Meridian 1

# System Overview

Document Number: 553-3001-100
Document Release: Standard 16.00
Date: April 2000

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# Revision history

**April 2000**

Standard 16.00. 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.

**November 1999**

Standard, release 15.00. Updated to include information on the Fiber Network product, including the Fiber Junctor Interface (FIJI) card, Core Network Interface 3 (CNI-3) card, and Optical Cable Management cards (OCMC).

**June 1999**

Standard, release 14.00. Updated to included information on the NT5D03 Call Processor card.

**October 1997**

Standard, release 13.00. Changes are noted by revision bars in the margin.

**August 1996**

Standard, release 12.00. Updated to include references to X11 software release 22. Changes are noted by revision bars in the margin.

**December 1995**

Standard, release 11.00. Corrections to text and figures.

**July 1995**

Standard, release 10.00. Added references to Option 81C switch, added international information to create a global NTP, and other minor changes. Changes are noted by revision bars in the margin.

**December 1994**

Standard, release 9.00. This document is reissued to include updated information on the small system multi disk unit (SMDU), Meridian 1 option 51C, and other minor updates. Changes to technical content are noted by revision bars in the margins.

**April 1994**

Standard, release 8.00. Added references to option 61C switch.

**August 1993**

Standard, release 7.00. Changes to technical content are noted by revision bars in the margins.

**April 1993**

Standard, release 6.00. Changes to technical content are noted by revision bars in the margins.

**December 1992**

Standard, release 5.00. This document is reissued to include information on system option 81 and equipment required for compatibility with X11 release 18. Only new information and changes to technical content are noted by revision bars in the margins.

**December 1991**

Standard, release 4.00. This document is reissued to include technical content updates. Due to the extent of changes revision bars are omitted.

**July 1990**

Standard, release 3.00.

**February 1990**

Standard, release 2.00.

**January 1990**

Standard, release 1.00.

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# About this document

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 a Meridian 1 product description and describes the hardware and software architecture.

## References

See the Meridian 1 planning and engineering guide for

- *Library Navigator* (553-3001-000)
- *Installation Planning* (553-3001-120)
- *System Engineering* (553-3001-151)
- *Power Engineering* (553-3001-152)
- *Spares Planning* (553-3001-153)
- *Equipment Identification* (553-3001-154)

See the Meridian 1 installation and maintenance guide for

- *System Installation Procedures* (553-3001-210)
- *Circuit Card: Installation and Testing* (553-3001-211)
- *Telephone and Attendant Console: Installation* (553-3001-215)
- *General Maintenance Information* (553-3001-500)
- *Fault Clearing* (553-3001-510)
- *Hardware Replacement* (553-3001-520)

See the X11 software guide 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.

See the *FNF Reference Guide* (553-3001-259) for a description of the Fiber Network system architecture, upgrade procedures and system messages.

# Product description

## Content list

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The Meridian 1 product line consists of system types referred to as system Options. A system option is made up of Universal Equipment Modules (UEMs) stacked one on top of another to form a column. Each column contains a pedestal, a top cap, and up to four modules. A system can have one column or multiple columns.

Each UEM is a self-contained unit that, when equipped, houses a card cage and backplane, power and ground cabling, power units, I/O panels, circuit cards, and cables. When the card cage is installed, the function of the UEM is established and the module is no longer “universal.” Meridian 1 modules are as follows:

- NT5K11 Enhanced Existing Peripheral Equipment Module for Options 51C, 61C, and 81C
- NT5D21 Core/Network Module for Options 51C, 61C, and 81C
- NT8D35 Network Module required for Options 51C, 61C, and 81C
- NT8D37 Intelligent Peripheral Equipment (IPE) Module required for Options 51C, 61C, and 81C
- NT8D47 Remote Peripheral Equipment (RPE) Module optional for Options 51C, 61C, and 81C

***Note:*** In addition, modules that house equipment for specific applications, such as Meridian Mail and Meridian Link, can be included in a column.

The pedestal generally houses a blower unit, air filter, Power Distribution Unit (PDU), and System Monitor.

The top cap provides airflow exits, input/output (I/O) cable entry and exit, and overhead cable-rack mounting. Thermal sensor assemblies for the column are attached to a perforated panel on top of the highest module in the column, under the top cap.

A system can have one column or multiple columns. To comply with FCC and CSA standards for containing electromagnetic interference and radio frequency interference (EMI/RFI), spacer kits connect the columns in a multiple-column system.

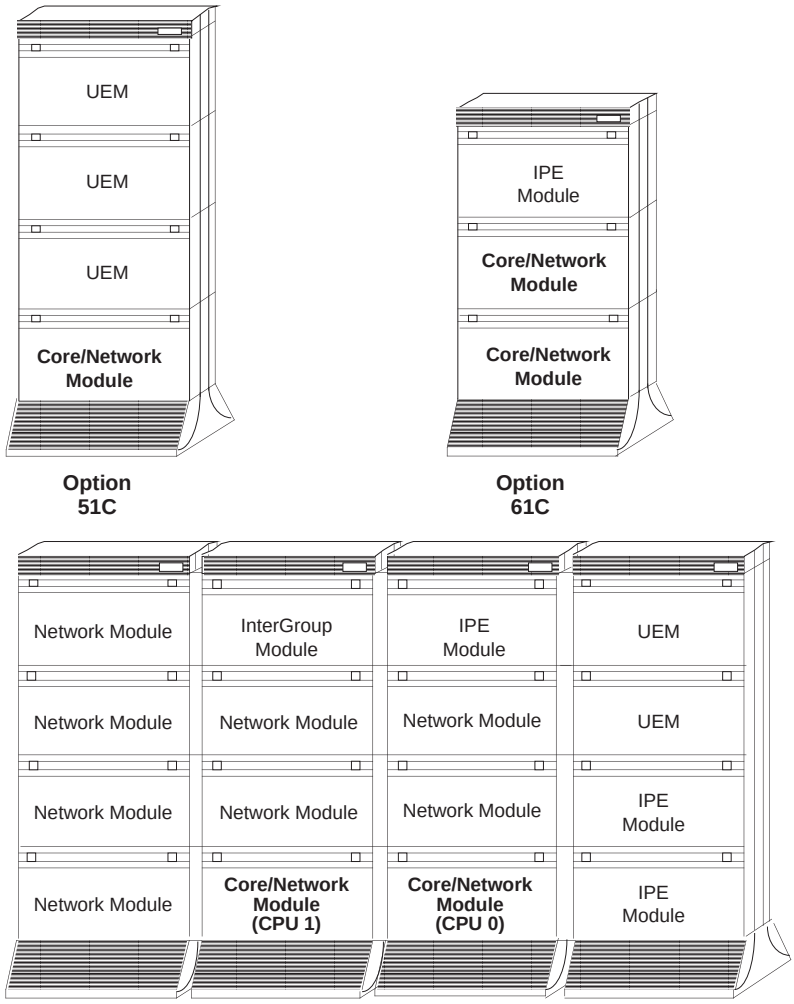
## Meridian 1 system options

This document includes information on the following Meridian 1 system types (see Figure 1):

- Option 51C: enhanced common control complex, single CPU, and half-network group
- Option 61C: enhanced common control complex, dual CPU, and one full-network group
- Option 81C: enhanced common control complex, dual CPU, and multiple-network groups

All system Options are available in AC- and DC-powered versions.

**Figure 1**
**Options 51C, 61C, and 81C**




**Option 81C** (example of five network groups)

***Note:*** Modules labeled "UEM" can be application modules (such as Meridian Mail), Network Modules configured for PRI/DTI, PE Modules, RPE Modules, or additional IPE Modules.

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## System Option 51C

Option 51C is a single-CPU system with a half-network group. One Core/Network Module and one IPE Module are required. Additional IPE Modules, PE Modules, RPE Modules, and application modules can be used.

Table 2 lists the specifications for Option 51C. Figure 1 shows the basic configuration.

**Table 1**
**Option 51C specifications (Part 1 of 2)**

| | | |
|---|---|---|
| **System characteristics:** | | |
| Maximum number of ports | — | 1000 |
| Input voltage | — | 208 V ac or –48 V dc |
| Number of CPUs | — | 1 |
| Number of network loops | — | 16 |
| **Memory options:** | | |
| X11 releases 19–21 | — | 24 or 48 MB NT6D66 or the NT9D19 CP card |
| X11 release 22 | — | 48 MB NT6D66 or any NT9D19 CP card |
| X11 release 23 | — | NT9D19 or NT5D10 CP card |
| X11 release 24 | — | NT9D19, NT5D10, or NT5D03 CP card |
| X11 release 25 | — | NT5D10 or NT5D03 CP card |
| Software generic | — | 1711 (release 20-21). Use only the NT6D66 CP card to run release 22 on this generic. |
| | — | 2211 if using the NT9D19 CP card or NT5D10 CP card (release 22 or later) |
| | — | 2811 if using the NT5D03 CP card to run this generic (release 24 or later) |

**Table 1**
**Option 51C specifications (Part 2 of 2)**

| **Base hardware:** | |
|---|---|
| Core/Network Module | Required per system:<br>— SDI-type card<br>Required in module:<br>— CE power supply (CEPS)<br>— Call Processor (CP)<br>— Input-Output Disk Unit with CD-ROM (IODU/C)<br>— Core to Network Interface (CNI)<br>— 3-Port Extender (3PE) card<br>— Clock Controller Card (MCLK) |
| IPE Module | — PE power supply<br>— IPE cards |
| Pedestal (one per column) | — System Monitor<br>— PDU<br>— Blower unit |
| Top cap (one per column) | — Thermostat harness<br>— Air probe harness |

## System Option 61C

Option 61C is a dual-CPU system with standby processing capability, fully redundant memory, and a full-network group. Two Core/Network Modules and one IPE Module are required. Additional IPE Modules, PE Modules, RPE Modules, and application modules can be used.

Table 2 lists the specifications for Option 61C. Figure 1 shows the basic configuration.

