Critical Release Notice

Publication number: 297-1001-304
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The content of this customer NTP supports the SN06 (DMS) and ISN06 (TDM) software releases.

Bookmarks used in this NTP highlight the changes between the baseline NTP and the current release. The bookmarks provided are color-coded to identify release-specific content changes. NTP volumes that do not contain bookmarks indicate that the baseline NTP remains unchanged and is valid for the current release.

Bookmark Color Legend

Black: Applies to new or modified content for the baseline NTP that is valid through the current release.

Red: Applies to new or modified content for NA017/ISN04 (TDM) that is valid through the current release.

Blue: Applies to new or modified content for NA018 (SN05 DMS)/ISN05 (TDM) that is valid through the current release.

Green: Applies to new or modified content for SN06 (DMS)/ISN06 (TDM) that is valid through the current release.

Attention!

Adobe® Acrobat® Reader™ 5.0 is required to view bookmarks in color.

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Change of phone number from 1-800-684-2273 to 1-877-662-5669, Option 4 + 1.

297-1001-304

DMS-100 Family

DMS100 Family

Capacity Administration Guide

BASE03 and up   Standard 03.02   April 1999

NORTEL
NORTHERN TELECOM

DMS-100 Family

DMS100 Family

Capacity Administration Guide

Publication number: 297-1001-304
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About this document

How to check the version and issue of this document

The version and issue of the document are indicated by numbers, for example, 01.01.

The first two digits indicate the version. The version number increases each time the document is updated to support a new software release. For example, the first release of a document is 01.01. In the *next* software release cycle, the first release of the same document is 02.01.

The second two digits indicate the issue. The issue number increases each time the document is revised but rereleased in the *same* software release cycle. For example, the second release of a document in the same software release cycle is 01.02.

To determine which version of this document applies to the software in your office and how documentation for your product is organized, check the release information in *Product Documentation Directory*, 297-8991-001.

References in this document

The following documents are referred to in this document:

- *Basic Administration Procedures*
- *Loading Administration Guide*
- *Log Report Reference Manual*
- *Memory Administration Guide*
- *Office Parameters Reference Manua*l
- *Operational Measurements Reference Guide*
- *Provisioning Manual*
- *Residential Services Administration Guide*
- *Translations Guide*

What precautionary messages mean

The types of precautionary messages used in NT documents include attention boxes and danger, warning, and caution messages.

An attention box identifies information that is necessary for the proper performance of a procedure or task or the correct interpretation of information or data. Danger, warning, and caution messages indicate possible risks.

Examples of the precautionary messages follow.

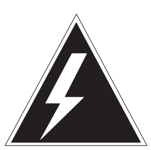
ATTENTION Information needed to perform a task

> **ATTENTION**
> If the unused DS-3 ports are not deprovisioned before a DS-1/VT Mapper is installed, the DS-1 traffic will not be carried through the DS-1/VT Mapper, even though the DS-1/VT Mapper is properly provisioned.

DANGER Possibility of personal injury

> **DANGER**
> **Risk of electrocution**
> Do not open the front panel of the inverter unless fuses F1, F2, and F3 have been removed. The inverter contains high-voltage lines. Until the fuses are removed, the high-voltage lines are active, and you risk being electrocuted.

WARNING Possibility of equipment damage



> **WARNING**
> **Damage to the backplane connector pins**
> Align the card before seating it, to avoid bending the backplane connector pins. Use light thumb pressure to align the card with the connectors. Next, use the levers on the card to seat the card into the connectors.

CAUTION Possibility of service interruption or degradation

> **CAUTION**
> **Possible loss of service**
> Before continuing, confirm that you are removing the card from the inactive unit of the peripheral module. Subscriber service will be lost if you remove a card from the active unit.

How commands, parameters, and responses are represented

Commands, parameters, and responses in this document conform to the following conventions.

Input prompt (>)

An input prompt (>) indicates that the information that follows is a command:

>BSY

Commands and fixed parameters

Commands and fixed parameters that are entered at a MAP terminal are shown in uppercase letters:

>BSY CTRL

Variables

Variables are shown in lowercase letters:

>BSY CTRL ctrl_no

The letters or numbers that the variable represents must be entered. Each variable is explained in a list that follows the command string.

Responses

Responses correspond to the MAP display and are shown in a different type:

```
FP 3 Busy CTRL 0: Command request has been submitted.
FP 3 Busy CTRL 0: Command passed.
```

The following excerpt from a procedure shows the command syntax used in this document:

1 Manually busy the CTRL on the inactive plane by typing

>BSY CTRL ctrl_no
and pressing the Enter key.

where

ctrl_no is the number of the CTRL (0 or 1)

Example of a MAP response:

```
FP 3 Busy CTRL 0: Command request has been submitted.
FP 3 Busy CTRL 0: Command passed.
```

Understanding capacity administration

Purpose

The purpose of this guide is to provide the DMS-100 Family capacity administrator with descriptions of the capacities of traffic sensitive switch components and to suggest methods and procedures to observe how these capacities are being used by an inservice switch. Traffic sensitive components are those major parts of the switch that are susceptible to service degradation as the offered load is increased and approaches the engineered capacity level.

Monitoring capacity is an essential administrative function because it determines if the switch is operating under the conditions projected for the engineered period. Deviations from the projections may alter the end of design date (forecast date when additional resources will be needed) for the switch.

Note: Remote modules are not addressed in this document. Information on remote equipment may be found in the *Operational Measurements Reference Manual*

Capacity definitions

Typically, the capacities of the DMS-100 Family switches are addressed in accordance with terms used by the design engineers. These terms, which reflect the different capacity concepts that are employed in the provisioning process, have been adopted for use in the day-to-day monitoring activities. These terms include:

- physical (termination) capacity
- traffic capacity
- real-time capacity
- memory capacity

Physical capacity

Physical capacity is the total number of terminations that can be accommodated by a switch component or group of components, for example, the total number of terminations for lines in a line concentrating module (LCM) or group of LCMs.

Traffic capacity

Traffic capacity is the maximum number of terminations or requests for service that can be accommodated by a component or group of components while still meeting established delay and blocking service standards.

Real-time capacity

Real-time capacity, as applied to the DMS-100 Family central processing unit (NT40) or DMS-Core (SuperNode), is the maximum number of call attempts that the central processing unit (CPU) or DMS-Core can process while meeting the high day busy hour (HDBH) service objective of not exceeding 20 percent dial tone delay (delay greater than 3 seconds).

Memory capacity

Memory can be a call limiting factor for a DMS-100 Family switch and should be monitored to assure that there is sufficient memory at all times to meet the engineered call capacity of the CPU. Memory capacity administration is not addressed in this document, but information on the subject can be found in *Memory Administration Guide* and the *Office Parameters Reference Manual*.

Administration functions

Administration of capacity includes monitoring capacity use and the effects that it may have on the DMS-100 Family switch. To monitor the use, data are gathered through performance indicators such as operational measurements (OMs), logs, and capacity tools such as MEMCALC, and various maintenance and administration position (MAP) status reports and counts.

Definitions of administration terms

Traffic sensitive switch components

Traffic sensitive switch components are the specific components or resources that are susceptible to performance degradation. Performance degradation may occur when the traffic load on a component or resource approaches or exceeds its engineered limits, or when a component or resource failure occurs.

The traffic sensitive components of the DMS-100 Family of switches discussed in this document are listed below (excluding those in the remote applications).

- central processing unit (NT40)
- DMS-Core (SuperNode)

- line module (LM)
- line concentrating module (LCM)
- enhanced line concentrating module (LCME)
- trunk module (TM)
- digital trunk controller (DTC)
- line group controller (LGC)
- line trunk controller (LTC)
- outside plant module (OPM)
- service circuits
- networks

Busy hours

The DMS-100 Family switches are engineered based on empirical data or forecast data for the busiest hour for individual components or for the entire office (switch). These hours are referred to as *busy hours*. Listed below are the most commonly used busy hours and their definitions.

Call busy hour

The call busy hour is the time-consistent 60-minute period having the most call originating plus incoming (O + I) attempts per main station or network access line (NAL). This hour is used primarily for the development of processor real time capacities.

Usage busy hour (office busy hour)

The usage busy hour is the time-consistent 60-minute period producing the most originating plus terminating (O + T) use per main station or NAL. This hour is used primarily for gathering data for load balancing and provisioning of switching hardware and software.

Service busy hour (dial tone busy hour)

The service busy hour is the time-consistent 60-minute period when the highest percentage of customers originating a call must wait more than 3 seconds for dial tone.

Component busy hour

The component busy hour is the time-consistent 60-minute period when call attempts or use are the highest for a particular switch component, for example, Digitone receivers, tones, and announcements.

Note: These hours may coincide, or each may be in a separate time period and administered separately.

Busy hour determination

Busy hours are derived from studies that are taken just prior to the office busy season. The busy season is defined as the three months (not necessarily consecutive) that have the highest average business day traffic during the office busy hour.

Busy hour determination studies are usually conducted for 5-15 days between the hours of 8 a.m. and 11 p.m. The busy hour that is determined is then used during the following busy season.

Busy hour studies may be conducted on a manual basis or through the use of a mechanized system. By whatever means, the studies should select the time periods that provide call data that can be used to engineer the switch most effectively and measure the level of service being rendered to the subscribers.

The characteristics of the office determine the periods of the day to be studied. In some offices, the calling patterns do not change significantly from one busy season to another. For those offices, a 5-day study is sufficient to verify that the hour has not changed. The hours chosen should be the known busy hour and the hours on either side of that hour. In other offices, several hours may carry loads of approximately the same level, so a longer study period (10 to 15 days) and the full range of hours (8 a.m. to 11 p.m.) should be considered. All data should be collected at least on a half-hourly basis.

The criteria for changing the designated busy hour from one time period to another is determined by the operating company.

Grade of service

The basic design philosophy of the DMS-100 Family is based on delay criteria from the peripheral originator (line or trunk) up to the network. The network and all terminating paths are designed based upon blockage criteria. Blockage is defined as the failure to find an idle channel and is referred to as matching loss. The rates of delay and blockage are referred to as the grade of service (GOS). The higher these rates become, the lower the GOS that is experienced by the subscriber.

Delay in the DMS-100 Family occurs in the form of dial tone delay (DTD) for originating calls and incoming start-to-dial delay (ISDD) for incoming calls. The percentage of delays greater than 3 seconds is used to assess the GOS for the overall switch design.

The criteria are 1.5 percent DTD and ISDD greater than 3 seconds for the average busy season busy hour (ABSBH) and 20 percent for the high day busy hour (HDBH).

Service criteria

Service criteria are those objective levels of call blocking and delay that are set for the measured busy hour. Effective capacity administration will ensure that these service objectives are met. Service criteria have been developed on the basis of judgment and experience. The overall objective is to provide the best possible service at a reasonable cost.

To establish a service standard, it is necessary to have a measurement that quantifies the inconvenience a customer experienced because of call blocking or call delay. When a call is blocked, a tone or message is delivered to the customer who then must hang up to try the call again. When a call is delayed, the customer is only considered to be inconvenienced if the delay exceeds some maximum tolerable value. The DMS-100 Family design applies a mixture of loss and delay criteria.

Loss criteria

All the line modules are engineered to meet objective service levels during the worst case of incoming matching loss (IML) during either the ABSBH or HDBH. Incoming matching loss is defined as that condition when a call cannot be completed because an idle path cannot be found between an incoming trunk and an idle line. Northern Telecom engineering tables are based on IML objectives.

The existing published matching loss criteria are stated for the entire office. They have two sources, peripheral matching loss and network matching loss. The peripheral portion is the predominant part of the HDBH criteria. The recommended incoming matching loss criteria for a DMS-100 are shown below.

Table 1-1
NT recommended matching loss criteria

Busy hour	Overall	Peripheral	Network
ABSBH	2.0%	1.9%	.1%
HDBH	5.0%	4.0%	1.0%

Delay criteria

When subscribers and calls are served on a delay basis, the concern is usually more with the duration of the delay than the probability of delay. At the present time, delays of less than 3 seconds are considered acceptable to the subscriber, or at least they do not annoy the subscriber if they do not happen too frequently. The delay criteria that are used for engineering purposes are as follows:

Table 1-2
Delay criteria

Delay criteria	Description
Dial tone delay (DTD)	The probability that a customer will experience a dial tone delay of more than three seconds
Incoming start-to-dial delay (ISDD)	The probability that an incoming trunk to a multifrequency receiver will experience a delay of more than 3 seconds before the receiver becomes available

The current recommended delay criteria are shown below.

Table 1-3
Recommended engineering delay criteria

	DMS-100		DMS-200	
Delay measurement	**ABSBH**	**HDBH**	**10HDBH**	**HDBH**
Dial tone delay	1.5%	20.00%	see note	see note
Incoming start-to-dial	1.5%	20.00%	8.0%	20.00%

Note: Not applicable to this office type.

With configurations that require a high penetration of Meridian Digital Centrex or Multiple Appearance Directory Number (MADN) features, a line peripheral can become limited by high day busy hour attempts. The load service relationship for an attempt limited line peripheral is dial tone delay (DTD). The attempt capacity can be obtained by using the Northern Telecom PRTCALC tool. Staying within this attempt limit maximizes throughput, minimizes any delay caused by the peripheral, and supports an overall DTD of 20 percent during the high day busy hour.

The traffic capacity tables, associated with line peripherals and the PRTCALC program, assume an even (balanced) flow of traffic across all line modules. This PRTCALC function is usually performed by the traffic engineer. The administrator may get the required information from the engineer that is responsible for the office in question.

Measurement methods

The following section describes methods for measuring the capacity in a DMS-100 Family switch. These methods are based on the measurements that are currently available in the data collection system.

Performance indicators

Performance indicators are measurements or records of events that occur during a given period of time or in a time sequence. For the DMS-100 Family switch, performance indicators take the form of operational measurements (OMs) and log reports. In addition, a method to measure and control the balance of traffic load offered to like components of the product or system is employed. This measurement method is developed by the operating company and uses the standard operational measurements provided by the DMS-100 Family switch.

Operational measurements

The administration of capacities in the DMS-100 switch makes use of the switch's data collection system. This system collects groups of data designated OMs. Operational measurements are derived by monitoring certain events in the switch and entering the results into registers in the data store. Each register has a unique name. The registers are scored individually each time an event occurs, or when the state of an item is scanned (sampled) at regular intervals regardless of the time of the occurrence of an event. Scan rates are either 100 seconds or 10 seconds.

Single events, measured individually, are referred to as peg counts. Sampled measurements are used to determine the degree of use of DMS-100 hardware and software resources and are referred to as usage counts.

Because each register can record either a single event or a group of similar events, the registers are provided on an office basis, or a unit basis. For example:

- Register CP_CPLEV measures the amount of real time spent by the CPU at the call processing level. One register is required for each office.
- Register TRK_NATTMPT records the number of call attempts allowed access to an outgoing trunk group. A register is provided for each trunk group.

The peg counts and usage counts are stored in active registers that are updated whenever new data are entered. The OM data in the active registers are useful only if related to the specific period of time of collection. Therefore, OM data cannot be copied directly from the active registers because of the probability that additional counts may occur during the copying process that would result in an inaccurate data output.

To prevent inaccurate data, two complete sets of registers are provided. During any collection period, one set is used to collect current data and is known as the active class. The other set, known as the holding class, contains the data collected in the previous collection period and is used to provide data to reports or to the various accumulating classes.

At the end of the collection period, data in the active registers are transferred to the holding registers and the active registers are zeroed. This transfer of data from active to holding occurs at the same time for all counts. Operating company defined accumulating registers are used to accumulate data over longer periods of time than the basic period (a day or week). The data accumulation process adds the contents of the holding class registers to the accumulating class registers just prior to the next data collection period. The accumulated data are available to the end of the accumulating period. At the end of the accumulating period, the registers are unloaded to a printer or other recording device and the registers are zeroed.

The control of the length of the basic time periods is in the table designated as OFCENG. The office parameter OMXFR in OFCENG defines the timing value OMXFERPERIOD. This value is set at either 15 or 30 minutes.

Whenever an active register count exceeds its 65,536 limit, an extension register needs to be assigned or the data will be understated. The extension register will peg once each time the limit is exceeded. The count on the regular register is added to the product of the extension register count multiplied by 65,536, for example:

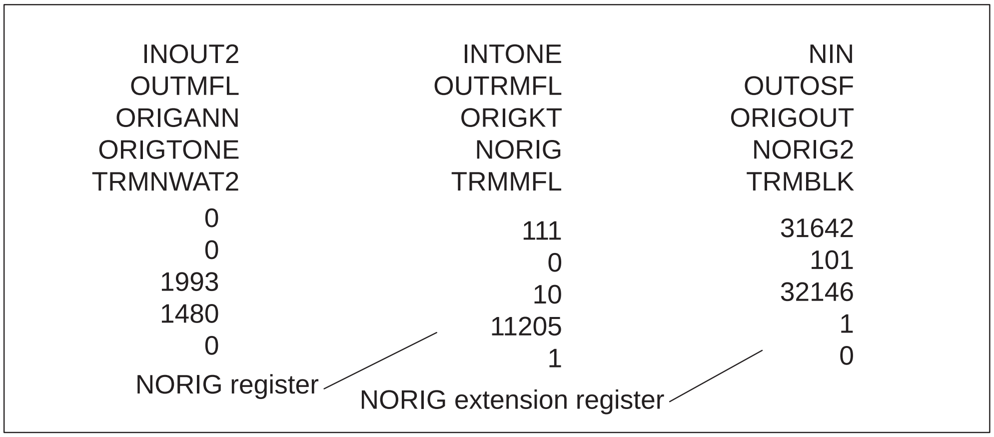
Regular register count	= 236
Extension register count	= 2
236 + (2 x 65,536)	= 131,308 (true total for this register)

The OMDUMP COMMAND (input at the MAP) may be used to determine which registers have been assigned extension registers. The command is as follows:

>OMDUMP CLASS (class name) FORMAT

The following figure shows an example of a portion of a printout containing a register value and its extension register value.

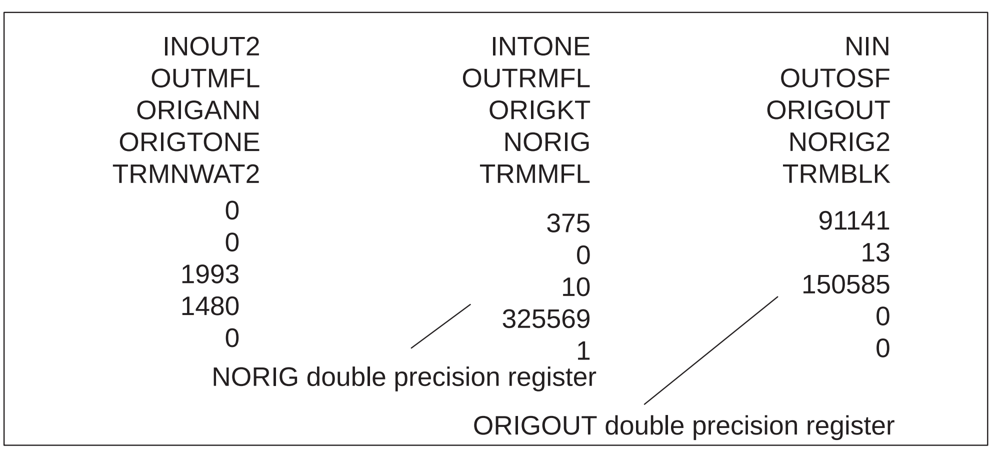
Figure 1-1
Example of a register and its extension register



If an accumulating register is expected to exceed the register limit, then it should be assigned to double precision. This assignment raises the limit to 4,294,967,296 counts (65,536 x 65,536) with a printout limit of 8 characters. Double precision uses two registers as previously described. When changing a class precision from single precision to double precision, all OM groups must first be deleted from the class. Refer to the *Basic Administration Procedures*, under command OMACCGRP, for detailed procedures.

The output from the OMs may be sent to a local printer or collected on a mechanized system, for example, the Engineering and Administrative Data Acquisition System (EADAS).

Figure 1-2
Example of a double precision register



Log reports

A log report is a message from the DMS whenever a significant event has occurred in the switch or one of its peripherals. Log reports include status and activity reports as well as reports on hardware or software faults, test results, and other events or conditions likely to affect the performance of the switch. A log report may be generated in response to a system or manual action. Complete descriptions of all log reports are contained in the *Log Report Reference Manual*.

Subscriber trouble reports

Subscriber trouble reports are another source for monitoring the capacity of switch components. These reports can often point to off-busy hour capacity problems that otherwise may go undetected.

Capacity factors

Capacity factors are those events that affect the capacity of a hardware or software component of the switch. The status of the capacity of switch components is measured by capacity indicators such as operational measurements and log reports. Capacity factors include such items as

- holding time
- call rate
- call blockage
- circuit failure
- average work time
- call processing messaging

Chapters 2-5 describe the capacity evaluating process for different switch components.

Capacity work sheets

Appendix A contains capacity work sheets. These work sheets are suggested formats for keeping records of individual component capacity study periods. These work sheets may be copied or modified to meet the requirements of the local operating company.

Automated tools

Several automated tools are available to the administrator that will aid in the monitoring of capacity. Northern Telecom developed these tools to assist in the initial provisioning of an office and for use in the ongoing surveillance of a working switch.

REAL::TIME

REAL::TIME is a PC program designed to provide an estimate of the DMS-100 Family CPU real time requirements. The DMS-100 switch provides distributed processing over many switching entities. The call attempt capacity of each of these switching entities must be predicted to establish operating guidelines. These guidelines are used to determine the loading levels for specific applications, including residential services. The real time can be predicted by using the anticipated call mix and timing per call.

Using traffic criteria along with detailed office provisioning data, REAL::TIME generates an estimated occupancy for the central processor. REAL::TIME can be used in the following office configurations:

- DMS-100 plain old telephone service (POTS), MDC (including MADN) or both, in an equal access end office (EAEO)
- DMS-200 in an access tandem operation
- DMS-100/200 in a combination of the above
- TOPS applications
- Signaling System #7 trunking applications
- Enhanced 800 Service
- Integrated Services Digital Network applications

REAL::QUICK

REAL::QUICK is an abbreviated form of REAL::TIME. Some assumptions and considerations are applicable to each processor. If there is a significant variance from these assumptions and considerations, a more detailed study should be performed using PRTCALC or REAL::TIME.

