DMS-100 FAMILY SYSTEM

DESCRIPTION

(c) NORTHERN TELECOM LIMITED, 1978

CONTENTS

PAGE

1. INTRODUCTION...1

2. OVERVIEW...3

3. HARDWARE SYSTEM DESCRIPTION............................5

4. MESSAGE SYSTEM..12

5. SOFTWARE SYSTEM DESCRIPTION...........................14

6. MAINTENANCE SYSTEM....................................15

7. ADMINISTRATION AND TRAFFIC............................16

8. CALL PROCESSING.......................................17

9. SYSTEM REQUIREMENTS SUMMARY...........................18

10. ABBREVIATIONS..19

APPENDICES

1. Call Description DMS-100 Intra-Office Call

2. Call Description DMS-200 Inter-Office Call

FIGURES

1. DMS-100 Family Block Diagram..........................F-1

2. Central Control Complex Bays..........................F-2

3. Switching Network Block Diagram.......................F-3

4. Floor Plan DMS-100 System. 4500 Lines Minimum..........F-4

5. Floor Plan. DMS-200 System............................F-5
10,000 Trunk Toll Office.

TABLES

A. Mechanical, Environmental and Power Characteristics....20

B. Performance Characteristics...........................21

1. INTRODUCTION

GENERAL

1.01 The DMS-100 Family of digital multiplex switching systems consists of a series of modular, software-controlled, digital central office switches, providing local and/or toll service with a variety of optional features. The particular package of services and features, specified by the customer, is assembled by selecting types and quantities of hardware and software modules from the DMS-100 Family range of products. The following basic types and capacities of switches are available.

(a) DMS-100. A local central office, having a capacity of 1500 to more than 100,000 subscriber lines.

(b) DMS-200. A toll central office, capable of handling from 400 to 60,000 trunks of various types.

(c) DMS-100/200. A local and toll central office, handling combinations of subscriber lines and trunks, within the ranges of (a) and (b), and as specified by the customer.

(d) DMS-300. An International (Gateway) switching center capable of handling up to 25,000 international trunks.

BASIC CONFIGURATION (Figure 1)

1.02 All types of DMS-100 Family switches have the same basic configuration, consisting of four main functional areas; the Central Control Complex (CCC) area, the Switching Network (NET) area, the Peripheral Modules (PM) area, and the maintenance and administration area.

1.03 The CCC and NET areas perform the same functions for all DMS-100 Family switches, but the PM area varies depending on the type of switch. The PM provide interfaces between the NET and a variety of external facilities, such as analog subscriber lines (DMS-100), analog trunks or DS1 digital trunks (DMS-200), or international trunks (DMS-300) to the standards of the International Telephone and Telegraph Consultative Committee (CCITT). The types of PM are selected to meet the specifications of the switch.

1.04 The components of the maintenance and administration area vary depending on the features required by the customer and the type of switch.

REFERENCES

1.05 The following documents contain detailed descriptions of items mentioned in this practice.

(a) Northern_Telecom_Practices

DMS-100 Family Central Control Description	NTP 297-1001-101
DMS-100 Family Switching Network	NTP 297-1001-102
DMS-100 Family Peripheral Modules	NTP 297-1001-103
Internal Message Handling	NTP 297-1001-104
Maintenance System	NTP 297-1001-106
Software System	NTP 297-1001-108
Maintenance and Administration Position	NTP 297-1001-110
DMS-100 Family Traffic Provisioning	NTP 297-1001-450

(b) General_Specifications

Central Processing Unit	GS1X41
Memory Module	GS3X31
Central Message Controller	GS1X32
Trunk Module	GS2X52
Digital Carrier Module	GS2X31
Maintenance and Administrative Position	GS0X57
Line Module	GS0X45
Network Module	GS0X48
Software System Structure	GS1V00
I/O Controller	GS1X61

2. OVERVIEW (Figure 1)

SPEECH AND MESSAGE LINKS

2.01 The four functional areas of the DMS-100 Family switches are interconnected by links carrying speech samples and/or control messages in the form of serial digital data.

2.02 Each link provides a 2-way (4-wire) transmission path for 32 channels of time division multiplexed data. The speech links have 30 channels allotted for transmission of Pulse Code Modulated (PCM) speech samples, and two channels for control mesages, while all the 32 channels of the message links are allotted exclusively to control messages.

