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Meridian 1

# System Engineering

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## Revision history

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**April 2000**

Standard 14.00. This is a global document and is up-issued for X11 Release 25.0x. Document changes include removal of: redundant content; references to equipment types except Options 11C, 51C, 61C, and 81C; and references to previous software releases.

**June 1999**

Standard, release 13.00.

**October 1997**

Standard, release 12.00.

**August 1996**

Standard, release 11.00. This document is reissued to include NT9D19 Call Processor and NT6D66 Call Processor memory requirements for X11 Release 22.

**December 1995**

Standard, release 10.00. This document is reissued to include NT9D19 Call Processor Card and minor edits.

**July 1995**

Standard, release 9.00. This document is reissued to include international information to create a global NTP, Option 81C, text and graphic edits.

**December 1994**

Standard, release 8.00. This document is reissued to include information on the Small systems Multi-Disk Unit (SMDU), Meridian 1 Option 51C, and minor edits.

**April 1994**

Standard, release 7.00. Added references to Option 61C systems.

**September 1993**

Standard, release 6.00.

**April 1993**

Standard, release 5.00.

**December 1992**

Standard, release 4.00. This document is reissued to include information on system Option 81 and equipment required for compatibility with X11 release 18.

**Note:** Product description information is provided in *Meridian 1 system overview* (553-3001-100). That information was formerly duplicated in this document.

**December 1991**

Standard, release 3.00. This document is reissued to include technical content updates.

**July 1990**

Standard, release 2.00.

**January 1990**

Standard, release 1.00.

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## About this document

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This document is a global document. Contact your system supplier or your Nortel Networks representative to verify that the hardware and software described is supported in your area.

This document provides guidelines for:

- determining the equipment requirements for a system installation
- configuring and assigning equipment in the system
- distributing traffic equally over the system components
- maintaining traffic distribution and equipment utilization levels when adding or removing equipment, or when altering the system configuration

The values and limits used in this document are not necessarily typical and should not be interpreted as limits of the system capacity. The values should be adjusted to suit the application of a particular system. Consult your Nortel Networks representative and use a configuration tool, such as Autoquote or Meridian Configurator, to fully engineer a system.

Memory values, which vary for each generic of software, are given in *Capacity Engineering* (553-3001-149).

## References

See the *Planning and Engineering* binder for:

- *System Overview* (553-3001-100)
- *Installation Planning* (553-3001-120)
- *Power Engineering* (553-3001-152)
- *Spares Planning* (553-3001-153)
- *Equipment Identification* (553-3001-154)

See the *Installation and Maintenance* binder for:

- *System Installation Procedures* (553-3001-210)
- *Circuit Card: Installation and Testing* (553-3001-211)
- *Telephone and Attendant Console: Installation* (553-3001-215)

See the *Software Management* binder for an overview of software architecture, procedures for software installation and management, and a detailed description of all X11 features and services. This information is contained in two documents:

- *X11 System Management* (553-3001-300)
- *X11 Features and Services* (553-3001-306)

See the *X11 Administration* (553-3001-311) for a description of all administration and maintenance programs, and *X11 System Messages Guide* (553-3001-411) for information about system messages.

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# Module configuration

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## Content list

The following are the topics in this section:

- [NT5D21 Core/Network Module 11](#)
- [NT8D35 Network Module 13](#)
- [NT8D37 Intelligent Peripheral Equipment Module 17](#)
- [NT8D47 Remote Peripheral Equipment Module 19](#)

This document contains information about the following modules:

- NT5D21 Core/Network Module
- NT6D60 Core Module
- NT8D35 Network Module
- NT8D37 Intelligent Peripheral Equipment (IPE) Module
- NT8D47 Remote Peripheral Equipment (RPE) Module

**Note:** For information on modules that house equipment for specific applications, such as Meridian Mail and Meridian Link, see the document for that application.

Each type of module is available in AC-powered and DC-powered versions.

AC-powered modules generally require a module power distribution unit (MPDU) to provide circuit breakers for the power supplies. DC-powered modules do not require an MPDU because a switch on each power supply performs the same function as the MPDU circuit breakers.

The figures in this section show a typical configuration for each module. (DC power supplies are shown in these examples.)

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## NT5D21 Core/Network Module

This module is used in Options 51C, 61C, and 81C:

- Option 51C, a single CP, half-network, requires one Core/Network Module.
- Options 61C and 81C, a dual CP, full-group 61C system and up to five-group 81C system, requires two Core/Network Modules.

The Core/Network Module supports up to 16 network loops. There are 12 card slots for the network interface cards and 7 slots for the CP, memory, and disk drive equipment listed below (see Figure 1):

In the section labeled NET:

- slots 0–7: NT1P61 Fibre Superloop Network Card  
NT8D04 Superloop Network Card  
NT8D17 Conference/Tone and Digit Switch (TDS) Card  
QPC414 Network Card  
Primary rate interface/digital trunk interface (PRI/DTI) card (slots 2–7 only)  
Serial data interface (SDI) card  
D-channel handler interface (DCHI) card (slots 0–7)  
Multi-purpose serial data link (MSDL) card  
Multi-purpose ISDN signaling processor (MISP) card
- slots 8–9: NTRB33 Fiber Junctor Interface (FIJI) Card and a spare slots for 51C and 61C
- slot 10: QPC43 Peripheral Signaling Card (minimum vintage R)
- slot 11: QPC441 3-Port Extender (3PE) Card (minimum vintage F)

In the section labeled Core:

- slot 12: NT6D65 Core to Network Interface (CNI) Card
- slot 13: NT6D65 Core to Network Interface (CNI) Card for 81C and a spare slot for Options 51C and 61C
- slot 14: NT6D65 Core to Network Interface (CNI) Card for 81C and a spare slot for Options 51C and 61C
- slots 15/16: Call Processor Card



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## NT8D35 Network Module

The Network Module houses up to four NT8D04 Superloop Network Cards, or eight QPC414 Network Cards, or a combination of the two, for a total of 16 network loops. The network cards are cabled to peripheral equipment controller cards in IPE Modules. In a typical configuration, one conference/TDS card is configured in the module, leaving 14 voice/data loops available. Two Network Modules are required to make a full network group of 32 loops. A maximum of ten Network Modules (five network groups) can be configured.

This module provides 15 card slots for the following network interface cards (see Figure 2):

- between PS and slot 1: NTRE39 Optical Cable Management Card (OCMC)
- slot 1: QPC441 3PE Card
- slots 2–3: NTRB33 Fiber Junctor Interface (FIJI) Card
- slots 2–3: QPC412 InterGroup Switch (IGS) Card
- slot 4: QPC43 Peripheral Signaling Card
- slots 5–12: NT1P61 Fibre Superloop Network Card
  - NT8D04 Superloop Network Card
  - QPC414 Network Card
  - NT8D17 Conference/TDS Card
  - PRI/DTI card (slots 5–11 only)
  - SDI-type card
  - MSDL card
  - MISP card
- slot 13: Clock Controller for Option81C
- slots 13–14: PRI/DTI card
  - SDI-type card (slot 13 only)
- slot 15: not used

The Network Module can be used as a PRI/DTI expansion module. When it is used in this configuration, the Network Module can be used with any system Option. Figure 3 shows the card slot configuration when the Network Module is used for PRI/DTI expansion.

**Figure 2**  
**NT8D35 Network Module**

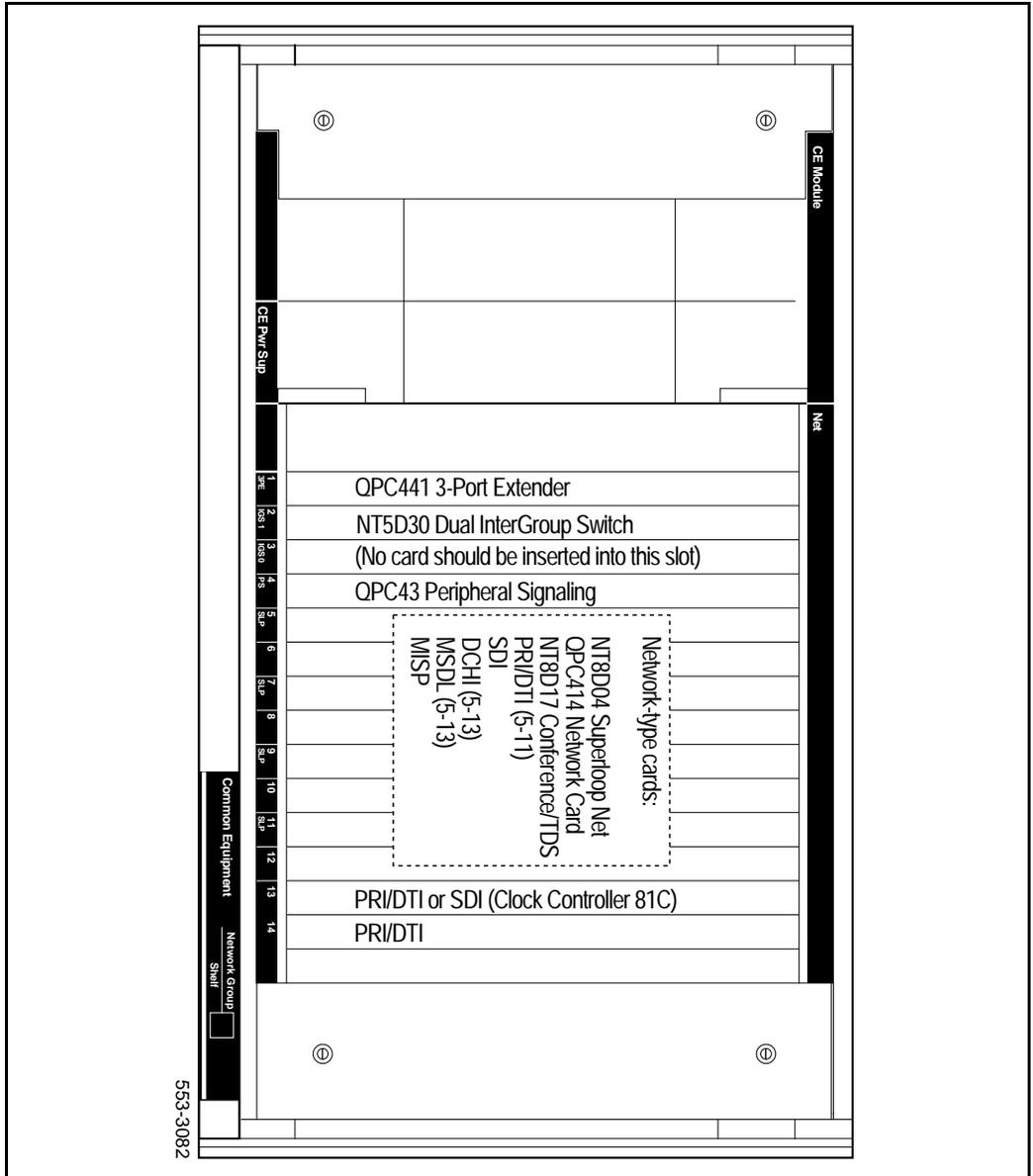
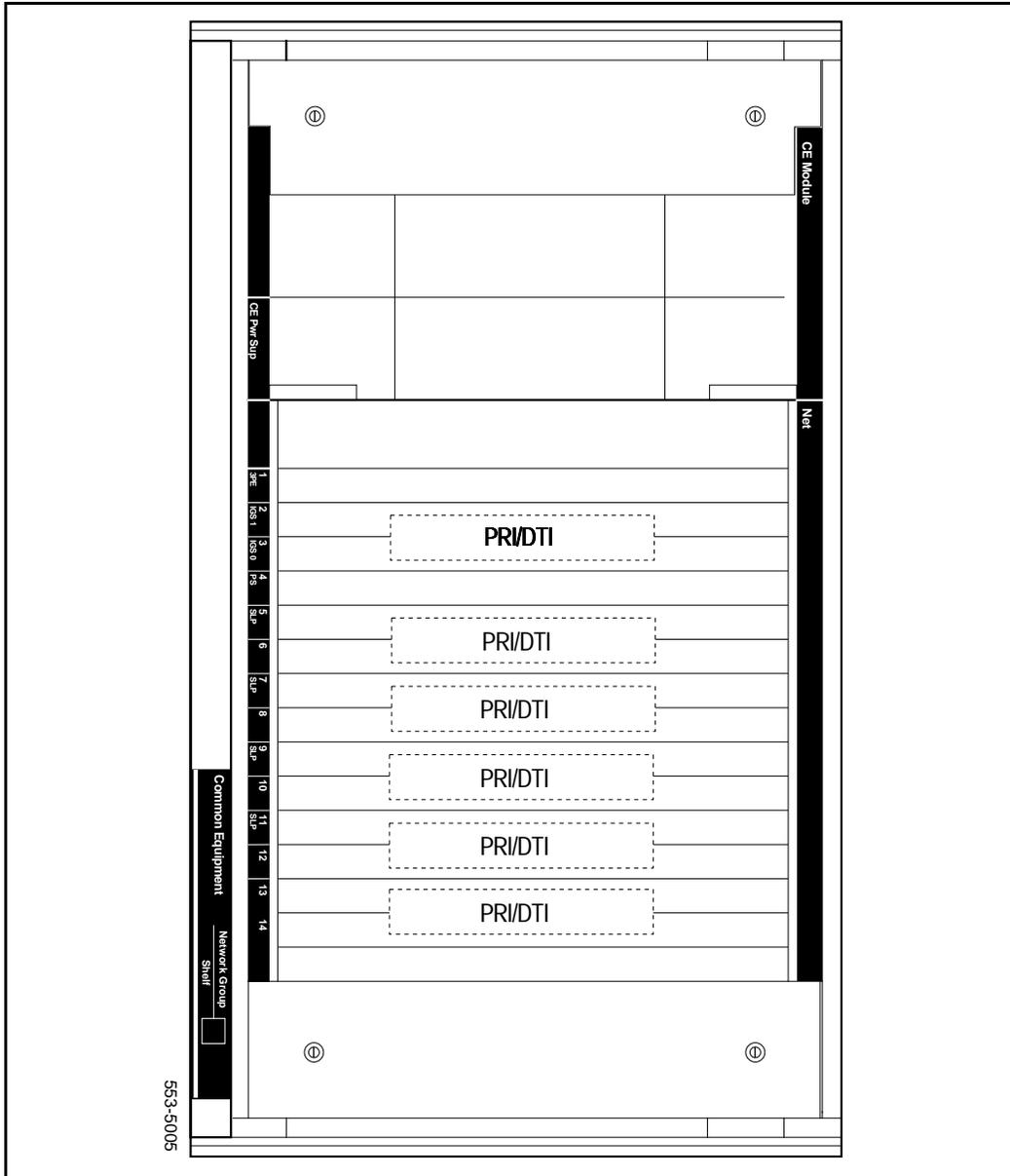


Figure 3  
NT8D35 Network Module configured for PRI/DTI expansion



## NT8D37 Intelligent Peripheral Equipment Module

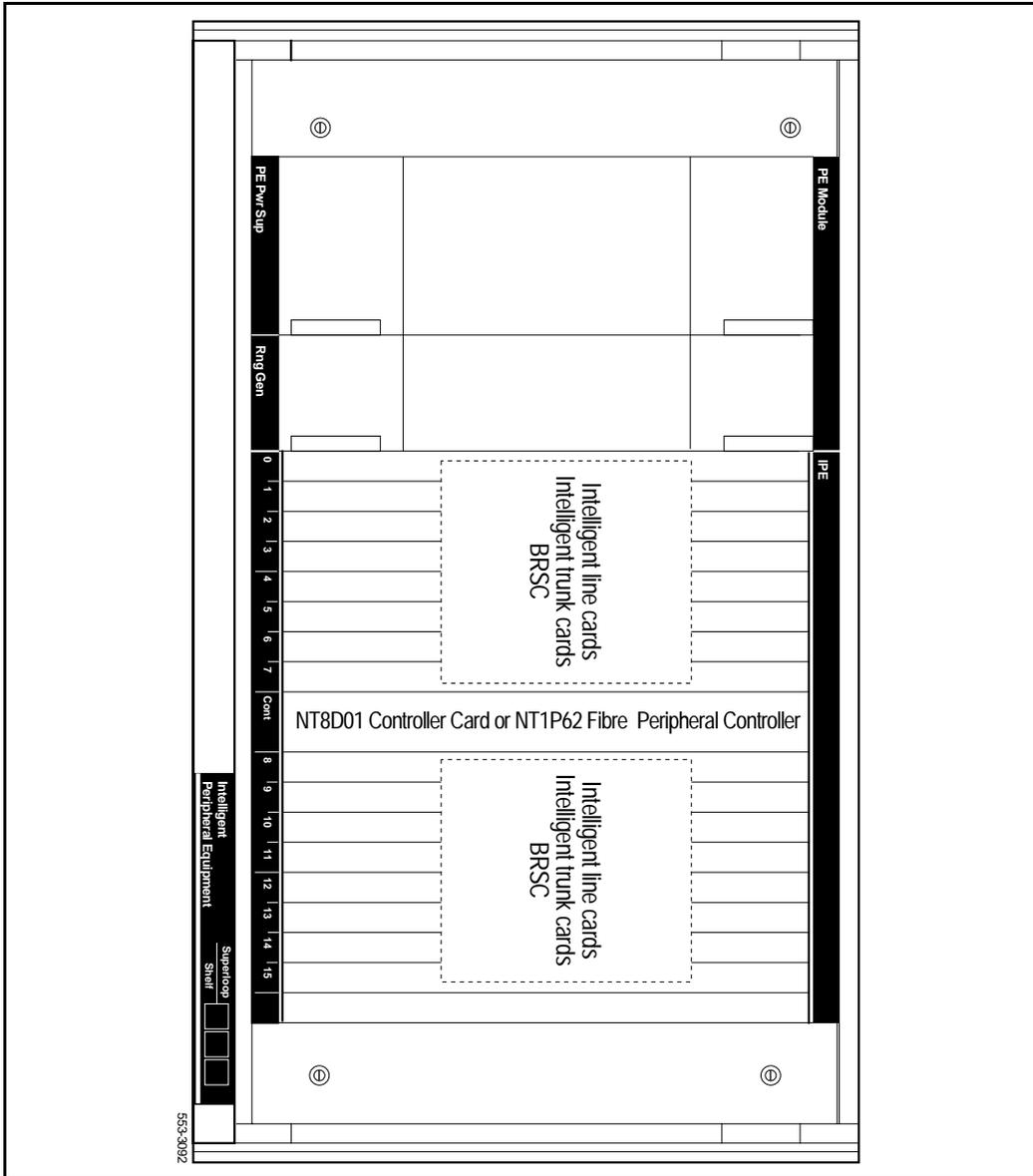
This module can be used in all system Options.