PRTCALC

PRTCALC is a PC program designed to provide an estimate of DMS-100 Family peripheral real-time requirements. PRTCALC can be used to calculate the real-time call attempt capacity for peripheral modules. PRTCALC is composed of three sections:

- an input section used to organize the controller call data and feature requirements
- a work sheet section that contains the PRTCALC call mix calculations. The call types derived from the input data are combined with the pre-call timings to determine the real-time requirements.
- an output section that is a summary of the input and the work sheet calculations

Input for PRTCALC comes either from projected (forecast) data based on current operational measurement trends, or from inputs to the NT-ACCESS tool.

Administering CPU real-time capacity

Understanding CPU real-time capacity

Real time is the actual time during which the central processing unit (NT40) or DMS-Core (SuperNode) performs its functions. The time is divided into two main categories: call processing time and noncall processing time. The call processing category includes both work time for the acceptance of call originations and call progression to completion or treatment. The CPU is active 100 percent of the time. Usually, the CPU is performing a combination of call processing and noncall processing activities. However, if no call requests are received during a period of time, the CPU remains active for 100 percent of the period, but uses the entire time on noncall activities.

The noncall processing category can be divided into subcategories of work that can be deferred and work that cannot be deferred. Work that can be deferred is postponed (if there are sufficient requests for call processing) until there is leftover call processing time in which to perform the work. Work that cannot be deferred is activity that the CPU must perform during each cycle of the system clock, referred to as overhead. The percentage of real time used for overhead depends on the type and number of features loaded, and the requirements for maintenance input/output devices. Theoretically, up to 31 percent of real time can be used by overhead if the switch is equipped for all features. In practice, switches do not contain all features available; therefore, the real time used for overhead is somewhere between the minimum and maximum values. Each switch configuration should be evaluated on its design and load to determine its overhead requirements.

The figure below illustrates real-time use in an NT40. In this example, 83 percent of the total real time available is allotted to call processing and the minimum nondeferrable work real time of 17 percent. Only a portion of this 83 percent is actually being used to process calls, with the remaining time being spent performing deferrable work activities. In actual use, the 83 percent could be used entirely for call processing (if there were sufficient requests for service), the entire time could be used for doing deferrable work (if there were no call processing requests), or both activities could be combined.

Figure 2-1
CPU real time—availability for call processing

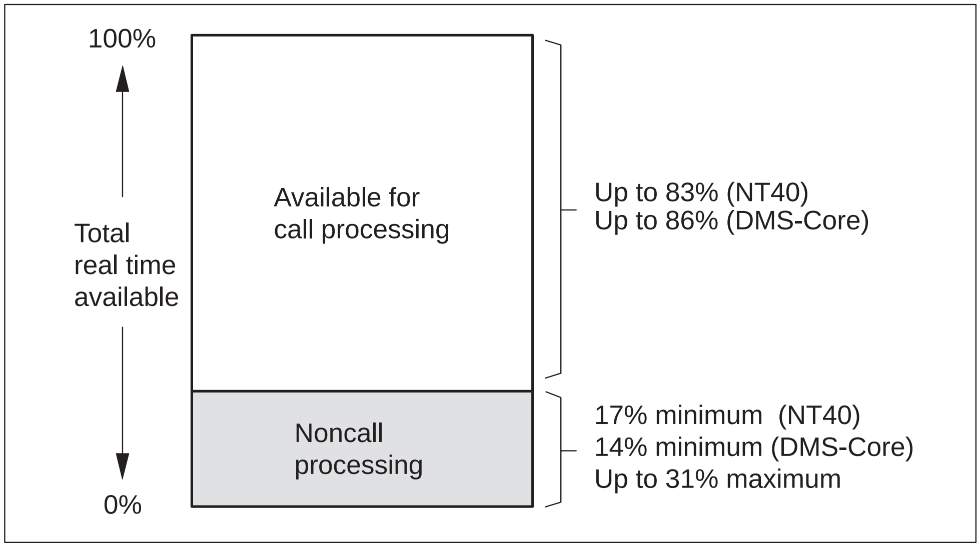
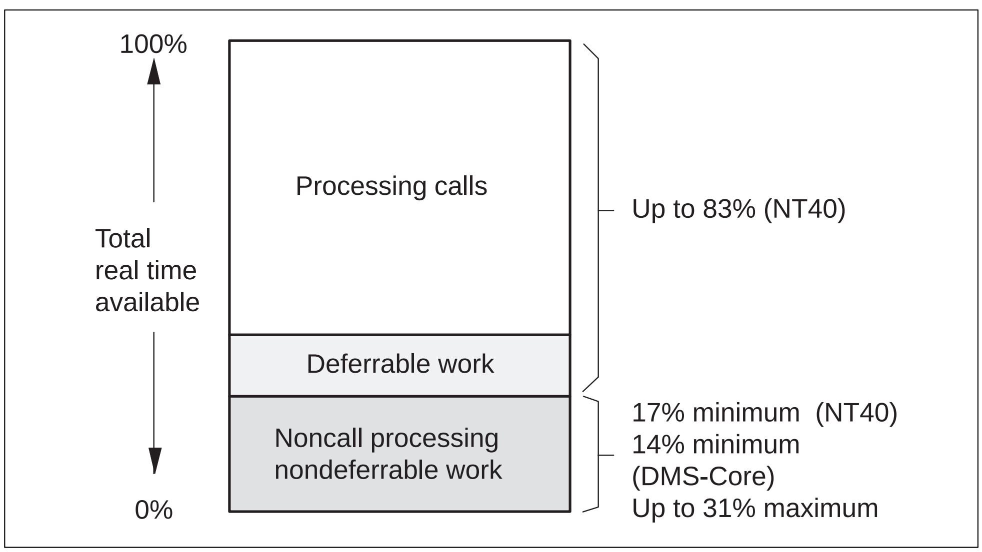


Figure 2-2
CPU real time—example of NT40 real-time use during a study period



Average CPU work time

The average CPU work time that is used to calculate the call capacity of the CPU is an estimate in the provisioning process. It is derived from estimates of the call mix that can be expected to be offered to the switch during the engineered period. Because it is an average of actual calls in a working office, the average work time will rise and fall from study period to study period depending on the call mix that is offered. Therefore, a representative average work time can only be derived from a number of study periods; that is, studies are accumulated until the average of the results does not significantly change when adding the results of another study period.

Note 1: In this document, CPU refers to both the NT40 and SuperNode central processors.

Monitoring CPU real-time capacity factors

There are real-time capacity factors that can be monitored to determine the amount of CPU capacity that is being used, how it is being used, and how much remains available. This section describes those factors and how they can be used to learn more about the status of real-time capacity for a particular time period.

Each of the following descriptions of real-time factors includes a table that lists the related OMs and associated log reports.

Call processing occupancy

Call processing occupancy is a measurement of the average percentage of CPU real time allotted to call processing that is used during the study period. A study period is usually the office call busy hour, although it can be during any other period of the day.

The following table lists the OM groups and registers that are associated with call processing occupancy.

Table 2-1
Performance indicators for CPU real-time capacity

Operational Measurements		Log reports
Group	**Register**	
CPUSTAT	CPSCPOCC	None
CPUSTAT	CCPAVAIL	None
OFZ	NORIG	None
OFZ	NIN	None

How to evaluate call processing occupancy

Call processing occupancy can be evaluated for different purposes. These purposes may include: determining why occupancy is high or low for a particular short period of time, verifying estimated average work time, verifying predicted real-time use derived from the REAL::TIME tool, and monitoring the effect of new services or features.

Evaluating abnormally high or low occupancy

If the percentage of call processing occupancy for a given number of call attempts continues to remain lower than expected, it may be due to a lower average work time than what was forecast. The reverse may be true if the percentage of occupancy remains higher than forecast. The average work time (AWT) can be calculated by the following formula:

$$AWT = \frac{3{,}600{,}000 \text{ ms x recorded \% occupancy}}{OFZ\_NORIG + OFZ\_NIN}$$

In this calculation, 3,600,000 ms represents the total number of milliseconds in an hour. This value is then multiplied by the recorded percent occupancy from CPUSTAT_CPSCPOCC. The result is divided by the sum of the number of originations (OFZ_NORIG) and number of incoming attempts (OFZ_NIN) recognized by the CPU. The value derived is the average work time for calls processed by the CPU during the study period.

Data evaluation procedure

The following procedure provides the steps required to evaluate abnormally high or low call processing occupancy.

> ***Note:*** The ACTIVITY tool uses up to 2 percent (NT40) and 3 percent (SuperNode) of call processing capacity when being run. For example, an NT40 office that has a maximum of 83 percent of real time available for call processing will be reduced to 81 percent available for call processing with ACTIVITY turned on. A more accurate evaluation of real-time use can be made with ACTIVITY turned off.

Table 2-2
Evaluating high or low call processing occupancy

Step	Action
1	**Collect data** Set data to collect during the call busy hour or other designated study hour. These data include: OMs CPUSTAT_CPSCPOCC, OFZ_NORIG, and OFZ_NIN.
2	**Derive AWT** Use the AWT formula to calculate the AWT for the study period data.
3	**Compare AWTs** Compare the study period AWT with the AWT used to engineer the current design period (obtained from the current provisioning documents). If the AWT is significantly higher or lower, continue to take studies to see if the AWT is consistently higher or lower than expected. If it is, report the values to the engineering group for consideration of the effect on the end of design date. These AWT values are especially important for an office that is near the point of upgrading to DMS SuperNode.
4	**Investigate cause** The cause of higher or lower than forecast average work times is usually due to a different call mix than was expected. Using empirical data, compare the actual call mix with the data that were used to engineer the office. Obvious differences should be reported to the provisioning engineer, and new call capacity calculations derived from the the REAL::TIME tool should be considered.
	—end—

CPU call rate

The rate that calls are being offered to the CPU is a factor that is part of the original provisioning calculations. The call-carrying capacity of the CPU is the result of dividing the total real time available for call processing by the average work time of the calls being offered. As the average work time rises the call capacity goes down, and as the average work time goes down the call-carrying capacity rises.

Because the CPU capacity is measured in terms of how many calls can be processed, and can be one of the limiting items in a DMS-100 Family switch, the call-carrying performance requires monitoring. A reduced capability of the CPU to process the forecast call-carrying capacity should be considered an indicator to investigate and determine the reasons for the reduced call capacity. The following table lists the operational measurements that are associated with the CPU call rate. These registers are read during the office call busy hour.

Table 2-3
Performance indicators for CPU real-time capacity

Operational Measurements		**Log reports**
Group	**Register**	
IFZ	NORIG	None
OFZ	NIN	None

Evaluating the CPU call rate

The purpose of monitoring the call rate is to see if it is tracking the projected call rate for the engineered period. This factor becomes more important as an NT40 CPU nears capacity and an upgrade to SuperNode (DMS-Core) is required, especially if the switch is processor-limited. Use the following formula for determining total call attempts:

Total call attempts = OFZ_NORIGATT + OFZ_NIN

Data evaluation procedure

The following procedure provides the steps required to evaluate the call rate.

Table 2-4
Evaluating the CPU call rate

Step	Action
1	**Collect data** Set data to collect during the call busy hour or other designated study hour. These data include: OMs CPUSTAT_CPSCPOCC, OFZ_NORIG, and OFZ_NIN.
2	**Derive call rate** Using the call attempts formula, calculate the call rate for the study period data.
3	**Compare call rates** Compare the study period call rate with the call rate used to engineer the current design period (obtained from the current provisioning documents). If the call rate is significantly higher or lower, continue to take studies to see if the call rate is consistently higher or lower than expected. If it is, report the values to the engineering group for consideration of the effect on the end of design date. These call rate values are especially important for an office that is near the point of upgrading to DMS SuperNode.
	—end—

Administering line peripheral capacity

Understanding line peripheral capacity

This chapter discusses capacity relating to peripherals that contain line equipment that connects the subscriber to the DMS-100 Family switch. It does not discuss remote peripheral modules which are addressed in other documentation (see “Where to find information” in “About this document”).

Line capacity is measured in terms of the total number of lines (or network access lines) that can be served and still meet an objective grade of service (GOS) established by the individual operating company. Grade of service as it applies to line peripherals usually refers to dial tone delay and matching loss. Dial tone delay is measured by the percentage of calls that do not receive dial tone in 3 seconds from the time the request for dial tone was made by taking the receiver off-hook. Matching loss refers to a call to an idle line that cannot complete because there is no available channel to the line.

The line peripheral capacity term CCS capacity refers to the total traffic, measured in centum call seconds (CCS), that the peripheral can process during a continuous 60-minute period and still meet an objective GOS established by the operating company. The CCS capacity values are contained in engineering tables and are measured in a working switch by operational measurements designed for that purpose.

Administering line concentrating module capacity

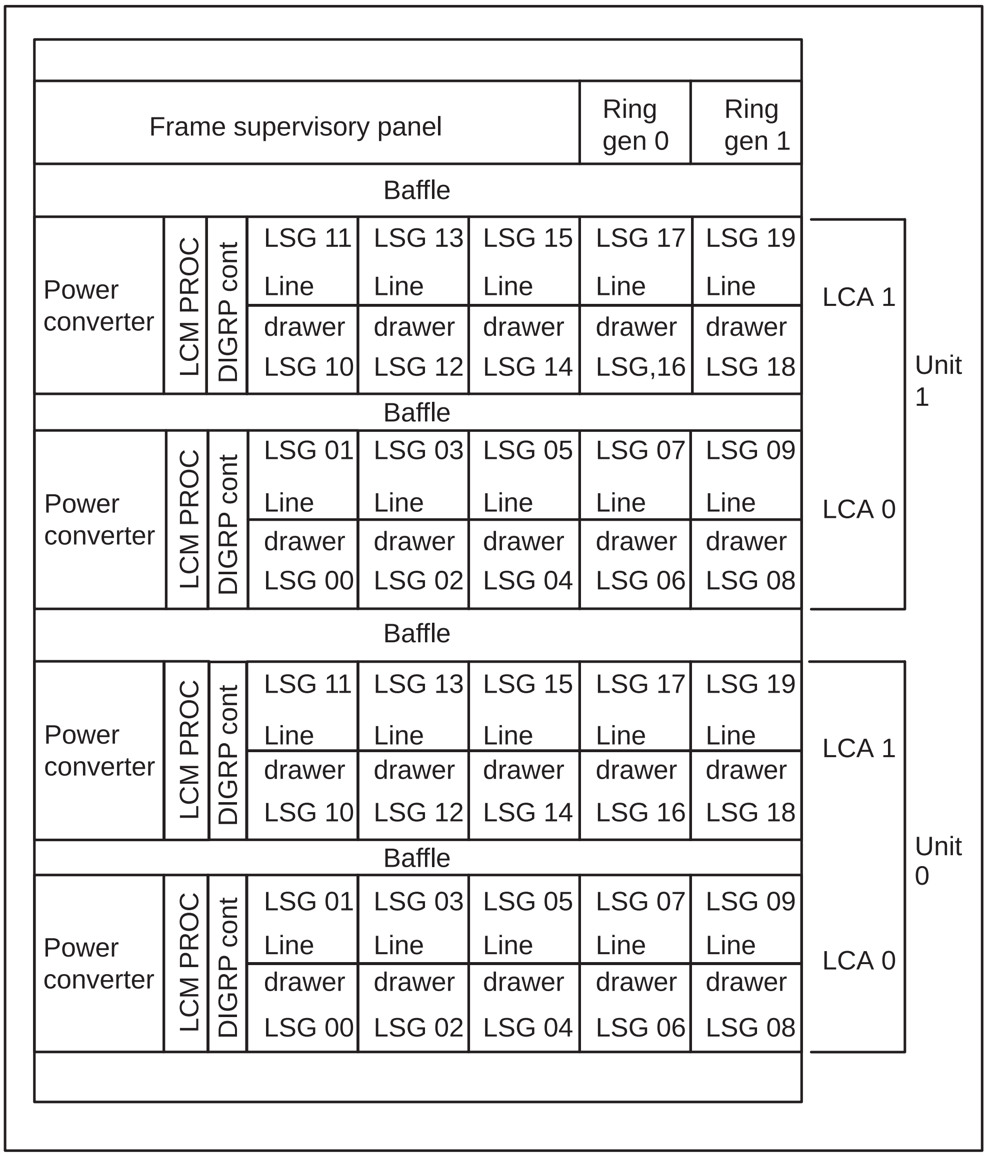
The line concentrating module (LCM) is a peripheral module (PM) that has been designed to provide for analog line connections in the DMS-100 switch. Through a combination of internal connections, the LCM associates a line with a DS30A channel to enable an outgoing call to be made or an incoming call to be received.

As the name implies, the LCM concentrates the switch access paths. The concentration results because the module is provided with more incoming paths than outgoing paths.

Physical capacity

The LCM, shown below, is a dual-shelf peripheral. Each shelf, called a line concentrator array (LCA), has its own control complex, which is composed of an LCM processor and digroup control and power converter. The two control complexes are referred to as unit 0 (lower shelf) and unit 1 (upper shelf).

Figure 3-1
Line concentrating equipment frame

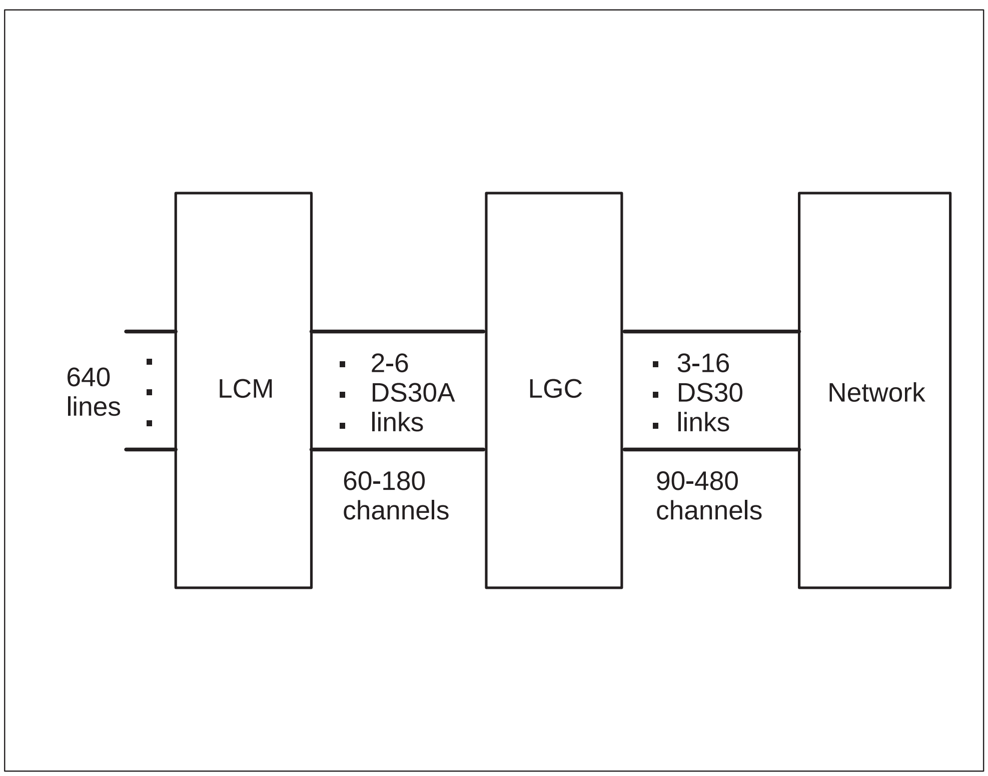


Each digroup control has eight C-side ports. Six of these ports are connected by means of DS30A links to the host line group controller (LGC). Three are in the active mode and three are normally inactive, used only if one control complex fails. The other two ports are used for link sharing, which enables unused DS30A channels to be accessed by either control complex.

The line concentrating module (see the figure below) can be connected to 2 through 6 DS30A links and can serve up to 639 lines (640 terminals provided with one terminal reserved for testing purposes). Each of the DS30A links is composed of 32 channels, 30 of which are used for speech and 2 for internal messaging. Therefore, concentration ratios can range from approximately 3:1 to 10:1 (639 lines/180 channels to 639 lines/60 channels).

If the use (CCS) per line served is very low, for example, plain ordinary telephone service (POTS), the line capacity for an LCM may be limited only by the total number of line terminals (639) and still meet the objective GOS for the percentage of matching loss and dial tone delay. However, in many cases the CCS per line is great enough, coupled with line concentration, to cause the LCM to be traffic load limited. When an LCM is load limited, the number of lines that can be assigned and still meet service objectives is fewer than 639.

Figure 3-2
Line concentrating module configuration



Line drawer capacity

Each shelf (LCA) also contains five line drawers. Each line drawer contains a pair of line subgroups (LSG) and a single bus interface card (BIC). Each line drawer consists of an even-numbered LSG and an odd-numbered LSG (for example, LSG 01/00). An LSG consists of 32 line cards which is one card for each subscriber.

Traffic capacity

Traffic capacity for LCMs is measured in terms of the total amount of traffic measured in CCS that can be carried and still meet the incoming matching loss (IML) objective. Engineering tables are provided showing the theoretical number of CCS during the high day and average busy season busy hours. The theoretical number of lines that each LCM can serve can be determined by dividing the CCS value from the table by the known or estimated office CCS per line.

Load balancing

Load balancing is accomplished by following locally designed procedures including such activities as: designing and administering a loading plan, monitoring the load on each of the line modules on a daily basis, and making line assignments based on the average daily load readings for each line module. Many operating companies use a mechanized load balancing system to make line assignments. Refer to the *Loading Administration Guide* for detailed information on loading administration.