CCC DUPLICATION

2.03 The components of the CCC area are duplicated, for reliability, and operate as synchronized pairs, with one CCC in service (active), performing call-processing and other operations, while the other CCC (inactive) performs the same operations, but checks for asynchronism between itself and the active CCC. Any discrepancy between the two CCC results in a maintenance interrupt, leading to recovery action.

NETWORK DUPLICATION

2.04 The components of the NET are also duplicated as separate identical entities, providing two parallel sets (or "planes") of 2-way transmission paths for each connected channel between peripheral modules. The duplicated parallel paths ensure that if one channel in a transmission path fails, the alternative channel is immediately available while recovery action is taken to restore the failed channel. The duplicated networks are referred to as Plane-0 and Plane-1.

PERIPHERAL MODULES AREA

2.05 The peripheral modules area comprises any one or all of three types of PM; the Line Module (LM), the Trunk Module (TM), and the Digital Carrier Module (DCM). The PM interface with subscriber lines (LM), analog trunks (TM), and digital DS1 Trunks (DCM), respectively. Each PM has a Peripheral Processor (PP) function which performs local processing action within its PM, and controls the flow of messages between itself and the CCC. This autonomous action by the PP relieves the CCC of routine local processing, enabling the CCC to concentrate on higher level activities.

MAINTENANCE AND ADMINISTRATION AREA

2.06 The Maintenance and Administration area comprises the Input/Output Controllers (IOC), which provide an interface between the various I/O devices, used for maintenance and administrative purposes, and the CCC. The IOC also contain PP, to perform local processing actions, and Device Controllers (DC), which communicate with the I/O device itself. Typical maintenance and administrative I/O devices are: magnetic tape units, Teletyprinters (TTY), and the Visual Display Unit (VDU).

2.07 The IOC collect data from the various DC, and communicate to and from the CCC area via message links. These message links are not duplicated as are those to the Network, but share the message traffic, since each IOC has access to either CCC area.

3. HARDWARE SYSTEM DESCRIPTION

CENTRAL CONTROL COMPLEX (CCC) (Figure 2)

3.01 The duplicated CCC is mounted on two adjacent bays. Each CCC contains a group of four units which act together to evaluate incoming messages, to formulate the proper response and to issue instructions to subsidiary units. The four units and their functions are:

(a) Central_Processing_Unit_(CPU)

Is the the central processor for the DMS system. The CPU has access to memories where stored programs and network data are located. The processor uses this data to decide what action is required to satisfy the needs of the network and issues the commands to carry them out.

(b) Program_Store_(PS)_Memory_Module

Is exclusively associated with one CPU and is a repository for the program instructions required by that CPU for call processing, maintenance and administrative tasks. The PS associated with the other CPU contains duplicate program instructions.

(c) Data_Store_(DS)_Memory_Module

Is associated with one CPU and contains transient information on a per-call basis, as well as customer data and office parameters. The other CPU is also associated with a DS containing duplicate data.

(d) Central_Message_Controller_(CMC)

Controls the flow and priority of messages between the other units of the CCC and the Network Message Controller (NMC) in the various Network Modules (NM), or the Input/Output Controller (IOC). The sub-group of three units (CPU, DS, PS) excluding the CMC, is referred to as the Central Control (CC). Both CPU have access to either CMC which share the message load to the PM.

CENTRAL PROCESSING UNIT (CPU)

3.02 The CPU is a high-speed data processor with a microcycle time of 111 nanoseconds and a word length of 16 bits, plus one parity bit. It has two independent parallel memory ports. One port (Program) interfaces with external memory containing variable-length instructions (PS), while the other port (Data) interfaces with the data store (DS). The CPU normally operates in duplicated matched mode with a mate CPU, but can also operate singly. A 36MHz free-running clock provides the basic CPU timing, controlling register gating and clocking, emergency timers and interrupt logic. The 111-nanosecond extendable microcycle period is derived from this clock.

3.03 The CPU uses a register stack to manipulate data internally as well as to and from the data port. The register stack is a high-speed bipolar store containing frequently-used data. This high-speed store, coupled with stack-oriented instructions, contribute to the fast execution speed of the CPU. The CPU contains the microstore and microsequencing logic necessary to execute the program instructions.