The IPE Module houses one NT8D01 Controller Card or one NT1P62 Fibre Peripheral Controller card and up to 16 IPE cards (such as line and trunk cards), supporting up to 512 terminal numbers (256 voice and 256 data). The controller card is cabled to the NT8D04 Superloop Network Card.

The controller card must be installed in the card slot labeled Cont (for controller). The other slots can house any IPE card (see Figure 4).

**Note:** When the backplane is configured for 16 cables (NT8D37 vintages BA and EC), the NT7D16 Data Access Card can be installed in any IPE slot. If the backplane is configured for 12 cables (NT8D37 vintages AA and DC), you must install the DAC in slots 0, 4, 8, or 12 because only those slots are fully cabled for 24 pairs.

Figure 4  
NT8D37 IPE Module



## NT8D47 Remote Peripheral Equipment Module

The RPE Module extends the network-to-peripheral equipment interconnection distance between local and remote sites.

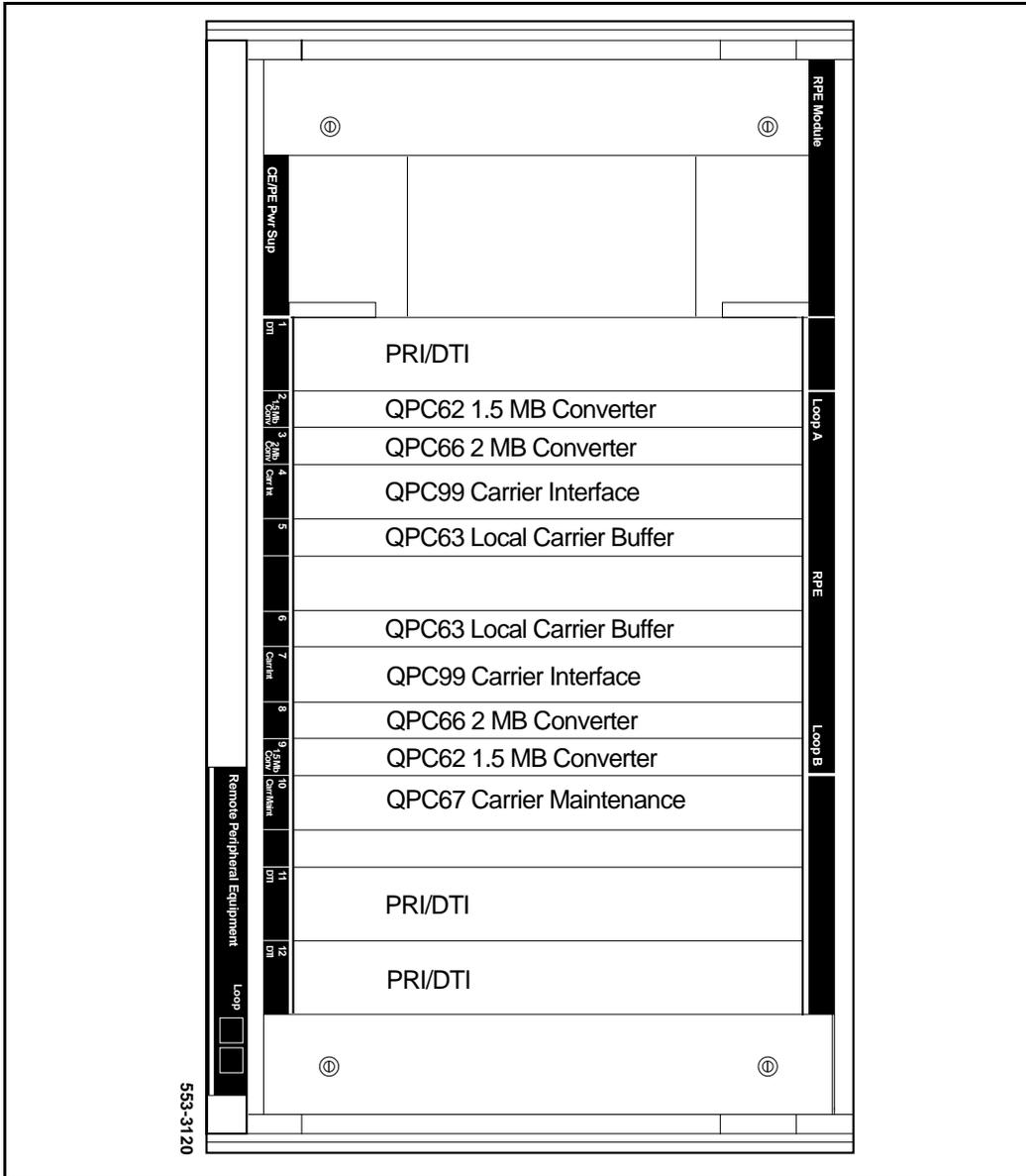
The RPE Module accommodates two network loops. The number of RPE Modules required per system depends on the number of connections required at the remote site.

At the local site, the RPE Module is equipped with QPC63 Local Carrier Buffer Cards. Although they are not related to RPE function, the RPE Module can also house PRI/DTI cards at the local site. At the remote site, the RPE Module is equipped with QPC65 Remote Peripheral Switch Cards.

This module provides 12 card slots for the following cards (see Figure 5 for cards housed at the local end):

- slots 1/11–12: PRI/DTI card (local end only)
- slots 2 and 9: QPC62 1.5 Mbyte Converter Card
- slots 3 and 8: QPC66 2 Mbyte Converter Card
- slots 4 and 7: QPC99 Carrier Interface Card
- slots 5 and 6: QPC63 Local Carrier Buffer Card (local end)  
QPC65 Remote Peripheral Switch Card (remote end)
- slot 10: QPC67 Carrier Maintenance Card

**Figure 5**  
**NT8D47 RPE Module—local site**



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# System capacity

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## Content list

The following are the topics in this section:

- [Network terminating capacity 21](#)
- [Network traffic capacity 21](#)
- [Memory capacity 22](#)
- [System limits 22](#)
- [Software configuration capacities 23](#)

## Reference list

The following are the references in this section:

- *Capacity Engineering (553-3001-149)*

## Network terminating capacity

The NT8D04 Superloop Network Card or NT1P61 Fibre Superloop Network Card provides four network loops grouped as one superloop. One superloop can serve up to two NT8D37 IPE Modules.

## Network traffic capacity

Each superloop can carry 3500 hundred call seconds (CCS), or 875 CCS per loop, of combined station, trunk, attendant console, and Digitone traffic during an average busy season busy hour (ABSBH). This capacity is subject to the following grades of service:

- the loss of no more than 1 percent of the incoming terminating calls, provided the called line is free

- the loss of no more than 1 percent of the originating outgoing calls in the system, provided an idle trunk is available
- the loss of no more than 1 percent of the intra-office calls, provided the called line is free
- no more than 1.5 percent of originating calls with more than a 3-second wait for dial tone
- the loss of no more than 1 percent of tandem calls, provided an idle outgoing trunk is available

## Memory capacity

Memory capacity varies with system type. Memory requirements depend on the system size and features available. To calculate memory requirements, refer to *Capacity Engineering* (553-3001-149).

**Table 1**  
**Memory capacity for Options 51C, 61C, 81C**

| System Option | X11 release | Mbytes  |
|---------------|-------------|---|
| 51C, 61C, 81C | 25          | 64, 80, 112, 128 (NT5D03 CP card or NT5D10 CP card) |

## System limits

Table 2 lists the system limit parameters defined in software.

**Table 2**  
**System limits**

| Parameters                        | 51C         | 61C         | 81C         |
|-----------------------------------|-------------|-------------|-------------|
| Low-priority input buffers        | 96 to 7500  | 96 to 7500  | 96 to 7500  |
| High-priority input buffers       | 16 to 7500  | 16 to 7500  | 16 to 7500  |
| 500-type telephone output buffers | 16 to 7500  | 16 to 7500  | 16 to 7500  |
| Number of call registers          | 26 to 20000 | 26 to 20000 | 26 to 20000 |

## Software configuration capacities

Maximum configuration capacities are given in Table 3. A system may not be able to simultaneously accommodate all of the maximum values listed due to system limitations on the real time, memory, or traffic capacity.

**Table 3**  
**Software configuration capacities**

| Maximum configurations                                       | 51C  | 61C  | 81C  |
|--|------|------|------|
| <b>Per system:</b>   |      |      |      |
| • steps in a hunting group                                   | 30   | 30   | 30   |
| • speed call lists   | 8191 | 8191 | 8191 |
| • members per trunk route                                    | 254  | 254  | 254  |
| • input output devices                                       | 16   | 16   | 16   |
| • appearances of the same directory number                   | 30   | 30   | 30   |
| • number of customers  | 100  | 100  | 100  |
| <b>Per customer:</b>   |      |      |      |
| • ringing number pickup groups                               | 4095 | 4095 | 4095 |
| • trunk routes   | 512  | 512  | 512  |
| • listed directory numbers (direct inward dialing only)      | 4    | 4    | 4    |
| • lamp field array (may be repeated once on another console) | 1    | 1    | 1    |
| • consoles   | 63   | 63   | 63   |
| <b>Per attendant console:</b>                                |      |      |      |
| • feature keys   |      |      |      |
| M1250  | 10   | 10   | 10   |
| M2250  | 20   | 20   | 20   |
| • incoming call indicators                                   | 20   | 20   | 20   |
| • trunk group busy indicators                                | 16   | 16   | 16   |
| M1250  | 20   | 20   | 20   |
| M2250  | 2    | 2    | 2    |
| • additional key/lamp strips                                 |      |      |      |



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# Configuration guidelines

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## Content list

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## Reference list

The following are the references in this section:

- *X11 Features and Services (553-3001-306)*

This section provides general rules for system configuration. The worksheets referenced in this section are provided at the end of this document.

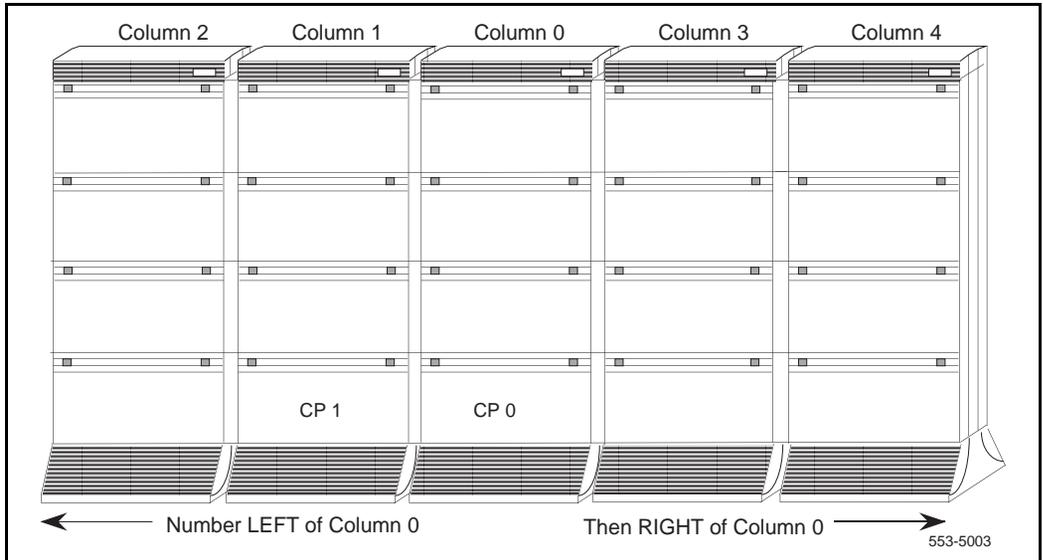
## Column configuration

Columns are numbered from 0 to 63 (the column containing CP 0 must be Column 0). At installation, number all columns to the left of column 0 consecutively, starting with column 1. The first column to the right of column 0 is then numbered after the last column on the left of column 0. Any other columns to the right are then numbered consecutively (see Figure 6). Note that as the system expands, column numbering may become more random.

**Note:** Modules containing the CP equipment should always be placed in the first two tiers of Meridian 1 system columns.

A column can contain up to four modules; however, some or all columns can be configured with fewer than four modules. The modules in each column are numbered from 0 to 3, starting from the bottom.

**Figure 6**  
**Column numbering**



Cabling between network components and peripheral equipment modules (IPE) can be routed externally, such as between rows, through input/output (I/O) panels or electromagnetic interference (EMI) filters.

Cabling between other types of modules, such as CP Modules, must remain within the Meridian 1 columns. All vertically routed internal cables must be routed on the right side of the column (facing the column) to avoid possible interference from the power supplies in the modules.

The possible positioning for modules in each column is highly flexible. However, the conventions described here are generally followed when a system is initially configured, and there are a few cooling and cabling constraints.

## IPE Modules

The distance allowed between a network card and the peripheral equipment module it serves is limited to a maximum network cable length of 13.7 m (45 ft). A peripheral equipment module can be placed anywhere in the system, as long as it is within the range of the network cable.

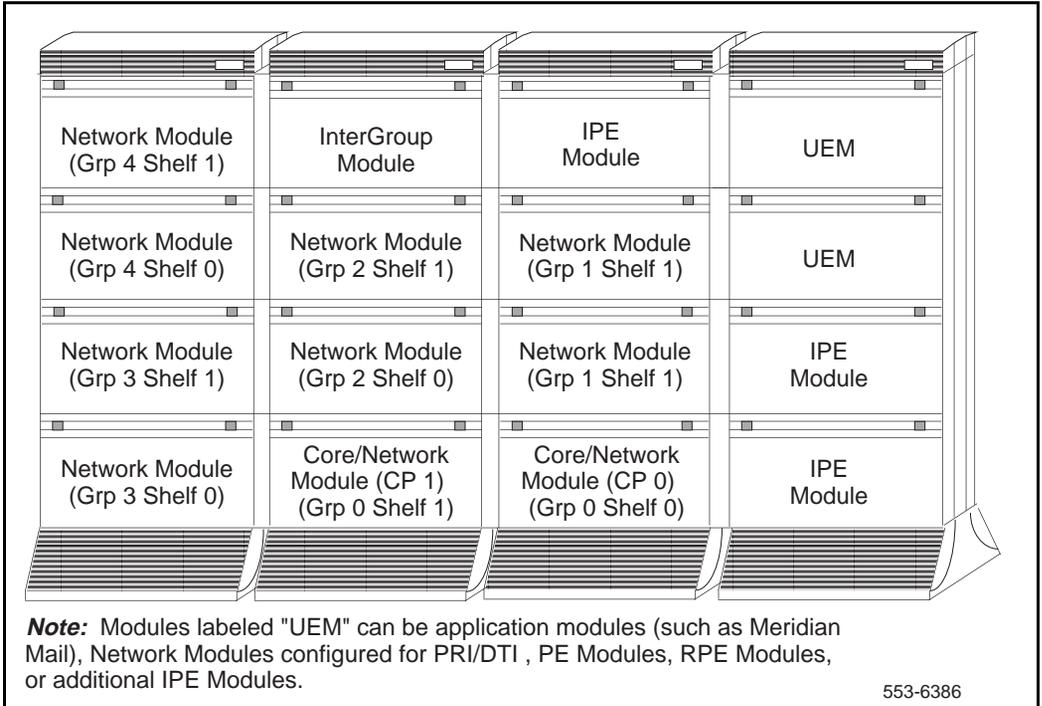
## Network Modules

The modules for each network group must be located together and in the same column (see Figure 7):

- The two modules that house each full network group are placed one on top of the other, with the module for shelf 0 on the bottom.
- The modules that house group 0 are located in column 0; the modules that house group 1 are located in column 1.
- Additional network groups are added to the left of the CP columns.

Figure 7 shows an Option 81C system. Option 81C provides one network group (Group 0) by the two Core/Network Modules. This allows replacement of Network Modules for Group 0 with IPE Modules for lines expansion.

**Figure 7**  
**Option 81C with network groups**



## I/O access

### System Option 81C

The system architecture assigns multiple address-mapped I/O spaces, one per network group, for accessing I/O devices. The I/O bus is extended to each network group through cables from secondary shrouds on the Core Module backplane to QPC441 3PE Cards in Network Modules. The backplane shrouds interface with the two ports on each NT6D65 CNI Card.

### CNI configuration (Options 51C, 61C, and 81C)

In the NT5D21 Core/Net Module, port 0 on the NT6D65 Core to Network Interface (CNI) Card in slot 12 supports a half-group, which does not have to be group 0, however, in a new system it is normally configured as group 0. Communication between the CNI and 3PE cards for group 0 is accomplished through the backplane; no cable is required.

There are two ports on each CNI card, and three ports on each CNI-3 card. CNI or CNI-3 cards are added when additional Network groups are required.

The default (factory) CNI port assignments are shown in Table 17. This table shows that port assignments for a CNI-3 card. CNI cards provide ports for two Network groups each. These connections are made from the backplane of the Core/Net modules. CNI-3 cards contain a third port on the CNI-3 faceplate.

**Note:** Network groups configuration is flexible. Any CNI port may support any given network group, however, for ease of maintenance, associate network groups and CNI ports in a logical sequence. Refer to Table 4 for a typical CNI port assignment and the associated network group. Port 0 of the CNI in slot 12 and the 3PE card are hard wired at the module's backplane.