**Table 2**
**Option 61C specifications (Part 1 of 2)**

| | | |
|---|---|---|
| **System characteristics:** | | |
| Maximum number of ports | — | 2000 |
| Input voltage | — | 208 V ac or –48 V dc |
| Number of CPUs | — | 2 (redundant) |
| Number of network loops | — | 32 |
| **Memory options:** | | |
| X11 releases 19–21 | — | 24 or 48 MB NT6D66 CP card or the NT9D19 CP card |
| X11 release 22 | — | 48 MB NT6D66 CP card or any NT9D19 CP card |
| X11 release 23 | — | NT9D19 CP card or NT5D10 CP card |
| X11 release 24 | — | NT9D19, NT5D10, or NT5D03 CP card |
| X11 release 25 | — | NT5D10 or NT5D03 CP card |
| Software generic | — | 1811 (release 19-21). Use only the NT6D66 CP card to run release 22 on this generic |
| | — | 2311 if using the NT9D19 CP or NT5D10 CP card (release 22 or later) |
| | — | 2911 if using the NT5D03 CP card to run this generic (release 24 or later) |

**Table 2**
**Option 61C specifications (Part 2 of 2)**

| **Base hardware:** | |
|---|---|
| Core/Network Module (two) | Required per system:<br>— SDI-type card<br>Required per module:<br>— CE power supply (CEPS)<br>— Input Output Disk Unit with CD-ROM (IODU/C)<br>— Call Processor (CP)<br>— Core to Network Interface (CNI) card<br>— 3-Port Extender (3PE) card<br>— Clock Controller card (MCLK)<br>— Hybrid Bus Terminators - with NT5D21 Core/Network Modules only<br>— Peripheral Signaling card (PS) |
| IPE Module | — PE power supply<br>— IPE cards |
| Pedestal (one per column) | — System Monitor<br>— PDU<br>— Blower unit |
| Top cap (one per column) | — Thermostat harness<br>— Air probe harness |

## System option 81C

Option 81C is a dual-CPU system with standby processing capabilities, fully redundant memory, and up to eight full-network groups. Option 81C is equipped with two redundant input/output processor and disk drive unit combination packs.

The following modules are required:

- two Core/Network Modules (provides one network group)
- a minimum of two Network Modules (provides one network group)
- a minimum of one IPE Module

Additional Network and IPE Modules are required for additional network groups. Or you may use PE Modules, RPE Modules, or application modules.

Table 3 lists the specifications for Option 81C. Figure 1 shows a typical configuration for eight full network groups. Additional columns can be added, and there can be more than one row of columns.

**Table 3**
**Option 81C specifications (Part 1 of 2)**

| **System characteristics:** | | |
|---|---|---|
| Maximum number of ports | — | 10,000 |
| Input voltage | — | 208 V ac or –48 V dc |
| Number of CPUs | — | 2 (redundant) |
| Number of network loops | — | 160 |
| Memory | — | 96 MB min (with 2 to 5 Network groups) 32 MB Flash and 64 MB DRAM required |
| | — | 112 MB min (with 6 to 8 Network groups) 32 MB Flash and 80 MB DRAM required |
| Software generic | — | 1911 |
| | — | 3011, with required software feature 299, if using the NT5D03 CP card to run this generic |

**Table 3**
**Option 81C specifications (Part 2 of 2)**

| **Base hardware:** | |
|---|---|
| Core/Network Module (two) (side-by-side or stacked on top of each other) | — CE power supply<br>— Input Output Disk Unit with CD-ROM (IODU/C)<br>— Call Processor (CP) card<br>— Core to Network Interface 3 (CNI-3) cards<br>— Hybrid Bus Terminators<br>— Fiber Junctor Interface (FIJI) cards<br>— Network cards<br>— Conference/TDS card<br>— Superloop Network cards<br>— Peripheral Signaling card (PS)<br>— 3-Port Extender card (3PE) |
| Network Module | — Superloop Network card<br>— Clock Controller card<br>— SDI-type card |
| IPE Module | — PE power supply<br>— IPE cards |
| Pedestal (one per column) | — System monitor<br>— Power Distribution Unit (PDU)<br>— Blower unit |
| Top cap (one per column) | — Thermostat harness<br>— Air probe harness |

# System modules

Each type of module is available in AC-power and DC-power versions (except the NT8D36 InterGroup Module that does not require power, and the NT5K11 EEPE module which is only available in DC-power). AC-power modules generally require a module power distribution unit (MPDU) to provide circuit breakers for the power supplies. DC-power modules do not require an MPDU because a switch on each power supply performs the same function as the MPDU circuit breakers.

***Note 1:*** In the UK, DC powered modules must be used.

***Note 2:*** Existing Peripheral Equipment (EPE) modules are not approved for use in the UK.

The figures in this chapter show a typical configuration for each module. (DC power is represented in these examples.)

## NT5K11 Enhanced Existing Peripheral Equipment

The NT5K11 Enhanced Existing Peripheral Equipment (EEPE) module supports the PE cards currently used in Meridian SL-1 PE shelves. It provides the interface to the system for trunks and stations. The NT5K11 module may be connected to an ENET (QPC414) circuit card.

The NT5K11 EEPE module houses two Dual Loop Peripheral Buffer circuit cards (NT5K10) and two Quad DIGITONE receiver cards (NT5K09) at the rear of the module (see Figure 2). It supports up to sixteen existing peripheral equipment circuit cards as shown in Figure 2.

The NT5K11 EEPE module is available only with an NT5K12 (EPEPS) DC power supply. This power supply provides the voltages to operate the circuit cards located in the module and includes a ringing generator.

All cable connections to the MDF are made in the rear of the module through I/O panels (see Figure 2). Twelve PE cables are required to the MDF for all 16 card slots.

When the Meridian Data Service ADM, SADM, ASIM, AIM are required, the NT5K11 EEPE module must be used.

**Figure 2**
**EEPE rear card slot assignment**

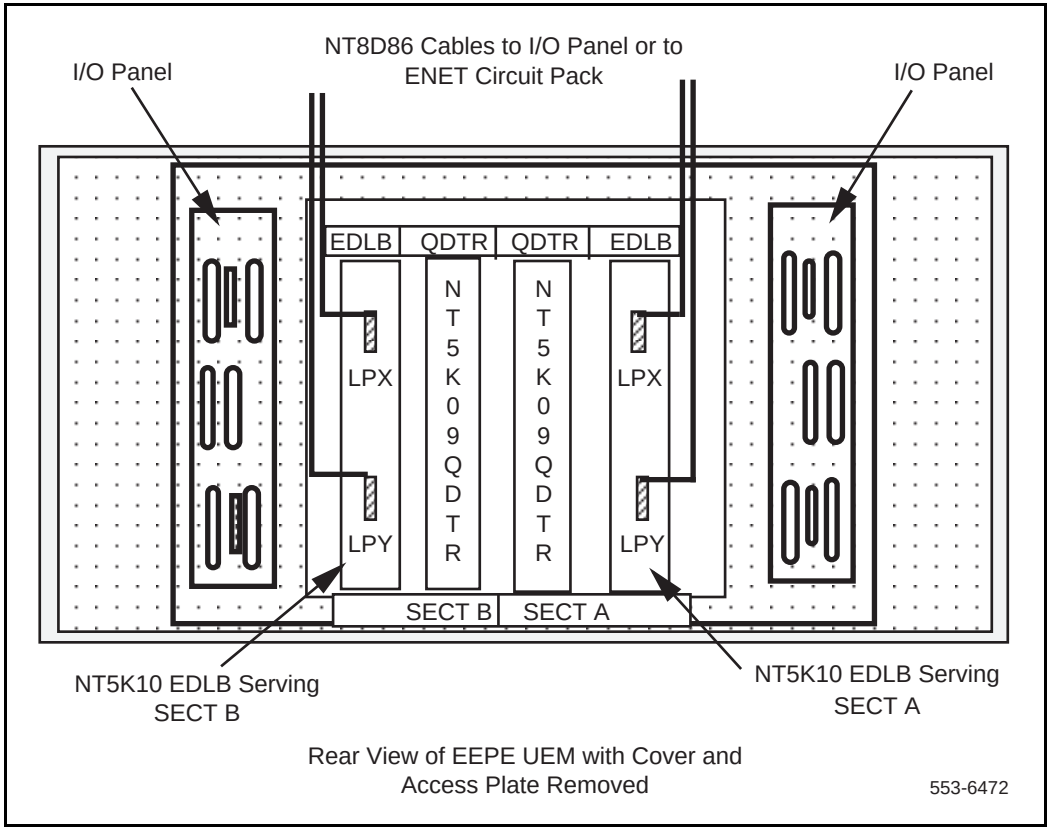
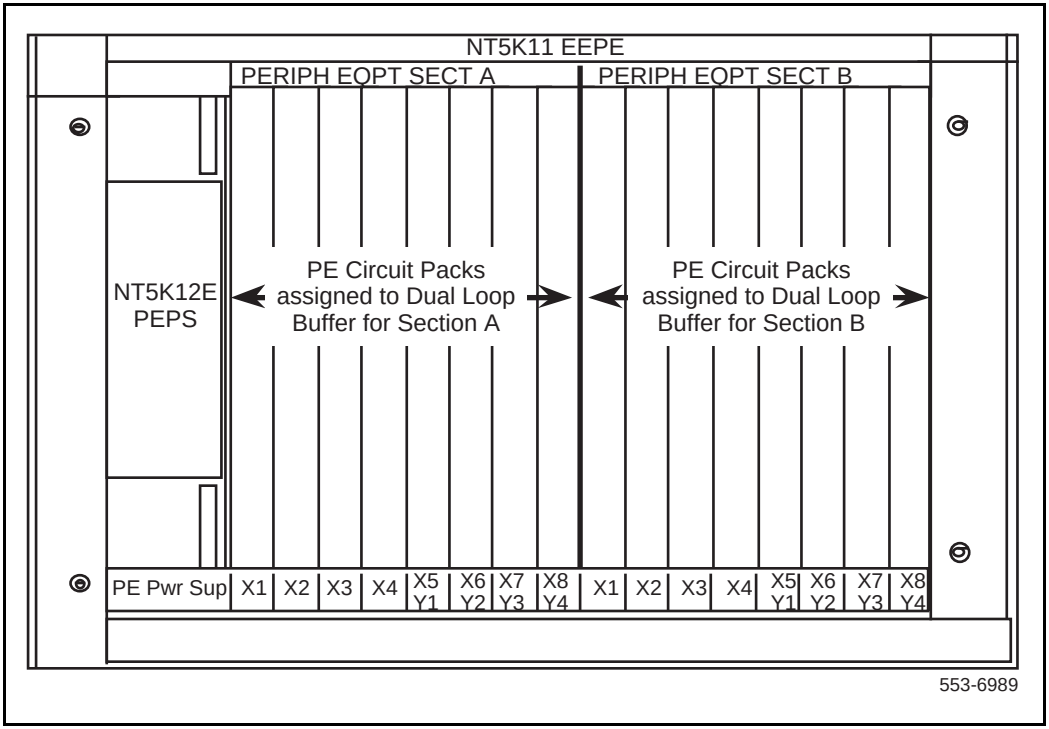


**Figure 3**
**EEPE front card slot assignment**



## NT5D21 Core/Network Module

This module provides common control and network interface functions in Options 51C, 61C, and 81C.

