Nortel Networks Multiservice Switch 15000/20000

Hardware Description

NN10600-120

Document status: Standard
Document issue: sPCR6.1S1
Document date: February 2005
Product release: sPCR6.1
Job function: Product Fundamentals
Type: NTP
Language type: U.S. English

Contents

About this document

The information in this document describes the hardware parts and subassemblies for housing a Nortel Networks Multiservice Switch 15000 or Multiservice Switch 20000 in a Network Equipment Building System (NEBS) frame or equivalent mounting apparatus. The frame has product engineering code (PEC) NTRU04.

The following topics are discussed in this section:

Who should read this document and why

This document is intended for use by:

- hardware maintenance personnel
- hardware installation personnel
- network planners
- network engineers

What you need to know

You should be familiar with fundamental data communications and basic electronic concepts and terms. You can acquire product knowledge by reading NN10600-030 *Nortel Networks Multiservice Switch 7400/15000/20000 Overview*.

Only information specific to Nortel Networks Multiservice Switch 15000 and Multiservice Switch 20000 hardware is contained in this guide.

WARNING
Risk of radio interference
Multiservice Switch 15000, Multiservice Switch 15000 VSS, and Multiservice Switch 20000 are class A and class B compliant for radio interference.

What's new in this document

The following features were added to this document:

- 4-port MR POS and ATM FP with PEC NTHW46 (page 12)
- CP support and CP/VPNXc warm standby equipment protection (page 13)
- Fabric card NTHR16EA (page 13)
- Recurring fan alarm (page 13)
- Voice services processor 3 with optical TDM interface (2pOC3ChSmIrVsp3) (page 13)

Other changes made to this document include the following:

- rebranded the terms Passport and PVG in conjunction with the new Nortel Networks' brand simplified naming format. Passport is now referred to as the Nortel Networks Multiservice Switch, and PVG is now Media Gateway 7480/15000. For more information on the product rebranding, refer to NN10600-000 *Nortel Networks Multiservice Switch 7400/15000/20000 What's New in PCR6.1*.
- changed the Caution regarding the class B status of equipment in What you need to know (page 10)
- updated the title of the document for an Astec MFA150 system of ac rectifiers in Related documents (page 13)
- added the chapter Switch hardware mounting apparatuses (page 26) to consolidate frame information
- added new anchoring kits NTRU0328 and NTRU0302 to
  - — Anchors for a NEBS 2000 frame (page 27)
  - — the table NEBS 2000 frame accessories and other filler hardware (page 318)
- added Cable specifications for custom-making female MT-RJ to male LC cable assemblies (page 200)
- indicated in the following sections the circumstances by which both ends of an interface cable connection are grounded for an electrical FP:
  - — 2-port DS3Ch TDM cable assemblies (page 133)

- — 4-port DS3 FR FP cable assemblies (page 137)
- — 4-port DS3Ch ATM FP with IMA cable assemblies (page 145)
- — 4-port DS3Ch FP with AAL1 CES cable assemblies (page 149)
- — 12-port DS3 FP cable assemblies (page 153)
- — 32-port E1 TDM cable assemblies (page 162)
- — 12-port E3 FP cable assemblies (page 166)

- added the section 16-port OC-3/STM-1 ATM FP with OAM cell conversion (page 198) for card NTHW24
- updated the figure A plastic cable management bracket P0937935 (page 268) to show the notch
- added a fiber cable guide to the figure of the faceplate of the following FPs and added the optional retrofit kit NTPS40 with the same guide to their cable assembly descriptions:
  - — 4-port Gigabit Ethernet FP (page 172)
  - — 16-port OC-3/STM-1 ATM FP with MT-RJ connectors (page 191)
  - — 16-port OC-3/STM-1 ATM FP with OAM cell conversion (page 198)
  - — 16-port OC-3/STM-1 ATM FP with LC connectors (page 194)
  - — 16-port OC-3/STM-1 POS and ATM FP (page 199)
- updated the description SFP optical modules (page 239) to add the modules' relationship with software configuration
- added a Caution regarding the grounding of interface cables in Managing telecom cables (page 265)
- increased the number of air filters to 10 in the tables Spare parts kit NTQS29AB for a Multiservice Switch 15000 (page 314) and Spare parts kit NTQH29AB for a Multiservice Switch 20000 (page 315)
- removed all mention of the 1-port OC-48/STM-16 POS FP with PEC NTHW39 and card type 1pOC48SmIrPos since it is service discontinued (SDed)

4-port MR POS and ATM FP with PEC NTHW46

The following sections were updated for this feature:

- 4-port MR POS and ATM FP (page 179)
- SFP optical modules (page 239)
- FP cards, SFP modules, and termination panels (page 310)

Fabric card NTHR16EA

The following have been updated for this feature:

- the table Features of a 40 Gbit/s Multiservice Switch 15000 fabric card pre-NTHR16EA (page 76)
- the table Features of a 40 Gbit/s Multiservice Switch 15000 fabric card NTHR16EA (page 77)
- the section Fabric replacement can affect system cooling (page 84)
- the section Fabric replacement may require a software patch (page 86)

Recurring fan alarm

The following sections were updated for this feature:

- Hardware alarm definitions and behaviors (page 48)
- Fabric replacement can affect system cooling (page 84)
- Alarm/BITS module (page 93)
- Status LEDs of a BIP alarm module (page 290)
- The impact of heat dissipation on rising shelf temperatures (page 109)

CP support and CP/VPNXc warm standby equipment protection

The following section was updated for this feature:

- VpnXc sparing (page 225)

Voice services processor 3 with optical TDM interface (2pOC3ChSmIrVsp3)

The following section was updated for this feature.

- VSP3-o FP line connections (page 236)

Related documents

See the following documents for related information:

- NN10600-001 *Nortel Networks Multiservice Switch 7400/15000/20000 About the Documentation*
- NN10600-002 *Nortel Networks Using Task-based Documentation Job Aid*
- NN10600-005 *Nortel Networks Multiservice Switch 7400/15000/20000 Terminology*
- NN10600-030 *Nortel Networks Multiservice Switch 7400/15000/20000 Overview*
- NN10600-125 *Nortel Networks Multiservice Switch 15000/20000 Planning Site Requirements*

- NN10600-130 *Nortel Networks Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*
- NN10600-550 *Nortel Networks Multiservice Switch 7400/15000/20000 Common Configuration Procedures*
- NN10600-551 *Nortel Networks Multiservice Switch 7400/15000/20000 FP Configuration Reference*
- NN10600-170 *Nortel Networks Multiservice Switch 7400 Hardware Description*
- UM6C28C (167-9021-102) *MFA150 Modular Front Access Power System -- Nt6C28C User Manual* from Astec Advanced Power Systems
- UM6C28D (167-9021-107) *Modular Front Access Power System MFA150 NT6C28D User Manual* from Astec Advanced Power Systems
- 167-9021-133 *Advanced Power Systems MFA150 Modular Front Access Power System Detailed Installation Guidelines and Procedures Manual*

How to get more help

For information on training, problem reporting, and technical support, see the “Nortel Networks support services” section in the *product overview document.*

Introducing Multiservice Switch 15000 and Multiservice Switch 20000 hardware

This section provides an introduction to Nortel Networks Multiservice Switch 15000 and Multiservice Switch 20000 hardware

Where appropriate, each of the topics provides a cross-reference to the section or sections where more detailed information is located.

Navigation

Multiservice Switch 15000 overview

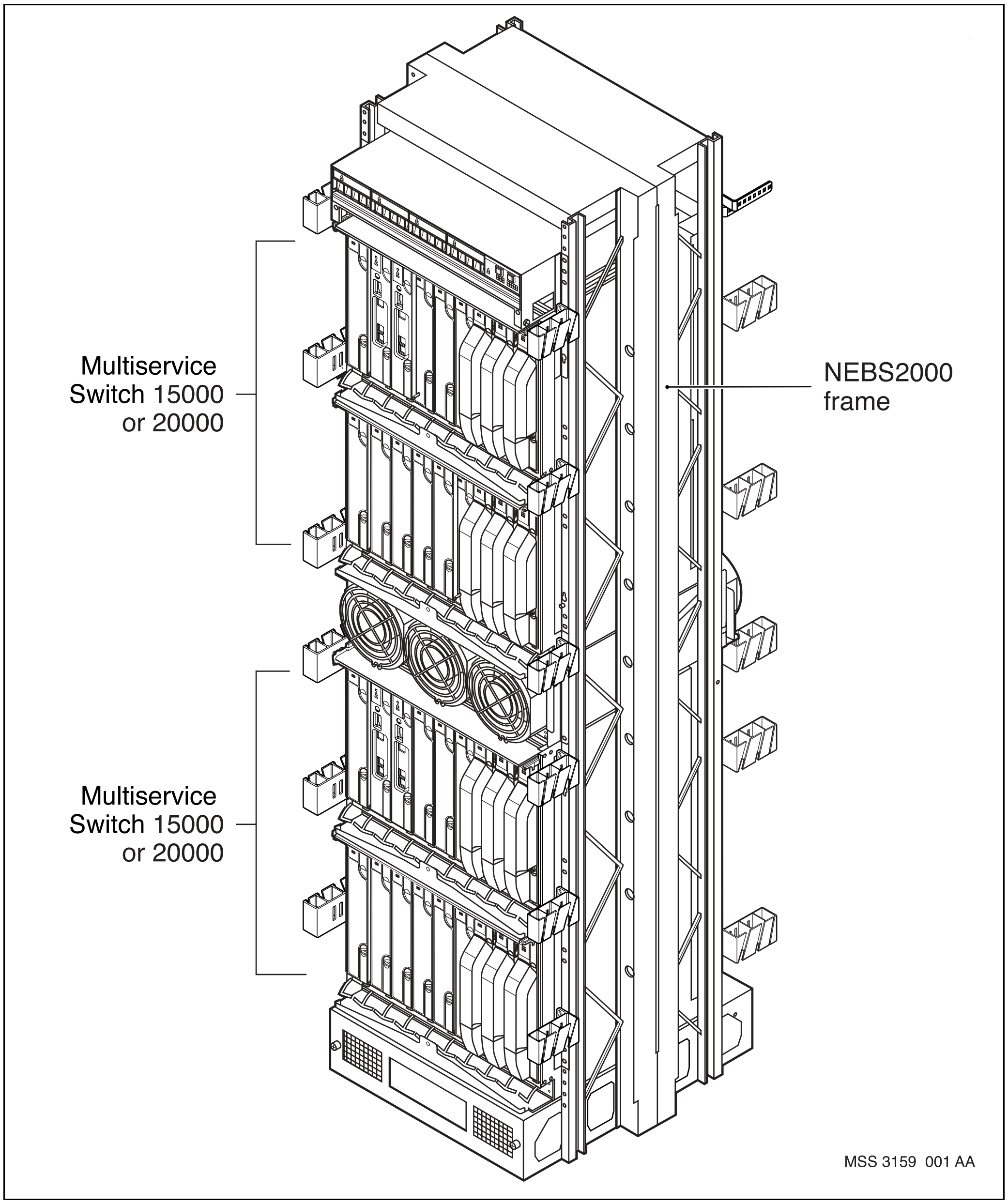
A Nortel Networks Multiservice Switch 15000 is a high-capacity ATM node, which can act as a backbone or edge node to an ATM network.

Each Multiservice Switch 15000 supports electrical and optical interfaces with a variety of speeds from E3 up to STM-16 and from DS3 up to OC-48.

Multiservice Switch 15000 nodes support two types of timing source: building integrated timing supply (BITS) to the alarm/BITS module, and line timing to a fiber optic functional processor (FP). The node can receive the external timing signal from BITS or line timing, and distribute either signal throughout the switch. That is, a Multiservice Switch 15000 simultaneously supports a combination of BITS and line timing.

The figure Two Multiservice Switch 15000 or Multiservice Switch 20000 nodes in a NEBS 2000 frame (page 17) shows two nodes mounted in one frame. The front view of a Multiservice Switch 20000 is very similar to a Multiservice Switch 15000.

Two Multiservice Switch 15000 or Multiservice Switch 20000 nodes in a NEBS 2000 frame



By combining a Multiservice Switch 15000 node with another Nortel Networks node, or by upgrading plug-in cards or modules, additional services, functionality, or capacities are provided. See the section Multiservice Switch 15000 VSS overview (page 17).

Multiservice Switch 15000 VSS overview

A Nortel Networks Multiservice Switch 15000 Variable Speed Switch (VSS) is an integrated edge node and a core multi-service node. Multiservice Switch 15000 VSS offers low speed accessibility at the edge of a network and high-speed switching at the core of a network. A Multiservice Switch 15000 VSS is a Multiservice Switch 7400 packaged within a Multiservice Switch 15000.

In addition to ATM, a Multiservice Switch 15000 VSS delivers a wide range of standard-based high-speed interfaces and services, including frame relay, circuit emulation, voice, and IP. These interfaces provide a wide variety of access and trunking speeds from channelized DS0 to OC-48.

The figure A Multiservice Switch 15000 VSS node in a NEBS 2000 frame (page 19) shows the main parts and subassemblies of a switch in a frame.

A Multiservice Switch 15000 VSS node in a NEBS 2000 frame

PPT 2912 001 AA

Multiservice Switch 20000 overview

A Nortel Networks Multiservice Switch 20000 is a member of the Multiservice Switch family of nodes. It operates with the same Product Carrier Release (PCR) software as Multiservice Switch 7400 series and Multiservice Switch 15000 nodes. A Multiservice Switch 20000 provides the same functionality and services as a Multiservice Switch 15000, and offers significant hardware improvements, most significantly a higher shelf (user) capacity. The figure Two Multiservice Switch 15000 or Multiservice Switch 20000 nodes in a NEBS 2000 frame (page 17) shows two switches in one frame. The front view of a Multiservice Switch 20000 is very similar to a Multiservice Switch 15000. The rear of the Multiservice Switch 20000 is configured in the same manner, but has a different look.

Although a Multiservice Switch 20000 shares much of the Multiservice Switch 15000 hardware, the shelf assembly of the Multiservice Switch 20000 has been re-designed with a scalable backplane, ship-in-place hardware, and different plug-ins. Because of the physical improvements that the shelf assembly provides, a Multiservice Switch 15000 cannot be upgraded to a Multiservice Switch 20000 by changing plug-in cards or modules. Processor cards from a Multiservice Switch 15000 or Multiservice Switch 20000 can be shared, but the Multiservice Switch 20000 is a unique shelf with its own software identity.

The plug-in modules and fabric cards at the rear of a Multiservice Switch 20000 are redesigned for improved capacity, performance, or usability. The modules include:

- the breaker interface modules (BIMs) with 25 A breakers
- the power interface modules (PIMs) with on/off LEDs
- a DS1 or a balanced E1 alarm/BITS module with an add-on balun cable assembly to make the E1 unbalanced
- the MAC address module
- two fabric cards each with 70 Gbit/s usable shelf capacity (actual capacity is 112.6 Gbit/s each)

The backplane of the shelf assembly is designed to accommodate fabric cards of different capacities and is scalable to 160 Gbit/s. The initial 112 Gbit/s fabric cards continue to load-balance and load-share with 70 Gbit/s of shelf (user) capacity so that either fabric card can take over the load of its mate and FP traffic is maintained.

A Multiservice Switch 20000 supports the same function processors (FPs) that are supported by a Multiservice Switch 15000, and supports these control processors (CPs), each with a building integrated timing supply (BITS) interface:

- NTHW06 for a DS1 CP3
- NTHW08 for an E1 CP3

A Multiservice Switch 20000 can re-deploy FPs that were previously loaded with Product Carrier Release (PCR) software 2.3 or later, and re-deploy CP3s with PCR 3.1 or later software provided the cards are migrated to the current PCR.

The shelf assembly of a Multiservice Switch 20000 is designed to ship with cards in place. This means that the control processor (CP3), function processor (FP), and fabric cards can be pre-loaded with software, placed in pre-determined slots (including filler cards), and shipped safely in a partially seated transportation position. Shipping in place means the cards can be powered up as soon as you seat them.

Multiservice Switch 20000 nodes support the same optional hardware, software functionality, and software services of Multiservice Switch 15000 nodes, however there is no equivalent Multiservice Switch 15000 VSS.

Planning and setup criteria for a Multiservice Switch 20000 can be found in NN10600-125 *Nortel Networks Multiservice Switch 15000/20000 Planning Site Requirements*. Most requirements are the same as those required by a Multiservice Switch 15000, however some of the hardware and module installation have slight changes.

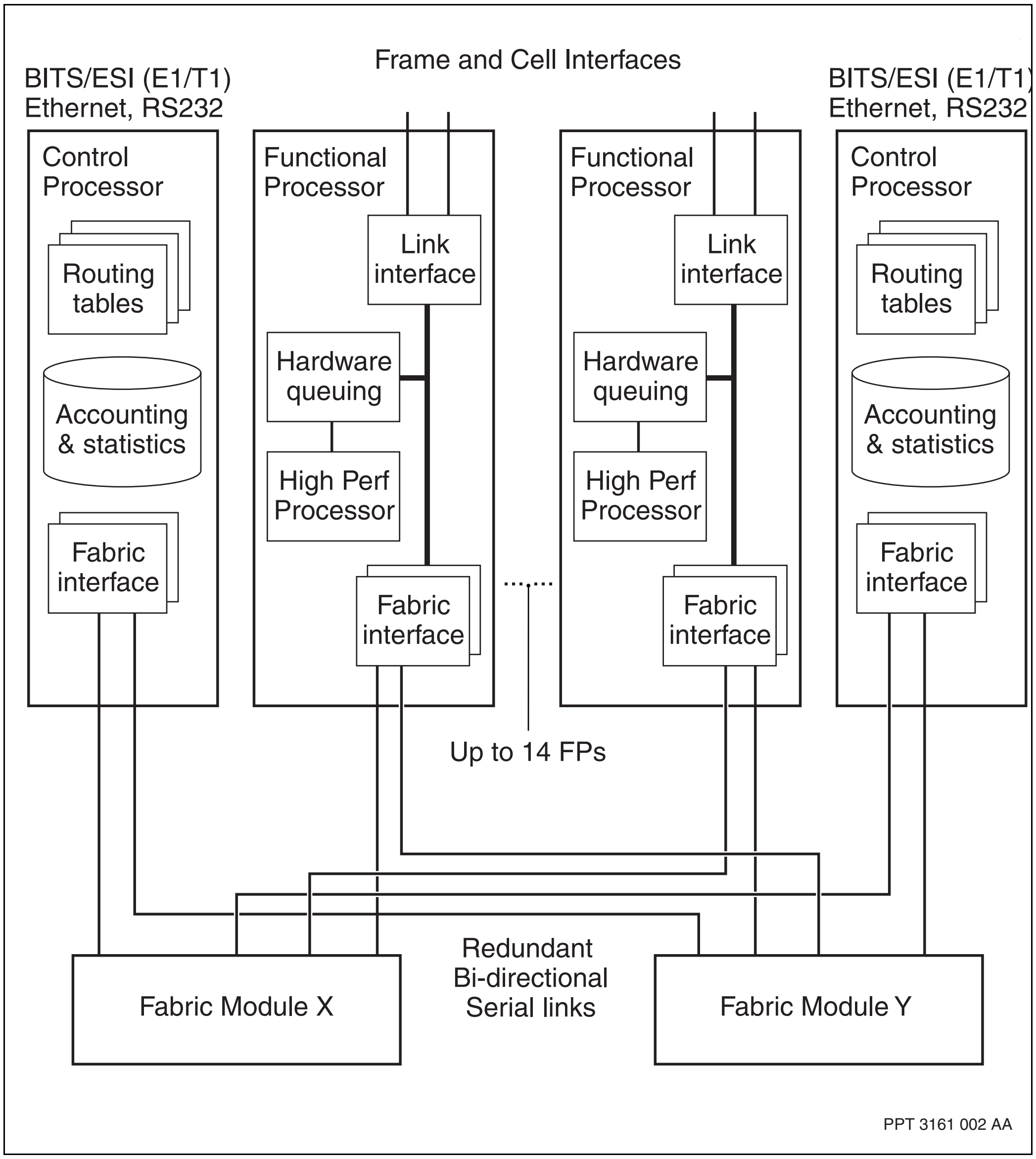
For a detailed description of Multiservice Switch 20000 cards or modules, see the appropriate section in this document.

For the procedures to initially install and maintain a Multiservice Switch 15000 or Multiservice Switch 20000, see NN10600-130 *Nortel Networks Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*.

Architecture of a Multiservice Switch 15000 or Multiservice Switch 20000

The architecture of a Nortel Networks Multiservice Switch 15000 or Multiservice Switch 20000 uses an input/output buffered cross-bar switching fabric with hardware support for both cell-based and frame-based services. The fabric is implemented with redundant serial links to a central 16 bi-directional port fabric card as shown in the figure Architecture of a Multiservice Switch 15000 or Multiservice Switch 20000 (page 22).

Architecture of a Multiservice Switch 15000 or Multiservice Switch 20000



Mounting apparatus overview

The mounting apparatus to house the switch hardware of a Nortel Networks Multiservice Switch is the NEBS 2000 frame with PEC NTRU04. The frame complies to the network equipment building system (NEBS). The frame accommodates:

- one or two Multiservice Switch 15000s
- one or two Multiservice Switch 20000s
- a Multiservice Switch 15000 VSS
- with one switch, other interworking hardware such as termination panels

A single Multiservice Switch 15000 or Multiservice Switch 20000 can also be installed in a mounting apparatus other than a NEBS 2000 frame. Continue at Switch hardware mounting apparatuses (page 26).

Breaker interface panel overview

The main function of the breaker interface panel (BIP) is to provide single or dual (redundant) dc power and frame-level alarm indications to one or two Nortel Networks Multiservice Switch 15000 or Multiservice Switch 20000 nodes mounted in the frame.

See Breaker interface panel (page 36) for a detailed description of the subassemblies and parts of the BIP.

Shelf assembly overview

Nortel Networks Multiservice Switch 15000 and Multiservice Switch 20000 shelf assemblies house most of the parts that make up the switch hardware, including the switching fabrics, backplane, plug-in processor cards, alarm/ BITS termination, power interfaces, and the MAC address module.

If a Multiservice Switch 20000 is shipped already installed in a NEBS 2000 frame, all cards and modules that plug into the shelf assembly are shipped in-place, but not seated. The modules at the rear of the shelf assembly are fully seated. The control and function processor cards and the fabric cards are partially installed but unseated in a transportation position. The transportation position prevents damage to the backplane connectors and pins from vibrations during shipping. The cards are also shipped in their appropriate slots and with the PCR software already loaded.

See Shelf assembly (page 66) for a detailed description.

Control and function processors overview

Control processors (CP) and function processors (FP) are the processing cards for performing and managing Nortel Networks Multiservice Switch 15000 and Multiservice Switch 20000 node functions. In most cases, the software providing a service is split into control and function parts. In general, the control part runs on the CP; the function part runs on the FP. This results in

- more efficient data flow since the FP does not do resource-consuming non-data-path processing
- more efficient memory resources for data transmission

See Control and function processors (page 114) for detailed information about each processor card available. For information about the various services supported by specific node FPs, see NN10600-551 *Nortel Networks Multiservice Switch 7400/15000/20000 FP Configuration Reference*.

Upgrading processor cards

You can upgrade or downgrade a processor card (CP or FP) from one version to another. Upgrading means to replace an existing processor card with another card of the same type but offering additional services or capacities. Downgrading means to replace an existing processor card with another card from a previous release with fewer services. Upgrading a card means:

- replacing a card with one of the same card type and product engineering code (PEC) but a later vintage (version)
- replacing a card with an equivalent one that has the same card type but a different PEC
- replacing an in-service (or failed) card with one that has a different card type and PEC and requires the card slot to be decommissioned and reconfigured in software

The following upgrade activities benefit the shelf performance, but they are not considered card upgrades:

- adding an FP to an empty slot
- adding an FP to create or increase a sparing configuration
- re-configuring spared FPs to operate as unspared FPs

For more information on upgrading and downgrading, see NN10600-130 *Nortel Networks Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*.

Cables and cable management overview

Cable management hardware for a Nortel Networks Multiservice Switch 15000 and Multiservice Switch 20000 node and frame assembly consists of hardware subassemblies for protecting, routing, securing cables (copper, fiber, and system interconnect cables), and managing cable slack.

See Cables and cable management (page 265) for detailed information.

Peripheral interworking equipment

Peripheral equipment is any non-Nortel Networks Multiservice Switch equipment that can be connected to a Multiservice Switch 15000 or Multiservice Switch 20000 to provide additional functionality, service, capability, or performance. Nortel Networks supports specific peripheral equipment to interwork with a Multiservice Switch 15000 or Multiservice Switch 20000. The peripheral equipment includes:

- an EdgeLink mux made by Telco Systems
- an external hardware alarm (for example, an end-of-aisle lamp)
- an MFA150 system of ac rectifiers made by Astec Advanced Power Systems
- a multiport aggregate device made by Nortel Networks
- some 19-wide sparing panels that are originally part of the optional hardware of the Multiservice Switch 7400 series of nodes
- a SER 5500 switch made by Nortel Networks

Information about the installation or operation of the equipment is included in the Multiservice Switch 15000 and Multiservice Switch 20000 suite of hardware documents. Where the information appears depends on what tasks are involved in getting the equipment installed, cabled, and tested. Refer to the table of contents to locate your task.

Equipment status of a Multiservice Switch 15000 or Multiservice Switch 20000

Each unit of operating hardware in Nortel Networks Multiservice Switch 15000 and Multiservice Switch 20000 nodes have status LEDs, which indicate what the hardware is doing.The patterns of LED behavior, per unit of hardware, are described in Using status indicator LEDs and sounds (page 287).

Sounds are provided through optional external alarms to customer premises equipment (CPE). Connecting external alarms is described in NN10600-130 *Nortel Networks Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*.

Hardware parts that can be replaced or upgraded

Most of the hardware units of a Nortel Networks Multiservice Switch 15000 and Multiservice Switch 20000 can be replaced in the event of failure or damage. All such field replaceable units (FRUs) and service replaceable units (SRUs) are listed in Field replaceable units (page 308). This list is more comprehensive than information found in the product Ordering Catalog because it includes part numbers of some assemblies. Some part numbers appear in procedures to simplify handling but they are not in the list of FRUs because they cannot be ordered individually.

Switch hardware mounting apparatuses

The switch hardware of a Nortel Networks Multiservice Switch 15000 or Multiservice Switch 20000 is mounted in the 21-inch wide NEBS 2000 frame (NTRU04). The frame has a footprint of 60 cm by 60 cm (23.62 in. by 23.62 in.) and a height of 212.5 cm (83.66 in.).

The frame includes the kits for anchoring it to a cement floor or through a raised floor to a cement subfloor. Using at least four anchors with the frame provides a zone 4 earthquake rating.

An example of the frame with switch hardware mounted into it and on it is shown in the figure Two Multiservice Switch 15000 or Multiservice Switch 20000 nodes in a NEBS 2000 frame (page 17).

The criteria to install a Multiservice Switch in a mounting apparatus other than a NEBS 2000 frame, such as a 21-inch wide EIA rack, is defined in NN10600-125 *Nortel Networks Multiservice Switch 15000/20000 Planning Site Requirements* at the section for using a different mounting apparatus.

