

Maintenance and Administration Tools Description

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1. INTRODUCTION

1.01 The DMS 100 Family of Digital Switching Systems provide a number of administrative and maintenance facilities with which Telco personnel can maintain the hardware, software and external facilities of the DMS office, measure system performance, and manage the network with the objective of optimizing it's efficiency.

1.02 This practice lists and describes the administrative and maintenance facilities available and provides a reference to supporting documentation.

2. DESCRIPTION OF ADMINISTRATION AND MAINTENANCE FACILITIES

2.01 DMS administration and maintenance facilities are realized

through a combination of software, hardware, and documentation.

2.02 For descriptive purposes they are classified into four functional groups as follows:

- (a) ADMINISTRATIVE: These facilities provide for the interrogation, collection and modification of data and for establishing schedules and thresholds.
- (b) INTERNAL MAINTENANCE: These include all DMS hardware (to the MDF) and software.
- (c) EXTERNAL MAINTENANCE: These include circuits on the transmission facility.
- (d) REPORTING: These include I/O facilities and the alarm system.

3. ADMINISTRATIVE FACILITIES

DATA MODIFICATION ORDERS

3.01 A Data Modification Order (DMO) is a request to Telco personnel to change system information. DMO's are divided into two order classes, namely:

- a) Customer Data Modification (CDM) - used to modify such items as directory number, hardware terminal identification, class of service and other features associated with a customer line.
- b) Office Data Modification (ODM) - used to modify such items as trunk group number, trunk type, service circuit type, digit and route translators, message routes, thresholds, test tables and Network Management control variables.

3.02 Changes are initiated by a need to add new lines, change or delete existing lines and line features, adjust routing patterns and trunk translations due to changing traffic patterns, and to adjust Network Management controls.

3.03 The user view of customer and office data in DMS takes the form of flat tables organized into rows and columns. Tables make the user aware of the relationships existing between the items comprising the data without having to know anything about the way the data are stored. DMO's are carried out at the table level by the use of a Table Editor. By using the Table Editor, Telco personnel can access customer or office data tables and then proceed to interrogate, update, or alter them. Once entered into the system a DMO can be activated immediately or it can be entered into a Pending Order file for activation at a later date.

3.04 The Table Editor can be accessed from a VDU or a teleprinter. DMO's are entered one by one from a designated MAP or dedicated DMO I/O terminal. Bulk or multiple changes are entered via magnetic tape.

For a description of the DMO system, refer to NTP 297-1001-115 DMS 100 Family Data Modification System. The Table Editor is described in NTP 297-1001-310 DMS Table Editor Description. Individual orders are covered in the Order Procedures POP, NTP 297-1001-300.

DATA INTERROGATION

3.05 A comprehensive database interrogation facility is provided which spans a broad range of requests for information contained in data store. Accessible data includes:

- Translation tables, eg. lines, line features, trunks, trunk groups, etc.
- Equipment status lists, eg. busy/idle, line plug-up, etc.
- Call status and connection information
- Traffic and plant measurements, eg. peg count, usage, overflow.
- Assignment tables, eg. CMC Port assignment.

3.06 The mechanisms by which these data are accessed include:

- Table Editor commands
- Translate and status request commands implemented in the various maintenance subsystems.
- Operational Measurements dumps

3.07 Data interrogations are done on a manual request basis by Telco personnel via the Visual Display Unit (VDU) contained in the Maintenance and Administration Position (MAP) or by teleprinter, or on a periodic basis by the system. Outputs are directed to the designated VDU (MAP), teleprinter, magnetic tape unit, or a data link.

OPERATIONAL MEASUREMENTS

3.08 The Operational Measurement (OM) system collects information relating to the call handling capability of the network node at which it is located, i.e. switcher plus incoming and outgoing trunks. Equipment usage, network occupancy, dial tone delay, quantity of calls handled and other useful measurements are made available to maintenance personnel and traffic and engineering departments. The measurements are used as the basis for:

- (a) plant maintenance action
- (b) automatic and manual network management controls
- (c) trend analysis on marginal conditions and equipment components
- (d) division of revenue
- (e) equipment traffic spread
- (f) provisioning equipment and trunk quantities
- (g) service indicators
- (h) traffic capacity determination.