Two Core/Network Modules are required in the Option 61C and 81C switch and one module is required in the Option 51C. The two modules in Options 61C and 81C provide redundant common control operation. If there is a failure in one of the modules, the function is transferred to the appropriate circuit cards in the other module without a loss of service.

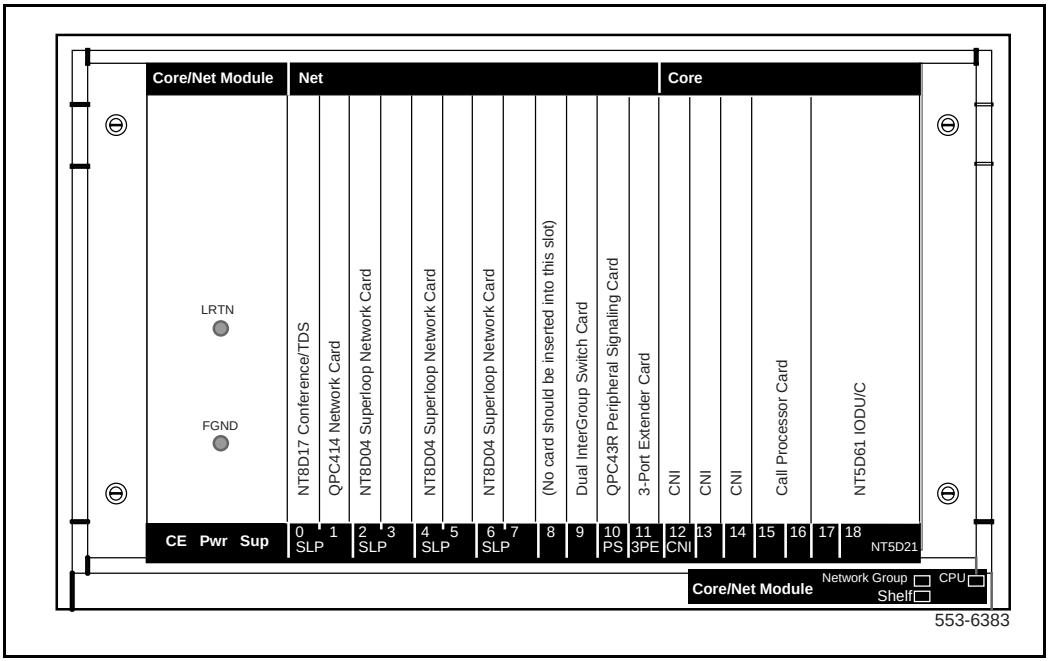
One section of this module houses the common control complex (CPU, memory, up to three CNI cards, and mass storage functions). The other section supports a Conference card, one Peripheral Signaling card, one 3-Port Extender card, and optional network cards.

> ***Note:*** Three CNI or CNI-3 cards are used only for Option 81C. For Options 51C and 61C, CNI card slots 13 and 14 remain empty.

Each Core/Network module houses up to four NT8D04 Superloop Network Cards, or seven QPC414 Network Cards, or a combination of the two, for a total of 16 network loops. Superloop Network cards are cabled to the backplane of an IPE Module. QPC414 Network Cards are cabled to the dual loop peripheral buffer card in a PE Module. In a typical configuration, one conference/TDS card is configured in the module, leaving 14 voice/data loops available.

Figure 4 shows the cards housed in the NT5D21 Core/Network Module as configured for Option 81C. For Options 51C and 61C, slots 8, 13, and 14 are spare and slot 9 contains the Clock Controller card, if required. Fiber Junctor Interface (FIJI) cards are not used in the Options 51C and 61C.

**Figure 4**
**NT5D21 Core/Network Module equipped for Option 81C**




## NT8D35 Network Module

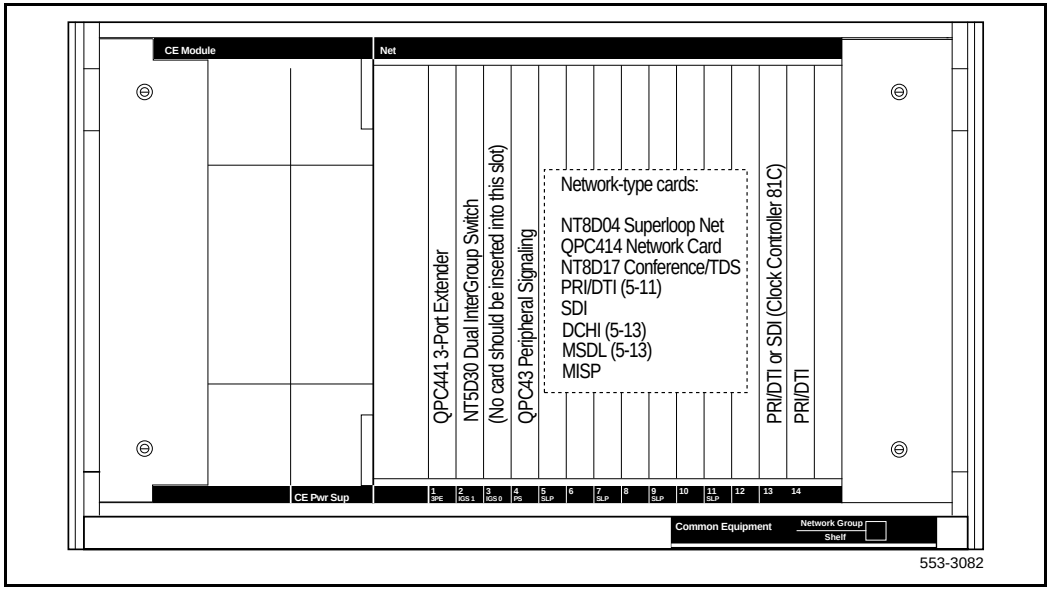
This module provides the network switching functions in the Option 81C.

Two Network Modules are required to make a full network group of 32 loops. A maximum of 16 Network Modules (eight network groups) can be configured in the Option 81C.

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. Superloop network cards are cabled to the backplane of an IPE Module. QPC414 Network Cards are cabled to the dual loop peripheral buffer card in a PE Module. In a typical configuration, one Conference/TDS card is configured in the module, leaving 14 voice/data loops available. In Option 81C, the Conference/TDS card is located in the Core/Network Module. The Clock Controller must be installed in slot 13.

Figure 5 shows the cards housed in the module.

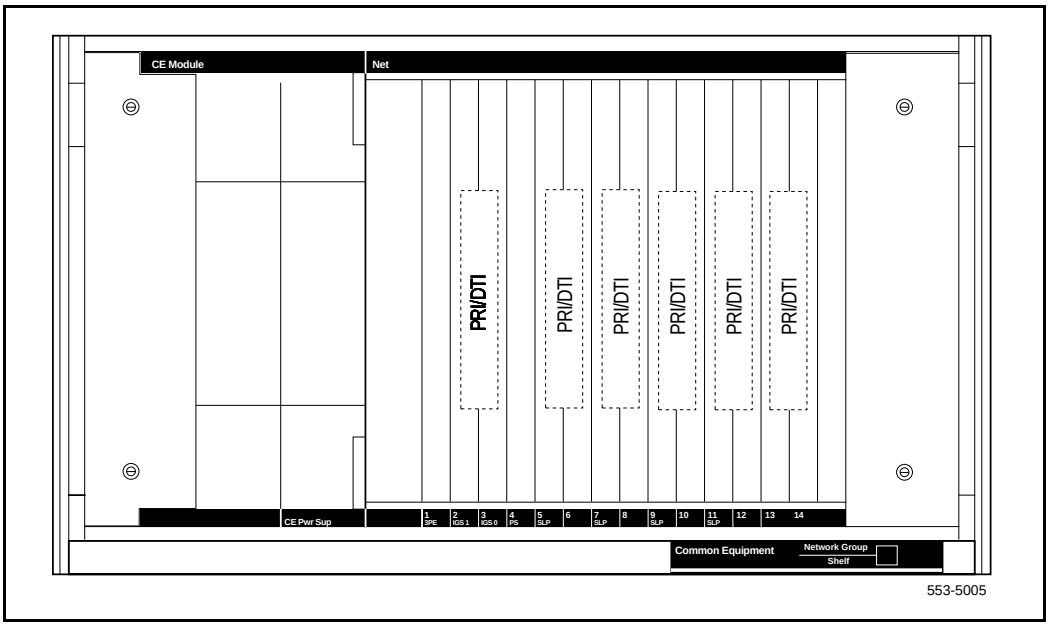
**Figure 5**
**NT8D35 Network Module**




The Network Module can be used as a PRI/DTI expansion module. The number of PRI/DTI expansion modules that can be used is determined by traffic considerations. Figure 6 shows the card slot configuration when the Network Module is used for PRI/DTI expansion.

***Note:*** The bus terminating units (BTUs) that are equipped in the NT8D35AA and NT8D35DC Network Module configuration are not required for, and will interfere with, the PRI/DTI expansion configuration. The NT8D35BA and NT8D35EA Network Modules do not use nor do they need BTUs for any application.