When a Multiservice Switch is mounted in a NEBS 2000 frame, it is referred to as frame-based. When a switch is mounted in an apparatus other than a NEBS 2000 frame, it is referred to as shelf-based. (There is also a shelf-based BIP and shelf-based cooling in the same context.)

When one switch is mounted in a frame, it is always mounted in the lower position to maximize the center of gravity. Basic switch hardware is typically shipped already installed in the frame, for example:

- the power distribution unit
- the shelf assembly or assemblies
- the plug-in modules at the rear of the shelf assembly
- the cooling unit or units
- basic cable management brackets
- power and alarm cabling between the power unit and the rest of the mounted switch hardware

The plug-in processor cards and fabric cards are shipped installed in a Multiservice Switch 20000, and separately for a Multiservice Switch 15000 or Multiservice Switch 15000 VSS.

Optional switch hardware and frame enclosure hardware is typically not installed on the frame and must be added either before or after a frame is anchored. The frame installation task flows indicate the sequence of installing optional hardware.

Due to the weight of the frame with one or two switches in it, the equipment is typically shipped in a horizontal position.

All information regarding frame installation (except for anchoring) and adding equipment into it or onto it is handled by NN10600-130 *Nortel Networks Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*. Details about available anchor kits and how to anchor an NTRU04 are included in NN10600-125 *Nortel Networks Multiservice Switch 15000/ 20000 Planning Site Requirements*.

Anchors for a NEBS 2000 frame

Due to the small footprint of the proportionately tall NEBS 2000 frame, and the top-heavy center of gravity when two switches are installed in the frame, a minimum of six anchors are required. Various kits are available to anchor a NEBS 2000 frame directly to a cement floor or through a raised floor into a cement subfloor. Of the available kits identified in the table Anchoring and anchoring stack-up kits for a NEBS 2000 frame (page 27), the kits NTRU0328 and NTRU0302 will be replacing the kits NTRU0327 and NTRU0325. Notice the quantities of anchors are different in the kits.

Anchoring and anchoring stack-up kits for a NEBS 2000 frame

Kit code	Description	CPC number	Description	Qty
A0502620	anchor kit	A0502620	two Hilti HSI-I *65 anchors each with a 120 mm (4.72 in.) threaded rod, a break-off (pre-torqued) nut, and flat washer	1
A0686271	anchor kit	A0686271	Hilti HSL-G M12 with coned nut	4
			(1 of 3)	

Anchoring and anchoring stack-up kits for a NEBS 2000 frame (continued)

Kit code	Description	CPC number	Description	Qty
NTRU0302	raised floor long threaded rod kit	N0012692	for a cement subfloor under a raised floor using anchor kit A0502620	1
	flat washer	P0133117	0.563” ID, 1.375” OD, 0.109” T	2
	hex nut	P0600400	M12 x 1.75, material code = S 289A finish	4
	Belleville washer	P0691892	.52” ID, 1.31” OD, 0.14” T	2
	plate washer	P0691895	.531” ID, 2.375” OD, 0.375” T	2
	threaded rods	N0001745	M12 x 745 mm (29.33 in.), grade 8.8 steel	2
NTRU0325	anchor kit with 3/8” threaded rod	A0681285	for a cement subfloor under a raised floor using anchor kit A0686271	1
	flat washer	P0284166	0.451” ID, 0.875” OD, 0.071” T	4
	hex nut	P0401452	3/8”, 0.375-16, material code = S, 289A finish	12
	expansion shield	P0649113	3/8”-16	4
	threaded rod (bolt)	P0691006	0.375-16 x 30”	4
	dished spring washer	P0691891	0.431” ID, 1.063” OD, 0.125” T	4
	isolation bushing	P0715199	2.5/.9” OD, 0.5” ID, 0.4/0.08” T (from AD7E70AA)	4
	plate washer	P0735806	from NT7E6020	12
	anchor drip tray	P0872813	to cover oval anchor openings in frame	4
NTRU0327	M12 concrete and raised floor anchor kit	A0682227	Hilti HSL-G M12 expansion anchor kit, steel sleeve, for a cement floor under a raised floor	1
	anchors	A0686271	M12 x 1.75, 762 mm (30”) threaded rod	6
	flat washer	P0133117	0.563” ID, 1.375” OD, 0.109” T	6
	hex nut	P0600400	M12 x 1.75	18
	bolt	P0601087	material code = S, 289A finish	6
	isolation bushing	P0715199	2.5/0.9” OD, 0.5” ID, 0.4/0.08” T	6
	anchor drip tray	P0872813	to cover oval anchor openings in frame	6
	anchor sleeve	P0873854	for M12 anchor, 12.3 mm ID, 17.3 mm OD	6
	Belleville washer	P0891271	0.5” ID, 1.75” OD	6
	flat washer	P0891273	0.6” ID	18
			(2 of 3)	

Anchoring and anchoring stack-up kits for a NEBS 2000 frame (continued)

Kit code	Description	CPC number	Description	Qty
NTRU0328	concrete floor anchor kit	A0682228	for a cement floor (non-raised floor application)	1
	anchor kit	A0502620	two Hilti HSI-I *65 anchors each with an M12 x 120 mm (4.72 in.) threaded rod with slot, a break-off (pre-torqued) nut, and flat washer	1
	Belleville washer	P0691892	.52” ID, 1.31” OD, 0.14” T	2
	plate washer	P0691895	.531” ID, 2.375” OD, 0.375” T steel	2
	isolation bushing	P0715199	2.5/0.9” OD, 0.5” ID, 0.4/0.08” T (from AD7E70AA)	2
	anchor drip tray	P0872813	to cover oval anchor openings in frame	2
Legend:		ID OD T	inside diameter outside diameter thickness	
		(3 of 3)		

The earthquake zone ratings and the number of required kits and anchors for an installation are identified in Quantities of anchoring kits and stack-up kits per NEBS 2000 frame (page 29).

Quantities of anchoring kits and stack-up kits per NEBS 2000 frame

Code of basic kit	Quantity and code of additional kit	Number of anchors per kit or kit combination	Earthquake rating	Optional number of anchors per frame
NTRU0302	one A0502620	2	4 anchors for zones 3 and 4	6 or 8
NTRU0325	one A0686271	4	4 anchors for zones 1 and 2	6 or 8
NTRU0327	not required	6	6 anchors for zones 3 and 4	6 or 8
NTRU0328	not required	1	4 anchors for zones 3 and 4	6 or 8

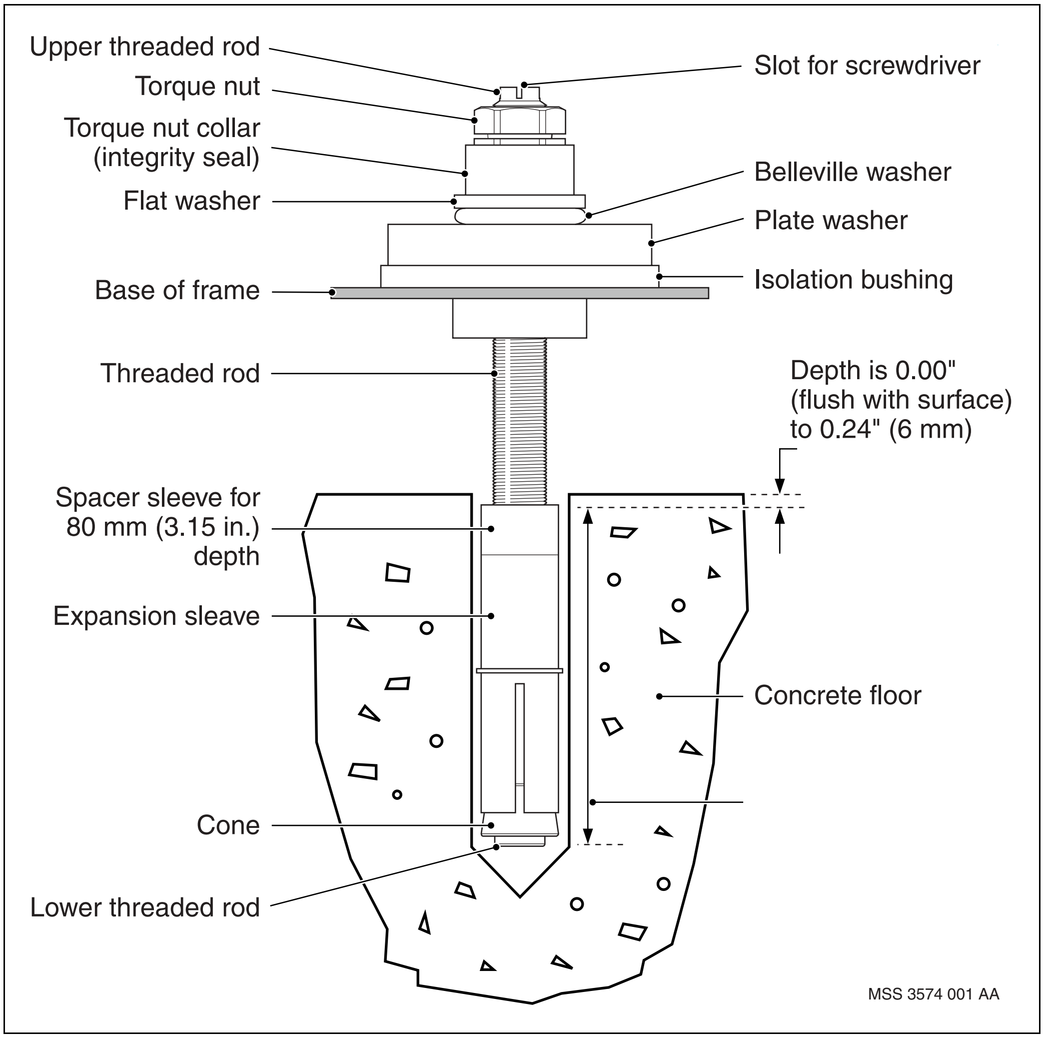
The anchor A0502620 has a pre-torqued nut that breaks off at 60 lbs-ft (81.35 Nm). The remaining anchor nut has a fixed plastic collar to indicate that the nut has not been re-tightened. Since the collar must be removed to unfasten or re-tighten the nut, it acts as an integrity seal, especially in earthquake zones. The cone of this anchor has its own threaded rod to enable fast and simple setting of the anchor before fastening the upper threaded rod into it through the frame.

The anchor assemblies for the kits are shown in the figures:

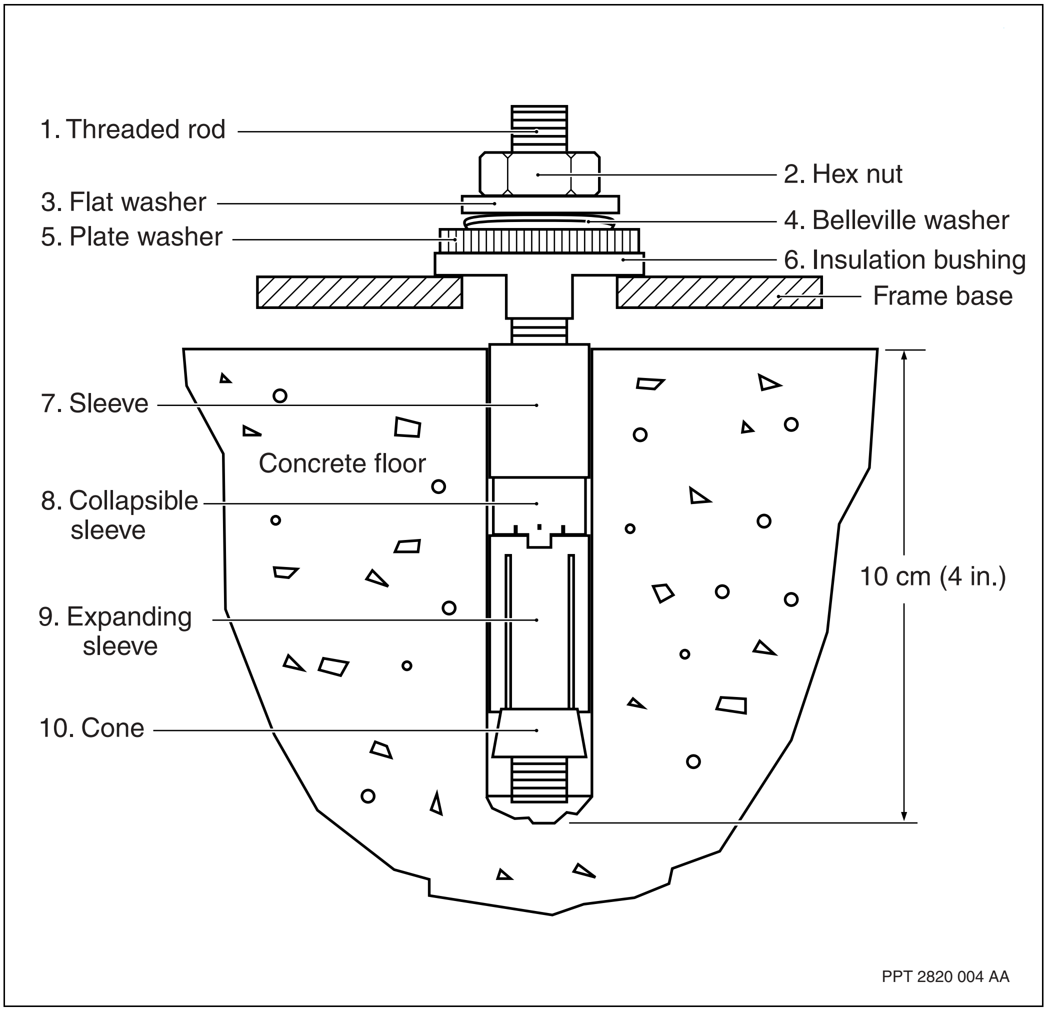
- Anchor A0502620 for a NEBS 2000 frame (page 30)
- Anchor A0686271 for a NEBS 2000 frame (page 31)

The anchor depth shown in the figure Anchor A0686271 for a NEBS 2000 frame (page 31) applies only to NTRU0327. The depth when the anchor is used with NTRU0325 is different because of the expansion shields.

Anchor A0502620 for a NEBS 2000 frame



Anchor A0686271 for a NEBS 2000 frame



The procedures for marking the footprint and drilling anchor holes is in NN10600-125 *Nortel Networks Multiservice Switch 15000/20000 Planning Site Requirements*. The procedures for anchoring the frame are included in the task flows of frame installation in NN10600-130 *Nortel Networks Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*.

Cable management on the mounting apparatus

Cable management brackets for signalling (interface) or power cables are provided with each shelf assembly. When the shelf assembly is mounted in a NEBS 2000 frame (frame-based), the brackets are installed at the factory. When the shelf assembly is to be mounted in a 23-inch wide EIA rack (shelf-based), cable management brackets are provided.

When high densities of signalling cables will exceed the capacity of the basic set of cable management brackets, additional or optional cable management brackets are available. To plan which brackets best suite your hardware configuration, see the chapter on cable management in NN10600-125 *Nortel Networks Multiservice Switch 15000/20000 Planning Site Requirements*.

Power cables are intended to be fastened to the strain relief bar behind the power distribution unit (the BIP) and down along a side of the frame to the zig-zag bars or up to a cable trough. A strain relief bar is provided for either a shelf-based or frame-based shelf.

A NEBS 2000 frame also has two removable plates in its base, one on each half. When the frame is anchored through a raised floor and a plate is removed, signalling or power cables can be run from either side of the frame into the base and down through the opening into a hole cut in the floor. If the hole in the floor matches the size of the opening in the frame, the integrity of the raised floor should not be jeopardized.

NEBS 2000 frame enclosure

The NEBS 2000 frame can be enclosed in part or completely by a combination of extended side panels and doors or regular side panels and frame cover panels. Enclosing the frame controls the accessibility of people or objects to the equipment inside the frame.

Enclosing the frame with doors and extended side panels

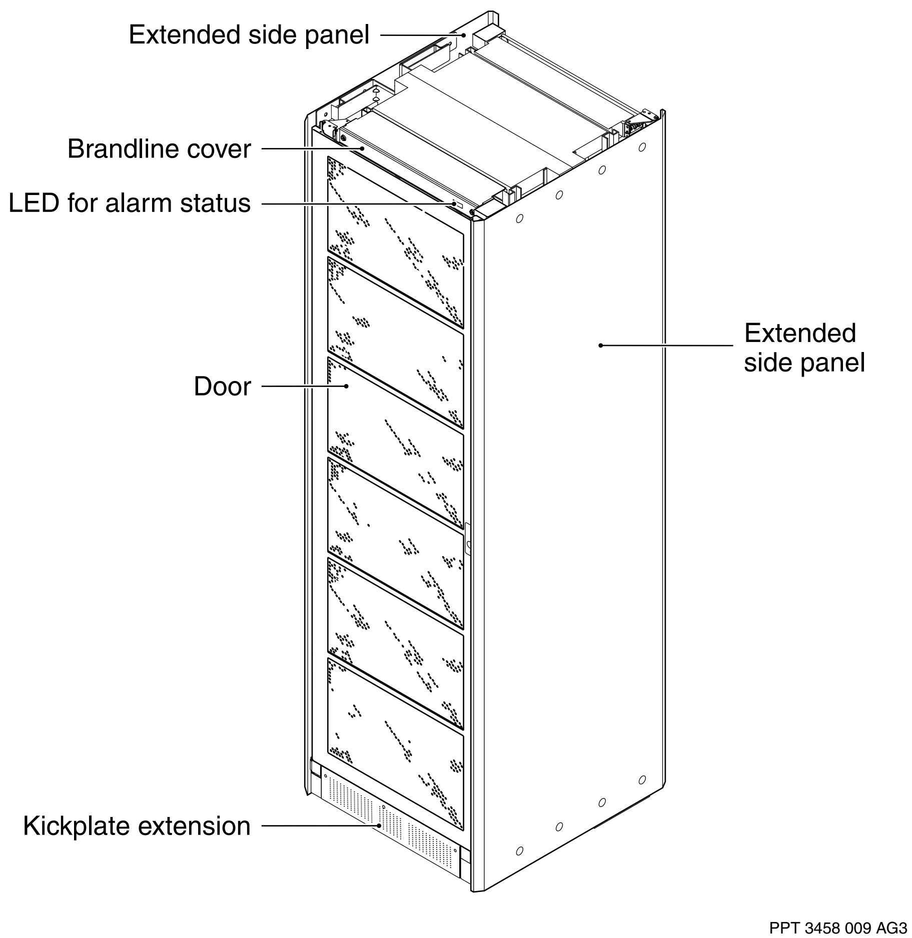
The doors are available in kit NTQS37AA or NTQSAB. The AB version is the same as AA except that it includes an illuminated brandline cover to replace the non-illuminated one that is already mounted on the frame.

The extended side panels are available in kit NTPX4050. An extended side panel can be installed alone or it with a door. Refer to the figure Installed extended side panels with a door (page 33).

The door or side panel hardware can be added to the frame at any time provided enough space around the frame is available. For example, a door kit requires an increase in the size of the frame footprint. The spacial requirements and considerations for installing a door kit or an extended side panel kit are in NN10600-125 *Nortel Networks Multiservice Switch 15000/20000 Planning Site Requirements*.

The tasks to install the hardware are in NN10600-130 *Nortel Networks Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*.

Installed extended side panels with a door



Enclosing the frame with regular side panels and frame cover panels

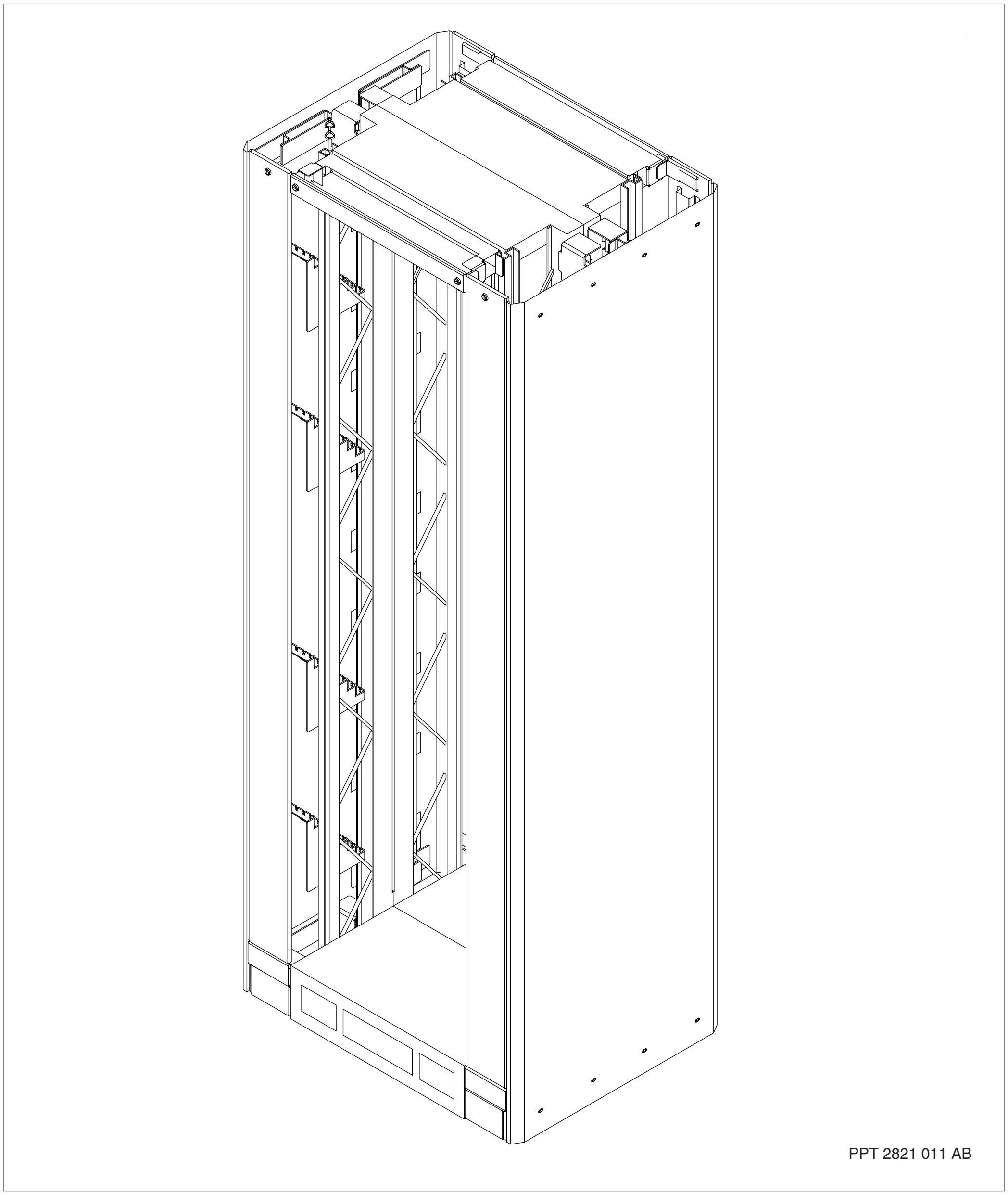
A regular-sized side panel is also available in kit NTRU0128. This panel will not work with a door, but it will cover the optional extended cable management brackets (NTRU0368 or NTRU0369) that can be mounted on a side of the frame. This panel also coordinates enclosure by the front or rear frame cover panels from kit NTRU0366. Refer to the figure Installed side panels with front and rear frame cover panels (page 35).

The frame cover panels are intended to hide the extended cable management brackets from the front or rear of the frame. These panels can be installed without the side panels being present, especially if the frame-joining hardware kit NTRU0370 is used to maximize space usage between adjacent frames.

The side panel and frame cover panel hardware can be added to the frame at any time provided enough space around the frame is available. Except for the thickness of a side panel, the frame footprint is not increased by adding the hardware. The spacial requirements and considerations for installing a regular side panel with or without frame cover panels to enclose the optional extended cable management brackets are in NN10600-125 *Nortel Networks Multiservice Switch 15000/20000 Planning Site Requirements*.

The tasks to install the hardware are in NN10600-130 *Nortel Networks Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*.

Installed side panels with front and rear frame cover panels



Breaker interface panel

The breaker interface panel (BIP) provides a central location where redundant input dc power feeds (nominal -48/-60 V) of up to 100 A are connected and routed to two or four breaker interface modules (BIMs). Power is distributed from the BIMs to the shelves and cooling units. A Nortel Networks Multiservice Switch 15000 or Multiservice Switch 20000 node supports the use of either a two-BIM (single shelf) or a four-BIM (dual shelf) BIP. The BIP also contains an alarm module which monitors system parts, generates alarms, and controls LED status indicators.

