 lb/sq. ft. (6.35 kN/sq. m).

### Equipment frame loading and support

The floor loading of fully equipped DMS-100 Family bays, including frame supporting cabling, averages 80 lb/sq. ft. (3.38 kN/sq. m). An additional allowance of 10 lb/sq. ft. (0.423 kN/sq. m) for ceiling supported cabling of the floor below should be included in multi-floor switching buildings. An allowance of 10 lb/sq. ft. (0.423 kN/sq. m) should also be added for

personnel and transient loads. The total floor loading in a multi-floor building is 100 lb/sq. ft. (4.2 kN/sq. m).

DMS-100 Family frames do not require any additional external supports other than the floor bolts. Both the overframe and the cross-aisle cable ducts are supported solely by the DMS-100 Family frames in a non-earthquake office. Cross-aisle cable ducts are not used in earthquake offices.

**Equipment frame earthquake resistance**

To cover the Applied Technology Council (ATC) seismic zones 1 through 7, two levels of earthquake protection are provided by the DMS-100 Family systems: the reinforced base frame (NT0X25AH), and the reinforced base frame and mechanical bracing frame (NT0X25AJ).

The ATC seismic zones 1 through 7 correlate with the Bellcore zones 1-4:

Seismic Zone ATC	Bellcore (NEBS)
1	1
2	
3	2
4	3
5	3
6	4
7	4

The type of earthquake protection required is dependent on the building size, total number of floors, floor location of the DMS-100 Family system, and the ATC zone.

Table 9-3 shows typical earthquake protection requirements for the seven ATC zones. The number of stories is equal to the number of floors, with a basement considered as an additional floor, or story.

<b>Table 9-3 Earthquake bracing requirements</b>			
<b>Where in Building Equipment is Installed</b>			
<b>ATC Zone</b>	<b>Ground Section</b>	<b>Mid Section</b>	<b>Top Section</b>
5, 6, 7	E	M	M
3, 4	E	E	M

<b>Table 9-3 Earthquake bracing requirements</b>			
<b>ATC Zone</b>	<b>Ground Section</b>	<b>Mid Section</b>	<b>Top Section</b>
1, 2	E*	E*	E
<p><b>Note:</b> E — The reinforced base frame is required.  M — The reinforced base frame and mechanical bracing frame are required.  E* — NT0X25AA Earthquake Framework assembly is recommended.</p> <p>Definition of Floor Level:</p> <p>Top Floor Section = Top 45% of the total floors.</p> <p>Mid Height Section = The floors below the top section, comprised of 26% of the total number of floors.</p> <p>Ground Section = Remaining lower stories</p> <p>Basement is considered a floor.</p>			

A floor plan study will be conducted with the operating companies, on individual sites, to determine the earthquake protection requirements.

Cables entering or leaving an equipment row must be given a minimum of 6 in. (152 mm) of slack to allow for relative motion between equipment rows, and a minimum of 12 in. (305 mm) of slack to allow for relative motion between a row and foreign cable securement (for example, pick up cable racks which are secured to the ceiling).

The slack must be situated at the entry and exit points wherever there will be a change of relative motion. It is not necessary to add 12 in. (305 mm) every time a DF cable crosses a row if it does not enter that row and is independent from the row.

Frame lineup length restrictions for zones and locations requiring the use of the reinforced frame but not the mechanical frame are a minimum of three frames and a maximum of eight. This cluster of eight frames may be continued in a lineup as required, with the restriction that there is to be a minimum of an 8-inch gap (a 12-in. [305-mm] gap is the standard) between each cluster and a minimum of a 12-in. (305-mm) slack in the cables.

For zones and locations requiring the reinforced frame and the mechanical frame, the maximum lineup is seven frames including the mechanical frame. This cluster may be continued in a line if the gap and cable restrictions are met.

For all installations, DMS-100 frames should be located at least one foot from walls, posts, or pipes. Any foreign equipment which is not earthquake braced should be located away from DMS-100 equipment at a distance at least the foreign equipment height plus one foot.

## **Equipment frame floor plans**

### **Host office floor plans**

Figure 9-1 shows a typical floor plan for a 25 000 line, 5000 trunk DMS-100 Family system. This office occupies two 20 ft. (6.1 m) X 20 ft. (6.1 m) building bays. The figure shows the CORE equipment (Central Control and I/O subsystems) located next to the maintenance area, with the network and peripheral frames capable of growth (as indicated) horizontally or vertically.

The maintenance area contains the maintenance and administrative positions which provide a person-machine interface with the DMS-100 Family system. The area contains a MAP configured for system maintenance, four Line Test Positions (LTP) and a MAP configured for a Trunk Test Position (TTP). The MAP consists of a VDU with keyboard, and a LOGIC key telephone set for voice communications. The physical position of the MAP equipment is flexible and can be located anywhere within the maintenance area or within 1200 cable ft. (366 m) of the CORE for local operation.

**Figure 9-1**  
**Typical floor for 25 000 line, 5000 trunk DMS-100 office**

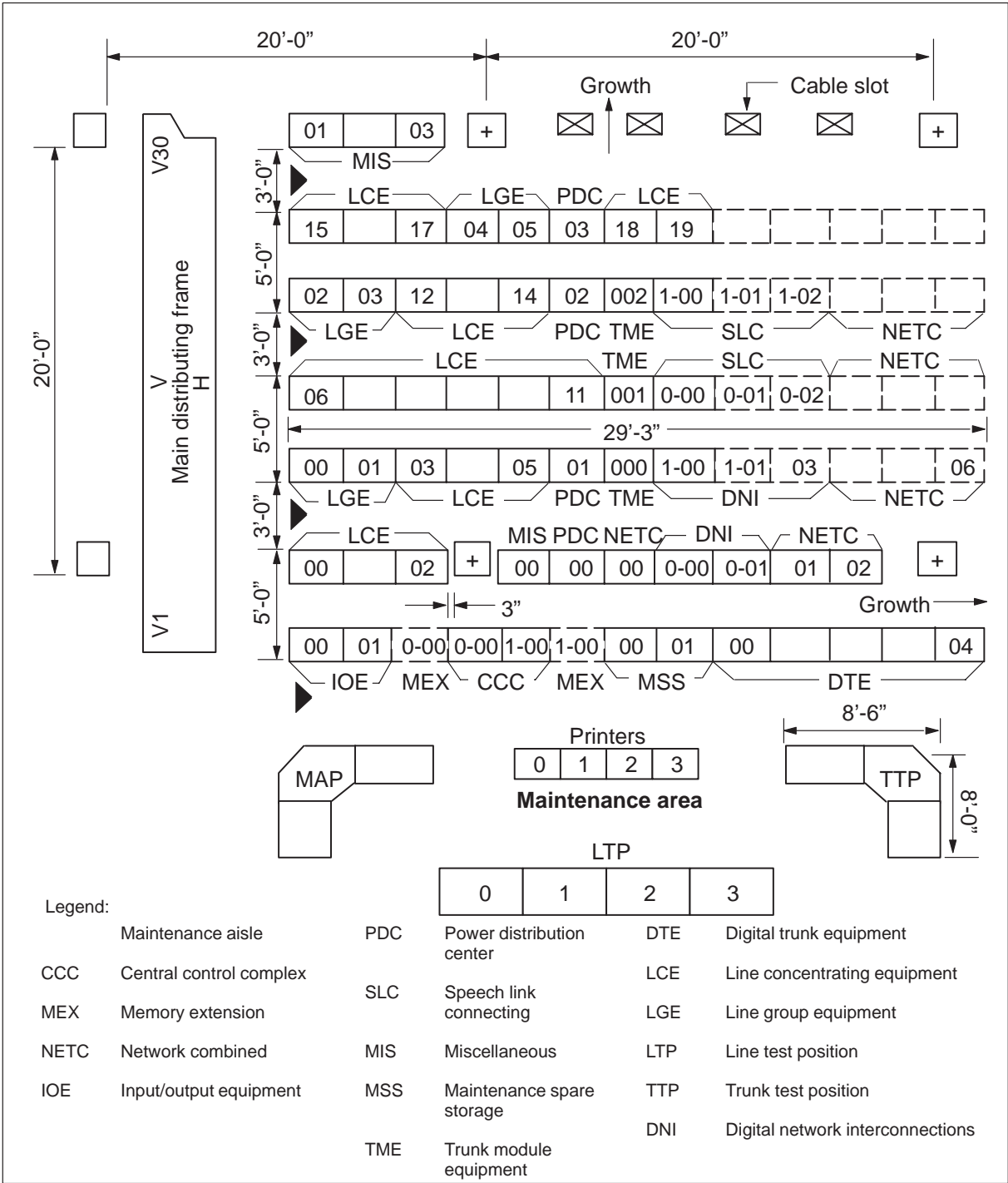


Figure 9-2 shows cable duct information:

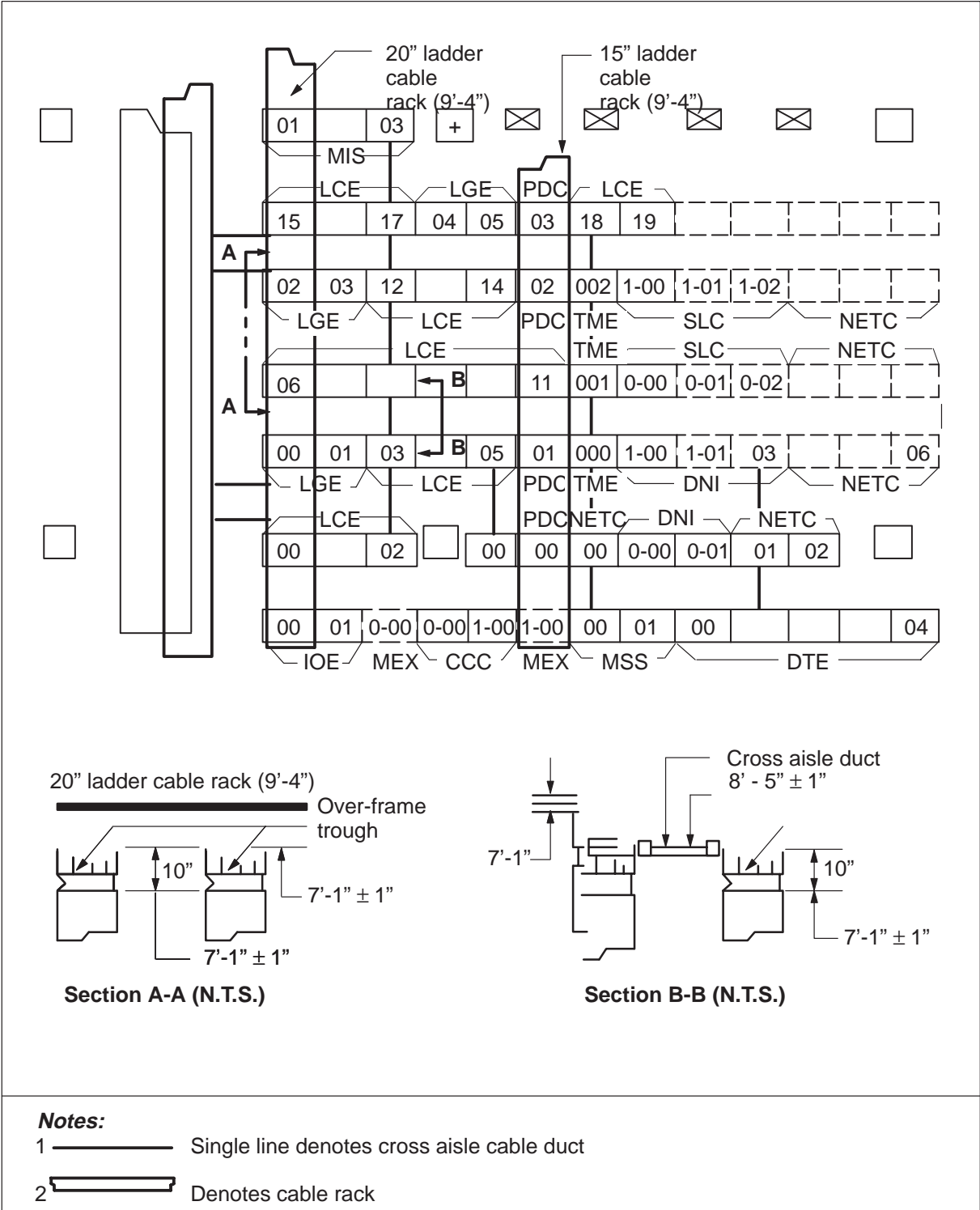
- Cross Aisle Cable Duct

- Cable Trough Location
- 15" & 20" Ladder Cable Racks at 9' 4" Level
- Office Cable Routing

The DMS-100 Family System has specific cable length restrictions:

- The total length of any cable run between a central control complex frame and a network frame shall not exceed 200 ft. (61 m). The cable length from a DNI frame and its associated network frames shall not exceed 100 ft. (30 m).
- The total length of any cable run between a peripheral equipment frame and a network frame shall not exceed 750 ft. (229 m).
- The total length of any cable run between an input/output equipment frame housing an Input/Output Controller (IOC) shelf and a Miscellaneous equipment frame housing a modem shelf shall not exceed 50 ft. (15 m). The direct cabling distance between the IOC shelf and any I/O terminal device shall not exceed 50 ft. (15 m).
- The total length of any cable run between the CPU of a central control complex frame and the last DS of a Memory Extension frame shall not exceed 40 ft. (12 m).
- The total length of power cable run between a power distribution center frame and any peripheral equipment frame is dependent on the equipment fusing (20, 10, 5 A) and cable size.

**Figure 9-2**  
**Typical cable duct and cable rack layout**

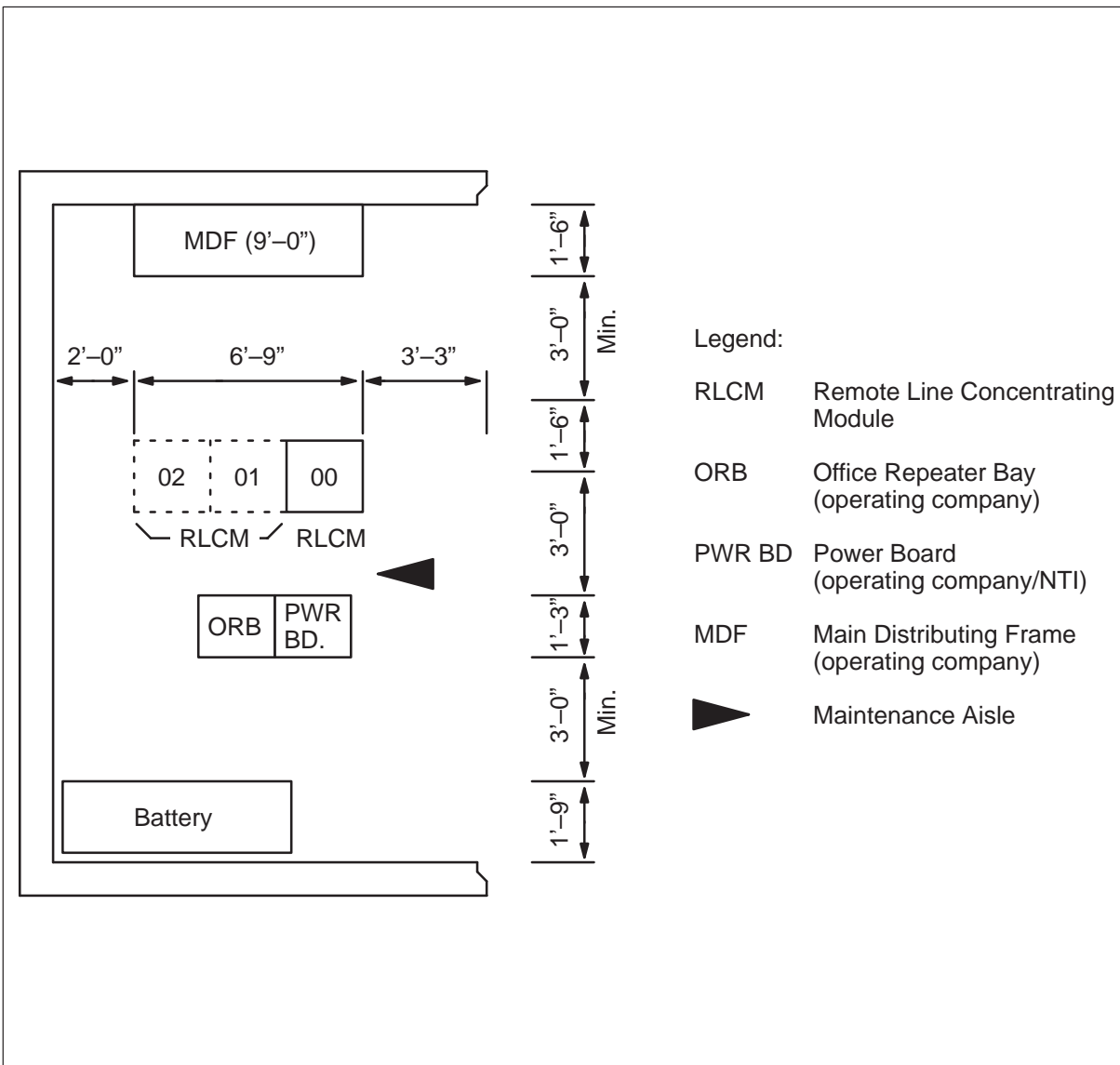


**Remote office floor plans**

**Remote line concentrating module (RLCM)**

Figure 9-3 shows a typical floor plan for a 640 line DMS-100 Family Remote Line Concentrating Module (RLCM) office with growth capabilities to 1920 lines. The RLCM offices, including a wall mounted MDF and dc power, occupy an area of 12 ft. (3.66 m) X 17 ft. (5.18 m).

**Figure 9-3**  
**Typical floor plan for a 640 line DMS-100 family RLCM office**





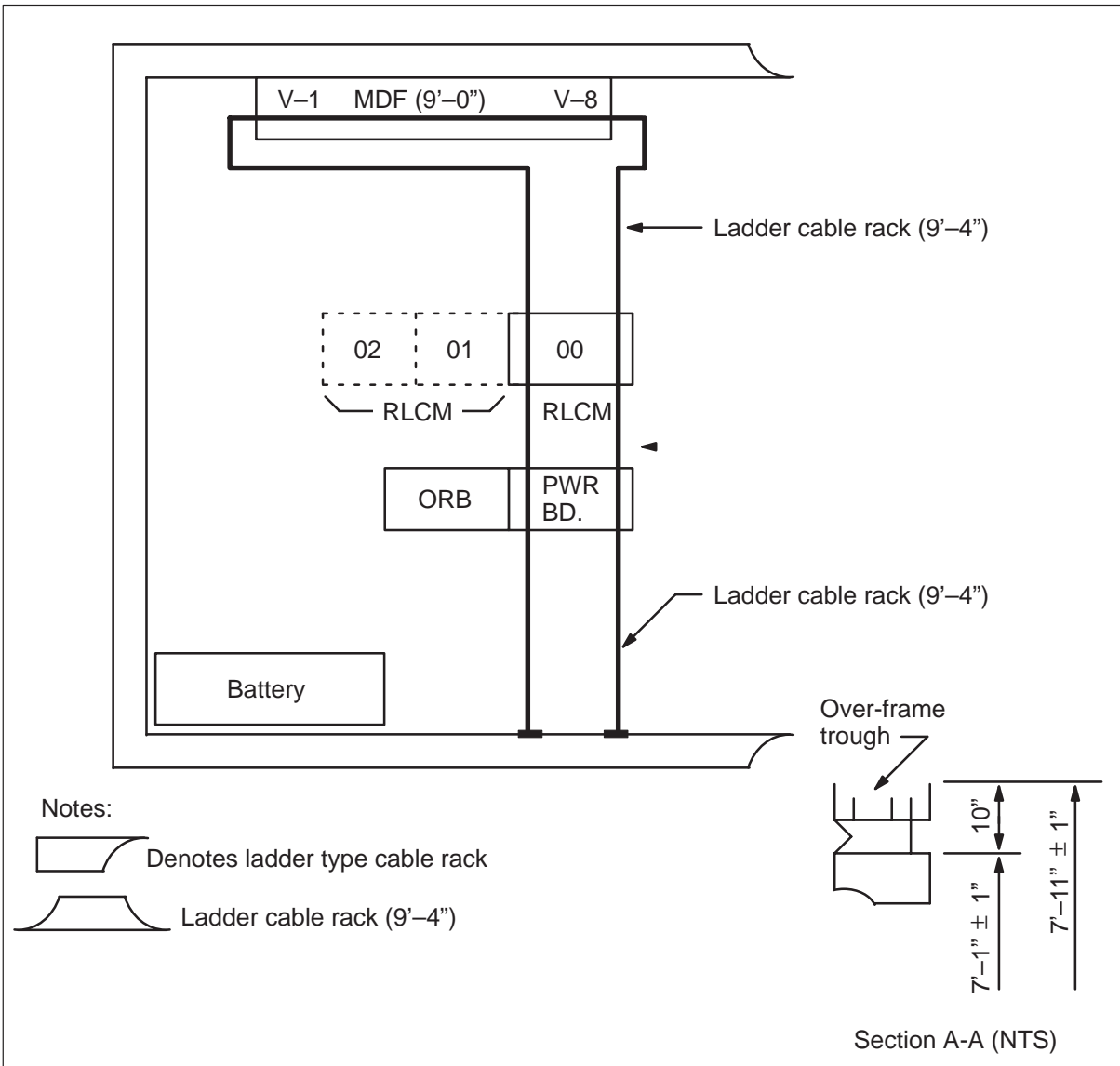
There is no maintenance area contained in this configuration since the MAP located at the host office provides the necessary person-machine interface for the DMS-100 Family RLCM system.

Figure 9-4 shows in detail the cable information for the RLCM:

- cable trough location
- ladder cable rack
- office cable routing

The total length of power cable run between a PDC frame and any remote line concentrating module frame shall not exceed 41 ft. (12.5 m).

**Figure 9-4**  
**RLCM typical cable duct and cable rack layout**



**Remote switching center (RSC)**

Figure 9-5 shows a typical floor plan for a 1280 line DMS-100 Remote Switching Center (RSC) office with growth capabilities to 5760 lines. The RSC offices, excluding a wall mounted MDF and dc power, occupy an area of 12 ft. (3.66 m) X 12 ft. (3.66 m).

There is no maintenance area contained in this configuration since the MAP, located at the host office, provides the necessary person-machine interface for the DMS-100 Family RSC.

Figure 9-5  
Typical floor plan for a 1280 line DMS-100 family RSC office

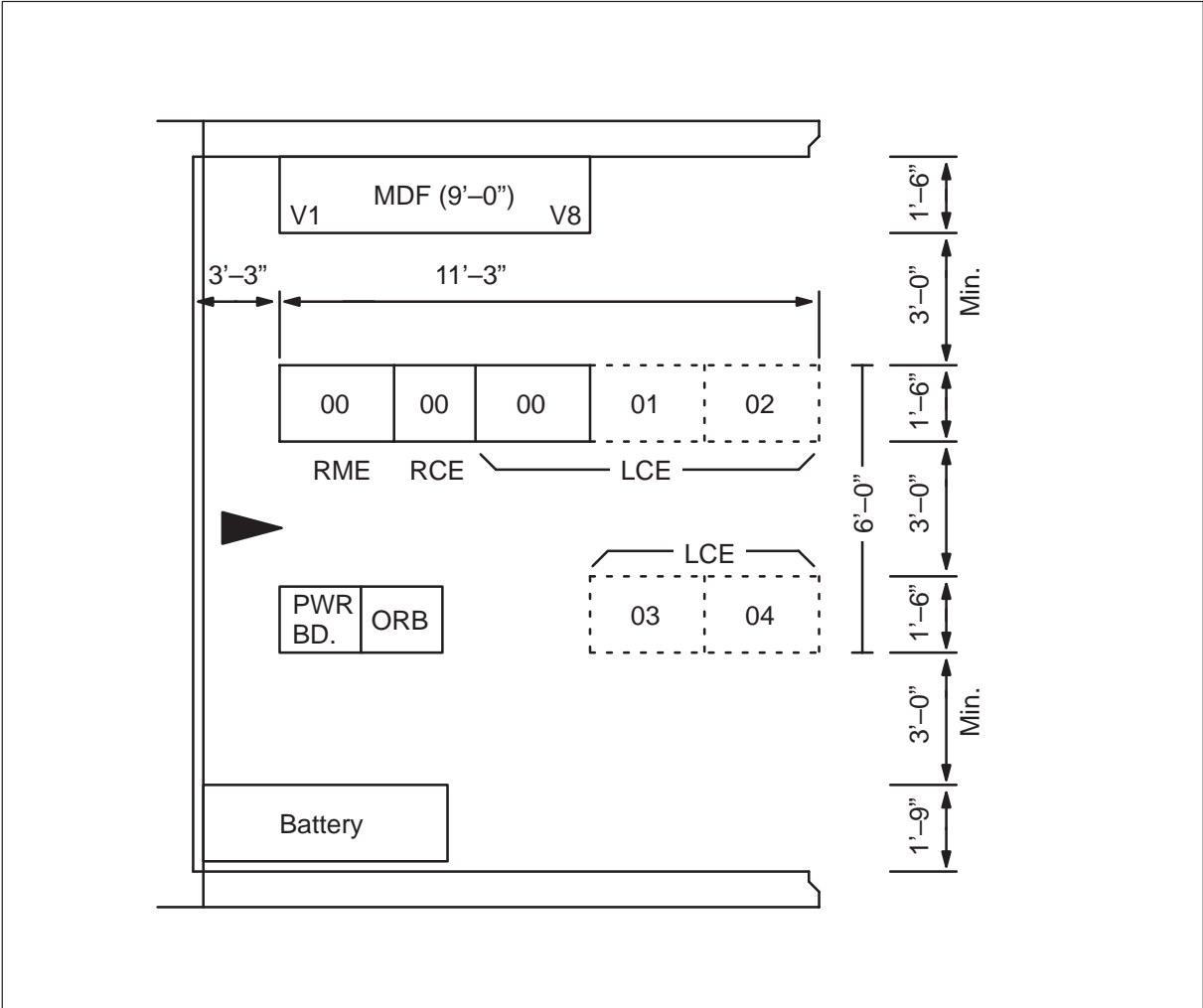
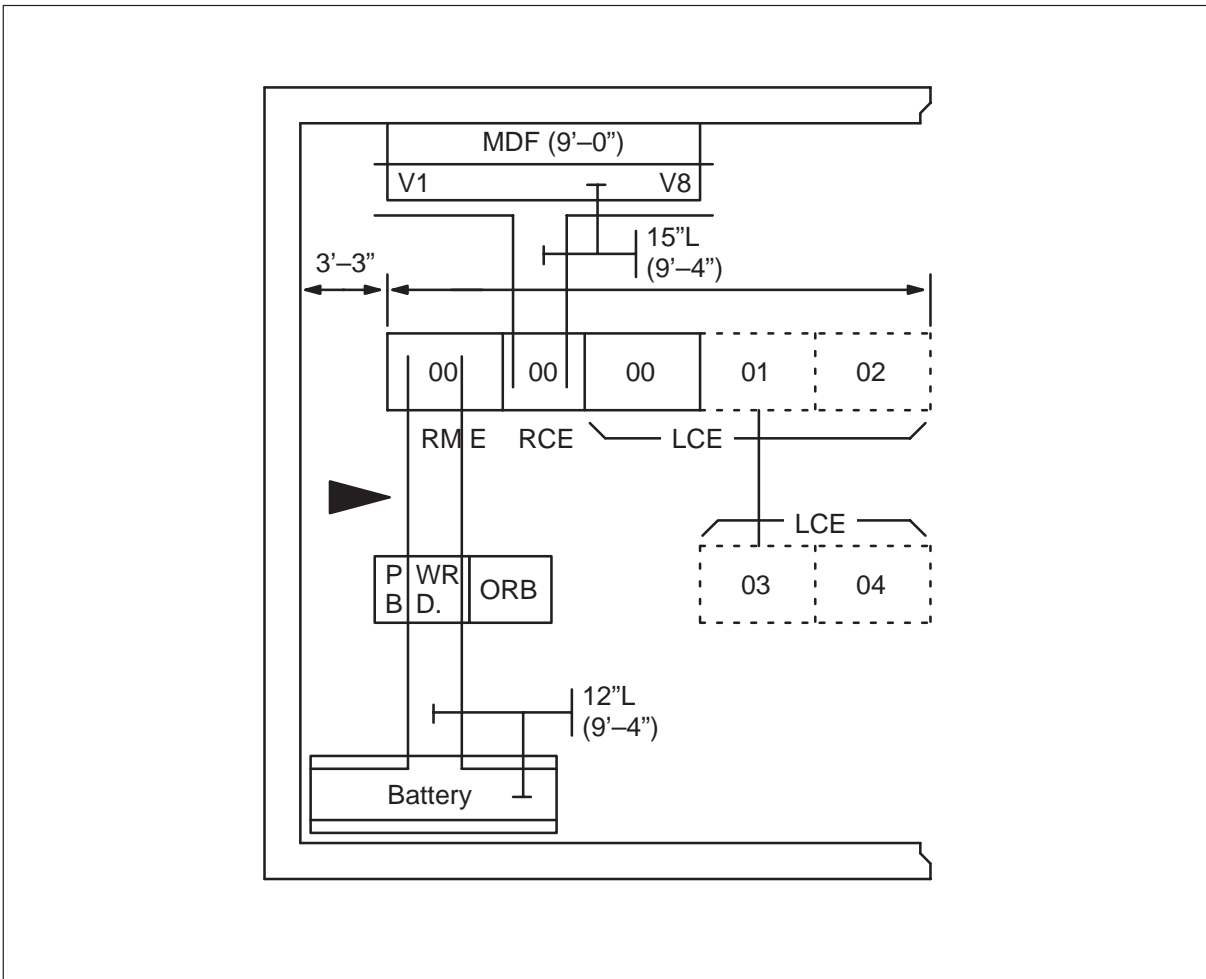


Figure 9-6 shows the RSC cable information:

- cable trough location
- ladder cable rack
- office cable routing

**Figure 9-6**  
RSC typical cable duct and cable rack layout



### Outside plant module (OPM)

The Outside Plant Module (OPM) is a package DMS-100 RLCM. Switching specifications are the same for the OPM version as for the RLCM. The most significant feature of the OPM is that the packaging allows it to be mounted on a concrete pad as outside plant equipment. The OPM design includes a weatherproof cabinet with an environmental control system to allow this exterior placement.

The OPM cabinet is 66 in. (1676 mm) wide, 66 in. (1676 mm) high, and 26 in. (660 mm) deep. It is constructed primarily of 13 gauge steel, ribbed for added strength, and is epoxy laminated for scratch resistance. A fully equipped cabinet, including electronics and batteries, weighs approximately 2200 lb (1000 kg). A view of the OPM interior layout is shown in Figure 9-7.

The OPM cabinet is composed of the main compartment and the end access compartment.

The main compartment houses the re-packaged RLCM, ac breakers, rectifiers, batteries, and environmental control system. The compartment is accessed from the front of the cabinet through a pair of doors. The majority of the equipment is housed on a pair of swing-out, double-latched, hinged bay frames. The hinged bays allow access to both the rear of the shelves and to additional equipment positioned against the back wall of the cabinet.

The end access compartment, physically isolated from the main compartment, houses protection, termination, and cross-connection equipment. Access is provided through a single door.

The doors of the cabinet are hinged with recessed lock pins and are provided with padlocking facilities. For security purposes, cabinet door alarms are provided.

Each hinged equipment frame contains three shelves of equipment. Four of the shelves within the swinging bays are occupied by the RLCM equipment consisting of a dual-shelf LCM, an RMM, and a Host Interface Equipment (HIE) shelf.

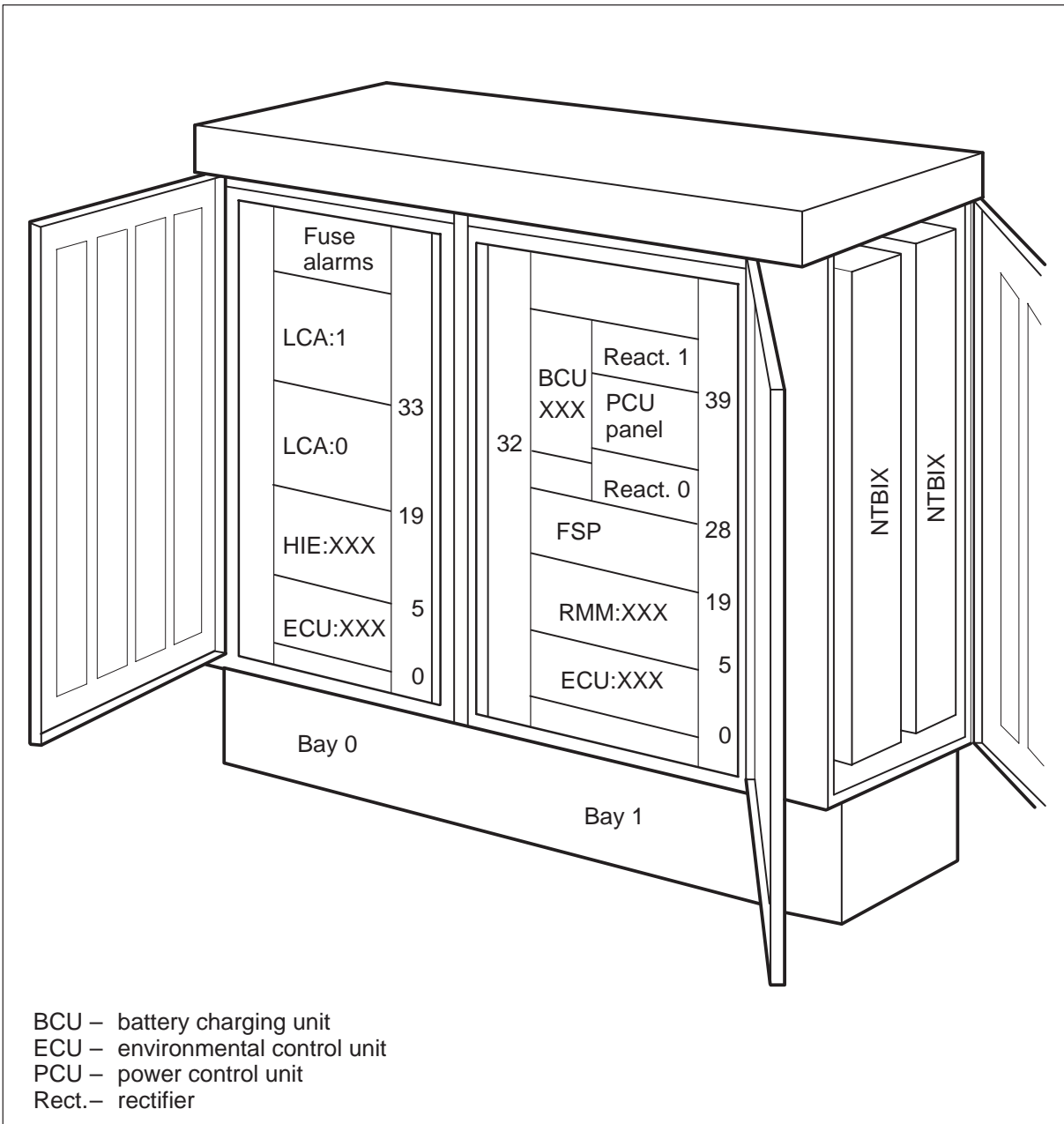
The remaining two shelves consist of an FSP which includes office repeaters, a Power Control Unit (PCU) for ac power, a rectifier system consisting of a pair of rectifiers, and a battery control unit. An Environmental Control Unit (ECU) is located at the bottom of each bay. The battery strings, ac entrance panel and optional test equipment are contained in fixed bays located behind the swing-out equipment bays.

Outside plant and power cables enter the cabinet at the left end of the cabinet base. Outside plant cable and termination is provided on the Service Protection Center (SPC) located in the end access compartment. The outside plant cable protection consists of both VF and DS-1 line protection. VF line protection is provided by carbon protector modules. DS-1 line protection is provided by gas tube protector modules.

Protection for 640 subscriber VF pairs and termination for 675 pairs is always provided. Optionally, an additional 1375 pair termination may be added, which will allow the end access compartment to serve a cross connection function.

The environmental control system regulates the environmental conditions in the main cabinet compartment to protect the OPM electronics. The OPM is designed for operation within an ambient temperature range from 5°C (40°F) to +40°C (104°F) and a relative humidity range from 5 to 99%.

**Figure 9-7**  
**Outside plant module — interior view**



**Floor plan data**

Table 9-4 shows the specific planning parameters for each type of subsystem.

**Table 9-4**  
**Floor plan data**

Sub syst	Type of frame	Heat dissip. watts/hr	Abbrev.	DC fuse rating	Typical current	Approx weight	
						kg	lb
Peripheral	Message switching 6 equipment	1050	MS6E	6-20A 2-5 A	23A	227	500
	Message switching 7 equipment	650	MS7E	6-20A 2-5 A	15A	—	—
	Trunk module equipment	480	TME	Inverter supply 2-20A	12A	227	500
	Digital carrier equipment	575	DCE	2-20A	12A	227	500
	Line concentrating equipment	1050	LCE	8-20A	23A	227	500
	Line group equipment	980	LGE	4-20A	20A	227	500
	Digital trunk equipment	1120	DTE	4-20A	20A	227	500
Network	Line trunk equipment	1120	LTE	4-20A	22A	227	500
	Double shelf network equipment	600	DSNE	4-10A 2- 5A	14A	—	—
	Network combined frame	1000	NETC	2-20A 2- 5A	22A (total)	285	630
	Speech link connecting	N/A	SLC	Nil	Nil	159	350
Central Control	Digital network interconnecting	N/A	DNI	Nil	Nil	136	300
	Central control complex	1720	CCC	4-20A 2- 5A	25A (total)	545	1200
I/O	Memory extension	850	MEX	4-20A	19A (total)	273	600
	Magnetic tape center	670	MTC	2-20A 1 - 10 per shelf	15A	273	600
	Input/output equipment	850	IOE	4-20A		273	600
Other	Miscellaneous equipment (rec. ann-machines, modems, etc.)	220	MIS	20A	5A	273	600
	Power distribution center	200	PDC	2-600A	Varies	227	500
	Maintenance spare storage	N/A	MSS	Nil	N/A	136	300
	Remote line module (double bay)	1000	RLM	2-20A per bay	25A (total)	454	1000
	Remote service equipment	385	RSE	2-20A	8A	—	—
	Remote line concentrating module	1360	RLCM	4-20A	A - 20A B - 17A	227	500
	Remote concentrating equipment	1000	RCE	3-20A	22A	—	—
Subscriber module equipment	1120	SME	4-20A	20A	227	500	

### **Floor plan requirements**

Within the general equipment grouping, more detailed arrangements are considered:

- The MEX frame(s) must be located adjacent to the CCC frame of the same plane.
- The IOE frame should be located as close to the CCC frame as possible.
- The MIS frame (housing the modem shelf) should be located as close to the IOE frames as possible.
- The SLC frames for each plane must be grouped together in the same lineup within the network area but as close to the peripheral area as possible.
- The DNI frames for each plane should be located as close and as central to the network frames of the same plane as possible.
- The MSS frame should be located near the core area or maintenance area if possible. If there is a need for more than one MSS frame, then subsequent ones can be placed in the peripheral area.
- All network frames should be centralized in one area, while peripheral equipment, such as DCE, DTE, LGE, LCE, and TME frames, can be placed in more than one area (or on a separate floor) if the cabling restrictions are observed.
- DCE or DTE frames, rather than TME frames are recommended to be mixed with Network (NETC) frames if the need exists.
- The SLC and DNI frames can be arranged facing each other, if floor area permits, and to alleviate cable congestion. Frames associated with different planes should be in different lineups.
- All RLM frames in a remote site should be located as near as possible to the RSE frames in order to meet cabling restrictions.

### **Distributing frame**

The distributing frame is furnished by the operating company; therefore, the physical properties are dependent upon the actual frame chosen.

### **DC power equipment**

The DMS-100 Family dc power equipment is furnished by the operating company. Current drains for the different DMS-100 Family bays and frames are supplied to the operating company for determining the size of the power plant and rectifiers on a per-site basis.

### **Power distribution center**

The power distribution center is described in Chapter 9.



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## Cable distribution

In DMS-100 Family systems, the overframe cabling duct is provided as part of the standard equipment frame. Earthquake protection is provided as described in Equipment frame earthquake resistance.

The cable duct is raised from the framework 4 in. (102 mm) to facilitate ventilation of the equipment mounted on the framework.

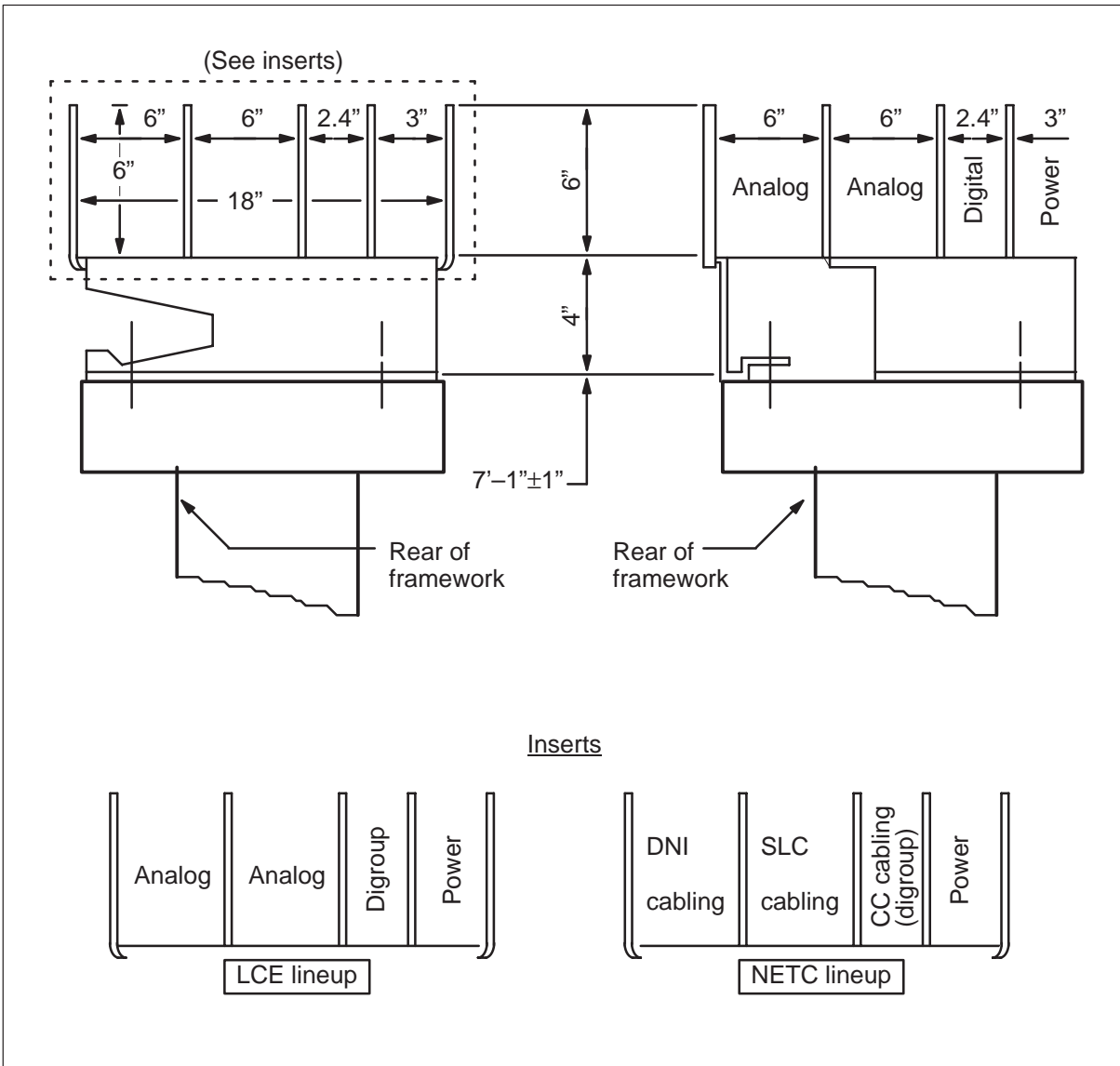
DMS-100 Family cable is routed in a frame modular cable trough as shown in Figure 9-8. The compartments are designed to provide functional separation for the various cables, and to minimize electromagnetic interference between digital, analog, and power circuits. A cross-aisle duct, whose section is somewhat similar, is available to distribute cable between aisles.