The NT5D21 Core/Network Module is also used in Options 51C and 61C. Again, port 0 is dedicated to group 0, and the CNI card must be installed in slot 12. This is because the Option 61C is a single group system and Option 51C is a half-group system.

**Table 4**  
**Typical CNI configurations (Option 81C)**

| Option 81C<br>CNI card slot / port | Network group supported |
|------------------------------------|-------------------------|
| CNI 12/ Port 0                     | Group 0                 |
| CNI 12/ Port 1                     | Group 1                 |
| CNI 13/ Port 0                     | Group 2                 |
| CNI 13/ Port 1                     | Group 3                 |
| CNI 14 / Port 0                    | Group 4                 |
| CNI 14 / Port 1                    | Group 5                 |
| CNI 13                             | Group 6                 |
| CNI 14                             | Group 7                 |

**Note:** You do not have to configure both ports on a CNI card.

## Network configuration

Network switching cards digitally transmit voice and data signals. Network switching also requires service loops (such as conference and TDS loops), which provide call progress tones and outpulsing.

The two types of network cards available are:

- the NT8D04 Superloop Network Card which provides four loops per card grouped together in an entity called a superloop
- the QPC414 Network Card which provides two loops per card

On most Meridian 1 system Options, network loops are organized into groups. A system is generally configured as one of the following:

- a half-group system which provides up to 16 loops
- a full-group system which provides up to 32 loops
- a multiple-group system which provides up to 160 loops

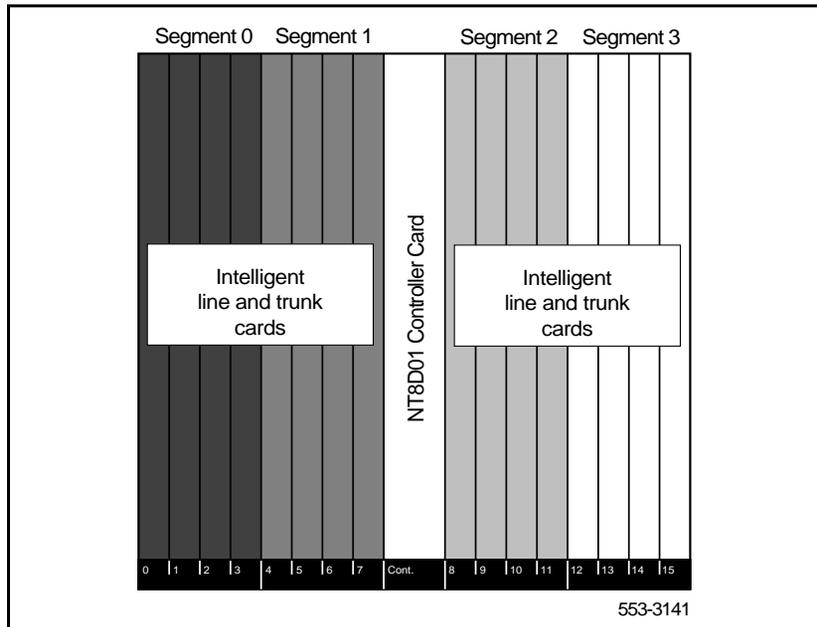
An additional switching stage is required for switching to be performed between groups in multiple-group configurations. This switching stage, an extension of the originating and terminating network loops, is provided by intergroup switch cards and the junction board in the InterGroup Module.

### Superloop network configurations

By combining four network loops, the superloop network card makes 120 traffic timeslots available to IPE cards. The increased bandwidth and larger pool of timeslots provided by a superloop increases network traffic capacity for each 120-timeslot bundle by 25 percent (at a P0.1 grade of service).

The NT8D37 IPE Module is divided into segments of four card slots numbered 0–3 (see Figure 8). Segment 0 consists of slots 0–3, segment 1 consists of slots 4–7, segment 2 consists of slots 8–11, and segment 3 consists of slots 12–15. A superloop can be assigned from one to eight IPE segments.

**Figure 8**  
**Superloop segments in the IPE Module**



A superloop is made up of NT8D04 Superloop Network Cards, NT8D01 Controller Cards, and from one to eight IPE segments. The NT8D01BC Controller-4 Card interfaces with up to four superloop network cards. The NT8D01BD Controller-2 Card interfaces with up to two superloop network cards.

The following superloop-to-segment configurations are supported:

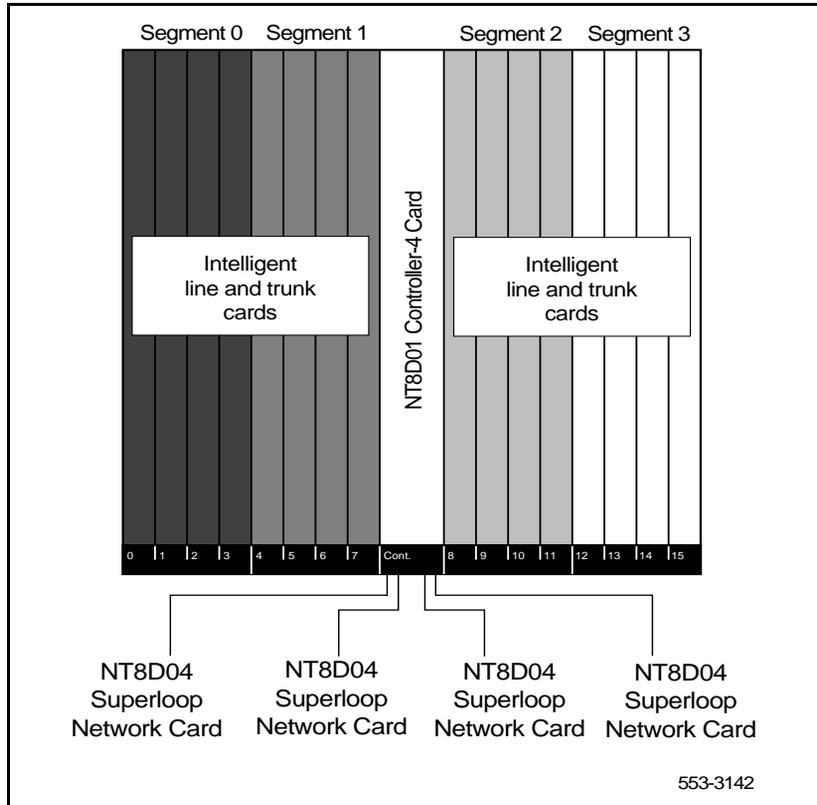
- one segment per superloop
- two segments per superloop
- four segments per superloop
- eight segments per superloop
- one segment per superloop/three segments per another superloop
- two segments per superloop/six segments per another superloop

### **One segment per superloop**

A configuration of one segment per superloop requires four superloop network cards and one NT8D01 Controller-4 Card (see Figure 9).

If the segment is equipped with digital line cards that have all 16 voice and all 16 data terminal numbers (TNs) provisioned, this configuration provides a virtual nonblocking environment (120 traffic timeslots to 128 TNs).

**Figure 9**  
**One segment per superloop**



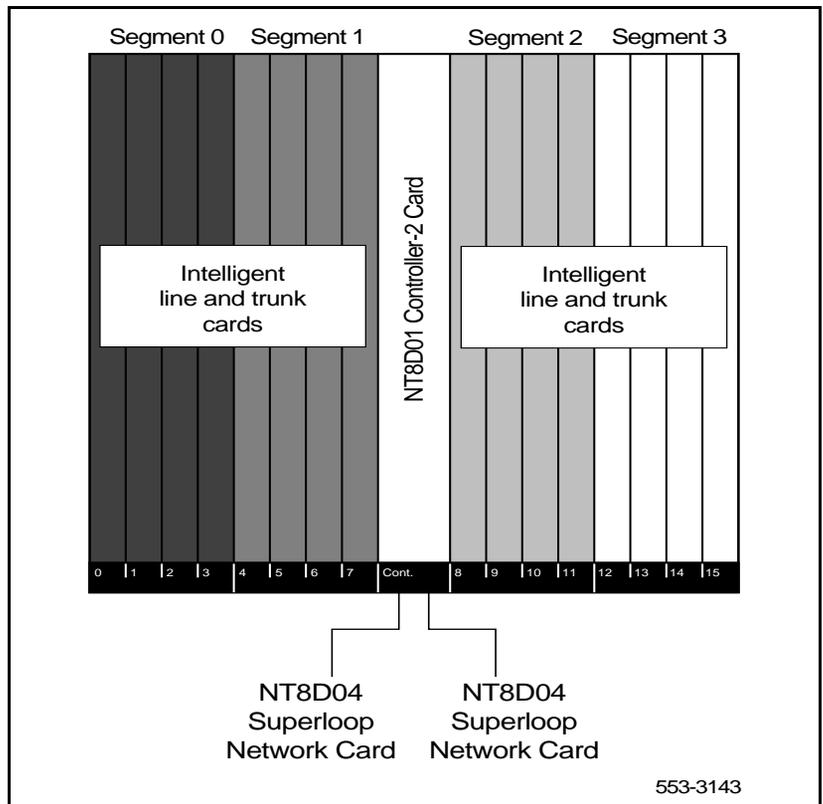
### Two segments per superloop

A configuration of two segments per superloop requires two superloop network cards and one NT8D01 Controller-2 Card (see Figure 10).

If the segments are equipped with analog line cards and trunk cards, this configuration provides a virtual nonblocking environment (120 traffic timeslots to 32–128 TNs).

If half of the data TNs on digital line cards are enabled, this configuration still provides a low concentration of TNs to timeslots (120 traffic timeslots to 196 TNs) and a very low probability of blocking.

**Figure 10**  
**Two segments per superloop**



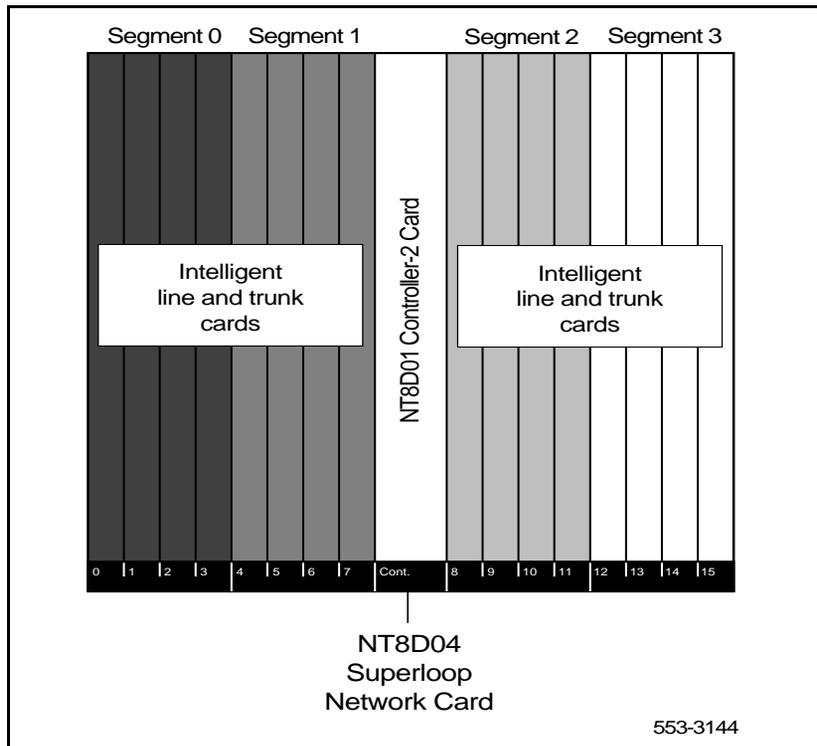
### Four segments per superloop

A configuration of four segments per superloop requires one superloop network card and one NT8D01 Controller-2 Card (see Figure 11).

If the segments are equipped with analog line cards and trunk cards, this configuration provides a medium concentration environment (120 traffic timeslots to 64–256 TNs).

If half of the data TNs on digital line cards are enabled, this configuration provides a concentration of 120 traffic timeslots to 384 TNs.

**Figure 11**  
**Four segments per superloop**



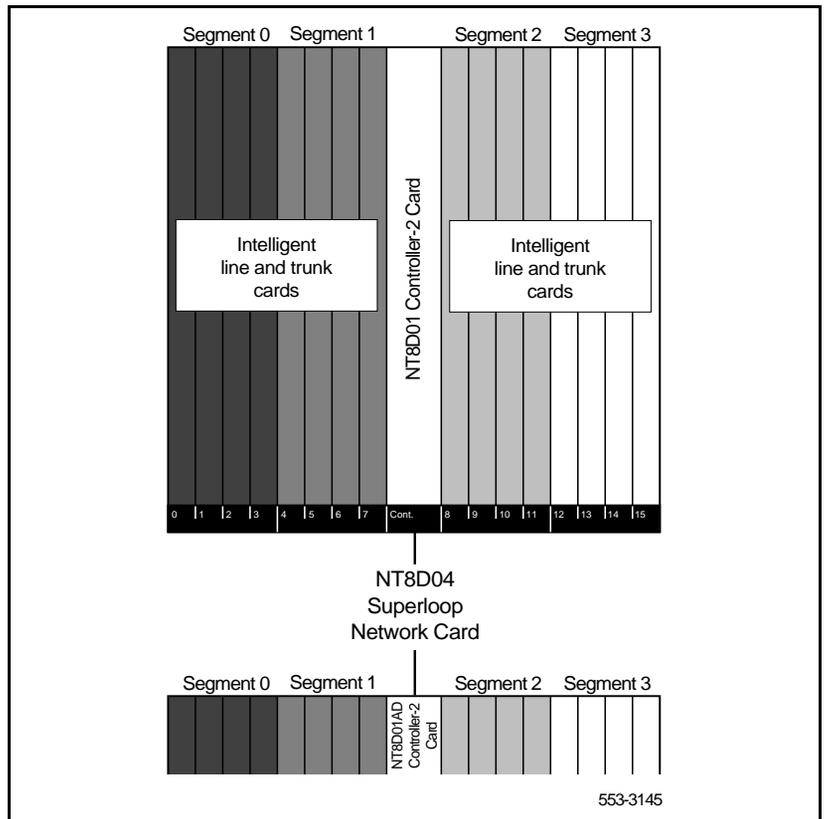
### Eight segments per superloop

A configuration of eight segments per superloop requires one superloop network card and two NT8D01 Controller-2 Cards (see Figure 12).

If the segments are equipped with analog line cards and trunk cards, this configuration provides a high concentration environment (120 traffic timeslots to 128–512 TNs).

If half of the data TNs on digital line cards are enabled, this configuration provides a concentration of 120 traffic timeslots to 768 TNs.

**Figure 12**  
**Eight segments per superloop**



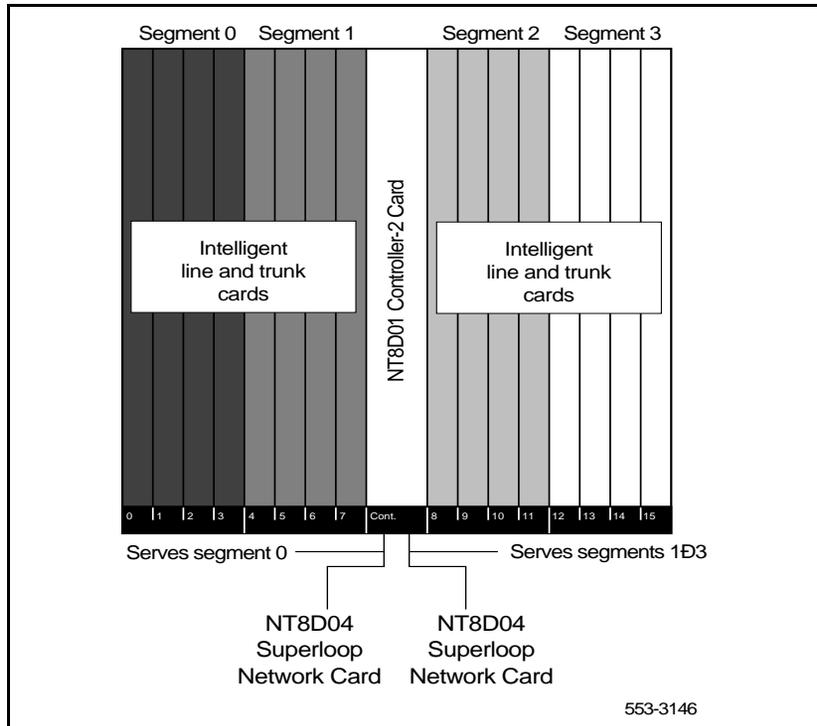
**One segment per superloop/three segments per another superloop**

A configuration of one segment per superloop/three segments per another superloop requires two superloop network cards and one NT8D01 Controller-2 Card (see Figure 13).