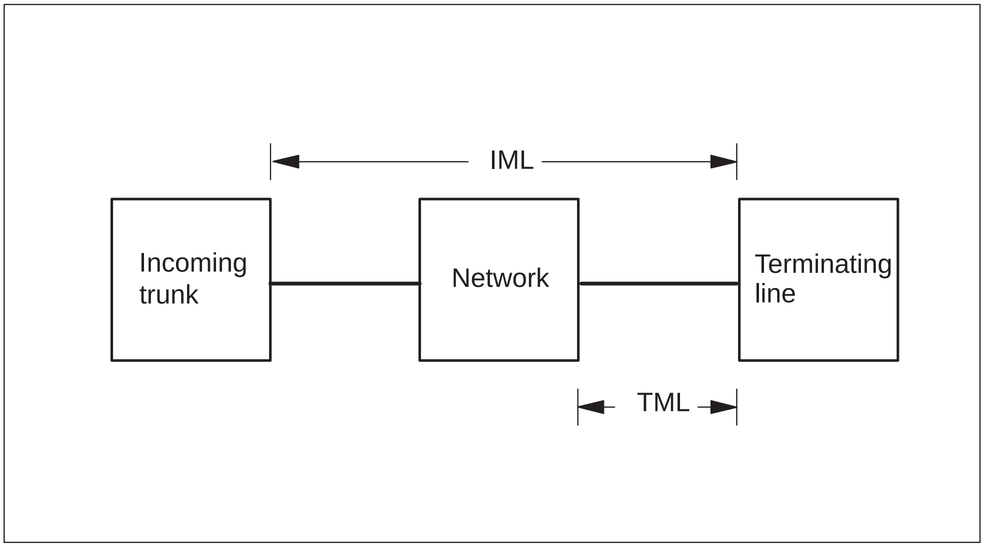
Monitoring grade of service indicators

Monitoring the capacity of line concentrating modules includes the recording of certain performance indicator values, for example, matching loss, CCS per line, and dial tone delay.

Incoming matching loss

Incoming matching loss is the service measurement that is used in engineering LCMs and is monitored to determine if the rate of IML is staying in the engineered and service objective limits. Incoming matching loss is compared to terminating matching loss (TML) in the figure below.

Figure 3-3
Comparison of IML and TML



Incoming matching loss is the failure to find a path from an incoming trunk to an idle line. The line concentrating equipment frame table below lists the operational measurements and any associated logs that can be used to evaluate incoming matching loss.

Table 3-1
Performance indicators for LCM incoming matching loss

Operational Measurements		Log reports
Group	**Register**	
OFZ	TRMMFL	NET130
		NET138
OFZ	INTRM	None

Terminating matching loss

Terminating matching loss is a failure to find an idle channel between the host network and an idle terminating line.

The following table lists the operational measurements and any associated logs that can be used in the evaluation of terminating matching loss.

Table 3-2
Performance indicators for LCM terminating matching loss

Operational Measurements		Log reports
Group	**Register**	
OFZ	TRMBLK	NET130
		NET138
OFZ	INTRM	None

How to evaluate matching loss

Matching loss is measured in terms of percentage of incoming matching loss, and is derived by dividing the total IML by the total number of terminating attempts and then expressed as a percentage. The grade of service for IML, as determined by the operating company, is the standard for evaluation. The two tables below indicate the incoming matching loss percentage and expected level of loss from each source when measured during the average busy season busy hour (ABSBH) and high day busy hour (HDBH).

The following table contains the present existing matching loss standard.

Table 3-3
Incoming matching loss-existing standard

Busy hour	Network	Peripheral	Incoming matching loss
ABSBH	0.1%	1.9%	2.0%
HDBH	1.0%	19.0%	20.0%

The following table contains the Northern Telecom recommended matching loss standards.

Table 3-4
Incoming matching loss-NT recommended standard

Busy hour	Network	Peripheral	Incoming matching loss
ABSBH	0.1%	1.9%	2.0%
HDBH	1.0%	4.0%	5.0%

Incoming matching loss can be calculated using the following formula:

$$\% \text{ IML} = \frac{\text{OFZ\_TRMMFL}}{\text{OFZ\_INTRM}} \times 100$$

Terminating matching loss can be calculated using the following formula:

$$\% \text{ TML} = \frac{\text{OFZ\_TERMBLK}}{\text{OFZ\_INTRM}} \times 100$$

Data evaluation procedure

The following procedure gives suggested steps for evaluating matching loss.

Table 3-5
Evaluating matching loss

Step	Action
1	**Collect data** Set OM schedule to collect matching loss data during the office call busy hour.
2	**Analyze data** Compare the busy hour matching loss data with the objective matching loss value for the ABSBH or HDBH and determine if the percentage exceeds the objective. Sufficient studies should be taken to arrive at a representative matching loss percentage for the switch. Terminating matching loss should also be compared to incoming matching loss to see if the blockage is in the network or between the network and the line. If the office matching loss exceeds the objective, determine if all channels were in service during the study. If a number of channels were not in service, analyze data from studies taken after the channels are returned to service. If the next studies still show matching loss exceeding the objective, look at the matching loss readings for the individual LCMs to determine if the matching loss is being caused by an unbalanced load on the LCMs. Unbalanced loads should be apparent if a mechanized load balance program is being maintained for the switch. Refer to the *Loading Administration Guide* for loading considerations.
3	**Take corrective action (if required)** Overloaded LCMs should be deloaded as soon as possible. If the load is reasonably balanced over the LCMs and matching loss remains above the objective, the provisioning group should be notified of the condition for corrective action. Serving new requests for service out of another switch should be considered in locations where this is an option.
	—end—

Usage (CCS) per line

Usage per line, usually referred to as CCS per line, is the actual or projected average usage (measured in CCS) per line served by the switch. The CCS per line value is derived by dividing the sum of the use of all line units by the number of lines and equivalent lines served by the switch.

The table below lists the operational measurements and any associated logs that can be used in the evaluation of CCS per line. Current line counts can be printed out using the BCSMON DUMP COUNTS command at the MAP display.

Table 3-6
Performance indicators for LCM terminating matching loss

Operational Measurements		Log reports
Group	**Register**	
LMD	LMTRU	None

Calculations used to evaluate CCS per line

The CCS per line value can be calculated using the following formula:

$$\text{CCS per line} = \frac{\text{Total LMD\_LMTRU}}{\text{Current total line count}}$$

How to evaluate CCS per line

The evaluation of CCS per line only requires that the current CCS per line be compared to the value used in the provisioning process to see if it is tracking with the forecast value. Tracking the CCS per line along with the forecast of line growth gives a clear indication if the end of design date for the switch is reasonably accurate. Any combination of higher than forecast values of line growth and CCS per line should be brought to the attention of the office provisioning engineers. Causes for increased or higher than forecast CCS per line can be determined by taking office counts of individual types of services and the number of features per line and comparing those totals with total features and services forecasts. Increases in lines that generate high use (for example, business lines) will raise the CCS per line value, compared to POTS lines which are typically lower-use lines.

Messaging

Features such as multiple appearance directory number (MADN) and Custom Local Area Signaling Services/Common Channel Signaling 7 produce an increased number of call processing messages that impact the real time of the LCM processor. For example, there are limitations on the number of MADN lines that may be served out of an LCM. Refer to the *Loading Administration Guide* for MADN loading guidelines and *Residential Services Administration Guide* for CLASS/CCS7 information. Operational measurement group PMMSGCNT provides messaging data.

Administering line module capacity

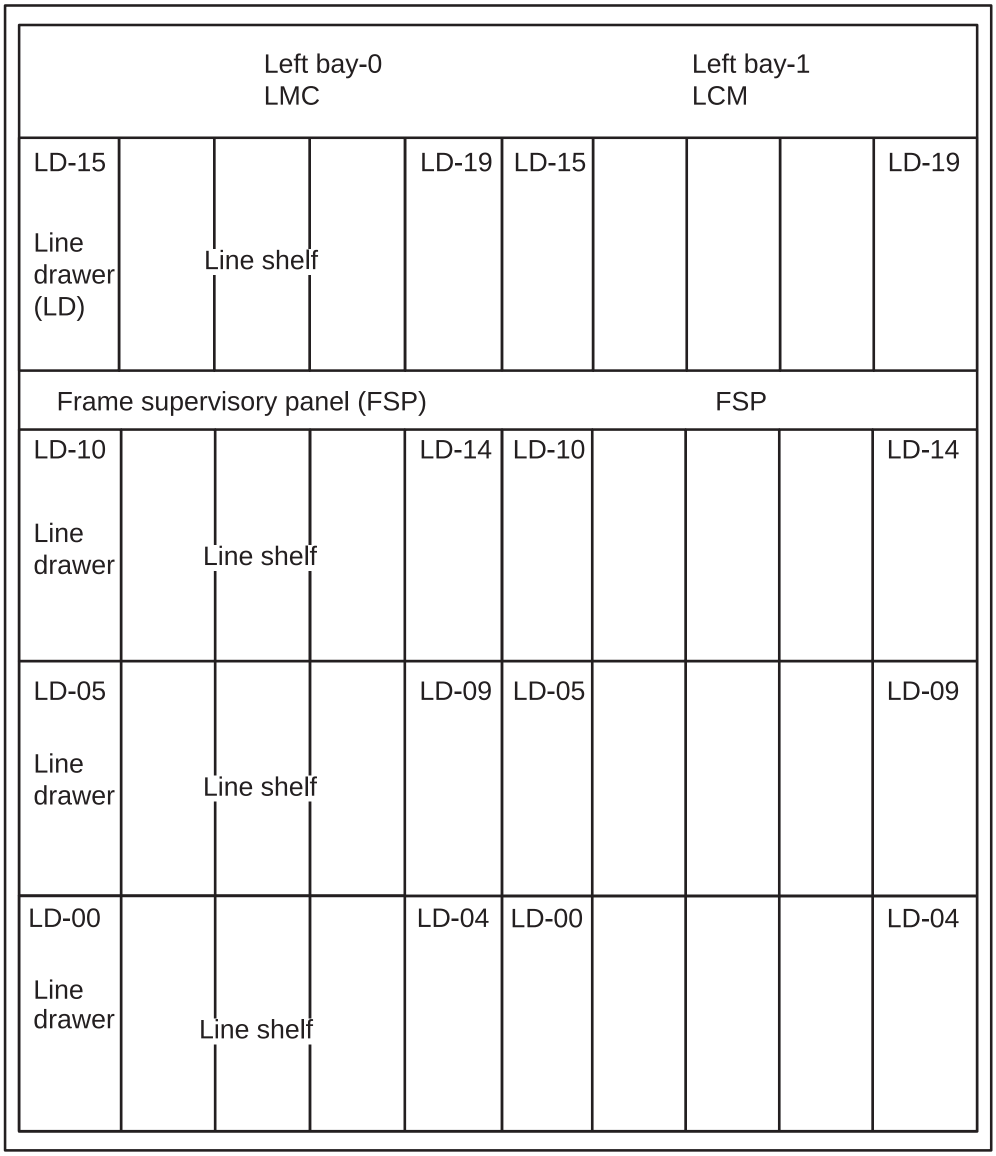
The line module (LM) is an old type peripheral unit that connects analog subscribers directly into the switching network through speech links. Three line module (or port) configurations are used, one for switching heavy traffic, one for medium, and another for light traffic.

Physical capacity

The LM is a two-stage system. In the first stage of time-switching, a group of 32 lines is concentrated into one of 20 digroups of 30 channels each. In the second stage the 20 internal digroups are effectively space-switched into 2, 3, or 4 speech links of 30 channels each. This two-stage concentration results in a range of concentration ratios of approximately 5:1 to 10:1. The LM can connect up to 640 lines, 639 of which are for subscribers and one for diagnostics/testing purposes.

The double bay line module equipment (LME) frame (see the figure below) contains two complete LM bays, which have the same configuration. An LM bay is composed of an LMC shelf, four line shelves, and a frame supervisory panel.

Figure 3-4
LM line equipment frame



The LMC controls the speech and signaling channels between 2 through 4 duplicated DS30 links to plane 0 and plane 1 of the network module, and 20 terminal groups (0-19) to the line drawers. Each line shelf contains 5 line drawers for a total of of 20 line drawers. The LMC contains a master processor and three subsidiary processors that perform the peripheral processor functions. Two processors handle central control messages, and one handles signaling and ringing.

Line drawers

Each line drawer can accommodate 32 line cards that provide bidirectional analog-to-digital and digital-to-analog interfaces between the subscriber lines and the terminal groups. Line drawer 00 makes connections for the first group of 32 lines. Similarly, line drawers 01 through 04 each accept 32 lines, totaling 160 lines for the first line shelf. The other three line shelves each accept 160 lines, totaling 640 lines (4 x 160) for the whole bay.

Each line drawer contains two bus interfaces (BI), one designated primary and one designated secondary, which collect 32 sets of bidirectional digital signals from their associated line card, and multiplexes them onto the 20 terminal groups to the LMC. Normally, the primary BI is active, but if the LMC in one bay fails, the secondary BI is activated and routes the 20 terminal groups to the LMC in the mate bay. This mutual support between the mate LM bays enables the traffic load from all 1280 lines to be handled by the one LMC until the other LMC is restored to service.

Any one of the 640 analog lines can be associated with any one of the 32 paths in each terminal group, and any channel in any one of the up to 120 speech channels (4 speech links) connected to the network.

Traffic capacity

Line modules were engineered using terminating matching loss (TML) as a service criterion. Terminating matching loss is defined as the failure on an incoming call to find an idle path from the network to an idle line. Traffic capacity for LMs is measured in terms of the total amount of traffic (measured in CCS) that can be carried and still meet the TML objective as defined locally. Terminating matching loss is no longer used as an NT engineering criterion for peripherals serving lines.

Monitoring line module performance factors

Line modules are monitored in the same way as LCMs except that instead of looking at incoming matching loss, emphasis is placed on terminating matching loss because LMs were engineered from capacity tables based on terminating matching loss. The OMs and logs associated with TML are listed in the following table.

Table 3-7
Performance indicators for LM terminating matching loss

Operational Measurements		Log reports
Group	**Register**	
OFZ	TRMBLK	NET130
		NET138
OFZ	INTRM	None

Calculations used to evaluate performance

The terminating matching loss calculation can be used to evaluate LM capacity and corresponds to evaluating LCM incoming matching loss. The TML calculation is as follows:

$$\%TML = \frac{OFZ\_TERMBLK}{OFZ\_INTRM} \times 100$$

Data evaluation procedure

Follow the same procedures that are shown for line concentrating modules.

Administering ISDN line concentrating module capacity

Integrated Service Digital Network (ISDN) supplies its users with standard access interfaces which provide B- and D-channels. The B-channel is a 64 kilobytes per second (kB/s) bidirectional information pipe that can carry any digital information, such as digitized voice or data. The D-channel is a signaling channel for controlling the B-channel and can be used to support low-speed packet data.

Through the ISDN, users can access the following standard interfaces:

- interface to customer premises equipment (CPE) such as computers, telephones, and fax machines through the basic rate interface (BRI)
- interface to digital private branch exchanges (PBX), host computers, and local area networks (LAN) through the primary rate interface

- trunk-side interface to the public switched network through Common Channel Signaling No. 7
- access to local packet data terminals and the public packet switched network (PPN) through X.25 and X.75/X.75’ packet services

Basic rate interface

An ISDN BRI loop from the subscriber’s premises has two B-channels at 64 kB/s each plus one D-channel at 16 kB/s. It gives the user the capability of using three channels and is commonly referred to as 2B+D. The 2B+D configuration provides for up to eight terminals as follows:

- The two B-channels can be used for circuit switched voice/data or high-speed packet switched data. The two channels can be used for two separate calls or independently and simultaneously for two connections associated with the same call. This would apply, for example, to a call between two voice/data terminals requiring separate connections for voice and data transmission.
- One 16 kB/s D-channel carries signaling and control information for the B-channels and may also be used to interleave low-speed packet data with this information. With its capability to support low bit rate data in packet mode, this channel can serve the telemetry services (for example, meter reading and alarm monitoring).

Access termination for 2B+D loops is provided by ISDN line cards housed in the enhanced line concentration module (LCME).

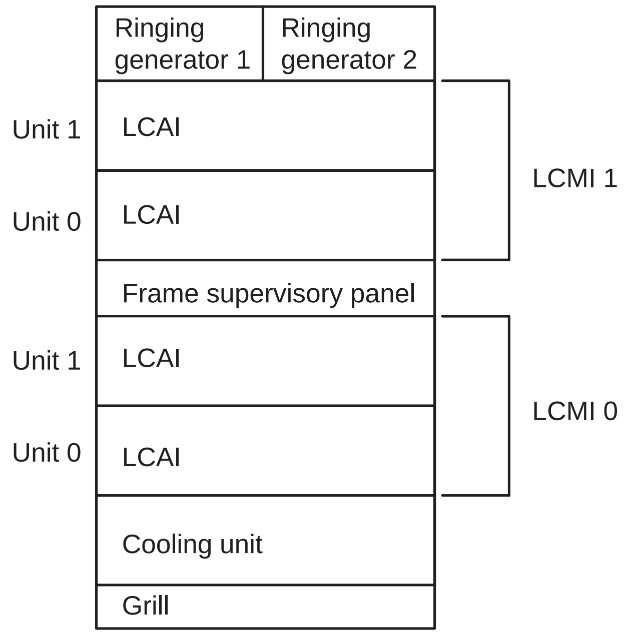
Primary rate interface

Primary rate interface (PRI) carries nB+D channels over a digital DS-1 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. The 23B+D configuration is just like the BRI with the following exceptions:

- D-channel low-speed user packet is not supported
- D-channel is 64 kB/s rather than 16 kB/s

Access termination at the DMS is provided by the ISDN digital trunk controller (DTCI) and/or ISDN line trunk controller (LTCI).

Figure 3-5
ISDN line concentrating equipment frame



The BRI subscriber lines terminate on ISDN line cards housed in the ISDN-LCM line drawers. These line cards transfer all three channels (2B+D) to the BIC over the L-bus. At the BIC, the three subscriber loop channels are transferred to the digroup controller by the scan chips (S14 in the LCME). Once inside the digroup controller, the pulse code modulation streams are moved to the incoming time switch where they are switched as appropriate into DS30A links destined for the ISDN line trunk controller.

The LCME

The enhanced LCM or LCME replaces the LCMI in housing the ISDN 2B+D BRI line cards.

The LCME houses 8 physical line drawers with 2 logical drawers per physical drawer, yielding a maximum of 16 logical drawers for each module. Each physical drawer has a capacity of 60 single slot line cards, which gives the LCME the capability to house 480 line cards.

The LCME supports mixed line types consisting of ISDN, Datapath, CSP02, and POTS with maximum capacities as follows:

- 480 ISDN 2B1Q U line cards (NTBX27AA)

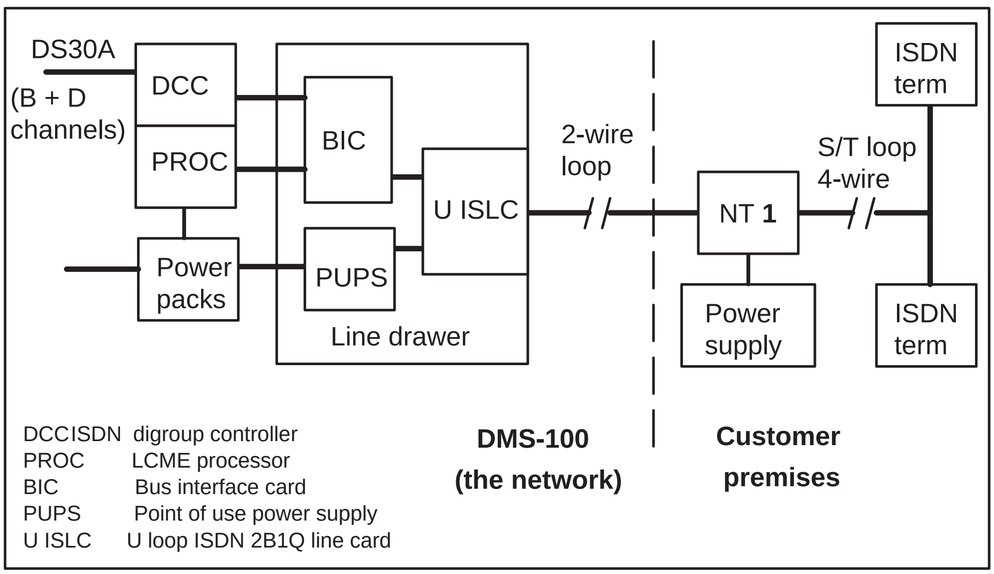
- 240 ISDN T line cards (NTBX26AA)
- 240 Circuit Switched Datapath line cards (NT6X71AA/AB)
- 208 AILC Datapath line cards (NT6X76AC)
- 1 IBERT Datapath line card (NT6X99AA)
- 480 CSP02 line cards (NT6X21AC)
- 480 POTS A line cards (NT6X17AA/AB)
- 472 POTS Message Waiting line cards (NT6X19AA/AB/AC)

A combination of the above cards is allowed without any mixing restrictions (BCS32 and up).

Note: POTS B line cards (NT6X18AA/AB) and ISDN U line cards (NTBX25AA/AB) are not supported.

The LCME has the capability of supporting nonblocking service for up to 320 ISDN loops for a module.

Figure 3-6
LCME line module configuration



LCME line drawers

The LCME line drawer (NTBX32BA) provides for the 2B1Q (two B one quaternary) access subsystem. It replaces the LCMI line drawer (NTBX32AA) and increases the capacity from 48 slots to 60 slots. This line drawer provides a physical capacity of 480 single slot lines for each LCME. Each drawer has 95 output channels, 15 of which are reserved for time division multiplexing (TDM) groups of ISDN D-channels. This arrangement enables an ISDN line to be placed anywhere in the drawer.

With four 16 Kbyte/s D-channels multiplexed to each 64 Kbyte/s drawer output channel, a drawer can accommodate up to a maximum of 60 ISDN lines (4 x 15). The remaining 80 channels are for switched traffic, both ISDN and non-ISDN.