**Figure 6**
**NT8D35 Network Module configured for PRI/DTI expansion**



## NT8D37 Intelligent Peripheral Equipment Module

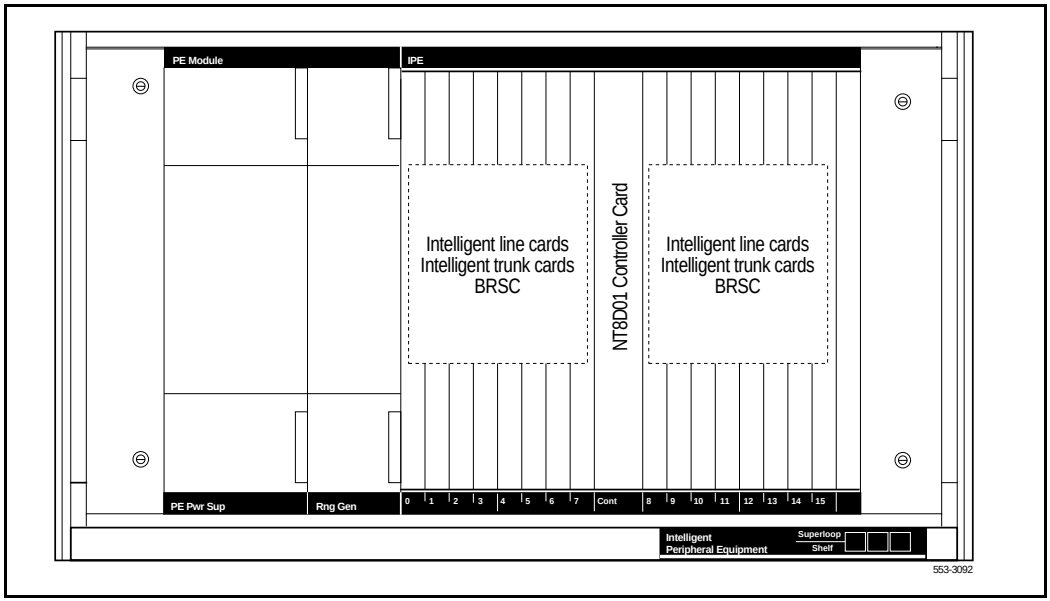
This module provides the interface between network switching and intelligent peripheral equipment cards, such as intelligent line and trunk cards, in all Options.

> ***Note:*** This module supports intelligent peripheral equipment (IPE) cards. Non-intelligent peripheral (PE) cards are housed in the NT8D13 PE Module.

The IPE Module houses one NT8D01 Controller Card, which is the peripheral equipment controller, and up to 16 IPE cards, supporting up to 512 terminal numbers (256 voice and 256 data). The controller card is cabled to the NT8D04 Superloop Network Card.

Figure 7 shows the card slot assignments in the module.

**Figure 7**
**NT8D37 IPE Module**



## NT8D47 Remote Peripheral Equipment Module

In conjunction with the NT8D13 PE Module, the RPE Module extends the network-to-peripheral equipment interconnection distance between local and remote sites. This module can be used with all Options.

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 may also house PRI/DTI cards at the local site. At the remote site, the RPE Module is equipped with QPC65 Remote Peripheral Switch Cards.

Figure 8 shows the cards housed in an RPE Module at the local site. Figure 9 shows the cards housed in the module at the remote site.

**Figure 8**
**NT8D47 RPE Module—local site**

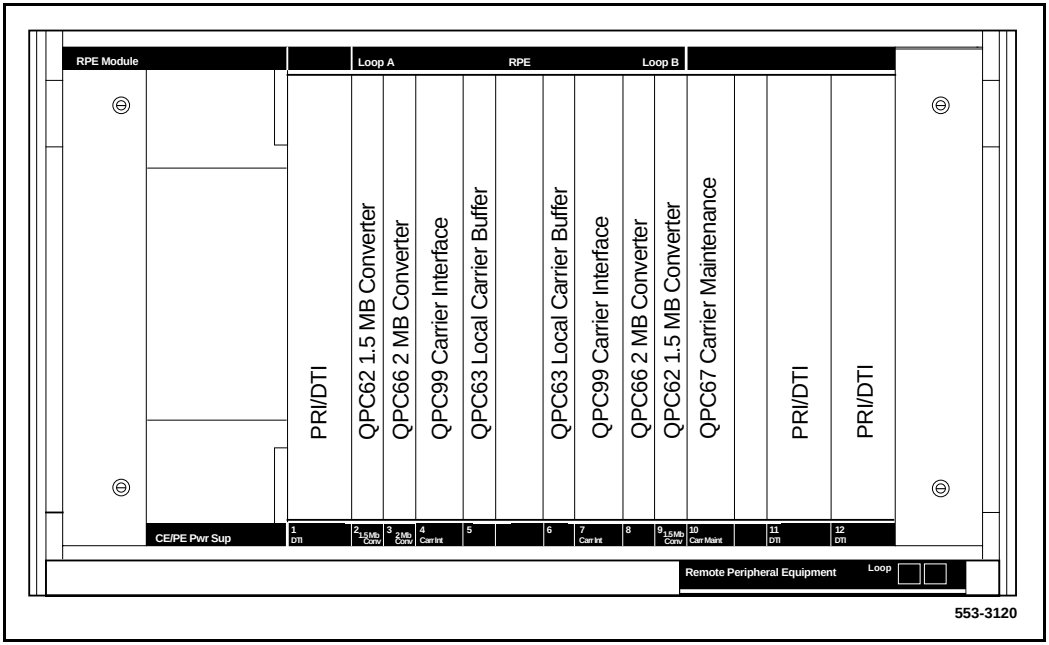
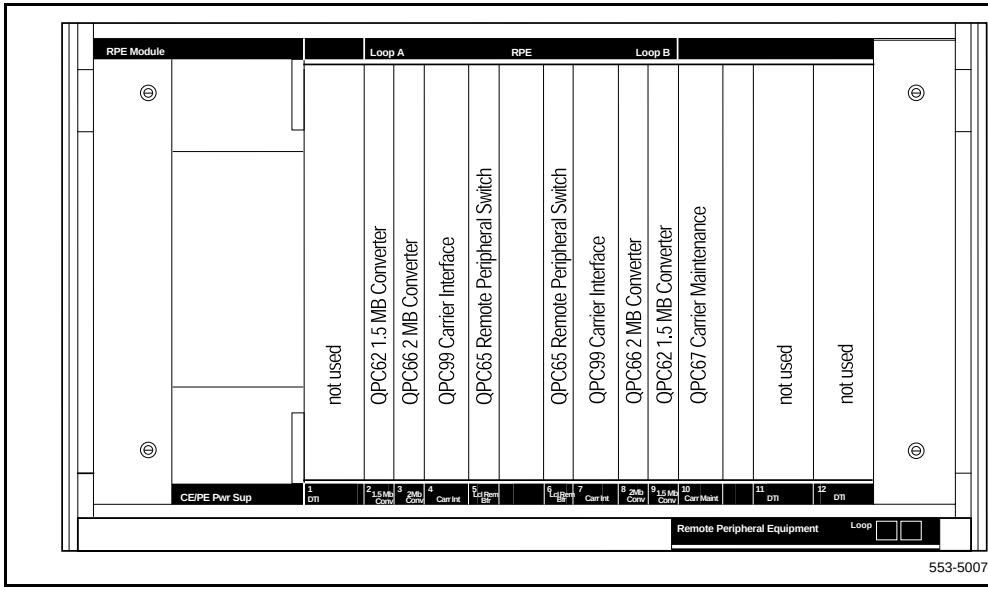


**Figure 9**
**NT8D47 RPE Module—remote site**



# System architecture

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## Reference list

The following are the references in this section:

- *FNF Reference Guide* (553-3001-259)
- *System Engineering* (553-3001-151)
- *Meridian 1 Telephones: Description and Specifications* (553-3001-108)

- *Meridian 1 European Digital Telephones* (553-3001-114)
- *M3900 Series Meridian Digital Telephones: Description, Installation, and Administration* (553-3001-216)
- *Attendant Consoles: Description* (553-2201-117)

## Hardware architecture

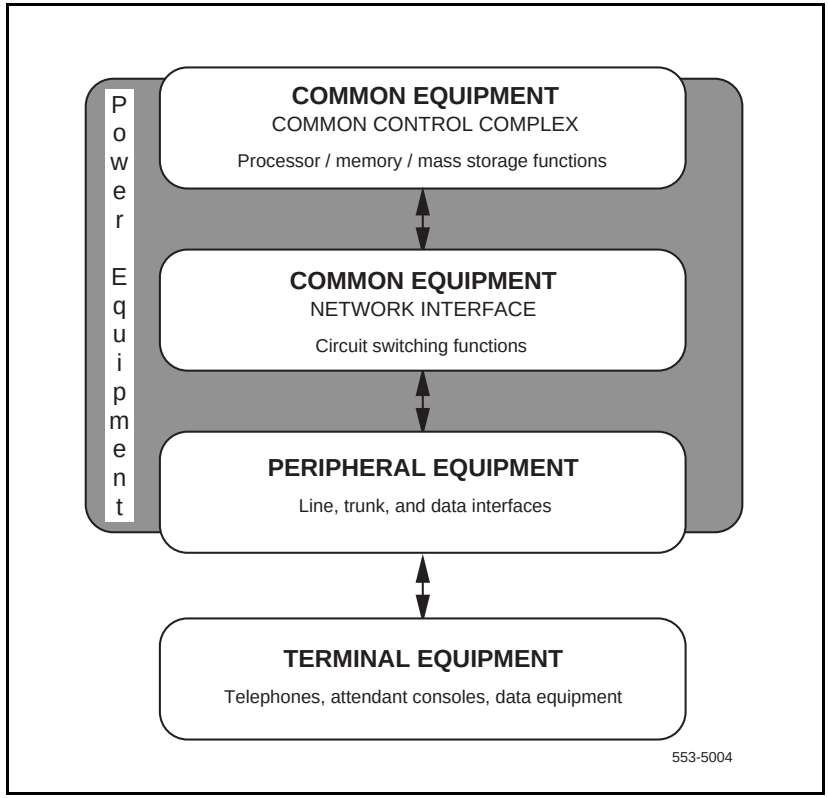
A Meridian 1 is a circuit-switched digital system that provides voice and data transmission. The internal hardware is divided into the following functional areas (see Figure 10):

- Common equipment circuit cards provide the processor control, software execution, and memory functions of the system.
- Network interface circuit cards perform switching functions between the processor and peripheral equipment cards.