3.09 The types of measurements made include peg count, overflow counts and usage. They are scheduled on a half-hourly, hourly, daily, or monthly basis depending on the item and according to a collection schedule. Collection schedules can be modified by Telco personnel via the Table Editor.

3.10 The collected data is output to a designated MAP,

teleprinter, data link, or to a magnetic tape unit, at the end of the collection period or when an associated threshold level is exceeded. An unscheduled printout can be requested by Telco personnel via the MAP or teleprinter. For more details refer to NTP 297-1001-114, DMS 100 Family Operational Measurements Description, and NTP 297-1001-117 DMS 100 Family Operational Measurement Guide.

NETWORK MANAGEMENT

3.11 Network Management is a set of facilities designed to control network operation with the objective of making optimum use of available facilities in overload conditions or facility failure. These controls fall into two categories: expansive and protective.

3.12 Expansive controls allow the manipulation of routing to direct traffic from it's normal route to other facilities that have spare capacity.

3.13 Protective controls restrict or block certain categories of traffic to prevent regenerative delays and degradation of network carried load.

3.14 The two categories of controls are applied to outgoing trunk groups, incoming trunk groups, code points and the routing tables. Activation of the controls is by:

- (a) traffic exceeding a threshold value
- (b) ODM
- (c) manual control by Telco personnel via a designated MAP or other I/O device.

3.15 Output messages include peg count reports, overflow reports, and exception reports, and are made according to a timetable modifiable by DMO.

3.16 The I/O interface for Network Management is based on the MAP. A dedicated Network Management Position (NMP) may be provided if requested by the Telco. Output is also available via a dedicated teleprinter or via a remote monitoring printer through a data link. All displays and printouts feature a 'plain language' format. For more information refer to NTP 297-2201-452, Network Management Description.

SERVICE ANALYSIS

3.17 Service analysis is a facility which can be used by Telco personnel to measure the overall quality of service taking into consideration the various factors that contribute to the performance of completing a call.

3.20 Subjective and non-subjective observations on calls may be made on both transmission and signalling paths. Subjective data includes all the observations made by personnel such as line noises and signal distortions. Non-subjective data includes connect time, transmission voice levels, and signalling accuracy.

3.21 A full range of service analysis features is provided in DMS. For more information refer to NTP 297-2201-490, Service Analysis Description.

4. INTERNAL MAINTENANCE FACILITIES

MAINTENANCE AND ADMINISTRATIVE POSITION (MAP)

4.01 The Maintenance and Administrative Position (MAP) is the primary interface between the Telco personnel and the DMS system. System tests, data interrogation and modification, and trouble analysis functions are provided. The MAP is designed to operate as a single entity for small office applications as well as a large system interface where several units can operate concurrently. It can be used in any of the maintenance and administrative environments in DMS. These include:

- General maintenance;
- Network Management;
- Operational Measurements;
- Service Analysis;
- Trunk Test;
- Data Modification;
- Line Test.

The MAP has three basic components, namely: the visual display unit (VDU), the communications module, and the position furniture.

4.02 The VDU is composed of a cathode ray tube display device and a typewriter-type keyboard for information entry. Using the VDU, and a telescoping process, Telco personnel can examine the system on several levels of detail. At each level of detail a menu of commands is displayed from which action requests can be selected. The result of a request is then displayed on the VDU. A printer associated with the VDU can be operated in parallel with it to provide a permanent copy of the display. Other printers or teletypes (TTY) can also be used for data entry and retrieval.

4.03 The communications module is based on a LOGIC 10 (Local use) or LOGIC 20 (Toll use) key telephone set. It provides the maintenance personnel with telephone links both within and out of the office and access to the office talk line. An automatic dialer, a hands-free unit and a headset may also be provided. A jack field on the position furniture is part of the trunk test facility. One jack can be used for Telco determined purposes such as connecting to a VF patch bay. The others connect to jack ended trunks through which access can be gained to any line or trunk in the office. Portable test equipment can be plugged into the jacks to perform various tests such as Echo Return Loss or Singing Point measurements.