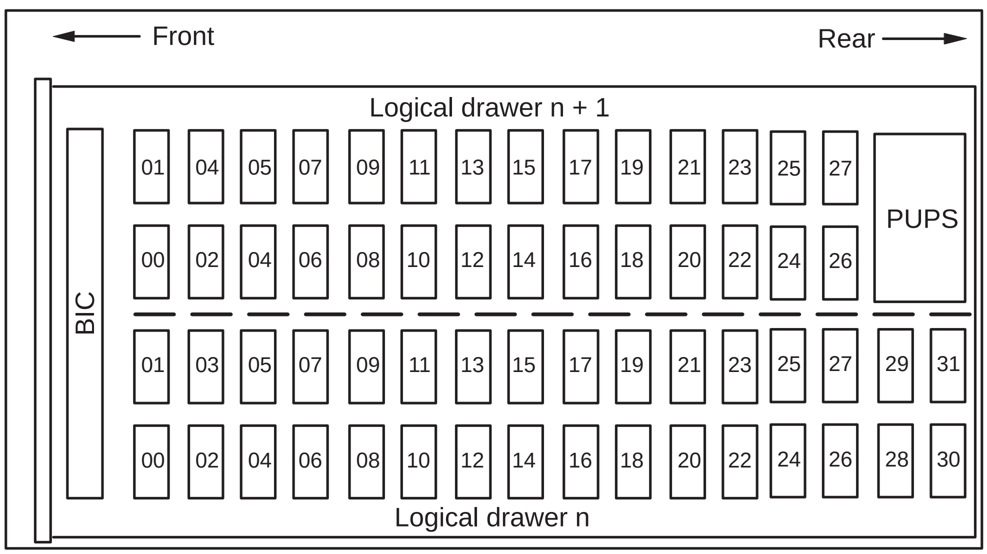
The ISDN 2B1Q line drawer consists of the following (see next figure below):

- one BIC
- 60 line card slots
- one point of use power supply (PUPS)

Note: The PUPS converts the common equipment –48V battery to +5V. This +5V is routed to the line card slots.

Each drawer is divided into two logical drawers or subgroups. One subgroup is numbered 00 through 31 and the other 00 through 27 (total of both subgroups is 60 line card slots).

Figure 3-7
LCME line drawer configuration



Traffic capacity

Traffic capacity for LCMEs that serve only ISDN lines is determined from capacity tables. The number of lines that may be assigned based on the traffic load offered and still meet objective service levels can be determined by reading the CCS capacity from the table column that matches the conditions in the switch (number of channels and high day/average busy season ratio). This value, divided by the expected CCS per line, will indicate the theoretical line capacity for that module.

Monitoring ISDN line module capacity factors

The procedure for monitoring the capacity factors for the ISDN line modules is the same as that for a regular LCM (see above). The main purpose in monitoring actual traffic is to compare the actual traffic characteristics with the forecast characteristics that were used to engineer the line modules for the design period. Deviations from the forecast data are evaluated to see what effect there is on the end of design date (if any) for the line modules. The following table contains the performance indicators for the LCME. The assignment of the MADN feature to ISDN lines has little to no impact on real-time use in the LCMI/LCME processor.

Table 3-8
Performance indicators for LCME modules

Operational Measurements		Log reports
Group	**Register**	
LMD	LMTRU	None
LMD	NORIGATT	None
LMD	INTERMATT	None
OFZ	TRMMFL	NET130
		NET138

Administering line group controller capacity

The line group controller (LGC) uses a common core of features that is also used in the line trunk controller (LTC) and the digital trunk controller (DTC). These features include the following:

- a duplicated (dual-shelf) configuration allowing either control complex to control all processing in the PM
- DS30 interface processing enabling the 3-16 C-side ports to service DS30 links to the network
- a control complex comprising: a master processor, messaging and signaling processors, and associated memory
- a standard shelf and panel arrangement and naming convention

Additional features can be added to produce a peripheral module that is tailored for a special function. The features that can be added are

- DS-1 interface processing, to allow the P-side ports to service DS-1 trunks

- DS-1 interface processing, to allow P-side ports to service DS-1 links to a remote PM
- DS30A interface processing, to allow the P-side ports to service DS30A links to a local PM
- digit collection processing, to allow the PM to collect and report digits to reduce the call processing load on the central control complex
- ring processing, to provide a remote PM with pulse code modulation ringing instructions
- pad processing, to attenuate speech samples before they are passed to the remote PM
- additional signaling processing, to maintain a DS-1 link with remote subscriber carrier equipment
- special tone detection, to allow the PM to detect and report reoriginations, special information tones (SIT), audio tone detection (ATD), and call progress tones

Physical capacity

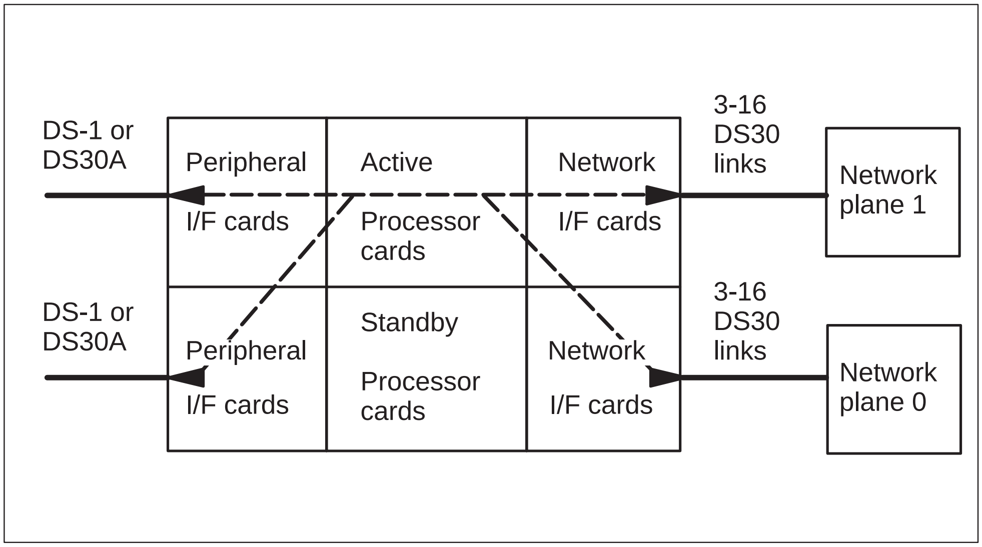
The line group controller consists of the common core of features listed above and the addition of the following:

- DS-1 interface cards, to allow the LGC to service links to a remote peripheral (RLCM or RCC/LCM)
- DS30A interface cards, to allow the LGC to service DS30A links to the local PM
- Universal tone receiver (UTR) cards, to allow the LGC to collect and report digits. Each UTR can collect digits from up to 30 channels at one time. An LGC can include up to two pairs of UTR cards. The UTR can be provisioned in slot 15 and 16, with up to two pairs of UTRs on each shelf
- CLASS modem resource card is an optional card used to implement the class calling number delivery (CND) features for residential enhanced service (RES) subscribers.

Two CLASS modem resource cards must be equipped in an LGC to provide the CND feature. One card is located in slot 13 of unit 0 and the other is located in slot 13 of unit 1. The CMR card has the resources to monitor 32 CND calls for ringing while simultaneously transmitting CND information for another 32 CND calls (a total of 64 CND calls).

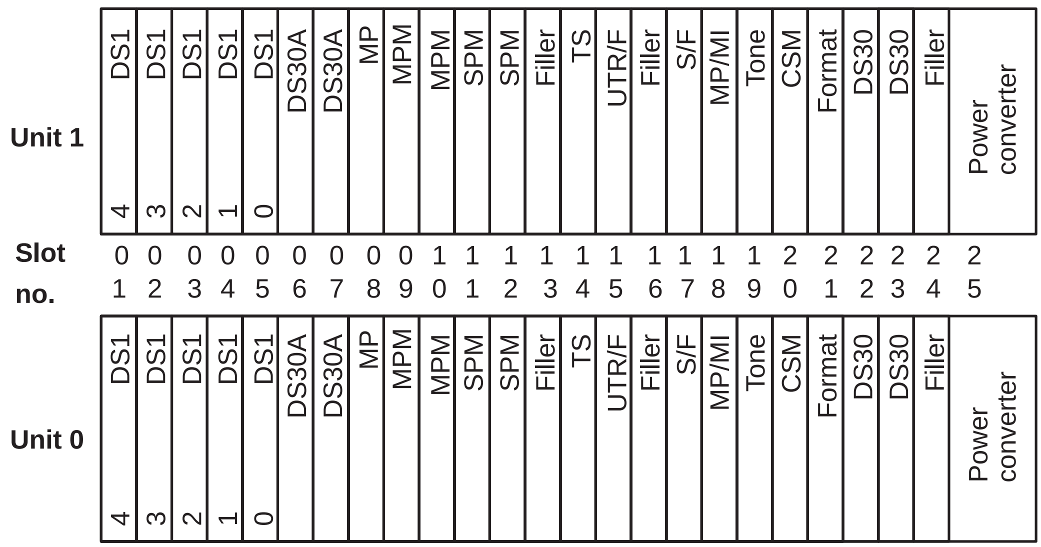
The following figure shows an LGC equipped to service DS-1 links or DS30A links and the DS30 links to both network planes.

Figure 3-8
Line group controller configuration



The following figure shows the shelf layout for the LGC/LTC/DTC.

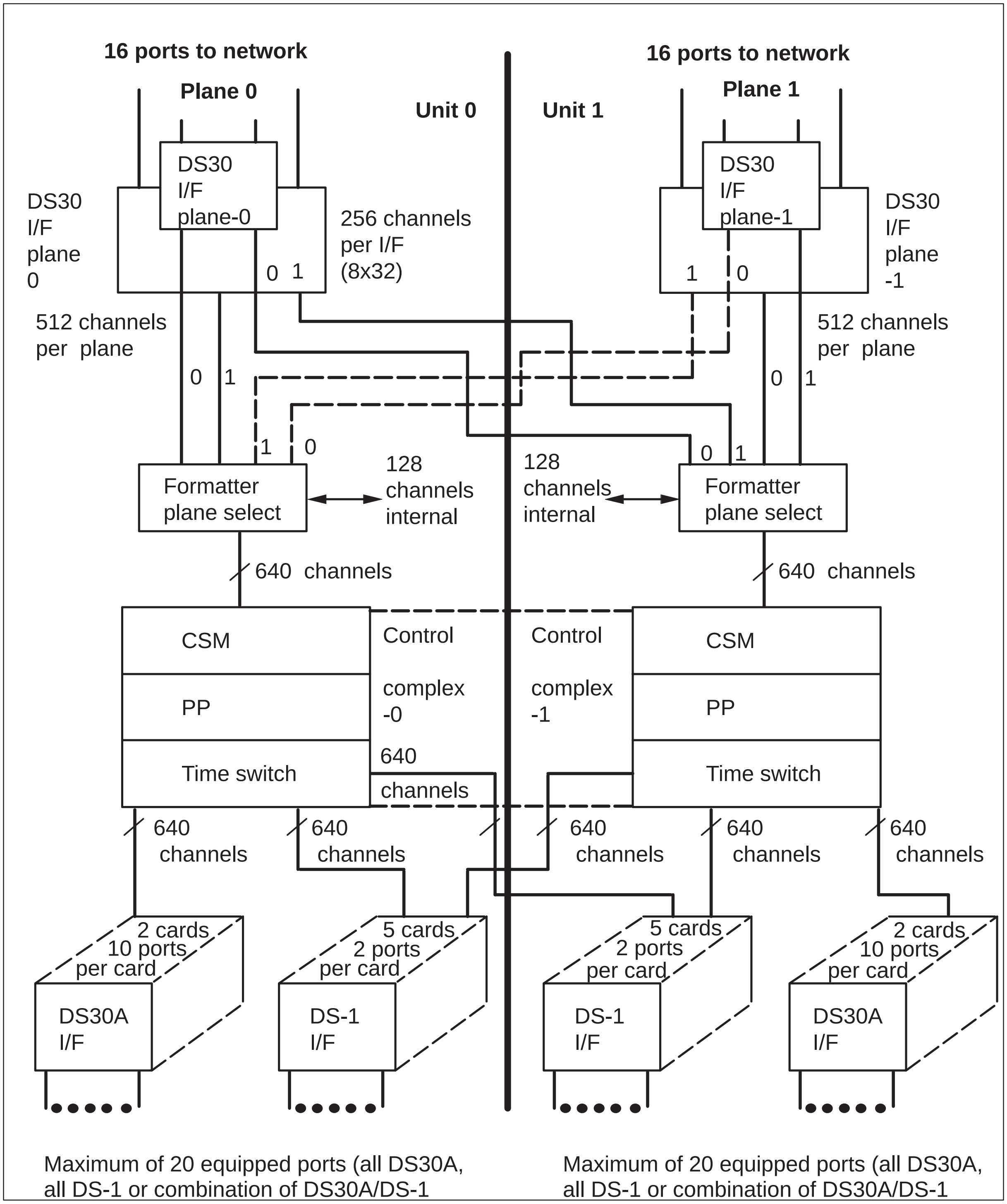
Figure 3-9
LGC/LTC/DTC shelf layout and card complement (T6X02)



Slot	Abbreviation	Description
01-05	DS-1	DS-1 interface (max. 5 cards)
06-07	DS30A	DS30A interface (max. 2 cards in LTC and LGC)
08	MP	Master processor
09-10	MPM	MP memory
11	SPM	SP memory
12	SP	Signaling process
13		Filler panel or continuity tone detector or modem resource card
14	TS	Time switch
15-16	UTR/F	Universal tone receiver (max. 4 per XPM) or filler panel
17	S/F	Specialized tone receiver (max. 2 per DTC only) or filler panel
18	MP/MI	Message protocol circuit or message interface card
19	Tone	Tone generator
20	CSM	Channel supervision message
21		Formatter
22-23	DS30	DS30 interface (8-port)
22	DS30	DS30 interface (16-port) If this card is provisioned, slot 23 is not used.
24		Filler panel
25		Power converter

Note: If slot 22 is provisioned, slot 23 is not provisioned.

Figure 3-10
LGC/LTC/DTC block diagram



Traffic capacity

There are no LGC capacity tables that are used by the provisioning engineer. The capacity is derived using an engineering algorithm (refer to Engineering Change Memorandum [ECM] 497). The engineered CCS per LGC should be available from the provisioning engineer.

Monitoring the LGC capacity factors

There are no operational measurements that are directly associated with LGCs. Therefore, to determine how much of the LGC capacity is being used at a particular time, the administrator must gather data from the individual line units that the LGCs serve. The sum of the individual CCS loads being offered to the LGC can be compared to the engineered LGC capacity, and the percentage of use can be developed at any given time. The line units that are served by an LGC include the following:

- mono remote switching center
- dual remote switching center
- line concentrating module
- remote line concentrating module
- outside plant module

Note: All RSC sites with community dial office/PBX trunks are connected to an LTC.

Table 3-9
Capacity indicators for LGC

Operational Measurements		Log reports
Group	**Register**	
LMD	LMTRU	None
LMD	NORIGATT	None
LMD	ORIGBLK	NET130
LMD	TERMBLK	NET130

Calculations used to evaluate performance

The calculation used to determine the LGC percentage of capacity use follows:

Figure 3-11
LGC percentage of capacity use

$$\%\ \text{LGC capacity use} = \frac{\text{Sum of LMDTRU (all line units served by the LGC)}}{\text{LGC engineered capacity}} \times 100$$

***Note**:* LGC engineered capacity = the sum of the capacities of the line units served by the LGC

How to evaluate LGC capacity factors

As the LGC capacity used approaches 100 percent, the grade of service objectives for lines served by that LGC may not be met. This condition may become apparent by the percentage of blockages encountered, especially if the rate is significantly higher through one LGC when compared to the others. Blockage rates that are exceeding the engineered limits in all LGCs are an indication of an overload and additional equipment is required.

If there is a blockage problem only in a particular LGC(s), no maintenance problems are in evidence, and the maximum number of links have been installed, the offered load to the LGC should be be reduced by moving lines to other line units served by other LGCs. This process should be continued until the blockage rate is within the objective range.

Monitoring the line trunk controller

A line trunk controller (LTC) is a fully duplicated PM used to connect line equipment PMs and digital trunks to the DMS-100 network. The LTC can be thought of as an integrated line group controller and digital trunk controller (DTC).

Load service relationships and limiting items are dependent on the use of the LTC. In general, the LTC engineering limits are a combination of the limits set for LGC and DTC applications. Operational measurements are obtained by a summation of the measurements associated with the peripherals and trunks connected to the LTC.

Administering Service Circuit Capacity

Understanding service circuit capacity

Service circuits are those switch components that are provisioned on an office basis and are in a common pool to serve all subscribers. The circuits discussed in this chapter include the following:

- receivers—multifrequency (MF), dual tone multifrequency (DTMF), and universal tone receivers (UTR)
- 3-port/6-port conference circuits
- special tones
- announcements

Multifrequency and Digitone receivers

The NT2X48 circuit card meets requirements of an MF receiver or a Digitone receiver. The circuits used for the two applications are identical. The firmware is different, which allows the circuits to perform different functions.

The purpose of the MF and Digitone receivers is to receive MF and Digitone tones, respectively, in pulse code modulation (PCM) format and produce a decoded 8-digit binary output. This method is used to pass signals and dialed digits necessary for call processing.

In addition to being used for regular call completion, Digitone receivers are used to support Mechanized Calling Card Service (MCCS). When used for this purpose, a separate group of Digitone receivers is engineered and dedicated for MCCS calls.

Physical capacity

The receivers each occupy either a two-card or single card position and can be mounted in either a maintenance trunk module (MTM) or trunk module of the DMS-100 Family. The number of cards used will depend on job engineering requirements.

Versions of the cards that are available include the following:

NT2X48AA Digital 4-Channel MF Receiver (2-card position)

NT2X48AB Digital 4-Channel Receiver (Digitone 2-card position)

NT2X48BA Digital 4-Channel MF Receiver (single card position)

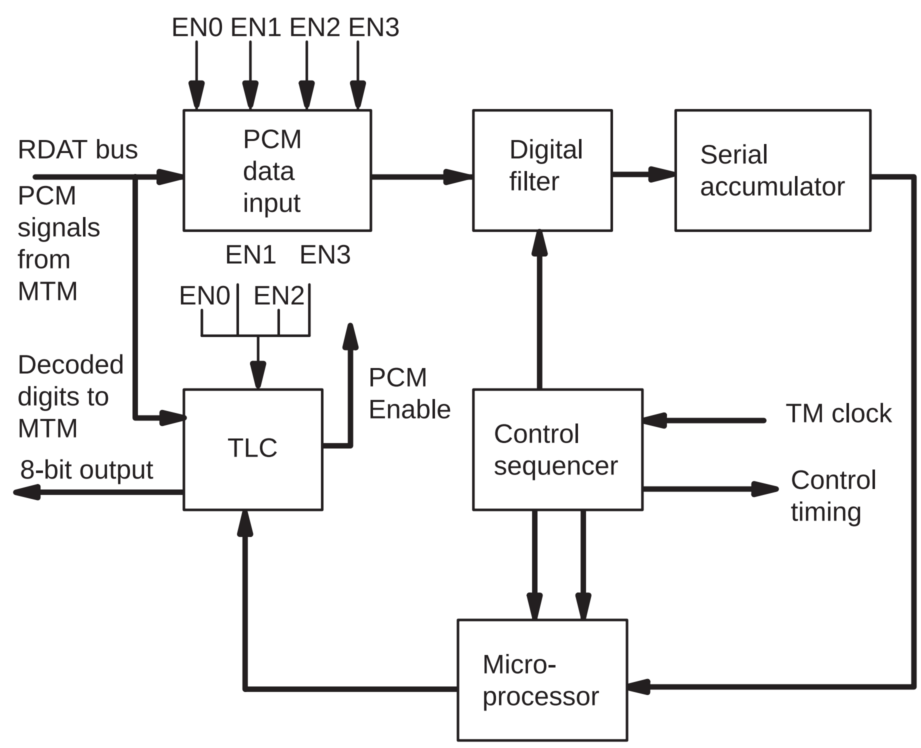
NT2X48BB Digital 4-Channel DTMF Receiver (single card position)

NT2X48CA A-law MF Receiver (international 2-card position)

NT2X48CB DT (Digitone) Receiver (British Telecom 2-card position)

The following figure diagrams MF and Digitone Receivers.

Figure 4-1
MF and Digitone receivers—block diagram



RDAT Receive data
PCM Pulse code modulation
EN Enable
MTM Maintenance trunk module
TLC Trunk logic circuit
TM Trunk module

Traffic capacity

The MF receivers and Digitone receivers, (all service circuits) are provisioned using Poisson tables.

Universal tone receivers

The universal tone receiver (UTR) is an optional card in the peripheral module (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 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.

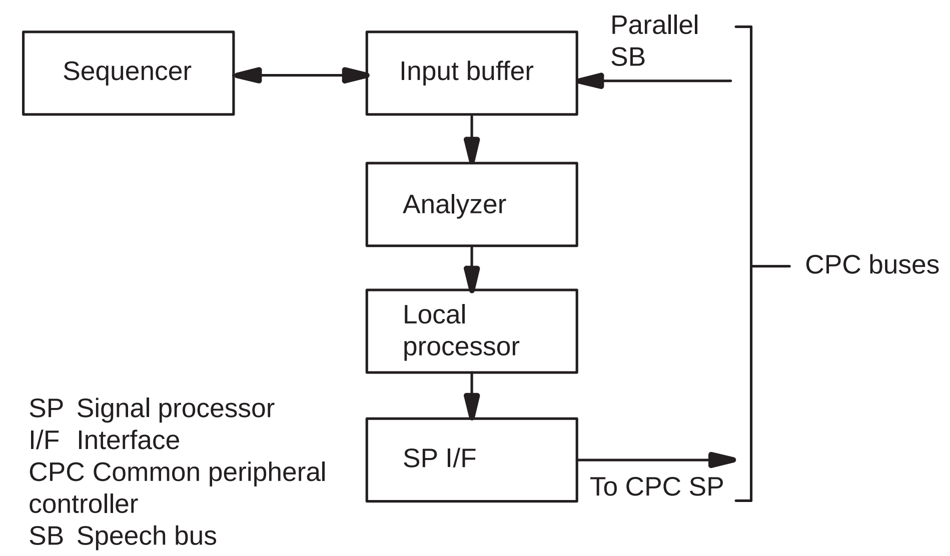
The UTR plugs into designated slots in any of the following configurations of the common peripheral controller shelves:

- LGC — line group controller
- LTC — line trunk controller
- DTC — digital trunk controller
- IDTC — international digital trunk controller

Physical capacity

Universal tone receivers (see the following figure) are provisioned on the basis of either one or two pairs of cards for each equipped peripheral module (30 or 60 channels).