  ***Note:*** As shown in Figure 10, the network interface function is generally considered a subset of the common equipment functions.

- Peripheral equipment circuit cards provide the interface between the network and connected devices, including terminal equipment and trunks.
- Terminal equipment includes telephones and attendant consoles (and may include equipment such as data terminals, printers, and modems).
- Power equipment provides the electrical voltages required for system operation, and cooling and sensor equipment for system protection.

**Figure 10**
**Meridian 1 basic architecture**



## Common control

The processor is the common control complex of the system. It provides the sequences to process voice and data connections, monitor call activity, and perform system administration and maintenance.

The processor communicates with the network interface over a common control bus that carries the flow of information.

The common control complex consists of:

- the processor card or cards that provide the computing power for system operation
- system memory that stores all operating software programs and data unique to each system
- the disk drive unit that provides mass storage for operating programs and data
- I/O interfaces that provide an information exchange between the user and the system

Options 51C, 61C, and 81C “core” processor cards more than double the real-time call processing capacity of earlier processor cards, support extensive networking, and provide intensive use of software features and applications, including call centers of up to 1000 agents.

The core software architecture incorporates a real-time multitasking operating system, as well as SL-1 code that delivers features and call processing. This architecture guarantees feature transparency to the user upgrading to the core CPU. The core architecture also provides significant operation, administration, and maintenance enhancements for the people who work closely with the system software and hardware.

All core overlays reside in dynamic random-access memory (DRAM) after they are loaded from the hard disk during an initial software load (software is shipped on redundant hard disks). The Resident Overlays featured in core based systems ensure subsecond speeds in accessing the overlays.

The capacity enhancement in the core architecture is provided by the core control complex. In the Option 81C with Core Modules, the core control complex refers to the two Core Modules, Core 0 and Core 1. In the Option 61C and Option 81C with Core/Network Modules, the core control complex refers to the two Core/Network Modules, Core/Network 0 and Core/Network 1. In the Option 51C, the core control complex refers to a Core/Network Module. The Core and Core/Network Modules are fully redundant, with Core 1 duplicating the contents of Core 0.

The backplane in the Option 81C Core Modules is divided into two functional areas. The “interface” side houses a clock controller card, a three-port extender card, and up to two optional PRI/DTI cards. The “core” side provides an interprocessor bus (IPB).

The backplane in the Options 51C, 61C, and 81C Core/Network Module is divided into “core” and “network” sides. The “network” side allows up to eight network cards to be installed for call processing capability.

The IPB is a very fast 32-bit address and data multiplexed multimaster bus that enables efficient communications with I/O interfaces and adjunct processors. The IPB is an asynchronous bus with speeds in the hundreds of megabits per second, resulting in a cumulative total speed many times greater than, for example, the 10-MB speed of Ethernet.

In each Core/Network Module, the core side houses the following equipment:

- one Call Processor (CP) card
- one Input/Output Disk Unit with CD-ROM (IODU/C)
- one (Options 51C and 61C) or up to three (Option 81C) Core-to-Network Interface (CNI or CNI-3) cards

Cabling between the CP cards allows memory shadowing and dual-CPU operation.

The CNI and CNI-3 cards provide the interface between the IPB and the network shelf, and between the CP card and three-port extender cards in the network shelf. Each CNI card provides two ports. Each CNI-3 card supports three ports. In a typical configuration, three CNI-3 cards support eight network groups.

The NT5D61 Input/Output Disk Unit with CD-ROM (IODU/C) uses an industry-standard 2MB floppy drive and CD-ROM drive to install system software from a CD-ROM.

The IODU/C uses a Security Device and an electronic Keycode to perform security authentication. The Keycode file contains information about which features the system provides as well as Incremental Software Management limits.

Core/Net modules diagnose faults in field-replaceable units for all core hardware, including cables. In case of a failure, a message appears on the system terminal and on the liquid crystal display (LCD) of the CP card. All messages can be stored in a file for future diagnostics.

Figure 11 provides a block diagram of the Option 61C and the Option 51C core architecture. The Option 51C architecture is represented by the top half of Figure 11. Figure 12 provides a block diagram of the Option 81C with Core/Network Module architecture.

**Figure 11**
**Options 51C and 61C core complex**

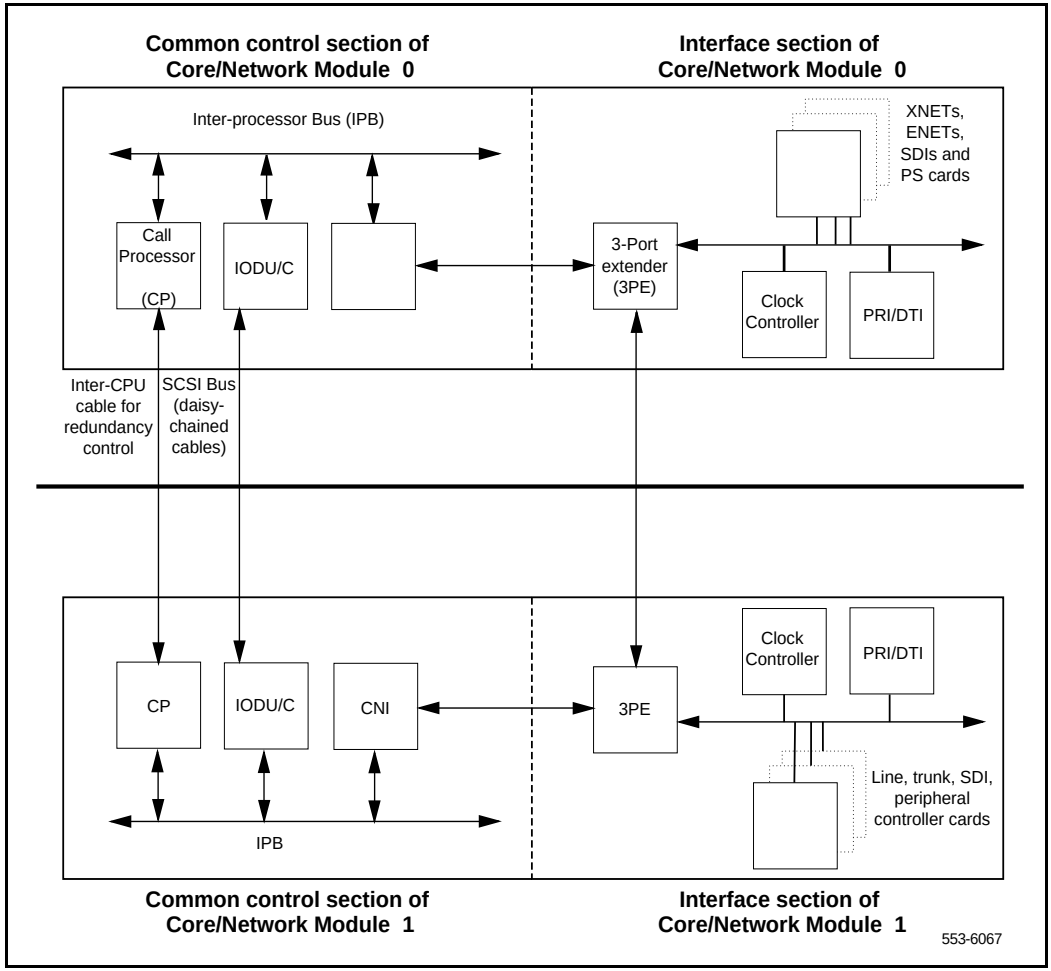
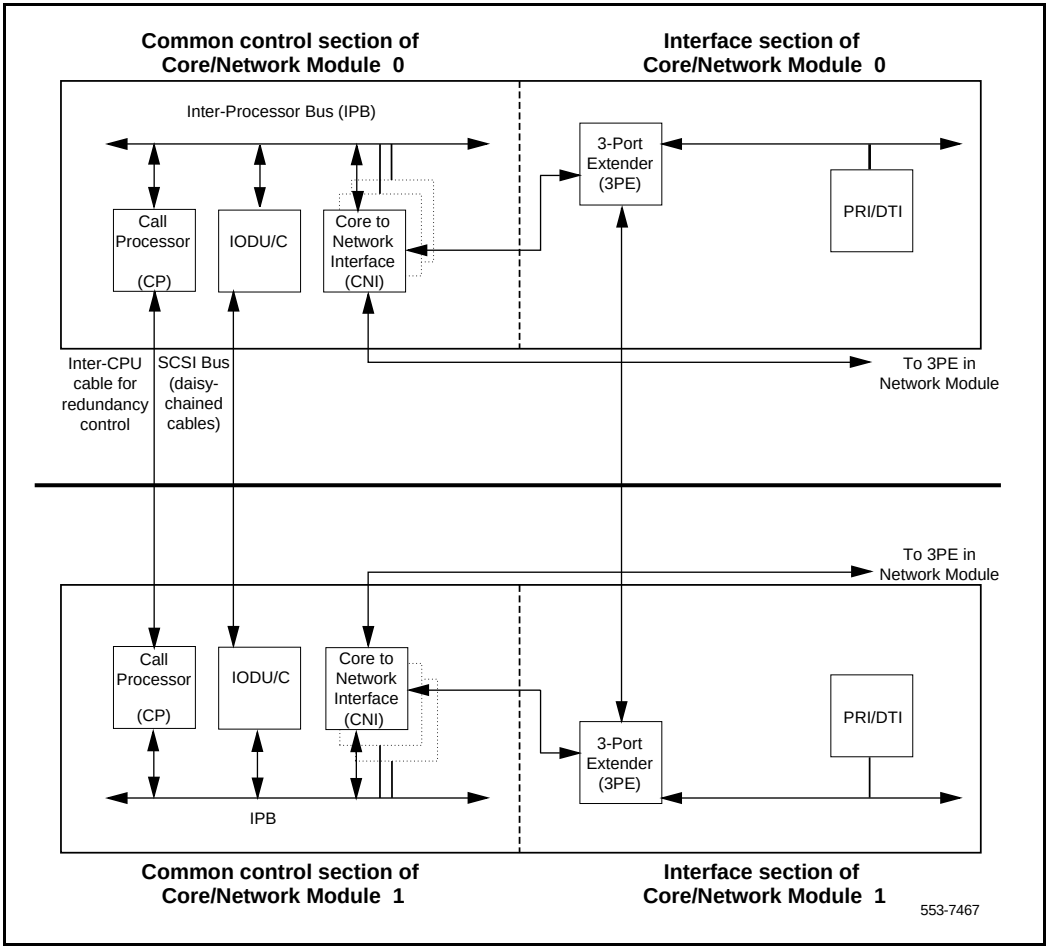


**Figure 12**
**Option 81C core/network complex**



## Network switching

Network switching, based on digital multiplexed loops, interconnects peripheral ports. A loop transmits voice, data, and signaling information over a bidirectional path between the network and peripheral ports.