The versions of Multiservice Switch 15000 BIPs are as follows:

- NT6C62, BIP with two 20-amp BIMs and two filler plates
- NT6C61, BIP with four 20-amp BIMs

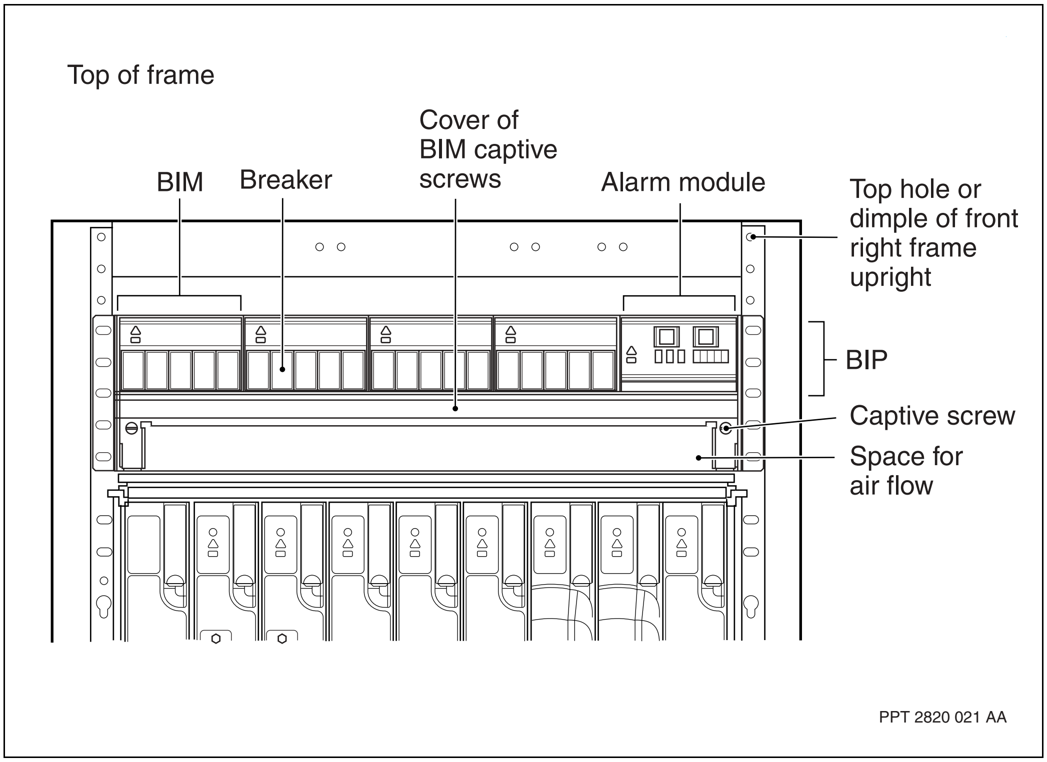
The versions of Multiservice Switch 20000 BIPs are as follows:

- AP6C68, BIP with two 25-amp BIMs and two filler plates
- AP6C67, BIP with four 25-amp BIMs

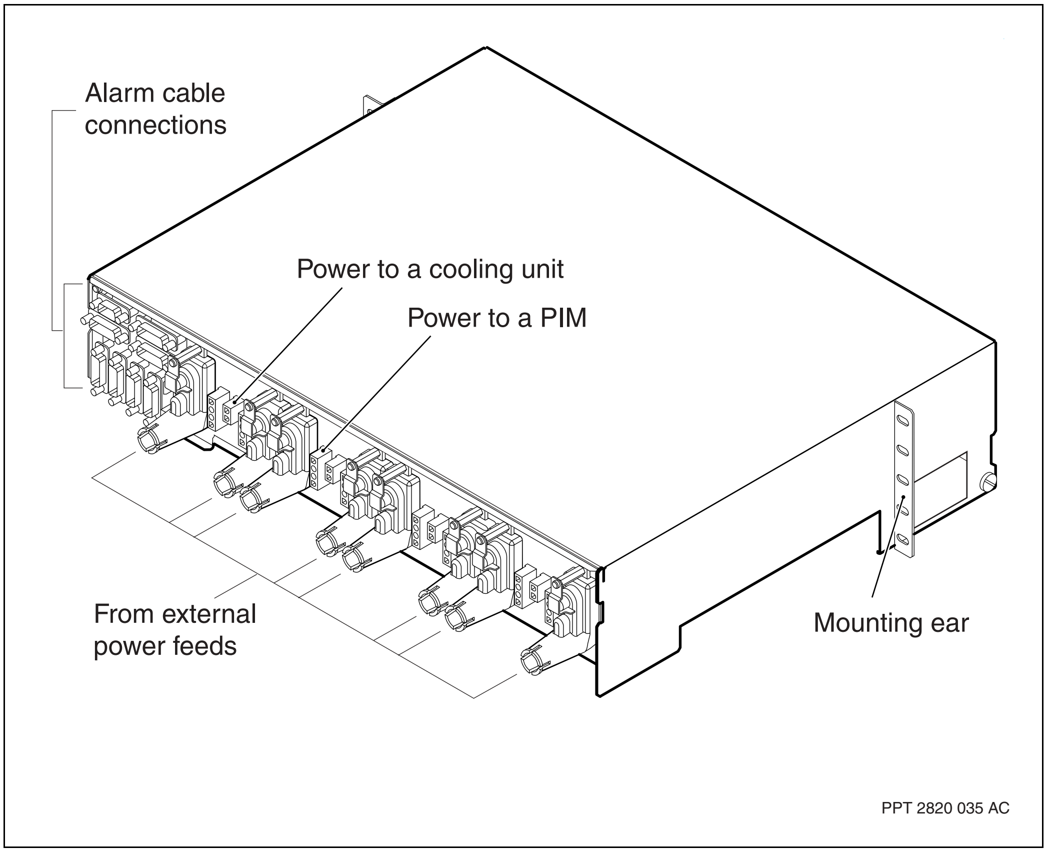
The following BIP components and connections are described in this section:

See the figure The BIP in a NEBS 2000 frame, front view (page 37) for the location of individual parts, and Rear of the BIP (page 38) for the location of input power cables.

The BIP in a NEBS 2000 frame, front view



Rear of the BIP



Front cover of the BIP

The BIP front cover has the following functions:

- it protects the parts and connections on the front of the power breakers and the alarm module
- it directs air exhaust venting from the upper cooling unit
- it provides tool-only access through captive screws (for security and convenience)

The front cover can be opened to access the retaining screws holding the breaker interface modules (BIMs) and alarm module in place. See The BIP in a NEBS 2000 frame, front view (page 37) for an illustration of the BIP with the front cover opened.

Breaker interface modules (BIMs)

The breaker interface modules (BIMs) inside the breaker interface panel (BIP) distribute the power from the BIP to the shelf assembly. BIMs are shipped already installed into the BIP. This section includes:

- BIP with two or four BIMs (page 39)

BIP with two or four BIMs

Two models of the BIP are available: one with two breaker interface modules (BIMs) or one with four BIMs. The two-BIM model is used in the NEBS 2000 frame or equivalent mounting apparatus to support only one Nortel Networks Multiservice Switch 15000 or Multiservice Switch 20000 node (for example, in equipment packages NTQS10 and NTHQ10). If a two-BIM model is used (for example, in NTQS04 and NTQH04), the empty BIM slots are covered with filler plates to protect BIP circuitry and to meet safety requirements. See BIM filler plates (page 45) for more information.

The four-BIM model is used when two Multiservice Switch 15000, or two Multiservice Switch 20000 nodes are housed in the same NEBS 2000 frame (for example, in equipment packages NTQS20 or NTQH20).

When a second switch is added to the NEBS 2000 frame, two additional BIMs can be added to the BIP to power that switch. Refer to the criteria in Combined BIM pairs in a BIP (page 43).

If the NEBS 2000 frame is shipped with one Multiservice Switch 15000 or Multiservice Switch 20000, the insulation boots and lugs are provided for the second set of BIMs. This accommodates adding a second switch of the same kind to the frame. The equipment package NTQS10 or NTQH10 includes the wiring harnesses for a second switch.

Location of the BIMs

The breaker interface modules (BIMs) are located inside the breaker interface panel (BIP). In four-BIM models, all BIM slots are filled up to the alarm module. In two-BIM models, the BIMs are located in the two right-hand slots next to the alarm module, with the two left BIM slots covered with filler plates. See the figure The BIP in a NEBS 2000 frame, front view (page 37). See BIM filler plates (page 45).

Functions of the BIMs

The power breakers on each BIM control the -48/-60 V dc A and B power feeds to the power interface modules (PIMs) and to the upper and lower cooling units. See the figure The BIP in a NEBS 2000 frame, front view (page 37) for the location of the power breakers.

For a Multiservice Switch 15000, each BIM with PEC NT6C60PA supports a maximum of five PCB-mount circuit breakers made up of four 20-amp shelf breakers and one central 5-amp cooling unit breaker. See the table Circuit breaker configuration for each BIM (page 40). The position of the breaker is relative to facing the front of the BIP.

Circuit breaker configuration for each BIM

Location of circuit breaker	Left	Middle left	Middle	Middle right	Right
Multiservice Switch 15000	20 amp	20 amp	5 amp	20 amp	20 amp
Multiservice Switch 20000	25 amp	25 amp	5 amp	25 amp	25 amp
	shelf upper half	shelf upper half	cooling units	shelf lower half	shelf lower half

For a Multiservice Switch 20000, each BIM with PEC AP6C67PA supports a maximum of five PCB-mount circuit breakers made up of four 25-A shelf breakers and one central 5 A cooling unit breaker. See the table Circuit breaker configuration for each BIM (page 40). The position of the breaker is relative to facing the front of the BIP.

Although the breakers of BIMs for a Multiservice Switch 20000 are greater than those of a Multiservice Switch 15000, the maximum power input feed is 100 A for both switches. When housing a Multiservice Switch 15000 and Multiservice Switch 20000 in the same frame, observe the criteria in Combined BIM pairs in a BIP (page 43).

The power breakers are arranged such that each either Multiservice Switch can draw power from two independent power sources (usually labelled A and B). See Function of the BIP backplane power input connections (page 56) for a summary of the BIP power breaker functions. Breakers should be set to off before a BIM is removed from the BIP. One BIM receives an input power feed for a shelf, so that two BIMs are required for each shelf.

BIMs distributing power to PIMs

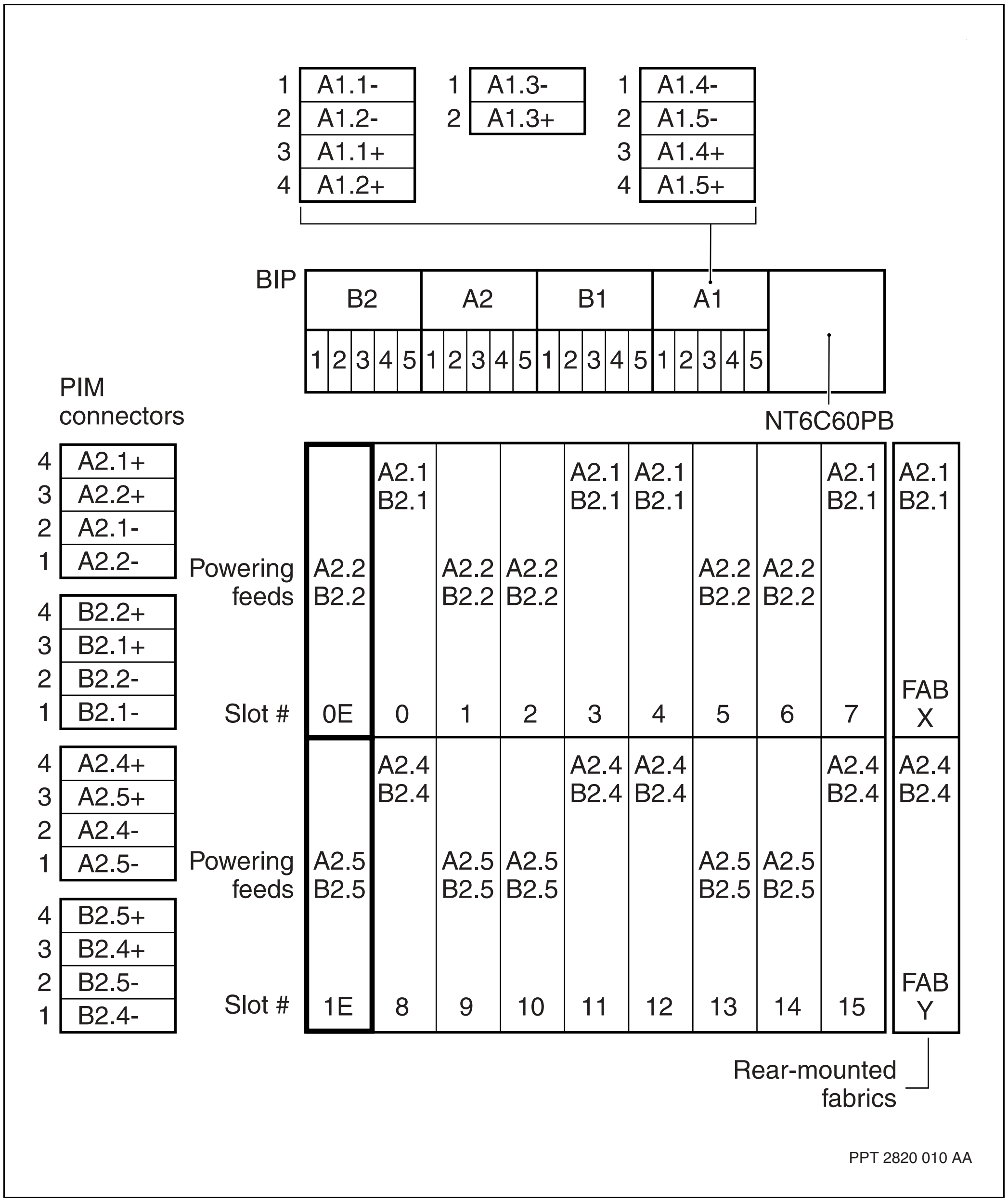
Each breaker interface module (BIM) receives power redundantly from the site power source through separate feeds, labelled A and B. Since the PIMs receive their power from the BIMs, each pair of PIMs per shelf also has an A and B feed. Each pair of PIMs is referred to as a rear upper (RU) or rear lower (RL) behind slots 7 and 15 to correspond to its position at the rear of the shelf. The five breakers in each BIM are referred to as breakers 1 to 5 counting from the left. Refer to the figures:

- Relationship between feeds, breakers, and equipment slots in upper shelf (page 41)

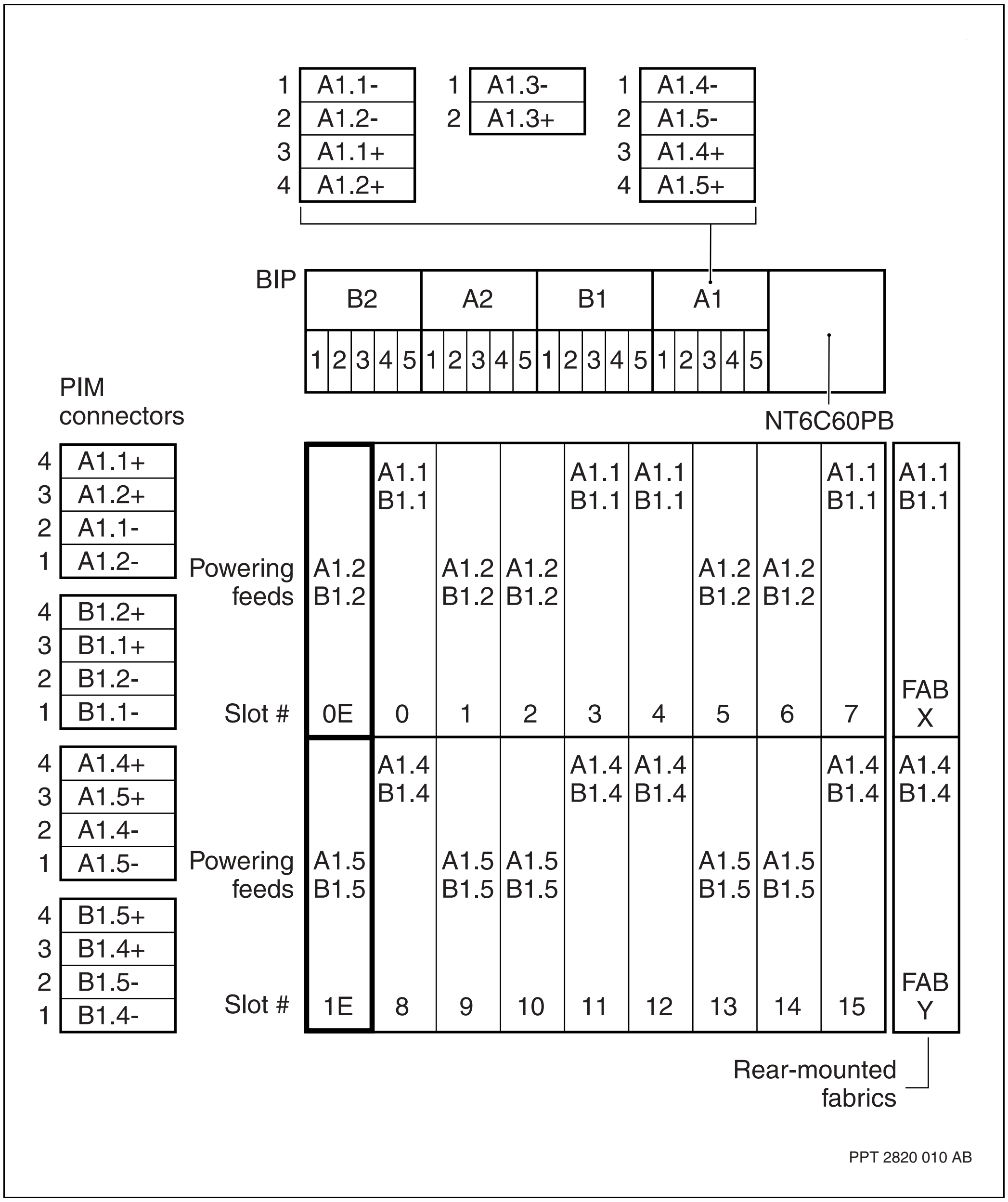
- Relationship between feeds, breakers, and equipment slots in lower shelf (page 42)

The BIP breakers that control specific PIMs are identified in the figure Cable paths of PIMs at the rear of a NEBS 2000 frame (page 43).

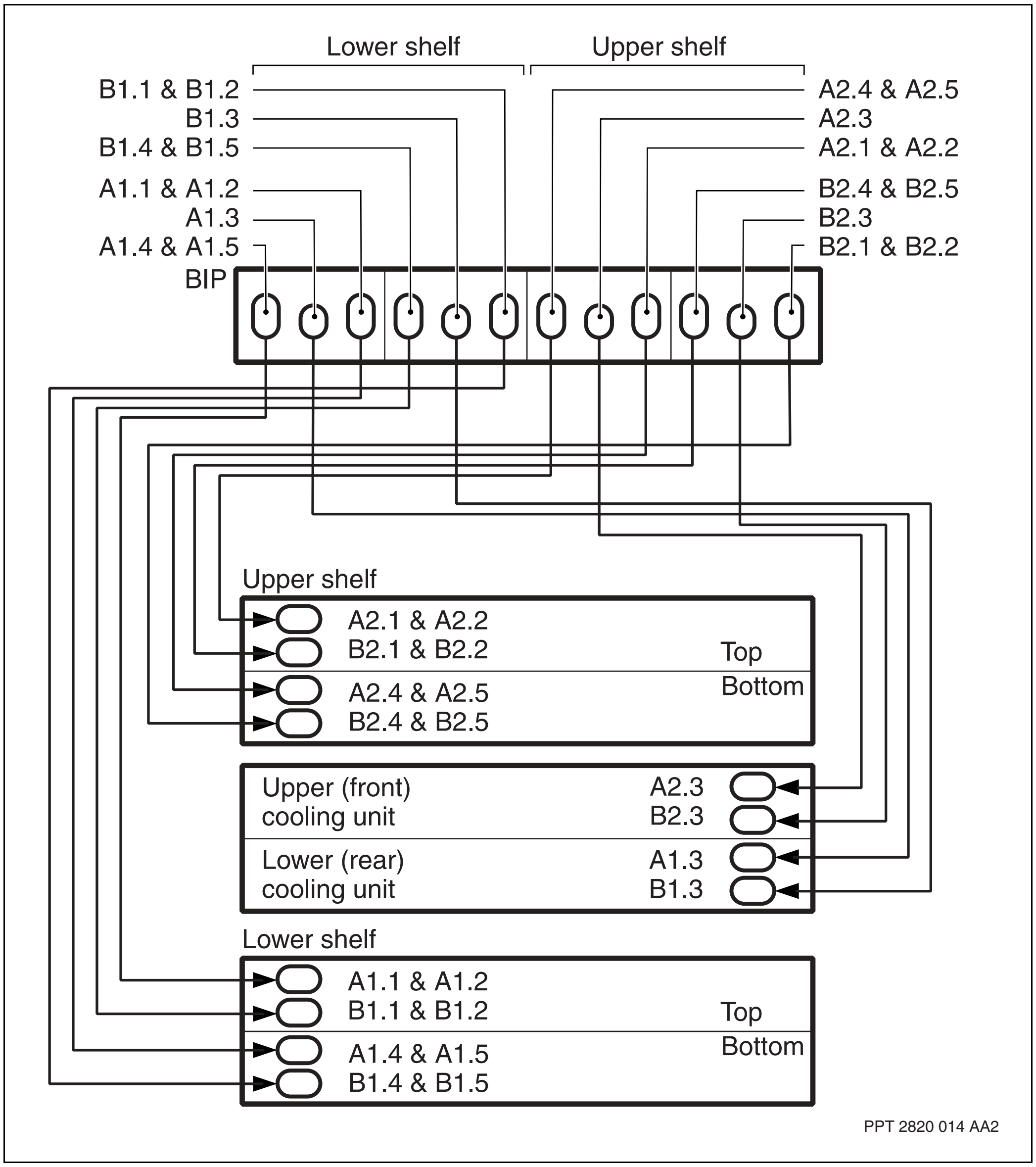
Relationship between feeds, breakers, and equipment slots in upper shelf



Relationship between feeds, breakers, and equipment slots in lower shelf



Cable paths of PIMs at the rear of a NEBS 2000 frame



Combined BIM pairs in a BIP

When two Multiservice Switch 15000s or two Multiservice Switch 20000s are installed in one NEBS 2000 frame, they share the same BIP. If a Multiservice Switch 15000 and a Multiservice Switch 20000 are installed in the same NEBS 2000 frame, they can safely share the BIP NT6C62 or AP6C68 even though the BIMs have different ampere ratings.

Each BIM must be matched with its mate to safely distribute power to the node, and the pair must be matched to the node as indicated in the table Combinations of BIMs in a BIP (page 44).

Combinations of BIMs in a BIP

Shelf type	PEC of a BIP with BIM combinations	PECs of the BIM pairs that can be installed
Multiservice Switch 15000	NT6C62	two or four 20-amp NT6C60PA for one or two nodes or two 20-amp NT6C60PA for a Multiservice Switch 15000 in the lower half of the NEBS 2000 frame and two 25-amp AP6C67PA for a Multiservice Switch 20000 in the upper half of the NEBS 2000 frame
Multiservice Switch 20000	AP6C68	two or four 25-amp AP6C67PA for one or two nodes or two 25-amp AP6C67PA for a Multiservice Switch 20000 in the lower half of the NEBS 2000 frame and two 20-amp NT6C60PA for a Multiservice Switch 15000 in the upper half of the NEBS 2000 frame

Since there is no visible exterior difference between the BIM faceplates on either type of switch, you must refer to the part number on the label of each unit.

Front panel of a BIM

The front panel of each breaker interface module (BIM) includes

- a triangular alarm LED
- a rectangular power LED
- five PCB circuit breakers (four 20 A and one 5 A)
  - — for a Multiservice Switch 15000, four 20 A and one 5 A
  - — for a Multiservice Switch 20000, four 25 A and one 5 A
- a captive screw to hold the module in place

There is no visible exterior difference between the BIM faceplate of either type of switch.

The different states of the LEDs are listed in the table Alarm LED status indicators for BIMs (page 45) and the table Power LED status indicators for BIMs (page 45).

Alarm LED status indicators for BIMs

LED color	Mode	Meaning
red	solid	major fault
off		no fault

Power LED status indicators for BIMs

LED color	Mode	Meaning
green	solid	no fault, in service — active
off		invalid state — test for loss of power

BIM power filters

Each BIM contains a power filter. Power filters ensure low frequency stability of the battery feed lines that supply -48/-60 V dc power to the node. This reduces the amount of electric noise produced by each node and ensures clean power for the point-of-use power supplies (PUPS) used in the processor cards and cooling units.

Attention: Power cycling the breakers can be done on either type of node without damaging equipment.

BIM filler plates

Filler plates are used to cover any empty power breaker interface module (BIM) slots. Filler plates are fastened to the front of the BIP, over the empty BIM slot, by a captive screw. Filler plates are used in two-BIM modules, when the BIP is installed in a frame that contains only one Nortel Networks Multiservice Switch.

Filler plates must cover any empty BIM slots to protect BIP circuitry and to ensure compliance to safety requirements.

Alarm module

This section provides information on the following topics relating to the BIP alarm module:

- Location of the BIP alarm module (page 46)
- Functions of the BIP alarm module (page 46)
- Front panel of the BIP alarm module (page 46)
- Hardware alarm definitions and behaviors (page 48)

- BIP alarm LED board (page 50)

Location of the BIP alarm module

The BIP alarm module is located at the front, on the right side of the BIP. See the figures The BIP in a NEBS 2000 frame, front view (page 37) and Alarm module of the BIP (page 47).

Functions of the BIP alarm module

The alarm module:

- monitors and filters alarms for hardware indicators and software displays
- drives the alarm LED board, the board that activates the audio-visual follow-me hardware indicators (see also BIP alarm LED board (page 50))
- is part of the aisle alarm system
- monitors the state of the power breakers
- has numbered switches on the top of the module that are preset at the factory and must not be adjusted

The alarm module can monitor up to four cages contained in two nodes housed in a single frame. The module can also be used to monitor external office equipment.

Front panel of the BIP alarm module

The BIP alarm module front panel has the following features:

- a triangular and a rectangular alarm LEDs for the alarm module; see the table Power LED status indicators for the BIP alarm module (page 47) for an explanation of the LED displays.
- three separate alarm indicators for minor, major, and critical alarms. See Hardware alarm definitions and behaviors (page 48) for a description of alarm types.
- a visual follow-me indicator of 10 LEDs to assist a crafts person to locate a faulty module; see the table Frame level indicators for the BIP alarm module (page 47)

Attention: When a Multiservice Switch 15000 shares the BIP with a Multiservice Switch 20000, that is, the two nodes are installed in the same frame, the LED test function operates only for the Multiservice Switch 20000.

- a LEDTEST button which, when pressed for five seconds, causes all the BIP LED alarm indicators to light up
- an audible alarm cut-off button labeled ACO
- a captive screw to hold the module in place

Power LED status indicators for the BIP alarm module

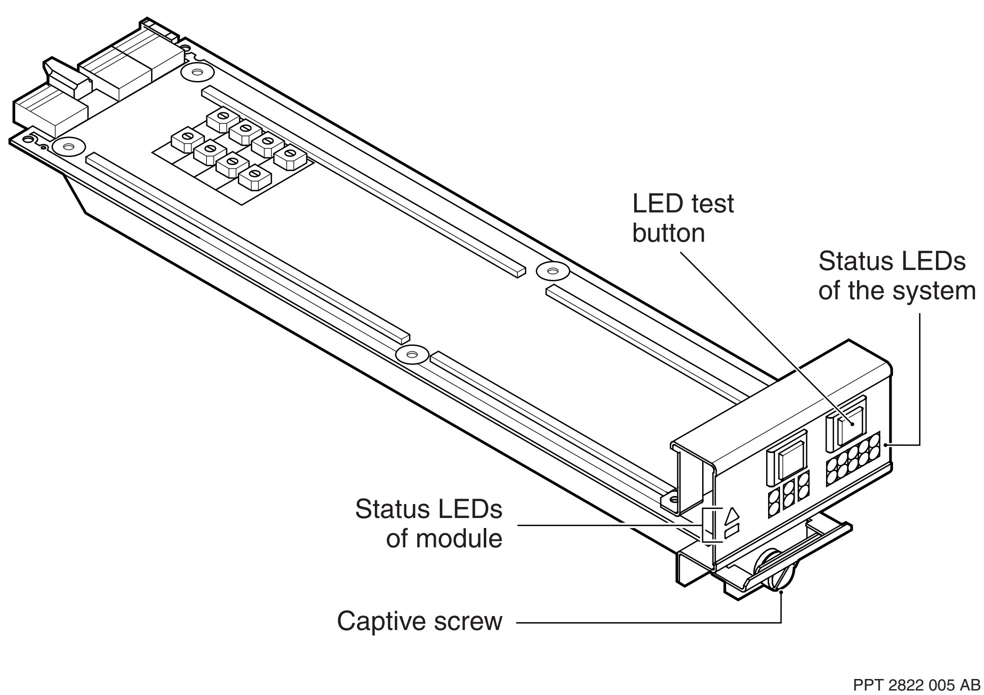
LED color	Shape	Mode	Meaning
green	triangle	solid	no fault, in service — active
red	square	solid	minor fault with the alarm module
off			invalid state — test for loss of power

Frame level indicators for the BIP alarm module

LED color	Quantity	Mode	Meaning
red	2	solid	critical alarm in the frame
red	2	solid	major alarm in the frame
amber	2	solid	minor alarm in the frame
amber	10 (2 rows)	solid	follow me indicators to attract attention to the frame under an alarm condition

See the figure Alarm module of the BIP (page 47).