4.04 The position furniture consists of table and shelf units which can be assembled in various configurations to provide work space and document storage for administrative or maintenance functions, and to mount the VDU and communications module components.

4.05 For more information on the MAP and its use, refer to NTP 297-1001-110 DMS 100 Family Maintenance and Administration Position (MAP). The format, content, and classification of output messages available to the MAP user are described in NTP 297-1001-510 DMS 100 Family Output Commands Description. Input commands are dependant on the Maintenance Subsystem entered. They are described in the series of NTP's 297-1001-511 to 297-1001-518 inclusive, entitled (Maintenance Subsystem Name) Man Machine Interface Description.

PERFORMANCE ORIENTED PRACTICE (POP)

4.06 The Performance Oriented Practice (POP) is a system of documentation designed to support the Telco in the operation and maintenance of the DMS 100 Family. The information it contains is of sufficient depth to support the inexperienced user but structured to permit the experienced user to bypass detailed instructions if the task can be performed from memory.

4.07 POP is task oriented rather than hardware or software oriented. It is accessed when a stimulus such as an alarm or trouble report is received. The instructions in POP then guide the user in performing the activities required to achieve the objective, i.e. retiring the alarm or clearing the trouble. Crossing hardware or software boundaries within or between subsystems does not generate a new task as long as the stimulus and objective remain the same.

4.08 The POP is packaged as an NTP. The Order procedures are separate from the Maintenance procedures. The maintenance POP is packaged as NTP 297-1001-500. For a detailed description of POP and it's use, refer to NTP 297-1001-040.

FAULT ISOLATION AND RECOVERY

4.09 Fault isolation and recovery functions are performed by the maintenance system. Faults are detected by hardware such as parity check circuitry or by software checks such as checksums on messages. Isolation and recovery software locates the source of the fault, alerts office personnel and configures suspected equipment out of service to reduce the chance of affecting call processing. Diagnostics determine the cause of the fault.

4.10 The maintenance system is divided into ten subsystems. Each subsystem can diagnose faults only within it's range of responsibility. A diagnostic within a subsystem can be initiated by the same or another subsystem, the alarm system, or by maintenance personnel on a scheduled, system demand, or manual request basis.

4.11 In response to a diagnostic action the maintenance system sends a report to the maintenance terminal. There are four types of report, namely: error, diagnostic result, action taken, and status.

4.12 With the MAP facilities office personnel can use telescoping techniques to obtain ever-increasing detail about system operation until a fault is isolated to one or more replaceable components. Defective components are identified in a list, and in order of most probably defective component, displayed on the VDU or teleprinter.

4.13 Details of the DMS Maintenance System can be found in NTP 297-1001-106 DMS 100 Family Maintenance System Description.

SOFTWARE MAINTENANCE

4.14 The correct operation of the DMS 100 family switching systems is dependent upon the integrity of the software system.

To ensure this integrity, hardware and software mechanisms are provided to continually verify its sanity. They include data table indexing range checks, audits of software structures, and a sanity timer which guards against software or micro-program loop errors not otherwise detectable.

BOOTSTRAP LOADER

4.15 Bootstrapping is the process of a Central Control autonomously loading it's Program Store (PS) and Data Store (DS) from a bootstrap input device, eg. a Magnetic Tape Unit (MTU). The bootstrap loader is implemented in microcode (firmware) permanently located in the Read Only Memory (ROM) card of the CPU. Bootstrapping a DMS office can occur in one of three modes as follows:

- a) Dead Office mode
- b) Active Controlled mode
- c) Autoload mode

All 3 modes share the same set of firmware.

4.16 Dead Office mode is used to load a nonfunctioning office. Telco personnel activate the loader by means of manual control switches located on the CPU, eg. the thumbwheel, DACT, and RESET. Progress reports identifying stages of initialization, error codes, load completion, etc. are made via the 2-digit display also located on the CPU.

4.17 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 DMS high level language PROTEL, and are resident in PS. Manual controls by Telco personnel and loader activity reports are via the normal office I/O facilities, eg. 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.

4.18 The Autoload mode is similar to the Dead Office mode except that it is activated automatically when the system determines that the number of office re-initializations in a specified period of time have exceeded a threshold. 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.