Figure 4-2
Block diagram of the UTR



Traffic capacity

The UTR cards are engineered on the total number of CCS of traffic offered with a probability of delay over 3 seconds less than 0.010. Refer to the following table for the CCS capacity of the one pair of cards (30 receivers) and two pairs of cards (60 receivers) configurations.

Table 4-1
UTR ABSBH capacity (CCS

Number of Receivers	Capacity
30	675
60	1565

Note: Table based on Poisson theory with a probability of delay over 3 seconds < 0 .010

Monitoring service circuit capacity factors

The following table lists the operational measurements used to evaluate receiver capacity. The OM group RCVR applies to both the MF and Digitone receivers. A separate OM group (UTR) applies to the universal tone receivers. Sufficient studies should be taken to assure that the holding times and occupancy rates developed are not the result of any unusual occurrence in the office traffic load.

In addition to the OMs associated with receiver capacity performance, receivers are measured for dial tone delay by the dial tone speed recording (DTSR) OM group and incoming start-dial-delay by the the ISDD OM group. From the DTSR, dial tone delay (over 3 seconds) percentages are obtained. In a similar fashion, incoming start-dial-delay (over 3 seconds to attach a receiver) percentages are produced. Both of these measurements can be used to determine if receiver capacity is adequate to meet service objectives for current traffic and projected loads to the end of design date.

Receiver capacity factors

Holding times and percent occupancy are the most significant capacity factors of receivers. These factors should be studied on a regular basis to determine if the holding times are in the expected values used for provisioning the office. Significant increases may be due to unanticipated changes in the call mix. Occupancy rates that exceed the forecast may be due to calling growth rates increasing faster than expected. Holding times and occupancy rates that exceed the forecast reflect an increase in the number of delays greater than 3 seconds.

Table 4-2
Capacity indicators for DTMF, MF, and UTR receiver capacity

Operational measurements		**Log reports**
Group	**Register**	
RCVR	RCVMBU	None
	RCVOFL	None
	RCVQOCC	None
	RCVQOVFL	None
	RCVSBU	None
	RCVSZRS	None
	RCVTRU	None
UTR	UTRLDLYP	None
	UTROVFL	None
	UTRQOCC	None

—continued—

Table 4-2
Capacity indicators for DTMF, MF, and UTR receiver capacity (continued)

Operational measurements		Log reports
Group	**Register**	
	UTRQOVFL	None
	UTRRADA	None
	UTRSZRS	None
	UTRTRU	None
	UTRUDLYP	None
	—end—	

How to evaluate performance

Receivers should be studied during the component busy hour. Incoming and outgoing calls may have separate busy hours if the office traffic loads are affected by factors such as a business that receives large numbers of incoming calls due to the nature of the business.

Calculations used to evaluate performance

Calculations are included here to determine the percentage of the receiver capacity used and the overflow rates during the study period. These calculations apply to both MF and Digitone receivers and are the most significant measurements for the evaluation process. These are the measurements on which the engineering capacity tables are based. The

DTS, and ISDD percentages of delay results are computed automatically and require no further calculations.

$$\text{\% of receiver capacity used} = \frac{\text{Sum of the RCV traffic use)}}{\text{Engineered (MF or Digitone)capacity}} \times 100$$

$$\text{\% receiver overflow} = \frac{\text{RCVQOVFL}}{\text{RCVSZRS}} \times 100$$

Note: RCVSZRS does not include calls abandoned while in queue.

$$\text{\% UTR overflow} = \frac{\text{UTRQOVFL}}{\text{UTRSZRS}} \times 100$$

Note: UTRSZRS does not include calls abandoned while in queue.

Data evaluation procedure

The following procedure gives suggested steps to evaluate receiver capacity. This procedure may be applied to MF receivers, Digitone receivers, and UTRs.

Table 4-3
Evaluating dial tone delay and incoming start–dial–delay

Step	Action
1	Assure that all busied equipment has been returned to service. Contact maintenance and begin the study when all equipment is in service and functioning properly.
2	Collect data. Set OM schedule to collect receiver data during the office call busy hour. The hours may be different for originating and incoming traffic loads.

Table 4-3
Evaluating dial tone delay and incoming start–dial–delay (continued)

Step	Action
3	Compare dial tone delay and incoming start-dial-delay to objectives. If the objectives are being met for the design period, file the data for reference. If not, continue with step 4.
4	Calculate percentage of capacity usage. Using the appropriate formulas, calculate the percentage for MF and Digitone receivers.
5	Compare data to engineered criteria. Compare the percentage of capacity being used for each of the receiver types with the engineering criteria. Save the results.
6	Refer shortages to provisioning engineer. If sufficient studies have been taken to assure that the data are an accurate representation of the service being given by the receivers under study and there is a shortage or projected shortage indicated, report the shortage to the engineer for relief consideration (and forward study results).
	—end—

Announcement circuits

Announcement circuits for the DMS-100 are provided through the use of a special equipment shelf containing a digital recorded announcement machine (DRAM) located in a maintenance trunk module (MTM). The announcements are recorded on three different types of speech cards. The DRAM description and administration procedures are found in the *Translations Guide*.

Physical capacity

The DRAM shelf can contain various mixtures of the recorded announcement cards, but the total number of cards cannot exceed eight cards. Each of the cards can record approximately 31 seconds of speech. In most offices without Residential Enhanced Services (RES) features, one DRAM unit is sufficient. A second DRAM is recommended for reliability.

A DRAM can accommodate a maximum of eight RAM or EEPROM cards or a combination of both. A fully equipped DRAM can store up to 30 messages with a combined total length of up to 248 seconds recorded.

Residential services features that require pre-recorded DRAM messages include the following:

- Call Forwarding Remote Activation
- Customer Originated Trace (COT)

- Automatic Call Setup (AR/ACB)
- Screening List Editing (SLE) Services

Custom Local Area Signaling System (CLASS) features use both standard and custom announcements. Calling Number Delivery (CND), Calling Number Delivery Blocking (CNDB), and Customer Originated Trace use standard announcements (DRMTRK) that are broadcast announcements for up to 255 simultaneous connections from one access circuit. Automatic Recall (AR) and Automatic Callback (ACB) use custom announcements (DRMUSER) that are nonbroadcast. Custom announcements require provisioning access circuits on a usage basis. The number of DRAMS required for standard CLASS announcements is the greater of the following:

$$\frac{\text{Total announcements}}{30} = \text{Number of DRAMs (round up)}$$

$$\frac{\text{Total seconds of recording}}{248} = \text{Number of DRAMs (round up)}$$

$$\frac{\text{Total usage (CCS)}}{\text{Traffic capacity (CCS) per DRAM}} = \text{Number of DRAMs (round up)}$$

To support the custom announcements of the Phase 2 selective screening features, an office requires 3 additional DRAM shelves and a total of 12 PROM cards. If the maximum size of the screening lists is kept to 12 directory numbers (instead of 31), then only 2 shelves and 8 PROM cards are required.

Traffic capacity

Announcements that are broadcast onto the network and the number of simultaneous connections allowed is a datafilled value in table ANNS. The maximum number of simultaneous connections for any one announcement is 255. The maximum number of simultaneous connections (total of all announcements in one DRAM) in 16 port network subgroups is 512. In 8 port network subgroups (NT0X48 network) the maximum is 256. With these maximums all ports in the subgroup serving the DRAM must be deloaded or network blocking may result. The following tables show the capacity in CCS that various configurations of deloaded ports and numbers of announcements.

The design of the enhanced network allows for each of the 30 possible announcements on one DRAM to be set at the maximum 255 simultaneous connections with no blocking introduced. Therefore, maximum simultaneous connections to one DRAM in the enhanced network (ENET) is 7,650 (255 x 30 announcements).

Note: Blocking in the ENET is avoided as long as the physical limitations of the network are not exceeded. Each simultaneous broadcast connection takes one time slot. Therefore, the total number of time slots required for broadcast announcements plus those required for other traffic should not exceed the total number of time slots provided

Table 4-4
Total DRA traffic (CCS) for NTOX48 network

Number of ports deloaded per NSG	Number of digital broadcast announcement channels			
	8	16	24	30
0	480	590	680	740
1	1180	1290	1380	1440
2	1880	1990	2080	2140
3	2580	2690	2780	2840
4	380	3390	3480	3540
5	3980	4090	4180	4240
6	4680	4790	4880	4940
7	5380	5490	5580	5640

Table 4-5
Total DRA traffic (CCS) for NT5X13 networkName of table

Number of ports deloaded per NSG	Number of digital broadcast announcement channels			
	8	16	24	30
0	950	1110	1240	740
1	1650	1810	1940	1440

—continued—

Table 4-5
Total DRA traffic (CCS) for NT5X13 networkName of table (continued)

Number of ports deloaded per NSG	8	16	24	30
2	2350	2510	2640	2730
3	3050	3210	3340	3430
4	3750	3910	4040	4130
5	4450	4610	4740	4830
6	5150	5310	5440	5530
7	5850	6010	6140	6230
8	6550	6710	6840	6930
9	7250	7410	7540	7630
10	7950	8110	8240	8330
11	8650	8810	8940	9030
12	9350	9510	9640	9730
13	10050	10210	10340	10430
14	10750	10910	11040	11130
15	11450	11610	11740	11830

—end—

Monitoring announcement capacity factors

When a call is directed to the DRAM, availability of the proper announcement is the most important measure of the announcement capacity. Therefore, attempts to connect to an announcement and any resulting overflows are significant indicators of how well the announcements are providing the required information to the subscribers.

Announcement overflows

Announcement overflow counts are part of the OM group ANN. The OM group and related registers are shown in the following table.

Table 4-6
Announcement circuit capacity indicators

Operational measurements		Log reports
Group	**Register**	
ANN	ANNATT	LINE 138
		TRK138
ANN	ANNOVFL	None

Calculations used to evaluate performance

The calculation required to determine the percentage of announcement overflow is as follows:

$$\text{Announcement \% overflow} = \frac{\text{ANNOVFL}}{\text{ANNATT}} \times 100$$

Data evaluation procedure

The following procedure outlines steps to evaluate announcement overflows.

Table 4-7
Evaluating announcement overflows

Step	Action
1	Assure that all busied equipment has been returned to service. Contact maintenance and begin the study when all equipment is in service and functioning properly.
2	Collect data. Set OM schedule to collect receiver data during the office call busy hour. The hours may be different for originating and incoming traffic loads.
3	Compare the overflow rate to the established engineered overflow criteria. If the objectives are being met for the design period, file the data for reference. If not, continue with step 4.

—continued—

Table 4-7
Evaluating announcement overflows (continued)

Step	Action
4	Consider increasing the maximum number of allowed simultaneous connections. Keep in mind that the total number of simultaneous connections for all announcements should not exceed 70 to 80 percent of the number of CPWAKEUPS. The total simultaneous connections for all announcements should not exceed the number of time slots available for announcements in the network subgroup (dependent on type of network and number of deloaded network ports in the subgroup that serves the DRAM). If the announcement is already set at maximum, go to Step 5.
5	Refer shortages to provisioning engineer. If sufficient studies have been taken to assure that the data are an accurate representation of the service being given by the announcement(s) under study and there is a shortage or projected shortage indicated, report the shortage to the engineer for relief consideration (and forward study results).
	—end—

Tone circuits

The DMS-100 provides a wide variety of tone treatments. These tones are typically provided in the peripheral modules (for example, the MTM). Tone generator circuit cards provide the tones as required; for example, the NT3X68 card provides tones for general purposes that include the following:

- permanent signal
- conference calling
- DTMF signaling
- call waiting

In general, it is expected that if sufficient tone capacity is provided, then no shortage will exist and no overflows would be encountered under normal circumstances. To determine which tones are provided, refer to the translations tables: TONES, STN (special tones), and SVRCKT (service circuits).

Operational measurements are provided for tones and special tones. Some of the tone types are registered in both OM groups. Tones that reside in an MTM are measured in OM group STN and may also score registers in the TONES OM group.

Table 4-8
Tones and operational measurements

OM group	Tones measured
STN	Call Waiting (CWT)
	Distinctive Call Waiting (DISCWT)
	Executive Busy Override (EBOT)
	Expensive Route Warning (ERWT)
	MDC Busy Verification (BVTONE)
	Off-hook Queuing (OHQT)
	Preset Conference Normal Notification (PCNOR)
	Preset Conference Precedence Notification (PCALR)
	Receiver Off-hook (ROH)
TONES	MDC Busy Verification (BVTONE)
	Call Waiting (CWT)
	Distinctive Call Waiting (DISCWT)
	Executive Busy Verification (EBOT)

Note: The STN OM group provides information about special tones that are broadcast from trunk cards in the maintenance trunk modules. Some counts are duplicated in the STN and TONES OM groups.

—continued—

Table 4-8
Tones and operational measurements (continued)

OM group	Tones measured
	Enhanced Call Waiting Tone for the First Secondary Directory Number (ENHCWT1)
	Enhanced Call Waiting Tone for the Second Secondary Directory Number (ENHCWT2)
	Enhanced Call Waiting Tone for the Third Secondary Directory Number (ENHCWT3)
	Expensive Route Warning (ERWT)
	Digital Outpulsing Circuit (SVDTMF)
	Off-hook Queuing (OHQT)
	Preset Conference Normal Notification (PCNOR)
	Preset Conference Precedence Notification (PCALR)
	Receiver Off-hook (ROH)
	R–2 Inter–register Signaling Circuit (SVMFC)
	Service Observing Circuit (SVOBSV)

Note: The STN OM group provides information about special tones that are broadcast from trunk cards in the maintenance trunk modules. Some counts are duplicated in the STN and TONES OM groups.

—end—

Physical capacity

The physical capacities for tone cards may vary and the number of circuits provided for each card should be determined by reference to *DMS 100 Provisioning Manual*. In addition, each of the controllers has 4 ports (of the 20 ports available) that are dedicated to tones.

Traffic capacity

Tone generators requirements are determined by a variety of calculations which are described in *DMS 100 Provisioning Manual*.

Monitoring tones capacity factors

Because overflows to tone circuits are not expected, tones are only monitored to become aware of any unusual condition that will cause overflows to occur. Tone circuit capacity is usually engineered based on Poisson table capacity values with acceptable overflow rates determined by the operating company.

Tone overflow rate

The rate at which requests for tones are sent to an overflow condition is determined by the OMs shown in the following table.

Table 4-9
Performance indicators for tone circuit capacity

Operational measurements		Log reports
Group	**Register**	
TONES	TONEATT	None
	TONEOVFL	None
STN	STNATTS	None
	STNOVFL	None

Calculations used to evaluate performance

The following calculations are used to evaluate tone overflow performance:

$$\%\ \text{tone overflow} = \frac{\text{TONEOVFL (designated tone)}}{\text{TONEATT (designated tone)}} \times 100$$

or

$$\%\ \text{tone overflow} = \frac{\text{STNOVFL (designated tone)}}{\text{STNATT (designated tone)}} \times 100$$

Data evaluation procedure

Suggested steps to evaluate tone capacity are shown in the following procedure.

Table 4-10
Evaluating tone capacity

Step	Action
1	Assure that all busied equipment has been returned to service. Contact maintenance and begin the study when all equipment is in service and functioning properly.
2	Collect data. Set OM schedule to collect tone data during the office call busy hour. The hours may be different for originating and incoming traffic loads.
3	Determine if overflows registered. If overflows have registered, check other office data to see if any unusual overload or maintenance condition occurred during the study period. If it did, discount the study and take a subsequent study. If no unusual event occurred, save the data and take another study to determine if the condition is repeated. If the condition continues, go to Step 4.
5	Refer shortages to provisioning engineer. If sufficient studies have been taken to assure that the data are an accurate representation of the service being given by the tones under study and there is a shortage or projected shortage indicated, report the shortage to the engineer for relief consideration (and forward study results).

Conference circuits

Conference circuits in the DMS-100 include 3-port and 6-port configurations. The 3-port circuits are used for three-party conference functions. The 6-port circuits provide a conference facility on a single card. Up to five conference circuits can be connected in tandem to permit conference connections for 3 through 26 parties.

Features that use 3-port conference circuits include the following:

- Meridian Digital Centrex (MDC) features
  - Call Transfer
  - Add-on
  - Three-Way Call Chaining
- Plain ordinary telephone service (POTS) features
  - Three-Way Calling
  - Local Coin Overtime
  - Three-Way Call Chaining
- Traffic Operator Position System (TOPS) features
  - Automated Alternate Call Billing (AABS)

— Automatic Coin Toll Services (ACTS)

Note: There is also a requirement of one 3-port conference circuit for each working TOPS position. Therefore, 36 CCS for each working TOPS position must be considered when determining 3-port usage requirements.

Physical capacity

The 3-port card occupies one card position in the MTM or trunk module (TM) and requires six trunk appearances. The 6-port card also requires one card position in the MTM or TM and requires six 4-wire PCM trunk appearances.

Traffic capacity

Three-port conference circuit provisioning is based on average busy season busy hour CCS expected load. The blocking probabilities are operating company defined (for example, P.01, P.001).

Six-port conference circuit provisioning is based on the expected number of high day simultaneous conferences.

Monitoring conference circuit capacity factors

The capacity factors related to conference circuits are the number of overflows occurring because the conference circuits are full and the conference circuit usage measured in CCS values (scan rate 10 seconds) compared to the engineered values.

Overflow rate

The following table lists the operational measurements used to determine the overflow rate for 3-port conference circuits and 6-port conference circuits.

Table 4-11
Performance indicators for conference circuit capacity

Operational measurements		Log reports
Group	**Register**	
CF3P	CNFOVFL	None
CF3P	CFNSZRS	None
CF6P	CF6OVFL	None
CF6P	CF6SZRS	None

How to evaluate performance

The operating company sets the acceptable rates of overflow for conference circuits. The administrator needs to know this information to make comparisons of these acceptable rates with the actual rates recorded during the study period.

Calculations used to evaluate performance

The following calculations are used to determine the overflow rates for 3-port and 6-port conference circuits:

$$\%\ \text{3-port overflow} = \frac{\text{CFNOVFL}}{\text{CFNSZRS}} \times 100$$

$$\%\ \text{6-port overflow} = \frac{\text{CF6OVFL}}{\text{CF6SZRS}} \times 100$$

Traffic usage of 3- and 6-port conference circuits is recorded in the following registers:

- 3-port conference circuit traffic usage is recorded in register CNFTRU for a non-TOPS environment and CNFTRUT in a TOPS environment
- 6-port conference circuit traffic usage is recorded in register CF6TRU

Data evaluation procedure

Suggested steps to evaluate the conference circuit overflow rate are shown in the following procedure.

Table 4-12
Evaluating conference circuit overflows

Step	Action
1	Assure that all busied equipment has been returned to service. Contact maintenance and begin the study when all equipment is in service and functioning properly.
2	Collect data. Set OM schedule to collect conference circuit data during the office call busy hour. The hours may be different for originating and incoming traffic loads.

—continued—

Table 4-12
Evaluating conference circuit overflows

Step	Action
3	Determine if overflows registered. If overflows have registered, check other office data to see if any unusual overload (nonrecurring) or maintenance condition occurred during the study period. If it did, discount the study and take a subsequent study. If no unusual event occurred, go to Step 4.
5	Refer shortages to provisioning engineer. If sufficient studies have been taken to assure that the data are an accurate representation of the service being given by the conference circuits under study and there is a shortage or projected shortage indicated, report the shortage to the engineer for relief consideration. Forward study results to the appropriate engineer.
	—end—

Conference circuit use

The following table lists the operational measurements used to determine and evaluate conference circuit use.

Table 4-13
Performance indicators for conference circuit use

Operational measurements		Log reports
Group	**Register**	
CF3P	CNFTRU	None
CF3PT	CNFTRUT	None
CF6P	CF6TRU	None

How to evaluate conference circuit use

Conference circuit use is measured in CCS and records the time that the conference circuits are busy.

Data evaluation procedure

Suggested steps to evaluate the conference circuit use are shown in the following procedure.

Table 4-14
Evaluating conference circuit use

Step	Action
1	Assure that all busied equipment has been returned to service. Contact maintenance and begin the study when all equipment is in service and functioning properly.
2	Collect data. Set OM schedule to collect 3–port and 6–port conference circuit data during the office call busy hour.
3	Compare the total busy hour CCS use to the engineered busy hour use forecast. If the use exceeds the engineered forecast value or is near the engineered level and the overflow rate exceeds the objective service level, go to Step 4. If not, file the results for later reference or trending of results.
4	Refer shortages to provisioning engineer. If sufficient studies have been taken to assure that the data is an accurate representation of the service being given by the conference circuits under study and there is a shortage or projected shortage indicated, report the shortage to the engineer for relief consideration (and forward study results).

Administering trunk peripheral capacity

Understanding trunk peripheral capacity

Trunk peripherals in the DMS-100 include the trunk module (TM), the digital trunk controller (DTC), and the line trunk controller (LTC). The LTC is described in this chapter.

Because the trunk peripherals have as many paths outgoing as incoming, there is no concentration; therefore, there is no blocking encountered due to the unavailability of paths. Since there is no blocking, this chapter describes only the physical capacity of the trunk modules. Administration of capacity beyond the limitation of the physical terminations of the trunk modules is in the area of trunk servicing, which is an operating company function and administered under operating company grade of service guidelines, for example, blockage probability rates (Poisson tables) of P.01 or P.001. The operational measurement group TRK provides information on each trunk group in the form of seizure attempts, seizure failures, total trunk usage, and busy state usage.

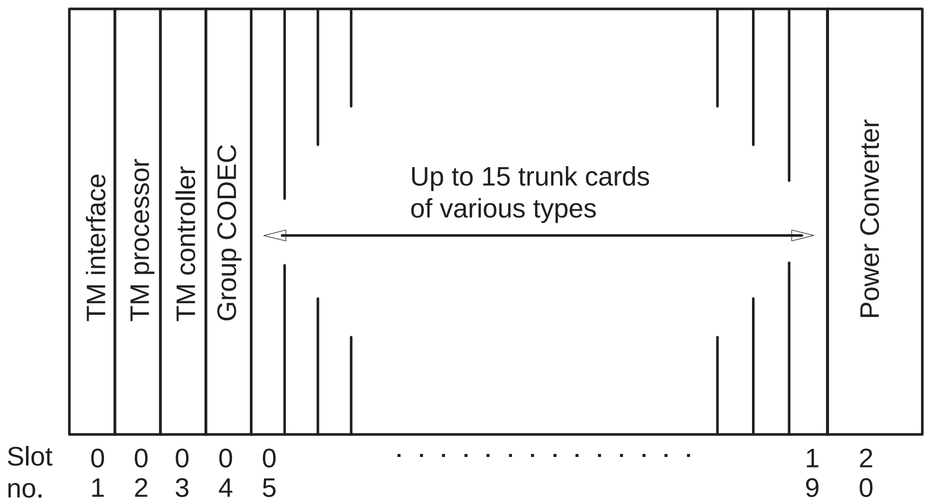
Trunk module

The trunk module is an equipment shelf, located in a trunk module equipment frame, which provides speech and signaling interfaces between one network port and thirty analog trunks. The trunk module contains common speech and data buses which carry 30 channels of speech and data converted from analog signals.