Alarm module of the BIP



All visual alarms on the BIP alarm module will remain on until the fault conditions are cleared. When a BIP alarm module LED is lit, an associated red LED is also lit on the module that has failed. The alarm module LED also lights when other shelf failures are detected. The section Hardware alarm definitions and behaviors (page 48) identifies the alarms that are indicated on the alarm module and reported in the software that monitors the operating status and performance of each switch.

Hardware alarm definitions and behaviors

The hardware alarms that are displayed on the front panel of a BIP alarm module and sometimes on the BIP BIM are indicated by LEDs as critical, major, or minor. Specific hardware actions or conditions trigger a specific severity. The hardware alarm severities are defined as follows.

Critical indicates that a severe, service-affecting condition has occurred and immediate corrective action is required. These are examples.

- A CP failure causes a loss of call processing capability when the standby CP (redundant or back-up) is not available to take over.
- A fabric card failure preventing a switchover to its load-sharing mate.
- A fabric temperature has reached or exceeded 55 degrees Celsius (131 Fahrenheit). A critical LED lights on the alarm module and software alarm 7002 0003 is generated. The alarm clears when the fabric reaches 53 degrees Celsius (127.4 Fahrenheit).
- A fabric temperature has increased 3 degrees Celsius (37 Fahrenheit) since an ongoing fan failure alarm was reported by the system. For example, when a second fan fails before the first is replaced, the temperature inside the shelf will increase. The rate of increase depends on how full the shelf is and how much traffic is running through the processor cards. A critical LED lights on the alarm module and software alarm 7002 0004 is generated. Both alarms clear when the fabric temperature returns to what it was when the fan failure alarm occurred. This clearing is independent of the status of alarm 7012 0051.
- A failed fan or fan controller has not been replaced within 24 hours of its failure and is escalated to critical. Major software alarm 7012 0051 recurs every 8 hours since the initial failure until the fan problem is addressed. After three recurrences, the alarm severity changes to critical. A critical LED lights. The original major LED unlights unless an additional failure has occurred in the meantime.

Attention: A fan alarm 7012 0051 will recur only when attribute *repeatFanAlarm* is enabled. See the procedure for configuring a fan alarm to recur in NN10600-550 *Nortel Networks Multiservice Switch 7400/15000/ 20000 Common Configuration Procedures*.

- The ambient shelf high temperature has reached 70 degrees Celsius (158 Fahrenheit). A critical LED lights on the alarm module and software alarm 7012 0059 is generated. Shelf temperature is typically higher and rises faster than either fabric's temperature. The fabric alarm thresholds are lower so as to trigger alarms earlier than the high shelf temperature. Fabric shutdown occurs when a fabric reaches 72 degrees Celsius (161.6 Fahrenheit). Some FP and CP operations will have already begun to degrade or fail after 55 degrees Celsius (131 Fahrenheit).

Attention: Software alarm 7012 0051 and its time of occurrence, plus the fabric temperature at the time of the fan failure, are preserved through a CP switchover so that alarm 7012 0051 can recur as required and alarms 7002 003 and 7002 0004 can be appropriately generated or cleared.

Major indicates that a service-affecting condition has occurred and urgent corrective action is required. Service-affecting conditions include disruption or degradation of service, or malfunction of an important circuit. These are examples.

- A breaker is tripped.
- A breaker has failed, meaning the breaker interface module (BIM) has failed or the input power to the BIM has failed.
- When an Astec MFA150 system of ac rectifiers is the power source and the external alarm cable assembly P0940531 is connected between it and the BIP, power to the BIP from one or more rectifiers has failed. Ac or dc failures are detected by the absence of voltage at the A or B feed of a function processor (FP). Three red LEDS are lit on the BIP alarm module. Software alarm 7012 0050 is also reported to the Multiservice Data Manager software.
- When an Astec MFA150 system of ac rectifiers is the power source and the system's alarm output wires are connected to J2 at the rear of the BIP, a rectifier or its fan has failed, or an ac or dc breaker on a Helios rectifier has tripped or been reset.
- When a system of ac rectifiers is the power source and the rectifier's alarm output wires are connected to the central office side of the BIP alarm module. In this case, a failed breaker alarm is also indicated.
- A fan or its controller has failed. A major, as well as a minor, frame-level alarm is generated. Software alarm 7012 0051 is also generated. The time of failure is logged by the CPs so that an internal alarm clock makes the alarm recur each 8-hour interval and escalate the severity to critical if the problem is still not fixed within 24 hours.

Minor indicates that a non-service-affecting hardware or software failure has occurred. Corrective action must be taken to prevent a minor fault from contributing to a more serious problem. These are examples.

- A fan or its controller has failed. A minor, as well as a major, frame-level alarm is generated.
- A fan's power connector has been unplugged. Software alarm 7012 0051 is also generated.
- The BIP alarm module has failed.

See the following sections for temperature-related information:

- Fabric replacement can affect system cooling (page 84)
- The impact of heat dissipation on rising shelf temperatures (page 109)
- Follow-me LEDs (page 288)
- Status LEDs of a BIP alarm module (page 290)

BIP alarm LED board

The BIP alarm LED board connects to the alarm backplane. The alarm LED board indicates

- shelf failure
- BIP failure

If a fault occurs in either of the nodes connected to the BIP, an alarm is generated. If physical maintenance at the frame site is necessary, the network operator can alert a crafts person to help clear the alarm. The LED indications on the alarm module assist the crafts person in locating the correct frame. LEDs on the alarm module and the cages then direct the crafts person to the part that caused the alarm.

The network operator can supply the crafts person with this information:

- the location and part responsible for the fault
- a list of possible pieces of equipment at fault

The crafts person can then use this information with the lit LEDs on site to determine which part to replace.

Amber follow-me lights are located on the BIP. A frame indicator light (aisle light), provided by the customer, can be connected to the alarm system. The following lights are designed to guide the technician to the system that generated the alarm:

- Aisle indicator (page 51)
- Follow-me indicator (page 51)

In addition, the alarm module provides a bank of 10 LEDs for frame failure which will come on when any of the other types of alarms are activated.

Aisle indicator

An aisle indicator, located at eye level in the aisle, indicates which row of nodes or frames contains the Multiservice Switch with a problem. The indicator light must be provided by the customer.

When the external alarm cable P0940531 is connected between the BIP and an MFA150 system of rectifiers, the aisle indicator trips if a rectifier is powered off or fails.

Follow-me indicator

A follow-me indicator draws attention from a crafts person to the frame that has an alarm. The LEDs at the frame indicate the alarm status of parts of the system.

Major and minor alarms generated in a system are indicated by the frame indicator light.

Alarm cable connectors

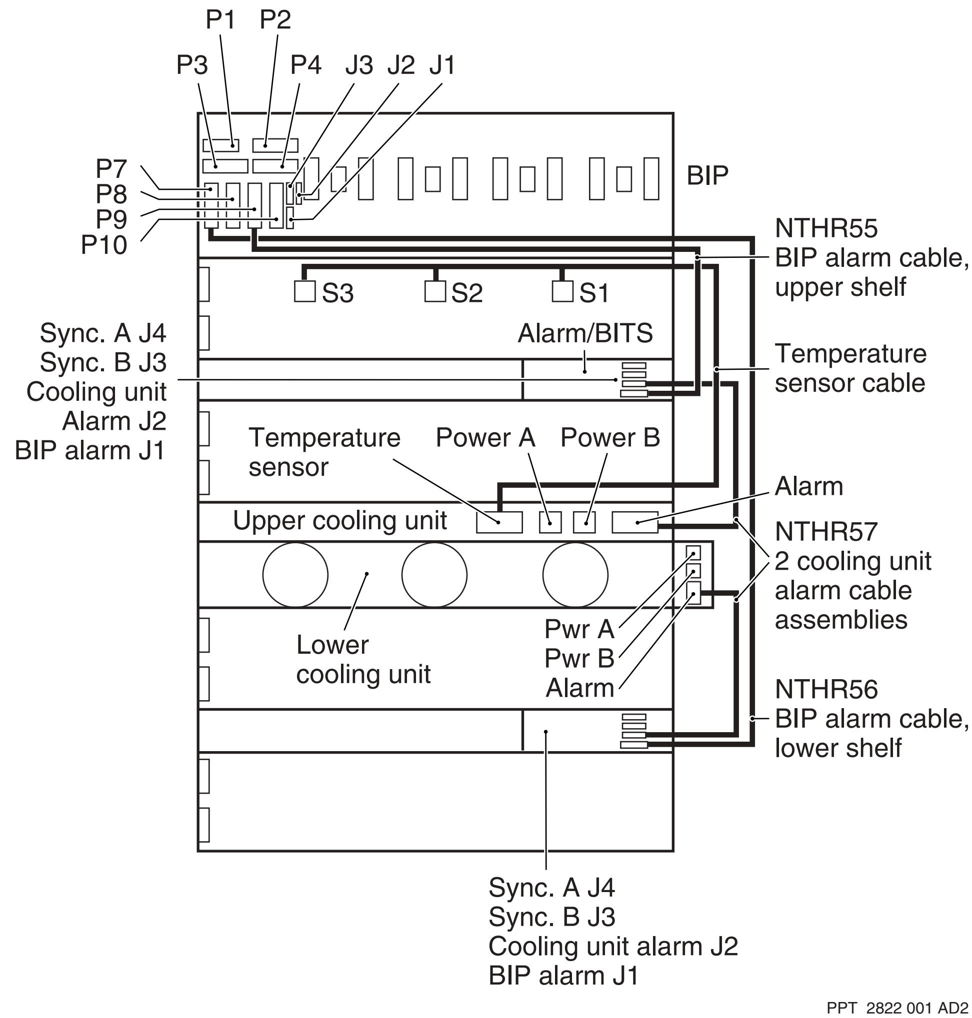
This section provides the following information about the BIP alarm cable connectors:

- Location of the BIP alarm connectors (page 51)
- Functions of the BIP alarm connectors (page 52)
- Features of the BIP alarm connectors (page 52)

Location of the BIP alarm connectors

The alarm cable connectors are located at the rear of the BIP backplane on the lower left side. See the figure Location of alarm cable connectors for two shelves (page 52).

Location of alarm cable connectors for two shelves



Functions of the BIP alarm connectors

The alarm cable connectors provide alarm connectivity from the BIP to each of the nodes in a frame, and to other frames in the aisle.

Features of the BIP alarm connectors

The features are listed in the table Features of the BIP alarm connectors (page 53).

Features of the BIP alarm connectors

Label	Type of connector	Feature
P1	15-pin D-sub, high density	interface for access by a craftsperson for connecting external telephone and data jacks when the BIP is in a DMS-100 office environment
P2	25-pin D-sub, high density	interface for office alarms to link or daisy-chain adjacent BIPs according to the DMS-100 office alarm scheme; used with connector J1 for an end-of-aisle lamp
P3	26-pin D-sub, high density	interface for stand-alone office alarms to connect a remote external alarm scanner in a stand-alone alarm environment (for example, to monitor the frame using an OEM scanner); for maximum flexibility, the connection is isolated form C (dry) contacts; the maximum is 100 mA/ 20 V
P4	25-pin D-sub, high density	interface for office alarms the same as connector P2
P5	110-pin	inside for the alarm module, not available for use
P6	55-pin	inside for the alarm module, not available for use
P7, P8, P9, P10	26-pin D-sub, high density	interfaces for shelf alarms such that: • P7 is for the bottom cage of the lower shelf • P8 is unconnected • P9 is for the bottom cage of the upper shelf • P10 is unconnected Unconnected connections will not generate alarms.
J1	1x2 MATE-N-LOK with louvertec contacts	for aisle lamp output when the BIP is at the end of a lineup; must be used with connectors P2 and P4, or if the drive is still needed, their pin 19 must be connected to L +ABS on BIP connector P2 or P4
J2	1x4 Berg (pin 1 is at the top position on the BIP, pin 4 at the bottom)	for use if external power equipment is to be monitored; the equipment must have isolated form C (dry) alarm contacts; the alarm is generated on contact closure; see BIP alarm connections from a system of ac rectifiers (page 54)
J3	2x4 Berg	large fail indicator (frame or follow-me) for the module when the view of the indicators are blocked (for example, by cabinet doors); for driving a front and rear LED board

The installation and pinout of each BIP alarm connector is described in NN10600-130 *Nortel Networks Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*.

BIP alarm connections from a system of ac rectifiers

When a system of ac rectifiers, such as an Astec MFA150 power system, rectifiers is used to power a Nortel Networks Multiservice Switch, external alarms can be connected between the two setups. Selected alarm connections can indicate a hardware status of the Multiservice Switch 15000 or Multiservice Switch 20000, while other selected alarm connections on the switch can indicate a hardware status of the rectifier system. Since Nortel Networks hardware supports the use of Astec MFA150 power systems, this section indicates the possible alarm connections at both ends.

When the BIP receives an alarm failure output from the rectifier of Astec MFA150 power system, it is a major alarm that indicates one or more of the following has occurred.

- One or more rectifiers has failed.
- One or more rectifier fans has failed.
- An ac failure occurred.
- An ac breaker was tripped or manually reset.
- A dc failure occurred.
- A dc breaker was tripped or manually reset.

The alarm cable connection end points between an MFA150 controller card and a BIP are identified in the table Pin-to-pin connections between an MFA150 controller card and a BIP (page 54). When the cable is connected and the system is operating normally, a failed rectifier generates critical alarm 7012 0050 that is reported to the network management software called Multiservice Data Manager (if present).

Pin-to-pin connections between an MFA150 controller card and a BIP

At the MFA150	At the BIP	Type of alarm
terminal block TB2: pin 1 for the black wire, pins 2 and 4 for the red wire, no connection (NC) for the white and green wires	J2, pin 2, L-	major

For the description of BIP alarm connector J2, see Features of the BIP alarm connectors (page 52).

The installation of the alarm cables for terminal block 2 (TB2) at the MFA150 are in Astec's document 167-9021-133 *Advanced Power Systems MFA150 Modular Front Access Power System Detailed Installation Guidelines and Procedures Manual*.

The prefabricated MFA-to-BIP external alarm cable assembly has part number P0940531. The installation of the cable and the pinout of the alarm connector are described in NN10600-130 *Nortel Networks Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*.

Power connections to and from the BIP backplane

Whether your site uses the top or bottom method of installing power cables, the BIP accommodates

- directly routing the cable from the site power source, or a branch panel as the last leg of connection, to the breaker interface panel (BIP) of the Nortel Networks Multiservice Switch
- using a cable tapped off a main power cable (instead of directly from the site power source) as the last leg of cable to the BIP
- including electrical conduit hardware with the power cables
- using the optional power-and-ground assembly at the rear of the BIP

This section includes the following information about the BIP backplane and the backplane power input connections:

- Location of the BIP backplane power connections (page 55)
- Function of the BIP backplane power input connections (page 56)
- Hardware for connecting power input cables to the BIP (page 57)
- Function of the BIP backplane power output connections (page 60)

Location of the BIP backplane power connections

The BIP backplane power connections are located along the right side of the rear of the BIP. A strain-relief bar is located directly in front of the power connections. This bar is used to prevent heavy input power cables from placing too much stress on the BIP backplane.

The power input connections located on the BIP backplane are shown in the figure Rear of the BIP (page 38).

The power output connections located on the BIP backplane are shown in the figures

- Location of power output cable connectors at rear of two shelves (page 62)
- Backplane connections at the BIP (page 61)

Function of the BIP backplane power input connections

The BIP backplane power connections are the terminations for input power feeds up to 100 A, and for output power cables from the BIP to the shelves and cooling units. A four-BIM model BIP supports four input feeds (a battery and battery return wire per BIM), while a two-BIM model supports two power feeds (four cables). A backplane safety cover overlays the backplane to prevent inadvertent shorts from metallic contact with the connectors. Each power input connection is covered by an insulating boot.

Each Nortel Networks Multiservice Switch 15000 or Multiservice Switch 20000 in a NEBS 2000 frame requires four power cables (two feeds) through the same BIP.

Installing top power cabling involves routing four or eight cables (two or four feeds) from the dc power source along an overhead trough (or equivalent setup) and down to the BIP.

Installing bottom power cabling involves routing four or eight cables (two or four feeds) from the site dc power source under or through the floor and up to the BIP.

Installing the feeds through conduit or not depends on the access classification of your site as restricted or non-restricted. For information on classifications, see NN10600-125 *Nortel Networks Multiservice Switch 15000/20000 Planning Site Requirements*.

The table BIP backplane power connections in a dual shelf frame (page 56) shows how the power connections on the backplane of the BIP are connected to other parts in the Multiservice Switch 15000 frame setup.

BIP backplane power connections in a dual shelf frame

BIM	Connector	Connects to
A1	P15	PIM 15RU lower shelf
	P16	cooling unit lower shelf
	P17	PIM 7RU lower shelf
B1	P18	PIM 15RL lower shelf
	P19	lower cooling unit
	P20	PIM 7RL lower shelf

(1 of 2)

BIP backplane power connections in a dual shelf frame (continued)

BIM	Connector	Connects to
A2	P21	PIM 15RU upper shelf
	P22	upper cooling unit
	P23	PIM 7RU upper shelf
B2	P24	PIM 15RL upper shelf
	P25	upper cooling unit
	P26	PIM 7RL upper shelf
	(2 of 2)	

Hardware for connecting power input cables to the BIP

The cables that input power to the rear of the breaker interface panel (BIP) can be connected by one of the following methods.

- directly to the studs on the rear of the BIP
- indirectly through one of the power-and-ground assemblies (described in Using an optional power-and-ground assembly (page 58))

See the figure Backplane connections at the BIP (page 61). The power input connections include the following parts for each BIM:

- one pair of studs for connecting one dc power input cable and one return, that is, one feed
- one power input stud with an anti-rotation mate for each 2-hole lug
- one lug per pair of studs that is a 90-degree offset narrow-tongued 2-hole lug sized No. 2/0 AWG; the lug is oversized so that it accommodates the different thicknesses of 1/0 AWG (53.49 mm^2) cable by various manufacturers, for example, with a 0.625 pitch

Attention: When using power input cables that are thinner than 1/0 AWG, you must provide lugs matched to the cable gauge. When powering from an Astec MFA150 power system of ac rectifiers, the appropriately sized lugs for power cable installation are specified for the installation.

- one insulating boot per pair of studs to safely cover the studs, the end of the 1/0 AWG cable, and the lug

Attention: When using power input cables that are thinner than 1/0 AWG, the same insulating boot is used and the gap is addressed by the procedure to connect each cable.

Using an optional power-and-ground assembly

The power-and-ground assemblies enable the connection of power input cables ranging in size from No 6 AWG (13.3 mm^2) to 2/0 AWG (67.43 mm^2), and enables using cable that is much less flexible than Super Flex. There is a polyvalent version (part number A0834143) and an equivalent version (part number A0834149) for the European Telecommunications Standards Institutes (ETSI). Both versions are identical in purpose and function. The mounting bracket of either assembly fits a NEBS 2000 frame, that is, a 21-inch wide mounting apparatus.

Each power-and-ground assembly includes:

- four pairs of terminal blocks along a rail, one per breaker interface panel (BIM); the uneven spacing is normal
- a bridge between the frame ground terminal and the adjacent battery return terminal (only on the ETSI terminal blocks)
- from each bridge, one ground cable ended with a straight 2-hole lug (ETSI only)
- at the top of the left and right terminal blocks, a clamping screw into the openings for the cables
- a blank label to identify the cable connection for each terminal block
- eight 2/0 AWG (67.4 mm^2) Super Flex excelene cables rated as (R) +105C 600V (manufactured by Essex), two per BIM, connecting the terminal blocks to the BIP power input studs
- each cable has a 90-degree offset narrow-tongued 2-hole lug

At each set of three ETSI terminal blocks on the power-and-ground assembly:

- the top of the left block receives a power input cable from the site power source, while the bottom has a power output cable to the BIP
- the top of the middle block has a ground cable to fasten to a frame ground
- the top of the right block receives a power input cable from the site power source, while the bottom has a power output cable to the BIP

A power-and-ground assembly must be added to the switch hardware on-site. The polyvalent or an ETSI assembly has a row of four unevenly spaced terminal blocks mounted on a flat metal bar. The bar is to be fastened to the frame uprights. An ETSI assembly has three terminal blocks per set instead of two. See the figures:

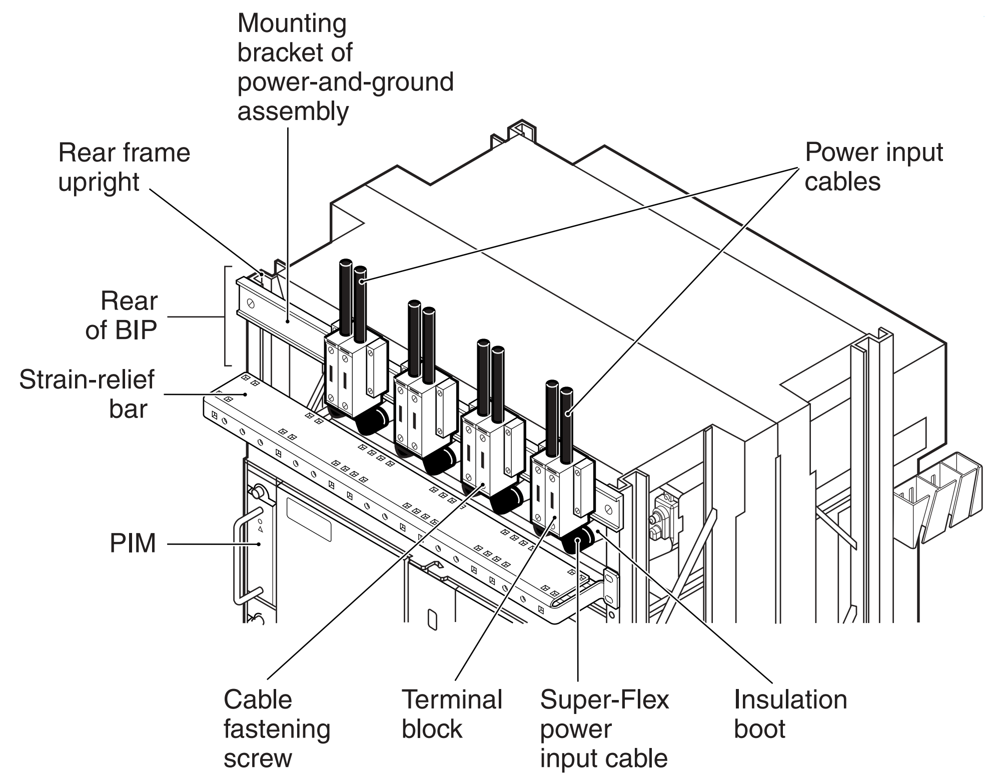
- The polyvalent power-and-ground assembly A0834143 (page 59)
- The ETSI power-and-ground assembly A0834149 (page 60)

All the site power cable preparation criteria up to the rear of the BIP also apply to a polyvalent or an ETSI power-and-ground cable assembly.

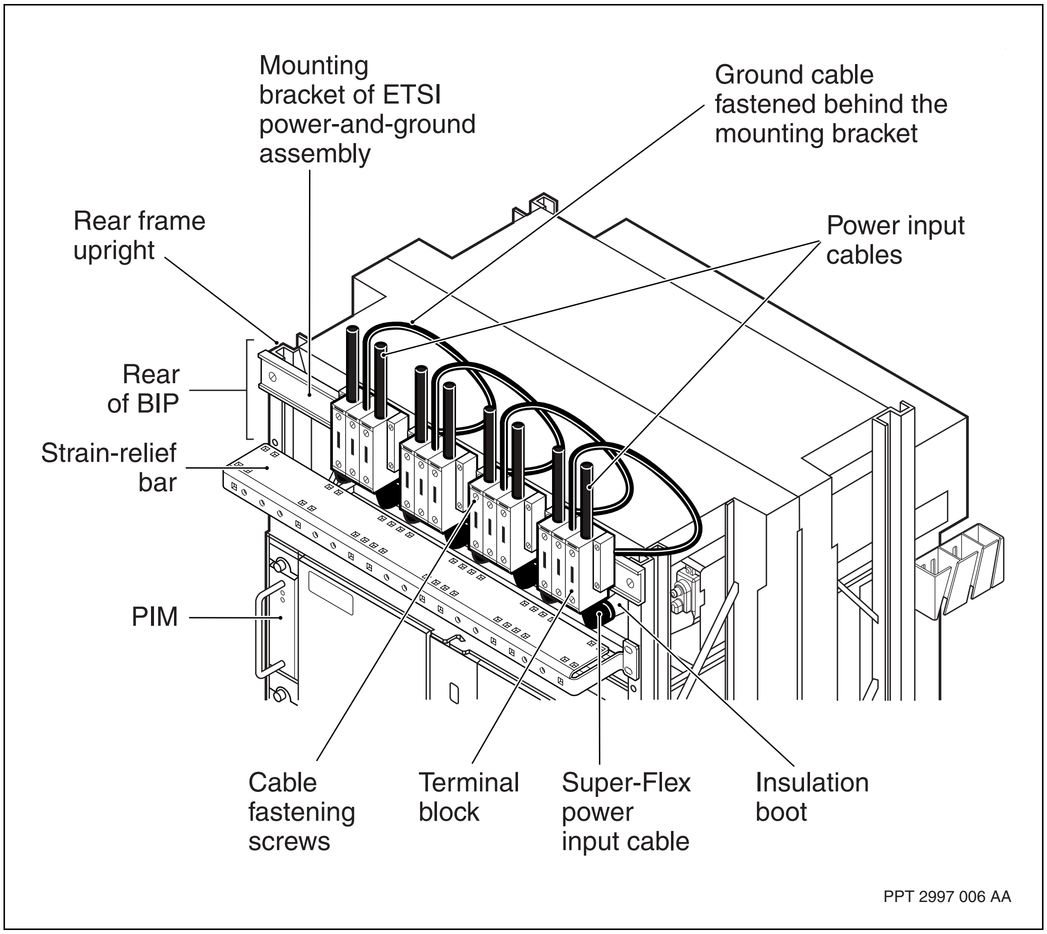
Adding a power-and-ground assembly in the field means either

- adding the assembly to the NEBS 2000 frame as an initial installation before the input power feeds are connected to the BIP
- adding the assembly after the Multiservice Switch has been powered up with feeds connected directly to the BIP

The polyvalent power-and-ground assembly A0834143



The ETSI power-and-ground assembly A0834149



Function of the BIP backplane power output connections

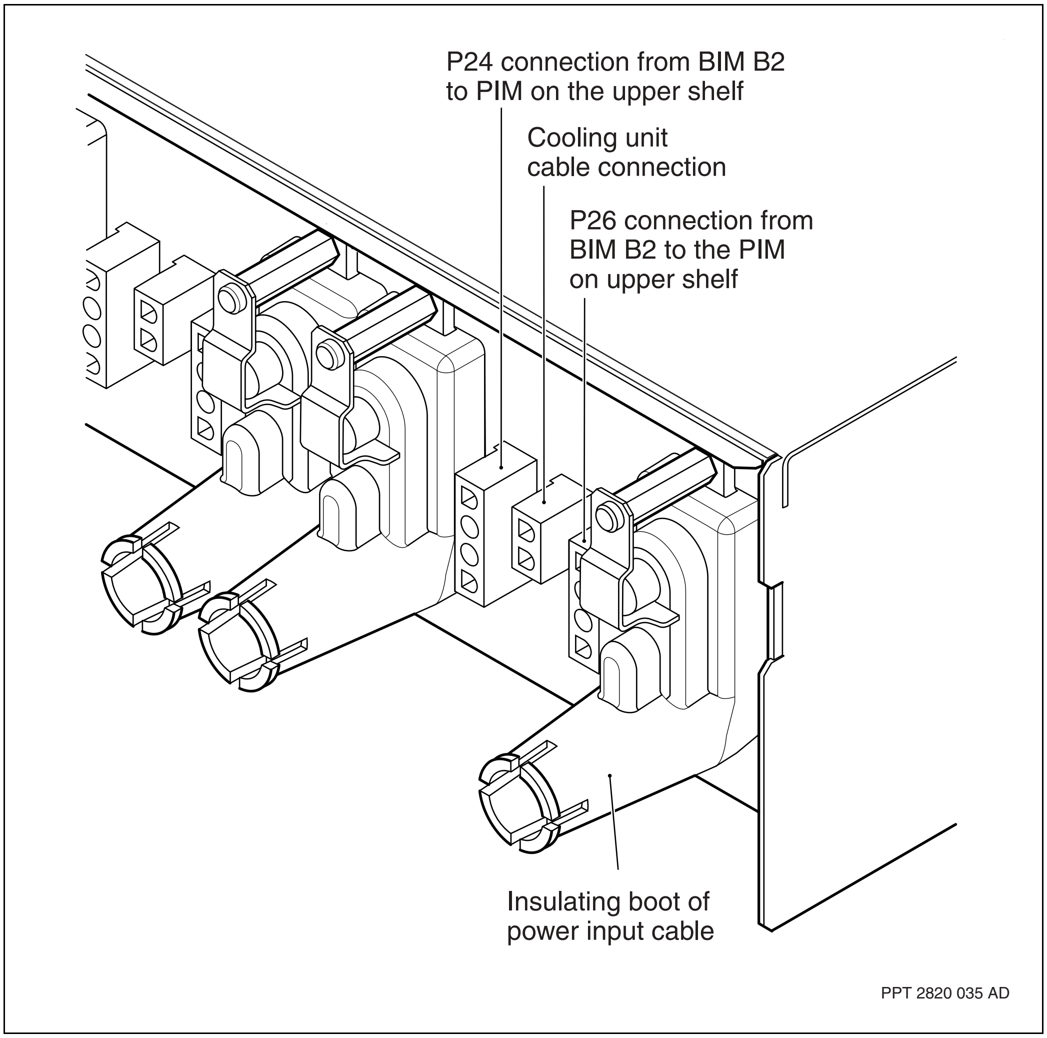
The power output connections at the BIP distribute the input power from the A and B feeds to a Multiservice Switch shelf or shelves, and the cooling unit or units. Each breaker interface module (BIM) is connected through the BIP backplane to a group of output connections. The group includes a connection to each PIM of a shelf and a connection to that shelf's cooling unit. See the figure Backplane connections at the BIP (page 61). The paired BIMs for each shelf provide redundant power to each shelf and its cooling unit.