3.04 In addition, the CPU contains the following functions required only for dual processor operation: matching, synchronization, inter-machine communication, fault indication and activity control. A match exchange bus (MEB) between the two CPU enables the operation of one CPU to be continuously compared to that of the other CPU. Any asynchronism between the two CPU is detected by maintenance circuitry and appropriate action is taken to change to the alternative CPU. The configuration of the CPU can be controlled and monitored by manual controls and status indicators which are accessible or visible from the front of the unit.

MEMORY MODULES

3.05 The Memory Modules used for the PS and DS functions are available in two configurations. One type provides Random Access Memory (RAM) in increments of 16K (K=1024) 17-bit words, while the other type has larger increments of 64K words. The increments of RAM are in the form of Metallic Oxide Semi-conductor (MOS) memory cards which are plugged into the Memory Module. A maximum of 16 active MOS Memory Cards, plus one spare card, can be accommodated per Memory Module. A Memory Module occupies one shelf in the CCC bay.

3.06 A fully-equipped Memory Module of the type using the 16K MOS memory cards, thus has a maximum memory capability of 256K words. The Memory Module using the 64K MOS memory cards has a maximum memory capability of 1024K words, or 1M word.

PROGRAM STORE (PS)

3.07 For PS usage, using 16K MOS memory cards, a maximum of two Memory Modules can be used, occupying both of the available shelf spaces in the lower part of the CCC bay. Total RAM capability it therefore 512K 17-bit words. In this case, the DS is located elsewhere, as described in the next paragraph. For a larger PS, 64K MOS Memory Cards are used, providing a maximum RAM capability of 1M word, and requiring one Memory Module.

DATA STORE (DS)

3.08 For DS usage, the Memory Module is equipped with special interface and termination cards, which permit the DS to be located either in the lower shelf of the CCC bay (for a small DMS system), or to be located in additional adjaent bays. These additional DS bays, known as Memory Extension (MEX) bays, have space for up to four Memory Modules per bay. The technology and packaging of the DS Memory Modules is otherwise similar to that of the PS. Maximum RAM capability per MEX bay is 1024K words, using 16K MOS memory cards, or 4M words using the 64K memory cards.

CENTRAL MESSAGE CONTROLLER

3.09 The Central Message Controller (CMC) acts as a collector/distributor unit for message buffering and routing between the CPU and the Network Message Controllers (NMC) or IOC. As such, it reduces the real time load that the CPU would otherwise incur. The CMC is duplicated and appears on both data port busses allowing access from either CPU. The two CMC operate in load-sharing mode. The side of the CMC which interfaces with the NMC and IOC is referred to as the "peripheral side" (P-side), while the side interfacing with the CPU is referred to as the "CC-side" (C-side).

3.10 Included in each CMC is a system clock which is the source of timing for the network, PM and IOC. The stability of the system clocl is one part in 10-6. The 8KHz framing signal controlling the 32-channel time-division multiplexing is derived from the same source. The clock contains two independent synchronized timing sources derived from 10.24 MHz crystal oscillators. Only one CMC provides timing for the system; the other is in synchronized standby mode.

3.11 Up to 64 Network Message Controllers (NMC) (32 in each plane of the duplicated network) and up to 6 IOC, which drive visual display units, teletypewriters, consoles, magnetic tape units, etc., are connected to the P-side of each CMC. The message links from the CMC to these peripherals are two-way, 2.56 Mb/s asynchronous ac, data channels over which the control and signalling messages flow. The CMC distributes timing to the Network Modules (NM) and, via the NM, to the Peripheral Modules. This ensures that the various components of the system operate at the same rate or a multiple thereof.

SWITCHING NETWORK (Figure 3)

3.12 The switching network employs four stages of time switching for each voice connection between the originating PM and the terminating PM. The paths for each connection through the network are assigned under the control of the Central Processing Unit (CPU). The network also distributes the control messages to and from the PM and the CPU. The network is fully duplicated, i.e., Plane 0 and Plane 1, from the originating PM to the terminating PM to achieve the necessary reliability.

3.13 Plane 0 and Plane 1 of the network each consist of a set of up to 32 Network Modules (NM), identified as NM-0 through NM-31, each set of NM forming an identical and independent half of the Network. The NM is the major building block of the plane, and each NM has two sides, as follows:

(a) "Receive", Side A (incoming paths from the PM)
(b) "Transmit", Side B (outgoing paths to the PM)

The separate receive and transmit paths give the network its inherent 4-wire characteristic.