4.19 For detailed bootstrapping procedures, refer to the POP, NTP 297-1001-500.

CALL TRACING

4.20 The call tracing facility can determine the characteristics of any connection set up through the office. It indicates where the specified circuit is connected in the office if a connection exists. If possible the path through the office will also be indicated. If no connection exists, the state of the circuit is determined.

4.21 Call trace requests are originated manually by Telco personnel or automatically by the system. Manual requests are initiated in the course of various maintenance procedures such as

line or trunk testing. Automatic traces are initiated as a result of system detected troubles in the call connection or Telco initiated camp-on trace requests.

4.22 In both Local and Toll environments, trunks and service circuits can be traced. Local offices also provide Line Trace and Calling Line Identification facilities. These allow Telco personnel to camp-on a specified customer line by requesting an automatic trace of all calls originating on or terminating to that line every time it is involved in a call. This provides a powerful nuisance-call tracing function.

4.23 Manual requests and system outputs are made via a designated MAP or other I/O device. More details on call tracing can be found in NTP 297-1001-116 Manual Trunk Testing Description and NTP 297-YYYY-XXX Manual Line Testing Description. Call tracing procedures are detailed in POP NTP 297-1001-500.

EQUIPMENT MANUAL MAKE BUSY

4.24 Equipment which is being routined or which has a service affecting fault can be made unavailable to call processing by the Manual-Make Busy facility (MMB). Using MMB, office personnel can isolate faults, perform routine maintenance on equipment, or extend an existing office without disrupting the system. All major equipment elements such as CMC, IOC, NM and PM as well as smaller equipment divisions such as communications busses (i.e. the data port), network ports or channels, line circuits, and trunk circuits can be MMB.

4.25 Requests to make equipment MMB and system reports as to equipment status are made via the designated MAP or other I/O device. A request to make equipment MMB when it is already system made busy results in the system made busy status being overridden by the MMB request and a report issued to reflect the new busy status. If the equipment is traffic busy, the MMB request will 'camp-on' and become effective only when the equipment is idled. When the equipment does become MMB, a report is issued to that effect.

5. EXTERNAL MAINTENANCE FACILITIES

MANUAL TRUNK MAINTENANCE

5.01 Manual trunk maintenance is performed in the trunk maintenance center in the DMS office or at any external location with access to the DMS machine. Tests can be performed on terminal circuits and on their associated transmission and signalling facilities to a distant office. Terminal circuits include the following:

- a) incoming and outgoing trunks
- b) 2-way trunks
- c) digit receivers
- d) test equipment
- e) special circuits (conference, recorded announcement, etc.)

Trunk maintenance functions that can be performed include:

- a) terminal status monitoring
- b) call tracing
- c) terminal status modification
- d) manually controlled tests applied on a step by step basis with result checking at each step.
- e) automatic diagnostic tests.

5.02 The interface between Telco personnel and the trunk maintenance system is the MAP. A MAP dedicated to trunk testing is called the Trunk Test Position (TTP). The full range of trunk tests, including those requiring external test equipment, can be performed at the TTP, or at a general maintenance MAP having access to test trunks. Trunk maintenance not requiring external test equipment can be performed from any general maintenance terminal from which trunk testing is allowed.

5.03 A detailed description of trunk maintenance is given in NTP 297-1001-116 DMS 100 Family Manual Trunk Testing Description. Detailed trunk test procedures are contained in the POP, NTP 297-1001-500.

TEST TRUNKS

5.04 Incoming test trunks are provided for the use of a distant office in testing it's outgoing facilities into the DMS office. The common toll network test trunks provided are: 100 - balanced termination; 101 - communications; 102 - milliwatt; 103 - supervisory; 104 - transmission and noise; 958 - communicating. The 103 - supervisory test trunk function is software simulated; therefore, no trunk need be provided.

AUTOMATIC TRUNK TESTING

5.05 The Automatic Trunk Test (ATT) system performs automatic maintenance tests on outgoing trunks, the outgoing portion of 2-way trunks, and on trunk signalling and transmission facilities from the DMS office to a distant office. The setting up and taking down of connections, the control of the ATT system and the actual testing is performed by software. The tests are performed automatically and the test results are output on the specified device or logged by the Routing and Reporting system. The tests performed are the standard test line sequences.