This configuration provides:

- a virtual nonblocking environment (120 traffic timeslots to 128 TNs) for the single segment served by the first superloop
- a medium concentration of TNs to timeslots for the three segments assigned to the additional superloop

**Figure 13**  
**One segment per superloop/three segments per superloop**



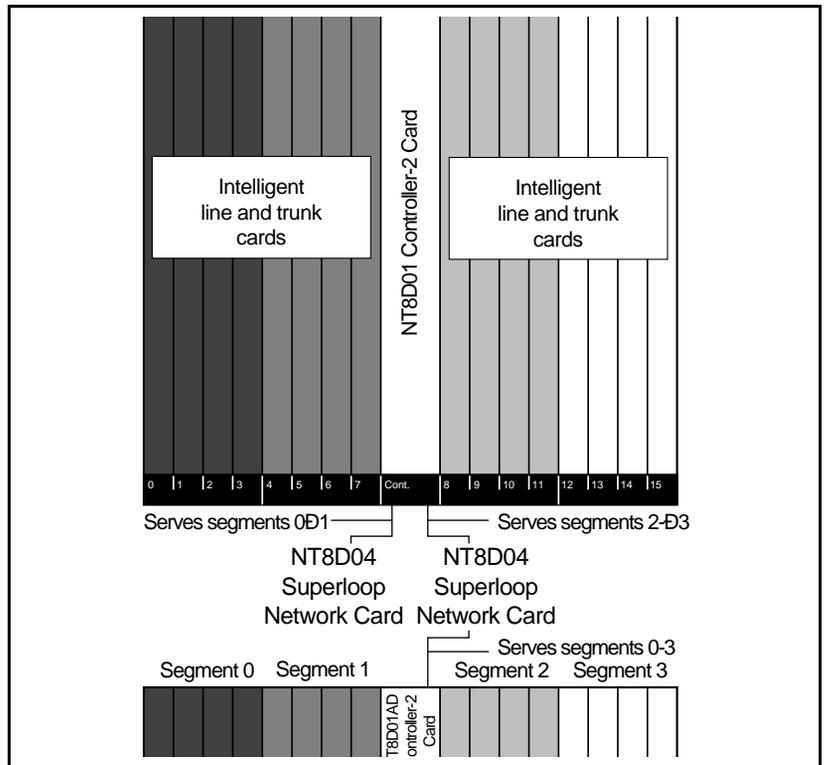
### Two segments per superloop/six segments per another superloop

A configuration of two segments per superloop/six segments per another superloop requires two superloop network cards and two NT8D01 Controller-2 Cards (see Figure 14).

This configuration provides:

- a virtual nonblocking environment for the two segments served by the first superloop (or a very low concentration of TNs to timeslots if some data TNs are enabled)
- a medium concentration of TNs to timeslots for the six segments assigned to the additional superloop

**Figure 14**  
Two segments per superloop/six segments per superloop



## IPE configuration

As described in “Network configurations,” an IPE Module is divided into segments of four card slots that are assigned to superloops. A superloop combines four regular network loops to make 120 traffic timeslots available to the IPE cards. There can be from one to eight segments in a superloop, in a number of configurations. Each configuration is selected based on system traffic requirements and the specific IPE cards used.

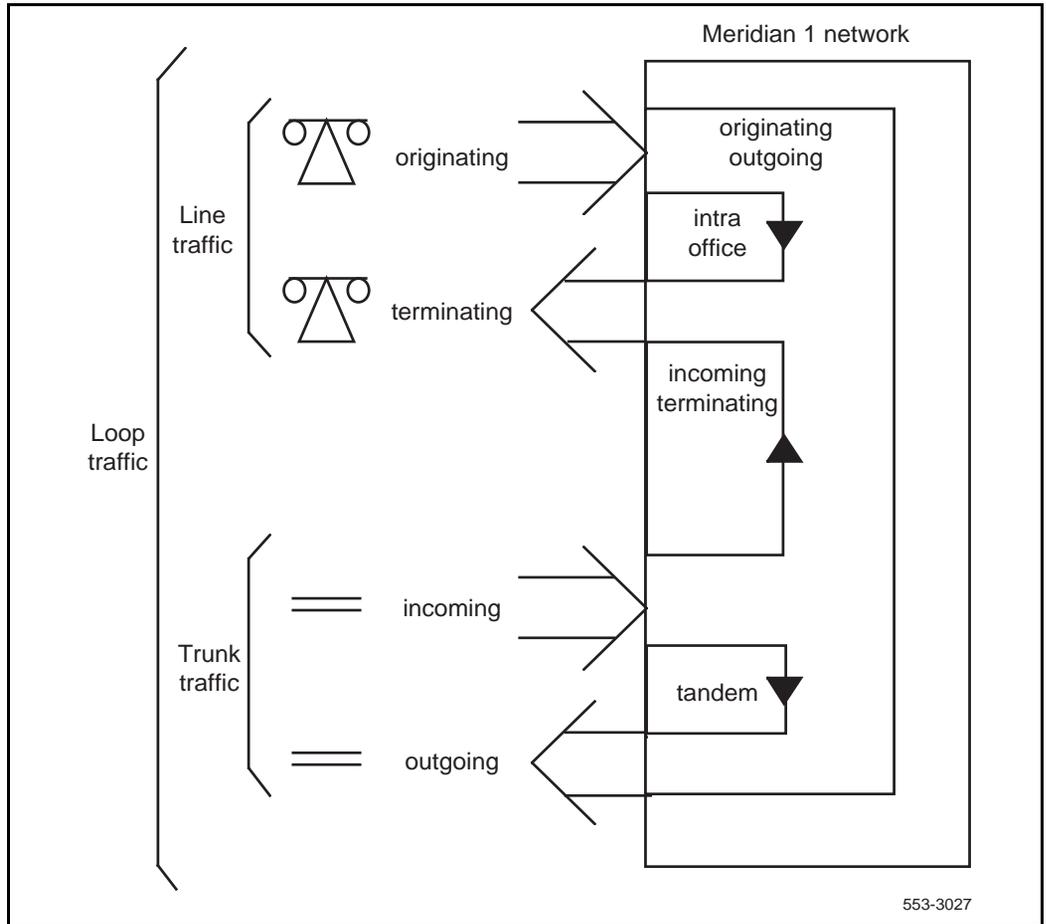
Preferably, a superloop should be configured to serve an even number of segments. You should assign full traffic and IPE cards to one superloop before assigning the next superloop. However, there may be empty IPE slots associated with a superloop if the superloop is not assigned to exact multiples of eight cards. As the system grows, more IPE cards can be added to that superloop.

The total number of ringing generators required in a system can be minimized by consolidating analog line cards in as few IPE Modules as possible. However, for traffic and reliability purposes, the analog line cards must not fill more than three-fourths of the IPE Module.

## Traffic configuration

The traffic distribution when considering individual customer or system traffic is shown in Figure 15.

**Figure 15**  
**Traffic distribution**



## Traffic definitions

The following list gives definitions for traffic terminology used in determining the provisioning requirements of a Meridian 1 system:

- CCS = Hundred call seconds is the unit in which amounts of telephone traffic are measured. One call that lasts for 100 seconds equals one CCS.
- Line CCS = Incoming terminating CCS + originating outgoing CCS + terminating intra-office CCS + originating intra-office CCS
- I/O = Intra-office traffic in CCS
- Intra-office Ratio (R) = Terminating intra-office CCS + originating intra-office CCS ÷ line traffic in CCS
- Loop CCS = Line CCS + incoming terminating + originating outgoing  
or  
= Line CCS x (2-R)
- Total line CCS = Total loop CCS ÷ (2-R)
- Total trunk CCS = Total line CCS x (1-R)  
or  
= Total loop CCS x (1-R) ÷ (2-R)
- Total intra-office capacity (terminating + originating) = Total loop CCS x R ÷ (2-R)
- Total I/O CCS = Total loop capacity x R ÷ (2-R)
- Network CCS = Total CCS handled by the switching network  
or  
= CCS offered to the network by stations, trunks, attendants, Digitone receivers, conference circuits, and special features
- InterGroup CCS = The measure of traffic flow between two network groups in systems with more than one network group

## Network loop traffic

Typically, initial equipment is configured at an 85 percent utilization level to leave room for expansion. The traffic level per network loop depends on whether or not the peripheral equipment uses Digitone equipment:

- 3500 CCS is the capacity of a fully loaded superloop.
- 2975 CCS is 85 percent utilized; Digitone traffic is a part of the capacity.

## Partitioning

The Meridian 1 can be configured as a partitioned or nonpartitioned system when it serves more than one customer.

A partitioned system dedicates each customer and the customer's associated lines and trunks to actual partitioned segments of the system in terms of loops and modules. Consoles and Digitone receivers are normally spread over all loops and modules in a partitioned system.

In a nonpartitioned system, all customers, trunks, lines, consoles, and Digitone receivers are spread over all loops and modules. A nonpartitioned system provides the following advantages:

- fewer traffic loops are required
- fewer peripheral equipment (IPE and PE) modules and cards are required
- system call-carrying capacity is more easily achieved and maintained
- customers are distributed evenly over the loops
- load balancing is more easily accomplished

## Network loop assignment

When assigning the loop number in systems equipped with two Network Modules, distribute the load evenly across both modules. Record the loops used in Worksheet A.

Distribute the total number of IPE Modules over the total number of voice and data loops. Normally, one IPE Module is assigned to a superloop. However, one IPE Module can be assigned from one to as many as four superloops, depending on the concentration of terminal number-to-timeslot ratio.

Compute the number of network groups based on the total number of loops required (excluding conference/TDS loops). Use Table 5 and the following equation to find the number of network groups required:

$$\text{Total number of loops} = (4 \times \text{the number of superloop network cards}) + (2 \times \text{the number of QPC414 Network Cards})$$

**Table 5**  
**Loop number assignment**

| Number of groups | Loop assignments |
|------------------|------------------|
| 1                | 28               |
| 2                | 56               |
| 3                | 84               |
| 4                | 112              |
| 5                | 140              |
| 6                | 168              |
| 7                | 196              |
| 8                | 224              |

## Peripheral equipment card distribution

Use Worksheet B to determine the total number of each type of IPE card (line, trunk, DTR) for each IPE Module.

Use Worksheets C and D to determine the number of multiple appearance groups (MAGs) assigned to each loop (use Worksheet E as an MAG record sheet). Distribute MAGs evenly over all the loops.

Do not assign MAGs that call each other frequently to the same loop; assign them to the same network group to reduce intergroup calls in multiple network group systems. If possible, avoid MAGs of more than ten.

Within a multiple network group system, assign users that call each other frequently to the same network group. Similarly, assign trunk groups that are used primarily by certain groups of users within the same network group as those users.

### Card slot priority

Input messages from card slots 0 and 1 in each IPE Module are directed to a high-priority input buffer. The input messages from the remaining slots are directed to a low-priority input buffer. To minimize input buffer delay on signals from devices in high-priority card slots, the system processes the low-priority input buffer only when the high-priority buffer and 500-type telephone output buffers are empty. This mechanism is important only for the types of trunks that require critical timing.

### Class-of-service priority

Selected telephones and trunks can be assigned a high-priority class of service that allows their requests for dial tone to be processed first. The fewer the telephones and trunks assigned as high priority, the better the service will be during heavy load conditions.

## Trunks

The recommended card slot assignment for trunks is as follows:

- Always assign automatic inward and outward dial trunks to card slots 0 and 1.
- If possible, assign delay dial, wink start, and DTMF-type trunks to a high-priority card slot. Other types of trunks can be assigned to high-priority card slots to avoid glare, but can also be assigned to low-priority card slots (2 through 10).
- To minimize the number of high-priority input messages during pulsing, do not assign trunks using 10 or 20 pps (incoming) to a high-priority card slot unless necessary.

## Attendant consoles

Do not assign attendant consoles to a high priority card slot. Too many high priority messages from attendant consoles assigned to these card slots can result in delays in output messages to attendant consoles, telephones, and trunks. Always assign attendant consoles to card slots 2 through 10. Do not assign a large number of attendant consoles to the same network loop since buffer overflow may result.

## 500/2500 telephones

The 500/2500 telephones can be assigned to any card slot. However, assigning a 500/2500 telephone to a high-priority card slot can cause input messages to delay output buffer processing during pulsing.

## Assigning card slots

Use Worksheet F to assign cards to slots in all peripheral equipment modules. Calculate the average load after all cards of a particular type have been assigned. Total the load and keep a running total. This method prevents the need to interchange cards at the end of the process because of load imbalance. Assign cards in the order listed below.

- 1 Assign cards requiring a high priority slot.

*Note:* For IPE Modules, both card slots 0 and 1 are reserved for high-priority signaling.

- 2 Assign cards for high-usage trunks, such as central office (CO) trunks.
- 3 Assign cards for low-usage trunks, such as paging and dictation.
- 4 Assign cards for attendant consoles.
- 5 Assign DTR cards.
- 6 Assign cards for telephones associated with multiple appearance groups.
- 7 Assign remaining cards. On a system that has a high density of Digitone telephones, assign the least number of 500-telephone line cards to loops that have DTRs assigned.

*Note:* Distribute loops and conference/TDS cards evenly across network modules and groups.

- 8 Calculate the total load per module.
- 9 Calculate the total load per loop.
- 10 If required, rearrange card assignments to balance the load.

## Assigning terminal numbers

Once the cards are assigned, the individual units on each card can be assigned. Use Worksheet G to record the terminal number (TN) assignments. TN 0000 cannot be used on superloop 0. Therefore, assign loop 0 to a QPC414 Network Card.

## Ongoing configuration

### Ongoing assignment plan

Use the initial assignment records to complete an assignment plan for each equipped network loop in the system (see Worksheet H). Assignments for future trunks, Multiple Appearance Group (MAG) stations, consoles, and DTR requirements can be developed for each loop according to this profile.

### Cutover study

Once the system is placed in service, a cutover study should be performed. The results of this study are used to update the loop profiles and create a new assignment plan. Ongoing assignments must follow the new assignment plan until the first customer busy-season trunking study. At that time, loop threshold measurements are set so that at least one of the predominant busy hours would produce a CCS load output.

### Threshold study

From the threshold study printout, the loop profile must be updated and a new assignment plan developed. At this time, it is advisable to estimate the system capacity for growth. If the growth capacity is sufficient to last beyond the next annual threshold study, assignments can continue in accordance with the assignment plan. If the growth capacity is insufficient, plans must be made to establish a tentative date when new equipment (loops or modules) must be ordered and installed. This date is generally controlled by physical capacity and tracked by total working physical terminations.

### Equipment relief

When additional equipment is installed, assignments should be concentrated on the new loop or modules until the first threshold study. At that time, the loop profile is updated and a new loading plan is developed. Any time a loop exceeds 560 CCS (based on an 85 percent traffic level), that loop must be suspended from future assignments. If a loop encounters service problems, it must be suspended and sufficient load removed to reduce service to an acceptable level.

## Assignment records

The following printouts are available from the system and should be used in addition to worksheets to assist in maintaining assignment records:

- list of trunk route members
- list of TN blocks
- list of unused card positions
- list of unused units
- directory number (DN) to TN matrix

Refer to *X11 Features and Services* (553-3001-306) for information on obtaining and manipulating data in the system.



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# Provisioning guidelines

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The values and limits used in this document are not necessarily typical and should not be interpreted as limits of the system capacity. The values should be adjusted to suit the application of a particular system. Consult your Nortel Networks representative and use a configuration tool, such as Autoquote or Meridian Configurator, to fully engineer a system.

To determine general equipment requirements, follow the provisioning guidelines in the order shown below. (These provisioning methods are based on a nonpartitioned system.) Use the worksheets prepared in the previous chapter and the reference tables at the end of this document.

- Step 1     Define and forecast growth
- Step 2     Estimate CCS per terminal
- Step 3     Calculate number of trunks required

- Step 4 Calculate line, trunk, and console load
- Step 5 Calculate DTR requirements
- Step 6 Calculate total system load
- Step 7 Calculate number of superloops required
- Step 8 Calculate number of network groups required
- Step 9 Calculate number of peripheral equipment cards required
- Step 10 Calculate number of peripheral equipment modules required
- Step 11 Provision conference/TDS loops
- Step 12 Calculate memory requirements
- Step 13 Assign equipment and prepare equipment summary

## Step 1: Define and forecast growth

The first step in provisioning a new system is to forecast the number of telephones required at two-year and five-year intervals.

The number of telephones required when the system is placed in service (cutover) is determined by the customer. If the customer is unable to provide a two-year and five-year growth forecast, then an estimate of annual personnel growth in percent is used to estimate the number of telephones required at the two-year and five-year intervals.

### Example

A customer has 500 employees and needs 275 telephones to meet the system cutover. The customer projects an annual increase of 5 percent of employees based on future business expansion. The employee growth forecast is:

- $500 \text{ employees} \times 0.05 \text{ (percent growth)} = 25 \text{ additional employees at 1 year}$
- $525 \text{ employees} \times 0.05 = 27 \text{ additional employees at 2 years}$
- $552 \text{ employees} \times 0.05 = 28 \text{ additional employees at 3 years}$
- $580 \text{ employees} \times 0.05 = 29 \text{ additional employees at 4 years}$
- $609 \text{ employees} \times 0.05 = 31 \text{ additional employees at 5 years}$
- $640 \text{ employees} \times 0.05 = 32 \text{ additional employees at 6 years}$

The ratio of telephones to employees is  $275/500$ , which equals 0.55. To determine the number of telephones required from cutover through a five-year interval, the number of employees required at cutover, one, two, three, four, and five years is multiplied by the ratio of telephones to employee (0.55).

- $500 \text{ employees} \times 0.55 = 275 \text{ telephones required at cutover}$
- $525 \text{ employees} \times 0.55 = 289 \text{ telephones required at 1 year}$
- $552 \text{ employees} \times 0.55 = 304 \text{ telephones required at 2 years}$
- $580 \text{ employees} \times 0.55 = 319 \text{ telephones required at 3 years}$
- $609 \text{ employees} \times 0.55 = 335 \text{ telephones required at 4 years}$
- $640 \text{ employees} \times 0.55 = 352 \text{ telephones required at 5 years}$

This customer requires 275 telephones at cutover, 304 telephones at two years, and 352 telephones at five years.

Each DN assigned to a telephone requires a TN. Determine the number of TNs required for each customer and enter this information in Worksheet I. Perform this calculation for cutover, two-year, and five-year intervals.

## Step 2: Estimate CCS per terminal

Estimate the station and trunk CCS per terminal (CCS/T) for the installation of a system using any one of the following methods:

- comparative method
- manual calculation
- default method

### Comparative method

Select three existing systems that have a historical record of traffic study data. The criteria for choosing comparative systems are:

- similar line size (+25 percent)
- similar business (such as bank, hospital, insurance, manufacturing)
- similar locality (urban or rural)

Once similar systems have been selected, their station, trunk, and intra-CCS/T are averaged. The averages are then applied to calculate trunk requirements for the system being provisioned (see the example in Table 6).