3.14 Each side of an NM provides two stages of time switching, the first stage performed by an incoming crosspoint (IC-XPT) time switch and the second stage by an outgoing crosspoint (OG-XPT) time switch. Each time switch has eight ports (ports 0 through

7), each port handling 32 channels (30 voice + 2 message) between the NM and PM. Each side of an NM contains eight IC-XPT time switches and eight OG-XPT time switches, usually referred to as an 8X8 time switch arrangement. The full capability of an NM is therefore as follows:

(a) Number of channels per port = 32 (30 voice + 2 message).
(b) Number of ports per time switch = 8.
(c) Number of time switches per side = 16 (8 x 8).
(d) Total number of ports per side = 64 incoming and outgoing.
(e) Total number of channels per time switch = 256 (8 x 32)
(f) Total number of channels per side = 2048 (32 X 64). Actually 1920 (30 X 64) voice, and 128 (2 X 64) messages.

3.15 Since each side of an NM performs two stages of time switching, the four stages of switching through the network are accomplished by connecting the outgoing ports of the OG-XPT switches in the receive side of an NM to the incoming ports of the IC-XPT switches in the transmit side of the same, or another NM. The connections between receive and transmit sides are called "junctors", and the pattern of connections between NM is dependent on traffic calculations.

NETWORK SIZE AND GROWTH

3.16 Since Plane 0 and Plane 1 each require a separate frame, each duplicated network occupies at least two frames. Growth of the network is accomplished by the addition of NM in each plane and rearrangements of the junctors. The full network consists of 32 NM in each plane and occupies 64 frames. It provides 61,440 voice channels in each direction in each plane (1920 channels X 32 NM per plane = 61,440).

NETWORK CONTROL

3.17 Each NM contains a Network Message Controller (NMC) which exchanges messages with the Central Control Complex (CCC) and the Peripheral Modules (PM) via the Central Message Controller (CMC). Inputs to the NMC from the CCC come in the form of commands to locate appropriate paths through the network, to establish or release network connections, or to send a maintenance code. Path selection is done under control of software residing in the CCC, based on a network map kept in the Data Store (DS). In the event of loss of the network map in the DS, the map can be reconstructed from information stored in the NMC. A fully-equipped network contains 32 NMC per plane (NMC-0 through NMC-31), or 64 NMC total for both planes.

DIGITAL CARRIER MODULE

3.18 The Digital Carrier Module (DCM) provides a direct interface between the DMS digital switching network and digital carrier signals referred to as DS1, which in North America consists of 24 2-way voice frequency channels, time division multiplexed onto a 1.544 Mb/sec bit stream. The DCM extracts and inserts signalling information for interfacing DS1 signals with the DMS-100 Family 32-channel, 2.56 Mb/sec speech links. The DCM is a self-contained shelf having the capability to interface a maximum of five DS1 links (5 X 24 = 120 voice channels) with four 30 voice channel (4 X 30 = 120) speech links.

TRUNK MODULE

3.19 The Trunk Module (TM) encodes and multiplexes incoming speech from a maximum of 30 analog trunks into 8-bit PCM speech samples. The TM combines the samples with internal control messages, as well as the trunk supervisory and control signals, for transmission at 2.56 Mb/sec to the network. In the other direction of transmission, the 30 digital speech signals and the two control channel signals received from the network, are demultiplexed and decoded by the TM into 30 individual channels of analog speech and associated signalling. The TM also accommodates service circuits such as MF receivers, announcement trunks, etc., either on dedicated TM or in common with analog trunks.

MAINTENANCE TRUNK MODULE, OFFICE ALARM UNIT

3.20 Test circuits are accommodated on a special type of TM, referred to as a Maintenance Trunk Module (MTM). Another module, similar to the MTM, accommodates alarm interface circuits and is referred to as the Office Alarm Unit (OAU). Both MTM and OAU have the capability of interfacing 30 test or alarm circuits with one 32-channel, 2.56 Mb/sec speech link to the network.