The cable assigned to the different compartments varies with the equipment lineup. Figure 9-8 shows the preferred standard. However, if it is necessary to mix peripheral equipment types within a lineup, some care is necessary to separate digital and analog cable, or cables for which there is danger of cross-talk interference. The cable trough is sectioned with metal dividers separating the digital cables from the analog to reduce such interference.

The sectional area of the overframe cable duct is designed to accommodate the worst case cable cross-section for an 18 frame lineup. It is expected that for normal office layouts the trough capacity will not be limited by the cross-section area, but by the need to segregate various cable types if peripheral equipment is mixed within a lineup. Should such situations arise cable may be rerouted with cross-aisle ducts.

A trough is available to bridge single frame gaps within a lineup without requiring stanchion or empty framework. Building columns require cross-aisle ducts to route cable to the continuation of the lineup. Cabling to DF, power, and other switching systems running perpendicular to the equipment lineups, are distributed in overframe using ladder cable racks. No provision has been made to route alarm and other miscellaneous signals, which are usually connected directly between the Frame Supervisory Panels (FSP) in each frame.

**Figure 9-8**  
**Cable trough assembly**



## Building provisions

### Ceiling height

A minimum clear ceiling height of 10 ft. (3 m) is recommended for the DMS-100 Family switching system. The recommended clear ceiling height is 11 ft. (3.4 m).

### Building ceiling supports

Building ceiling supports are not required for DMS-100 Family equipment frames or intra-switch cabling. Cable racks for cabling to MDF, power, and

other equipment (for example, ladder-type cable racks) are not supported by the DMS-100 Family frames and require ceiling supports.

### **Column and cable hole spacing and arrangements**

Due to the compactness of the DMS-100 Family systems, column and cable hole spacing and arrangements are not critical and flexible floor plan layouts may be engineered to accommodate various arrangements as required.

### **Frame handling and door openings**

Frames in the DMS-100 Family can be handled in a vertical or horizontal position provided that when they are lying horizontal, they are positioned on their side, not on the front or back. Each frame must be kept fully packed, to avoid damage, until it reaches the office floor location.

Hoisting Tool No. ITA-9938 can be used to hoist equipment frames in a horizontal position.

Crated frames are 7 ft. 5 in. (2.26 m) high, 2 ft. 5 in. (.74 m) deep, and up to 5 ft. 6 in. (1.68 m) wide. To accommodate hoisting fixtures, the recommended equipment entrance door opening into the building should at least be 5 ft. (1.5 m) wide by 10 ft. (3 m) high. Within the building, the uncrated frames on shipping dollies require an equipment entrance door opening of 3 ft. (.91 m) wide by 8 ft. (2.4 m) high.

### **Air conditioning**

The size of the building area housing the DMS-100 Family system, the building insulating properties, the climatic condition, the interior airflow and the size of the system itself all influence the air conditioning requirements.

The heat to be dissipated in DMS-100 Family systems per square foot averaged over the equipment room floor area is 40W. This is for DMS-100 Family switching equipment only. Other factors, such as the number of maintenance personnel, have to be taken into consideration to calculate the overall heat to be dissipated.

## **Environment**

### **Ambient temperature and humidity**

The DMS equipment, including remotes, is designed for operation within the ambient temperature and relative humidity ranges shown in Table 9-5:

<b>Table 9-5 Ambient temperature and humidity</b>		
	<b>Normal (Note 1)</b>	<b>Short Term (Note 2)</b>
Ambient temperature:	50°F to 86°F 10°C to 30°C	40°F to 120°F 5°C to 49°C
Relative humidity (Non-condensing):	20% to 55%	20% to 80%
Atmospheric pressure:	523 mmHg (69.2 KPa) corresponding to 10 000 feet (3048 m) of altitude	
<p><b>Note 1</b> Operation in the temperature range 40°F – 100°F (5°C – 38°C), are permissible if the monthly average for the upper range does not exceed 86°F (30°C). All performance and reliability parameters are met in this temperature range. Relative humidity of 80% is allowed at an ambient temperature that cannot exceed 70°F (21°C). At an ambient temperature of 120°F (49°C), the maximum allowable relative humidity is 30%.</p> <p><b>Note 2</b> Short term is defined as 72 hr. continuous and 15 days maximum per year.</p>		

Temperature and humidity are measured at a point 5 ft. (1.254 m) above floor level and mid-aisle, or 15 in. (381 mm) in front of the equipment (whichever is smaller). Rate of change should not exceed 15°F (6.7°C) per hour.

### Heat dissipation

The heat dissipation of DMS-100 Family switch averaged over the equipment room floor area and over 24 hr will not exceed 80 W/sq. ft (861 W/sq. m). Table 9-4 gives the maximum quantity of heat to be dissipated per frame, assuming that each frame is fully equipped.

### Air cleanliness

DMS-100 Family equipment functions indefinitely in an ambient air having a cleanliness standard no higher than class 100 000.

Classes are defined as the number of particles of 0.5 microns and larger, per cubic ft.

### Fire resistance

The DMS-100 Family System is designed using materials and techniques consistent with good design practice reflected in the telephone industry.

**PCB design**

Nortel Networks Procurement Specification 25001 on Printed Circuit Boards restricts all PCB laminated material to NEMA LI-1 Grade FR-4 epoxy glass material.

Each printed circuit board is marked to indicate that the material passed the UL flammability test (UL 94 V-0).

**Structural material**

All structural material, including the PCB and backplanes, have an oxygen index of 28% or greater, and a 94 V-0 rating as determined by Underwriters Laboratories standard 94 test for flammability of plastic materials.

**Component selection**

All components are selected to meet the appropriate IEC needle flame test.

**Wire and cable**

Wire and cable used throughout the DMS-100 Family of products meet ASTM D2633 requirements for thermoplastic insulation and jacketed wire and cable.

**Transportation and storage environments****Transportation**

DMS-100 Family equipment packaged for transportation is capable of enduring the rigors of shipping through truck, rail, sea, or air. The environmental conditions during transportation must not exceed specifications:

- Ambient temperature: –40°F (–14°C) to 160°F (71°C)
- Humidity: 10% to 95%; max water vapor pressure not to exceed 25 mmHg
- Vibration: up to 3.5 g at 5 Hz to 500 Hz
- Shock: equivalent to a 6-in. (152-mm) drop for a 1000-lb (454-kg) equipped bay

**Storage**

DMS-100 Family equipment may be stored packed in a sheltered environment under specific environmental conditions:

- Ambient temperature: –40°F (–14°C) to 160°F (71°C)
- Humidity: 10% to 95%; max water vapor pressure not to exceed 25 mmHg.

**Grounding**

The use of ac coupling for signal leads, together with input-output isolation of ac to dc converters, essentially eliminates the need for a ground window.

In the DMS-100 Family, the battery return, signal ground, and frame ground are separate entities although they are brought to the same dc potential. See "Cable distribution" for physical grounding arrangements.

### **AC coupling**

AC coupling is employed between the central message controller and network, and between network and peripheral equipment. This ac coupling refers only to the signal leads. Network and peripheral frames need not be insulated from the floor unless they form part of the CPU lineup.

### **DC coupling**

The CPU, associated memory, and the central message controller are all dc coupled. These units are considered for grounding purposes as a single group entity. All frames in a lineup that contains this entity must be insulated from foreign grounds.

### **Frame ground**

A frame ground bus is bonded to each frame in the lineup at the top. The bus terminates at the PDC frame ground which is also the battery return ground.

The PDC frame ground bus of all PDCs are bonded together and connected at one point to the central office ground for that floor for a dedicated power plant, or to the battery ground reference point for a shared power plant.

### **Framework isolation**

The equipment lineup that contains the CCC module must have all framework isolated from any ground other than framework ground. This isolation of frames prevents possible malfunction of memory shelves due to electromagnetic fields which may be generated if an unusually large fault current was allowed to flow through the CCC framework.

DMS-100 Family frames not in the CCC module lineup need not be isolated from other grounds. Isolation may be specified by the operating company during the engineering period, if local arrangements so require.

### **Signal ground**

Advantage is taken of the printed circuit backplane construction to isolate the signal ground on a per-shelf basis. A single ground connection is taken from the signal ground of each shelf and all of them connected to a single bonding point of the frame ground stop at that frame. Exceptions to this rule are in the central control complex and the MSB, where all signal grounds from the shelves are connected to a single point on the frame ground bus for all the frames in the central control complex.

**Illumination**

Lighting levels are provided and maintained in the DMS-100 Family System so as to afford satisfactory and safe working conditions at all times. To this end, two types of lighting are provided in the DMS-100 Family on an optional basis, using normal lighting and low intensity lighting (for emergency conditions).

**Electromagnetic interference**

**Electromagnetic emissions**

The system, with available options, conforms to the emission requirements of the Federal Communication Commission (Part 15, Subpart J). Frames are available which are in compliance with FCC regulations for location on customer premises.

**Radiated susceptibility**

The system shall not exhibit any malfunctions or be degraded beyond its specified tolerances when subjected to electric field strengths of 5 V/m or less, root-mean-square value corresponding to the peak of the envelope, if modulated, over the frequency range 10 kHz to 10 GHz.

**Audio noise emissions**

Maximum sound levels produced by equipment to be located in power rooms or special sound tested areas shall not exceed 85 dBA. Maximum sound levels for all other equipment shall not exceed 75 dBA.

**Miscellaneous**

**Hardware**

In addition to the DMS-100 Family equipment bays, other equipment may be supplied as requested for testing purposes. This equipment is shown in Table 9-6.

<b>Table 9-6 Additional equipment</b>	
<b>Description</b>	<b>Code</b>
Echo Return Loss Measuring and Singing Point Measuring Set	Wiltron Model 904I
Digital Multimeter with Battery (Including Battery Eliminator)	Fluke Model 8010A-01
Multimeter Test Lead Set	Fluke Model Y8134
—continued—	

<b>Table 9-6 Additional equipment(continued)</b>	
<b>Description</b>	<b>Code</b>
Multimeter Carrying Case	Fluke Model Y8205
Test Cord (310 to 309) 6' Long	ADC Telecommunication Model PJ-955
Test Cord (309 to 309) 3' Long	ADC Telecommunication Model 4-15195-0030
Test Cord (310 to 360) 6' Long	Northeast Electronics Model 2W-17A
Cord Set Assembly	Northeast Electronics Model 931800-100
Universal Signaling Sender	Northeast Electronics Model TTS59C
DP/MF/DTMF Signaling Display	Northeast Electronics Model 2763
Test Cord (309 to 310) 2' Long	ADC Telecommunication Model PJ-953
Transmission and Noise Measuring Set	Northeast Electronics Model 4002
T-1 Repeater Slot Extender	Northeast Electronics Model 7015
Pulse Signaling Test Set	Northeast Electronics Model 1260-A
PCM Span Repeater Test Set	Northeast Electronics Model 7040
4.5 Digit DMM W/Rech Batt	Fluke 8050A-01
Local Test Cabinet	Nortel Networks Model 3703
Dual Channel 100 MHz Scope	HP 1740A
Impairment Measuring Test Set	HP 4935A
Universal Counter	HP 5334A
—continued—	



<b>Table 9-6 Additional equipment(continued)</b>	
<b>Description</b>	<b>Code</b>
225 MHz Freq. Counter	HP 5382A
Logic Probe	Hewlett Packard Model 545A
Transmission Test Set	Hewlett Packard Model TTS 44
Digital Test Head/Remote Office Test line	Nortel Networks DTH/ROTL
Trunk Signaling Analyzer	Berry Model 966A
Digital Carrier Test Set	Bowmar Model 273A
300 MHz Oscilloscope	Tektronix Model 2465
<b>End</b>	

### Floor maintenance

Floor maintenance procedures as outlined on pages 1 and 2 of AT & T practice "BSP 770-140-010" Issue 1, August 1977, are suitable in the DMS-100 environment.

## Craftsperson interfaces

### Input/output system

The I/O system consists of this equipment:

- Magnetic Tape Devices (MTD)
- Disk Drive Units (DDU)
- Visual Display Units (VDU)
- Teleprinters (PRT) Receive and/or Send
- Data Buffer Units
- Data Sets (Modems)
- Billing Media Converter (BMC)
- Distributed Processing Peripheral (DPP).

These devices are the primary means of communication between the operating personnel and the DMS-100 Family system. The I/O devices are used to input machine controls, run tests, request information, and output system generated messages.

With the exception of the magnetic tape devices, disk drive units, and DPPs, all other I/O devices may be supplied by either the operating company or Nortel Networks. All devices supplied by the operating company require a determination of compatibility with DMS-100 Family systems.

A minimum of five I/O ports, excluding MTDs, must be provided for all DMS-100 Family systems:

- 1 VDU port for the Maintenance and Administration Position (MAP)
- 2 VDU, PRT ports for the Technical Assistance Service (TAS)
- 2 VDU ports for the Portable Maintenance (AXU).

I/O devices, as shown in Table 9-7, are supported by the DMS-100 software for logging maintenance and machine activity.

<b>Table 9-7 I/O devices</b>			
• Visual Display Units			
Digital Equipment Corporation		VT 220	300/1200 baud
• Teleprinters			
Datacom			
	1200	S/R	300/1200 baud
Texas Instruments			
OMNI	810	R/O	300/1200 baud
OMNI	820	S/R	300/1200 baud
Data products M-200		R/O	1200 baud
Data Speed 40/2 & 40/3			300/1200 baud
GE	2120	R/O	300/1200 baud
		KSR	

### **Magnetic tape devices (MTD)**

Magnetic tapes are used in DMS-100 Family systems as external storage devices and as a media for transferring batch data and operating software into and out of the system. The read-write device for magnetic tapes is the MTD. The MTD used for DMS-100 Family application is the nine-track Cook tape drive, NTI No. A0277744.

The number of MTDs required will depend on the features to be supported and the operating company administrative policy. A separate MTD is not required for each feature; for example, operational measurements, service analysis, and trouble diagnostics and reports may be assigned to the same

magnetic tape drive or disk drive unit. A minimum of one MTD is required per system.

**Disk drive units**

The disk drive unit used in the DMS-100 Family is the 14-in. (355 mm) PRIAM 15450. The unit is dc powered, fits into a standard DMS shelf, and has a capacity of 154 Mbytes.

The recommended configuration per system is two disk drive units. In addition to AMA, OM, and journal files storage, a single disk drive unit is typically used for office image storage and bootstrap loading.

**Visual display units**

The Digital Equipment Corporation VT 220 VDU is supported by the DMS-100 Family.

A VDU baud rate of 1200 is recommended for all applications (a baud rate of 300 is also supported).

**Teleprinters**

The DMS-100 Family supports the five types of teleprinters shown in Table 9-8..

<b>Table 9-8 Teleprinters</b>	
<b>Make/model</b>	<b>Baud rate</b>
DATACOM I200 S/R	1200/300
Texas Instruments OMNI 810: R/O	1200/300
OMNI 820: S/R	
Data Products M200 R/O	1200
Data Speed 40/2 & 40/3	1200/300
GE 2120	1200/300

Device controllers are used to interface with the teleprinters. As shown in Table 9-9, the device controllers are equipped with two types of transmission interfaces: current loop or RS232. The type selected for use depends on the cabling distance between the I/O device and the IOC.

<b>Table 9-9 Device requirements</b>		
<b>Cabling distance (ft.)</b>	<b>Interface type</b>	<b>Modem required</b>
up to 50	RS232	No
up to 1200	Current Loop	No
over 50	RS232	Yes

Each terminal, regardless of its type, can appear either in a local or remote location. Modems may be arranged for either dial-up or dedicated operation.

Table 9-10 shows the modem recommended for use with DMS-100 Family systems:

<b>Table 9-10 Modem requirements</b>		
RIXON	108/113 C202/C212	300/120

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# Chapter 10: Power requirements

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## Operating voltage

Power in the DMS SuperNode and the DMS-100 Family switching systems is distributed at a nominal potential of  $-48\text{ V dc}$ . The operating voltage ranges cover two conditions:

- 1 Normal conditions:  $-43.75\text{ Vdc}$  to  $-55.8\text{ Vdc}$

*Note:* The voltage limits may be encountered under battery discharge conditions following a loss of ac power to the dc power plant ( $-43.75\text{ V}$ ) or battery equalization ( $-55.8\text{ V}$ ).

- 2 Extreme conditions:  $-42.75\text{ Vdc}$  to  $-55.8\text{ Vdc}$

*Note:* Extreme conditions occur during commercial power failure (low end) and battery equalization charging (high end). Interface equipment may necessitate modification of these limits when sharing a power plant with other equipment.

The actual operating voltages are measured at the input to the Power Distribution Center (PDC), and include the loop voltage drops between the office battery terminals and the PDC. Except for line current and some relay equipment, all input power in the DMS-100 Family system is further processed by converters and inverters to different dc and ac voltages.

## Battery noise limits

The DMS-100 Family system may share power plants with other systems provided that the requirements of power plant sharing are met and that the office voltage range and battery noise level are within specified limits:

- Voltage range  $-43.75\text{ Vdc}$  and  $-55.8\text{ Vdc}$
- The noise present at the battery terminals of any dc source to which the DMS-100 switch will be connected, shall not exceed  $55\text{ dBrc}$  or  $300\text{ mV rms}$  in any  $3\text{ kHz}$  band between  $10\text{ kHz}$  and  $20\text{ MHz}$ .

- Step voltage changes on the dc source (measured at PDC) should not exceed 5 Vdc in magnitude at a rate of change of 1 V/ms. Faster rates of change can be tolerated if the step voltage magnitude is less than 5 V. The product of magnitude and rate of change should not exceed 5 V<sup>2</sup>/ms., and the voltage limits (operating voltage) must not be exceeded.

End cell switching is permissible for use with the DMS-100 Family systems subject to the above step voltage changes.

### Power consumptions

The current drain and power consumption are normally engineered by Nortel Networks on a per-job basis.

Table 10-1 provides the maximum power consumption on a per-frame basis, assuming that each frame is fully equipped and all equipment is operating at maximum capacity.

<b>Table 10-1 Maximum power consumption per frame</b>		
<b>Frame</b>	<b>Code</b>	<b>Max watt</b>
Trunk module equipment	TME	480
Digital carrier equipment	DCE	575
Network frame	NETC	960
Central control complex (double bay)	CCC	1720
Memory extension	MEX	850
Magnetic tape center	MTC	670
Miscellaneous equipment	MIS	220
Power distribution center	PDC	200
Remote line module (double bay)	RLM	1150
Remote service equipment	RSE	385
Line concentrating equipment	LCE	1050 (6ccs) 1550 (8ccs)
Digital trunk equipment	DTE	1120
Line group equipment	LGE	980
Line trunk equipment	LTE	850
Input/output equipment	IOE	1360 (6ccs) 1860 (8ccs)
—continued—		

<b>Table 10-1</b>		
<b>Maximum power consumption per frame</b> (continued)		
<b>Frame</b>	<b>Code</b>	<b>Max watt</b>
Remote line concentrating module	RLCM	
Double shelf network equipment	DSNE	600
Remote controller equipment	RCE	1000
Message/switching 6 equipment	MS6E	1150
<b>End</b>		

### Power alarms

DMS-100 Family power plant failures/alarms are detected through alarm scan points in the associated maintenance trunk module. Power plant alarms are grouped together (the grouping is definable by operating company) and may be assigned optionally by the operating company into any of these categories:

- critical alarm from system power plant
- major alarm from system power plant
- minor alarm from system power plant

The external alarms subsystem monitors the hardware of the DMS-100 Family alarm system through alarm scan points in the Office Alarm Unit (OAU) in the associated Maintenance Trunk Module (MTM). These scan points detect inputs from one of three sources:

- 1 hardwired alarm contacts in the DMS-100 Family hardware
- 2 the operation of manual control switches
- 3 the alarm circuits of miscellaneous equipment associated with the DMS-100 Family office

Whenever a scan point changes state, the external alarms subsystem status display on the Visual Display Unit (VDU) is updated to reflect the change. The status can also be printed on the maintenance teletypewriter (TTY). The alarm system software responds to detected alarm or control inputs by operating or releasing the appropriate Signal Distribution (SD) points in the alarm system hardware, to initiate or terminate the corresponding audible and visual alarm, or control function.

The DMS-100 Family alarm control and display panel incorporates visual lamps to indicate four types of failures:

- 1 critical power plant failure
- 2 major power plant failure

- 3 minor power plant failure
- 4 power distribution center Alarm Battery Supply (ABS) failure

### **DC power distribution (PDC)**

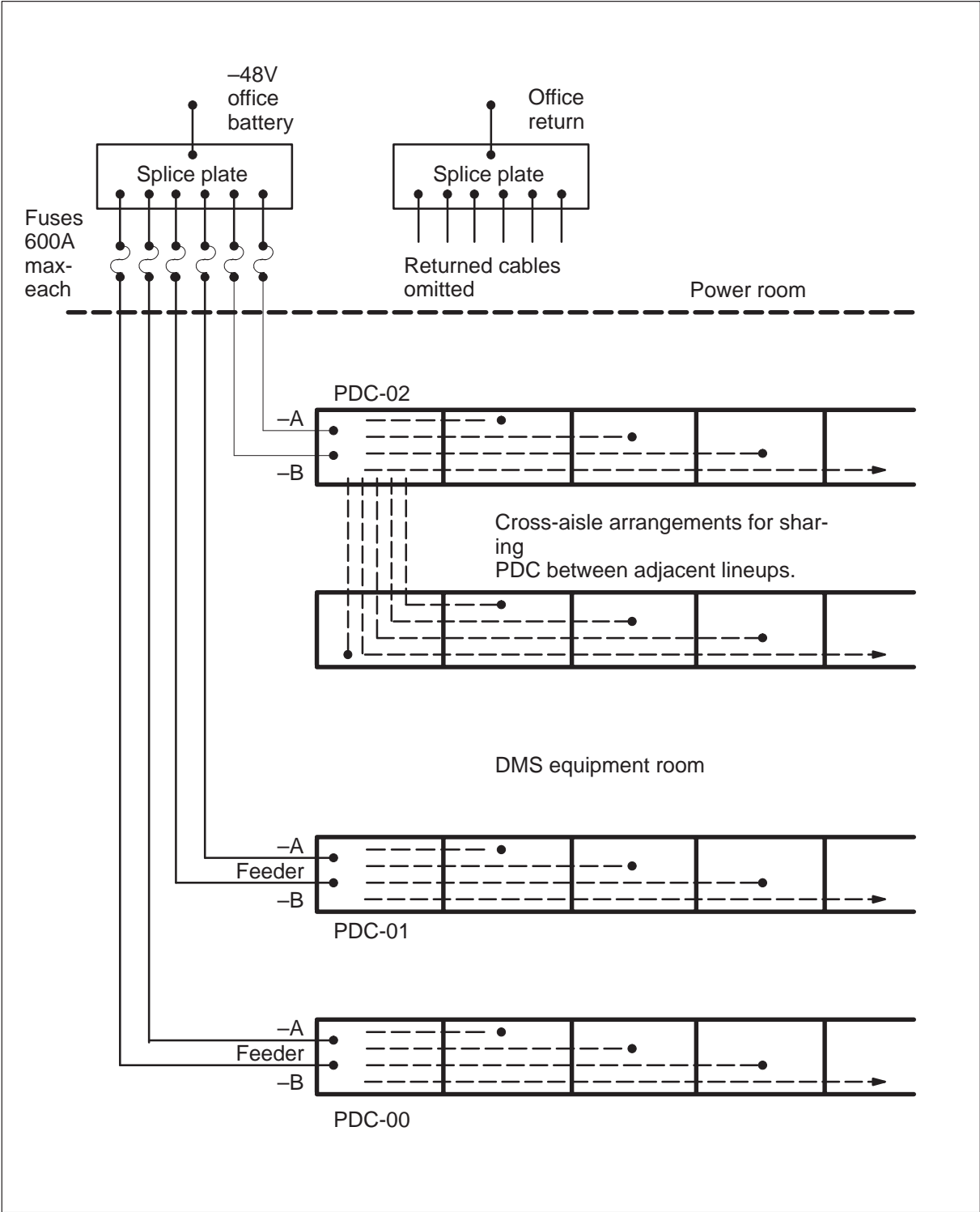
#### **Office battery to power distribution center**

The feeders and returns to the PDC from the office battery consist of two separate sets of cables. One set is designated Battery Cable –A and Return Cable –A, and the other set, Battery Cable –B and Return Cable –B (see Figure 10-1). The battery cable and its mate return cable must be routed from the office battery to the PDC using the same cable racks. At the PDC, both return cables are connected to a common return bus that is isolated from the PDC framework. The total dc distribution capability of a PDC is 800 amperes, 400 A on feeder –A and 400 A on feeder –B.

Battery feeder cables from the office battery to each PDC are fused in the power room at 600 A maximum. The operating company can engineer the power to the maximum capability so that the site will not have to be re-engineered as office expansion occurs. If anticipating future office growth, the fuse capacity should be sized for the maximum 400 A PDC load and not based on current equipment load.



Figure 10-1  
Typical PDC arrangement



### **PDC to DMS-100 family frames DC distribution**

Feeders to individual equipment frames are allocated so that each subsystem of the DMS-100 Family is fed from an individual fuse on the PDC. Every battery feeder is accompanied by a return feeder, of equal current carrying capacity and routed in close proximity to it. Feeder size is chosen on a site basis to satisfy the voltage drop constraints.

Each active DMS-100 Family equipment frame has a Frame Supervisory Panel (FSP) which receives the feeder cables from the PDC fuse and distributes dc power through local fuses or circuit breakers to the shelves in the frame. The FSP also receives the ABS multiple feeder from the ABS fuse in the PDC and routes the ABS through internal fuses to the frame alarm circuits. The battery and return feeds to the DMS-100 Family frames vary in connection arrangements depending on the types and quantities of shelves provisioned.

### **Grounding systems in DMS-100 family**

The DMS-100 Family grounding system is designed to encompass a variety of installation environments and situations with a minimum of reconfiguration between any two environments. The basic principle applied to the DMS-100 switch grounding is the Single Point Ground (SPG).

Single point grounding consists of the interconnection of all backplane logic returns within a module by one or more copper busbars and straps. This connection may be made externally to each module or within the module, but it must be made at only one point.

All shelf backplanes and interconnecting busbars are electrically isolated from the module framework. The framework and logic return planes are internal to the DMS-100 switch and are not for external use.

Non-Isolated System Grounding (Non-ISG) framework and logic return arrangements are based on the same principles as systems with ISG. Specific individual installations may be customized to meet customer standards for particular situations.

### **Framework ground arrangements for non-ISG installations**

Figure 10-2 shows the framework ground and logic return arrangements for non-ISG systems. The framework ground consists of a specific configuration:

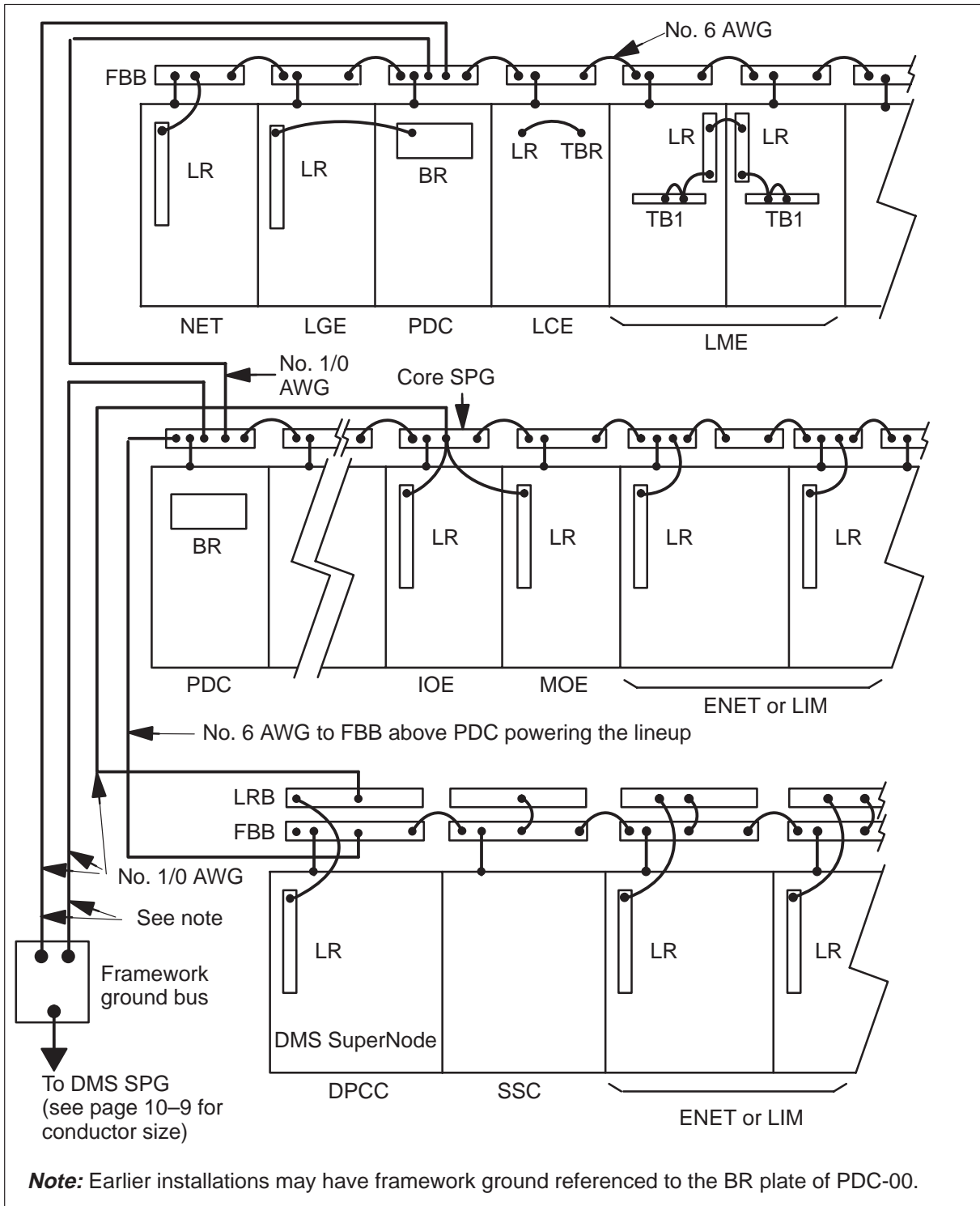
- copper busbars located above each equipment frame with a copper braid strap connection to the top, rear left hole (No. 77) of the frame
- copper braid straps linking the overhead busbars on adjacent frames in a line-up
- No. 6 AWG wire interconnecting the framework ground on line-ups that do not contain a PDC to an adjacent line-up that contains a PDC

- a copper plate or busbar (framework ground bus) which serves to interface the DMS framework ground network with the CO ground network. This bus should be located in close proximity to the PDC that is nearest to the interface with the CO ground (usually PDC00)
- No. 0 AWG interconnecting the framework ground bus in a ring formation with the individual copper busbars located above each PDC

The framework ground plane formed by the above configuration is then bonded to the CO ground network. The size of the cable used for the bond between the DMS framework ground bus and the CO ground is determined in relation to the conductive length of the actual bond. If conductive length is less than 100 ft., use No. 0 AWG. If conductive length is equal to or more than 100 ft., use 750 MCM.

Because the framework ground is an extension of the main ground reference local to each frame, it provides a convenient point for connection and referencing of the SPG from each module. The framework ground is used by all modules except the LCM. Each LCM must use its internal talk battery return for the SPG. Where the module SPG lead consists of two or more braided straps from the module logic ground busbars (for example, in the CC) the straps are physically connected to a single point on the framework ground bus. Some earlier vintage systems were customized to allow connection of MEX logic grounds to the framework ground bus located directly above each MEX frame. This arrangement is adequate for those systems and does not require reconfiguration.

**Figure 10-2**  
**Framework arrangement – non-ISG installations**



## Framework ground for ISG installations

Figure 10-3 shows the framework ground and logic return arrangements for ISG systems. This configuration provides isolation between the framework ground and logic return planes throughout the entire DMS-100 switch. The only point of connection between framework ground and logic return occur at the DMS SPG bus. This facilitates detection of grounding violations.

The logic return for the Input/Output equipment (IOE) frame must always be connected to the same logic return as the CCC or DPCC, even when located in a separate line-up. A single point connection is not mandatory for the IOE logic return.

The DTE frame logic return bus is connected to the battery return bus plate of the PDC that supplies the DTE power. Power for an LGE/LCE cluster (several LCE's served by one LGE) must be obtained from the same PDC. The frame logic return bus for the LGE equipment shall be bonded to the battery return plate of the PDC that supplies the LGE power.

The cable size for referencing the logic return equalizer and framework bonding equalizer plates to the DMS SPG bus shall be based on the conductor length:

- 0–50 ft. (0–15.3 m), use No. 2/0 AWG
- 50–150 ft. (15.3–45.7 m), use No. 350 MCM
- over 150 ft. (45.7 m), use No. 750 MCM
- if DMS SPG is on a separate floor, use 750 MCM

## Framework isolation (non-isolation installations)

In non-ISG installations, the equipment line-up that contains the CCC or DPCC module must have all framework isolated from any ground other than framework ground. This module is vital to the DMS-100 switch and framework isolation prevents possible malfunction of memory equipment due to electromagnetic fields which may be generated if an unusually large fault current was allowed to flow through the CCC or DPCC framework. As a general rule, isolation of all frames from any ground other than framework ground is recommended, and specific framework isolation is mandatory:

- all frames in any CCC or DPCC module line-up
- all frames when the point of DMS SPG reference is located on another floor
- all frames when dc power plant is shared with other systems that specify isolation
- to comply with specific customer grounding standards

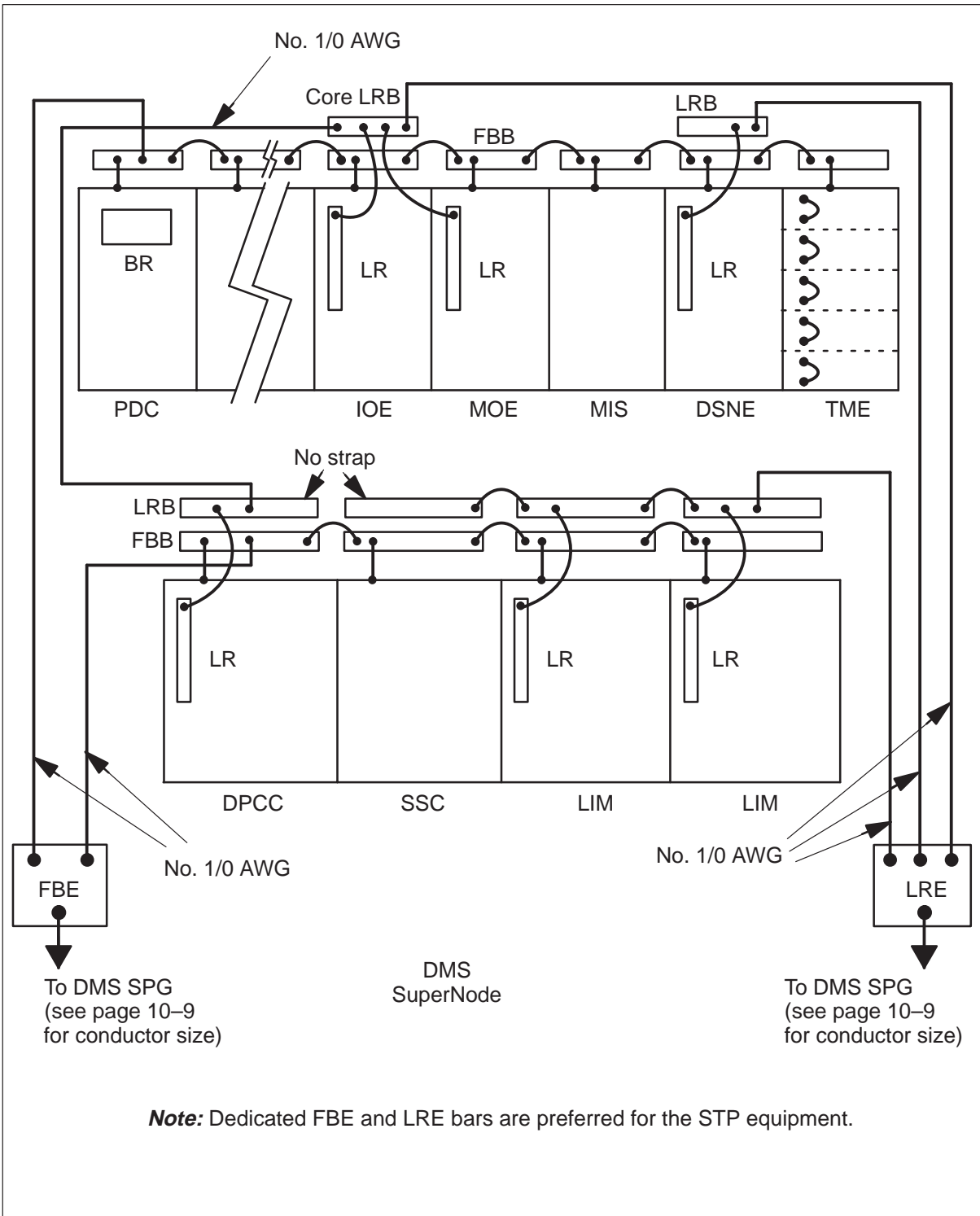
**Framework isolation (ISG installations)**

For systems with ISG, isolation of all frames from any ground other than framework is mandatory. All DMS-100 equipment has its framework and logic return isolated and connected to the DMS SPG at only one point. This isolation ensures that all other building grounds, grounding conductors, and return conductors do not contaminate the logic return or framework ground. Refer to the section on Power plant sharing for more information on frame isolation.

**Central office building ground**

It is recommended that resistance between of the central office building principal ground to earth should be as low as is practically possible (preferably 5  $\Omega$  or less) and in no case should it exceed 25  $\Omega$ . This coincides with the requirements set by the National Electrical Code (ANSI/NFPA No. 70-1978, Article 250-84) for the commercial ac ground in any building.

**Figure 10-3**  
**Framework ground and logic return – ISG systems**



### **AC grounding arrangements**

Conforming with national electrical codes, each ac distribution circuit must be provided with an additional conductor, commonly referred to as the “green wire.” A separate green-wire network is required for each ac source. Commercial ac is a source that originates (has a ground reference) external to the DMS-100 system. Each protected ac inverter constitutes a source that originates (has a ground reference) internal to the DMS-100 switch.

The main ac and telecommunication system grounds must be connected together at the building principle ground. A connection is also required between the Central Office DMS SPG ground appearance used for the DMS-100 System and the green-wire network for all commercial ac circuits used on or within the DMS-100 System. As a minimum, the size of the connection should conform to electrical code requirements for equipment grounding conductors.

The DMS-100 switch may be configured with either of two configurations of the green-wire network. Because of the ground interconnections and the circuit isolation inherent to the DMS-100 switch, the green wire network can be configured to make contact with the DMS-100 framework while retaining operational and personnel safety integrity. In this configuration, the DMS-100 switch and the green wire are isolated from incidental contact with building ground.

If an isolated green-wire network is chosen, the green wire and ac components will be isolated from the DMS-100 framework. All ac will be insulated from contact with the DMS-100 framework and incidental building ground.

Four types of equipment can be affected:

- 1 ac receptacle
- 2 conduit and junction boxes
- 3 shoulder bushings and mounting hardware
- 4 the ac safety ground wire

The green wire for each protected ac inverter is bonded to the inverter chassis and referenced to the DMS framework ground. To preserve isolation of the commercial ac green-wire network, inverters must not be used to power any equipment whose chassis may have electrical contact with the building ground.

### **Frame loads**

The secondary distribution of dc power from the PDC to individual DMS frames is described in the following paragraphs in conjunction with identified figures. All figures are based on the latest equipment and frame



arrangements. An explanation of differences between these and earlier equipment and arrangements that are still in service is provided in the text.