**Table 6**  
**Example of station, trunk, and intra-CCS/T averaging**

|             | Customer A | Customer B | Customer C | Total | Average |
|-------------|------------|------------|------------|-------|---------|
| Line size   | 200        | 250        | 150        | 600   | 200     |
| Line CCS/T  | 4.35       | 4.75       | 3.50       | 12.60 | 4.20    |
| Trunk CCS/T | 2.60       | 3.0        | 2.0        | 7.60  | 2.53    |
| Intra CCS/T | 1.70       | 1.75       | 1.50       | 4.95  | 1.65    |

If only the trunk CCS/T is available, multiply the trunk CCS/T by 0.5 to determine the intra-CCS/T (assuming a normal traffic pattern of 33 percent incoming calls, 33 percent outgoing calls, and 33 percent intra-system calls). The trunk CCS/T and intra-CCS/T are then added to arrive at the line CCS/T (see the example in Table 7).

**Table 7**  
**Example of CCS/T averaging when only trunk CCS/T is known**

| Trunk type  | Number of trunks | Grade of service | Load in CCS | Number of terms | CCS/T        |
|---|------------------|------------------|-------------|-----------------|--------------|
| DID   | 16               | P.01             | 294         | 234             | 1.20         |
| CO  | 14               | P.02             | 267         | 234             | 1.14         |
| Tie   | 7                | P.05             | 118         | 215             | 0.54         |
| Paging  | 2                | 10 CCS/trunk     | 20          | 207             | 0.09         |
| Out WATS  | 4                | 30 CCS/trunk     | 120         | 218             | 0.54         |
| FX  | 2                | 30 CCS/trunk     | 60          | 218             | 0.27         |
| Private line  | 4                | 20 CCS/trunk     | 80          | 4               | 20.00        |
|   |                  |                  |             | Total: 956      | Total: 23.79 |
| <p><b>Note:</b> The individual CCS/T per trunk group is not added to form the trunk CCS/T. The trunk CCS/T is the total trunk load divided by the total number of lines at cutover.</p> |                  |                  |             |                 |              |

From the preceding information, trunk CCS/T can be computed as follows:

$$\text{trunk CCS/T} = \text{total trunk load in CCS} / (\text{number of lines}) = 959 / 234 = 4.1$$

Assuming a 33 percent intra-calling ratio:

$$\text{intra CCS/T} = 4.1 \times 0.5 = 2.1, \text{ and}$$

$$\text{line CCS/T} = 4.1 (\text{trunk CCS/T}) + 2.1 (\text{intra-CCS/T}) = 6.2$$

## Manual calculation

Normally, the customer can estimate the number of trunks required at cutover and specify the grade of service to be maintained at two-year and five-year periods (see Table 8). (If not, use the comparative method.)

The number of trunks can be read from the appropriate trunking table to select the estimated usage on the trunk group. The number of lines that are accessing the group at cutover are divided into the estimated usage. The result is the CCS/T, which can be used to estimate trunk requirements.

### Example

- Line CCS/T = 6.2
- Trunk CCS/T = 4.1
- 2 consoles = 30 CCS

**Table 8**  
**Example of manual calculation of CCS/T**

|                |                                |      |
|----------------|--------------------------------|------|
| <b>Cutover</b> | Line CCS = $275 \times 6.2 =$  | 1705 |
|                | Trunk CCS = $275 \times 4.1 =$ | 1128 |
|                | Subtotal =                     | 2833 |
|                | Console CCS =                  | 30   |
|                | Total system load =            | 2863 |
| <b>2 years</b> | Line CCS = $304 \times 6.2 =$  | 1885 |
|                | Trunk CCS = $304 \times 4.1 =$ | 1247 |
|                | Subtotal =                     | 3132 |
|                | Console CCS =                  | 30   |
|                | Total system load =            | 3162 |
| <b>5 years</b> | Line CCS = $352 \times 6.2 =$  | 2183 |
|                | Trunk CCS = $352 \times 4.1 =$ | 1444 |
|                | Subtotal =                     | 3627 |
|                | Console CCS =                  | 30   |
|                | Total system load =            | 3657 |

This method is used for each trunk group in the system, with the exception of small special services trunk groups (such as tie, WATS, and FX trunks). Normally, the customer will tolerate a lesser grade of service on these trunk groups. Table 9 lists the estimated usage on special services trunks.

**Table 9**  
**Estimated load per trunk**

| Trunk type           | CCS |
|----------------------|-----|
| Tie                  | 30  |
| Foreign exchange     | 30  |
| Out WATS             | 30  |
| In WATS              | 30  |
| Paging               | 10  |
| Dial dictation       | 10  |
| Individual bus lines | 20  |

### Default method

Studies conducted estimate that the average line CCS/T is never greater than 5.5 in 90 percent of all businesses. If attempts to calculate the CCS/T using the comparative method or the manual calculation are not successful, the default of 5.5 line CCS/T can be used.

The network line usage is determined by multiplying the number of lines by 5.5 CCS/T. The total is then multiplied by 2 to incorporate the trunk CCS/T. However, when this method is used, the intra-CCS/T is added twice to the equation, and the result could be over provisioning if the intra-CCS/T is high.

Another difficulty experienced with this method is the inability to forecast individual trunk groups. The trunk and intra CCS/T are forecast as a sum group total. Examples of the default method and the manual calculation method are shown in Table 10 for comparison.

**Example**

- 275 stations at cutover
- 304 stations at two years
- 352 stations at five years

|           |   |                            |
|-----------|---|----------------------------|
| Cutover   | $275 \times 5.5 \text{ (CCS/T)} \times 2 =$ | 3025 CCS total system load |
| Two-year  | $304 \times 5.5 \text{ (CCS/T)} \times 2 =$ | 3344 CCS total system load |
| Five-year | $352 \times 5.5 \text{ (CCS/T)} \times 2 =$ | 3872 CCS total system load |

**Table 10**  
**Default method and manual calculations analysis**

|            | <b>Default method</b> | <b>Manual calculations</b> | <b>Difference</b> |
|------------|-----------------------|----------------------------|-------------------|
| Cutover    | 3025                  | 2863 CCS                   | 162 CCS           |
| Two years  | 3344                  | 3162 CCS                   | 182 CCS           |
| Five years | 3872                  | 3657 CCS                   | 215 CCS           |

### Step 3: Calculate number of trunks required

Enter the values obtained through any of the three previous methods in Worksheet I. Add the calculations to the worksheet. Once the trunk CCS/T is known and a grade of service has been specified by the customer, the number of trunks required per trunk group to meet cutover, two-year, and five-year requirements is determined as shown in the following example.

#### Example

The customer requires a Poisson 1 percent blocking grade of service (see Reference Table 1 on page 98). The estimated trunk CCS/T is 1.14 for a DID trunk group. With the cutover, two-year, and five-year number of lines, the total trunk CCS is determined by multiplying the number of lines by the trunk CCS/T:

|           |                                    |            |
|-----------|------------------------------------|------------|
| Cutover   | 275 (lines) x 1.14 (trunk CCS/T) = | 313.5 CCS  |
| Two-year  | 304 (lines) x 1.14 (trunk CCS/T) = | 346.56 CCS |
| Five-year | 352 (lines) x 1.14 (trunk CCS/T) = | 401.28 CCS |

Use Reference Table 2 on page 100 to determine the quantity of trunks required to meet the trunk CCS at cutover, two-year, and five-year intervals. In this case:

- 17 DID trunks are required at cutover
- 18 DID trunks are required in two years
- 21 DID trunk are required in five years

**Note:** For trunk traffic greater than 4427 CCS, allow 29.5 CCS/T.

## **Step 4: Calculate line, trunk, and console load**

Once the quantity of trunks required has been estimated, enter the quantities in Worksheet I for cutover, two-year, and five-year intervals. This calculation must be performed for each trunk group to be equipped. The total trunk CCS/T is the sum of each individual trunk group CCS/T. This value is also entered in Worksheet I.

### **Line load**

Line load is calculated by multiplying the total number of TNs by the line CCS/T. The number of TNs is determined as follows:

- one TN for every DN assigned to one or more single-line telephones
- one TN for every multi-line telephone without data option
- two TNs for every multi-line telephone with data option

### **Trunk load**

Trunk load is calculated by multiplying the total number of single- and multi-line TNs that have access to the trunk route by the CCS/T per trunk route.

### **Console load**

Console load is calculated by multiplying the number of consoles by 30 CCS per console.

## Step 5: Calculate Digitone receiver requirements

Once station and trunk requirements have been determined for the complete system, the DTR requirements can be calculated. The DTRs are shared by all customers in the system and must be distributed equally over all the network loops.

Reference Tables 3 through 6 are based on models of traffic environments and can be applied to determine DTR needs in most cases. When the system being provisioned does not fall within the bounds of these models or is equipped with any special features, the detailed calculations must be performed for each feature and the number of DTRs must accommodate the highest result.

Some special features are:

- Authorization Code
- Centralized Attendant Service (CAS)
- Charge Account for Call Detail Recording (CDR)
- Direct Inward System Access (DISA)
- Integrated Messaging System Link

*Note:* Go to “DTR/Feature calculations” on page 73 for more information on these features.

From the appropriate reference table (Reference Tables 3 through 6), determine the number of DTRs required and the DTR load for cutover, two-year, and five-year intervals. Record this information in Worksheet J.

The following models are based on some common PBX traffic measurements.

## Model 1

Reference Table 3 on page 102 is based on the following factors:

- 33 percent intra-office calls, 33 percent incoming calls, and 33 percent outgoing calls
- 1.5 percent dial tone delay grade of service
- no Digitone DID trunks or incoming Digitone tie trunks

## Model 2

Reference Table 4 on page 103 is based on the following factors:

- the same traffic pattern as Model 1
- Digitone DID trunks or incoming Digitone tie trunks
- Poisson 0.1 percent blockage grade of service

## Model 3

Reference Table 5 on page 104 is based on the following factors:

- 15 percent intra-office calls, 28 percent incoming calls, and 56 percent outgoing calls
- 1.5 percent dial tone delay grade of service
- no Digitone DID trunks or incoming Digitone tie trunks

## Model 4

Reference Table 6 on page 105 is based on the following factors:

- the same traffic pattern as Model 3
- Digitone DID trunks or incoming Digitone tie trunks
- Poisson 0.1 percent blockage grade of service

## Detailed calculation: Method 1

This method can be used when there are no incoming Digitone DID trunks and the following is assumed:

- Digitone receiver traffic is inflated by 30 percent to cover unsuccessful dialing attempts.
- Call holding time used in intra-office and outgoing call calculations is 135 seconds if unknown.
- Digitone receiver holding times are 6.2 and 14.1 seconds for intra-office and outgoing calls, respectively.
- Factor  $(1 - R)/2$  in (1) outgoing (incoming calls and outgoing calls are equal). R is the intra-office ratio.

Follow the procedure below for detailed calculation Method 1.

**1** Calculate Digitone calls:

Intra-office =  
 $100 \times \text{Digitone station traffic (CCS)} \div \text{call holding time} \times (R \div 2)$

Outgoing =  
 $100 \times \text{Digitone station traffic (CCS)} \div \text{call holding time} \times [(1-R) \div 2]$

**2** Calculate total DTR traffic:

$1.3 \times [(6.2 \times \text{Intra}) + (14.1 \times \text{Outgoing})] \div 100$

**3** Calculate average holding time:

$(6.2 \times \text{intra}) + (14.1 \times \text{outgoing}) \div \text{intra calls} + \text{outgoing calls}$

**4** See Reference Table 7 or 8 and use the answers from steps 2 and 3 to determine the number of DTRs required.

## Detailed calculation: Method 2

This method is used when incoming Digitone trunks are included in the system. This method uses the same assumptions as Method 1, with the DTR holding time assumed to be 2.5 seconds for a DID call. Follow the procedure below for detailed calculation Method 2.

- 1 Calculate intra-office and outgoing Digitone calls as shown in step 1 of Method 1:

$$\text{DID calls} = \text{DID Digitone trunk traffic (CCS)} \times 100 \div \text{call holding time}$$

- 2 Calculate total DTR traffic:

$$[(1.3 \times 6.2 \times \text{intra}) + (1.3 \times 14.1 \times \text{outgoing calls}) + (2.5 \times \text{DID calls})] \div 100$$

- 3 See Reference Table 9 on page 110 and use the answer from step 2 to determine the number of DTRs required.

## Step 6: Calculate total system load

Total the line, trunk, console, and DTR load for each customer to get the total load figure for each customer for cutover, two-year, and five-year intervals. Enter this figure in Worksheets J and K.

## Step 7: Calculate number of network loops required

The system network loop requirement is the total of all individual customer loops and superloops required. The number of network loops and superloops required is calculated for each customer for cutover, two-year, and five-year intervals. Network loops and superloops are provisioned at cutover based on the two-year loop requirement figure.

To determine the number of superloops required, first separate the traffic supported by QPC414 Network Cards: data line cards, RPE, and PRI/DTI. The remaining traffic (including DTR traffic) must be engineered for superloops.

$$\text{Number of superloop network cards or number of superloops} = \text{traffic to be handled by superloop network} \div 2975$$

These figures are based on an 85 percent utilization level. Round the value obtained to the next higher number.

## Nonblocking configuration with superloop network

For nonblocking applications (or a non-blocking part of the system), provide one superloop for every 120 TNs. Generally, each line or trunk is one TN, but an integrated voice and data line is two TNs (assuming the data port is configured).

## Blocking configuration with superloop network

For applications where blocking is allowed, one superloop can serve up to 512 lines (1024 TNs). The actual number of lines depends on the traffic requirement of the lines.

## QPC414 Network Cards

The traffic carried by QPC414 Network Cards includes data, RPE, and PRI/DTI traffic (which includes both data and voice traffic).

Provide separate loops for RPE and PRI/DTI traffic. Based on 85 percent utilization, calculate the number of loops required as follows:

- 1 Number of loops =  
traffic to be carried by QPC414 Network Cards  $\div$  560
- 2 Number of QPC414 Network Cards =  
number of loops  $\div$  2

*Note:* Round the value obtained to the next higher number.

## PRI/DTI cards

The PRI and DTI cards provide the interface between the system switch and T-1/DS-1 digital transmission trunks. Digital trunks are offered in a group of 24 trunks. Table 11 lists the number of PRI/DTI cards required when PRI/DTI traffic is known.

**Note:** The number of PRI/DTI loops is the same as the number of PRI/DTI cards.

**Table 11**  
**Number of cards required when PRI/DTI traffic is known**

| PRI/DTI traffic (CCS) | Number of PRI/DTI cards   |
|-----------------------|---|
| 1–507                 | 1   |
| 508–1201              | 2   |
| 1202–1935             | 3   |
| 1936–2689             | 4   |
| 2690–3456             | 5   |
| 3457–4231             | 6   |
| 4232–5006             | 7   |
| 5007–5781             | 8   |
| over 5781             | provide 8 plus one PRI/DTI for each 774 CCS in excess of 5781 CCS |

**Note:** In a Network Module, if two network slots are available but not next to each other, the network cards can be moved to create a 2-inch slot for a PRI/DTI card.

For nonblocking applications, the Ring Again feature must be provided since blocking may occur at the far end of the trunk.

Since a PRI/DTI card physically occupies two network slots, multiply the number of PRI/DTI cards by two to obtain the required number of slots.

The PRI/DTI cards can be installed in any module except IPE Modules. After all essential cards are configured, estimate the available slots for PRI/DTI. If not enough slots are available for all PRI/DTIs required, a Network Module can be added to the system to house the PRI/DTI cards required.

## Step 8: Calculate number of network groups required

Compute the number of network groups based on the total number of loops required (excluding conference/TDS loops). Record the network groups in Worksheet L. Use Table 12 and the following equation to find the number of network groups required:

$$\text{Total number of loops} = (4 \times \text{the number of superloop network cards}) + (2 \times \text{the number of QPC414 Network Cards})$$

**Table 12**  
**Number of network groups based on total number of loops required**

| Number of network groups | Number of loops |
|--------------------------|-----------------|
| 1                        | 28              |
| 2                        | 56              |
| 3                        | 84              |
| 4                        | 112             |
| 5                        | 140             |

**Note:** Use Worksheet K. Install a multiple-group system if the total number of loops required exceeds 28.

**Note:** Based on the criteria above, installing a multiple-group system initially is more cost-effective than converting to a multiple-group system (from a single-group system) between the two-year and five-year intervals.

For Options 81C, use Table 13 to calculate the number of NT6D65 CNI Cards needed to support the network groups.

**Table 13**  
**CNI configurations (Options 81C)**

| Number of network groups supported | Required number of CNI cards | Optional number of CNI cards |
|------------------------------------|------------------------------|------------------------------|
| "group 5" (bus extender)           | 1 (slot 8 port 0)            | (required)                   |
| 1 (group 0)                        | 1                            | 2                            |
| 2 (group 1)                        | 2                            | 3                            |
| 3 (group 2)                        | 2                            | up to 4                      |
| 4 (group 3)                        | 3                            | up to 5                      |
| 5 (group 4)                        | 3                            | up to 5                      |

## Step 9: Calculate number of IPE/PE cards required

In Worksheet M, enter the number of DTRs required (from Worksheet J). Use a separate worksheet for cutover, two-year, and five-year intervals.

Using information from Worksheet I, enter the number of single-line telephone TNs, multi-line telephone TNs, and trunk TNs required at cutover, two-year, and five-year intervals (for all customers) in Worksheet M.

Divide each entry by the number of TN assignments for each card, round up to the next higher figure, and total the number of cards required.

Calculate the number of IPE cards separately.

## Step 10: Calculate number of IPE/PE modules required

The number of peripheral equipment modules provided at cutover is based on the two-year estimate of peripheral equipment cards required and an 85 percent utilization level.

The maximum capacity of an IPE Module is 256 integrated voice and data or analog lines; however, a typical configuration includes a combination of lines, trunks, and DTRs, which provides up to 160 lines.

Divide the number of peripheral equipment cards required at two years by 8.5, round to the next higher number, and enter this value in Worksheet M.

To compute the number of peripheral equipment modules, divide the total number of line, trunk, and DTR cards required at two years by 13.6 and round to the next higher number. Enter this value in Worksheet M.