LINE MODULE

3.21 For local applications, the Line Module (LM) provides voice and signalling interfaces between 2, 3, or 4, 32-channel 2.56 Mb/sec speech links and a concentration of up to 640 analog subscriber lines. LM are installed in pairs on a double-bay frame, with one LM on each bay. LM Controllers (LMC) on adjacent bays operate as reliability mates with separate battery feeds. The LMC contains the PP function. Each LM has access to its own LMC and to the mating LMC to increase reliability. One LM occupies a single bay and has four line shelves and one LMC shelf. Each line shelf contains five line drawers which accommodate 32 line cards each for a total of 640 (4 shelves X 5 drawers X 32 line cards = 640) line cards per LM.

REMOTE LINE MODULE

3.22 The Remote Line Modules (RLM) consist of specially-equipped LM which are located remotely, but which operate as peripheral modules of the DMS-100 Family office via DS1 carrier links. Special interface circuits in the RLM transform the usual 32-channel speech link format at the remote end to 24-channel DS1 format for transmission to the office. The office end is equipped with DCM which transform the DS1 signals back to DMS-100 Family speech link format. The RLM provides an economical and efficient method of increasing the serving area of a DMS-100 Local or DMS-100/200 Local/Toll office.

PERIPHERAL PROCESSORS

3.21 The Peripheral Processors in the PM (DCM, TM or LM) each consist of a microprocessor with associated Read-Only Memory (ROM), Random-Access Memory (RAM) and Arithmetic and Logic Unit (ALU). The ROM contains "firmware" (fixed instructions) which control the microprocessor as it performs the following local tasks:

(a) Scanning the trunk or line interface circuits and detecting a change of state on the associated trunk or line transmission facility.

(b) Timing of call processing functions.
(c) Collecting and storing dialled digits.
(d) Generating digital tones.
(e) Sending and receiving signalling and control information to aid from the CCC.
(f) Providing integrity checking of network paths between connected PM.

INPUT/OUTPUT CONTROLLER

3.22 The Input/Output Controller (IOC) operates similarly to a PM, but its PP communicates directly with the CMC instead of via the NMC. Each IOC accommodates up to nine device controllers (DC), each of which has its own subsidiary PP. There are two types of DC, one provides an interface to one magnetic tape unit on which system data such as Automatic Message Accounting (AMA), or Operational Measurements (OM) are recorded. The other type of DC is a multi-purpose controller capable of handling interfaces with up to four I/O devices. The configurations of the four ports on the multi-purpose DC can be set, via software commands, to match the characteristics of the I/O devices (TTY, VDU, etc.) connected to the ports.

3.23 A special type of IOC is used for the DMS-300 (International) switch application, in addition to the regular type of IOC. This special IOC provides an interface to handle signalling messages in No. 6 CCITT format. The common circuitry and PP of this type of IOC are the same as the regular IOC, but instead of DC, the IOC is equipped with No. 6 Signalling Interface cards. In this configuration, the IOC is referred to as a No. 6 Signalling Shelf.

4. MESSAGE SYSTEM

PURPOSE

4.01 The Message System (MS) provides the media and protocol for the transmission of inter-module control messages.

TRANSMISSION MEDIA

4.02 The MS consists of hardware units, within each module, which are inter-connected via the message channels in the message and speech links.These units, at the terminating points of the message channels between the modules, have the capability of accepting and/or originating messages, and thus control the flow of messages throughout the MS.

MESSAGE PROTOCOL

4.03 Control messages contain a fixed-length header section, followed by a data section of variable length, depending on the complexity of the message. Message transmission uses "handshake" protocol (two-way sequences). No message sequence is sent without receiving an acknowledgement from the receiver that it is ready to receive, and no sequence is completed without another acknowledgement after transmission that the reception was error-free.

OPERATION

4.04 Via the message system, the CC controls the logic of calls and directs the action of NM, PM and IOC. The DMS System structure is based on distributed processing. Microprocessors, located in the NM, PM, and IOC, relieve the CC of repetitive real-time consuming functions such as scanning and digit collection.

4.05 The two CPU are linked to the Central Message Controllers via the data port bus (which also gives each CPU access to its private Data Store). CMC connect to NMC and IOC via 2.56 Mb/s serial data channels on the message links. NMC communicate with PM via dedicated signalling channels on the speech links at 64 Kb/s per channel.

4.06 The CPU contains firmware which controls the movement of messages over the data port bus between the CMC and the active CPU. The CMC scan Network Message Controllers and I/O Controllers for incoming messages to the CPU and direct outgoing messages from the CPU to the appropriate controller.