### **DMS SuperNode cabinet**

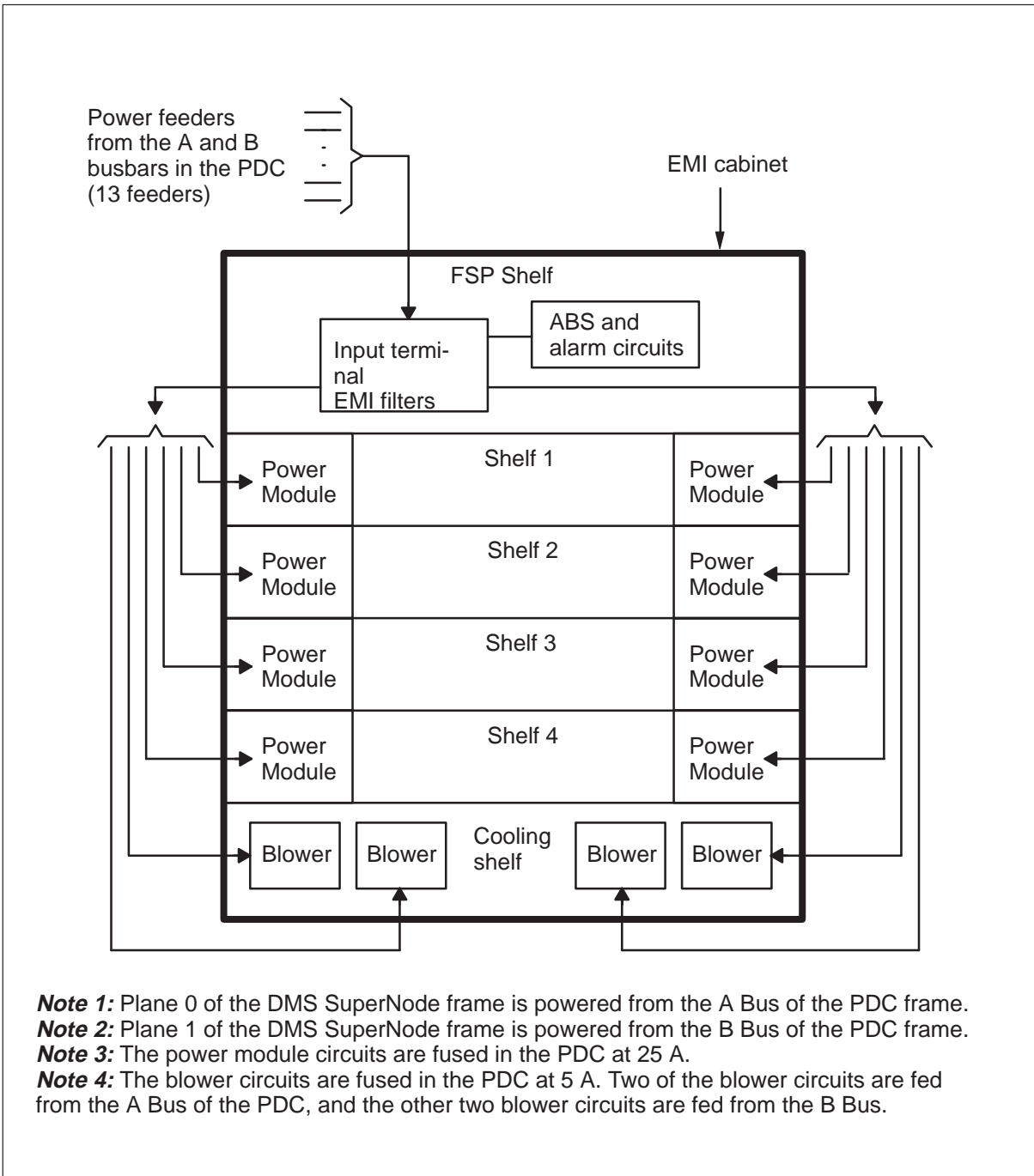
The DMS SuperNode (DPCC: NT9X01BA or NT9X01JA) cabinet (shown in Figure10–4) contains combinations of the Computing Module, Enhanced Network, Message Switch, and/or System Load Unit (SLU)) as well as the –48V cabling arrangements for a fully equipped configuration.

Power distribution for the DMS SuperNode cabinet is as follows.

- Thirteen power feeders from the PDC are required:
  - eight feeders for Power Modules, each feeder fused at 25 A in the PDC. Feeders serving components in plane 0 are obtained from the A Bus of the PDC. Feeders for the components of plane 1 are obtained from the B Bus.
  - The blowers require four power feeders, with each feeder fused at 5 A in the PDC. Two feeders are obtained from the A Bus and two feeders are from the B Bus.
  - One feeder is used for ABS. It normally originates from a single A Bus feeder fused at 10 A in the PDC.
- Each Power Module consists of two power converters: NT9X30AA (+5 V, 86 A) and either NT9X31AA (–5.2 V, 20 A) for the Computing Module and Network, or NT9X47AA (+12 V, 10 A) for the SLU.
- Each blower in the cooling shelf is powered directly from the –48V source.

Other DMS SuperNode cabinets, such the CMDC, MSDC, LIM, and ENET, are powered as described above.

**Figure 10-4**  
**DMS SuperNode cabinet power distribution**



**Central control complex and memory extension frame**

Power is distributed to each shelf in a central control complex (CCC) frame or in a memory extension (MEX) frame from a separate 20 A fuse in the

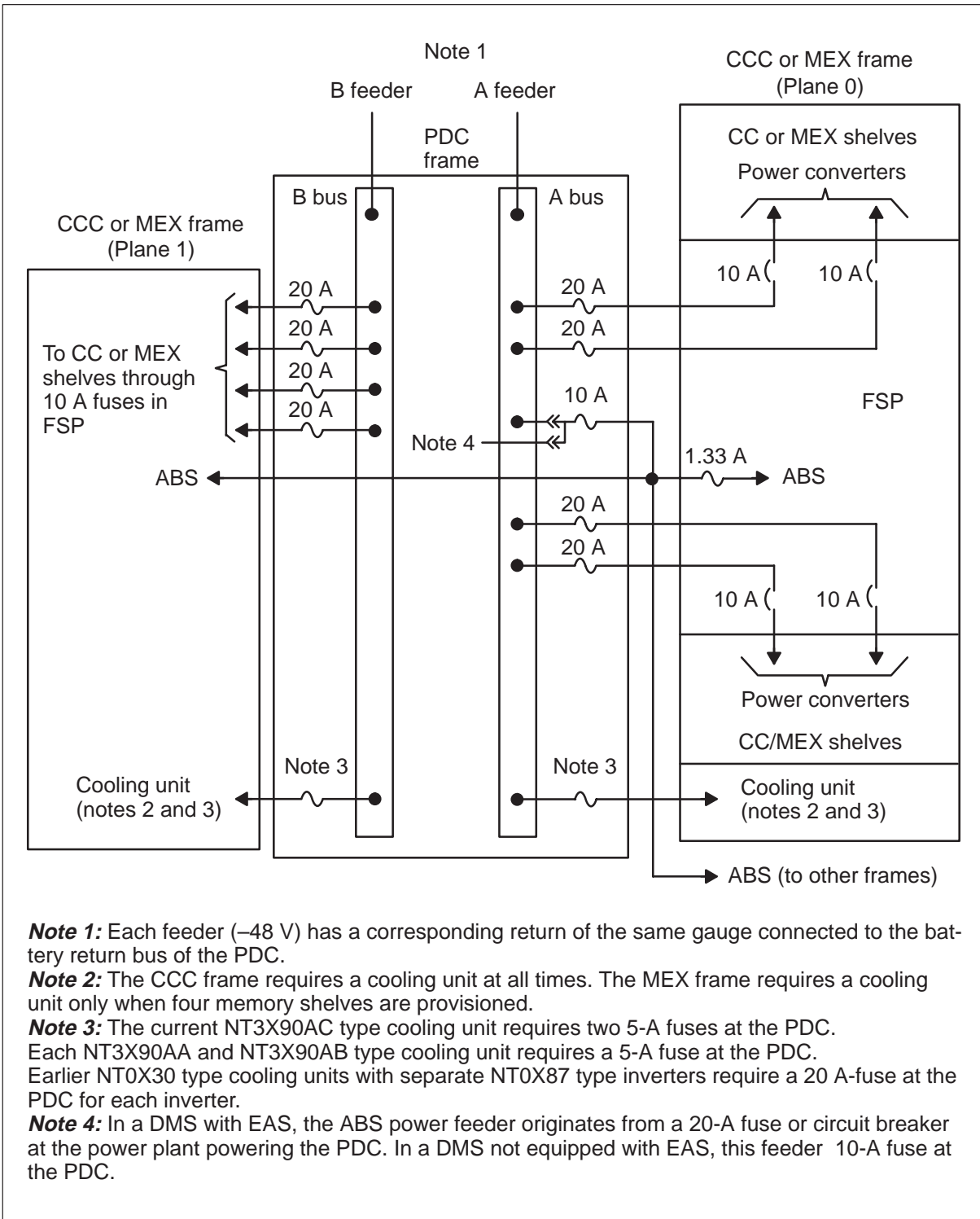
PDC (see Figure 10–5.) A cooling unit is located in the bottom shelf of each frame.

The cooling unit for present vintage systems (NT3X90AC) contains five fans, each of which requires –48V dc power. Power for the NT3X90AC type cooling unit is obtained from two 5-A fuses at the PDC.

The cooling unit in earlier vintage systems, (NT0X30) contains five fans, each of which requires 120 V, 60 Hz no-break ac power. The no-break ac supply is generated by separate dc-ac inverters. Two inverters feed a maximum of four cooling units. Each inverter is fed from a 20-A fuse at the PDC. To increase reliability, the inverters are alternately connected to the A Bus and the B Bus of the PDC.

The ABS is protected by a 10-A fuse at the FSP of the PDC. In a DMS equipped with an Enhanced Alarm System (EAS), the ABS power feeder originates from a 20-A fuse or circuit breaker at the power plant powering the PDC. In a DMS not equipped with EAS, this feeder originates at the A Bus of the PDC.

**Figure 10-5**  
**CCC and MEX frame power distribution**



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## Network module frame

There are two types of Network Module (NM) frames, types NT5X13 (NETC) and NT0X48 (NET).

### Network type NT5X13

The NT5X13 type frame is a standard frame equipped with network modules (NM) and a cooling unit. The NMs in shelf positions 51 and 65 are designated as Plane 0, and the NMs in shelf positions 18 and 45 make up Plane 1. The power distribution to the NM planes is as follows (see figure 10–6).

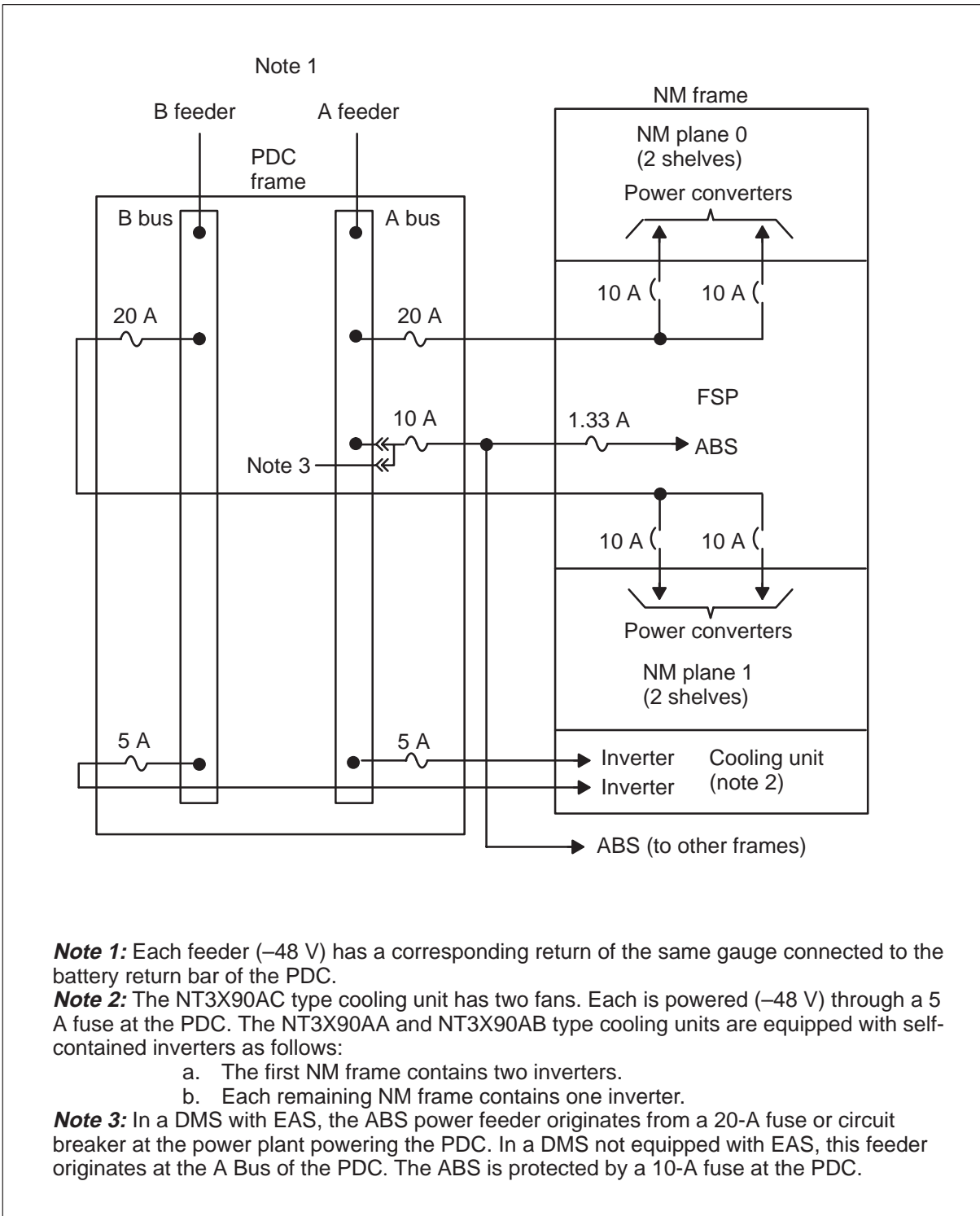
- Each NM plane is powered by one battery feeder fused in the PDC at 20 A. Plane 0 is fed from the A Bus and Plane 1 is fed from the B Bus.
- The 20-A feeder is divided at the frame FSP into two 10-A feeders, one for each shelf position.

An NT3X90 cooling unit is provided in the bottom shelf of each NM frame. The cooling units in the NM frames are configured in the same manner as in the CCC or MEX frames. The NT3X90AC cooling units use 48 V powered fans. Each unit is fed from dual 5 A fuses (A and B feeders) at the PDC.

For earlier installations using the NT3X90AA and NT3X90AB type cooling units, the cooling unit in the first NM frame is equipped with two dc-ac inverters, where one inverter is fed from the A Bus of the PDC through a 5-A fuse, and the other inverter is fed from the B Bus of the PDC through a 5-A fuse. The cooling units for the remaining NMs are equipped with one dc-ac inverter powered from a PDC bus through a 5-A fuse. Power distribution to the inverters is configured so alternate inverters are fed from the A Bus of the PDC, and the remainder are fed from the B Bus of the PDC.

The ABS is protected by a 10-A fuse at the FSP of the PDC. In a DMS equipped with EAS, the ABS power feeder originates from a 20-A fuse or circuit breaker at the power plant powering the PDC. In a DMS not equipped with EAS, this feeder originates at the A Bus of the PDC.

**Figure 10-6**  
**NT5X13 NM frame power distribution**

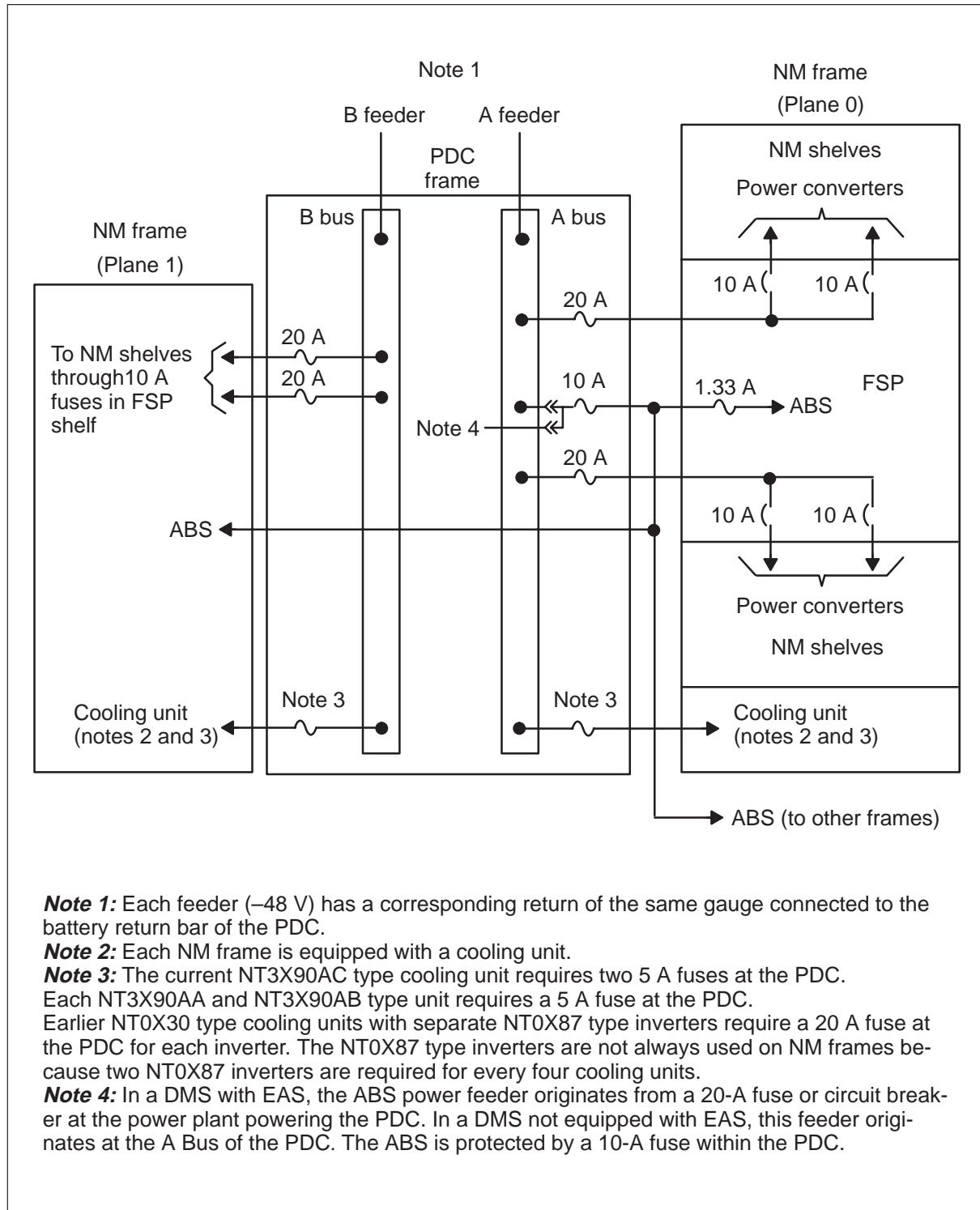


**Network type NT0X48**

A single network module (NM) is contained in an NT0X48 type NM frame, as shown in Figure 10–7. The configuration and powering of these NMs is as follows:

- Two NMs are used in parallel for reliability purposes.
- One of the parallel pair of NMs is designated plane 0 and the other is designated plane 1.
- Each NM is powered by two battery feeders as follows:
  - Each of the feeders is fused separately at 20 A in the PDC.
  - NMs in plane 0 are fed from the A Bus of the PDC.
  - NMs in plane 1 are fed from the B Bus of the PDC.
- Each of the 20 A feeders is divided into two 10-A feeders at the frame FSP.
- Each NM shelf is powered from one of the 10-A feeders at the frame FSP.
- A cooling unit is located in the bottom shelf of each NM frame. For reliability, NT3X90 and NT0X30 type cooling units in an NM frame are configured in the same manner as that for the CCC or MEX frame.
- The ABS is protected by a 10-A fuse at the FSP of the PDC. In a DMS equipped with EAS, the ABS power feeder originates from a 20-A fuse or circuit breaker at the power plant powering the PDC. In a DMS not equipped with EAS, this feeder originates at the A Bus of the PDC.

**Figure 10-7**  
**NT0X48 NM frame power distribution**





### Trunk module equipment frame

The trunk module equipment (TME) frame may contain only trunk module (TM) shelves or a combination of TM and digital carrier module (DCM), maintenance trunk module (MTM), or office alarm unit (OAU) shelves as shown in Figure 10–8. To avoid possible overload of the power supply, use the following combinations:

- five TM shelves in positions 65, 51, 32, 18, and 04 (position 04 is used last)
- four TM shelves and one MTM shelf
- three TM or MTM shelves with another MTM shelf in position 51 and one alarm cross-connect Unit (AXU) shelf in position 65
- two TM or MTM shelves and one DCM shelf, with another MTM shelf in position 51 and one AXU shelf in position 65

Power-feed arrangements for these shelf combinations are designed during job engineering, in conjunction with GS0X82. Depending on the type of interface, the following significant factors must be considered in power-feed arrangements.

### Analog trunk interface

The following applies for analog trunks:

- TME frames are fed through 20-A fuses at the PDC.
- Power feeds are equally distributed across the A Bus and the B Bus to balance the load.
- The 20-A feed is divided into four 10-A feeds at the FSP of the TME frame.
- Each TME shelf is powered from one of the 10-A feeders at the FSP of the TME (earlier installations use 5-A fuses).
- When required, an additional 5-A feed for an AXU shelf and its associated MTM is provided.
- When the MTM in the TME is not associated with an AXU, an additional 20-A feed is provided for the TME. This feed powers the MTM through the 10-A fuse in the FSP assigned to the top shelf.
- When TM and DCM shelves are mixed, all TM shelves are powered from the same feeder, and DCM shelves are fed alternately from the A and B Buses.

### Maintenance trunk module and office alarm unit

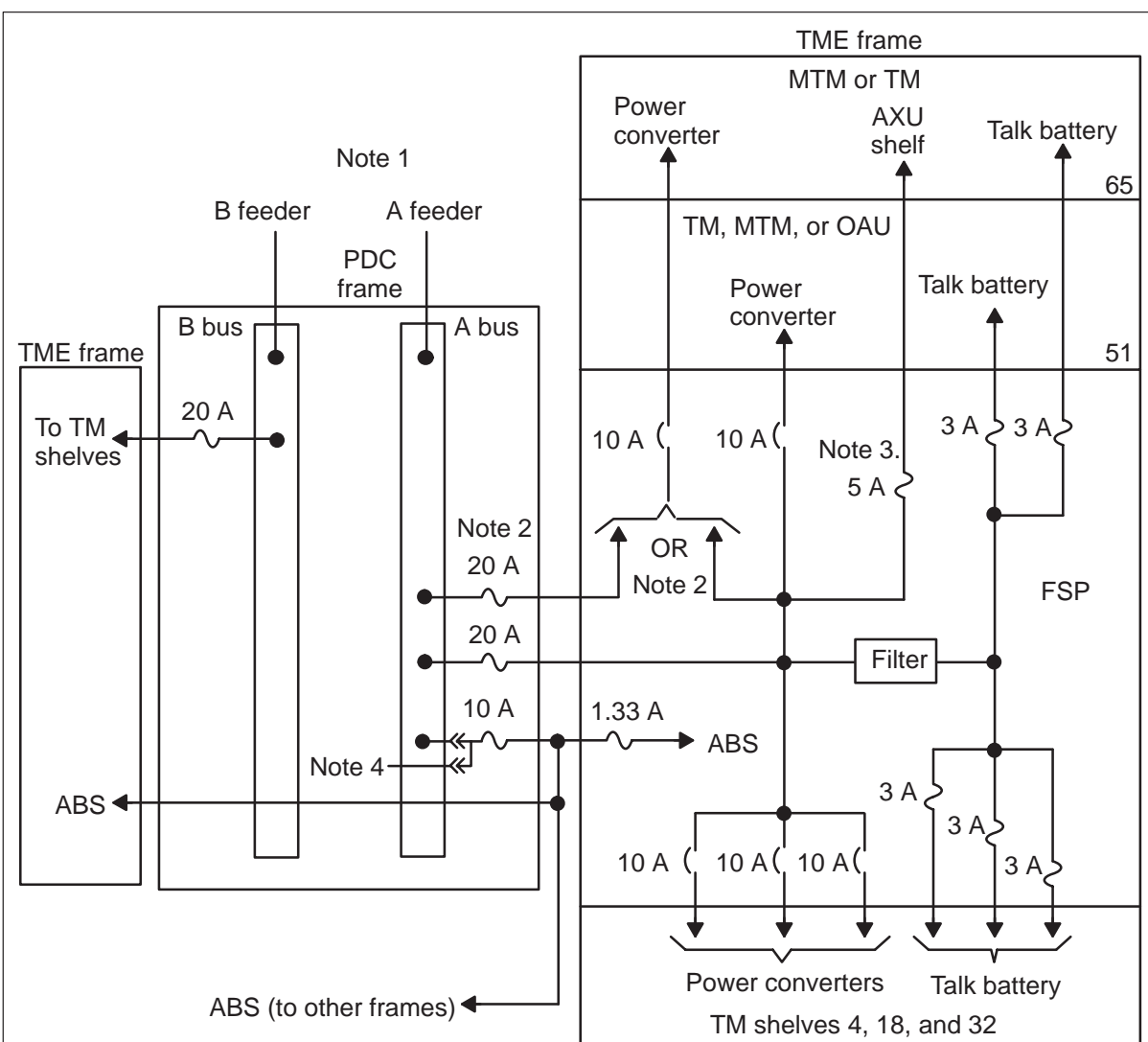
When the AXU shelf and its associated primary alarm MTM are mounted in the TME frame positions 65 and 51, the secondary alarm MTM must be mounted in position 65 on another TME frame and powered from a different feed than the primary alarm MTM. The AXU, or OAU, is fed from a 5-A fuse at the FSP. When the MTM is not used for alarms, the location of the MTM in the TME frame is not restricted.

In a DMS-100F system equipped with the EAS, the 20-A power feeders associated with the primary alarm MTM (OAU) and secondary alarm MTM originate directly from the power plant powering the PDCs. When a TME requires two power feeders, it can be powered either (a) by two feeders from the PDC, or (b) by one feeder from the PDC and another feeder from the power plant.

**E&M trunk interface**

For E&M circuits, the battery return of the PDC is used as a separate logic return, and a talk battery supply is provided from the PDC battery feed through a filter at the FSP. The talk battery supply is then distributed to each shelf through a 3-A fuse at the FSP.

**Figure 10-8**  
TME frame power distribution



**Note 1:** Each feeder (-48 V) has a corresponding return of the same gauge connected to the battery return bar of the PDC.

**Note 2:** For an OAU application, the 10-A circuit breaker assigned to the the top shelf is fed through a separate 20-A fuse in the PDC. For an OAU application with EAS, the -48V feeders and their returns for the primary and secondary alarm MTMs originate directly from the power plant powering the PDC. The MTM in the top shelf is a secondary alarm, and the MTM in position 51 is a primary alarm.

**Note 3:** For an OAU application, the 5-A breaker is provided for the AXU shelf associated with the MTM in shelf position 51.

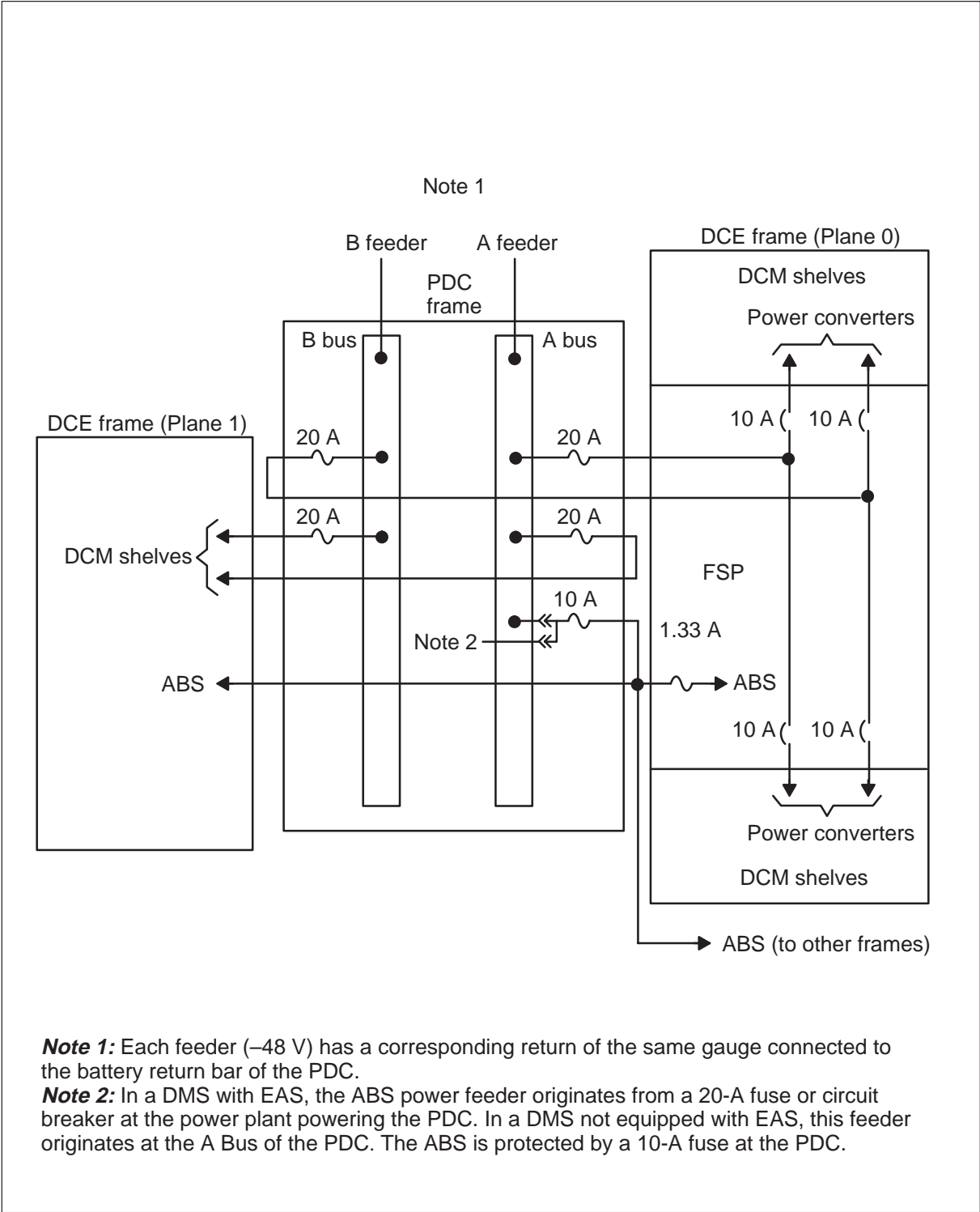
**Note 4:** In a DMS with EAS, the ABS power feeder originates from a 20-A fuse or circuit breaker at the power plant powering the PDC. In a DMS not equipped with EAS, this feeder originates at the A Bus of the PDC. The ABS is protected by a 10-A fuse within the PDC.

### **Digital carrier equipment frame**

When all shelves in a frame contain digital carrier modules (DCMs), the frame is called a digital carrier equipment (DCE) frame, as shown in Figure 10–9. Factors to be considered when arranging the power feed for a DCE are as follows.

- The DCE is powered from a 20-A fuse from the A Bus and a 20-A fuse from the B Bus in the PDC.
- The 20-A fused supplies are subdivided into 10-A fused supplies at the frame FSP of the DCE.
- The DCM shelves are alternately powered from the A Bus and B Bus through 10-A fuses. (Earlier installations use 5-A fuses for the DCM shelf feeds.)
- The DCE is equipped with a maximum of four DCM shelves.
- DCM loads are balanced as evenly as possible between the A and B Buses.
- The ABS is protected by a 10-A fuse at the FSP of the PDC. In a DMS equipped with EAS, the ABS power feeder originates from a 20-A fuse or circuit breaker at the power plant powering the PDC. In a DMS not equipped with EAS, this feeder originates at the A Bus of the PDC.

Figure 10-9  
DCE frame power distribution

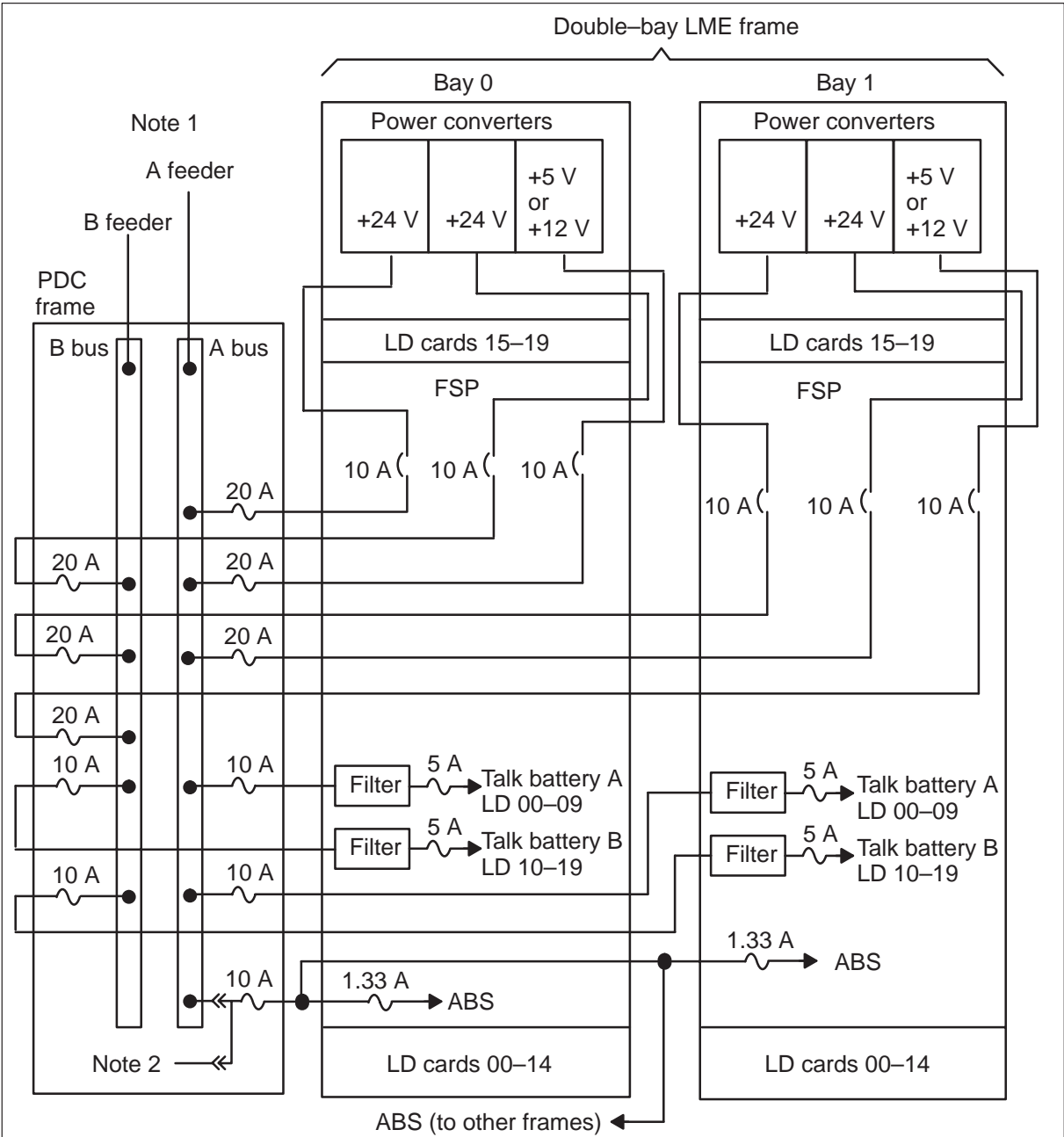


**Line module equipment frame**

The line module equipment (LME) frame is a double-bay frame. Each bay contains one line module (LM) with 640 lines and its associated line module controller (LMC) as shown in Figure 10–10. When one LMC fails, the other LMC in the LME controls both LMs. Each LMC contains two –48V power converters that provide +24 V and one converter that provides +5 V and +12 V for the LM and its associated equipment. Factors that must be considered when designing power feeds to LMs are:

- LM loads are fed alternately from the A Bus and B Bus of the PDC. This arrangement balances the load and provides reliability in the event of a power failure on the A or B Bus.
- One of the +24V converters in each bay is powered from a 20-A fuse of the A Bus. The other is powered from a 20-A fuse of the B Bus.
- The +5V and +12V converter in the LCM Bay 0 is powered from a 20-A fuse of the A Bus. The equivalent converter in Bay 1 is powered from a 20-A fuse of the B Bus.
- Talk battery filters in the bay FSPs are fed from 10-A fuses as follows.
  - The filter assigned to Line Drawers (LDs) 00 to 09 is fed from the A Bus.
  - The filter assigned to LD 10 to 19 is fed from the B Bus.
- The ABS is protected by a 10-A fuse at the FSP of the PDC. In a DMS equipped with EAS, the ABS power feeder originates from a 20-A fuse or circuit breaker at the power plant powering the PDC. In a DMS not equipped with EAS, this feeder originates at the A Bus of the PDC.

Figure 10-10  
LME frame power distribution



**Note 1:** Each feeder (-48 V) has a corresponding return of the same gauge connected to the battery return bar of the PDC.

**Note 2:** In a DMS with EAS, the ABS power feeder originates from a 20-A fuse or circuit breaker at the power plant powering the PDC. In a DMS not equipped with EAS, this feeder originates at the A Bus of the PDC. The ABS is protected by a 10-A fuse at the PDC.

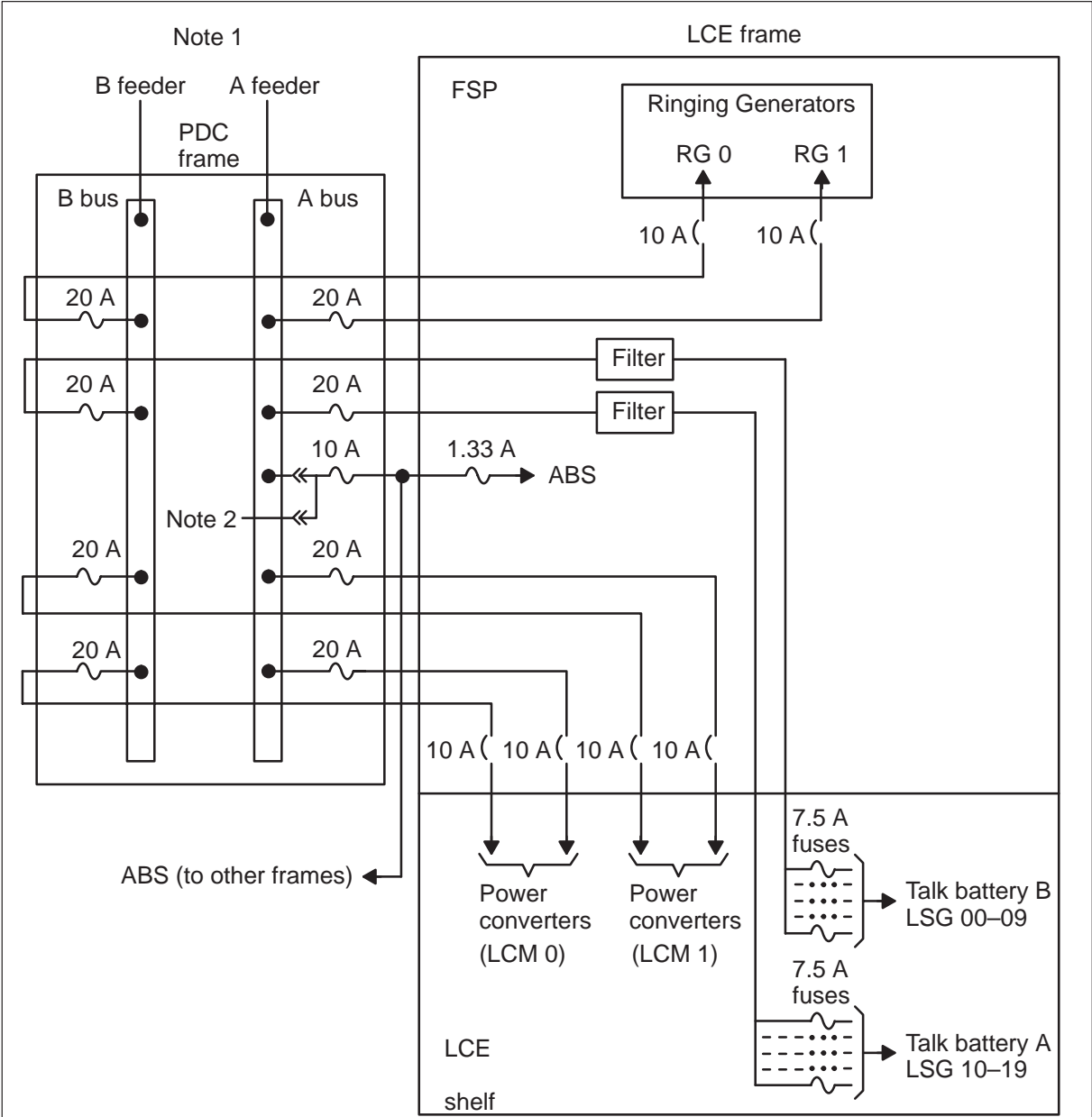
### Line concentrating equipment frame

Each line concentrating equipment (LCE) frame contains two line concentrating modules (LCMs), as shown in Figure 10–11. Factors that must be considered when designing power-feeding arrangements for the LCMs are as follows.

- There are two power feeds from the PDC, a 20 A fused feed from the A Bus and another from the B Bus.
- Each feed is connected to a 10 A circuit breaker at the LCE and distributed to the LCMs.
- The FSP of the LCE powers the following equipment:
  - Ringing generator RG 0 is fed from the A Bus and generator RG 1 is fed from the B Bus. Each feed is protected by a 20 A fuse at the PDC and a 10-A circuit breaker at the FSP.
  - Each talk battery supply is protected by a 20 A fuse at the PDC. The talk battery circuit for each line drawer is protected by a 7.5 A fuse at the FSP of the line drawer. One of the talk battery supplies is fed from the A Bus; the other is fed from the B Bus.
- The ABS is protected by a 10 A fuse at the FSP of the PDC. In a DMS equipped with EAS, the ABS power feeder originates from a 20 A fuse or circuit breaker at the power plant powering the PDC. In a DMS not equipped with EAS, this feeder originates at the A Bus of the PDC



**Figure 10-11**  
**LCE frame power distribution**



**Note 1:** Each feeder (-48 V) has a corresponding return of the same gauge connected to the battery return bar of the PDC.