The power output cables from the rear of the BIP to the parts of the shelf include:

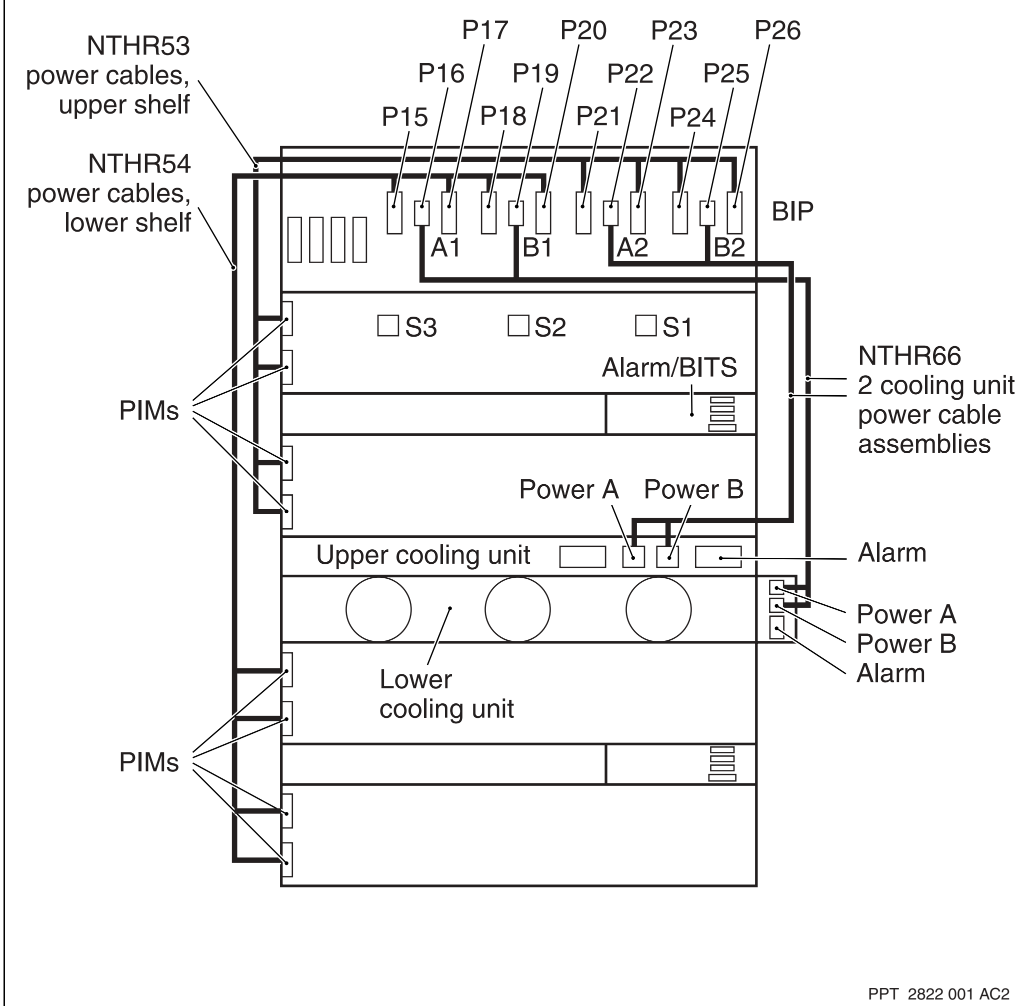
- two 1x4 MATE-N-LOK II connectors with louvertec contacts for cables providing power output to the PIMs in the shelves
- one 1x2 MATE-N-LOK II connector with louvertec contacts for cables providing power output to either the upper or lower cooling unit

The power output cable assemblies are always installed for both shelves even if only one is mounted in a NEBS 2000 frame. For the cable connection points, see the figure Location of power output cable connectors at rear of two shelves (page 62).

Backplane connections at the BIP



Location of power output cable connectors at rear of two shelves



Sources of dc input power to the BIP backplane

The breaker interface panel (BIP) of a Nortel Networks Multiservice Switch 15000 receives and distributes dc power for the system. The source of dc power can be from either:

- a dc power setup for the building or room of operation at the site
- co-located ac rectifiers, for example, when using an Astec MFA150 power system

Most of the preparations and requirements for dc power cabling between the MFA150 rectifiers and the BIP of the Multiservice Switch 15000 have the same criteria as cabling from a site dc power plant. For information of this kind, see NN10600-125 *Nortel Networks Multiservice Switch 15000/20000 Planning Site Requirements*.

Powering the BIP from ac rectifiers

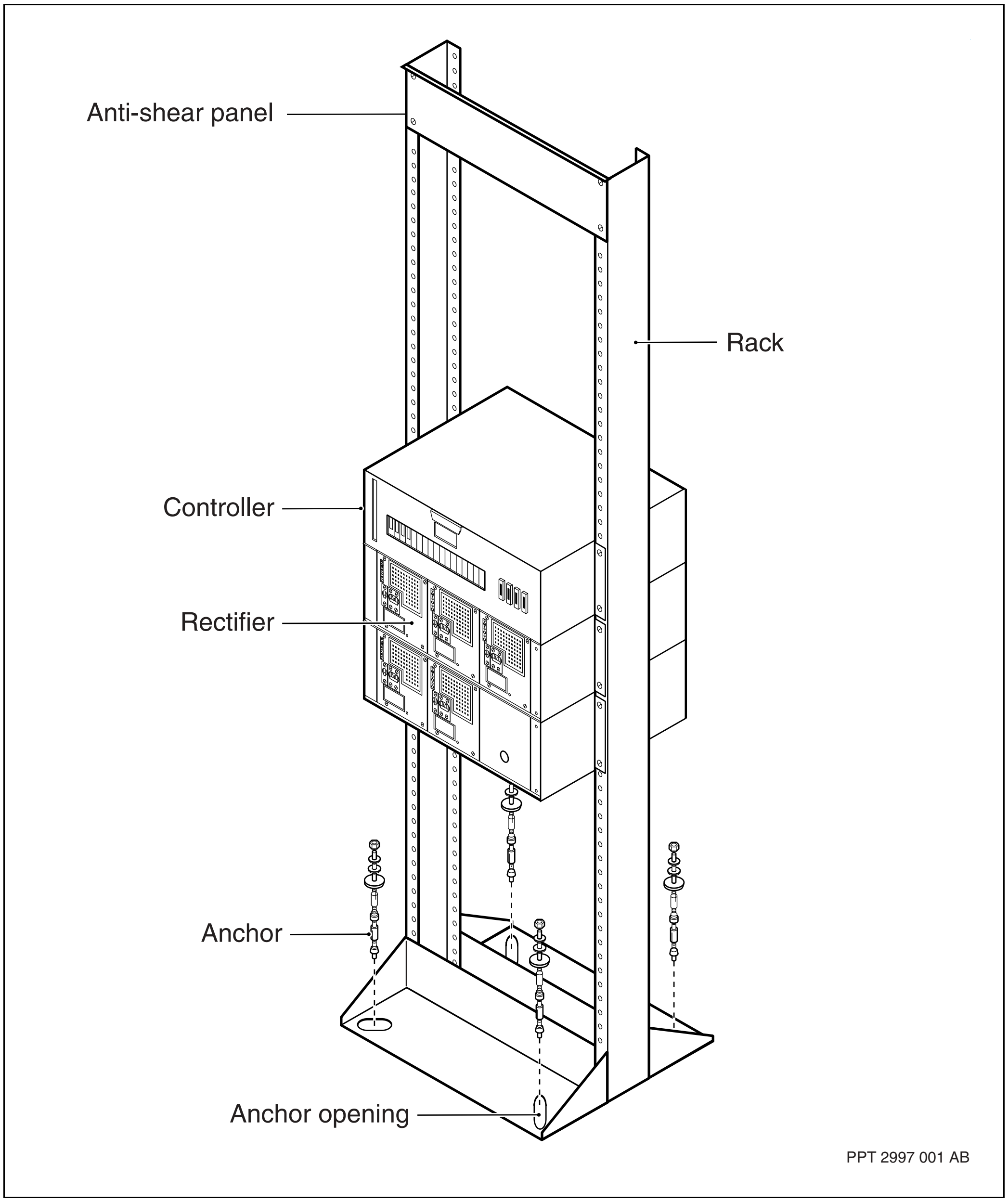
The BIP can be powered from any system of ac rectifiers that provides the power, safety, and performance required to operate one or two Nortel Networks Multiservice Switch 15000 or Multiservice Switch 20000 nodes (not a combination). Nortel Networks recommends using one of the configurations of the Astec MFA150 power system of rectifiers. The system is manufactured by Astec Advanced Power Systems. Consult your Nortel Networks sales representative for the available equipment. For an example, see the figure MFA150 power system of five rectifiers for a dual shelf configuration (page 64).

One configuration provides up to 100 A of dc power with 25 A of redundancy for two Multiservice Switch 15000 or Multiservice Switch 20000 nodes (50 A per switch). Another configuration provides 50 A of dc power with 25 A of redundancy for one switch. Both configurations support n+1 redundant sparing of power output.

The MFA150 system consists of an integrated distribution and control panel and one or two rectifier shelves. Optional parts include an external battery return panel and a battery disconnect panel. Supplementary distribution and battery trays can also be added. The system may be engineered on a standard 59-cm (23-inch) relay rack or in a special wall-mounted enclosure.

To plan for the installation of an Astec MFA150 power system of ac rectifiers, refer to NN10600-125 *Nortel Networks Multiservice Switch 15000/20000 Planning Site Requirements*.

MFA150 power system of five rectifiers for a dual shelf configuration



Grounding the switch and interworking equipment

The NEBS 2000 frame is the grounding point for the switch hardware. The frame has a silvery grounding strip bonded to the front of each frame upright and across the top front. Mounting any Nortel Networks Multiservice Switch equipment onto the frame using the provided self-tapping bolts automatically grounds it to the frame.

The NEBS 2000 frame is to be grounded to the site ground window using a cable with a straight two-hole lug from a top front or top rear pair of pre-drilled unthreaded holes through the silvery strip. Grounding the frame to the site ground window grounds all equipment mounted onto the frame.

Any optional Multiservice Switch or non-Multiservice Switch equipment that is connected to or interworks with the hardware of a Multiservice Switch must share the same ground window even if the equipment is mounted in different mounting apparatuses.

Shelf assembly

Each node is a separate Nortel Networks Multiservice Switch 15000 or Multiservice Switch 20000. A switch is mostly comprised of the power distribution unit, the cooling unit, and a shelf assembly. A shelf assembly accommodates:

- plug-in processor cards or filler cards in two rows (cages) across the front
- a cable management channel across the front
- the identification logo of the Multiservice Switch model on the cover of the upper cable management channel (needed because the front of a Multiservice Switch 20000 is identical to a Multiservice Switch 15000; on some earlier models of Multiservice Switch 15000, the cable cover is blank)
- two plug-in fabrics across its rear
- plug-in modules (PIM, Alarm/BITS, MAC address modules) at the rear for power input, hardware alarms, external timing interfaces, and the MAC address
- the temperature sensors on an upper shelf for the upper cooling unit
- support for the cooling fans needed to dissipate the heat generated by the processor cards
- an ESD jack used to ground an ESD wrist strap

The card slots are numbered sequentially through both cages. The cages hold the processor cards which manage the node and provide physical interfaces for connection to high-speed data networks. The parts which make up the shelf assembly allow the processor cards to

- inter-communicate (across both card cages)
- support alarm, timing, and node addressing

A module is different from a card because it requires no software configuration and has no connected signaling (traffic) cables. All modules are installed at the rear of the shelf assembly. A fabric card is the only rear card and the only card without signaling cables. Whether or not replacing a rear card or module in a Multiservice Switch 15000 or Multiservice Switch 20000 node affects performance depends on if the card has a redundant mate (backup). Each replacement procedure minimizes the amount of time a card or module or a backup is out of service.

The software term *shelf* refers to the node rather than the shelf assembly. The term *shelf assembly* refers to the hardware part of a node that contains the plug-in processor cards and modules.

These sections describe the hardware parts that constitute a single Multiservice Switch 15000 or Multiservice Switch 20000 shelf assembly:

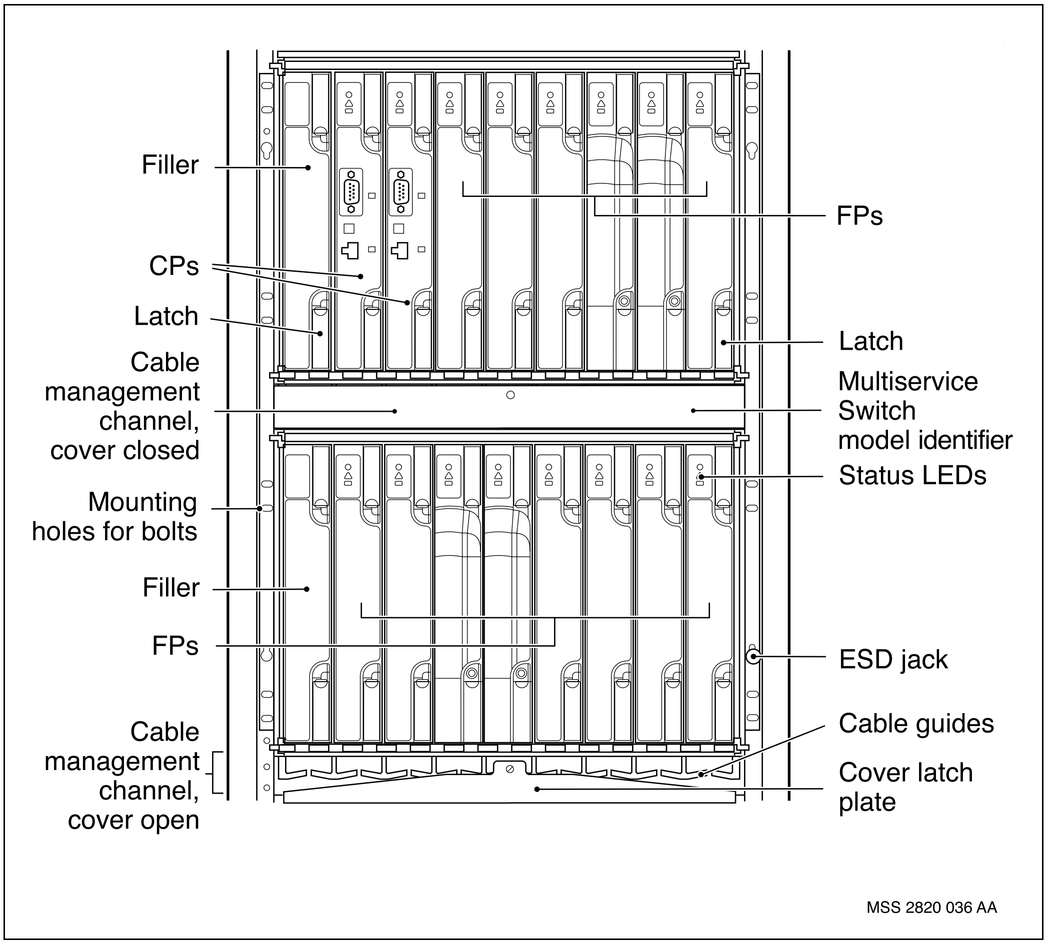
- Common backplane (page 70)
- Fabric cards (page 73)
- Power interface modules (PIMs) (page 87)
- Media access control (MAC) address module (page 92)
- Alarm/BITS module (page 93)
- Cooling units (page 104)

The exterior parts of the shelf assembly are shown in the figures

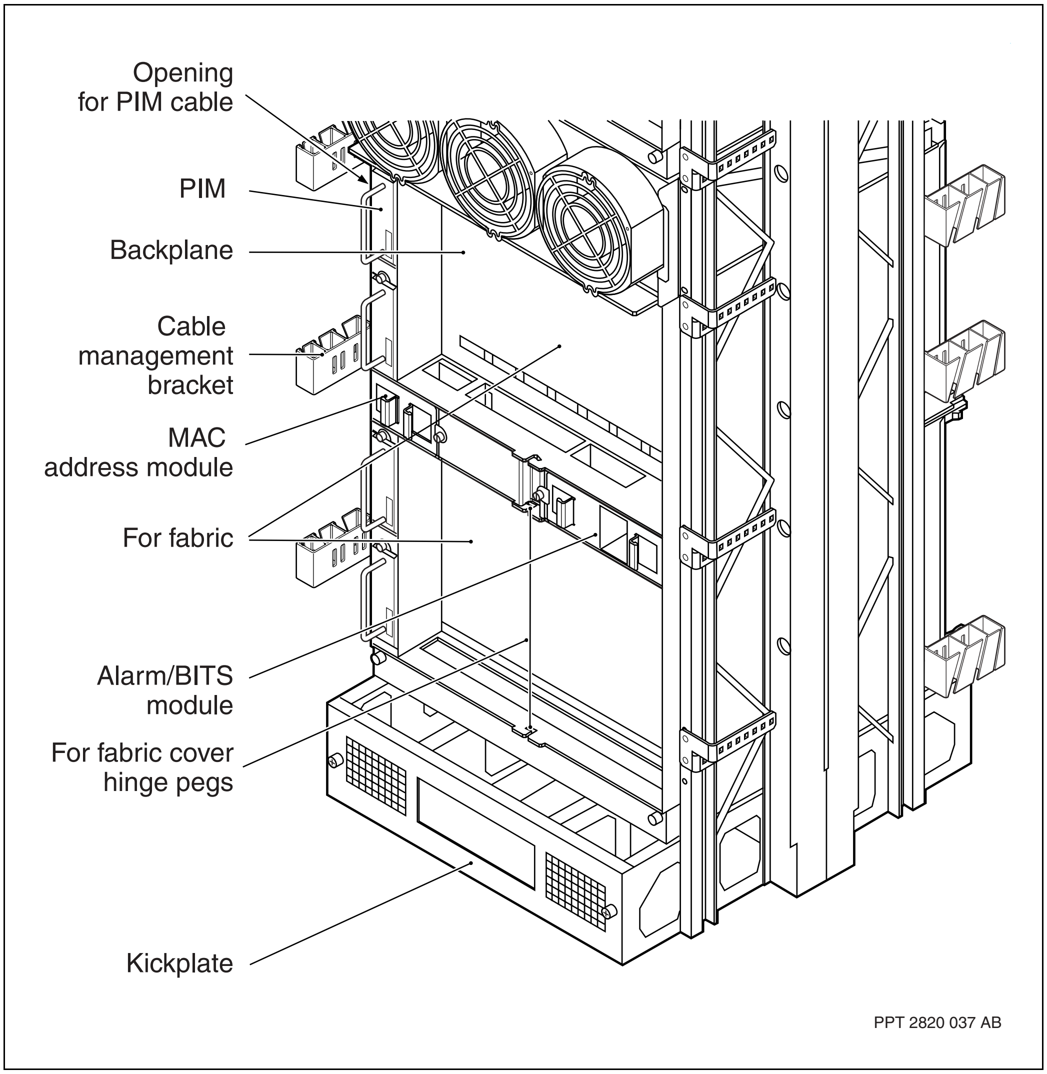
- A typical shelf assembly, front view (page 68)
- A shelf assembly of a Multiservice Switch 15000 without fabric cards, rear view (page 69)
- A shelf assembly of a Multiservice Switch 20000 with one fabric card removed, rear view (page 70)

For information about installing or maintaining any of the shelf parts described in this section, see NN10600-130 *Nortel Networks Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*.

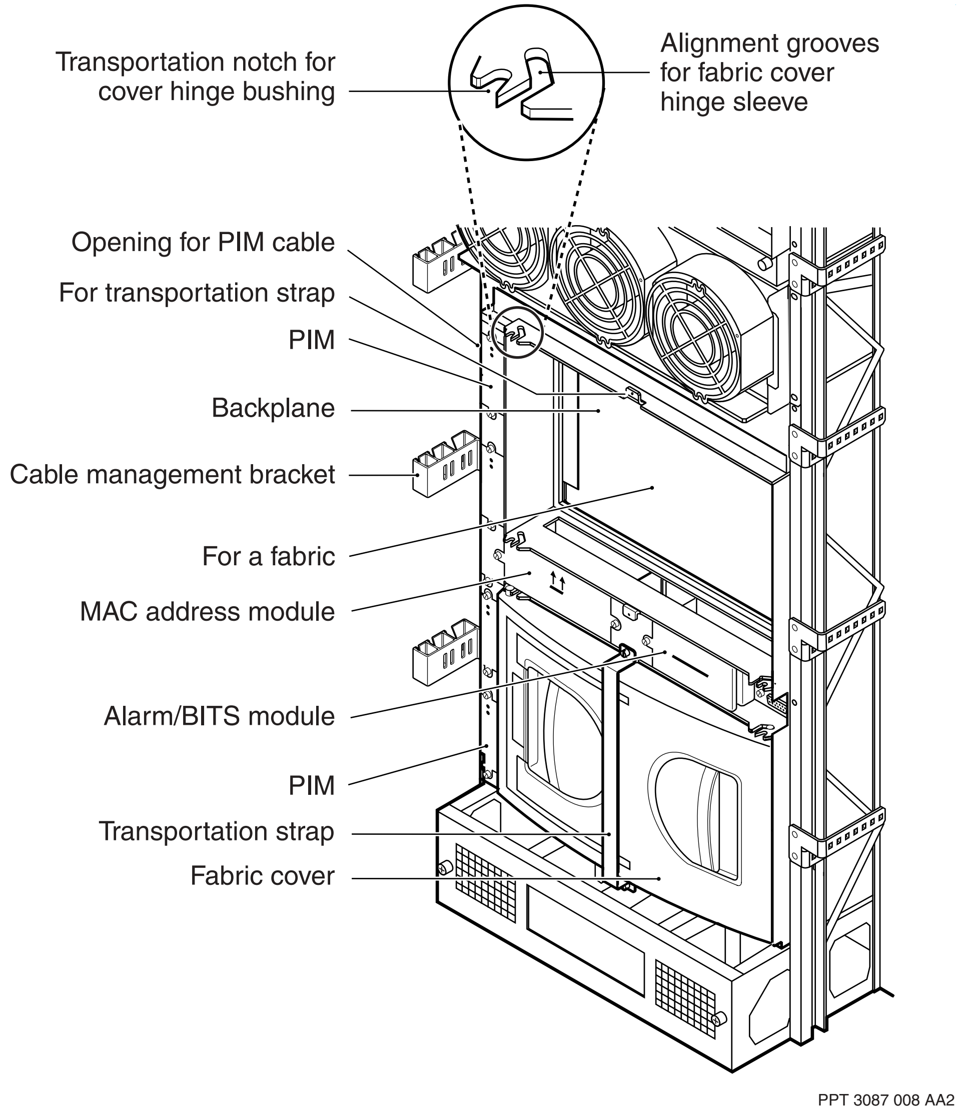
A typical shelf assembly, front view



A shelf assembly of a Multiservice Switch 15000 without fabric cards, rear view



A shelf assembly of a Multiservice Switch 20000 with one fabric card removed, rear view



Common backplane

This section provides the following information about the shelf assembly common backplane:

- Backplane location and physical description (page 71)
- Function of the common backplane (page 71)

The backplane can also be considered a midplane since cards can be inserted on both sides.

Backplane location and physical description

The backplane is located at the rear of the shelf assembly between the processor cards and the fabric cards. The backplane spans both card cages and extends over the full height and width of the shelf. The backplane is not a field-replaceable unit. The location of the backplane is shown in the figure:

- A shelf assembly of a Multiservice Switch 15000 without fabric cards, rear view (page 69)
- A shelf assembly of a Multiservice Switch 20000 with one fabric card removed, rear view (page 70)

The backplane of a Nortel Networks Multiservice Switch 15000 is a 20-layer printed circuit board containing 8 signal layers and 12 power/ground layers. Each processor card connects to the backplane with 4 Z-PACK connectors with a total of 658 pins per processor card slot, plus additional pins for the fabric card, MAC address module, alarm/BITS module, and the power interface modules (PIMs). Compliant pins are mechanically inserted in the backplane with a friction fit. The backplane circuit board itself contains no active electronic parts.