4.07 Network Message Controllers (NMC) scan the PM for incoming messages which they pass on to the CMC and receive outgoing messages from CMC for transfer to the PM. The IOC provide interfaces between CMC and visual display units, tape units, etc.

4.08 Peripheral Modules have message-handling hardware/firmware to transfer messages to the NMC and to accept CPU messages from the NMC.

4.09 All elements of the Message System collection/distribution system are duplicated. Links also exist so that the failure of a single unit does not force other units into 'simplex' (non-duplicated) operation. The path taken by a message is governed by the CPU master routing algorithm which ensures that all paths are used. In this way, failures are quickly detected and the routing modified to bypass the faulty unit or link. Messages between the CPU and PM normally follow only one path per message. However, because the duplicate networks operate in step, messages originating or terminating in one (e.g.: Plane-0) NMC, also involve the other NMC associated with Plane 1.

5. SOFTWARE SYSTEM DESCRIPTION

5.01 The DMS software system is designed for flexibility and efficiency. It includes all the programs necessary for an operational system. Included in the software are call processing programs, administrative programs, maintenance programs, and operating system programs.

5.02 The basic logical building block of the DMS software system is the module. Each module contains the program code and data necessary for carrying out a specific telephony function or sequence. The flexibility of the software system is achieved through the organization of the system into many separately compilable modules. In addition, provision is made for a group of optional modules containing the code and data necessary for implementing feature-dependent functions. An appropriate subset of these modules can be chosen to engineer a particular office.

5.03 The basic language for the DMS system is PROTEL (PRocedure Oriented Type Enforcing Language). It is a high level language designed for use in switching systems. PROTEL contains many features which facilitate the implementation of a reliable and maintainable software system.

6. MAINTENANCE SYSTEM

6.01 The DMS maintenance system is designed to detect and analyze faults, to take corrective action, and to alert the maintenance personnel. The maintenance system is responsible for maintaining both the software and the hardware resources of the DMS switch.

6.02 The maintenance system is subdivided into several subsystems, each of which is responsible for its own level of hardware. The responsibilities of each subsystem include:

a) routine testing,
b) fault detection,
c) fault analysis,
d) error reporting, diagnostic reporting, and/or subsystem status reporting.

6.03 The Maintenance and Administration Position (MAP) provides an interface between maintenance personnel and the various maintenance subsystems. It provides maintenance personnel with the information and tools necessary for efficient diagnosis and identification of system faults at a level where the fault can be corrected by the replacement of a card.

6.04 Current status information about the system is displayed on a Visual Display Unit (VDU) associated with the MAP. Various levels of system status information can be accessed via commands input at the VDU. The requested information is displayed on the VDU screen.

7. ADMINISTRATION AND TRAFFIC

7.01 Data contained in the DMS system is modifiable via the Data Modification System. The modifications of the data may be input either manually via a Visual Display Unit (VDU) or in bulk via magnetic tape.

7.02 Peg counts and usage measurements of a large group of traffic sensitive items of the DMS office are accumulated for half hour periods. The sets of data on the accumulators may be transferred to magnetic tapes or VDU for traffic analysis.

7.03 Individual groupings of data are available on VDU via a query system. The queries cover such items as status on various groups of equipment, traffic data collected during the current accumulation interval, rating information, and individual line and trunk information. These data provide material for compiling statistics concerning areas such as: analysis of switch performance, division of revenue, provisioning requirements, etc.

8. CALL PROCESSING

INTRA-OFFICE CALL

8.01 The sequence of events which occur when processing a call connection between subscriber lines connected to the same office, is described in Appendix 1.

INTER-OFFICE CALL

8.02 The sequence of events which occur when processing a connection between an originating trunk and a terminating trunk, is described in Appendix 2.

9. SYSTEM REQUIREMENTS SUMMARY

9.01 Space requirements to accomodate the DMS-100 family equipment are illustrated in typical floor layouts in Figures 4 and 5.

9.02 Mechanical, environmental and power requirements are summarized in Table A and performance characteristics in Table B.