5.06 Requests for ATT tests are initiated by sources external to the ATT system, or by the ATT system itself. These sources include:

- a) telco personnel
- b) remote test centres
- c) call processing
- d) system analysis programs
- e) trunk group test timetable (Telco modifiable)

Depending on the type of request, the following request categories are provided:

- a) Manual - Performs automatic tests on trunks requested by Telco personnel. The request can include the test type, the trunks to be tested, and how the test should be run.
- b) Remote - Performs tests on request from external sources such as automatic test systems or remote maintenance centers.
- c) System - Performs test on outgoing trunks randomly selected by the system.
- d) Periodic - Performs tests on outgoing trunk groups as specified by their test frequency period.

Tests in each of these categories are performed independently of each other and all categories can operate simultaneously.

5.07 The tests performed by the ATT system are as follows:

- a) Operational - These are test line tests to the distant office operational test line. These tests give reasonable assurance that the trunk signalling circuitry functions properly on a normal call.
- b) Transmission - a test line test to the distant office transmission test line. It ensures the trunk and it's associated facility meets Telco transmission requirements and the signalling is in good operating condition.
- c) Call-Through - A test line test to any distant office termination specified by the called number.
- d) Miscellaneous - Tests on trunks within the same office on which an automatic test can be performed. The trunks tested include: announcement trunks, miscellaneous circuits, test lines, and test equipment.

5.08 Tests can be requested on an individual trunk or trunk group, on several selected trunks or trunk groups, or on all trunks located on a specified Trunk Module (TM). Trunks that fail tests are made system Busy (SB). Telco personnel can request a list of SB trunks. Generally, no more than one quarter of the trunks in a trunk group can be made SB as a result of failures. Trunks in service can be camped-on for a Telco specifiable length of time before a test request is abandoned. If the trunk becomes idle before the timeout occurs, the ATT system will seize it and perform the requested tests on it.

5.09 For more details on ATT, refer to NTP 297-1001-121 DMS 100 Family Automatic Trunk Testing Description. ATT operating procedures are in the POP, NTP 297-1001-500.

6. REPORTING FACILITIES

ROUTING AND REPORTING SYSTEM

6.01 The Routing and Reporting system (RR) is responsible for controlling message flow to Telco personnel. Messages are routed through the RR system which provides an interface between the maintenance system, the alarm system, the logging system, and I/O devices such as the MAP, printers and magnetic tape drives. The RR system assigns priorities to messages, formats them, checks for thresholds, determines output routes, and activates appropriate alarms. A message with a threshold value will not be output until the threshold has been exceeded, in which case it is proceeded by a warning message. An inhibited message will not be output at all.

6.02 Input and output messages are assigned one of 32 input or output message classes. The message classes are fixed-assigned to any combination of the 32 I/O channels by the Telco, in the office specification. A threshold can be assigned to any message to limit the number of times it is issued. When the threshold value is exceeded, a 'threshold exceeded' message is output, followed by the message itself. Output messages can be temporarily rerouted or inhibited by Telco personnel via the MAP or other I/O device. The message class to I/O channel assignment can be changed via DMO procedures using the Table Editor.

6.03 A message holding area, referred to as the LOG, is provided for storing up to several hours of output messages. The quantity of messages stored is dependant on the number of messages generated by the system and on the amount of memory provided. In general, output messages requiring maintenance action are sent to the designated MAP or other I/O device and the remainder to the log, thus preventing Telco personnel from being inundated with irrelevant data on topics other than the problem at hand. Once the log is full, entry of a new message causes the oldest message to be pushed out of the log and become lost. Telco personnel can extract individual messages from the log on a message class or alarm class basis in chronological order starting with the most recent one, thus obtaining a history of maintenance action.

6.04 For more details on the RR system, refer to NTP 297-1001-106 DMS 100 Family Maintenance System. The format, content, and classification of output messages is described in NTP 297-1001-510 DMS 100 Family Output Messages Description.

ALARM SYSTEM

6.05 The alarm system is responsible for providing audible and visible indications of various trouble conditions within the DMS switching office or external to it, and aiding maintenance personnel in the identification and location of the source.