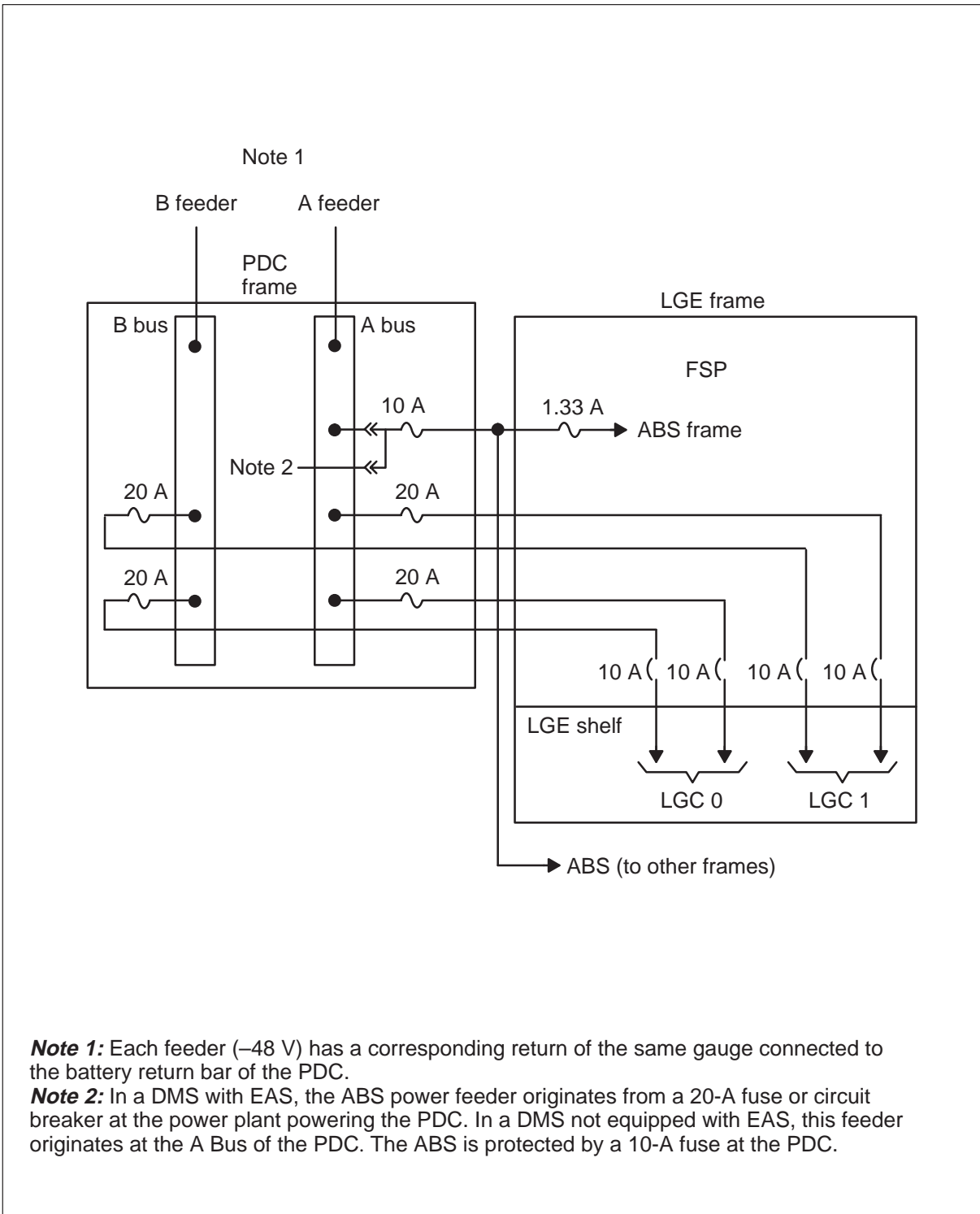
**Note 2:** In a DMS with EAS, the ABS power feeder originates from a 20-A fuse or circuit breaker at the power plant powering the PDC. In a DMS not equipped with EAS, this feeder originates at the A Bus of the PDC. The ABS is protected by a 10-A fuse at the PDC.

### **Line group equipment frame**

The line group equipment (LGE) frame contains two line group controllers (LGCs) as shown in Figure 10–12. Factors that must be considered when designing power-feed arrangements for LGEs are as follows:

- One LGC is powered by the A Bus and the other by the B Bus.
- Each of the secondary feeds is fused at 20 A in the PDC and protected by a 10 A circuit breaker in the FSP before distribution to an LGC.
- For ISG, the LGE and its associated LCMs must be powered from the same PDC.
- The ABS is protected by a 10 A fuse at the FSP of the PDC. In a DMS equipped with EAS, the ABS power feeder originates from a 20 A fuse or circuit breaker at the power plant powering the PDC. In a DMS not equipped with EAS, this feeder originates at the A Bus of the PDC.

**Figure 10-12**  
**LGE frame power distribution**



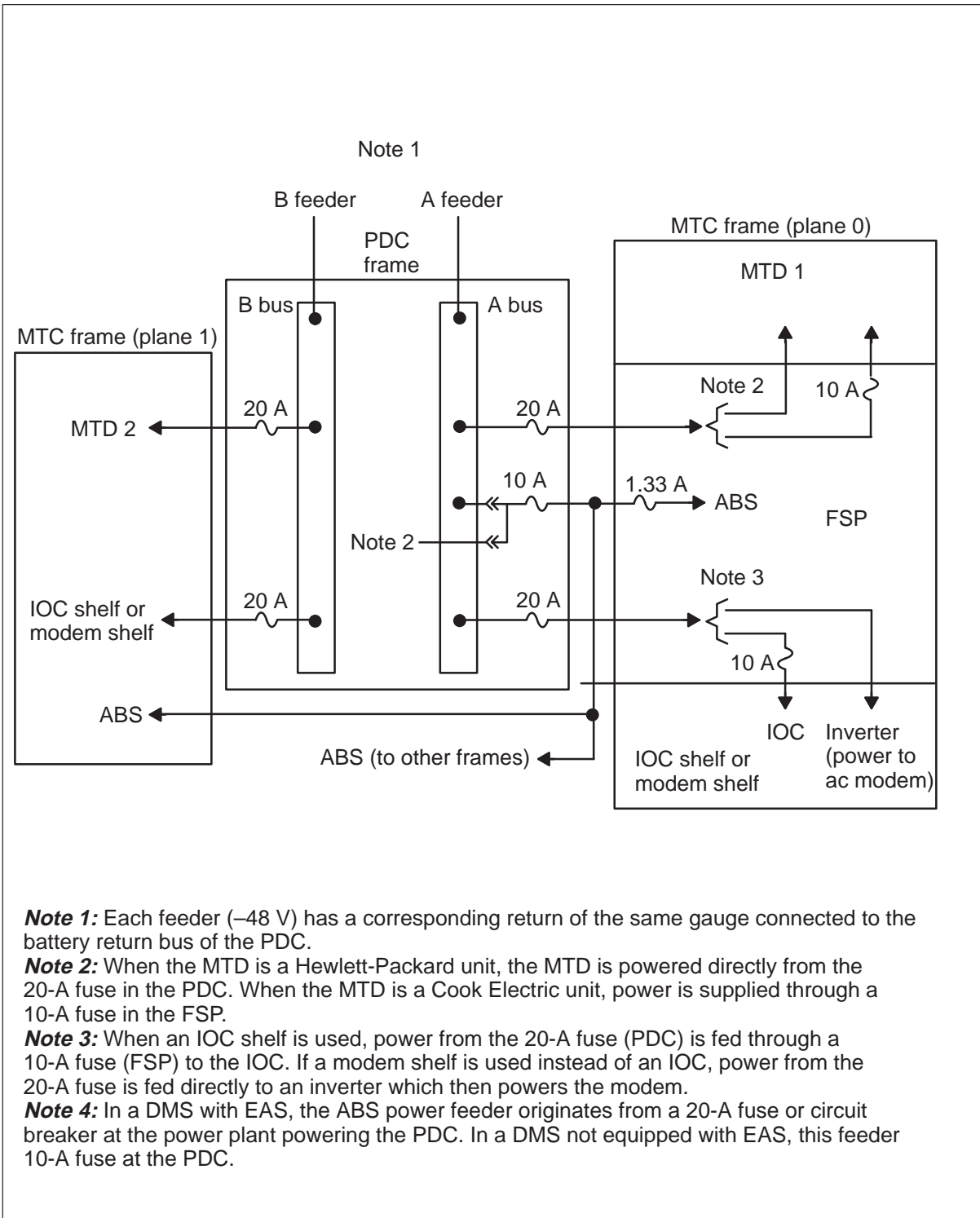
### **Magnetic tape center frame**

The magnetic tape center (MTC) frame contains a magnetic tape drive (MTD) and an input/output controller (IOC) or modem shelf. The power-feed arrangement of these units is shown in Figure 10-13.

Factors that must be considered when designing a power feeding arrangement for an MTC frame are as follows:

- The MTD is powered from a 20 A fuse on the PDC.
- The MTD is powered from the same bus that powers its associated IOC.
- The IOC or modem shelf is powered from a 20 A fuse on the PDC.
- The 20-A feed to an IOC is fused at 10 A in the FSP before it is routed to the IOC.
- If a modem shelf is used instead of an IOC, power from the 20 A fuse is fed directly to an inverter which then powers the modem.
- The ABS is protected by a 10 A fuse at the FSP of the PDC. In a DMS equipped with EAS, the ABS power feeder originates from a 20 A fuse or circuit breaker at the power plant powering the PDC. In a DMS not equipped with EAS, this feeder originates at the A Bus of the PDC.

**Figure 10-13**  
MTC frame power distribution



### **Remote line facility**

Some line modules may be located remotely from the DMS. Remote line modules, such as the remote line module (RLM), remote line concentrating module (RLCM), and remote switching center (RSC), are subject to the same power distribution rules that are specified for the DMS, except that large remotes may have their own PDC, and a PDC can be shared between collocated remotes, provided that all remotes are in the same IBN.

### **Miscellaneous equipment frame**

The miscellaneous equipment (MIS) frame can be configured as a standard MIS or MOE, a dedicated MIS, IMAP MIS, or MAP MIS. The MIS frame contains a variety of equipment such as the following items:

- a metallic test access circuit
- a recorded announcement machine
- modems
- OEM equipment
- inverters

Power-feeding arrangements for MIS frames vary in the job engineering process because of the wide variation of shelf complements and office configurations.

### **Clustering**

To ensure optimal logic referencing of their functional circuits, some hardware modules must be clustered as follows.

- they must be powered from the same PDC
- their vertical logic return bars must be bonded to the BR plate of the common PDC with a No. 6 AWG

The following equipment entities require clustering:

- LCE frame with associated LGE, LTE, DTE, RCE, RME, RCME, SME, ILGE, ILTE, IDTE, and SMS frames
- ILCE frame with associated ILGE, ILTE, IDTE, IAE, and STE frames
- ISLM frame with associated IAE, and STE frames
- MS6E frame with associated DME frames
- MS7E frame with associated ST7E frames

Exception: For DMS-200 and DMS-300 applications, the DTE/IDTE logic return bus shall be: (a) bonded to the lineup logic return cable that connects to the LRE splice plate, or (b) connected to the LRB busbar assembly.

For all other applications, the DTE/IDTE logic return bus shall be connected to the battery return plate of the PDC that supplies power to the DTE/IDTE.

**Integrated maintenance and administration position (IMAP)**

The integrated maintenance and administration position (IMAP) is a version of the the MAP configured for installation in a CBN rather than in a DMS IBN. Consequently, direct metallic communication or power links between DMS-100F and IMAP are not permitted. The IMAP and its associated equipment can be powered from any suitable source of ac power. To ensure availability of the IMAP under adverse conditions, the use of a UPS or an inverter is recommended.

If the inverter incorporates facilities for transfer to commercial ac, the transfer time generally should not exceed 15 ms. Equipment such as a smart modem constitutes protected load and must be powered accordingly.

As an alternative to customer-provided power, a 500-W inverter is available for installation in a collocated IMAP MIS frame. In all US installations, fixed wiring shall be used in accordance with NEC requirements for power distribution from the ac power source to IMAP outlets. Cord and plug distribution can be used in accordance with CEC requirements in Canadian installations. Distribution facilities, including conduit and PAC poles, should not simultaneously carry power from different sources, such as commercial ac and protected ac.

Receptacles can be installed as floor outlets, wall outlets, or PAC pole outlets. Isolated ground (orange) outlets can be used in non-BOC installations only, provided that they comply with NEC Article 250–74 or CEC Section 10–906, whichever is applicable. Receptacles providing protected ac shall be marked accordingly.

The use of extension cords to connect OEM equipment to the IMAP receptacles is not recommended.

**Maintenance and administration position (MAP)**

The basic IMAP equipment subsystems can be configured as part of an IBN, effectively becoming a MAP configuration.

When the MAP is installed in an IBN, direct metallic communication and power links are not permitted. All ac power facilities required by the MAP must be installed in accordance with the distribution and grounding rules established for that IBN.

An earlier version of the MAP is installed as part of the DMS IBN.

- With the ISG version of DMS-100F, direct metallic communication links between the MAP and DMS are not permitted. All ac power is produced by NTOX87 inverters installed in a MIS frame and distributed by way of plugs and cords to PAC poles.

- With the non-ISG version of DMS-100F, direct metallic communication links (such as EIA RS-232, current loops, or modem-to-modem links) are used.

### **Power distribution center (PDC)**

The power distribution center provides interface between the -48V dc (nominal) office batteries and the individual loads within the DMS-100 Family System. In Figure 10-1, the PDCs are shown as being located at the end of the frame lineup, but may be located at any other position, consistent with the voltage drop limitations. Depending on PDC distribution capability and the current drain which is engineered by Nortel Networks on a per-job basis, one PDC can be shared by multiple (normally a maximum of three) lineups. Cross-aisle power cable runs, when necessary, are limited to one cable tray.

### **PDC frame description**

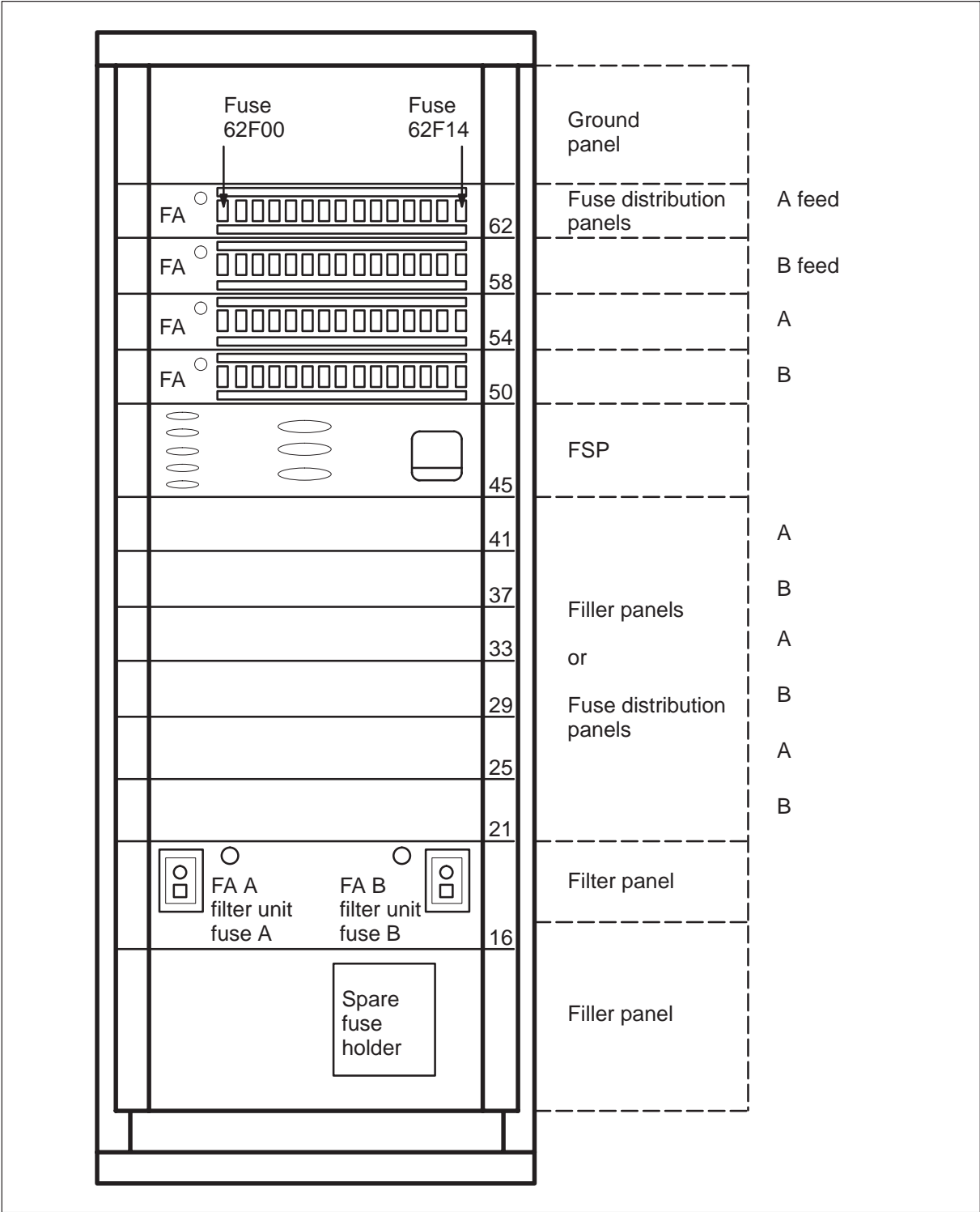
Figure 10-14 shows a front view of a typical PDC Frame. A fully-equipped PDC frame has five components:

- 1 ten fuse panels for dc feeds to DMS-100 Family shelves and frames
- 2 a Frame Supervisory Panel (FSP) containing alarm circuitry
- 3 a filter panel, containing noise and transient suppression components
- 4 a ground panel containing the common battery return busbar
- 5 a filler panel with holders for spare fuses

Positions of panels on the PDC frame are identified by the level of the holes in the vertical supports of the frames.



**Figure 10-14**  
**Typical PDC frame configuration (front view)**



### **DC-DC converters**

The DMS-100 Family uses most of the input power at voltages other than -48 V dc. The voltages are derived from the nominal -48 V dc by dc-dc converters in the shelf or frame in which they are used. Although these voltages are dictated by the technology used, most of them are standardized to  $\pm 5$  V,  $\pm 12$  V,  $\pm 15$  V, or +24 V.

#### **Converter features**

Several different types of dc-dc converters are required to meet the voltage and current requirements of the DMS-100 switch. All of the dc-dc converters used in the DMS-100 switch have three features:

- 1 Isolation between battery return and logic ground.
- 2 Regulation of the output voltages against changes in load and/or battery voltage, within specified limits.
- 3 Protection against overload of the outputs.

### **AC power distribution**

#### **Protected AC sources**

The only protected 60 Hz 120 V ac power required in the DMS-100 Family System is for the Maintenance and Administration Position (MAP) VDU, Technical Assistance (TAS) data sets, analog recorded announcement equipment and cooling units. The protected ac source is derived from -48 V dc through separate 500 VA inverters. Inverter power may be provided for a MAP associated printer, TTY and other input/output devices at the request of the operating company.

### **Outside plant module power requirements**

The OPM cabinet electrical system consists of power distribution equipment, two rectifiers, and batteries. The OPM uses 30 A, single phase, 220 V, 60 Hz, commercial ac supply. Backup batteries may be provisioned to provide power during ac failure conditions. The batteries may be sized (200 AH) to provide the power required to maintain OPM operation for up to 8 hr. at a traffic level of approximately 5 ccs/line.

An emergency generator plug is provided for attachment of a 220 V ac generator to supply power during extended commercial ac failure. Any emergency generator attached to the OPM must be capable of supplying an average power of 1500 watts with peaks to 4000 W.

The cabinet ground bar, located in the end access compartment, is to be connected to a ground rod provided by the user in accordance with local utility codes. Maximum recommended ground to earth resistance is 25  $\Omega$ . There are eight terminations on the ground bar. These consist of the protector block ground connection, electronic equipment ground, the

incoming ac main ground, a connection to the ground rod and finally, four incoming outside plant cable sheath grounds.

### **Lighting and AC receptacles**

The distribution of commercial 115 V, 60 Hz power for normal lighting and convenience outlets throughout the DMS-100 Family office is through operating-company furnished, wall-mounted ac distribution centers containing circuit breakers. The PDC is not involved in ac power distribution.

Two types of circuits are provided for lighting. One is used for normal lighting and the other for low-intensity lighting and convenience outlets.

#### **Normal lighting**

(Where center aisle lighting, or frame mounted lighting fixtures are available.)

Frame mounted lighting for the DMS-100 Family equipment area consists of fluorescent tubes mounted in lighting fixtures at the top front of every DMS-100 Family bay. Rear bay lighting using fixtures at the top rear of the bay can be provided on an optional basis. All bay lighting fixtures are wired to commercial 115 V, 60 Hz circuits and are directly controlled by switches mounted in lineup end guards. The illumination level in the maintenance aisles of the equipment area is 24–30 footcandles maintained at the equipment floor level.

Center aisle lighting consists of 2 ft., 4 ft. or 8 ft. lighting fixtures mounted in the front and rear center of the aisles from either frame mounted cantilever support or auxiliary framing.

The lighting in the maintenance area where the person-machine interface devices (for example, VDUs or TTYs) are located will normally be standard overhead lighting as arranged by the operating company. This lighting does not form part of the DMS-100 Family.

#### **Low-intensity lighting**

Low-intensity lighting fixtures are wired to an essential (operating-company supplied) 115 V, 60 Hz supply so that minimum lighting is available if commercial power fails. (The transfer circuitry is operating-company supplied.) Low-intensity lighting consists of one front aisle light fixture and, when provided as an option, one rear aisle light fixture for each lineup. Normal lighting fixtures are used for the low-intensity lighting. Low-intensity lighting is directly controlled from a wall-mounted switch at the office entrance.

### **AC receptacle**

A duplex receptacle will be mounted in the end guards of each completed lineup. A duplex receptacle may also be mounted on every third frame, on front and rear, of a lineup on an optional basis.

## **Power and ground interfacing**

### **Dedicated power plant**

When the dc power plant is dedicated to DMS-100 use, the preferred arrangement of power and grounding is shown in Figure 10-15. This arrangement has three features:

- 1 Ground referencing of the power plant battery is obtained using PDC 00.
- 2 System frame grounding conforms to the arrangement described in Framework ground arrangements for non-ISG installations.
- 3 The vertical separation between the DMS-100 switch and the power plant should be minimized but is not limited to a specific distance.



Shared power plant has the three applications:

- 1 isolated return (Figure 10-16)
- 2 non-isolated battery return (Figure 10-17)
- 3 ground window/single point ground (Figure 10-18)

### **Isolated ground planes**

Systems that use an isolated system ground plane are characterized by the presence of a ground window. The requirements for interfacing these systems with the CO ground network are usually more stringent than those of the DMS-100 switch. Therefore, the DMS-100 switch must conform to the rules established for the co-located system. Internal grounding of the DMS-100 switch will not require any modification. However, it is probable that the co-located system rules will require isolation of all DMS-100 frames from contact with incidental grounds and also impose restrictions on the distance of the DMS-100 frames from the “ground window.” Figure 10-16 shows a typical arrangement.

### **Integrated ground planes**

With integrated ground plane formats, no deliberate attempt is made to separate system circuit grounds, battery returns or framework from multiple contact with the CO ground network. DC power plants serving systems with this type of ground plane do not have the power plant battery isolated from local CO ground. When sharing power with such systems, the DMS-100 system should follow the arrangement shown in Figure 10-18:

- The framework ground reference cable should be bonded at the same point on the CO ground network as the power plant battery return.
- The vertical separation between frames and the framework ground/battery return bond on the CO ground must not exceed one floor.
- A physical separation of 7 ft. (2 m) should be allowed between all other equipment not referenced to the same point on the CO ground as the DMS-100 framework. All frames should be isolated from contact with incidental grounds.

The DMS-100 frame grounding conforms to the arrangement described in Framework ground arrangements for non-ISG installations.

**Figure 10-16**  
**Specific isolated battery return configuration shown here with MDG/ground window arrangement**

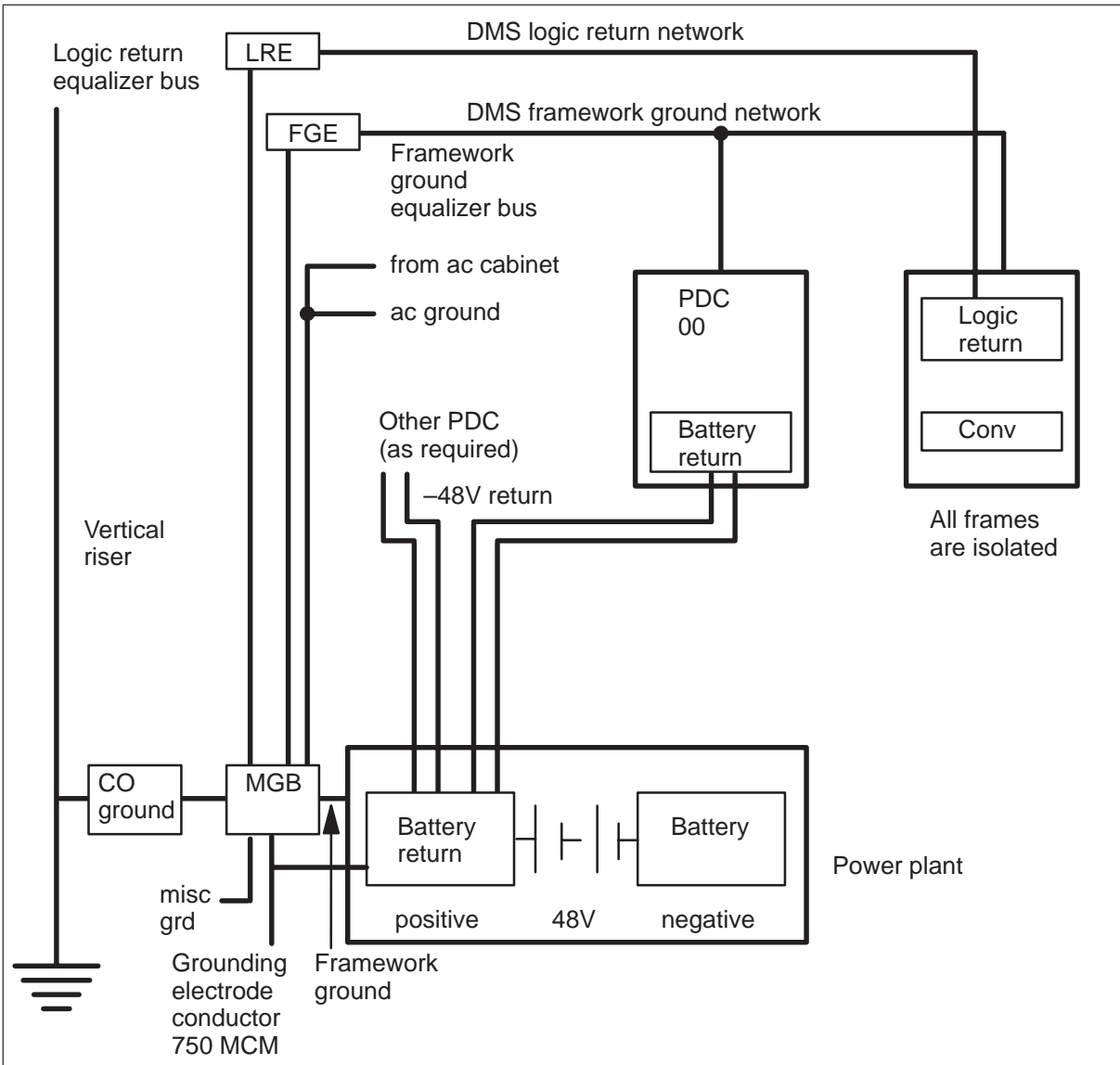


Figure 10-17  
Configuration with non-isolated battery return

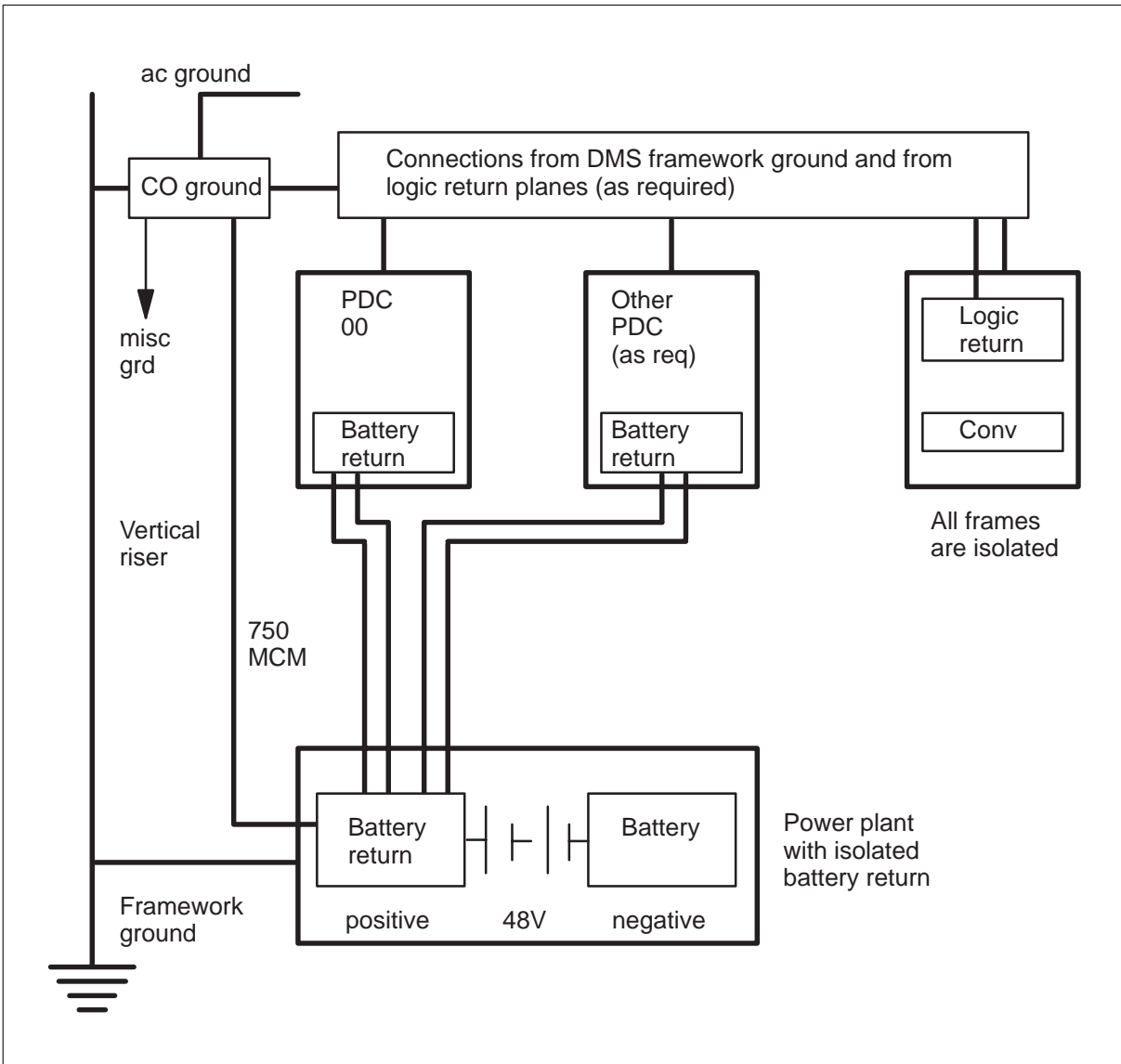
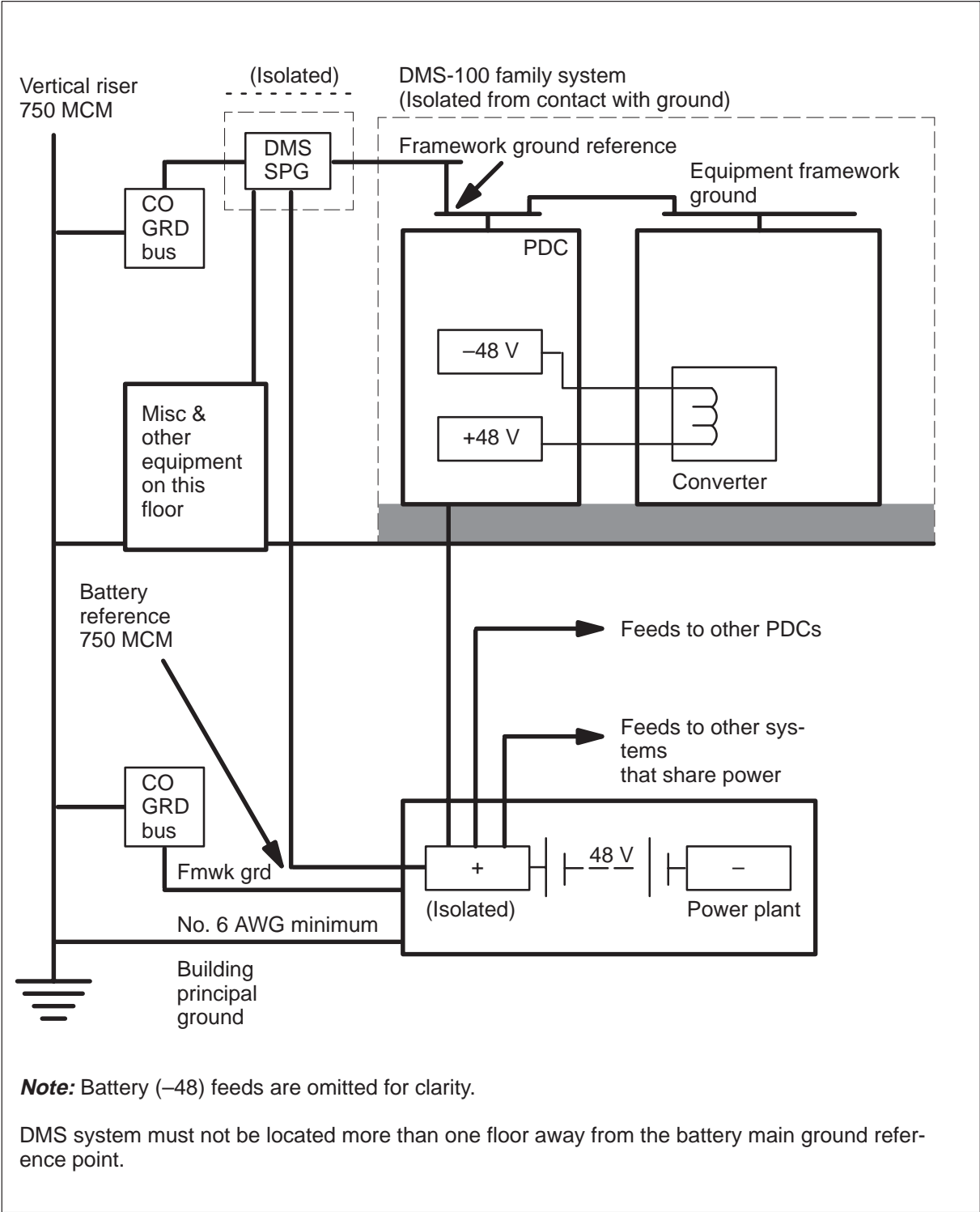




Figure 10-18 Shared power plant



## Electrical code compliance

Nortel Networks designs and manufactures the DMS SuperNode, DMS-100 Family switching systems and related products to the highest quality standards within the telecommunications industry. Nortel Networks complies with the latest requirements of the National Electrical Code (NEC), and the Canadian Electrical Code (CEC) for North American (USA and Canada).

### Code reference documents

The following are code reference documents:

- ANSI TL313—1991: *Electrical Protection for Telecommunications Central Offices and Similar Type Facilities*
- ANSI/NFPA No. 70: *National Electrical Code—1990*
- ANSI/NFPA No. 75: *Protection of Electronic Computer/Data Processing Equipment—1989*
- ANSI/NFPA No.78: *Lightning Protection Code—1989GX)X40:*
- CSA C22.1: *Canadian Electrical Code—1990*
  
- *Rural Electrification Administration (REA) Telecommunications Engineering and Construction Manual, Section 810: Electrical Protection of Electronic Analog and Digital Central Office Equipment*
  
- TR-EOP-000295: *Bell Communications Research Technical Reference, Isolated Ground Planes; Definition and Application to Telephone Central Offices*
  
- GSOX40: *Frame Supervisory Panel (Power Distribution Center—Fused)*
- GSOX82: *Frame Supervisory Panel (Peripheral Frames)*
- ISOX00: *Isolated Systems Grounding Topology*
- ISOX07ZA: *Digital Multiplex System AC Grounding*
- Federal Information Processing Standard (FIPS) Pub 94: *Guideline on Electrical Power for ADP Installations*

### United Laboratories Inc. (UL)

Nortel Networks has requested and received approvals for DMS SuperNode, DMS-100 Family switching systems and related telecommunication products. The following is only a partial 1991 and 1992 listing:

DMS SuperNode, DMS-100 F, DMS-Core, Enhanced Network, Fibertized Link interface shelf, ISDN telephone, Optical Network interface, Outside plant modules, Signal Transfer Point/Link Interface Modules, Low speed

network interface, Display phones, Cabinet telephones, Accessory lighting systems, telephone system and modules.

### **OSHA regulation compliance**

OSHA Regulation Section 1910.7 covers the requirements for a nationally recognized testing laboratory (NRTL). For the DMS-100 Family and the DMS SuperNode, Nortel Networks uses the Underwriters Laboratories Inc. for the testing and listing of NT products. Nortel Networks Corporate Policy 400.06 states in part, "all telecommunication products powered from electrical mains shall be designed to conform to applicable electrical and fire safety standards . . ." The Underwriters Laboratories in the USA and the Canadian Standards Association (CSA) are the authorities responsible for Listing or certification of equipment to their respective national standards. The National Electrical Code (NEC) states that all products connected to the Telephone Network shall be Listed by a NRTL. Between UL and NEC regulations, all of the Nortel Networks products are covered under OSHA Regulations.

OSHA Regulations Section 1910.268 covers telecommunications products, but the main concern is for the employees who climb telephone poles and work in manholes. Since Nortel Networks DMS equipment does not apply to those areas, we can ignore this particular section of OSHA requirements.

OSHA Regulations Subpart Z covers Toxic and Hazardous Substances. The "Right to Know" law states that the employer must inform his employees as to hazardous materials that the workers are in contact with in the performance of their duties. To comply with this OSHA requirements and the requirements of EPA and the Transportation Department, Nortel Networks has issued a "Technical Report on Hazardous Material." This report is distributed to all NT customers. This document is also available at a nominal cost through the NT order process, if additional copies are required.



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# Chapter 11: Documentation

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## General

A variety of document types are used to support and maintain an accurate record of the design and capabilities of the DMS-100 Family. These document types include job specific, non-proprietary hardware, systems, proprietary, installation, and various other documents. This section lists and describes these different document types.

### Documentation media

Nortel Networks' documentation for the DMS-100 Family and the DMS SuperNode switching system is available on HELMSMAN CD-ROM, paper, microfiche, or microfilm form. User documentation is included when a switching system is shipped. Nortel Networks' primary documentation offer is CD-ROM, however, the user may choose a mixture of paper and microfiche. Software listings of each specific BCS program are available only in microfiche.

### Documentation ordering

Documentation can be ordered in one of two ways:

- 1 Documentation can be ordered through the NT86XX questionnaire at customer information (CI) time of the switch or any extension (growth) to an existing switch in accordance with the purchasing agreement.
- 2 Documentation may be purchased by submitting a purchase order for documents to the Nortel Networks merchandise order specialist. Documentation standing order services can also be ordered through the merchandise order specialist.

### Documentation catalogs

Documentation catalogs, giving document titles and prices, will be released annually.

### Documentation structure

There are three types of standard documentation provided with DMS-100 Family Systems:

- 1 job specific documentation

- 2 non-proprietary hardware documentation
- 3 systems documentation

Job specific and non-proprietary hardware documents are organized according to the modular documentation system (MDS). The MDS documents are associated with Nortel Networks product engineering codes.

### **Modular documentation system**

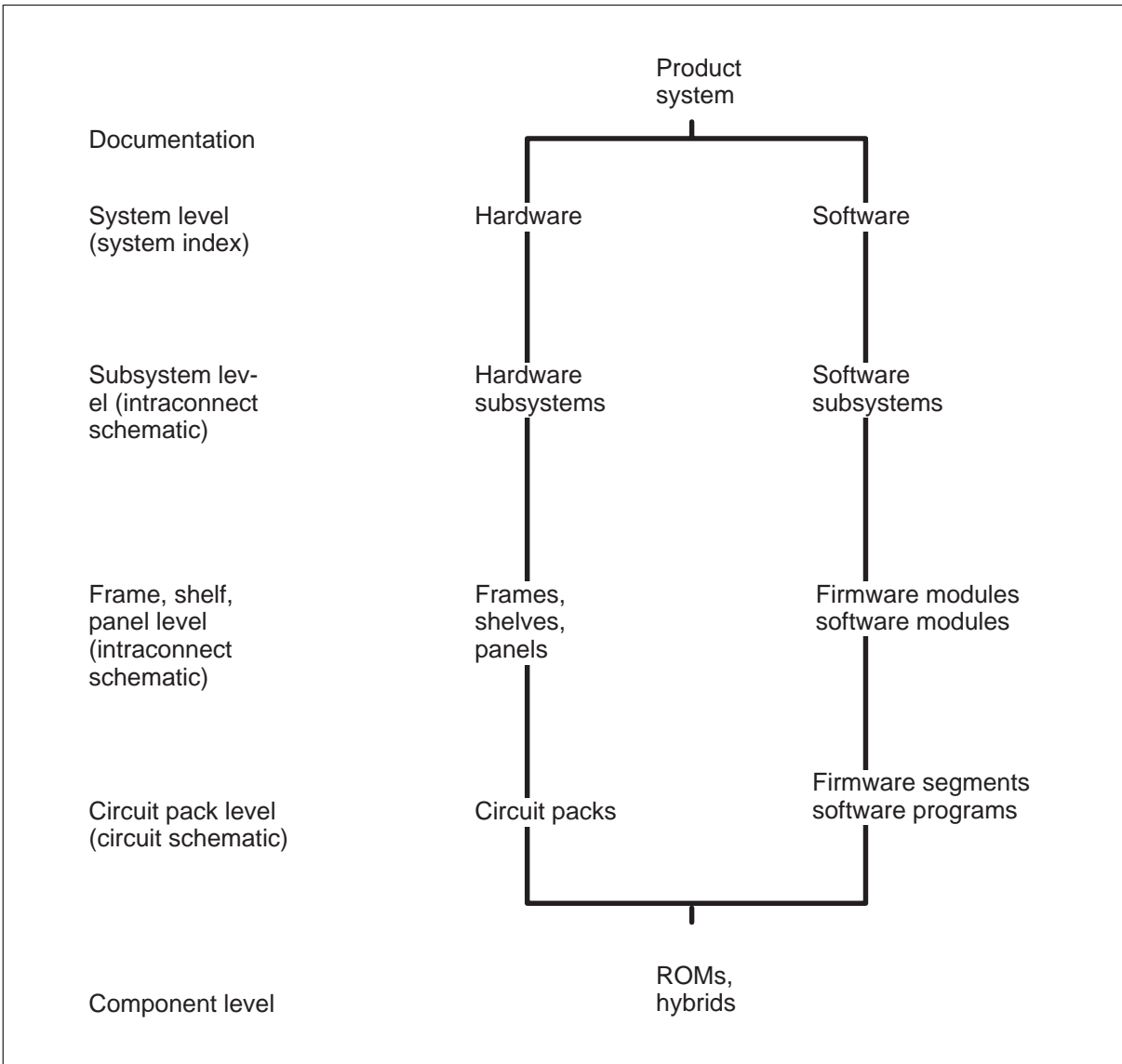
The modular documentation system (MDS) structure complements the modular nature of the system. The MDS has four functions:

- 1 to produce documents whose contents satisfy the specific needs of their most frequent users, and the general needs of all users
- 2 to be technology-independent – changes in the technology used in the product must not affect the documentation system
- 3 to provide a document identifier (prefix) which relates to the type of information contained within the document and to aid a user when searching for a specific type of information
- 4 to provide a document identifier which relates to the product identifier and to aid a user in the search for information on a product

### **Characteristics of MDS**

MDS has a “top down” structure. Documents are stratified to conform to each level of the product structure, such as system, subsystem, or module (see Figure 11-1.)

**Figure 11-1**  
**Modular documentation system structure**



MDS documents describe a product as a module; that is, as something which stands alone in its internal functions and whose interfaces with the rest of the system (input and output signals, and connections) are defined in terms of this module only. As a result, the module and its documentation can be changed as required without affecting the rest of the system.