10. ABBREVIATIONS

CC - Central Control
CCC - Central Control Complex
CCS - One hundred call seconds per hour
CDM - Customer Data Modifications
CMC - Central Message Controller
CPS - Circuit Pack Storage
CPU - Central Processing Unit
CSM - Channel Supervision Message
CDE - Digital Carrier Equipment
DCM - Digital Carrier Module
DMS - Digital Multiplex System
DNI - Digital Network Interconnecting
DP - Dial Pulse
DS - Data Store
DS1 - Primary digital carrier, 24 channels, 1.544 Mb/sec bit rate
I/O - Input/Output
IOC - Input/Output Controller
LM - Line Module
LME - Line Module Equipment
LMC - Line Module Controller
MAP - Maintenance and Administration Position
MF - Multifrequency
MFR - Multifrequency receiver
MIS - Miscellaneous Equipment
MS - Message System
MTC - Magnetic Tape Center
NET - Network
NM - Network Module
NMC - Network Message Controller
ODM - Office Data Modification
PCM - Pulse Code Modulated
PDC - Power Distribution Center
PM - Peripheral Module
PP - Peripheral Processor
PROTEL - Procedure Oriented Typoe Enforing Language
PS - Program Store
RAM - Random Access Memory
ROM - Read Only Memory
TM - Trunk Module
TME - Trunk Module Equipment
TTY - Teletype
VDU - Visual Display Unit
VF - Voice Frequency
TDM - Time Divison Multiplex

TABLE_A

o Frame - Single type of frame for use in the core and peripheral area

Dimensions:	Width	27 in. (686 mm)
	Depth	18 in. (457 mm)
	Height	84 in. (2.1 m)

o Shelf

Provides 24 in. (610 mm) of usable space between its side plates.

Dimensions:	Width	26 in. (660 mm)
	Depth	12.5 in. (318 mm)
	Height	35.6 cm (14 in.)

o Ambient Temperature (~C)

Normal: 10 to 30~C Extreme: 5 to 49~C

o Relative Humidity

Normal: 20 to 50% Extreme: 20 to 80%

o Power

Nominal: -48 volt battery power plant

Normal: -49 to -53.5 volts

Extreme: -44.75 to -55.8 volts

Note: Extreme conditions may exist for up to 72 hours.

o Call Capacity: 350,000 attempts per Average Busy Season Busy Hour (ABSBH)

o Reliability: Less than 2 hours downtime in 40 years.

o Grade of Service

Local	ABSBH	10_HDBH	HDBH*
Dial tone delay > 3 secs	1.5% max	8%	20%
Originating Matching loss (ML)	1.0% max		
Incoming ML	2.0% max		
Tandem ML	1.0%		20%

Toll	10HDBH	HDBH
Inc. digit receiver delay	0.5%	2%
Tandem ML	0.5%	2%

* High Day Busy Hour (HDBH)

CALL DESCRIPTION DMS-100 (INTRA-OFFICE CONNECTION)

1.01 The main components of the DMS switching system and the means by which they communicate are described in NTP 297-1001-100. The way that these components interact in the system is described by following an inter-office call (line to line) from origination to termination. Figures 1 through 5 illustrate the sequence of events in chronological order, starting at the top of each figure.

1.02 Refer to Figure 1. Each line module (LM) has a Peripheral Processor (PP), which continually scans the lines in the module for a change of state. When the PP detects a change of circuit state indicating an OFF-HOOK, a message is sent via the message channel to the Central Control (CC) informing it of the event.

1.03 Upon receiving the OFF-HOOK message, the CC assigns a voice channel on the speech link between the originating LM and the network and assigns an integrity message to the calling line. The CC then begins building a message for the calling LM. This consists of a number of commands, i.e., associate the assigned voice channel with the calling line, begin sending and checking integrity, give dial tone, start receiving digits (assume a DP -dial pulse- origination), and report to the CC after the first digit. (Integrity is a continuity check message, which is transmitted over the voice channel. If a discontinuity in transmission of the integrity message is detected, the connection is automatically switched over to the other network plane.)

1.04 When the first digit has been reported, the CC determines the total number of digits required (7 in this case). A message is then sent to the calling LM to report after 7 digits. When the digits have been reported, the CC translates the digits to determine the location of the called line. Upon reception of all the necessary digits, the CC sends a message to the originating LM to stop receiving digits.

1.05 Refer to Figure 2. The CC determines the location of the called line and assigns a voice channel on the speech link bet called LM and the network. It then sets up a network connection in both planes between the calling and called LM . A message is sent to the called LM telling it to stop looking for an OFF-HOOK on the called line, associate the assigned voice channel, and begin sending and checking integrity. In case the called LM has already reported an OFF-HOOK, the CC commands it to disregard the message.