The backplane of a Multiservice Switch 20000 is a 20-layer printed circuit board containing 10 signal layers, 12 ground, and 2 power layers. Each processor card connects to the backplane with 4 Z-PACK connectors and 2 power connectors with a total of 658 pins per processor card slot. This includes pins for the fabric card, MAC address module, alarm/BITS module, and the power interface modules (PIMs). Compliant pins are mechanically inserted in the backplane with a friction fit. The backplane circuit board itself contains no active electronic parts.

Function of the common backplane

The backplane is referred to as the common backplane because it is the point across which all processor cards and fabric cards in a shelf intercommunicate.

In a Multiservice Switch 15000, the backplane provides redundant 3.52 Gbit/s serial links between the processor cards and the fabric cards to support power and signal distribution. The high-speed lines on the backplane have a nominal impedance of 50 ohm and 100 ohm differential to reduce signal ringing and reflections caused by impedance mismatches. The serial link architecture of the backplane allows for hot-swapping packs by isolating each card to a single fabric port, preventing card failures from propagating through the switching fabric. The backplane also provides links between adjacent FPs for functions such as sparing, clock distribution, and distribution of -48/-60 V dc.

In a Multiservice Switch 20000, the backplane provides redundant serial links or Unilinks between the processor cards and the fabric cards to support power and signal distribution. Multiservice Switch 20000 nodes have the 3.52 Gbit/s link capability of Multiservice Switch 15000 nodes, plus an overlay of

16.0 Gbit/s of link capability. Only one capability is active per slot. The high-speed lines on the backplane have a nominal impedance of 50 ohm and 100 ohm differential to reduce signal ringing and reflections caused by impedance mismatches. The serial link architecture of the backplane allows for hot-swapping packs by isolating each card to a single fabric port, preventing card failures from propagating through the switching fabric.

The backplane also provides links between adjacent FPs for functions such as sparing and clock distribution. The backplane has layers dedicated to power distribution of -48/-60 V dc to all plug-in cards and modules.

The backplane can function in dual- or single-fabric mode. Traffic is typically load-shared through the backplane across both fabric cards. Dual-fabric mode is the standard mode used by both types of node. Single-fabric mode occurs while one of the fabrics is being replaced or upgraded.

Fabric cards

This section contains the following information about the fabric cards:

Function and operation of fabric cards

Fabric cards provide the node with two redundant 16x16 switching elements for interconnecting up to 16 processor cards. Both fabric cards balance and load-share traffic. Each one operates at about half capacity so that it can take over the traffic of its mate. Either card can handle all traffic carried by a fully provisioned and configured Multiservice Switch 15000 or Multiservice Switch 20000.

Under normal operation, each processor card transmits to and receives from half the processors on the upper fabric card (fabric X in software) and half on the lower fabric card (fabric Y in software). When the control processor (CP) detects a fault in a fabric card, or when the card is manually locked, the CP blocks all new traffic to that fabric card and reroutes its established traffic to the unlocked card. When all traffic in progress is established on the fabric card that is taking over the full load, the locking of the fabric card completes.

Fabric cards are hot-swappable. When the software is prepared for the removal by manually locking fabric X or fabric Y in software, and then returning the replacement to service by the manually unlocking it, traffic in progress on the cards is maintained. When hot-swapping a fabric card without locking it in software the traffic in progress on the removed card is lost and the inserted fabric card is automatically tested and returned to service provided the tests pass.

Unlocking a fabric card returns it to service. The CP allows new traffic to use the card. Traffic that was transferred to the other fabric card is transferred back so that balanced load sharing resumes.

The internal port-to-card mapping of the 70G fabrics is different from the 40G fabric cards (and their physical connectors to the backplane are different). This means a 40G fabric card cannot be used in a Nortel Networks Multiservice Switch 20000 node, and a 70G cannot be used in a Multiservice Switch 15000 node. When the system first detects the type of fabric card, the system automatically:

- knows how to treat the fabric card, that is, as two 40Gs of a Multiservice Switch 15000 node, or two 70Gs of a Multiservice Switch 20000 node
- compares the firmware versions between the pre-loaded firmware on the fabric card and in the software load on the system and flags any discrepancy
- adjusts the port-to-card mapping between the fabric cards and the processor cards (transparent to the end-user)
- updates the system with the total fabric card capacity of the node

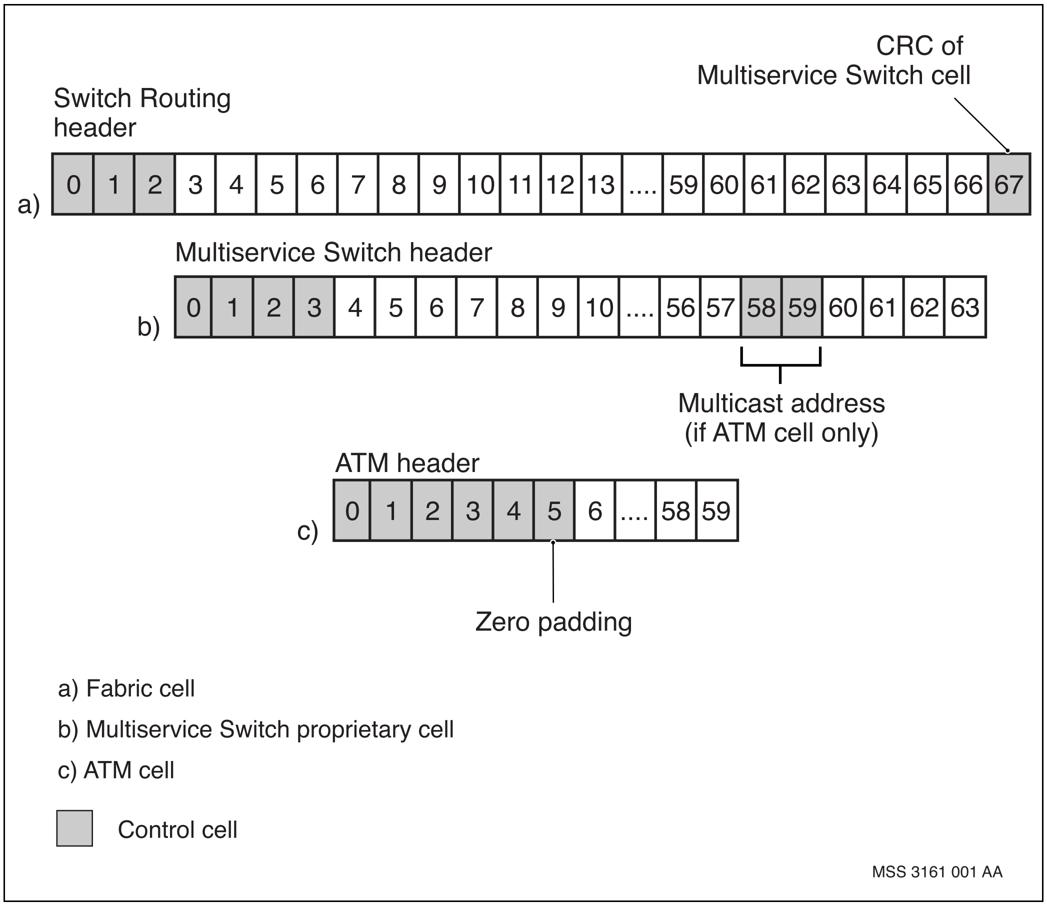
For both node types, each of the 16 links to the fabric card supports 3.52 Gbit/s bi-directional data rate per link or 2.5 Gbit/s user data rate. The fabric card data rate is greater than the user date rate for two key reasons:

- bandwidth reserved to accommodate internal cell headers
- fabric card speedup to provide non-blocking architecture

Both node types use fixed 68 byte cells or packets in the fabric route between the processor cards. The figure Multiservice Switch 15000 and Multiservice Switch 20000 fabric cell (page 75) shows cell formats and encapsulation. It encapsulates the following:

- 3 bytes for the switch routing header
- 64 bytes for the Multiservice Switch proprietary cell
- 1 byte for CRC (cyclic redundancy check) to protect payload

Multiservice Switch 15000 and Multiservice Switch 20000 fabric cell



For more information, see the chapter on fabric cards in NN10600-550 *Nortel Networks Multiservice Switch 7400/15000/20000 Common Configuration Procedures*.

Fabric LED behavior is different from FPs

Since a red LED can be caused by more than disabling, a fabric card with a red LED can still be transmitting traffic. Similarly, a fabric card with a green LED might be prevented from transmitting traffic. To handle these unusual behaviors, and to prevent uncontrolled errors caused by hot-swapping an unlocked fabric, always manually lock a fabric card and allow time for the transfer of traffic before physically removing it from a shelf, and unlock it as soon as a replacement is seated.

For the complete pattern of LED behaviors, refer to Status LEDs of fabric cards in a Multiservice Switch 15000 (page 295), and Status LEDs of fabric cards in a Multiservice Switch 20000 (page 296).

Fabric card location and physical description

Each Multiservice Switch 15000 or Multiservice Switch 20000 houses two fabric cards, located one above the other at the rear of the shelf assembly. The fabric card in the upper position is referred to by the software as fabric X, while the lower is fabric Y.

Each fabric card is an individual switch embedded in a chip set.

Multiservice Switch 15000 fabric cards

Multiservice Switch 15000 fabric cards are installed in opposite orientations relative to each other (unlike Multiservice Switch 20000) to minimize serial link lengths. The figure Faceplates of both fabric cards installed in a lower Multiservice Switch 15000 (page 80) shows the fabrics rotated. When installing a fabric card, orient the card by using the insertion alignment arrows that are labeled on the card and in the middle of the shelf assembly.

Each fabric card provides 16 input and 16 output DASL ports at 3.52 Gbit/s bandwidth for each port. The fabric capacity is 56 Gbit/s while the shelf (usable) capacity using that fabric is 40 Gbit/s. The 40G fabric card supports the 2.5 Gbit/s function processors (FPs).

The tables Features of a 40 Gbit/s Multiservice Switch 15000 fabric card pre-NTHR16EA (page 76) and Features of a 40 Gbit/s Multiservice Switch 15000 fabric card NTHR16EA (page 77) list the major features.

Features of a 40 Gbit/s Multiservice Switch 15000 fabric card pre-NTHR16EA

Feature	Description
throughput capacity	56.32 Gbit/s (40 Gbit/s shelf capacity) from 2 fabrics each with 40 Gbit/s operating at half capacity in load-sharing (redundant) mode for a total shelf capacity of 40 Gbit/s
port configuration	16 x 16 non-blocking
base speed per port	3.52 Gbit/s
self routing	yes
multicast, broadcast	yes
flow control	grant
shared memory depth	256 or 512 cells
QoS support	Multiservice Switch 15000 uses 2 priorities
DASL interface	440 Mbit/s
JTAG	yes

(1 of 2)

Features of a 40 Gbit/s Multiservice Switch 15000 fabric card pre-NTHR16EA

Feature	Description
technology	CMOS5S6, 0.35 Um
backplane signaling	1.5 V
Class B compliance	yes
CP dependency	CP2s or CP3s
	(2 of 2)

Features of a 40 Gbit/s Multiservice Switch 15000 fabric card NTHR16EA

Feature	Description
throughput capacity	56.32 Gbit/s (40 Gbit/s shelf capacity) from 2 fabrics each with 40 Gbit/s operating at half capacity in load-sharing (redundant) mode for a total shelf capacity of 40 Gbit/s
port configuration	16 x 16 non-blocking
base speed per port	3.52 Gbit/s
self routing	yes
multicast, broadcast	yes, increased over predecessors
flow control	grant, increased over predecessors
congestion control	yes, decreased over predecessors
queuing buffer	128 and 64 for high and low priority, increased over predecessors
shared memory depth	1024 cells, increased over predecessors
QoS support	Multiservice Switch 15000 uses 2 priorities
DASL interface	440 Mbit/s
JTAG	yes
technology	CMOS5S6, 0.35 Um
power consumption	almost half of its predecessors’
backplane signaling	1.8 V
Class B compliance	yes
CP dependency	CP3s only

Multiservice Switch 20000 fabric cards

In a Multiservice Switch 20000, the fabric cards are both installed with the same orientation. (This is different from a Multiservice Switch 15000.)

The fabric card capacity is 112 Gbit/s each while the shelf capacity using that card is 70 Gbit/s. Shelf capacity is the portion that is available to traffic. Each fabric card provides 16 input ports and 16 output ports. Both fabric cards connect to the 16 processor cards (2 CP3s and 14 FPs) in the shelf using one of two types of serial link ports:

- DASL for a 3.52 Gbit/s full duplex connection used by the 2.5 Gbit/s FPs
- Unilink for a 16 Gbit/s full duplex connection in preparation for use by the upcoming 10 Gbit/s FPs

Each 70G fabric card provides up to 16 ports in a combination of DASL and Unilink ports with a maximum of 4 Unilink ports. For example, the combination can be 4 Unilinks and 12 DASLs, or 3 Unilinks and 13 DASLs.

DASL connections are used by the function processors (FPs) that have ASIC devices called CPAC1 or CPAC2. Unilink connections will be used by the FPs that have the C192 ASICs. (The ASICs of each FP type are identified in NN10600-551 *Nortel Networks Multiservice Switch 7400/15000/20000 FP Configuration Reference*.) Card slots 6 and 7 or 14 and 15 can accommodate FPs that use either DASL or Unilink. All other slots accommodate DASL. The slots are paired so that they can be configured for card-to-card sparing.

The 70G fabric card supports both the 2.5 Gbit/s FPs and the 10 Gbit/s (C192) FPs. The 10G FPs must be installed in the Unilink slots.

The table Features of a 70 Gbit/s Multiservice Switch 20000 fabric card (page 78) lists the major features.

Features of a 70 Gbit/s Multiservice Switch 20000 fabric card

Feature	Description
throughput capacity	112.6 Gbit/s (70 Gbit/s shelf capacity) from 2 fabrics each with 70 Gbit/s operating at half capacity in load-sharing (redundant) mode for a total shelf capacity of 70 Gbit/s
port configuration	16 x 16 non-blocking
base speed per port	4.0 Gbit/s and 16.0 Gbit/s for the four slots when 10 G cards are installed
self routing	yes
multicast, broadcast	yes
flow control	grant
shared memory depth	256 or 512 cells
QoS support	Multiservice Switch 20000 uses 2 priorities

(1 of 2)

Features of a 70 Gbit/s Multiservice Switch 20000 fabric card (continued)

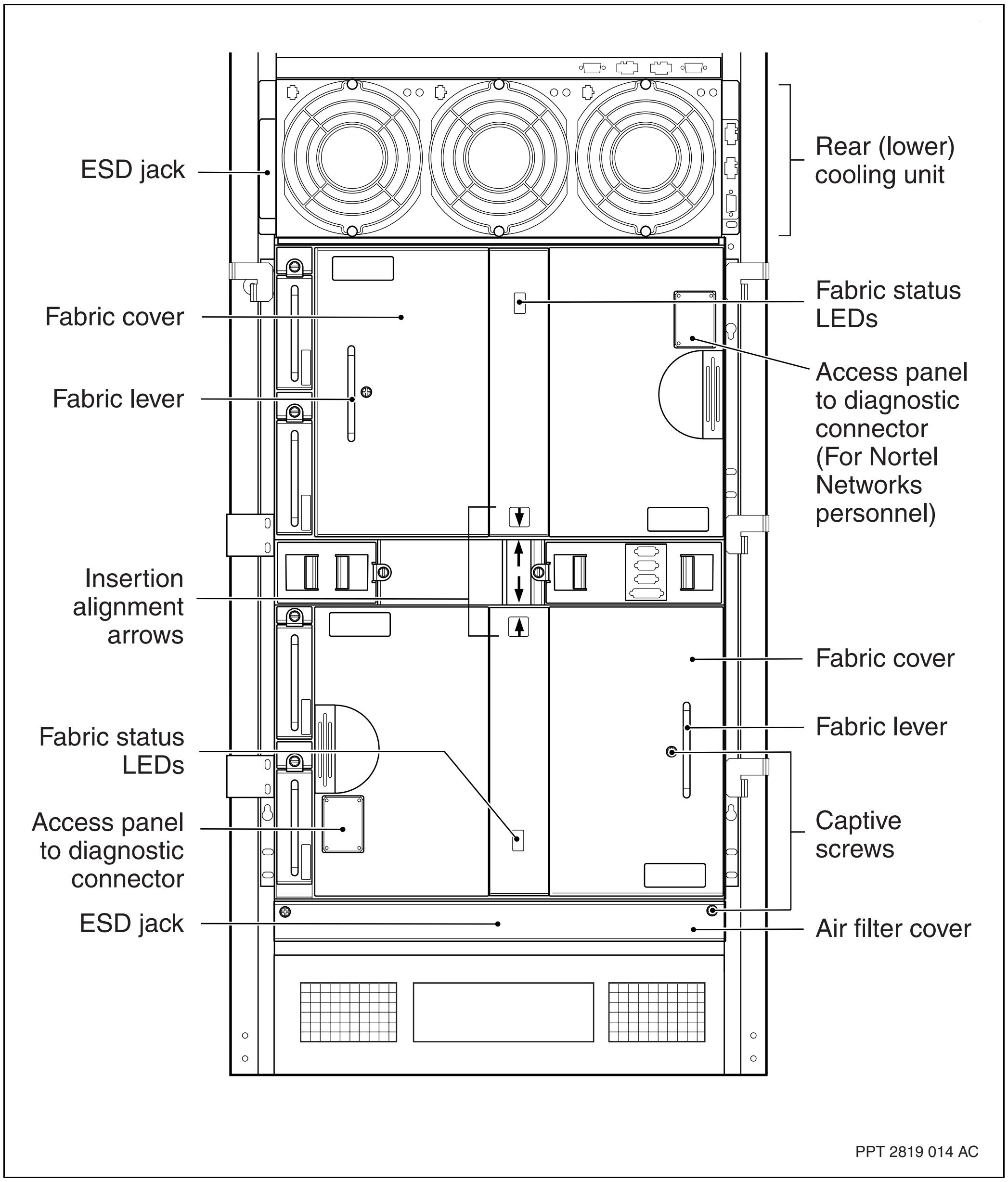
Feature	Description
DASL interface	3.52 Gbit/s
Unilink interface	16 Gbit/s
JTAG	yes
technology	CMOS5S6, 0.35 Um
	(2 of 2)

Fabric card carrier

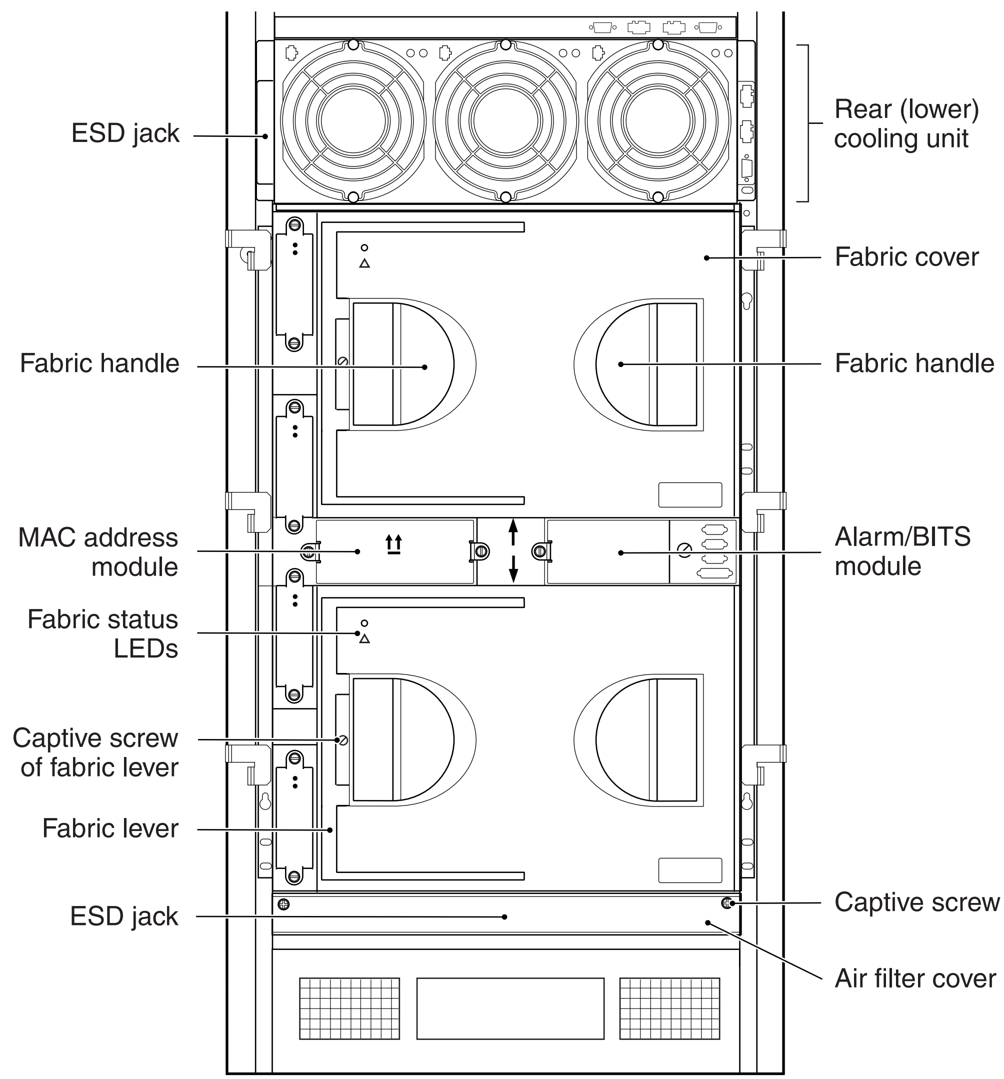
Each shelf assembly contains two fabric cards, each of which is enclosed in a carrier module. The carrier protects the fabric card, provides EMC compliance, and provides a mechanism for inserting the card. The carrier is an integrated non-removable part of each fabric.

See Faceplates of both fabric cards installed in a lower Multiservice Switch 15000 (page 80) and Faceplates of both fabric cards installed in a lower Multiservice Switch 20000 (page 81), for the location of the fabric cards.

Faceplates of both fabric cards installed in a lower Multiservice Switch 15000



Faceplates of both fabric cards installed in a lower Multiservice Switch 20000



Fabric card transportation

The method of transporting fabric cards differs between Nortel Networks Multiservice Switch 15000 and Multiservice Switch 20000 nodes.

Fabric cards for a Multiservice Switch 15000 are shipped in their own transportation container. The container and packaging protects the card from damage by minor impacts and electromagnetic discharges (ESD).

Fabric cards for a Multiservice Switch 20000 are strapped into a transportation position against the rear of the shelf assembly. During transportation, the card connectors are not engaged with the backplane. The outer card carrier provides protection from ESD. After the NEBS 2000 frame or equivalent mounting apparatus is anchored to the floor and the switch hardware is fastened to that apparatus, removing the transportation strap allows the fabric to be seated. Store the strap for re-use in case the shelf assembly is ever moved from its position. See the figure Transportation strap for shipping a Multiservice Switch 20000 fabric card (page 83).

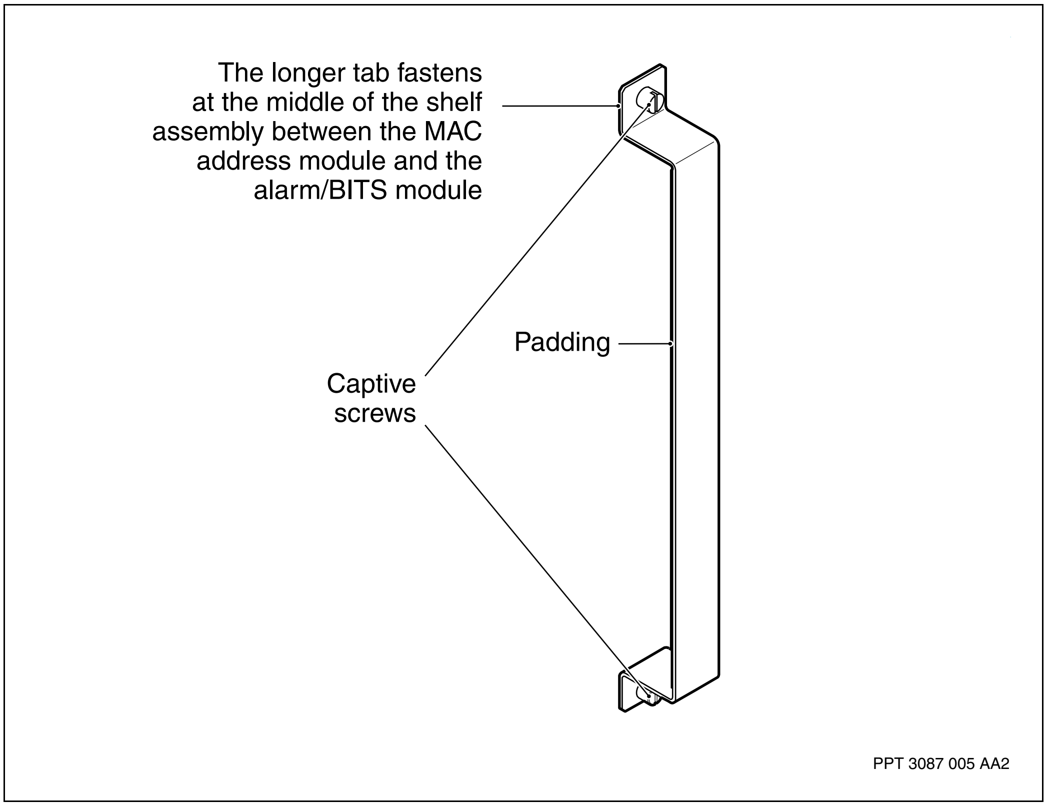
The transportation strap for a fabric card (part number P0936800) is not supposed to be mounted on an in-service system, because removing it to replace a fabric card delays removal of the card. Replacing a fabric card is a time-sensitive task.

Put the strap aside for re-use whenever the shelf assembly is to be moved with a fabric card in the transportation position. Always keep a hand on the fabric card to ensure it stays against the shelf assembly.

Attention: When the shelf assembly is shipped in its own container as part of a shelf-based package (for example, NTQH03), the fabric card is also shipped in its own container. This makes the shelf assembly weigh less for handling during installation into the mounting apparatus.

Each Multiservice Switch 20000 mounted in the upper position of a NEBS 2000 frame is shipped with temporary protective tape covering the air vent of the fabric cage. If the tape is not removed before powering up the node, the accumulated heat that is trapped against the fabric cards can exceed each card’s temperature threshold. When the threshold is exceeded, the fabric card drops its traffic until the temperature goes below the threshold. Built-in hysteresis prevents the fabric card from toggling between on and off at the temperature threshold. A node mounted in the lower position of a NEBS 2000 frame does not have the strip of tape. A node from package NTQS03 or NTQS04 may not have the tape on it. Removing the protective tape is an essential step in the installation procedure.