6.06 Alarms are grouped into three categories as follows:

- a) Locally Detected Alarms - These are initiated by hardwired alarm contacts and tend to be power related, eg. fuse and power converter failures.
- b) System Detected Alarms - These are generated as a result of software detected system faults.
- c) Externally Detected Alarms - These are generated outside the switching office although they may be initiated by related devices such as Carrier Group alarms. External alarms are interfaced to the DMS system by scanpoints, assignable

by Telco personnel.

Alarms are reported at 3 levels of severity according to the urgency to restore the system to normal. In decreasing order of urgency they are:

- a) Critical
- b) Major
- c) Minor

6.07 Alarm messages are sent to the MAP or, via a data link, to a remote terminal. Audible and visible indicators can be activated in the office, on another floor, or in a remote monitoring center. Aisle indicators assist Telco personnel in locating fuse and power failures.

6.08 Transferring or grouping of alarms is accomplished by the operation of a key on the Alarm Control and Display unit (ACD) located near the MAP. Cancellation of an audible alarm is accomplished by removal of the alarm condition or, if it is a system detected alarm, by the operation of a key at the MAP. Visual alarms are cancelled by means of a key on the ACD.

6.09 A dead system alarm is initiated when two relays, controlled by two Signal Distribution (SD) points, both operate. This indicates the loss of minimal call processing capability. A detailed description of the DMS alarm system will be found in NTP 297-YYYY-ZZZ. Detailed procedures for dealing with each type of system alarm are found in the POP, NTP 297-1001-500.

7. ABBREVIATIONS

ACD - Alarm Control and Display
ATT - Automatic Trunk Testing
CC - Central Control
CCC - Central Control Complex
CDM - Customer Data Modification
CMC - Central Message Controller
DMO - Data Modification Order
DMS - Digital Multiplex System
I/O - Input/Output
IOC - Input/Output Controller
MAP - Maintenance and Administration Position
MDF - Main Distribution Frame
MMB - Man Made Busy
MTU - Magnetic Tape Unit
NM - Network Module
NMP - Network Management Position
NTP - Northern Telecom Practice
ODM - Office Data Modification
OM - Operation Measurement
PM - Peripheral Module
POP - Performance Oriented Practice
RR - Routing and Reporting
SB - System Busy
TTP - Trunk Test Position
TTY - Teletype
VDU - Visual Display Unit

8. REFERENCES

DMS 100 Family Automatic Trunk Testing Description	NTP 297-1001-121
DMS 100 Family Data Modification System Description	NTP 297-1001-115
DMS 100 Family Maintenance and Administration Position	NTP 297-1001-110
DMS 100 Family Maintenance System Description	NTP 297-1001-106
DMS 100 Family Manual Line Testing Description	NTP 297-YYYY-ZZZ
DMS 100 Family Manual Trunk Testing Description	NTP 297-1001-116
DMS 100 Family Network Management Description	NTP 297-2201-452
DMS 100 Family Operational Measurements Description	NTP 297-1001-114
DMS 100 Family Operation Measurements Guide	NTP 297-1001-117
DMS 100 Family Order Procedures	NTP 297-1001-300
DMS 100 Family Output Messages Description	NTP 297-1001-510
DMS 100 Family Performance Oriented Practices (POP)	NTP 297-1001-500
DMS 100 Family System Description	NTP 297-1001-100
DMS 100 Family Table Editor Description	NTP 297-1001-310
Central Control (CC) Man-Machine Interface Description	NTP-297-1001-511
Central Message Controller (CMC) Man-Machine Interface Description	NTP-297-1001-512
External (Ext) Man-Machine Interface Description	NTP 197-1001-517
Input/Output Device (IOD) Man-Machine Interface Description	NTP 297-1001-513
Network Module (Net) Man-Machine Interface Description	NTP 297-1001-514
Peripheral Modules (PM) Man-Machine Interface Description	NTP 297-1001-515
POP Users Guide	NTP 297-1001-040
Service Analysis Description	NTP 297-2201-490
Traffic (Traf) Man-Machine Interface Description	NTP 297-1001-518
Trunks (Trks) Man-Machine Interface Description	NTP 297-1001-516