Physical capacity

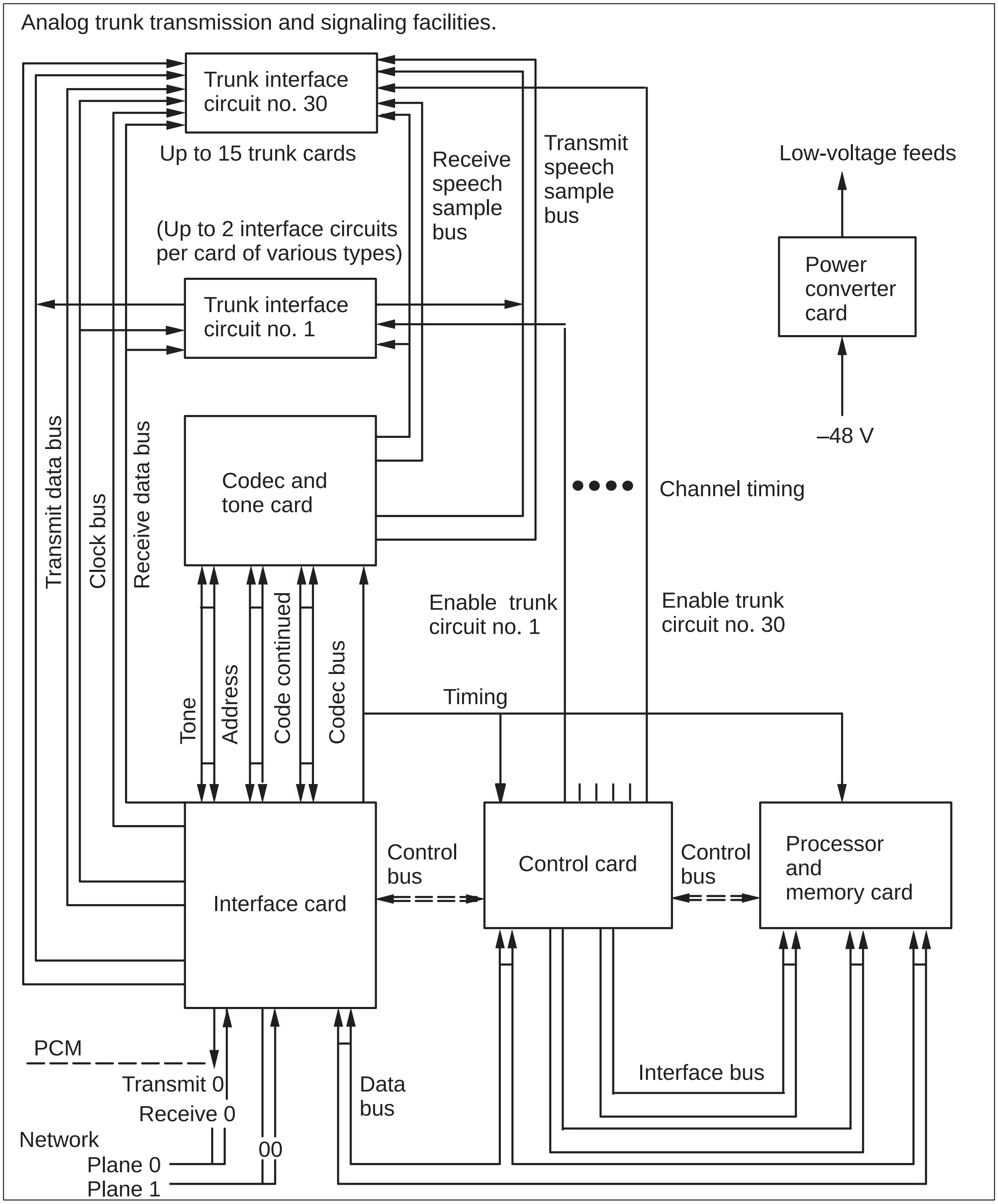
The trunk module contains a common control section and up to 15 interchangeable trunk interface cards of various types (see the two following figures). Each trunk card contains one or two trunk interface circuits that are selected to match the speech transmission characteristics and signaling methods of the trunk facility connected to it.

Figure 5-1
Trunk module shelf layout and card complement (front view)



Slot	NT PEC	Remarks
01	2X45AB	TM interface (to network)
02	0X70AA	TM processor
03	2X53AA	TM control
04	2X59AA	Group CODEC
05	-	
to	-	
19	-	Trunk circuit cards
20	2X09AA	Power converter

Figure 5-2
Trunk module block diagram



Digital trunk controller

The DTC is a peripheral that replaced the digital carrier module (DCM). The DTC is a fully duplicated peripheral module used to connect digital trunks. The DTC connects a minimum of one (24 channels) to a maximum of twenty (480 channels) digital carrier systems. The network side of the DTC is connected with a minimum of four (120 channels) to a maximum of sixteen (480 channels) DS30 links.

Because the DTC has 480 channels incoming and outgoing, it is nonconcentrating. Provisioning is based on physical trunk terminations. However, if the majority of the calls processed have very short holding times, and the call rate is high, the DTC can become real-time limited. When the capacity is attempt-limited (or real-time limited) the total number of trunks that can be served is reduced to a number less than the 480 physical trunk termination capacity.

Operational measurements used to evaluate capacity

Table 6-1
Capacity operational measurements

Operational Measurement	Description
ANN (OM group)	Purpose: ANN provides information on traffic for recorded announcement machines. ANN contains two peg registers: ANNATT and ANNOVFL, and three usage registers: ANNTRU, ANNSBU, and ANNMBU. The scan rate for the usage registers is slow (100 seconds). BCS history: ANN was created prior to BCS20.

—continued—

Table 6-1
Capacity operational measurements (continued)

Operational Measurement	Description
ANN_ANNATT	Announcement attempts: This register counts the number of calls that are routed to an announcement. This count is available for each announcement type and counts both single attempts and all simultaneous connections. BCS history: ANNATT was created in BCS20. Associated registers: • OFZ_INANN counts calls that originate on a trunk and are initially routed to an announcement. • OFZ_ORIGANN counts calls that originate on a line and are initially routed to an announcement. • OTS_ORIGTRMT counts calls that originate on a line and are connected to a tone or an announcement. • OTS_INCTRMT counts calls that originate on a trunk and are routed to a tone or an announcement. • TONES_TONEATT counts attempts to connect to a tone generator. Associated logs: • LINE138 is generated if a call is routed to a treatment after being call-processing busy. • TRK138 is generated if a call is routed to a treatment after being call-processing busy.
ANN_ANNOVFL	Announcement overflow: This register counts calls that are routed to a recorded announcement, but fail to connect to the announcement because the maximum number of calls are connected, or the announcement is maintenance-busy. ANNOVFL does not count the number of calls that overflow due to network blockage. BCS history: ANNOVFL was created before BCS20. Associated registers: None Associated logs: None

—continued—

Table 6-1
Capacity operational measurements (continued)

Operational Measurement	Description
CF3P (OM group)	3-port conference circuits: 3-port conference circuits are requested by lines using the three-way calling feature, calls to service analysis positions on activation of the position, and trunk test positions, when a request to monitor talking has been issued. The registers in CF3P provide information on the use of 3-port conference circuits, including the number of times that a circuit is seized, the number of times that a circuit is unavailable, and the number of queue overflows and abandons. There are two variations of registers in the CF3P OM group. The first variation is applicable to non-TOPS environments. Eight registers are provided with this group. The second variation is applicable to TOPS offices with toll and combined local/toll. Eleven registers are provided with this group. BCS history: CF3P was created prior to BCS20.
CF3P_CNFOVFL	CF3P overflows: This register counts the number of requests for a 3-port conference circuit that cannot be satisfied immediately because all conference circuits are busy. BCS history: CFNOVFL was created prior to BCS20. Associated registers: None Associated logs: ATB100.
CF3P_CFNSZRS	CF3P seizures: This register is scored when a circuit is assigned in response to a request for a 3-port conference circuit. The register is scored before any attempt to set up network paths to the 3-ports. BCS history: CNFSZRS was created prior to BCS20. Associated registers: None Associated logs: None

—continued—

Table 6-1
Capacity operational measurements (continued)

Operational Measurement	Description
CF3P_CNFTRU	CF3P traffic busy usage: This register records whether conference circuits are call processing busy, deloaded, or locked out. Scan rate is 10 seconds. BCS history: CNFTRU was created prior to BCS20 Associated registers: None Associated logs: None
CF6P_CNFOVFL	CF6P overflows: This register counts the number of requests for a 6-port conference circuit that cannot be satisfied immediately because all conference circuits are busy. BCS history: This register was created prior to BCS20. Associated registers: None Associated logs: ATB100.
CF6P_CFNSZRS	CF6P seizures: This register counts calls that successfully seize a 6-port conference circuit. BCS history: CFN6SZRS was created prior to BCS20 Associated registers: None Associated logs: None
CF6P_CF6PTRU	CF6P traffic usage busy: This register records whether conference circuits are call processing busy, deloaded, or locked out. Scan rate is 10 seconds. BCS history: CF6PTRU was created prior to BCS20 Associated registers: None Associated logs: None

—continued—

Table 6-1
Capacity operational measurements (continued)

Operational Measurement	Description
CPUSTAT (OM group)	This OM group provides information on central processing unit (CPU) occupancies. Ten registers record the following CPU occupancies: • call processing • call processing occupancy available • scheduler • system operations • critical system maintenance • network operating system (NOS) file transfer • operational measurements • guaranteed terminals • non–guaranteed processes and processes that can be deferred • idler
CPUSTAT_CCPAVAIL	CPU call processing occupancy available: This register records the percentage of CPU time still available for call processing. At the beginning of the transfer period, CCPAVAIL is initialized to the current value of CPU time still available for call processing. CCPAVAIL accumulates the values for CPU time still available as they are updated at one-minute intervals. The average CPU time available for call processing for one minute is obtained by dividing the holding register value by the transfer period (in minutes). BCS history: CCPAVAIL was created in BCS25. Associated OMs: None Associated logs: None

—continued—

Table 6-1
Capacity operational measurements (continued)

Operational Measurement	Description
CPUSTAT_CPSBKG	CPU status background occupancy: This register records the percentage of CPU time being used for the following processes: the log system, audits, noncritical system maintenance, non–guaranteed MAPs, OM accumulation, and reporting. The average CPU background occupancy for one minute is obtained by dividing the holding register value by the transfer period (in minutes). BCS history: CPSBKG was created prior to BCS25. Associated OMs: None Associated logs: None
CPUSTAT_CPSCPOCC	CPU status call processing occupancy: This register records the percentage of CPU time being used for call processing. Included are the following scheduler classes: high-priority call processing, call processing, and work that can be deferred. The average occupancy for one minute is obtained by dividing the holding register value by the transfer period (in minutes). BCS history: CPSCPOCC was created in BCS25. Associated logs: None
CPUSTAT_CPSDNC	CPU status dynamic network controller occupancy: This register records the percentage of CPU time being used for NOS processes that communicate with the dynamic network controller (DNC). The value recorded is referred to as DNC occupancy. The CPU occupancy consists of processes in the NOS file transfer scheduler class. The average occupancy for one minute is obtained by dividing the holding register value by the transfer period (in minutes). BCS history: CPSDNC was created in BCS25. Associated OMs: None Associated logs: None

—continued—

Table 6-1
Capacity operational measurements (continued)

Operational Measurement	Description
CPUSTAT_CPSFORE	CPU status foreground occupancy: This register records the percentage of CPU time being used for system operations (foreground). Foreground consists of processes in the System 7 and System 6 scheduler classes. BCS history: CPSFORE was created in BCS25. Associated OMs: None Associated logs: None The average occupancy for one minute is obtained by dividing the holding register value by the transfer period (in minutes).
CPUSTAT_CPSGTERM	CPU status guaranteed terminal occupancy: This register records the percentage of CPU time being used for guaranteed MAP positions, guaranteed log devices, and the login process. BCS history: CPSGTERM was created in BCS25. Associated OMs: None Associated logs: None The average occupancy for one minute is obtained by dividing the holding register value by the transfer period (in minutes).
CPUSTAT_CPSIDLE	CPU status guaranteed terminal occupancy: This register records the percentage of CPU time being used for guaranteed MAP positions, guaranteed log devices, and the login process. BCS history: CPSGTERM was created in BCS25. Associated OMs: None Associated logs: None The average occupancy for one minute is obtained by dividing the holding register value by the transfer period (in minutes).

—continued—

Table 6-1
Capacity operational measurements (continued)

Operational Measurement	Description
CPUSTAT_MAINT	CPU status maintenance occupancy: This register records the CPU time being used for critical system maintenance processes. The CPU maintenance consists of processes in the maintenance scheduler class. BCS history: MAINT was created in BCS25. Associated OMs: None Associated logs: None The average occupancy for one minute is obtained by dividing the holding register value by the transfer period (in minutes).
CPUSTAT_CPSOM	CPU status operational measurements occupancy: This register records the CPU time being used for operational measurement processes. The CPU OM occupancy consists of processes in the guaranteed and non–guaranteed OM scheduler classes. BCS history: CPSOM was created in BCS25. Associated OMs: None Associated logs: None The average occupancy for one minute is obtained by dividing the holding register value by the transfer period (in minutes).
CPUSTAT_CPSSCHED	CPU status scheduler occupancy: This register records the percentage of CPU time that the scheduler is in use. BCS history: CPSSCHED was created in BCS25. Associated OMs: None Associated logs: None The average occupancy for one minute is obtained by dividing the holding register value by the transfer period (in minutes).

—continued—

Table 6-1
Capacity operational measurements (continued)

Operational Measurement	Description
LMD	Line module traffic: This OM group provides information on traffic for the following peripherals: • line modules (LM) • remote line modules (RLM) • line concentrating modules (LCM) • remote concentrating terminals (RCT) • remote concentrator subscribers (RCS) • digital line modules (DLM) • enhanced line concentrating modules (LCME) • Integrated Services Digital Network line concentrating module (LCMI) BCS history: This OM group was created prior to BCS20.
LMD_LMTRU	Traffic busy usage: This register records line use by recording the number of lines that are in line_cp_busy and line_cp_busy_deload states. The scan rate is 100 seconds. BCS history: This register was created prior to BCS20.
LMD_MADNTATT	Multiple appearance directory number (MADN) secondary member terminating attempts: This register counts secondary MADN groups in the line module that are notified of an incoming call. This register does not count recalls or re–rings of a group member. BCS history: MADNTATT was created prior to BCS20. Associated registers: None Associated logs: None

—continued—

Table 6-1
Capacity operational measurements (continued)

Operational Measurement	Description
LMD_NORIGATT	Originating attempts: This register counts originating call attempts that are reported by the line module to the central control. The count includes attempts to originate a 3-way call. BCS history: NORIGATT was created prior to BCS20. Associated registers: • OFZ_NORIG counts originating call attempts that are recognized by the central control. • OTS_NORG counts originating call attempts that are recognized by the central control. • ORIGBLK counts originating call attempts that fail because there is no idle path from the originating line module to the network Associated logs: None
LMD_NTERMATT	Terminating attempts: This register counts the attempts to find an available speech link from the network to a terminating line after call processing has determined that the terminating line is available. This count includes call-waiting calls that are rung through upon termination of the earlier conversation, and calls that are answered by the secondary member of a MADN group. BCS history: This register was created prior to BCS20. Associated registers: • OFZ_TRMNWAT counts attempts to find a speech path to a terminating line. • SOTS_STRMNWT counts attempts to find a speech path to a terminating line. Associated logs: None

—continued—

Table 6-1
Capacity operational measurements (continued)

Operational Measurement	Description
LMD_ORIGABN	Originating abandons before connection: ORIGABN counts originating call attempts that are abandoned by the customer before call setup is complete. BCS history: ORIGABN was created prior to BCS20. Associated registers: • OFZ_ORIGABDN counts originating call attempts that are abandoned by the subscriber before the call is routed. • OTS_ORGABND counts originating call attempts that are abandoned by the subscriber before the call is routed. Associated logs: • LINE106 is generated when trouble is encountered during dial pulse reception on a line. • LINE108 is generated when trouble is encountered during Digitone reception on a line.
LMD_ORIGBLK	Originating blocking: This register counts originating calls that fail because there is no idle path from the originating line module to the network. The peripheral module originates the call again as long as the caller stays off–hook. BCS history: ORIGBLK was created prior to BCS20. Associated registers: OFZ_ORIGLKT counts originating call attempts that fail and are routed to lock-out, but are not connected or routed to treatment. Associated logs: NET130 is generated when a network path cannot be found.

—continued—

Table 6-1
Capacity operational measurements (continued)

Operational Measurement	Description
LMD_ORIGFAIL	Originating attempt failures: This register counts the originating call attempts that fail for one of the following reasons: • not enough digits are sent before time-out occurs (partial dial) • no digits are sent before time-out occurs (permanent signal) • extra digits or bad tones are sent • two Digitone frequencies that have more than a 6 decibel spread between them are generated • an unexpected message type (for example, a test failure) is received from a peripheral module during automatic number identification (ANI) testing on recordable calls BCS history: ORIGFAIL was created prior to BCS20. Associated registers: • TRMTCM_TCMPSIG counts call that are routed to permanent signal time-out (PSIG). • TRMTCM_TMCPDIL counts calls that are routed to partial dial time-out (PDIL). • TRMTER_TERRODR counts calls that are routed to reorder (RODR). Associated logs: • AMAB151 • LINE108 • LINE109 • LINE120 • LINE138 • LINE104 • LINE105 • LINE106

—continued—

Table 6-1
Capacity operational measurements (continued)

Operational Measurement	Description
LMD_PERCLFL	Terminating call attempt failures: This register counts calls that cannot successfully terminate to a line because of problems in ringing the terminating line. If the office parameter PER_CALL_GND_LOOP_TEST in table OFCVAR is set to Y, PERCLFL also includes loop faults detected during attempted terminations on ground start lines. BCS history: PERCLFL was created prior to BCS20. Associated registers: TRMTER_TERSYFL counts calls that are routed to system failure (SYFL) treatment because of a software or hardware failure in the switching unit. Associated logs: • LINE107 • LINE110 • LINE113
LMD_REVERT	Revertive call attempts: This register counts revertive calls initiated on a line module. This register is scored when ringing starts, after the caller has gone on-hook for the first time. BCS history: REVERT was created prior to BCS20. Associated registers: None Associated logs: LINE138

—continued—

Table 6-1
Capacity operational measurements (continued)

Operational Measurement	Description
LMD_TERMBLK	Terminating blocking: This register counts attempts to find a speech link from the network to a terminating line that fail for one of the following reasons: • no speech links are available from the network to a terminating line • no match can be found between an idle channel on the links to the network and an idle channel on the link shelf serving the terminating line BCS history: TERMBLK was created prior to BCS20. Associated registers: None Associated logs: NET130
OFZ (OM group)	The OFZ OM group provides information for traffic analysis. It summarizes the composition of traffic that arrives at an office, initial routing, and routing of outgoing traffic. Registers count calls depending on the source of the call (trunk or line) and the intended destination (rather than the actual destination). This is referred to as as a primary route scoring philosophy. BCS history: This OM group was created in BCS20.
OFZ-INTRM	Incoming to terminating: This register counts incoming calls that are routed to a line. BCS history: This register was created in BCS20. Associated registers: None Associated logs: None

—continued—

Table 6-1
Capacity operational measurements (continued)

Operational Measurement	Description
OFZ_NIN	Number of incoming calls: This register counts incoming calls that are recognized by the central controller (CC). The intended destination of the call is a line, trunk, announcement, or tone. NIN counts calls after a call condense block and a call process are obtained, but before in-pulsing is set up. BCS history: This register was created prior to BCS20. Associated registers: NIN counts each incoming call. Each call is then counted according to destination: • INOUT if the destination is a trunk • INANN if the destination is an announcement • TONE if the the destination is a tone • INLKT if the call is locked out • INTRM if the destination is a line • INABNC if the call is abandoned by the subscribe • INABNM if the call is abandoned by the machine Associated logs: None
OFZ_NORIG	Number of originating calls. This register counts originating calls that are recognized by the CC. BCS history: This register was created prior to BCS20. Associated registers: • ORIGOUT if the destination is a trunk • ORIGTRM If the destination is a line • ORIGANN if the destination is an announcement • ORIGTONE if the destination is a tone • ORIGLKT if the call is locked out • ORIGABDN if the call is abandoned Associated logs: None

—continued—

Table 6-1
Capacity operational measurements (continued)

Operational Measurement	Description
OFZ_TRMBLK	Terminating blocks: This register counts attempts that fail to obtain a voice path to a terminating line because no free channel can be found between the host network and the terminating line. More than one failed attempt may occur and be counted if the call is to a member of a hunt group. Each attempt will also be counted in OFZ registers TRMMFL and TRMNWAT, and in LMD registers NTERMATT and TERRMBLK for the terminating line control device. BCS history: This register was created prior to BCS20. Associated registers: The relationship between OFZ_TRMBLK and LMD_TERMBLK is: OFZ_TRMBLK = LMD_TERMBLK (for all line modules) Associated logs: • NET130 is generated if the system cannot find a network path. • TRK138 is generated if a call is routed to treatment after being call-processing busy. • LINE138 is generated if a call is routed to treatment after being call-processing busy.