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

Two types of cards provide network switching control:

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

### Network organization

Network loops are organized into groups. A system is generally configured as one of the following:

- a half-group system that provides up to 16 loops
- a full-group system that provides up to 32 loops
- a multiple-group system that provides up to 256 loops

The Fiber Junctor Interface (FIJI) cards in the Network modules are connected with fiber optic cables to form a Dual Ring Fiber Network. This network consists of two separate rings: one ring connects all the Network shelf 0's while the second ring connects all the Network shelf 1's. This network communicates on a subset of the Sonet OC12c protocol (622 MB bandwidth on each ring).

The Dual Ring fiber optic cable configuration provides complete non-blocking communication between the Network groups; this eliminates the incidence of busy signals for calls switched between groups. Each FIJI card can handle 32 PCM links. A system of eight Network groups provides 7680 timeslots for 3840 simultaneous conversations.

This Dual Ring network is fully redundant: each of the fiber optic cable rings is capable of handling the traffic for an entire eight group network. If a fault in one ring is detected, the other ring automatically takes over call processing. No calls are lost during the switchover.

The Dual Ring Fiber network operated under four states:

**Normal**

- Traffic is shared between the two rings.
- Each FIJI card drives 480 timeslots.

**Full**

- Traffic is handled by a single ring.
- Each FIJI card drives 960 timeslots

**Survival**

- FIJI cards in both rings are used to maintain intergroup traffic.

**Disabled**

- The ring is inactive and does not support call processing.

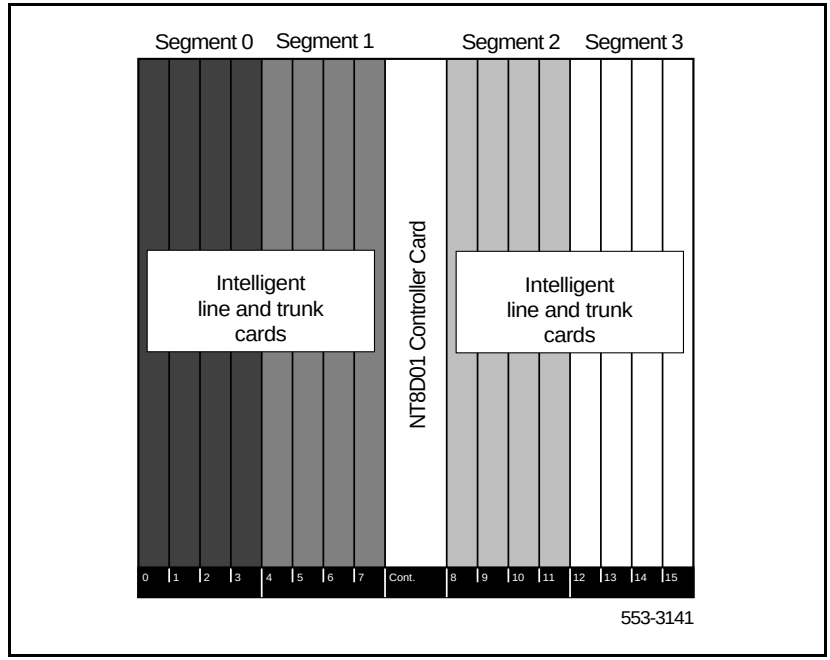
For more information on Fiber Network, refer to the *FNF Reference Guide* (553-3001-259).

### Superloop network configurations

By combining four network loops, the superloop network card makes 120 timeslots available to IPE cards. Compared to regular network loops, the increased bandwidth and a larger pool of timeslots 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 numbered 0–3 of four card slots each (see Figure 13). 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.

**Figure 13**
**Superloop segments in the IPE Module**



A superloop is made up of NT8D04 Superloop Network cards, NT8D01AC or NT8D01BC Controller-4 or NT8D01AD Controller-2 cards, and from one to eight IPE segments. The NT8D01BC Controller-4 replaces the NT8D01AC and NT8D01AD Controller cards for replacements and new installations.

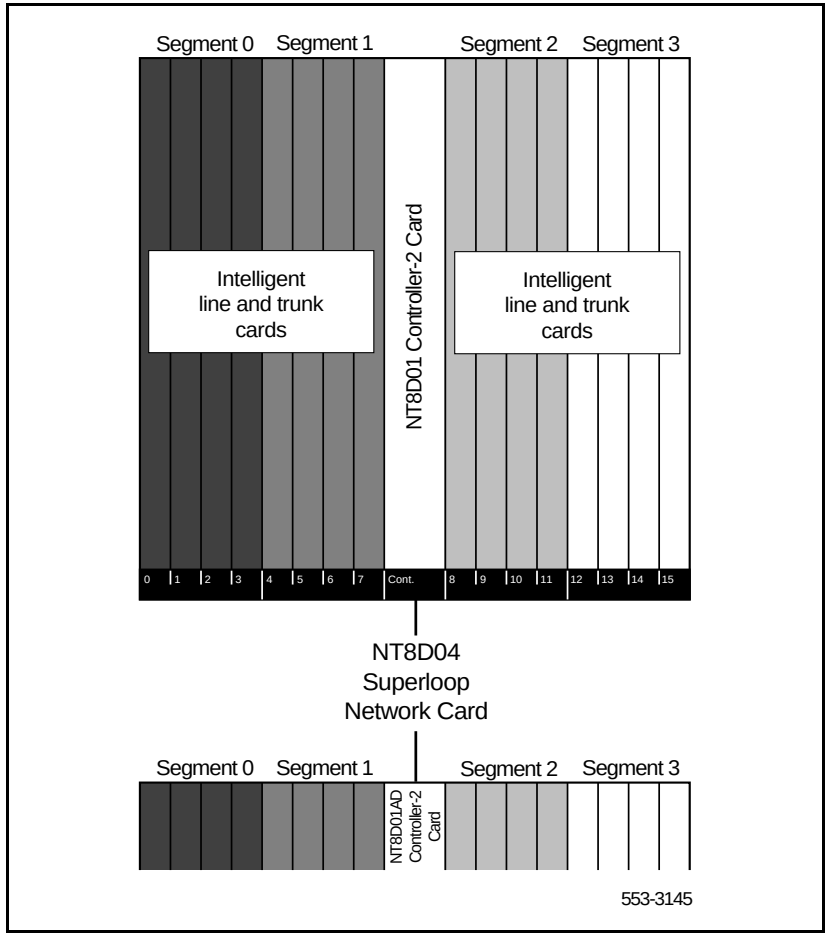
A number of superloop-to-segment configurations are possible:

- one segment per superloop requires four superloop network cards and one controller-4 card
- two segments per superloop requires two superloop network cards and one controller-2 card
- four segments per superloop requires one superloop network card and one controller-2 card
- eight segments per superloop requires one superloop network card and two controller-2 cards
- one segment per superloop/three segments per another superloop requires two superloop network cards and one controller-2 card
- two segments per superloop/six segments per another superloop requires two superloop network cards and two controller-2 cards

As an example of a superloop configuration, Figure 14 shows eight segments per superloop. If a segment in this configuration is equipped with analog line cards and trunk cards, a high concentration environment of 120 timeslots to 128–512 terminal numbers (TNs) is provided. If half of the data TNs on digital line cards are enabled, this configuration provides a concentration of 120 timeslots to 768 TNs.

For a detailed description of superloop-to-segment configurations, see *System Engineering* (553-3001-151).

**Figure 14**
**Eight segments per superloop**



## Peripheral equipment

Using pulse code modulation (PCM), peripheral equipment converts analog signals to digital signals before switching is performed by the network. This conversion method samples the amplitude of the analog signal at a rate of twice the highest signal frequency, then converts the amplitude into a series of coded pulses. For telecommunications, the PCM-sampling frequency standard is 8 kHz.

Compressing-expanding (companding) PCM is a standard technique for using 8-bit words to efficiently represent the range of voice and data signals. Two standards for companding, A-Law and µ-Law, are recognized worldwide. Meridian 1 intelligent peripheral equipment conforms to both standards; the standard required is selected through software.

Peripheral equipment is associated with network loops. Intelligent peripheral equipment (IPE) cards are supported by NT8D04 Superloop Network Card loops. The traffic requirements of all peripheral equipment cards provisioned on a particular network loop must match the traffic capacity of that loop.

Intelligent peripheral equipment includes:

- controller cards that provide timing and control sequences and monitoring capabilities
- analog and digital line and trunk cards that provide interfaces to equipment outside the modules (such as telephones, data terminals, and trunks)

Table 4 lists the IPE cards and the number of terminations each supports.

### Remote peripheral equipment

In a local operating environment, peripheral equipment can be housed up to 15.2 m (50 ft) from the common equipment. Remote peripheral equipment (RPE) extends this range, allowing approximately 112.6 km (70 miles) between local and remote facilities.

This extension is achieved by converting multiplexed loop signals to a form compatible with the commonly used T-1 type digital transmission system. The cards required are housed in the NT8D47 RPE Module, refer to Table 4 for a list of peripheral equipment cards that can be used at the remote site.

**Table 4**
**Intelligent peripheral equipment**

| Intelligent peripheral equipment cards | Number of terminations |
|---|---|
| Controller cards: | |
| NT8D01 Controller Card-4 | N/A |
| NT8D01 Controller Card-2 | N/A |
| Line cards: | |
| NT1R20 OPS Analog Line Card | 8 |
| NT5K02 Analog Line Card | 16 |
| NT5K96 Analog Line Card | 16 |
| NT8D02 Digital Line Card | 16 to 32 |
| NT8D09 Analog Message Waiting Line Card | 16 |

***Note 1:*** Terminal number (TN) density per segment is 16 to 128 TNs, with 64 to 512 TNs per IPE Module. The maximum TN density assumes all slots are equipped with NT8D02 Digital Line Cards with 16 voice and 16 data TNs provisioned. A typical mix of line and trunk cards yields a nominal density of 64 TNs per segment, 256 TNs per IPE Module.