Calculate the number of IPE Modules required.

## Step 11: Provision conference/TDS loops

Conference/TDS loops are provisioned according to the two-year figure for the number of network loops required. All systems must be equipped with a minimum of two conference and two TDS loops.

See Reference Tables 10 and 11 to determine conference/TDS loop requirements. Enter these figures in Worksheet N.

## Step 12: Calculate memory requirements

Use Worksheets O through Q to calculate memory requirements. Use the two-year figure for telephones, consoles, and trunks for the calculation. Add 10 percent to the total memory requirements.

**Note 1:** Real-time memory requirements must be calculated using the data in *Capacity Engineering* (550-3001-149).

**Note 2:** This step does not apply to Options 51C, 61C, and 81C because there is no variable number of memory cards.

## **Step 13: Assign equipment and prepare equipment summary**

Use Worksheet R to record the equipment requirements for the complete system at cutover. Assign the equipment. The equipment summary may have to be updated as a result of assignment procedures. Use the finalized equipment summary to order the equipment for the system.



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# DTR/Feature calculations

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## Content list

The following are the topics in this section:

- [Calculations with Authorization Code 73](#)
- [Calculations with Centralized Attendant Service 74](#)
- [Calculations with Charge Account for Call Detail Recording 74](#)
- [Calculations with Direct Inward System Access 75](#)
- [Calculations with Integrated Messaging Service Link 75](#)

## Calculations with Authorization Code

With Authorization Code, the DTR holding times change from 6.2 seconds to 19.6 seconds for intra-office calls, and from 14.1 seconds to 27.5 seconds for outgoing calls.

Use the values in steps 2 and 3 of “Detailed calculation: Method 1” and step 2 of “Detailed calculation: Method 2” to calculate the DTR requirements for a system with the Authorization Code option.

The following is assumed:

- all Digitone intra-office and outgoing calls require authorization
- the average number of special services prefix (SPRE) digits is two (the maximum is four)
- the average number of Authorization Code digits is 10 (the range is 1 to 14 digits)
- the average DTR holding time is 13.4 seconds

## Calculations with Centralized Attendant Service

This method determines the DTR requirements for the main location of a system equipped with the CAS option. The following is assumed:

- all attendant calls presented through release link trunks from a remote PBX require DTRs
- the average number of digits dialed is four
- the average DTR holding time is 6.2 seconds

Use the procedure below to determine DTR requirements.

**1** Calculate the attendant calls from the remote PBX:

$100 \times \text{attendant traffic from the remote (CCS)} \div \text{attendant work time (in seconds)}$

**2** Add the attendant calls to the intra-office calls calculated in step 1 of “Detailed calculation: Method 1” and proceed with the remaining calculations of Method 1.

## Calculations with Charge Account for Call Detail Recording

The DTR holding time for outgoing calls changes from 14.1 seconds to 20.8 seconds.

Apply this change to steps 2 and 3 of “Detailed calculation: Method 1” and step 3 of “Detailed calculation: Method 2” to determine the DTR requirements for a system with the Charge Account for CDR option.

The following is assumed:

- 50 percent of Digitone outgoing calls require a charge account
- the average number of SPRE digits is two (maximum is four)
- the average number of digits in the account number is 10 (the range is 2 to 23 digits)
- the average DTR holding time is 13.4 seconds (see Reference Table 7 on page 106)

## Calculations with Direct Inward System Access

This method is used when a system is equipped with the DISA feature. The following is assumed:

- DISA calls come through DISA trunks or DID trunks
- 75 percent of DISA calls require a security code
- the average number of digits in the security code is four (the range is one to eight)
- the DISA DTR holding time is 6.2 seconds

Use the procedure below to determine DTR requirements.

- 1 Calculate the number of DISA calls:

$$100 \times \text{DISA traffic} \div \text{call holding time}$$

- 2 Calculate the DISA DTR traffic:

$$6.2 \times \text{DISA calls} \div 100$$

- 3 Add this traffic to step 2 of “Detailed calculation: Method 2” and proceed with the remaining calculations of Method 2.

## Calculations with Integrated Messaging Service Link

This method is used when a system is equipped with Integrated Messaging Service Link. The following is assumed:

- only messaging calls from 2500-type telephones require DTR service
- there is a 50-50 split of originating and terminating calls and 135 seconds average call holding time (step 1 next page)
- 50 percent of the calls from 2500-type telephones are intra-PBX calls (step 2 next page)
- the average time a caller listens to an announcement is 4 seconds (step 4 next page)
- if not known, assume the actual number of 2500-type telephones to be 60 percent of total lines

Use the procedure below to determine the DTR requirements.

- 1 Calculate originating calls from 2500 telephones:  
calls from 2500 telephones =  $\text{CCS/line} \times 100 \times \text{number of 2500 telephones} / (2 \times 135) = A$
- 2 Calculate intra-PBX calls from 2500 telephones:  
intra-PBX 2500-telephone calls =  $A \times 0.5 = B$
- 3 Calculate calls requiring service of DTR:  
calls to DTR =  $B \times 0.5 = C$ , where 0.5 is the portion of B that goes to the messaging service
- 4 Calculate traffic (CCS) to DTR:  
messaging CCS to DTR =  $C \times 4/100$
- 5 Add messaging CCS to the total DTR traffic to determine overall DTR requirements.

# Worksheets

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## Content list

The following are the topics in this section:

- [Worksheet A: Load balancing 79](#)
- [Worksheet B: Card distribution 80](#)
- [Worksheet C: Multiple appearance group assignments 81](#)
- [Worksheet D: Station load balancing 82](#)
- [Worksheet E: Multiple appearance group record 83](#)
- [Worksheet F: Card assignment 84](#)
- [Worksheet G: Terminal number assignment 85](#)
- [Worksheet H: System assignment plan 86](#)
- [Worksheet I: Growth forecast 87](#)
- [Worksheet J: Total load 88](#)
- [Worksheet K: Network loops 89](#)
- [Worksheet L: Network loop balancing 90](#)
- [Worksheet M: Intelligent Peripheral Equipment modules 91](#)
- [Worksheet N: Conference and TDS loop requirements 92](#)
- [Worksheet O: Unprotected memory calculations 93](#)
- [Worksheet P: Protected memory calculations 94](#)
- [Worksheet Q: Program store calculations 95](#)
- [Worksheet R: Equipment summary 96](#)

## Reference list

The following are the references in this section:

- *Capacity Engineering* (553-3001-149)

The worksheets provided give examples of information needed to do traffic and equipment engineering. However, more detailed information is needed to fully engineer a system. Consult your Nortel Networks representative and use a configuration tool, such as Autoquote or Meridian Configurator, to fully engineer a system.

Memory values, which vary for each generic of software, are given in *Capacity Engineering* (553-3001-149).



## Worksheet B: Card distribution

CIRCUIT CARD DISTRIBUTION

CUSTOMER \_\_\_\_\_ DATE \_\_\_\_\_

One sheet for the complete system.

Divide the total number of a card type by the total number of IPE modules to arrive at a cards-per-module number.

| CARD TYPE | QUANTITY | TOTAL IPE MODULES | CARDS PER MODULE |
|-----------|----------|-------------------|------------------|
|           |          |                   |                  |

553-5367

## Worksheet C: Multiple appearance group assignments

### MULTIPLE APPEARANCE GROUP (MAG) ASSIGNMENTS

CUSTOMER \_\_\_\_\_ DATE \_\_\_\_\_

One sheet for the complete system.

| LOOP #                                       |
|--|--|--|--|--|
| MAG #<br>Single-line TN<br>Multi-line TN     |
| MAG #<br>Single-line TN<br>Multi-line TN     |
| MAG #<br>Single-line TN<br>Multi-line TN     |
| MAG #<br>Single-line TN<br>Multi-line TN     |
| MAG #<br>Single-line TN<br>Multi-line TN     |
| CARDS<br>Single-line ____<br>Multi-line ____ |

553-4054

## Worksheet D: Station load balancing

STATION LOAD BALANCING

CUSTOMER \_\_\_\_\_ DATE \_\_\_\_\_

One sheet required for the complete system.

Total single-line TNs to be assigned \_\_\_\_\_

Less number of single-line TNs assigned to MAG - \_\_\_\_\_

Equals number of single-line TNs not in MAG = \_\_\_\_\_

Single-line TNs not in MAG = \_\_\_\_\_ Number of single-line TNs not in MAG  
 Total IPE modules Assigned per module

Total multi-line TNs to be assigned \_\_\_\_\_

Less number of multi-line TNs assigned to MAG - \_\_\_\_\_

Equals number of multi-line TNs not in MAG = \_\_\_\_\_

Multi-line TNs not in MAG = \_\_\_\_\_ Number of multi-line TNs not in MAG  
 Total IPE modules Assigned per module

553-5372



# Worksheet F: Card assignment

CIRCUIT CARD TO MODULE ASSIGNMENT

CUSTOMER \_\_\_\_\_ DATE \_\_\_\_\_

One table for each IPE shelf in the system.

|              |                |   |   |   |   |   |   |   |   |   |    | TOTAL<br>CARDS | CCS<br>LOAD |
|--------------|----------------|---|---|---|---|---|---|---|---|---|----|----------------|-------------|
| LOOP # _____ | MODULE # _____ |   |   |   |   |   |   |   |   |   |    |                |             |
| Position     |                | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |                |             |
| Type         |                |   |   |   |   |   |   |   |   |   |    |                |             |
|              |                |   |   |   |   |   |   |   |   |   |    |                |             |
| LOOP # _____ | MODULE # _____ |   |   |   |   |   |   |   |   |   |    |                |             |
| Position     |                | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |                |             |
| Type         |                |   |   |   |   |   |   |   |   |   |    |                |             |
|              |                |   |   |   |   |   |   |   |   |   |    |                |             |
| LOOP # _____ | MODULE # _____ |   |   |   |   |   |   |   |   |   |    |                |             |
| Position     |                | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |                |             |
| Type         |                |   |   |   |   |   |   |   |   |   |    |                |             |
|              |                |   |   |   |   |   |   |   |   |   |    |                |             |
| LOOP # _____ | MODULE # _____ |   |   |   |   |   |   |   |   |   |    |                |             |
| Position     |                | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |                |             |
| Type         |                |   |   |   |   |   |   |   |   |   |    |                |             |

553-5369

# Worksheet G: Terminal number assignment

TN ASSIGNMENT RECORD  
 CUSTOMER \_\_\_\_\_ DATE \_\_\_\_\_  
 One sheet for each IPE module in the system.  
 LOOP # \_\_\_\_\_ MODULE # \_\_\_\_\_ GROUP # \_\_\_\_\_

| CARD POS | CARD TYPE | UNIT | DN | RTMB | CUST | CARD POS | CARD TYPE | UNIT | DN | RTMB | CUST |
|----------|-----------|------|----|------|------|----------|-----------|------|----|------|------|
| 1        |           | 0    |    |      |      | 6        |           | 0    |    |      |      |
|          |           | 1    |    |      |      |          |           | 1    |    |      |      |
|          |           | 2    |    |      |      |          |           | 2    |    |      |      |
|          |           | 3    |    |      |      |          |           | 3    |    |      |      |
|          |           | 4    |    |      |      |          |           | 4    |    |      |      |
|          |           | 5    |    |      |      |          |           | 5    |    |      |      |
|          |           | 6    |    |      |      |          |           | 6    |    |      |      |
|          |           | 7    |    |      |      |          |           | 7    |    |      |      |
| 2        |           | 0    |    |      |      | 7        |           | 0    |    |      |      |
|          |           | 1    |    |      |      |          |           | 1    |    |      |      |
|          |           | 2    |    |      |      |          |           | 2    |    |      |      |
|          |           | 3    |    |      |      |          |           | 3    |    |      |      |
|          |           | 4    |    |      |      |          |           | 4    |    |      |      |
|          |           | 5    |    |      |      |          |           | 5    |    |      |      |
|          |           | 6    |    |      |      |          |           | 6    |    |      |      |
|          |           | 7    |    |      |      |          |           | 7    |    |      |      |
| 3        |           | 0    |    |      |      | 8        |           | 0    |    |      |      |
|          |           | 1    |    |      |      |          |           | 1    |    |      |      |
|          |           | 2    |    |      |      |          |           | 2    |    |      |      |
|          |           | 3    |    |      |      |          |           | 3    |    |      |      |
|          |           | 4    |    |      |      |          |           | 4    |    |      |      |
|          |           | 5    |    |      |      |          |           | 5    |    |      |      |
|          |           | 6    |    |      |      |          |           | 6    |    |      |      |
|          |           | 7    |    |      |      |          |           | 7    |    |      |      |
| 4        |           | 0    |    |      |      | 9        |           | 0    |    |      |      |
|          |           | 1    |    |      |      |          |           | 1    |    |      |      |
|          |           | 2    |    |      |      |          |           | 2    |    |      |      |
|          |           | 3    |    |      |      |          |           | 3    |    |      |      |
|          |           | 4    |    |      |      |          |           | 4    |    |      |      |
|          |           | 5    |    |      |      |          |           | 5    |    |      |      |
|          |           | 6    |    |      |      |          |           | 6    |    |      |      |
|          |           | 7    |    |      |      |          |           | 7    |    |      |      |
| 5        |           | 0    |    |      |      | 10       |           | 0    |    |      |      |
|          |           | 1    |    |      |      |          |           | 1    |    |      |      |
|          |           | 2    |    |      |      |          |           | 2    |    |      |      |
|          |           | 3    |    |      |      |          |           | 3    |    |      |      |
|          |           | 4    |    |      |      |          |           | 4    |    |      |      |
|          |           | 5    |    |      |      |          |           | 5    |    |      |      |
|          |           | 6    |    |      |      |          |           | 6    |    |      |      |
|          |           | 7    |    |      |      |          |           | 7    |    |      |      |

DN = Directory Number. RTMB = Route Member Number (trunks)

553-5368

# Worksheet H: System assignment plan

SYSTEM ASSIGNMENT PLAN  
CUSTOMER \_\_\_\_\_ DATE \_\_\_\_\_  
One sheet for each equipment voice loop.

LOOP #: \_\_\_\_\_ GROUP #: \_\_\_\_\_

Modules equipped \_\_\_\_\_  
Trunks working \_\_\_\_\_  
Trunks equipped \_\_\_\_\_  
Consoles \_\_\_\_\_  
DTRs \_\_\_\_\_  
Single-line TNs \_\_\_\_\_  
Multi-line TNs \_\_\_\_\_  
MAGs assigned \_\_\_\_\_  
Load capacity \_\_\_\_\_

RECOMMENDED ASSIGNMENT PLAN \_\_\_\_\_

553-5370



## Worksheet J: Total load

LINE, TRUNK, AND CONSOLE USAGE

CUSTOMER \_\_\_\_\_ DATE \_\_\_\_\_

One sheet for each customer for cutover, 2-year, and 5-year interval.  
 One sheet for the system cutover, 2-year, and 5-year interval.

LINE USAGE:

Single-line TNs \_\_\_\_\_ X \_\_\_\_\_ CCS/T = \_\_\_\_\_ CCS  
 Multi-line TNs \_\_\_\_\_ X \_\_\_\_\_ CCS/T = \_\_\_\_\_ CCS

TOTAL LINE LOAD = \_\_\_\_\_ CCS

TRUNK USAGE:

| Trunk route | Number of TNs accessing route | CCS/T per trunk route | Total CCS load per trunk route |
|-------------|-------------------------------|-----------------------|--------------------------------|
| _____       | _____                         | X _____               | = _____ CCS                    |
| _____       | _____                         | X _____               | = _____ CCS                    |
| _____       | _____                         | X _____               | = _____ CCS                    |
| _____       | _____                         | X _____               | = _____ CCS                    |
| _____       | _____                         | X _____               | = _____ CCS                    |
| _____       | _____                         | X _____               | = _____ CCS                    |
| _____       | _____                         | X _____               | = _____ CCS                    |

TOTAL TRUNK LOAD = \_\_\_\_\_ CCS

CONSOLE USAGE:

Number of consoles \_\_\_\_\_ X 30 CCS = \_\_\_\_\_ TOTAL CONSOLE LOAD

DIGITONE RECEIVERS:

Table \_\_\_\_\_ Number of DTRs \_\_\_\_\_ TOTAL DTR LOAD \_\_\_\_\_ CCS

TOTAL LOAD \_\_\_\_\_ CCS

553-4042

## Worksheet K: Network loops

### NETWORK LOOP CALCULATION

CUSTOMER \_\_\_\_\_ DATE \_\_\_\_\_

One sheet for each customer. One sheet for the complete system.

|         | Total load    | CCS per load | Number of loops | Round to next highest number |
|---------|---------------|--------------|-----------------|------------------------------|
| Cutover | _____ ÷ _____ | _____        | = _____         | _____                        |
| 2-year  | _____ ÷ _____ | _____        | = _____         | _____                        |
| 5-year  | _____ ÷ _____ | _____        | = _____         | _____                        |

Number of network loops required at 2 years = \_\_\_\_\_

Number of network groups required at 2 years (use table below) = \_\_\_\_\_

| Number of network groups | Maximum number of voice loops | Without Digitone trunks<br>744/560 CCS/loop | With Digitone trunks<br>720/540 CCS/loop |
|--------------------------|-------------------------------|---|--|
| 1                        | 28                            | 20,832 / 15,680                             | 20,160 / 15,120                          |
| 2                        | 56                            | 41,664 / 31,360                             | 40,320 / 30,240                          |
| 3                        | 84                            | 62,496 / 47,040                             | 60,480 / 45,360                          |
| 4                        | 112                           | 83,328 / 62,720                             | 80,640 / 60,480                          |
| 5                        | 140                           | 104,160 / 78,400                            | 100,800 / 75,600                         |

**Note 1:** The table above is based on an 85 percent utilization level.

For superloops, the *maximum* CCS/loop is 875 without Digitone trunks, 848 with Digitone trunks. Using the 85 percent utilization level, the CCS/loop is 744 without Digitone trunks, 720 with Digitone trunks.