### MDS document identifiers

Each hardware product of the DMS 100 Family is identified by a unique product engineering code (PEC). A PEC consists of eight characters and has a specific structure:

(Prefix)	(Base)	(Suffix)
NT	NANN	XX
NT	AANN	XX

Where: NT is Nortel Networks

N is numeric

A is alphabetic

X is either numeric or alphabetic

Examples of PECs are NT0X25AA, NT4X25BH and NT6X10AC.

- **Prefix:** The prefix NT is assigned to all codes, thereby identifying this item as a Nortel Networks product.
- **Base Code Group:** Uniquely identifies a family of products. Associated hardware documents bear an identical base code.
- **Suffix:** A 2-character suffix uniquely identifies each member within a family of products. It is assigned in sequence: AA, AB, AC and 01, 02, 03. Combination alphabetic-numeric suffixes are allowed, but are not presently used.

The documents prepared to support each PEC are identified in a similar manner:

(Prefix)	(Base)	(Suffix)	(Stream)	(Issue)
AA	NANN	XX	NN	NN

- **Prefix:** The Alpha-Alpha prefix identifies each type of document. An Interconnect Schematic has the prefix IS, Assembly Drawing is AD, General Specification has the prefix GS, and Module structure has the prefix MS.
- **Base Code:** The base code is identical to the associated PEC.
- **Suffix:** If the suffix is present, it will be the same as the suffix of the PEC. Some documents are written for more than one very similar PEC. Such an example is GS6X17, which is applicable to the NT6X17AA, NT6X17AB, NT6X17AC, and the NT6X17AD.



- **Stream:** The stream of a document is changed when major revisions to the features or operations of the PEC are involved, but would remain unchanged for minor enhancements or refinements to a product.
- **Issue:** The issue of the document is changed whenever minor revisions, corrections or improvements are made to a product or document.

Within this set, all documents bear the same base (see Table 11-1).

<b>Table 11-1 Associated documents</b>	
<b>PEC code</b>	<b>Description</b>
NT3X31AB	Product (The data store shelf)
IS3X31	The interconnect schematic for the data store shelf
AD3X31AB	The assembly drawing for the data store shelf
MS3X31AB	The module structure for the data store shelf

Changes, issues, and releases are controlled and recorded by the change control system. Two customer documents contain information related to this system. They are the document index (DI) and the office inventory record (OIR). In the DI, the customer is informed of the documents which are being provided for each office and the issues of these documents. The documents defined as requirements in the DI are those that are compatible with the associated equipment. In the OIR, the products supplied against each order are listed by product engineering code (PEC), title, release number, and quantity installed. The OIR is intended to be kept (by the customer) as an office log of changes.

### **Nortel Networks publications**

Nortel Networks publications (NTPs) are issued to document various aspects of the DMS-100 Family of switches and in general cover several disciplines:

- administration
- engineering
- installation and testing
- operations
- provisioning
- translations
- maintenance

297-1001-001 is maintained as a current index of all NTPs and lists the publications in four ways:

- 1 numerically by ten-digit NTP number

- 2 alphabetically by title as shown in Table B
- 3 cross reference of NTP to batch change supplement (BCS) software releases, for each NTP, lists the NTP releases supported and, for each release, the BCS number to which it applies. Refer to Table C.
- 4 cross reference of BCS to NTP. Each table applies to one BCS; it identifies the NTP numbers required and which release is most suitable. Refer to Table D.

Practices are identified in Table A of 297-1001-001 by NTP number, release, rating, date, and title. Where an NTP number appears more than once, Table C of the index must be used to determine which release of NTP should be consulted.

### **NTP index**

This is an explanation of the column headers used in the A, B, and C tables of NTP 297-100-001:

**NTP 29** Layer and section part (last seven digits) of the standard ten-digit NTP number appear in this column. All DMS-100 Family Practices are in division 297.

**RELEASE** This column contains two-part code consisting of a two-digit stream number left of the decimal point, and a two-digit issue number to the right of the decimal point. The code is not printed on some NTPs; it will be added when the NTP is reissued.

If an NTP is reissued with new information specific to one or more BCS software releases, the stream number is increased by one. If the NTP is reissued to make other corrections, the issue number is increased by one.

**RATING** This column contains the document ratings:

DRAFT	Draft, contents subject to change due to development
PREL	Preliminary
STD N	Standard within Nortel Networks.

**Note 1:** Some NTPs are rated STD N by means of an N suffix to the NTP number on the document (for example, 297-2101-102N); however, the term STD N is used in the index.

**Note 2:** Some earlier issues of NTPs used a three-part rating code such as, 01D02. Those Practices are considered DRAFT rated if the letter is W, and STD N if the letter is D.

**STD** Standard

**DATE** The date published on the cover of the practice appears in this column. This is the date that the NTP was issued.

**TITLE** This column contains the title of the NTP.

**BCS** This column appears in Table C and contains the batch change supplement (BCS) number. This is the release number of the software to which the NTP applies.

Other codes may appear in the left margin of Tables A and B, of NTP 297-1001-001:

- A bullet indicates that an item that has been added or changed since the previous issue of the index.
- [] A square indicates a cancelled or renumbered item. Related information is shown in a note following the item.

Add indicates an addendum to a practice

Apx indicates an appendix to a practice

Can indicates a cancellation notice

Sup supplement

**NTP numbering plan**

This section describes the NTP numbering plan:

NTP division number assigned to digital switching systems, subdivided into layers as follows:

- 0YY1 Indexes, general and common to digital switching systems
- 1YY1 Information common to all members of the DMS-100 Family
- 1211 Packaged DMS-100 Family
- 1401 Custom Local Area Signaling Service
- 2YY1 Reserved for specific members of the DMS-100 Family:
 

— 297-2001-ZZZ	DMS-100	IBN
— 297-2011-ZZZ	DMS-100	BUSINESS SET
— 297-2101-ZZZ	DMS-100	LOCAL
— 297-2021-ZZZ	DMS-100	Large Business Remote
— 297-2031-ZZZ	DMS-100	Meridian business service
— 297-2041-ZZZ	DMS-100	Automatic call distribution

— 297-2071-ZZZ	DMS-100	Station message detail recording
— 297-2111-ZZZ	DMS-100	CSDDS
— 297-2121-ZZZ	DMS-100	DATAPATH
— 297-2201-ZZZ	DMS-200	TOLL OR TANDEM
— 297-2271-ZZZ	DMS-200	TOPS
— 297-2281-ZZZ	DMS-200	TOPS MP
— 297-2301-ZZZ	DMS-300	GATEWAY
— 297-2401-ZZZ	DMS-100	ISDN
— 297-4101-ZZZ	DMS-100	MDC
— 297-5001-ZZZ	DMS	SuperNode
— 297-5101-ZZZ	DMS	SuperNode STP

The ZZZ code has an unique assignment:

— 297-YYYY-000 TO 009	Indexes and cross-reference lists
— 297-YYYY-010 TO 029	Technical administration publications
— 297-YYYY-030 TO 039	Not used
— 297-YYYY-040 TO 059	Training aids
— 297-YYYY-060 TO 099	Not used
— 297-YYYY-100 TO 149	Descriptions
— 297-YYYY-150 TO 199	Engineering equipment and ordering information
— 297-YYYY-200 TO 299	Identification, installation and tests
— 297-YYYY-300 TO 399	Operating procedures
— 297-YYYY-400 TO 499	Traffic provisioning, translation, administration
— 297-YYYY-500 TO 599	Maintenance procedures, reference manuals, descriptions of man-machine interfaces (commands, displays, and log reports)
— 297-YYYY-600 TO 999	Not used

### **Job specific documentation**

Documents are provided for a particular DMS-100 Family office with the initial delivery of the system. These documents are office specific.

### **Document index**

The document index (DI) is an index of all standard and job related documents provided for each office and includes the issue of each document supplied.

**Office-inventory record**

The office inventory record (OIR) contains the list of all the components of a customer office, the quantity and the release. Input is from job specifications and on-site equipment audits. The OIR is used for keeping track of the contents of a particular office, change control and extended warranty service.

**Office feature record**

The office feature record (OFR) contains a short description of each PROTEL software subsystem resident in a particular office and a list of feature packages provided in the software load.

**Central office job specifications**

The main function of the job specification is to list the materials needed to assemble and install a job. There are three types of job specifications: material requirement, configuration, and cable. After the job specification has been used by manufacturing to assemble the job, and by the installer to install the job, it is no longer required since the job drawings contain all the information about the contents of the office.

**Central office job drawings**

Job drawings are generated by customer engineering job specifications, job information memorandum (JIM) or 88K orders. Job drawings are permanent records of what is in a particular office and indicate the location of components when the positioning is variable. A breakdown of the drawings for a standard job would be up to 20 job drawings, six facility drawings showing floor plan, lighting, cable racks, ceiling inserts, earthquake bracing and grounding schematics, one distributing frame (DF) drawing and one transmission drawing.

**Common systems drawings (as required)**

These drawings portray equipment which is not part of the DMS-100 Family equipment but is part of the installation, such as power or cable racking.

**Non-proprietary hardware documentation**

Hardware documentation consists of drawings and documents that depict actual hardware configurations and interconnections.

**General specification (GS)**

The general specification (GS) contains information pertaining to a single product (module) or to a set of products within the same family. The information only applies to the module external interface.

### **Module structure (MS)**

The module structure (MS) describes how to select equipment to engineer features. MS updates occur in response to a new member within a family of products.

### **Assembly drawings (AD)**

Products that are the assembly of various elements may be pictorially displayed on an assembly drawing (AD). The AD, created by equipment design or mechanical design, is required for manufacturing to assemble and inspect the product and for on-site installation and maintenance. These drawings show the construction of frames, shelves, and other miscellaneous equipment. These drawings also illustrate the placement of circuit packs in a drawer, drawers in a module, and modules in a frame.

### **Interconnect schematics (IS) or functional schematics (FS)**

The functional schematic (FS) applies to electromagnetic equipment and has now been largely replaced by the interconnect schematic (IS). The FS illustrates functional interconnectivity between sub-assemblies of the product. The IS describes connectivity between modules by using block diagrams in which functional blocks are joined by lines. Each line represents a set of connections. Detailed connections are identified in tabular form using separate tables to group similar connections. Notes are used as required to supplement the block diagram and detailed tabular information.

### **Cabling assignments (CA)**

The cabling assignment (CA) drawing defines the specific interconnections among products within a system. It includes information on both the originating and terminating ends of a cable, the specific type of cable, and the number of leads required.

Cabling assignment drawings also describe drop lengths of cables and pin-to-pin connections between frames and are used to engineer offices. CA are one of the key documents used in the creation of job specifications. The CA drawings are necessary documentation for the assembly plant, installer and customer.

## **Systems documentation**

### **Nortel Networks practices**

NTPs are required to engineer, operate, and maintain a Nortel Networks product. NTPs describe the DMS-100:

- System description—Describes the system, its features, and how it operates.
- Engineering, equipment application and ordering information—Contains the information required to select the proper equipment when planning a new office or expanding the facilities of an existing office.

- System/equipment performance specification—written for engineers to enable them to assess the applicability of the system or equipment to their requirements.
- Identification, installation, and tests—written for technicians of operating companies whose duties include installation, field adjustments, and tests that are necessary before turnover for regular operation.
- Operating procedures—written for all field personnel who operate equipment. The contents has four parts:
  - identification of controls and indicators and their function
  - step-by-step procedures for operating the controls
  - alternative methods of operation under trouble conditions
  - ecommended methods for maintaining service under trouble conditions
- Simple trouble test and repair procedures—written for operating company field service technicians and aimed at quick restoral of service without extensive test, adjustment, and repair procedures.
- Preventive in-service maintenance—written for operating company technicians:
  - recommended time intervals between tests and adjustments
  - detailed test and adjustment procedures which indicate limits at or beyond which corrective adjustment or repair must be done
  - special procedures for maintenance and cleaning of floors, offices and equipment which is likely to affect the operational reliability of the equipment.
- Traffic—written for operating company personnel and include traffic provisioning, translations, and administration.
- Maintenance center procedures—document tests and adjustments that are required on equipment or apparatus prior to their use as replacement items in the field.

### **BCS release document (Site)**

The DMS-100 Family switching system software structure is based on a packaged concept and is non-generic in nature. Thus, every software load built into a particular office is a combination of feature packages unique to that office.

The BCS program is a delivery process which enables Nortel Networks to provide the latest software design to its customers in an efficient and quality-controlled manner. The BCS release occurs at planned intervals.

BCS release documents are issued for each DMS-100 Family software release. They support the addition of new software and features to a

customer's switch, and they contain instructions for the application and on-site verification of the software load.

Customized BCS release documents describe new software features that are specific to a given site. Instructions for applications and on-site verification of the software load are included. This document is distributed automatically to each site that orders a new BCS, and is part of the standard distribution for an initial DMS-100 office.

### **Peripheral module software release document**

The peripheral module software release document addresses the changes associated with a given software release for peripheral equipment. The method of applying the software is described.

### **BCS preparation guide**

This guide identifies new features that have a potentially significant impact on the operation of other features.

## **Optional documentation**

Nortel Networks is expanding the available DMS-100 Family documentation as described in this section.

### **General feature descriptions (GFD)**

The general feature description (GFD) provides the information to implement, operate, and maintain a feature package in the DMS-100 Family of Switches. The feature package is defined by the software management system (SMS) data base. There are six aspects to the GFD:

- 1 a description of each feature in the package, its intent and the major elements of its operation
- 2 feature package interfaces, inputs and outputs
- 3 feature limitations and restrictions
- 4 interaction with other features
- 5 engineering, maintenance, and administration requirements
- 6 data schema impact

### **Feature description manual (FDM)**

The Feature description manual (FDM) contains brief descriptions of DMS-100 Family features, and indexes of software packages.

The FDM is divided into two sections: A and B.

- Section A contains five indexes:
  - index of major packages and the feature packages that they contain
  - index of packages listed numerically by software package code



- index of features listed alphabetically by title
- index of cross-referenced feature packages
- index of package interdependencies
- Section B contains descriptions of currently available features.

### **BCS release document (Complete)**

The DMS-100 Family switching system software structure is based on a packaged concept and is non-generic in nature. Thus, every software load built into a particular office is a combination of feature packages unique to that office.

The BCS program is a delivery process which enables Nortel Networks to provide the latest software design to its customers in an efficient and quality-controlled manner. The BCS release occurs at planned intervals.

BCS release documents are issued for each DMS-100 Family software release. They support the addition of new software and features to a customer's switch, and they contain instructions for the application and on-site verification of the software load.

This document, offered in two versions:

- 1 Preliminary—available two months prior to each new BCS.
- 2 Standard—available at the time of general software availability for the BCS.

Orders are accepted for both versions or for the Standard version only.

### **Peripheral module software release document**

The peripheral module software release document addresses the changes associated with a given software release for peripheral equipment. The method of applying the software is described.

### **MDC feature description**

The meridian digital centrex (MDC) translations description (TDM-2001-002) contains MDC feature descriptions as well as information on system, attendant console, station, and business set features:

- description
- operation
- restrictions
- interactions
- office parameters
- datafill sequence

- datafill procedure

This manual also contains a section on special features, which describes several specialized MDC translation techniques.

### **TOPS call descriptions**

This manual (NED 297-0002) contains a general overview of TOPS, TOPS basic call progression, InterLATA call type descriptions, and IntraLATA call type descriptions. It may be used for checking all table entries (tuples); provides call progression maps; and serves as a supplemental document to existing TOPS translation information.

The information provided with each basic call type and variation is listed in this manual:

- description
- call progression (tables accessed, associated tables, NTPs, and forms)
- call progression narrative
- call map (flowcharts with reference pointers)
- basic datafill sequence (included in call progression table and call map)
- sample datafill
- translations for TOPS equal access is also covered in this manual

### **DMS-100 family translations description manual**

The Translations description manual (TDM-1001-001) provides guidelines for preparing and understanding initial and ongoing translations. The greenblade office record (TDM-1001-0020) contains an example office record that shows one translation of the DMS. This record is available for BCS26 and BCS27 only. Order the BCS issue that matches the BCS level of the DMS being translated.

### **Maintenance and operations manual**

The Maintenance and operations manual (NED 297-0003) provides working levels of management with a summary of the DMS-100 family maintenance tools, key administrative maintenance procedures, and typical examples of those procedures.

### **DMS-100 family capacity manual**

The DMS-100 Family capacity manual (ENG-1001-001) provides information related to the capacities of individual switch components for the DMS-100 installations that use either the NT40 or DMS SuperNode architecture. This manual contains information concerning capacities (call attempts and traffic), real time models, engineering and monitoring guidelines, load service curves, and overload controls.

**BCS maintenance synopsis**

The BCS maintenance synopsis (TAM-1001-006) is a summary of maintenance affecting items contained in a new BCS release. It is intended to reduce the maintenance preparation time and effort required in implementing a BCS change application.

**BCS traffic synopsis**

The BCS traffic synopsis (TAM-1001-005) summarizes the traffic affecting items in the BCS release document. It is intended to reduce the telephone operating company preparation time and effort required in implementing a BCS change application.

**MDC implementation guide**

The MDC implementation guide (PLN-2001-001) outlines the critical path method for implementation of a series of distinct phases and milestones for implementing MDC.

**TRAVER**

This Technical assistance manual (TAM-1001-002) describes how the Translation and Routing Verification (TRAVER) tool allows examination of the translation and routing data that is used for a particular call.

**Proprietary documentation**

The documents described in this section identify proprietary documents.

**Proprietary information list**

The following list of proprietary documents are described in proprietary documentation:

- Release control record (RCR)
- Circuit schematic (CS)
- Functional description (FD)
- Detailed assembly drawing (AD)
- Wiring document (WD)
- Program documentation index (PDI)
- Central control software program listings
- XPM peripheral module software program listings
- Operating manuals
- Support operating system (SOS) loader reference manual
- DMS-100 Family Software update controller user manual
- Attendant console software debugging tools
- Programmers manuals

- Software debug manuals
- Network integrity fault analysis guidelines
- DMS-100 Family system description
- Technical assistance manuals (TAM)
- Installation manuals

### **Release control record**

Nortel Networks maintains a release control record (RCR) by PEC which identifies issue numbers for all drawings associated with DMS-100 Family equipment. This proprietary document also records equipment issue compatibility information.

### **Circuit schematic (CS)**

The circuit schematic (CS) is a logical representation of the electronic circuitry of a circuit pack. Each CS document defines the circuitry for one specific product. It is identified with the prefix CS, followed by the same base number and suffix as the product engineering code (PEC).

### **Functional description (FD)**

An functional description (FD) describes the purpose and method of operation of a circuit forming part of a larger system and defined by a CS or IS. An FD includes circuit operation functions not readily apparent from an inspection of the schematic drawing.

### **Detailed assembly drawing (DAD)**

The circuit pack assembly drawings (AD) indicate connections of faceplate-mounted components, illustrate mounting arrangements which are not apparent, and display stamping and lettering.

### **Wiring document (WD)**

The wiring document (WD) describes the wiring within the equipment. It includes loose wiring (LWJ), soldering records (SWJ), running lists (RLJ), routing information (D1J/D3J), and checklists (CLJ).

### **Program documentation index (PDI)**

The program documentation Index (TID-1001-000), common to all the DMS-100 Family software versions, describes the proprietary documents of the software documentation package. It also describes how to use the documentation and on-line tools to ascertain specific information:

- which program elements are loaded into a given office
- the physical locations of various programs and data elements in a given office.

## Central control software program listings

Program listings are generated from data files maintained by Nortel Networks. The listings contain all the instructions for the program modules and may contain supplementary information defining the function of the module and how the module unit relates to the other units and the overall system. Program listings are produced for each version of the software library released.

## Program description information

DMS-100 Family programs are written in a high-level language called PROTEL. As with other high-level languages, the programs are largely self-documenting with the code itself the primary body of the explanation. In addition to the code, each module may contain a prologue or overview of the function of the module. Comments embedded within the code clarify the code usage.

## Central control cross references (subsystem SEXREF, GXREF)

This document lists all declarable PROTEL symbols and the program elements which invoke them. As part of the program listings, it is produced in the form of microfiche for each version of the library software released.

## XPM peripheral module firmware/software listing

The DMS-100 Family XPM peripheral module firmware/software listing is documented from data files maintained by Nortel Networks. Three documents are produced from these files:

- 1 program listings including explanatory comments
- 2 cross references
- 3 directories

Program listings, cross reference, and directory are produced for each version of the firmware/software released.

## Program listings

The XPM software is written in assembler code. Line peripheral code is assembled using a relocatable assembler; the rest of the PMs use an absolute assembler. The program listings provided on the fiche are assembled source listings.

## Cross references

For the XPM software that uses the absolute assembler, a cross reference is provided on a subsystem basis. For XPM firmware/software that uses the relocatable assembler, a cross reference consists of an alphabetical list of all the labels in the subsystem or module listing.

## **Directories**

A directory exists only for the XPM firmware/software that uses the absolute assembler. The directory (label dictionary) is provided on a subsystem basis. It consists of an alphabetical list of all the labels defined within the subsystem.

## **Operating manuals**

These manuals provide information on tools to implement and manage updates to the DMS-100 and peripheral software loads.

### **SOS loader reference manual**

The support operating system (SOS) loader reference manual contains information common to all software versions.

The SOS loader reference manual gives detailed information for using on-line tools to determine what modules are loaded in a specific office. It is also used to determine the physical address of the program code and data elements in a specific office.

### **DMS-100 family software update controller user manual**

The DMS-100 Family software update controller (DSU) user manual describes how to use the DSU to implement and manage updates to DMS-100 software loads.

### **Attendant console software debugging tools**

This manual describes three CI commands that can be used to investigate software problems associated with attendant consoles either in the field or in the captive office environment.

## **Programmers manuals**

This documentation common to all the software versions provides information on the PROTEL language and supportive information on machine architecture and operating system. It consists of six manuals:

- 1 PROTEL Introductory Manual
- 2 PROTEL Reference Manual
- 3 DMS-100 Family central control complex guide 1 (machine architecture)
- 4 DMS-100 Family central control complex guide 2 (user's manual)
- 5 XPM Assembler user's manual
- 6 XPM Pascal manual

## Software debug manuals

This set of documents common to all the software versions provides a guide to the available debug tools:

- DMS-100 Synchronizable clock debug software
- DMS-100 debugging and measuring tools: a survey
- DEBUG and SWERR monitors
- New peripheral debugging
- I/O Query – user’s guide

## DMS-100 family system description

This documentation provides a detailed description of the DMS-100 Family hardware and software including DMS SuperNode software. Included are discussions and detailed explanation of the hardware system, software structure, and run-time organization. Also included are discussion of PROTEL and other aspects of the software environment, such as the BCS release process and the DMS-100 Family program patch system. The intent of this documentation is to provide sufficient overview and background so that a properly qualified person may, after absorbing this material, read and understand the DMS-100 Family program listings.

## Network integrity fault analysis guidelines

This manual provides a brief description of “integrity” in the DMS-100 switching system and the possible causes of integrity failures. Trouble-shooting guidelines and approaches to correcting integrity failures are also provided.

## Technical assistance manuals

The Technical assistance manual (TAMs) provide DMS-100 Family maintenance personnel with the information that is necessary for testing software debugging tools in the field. These manuals describe the tools that are contained on the TAS Non-Res tape (NTX181AA).

### PMIST

The Peripheral module intercept system (PMIST) is a low level internal diagnostic tool that records messages sent between the CC and the PMs. This manual (TAM-1001-007) provides a description of, as well as instructions for using PMIST. This TAM is used by maintenance personnel for maintenance of the DMS-100 switch.

### DISPCALL

This Technical assistance manual (TAM-1001-003) describes the display call (DISPCALL) software tool and provides instructions for the proper use of the tool. The manual is used by the maintenance personnel responsible for maintaining the DMS-100 switch.

**TAS non-res tool listing (TAM-1001-001)**

The TAS non-res tool listing contains a list of the tools residing on the TAS non-res tape.

**PMDEBUG user guide (TAM-1001-004)**

This TAM provides an introduction to PMDEBUG with definitions of PMDEBUG levels and commands. Procedures are also provided to allow specific XPM information to be displayed.

**DEBUG user guide (TAM-1001-008)**

This TAM describes the DEBUG utility and provides background information and definitions of the DEBUG commands. It also contains a detailed section about data store display.

**Installation manuals**

These manuals are used by DMS-100 Family equipment installation personnel. They describe all the various tests that are applied before the system is turned over to a telephone operating company. These manuals are available under a separate installation agreement.



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## Appendix A: Probability of cutoff calls

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The equation used to calculate the probability of a cutoff is obtained from a paper by M. Tortorella; "Cutoff calls and Telephone Equipment Reliability," published in the Bell System Technical Journal, Volume 60, Number 8, pp. 1861 – 1889, October 1981.

Use this equation:

$$P_c = \frac{\sum_{i=1}^M K_i l_i P_i}{\mu + \sum_{i=1}^M K_i l_i P_i}$$

**where**

$P_c$  = the probability that a call in the system will be cut off because of failure

$l_i$  = failure rate for failure mode  $i$

$\mu$  = reciprocal of the mean call holding time

$$P_i = \frac{n_i (2N - n_i - 1)}{N (N - 1)}$$

$M$  = the total number of failure modes

**where**

$N$  = number of trunks in the office

$n_i$  = number of trunks cutoff by failure mode  $i$

**and**

$K_i$  = the number of modules in the system which can experience failure mode  $i$ .

$$= \left[ \frac{N}{n_i} \right]$$

$[X]$  = smallest integer  $\geq X$

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## Appendix B: PRRIMA

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P(RRIMA) (the Probability of a Reliability Related Ineffective Machine Attempt) has been defined by M. Tortorella in a Bell Lab internal paper titled “Predicting the Rate of Ineffective Machine Attempts Caused by Equipment Failures II,” (Case 49428-400). The simplified equation used for the DMS-100 calculation is defined in a paper presented by B.S. Liebesman and M. Tortorella at the 1982 Annual Reliability and Maintainability Symposium, Los Angeles, California, January 26–28, 1982 (“Reliability of a Class of Telephone Switching Systems”).

Use this equation:

$$P(\text{RRIMA}) = \lambda_1 \text{MTTR}_1 + 2 \sum_{j=2}^M \lambda_j \text{MTTR}_j$$

**where**

$\lambda_1$  = failure rate of level 1; and  
 $\text{MTTR}_1$  = meantime to restoral of level 1

$\lambda_j$  = failure rate of level j; and  
 $\text{MTTR}_j$  = mean time to restoral of level j

$M$  = total number of failure modes that remove units from service



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## List of terms

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**ABBT**

Automatic board-to-board testing

**ABS**

Average busy season, also alarm battery supply

**ACB**

Automatic call back

**ACCS**

Automatic calling card

**ACD**

Alarm and control display

**ACED**

Alternate current equipment ground

**ACTS**

Automatic coin toll service

**ACDMIS**

Automatic call distribution management information system

**ACM**

Address complete message

**access module (AM)**

The unit that provides access to the network modules of a digital packet network switching system from a local subscriber packet data line or the digital interworking unit.

**access privilege (AP)**

The way that bearer services for an ISDN logical terminal are defined. Nortel Networks currently defines four APs:

- 1 B (circuit-switched voice/data)

- 2 D (low-speed packet data)
- 3 PB (high-speed packet-switched data)
- 4 PB (high-speed packet-switched data)

**access termination (AT)**

The functional term used to describe the part of the exchange termination which terminates the access interfaces (BRI and PRI). It defines the access privileges of the terminals on an interface and provides the terminals on an interface with access to ISDN circuit and packet-switching services.

**access vehicle**

One or more network elements that multiplex information (such as speech) from subscriber lines and transport it to a switching system. Circuit-switched connections are established in the switching system, not in the access vehicle. The DMS-1 Urban is an example of an access vehicle. The AccessNode is the access vehicle used for both integrated (connected with the DMS-100) and non-integrated configurations.

**action request (AR)**

An input to the DMS-100 Family maintenance system that may result in a status change and an update to the VDU.

**ACTS**

Automatic coin toll service

**actual measured loss (AML)**

Actual loss reading when a test is made under specified conditions.

**actual work time (AWT)**

The time in seconds required by a TOPS operator to handle an average call and perform other related duties.

**ACU**

Acknowledge unit

**A/D**

Analog-to-digital

**adaptive differential pulse code modulation (ADPCM)**

Used to encode speech for storage in memory. ADPCM is memory efficient. It uses 4 bit speech samples taken at an 8 kHz rate and represents a saving of 50 percent over 64 kbyte pulse code modulation.

**additional functional calls (AFC)**

A service that is assigned to a directory number (DN) on a functional terminal, permitting multiple calls to the DN.

**address complete message (ACM)**

A Common Channel Signaling No. 7 (CCS7) protocol message sent in the backward direction, indicating that all the address signals required for routing the call to the called party have been received and that the call can be routed.

**address signals**

Address signals consist of the digits dialed by the subscriber and outpulsed by the switch, including the digits 0–9, KP, and ST signals.

**ADPCM**

Adaptive differential pulse code modulation

**ADTC**

Austrian digital trunk controller

**AFC**

Additional functional calls

**AIFL**

Automatic identified outward dialing failure (treatment)

**AIOD**

Automatic identified outward dialing

**AK**

Attendant key

**alarm (ALM)**

A visual signal, an audible signal, or both used to alert staff to a condition requiring attention.

**alarm battery supply (ABS)**

A separate nominal -48 V supply obtained from the central office battery-A feed and distributed to the alarm circuits of the DMS-100 Family system.

**alarm control and display (ACD)**

A panel connected to the office alarm unit that carries lamps and switches providing control and display of alarm facilities according to the type and class of alarm.

**alarm sending and checking system (ASCS)**

Provides a facility for sending indications of alarm conditions occurring in a DMS office over a trunk to a remote operator position.

**A link**

A signaling data link that connects service switching points (SSP) and service control points (SCP) to signaling transfer points (STP). *See also* service control point, signaling data link, service switching point, signaling transfer point.

**ALIT**

Automatic line insulation test

**all trunks busy (ATB)**

Condition indicated when all the circuits in a group are occupied.

**ALM**

Alarm

**ALT**

Automatic line testing, automatic line test level

**alternate mark inversion (AMI)**

A system for line transmission in which the mark condition of a coded signal is represented alternately by a positive and negative voltage of equal amplitude, and in which space is represented by zero amplitude.

**alternate route cancel (ARC)**

A network management control that provides a means of limiting a percentage of the traffic into a congested area to the direct route only. The percentage can be set in the range 1 to 100.

**alternate routing**

A telephony function that provides for routing a call to an alternate trunk group if no trunks are available on the primary trunk group.

**alternative route**

*See* alternate route

**AM**

Access module

**AMA**

Automatic message accounting

**AMAT**

Automatic message accounting transmitter

**AMATPS**

Automatic message accounting teleprocessing system



**ANI**

Automatic number identification

**announcement (AN) machine**

A recording machine that gives voice guidance to a subscriber if, for example, the call cannot be connected.

**anonymous caller rejection (ACRJ)**

Anonymous caller rejection (ACRJ) is a CLASS feature for residential customers. This feature rejects incoming calls to a subscriber's line when the calling party has suppressed (that is, blocked) the identity of their name or directory number (DN). Anonymous calls are prevented from termination to a subscriber's line by routing them to an announcement.

**answer message (ANM)**

A common channel signaling protocol message sent in a backward direction, indicating that the call has been answered and that the terminating office has connected the voice path.

**AOCR**

Automatic out-of-chain reroute

**AOSS**

Auxiliary operator services system

**AOP**

Average occupied positions

**AP**

Access privilege, also application processor

**application code**

All software, excluding the operating system, that is loaded by the support operating system loader.

**APS**

Attended pay station

**AQ**

Autoquote

**AR**

Action request, alternate route, automatic recall

**AR/ACB**

Automatic call setup

**ARC**

Alternate route cancel

**ASCS**

Alarm sending and checking system

**ASIC**

Application-specific integrated circuit

**ASO**

Automatic service observing

**assistance position**

An administrative position that provides assistance to operators, monitors and pages operators, places outgoing calls, and performs administrative searches.

**associated mode**

CCITT No. 6 signaling (N6) or CCITT No. 7 signaling (N7) mode in which signals are transferred between two exchanges over a common signaling link. The common signaling link terminates at the same exchanges as the group of speech circuits to which the signaling link has been assigned.

**associated signaling**

A mode of operation in which the signals carried by the signaling network relate to a group of speech circuits that terminate in the same switching office as the signaling network.

**ASU**

Acknowledgment signal unit

**AT**

Access tandem

**ATB**

All trunks busy

**ATC**

Automatic time and charges

**ATD**

Audio tone detector

**ATM**

Asynchronous transfer mode

**applique circuit**

The carrier test reporting circuit that supports a mechanized loop tester (MLT) or line test desk (LTD) on carrier system lines. The applique circuit provides DC signals used to report line card test results to the MLT or LTD.

**ATME**

Automatic transmission measuring equipment, automatic trunk maintenance equipment

**ATMS**

Automatic transmission measuring system

**ATT**

Automatic trunk testing

**attended pay station (APS)**

Attendant-supervised groups of non-coin public telephones located in areas of high pedestrian traffic (for example, airports) that allow subscribers to place local, long distance, or overseas calls and pay an attendant for the chargeable calls on completion.

**attributes**

The functional and physical details of a call.

**audible ringing tone**

Information tone sent back to the calling telephone subscriber as an indication that the called line is being rung. Formerly called ringback tone.

**audit**

The process of verifying the integrity of the system, and attempting to correct errors when detected.

**automatic board-to-board testing (ABBT)**

A procedure that is used before a new DMS is cut into service to verify that each subscriber terminal is identified with the same line equipment number in the new DMS office as in the old office.

**automatic call back (ACB)**

The custom local area signaling service (CLASS) that enables subscribers to dial a feature code to automatically set up a call to the last directory number that was dialed. If the destination line is busy, ACB monitors it until it becomes idle and can accept the call.

**Automatic call distribution (ACD)**

A set of Meridian Digital Centrex features that assigns answering machine priorities to incoming calls, and then queues and distributes them to a predetermined group of telephone sets designated as answering positions.

**Automatic call distribution management information system (ACDMIS)**

A management information system that allows a downstream processor to request and assemble ACD information.

**Automatic calling card service (ACCS)**

A feature in which the subscriber dials a call and bills it to a calling card number provided by the operating company. In Canada, ACCS is known as custom charge calling.

**Automatic coin toll service (ACTS)**

A feature that enables the operating company to handle long distance (1+) coin calls from a coin station without operator assistance.

**automatic identified outward dialing (AIOD)**

A PBX feature used in PBX applications to identify the station from which a call is originating.

**automatic identified outward dialing failure (AIFL) treatment**

An automatic identified outward dialing system that redirects a call to a tone, announcement, or an outgoing operator trunk when the AIOD message is not received during a delay time specified by the operating company.

**automatic line insulation test (ALIT)**

Used to automatically test subscriber loops for insulation integrity.

**Automatic line (AUL)**

A directory-number feature that can be assigned to individual directory number appearances, including the primary directory number, on a Meridian business set.

**automatic line testing (ALT)**

Testing of both line circuits and the attached loops. In most situations, ALT is run on a large group of lines during a low traffic period. *See also* extended diagnostic test, line insulation test, on-hook balanced network test, and short diagnostic test.

**automatic line test (ALT) level**

The level of line maintenance accessed from the LNS level of the MAP.

**automatic message accounting (AMA)**

An automatic recording system that documents all the necessary billing data of subscriber-dialed long distance calls.

**automatic message accounting teleprocessing system (AMATPS)**

A system that is used to manage subscriber billing data. The system consists of a data collecting computer that polls central offices for automatic message accounting data.

**automatic message accounting transmitter (AMAT)**

A subsystem of the automatic message accounting teleprocessing system that, on request, transmits automatic message accounting data to the collector in the central office.

**automatic number identification (ANI)**

The number identification of the calling station. This number is used for billing records generated by an interLATA/international carrier. *See also* operator number identification.

**automatic number identification failed (ANIF)**

Allows the operator to manually enter the calling number when automatic number identification fails.

**automatic out-of-chain reroute (AOCR)**

A network management feature that provides extended routing for calls that overflow their in-chain routes.

**automatic recall (AR)**

The CLASS that enables subscribers to dial a feature code to automatically set up a call to the directory number from which the last incoming call was placed. If the destination line is busy, AR monitors it until it becomes idle and can accept the call.

**automatic service observing (ASO)**

In a DMS, an optional feature that collects details of calls occurring on specified lines or private branch exchange trunks. ASO can record these details on a recording device and provide teleprinter printouts.

**automatic switching system**

A system in which switching operations are performed by electrically controlled devices without the need for the intervention of operators.

**automatic time and charges (ATC)**

An option that applies to lines with the time and charges option and allows the NXID to print call details at a printer for all 1+ calls.

**automatic transmission measuring equipment (ATME)**

Equipment that makes transmission measurements on circuits terminating on long distance switching centers.

**automatic transmission measuring system (ATMS)**

A system for testing the transmission capability of trunk circuits and reporting the results.

**automatic trunk testing (ATT)**

A set of hardware and software entities that provides automatic testing for outgoing trunks and the outgoing portions of two-way trunks.

**autoquote (AQ)**

A service provided for hotels and motels whereby guest billing information is automatically transmitted over a dedicated facility to a receive-only teletypewriter located at the hotel. *See also* HOBIC administrative teletypewriter, record teletypewriter, voice quote.

**auxiliary operator services system (AOSS)**

A service-related system in which operators provide subscribers with such services as local and long distance directory assistance and call intercept.

**available time**

The time during which a unit can be used. *See also* maintenance time.

**average busy hour (ABH)**

*See* busy hour.

**average busy season (ABS)**

The three months, not necessarily consecutive, having the highest average time-consistent busy hour traffic. *See also* busy hour, busy season.

**average busy season busy hour (ABSBH)**

A time-consistent hour, though not necessarily a clock hour, having the highest average business-day load throughout the busy season.

**AWC**

Area Wide Centrex

**AWT**

Actual work time

**AXU**

Alarm Crosspoint Unit

**B**

An ISDN bearer service identifying the use of 64-kb/s B-channel for either circuit-switched voice or data.

**backward channel**

The channel of a data circuit on which acknowledgements or other control data may be transferred in a direction opposite to that of its associated forward channel.

**backward supervision**

In data communications, the use of supervisory sequences sent from the slave to the master station. *See also* forward supervision.

**BAF**

Bellcore AMA Format

**basic 800 service**

A one-way incoming long distance service providing called-party billing on vocal and data type calls. Each 800 line is associated with a standard unlisted telephone number. *See also* 800 Plus Service, Enhanced 800 Service.

**basic rate access (BRA)**

Access to Integrated Services Digital Network (ISDN) service provided by a set of time-division multiplexed digital channels, including two B channels, one D channel, and one or more maintenance channels. These are often described as 2B (channels) + D (channel). BRA is typically used on lines between customer premises and a central office switch.

**basic rate access functional set (BRAFS)**

An ISDN set that uses functional signaling. The M5317T is the BRAFS set for Nortel Networks. *See* functional signaling.

**basic rate access key set (BRAKS)**

An ISDN set that uses stimulus signaling. The M2317T is the BRAKS set for Nortel Networks. *See* functional signaling, stimulus signaling.

**basic rate interface (BRI)**

A type of access to ISDN service provided by a set of time-division multiplexed digital channels of information, including two B-channels, one D-channel, and one or more maintenance channels, often described as 2B (channels) + D (channel). A BRI is typically used on lines between customer premises and a central office switch.

**batch change supplement (BCS)**

A DMS-100 Family software release.

**battery and ground pulsing**

Signaling accomplished by applying battery and ground at both ends of a loop using opposite polarity at each end. This type of pulsing doubles current available for signaling, which, in effect, increases the range of the loop.

**battery-ground (BG) signaling**

A signaling method used on trunk circuits where the presence or absence of office battery between the signaling circuit and ground indicates an on-hook or off-hook condition at the far end of a trunk.

**bay**

A physical structure of the DMS-100 that houses equipment such as shelves, frame supervisory panels, and cooling units. *See also* frame, shelf.

**Bb**

A B sub-b channel. A DS-0 channel that provides the B channel subscriber packet service. Bb is one of 24 channels on a DS-1 facility between the ET and the PH.

**Bb channel**

A 64 kb/s channel carrying multiplexed B channel packets to the network.

**B bit**

Signaling bit used to pass per-channel signaling information, such as hook status or ringing, between a peripheral module and a subscriber carrier module.

**BCS**

Batch change supplement

**BCU**

Battery control unit

**Bd**

A B sub d channel. A DS-0 channel that carries low-speed, packet-switched data statistically multiplexed from up to 32 different sources. Bd is one of 24 channels on a DS-1 facility between the ET and the PH.

**BD**

Access privilege BD-ISDN bearer service identifying the use of a 64 kb/s B-channel for either circuit-switched voice or data and the use of a 16 kb/s D-channel for low speed packet-switched data onto the same device.

**BDTC**

British digital trunk controller



**Bell Communications Research (Bellcore)**

A group responsible for coordinating Bell operating company projects and setting guidelines for a switching system.

**Bellcore AMA Format (BAF)**

The standard format for AMA data used by the operating companies. The format consists of a structure code that identifies the format of the data fields in the call record, a call code that identifies the type of call recorded in the call record, other data fields that define the attributes of the call, and if needed, one or more module codes that identify the format of any additional data appended to the call record. *See also* Expanded Bellcore AMA Format.

**BERT**

Bit error rate test

**BFU**

Booster fan unit

**BG**

Battery-ground (signaling)

**BH**

busy hour

**BIC**

bus interface card

**billed number screening (BNS)**

A Common Channel Signaling No. 7 (CCS7) application process that performs a validation check on the number to which a call is billed. This check is initiated by the operator on operator-assisted and third-number billed calls.

**biller**

In DMS call processing, a function procedure used to implement billing

**bipolar violation (BpV)**

An error in the transmission of bipolar signals when two successive marks have the same polarity.

**bit error rate test (BERT)**

A test that is used to measure the transmission quality of a loop. The BERT transmits a known bit pattern over a line and compares the reflected signal against the initial pattern.

**block descriptor word (BDW)**

A 4 byte word that is part of the format that organizes and identifies variable-blocked-spanned blocks of data recorded on magnetic tapes. The BDW contains information concerning the records or segments of records included in the data block.

**BO**

Busy-out

**booked database call**

A call that has been entered in the delay call database. It is to be recalled for processing at a later, specified time.

**bootstrap loading**

In a DMS, a brief development subroutine that reloads software from an external storage device (magnetic tape drive or disk drive unit) into DMS-100 Family machines.

**B-packet**

Packet data that is transmitted over a B channel

**BPI**

Bits per inch

**BpV**

Bipolar violation

**BRA**

Basic rate access

**BRAFS**

Basic rate access functional set

**BRA interface**

Setup that provides basic rate access to ISDN services for up to eight ISDN terminals. All terminals must be carried on one customer premises loop and on one line between the customer premises and the ISDN switch.

**BRAKS**

Basic rate access key set

**BRI**

Basic rate interface

**buffer storage**

Data can be read from or written into the buffer storage area.