**Table 4**
**Intelligent peripheral equipment**

| Intelligent peripheral equipment cards | Number of terminations |
|---|---|
| Trunk cards: | |
| NT5K07 Universal Trunk Card | 8 |
| NT5K17 Direct Dial Inward Trunk Card | 8 |
| NT5K18 Extended CO Trunk Card | 8 |
| NT5K19 E&M/2280 Hz Trunk Card | 4 |
| NT5K36 Direct Inward/Direct Outward Dial | 4 |
| NT5K70 Extended CO Trunk Card | 8 |
| NT5K71 Extended CO Trunk Card | 4 |
| NT5K72 E&M Trunk Card | 4 |
| NT5K82 Extended CO Trunk Card | 8 |
| NT5K83 E&M Trunk Card | 4 |
| NT5K84 Direct Inward Dial Trunk Card | 8 |
| NT5K90 Extended CO Trunk Card | 8 |
| NT5K93 Extended CO Trunk Card | 8 |
| NT5K99 Extended CO Trunk Card | 8 |
| NT8D14 Universal Trunk Card | 8 |
| NT8D15 E&M Trunk Card | 4 |
| NTAG03 Extended CO Trunk Card | 8 |
| NTAG04 Extended CO/Direct Inward Dial | 8 |
| NTAG36 Meridian Integrated RAN | 8 |
| NTCK16 Generic Extended Flexible CO Card | 8 |

***Note 1:*** Terminal number (TN) density per segment is 16 to 128 TNs, with 64 to 512 TNs per IPE Module. The maximum TN density assumes all slots are equipped with NT8D02 Digital Line Cards with 16 voice and 16 data TNs provisioned. A typical mix of line and trunk cards yields a nominal density of 64 TNs per segment, 256 TNs per IPE Module.

**Table 4**
**Intelligent peripheral equipment**

| Intelligent peripheral equipment cards | Number of terminations |
|---|---|
| Special: | |
| NT5K20 Extended Tone Detector Card | 8 |
| NT5K48 Global Extended Tone Detector | 8 |
| NT5K92 Direct Inward Dial Tester | 1 |

***Note 1:*** Terminal number (TN) density per segment is 16 to 128 TNs, with 64 to 512 TNs per IPE Module. The maximum TN density assumes all slots are equipped with NT8D02 Digital Line Cards with 16 voice and 16 data TNs provisioned. A typical mix of line and trunk cards yields a nominal density of 64 TNs per segment, 256 TNs per IPE Module.

Any medium that conforms to the DS-1 format (1.544 Mbps) can be used to link local and remote sites, including digital microwave radio and fiber optic transmission systems.

## Terminal equipment

Meridian 1 supports a wide range of telephones, including multiple-line and single-line telephones, as well as digital telephones with key and display functions and data transmission capabilities. A range of options for attendant call processing and message center applications is also available. In addition, a number of add-on devices are available to extend and enhance the features of telephones and consoles. Add-on devices include key/lamp modules, lamp field arrays, handsets, and handsfree units. Refer to *Meridian 1 Telephones: Description and Specifications* (553-3001-108), *Meridian 1 European Digital Telephones* (553-3001-114), and *M3900 Series Meridian Digital Telephones: Description, Installation, and Administration* (553-3001-216) for more information.

### Digital telephones

Analog-to-digital conversion takes place in the digital telephone itself, rather than in the associated peripheral line card. This eliminates attenuation, distortion, and noise generated over telephone lines. Signaling and control functions are also handled digitally. Time compression multiplexing (TCM) is used to integrate the voice, data, and signaling information over a single pair of telephone wires.

For applications where data communications are required, Meridian 1 digital telephones offer an integrated data option that provides simultaneous voice and data communications over single pair wiring to a port on a digital line card. Refer to *Attendant Consoles: Description* (553-2201-117) for more information.

Meridian 1 supports the following digital telephones:

- i2004 internet telephone.
- M3901 Entry single-line telephone.
- M3902 Basic single-line telephone.
- M3903 Enhanced telephone.
- M3904 Professional telephone.
- M3905 Call Center telephone.
- M3820 Digital telephone.
- M3310 Digital telephone.
- M3110 Digital telephone.
- M2006 Single-line telephone.
- M2008 Standard Business telephone.
- M2016S Secure telephone.
- M2216 Automatic Call Distribution (ACD) telephone.
- M2317 Intelligent telephone.
- M2616 performance-plus telephone.
- M2616CT Cordless telephone.

### Attendant consoles

Meridian 1 attendant consoles (M1250 and M2250) provide high-volume call processing. Indicators and a 4 x 40 liquid crystal display provide information required for processing calls and personalizing call answering. Loop keys and incoming call indicator (ICI) keys allow the attendant to handle calls in sequence or to prioritize answering for specific trunk groups. An optional busy lamp field provides the attendant with user status.

Meridian attendant consoles support attendant message center options. The attendant console can be connected to an IBM PC (80286, 80386, or PS2) or IBM-compatible personal computer to provide electronic directory, dial-by-name, and text messaging functions. All call processing features can be accessed using the computer keyboard.

## Power equipment

Meridian 1 provides a modular power distribution architecture.

Each column includes:

- a system monitor that provides:
  - — power, cooling, and general system monitoring capabilities
  - — error and status reporting (except in Option 21A) down to the specific column and module
- circuit breaker protection
- a cooling system with forced air impellers (except in Option 21A) that automatically adjusts velocity to meet the cooling requirements of the system
- backup capabilities

Each module includes:

- an individual power supply unit with shut-off (switch or breaker) protection
- a universal quick-connect power wiring harness that distributes input voltages and monitor signals to the power supply

All options are available in both AC-power and DC-power versions. The selection of an AC- or DC-powered system is determined primarily by reserve power requirements and existing power equipment at the installation site.

Although AC-powered and DC-powered systems have different internal power components, the internal architecture is virtually identical. AC- and DC-powered systems differ primarily in the external power components.

### AC power

AC-powered systems require no external power components and can plug directly into commercial AC (utility) power. AC-powered systems are especially suitable for applications that do not require reserve power. They are also recommended for small to medium-sized systems (Options 51C through 61C) that require reserve power with backup times ranging from 15 minutes to 8 hours.

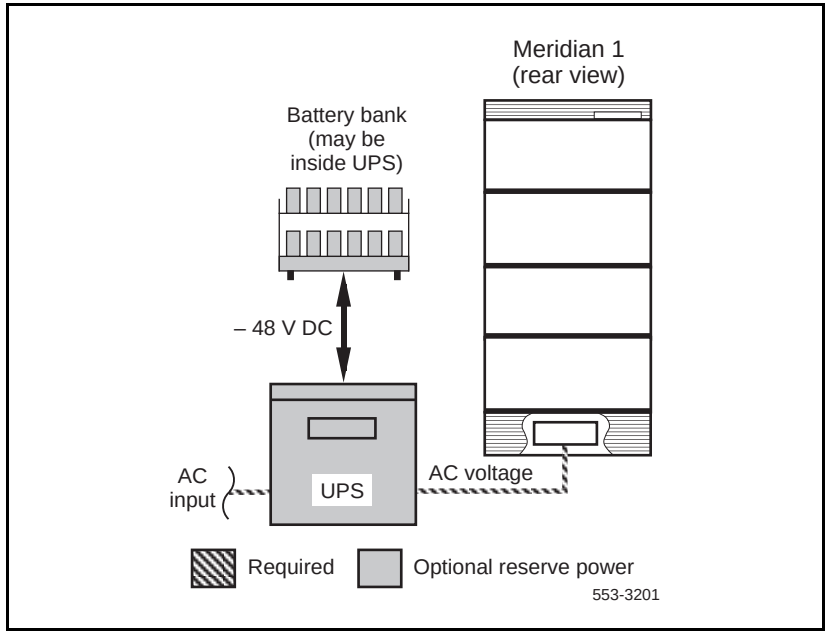
If reserve power is required with an AC-powered system, an uninterruptible power supply (UPS), along with its associated batteries (either internal or external to the unit), is installed in series with the AC power source (see Figure 15). AC-powered systems that do not require long-term backup can benefit from a UPS with short-term backup because the UPS typically provides power conditioning during normal operation, as well as reserve power during short outages or blowouts.

### DC power

DC-powered systems are available as complete systems, with external power equipment provided by Nortel Networks; these systems can also be equipped for customer-provided external power.

DC-powered systems always require external rectifiers to convert commercial AC power into the standard –48 V dc required within the system (see Figure 16). Batteries are generally used with DC-powered systems, as the traditional telecommunications powering method is for the rectifiers to continuously charge a bank of batteries, while the system power “floats” in parallel on the battery voltage. However, batteries are only required if reserve power is needed.

**Figure 15**
**External AC-power architecture with reserve power**

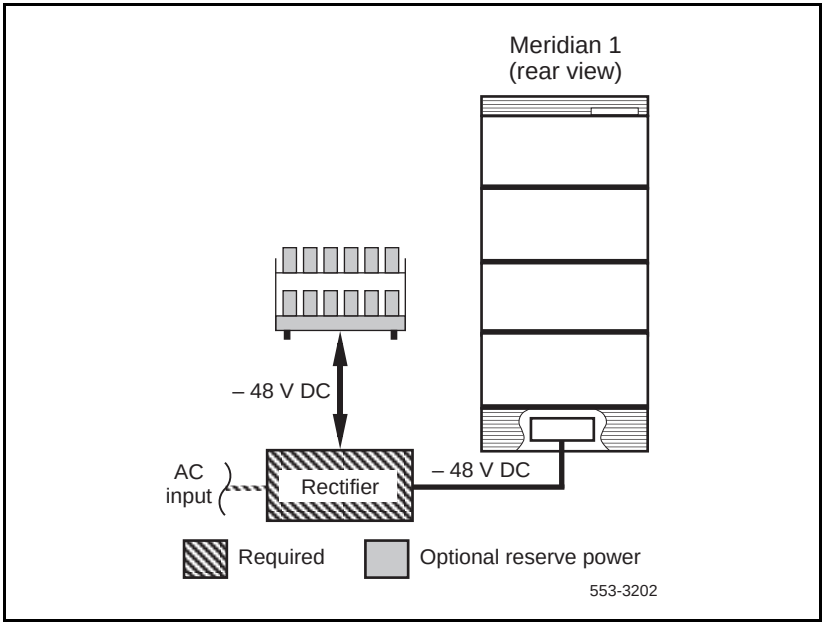



## Software architecture

The superloop network card and IPE cards contain microprocessors that allow you to download software changes and upgrades from the disk drive unit. These downloads can occur automatically, after a system reload, or manually, through software program commands.