For regular loops, the *maximum* CCS/loop is 660 without Digitone trunks, 560 with Digitone trunks. Using the 85 percent utilization level, the CCS/loop is 560 without Digitone trunks, 540 with Digitone trunks.

**Note 2:** At high traffic levels the CPU capacity needs to be calculated to determine whether there is sufficient capacity to process the given load.

553-5361

## Worksheet L: Network loop balancing

BALANCING NETWORK LOOPS OVER NETWORK GROUPS

CUSTOMER \_\_\_\_\_ DATE \_\_\_\_\_

One sheet for the complete system.

| CUSTOMER | NETWORK GROUP 0 | NETWORK GROUP 1 | NETWORK GROUP 2 | NETWORK GROUP 3 | NETWORK GROUP 4 |
|----------|-----------------|-----------------|-----------------|-----------------|-----------------|
|          |                 |                 |                 |                 |                 |
|          |                 |                 |                 |                 |                 |
|          |                 |                 |                 |                 |                 |
|          |                 |                 |                 |                 |                 |

553-4051

# Worksheet M: Intelligent Peripheral Equipment modules

## IPE card calculations

| IPE CARD CALCULATIONS   |         |            |      |
|---|---------|------------|------|
| CUSTOMER _____  |         | DATE _____ |      |
| One for the complete system at cutover, 2-year, and 5-year interval.            |         |            |      |
| NUMBER OF:  | CUTOVER | 2-YR       | 5-YR |
| Digital line cards =<br>Digital line cards plus number of<br>M2250 consoles x 6 |         |            |      |
| Analog line cards =<br>Analog ports ÷ 16  |         |            |      |
| Analog message waiting line cards =<br>Analog ports with message waiting ÷ 16   |         |            |      |
| Universal trunk cards =<br>CO/DID/RAN/paging trunks ÷ 8                         |         |            |      |
| 2-W E&M/DX/paging trunks ÷ 2  |         |            |      |
| E&M trunk cards =<br>E&M/paging/dictation trunks ÷ 4                            |         |            |      |
| TOTAL CARDS   |         |            |      |

IPE MODULE CALCULATIONS:  
Use the total cards required at 2 years to determine the number of IPE Modules to be provisioned at cutover.

IPE Modules required = Total cards (round to next higher number) ÷ 8.5

NUMBER OF IPE MODULES REQUIRED AT CUTOVER \_\_\_\_\_

553-5363

## Worksheet N: Conference and TDS loop requirements

### CONFERENCE AND TDS LOOP REQUIREMENTS

CUSTOMER \_\_\_\_\_ DATE \_\_\_\_\_

One sheet for the complete system.

#### CONFERENCE LOOP REQUIREMENTS:

Conference loops are provisioned according to the 2-year network loop requirements.

Conference loops required = \_\_\_\_\_

#### TONE AND DIGIT LOOP REQUIREMENTS:

Tone and digit loops are provisioned according to the 2-year network loop requirements.

Tone and digit loops required = \_\_\_\_\_

#### ESTIMATED REAL TIME USAGE (ERTU) CALCULATION:

$$\text{ERTU} = \frac{\text{Total line load} \times 100 \times T}{150 \times 2} / 2100 = \text{Percent utilization of CPU real time}$$

**Legend:**

- Total load = the sum of total line load and total trunk load of the 2-year figure, in CCS
- T = the average processing time for a call in seconds (using 1.2 s for option 21 and 0.24 s for options 51, 61, and 71); these are average numbers for a featured call
- 150 = the average holding time in seconds
- 2520 = the rated capacity (70% loading) of the CPU in seconds
- 2 = the total originating and terminating traffic is divided by 2 to account for only call originations

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# Worksheet P: Protected memory calculations

*Note:* This calculation does not apply for options 61C, and 81C.

PROTECTED MEMORY CALCULATIONS  
 CUSTOMER \_\_\_\_\_ DATE \_\_\_\_\_  
 One sheet for the complete system.

|                                      | ITEMS | WORDS | TOTAL |
|--------------------------------------|-------|-------|-------|
| Fixed amount of storage              |       |       |       |
| Single-line TNs                      |       |       |       |
| Multi-line TNs                       |       |       |       |
| Add-on modules                       |       |       |       |
| Network groups                       |       |       |       |
| Trunk units                          |       |       |       |
| Consoles                             |       |       |       |
| Customer groups                      |       |       |       |
| Trunk routes                         |       |       |       |
| Code restricted trunk routes         |       |       |       |
| Network loops (excluding conference) |       |       |       |
| DTR loops                            |       |       |       |
| Speed call head table                |       |       |       |
| Speed call lists (10 numbers)        |       |       |       |
| Speed call lists (50 numbers)        |       |       |       |
| TDS loops                            |       |       |       |
| Conference loops                     |       |       |       |
| History file                         |       |       |       |
| TOTAL _____                          |       |       |       |
| ADD 10% _____                        |       |       |       |
| TOTAL WORDS _____                    |       |       |       |

Memory card code \_\_\_\_\_

Capacity \_\_\_\_\_ k words (1k = 1024)

Unprotected memory cards required \_\_\_\_\_

Memory card addresses required \_\_\_\_\_

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## Worksheet R: Equipment summary

EQUIPMENT SUMMARY

CUSTOMER \_\_\_\_\_ DATE \_\_\_\_\_

One sheet for the complete system.

| QUANTITY | BASED ON |
|----------|----------|
|          | Cutover  |
|          | 2 year   |
|          | Cutover  |
|          | 2 year   |
|          | 2 year   |
|          | 2 year   |

553-5365

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# Reference tables

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- Reference Table 3: Digitone receiver requirements—Model 1
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- Reference Table 7: Digitone receiver load capacity—6- to 15-second holding time
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- Reference Table 9: Digitone receiver requirements—Poisson 0.1 percent blocking
- Reference Table 10: Conference and TDS loop requirements
- Reference Table 11: Digitone receiver provisioning

**Reference Table 1**  
**Trunk traffic—Poisson 1 percent blocking (Part 1 of 2)**

| Trunks | CCS  |
|--------|------|--------|------|--------|------|--------|------|--------|------|
| 1      | 0.4  | 31     | 703  | 61     | 1595 | 91     | 2530 | 121    | 3488 |
| 2      | 5.4  | 32     | 732  | 62     | 1626 | 92     | 2563 | 122    | 3520 |
| 3      | 15.7 | 33     | 760  | 63     | 1657 | 93     | 2594 | 123    | 3552 |
| 4      | 29.6 | 34     | 789  | 64     | 1687 | 94     | 2625 | 124    | 3594 |
| 5      | 46.1 | 35     | 818  | 65     | 1718 | 95     | 2657 | 125    | 3616 |
| 6      | 64   | 36     | 847  | 66     | 1749 | 96     | 2689 | 126    | 3648 |
| 7      | 84   | 37     | 876  | 67     | 1780 | 97     | 2721 | 127    | 3681 |
| 8      | 105  | 38     | 905  | 68     | 1811 | 98     | 2752 | 128    | 3713 |
| 9      | 126  | 39     | 935  | 69     | 1842 | 99     | 2784 | 129    | 3746 |
| 10     | 149  | 40     | 964  | 70     | 1873 | 100    | 2816 | 130    | 3778 |
| 11     | 172  | 41     | 993  | 71     | 1904 | 101    | 2847 | 131    | 3810 |
| 12     | 195  | 42     | 1023 | 72     | 1935 | 102    | 2879 | 132    | 3843 |
| 13     | 220  | 43     | 1052 | 73     | 1966 | 103    | 2910 | 133    | 3875 |
| 14     | 244  | 44     | 1082 | 74     | 1997 | 104    | 2942 | 134    | 3907 |
| 15     | 269  | 45     | 1112 | 75     | 2028 | 105    | 2974 | 135    | 3939 |
| 16     | 294  | 46     | 1142 | 76     | 2059 | 106    | 3006 | 136    | 3972 |
| 17     | 320  | 47     | 1171 | 77     | 2091 | 107    | 3038 | 137    | 4004 |
| 18     | 346  | 48     | 1201 | 78     | 2122 | 108    | 3070 | 138    | 4037 |
| 19     | 373  | 49     | 1231 | 79     | 2153 | 109    | 3102 | 139    | 4070 |
| 20     | 399  | 50     | 1261 | 80     | 2184 | 110    | 3135 | 140    | 4102 |
| 21     | 426  | 51     | 1291 | 81     | 2215 | 111    | 3166 | 141    | 4134 |

**Note:** For trunk traffic greater than 4427 CCS, allow 29.5 CCS per trunk.

**Reference Table 1**  
**Trunk traffic—Poisson 1 percent blocking (Part 2 of 2)**

| Trunks | CCS | Trunks | CCS  | Trunks | CCS  | Trunks | CCS  | Trunks | CCS  |
|--------|-----|--------|------|--------|------|--------|------|--------|------|
| 22     | 453 | 52     | 1322 | 82     | 2247 | 112    | 3198 | 142    | 4167 |
| 23     | 480 | 53     | 1352 | 83     | 2278 | 113    | 3230 | 143    | 4199 |
| 24     | 507 | 54     | 1382 | 84     | 2310 | 114    | 3262 | 144    | 4231 |
| 25     | 535 | 55     | 1412 | 85     | 2341 | 115    | 3294 | 145    | 4264 |
| 26     | 562 | 56     | 1443 | 86     | 2373 | 116    | 3326 | 146    | 4297 |
| 27     | 590 | 57     | 1473 | 87     | 2404 | 117    | 3359 | 147    | 4329 |
| 28     | 618 | 58     | 1504 | 88     | 2436 | 118    | 3391 | 148    | 4362 |
| 29     | 647 | 59     | 1534 | 89     | 2467 | 119    | 3424 | 149    | 4395 |
| 30     | 675 | 60     | 1565 | 90     | 2499 | 120    | 3456 | 150    | 4427 |

**Note:** For trunk traffic greater than 4427 CCS, allow 29.5 CCS per trunk.

**Reference Table 2**  
**Trunk traffic—Poisson 2 percent blocking (Part 1 of 2)**

| Trunks | CCS  |
|--------|------|--------|------|--------|------|--------|------|--------|------|
| 1      | 0.4  | 31     | 744  | 61     | 1659 | 91     | 2611 | 121    | 3581 |
| 2      | 7.9  | 32     | 773  | 62     | 1690 | 92     | 2643 | 122    | 3614 |
| 3      | 20.9 | 33     | 803  | 63     | 1722 | 93     | 2674 | 123    | 3647 |
| 4      | 36.7 | 34     | 832  | 64     | 1752 | 94     | 2706 | 124    | 3679 |
| 5      | 55.8 | 35     | 862  | 65     | 1784 | 95     | 2739 | 125    | 3712 |
| 6      | 76.0 | 36     | 892  | 66     | 1816 | 96     | 2771 | 126    | 3745 |
| 7      | 96.8 | 37     | 922  | 67     | 1847 | 97     | 2803 | 127    | 3777 |
| 8      | 119  | 38     | 952  | 68     | 1878 | 98     | 2838 | 128    | 3810 |
| 9      | 142  | 39     | 982  | 69     | 1910 | 99     | 2868 | 129    | 3843 |
| 10     | 166  | 40     | 1012 | 70     | 1941 | 100    | 2900 | 130    | 3875 |
| 11     | 191  | 41     | 1042 | 71     | 1973 | 101    | 2931 | 131    | 3910 |
| 12     | 216  | 42     | 1072 | 72     | 2004 | 102    | 2964 | 132    | 3941 |
| 13     | 241  | 43     | 1103 | 73     | 2036 | 103    | 2996 | 133    | 3974 |
| 14     | 267  | 44     | 1133 | 74     | 2067 | 104    | 3029 | 134    | 4007 |
| 15     | 293  | 45     | 1164 | 75     | 2099 | 105    | 3051 | 135    | 4039 |
| 16     | 320  | 46     | 1194 | 76     | 2130 | 106    | 3094 | 136    | 4072 |
| 17     | 347  | 47     | 1225 | 77     | 2162 | 107    | 3126 | 137    | 4105 |
| 18     | 374  | 48     | 1255 | 78     | 2194 | 108    | 3158 | 138    | 4138 |
| 19     | 401  | 49     | 1286 | 79     | 2226 | 109    | 3190 | 139    | 4171 |
| 20     | 429  | 50     | 1317 | 80     | 2258 | 110    | 3223 | 140    | 4204 |

**Note:** For trunk traffic greater than 4533 CCS, allow 30.2 CCS per trunk.

**Reference Table 2**  
**Trunk traffic—Poisson 2 percent blocking (Part 2 of 2)**

| Trunks | CCS | Trunks | CCS  | Trunks | CCS  | Trunks | CCS  | Trunks | CCS  |
|--------|-----|--------|------|--------|------|--------|------|--------|------|
| 21     | 458 | 51     | 1348 | 81     | 2290 | 111    | 3255 | 141    | 4237 |
| 22     | 486 | 52     | 1374 | 82     | 2322 | 112    | 3288 | 142    | 4269 |
| 23     | 514 | 53     | 1352 | 83     | 2354 | 113    | 3321 | 143    | 4302 |
| 24     | 542 | 54     | 1441 | 84     | 2386 | 114    | 3353 | 144    | 4335 |
| 25     | 571 | 55     | 1472 | 85     | 2418 | 115    | 3386 | 145    | 4368 |
| 26     | 562 | 56     | 1503 | 86     | 2450 | 116    | 3418 | 146    | 4401 |
| 27     | 627 | 57     | 1534 | 87     | 2482 | 117    | 3451 | 147    | 4434 |
| 28     | 656 | 58     | 1565 | 88     | 2514 | 118    | 3483 | 148    | 4467 |
| 29     | 685 | 59     | 1596 | 89     | 2546 | 119    | 3516 | 149    | 4500 |
| 30     | 715 | 60     | 1627 | 90     | 2578 | 120    | 3548 | 150    | 4533 |

**Note:** For trunk traffic greater than 4533 CCS, allow 30.2 CCS per trunk.

**Reference Table 3**  
**Digitone receiver requirements—Model 1**

| Number of DTRs | Max. number of Digitone lines | DTR load (CCS) | Number of DTRs | Max. number of Digitone lines | DTR load (CCS) |
|----------------|-------------------------------|----------------|----------------|-------------------------------|----------------|
| 2              | 7                             | 2              | 17             | 1181                          | 319            |
| 3              | 33                            | 9              | 18             | 1244                          | 336            |
| 4              | 69                            | 19             | 19             | 1348                          | 364            |
| 5              | 120                           | 33             | 20             | 1455                          | 393            |
| 6              | 179                           | 49             | 21             | 1555                          | 420            |
| 7              | 249                           | 68             | 22             | 1662                          | 449            |
| 8              | 332                           | 88             | 23             | 1774                          | 479            |
| 9              | 399                           | 109            | 24             | 1885                          | 509            |
| 10             | 479                           | 131            | 25             | 1988                          | 537            |
| 11             | 564                           | 154            | 26             | 2100                          | 567            |
| 12             | 659                           | 178            | 27             | 2211                          | 597            |
| 13             | 751                           | 203            | 28             | 2325                          | 628            |
| 14             | 848                           | 229            | 29             | 2440                          | 659            |
| 15             | 944                           | 255            | 30             | 2555                          | 690            |
| 16             | 1044                          | 282            |                |                               |                |

**Note:** See “Step 5: Calculate Digitone receiver requirements” for Model 1 assumptions.

**Reference Table 4**  
**Digitone receiver requirements—Model 2**

| Number of DTRs | Max. number of Digitone lines | DTR load (CCS) | Number of DTRs | Max. number of Digitone lines | DTR load (CCS) |
|----------------|-------------------------------|----------------|----------------|-------------------------------|----------------|
| 2              | 2                             | 2              | 17             | 843                           | 253            |
| 3              | 21                            | 7              | 18             | 920                           | 276            |
| 4              | 52                            | 15             | 19             | 996                           | 299            |
| 5              | 90                            | 27             | 20             | 1076                          | 323            |
| 6              | 134                           | 40             | 21             | 1153                          | 346            |
| 7              | 183                           | 55             | 22             | 1233                          | 370            |
| 8              | 235                           | 71             | 23             | 1316                          | 395            |
| 9              | 293                           | 88             | 24             | 1396                          | 419            |
| 10             | 353                           | 107            | 25             | 1480                          | 444            |
| 11             | 416                           | 126            | 26             | 1563                          | 469            |
| 12             | 483                           | 145            | 27             | 1650                          | 495            |
| 13             | 553                           | 166            | 28             | 1733                          | 520            |
| 14             | 623                           | 187            | 29             | 1816                          | 545            |
| 15             | 693                           | 208            | 30             | 1903                          | 571            |
| 16             | 770                           | 231            |                |                               |                |

**Note:** See “Step 5: Calculate Digitone receiver requirements” for Model 2 assumptions.

**Reference Table 5**  
**Digitone receiver requirements—Model 3**

| Number of DTRs | Max. number of Digitone lines | DTR load (CCS) | Number of DTRs | Max. number of Digitone lines | DTR load (CCS) |
|----------------|-------------------------------|----------------|----------------|-------------------------------|----------------|
| 2              | 5                             | 2              | 17             | 862                           | 319            |
| 3              | 22                            | 9              | 18             | 908                           | 336            |
| 4              | 50                            | 19             | 19             | 983                           | 364            |
| 5              | 87                            | 33             | 20             | 1062                          | 393            |
| 6              | 132                           | 49             | 21             | 1135                          | 420            |
| 7              | 180                           | 68             | 22             | 1213                          | 449            |
| 8              | 234                           | 88             | 23             | 1294                          | 479            |
| 9              | 291                           | 109            | 24             | 1375                          | 509            |
| 10             | 353                           | 131            | 25             | 1451                          | 537            |
| 11             | 415                           | 154            | 26             | 1532                          | 567            |
| 12             | 481                           | 178            | 27             | 1613                          | 597            |
| 13             | 548                           | 203            | 28             | 1697                          | 628            |
| 14             | 618                           | 229            | 29             | 1781                          | 659            |
| 15             | 689                           | 255            | 30             | 1864                          | 690            |
| 16             | 762                           | 282            |                |                               |                |