- a storage device compensates for differences in the rate of flow of data between components of an automatic data processing system or in the times that events occur in the components.
- an isolating circuit that prevents a driven circuit from influencing the driving circuit
- an area of storage that is temporarily reserved for use in performing an input/output operation

**burst**

A burst may be either:

- interference with, or interruption of, a digital signal
- transmission of a packet of data
- in data communications, a sequence of signals counted as a unit in accordance with a specific criterion or measure

**burst mode**

A burst mode may be either:

- A system of obtaining full-duplex two-way transmission of digital speech signals over a two-wire circuit. The two directions of transmission are separated in time by alternation.
- The transfer of a packet of data from a peripheral unit to a central processing unit, with a start signal at the beginning and an end-of-burst signal at the end. The length of the burst can be varied to suit particular requirements.

**bus interface card (BIC)**

A card located in the drawer of the line concentrating module that connects two 32-channel digroups to a maximum of 64 line cards.

**business set**

A control device with addressable points, for example, directory number keys, feature keys, display units. Business sets can support multiple simultaneous calls, premium voice features, and low-speed data service.

**busy hour (BH)**

A busy hour may be either:

- The uninterrupted period of 60 min, which is not necessarily a clock hour, for which the average intensity of traffic is at the maximum.
- The busiest hour of the busiest day of a normal week, excluding holidays, weekends, and special event days. *See also* average busy season.

**busy-out (BO)**

To take an action that causes the line on equipment to test busy to an incoming call.

**BVC**

Billing validation center

**byte multiplexing**

A form of time-division multiplexing in which the whole of a byte from one subchannel is sent as a unit, and bytes from other subchannels follow in successive time slots.

**C**

Centigrade

**CA**

Call Attempt

**CADA**

Compact asynchronous data adapter

**call busy hour**

The time-consistent, 60 min. period having the most call originating plus incoming (O + I) attempts per main station or network access line. This hour is used primarily for the development of processor realtime capacities.

**call data block (CDB)**

A data block associated with a call only while it is being processed. The CDB has the capability of being extended if required.

**call detail recording (CDR)**

A system that collects and records data on all calls processed by the DMS-300 gateway international switching system. CDR data is stored on a recording device, and is used to compile studies on traffic and equipment service, division of revenue, engineering, and fraud.

**call duration**

The interval of time between the moment a connection is established between the calling and called stations and the moment the calling station gives the clearing signal (or the moment that the connection is taken down by the operator).

**Call forwarding (CF)**

A Meridian Digital Centrex feature that allows a subscriber to have incoming calls to a station's directory number forwarded to a predetermined directory number. The five types of call forwarding are:

- Call Forwarding Universal (CFU) — permits stations to forward calls to locations inside or outside the customer group
- Call Forwarding Intragroup (CFI) — permits stations to forward calls only to customer-defined locations within the customer group
- Call Forwarding Fixed (CFF) — permits stations to forward calls to locations determined by the operating company
- Call Forwarding Don't Answer (CFD) — permits an incoming call that is not answered within a specified length of time to be forwarded to another designated station.
- Call Forwarding Busy (CFB) — permits all calls to a busy station to be forwarded to a designated station within the customer group

**Calling card validation (CCV)**

A Common Channel Signaling No. 7 (CCS7) feature that allows the traffic operator position system (TOPS) operators to validate card numbers in the network service database system. The TOPS operators perform this task by entering the special billing class charge and the calling card number.

**calling line identification (CLI)**

In data transmission, a supplementary service provided by the network that allows a terminating party to be notified of the network address of the originator. Screening of CLI is performed during call set-up only.

**calling number and name blocking (CNNB)**

An outgoing call service enabling a subscriber to block the display of the directory number and name information on the subscriber set of the person being called.

**calling number delivery (CND)**

The CLASS service that shows the 10 digit (NPA-NXX-XXXX) directory number of a calling party and the date and time of the call.

**call reference**

This identifies the call on the local ISDN interface to which the message applies. Stimulus call control messages have dummy call references because the network controls the call. Functional call control messages are used by the ISDN terminal to distinguish between call appearances of the same directory number, and to selectively control a number of simultaneous calls (for example, an active call, calls on hold, and calls waiting).

**Call restriction**

A PABX feature that prevents selected extension stations from dialing toll calls or reaching a toll operator except through an attendant.

**call-through simulator (CTS)**

Used in testing peripheral modules. The CTS originates and terminates calls to the DMS system and records the completion rate of each trunk.

**Call transfer (CXR)**

A service-related telephony feature that allows the called subscriber to instruct the switching equipment or operator to transfer an incoming call to another station.

**Call waiting terminating (CWT)**

A service-related telephony feature that allows subscribers already talking to be alerted—by means of an audible tone—that other calls to their station are being attempted.

**Call waiting ringback (CWR)**

This feature allows a caller who has reached a busy station with the call waiting terminating (CWT) feature to receive a distinctive audible ringback when the called station is available for call waiting. CWR allows the calling party to wait for the called party to answer.

**CAMA**

Centralized automatic message accounting

**CAMA TOPS recording unit (CTRU)**

A software storage area designed to hold CAMA and TOPS call data for use by the central control in the handling of these calls.

**card**

A plug-in circuit pack containing components. In a DMS, card is the preferred term for a printed circuit pack or a printed circuit board.

**card pair**

In the enhanced network (ENET), a card pair consists of an ENET card and its mate card in the other plane.

**CAROT**

Centralized automatic reporting on trunks

**CARPAC**

Carrier pretest and cutover

**carrier**

The definitions of carrier are:

- in a DMS, the communications links between switching offices.
- the protocol by which these links communicate.

**carrier pretest and cutover (CARPAC)**

A software subsystem that is used to test a digital carrier and then cut it into service. CARPAC is used to cutover both 30 channel international carriers and 24 channel domestic carriers. The 30 channel international carriers are connected into a DMS switch through an international digital trunk controller, an international line trunk controller, or an international remote cluster controller. The 24 channel domestic carriers are connected into a DMS switch through a digital trunk controller, a line trunk controller, a digital carrier module, or a remote cluster controller. *See also* digital carrier module pretest and cutover.

**Carrier toll denied (CTD)**

This feature denies access to specified carriers for the designated line.

**CAS**

Channel-associated signaling

**CBK**

Code blocking

**CC**

Central control

**CCB**

Call condense block

**CCC**

Central control complex; custom charge calling

**CCF**

Custom calling feature; coin operation, coin first

**CCH**

Connections per circuit per hour

**CCIS6**

Common Channel Inter-office Signaling No. 6

**CCITT**

Consultative Committee on International Telephony and Telegraphy

**CCITT no. 5 signaling (N5)**

N5 is an analog, in-band signaling system used internationally between gateway (DMS-300) switches and nationally between toll switches.

**CCITT no. 6 signaling (N6)**

N6 is a standardized, out-of-band (common channel) signaling system that is suitable for terminal working (inside the same world zone) and transit working (between world zones). N6 normally uses a 2.4 kb/s transmission rate. *See also* CCIS6.

**CCITT no. 7 signaling (N7) (CCS7)**

N7 is a standardized, out-of-band (common channel) signaling system that is suitable for terminal working (inside the same world zone) and transit working (between world zones). N7 normally uses a 64 kb/s transmission rate and occupies one slot in a PCM system. This signaling system is designed for digital networks. N7 is sometimes called CCS7 or SS7, but these acronyms also can refer to national signaling variations.

**CCITT recommendations**

A series of standards prepared by the CCITT that are called recommendations because they are advisory in nature and not obligatory. For example, ISDN standards are CCITT recommendations.

**CCS**

Hundred call seconds, common channel signaling

**CCS6**

Common Channel Signaling No. 6. *See also* N6.

**CCS7**

Common Channel Signaling No. 7. *See also* N7.

**CCS7 link interface unit 7 (LIU7)**

A peripheral module that processes messages entering and leaving a link peripheral processor through an individual signaling data link. Each LIU7 consists of a set of cards and a paddle board that is provisioned in one of the link interface shelves of the link peripheral processor. *See also* link peripheral processor.

**CCSA**

Common control switching arrangement

**CCV**

Calling card validation



**cell site controller (CSC)**

A peripheral module that acts as an interface between a mobile telephone exchange and radio equipment at the cell site.

**cellular mobile radio**

A mobile telephone service that allows a call in progress to continue as the mobile station moves from the vicinity of one cell to that of another. This service is possible when cells (radio transmit-receive facilities), distributed over an extended area, can pass on or take over the call handling functions associated with a call in progress.

**central control (CC)**

Comprises the data processing functions of the DMS-100 Family with associated data store and program store.

**central control complex (CCC)**

Comprises all the central control functions of the DMS-100 Family system. It consists of the central message controller, central processing unit, program store, and data store.

**central control CPU (NT40)**

A 16 bit, stack-oriented, micro-programmable processor. It is equipped with two independent parallel bus memory ports. One port is connected to the external memory that contains variable-length program instructions (program store). The other port is connected to the external memory that contains data (data store) and two central message controllers that provide communication with other elements of the system.

**centralized automated loop reporting system (CALRS)**

A support system that provides full automation of the telephone company repair service bureau operating environment. The integrated test system permits remote testing independent of transmission media and geographic locations.

**centralized automatic message accounting (CAMA)**

A system that produces itemized billing details for subscriber-dialed long distance calls. Details are recorded at a central facility serving a number of exchanges. In exchanges not equipped for Automatic Number Identification, calls are routed to a CAMA operator who obtains the calling number and keys it into the computer for billing. *See also* local automatic message accounting.

**centralized automatic reporting on trunks (CAROT)**

A system for automatically reporting faults identified on toll trunk circuits.

**centralized operation, administration, and maintenance (COAM)**

An application on DNC-500 hardware providing centralized operation, administration, and maintenance for DMS-100 Family products. One application is for the DMS-100 host and up to eight large business remotes in a DMS-100 switching cluster.

**central message controller (CMC)**

A hardware entity, located in the central control complex frame, that provides an interface between the central processing unit, network module controllers, and input/output controllers.

**central office (CO)**

A switching office arranged for terminating subscriber lines and provided with switching equipment and trunks for establishing connections to and from other switching offices. Synonymous with class 5 office; end office; local office. *See also* office classification.

**central processing unit (CPU)**

A hardware entity, located in the central control complex frame, that contains the central data processor for the DMS-100 Family system.

**central processor and memory (CPM)**

The shelf in the central control complex combining a central processing unit and program store.

**central side (C-side)**

The side of a node facing away from the peripheral modules (PM) and toward the central control (CC). Also known as control side. *See also* peripheral side.

**centrex**

Centralized private branch exchange (PBX). A service that provides a business telephone subscriber with direct inward dialing to extensions on the same system and direct outward dialing from all extensions. Centrex switching equipment normally is at the central office, but can be on the operating company client's premises.

**CHB**

Call handler block

**CI**

Command interpreter

**CICS**

Customer information control system

**CIR**

Clock interrupt register, circular

**circuit pack (CP)**

In DMS SuperNode, consists of multi-layered PCB, through-hole electronic components, a backpanel connector, a faceplate, lock latches, and stiffeners.

**CLASS**

Custom local area signaling service

**CLASS automatic call setup**

The call setup capability that is provided by the combination of CLASS automatic recall (AR) and CLASS automatic call back (ACB) services.

**CLASS base**

The base capability on which the DMS-100 implementation of CLASS services is built. CLASS base comprises: origin directory number (DN) attribute identification that assembles calling DN details, CCS7 ISUP signaling that passes calling DN attributes to the destination as part of call setup, and incoming and outgoing call memory update that stores details of the last incoming and last outgoing call.

**CLASS modem resource (CMR) card**

The NTX78 card that is used by CLASS features to transmit calling number and name information to customer premises equipment.

**classes of exchange**

*See* office classification

**class of office**

A rank assigned to switching offices in the telephone network. An office's rank is determined according to the office's switching functions, its relationship to other offices, and transmission requirements. *See also* office classification.

**class of service**

The categorization of telephone subscribers according to the specific types of service extended. Telephone service distinctions include such items as rate differences between individual and party lines, flat rate and message rate, and restricted and extended area service.

**C-link**

The signaling data link (SDL) that connects the mates of a signaling transfer point (STP) pair. *See also* signaling data link, signaling transfer point.

**CLK**

Clock

**CLLI**

Common language location identifier

**clock (CLK)**

clock may be either:

- a repetitive precisely-timed signal used to control a synchronous process such as logic or transmission
- a repetitive precisely-timed signal used to control a synchronous process such as logic or transmission
- a hardware device that provides accurate timing signals to synchronize DMS-100 Family system circuits
- an ultra-stable square-wave oscillator capable of maintaining a precise output frequency for long periods of time

**CM**

Communications module, computing module, connection memory

**CMC**

Central message controller

**CMDC**

Computing module duplex cabinet

**C-message weighting**

A noise weighting used to measure noise on a line that is terminated by a standard telephone or similar instrument.

**CMIC**

Computing module interface card

**CMR**

CLASS modem resource

**CMWI**

CLASS message waiting indicator

**CO**

Central office, cutoff (relay)

**COAM**

Centralized operation, administration, and maintenance

**code blocking (CBK)**

A network management control that provides a means of limiting a percentage of the traffic into a congested area based on the destination code. CBK is applied or removed through the MAP. The percentage level can be set in the range of 1 to 100.

**coin operation**

A coin telephone operation is divided into three categories:

- Prepay, or coin first (CCF) – coin must be deposited before a dial tone is returned. The coins are collected or returned at the end of the call.
- Semi-postpay (CSP) – dial tone is provided to the coin telephone when the handset is lifted. A call is dialed, and when the called party answers, a line reversal is applied to the coin telephone set to block voice transmission until the initial rate is deposited. On calls to free numbers, no reversal signal is returned to the coin station. All deposited coins proceed directly to the coin box and cannot be returned to the caller.
- Dial tone first (CDF) – coin service that uses a loop start line to provide dial tone with no prior coin deposit. After sufficient digits are dialed, the central office makes a ground test for initial deposit and checks to determine whether or not the call is directed to a free number. If the initial rate is satisfied or if the call is directed to a free number, the connection is completed. The coins are returned or collected at the end of the call or at the end of dialing, depending on the type of call.

**cold restart**

An initialization phase during which temporary storage is deallocated and cleared. All calls are dropped and the peripheral processors clear all channel assignments. *See also* warm restart.

**collector**

In DMS call processing, the software used to build messages to collect digits.

**combined trunk**

A trunk that carries traffic from various stations such as coin and noncoin.

**command interpreter (CI)**

A support operating system component that functions as the main interface between machine and user. Its principal roles include:

- reading lines entered by a terminal user
- breaking each line into recognizable units
- analyzing the units
- recognizing command item-numbers on the input lines
- activating these commands

**common language location identifier (CLLI)**

A standard identification method for trunk groups in the form:

aaaa bb xx yyyy

where:

aaaa=city code  
bb=province or state code  
xx=trunk group identity  
yyyy=trunk number

*See also* short common language location identifier.

**common peripheral processor (CPP)**

In the DMS-100 packaged system, a dual-shelf peripheral module that acts as an interface with the network module.

**communications module (CM)**

Connects to key telephone systems installed in DMS-100 Family offices. The CM is used for voice communication applications where control of key telephone service (KTS) lines on a priority basis and a conferencing capability of up to five KTS lines are required.

**Common Channel Inter-office Signaling No. 6 (CCIS6)**

A Common Channel Signaling system using analog trunks for the North American market. CCIS6 uses fixed length signaling messages.

**common channel signaling (CCS)**

A signaling method in which information relating to a multiplicity of labelled messages is transmitted over a single channel using time-division multiplex (TDM) digital techniques.

**Common Channel Signaling No. 7 (CCS7)**

A digital, message-based network signaling standard defined by the CCITT which separates call signaling information from voice channels so that interoffice signaling is exchanged over a separate signaling link.

- the signal has been acknowledged in the opposite direction by the receiving terminal
- an acknowledgement has been received by the originating terminal

**component busy hour**

The time-consistent 60 min. period when call attempts or use is the highest for a particular switch component (for example, Digitone receivers, tones, and announcements).

**composite signaling (CX)**

A signaling arrangement that provides the means for DC signaling and dial pulsing beyond the range of loop signaling methods.

**compress and expand (compand)**

A process used in some pulse code modulation (PCM) systems to reduce noise. Analog signals are compressed before being sampled for quantizing and expanded at the receiving end after decoding.

**computing module (CM)**

The processor or memory complex of DMS SuperNode.

**computing module duplex cabinet (CMDC)**

One of the three cabinet models for DMS SuperNode. The CMDC is dedicated to a computing module and consists of a computing module shelf and one provisionable system load module (SLM) extension shelf to house the SLMs.

**computing module interface card (CMIC)**

In DMS SuperNode, the card used by the message switch to act as an interface with the computing module. The CMIC uses fiber optic transmission links.

**concentrator**

A device that connects a large number of inlets, which are not all used at once, to a small group of outlets for economical transmission. A telephone concentrator achieves the reduction by means of a circuit-switching mechanism. A data concentrator buffers incoming data and retransmits it over appropriate output lines.

**conference call**

A call established among three or more parties in such a manner that each of the stations is able to communicate with all of the others. Synonymous with conference connection.

**conference connection**

*See* conference call.

**connectionless signaling**

A type of signaling used with CCS7 that is not associated with the take-down of a call. For example, signaling used to access a database for 800-number translations and maintenance signaling between signaling points is considered to be connectionless signaling.

**connection memory (CM)**

The part of each crosspoint switch within a network module that stores the addresses of speech samples. These speech samples are to be manipulated during the network frame-switching process.

**connection-oriented signaling**

Signaling used by CCS7 in the DMS-100 Family of switches to set up, monitor, and take down a call.

**connections per circuit per hour (CCH)**

The number of connections established at a switching point each hour. CCH is a unit of traffic measurement.

**cooling unit (CU)**

Typically, a five fan unit mounted on equipment frames to ventilate equipment and prevent overheating.

**core**

A packaged system in the DMS-100 Family consisting of the central processing unit, memory, and central message controller. The DMS-100 packaged system core also includes the input/output controller and network module. *See also* dual network packaged core.

**CPM**

Central processor and memory

**CPOCC**

Call processing occupancy

**CPP**

Common peripheral processor

**CPU**

Call pickup, central processing unit

**C-side**

Central side

**CSM**

Channel supervision message

**CTRU**

CAMA TOPS Recording Unit

**CTX**

Centrex system number



**customer data schema**

A complete and detailed description of the tables associated with the DMS-100 Family of systems. It lists the contents of tables and the range of the data controlling the operation of the office.

**customer information control system (CICS)**

A system that permits an operating company to manipulate its own switching system, thus allowing the operating company, for example, to determine feature applications and class of service

**customer premises equipment (CPE)**

Equipment, such as ISDN terminals, that is located on the customer's premises

**customer service report (CSR)**

A Nortel Networks term referring to a problem report from the field. Formerly known as master trouble file.

**custom local area signaling service (CLASS)**

A set of call services that provides the ability to supply calling line identification to the call destination, store information on the last incoming and last outgoing call, and monitor the status of a destination line.

**CW**

Calls waiting

**D/A**

Digital-to-analog

**data cache**

A fast memory on the CPU card of DMS SuperNode that is used to store copies of data from the data store.

**data circuit**

A means of two-way data transmission between two points comprising associated transmit and receive channels.

**data communications equipment (DCE)**

In a data communications system, any piece of equipment that sets up, monitors, and terminates a connection. DCE also provides the protocol conversion so that DTE can communicate with other terminals in the data network.

**data concentrator**

In data transmission, a unit that permits a common transmission medium to serve more data sources than there are channels currently available within the medium.

**datafill**

The entry of data into tables

**data line card (DLC)**

The line card that connects a data path loop to a data unit. The DLC is part of a line subgroup in a line concentrating module.

**data link**

A full-duplex data set used to connect message desk terminal devices to the DMS-100 switch. It is also used to transmit messages between the message desk and the DMS-100 switch.

**DATALINK**

A Bell Canada digital data service. DATALINK is a trademark of Bell Canada.

**data link layer**

Layer 2 in the open systems interconnection (OSI) model that is used to create logical links between ISDN terminals and the services they access. The datalink layer provides error-free, sequenced messaging over a channel.

**data network**

A data network may be either:

- the assembly of units that establishes data circuits between data terminal equipment units.
- the interconnection of a number of locations, by means of communication facilities such as telegraph lines, telephone lines, or microwaves, for the purpose of transmitting or receiving data.

**data network address (DNA)**

A number used to access a terminal on a packet switched network.

**data network identification code (DNIC)**

For ISDN, a code that is used in packet switching to identify the network being addressed.

**DATAPAC**

A system of transmitting data between switching points over a switched network dedicated to data. Packages of data are transmitted and checked for errors before further packages are sent. DATAPAC is a trademark of Bell Canada.

**data packet collector (DPC)**

An input/output device used for data communications with the DMS-100

**data packet network (DPN)**

A packet-switched networking system that is manufactured by Nortel Networks

**Datapath**

Nortel Networks' system for providing direct, circuit-switched digital data transmission through a DMS switch over existing telephone networks. Datapath also provides connectivity to public and private networks. Datapath functions with industry standard data terminal equipment and applications, using T-link rate adaption protocol for communication. Datapath is a trademark of Nortel Networks.

**data port (DP)**

The point of connection in the central processing unit (CPU) of the parallel data buses between the CPU and the central message controller or data store.

**DATAROUTE**

A Bell Canada point-to-point digital data facility. DATAROUTE is a trademark of Bell Canada.

**data schema**

The format of data for a particular data base table

**data store (DS)**

One of the two distinct elements of a DMS-100 memory, DS is part of the central control complex. It contains transient information on an each call basis as well as customer data and office parameters. The other main element is program store. *See also* program store.

**data terminal equipment (DTE)**

Equipment consisting of digital end instruments that convert user information into data signals for transmission or convert the received data signals into user information.

**data unit (DU)**

Equipment used as a data interface, enabling DTE to access the DMS-100 switch network. A DU can be configured as a desk top unit or as a rack-mounted component of the switch.

**dBm**

Power relative to one mw. The DMS-300 is assumed to be at a 0 dBm point in the network.

**DC**

Device controller

**D-call control**

Call control information that is carried on the D-channel and used to establish, maintain, or clear a voice or circuit-switched data call on a B-channel of an ISDN.

**D-channel**

For BRI, the D-channel is a 16 kb/s, bi-directional channel. A D-channel carries call control messages between a terminal on an ISDN interface and the exchange termination. These call control messages are used to set up, maintain, or clear a circuit-switched call on a B-channel. The D-channel also carries low-speed packet data between a terminal on an ISDN interface and a terminal in the packet data network. For PRI, the D-channel is a 64 Kbps, bi-directional channel. *See also* Bd channel, BRI, PRI.

**D-channel handler (DCH)**

A card in an ISDN line group controller (LGCI) or in an ISDN line trunk controller (LTCI) that provides the primary interface to all D-channels. The DCH also performs Q.921 LAPD layer 2 processing. The DCH is connected permanently to an ISDN loop and receives or sends messages on the signaling/packet data channel.

**D-channel handler interface (DCHI)**

Connects the MSL-1 with the D-channel in ISDN primary rate access. The DCHI performs link access procedures on the D-channel for primary rate access.

**DCM**

Digital carrier module

**DCP**

Data communications processor

**DCT**

Digital carrier terminal

**DD**

Data dictionary, delay dial, or direct dial

**DDD**

Direct distance dialing

**DDU**

Disk drive unit

**dedicated**

Used exclusively for a single purpose or by a single subscriber

**dedicated access line (DAL)**

A trunk interface that connects a PBX, a key system, or a single telephone to a DMS-250

**dedicated trunk**

A trunk that carries traffic for one station class only.

**definitions module**

A module that contains only type definitions and no data. It is used for compiling and is never loaded onto the switch.

**derived data link (DDL)**

A data line over which the subscriber module SLC-96 and remote concentrator SLC-96 exchange messages. The link is a 2.2 kb/s data path formed by robbing superframe Fs framing bits.

**derived data link (DDL) facility**

Call processing software located in the SMS signaling processor that assigns and deassigns DS-1 channels to subscriber loops and maintains an inventory of available DS-1 channels.

**destination point code (DPC)**

A Common Channel Signaling No. 7 term defining the termination of a signaling message. *See also* origination point code.

**device controller (DC)**

Hardware entity in the form of printed circuit boards that plug into positions in the input/output controller (IOC). It provides an interface between the IOC and external I/O devices such as the visual display unit, magnetic tape unit, and teletypewriter.

**device independent recording package (DIRP)**

Software that automatically directs data from the various administrative and maintenance facilities to the appropriate recording devices

**DF**

Distribution frame

**DGT**

Digitone

**DI**

Document index

**diagnostic request (DR)**

An input to the DMS-100 Family maintenance system from an input/output device requesting that a diagnostic procedure be run on a specific item.

**dialable number delivery (DND)**

The CLASS that shows the directory number in a dialable format of the calling party and the date and time of the incoming call on a display on a CND subscriber's set.

**dial long lines circuit**

A circuit used to extend the range of subscriber loops by repeating supervision and dial pulses from the subscriber to the central office and by repeating ringing from the central office to the subscriber.

**dial pulse (DP)**

A method of transmitting signaling information from a telephone set or a trunk circuit. Dial pulses are generated by alternately opening and closing a contact in the telephone through which the direct current flows. Also known as decadic signaling. *See also* dual-tone multifrequency (signaling).

**Dial pulsing**

A telephony feature that provides the capability of transmitting and receiving direct current address signals between offices

**dial-tone delay (DTD)**

The time elapsed between the subscriber going off-hook and reception of dial tone

**DIALAN**

DMS integrated access local area network

**DID**

Design intent document, or direct inward dialing

**DigiPulse**

A telephone apparatus that employs a key-pad to effect dial pulse dialing. DigiPulse is a trademark of Nortel Networks.

**digital carrier equipment (DCE) frame**

An equipment frame that houses digital carrier modules.

**digital carrier module (DCM)**

A peripheral module, located in a digital carrier equipment frame, that provides speech and signaling interfaces between a DS-30 network port and digital trunks. A DCM is provisioned with up to five line cards.

**digital interworking unit (DIU)**

The unit in a digital packet network switch that converts B-channel and D-channel data packets received in a DS-1 format from the ISDN access controller to a VR-35 format that is suitable for the access module. For packets being sent in the opposite direction, the DIU performs the reverse conversion.

**Digital Multiplex System (DMS)**

A central office switching system in which all external signals are converted to digital data and stored in assigned time slots. Switching is performed by reassigning the original time slots. DMS is a trademark of Nortel Networks.

**digital network interconnecting (DNI) frame**

A frame or group of frames housing network junctor connecting panels, which organize the pattern of connections between the junctor faces of network modules

**digital recorded announcement (DRA)**

A set of one or more phrases routed to a subscriber as a recorded announcement. The DRA is stored in the digital recorded announcement machine and is initiated by the system software.

**digital recorded announcement machine (DRAM)**

A peripheral module, developed for DMS, in which voice messages are stored in digital form, providing access to up to 30 different service voice announcements

**Digitone (DT) or (DGT)**

A service-related telephony feature that provides for the generation of address information from a telephone set in the form of dual-tone multifrequency (DTMF) signals by the manual pressing of non-locking buttons. Also known as dual-tone multifrequency dialing. Digitone is a trademark of Nortel Networks.

**direct dial (DD)**

A call origination type that applies to calls that require no operator intervention.

**direct dial overseas (DDO)**

Dialing of calls to an overseas destination without the help of the operator. Usually accomplished by first dialing 011 followed by a country code and a city code.

**direct distance dialing (DDD)**

A telephone exchange service that permits a subscriber to call a number outside his local area without operator assistance.

**Direct Inward Dialing (DID)**

An optional telephony feature that allows an incoming exchange network call (not FX or wide area telephone service) to reach a specific private branch exchange station line without attendant assistance. When DID is available, central offices are capable of providing specific station identification to the PBX.

**direct memory access (DMA)**

A device for transferring blocks of continuous data to and from memory at a high rate

**directory**

In a DMS, a software structure that can be used to look up, store, and delete symbols

**directory number (DN)**

The full complement of digits required to designate a subscriber's station within one NPA; usually a three digit central office code followed by a four-digit station number.

**Direct outward dialing (DOD)**

A service related telephony feature that permits a PBX or Centrex station user to gain access to the exchange network without the assistance of an attendant

**DIRP**

Device independent recording package

**disk drive unit (DDU)**

Consists of a disk drive and a power converter card installed in an input/output equipment frame.

**distributed line hunt (DLH)**

A hunting arrangement consisting of lines divided into groups. The hunt is sequential over all groups until a line is selected in an available group. *See also* line hunting.

**distributed processing peripheral (DPP)**

A peripheral module that accepts data from the DMS-100, formats the data if necessary, and stores it on a disk. On request, the DPP retrieves and sends data to the host office collector.



**distribution frame (DF)**

A distribution frame may be either:

- a hardware entity that, on one side, provides metallic terminations for cables carrying incoming and outgoing voice paths to the peripheral modules and, on the other side, provides terminations for outside cables.
- a structure with terminations for connecting permanent wiring in such a manner that interconnection can be achieved readily by means of cross-connecting wires.

**divided ringing**

Line configuration in which ringer connections are divided between two-party lines or among multi-party lines. One party or group of parties connects to the line's tip lead and to ground. The other party or group of parties connects to the line's ring lead and to ground. Single frequency ringing can be used for two parties. Selective ringing must be used on lines shared by more than two stations.

**DLC**

Data line card, dynamic load control (unit)

**D-link**

A signaling data link that connects a signaling transfer point (STP) of one STP pair to another STP pair in the network. *See also* signaling data link, signaling transfer point.

**DM**

Data memory or data modification

**DMA**

Direct memory access

**DMS**

Digital Multiplex System

**DMS-1**

A digital subscriber carrier system serving up to 256 lines.

**DMS-100 Family of switches**

A family of digital multiplexed switching systems, which includes the following:

**DMS-10**

A small, class 5 digital switch accommodating 400 to 6000 lines.

**DMS-100**

Local switch

**DMS-200**

Toll switch

**DMS-100/200**

Switch of mixed function, in this case a combined local/toll switch. Other combinations are possible.

**DMS-250**

Toll switch designed for private toll networks

**DMS-300**

Gateway switch

**DMS-100 switching cluster**

A DMS-100 host, up to eight large business remotes, and a centralized operation, administration, and maintenance application. Together these components operate and are maintained as a single switching center.

**DMS-100 switching network**

Multiple DMS-100 Family products that are maintained from a centralized operation, administration, and maintenance application.

**DMS-bus**

The messaging control component of DMS SuperNode. It consists of a pair of message switches.

**DMS-core**

The call management and system control portion of DMS SuperNode. It consists of a computing module and a system load module.

**DMS-link**

The networking software of DMS SuperNode. DMS-link consists of open and standard protocols that enable DMS SuperNode to function in a multi-vendor environment.

**DMS-STP**

Digital Multiplex System signaling transfer point. DMS-STP is a trademark of Nortel Networks.

**DMS SuperNode**

A central control complex for the DMS-100. The two major components of DMS SuperNode are the computing module and the message switch. Both are compatible with the current network module, the input/output controller, and XMS-based peripheral modules.

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<b>DMS-X</b>	A link control protocol used with DS-30A links for messaging between peripheral modules.
<b>DN</b>	Directory number
<b>DNA</b>	Data network address
<b>DNC</b>	Dynamic network controller
<b>DOD</b>	Direct outward dialing
<b>down stream processor (DSP)</b>	A stand-alone computer that receives automatic call distribution, call-related, and agent positioned-related event messages generated by a DMS-100 Centrex switch. The DSP stores and processes the information to generate realtime operation displays and historical reports.
<b>DP</b>	Data port, dial pulse
<b>D-packet</b>	Packet data that is carried on the D-channel between the packet handler and an ISDN BRA terminal
<b>DPC</b>	Data packet collector, destination point code
<b>DPN</b>	Data packet network
<b>DPP</b>	Distributed processing peripheral
<b>DRA</b>	Digital recorded announcement
<b>DRAM</b>	Digital recorded announcement machine

**drawer**

A sliding container within a shelf in the DMS-100 cabinet. A drawer contains components, such as cards, to which easy access is required for maintenance and service requests.

**DS**

Data store

**DS-0**

A protocol for data transmission that is used to represent one channel in a 24 channel DS-1 trunk.

**DS-1 interface circuit pack**

An SMS or SMU card that has a product engineering code of 6X85AA or 6X85AB. The card links the RCS and SMS or the RCU and SMU.

**DS-1 link**

The 8 bit, 24 channel, 1.544 Mb/s digital signaling format as used in the DMS-100 Family. DS-1 is the North American standard for digital trunks. It is a closely specified bipolar pulse stream with a bit rate of 1.544 Mb/s. The DS-1 signal is the standard signal used to interconnect Nortel Networks digital systems. The DS-1 signal carries 24 information channels of 64 Kbps each (DS-0s).

**DS-30 link**

A DS-30 link may be either:

- a 10 bit, 32 channel, 2.048 Mb/s speech-signaling and message-signaling link as used in the DMS-100 Family
- the protocol by which DS-30 links communicate

**DS-30A link**

A 32 channel transmission link between the line concentrating module and controllers in the DMS-100 Family. DS-30A is similar to DS-30, though intended for use over shorter distances.

**DS-512 fiber link**

The fiber optic transmission link implemented in DMS SuperNode. The DS-512 is used for connecting the computing module to the message switch. One DS-512 link is the equivalent of 16 DS-30 links.

**DSN**

Data set name

**DSNE**

Double shelf network equipment (frame)

**DT**

Digitone

**DTC**

Digital trunk controller

**DTCI**

ISDN digital trunk controller

**DTD**

Dial-tone delay

**DTE**

Data terminal equipment, digital trunk equipment (frame)

**DTMF**

Dual-tone multifrequency (signaling)

**DTS**

Dial-tone speed, digital test sequence

**DTSR**

Dial-tone speed recording

**DU**

Data unit

**dual plane combined core cabinet (DPCC)**

One of the three cabinet models for DMS SuperNode. The DPCC packages two message switches and a system load module.

**dump/restore**

*See* local dump and restore, remote dump and restore

**duplexing**

The use of duplicate computers, files, circuitry, or transmission lines to allow the duplicate to take over in the event of a component failure

**duplex signaling**

A signaling system that occupies the same cable pair as the voice path, yet does not require filters. One duplex signaling section is confined to 400 ohms of loop resistance, though several sections can be used in tandem.

**dynamic multiplexing**

A form of time division multiplexing in which the allocation of time to constituent channels is made according to the demands of these channels.

**dynamic network controller (DNC)**

A family of applications that is part of Northern Telecom's dynamic network architecture. These applications generally provide an enhanced level of network control. Also, they allow operating companies to develop their service management and administration system independently of the evolution of their network equipment.

**dynamic overload control (DOC)**

A network management control applied automatically in response to an external signal or an overload condition detected in the switch itself. *See also* internal dynamic overload control, preplanned control.

**E & M signaling**

An arrangement whereby signaling between a trunk circuit and an associated signaling unit is effected over two leads: an M lead to transmit signals to the signaling unit, and an E lead to receive signals from the signaling unit. E & M signaling provides full-time, two-way, and two-level supervision.

**EA**

Equal access

**EABS**

Exchange alternate billing service

**EADAS**

Engineering and administrative data acquisition system

**EAEO**

Equal access end office

**EAS**

Extended area service

**EBAF**

Expanded Bellcore AMA format

**EBS**

Electronic business set

**EIA**

Electronic Industries Association

**800 Service**

An intertoll office service in which the called party subscribes to the service and pays for toll calls. Also called inward wide area telephone service (INWATS).

**EIU**

Ethernet interface unit

**electromagnetic interference (EMI)**

In a DMS, the hardware used to control radiated and conducted energy from digital electronic equipment that might interfere with radio transmissions.

**electronic business set (EBS)**

A telephone set that provides subscribers with push-button access to various business features.

**Electronic Industries Association (EIA)**

An American organization made up of manufacturers of a wide variety of electronic products including telecommunications equipment. The EIA is active in setting industry standards.

**electronic key telephone service (EKTS)**

A set of services for ISDN voice terminals on a BRA interface. EKTS provides shared directory numbers (DN), multiple DNs for each service profile, and conference and intercom calling.

**Emergency technical assistance service (ETAS)**

A Nortel Networks department that provides technical support for emergencies, cutovers, software updates, and product verification.

**EMI**

Electromagnetic interference

**encoder**

A device that encodes data. It consists of a number of input lines of which not more than one at a time can carry a signal and a number of output lines of which any number can carry signals. A one-to-one correspondence exists between the input signals and the combinations of output signals. *See also* decoder.

**ENCP**

Enhanced network central processor

**end office (EO)**

A switching office arranged for terminating subscriber lines and provided with trunks for establishing connections to and from other switching offices.

**ENET**

Enhanced network

**engineering and administrative data acquisition system (EADAS)**

An operational measurements support system that collects data from many central offices. It has two components, one for data collection and one for network management.

**enhanced 800 service (E800 Service)**

A Common Channel Signaling No. 7 feature available in the United States that allows inter-exchange carriers equal access to the Basic 800 Service. E800 Service presents network intelligence at an access tandem office or an end office (EO) using an on-line database query system. Also known as E800. *See also* Basic 800 Service, 800 Plus Service, 800 Service.

**enhanced ACD**

Enhanced Automatic Call Distribution

**enhanced network (ENET)**

A channel-matrixed time switch that provides pulse code modulated voice and data connections between peripheral modules. The ENET also provides message paths to the DMS bus.

**EO**

End office

**equal access (EA)**

An operating telephone company tariff offering for local access and transport area (LATA) access that is equal in type, quality, and price for all connected interLATA and international carriers.

**equal access end office (EAEO)**

A central office that provides access to several long distance carriers

**ESA processor**

Emergency Stand-Alone processor

**ESCO**

Emergency service central office (number)

**ESN**

Emergency service number

**ESP**

Enhanced service provider, essential services protection

**Ethernet interface unit (EIU)**

The unit that connects the DMS SuperNode to the local area network



**EWT**

Estimated work time

**exclusive exchange line**

*See* direct exchange line

**expanded Bellcore AMA format (EBAF)**

The ability to append additional data in modular form to Bellcore AMA format (BAF) AMA records. Module codes are used to identify the format of the data appended to the BAF call record. One or more modules can be appended to a BAF call record.

**FA**

Feature activator

**FADS**

Force administration data system

**F-bus**

Frame transport bus

**F-bus tap**

Frame transport bus tap

**feature activator (FA)**

The key on an ISDN stimulus terminal with circuit-switched service that activates supplementary services such as ring again.

**feature appearance (FAP)**

A feature key on an M5317T or any ISDN terminals that activates a feature.

**feature document (FDOC)**

A document that describes in detail hardware and software features of the DMS Family of switches. Formerly known as design intent document.

**feature indicator (FI)**

A device that indicates the state or condition of a call when using a supplementary service on an ISDN stimulus terminal with circuit-switched service.

**feature key management (FKM)**

Feature key management may be either:

- the concept of using FAs and FIs to access supplementary services. This way of accessing features is unique to stimulus terminals.
- a facility available on ISDN voice terminals that provides access to supplementary services such as ring again.

**fiber peripheral module (FPM)**

A version of peripheral in which DS-512 compatible fiber links replace DS-30 interfaces

**flat rate area**

*See* flat rate charge service

**flat rate charge service**

A service-related telephony feature that, for a fixed monthly charge, permits an unlimited number of completed calls from a local non-coin line to a group of specified destinations. This group is referred to as a flat rate area and is usually located within a geographic boundary surrounding the central office. Two or more flat rate areas can be specified for a central office with some destinations assigned to more than one flat rate area.

**floating point (FP)**

An exponent representing the position of the decimal point in the output from the level meter section of the pulse code modulation (PCM) level meter card in the maintenance trunk module

**force administration data system (FADS)**

Data derived from traffic operator position system (TOPS) operational measurements and used for force management and for operating performance calculation

**force management**

The administrative system that manages the entire TOPS work force

**force managers position**

A position provided for the administration of the operator force in a TOPS complex with more than one traffic office. It consists of a video monitor and a teletypewriter.

**foreign exchange (FX)**

A service that allows a telephone or a PBX to be served by a distant central office (CO), rather than by the CO in the immediate geographical area

**foreign exchange trunk (FX trunk)**

A PBX or an integrated business network (IBN) foreign exchange trunk that provides access to a remote central office

**formatter**

A device that allows the conversion of any type known to the data dictionary from its human-readable character representation to its PROTEL representation and from its PROTEL representation to its human-readable character representation.

**forward supervision**

In data communications, the use of supervisory sequences sent from the main to the auxiliary station. *See also* backward supervision.

**four-party line**

A common line arranged to serve four main stations. Identification of each party is not automatic, and ringing selectivity is dependent upon central office ringing arrangements in accordance with the Multiparty Ringing feature.

**FP**

Floating point

**FPM**

Fiber peripheral module

**frame**

A frame may be either:

- one complete cycle of events in time-division multiplexing. The frame usually includes a sequence of time slots for the various channels and extra bits, which are used, for example, for control or framing.
- a unit of hardware in DMS that contains usually one bay but can contain two or more functionally related bays.

**frame loss**

Loss of one complete cycle of events (193 bits) in time division multiplexing, including the voice channels and control bits.

**frame supervisory panel (FSP)**

Accepts the frame battery feed and ground return from the power distribution center. The FSP distributes the battery feed, by means of subsidiary fuses and feeds, to the shelves of the frame or bay in which it is mounted. The FSP also contains alarm circuits.

**frame transport bus (F-bus) tap**

An eight bit bus that provides data communications between a local message switch (LMS) and the link interface units that are provisioned in a link peripheral processor (LPP). To ensure readability, two load-sharing F buses are provided in an LPP. Each F bus is dedicated to one of the two LMSs. *See also* link interface module.

**frame transport bus (F-bus) tap**

Provides messaging access to a frame transport bus (F-bus). For DMS signaling transfer point (DMS-STP) applications, the tap is either part of the F bus rate adaptor card that is used by the local message switch or is part of the CCS7 link interface unit (LIU7). *See also* F-bus.

**frequency-division multiplex (FDM)**

A multiplex system in which the available transmission frequency range is divided into narrower bands, each used for a separate channel

**frequency selective ringing (FSR)**

**FT**

Phototool

**FX**

Foreign exchange

**FX trunk**

Foreign exchange trunk

**gate interface**

The part of a gate module that defines the procedures available to the user

**gate module**

A utility module that provides the mechanism for selecting functions coded in various agencies on the basis of information passed to and stored in the gate

**gate utility**

A subsystem of software that provides a PROTEL procedural interface, which is implemented in another subsystem. The procedures are known as target procedures and are chosen based on a selector.

**GBH**

Group busy hour

**general feature description (GFD)**

A Nortel Networks customer document that describes all or part of a Nortel Networks software feature package for a particular batch change supplement (BCS).

**GFD**

General feature description

**glare**

A condition that results from the simultaneous seizure of a two-way trunk at both ends, also known as double seizure

**global timer**

A timer located in the peripheral processor that records the passage of real time. The register that indicates the current time value is incremented every 10 min.

**GFD**

General feature description

**glare**

A condition that results from the simultaneous seizure of a two-way trunk at both ends. Also known as double seizure.

**global timer**

A timer located in the peripheral processor that records the passage of real time. The register that indicates the current time value is incremented every 10 minutes.