Transportation strap for shipping a Multiservice Switch 20000 fabric card



Fabric replacement can affect traffic

When both fabric cards in either Nortel Networks Multiservice Switch node are in service, they operate in a load-sharing mode such that either card can take over all the traffic of its mate. When a fabric card fails completely, the failure triggers the remaining card to take over the incoming traffic from the failed card, and the failed card is put into a lock-out state. Traffic in progress is unavoidably lost during the switchover.

When the system removes a fabric card from service (disables it), it puts the card in a lock-out state, but it does not automatically lock it in software. Prior to removing a fabric card from a shelf assembly, you must always manually lock the fabric card in software. (This is not the same as the lock-out state of a failed fabric card.) Locking the target card allows a takeover of traffic by its mate and prepares the system to allow returning the replacement fabric card to service. Without manual locking, the system cannot put the replacement fabric card into service. Manually unlocking the fabric card triggers the return to service, but the lock command must have been used first.

If the fabric card you must replace still has traffic passing through it, then the traffic in-progress can be maintained through its redundant mate provided that mate is in-service and operating normally. Traffic is maintained by manually locking the target fabric card so that the mate card takes over its traffic.

Replacing a fabric card that has no in-service mate causes all CPs and FPs to reset. A reset loses all in-progress traffic. The CPs and FPs will not reboot until a fabric card is installed and returns to service.

For a description of handling fabric card software sparing, takeover, and lockout, see to NN10600-550 *Nortel Networks Multiservice Switch 7400/15000/20000 Common Configuration Procedures*.

Fabric replacement can affect system cooling

An installed fabric card is an integral part of the cooling system and electromagnetic compatibility (EMC). The length of time that it takes to replace a fabric card can affect the node's cooling system and electromagnetic compatibility (EMC).

CAUTION
Risk of service loss or equipment damage
Removing a fabric card for an extended period of time affects the cooling system's capability to maintain a nominal temperature of operation inside the node. The period of time varies according to the ambient temperature of the room. See the table Durations for replacing a fabric (page 84).

Durations for replacing a fabric

Ambient room temperature	Interval between removing and inserting
25 degrees Celsius (77 degrees Fahrenheit)	20 minutes
30 degrees Celsius (86 degrees Fahrenheit)	8 minutes
40 degrees Celsius (104 degrees Fahrenheit)	3 minutes

Before removing a fabric card, ensure that the cooling unit is operating all three fans at normal speeds. If even one fan is not operating at normal speed, see NN10600-130 *Nortel Networks Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*.

While a fabric is locked, no temperature reading can be received from that fabric.

A fabric takeover does not reset temperature readings that have already been taken by the CP or generated into alarms, nor prevent a reading.

When a fabric card NTHR16EA has a mate in the same shelf that is a pre-EA version, the temperature readings between the two fabrics vary slightly because of card design and due to position in the shelf assembly. When a fabric is in the X position (upper half), the exhaust heat from the fabric in the Y position (lower half) makes it a few degrees warmer. The switch always uses the higher sensor reading for the temperature thresholds.

Fabric replacement may require a firmware upgrade

A fabric card stores fixed firmware from the factory, and can be loaded with additional firmware after being seated into an operating node. After the writable memory bank is loaded, for example with version 9.3, it automatically becomes active and controls the operation of the fabric card. For information on installing new firmware on the fabric card, see NN10600-272 *Nortel Networks Multiservice Switch 7400/15000/20000 Upgrading Software*.

An upgrade to fabric card firmware occurs independently of software upgrades to the function processors (FPs) and control processors (CPs). All Multiservice Switch software is compatible with all fabric card firmware. Some versions of fabric card firmware can include enhanced or new functionality to increase efficiency. For example, the software package called fabric_CB02A is used by PCR 2.2 GA software and contains the firmware. The B refers to the 2 in PCR 2.x, the 02 refers to the .2 in PCR 2.2, and the A refers to GA. CB02S1A would refer to the first software supplement for PCR 2.2 GA software. Both fabric_CB02A and fabric_CB02S1A use the same firmware.

When inserting a version of a fabric card with a product engineering code (PEC) that is different from the card being replaced, the replacement may require a different firmware load to be downloaded from the software distribution site (SDS). When a new fabric card is installed, the system software prompts the operator to upgrade the firmware to a specific version if that version is not already running. Information about fabric card firmware is described in NN10600-550 *Nortel Networks Multiservice Switch 7400/15000/20000 Common Configuration Procedures*. The work flow for installing new fabric card firmware is identified in NN10600-272 *Nortel Networks Multiservice Switch 7400/15000/20000 Upgrading Software*.

While a fabric is receiving a fabric firmware upgrade, no temperature reading can be received from that fabric.

Fabric replacement may require a software patch

When a fabric NTHR16 with version EA (NTHR16EA) is to be inserted into a Multiservice Switch 15000 as a replacement for a fabric that does not have the EA or later version, software on the switch should have either the fabric feature or a patch that enables the operation of the EA version. The feature or patches remove nuisance alarms for firmware mismatch between the two fabrics and allow fabric firmware upgrade on the NTHR16EA should it be required in the future.

The software feature is in PCR 6.1 GA or later software loads, and PCRs 5.1.4 or 5.2.3. Any other PCR prior to 6.1 GA requires a software patch. The patch identifier is baseFTxxxxAyyyyyy, where xxxx is the sequence number and yyyyyy is the load name. The procedure to check whether the software has the patch and the procedure to load the patch are in NN10600-272 *Nortel Networks Multiservice Switch 7400/15000/20000 Upgrading Software*, the procedure for applying a patch.

Compared to its predecessors, the NTHR16EA fabric:

- also has 40 Gbit/s user capacity and Class B compliance
- needs CP3 processor cards to operate (NTHW08 or NTHW06)
- has the same external design and method of installation
- has a significantly lower power consumption (almost half)
- has increased backplane signaling from 1.5 V to 1.8 V
- has a larger shared memory buffer
- has a deeper queuing buffer
- has less congestion
- has better multicasting

Refer to the table Features of a 40 Gbit/s Multiservice Switch 15000 fabric card pre-NTHR16EA (page 76).

Power interface modules (PIMs)

The power interface modules (PIMs) pass power from the breaker interface panel (BIP) into the shelf assembly. This section provides the following information about the PIMs:

- Location and physical description of the PIMs (page 87)
- PIM faceplate (page 87)
- PIM cable assembly (page 90)
- Power LED status indicators for PIMs (page 89)
- PIM cable assembly (page 90)

Location and physical description of the PIMs

Four power interface modules (PIMs) are located along the left side of the rear of the shelf assembly. See the figure A shelf assembly of a Multiservice Switch 15000 without fabric cards, rear view (page 69).

Each PIM provides a point to which power cables from the BIP are connected. Each shelf assembly contains four PIMs: two for the A power feeds and two for the B feeds. See Function of the BIP backplane power input connections (page 56) for more information about how input power feeds from the BIP are routed to each shelf. Each PIM provides separate power filtering for the portions of the shelf it supports. The PIMs also provide termination for the shelf clocks and for the secondary control bus.

The PIM is a field-replaceable unit; however, the node must be powered down from the appropriate BIP circuit breakers must be off, and the PIM power cables disconnected, before the module can be removed.

PIM faceplate

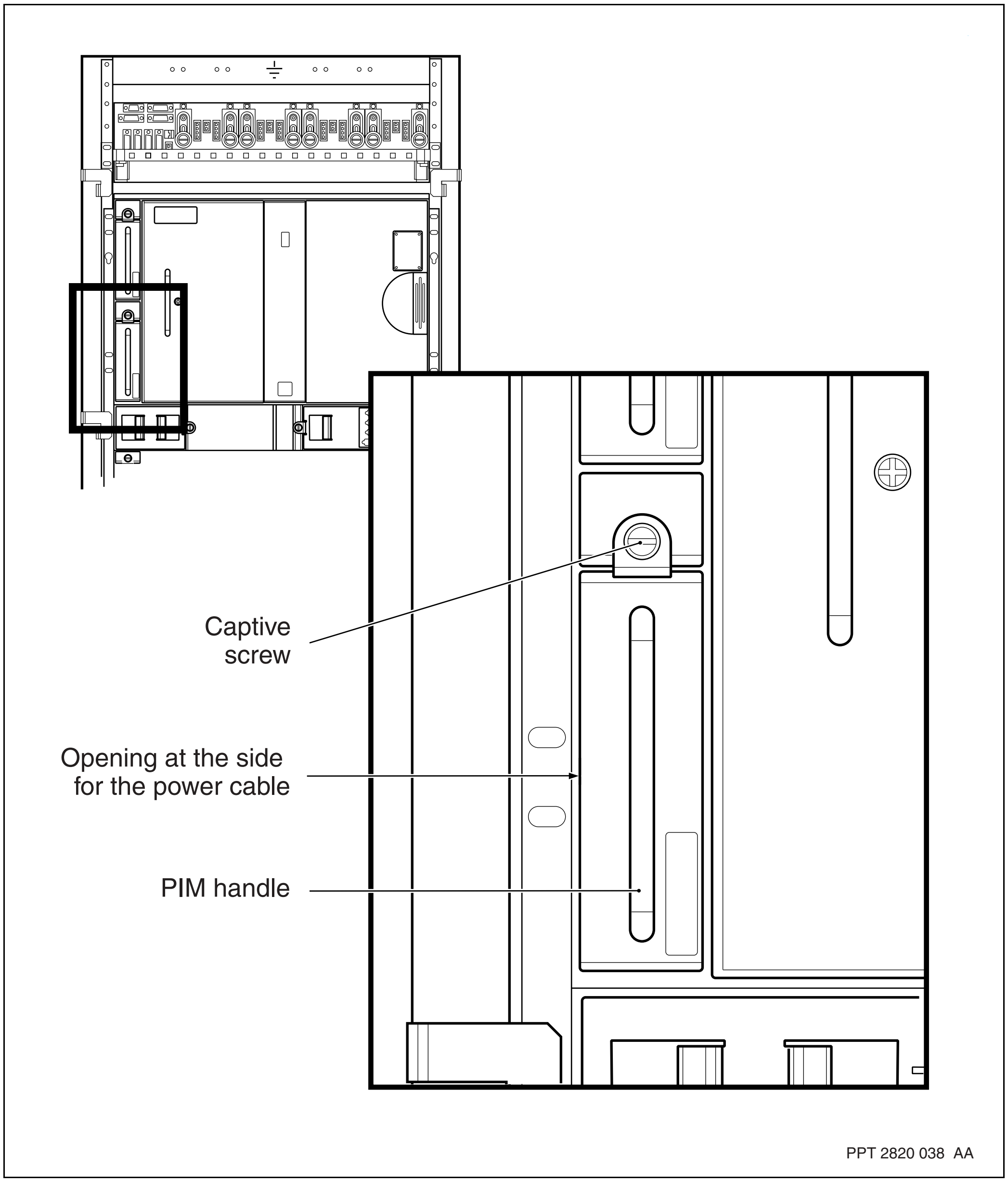
The faceplate is the side of a power interface module (PIM) to which the power cables from the BIP are connected. The faceplate is designed such that you cannot remove the PIM unless the power cable is removed first. This protects the backplane pins from arcing if the PIM is pulled with the power left on. The figure Faceplate of a PIM on a Multiservice Switch 15000 (page 89) shows the opening for the connection point.

The table Pin description for the PIM faceplate power connector (page 88) lists the pin assignments.

Pin description for the PIM faceplate power connector

Pin number	Signal	Function	Description
4	L +1	input	battery return feed 1/3
3	L +2	input	battery return feed 2/4
2	L -1	input	negative battery feed 1/3
1	L -2	input	negative battery feed 2/4

Faceplate of a PIM on a Multiservice Switch 15000



Power LED status indicators for PIMs

Each PIM in a Nortel Networks Multiservice Switch 20000 has LEDs to monitor the status of the A and B power feeds to the BIP. See the figure Location of the PIMs, MAC address, and alarm/BITS module in a Multiservice Switch 20000 (page 91). While a PIM is powered, the green LED is lit solid. See the table Power LED status indicators for each PIM (page 90) for an explanation of the LED displays.

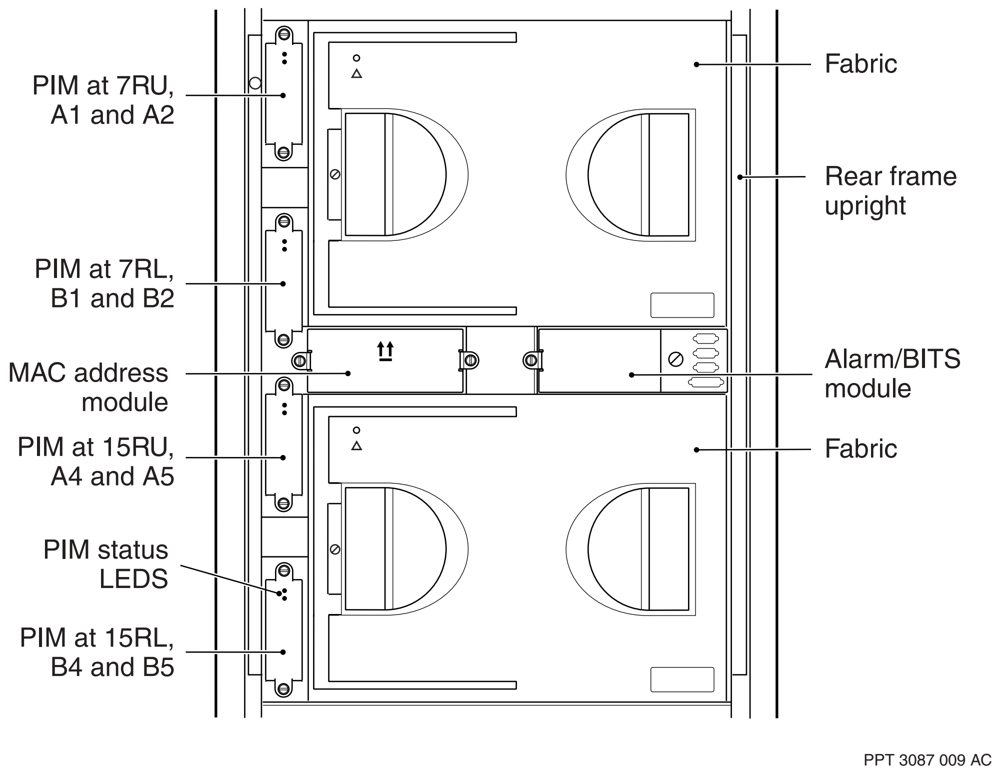
Power LED status indicators for each PIM

LED color	Mode	Meaning
green	solid	power is on for the slots powered by the PIM
off		power is off due to one or more of the following conditions: • the breaker on the BIM that distributes power to it is off • the cable from the BIP to the PIM is disconnected at one or both ends • the power input to the BIP is off or missing for the indicated A or B feed • the BIM is missing or defective • the LED is burned out

PIM cable assembly

A cable assembly distributes power from the breaker interface modules (BIMs) in the breaker interface panel (BIP) to the PIMs. The cable assemblies for the upper and lower nodes in a frame are of different lengths. The cable assemblies are installed when a node is installed in a NEBS 2000 frame. The cable assembly of the second node is typically installed even if the frame is shipped with only one node.

Location of the PIMs, MAC address, and alarm/BITS module in a Multiservice Switch 20000



Media access control (MAC) address module

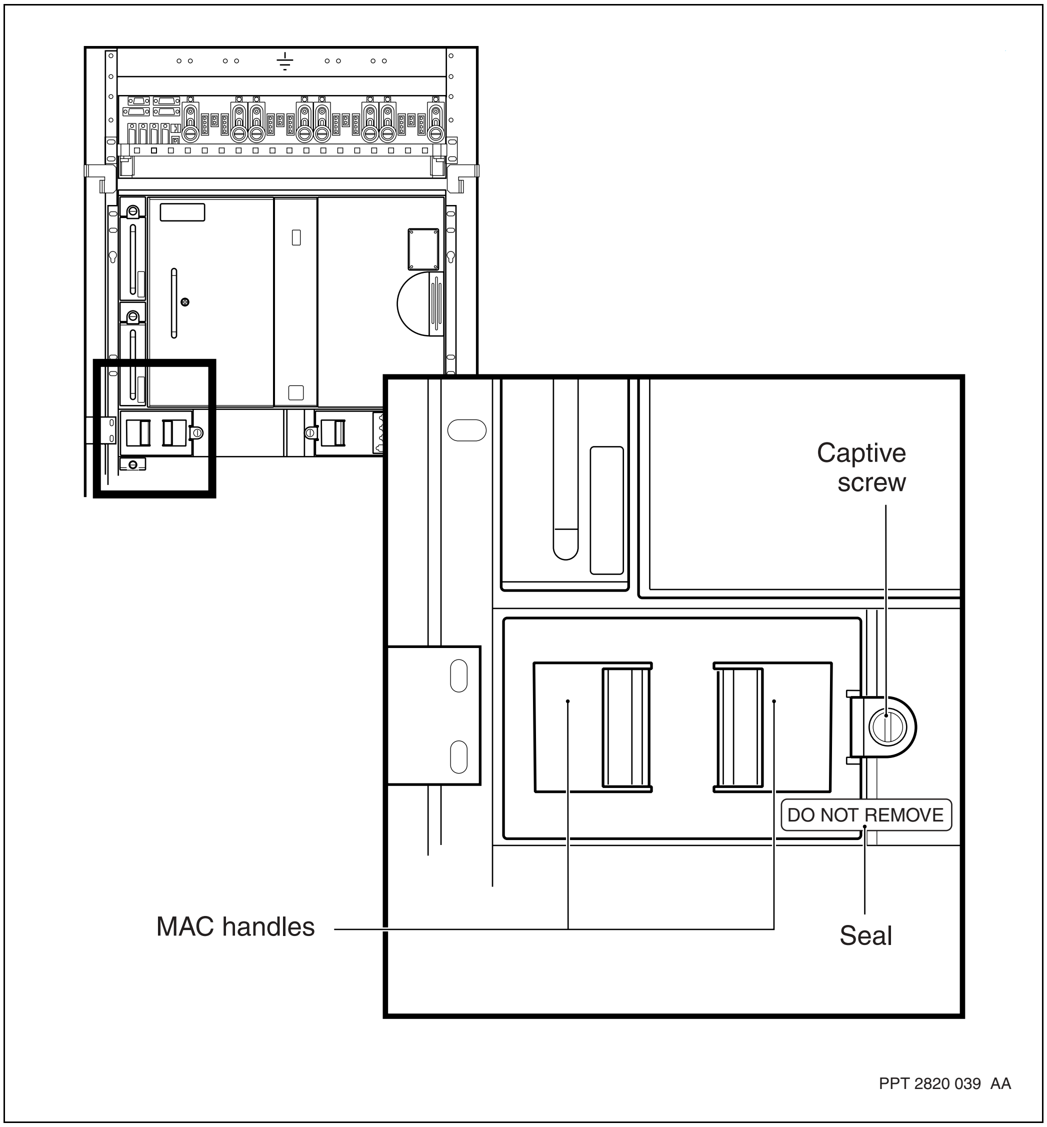
The media access control (MAC) address module contains a circuit board with an 87C51 8-bit micro-controller and a Z-PACK connector used to provide an interface to the shelf backplane. The module contains the base MAC address and the range of MAC addresses available for assignment (based on the base address value). During the node software boot sequence, the active control processor (CP) card takes the range stored in the MAC address module, divides this value by the number of functional processor (FP) cards, and distributes to each FP a base value and a range.

The MAC address module is located on the left side of the rear of the shelf assembly, between the two fabric cards and between the power interface modules (PIMs) of the upper and lower module cage. The location of the MAC address module is shown in the figure A shelf assembly of a Multiservice Switch 15000 without fabric cards, rear view (page 69).

The MAC address module is a field-replaceable unit (FRU) which provides the shelf with MAC addresses for the CP and FP cards. The module also communicates the shelf type to the CP cards.

The faceplate is shown in the figure Faceplate of a MAC address module (page 93) and Location of the PIMs, MAC address, and alarm/BITS module in a Multiservice Switch 20000 (page 91).

Faceplate of a MAC address module



Alarm/BITS module

The alarm/BITS module provides the alarm monitoring and the building integrated timing supply (BITS). There is only one alarm/BITS module per node. When it is removed or fails, there is no:

- BITS timing signal to the control processors (CPs)
- reporting of the fabric LED status to the software
- reporting of any cooling unit alarms to the control processors (CPs)
- reporting of any CP alarms to the breaker interface panel (BIP)

The suspension of timing depends on how the timing was configured in the software. Since the software detects and reports a missing card, which is triggered as soon as the cable to a card is disconnected, your replacement activity must be coordinated with the software operator of the node to ensure minimum impact on service. Have the software operator consider putting the CP timing in holdover mode or line timing for the duration of the replacement.

There are no software or hardware alarms specific to the removal of the alarm/BITS module itself or leaving its slot empty. Other alarms that may occur as a result of the removal of the alarm/BITS module are described in Hardware alarm definitions and behaviors (page 48).

When the module is replaced, reporting of current alarm status resumes.

Unlike most other hardware parts in a Multiservice Switch 15000 or Multiservice Switch 20000, there is no software command associated with locking, removing, inserting, or unlocking the alarm/BITS module, however there are commands for locking the ports on the module.

The alarm/BITS module passes the signals over the shelf backplane to the control processor (CP) cards and expansion slots. (The expansion slots are currently unsupported.)

The alarm/BITS module is a field-replaceable unit (FRU).

This section provides the following information about the alarm/BITS module:

Types of alarm/BITS modules

The types of alarm/BITS module are matched to the CP cards for the type of interfacing signal as follows.

The types of the alarm/BITS module for a Multiservice Switch 15000 include

- NTHR12, for balanced DS1 twisted pair (matched to the DS1 CP NTHR06 or NTHW06)
- NTHW76, also for the DS1 CP types NTHR06 or NTHW06. This module is intended for use with the external sync wire-wrap cable assembly

NTHW75. The module and cable assembly are typically factory-installed. In the case of a retrofit, the parts are also available as external sync wire wrap hardware kit NTHW74. This alarm/BITS module is for use in an environment requiring an 8 kHz BITS timing source signal for customers requiring GR-1244 compliance.

- NTHR13, for balanced E1 twisted pair (matched to the E1 CP NTHR35 or NTHW08)
- NTHR14, for unbalanced E1 coax (matched to the E1 CP NTHR35)

The types of the alarm/BITS module for a Multiservice Switch 20000 include

- NTPN12, for balanced DS1 twisted pair (matched to the DS1 CP NTHW06)
- NTPN78, also for the DS1 CP type NTHW06. This module is intended for use with the external sync cable wire-wrap assembly NTHW75. The module and cable assembly are typically factory-installed, if that is how the node was initially ordered. In the case of a retrofit, the parts are also available separately. This alarm/BITS module is for use in an environment requiring an 8 KHz BITS timing source signal for customers requiring GR-1244 compliance.
- NTPN13, for balanced E1 twisted pair (matched to the E1 CP NTHW08, or matched to the E1 CP NTHR14 when used with the E1 balanced-to-unbalanced cable assembly NTHR81)

Alarm/BITS module faceplate

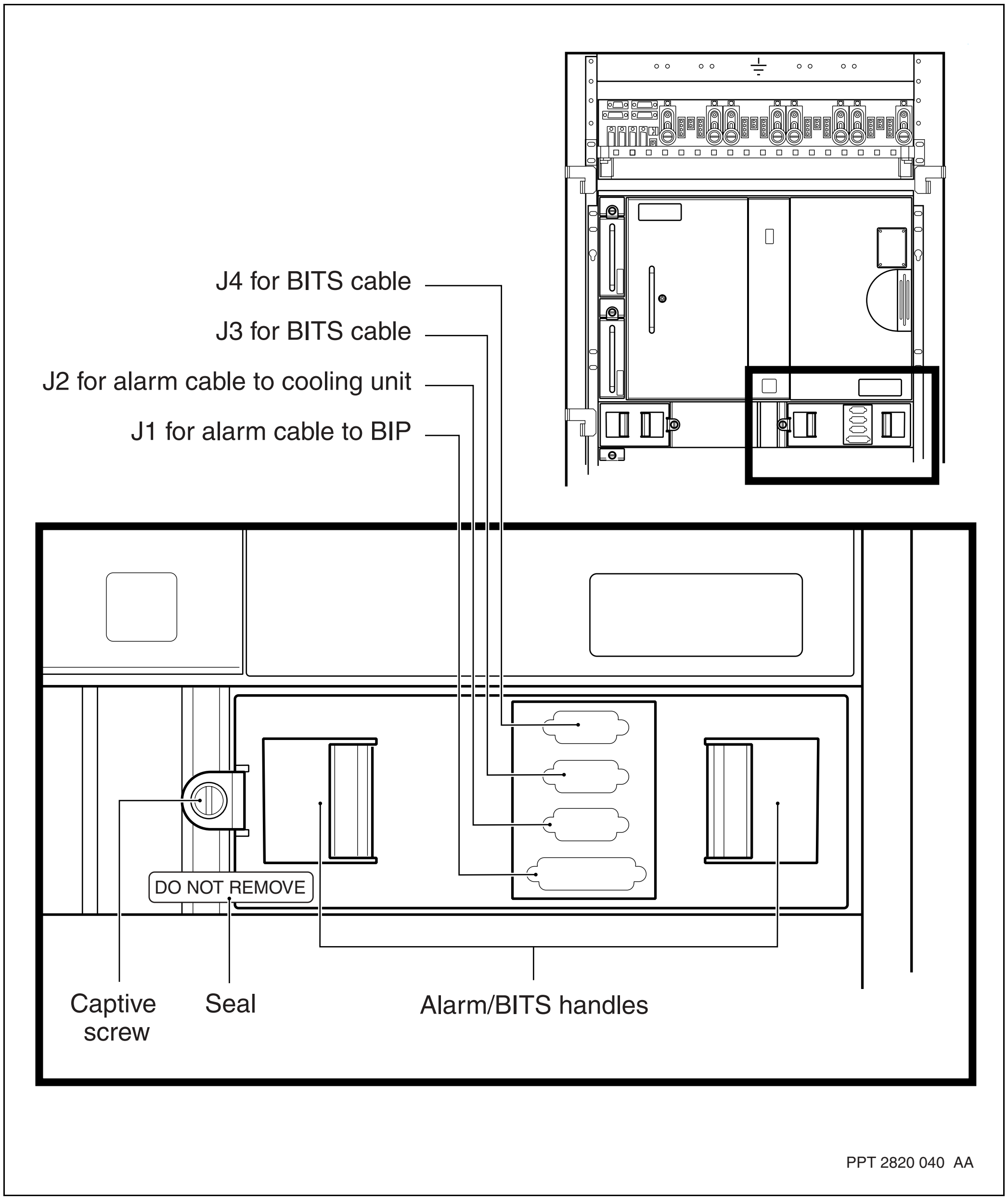
The alarm/BITS module is located at the right side of the rear of the shelf assembly, between the upper and lower fabric modules (see the figure A shelf assembly of a Multiservice Switch 15000 without fabric cards, rear view (page 69)).