**Note:** See “Step 5: Calculate Digitone receiver requirements” for Model 3 assumptions.

**Reference Table 6**  
**Digitone receiver requirements—Model 4**

| Number of DTRs | Max. number of Digitone lines | DTR load (CCS) | Number of DTRs | Max. number of Digitone lines | DTR load (CCS) |
|----------------|-------------------------------|----------------|----------------|-------------------------------|----------------|
| 2              | 4                             | 2              | 17             | 683                           | 253            |
| 3              | 18                            | 7              | 18             | 745                           | 276            |
| 4              | 41                            | 15             | 19             | 808                           | 299            |
| 5              | 72                            | 27             | 20             | 872                           | 323            |
| 6              | 109                           | 40             | 21             | 935                           | 346            |
| 7              | 148                           | 55             | 22             | 1000                          | 370            |
| 8              | 193                           | 71             | 23             | 1067                          | 395            |
| 9              | 240                           | 88             | 24             | 1132                          | 419            |
| 10             | 291                           | 107            | 25             | 1200                          | 444            |
| 11             | 340                           | 126            | 26             | 1267                          | 469            |
| 12             | 391                           | 145            | 27             | 1337                          | 495            |
| 13             | 448                           | 166            | 28             | 1405                          | 520            |
| 14             | 505                           | 187            | 29             | 1472                          | 545            |
| 15             | 562                           | 208            | 30             | 1543                          | 571            |
| 16             | 624                           | 231            |                |                               |                |

**Note:** See “Step 5: Calculate Digitone receiver requirements” for Model 4 assumptions.

**Reference Table 7**  
**Digitone receiver load capacity—6- to 15-second holding time (Part 1 of 2)**

| Average holding time in seconds | 6   | 7   | 8   | 9   | 10  | 11  | 12  | 13  | 14  | 15  |
|---------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| <b>Number of DTRs</b>           |     |     |     |     |     |     |     |     |     |     |
| 1                               | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   |
| 2                               | 3   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   |
| 3                               | 11  | 10  | 10  | 9   | 9   | 9   | 9   | 8   | 8   | 8   |
| 4                               | 24  | 23  | 22  | 21  | 20  | 19  | 19  | 19  | 18  | 18  |
| 5                               | 41  | 39  | 37  | 36  | 35  | 34  | 33  | 33  | 32  | 32  |
| 6                               | 61  | 57  | 55  | 53  | 52  | 50  | 49  | 49  | 48  | 47  |
| 7                               | 83  | 78  | 75  | 73  | 71  | 69  | 68  | 67  | 66  | 65  |
| 8                               | 106 | 101 | 97  | 94  | 91  | 89  | 88  | 86  | 85  | 84  |
| 9                               | 131 | 125 | 120 | 116 | 113 | 111 | 109 | 107 | 106 | 104 |
| 10                              | 157 | 150 | 144 | 140 | 136 | 133 | 131 | 129 | 127 | 126 |
| 11                              | 185 | 176 | 170 | 165 | 161 | 157 | 154 | 152 | 150 | 148 |
| 12                              | 212 | 203 | 196 | 190 | 185 | 182 | 178 | 176 | 173 | 171 |
| 13                              | 241 | 231 | 223 | 216 | 211 | 207 | 203 | 200 | 198 | 196 |
| 14                              | 270 | 259 | 250 | 243 | 237 | 233 | 229 | 225 | 223 | 220 |
| 15                              | 300 | 288 | 278 | 271 | 264 | 259 | 255 | 251 | 248 | 245 |
| 16                              | 339 | 317 | 307 | 298 | 292 | 286 | 282 | 278 | 274 | 271 |
| 17                              | 361 | 346 | 335 | 327 | 320 | 313 | 310 | 306 | 302 | 298 |
| 18                              | 391 | 377 | 365 | 356 | 348 | 342 | 336 | 331 | 327 | 324 |
| 19                              | 422 | 409 | 396 | 386 | 378 | 371 | 364 | 359 | 355 | 351 |
| 20                              | 454 | 438 | 425 | 414 | 405 | 398 | 393 | 388 | 383 | 379 |
| 21                              | 487 | 469 | 455 | 444 | 435 | 427 | 420 | 415 | 410 | 406 |

**Note:** Load capacity is measured in CCS.

**Reference Table 7**  
**Digitone receiver load capacity—6- to 15-second holding time (Part 2 of 2)**

| Average holding time in seconds | 6    | 7    | 8    | 9    | 10   | 11   | 12   | 13  | 14  | 15  |
|---------------------------------|------|------|------|------|------|------|------|-----|-----|-----|
| <b>Number of DTRs</b>           |      |      |      |      |      |      |      |     |     |     |
| 22                              | 517  | 501  | 487  | 475  | 466  | 456  | 449  | 443 | 438 | 434 |
| 23                              | 550  | 531  | 516  | 504  | 494  | 487  | 479  | 472 | 467 | 462 |
| 24                              | 583  | 563  | 547  | 535  | 524  | 515  | 509  | 502 | 497 | 491 |
| 25                              | 615  | 595  | 579  | 566  | 555  | 545  | 537  | 532 | 526 | 521 |
| 26                              | 647  | 628  | 612  | 598  | 586  | 576  | 567  | 560 | 554 | 548 |
| 27                              | 680  | 659  | 642  | 628  | 618  | 607  | 597  | 589 | 583 | 577 |
| 28                              | 714  | 691  | 674  | 659  | 647  | 638  | 628  | 620 | 613 | 607 |
| 29                              | 746  | 724  | 706  | 690  | 678  | 667  | 659  | 651 | 644 | 637 |
| 30                              | 779  | 758  | 738  | 723  | 709  | 698  | 690  | 682 | 674 | 668 |
| 31                              | 813  | 792  | 771  | 755  | 742  | 729  | 719  | 710 | 703 | 696 |
| 32                              | 847  | 822  | 805  | 788  | 774  | 761  | 750  | 741 | 733 | 726 |
| 33                              | 882  | 855  | 835  | 818  | 804  | 793  | 781  | 772 | 763 | 756 |
| 34                              | 913  | 889  | 868  | 850  | 836  | 825  | 812  | 803 | 795 | 787 |
| 35                              | 947  | 923  | 900  | 883  | 867  | 855  | 844  | 835 | 826 | 818 |
| 36                              | 981  | 957  | 934  | 916  | 900  | 886  | 876  | 866 | 857 | 850 |
| 37                              | 1016 | 989  | 967  | 949  | 933  | 919  | 909  | 898 | 889 | 881 |
| 38                              | 1051 | 1022 | 1001 | 982  | 966  | 951  | 938  | 928 | 918 | 912 |
| 39                              | 1083 | 1055 | 1035 | 1015 | 999  | 984  | 970  | 959 | 949 | 941 |
| 40                              | 1117 | 1089 | 1066 | 1046 | 1029 | 1017 | 1002 | 990 | 981 | 972 |

**Note:** Load capacity is measured in CCS.

**Reference Table 8**  
**Digitone receiver load capacity—16- to 25-second holding time (Part 1 of 2)**

| Average holding time in seconds | 16  | 17  | 18  | 19  | 20  | 21  | 22  | 23  | 24  | 25  |
|---------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| <b>Number of DTRs</b>           |     |     |     |     |     |     |     |     |     |     |
| 1                               | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   |
| 2                               | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   |
| 3                               | 8   | 8   | 8   | 8   | 8   | 8   | 8   | 8   | 8   | 8   |
| 4                               | 18  | 18  | 18  | 18  | 18  | 17  | 17  | 17  | 17  | 17  |
| 5                               | 31  | 31  | 31  | 30  | 30  | 30  | 30  | 30  | 30  | 29  |
| 6                               | 47  | 46  | 46  | 45  | 45  | 45  | 45  | 44  | 44  | 44  |
| 7                               | 64  | 63  | 63  | 62  | 62  | 62  | 61  | 61  | 61  | 60  |
| 8                               | 83  | 82  | 82  | 81  | 80  | 80  | 79  | 79  | 79  | 78  |
| 9                               | 103 | 102 | 101 | 100 | 100 | 99  | 99  | 98  | 98  | 97  |
| 10                              | 125 | 123 | 122 | 121 | 121 | 120 | 119 | 119 | 118 | 118 |
| 11                              | 147 | 145 | 144 | 143 | 142 | 141 | 140 | 140 | 139 | 138 |
| 12                              | 170 | 168 | 167 | 166 | 165 | 164 | 163 | 162 | 161 | 160 |
| 13                              | 193 | 192 | 190 | 189 | 188 | 186 | 185 | 184 | 184 | 183 |
| 14                              | 218 | 216 | 214 | 213 | 211 | 210 | 209 | 208 | 207 | 206 |
| 15                              | 243 | 241 | 239 | 237 | 236 | 234 | 233 | 232 | 231 | 230 |
| 16                              | 268 | 266 | 264 | 262 | 260 | 259 | 257 | 256 | 255 | 254 |
| 17                              | 294 | 292 | 290 | 288 | 286 | 284 | 283 | 281 | 280 | 279 |
| 18                              | 322 | 319 | 317 | 314 | 312 | 311 | 309 | 308 | 306 | 305 |
| 19                              | 347 | 344 | 342 | 339 | 337 | 335 | 334 | 332 | 331 | 329 |
| 20                              | 374 | 371 | 368 | 366 | 364 | 361 | 360 | 358 | 356 | 355 |
| 21                              | 402 | 399 | 396 | 393 | 391 | 388 | 386 | 385 | 383 | 381 |

**Note:** Load capacity is measured in CCS.

**Reference Table 8**  
**Digitone receiver load capacity—16- to 25-second holding time (Part 2 of 2)**

| Average holding time in seconds | 16  | 17  | 18  | 19  | 20  | 21  | 22  | 23  | 24  | 25  |
|---------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| <b>Number of DTRs</b>           |     |     |     |     |     |     |     |     |     |     |
| 22                              | 431 | 427 | 424 | 421 | 419 | 416 | 414 | 412 | 410 | 409 |
| 23                              | 458 | 454 | 451 | 448 | 445 | 442 | 440 | 438 | 436 | 434 |
| 24                              | 486 | 482 | 478 | 475 | 472 | 470 | 467 | 465 | 463 | 461 |
| 25                              | 514 | 510 | 506 | 503 | 500 | 497 | 495 | 492 | 490 | 488 |
| 26                              | 544 | 539 | 535 | 532 | 529 | 526 | 523 | 521 | 518 | 516 |
| 27                              | 573 | 569 | 565 | 561 | 558 | 555 | 552 | 549 | 547 | 545 |
| 28                              | 603 | 598 | 594 | 590 | 587 | 584 | 581 | 578 | 576 | 573 |
| 29                              | 631 | 626 | 622 | 618 | 614 | 611 | 608 | 605 | 602 | 600 |
| 30                              | 660 | 655 | 651 | 646 | 643 | 639 | 636 | 633 | 631 | 628 |
| 31                              | 690 | 685 | 680 | 676 | 672 | 668 | 665 | 662 | 659 | 656 |
| 32                              | 720 | 715 | 710 | 705 | 701 | 698 | 694 | 691 | 688 | 686 |
| 33                              | 751 | 745 | 740 | 735 | 731 | 727 | 724 | 721 | 718 | 715 |
| 34                              | 782 | 776 | 771 | 766 | 761 | 757 | 754 | 750 | 747 | 744 |
| 35                              | 813 | 807 | 801 | 796 | 792 | 788 | 784 | 780 | 777 | 774 |
| 36                              | 841 | 835 | 829 | 824 | 820 | 818 | 814 | 810 | 807 | 804 |
| 37                              | 872 | 865 | 859 | 854 | 849 | 845 | 841 | 837 | 834 | 831 |
| 38                              | 902 | 896 | 890 | 884 | 879 | 875 | 871 | 867 | 863 | 860 |
| 39                              | 934 | 927 | 921 | 914 | 909 | 905 | 901 | 897 | 893 | 890 |
| 40                              | 965 | 958 | 952 | 945 | 940 | 936 | 931 | 927 | 923 | 920 |

**Note:** Load capacity is measured in CCS.

**Reference Table 9**  
**Digitone receiver requirements—Poisson 0.1 percent blocking**

| Number of DTRs | DTR load (CCS) | Number of DTRs | DTR load (CCS) |
|----------------|----------------|----------------|----------------|
| 1              | 0              | 26             | 469            |
| 2              | 2              | 27             | 495            |
| 3              | 7              | 28             | 520            |
| 4              | 15             | 29             | 545            |
| 5              | 27             | 30             | 571            |
| 6              | 40             | 31             | 597            |
| 7              | 55             | 32             | 624            |
| 8              | 71             | 33             | 650            |
| 9              | 88             | 34             | 676            |
| 10             | 107            | 35             | 703            |
| 11             | 126            | 36             | 729            |
| 12             | 145            | 37             | 756            |
| 13             | 166            | 38             | 783            |
| 14             | 187            | 39             | 810            |
| 15             | 208            | 40             | 837            |
| 16             | 231            | 41             | 865            |
| 17             | 253            | 42             | 892            |
| 18             | 276            | 43             | 919            |
| 19             | 299            | 44             | 947            |
| 20             | 323            | 45             | 975            |
| 21             | 346            | 46             | 1003           |
| 22             | 370            | 47             | 1030           |
| 23             | 395            | 48             | 1058           |
| 24             | 419            | 49             | 1086           |
| 25             | 444            | 50             | 1115           |

**Reference Table 10**  
**Conference and TDS loop requirements**

| <b>Network loops<br/>required at 2 years</b> | <b>TDS<br/>loops required</b> | <b>Conference loops<br/>required</b> |
|--|-------------------------------|--------------------------------------|
| 1–12   | 1                             | 1                                    |
| 13–24  | 2                             | 2                                    |
| 25–36  | 3                             | 3                                    |
| 37–48  | 4                             | 4                                    |
| 49–60  | 5                             | 5                                    |
| 61–72  | 6                             | 6                                    |
| 73–84  | 7                             | 7                                    |
| 85–96  | 8                             | 8                                    |
| 97–108                                       | 9                             | 9                                    |
| 109–120                                      | 10                            | 10                                   |

**Reference Table 11**  
**Digitone receiver provisioning (Part 1 of 3)**

| DTR CCS | DTR ports | DTR CCS   | DTR ports |
|---------|-----------|-----------|-----------|
| 1–2     | 2         | 488–515   | 24        |
| 3–9     | 3         | 516–545   | 25        |
| 10–19   | 4         | 546–576   | 26        |
| 20–34   | 5         | 577–607   | 27        |
| 35–50   | 6         | 608–638   | 28        |
| 51–69   | 7         | 639–667   | 29        |
| 70–89   | 8         | 668–698   | 30        |
| 90–111  | 9         | 699–729   | 31        |
| 112–133 | 10        | 730–761   | 32        |
| 134–157 | 11        | 762–793   | 33        |
| 158–182 | 12        | 794–825   | 34        |
| 183–207 | 13        | 826–856   | 35        |
| 208–233 | 14        | 857–887   | 36        |
| 234–259 | 15        | 888–919   | 37        |
| 260–286 | 16        | 920–951   | 38        |
| 287–313 | 17        | 952–984   | 39        |
| 314–342 | 18        | 985–1017  | 40        |
| 343–371 | 19        | 1018–1050 | 41        |
| 372–398 | 20        | 1051–1084 | 42        |
| 399–427 | 21        | 1085–1118 | 43        |
| 428–456 | 22        | 1119–1153 | 44        |
| 457–487 | 23        | 1154–1188 | 45        |

**Reference Table 11**  
**Digitone receiver provisioning (Part 2 of 3)**

| <b>DTR CCS</b> | <b>DTR ports</b> | <b>DTR CCS</b> | <b>DTR ports</b> |
|----------------|------------------|----------------|------------------|
| 1189–1223      | 46               | 1961–1995      | 68               |
| 1224–1258      | 47               | 1996–2030      | 69               |
| 1259–1293      | 48               | 2031–2065      | 70               |
| 1294–1329      | 49               | 2066–2100      | 71               |
| 1330–1365      | 50               | 2101–2135      | 72               |
| 1366–1400      | 51               | 2136–2170      | 73               |
| 1401–1435      | 52               | 2171–2205      | 74               |
| 1436–1470      | 53               | 2206–2240      | 75               |
| 1471–1505      | 54               | 2241–2275      | 76               |
| 1506–1540      | 55               | 2276–2310      | 77               |
| 1541–1575      | 56               | 2311–2345      | 78               |
| 1576–1610      | 57               | 2346–2380      | 79               |
| 1611–1645      | 58               | 2381–2415      | 80               |
| 1646–1680      | 59               | 2416–2450      | 81               |
| 1681–1715      | 60               | 2451–2485      | 82               |
| 1716–1750      | 61               | 2486–2520      | 83               |
| 1751–1785      | 62               | 2521–2555      | 84               |
| 1786–1802      | 63               | 2556–2590      | 85               |
| 1821–1855      | 64               | 2591–2625      | 86               |
| 1856–1890      | 65               | 2626–2660      | 87               |
| 1891–1926      | 66               | 2661–2695      | 88               |
| 1926–1960      | 67               | 2696–2730      | 89               |

**Reference Table 11**  
**Digitone receiver provisioning (Part 3 of 3)**

| <b>DTR CCS</b> | <b>DTR ports</b> | <b>DTR CCS</b> | <b>DTR ports</b> |
|----------------|------------------|----------------|------------------|
| 2731–2765      | 90               | 2941–2975      | 96               |
| 2766–2800      | 91               | 2976–3010      | 97               |
| 2801–2835      | 92               | 3011–3045      | 98               |
| 2836–2870      | 93               | 3046–3080      | 99               |
| 2871–2905      | 94               | 3081–3115      | 100              |
| 2906–2940      | 95               | 3116–3465      | 101              |

**Note:** Provisioning assumes an 11-second holding time.

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# Meridian 1

## System Engineering

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