**global title (GT)**

An application address that does not explicitly contain the necessary information that would allow routing by the signaling connection control part (SCCP) of the message transfer part (MTP). The SCCP global title translation (GTT) function is required to translate a GT into a valid network address.

**global title translation (GTT)**

The process that translates an application-specific address (such as a dialed 800 number) into the CCS7 network address, usually that of the appropriate service control point.

**GOS**

Grade of service

**GPF**

General planning forecast

**grade of service (GOS)**

The rates of delay and blockage in a DMS-100. The higher these rates become, the lower the grade of service that is experienced by the subscriber.

**ground start line**

A line circuit arrangement in which a dial tone is sent in response to a ground signal on the ring conductor applied by the calling station or PBX. This process differs from the more common loop start configuration in which seizure is accomplished by bridging the tip and ring conductors.

**ground start mode**

A condition that applies to CCF lines, with the battery applying –48 V to the ring side of the subscriber loop and the tip side open.

**group**

Twelve voice channels that are frequency-division multiplexed together into a single frequency band. Also known as channel group.

**group busy hour (GBH)**

The hour when a line or trunk group carries the most traffic. GBH is used as a factor in traffic provisioning calculations.

**GS**

General specification

**GT**

Global title

**GTT**

Global title translation

**GWB**

Ground window bar

**HADS**

Hotel administration data system

**Hard-to-reach peg (HTRP) count**

A network management feature in the DMS-300 system that allows the network management to obtain peg counts on suspected hard-to-reach (HTR) codes.

**HDBH**

High day busy hour

**HDLC**

High-level data link control

**HIE**

Host interface equipment (shelf)

**high day busy hour (HDBH)**

The hour, not necessarily a clock-hour, that produces the highest load during busy season

**high idle (HIDLE)**

A class of message used in the DMS-100 Family input/output message system. HIDLE is sent by a module to indicate that only high-priority messages are to be transmitted to it.

**HNPA**

Home numbering plan area

**HOBIC**

Hotel billing information center

**HOBIC administrative (HADS) teletypewriter**

A send/receive teletypewriter located in the HOBIC. Its functions include:

- enabling HOBIC operators to enter billing information into the TOPS that is to be relayed to the autoquote (AQ), voice-quote (VQ), or record teletypewriter
- permitting HOBIC personnel to place any AQ, VQ, or record teletypewriter that is in service or out of service
- receiving hotel change-adjust (credit) messages generated by TOPS operators
- receiving teletypewriter service alarm messages
- receiving HOBIC operational measurements information

**HOC**

Host office collector

**host channel**

A link between the RLCM and the DMS central control.

**host interface equipment (HIE) shelf**

Located in the remote line concentrating module (RLCM) frame, the shelf that provides interface circuits between the host office and the RLCM.

**host office**

In a DMS, a central office equipped to control peripheral modules at remote sites.

**host office collector (HOC)**

A data center that collects automatic message accounting data from central offices within a given region. The HOC collects the data onto tapes and passes the information to the revenue accounting office for the production of subscriber bills.

**hotel billing information center (HOBIC)**

A centralized, operator-attended location that provides:

- call details to hotels for guest-dialed long distance calls
- time and cost information to guests upon request
- details on hotel equipment problems and billing inquiries (optional)

**hot standby**

The operating mode of duplicated units in the DMS-100 Family systems whereby both units simultaneously perform the same operations, but the output of only one is used. In the event of a failure, the other unit takes over the operations without processing loss.

**HSDA**

High-speed data access

**HSL**

High-speed line

**HSI**

High-speed interface

**HU**

High usage

**hundred call seconds (CCS)**

Calculated by multiplying the average number of calls during busy hour by the average holding time in seconds divided by 100.  $36 \text{ CCS} = 1 \text{ Erlang}$ .

**hunt group**

The association of several stations in the MDC subscriber group to allow incoming calls to search for an idle line. Three types of hunt groups are: directory number hunting (DNH), multiline hunting (MLH), and distributed line hunting (DLH). All of these options can be associated with ISDN terminals.

**hybrid circuit**

A circuit with a multi-winding bridge coil used with a balancing network to connect a two-wire circuit to a four-wire circuit.

**IAC**

Intracalling, ISDN access controller

**IAE**

Integrated access equipment (frame)

**IAML**

Intraoffice matching loss

**IAS**

Intraswitching



<b>IB</b>	In-band
<b>IBERT</b>	Integrated bit error rate test
<b>IBG</b>	Interblock gap
<b>IBN</b>	Integrated business network
<b>IBN EBS</b>	Integrated business network electronic business set
<b>IC</b>	InterLATA carriers
<b>ICAMA</b>	International centralized automatic message accounting
<b>ICI</b>	Incoming call identification
<b>ID</b>	Immediate dial
<b>IDF</b>	Intermediate distribution frame
<b>idler</b>	In DMS call processing, a function or procedure that is used to idle an agent in the event of abnormal call processing behavior
<b>IDTC</b>	International digital trunk controller
<b>IEC</b>	Inter-exchange carrier
<b>IF</b>	Interface (card)
<b>IGP</b>	Isolated ground plane

**ILCM**

International line concentrating module

**ILGC**

International line group controller

**immediate dial (ID)**

A mode of operation whereby dial-pulse address signals are transmitted after initiating a connect signal but without waiting for a proceed-to-send signal from the called end. The dial-pulse address signals are transmitted to the called end of an outgoing trunk to a step-by-step office.

**impulses per minute (IPM)**

Interruption rate for call progress tones or supervisory lamps

**IMR**

Individual message register

**IMS**

Input/output message system

**IN**

Intelligent network

**inactive**

A state in which an LCM unit is no longer connecting calls. It has dropped its activity. The call connections are taken over by the other LCM unit.

**Incoming trunk busy (ITB)**

A network management feature that allows the network manager to restrict incoming attempts to an overloaded switch. ITB performs this activity by selectively removing from service a percentage of incoming trunks that have remote make-busy capability.

**individual message register (IMR)**

Message register associated with the operational measurements system, which provides peg counts from 0 to 32 767 then resets automatically to 0.

**Infodisc**

An information storage, search, and retrieval system for Nortel Networks DMS-100 technical documentation. The information is stored on a read-only compact disc, which can store the equivalent of 275 000 pages of text. Infodisc is a trademark of Nortel Networks.

**information element**

Conveys additional information related to the routing and management of calls for the terminal and network in ISDN functional call control. Information elements vary depending on the message type.

**initial program load (IPL)**

In a DMS, the first time a particular program is initialized. *See also* cold restart, reload-restart, warm restart.

**input/output (I/O)**

A device or medium that is used to achieve a bi-directional exchange of data. Data exchange in the DMS-100 Family system is performed in accordance with the input/output message system (IMS).

**input/output controller (IOC)**

An equipment shelf that provides an interface between up to 36 input/output devices and the central message controller. The IOC contains a peripheral processor that independently performs local tasks, thus relieving the load on the central processing unit.

**input/output message system (IMS)**

A system that organizes the transmission and reception of internal messages between components of the DMS-100 Family system. IMS defines the structure, protocol, and maintenance features of internal message handling.

**installation busy (INB)**

A state assigned to a line under specified conditions in which call processing cannot take place but tests can be performed.

**instruction cache**

A fast memory built into the Motorola 68020 microprocessor that is used to store copies of instructions from the program store.

**integrated access equipment (IAE) frame**

For primary rate access, a frame containing one ISDN access controller.

**integrated bit error rate test (IBERT)**

A test that a MAP operator uses with an IBERT card to test the transmission quality of a selected data line. The card resides in the line drawer of a line concentrating module and generates the bit stream for an IBERT. An IBERT can be used to test most types of lines connected to the DMS if the lines will support the T-link protocol.

**Integrated business network (IBN)**

Now known as Meridian Digital Centrex. A special DMS business services package that utilizes the data-handling capabilities of a DMS-100 Family

office to provide a centralized telephone exchange service. Many optional features also are available.

**Integrated business network electronic business set (IBN EBS)**

A control device with addressable points (for example, directory number keys, feature keys, and display units). Business sets can support multiple simultaneous calls. They also can support premium voice features and low-speed data service.

**Integrated services access (ISA)**

Uses call set-up messages and dialed digits to permit access to public and private network services through one bi-directional common access facility. ISA provides the capability to support multiple call types (such as public, private, OUTWATS, INWATS, FX, and tie) on a single trunk.

**integrated services digital network (ISDN)**

A set of standards proposed by the CCITT to establish compatibility between the telephone network and various data terminals and devices. ISDN is a communications network that provides access to voice, data, and imaging services from a single type of connector.

**integrated services line module (ISLM)**

A line concentrating module that supports ISDN line cards. The ISLM works in association with the ISDN access controller.

**inter link-to-link protocol (ILLP)**

A level two CCS7 protocol that is used to detect message losses between CCS7 link interface units (LIU7). *See also* CCS7, LIU7.

**intermediate distribution frame (IDF)**

The frame that provides flexibility in the allocation of a subscriber number to the line unit or equipment in the office that is to be associated with the particular line.

**international alphabet 5 (IA5)**

The international alphabet is similar to ASCII and it supports some ASCII characters

**interperipheral connection (IPC)**

A connection in the interperipheral message link in common channel interoffice signaling. Two IPCs normally share the message handling load.

**Interswitch trunk (ISW)**

A trunk between switching centers

**Intraswitching (IAS)**

An optional feature that permits calls to be switched within one double-bay remote line module frame without using the host office switching network. *See also* mate remote line module link, intrabay link, interbay message link.

**inverter unit (INV)**

A hardware entity used to convert a 48 Vdc nominal office battery to a 115 V, 60 Hz supply for the cooling units

**inward wide area telephone service (INWATS)**

A telephony service that allows a subscriber to receive long distance telephone calls originating within specified service areas without a charge to the originating party. A 1-800 number is assigned to a certain PBX to allow for free calls. *See also* outward wide area telephone service, wide area telephone service, Basic 800 Service.

**I/O**

Input/output

**IOC**

Input/output controller

**IOC shelf**

A hardware shelf that provides an interface between up to 36 I/O devices and the central message controller. *See also* input/output controller.

**ISDN**

Integrated services digital network

**ISDN access controller (IAC)**

A frame used to support ISDN access between a DMS and voice and packet services

**ISDN line**

The physical part of a basic rate interface (BRI) that connects the terminals to the network termination (NT1 or NT2)

**ISDN line concentrating array (LCAI)**

A shelf in the ISDN line concentrating module (LCMI). It contains four physical line drawers. The LCMI consists of two line concentrating arrays, which operate in a load sharing mode with mutual takeover capability.

**ISDN line concentrating equipment (LCEI)**

A single-bay equipment frame containing two LCMI's

**ISDN line concentrating module (LCMI)**

A dual unit peripheral module that terminates ISDN lines. The LCMI will eventually replace the ISLM. Unlike those on the ISLM, LCMI B-channel connections are dynamic and can be used on an each call basis.

**ISDN line group controller (LGCI)**

A peripheral module that connects DS-30 links from the network

**ISDN service group (ISG)**

Defines the services that a D-channel handler (DCH) provides and their allocation to the channels within the DCH. ISG allows hardware-independent access to service-related functions at the MAP. The ISG MAP level provides a view of the services and the DCH MAP level provides a view of the hardware.

**ISDN signaling pre-processor (ISP)**

Provides call control messaging and D-channel handler maintenance functions

**ISDN switch**

A DMS switch configured to provide ISDN services. Its main functional components are the access termination and the packet handler.

**ISDN terminal**

A digital telephone or personal computer that is connected to a customer premises loop which forms part of a BRI

**ISDN U-line card (U-ISLC)**

An ISDN line card which terminates the U-loop in the enhanced line concentration module (LCME) or ISDN line concentration module (LCMI). When a U-ISLC is used, the network termination 1 (NT1) situated on customer premises acts as the network termination. Synonymous with ISLC and U-line card.

**ISDN user part (ISUP)**

A CCS7 message-based signaling protocol which acts as a transport carrier for ISDN services. The ISUP provides the functionality within a CCS7 network for voice and data services.

**journal file (JF)**

A facility that records changes made to the data tables of the DMS-100 Family systems. The JF provides a means of restoring the tables should it be necessary to reload office software from a backup.

**junctor**

The interface equipment at the end of any interoffice circuit or intraoffice trunk that provides circuit and signaling compatibility.

**Kb/s**

Kilobits per second

**keyboard send/receive (KSR)**

An input/output printer that is equipped with a keyboard for transmitting and receiving information

**key telephone set (KTS)**

A multiline telephone set where lines can be selected or placed on hold by push-buttons. Features of the system include pickup and holding, intercommunications, visual and audible signals, cutoff, exclusion, and signaling. *See also* key telephone system.

**kilobits per second (Kb/s)**

A bit rate expressed in thousands of bits per second

**LAMA**

Local automatic message accounting

**large business remote (LBR)**

A DMS-100 that is configured to serve as a switching unit at a remote site

**last trunk busy (LTB)**

Condition when the last of a group of circuits is busy. If the group has automatic alternative routing, an attempt is made automatically to route additional calls another way.

**LBR**

Large business remote

**L-bus**

A bi-directional link that acts as the interface between the bus interface card and the line card in an enhanced line concentrating module (LCME)

**LCEI**

ISDN line concentrating equipment

**LCM**

Line concentrating module

**LCME**

Enhanced line concentrating module

**LCMI**

ISDN line concentrating module

**least significant bit (LSB)**

In binary numbers, the bit representing the lowest power of two.

**LEN**

Line equipment number

**LGC**

Line group controller

**LGCI**

ISDN line group controller

**LGE**

Line group equipment (frame)

**LIM**

Link interface module

**line card**

One of the line circuit cards contained in a line drawer. *See also* data line card, voice line card.

**line circuit (LC)**

A hardware entity that provides an interface between subscriber lines and the digital switch. Each subscriber line has a dedicated line circuit. *See also* line drawer.

**line concentrating array (LCA) shelf**

A unit of the line concentrating module (LCM). An LCM has two LCA shelves

**line concentrating device (LCD)**

The generic term for all modules such as line module, line concentrating module, remote line module, and remote concentrating SLC-96 that can accommodate a subscriber line card.

**line concentrating equipment (LCE) frame**

A single-bay frame containing two line concentrating modules

**line concentrating module (LCM)**

A peripheral module that connects the line trunk controller or line group controller and up to 640 subscriber lines using two to six DS-30A links.



**line concentrating module (enhanced) (LCME)**

*See* enhanced line concentrating module

**line concentrating module (ISDN) (LCMI)**

*See* ISDN line concentrating module

**line concentrating module processor (LCMP)**

A circuit in an LCM unit that handles messaging to the host office for the lines supported (up to 320) by the host LCM or RLCM uni

**line control card (LCC)**

A card within a remote line concentrating module (RLCM) that provides an interface between the RLCM and host office equipment

**line drawer (LD)**

A hardware entity located in the line module (LM) and LCM that contains line circuit cards. *See also* line circuit.

**line equipment number (LEN)**

A 7 digit function reference used to identify line circuits

**line group controller (LGC)**

A peripheral module that connects DS-30 links from the network to LCMs

**line group equipment (LGE) frame**

A single-bay frame containing LGC modules

**line insulation test (LIT)**

In automatic line testing, a test performed on an idle subscriber line to check for insulation defects. The test is based on measurements of resistance.

**line load control (LLC)**

Selective denial of call origination capability to specified subscriber lines when excessive demands for service are offered to a switching center. LLC does not affect the capability to receive calls.

**line module (LM)**

A peripheral module that provides speech and signaling interfaces for up to 640 subscriber lines. The LM consists of line drawers, a line module controller, and a frame supervisory panel.

**line module controller (LMC)**

The controller shelf for the line module. LMC performs the peripheral processor functions.

**line module equipment (LME) frame**

A double-bay frame containing a supporting pair of line modules

**line trunk controller (LTC)**

A peripheral module that is a combination of the line group controller and the digital trunk controller and provides all of the services offered by both

**line trunk equipment (LTE) frame**

Frame containing up to two dual-shelf LTCs

**link access procedure balanced (LAPB)**

ISDN access protocol that is used with links established on a B channel. LAPB supports a single data link that operates with a fixed, single-byte address convention between the ISDN terminal and the network.

**link access procedure on the D-channel (LAPD)**

ISDN access protocol that is used with links established on a D channel.

**link interface module (LIM)**

A peripheral module that controls messaging between link interface units (LIU) in a link peripheral processor (LPP). The LIM also controls messages between the LPP and the DMS-bus. An LIM consists of two local message switches (LMS) and two frame transport buses (F-bus). One LMS normally operates in a load sharing mode with the other LMS. This ensures LIM reliability in the event of an LMS failure because each LMS has adequate capacity to carry the full message load of an LPP. Each LMS uses a dedicated F-bus to communicate with the LIUs in the LPP.

**link interface unit (LIU)**

A peripheral module that processes messages entering and leaving a link peripheral processor through an individual signaling data link. *See also* CCS7 link interface unit 7.

**link peripheral processor (LPP)**

The DMS SuperNode equipment frame for DMS-STP that contains two types of peripheral modules: an LIM and an LIU. For DMS-STP applications, CCS7 link interface units 7 (LIU7) are used in the LPP. *See also* link interface module, CCS7 link interface unit 7.

**linkset**

A collection of links connecting two adjacent signaling points in N6, CCIS6, and CCS7. *See also* N6, CCIS6, CCS7

**link sharing**

A connection between an LTC and a terminal on an RLCM. In a link sharing connection, the terminal is on a different unit of the LCM than the LTC bound, C side port.

**LIT**

Line insulation test

**LIU**

Link interface unit

**LIU7**

CCS7 link interface unit 7

**LLC**

Line load control

**LM**

Line module

**LMC**

Line module controller

**LMS**

Local message switch

**loader control file**

A file that contains a set of commands for instructing the loader to load modules and to organize them into various programs, processes, or program increments

**load sharing**

The operating mode of duplicated units in the DMS-100 Family systems whereby the two units share processing operations. In the event of a failure in one of the units, the other can take over the entire load. *See also* hot standby.

**load transfer (LTR)**

In CCS7, a signal generated in order to transfer signaling to a new transmission link

**local automatic message accounting (LAMA)**

A system similar to automatic message accounting but providing local collection and recording of billing information. LAMA consists of a combination of automatic message accounting (AMA) equipment and automatic number identification (ANI) equipment in the same office. Such a

system can automatically process a subscriber-dialed toll call without operator assistance. *See also* central automatic message accounting.

**LP**

Loop

**LPC**

Linear predictive coding

**LPP**

Link peripheral processor

**LSB**

Least significant bit

**LSG**

Line subgroup

**LSU**

Lone signal unit

**LTA**

Line test access

**LTB**

Last trunk busy

**LTC**

Line trunk controller

**LTCI**

ISDN line trunk controller

**LTCINV**

LTC inventory table

**LTC inventory table (LTCINV)**

A data table containing physical location, load, exec, and C-side link information for several peripherals: line group controllers, digital trunk controllers, line trunk controllers, Subscriber Carrier Module-100 Rurals, and Subscriber Carrier Module-100Ss.

**LTC P-side inventory table (LTCPSINV)**

A data table containing P-side link information for several peripherals: line group controllers, digital trunk controllers, line trunk controllers, Subscriber Carrier Module-100 Rurals, and Subscriber Carrier Module-100Ss.

**LTCPSINV**

LTC P side inventory table

**LTE**

Line trunk equipment (frame)

**LTID**

Logical terminal identifier

**LTP**

Line test position

**LTPLTA**

Line test position test access

**LTR**

Load transfer

**LTU**

Line test unit

**magnetic tape drive (MTD)**

In a DMS, a device used to record DMS-100 Family data. An MTD can be mounted on either an MTC frame or an input/output equipment frame.

**magnetic tape unit (MTU)**

A general term used to describe the magnetic tape recording function as a maintenance tool. The MTU can be any type of magnetic tape drive that functions in this way.

**main distribution frame (MDF)**

A frame containing terminal blocks where cables from outside plant and office equipment are terminated. Outside plant equipment is terminated on vertical rows of blocks and office equipment on horizontal rows. Cross-connection flexibility and organization is provided by jumper pairs between horizontal and vertical terminal blocks.

**maintenance spare storage (MSS) frame**

A frame containing card position slots for storing spare cards

**maintenance (MTCE) subsystem**

A MTCE may be either;

- A group of hardware elements and software resources in the DMS-100 Family systems that is used to detect, analyze, and correct errors in the system. System status is displayed on the visual display unit (VDU), and the MTCE subsystem can be accessed using the VDU keyboard.

- Central control software responsible for the maintenance of system devices. This responsibility includes manual and automatic testing and the interpretation and resolution of error conditions. One maintenance subsystem is allocated for each type of peripheral.

**maintenance trunk module (MTM)**

A peripheral module located in a trunk module equipment frame. The MTM is equipped with test and service circuit cards and contains special buses to accommodate test cards for maintenance purposes. The MTM provides an interface between the DMS-100 Family digital network and digital or analog test and service circuits.

**MAP**

The maintenance and administration position. MAP is a group of components that provides a user interface between operating company personnel and the DMS-100 Family systems. A MAP consists of a visual display unit and keyboard, a voice communications module, test facilities, and MAP furniture. MAP is a trademark of Nortel Networks.

**MAPCI**

MAP command interpreter

**MAP command interpreter (MAPCI)**

A MAP level for accessing maintenance and other functional levels

**mapper**

A circuit pack used in routing messages within the DMS SuperNode message switch

**master position (MP)**

In a traffic operator position system (TOPS), a position used by on-site personnel to perform diagnostic tests

**master processor (MP)**

In a DMS, the processor containing the instruction set that implements the tasks assigned by the central control software. The MP carries out all high-level tasks.

**master processor card**

A circuit pack that handles most of the computation involved in switching and routing calls

**master processor memory card**

A circuit pack that contains memory for the master processor card

**master reference frequency frame (MRFF)**

In the DMS synchronous clock system, a frame that houses two external reference oscillators and a fuse panel.

**Mb/s**

Megabits per second

**MC**

Message controller

**MC 68020**

The Motorola Corporation (MC) MC 68020 series of 32 bit microprocessors.

**MCCS**

Mechanized calling card service

**MDC**

Meridian Digital Centrex, message and device controller

**MDF**

Main distribution frame

**MDM**

Memory and device module

**mechanized calling card service (MCCS)**

A service that enables a subscriber to make chargeable long distance calls without operator assistance. A subscriber makes these calls by using a credit card and entering the special billing information.

**mechanized force administration data system (MFADS)**

A minicomputer system that extracts force management operational measurements from a pollable port every half-hour. The system returns service and force summaries, as well as projections of operators required, to traffic office managers.

**megabits per second (Mb/s)**

Expresses the rate of transmission of serial data bits in a time-division multiplexed frame format.

**memory and device module (MDM)**

Central message controller with data store. The MDM controls internal message paths between the central processing unit and other DMS-100 packaged units.

**memory extension (MEX) frame**

A frame containing an extension to the data store. MEX is used when the central control complex does not have sufficient space to accommodate an expanded data store.

**Meridian 2000**

A series of digital telephone sets (M2009, M2018, and M2112) designed for use with the Nortel Networks signaling link (SL) family of digital switches. With a compact asynchronous data adapter, the sets provide simultaneous asynchronous voice and data capabilities. Meridian 2000 is a trademark of Nortel Networks.

**Meridian Digital Centrex (MDC)**

A special DMS business services package that uses the data handling capabilities of DMS-100 Family offices. MDC provides a centralized telephone exchange service and was known formerly as Integrated Business Network (IBN). Meridian Digital Central is a trademark of Nortel Networks.

A message is a type of control mechanism used in the input/output message system of the DMS-100 Family. The MSG byte specifies that the information to come is a data message.

**message and device controller (MDC)**

A controller with data store that controls internal message paths between the central processing unit and other units of the DMS-100 Family system. MDC also performs the input/output controller (IOC) function for small offices.

**message interface card**

Circuit pack that provides tones such as dial tone and busy tone and collects CC messages. The signaling processor accesses these messages on the message interface circuit pack.

**message switch (MS)**

A high capacity communications facility that functions as the messaging hub of DMS SuperNode. The MS allows DMS-100 components to communicate freely. For the purposes of redundancy, the MS uses two planes. Each plane provides an interface with the two planes of the computing module.

**message switch and buffer (MSB)**

A peripheral module used by the DMS-100 Family, along with a signaling terminal (ST), to act as an interface to and operate within a common channel signaling environment. The MSB supports the ST and routes the messages received by the ST through the network module to the digital trunk controller. The MSB also receives messages sent from CC and routes them to the signaling link through the ST. A different configuration of the MSB exists for each of the two protocols used to implement common channel



signaling. *See also* message switch and buffer 6, message switch and buffer 7.

**message switching**

An arrangement whereby a message is received, stored until the proper outgoing line is available, and then re-transmitted. *See also* circuit switching, store and forward mode.

**message switch simplex cabinet (MSSC)**

One of the three cabinet models for DMS SuperNode. The MSSC is dedicated to a message switch consisting of one message switch shelf.

**message system (MS)**

In the DMS-100 Family, a system that provides the media and protocol for the transmission of intermodule control messages.

**message transfer part (MTP)**

Provides a connection-less transport system for carrying CCS6, CCIS6 and CCS7 signaling messages between user locations or applications functions. MTP is a CCITT N7 protocol. Also known as message transport part.

**method of procedure (MOP)**

The guide to the installation of a batch change supplement (BCS). The MOP is supplied by Nortel Networks to an operating company with each software release.

**MEX**

Memory extension (frame)

**MF**

Multifrequency

**MFADS**

Mechanized force administration data system

**MFC**

Multifrequency compelled

**MIC**

Modem interface card

**MOP**

Method of procedure

**MOS**

Metallic oxide semiconductor

**MP**

Master position, master processor, modem pool

**MPC**

Multi-protocol controller

**MR**

Manual request

**MRFF**

Master reference frequency frame

**MRLM**

Mate remote line module (link)

**MS**

Message switch, message system

**MSB**

Message switch and buffer

**MTC**

Magnetic tape center

**MTCE**

Maintenance (subsystem)

**MTD**

Magnetic tape drive

**MTP**

Message transfer part

**MTR trunk**

Metering trunk

**MTU**

Magnetic tape unit, or metallic test unit

**multi-unit message (MUM)**

In common channel signaling, a message transmitted using more than one signal unit

**multi-unit message rate (MUMR) service**

A service that permits an operating company to charge local calls on a basis other than a flat rate

**multiwink (MW)**

A method of coin control used between a TOPS, a local control office, and a key set. MW consists of up to five winks of 70–130 ms duration transmitted at intervals of 100–150 ms.

**N7 signaling network**

An N7 signaling network comprises a number of switching and processing nodes that are connected to each other by signaling links. N7 networks can contain the following nodes: signaling point (SP), signaling transfer point (STP), service control point (SCP), and service switching point (SSP). For further information, refer to NTP 297-1001-011.

**nailed-up connection (NUC)**

A permanently assigned network connection that forms part of the speech path between suitably equipped peripheral modules.

**nailed-up cross-connection**

Special-services connection where channels on a DS-1 link used for special-services cards are not switched through the DMS-100 network. Instead, they are looped around in the SMS or SMU formatter card onto a second DS-1 link leading to a channel bank, DMS-100 switch, or other telephone equipment.

**negative loop mode**

A condition that applies to coin, dial tone first (CDF) lines with the battery applying –48 V to the ring side of the subscriber loop and the tip side of the loop grounded.

**NET**

Network

**NETC**

Network combined (frame)

**network (NET)**

A network may be either:

- an organization of stations capable of intercommunication but not necessarily on the same channel
- two or more interrelated circuits
- a combination of terminals and circuits in which transmission facilities interconnect user stations directly
- an interconnected group of computers or terminals
- the NET module frame of the DMS-100 Family system

- a combination of circuits and terminals serviced by a single switching or processing center.

**network administration system (NAS)**

A stand-alone computer that is involved in operation, administration, and maintenance for ISDN services. The NAS uses data on service and system operation to generate files that contain information on alarms, accounting, billing, and network operation.

**network build-out capacitance (NBOC)**

Used to balance the 2 wire/4 wire terminating set which matches a 2 wire trunk facility to a DMS-100 Family interface circuit. NBOC is sometimes used in conjunction with network build-out resistance. *See also* network build-out resistance.

**network build-out resistance (NBOR)**

Used to balance the 2 wire/4 wire terminating set, which matches a 2 wire trunk facility to a DMS-100 Family trunk interface circuit. NBOR is used in conjunction with NBOC. *See also* network build-out capacitance.

**network combined (NETC) frame**

A single-bay network frame containing two network modules

**network component interface (NCI)**

A compact version of the DMS-100 network module providing an all-digital telephone switching network

**network crosspoint (NC) shelf**

Contains the crosspoint cards that perform time switch functions. The NC shelf is located in the NET frame.

**network interface (NI)**

A circuit card used in the network modules that provides an interface between a peripheral module and the crosspoint switches in the network module. Also known as a speech interface card.

**network junctor connecting (NJC) panel**

A panel located in the digital network interconnecting frame that accepts patch cards enabling junctor patterns to be organized

**network layer**

Layer 3 in the OSI model. In ISDN, the network layer is used to send call control messages.

**network management (NWM)**

A set of facilities that controls operation of a DMS-100 Family network, with the objective of making optimum use of available resources in

conditions of overload or facility failure. NWM is exercised from the network management position.

**network management center (NMC)**

The location from which maintenance personnel monitor a switched network. Facilities are provided for fault correction and handling special traffic conditions.

**network management position (NMP)**

A specially-furnished MAP. The NMP exercises expansive and protective controls with the objective of making optimum use of network facilities in overload or failure conditions.

**network module controller (NMC)**

A group of circuit cards that communicates with the central message controller. The NMC is located in the network module. The NMC organizes the flow of internal messages by directing messages to the peripheral modules or interpreting connection instructions to the crosspoint switches.

**network module (NM)**

The basic building block of the DMS-100 Family switching network. The NM accepts incoming calls and uses connection instructions from the central control complex to connect the incoming calls to the appropriate outgoing channels. Network module controllers control the activities in the NM.

**network operating system (NOS)**

A facility providing the DMS-100 with the capability of transferring data over communications links to a telephone network operating system

**network operation protocol (NOP)**

A protocol that provides an interface between a DMS-100 Family switch and its remote systems

**network operator trouble information system (NOTIS)**

A group of facilities provided at a TOPS position that enable an operator to report trouble conditions by keying a previously defined 1 digit or 2 digit code. This code is then translated into an output message through an operating company client-controlled table and the trouble condition is logged.

**network service part (NSP)**

Includes the message transfer part and the signaling connection control point in CCS7

**network subgroup (NSG)**

The transmit and receive channels provided by a network module. Each set of eight ports constitutes one NSG.

**NI**

Network interface

**NJC**

Network junctor connecting (panel)

**NM**

Network module

**NMC**

Network management center, network module controller

**NMP**

Network management position

**node**

The terminating point of a link. Node is a relative term in that its meaning depends entirely on the context in which it is used. For example, a circuit can be a node in the context of another circuit within a module; the module itself can be a node in the context of another component of the network, and so forth. Some common applications are

- in network topology, a terminal of any branch of a network or a terminal common to two or more branches of a network
- in a switched communications network, the switching points, including patching and control facilities
- in a data network, the location of a data station that interconnects data transmission lines
- a unit of intelligence within a system; in a DMS, includes the central processing unit, network module, and peripheral modules

**NOP**

Network operation protocol

**Nortel Networks Publication (NTP)**

A document that contains descriptive information about DMS-100 Family hardware and software modules and performance-oriented practices for testing and maintaining the system. These documents are supplied as part of the standard documentation package provided to an operating company.

**NOS**

Network operating system

**NOTIS**

Network operator trouble information system

<b>NP</b>	Network processor
<b>NPA</b>	Numbering plan area
<b>NSG</b>	Network subgroup
<b>NSP</b>	Network service part
<b>NT40</b>	Central control CPU
<b>NTP</b>	Nortel Networks publication
<b>NTT</b>	No test trunk
<b>NUC</b>	Nailed-up connection
<b>nucleus</b>	In a DMS, a collection of support modules that provides vital operating system functions, including synchronizing primitives, scheduling, timing, queueing primitives, storage allocation, message passing, process creation primitives, and a directory system.
<b>numbering plan area (NPA)</b>	Any of the designated geographical divisions of the United States, Canada, Bermuda, the Caribbean, Northwestern Mexico, and Hawaii within which no two telephones have the same 7 digit number. Each NPA is assigned a unique 3-digit area code. Also known as area code.
<b>NWM</b>	Network management
<b>OA</b>	Operator assisted
<b>OAM</b>	Operation, administration, and maintenance

**OAS**

Office alarm system

**OAU**

Office alarm unit

**OBH**

Office busy hour

**OC**

Operator centralization

**occupancy**

Occupancy may be either:

- The percentage of time a circuit or facility is in use. One circuit in continuous use represents 1 Erlang (or 36 hundred call seconds) of traffic
- The ratio of that portion of operator time spent on call-handling to the total amount of time operators are assigned traffic operator position system (TOPS) positions for the purpose of handling calls.

**octet**

A byte composed of eight binary elements

**ODM**

Office data modification

**OEM**

Original equipment manufacturer, outside equipment manufacturer

**off-hook**

Off hook may be either:

- in telephone operations, the condition existing when the receiver or handset is removed from its hook-switch
- one of two possible signaling states: tone or no-tone; ground connection or battery connection
- the active state (closed loop) of a subscriber or PBX line loop. *See also* on-hook.

**office alarm system (OAS)**

A system that reports trouble conditions to office personnel who are located either on-site or at a remote site. The severity of each problem is indicated according to its level of urgency—critical, major, or minor.



**office alarm unit (OAU)**

A peripheral module located in a trunk module equipment frame. The OAU is similar to the maintenance trunk module, but is equipped with circuit cards that provide an interface with various types of office alarm circuits instead of test circuits.

**office busy hour (OBH)**

The hour when an office carries the most traffic. OBH is not necessarily a clock hour in duration or the same period as the average busy hour. The OBH is used as a factor in traffic-provisioning calculations.

**office classification**

Numbers assigned to offices according to their function in the North American direct distance dialing network. The class numbers used are

- class 1 – regional center (RC)
- class 2 – sectional center (SC)
- class 3 – primary center (PC)
- class 4 – toll center (TC) if operators present, otherwise toll point (TP)
- class 5 – end office (EO)

**off-line storage**

Memory not under the control of the central processing unit, for example, on a magnetic tape

**off-net access line (ONAL)**

A trunk interface that connects a DMS-250 to the line side of a class 5 central office

**OG**

Outgoing

**OG-XPT**

Outgoing crosspoint

**OM**

Operational measurement

**OMB**

Outgoing message buffer

**ONA**

Open Network Architecture

**on-board task microprocessor**

An 8085 microprocessor in the A-bit/B-word DDL card that automatically scans RCS lines, provides online and offline diagnostics, and times RCS responses to commands.

**ONI**

Operator number identification

**OOS**

Out-of-service, out of service

**OPC**

Origination point code

**open systems interconnection (OSI) model**

A seven layer protocol model for communications networks developed by the International Standards Organization and adopted by the Consultative Committee on International Telephony and Telegraphy (CCITT) for an ISDN.

**operating company**

The owner/operator of a DMS switch

**operating system (OS)**

Software that manages the basic resources of DMS-100 Family machines. *See also* support operating system.

**operation, administration, and maintenance (OAM)**

All of the tasks necessary for providing, maintaining, or modifying the services provided by a switching system. These tasks include provisioning of hardware, creation of service, verification of new service, and trouble recognition and clearance.

**operational measurement (OM)**

The hardware and software resources of the DMS-100 Family systems that control the collection and display of measurements taken on an operating system. The OM subsystem organizes the measurement data and manages its transfer to displays and records. The OM data is used as a basis for maintenance, traffic, accounting, and provisioning decisions.

**operator assisted (OA)**

Calls that are dialed by the subscriber but require help from the operator

**operator centralization (OC)**

An extension of the operator services provided by TOPS. OC enables the operating company to handle traffic in several remote toll centers as though they were operator centers.

**operator number identification (ONI)**

The equipment used to bring an operator into the circuit to check the calling number when a subscriber has direct-dialed a long distance call that is to be charged on an itemized bill basis by CAMA equipment. *See also* automatic number identification.

**OPM**

Outside plant module

**optimizable intermediate language (OIL)**

An intermediate compiler stage between procedure-oriented type enforcing language (PROTEL) source code and target machine-dependent object code

**originating screen office (OSO)**

In outward wide area telephone service (OUTWATS), the OSO controls station access to wide area telephone service (WATS) zones

**origination point code (OPC)**

A Common Channel Signaling No. 7 (CCS7) term defining the address of a signaling point that generated the message. *See also* destination point code.

**originator**

In DMS call processing, an agent that starts a call by detecting an origination request

**ORR**

Office release record

**ORU**

Office repeater unit

**OSI**

Open systems interconnection (model)

**OSO**

Originating screen office

**OSS**

Operator service signaling

**outgoing message buffer (OMB)**

Registers that contain control and data messages between components of the central control complex, network module controllers, and peripheral modules. Each OMB is associated with the transmit path of a message link and stores the message while the input/output protocol is performed.

**out-of-band signaling**

A signaling method in which signals are sent over the same transmission channel or circuit as the user's communication but in a different frequency band from that provided for the user.

**outside plant module (OPM)**

A stand alone, weather proof enclosure equipped to connect between two and six DS-1 links from a line group controller at a host office and up to 640 locally-connected subscriber lines. An OPM consists of one line concentrating module, a remote maintenance module, a host interface equipment shelf, a power supply, environmental control equipment, and a cable cross-connection for up to 1280 pairs.

**outward wide area telephone service (OUTWATS)**

A telephony service provided over one or more dedicated access lines to the serving central office. OUTWATS permits subscribers to make calls to specified service areas on a direct dialing basis for a flat monthly charge or for a charge based on accumulated use. OUTWATS lines have special directory numbers. *See also* inward wide area telephone service, wide area telephone service.

**PABX**

Private automatic branch exchange

**PACK**

Pack may be either:

- positive acknowledgment
- A term used in data description language as part of a type description in the data format file. PACK is followed by a positive number that specifies the number of bits required to store data of the declared type.

**packaged core auxiliary module (PCAM)**

A DMS-100 packaged system frame containing a compact power distribution center, two package trunk modules, and a disk drive unit.

**packaged core basic module (PCBM)**

An auxiliary frame in the DMS-100 packaged switch. The frame contains power distribution, fuse panel, peripheral trunk modules equipped with metallic test access, and a line test unit. The frame also contains an

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input/output controller for extra RS-232 terminals and an extra metallic test unit if required.

**packaged core expansion module (PCXM)**

A DMS-100 packaged system frame containing a compact power distribution center, two package trunk modules, and an input/output controller

**packaged core interface module (PCIM)**

A single-bay frame in the DMS-100 packaged switch that contains interface circuits—a second metallic test unit or outside equipment manufacturer (OEM) unit, and two peripheral trunk units with scan and signal distribution cards—for extra alarms and OEM equipment.

**packaged core line module (PCLM)**

A DMS-100 packaged system frame containing two dual-shelf line concentrating modules

**packaged core memory module (PCMM)**

A DMS-100 packaged system frame containing a magnetic tape drive, a disk drive unit, and two data store shelves

**packaged core network module (PCNM)**

A DMS-100 packaged core system frame containing four network modules, each of which supports 56 peripheral ports and 64 junctor ports

**packaged core power module (PCPM)**

A DMS-100 packaged system frame containing two package trunk modules, a compact power distribution center, and a disk drive unit

**packaged core service module (PCSM)**

A DMS-100 packaged system frame containing five service trunk modules

**packaged core trunk module (PCTM)**

A DMS-100 packaged system frame that contains two dual-shelf line trunk controllers

**package trunk module (PTM)**

A DMS-100 packaged system peripheral module that encodes and multiplexes incoming speech from a maximum of 30 analog trunks into 8 bit pulse code modulation (PCM) format. The PTM combines the information with internal and supervisory control signals for transmission at 2.56 Mb/s to the network.

**packet**

A group of binary digits, including data and call control signals, that is switched as a composite whole. Data, call control signals, and possible error

control information are arranged in a specified format for transmission through the network.

**packet assembler/disassembler (PAD)**

A device that enables data terminal equipment (DTE) not equipped for packet switching to access a packet-switched network. Functions of a PAD include assembling characters into packets, forwarding data packets, handling virtual call setup and clearing, and disassembling user data in packets for delivery to start-stop DTE.

**packet handler (PH)**

The CCITT term for the component of an ISDN switch that provides packet switching services

**packet handler interface (PHI)**

The functional name of the device in an exchange termination used for multiplexing low-speed packet data on the D channel into a DS-1 format for transmission on links joining the exchange termination to the packet handler. The PHI also performs the reverse operation.

**packet sequencing**

A process of ensuring that packets are delivered to the receiving data station in the same sequence in which they were received from the sending station

**packet switching**

The transmission of data by means of addressed packets, whereby a transmission channel is occupied only for the duration of transmission of the packet

**packet switching network**

A communications system designed to carry packet data. In a packet switching network, packet data in different formats can be handled by external interfaces. Network conversion of these formats occurs through an interface computer.

**PAD**

Packet assembler/disassembler

**paddle board (PB)**

A short circuit pack based on the standard circuit pack. The PB carries the cable interfaces and local service functions, such as local clock sources and bus terminations or both, located on the back of a DMS SuperNode shelf.

**PAM**

Pulse amplitude modulation

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<b>PAX</b>	Private automatic exchange
<b>PB</b>	Paddle board
<b>P-bus</b>	Processor bus
<b>PBM</b>	PBX message register
<b>PBX</b>	Private branch exchange
<b>PC</b>	Primary center
<b>PCAM</b>	Packaged core auxiliary module
<b>PCB</b>	Process control block
<b>PCBM</b>	Packaged core basic module
<b>PCIM</b>	Packaged core interface module
<b>PCLM</b>	Packaged core line module
<b>PCM</b>	Pulse code modulation
<b>PCM plane</b>	The plane (0 or 1) of the network module to which the terminal is connected to receive speech signals.
<b>PCPM</b>	Packaged core power module
<b>PCSM</b>	Packaged core service module

**PCTM**

Packaged core trunk module

**PCXM**

Packaged core expansion module

**PDC**

Power distribution center

**PE**

Peripheral equipment, phase encoded, processor element

**PEC**

Product engineering code

**peg count**

The number of times an event occurs; for example, the number of telephone calls originated during a specified period of time

**peripheral control unit**

Synonymous with input/output controller

**peripheral interface (PI)**

Part of the access module. The PI is joined with peripheral equipment to provide access module ports.

**peripheral module (PM)**

A generic term referring to all hardware modules of DMS-100 Family systems that provide interfaces with external line, trunk, or service facilities. A PM contains peripheral processors, which perform local routines, thus relieving the load on the central processing unit.

**peripheral side (P-side)**

The side of a node facing away from the central control and towards the peripheral modules. *See also* central side.

**permanent store (PERM)**

An unprotected data store type that can be written to directly and remains allocated over all restarts. Network maps and error report logs are kept in PERM.

**permanent virtual circuit (PVC)**

A continuously available virtual path between remote applications and DMS applications. The PVC eliminates the need to establish a circuit on an each call basis.