1.06 When the CC receives a message from both LM indicating reception of integrity, the CC sends two messages. It sends a message to the calling LM to start audible ringing and begin scanning for an ON-HOOK, and a message to the called LM to start ringing the called line and begin sending the Channel Supervision Message (CSM) to the calling LM . [The CSM is a digital signal multiplexed over the voice channel which reflects changes of state (answer supervision).]

1.07 Refer to Figure 3. When the called line goes OFF-HOOK, the CSM signal changes state indicating to the calling LM that the called line has gone OFF-HOOK. The calling LM sends a message to the CC that the called party has answered. The CC then sends a message to the called LM to stop ringing the called line. The two parties are now in the talking state.

1.08 Refer to Figure 4. Suppose the calling line goes ON-HOOK. The calling LM sends an ON-HOOK message to the CC. The CC responds with a message to both the calling and the called LM to stop sending and checking integrity. When the CC receives messages from both LM indicating that integrity is stopped, the CC releases the network connection. It then sends a message to the called LM to release the voice channel and start looking for an OFF-HOOK after the called party goes ON-HOOK. The same message is then sent to the calling LM.

1.09 Refer to Figure 5. The disconnect is handled similarly, when the called line goes ON-HOOK first.

CALL DESCRIPTION DMS-200 (INTER-OFFICE CONNECTION)

1.01 The main components of the DMS switching system and the means by which they communicate are described in NTP 297-1001-100. The way that these components interact in the system is described by following an inter-office trunk connection from origination to termination. Figures 1 through 4 illustrate the sequence of events in chronological order, starting at the top of each figure.

1.02 Refer to Figure 1. Each Trunk Module (TM) has a Peripheral Processor (PP) which continually scans the trunks in the module for state changes. When the PP detects a seizure, a message is sent via the signalling channel to the Central Control (CC) informing it of the event.

1.03 Upon receiving the seizure message, the CC determines the trunk group type. Suppose the originating trunk is a Multifrequency (MF) trunk. The CC then selects an MF receiver (MFR), assigns an integrity message and voice channels on the speech links between the MFR TM, and the network, and between the seized originating trunk TM and the network. The CC establishes a connection in both network planes between the originating TM and the TM associated with the MFR (MFR TM). It then sends a message to both the originating TM and MFR TM to associate the voice channel and start sending and checking integrity.

1.04 Refer to Figure 2. Once the CC has received acknowledgement from both TM that they are receiving integrity, thus ensuring that the network connection is complete, the CC sends a message to the originating TM to send the start dial signal to the originating office. The received frequencies from the originating office are transmitted over the voice channel to the MFR, where they are translated into digits and stored in the MFR TM. Upon reception and translation of all the digits the MFR TM sends the digits via the message channel to the CC. The CC then sends a message to the originating TM and the MFR TM to stop sending and checking integrity. Once the TM have responded with messages indicating that integrity is stopped, the CC releases the network connection. The CC then sends a message to the MFR TM to idle the MFR receiver. The CC translates the digits from the MFR, determines that a terminating trunk is required, and then finds an idle trunk in a trunk group to the terminating office.

1.05 Refer to Figure 3. The CC assigns an integrity message, and assigns a voice channel on the speech link between the network and the terminating TM. The CC sets up a network connection through both network planes between the originating and terminating TM. Two messages are sent, one to the terminating TM to associate the voice channel, to send and check integrity, and to send the CSM, the other to the originating TM to send and check integrity and to look for the CSM. When both TM respond with messages confirming reception of integrity, the connection through the office is complete.

1.06 The CC then sends a message to the outgoing TM to send the seizure message to the far end office and to look for the start dial signal. When the terminating TM receives the start dial signal, it sends a message to the CC indicating that it has received it. The CC responds by sending the necessary digits over the message channel to the terminating TM.

1.07 Refer to Figure 4. When a disconnect is detected on the originating trunk, the TM sends a message to the CC. The CC sends a message to both TM to stop sending and checking integrity. Upon reception of messages from both TM, indicating that integrity is stopped, the CC releases the network connection. A message is then sent to the outgoing TM to idle the outgoing trunk, followed by a message to the originating TM to idle the originating trunk.