—continued—

Table 6-1
Capacity operational measurements (continued)

Operational Measurement	Description
OFZ_TRMMFL	Terminating match failures: This register counts failed attempts to find a voice path to a terminating line. More than one attempt may be counted to a member in a hunt group. BCS history: This register was created prior to BCS20. Associated registers: The relationship between TRMMFL and SOTS_STRMMFL is: OFZ_TRMMFL = SOTS_STRMMFL. Associated logs: • NET130 is generated if the system cannot find a network path. • TRK138 is generated if a call is routed to treatment after being call-processing busy. • LINE138 is generated if a call is routed to treatment after being call-processing busy.
RCVR (OM group)	Receiver service circuits: This OM group counts successful and failed attempts to obtain receiver circuits. BCS history: This register was created prior to BCS20.
RCVR_RCVMBU	Receiver manual busy usage: This register records usage generated by receivers manually removed from service and receivers seized for manual or system action. BCS history: This register was created prior to BCS20. Associated registers: None Associated logs: None

—continued—

Table 6-1
Capacity operational measurements (continued)

Operational Measurement	Description
RCVR_RCVOFL	Receiver overflows: This register counts requests for a receiver that cannot be satisfied because all receivers are busy. When the receivers are all busy, the request attempts to enter the waiting queue. BCS history: This register was created prior to BCS20. Associated registers: RCVR_RCVOVFL - RCVR_RCVQOVFL = Calls entering the wait queue. Associated logs: None
RCVR_RCVQOCC	Receiver queue occupancy: This register records whether there are receiver requests in the wait queue. BCS history: This register was created prior to BCS20. Associated registers: None Associated logs: None
RCVR_RCVQOVFL	Receiver queue overflow: This register is scored when a request for a receiver fails when it attempts to enter the wait queue. The size of the wait queue is equal to the number of receivers that are datafilled in table RECEIVER, except for Digitone receivers. The size of the wait queue for Digitone receivers is equal to half the number datafilled in table RECEIVER or 100, whichever is less. BCS history: This register was created prior to BCS20. Associated registers: TRK_INFAIL counts incoming calls overflow from the receiver queue that are routed to NOSC treatment. Associated logs: None

—continued—

Table 6-1
Capacity operational measurements (continued)

Operational Measurement	Description
RCVR_RCVSBU	Receiver system busy: This register records receiver use caused by trunks that are: • removed from service by system maintenance • not available to traffic because the associated peripheral modules are out of service • slated for use by maintenance after call processing, but available now BCS history: This register was created prior to BCS20. Associated registers: None Associated logs: None
RCVR_RCVSZRS	Receiver seizures: This register is scored when a receiver is assigned to a call. The register is scored before a network path is set from the receiver to the line, trunk, or position. If a path is unavailable, the receiver is released. Incoming calls that are not assigned a receiver on the second attempt are routed to no service circuit (NOSC) treatment. Calls that are unable to get a network path on a second attempt are routed to network blockage heavy traffic (NBLH) treatment. BCS history: This register was created prior to BCS20. Associated registers: None Associated logs: None

—continued—

Table 6-1
Capacity operational measurements (continued)

Operational Measurement	Description
RCVR_RCVTRU	Receiver traffic usage: This register records whether receivers are being used by trunks that are: • carrying traffic • carrying traffic and will inform maintenance when idle • seized by the far office for lock-out This register has a 10 second scan rate. BCS history: This register was created prior to BCS20. Associated registers: None Associated logs: None
STN (OM group)	Special tones: Refer to Chapter 5.
TONES (OM group)	Tones: Refer to Chapter 5.
TRK (OM group)	Trunk group: Refer to *Operational Measurements Reference Guide*.
UTR	Universal tone receivers: These registers count and record call processing requests from lines and trunks for UTRs and the activities in the request wait queues. BCS history: This OM group was created prior to BCS20.
UTR_LDLYP	Universal tone receiver lower delay peg: This register counts requests for universal tone receivers that are queued for 3 seconds or more, plus the number of requests that are denied. This register also counts requests that are abandoned after 3 seconds or more. BCS history: UTRLDLYP was created in BCS20. Associated registers: A queued request that waits 7 seconds or longer causes registers UTRUDLYP and UTRLDLYP to be scored. If the request for a UTR is denied, both registers will be scored. Associated logs: None

—continued—

Table 6-1
Capacity operational measurements (continued)

Operational Measurement	Description
UTR_UTROVFL	Universal tone receiver overflow: This register is scored when no receivers are available and a request for a receiver is made. BCS history: UTROVFL was created prior to BCS20. Associated registers: None Associated logs: None
UTR_UTRQOCC	Universal tone receiver queue occupied: This register records whether there are requests for a UTR in the wait queue. BCS history: UTRQOCC was created prior to BCS20. Associated registers: UTRQOCC represents the accumulated total of UTR requests queued at the times that UTRSAMPL is scored. Associated logs: None
UTR_UTRQOVFL	Universal tone register queue overflow: This register is scored when a UTR request is denied a position in the wait queue because the queue is full. The wait queue can hold the same number of requests as there are UTR channels available. Each UTR has 32 channels. BCS history: UTRQOVFL was created prior to BCS20. Associated registers: TRK_INFAIL is scored when UTRQOVFL is scored. Associated logs: None
UTR_UTRRADA	Universal tone receiver receiver attachment delay: This register counts requests for a UTR channel on which receiver attachment delay record (RADR) measurements are performed. BCS history: This register was created in BCS20. Associated registers: None Associated logs: None

—continued—

Table 6-1
Capacity operational measurements (continued)

Operational Measurement	Description
UTR_UTRSZRS	Universal tone receiver seizures: This register is scored when a universal tone receiver has been allocated for a call. BCS history: UTRSZRS was created prior to BCS20. Associated registers: None Associated logs: None
UTR_UTRTRU	Universal tone receiver traffic usage: This register records the number of UTRs currently in use. Scan rate is 10 seconds. BCS history: This register was created in BCS20. Associated registers: None Associated logs: None
UTR_UTRUDLYP	Universal tone receiver upper delay peg: This register counts requests for UTRs that are queued for 7 seconds or more, plus the number of requests that are denied. This register also counts requests that are abandoned after 7 seconds. BCS history: This register was created in BCS20. Associated registers: A queued request that is denied or is in the queue longer than 7 seconds scores both UTRUDLYP and UTRLDLYP. Associated logs: None

—end—

Capacity tracking work sheets

Using capacity work sheets

A group of suggested capacity tracking work sheets are provided here for the administrator to record selected performance indicators for analysis and trending purposes. These work sheets may be copied or modified as locally required.

Where appropriate, the work sheets have been designed to express capacity in terms of a common denominator such as main station capacity and CCS per main station or CCS per line. The term network access line (NAL) can be substituted for main station in those locations that prefer to relate capacity to NAL values.

The work sheets can be used to record any period of study. However, they are typically used for recording data from the normal busy hour for the component being studied. This hour may be the office busy hour or a separate component busy hour depending on the characteristics of the office.

Work sheet descriptions

The following procedure tables contain the instructions necessary to complete the capacity tracking work sheets.

Host Switch–LM&LCM work sheet

The Host Switch—LM &LCM work sheet tracks the capacity of line modules and line concentrating modules and the percentages of capacity use. The work sheet is designed to show capacities for line terminations and CCS per main station.

Table 7-1
Host switch–LM & LCM work sheet

Heading	Entry
OFFICE	The office name where the LMs or LCMs are under study.
STUDY PERIOD	The date(s) of the study.
1. LM OR LCM	The type of line module being studied.
2. NO SPEECH LINKS	The number of speech links associated with each line. Source: LMINV or LCMINV listing.
3. HOST MS DEMAND	The main station demand for the period under study. Source: planning forecast.
4. NO LM OR LCM	The number of LMs or LCMs installed. Source: inventory table LMINV listing, LCMINV listing, or busy hour report.
5. NO LINES EQUIPPED	The number of LMs or LCMs multiplied by the number of lines each module can support (column 4 x 640).
6. % ADM. SPARE	The percentage of lines designated for administrative spare (operating company determined).
7. NO LINES UNAVAIL	The number of lines unavailable because of administrative reasons (column 5 x column 6 plus any other lines set aside for administrative purposes).

—continued—

Table 7-1
Host switch–LM & LCM work sheet (continued)

Heading	Entry
8. NO LINES AVAIL	The result of subtracting column 7 from column 5.
9. MS PER LINE RATIO	The number of working main stations divided by the number of working line equipment. If the office serves party lines, the ratio will be over 1.0. Source: Latest line count.
10. MS CAPACITY	The product of multiplying the number of lines available (column 8) by the main station per line ratio (column 9). This result is the main station capacity based on the physical limitations of the equipment.
11. % UTIL	The result of dividing column 3 by column 10. This figure is the percentage of main station capacity that is being used at the time of the study.
12. ENG. CRITERIA	The method used to engineer the LMs or LCMs—high day (HD) or average busy season (ABS).
13. ENG. CCS/LM	The engineered capacity per LM from the appropriate table in *Provisioning,* 297-1001-450.
14. ENG. CCS/LCM	The engineered capacity by LCM from the appropriate table in Appendix (of this document) or *Provisioning,* 297-1001-450.
15. CCS CAPACITY FOR LM	The result of multiplying the number of LMs by the engineered CCS per LM (column 13 x column 4).
16. CCS CAPACITY FOR LCM	The result of multiplying the number of LCMs by the engineered CCS per LCM (column 14 x column 4).
17. CCS CAPACITY FOR HOST	The total (LM + LCM CCS) capacities (column 15 plus column 16).

—continued—

Table 7-1
Host switch–LM & LCM work sheet (continued)

Heading	Entry
18. O + T CCS/MS	The originating plus terminating LM or LCM CCS per main station value that is expected for the study period.
19. MS CAPACITY FOR HOST	The total installed line unit (LM + LCM) capacity divided by the projected O + T CCS for main station, which represents the maximum number of main stations that can operate in the line modules at objective service levels during the study period.
20. % UTIL	The result of dividing the host main station demand by the host main station capacity (column 3 by column 19) and multiplying by 100. This figure indicates the percentage of use of the main station capacity during the study period.

—end—

Main Stations–networks work sheet

The networks work sheet is used to determine the network capacity based on network ports and time switch 2-way CCS per main station. The latter term is referred to as 2-way CCS usage because each call is measured first as it enters and again, as it exits the network.

Table 7-2
Networks work sheet

Heading	Entry
OFFICE	The office name where the network is under study.
STUDY PERIOD	The date(s) of the study.
1. PM	All the peripheral modules that terminate on the network modules for each generation of peripheral unit.
2. NO PM	The number of peripheral modules of each type that appears in column 1. Source: inventory table LMINV.
3. PORTS PER PM	The number of network ports used by the respective peripheral module listed in column 1. Source: inventory table LMINV.
4. PORTS REQUIRED	The product of multiplying column 2 by column 3.
5. TOTAL PORTS REQ'D	The sum of column 4 (at the bottom of the record). This is the total number of assigned network peripheral ports in the office.
6. NETWORKS INSTALLED	The number of networks installed. Source: Busy Hour Report.
7. PORTS PER NETWORK	This column is preprinted and indicates that there are 64 ports per network module.
8. PORTS INSTALLED	The product of multiplying the number of networks installed by the number of ports per network (column 6 x column 7).

—continued—

Table 7-2
Networks work sheet (continued)

Heading	Entry
9. NO. SPARE PORTS	The difference between the number of of ports installed and the number of ports used (column 8 minus column 5).
10. % PORT UTIL	The total ports (network) assigned divided by the number of ports installed (column 5 divided by column 8) multiplied by 100. This is the percentage of ports being used during the study period.
11. ENGINEERING CRITERIA	This column provides for a space to identify the engineering criteria (ABS or HD) used to calculate columns 12-17.
12. ENGINEERED CCS PER NETWORK	Refer to the appropriate capacity tables in *Provisioning,* 297-1001-450 and enter the operating company selected engineered value.
13. NETWORK CCS CAPACITY	The product of multiplying the number of network modules installed by the CCS for each network module (column 6 x column 12).
14.MS DEMAND	The maximum number of main stations working during the study period. Source: loading plan or other forecast of main stations.
15. NETWORK TS 2W CCS PER MS	An estimation of the total TS (time switch) CCS per main station that is expected in the study period and is derived by dividing the TS use by the total main stations.

—continued—

Table 7-2
Networks work sheet (continued)

Heading	Entry
16. MS CAPACITY	The installed network capacity divided by the CCS for main station (column 13 divided by column 15). This value represents the maximum number of main stations that can operate on this network at the objective service levels.
17. % UTIL	The result of dividing the main station demand by the main station capacity (column 14 by column 16) multiplied by 100.
—end—	

Main station capacity–numbers work sheet

The numbers work sheet is used to determine the directory number capacity of a switch and its associated remote sites. The numbers are then expressed in a main station capacity relationship.

Table 7-3
Numbers work sheet

Heading	Entry
OFFICE	The office name where the network is under study.
STUDY PERIOD	The date(s) of the study.
1. OFFICE NXX	Each working NXX for the host office and each remote site, rate zone, or both. If the percentage of administrative spare is different for major classes of service, list the classes separately under the corresponding NXX or list all classes of service(as locally desired) and calculate the number capacity. Source: table THOUGRP.
2. HOST OR REMOTE	H for host or R for remote to designate whether the number series is assigned to or reserved for the host or remote location.
3. RATE ZONE	The local calling rate zone to which the NXX number series is assigned.
4. CLASS OF SERVICE	The main station class of service required to correspond to the entries in columns 1, 2, and 3.
5. % ADM SPARE	The percentage of administrative spare (operating company determined).
6. INSTALLED NUMBERS	The directory number quantities associated with every class of service listed in column 4 for each NXX at the host and remote sites. The quantities should total 10,000 numbers for each NXX. Unassigned numbers may be spread across each class of service based on expected growth.

—continued—

Table 7-3
Numbers work sheet

Heading	Entry
7. MS CAPACITY	The product of the numbers installed multiplied by (100 percent minus the administrative percentage). [column 6 x (100% – column 5)]. The individual number capacities in this column should be totaled and the result entered at the bottom of the record. This value represents the directory number capacity of this office.
8. REMARKS	This space is reserved for comments and notes.
—end—	

Main station capacity–DRAM work sheet

The DRAM work sheet is used to determine the DRAM capacity based on main station demand and is expressed in terms of main station capacity.

Table 7-4
DRAM work sheet

Heading	Entry
OFFICE	The office name where the network is under study.
STUDY PERIOD	The date(s) of the study.
1. DRAM	The DRAM being evaluated (in an office with more than one DRAM), including backups. The number of DRAMs and their associated announcements can be determined from table ANNMEMS.
—continued—	

Table 7-4
DRAM work sheet (continued)

Heading	Entry
2. PORTS DELOADED IN TIME SWITCH	The number of ports that are deloaded (are to remain unused) in the network subgroup that serves the DRAM. Source: Tables LMINV, TMINV, and DCMINV indicate the network port assignments. When these assignments are laid out on a matrix showing every network time switch and its associated peripheral ports (16 per time switch), unassigned or spare time switch ports become apparent.
3. MAXIMUM CHANNELS	The maximum number of channels that are enabled to the DRAM. The number is determined by the dip switch settings located on the controller card (8, 16, 24, or 30).
4. ENG. CRITERIA	The engineering criteria (high day or average busy season) as determined by the operating company.
5. TABLE	The table that corresponds to the entry in column 4. Refer to DRAM table T and table U in *Provisioning,* 297-1001-450.
6. ENGINEERING CCS CAPACITY	The value obtained from the table indicated in column 5.
7. COMPONENT MS CAPACITY	The maximum number of main stations expected to use the DRAM during the study period. This is the total number of office main stations. Source: loading plan or other main station forecast.

—continued—

Table 7-4
DRAM work sheet (continued)

Heading	Entry
8. BUSY HOUR FACTOR	This factor is a relationship (ratio) of another hour to the regular busy hour that may be used to estimate data that were not gathered during the normal busy hour. This factor is usually developed when a busy hour determination study is being conducted.
9. HOLDING TIME	The average holding time per DRAM call by dividing the total use of all DRAM channels by the corresponding call peg counts.
10. CALLS/MS TOTAL CHANNELS	An estimate of the total busy hour calls per main station expected during the study period. This estimate should be based on historical data (if available) from this office or a similar office.
11. CCS/MS TOTAL CHANNELS	An estimate of the total CCS per main station for all channels expected during the study period. The base used to provide this estimate is the total use for all DRAM channels divided by the main stations that generated it. Source: office historical data.

—continued—

Table 7-4
DRAM work sheet (continued)

Heading	Entry
12. MS CAPACITY	The result of dividing the CCS capacity provided by the CCS per main stations (column 6 divided by column 11). This value is the maximum number of main stations that the DRAM can serve during the study period and still meet the objective service level.
13. % UTIL	The result of dividing column 7 by column 12 and multiplying by 100. This is the percentage of DRAM main station capacity that is expected to be used during the study period.

—end—

Main station capacity–receivers work sheet

The receivers capacity work sheet is designed to track the capacities of multifrequency (MF) receivers, Digitone receivers, and universal tone receivers (UTR). The instructions are grouped by type of receiver, but the work sheet is designed to record all three types on one work sheet.

MF receivers work sheet

The following table contains the instructions for completing the MF receiver portion of the receivers work sheet.

Table 7-5
Receivers work sheet–MF receivers

Heading	Entry
OFFICE	The office name where the network is under study.
STUDY PERIOD	The date(s) of the study.
1. RECEIVER TYPE	Preprinted for each type of receiver.
2. CIRCUITS PER PACK	The number of circuits per pack.
3. CIRCUITS PROVIDED TOTAL	The number of circuits installed. Source: busy hour report.
4. CIRCUITS PROVIDED TRAFFIC	This column is for those operating companies that provide circuits for service protection. If service protection circuits are provided, subtract their number from column 3 and enter the remainder in column 4. This value represents the number of circuits that are actually required for the traffic offered.
5. ENGINEERING CRITERIA	Both high day and average busy season are shown. Cross out the one that does not apply.
6. ENGINEERING TABLE	The engineering table being used (operating company determined). Refer to *Provisioning,* 297-1001-450 for NT recommendations.
7. CCS CAPACITY PROVIDED	The capacity from the selected engineering table for the number of circuits in column 4.

—continued—

Table 7-5
Receivers work sheet–MF receivers (continued)

Heading	Entry
8. COMPONENT MS DEMAND	For the MF receiver group, both main station and MF trunks should be entered in this column. The value entered is the maximum number of main stations and trunks expected to use this circuit group in the study period. Sources: loading plan or other main station forecast and the general trunk estimate or similar forecast.
9. BUSY HOUR FACTOR	This factor is a relationship (ratio) of another hour to the regular busy hour that may be used to estimate data that were not gathered during the normal busy hour. This factor is usually developed when a busy hour determination study is being conducted.
10. HOLDING TIME	This value is calculated by dividing the MF receiver group use by the corresponding call peg counts (excluding receiver attachment delay reports).
11. CALLS/MS OR CALLS/TRUNK	The result of dividing the number of busy hour call peg counts for this component by the main stations or trunks working during the same time period. These data should be trended or estimated to reflect call rates expected during the study period. These data are used primarily in the initial office design when no empirical data are available.

—continued—

Table 7-5
Receivers work sheet–MF receivers (continued)

Heading	Entry
12. CCS/MS OR CCS/TRUNK	An estimation of the CCS per main station or trunk that is expected during the study period. The base used to provide these data is the circuit group use divided by the main stations or trunks that generated the use. These data are normally compiled daily by the administration group.
13. MS OR TRUNK CAPACITY	The result of dividing the CCS capacity provided by the CCS per main station or trunk (column 7 divided by column 12). This represents the maximum number of main stations or trunks that can be served by this service circuit group during the study period and still meet the service objectives.
14. % UTIL	The result of dividing column 8 by column 13 and multiplying by 100. This value is the percentage of the MF receiver main station or trunk capacity that is expected to be used.
—end—	

Digitone receivers work sheet

The following table contains the instructions for completing the Digitone receiver portion of the receivers work sheet.

Table 7-6
Receivers work sheet–Digitone receivers

Heading	Entry
OFFICE	The office name where the network is under study.
STUDY PERIOD	The date(s) of the study.
1. RECEIVER TYPE	Preprinted for each type of receiver.
2. CIRCUITS PER PACK	The number of circuits per pack.
3. CIRCUITS PROVIDED TOTAL	The number of circuits installed. Source: busy hour report.
4. CIRCUITS PROVIDED TRAFFIC	This column is for those operating companies that provide circuits for service protection. If service protection circuits are provided, subtract their number from column 3 and enter the remainder in column 4. This value represents the number of circuits that are actually required for the traffic offered.
5. ENGINEERING CRITERIA	Both high day and average busy season are shown. Cross out the one that does not apply.
6. ENGINEERING TABLE	The engineering table being used (operating company determined). Refer to *Provisioning,* 297-1001-450 for NT recommendations.
7. CCS CAPACITY PROVIDED	The capacity from the selected engineering table for the number of circuits in column 4.

—continued—

Table 7-6
Receivers work sheet–Digitone receivers (continued)

Heading	Entry
8. COMPONENT MS DEMAND	For the Digitone receiver group, the value entered is the maximum number of main stations expected to use this circuit group in the study period. This consists of only Digitone main stations in both the host and any remote site. Source: loading plan or other main station forecast.
9. BUSY HOUR FACTOR	This factor is a relationship (ratio) of another hour to the regular busy hour that may be used to estimate data that were not gathered during the normal busy hour. This factor is usually developed when a busy hour determination study is being conducted.
10. HOLDING TIME	This value is calculated by dividing the Digitone receiver group use by the corresponding call peg counts (excluding dial tone speed tests).
11. CALLS/MS OR CALLS/TRUNK	The result of dividing the number of busy hour call peg counts for this component by the main stations working during the same time period.
12. CCS/MS	An estimation of the CCS per main station that is expected during the study period. The base used to provide these data is the circuit group use divided by the main stations that generated the use. These data are normally compiled daily by the administration group.

—continued—

Table 7-6
Receivers work sheet–Digitone receivers (continued)

Heading	Entry
13. MS OR TRUNK CAPACITY	The result of dividing the CCS capacity provided by the CCS per main station (column 7 divided by column 12). This represents the maximum number of main stations that can be served by this service circuit group during the study period and still meet the service objectives.
14. % UTIL	The result of dividing column 8 by column 13 and multiplying by 100. This value is the percentage of the Digitone receiver main station capacity that is expected to be used.