<b>PFS</b>	Physical file system
<b>PH</b>	Packet handler
<b>PHI</b>	Packet handler interface
<b>phrase</b>	A digital recording in the digital recorded announcement module that is made up of one or more subphrases. The phrase list in an announcement is selected by the central control and passed to the digital recorded announcement machine (DRAM) on playback initiation.
<b>PI</b>	Peripheral interface
<b>PM</b>	Peripheral module
<b>PM firmware</b>	<p>The peripheral module operating system. Software resident in the PM can be divided into three classes:</p> <ul style="list-style-type: none"><li>• software that is resident in read-only memory and satisfies the customary definition of firmware</li><li>• software that is loaded into random access memory when the peripheral is put into service</li><li>• software that comprises execs, which are resident subprograms made up of primitive instructions</li></ul>
<b>PMBX</b>	Private manual branch exchange
<b>PMIST</b>	Peripheral module intercept system test
<b>PMUX</b>	Primary multiplex (equipment)
<b>POF</b>	Pending order file

**polling**

In data communications, the process of inviting data stations to transmit information, one station at a time. The polling process usually involves the sequential interrogation of several data stations.

**pool**

An operating system facility that allows processes to define a new data type and to allocate groups of these items. Items in a group or pool are all the same size and type.

**POP**

Performance-oriented practice

**port**

In a DMS, the point at which a speech or message link is connected to a peripheral module, network module, input/output controller, or central message controller

**POTS**

Plain ordinary telephone service

**power distribution center (PDC)**

The frame containing the components for distributing office battery feeds to equipment frames of the DMS-100 Family systems. The PDC accepts A and B cables from the office battery and provides protected subsidiary feeds to each frame or shelf. It also contains noise suppression and alarm circuits, and provides a dedicated feed for the alarm battery supply.

**PP**

Peripheral processor, program port

**PPSN**

Public packet switching network

**PRA**

Primary rate access

**PRE**

Protective reservation equipment

**preplanned control (PPLN)**

A network management control that applies remote dynamic overload controls in response to an external signal from a subtending office. This feature consists of preplanned controls that are activated by scan point or through the MAP; also known as remote dynamic overload control. *See also* dynamic overload control, internal dynamic overload control.

**PRI**

Primary rate interface

**PRI card**

Primary rate interface card

**primary rate access (PRA)**

An interface to ISDN that connects an external network device such as a PBX to an ISDN switch. Access is provided by a number of bi-directional, digital channels that are time-division multiplexed. In North America, these channels are arranged as 23 B channels and one D channel (23B+D).

**primary rate interface (PRI)**

Carries B+D channels over a digital DS-1 facility (23B+D in North America and 30B+D in Europe). PRI is used to link private networking facilities, such as PBXs, LANs, and host computers with a standardized architecture acting as the bridge between private switching equipment and the public network.

**primary rate interface (PRI) card**

The PRI is an access protocol connecting an external network device, such as a PBX, to an ISDN switch. This access is provided by multiple, bi-directional, time-division multiplexed, digital channels of information. In North America, access is typically through 23 B channels and one D channel (23B+D). A PRI card provides the physical interface to the DS-1 for the MSL-1.

**private (PVT)**

Incoming and outgoing calls that connect the PBX to its virtual private network. The digits dialed may not conform to E.164 standards. *See also* public.

**private automatic branch exchange (PABX)**

Local automatic telephone office serving extensions in an organization and providing access to the public network

**private automatic exchange (PAX)**

An automatic telephone exchange that provides telephone service within an organization but does not provide connections to the public network

**private branch exchange (PBX)**

A private telephone exchange, either automatic or attendant-operated, serving extensions in an organization and providing access to the public network

**private data segment**

A temporary-store head segment that contains preprocess variables and descriptors for a particular instance of the module

**private exchange (PX)**

A telephone exchange, either automatic or attendant-operated, that provides telephone service within an organization but does not provide connections to the public network

**private manual branch exchange (PMBX)**

A private branch exchange with manual switching under the control of an operator

**process control block (PCB)**

A block of data used by the operating system to keep track of the status of a process. Each process in the system has a unique PCB.

**process entry module**

A module that contains a procedure where a process begins running after initialization

**processor bus (P-bus)**

The bus used in DMS SuperNode modules for processor communications

**processor element (PE)**

Part of the access module. A PE contains its own software and is used to process the link access procedure balanced (LAPB), link access procedure on the D channel (LAPD) channels, or both, that are being received.

**product engineering code (PEC)**

An 8 character code that provides a unique identification for each marketable product manufactured by Nortel Networks.

**program store (PS)**

In a DMS, programmed instructions for the various procedures required to perform processing, administration, and maintenance. PS is one of the two distinct elements of a DMS-100 memory. The other main element is data store. *See also* data store.

**PROTEL**

Procedure-oriented type enforcing language

**PRP**

Preroute peg count

**PS**

Program store

**PSAP**

Public safety answering point

**PSDS**

Public switched data service

**P-side**

Peripheral side

**PSK**

Phase shift keying

**PTE**

Partitioned table editor

**PTM**

Package trunk module

**PTP**

Point-to-point

**PTS**

Per trunk signaling

**public packet switching network (PPSN)**

Any common carrier network designed to carry data in the form of packets between public users

**public safety answering point (PSAP)**

An agency or facility authorized to receive and respond to emergency calls requiring public services such as fire, police, and ambulance services

**public switched data service (PSDS)**

Any common carrier network designed to switch data that is not necessarily in packet form between public users

**pulse amplitude modulation (PAM)**

A modulation system in which the magnitude and polarity of an analog waveform at a series of sample instants is represented by pulses of equivalent magnitude and polarity at the same relative instants of time

**pulse code modulation (PCM)**

PCM may be either:

- the process used to convert an analog (voice waveform) signal to a digital code
- a form of modulation in which the modulating signal is sampled and the sample is quantified, coded, and sent as a bit stream.
- the representation of an analog waveform by coding and quantifying periodic samples of the signal such that each element of information consists of a binary number representing the value of the sample

**pulsed signaling**

A signaling method used by some analog signaling systems, such as CCITT signaling system R1 (R1) and CCITT No.5 signaling (N5), for interregister signaling. Pulsed signaling requires more complex signal recognition arrangements than continuous signaling. The signaling tone is recognized by the receiver, but it requires persistence checking and correlation with the circuit state before the signal is validated.

**PVN**

Private virtual network

**PVC**

Permanent virtual circuit

**PVT**

Private

**PWM**

Pulse width modulation

**PX**

Private exchange

**RAO**

Revenue accounting office

**RB**

Reverse battery (signaling)

**RC**

Recording completing, regional center

**RCA**

Remote controller array (shelf)

<b>RCC</b>	Remote cluster controller
<b>RCCI</b>	ISDN remote cluster controller
<b>RCCO</b>	Remote cluster controller offshore
<b>RCE</b>	Remote controller equipment (frame)
<b>RCS</b>	Remote concentrator SLC-96
<b>RCS inventory table (RCSINV)</b>	Data table containing information on the physical location of the RCS, c side links, SMS to which the links connect, mode of operation of the RCS shelf groups, protection switching details, and related information.
<b>RCT</b>	Remote concentrator terminal
<b>RCU</b>	Remote carrier urban
<b>RDOC</b>	Remote dynamic overload control
<b>RDR</b>	Remote dump and restore
<b>RDW</b>	Record descriptor word
<b>ready to manufacture (RTM)</b>	A BCS load that has been approved for release to Nortel Networks for manufacture
<b>realtime</b>	The actual time during which the CPU (NT40) or DMS-Core SuperNode performs its functions. The time is divided into two main categories: call processing time and noncall processing time.

**realtime capacity**

As applied to the DMS-100 Family CPU (NT40) or DMS-Core SuperNode, the maximum number of call attempts that the CPU or DMS-Core can process while meeting the high day busy hour service objective of not exceeding 20 percent dial tone delay (delay greater than 3 sec).

**receive-only (RO)**

A teleprinter or visual display unit that receives data through the input/output controller. This data consists of such items as operational measurements and maintenance output reports from the DMS-100 Family system. RO printers are located in maintenance and traffic management areas.

**redundancy**

The components of a message that may be ignored or eliminated without loss of essential information

**redundancy check**

A check employing systematically inserted redundant data

**regenerator**

Equipment that restores the shape, timing, and pulse amplitude of a digital signal that has been distorted by transmission

**register**

Register may either:

- the apparatus in an automatic switching system that receives address signals and controls the subsequent switching operation
- the first unit in the assembly of common control equipment in an automatic central office. The register receives address information and stores it for possible conversion or translation. A register frequently operates in conjunction with a sender.
- a storage device having a specified storage capacity such as a bit, byte, or computer word, and usually intended for a special purpose

**re-initialize interrupt**

An interrupt generated when the need for a restart is detected

**reload-restart**

The setting of software pointers in a program to simulate actual reload of software into DMS-100 Family switches. Office configuration and translation data is retained, but all dynamic data is cleared.



**Remote call forwarding service**

A service-related telephony feature that permits all calls placed to a local directory number to be forwarded to a remote station. No physical telephone station needs to be associated with the local number.

**remote carrier urban (RCU)**

A peripheral module that provides remote subscriber loop concentration for a DMS-1 urban carrier system. The RCU uses high-level message protocol to communicate over one or two message channels and, in configuration with a digital switch, supports up to 560 subscriber lines over a maximum of eight DS-1 links.

**remote cluster controller (RCC)**

A dual-shelf peripheral module that provides a master controller for all units at the remote switching center and is, in turn, controlled by the host line trunk controller.

**remote concentrator SLC-96 (RCS)**

A peripheral module that provides remote subscriber loop concentration for an SLC-96 subscriber carrier system. The RCS supports up to 96 subscriber lines over two to four DS-1 links.

**remote concentrator terminal (RCT)**

In the DMS-1 system, a peripheral module that provides remote subscriber loop concentration over two DS-1 links for a maximum of 256 subscriber lines.

**remote controller array (RCA) shelf**

A unit of the remote cluster controller. An RCC consists of two RCA shelves

**remote controller equipment (RCE) frame**

A single-bay frame containing two remote maintenance modules and a dual-shelf remote cluster controller

**remote data polling system (XFER)**

A system that permits an operating company to transfer information concerning the operation of a DMS-100 Family office to its data processing center.

**remote digital trunking**

The assignment of up to six available DS-1 ports on a remote cluster controller to interface with DS-1 digital trunk groups. Remote digital trunks handle only trunk traffic originating from or terminating on subscriber lines that are connected to the LCMs or remote LCMs controlled by the same RCC.

**remote dump and restore (RDR)**

A software change process in which operating company data that is integrated with an active software release is dumped and temporarily stored, pending an update of that software. This procedure is performed remotely from a Northern Telecom facility. *See also* local dump and restore.

**remote dynamic overload control (RDOC)**

*See* preplanned control

**remote line concentrating module (RLCM)**

An equipment frame that provides an interface between two to six DS-1 links (from the line group controller at the host office) and up to 640 subscriber lines (connected locally). An RLCM is equipped with one line concentrating module, a remote maintenance module, and a host interface equipment shelf.

**remote line controller (RLC)**

The basic control unit in the remote line module. Its operation is similar to that of the line module controller

**remote line module (RLM)**

A pair of remotely located line modules that provide an interface (over two to eight DS-1 links) between a digital carrier module at the host office and up to 1280 subscriber lines.

**remote maintenance module (RMM)**

A peripheral module with a configuration similar to that of the maintenance trunk module. An RMM accommodates up to twelve service and test cards.

**remote make-busy (RMB)**

A status signal received on a two-way trunk from the far-end trunk circuit indicating that the affected circuit is classed as made-busy to incoming traffic.

**remote service module (RSM)**

A peripheral module that operates in conjunction with and controls the metallic test access unit at a remote line module site

**remote switching center (RSC)**

A center that provides facilities for interfacing with a large number of analog lines, digital trunking, or both at a remote location. The RSC also handles remote-off-remote connections from other remote sites.

**revenue accounting office (RAO)**

A data center that produces subscriber bills from host office automatic message accounting data

<b>REX</b>	Routine exercise (tests)
<b>RFA</b>	Request for action
<b>RFF</b>	Request for feature
<b>RG</b>	Ringling generator
<b>ringback tone</b>	<i>See</i> audible ringing tone
<b>ringing generator (RG)</b>	A programmable generator that can produce a variety of ringing waveforms on receipt of a suitable drive signal
<b>ring/pad circuit pack</b>	An SMS or SMU card that receives parallel speech PCM from the formatter card, modifies it, and re-injects the PCM into the time switch card. It provides losses (0 to 7 dB) to the speech PCM on an each call basis.
<b>ring trip</b>	Cancellation of ringing to a subscriber after the subscriber lifts the phone set receiver in response to ringing. The ringing signal is stopped to prevent the subscriber from hearing ringing.
<b>RLC</b>	Remote line controller
<b>RLCM</b>	Remote line concentrating module
<b>RLM</b>	Remote line module
<b>RLS</b>	Release message
<b>RM</b>	Resource module
<b>RMB</b>	Remote make-busy

**RMM**

Remote maintenance module

**RO**

Receive only

**RONI**

Remote operator number identification

**routeset management (RSM)**

Transfers messages over the signaling network and helps to maintain the network by checking for link problems through the use of an integrity source

**routine exercise (REX) tests**

Automatic tests that are performed at regular intervals on DMS equipment by internal software

**RP**

Resource processor

**RPAM**

Receive pulse amplitude modulation

**RPCM**

Receive pulse code modulation

**RPOA**

Recognized private operating agency

**RR**

Routing and reporting

**RRTE**

Reroute (control)

**RSB**

Repair service bureau

**RSC**

Remote switching center

**RSE**

Remote service equipment (frame)

**RSM**

Remote service module, routeset management

<b>RTIF</b>	Reset terminal interface
<b>run time</b>	In a DMS, the time during which the central processing unit is allocated to a process.
<b>SADS</b>	System administration data system
<b>SAM</b>	Subscriber access multiplexer, subsequent address message
<b>SAPI</b>	Service access point identifier
<b>SAS</b>	Status assembly system
<b>S-bus</b>	Segmented bus
<b>SC</b>	Sectional center
<b>SCCP</b>	Signaling connection control part
<b>scheduler</b>	A component of the operating system that arranges sharing of the CPU among the system processes, based on a pre-emptive priority scheme
<b>schema</b>	In a DMS, the representation of data in the system as seen by the various users. It includes both tables and associated operations
<b>SCLLI</b>	Short common language location identifier
<b>SCM</b>	Subscriber carrier module
<b>SCP</b>	Service control point

**screening**

A telephony function that determines the eligibility to complete a call as dialed based upon class of service information associated with the line

**SCU**

System-control signaling units

**SD**

Signal distribution, signal distribution (points)

**SDL**

Signaling data link

**SDW**

Segment descriptor word

**SEAS**

Signaling engineering and administration system

**second-choice route**

*See* alternate route

**selective routing database (SRDB)**

Enables a person making an E911 emergency call to be linked directly to the public safety answering point that can respond the fastest

**Selective trunk reservation (STR)**

A network management feature that dynamically observes the occupancy of an outgoing trunk group and applies one of two level filters to the offered traffic at high levels of trunk group occupancy

**selector**

In a DMS, an identifier that reflects a particular agency associated with a gate utility. A unique selector value is associated with each agency. Depending on the gate utility, the selection can be allocated either automatically or manually.

**send/receive (S/R)**

Teleprinters assigned to classes of input/output users having the authority to enter commands as well as receive responses from DMS-100 Family systems

**sequence number (SEQNO)**

In a DMS, a 4 bit field used in combination with the call condense block (CCB) index to generate unique call identifiers. Each time the CCB is used for a new call, the SEQNO is changed.

**serial interface module (SIM)**

A component of the digital interworking unit (DIU). The SIM provides the multiplexing or demultiplexing of the DS-1 links from the exchange termination (ET). One SIM demultiplexes eight channels from the DS-1 into eight individual circuits; therefore, three SIMs are required for each DS-1.

**serial-to-parallel converter**

A serial– to–parallel converter may be either:

- a device that accepts a single time sequence of signal elements and distributes them among multiple parallel outputs
- a device that accepts a single time sequence of signal states representing data and translates these states into a spatial distribution of digits, all of which are presented simultaneously

**Series completion**

A service-related telephony feature that permits calls to a busy line to be routed to another specified directory number in the same switching office. More than two lines can be linked for a series completion list, although the system prevents unlimited looping and excessive realtime consumption.

**service access point identifier (SAPI)**

Identifier that is used by datalink layer (layer 2) protocol to define the type of service allowed to an ISDN terminal

**service busy hour**

The time-consistent 60 min. period when the highest percentage of customers originating a call must wait more than 3 sec. for dial tone. Service busy hour is sometimes called dial tone busy hour.

**service control point (SCP)**

A node in a CCS7 signaling network that supports application databases. The function of an SCP is to accept a query for information, retrieve the requested information from one of its application databases, and send a response message to the originator of the request.

**service order (SO)**

A facility consisting of commands that can be used to change subscriber line service tables

**service order system (SERVORD)**

A user interface used to change, add, or delete a subscriber line. Standard telephone industry command format is used.

**service position (SP)**

A type of trunk circuit with the capability of interfacing with a traffic service position

**service profile identification (SPID)**

A layer 3 identifier programmed into the logical terminal by the user during configuration. SPID uniquely identifies a logical terminal and its service profile to the switch. SPID is unique on a switch and has significance only on the local interface.

**service switching point (SSP)**

A CCS7 signaling node that interacts with the SCP to implement special service code features

**service trunk module (STM)**

In the DMS-100 Family, a peripheral module that consists of two compact maintenance trunk modules

**shelf**

A container for drawers, cards, or both

**short common language location identifier (SCLLI)**

Shortened version of the CLLI, used in data tables to identify the physical transmission paths between office

**signal distribution (SD) points**

Writable bits in the trunk logic circuit that usually correspond to relays in the hardware. SD points are used to control activities in the hardware.

**signaling connection control part (SCCP)**

A level of CCS7 layered protocol. It supports advanced services such as E800 and SSP and the Automatic Calling Card Service feature. The main functions of the SCCP include the transfer of signaling units with or without the use of a logical signaling connection and the provisioning of flexible global title translations for different applications.

**signaling data link (SDL)**

A bi-directional transmission path for signaling. An SDL consists of two data channels operating together in opposite directions at the same data rate. It constitutes the lowest functional level (level 1) of N6, CCIS6, and CCS7 hierarchy.

**signaling engineering and administration system (SEAS)**

Provides a single administrative center that uses network signaling transfer points (STP) to monitor and coordinate the elements of a CCS7 network. The administration and engineering functions of the SEAS allow the operating company to process, store, and report traffic and performance data on a network-wide basis. This data can be used to evaluate network performance, to balance loads between STP nodes, and to perform other network management tasks.



**signaling link (SL)**

The term used to describe the first two levels of the CCS7 protocol: the physical level (level 1) and the link level (level 2). Level 2 functions, combined with a level 1 signaling data link, constitute an SL that is used for the reliable transfer of signaling messages between two signaling points.

**signaling point (SP)**

Any node in a CCS7 network that originates, terminates, or transfers signaling messages from one signaling link to another

**signaling processor (SP)**

The interface between a master processor and the control circuits in the line-side of a line module. Through the SP, line circuits, ringing multiplexers, programmable ringing generators, and the activity circuit are controlled, and their status reported.

**signaling processor card**

A circuit pack that controls Subscriber Carrier Module-100S (SMS) cards and handles message routing

**signaling processor memory card**

A circuit pack that contains memory required by the signaling processor

**Signaling System 7 (SS7)**

A version of Signaling System #7 that was developed for North American use

**signaling terminal (ST)**

The hardware that performs error checking, coding, and decoding of signaling messages. In common channel interoffice signaling and CCITT6, it consists of a signaling terminal controller, modem, and a modem interface card. In CCS7, the signaling terminal is a single card.

**signaling terminal controller (STC)**

In CCIS6 and CCITT6, there is a single card that receives and constructs signal units, controls modem interface, and performs error checking of signaling messages.

**signaling terminal controller module (STCM)**

A group of eight signaling terminal controllers associated with a message switch and buffer. *See also* signaling terminal controller.

**signaling terminal equipment 7 (ST7E)**

A frame containing the extra signaling terminal cards required when a basic rate access office is equipped with a large number of ISDN lines or terminals equipped with D packet service.

**signaling terminal 7 (ST7)**

A dual processor device with an 8085-based master processor (MP) and an 8031-based data link processor resident in a single card in the MBS7 frame. In CCS7, ST7 is the same as a signaling terminal controller.

**signaling transfer point (STP)**

A node in a CCS7 network that routes messages between nodes. STPs transfer messages between incoming and outgoing signaling links but, with the exception of network management information, do not originate or terminate messages. STPs are deployed in pairs. If one STP fails, the mate takes over, ensuring that service continues without interruption.

**simplex signaling (SX)**

Signaling using two conductors for a single channel. A center-tapped coil or its equivalent is used at both ends for this purpose.

**single frequency (SF)**

A signaling method using a 2600 Hz tone to transmit and receive on-hook/off-hook address and supervisory signals. SF is used in conjunction with E & M signaling on four-wire trunk facilities.

**single rate area (SRA)**

An area designated by the operating company as a fixed rate destination and assigned a single rate step. SRA is used in calculating rate steps.

**SL**

Signaling link

**SLC**

Speech link connecting (frame)

**SLC-96**

A subscriber loop carrier that can provide service to 96 subscribers over two to four DS-1 links running from a remote terminal to a central office. SLC-96 is a registered trademark of AT&T.

**SLM**

System load module

**SMDR**

Station message detail recording (system)

**SMR**

Subscriber Carrier Module-100 Rural

**SMS**

Software management system, subscriber carrier module-100S

**SMSR**

Subscriber carrier module-100S remote

**SMU**

Subscriber carrier module-100 urban

**SO**

Service order, switching office

**SONET**

Synchronous optical network

**SOS**

Support operating system

**SP**

Service position, signaling point, signaling processor, signal present

**SPC**

Stored program control

**speech link connecting (SLC) frame**

The frame in which the speech link connections between peripheral modules and network modules are organized. The pattern of connections is determined by interchangeable patch cards and panels.

**SS7**

Signaling System 7

**standard work seconds (SWS)**

A unit of work time used in the traffic service position system. Calculations are based on the type of call handled and take into account average allowances for inexperienced operators and time spent on other activities.

**standard work time (SWT)**

The average work time for each call over all calls and operators at a TOPS serving area

**station message detail recording (SMDR) system**

In Meridian Digital Centrex (MDC), a system that provides recording facilities for the details of billable and nonbillable calls for each MDC customer group

**station ringer test (SRT)**

Test performed on station equipment, usually a residential telephone station or a coin station, by a person at that station without the involvement of the switch operator at the central office. The SRT checks digit collection, coin return, and on-hook and off-hook ground.

**status request (SR)**

A request to the DMS-100 Family maintenance system (through a visual display unit) for information on the status of any of the maintenance subsystems

**S/T-bus**

An eight-wire bus (of which only four wires are used to transmit and receive messages) that connects terminals to the NT1 for access to the ISDN. Also known as an S/T-interface and an S/T-loop. Formerly known as a T-bus.

**STC**

Signaling terminal controller

**STCM**

Signaling terminal controller module

**STE**

Signaling terminal equipment

**stimulus signaling**

For ISDN call control, stimulus signaling mode messages for call control are sent by the terminal to the network as a direct result of actions by the terminal user. Terminals that use stimulus signaling have little local intelligence and are driven by the network. These terminals do not keep records of call states. *See also* functional signaling.

**S/T-interface**

The CCITT name for the S/T-bus.

**S/T-line card**

An ISDN line card that terminates the S/T-bus in the LCMI. When S/T-line cards are used, the U-interface and the NT1 are not required. The exchange termination acts as a network termination. *See also* U-line card.

**STM**

Service trunk module

**store and forward mode**

A method of operating a data network in which packets or messages are stored before transmission to the final destination. *See also* message switching.

**stored program control (SPC)**

An SPC may be either:

- control of an automatic switching arrangement in which the call processing is determined by a program stored in an alterable memory
- control of a function by sequentially interpreting information stored in a memory whose structure is independent of the function to be performed

**STP**

Signaling transfer point

**STR**

Selective Trunk Reservation

**subscriber access multiplexer (SAM)**

A subscriber premises modem that provides an interface to the data above voice (DAV) system for the subscriber's telephone and data terminal equipment.

**subscriber carrier module (SCM)**

In a DMS, SCM refers to the SCM-100 that connects three types of remote terminals with DMS-100 Family switches. The SCM-100 is a family of four peripheral modules: the Subscriber Carrier Module-100 Rural, the Subscriber Carrier Module-100S, the Subscriber Carrier Module-100S Remote, and the Subscriber Carrier Module-100 Urban.

**Subscriber carrier module-100 rural (SMR)**

A subscriber carrier module that provides an interface between the remote concentrator terminal of a DMS-1 and the central office of a DMS-100 Family switch

**Subscriber carrier module-100S (SMS)**

A subscriber carrier module that provides an interface between the remote concentrator SLC-96 of an SLC-96 system and the central office of a DMS-100 Family switch

**Subscriber carrier module-100S remote (SMSR)**

A subscriber carrier module that provides an interface between the remote concentrator SLC-96 of an SLC-96 system and a remote switching center

**Subscriber carrier module-100 urban (SMU)**

A subscriber carrier module that provides an interface between the remote carrier urban of a DMS-1 and the central office of a DMS-100 Family switch

**subscriber line usage (SLU)**

In operational measurements, SLU registers monitor the peg and usage counts on any line or group of lines connected to a DMS-100 office or a DMS-100/200 office

**subscriber premises meter (SPM)**

An electromechanical counter attached to a subscriber's phone and incremented during a call originating from the subscriber's line

**subsystem number (SSN)**

The identification of a subsystem located at a CCS7 point code that is able to supply data

**support operating system (SOS)**

The software that sets up the environment for loading and executing the application software in the DMS-100 Family system. SOS includes the nucleus, file system, command interpreter, and loader.

**swappable module**

A module with no per-process data. A swappable module has two head segments (protected and unprotected) that are addressed by swapping base registers 1, 2, and 3 on module entry and exit.

**switch activity (SwAct)**

Fault tolerant systems in a DMS consist of two identical devices devoted to the same function. One is active while the other remains inactive. A SwAct switches the roles of the two devices.

**switched virtual circuit (SVC)**

A logical, end-to-end connection for data communications made through a packet data network. An SVC is established dynamically.

**switching center**

A location housing a complete set of switching equipment, including related power supplies, transmission facilities, maintenance equipment, and test equipment

**switching office (SO)**

A node in the CCS7 network that originates and terminates signaling messages related to the set up and take down of associated ISDN user part (ISUP) trunks

**switchover**

The transfer of function to an alternative component in the event of a failure. Switchover can be manual or automatic.

**SWS**

Standard work seconds

**SWT**

Standard work time

**SX**

Simplex signaling

**synchronous optical network (SONET)**

An optical interface standard that allows interworking of transmission products from multiple vendors

**SysB**

System busy

**SYSDATA**

System data

**SYSINIT**

System initialization

**SYSLOG**

System log

**SYSMON**

System monitor

**system administration data system (SADS)**

The teletypewriter that records data derived from TOPS operational measurements. The TOPS operational measurements are used for the management of a single office operation.

**system busy (SysB)**

A system busy may be either:

- a busy state that is automatically imposed by equipment in response to a fault condition
- the status of trunk circuits that have failed the tests performed by the automatic trunk testing facilities. Failed trunks are taken out of service and added to a list of SysB trunks that can be accessed by operating company personnel.

- the equipment state that occurs when the central control has removed equipment from normal service. *See also* manual busy.

**system-control signaling units (SCU)**

Control signals in N6 that are used to transmit changeover, load transfer, and standby-ready signals

**system data (SYSDATA)**

Data structures with a greater scope than their strict definition that can be used by most of the system

**system index (SI)**

A list of key equipment structures, provisioning information, and marketable products applicable to a specific DMS-100 Family system. The SI forms part of the standard documentation package provided to an operating company.

**system initialization (SYSINIT)**

A process used primarily in support operating system restarts

**system load module (SLM)**

A mass storage system in DMS SuperNode that is used to store office images. From the SLM, new loads or stored images can be booted into the computing module.

**system log (SYSLOG)**

Contains a selection of reports from various logs following a reload-restart. SYSLOG is the only log which survives a reload-restart.

**system monitor (SYSMON)**

Monitors system performance and is used principally to monitor the state of a working system. SYSMON can be used to detect error conditions.

**TADS**

Traffic administration data system

**tandem office**

An office that is used to interconnect the end offices in a densely settled exchange area. The interconnection is done over tandem trunks when it is not economical for an operating company to provide direct interconnection between all end offices.

**tandem originating (TO) trunk circuit**

In a DMS, a type of trunk circuit that interfaces with an inter-local, tandem-originating trunk

**tandem tie trunk network (TTTN)**

The switched interconnection of tie trunk networks



**tandem trunk**

A trunk to or from a tandem office or exchange. Also, a trunk between end offices that can be used to pass traffic to other end offices.

**TAS**

Technical assistance service

**T-bus**

Transaction bus

**TCAP**

Transaction capability application part

**TCTS**

Trans-Canada Telephone System

**TDF**

Trunk distribution frame

**TDM**

Time-division multiplex. A means of obtaining a number of channels over a single path by dividing the path into a number of time slots and assigning each channel its own intermittently repeated time slot.

**technical assistance and surveillance center (TASC)**

Monitors the activities of unattended DMS-100 Family systems and provides technical assistance to switch maintenance personnel as required. The operating company personnel have access to data and input commands applicable to switch maintenance.

**technical assistance service (TAS)**

Nortel Networks' technical services organization for customers in the United States. TAS handles all emergency and non-emergency support, technical queries not related to pricing and product availability, cutovers, and software updates including patches.

**Telecom Canada**

An organization comprised of several of Canada's major telephone and telecommunications companies that was formerly known as Trans-Canada Telephone System

**Teleglobe**

A former Canadian Crown Corporation that handled international telephone traffic. Because Teleglobe used DMS-300 switches, they were often used in a Canadian context to refer these switches themselves.

**telephone network operating system (TNOS)**

The equipment located on an operating company's premises that collects data from multiple DMS switches

**telescoping**

The method by which successively lower levels can be accessed on a MAP display to pinpoint a fault

**ten high day busy hour (10 HDBH)**

The hour, not necessarily a clock hour, that produces the highest average load for the ten highest business day loads in a busy season.

**terminal process**

In a DMS, one of the processes associated with each terminal in a peripheral module. Terminal process performs functions that require ongoing operation, such as digit collection, outpulsing, and hook-switch monitoring.

**test access (TA)**

Connection points on the speech interface circuits of a special type of trunk module used in the DMS-300 system. TA permits metallic connections to be made for test purposes.

**test access network (TAN)**

A peripheral module that provides metallic connections between a trunk test position or a test trunk and the access bus on a special type of trunk module used in the DMS-300 system

**test code (TC)**

In a DMS, a special pattern of 10 bit words that are substituted for PCM speech samples. TCs are transmitted through the network modules to provide a test of all circuits in its path.

**test signal generator (TSG)**

In a DMS, a test circuit card used with the maintenance trunk module. The TSG provides digital tones for trunk test purposes. Various levels and filters are selectable under software control.

**Three-Way Calling (3WC)**

A service-related telephony feature that permits a subscriber who is talking to add a third party to the call without operator assistance.

**TID**

Terminal ID

**tie call**

A type of call that occurs on private incoming and outgoing lines between private branch exchanges (PBX)

**tie line**

A leased or private dedicated telephone circuit provided by communication common carriers for linking two or more points together without using the switched network

**tie trunk**

A trunk directly connecting two private branch exchanges

**timer**

A register whose content is changed at regular intervals so as to measure time. Synonymous with clock register and time register.

**TLB**

Terminal linkage block

**TLC**

Trunk logic circuit

**T-link**

A full duplex, byte-oriented adaption protocol designed to transfer synchronous or asynchronous data over a digital circuit at digital trunk equipment data rates of up to 64 kb/s.

**TM**

Trunk module

**TM2**

A trunk module with 30 pairs (two-wire circuits) of conductors wired to the distribution frame

**TM4**

A trunk module with 60 pairs (four-wire circuits) of conductors wired to the distribution frame

**TM8**

A trunk module with 120 pairs (eight-wire circuits) of conductors wired to the distribution frame

**TME**

Trunk module equipment (frame)

**TML**

Terminating matching loss

**TNOS**

Telephone network operating system

**TNP**

Toll network protection

**TO**

Tandem originating (trunk circuit)

**toll center (TC)**

A class 4, central office where toll message circuits terminate and operator services are provided. *See also* office classification, toll point.

**toll connecting trunk**

A trunk used to connect a class 5 office to the direct distance dialing network

**toll point (TP)**

A class 4 office where switching is performed without provision for operator functions, or in which operators handle outward calls only. *See also* office classification, toll center.

**toll restriction**

Removal of the ability of some or all extensions on a PBX to make toll or long distance calls other than through an attendant

**toll switching (TS)**

In a DMS, a trunk circuit capable of interfacing with a toll connecting trunk facility

**toll tandem (TT)**

A type of trunk circuit used to interface with an intertoll or toll tandem trunk

**TOPS**

Traffic operator position system

**TOPS recording unit (TRU)**

A software storage area designed to hold TOPS call data for use by the central control in the handling of these calls

**touchtone dialing**

A service-related telephony feature that permits a subscriber to send dual-tone multifrequency address signals to the system. Synonymous with Dual-Tone Multifrequency Dialing. Touchtone is a trademark of AT&T.

**TP**

Toll point

**traffic administration data system (TADS)**

The teletypewriter that records data derived from TOPS operational measurements used for traffic office management.

**traffic operator position system (TOPS)**

A call processing system made up of a number of operator positions. Each operator position consists of a visual display unit (VDU), a controller, a keyboard, and a headset. TOPS is a trademark of Nortel Networks.

**traffic service position system (TSPS)**

A toll operator position consisting of a push-button console.

**transaction bus (T-bus)**

An internal bus in the duplicated message switches of the DMS SuperNode. Messages are transmitted from port to port over the T-bus, a synchronous bus operating at 4.096 Mb/s. *See also* S/T-bus.

**TRD**

Timed-release disconnect

**TRU**

TOPS recording unit

**trunk distribution frame (TDF)**

A distribution frame dedicated to trunk circuits

**trunk logic circuit (TLC)**

A digital circuit that provides a buffer for the transfer of data on the receive-data and transmit-data buses of a maintenance trunk module, office alarm unit, trunk module, and other peripheral modules

**trunk module (TM)**

A peripheral module, in a trunk module equipment frame, that provides speech and signaling interfaces between a DS-30 network port and analog trunks

**trunk module equipment (TME) frame**

A frame containing one or more trunk modules, maintenance trunk modules, or office alarm unit

**trunk test center (TTC)**

The area of a DMS-100 Family office where the MAP used as a trunk test position is located

**trunk test position (TTP)**

A MAP that is specially equipped to perform trunk testing

**2WW**

Two-way wide area telephone service (WATS)

**UCD**

Uniform Call Distribution

**UHL**

User header label

**UI**

User interface

**U-interface**

The CCITT term for a U-loop. *See also* U-loop.

**U-ISLC**

ISDN U-line card

**U-loop**

The portion of a BRA interface that connects an NT1 to an ISDN line concentrating module (LCMI) or an enhanced line concentrating module (LCME). *See also* U-interface.

**unbalanced line (UNBAL)**

A transmission line, such as a coaxial line, in which the magnitudes of the voltages on the two conductors are not equal with respect to ground.

**unequipped port**

Port of an LCM in an RLCM that does not map to a DS-1 link. The unequipped port provides 18 intrachannels and 12 interchannels for calls. It does not have host channels.

**uniform call distribution (UCD)**

A Meridian Digital Centrex feature that allows calls to be evenly distributed to a number of predesignated stations known as UCD stations or UCD positions. This feature is used to queue incoming calls to the message desk.

**universal terminal adapter (UTA)**

A device with associated software that allows a personal computer to connect to a Nortel Networks ISDN.

**universal tone receiver (UTR)**

An optional card in the PM. If the UTR is not included in a specific PM, the central control can establish a network connection between that PM and one that has a UTR. The UTR is a 32-channel tone receiver. Thirty channels detect a variety of tones including DTMF for lines and MF for trunks. Tone samples are switched onto the parallel speech bus by the time switch, and they are collected by the UTR at the appropriate time slots. The UTR analyzes the samples and identifies the tones. The results are then sent to the signaling processor.

**user interface (UI)**

The series of commands and responses that are used by operating company personnel to communicate with the DMS-100 Family system machines. The user interface is achieved through the MAP and other input/output devices.

**UTL**

User trailer label

**UTR**

Universal tone receiver

**utility**

In DMS software, a module that provides resources that it can allocate on request and recover when filed. It also controls access to data structure.

**variable-blocked (VB)**

In a DMS, a magnetic tape format for blocks of variable-length data records. In a VB format, the total length of one or more records in a block cannot exceed the maximum block size. *See also* variable-blocked-spanned.

**variable-blocked-spanned (VBS)**

In a DMS, a magnetic tape format for blocks of variable-length data records where the total length of one or more records may exceed the maximum block size. In a VBS format, the overflow of the last record is spanned into the beginning of the next block. *See also* variable-blocked.

**VDU**

Visual display unit

**verification office (VO)**

A central office in which new equipment, new features, or both are tested prior to general release.

**vertical-horizontal (V-H) coordinate system**

The V-H coordinate system is a theoretical grid of vertical and horizontal lines covering Canada, the United States, and part of Mexico. This system is used in calculating rate steps.

**VF**

Voice frequency

**VFG**

Virtual Facility Group

**V-H**

Vertical-horizontal (coordinate system)

**virtual circuit**

In packet switching, a network facility used for transferring data between those data stations emulating physically-connected stations

**virtual private network (VPN)**

A call case that makes use of the public network to support a private numbering plan. It is included with N7 user part supplementary services. The role of the DMS-300 ISSU in a VPN is to provide tandem access to other national networks.

**visual display unit (VDU)**

An electronic output device that presents data to a terminal user in the form of a television picture. In a DMS, the VDU is one of the components of the MAP and, along with a keyboard, provides the main user interface in the DMS-100 Family of systems.

**VNL**

Via net loss

**VO**

Verification office



**voice frequency (VF)**

The band of frequencies from 300 Hz to 3400 Hz used for telephony transmission. This band of frequencies is known commonly as the commercial speech band.

**voice line card (VLC)**

A card that is equivalent to a line card. The term is used to contrast with data line card when both cards are present in a hardware configuration. *See also* line card and data line card.

**Voice message exchange (VMX)**

An optional feature that allows users to send and receive voice messages. Voice messages are sent, stored, and retrieved using a VMX microprocessor connected to the host through two-way, four-wire E & M type II trunks.

**voice quote (VQ)**

A service provided for hotels/motels not equipped with autoquote whereby guest billing information is transmitted to a receive-only teletypewriter in the hotel billing information center. The HOBIC operator telephones the hotel and verbally quotes call details. *See also* autoquote, HOBIC administrative (teletypewriter), record teletypewriter.

**volume**

Volume may be either:

- a certain portion of data, together with its data carrier, that can be handled conveniently as a unit
- a data carrier, such as a reel of magnetic tape, that can be mounted and dismounted as a unit
- that portion of a single unit of storage that is accessible to a single read/write mechanism, for example, a disk pack. *See also* device.

**volume label (VOL)**

A standard IBM label that is recorded on magnetic tape ahead of the header and user header labels. A VOL identifies the volume by serial number and tape user name.

**VPN**

Virtual private network

**VQ**

Voice quote

**warm restart**

An initialization phase during which temporary storage is deallocated and cleared. Transient calls are dropped while calls in the talking state continue. *See also* cold restart.

## **WATS**

Wide area telephone service

### **wide area telephone service (WATS)**

A special direct distance dialing service that, for a flat monthly charge or a charge based on accumulated usage, permits either inward or outward dialing between a subscriber and specified areas. *See also* inward wide area telephone service, outward wide area telephone service.

### **wink (WK)**

A method of signaling between idle trunk circuits whereby trunks signal off-hook towards each other. A WK signal consists of timed off-hook signals transmitted to the calling end after a connection is made. *See also* multiwink.

### **wink operation**

A timed off-hook signal, normally of 140 ms, that indicates the availability of an incoming register for receiving digital information from the calling office.

### **wink signal**

A wink signal may be either:

- a short interruption of current to a switchboard lamp to indicate that the circuit is busy
- on key telephone sets, a flashing lamp that indicates that a line is being held
- an indication of change of state between an on-hook and off-hook condition

### **Wink start**

A telephony feature that provides control for address signaling. The Wink Start feature is used to inform the calling office that the called office is prepared to receive address signals. The Wink Start signal consists of an on-hook to off-hook to on-hook transition, with the off-hook to on-hook state representing the start dial signal.

## **X.25**

A CCITT-defined, network layer protocol that is used in packet switching to establish, maintain, and clear virtual circuit connections between an ISDN terminal and a destination in the packet switching network.

## **X.28**

A CCITT-defined protocol for terminal user control of a packet assembler/disassembler (PAD). The CCITT recommendation defines the establishment of an information path, and the exchange of control information and user data between start-stop digital trunk equipment (DTE) and a PAD.

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<b>X.29</b>	A CCITT-defined protocol for host control of a remote PAD. The CCITT recommendation defines the exchange of user data and PAD control information between the PAD and the network.
<b>X.3</b>	A CCITT-defined set of internal variables called PAD parameters that govern the operation of a PAD
<b>X.75</b>	A CCITT-defined, network layer protocol that is used in packet switching to establish, maintain, and clear virtual circuit connections between packet switching networks
<b>XDAT</b>	Transmit data
<b>XFER</b>	Remote data polling system
<b>XLCM</b>	The domestic version of the drawer portion and ring generation of a large memory line concentrating module (LCM)
<b>XMS</b>	A workstation-based microcomputer with networking capabilities. XMS is based on a Motorola 68000 microprocessor with system software written in Pascal.
<b>XMS-based peripheral module (XPM)</b>	The generic name for XMS peripherals that use the Motorola 68000 microprocessor. An XPM has two processors in a hot standby configuration: a signaling processor and a master processor.
<b>XPAM</b>	Transmit pulse amplitude modulation
<b>XPCM</b>	Transmit pulse code modulation
<b>XPT</b>	Crosspoint

### **zero suppression**

Zero suppression may be either:

- The elimination of insignificant zeros from a number. This includes zeros to the left of the left-most, non-zero digit on the left side of a decimal point, and zeros to the right of the right-most, non-zero digit on the right side of a decimal point.
- In telephone digital transmission, refers to the insertion of pulses to break up a string of 0 bits, when the string is sufficiently long to disrupt clock synchronizationmultifrequency (



DMS-100 FAMILY  
**DMS SuperNode**  
Technical Specification

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Allowing this equipment to be operated in such a manner as to not provide for proper answer supervision is a violation of Part 68 of FCC Rules, Docket No. 89-114, 55FR46066

This equipment is capable of providing users with access to interstate providers of operator services through the use of equal access codes. Modifications by aggregators to alter these capabilities is a violation of the Telephone Operator Consumer Service Improvement Act of 1990 and Part 68 of the FCC Rules

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