Meridian 1 call processing, maintenance, and administration are controlled by software programs stored either as firmware programs, as software programs resident in system memory, or as nonresident programs on disk. The information that describes system configuration and associated peripheral equipment is called office data. This data resides in the system memory and on disk.

**Figure 16**
**External DC-power architecture with reserve power**




## Firmware

Firmware provides fundamental programs consisting of hard-wired logic instructions stored in programmable read-only memory (PROM). Firmware programs manipulate data in the central processor and control input/output operations, error diagnostics, and recovery routines.

## Software

Software programs consist of instruction sequences that control call processing, peripheral equipment, administration, and maintenance functions. Several generic software programs with optional feature packages are available.

## Office data

Office data describes the characteristics of the system in terms of configuration and call-dependent information, such as features and services. Office data is arranged in blocks defining peripheral equipment, system configuration, and transient data.

## Resident programs

Resident programs are always available in memory during system operation. Some resident programs are permanently programmed into the ROM portion of system memory. Other resident programs are automatically loaded into system memory at system power-up.

Resident programs include the:

- Error Monitor, which continuously monitors call processing
- Initialize Program, which locates faults and rebuilds data, and releases reserve memory areas
- Overlay Loader, which locates, checks, and loads programs into the overlay area
- Overload Monitor, which monitors the volume of system messages and determines where overloads occur
- Resident Trunk Diagnostic, which monitors all trunk calls
- System Loader, which loads resident programs from the disk drive unit into system memory at power-up
- Traffic Monitor, which examines the system schedule, transfers traffic data from accumulating to holding registers, and outputs reports

All software programs, including the nonresident programs listed in the following section are resident in, and accessible from, the memory on the cards listed above.

## Nonresident programs

Nonresident programs are stored on data disk and loaded into the overlay area of system memory to perform specific tasks. Only one program can be loaded at a time and is removed from the overlay area when no longer required. Nonresident programs can be loaded automatically, under program control, or manually, through software commands.

Nonresident programs are manually loaded into memory through the system terminal (or maintenance telephone). Only one device can access the overlay area at any time. More than one device, however, can receive output simultaneously. A terminal can be configured as an input-only, output-only, or input and output device.

Software programs provide the system interface for maintenance, service change, and traffic measurement. Each program is independent and has its own specific set of commands and formats. These programs run concurrently with normal call processing without interfering with system traffic.

There are five main categories of nonresident programs:

- service change and print routines
- maintenance diagnostics
- traffic
- equipment data dump
- software audit

### Service change and print routines

Service changes do not usually require hardware changes. Instead, the service administration programs are used to create or modify all aspects of the system from individual feature key assignments to complete system configurations. There are also programs and print routines for retrieving data from the system to check the status of office data assignments.

### Maintenance diagnostics

These programs are the primary instrument for clearing system faults. Individual programs are used for automatically or manually testing the common equipment and peripheral equipment. The programs can be loaded into the overlay area at the request of maintenance personnel, or as part of a daily maintenance routine automatically initiated by the system at a specified time. In addition, background and signaling diagnostic routines can occupy the overlay area when it is not in use.

### Traffic

All systems are equipped with traffic data accumulation programs. There is also a resident traffic print program that examines the schedules, transfers data from accumulating to holding registers in accordance with schedules, and prints the traffic data. In addition, there is a traffic program used to query and modify schedules, options, and thresholds.

### Equipment data dump

After making service changes, the changes must be transferred to disk in order to save them. When the equipment data dump program is run, all the office data in the read/write memory is written to the system disk. The program can be run automatically during the midnight routine or on a conditional basis (for example, a data dump would only occur if a software service change has been made). It can also be run manually through the system terminal.

The data dump program is also used to install a new generic version or issue and capture protected data store information (such as speed call lists) that may be changed by a user.

### Software audit

This program monitors system operation and gives an indication of the general state of the system operation. The program is concerned mainly with the system software. When a software problem is encountered, the program attempts to clear the problem automatically.

# List of terms

**AC**

Alternating current

**analog**

A process that models information in the form of a continuously varying parameter such as current, voltage, or phase

**analog signal**

A signal that varies in a continuous manner such as voice or music. An analog signal can be contrasted with a digital signal, which represents only discrete states. The signal emitted by a data set has both analog and discrete characteristics.

**architecture**

The interrelationship between the parts of a system; the framework of a system

**backplane**

A printed circuit board that extends across the width of the card cage and connects to the circuit card connectors

**battery backup**

System power furnished by standby batteries that are charged by a charger. If commercial power fails, the batteries maintain service for a limited period of time, determined by the size of the batteries and the traffic on the system.

**capacity**

The information-carrying ability of a telecommunications facility, group, network, or system measured in bits per second (bps).

**card cage**

A frame for holding circuit cards in a module; also called a card chassis

**CBT**

Core Bus Terminator

**CE**

Common Equipment

**central office (CO)**

The site where a telephone company terminates customer lines and houses the switching equipment that interconnects those lines

**central processing unit (CPU)**

The main portion of a computer that contains the primary storage, arithmetic and logic units, and the control unit (may also mean a mainframe computer)

**circuit cards**

Circuit cards carry the electronics for particular functions (such as memory and switching functions). Most cards are housed in the card cage in a module and connect to the backplane. Some cards must be installed in dedicated slots in a card cage. (Also called circuit packs or boards.)

**CNI**

Core to Network Interface

**CO**

Central office

**common equipment (CE)**

A hardware subsystem that houses one or more central processing units (CPUs), memory cards, disk drive units, and service cards

**configuration**

A group of machines (hardware) that are interconnected and are programmed to operate as a system

**CP**

Call Processor

**CPU**

Central Processing Unit

**DC**

Direct current

**diagnostic programs**

Software routines used to test equipment and identify faulty components

**digital signal**

A signal made up of discrete, noncontinuous pulses whose information is contained in the duration, periods, and/or amplitude

**DTR**

Digitone Receiver

**EEPE**

Enhanced Existing Peripheral Equipment

**electromagnetic interference (EMI)**

Unwanted electromagnetic coupling, such as a ham radio heard on a television, or static

**firmware**

A set of instruction sequences stored permanently in hardware (ROM)

**input/output (I/O)**

Exchange between a machine and end user equipment

**IODU/C**

Input/Output Disk Unit with CD-ROM.

**IPB**

Inter-Processor Bus

**IPE**

Intelligent Peripheral Equipment

**ISDN**

Integrated Services Digital Network

**line**

A communications channel or circuit; an electrical path

**loop**

A bidirectional path between network equipment and peripheral equipment

**module power supplies**

Individual power units that generate the different DC voltages required by the cards installed in each module

**multiplex (MUX)**

The process of combining two or more information channels into a single transmission channel

**network equipment**

A hardware subsystem that provides digital multiplexed switching for voice, data, and signaling paths

**office data**

Office data represents system configuration data, peripheral equipment data, and transient data (temporary) used for call processing

**PCM**

Pulse code modulation

**PE**

Peripheral Equipment

**pedestal**

The bottom element in a column. Each pedestal houses a blower unit, an air filter, the PDU (which contains the column circuit breakers), and the system monitor.

**peripheral equipment (PE)**

A hardware subsystem that provides analog and digital line and trunk interfaces and houses a combination of line, trunk, and Digitone receiver circuit cards

**power distribution unit (PDU)**

Input power for Meridian 1 is brought into the pedestal to the PDU. The PDU distributes input power to the column.

**pulse code modulation (PCM)**

A modulation technique where the signal is converted from an analog to a digital format by sampling the signal at periodic intervals and digitizing the amplitude into a finite number of discrete levels

**random-access memory (RAM)**

A storage system or computer memory accessible by the user for either storing or retrieving information. RAM is volatile memory.

**read-only memory (ROM)**

Storage system or computer memory that is “burned into” the microprocessor chip and can be read, but not written to or modified. ROM is nonvolatile memory.

**redundancy**

The duplication of software, or hardware, or both (such as redundant CPUs) used as a standby in case one fails

**RPE**

Remote Peripheral Equipment

**SDI**

Serial Data Interface. A family of cards equipped with SDI ports provide the I/O interface for the Meridian 1.

**software**

A set of programmed instruction sequences stored either as resident programs in system memory or as nonresident programs stored on disk and loaded into memory when needed

**software generic**

A term used to identify the system software. Each software generic (X11, for example) has a series of releases (such as release 25), so a software generic might be identified as X11 release 25.

**system monitor**

A microprocessor-based circuit card that controls and monitors the status of cooling equipment and power-related hardware and functions

**TDS**

Tone and Digit Switch

**time compression multiplexing (TCM)**

The combination of two or more information channels into a single transmission channel by assigning each information channel an exclusive periodic transmission time interval

**TN**

Terminal Number

**top cap**

The top cap is mounted on the top module of each column. It provides airflow exits, EMI/RFI shielding, I/O cable entry and exit, and overhead cable-rack mounting. The top cap covers thermal sensor assemblies for the column.

**trunk**

A single circuit between two points, both of which are switching centers or individual distribution points

**universal equipment module (UEM)**

A modular, self-contained hardware cabinet that houses a card cage, power supply, backplane, circuit cards, and other basic equipment. When equipped, the UEM becomes a specific type of module, such as a CPU Module or Network Module.

**UPS**

Universal Power Supply

**V ac**

Voltage alternating current

**V dc**

Voltage direct current

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# System Overview

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Publication number: 553-3001-100
Document release: Standard 16.00
Date: April 2000
Printed in Canada

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