—end—

UTR work sheet

The following table contains the instructions for completing the UTR portion of the receivers work sheet.

Table 7-7
Receivers work sheet–UTR

Heading	Entry
OFFICE	The office name where the network is under study.
STUDY PERIOD	The date(s) of the study.
1. RECEIVER TYPE	Preprinted for each type of receiver.
2. CIRCUITS PER PACK	The number of circuits per pack.
3. CIRCUITS PROVIDED TOTAL	The number of circuits installed (either 30 or 60). Source: busy hour report.
4. CIRCUITS PROVIDED TRAFFIC	This column is for those operating companies that provide circuits for service protection. If service protection circuits are provided, subtract their number from column 3 and enter the remainder in column 4. This value represents the number of circuits that are actually required for the traffic offered.
5. ENGINEERING CRITERIA	Both high day and average busy season are shown. Cross out the one that does not apply.
6. ENGINEERING TABLE	The engineering table being used (operating company determined). Refer to *Provisioning,* 297-1001-450 for NT recommendations.
7. CCS CAPACITY PROVIDED	The capacity found in the selected engineering table for the number of circuits in column 4.

—continued—

Table 7-7
Receivers work sheet–UTR (continued)

Heading	Entry
8. COMPONENT MS DEMAND	For the UTR group, the value entered is the maximum number of main stations expected to use this circuit group in the study period. This consists of main stations in both the host and any remote site. Source: loading plan or other main station forecast and the general trunk forecast or similar forecast.
9. BUSY HOUR FACTOR	This factor is a ratio of the regular busy hour to another hour that may be used to estimate data that were not gathered during the normal busy hour. This factor is usually developed when a busy hour determination study is being conducted.
10. HOLDING TIME	This value is calculated by dividing the UTR group use by the corresponding call peg counts (excluding dial tone speed tests and receiver attachment delay reports). There is no distinction made between line or trunk use; therefore, only one value can be derived. Source: OM group UTR.
11. CALLS/MS OR CALLS/TRUNK	The result of dividing the number of busy hour peg counts (UTR seizures) for this component by the main stations or trunks working during the same time period.
12. CCS/MS	An estimation of the CCS per main station or trunk that is expected during the study period. The base used to provide these data is the circuit group use divided by the main stations that generated the usage. These data are normally compiled daily by the administration group.

—continued—

Table 7-7
Receivers work sheet–UTR (continued)

Heading	Entry
13. MS OR TRUNK CAPACITY	The result of dividing the CCS capacity provided by the CCS per main station (column 7 divided by column 12). This represents the maximum number of main stations that can be served by this service circuit group during the study period and still meet the service objectives.
14. % UTIL	The result of dividing column 8 by column 13 and multiplying by 100. This value is the percentage of the Digitone receiver main station capacity that is expected to be used.
—end—	

Service circuits–three-port conference circuits work sheet

The three-port conference circuit work sheet is used to determine the capacity of this type of circuit during a designated study period. The results are converted to reflect a main station capacity for the installed three-port conference circuits.

Table 7-8
Receivers work sheet–UTR

Heading	Entry
OFFICE	The office name where the network is under study.
STUDY PERIOD	The date(s) of the study.
1. CIRCUITS PER PACK	The number of circuits per pack.
2. CIRCUITS PROVIDED TOTAL	The number of circuits installed.
3. CIRCUITS PROVIDED TRAFFIC	This column is for those operating companies that provide circuits for service protection. If service protection circuits are provided, subtract their number from column 3 and enter the remainder in column 4. This value represents the number of circuits that are actually required for the traffic offered.
4. ENGINEERING CRITERIA	Both high day and average busy season are shown. Cross out the one that does not apply.
5. ENGINEERING TABLE	The engineering table being used (operating company determined). Refer to *Provisioning,* 297-1001-450 for NT recommendations.
6. CCS CAPACITY PROVIDED	The capacity from the selected engineering table for the number of circuits in column 4.
7. COMPONENT MS DEMAND	An estimate of the number of main stations that are expected to use this circuit group during the study period. This value should be obtained from the general planning forecast, loading plan, or other forecast of 3-port conference requirements.

—continued—

Table 7-8
Receivers work sheet–UTR (continued)

Heading	Entry
8.BUSY HOUR FACTOR	This factor is a relationship (ratio) of another hour to the regular busy hour that may be used to estimate data that were not gathered during the normal busy hour. This factor is usually developed when a busy hour determination study is being conducted.
9. HOLDING TIME	The result of dividing the 3-port conference circuit usage by the corresponding 3-port conference circuit peg counts.
10. CALLS/MS	The result of dividing the busy hour peg count for these circuits by the number of working main stations and then trend or estimate this value for the study period.
11. CCS/MS	An estimate of the 3-port CCS per main station expected during the study period based on historical data.
12. MS CAPACITY	The result of dividing column 6 by column 11. This value represents the maximum number of main stations this circuit group can serve and still meet the service objectives.
13. % UTIL	The result of dividing column 7 by column 12 and multiplying by 100. This value represents the percentage of main station capacity for 3-port conference circuits that is expected to be used during the study period.

—end—

Service circuits–ROH tone circuits work sheet

The ROH (receiver off-hook) tone work sheet is used to determine the capacity of this type of circuit during a designated study period. The results are converted to reflect a main station capacity for the installed ROH tone circuits.

Table 7-9
ROH tone circuit work sheet

Heading	Entry
OFFICE	The office name where the network is under study.
STUDY PERIOD	The date(s) of the study.
1. CIRCUITS PER PACK	The number of circuits per pack.
2. NO BROAD CONN	The number of simultaneous calls that can connect to this circuit group (excluding any circuits provided for service protection). This value can be calculated by multiplying the value in column 4 by the number of channels to which each circuit can broadcast. This information can be found in table STN in the ‘‘Max connection’’ column.
3. CIRCUITS PROVIDED TOTAL	The number of circuits installed.
4. CIRCUITS PROVIDED TRAFFIC	This column is for those operating companies that provide circuits for service protection. If service protection circuits are provided, subtract their number from column 3 and enter the remainder in column 4. This value represents the number of circuits that are actually required for the traffic offered.
5. ENGINEERING CRITERIA	The engineering criteria used: high day (HD), 10 high day (10HD), or average busy season (ABS).
6. ENGINEERING TABLE	The engineering table being used (operating company determined). Refer to *Provisioning,* 297-1001-450 for NT recommendations.

—continued—

Table 7-9
ROH tone circuit work sheet (continued) (continued)

Heading	Entry
7. CCS CAPACITY PROVIDED	The capacity from the selected engineering table for the number of circuits in column 4.
8. COMPONENT MS DEMAND	An estimate of the number of main stations that are expected to use this circuit group during the study period. This value should be obtained from the general planning forecast, loading plan, or other forecast of 3-port conference requirements.
9. BUSY HOUR FACTOR	This factor is a relationship (ratio) of another hour to the regular busy hour that may be used to estimate data that were not gathered during the normal busy hour. This factor is usually developed when a busy hour determination study is being conducted.
10. HOLDING TIME	The result of dividing the ROH tone circuit use by the corresponding ROH tone circuit peg counts.
11. CALLS/MS	The result of dividing the busy hour peg count for these circuits by the number of working main stations and then trend or estimate this value for the study period.
12. CCS/MS	An estimate of the ROH tone CCS per main station expected during the study period, based on historical data.

—continued—

Table 7-9
ROH tone circuit work sheet (continued) (continued)

Heading	Entry
13. MS CAPACITY	The result of dividing column 7 by column 12. This value represents the maximum number of main stations this circuit group can serve and still meet the service objectives.
14. % UTIL	The result of dividing column 8 by column 13 and multiplying by 100. This value represents the percentage of main station capacity for ROH tone circuits that is expected to be used during the study period.

—end—

Service circuits–announcement circuits work sheet

The announcements work sheet is used to determine the capacity of this type of circuit during a designated study period. The results are converted to reflect a main station capacity for the installed announcement circuits.

Table 7-10
Announcement circuits work sheet

Heading	Entry
OFFICE	The office name where the network is under study.
STUDY PERIOD	The date(s) of the study.
1. ANNOUNCEMENT	The announcement under study.
2. NO BROAD CONN	The number of simultaneous calls that can connect to this announcement. This value can be found in table ANNS.
3. CIRCUITS PROVIDED TOTAL	One (1) is entered in this column as only one channel is being evaluated.
4. CIRCUITS PROVIDED TRAFFIC	One (1) is entered in this column. No consideration is given to service protection circuits, if provided.
5. ENGINEERING CRITERIA	The engineering criteria used: high day (HD) or average busy season (ABS).
6. ENGINEERING TABLE	The engineering table being used (operating company determined). Refer to *Provisioning,* 297-1001-450 for NT recommendations.
7. CCS CAPACITY PROVIDED	The capacity from the selected engineering table for the number of circuits in column 6.
8. COMPONENT MS DEMAND	An estimate of the number of main stations that are expected to use this circuit group during the study period. This value should be obtained from the general planning forecast, loading plan, or other forecast of three-port conference requirements.

—continued—

Table 7-10
Announcement circuits work sheet (continued)

Heading	Entry
9. BUSY HOUR FACTOR	This factor is a relationship (ratio) of another hour to the regular busy hour that may be used to estimate data that were not gathered during the normal busy hour. This factor is usually developed when a busy hour determination study is being conducted.
10. HOLDING TIME	The result of dividing the announcement circuit usage by the corresponding peg count.
11. CALLS/MS	The result of dividing the busy hour call peg count for each of these circuits by the number of working main stations and trend or estimate this value for the study period. This value is used primarily for initial office design when no empirical data are available.
12. CCS/MS	An estimate (based on historical data) of the CCS per main station for this circuit group expected during the study period.
13. MS CAPACITY	The result of dividing column 8 by column 12. This value represents the maximum number of main stations this circuit group can serve and still meet the service objectives.
14. % UTIL	The result of dividing column 8 by column 13 and multiplying by 100. This value represents the percentage of main station capacity for the announcement channels that is expected to be used during the study period.

—end—

CPU status work sheet

The CPU status work sheet tracks the occupancy of the central control processor unit. The work sheet can be used daily or for specific study periods. All the work sheet entries are derived from from the OM group CPUSTAT. Each of the readings must be divided by the number of minutes of the total collection period. For example, if the period of data collection is 30 minutes, divide the OM output by 30. To display the measurements at the MAP terminal, enter the command CPSTATUS at the MTC level or enter the nonmenu CI command CPSTAT at any level.

Table 7-11
CPU status work sheet

Heading	Entry
OFFICE	The office name where the network is under study.
STUDY PERIOD	The date(s) of the study.
1. CATMP/HR	The quantity of call attempts in an hour. This count is recorded by OM groups AVOFZ, OFZ, OTS.
2. CPSCPOCC	The accumulated call processing occupancy for the OM transfer period divided by the number of minutes in the collection period.
3. CCPAVAIL	The accumulated CPU availability for call processing as sampled once each minute.
4. ENGLEVEL	Indicates whether the value of CPOCC has exceeded the threshold assigned by the parameter CC_ENGLEVEL_WARNING_THRESHOLD of table OFCENG.
5. ENGPARM	This value is the percentage for the threshold at which a switch becomes overloaded, as specified by the parameter CC_ENGLEVEL_WARNING_THRESHOLD of table OFCENG.

—continued—

Table 7-11
CPU status work sheet (continued)

Heading	Entry
6. CCOVRLD	This measurement is scored as *ON* when the CC is overloaded and indicates that overload controls were active in the last minute. An *OFF* indicates that the CC controls were not active in the last minute. This count is the total minutes that the CC was in the *ON* state.
7. CPSSCHED	This value is the accumulated CPU scheduler occupancy. The scheduler is interrupt driven and maintains the CPU allocation of work by scheduling call processing, maintenance, background, and foreground processes.
8. CPSFORE	The CPU foreground occupancy (SYSTEM 6 and SYSTEM 7 class functions).
9. CPSMAINT	The accumulated CPU maintenance occupancy. Functions in this group include: dial tone speed recorder, receiver attachment delay recorder, network maintenance, reloading processes, and device independent recording package (DIRP) audits.
10. CPSDNC	The percentage of CPU real time for processes used by the dynamic network controller feature.
11. CPSOM	The accumulated operational measurement occupancy. This category includes OM scanning and the OM transfer process.
12. CPSGTERM	The accumulated guaranteed terminal occupancy collected over the last OM transfer period.

—continued—

Table 7-11
CPU status work sheet (continued)

Heading	Entry
13. CPSBKG	The accumulated background occupancy, which includes BKG and DEFBKG scheduler class occupancies.
14. CPSIDLE	The accumulated occupancy of the processor running the idle and audit functions.
—end—	

Data store and program store work sheet

The data store and program store capacity work sheet tracks the memory capacity used. The memory can be monitored at the MAP terminal using the CCMNT output (NT40) and the CMMNT output (SuperNode). These MAP data record the memory used and memory available for both the data store and the program store for the NT40, and total words used and available for SuperNode. The work sheet entries need no explanation and are as follows:

- words used
- words available
- total words
- percentage used

This work sheet may be used to track memory daily or for a specific period of time.

BUILDING______________

OFFICE______________

DMS-100 MAIN HOST

LM OR LCM	NO SPEECH LINKS	HOST MS DEMAND	NO LM OR LCM	LINE TERMINATIONS						
				NO. LINES EQUIPPED	% ADM. SPARE	NO. LINES UNAVAIL	NO. LINES AVAIL	MS PER LINE RATIO	MS CAPACITY	% UTIL
1	2	3	4	5	6	7	8	9	10	11

INSTRUCTIONS:
1. Column 5 = column 4 x 640
2. Column 8 = column 5 – (column 6 x column 5 + column 7)
3. Column 10 = column 8 x column 9
4. Column 11 = column 3 / column 10

PREPARED BY:
NAME________________________ DATE_________________ TEL.NO._________________

STATION CAPACITY
SWITCH–LM & LCM

STUDY PERIOD____________

CCS CAPACITY								
ENG. CRITERIA	ENG. CCS/LM	ENG. CCS/LCM	CCS CAPACITY FOR LM	CCS CAPACITY FOR LCM	CCS CAPACITY FOR HOST	O + T CCS/MS	MS CAPACITY FOR HOST	% UTIL
12	13	14	15	16	17	18	19	20

INSTRUCTIONS (continued):
5. Column 15 = column 4 x column 13
6. Column 16 = column 4 x column 14
7. Column 17 = column 15 + column 16
8. Column 19 = column 17 / column18
9. Column 20 = column 3 / column 19

BUILDING_____________

OFFICE______________

DMS-100 MAIN NUM

OFFICE NXX	HOST OR REMOTE	RATE ZONE	CLASS OF SERVICE	% ADMIN SPARE
1	2	3	4	5

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STATION CAPACITY
BERS

STUDY PERIOD____________

NUMBERS		
INSTALLED	MS CAPACITY	REMARKS
6	7	8

BUILDING______________

OFFICE______________

DMS-100/200 MAIN NET

CAPACITY BASED ON NETWORK PORTS								
PM	NO. PM	PORTS PER PM	PORTS REQUIRED	TOTAL PORTS REQ'D	NETWORKS INSTALLED	PORTS PER NETWORK	PORTS INSTALLED	NO. SPARE PORTS
1	2	3	4	5	6	7	8	9
TM		1				64		
MTM		1						
DES		3						
LM								
LM								
DCM		4						
DTC								
LGC								
LGC								
LTC								
LTC								
SCM								
SCM								
SCM								
MSB7								
ISDN								
LPP								
TOTAL PORTS REQUIRED								

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STATION CAPACITY WORKS

STUDY PERIOD____________

	CAPACITY BASED ON CCS						
% PORT UTIL	ENGINEERING CRITERIA	ENGINEERED CCS PER NETWORK	NETWORK CCS CAPACITY	MS DEMAND	NETWORK TS 2W CCS PER MS	MS CAPACITY	% UTIL
10	11	12	13	14	15	16	17
	ABS						
	HD						

INSTRUCTIONS

1. PORTS REQUIRED (4) = column 2 x column 3.
2. TOTAL PORTS (5) = TOTAL of column 4 (PORTS REQUIRED).
3. For ENGINEERED CCS PER NETWORK (12) refer to the network capacity table.
4. The MAIN STATION DEMAND (working main stations) value (14) is the total main stations (host plus remotes).
5. The MAIN STATION CAPACITY value (16) includes remotes.
6. DES = Digital echo suppressor
7. List LM, DCT, LGC, LTC, and SCM separately according to the number of total ports per module.
8. TS 2W (column 15) indicates that each call is measured as it enters and exits the network.

BUILDING______________

OFFICE_______________

DMS-100/200 MAIN
DRA

DRAM	PORTS DELOADED IN TIME SWITCH	MAXIMUM CHANNELS	ENG. CRITERIA	TABLE	ENGINEERED CCS CAPACITY	COMPONENT MS DEMAND
1	2	3	4	5	6	7

Note 1: Deloading ports in a time switch serving a DRAM will increase the DRAM capacity (refer to DRAM tables T and U in *Provisioning Guide*.

Note 2: Maximum channels (column 3) = the number of digital broadcast announcement channels. This value will be 8, 16, 24, or 32 channels depending on the number of announcements per DRAM (one channel per announcement).

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STATION CAPACITY
MS

STUDY PERIOD____________

BUSY HOUR FACTOR	HOLDING TIME	BUSY HOUR		MS CAPACITY	% UTIL
		CALLS/MS TOTAL CHANNELS	CCS/MS TOTAL CHANNELS		
8	9	10	11	12	13

INSTRUCTIONS: Column 12 = column 6 / column11
Column 13 = column 7 / column 12

BUILDING____________

OFFICE_____________

DMS-100/200 MAIN SERVICE

RECEIVER TYPE	CIRCUITS PER PACK	CIRCUITS PROVIDED		ENGINEERING CRITERIA	ENGINEERING TABLE	CCS CAPACITY PROVIDED
		TOTAL	TRAFFIC			
1	2	3	4	5	6	7
MF RECEIVERS				10HD OR ABD		
DIGITONE RECEIVERS				HD OR ABS		
UTR	30	30 OR 60	NA	HD OR ABS		
MF RECEIVERS				10HD OR ABD		
DIGITONE RECEIVERS				HD OR ABS		
UTR	30	30 OR 60	NA	HD OR ABS		

INSTRUCTIONS: Column 13 = column 7 / column12
Column 14 = column 8 / column 13

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STATION CAPACITY CIRCUITS–RECEIVERS

STUDY PERIOD____________

COMPONENT MS DEMAND	BUSY HOUR FACTOR	HOLDING TIME	BUSY HOUR CALLS/MS OR CALLS/TRUNK	BUSY HOUR CCS/MS OR CCS/TRUNK	MS OR TRUNK CAPACITY	% UTIL
8	9	10	11	12	13	14
MS						
TRK						
MS						
TRK						
MS						
TRK						
MS						
TRK						

BUILDING______________

OFFICE_______________

DMS-100/200 MAIN SERVICE CIRCUITS–THREE

CIRCUITS PER PACK	CIRCUITS PROVIDED		ENGINEERING CRITERIA	ENGINEERING TABLE	CCS CAPACITY PROVIDED	COMPONENT MS DEMAND
	TOTAL	TRAFFIC				
1	2	3	4	5	6	7

INSTRUCTIONS: Column 12 = column 6 / column11
Column 13 = column 7 / column 12

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STATION CAPACITY
–PORT CONFERENCE

STUDY PERIOD____________

BUSY HOUR FACTOR	HOLDING TIME	BUSY HOUR		MS CAPACITY	% UTIL
		CALLS/MS	CCS/MS		
8	9	10	11	12	13

BUILDING_____________

OFFICE______________

DMS-100/200 MAIN SERVICE CIRC

CIRCUITS PER PACK	NO BROAD CONN	CIRCUITS PROVIDED		ENGINEERING CRITERIA	ENGINEERING TABLE	CCS CAPACITY PROVIDED	COMPONENT MS DEMAND
		TOTAL	TRAFFIC				
1	2	3	4	5	6	7	8

INSTRUCTIONS: Column 12 = column 6 / column11
Column 13 = column 7 / column 12

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STATION CAPACITY
UITS–ROH TONE

STUDY PERIOD____________

BUSY HOUR FACTOR	HOLDING TIME	BUSY HOUR		MS CAPACITY	% UTIL
		CALLS/MS	CCS/MS		
9	10	11	12	13	14

BUILDING_____________

OFFICE______________

DMS-100/200 MAIN SERVICE CIRCUITS

ANNOUNCEMENT	NO BROAD CONN	CIRCUITS PROVIDED		ENGINEERING CRITERIA	ENGINEERING TABLE	CCS CAPACITY PROVIDED
		TOTAL	TRAFFIC			
1	2	3	4	5	6	7

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STATION CAPACITY –ANNOUNCEMENTS

STUDY PERIOD____________

			BUSY HOUR			
COMPONENT MS DEMAND	BUSY HOUR FACTOR	HOLDING TIME	CALLS/MS	CCS/MS	MS CAPACITY	% UTIL
8	9	10	11	12	13	14

BUILDING______________
OFFICE_______________

DMS-100/200 MAIN AND PROGRAM

DATA STORE			
WORDS USED	WORDS AVAILABLE	TOTAL WORDS	PERCENT USED
1	2	3	4 (column 1/ column 2)

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DATA STORE
STORE CAPACITY

STUDY PERIOD____________

PROGRAM STORE			
WORDS USED	WORDS AVAILABLE	TOTAL WORDS	PERCENT USED
5	6	7	8 (column 1/ column 2)

BUILDING______________

OFFICE______________

DMS-100/200 MAIN CPU ST

1 CATMP/HR	2 CPSCPOCC	3 CCPAVAIL	4 ENGLEVEL	5 ENGPARM	6 CCOVRLD	7 CPSSCHED

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CAPACITY
ATUS

STUDY PERIOD____________

8 CPSFORE	9 CPSMAINT	10 CPSDNC	11 CPSOM	12 CPSGTERM	13 CPSBKG	14 CPSIDLE

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DMS-100 Family

DMS100 Family

Capacity Administration Guide

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