The alarm/BITS module contains the following connectors:

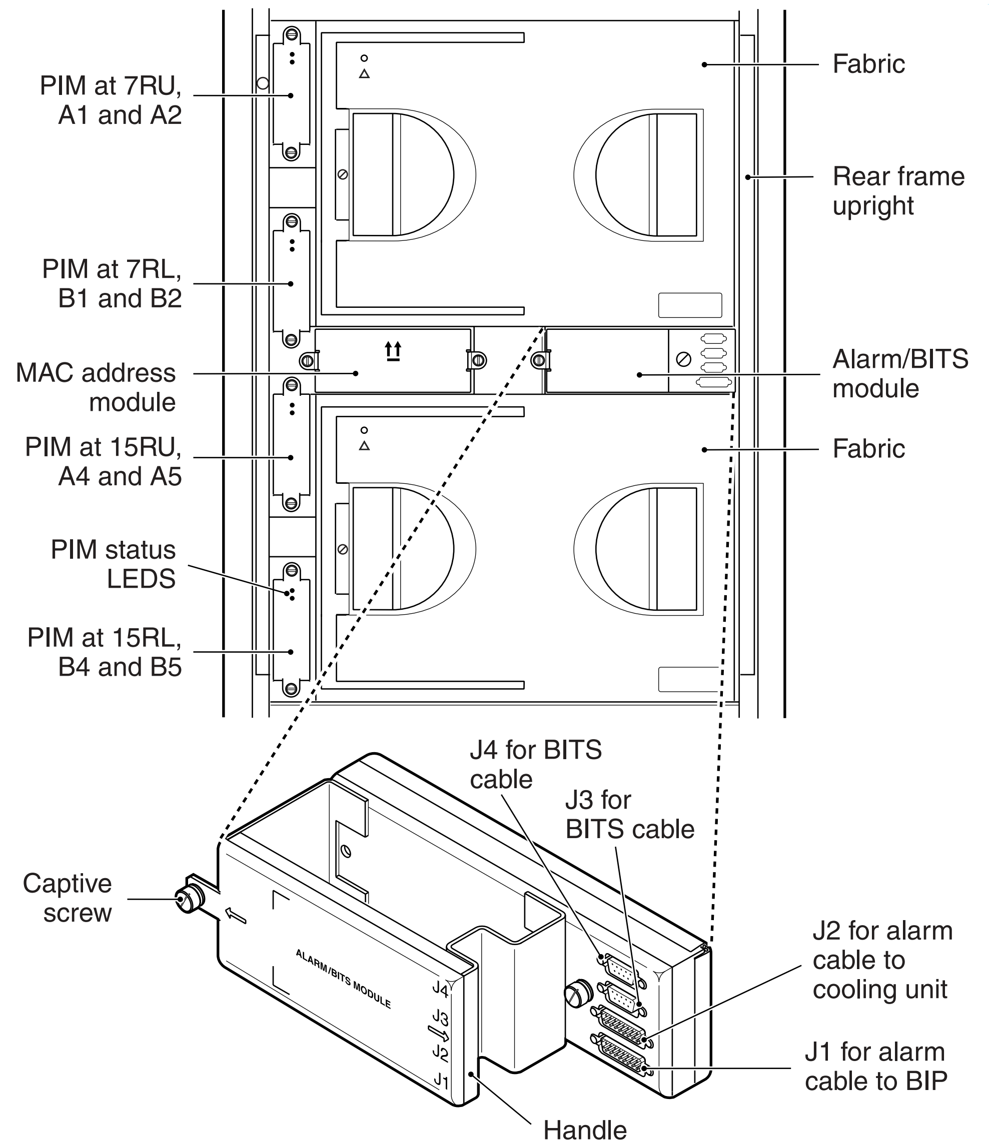
- BITS ports (Sync A-J4 and Sync B-J3) (page 97)
- Cooling unit alarm connector (page 98)
- BIP alarm connector (page 99)

The alarm/BITS faceplate is shown in the figure Faceplate of an alarm/BITS module in a Multiservice Switch 15000 (page 96) and Location of the PIMs, MAC address, and alarm/BITS module in a Multiservice Switch 20000 (page 91).

Faceplate of an alarm/BITS module in a Multiservice Switch 15000



Faceplate of an alarm/BITS module in a Multiservice Switch 20000



BITS ports (Sync A-J4 and Sync B-J3)

The alarm/BITS module provides two ports for connecting the node to a building integrated timing supply (BITS) interface. The ports are labeled Sync A-J4 and Sync B-J3. These ports are paired with the control processors that contain the active BITS circuits. Depending on the variant of the alarm/BITS module used, these ports support connection to

- a DS1 balanced cable (twisted pair D-sub)

- a DS1 wire-wrap cable assembly for operation and direct connection of BITS wires to an externally-mounted terminal block
- an E1 balanced cable (twisted pair D-sub)
- an E1 unbalanced cable (75-ohm coax D-sub)

The BITS ports are shown in the figure Faceplate of an alarm/BITS module in a Multiservice Switch 15000 (page 96).

Pin assignments and the functional specifications for the transmit and receive circuits for the BITS connectors are listed in NN10600-130 *Nortel Networks Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade* under the section for connecting the timing wires.

Cooling unit alarm connector

The cooling unit alarm connector is a 9-pin D connector which receives alarm signals from the shelf's cooling unit and transmits them to the node backplane through the alarm/BITS module.

The cooling unit alarm connector is shown in the figure Faceplate of an alarm/BITS module in a Multiservice Switch 15000 (page 96).

Pin assignments for the fan alarm connectors are shown in the table Fan connector pin-out (page 98).

Fan connector pin-out

Pin	Signal
1	no connection
2	FANTEMP
3	no connection
4	GND (ground)
5	no connection
6	no connection
7	GND (ground)
8	FANFAIL
9	no connection

BIP alarm connector

The BIP alarm connector is the bottom connector in the alarm/BITS module. It performs the following functions:

- BIP alarm termination, which provides proper over-voltage protection for all BIP alarms and provides an interface between the BIP and the CP and CPX slots through the backplane
- shelf ID termination, which provides proper over-voltage protection and a backplane interface for shelf ID and the BIP signals to the CP and CPX slots
- audio/visual alarm termination, which provides a connection between the backplane audio/visual alarm signals and the BIP interface to the CP and CPX slots

The location of the BIP alarm connector is shown in the figure Faceplate of an alarm/BITS module in a Multiservice Switch 15000 (page 96).

The pin assignments for the BIP alarm connector are shown in the table BIP alarm connector pin-out (page 99).

BIP alarm connector pin-out

Pin	Signal
1	MINAUDN
2	MAJAUDN
3	CRITAUDN
4	SHID4
5	GND
6	+5BIP
7	ALMFAILN
8	no connection
9	LEDTESTN for Multiservice Switch 20000 nodes, no connection for Multiservice Switch 15000 nodes
10	MINVISN
11	MAJVISN
12	CRITVISN
13	SHID3
14	no connection
15	no connection
(1 of 2)	

BIP alarm connector pin-out (continued)

Pin	Signal
16	BKRFAILBN
17	EXTPWRN
18	ACON
19	SHID0
20	SHID1
21	SHID2
22	SHID5
23	BKRTRIPAN
24	BKRFAILAN
25	BKRTIPBN
26	no connection

(2 of 2)

Alarm/BITS module cable assemblies

The alarm/BITS module connects to four cable assemblies:

- two for incoming external timing signals
- one for sending cooling unit alarms and receiving LED status changes
- one for sending hardware alarms to the BIP and receiving LED status changes for cards from the CP

The part numbers of the cable assemblies vary according to their length for reaching the module in an upper or a lower shelf assembly and according to the type of alarm/BITS module.

The alarm cable assemblies have part numbers NTHR55 for an upper switch or NTHR56 for a lower switch, or NTHR57 for both. The assembly includes the wires and connectors for connecting to the J1 and J2 outlets on either type of switch.

The prefabricated alarm/BITS timing cables are identified by these PECs:

- NTHR75 unbalanced E1 coax for J3 or J4 of the alarm/BITS module NTHR14
- NTHW76 wire-wrap DS1 for J3 or J4 of the alarm/BITS module NTHW76 for a Multiservice Switch 15000, or NTPN78 for a Multiservice Switch 20000
- NTPN81 unbalanced E1 for J3 or J4 of the alarm/BITS module NTPN13

The optional balun cable assembly NTPN81 for a Multiservice Switch 20000 converts the balanced E1 alarm/BITS module into an unbalanced E1 module.

Using custom or prefabricated timing cable assemblies for the building integrated timing supply (BITS) is described in NN10600-130 *Nortel Networks Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*.

Timing cable specifications for the DS1 circuit

The DS1 BITS interface is a digital clocking (SF (D4) framing is default, ESF (Fe) is also supported) format interface - no signals or analogue modes. It must have the following operational characteristics into the alarm/BITS module.

- The BIT rate/accuracy is 1.544 kbits/sec +/- 50 bits/sec (+/- 32 ppm) or better in self-timed, free-running mode.
- The Pulse Amplitude is between 2.4 to 3.6 V peak at the source for a "mark" isolated pulse, across a 100 Ohm impedance (cable run is dependant on line build out).
- See the ITU-T G.703 Section 5 for other details with respect to pulse mask, power levels for all ones, and other considerations.

The functional specifications for the DS1 receive (RX) circuit for a 100-ohm twisted pair of the A or B timing reference interface are

- two 475-ohm resistors for over-voltage protection
- two surface-mounted fuses for current protection on the network side
- a diode bridge for voltage protection
- 33-pF capacitors used as a high frequency filter for immunity to noise
- two 49.9-ohm resistors for matching impedance
- generally, a 1-to-1 step-up transformer is added to interface to the transceiver

Timing cable specifications for the E1 balanced circuit

The E1 balanced BITS interface is the digital clocking source with the line format called common channel signalling (CCS)- no signals or analogue modes. Zero suppression is HDB3, CRC-4 is enabled. It must have the following operational characteristics into the alarm/BITS module.

- The operating frequency is 2,048 kbit/s with a tolerance of +/- 50 ppm or better.
- The Pulse Amplitude for balanced is at 3.0 V with peak "mark", a value of 0 (zero) +/- 0.3 V "space" into 120 Ohms at the transmitter.
- Balanced is 120-Ohm twisted pair cable.

- At the receiver end at 1024 kHz, the maximum loss due to cables is 0 to 6 db.
- See the ITU-T G.703 Section 9 for other details with respect to pulse mask, one's ratio, and other considerations.

The functional specifications for the E1 balanced receive (RX) circuit for a 120-ohm twisted pair of the A or B timing reference interface are

- two 475-ohm resistors for over-voltage protection on the ZPACK connector
- two surface-mounted fuses for current protection on the network side
- a diode bridge for voltage protection
- 33-pF capacitors used as a high frequency filter for immunity to noise
- two 68.1-ohm resistors for matching impedance
- generally, a 1-to-1 step-up transformer is added to interface to the transceiver

Timing cable specifications for the E1 unbalanced circuit

The E1 unbalanced BITS interface is the digital clocking source with the line format called common channel signalling (CCS)- no signals or analogue modes. Zero suppression is HDB3, CRC-4 is enabled. It must have the following operational characteristics into the alarm/BITS module.

- The operating frequency is 2,048 kbit/s with a tolerance of +/- 50 ppm or better.
- The Pulse Amplitude for unbalanced is at 2.37 V with peak "mark", a value of 0 (zero) +/- 0.273 V "space" into 75 Ohms at the transmitter.
- Unbalanced is 75-Ohm coax cable.
- At the receiver end at 1024 kHz, the maximum loss due to cables is 0 to 6 db.
- See the ITU-T G.703 Section 9 for other details with respect to pulse mask, one's ratio, and other considerations.

The functional specifications for the E1 unbalanced coax receive (RX) circuit for a 75-ohm coax of the A or B timing reference interface are

- two 475-ohm resistors for over-voltage protection on the ZPACK connector
- two surface-mounted fuses for current protection on the network side
- a diode bridge for voltage protection
- 470-pF capacitors used as a high frequency filter for immunity to noise
- two 37.4-ohm resistors for matching impedance
- generally, a 1-to-1 step-up transformer is added to interface to the transceiver

Line build out application settings

Cable length depends on the transmitter line build out and the gauge of the cable. See the table Typical line build out application settings (page 103).

Typical line build out application settings

0	0 to 41 m (133 ft)	0 db DSX-1/CSU
1	41 m (133 ft) to 81 m (266 ft)	DSX-1
2	81 m (266 ft) to 122 m (399 ft)	DSX-1
3	122 m (399 ft) to 163 m (533 ft)	DSX-1
4	163 m (533 ft) to 200 m (655 ft)	DSX-1
5		-7.5 db CSU
6		-15 db CSU

Cooling units

Each Nortel Networks Multiservice Switch has a cooling unit to maintain an ambient operating temperature inside its shelf assembly. Maintaining the temperature at optimum levels maintains the operation and performance of the hardware. Keeping the internal temperature within its normal operating range will improve the system's service life.

When two of either type of Multiservice Switch are mounted in a NEBS 2000 frame, their cooling units are nested against each other. This integration maximizes the use of hardware real estate. The cooling unit that operates with the node in the bottom half of a NEBS 2000 frame is the lower cooling unit, also known as the rear cooling unit because its fans face the rear of the hardware and it is accessed from there. The unit that operates with the node in the upper half is the upper cooling unit, also known as the front cooling unit because its fans face the front of the hardware (where the processor cards are) and it is accessed from there.

The versions of the lower cooling unit are NTHR51AA and AB while the versions of the upper cooling unit are NTHR52AA and AB. Each cooling unit has a modular design that enables field replacement of the whole unit or any of its parts.

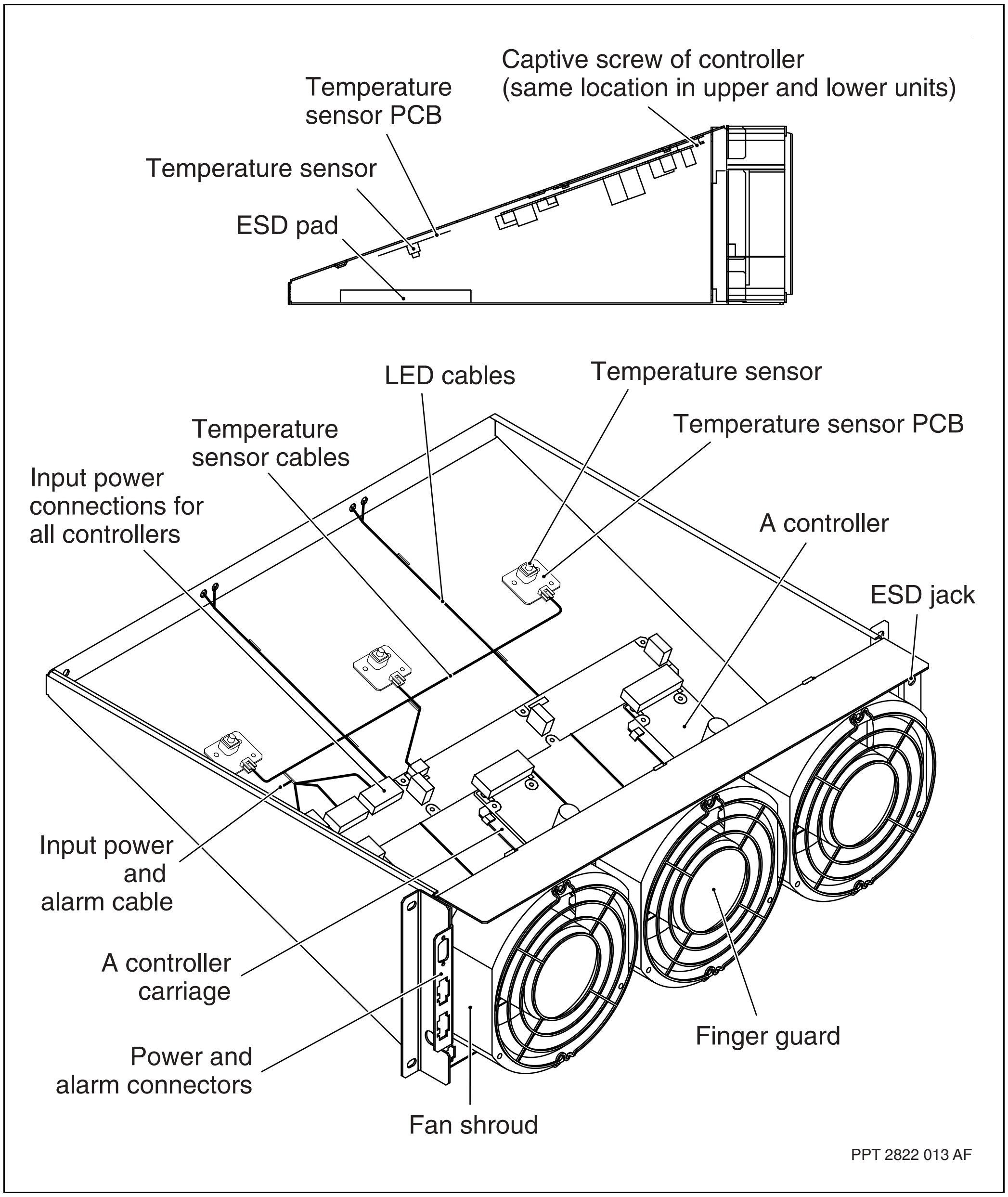
The physical versions of fans, fan controllers, and temperature sensors are different depending which version of cooling unit you have. A replacement part must match the part number that is identified in the tables Cooling unit parts for the AA versions (page 316) and Cooling unit parts for the AB versions (page 317).

The different versions of parts provide the same performance except the shroud of the middle Dyna fan is shaped to reduce the overall noise level of the lower or upper cooling unit NTHR51AB and NTHR52AB.

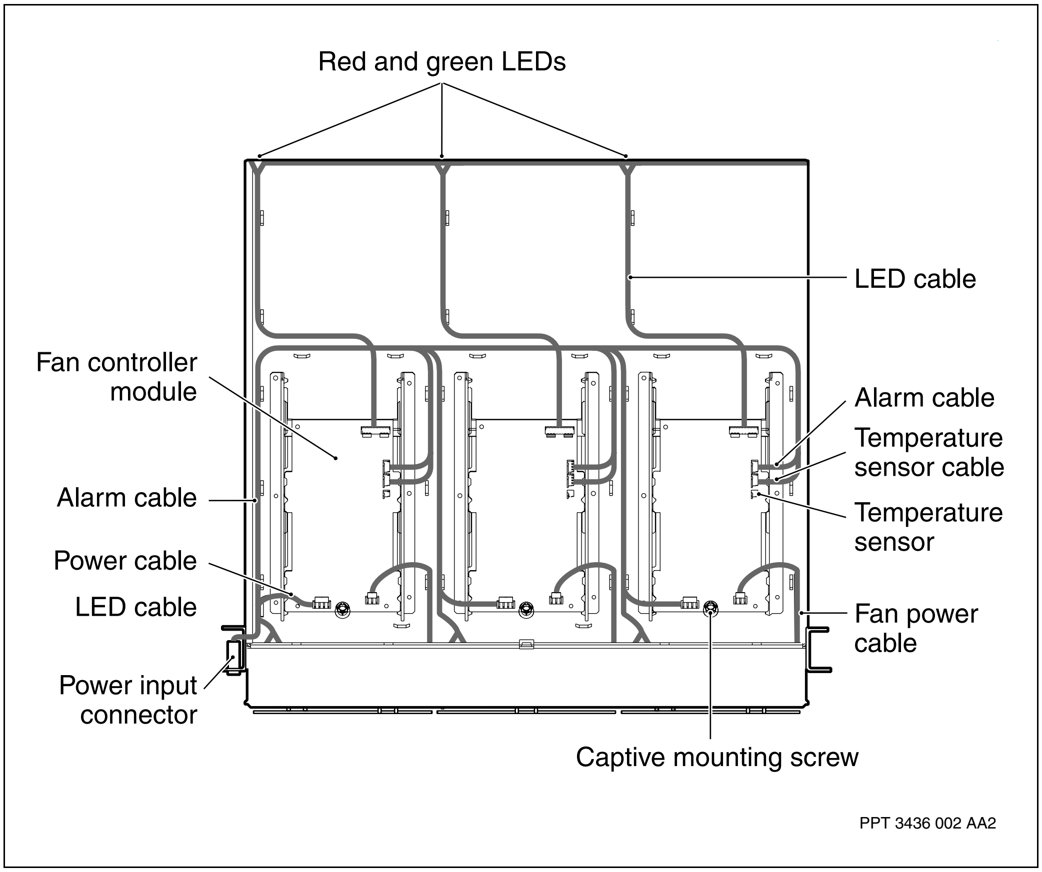
For the names and locations of the parts, see these figures:

- Parts inside a lower cooling unit NTHR51AA (bottom shown upside down) (page 105)
- Parts inside a lower cooling unit NTHR51AB (bottom shown upside down) (page 106)

Parts inside a lower cooling unit NTHR51AA (bottom shown upside down)



Parts inside a lower cooling unit NTHR51AB (bottom shown upside down)



The parts of the upper and lower cooling units are described in these sections:

- Environmental control equipment (page 106)
- The impact of heat dissipation on rising shelf temperatures (page 109)
- Fans (page 111)
- Fan controllers (page 111)
- Air filters (page 111)
- Temperature sensors (page 112)
- Cooling unit LED indications (page 112)
- Cooling unit connections (page 112)

Environmental control equipment

Nortel Networks Multiservice Switch environmental control equipment consists of two cooling units located in the middle of the frame between the upper and lower shelf assemblies. The upper cooling unit pushes air from the fan under the modules in the upper shelf assembly and out through the exhaust plenum under the BIP. The lower cooling unit pulls air in from the bottom of the NEBS 2000 frame, over the modules in the lower node shelf assembly and out through the fan assembly. This arrangement in a NEBS 2000 frame is shown in the figure Upper and lower cooling unit in a frame with air flow direction (page 108).

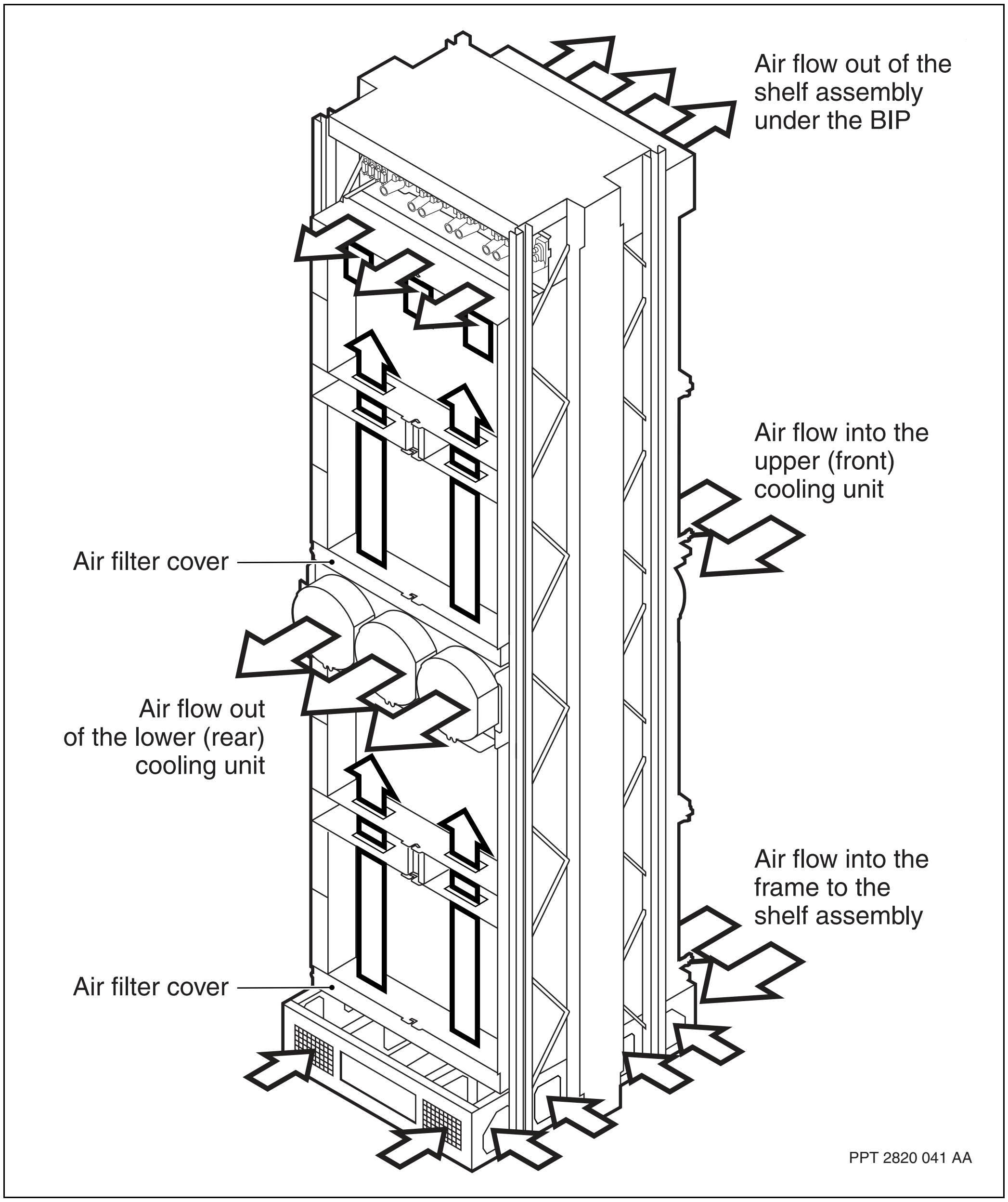
When either type of Multiservice Switch is in a mounting apparatus other than a NEBS 2000 frame (is shelf-based), its cooling unit is an upper cooling unit that is mounted upside down in a lower shelf position and therefore draws air into the node from the front and exhausts it under the BIP.

Each cooling unit consists of three fans and a cooling unit housing located in a common shelf. Each cooling unit is controlled by temperature sensors located near the warm air exhaust. Air temperature is measured as the air exits the shelf enclosure.

Under normal operation and with 3000 Watts dissipated power, the cooling unit will provide, in the case of air conditioner failure, sufficient air flow (1 to 1.2 m/s) to maintain overall air temperature rise across the shelf of less than 15 degrees Celsius (59 Fahrenheit).

When the exhaust air temperatures rises above 55 degrees Celsius (131 Fahrenheit), the fans' speed changes to high (full) speed to increase air flow, thereby cooling of the shelf. The fans return to normal speed when the temperature falls below 46 degrees Celsius (115 Fahrenheit). Each Multiservice Switch should always be operated with the cooling units on to avoid damage to the CP, FPs, and fabric cards, even when dusty air filters are removed.

Upper and lower cooling unit in a frame with air flow direction



The impact of heat dissipation on rising shelf temperatures

As soon as the cooling unit is removed from service (for example, to replace a failed fan or controller) for an in-service node, the air temperature inside the shelf assembly rises very rapidly and the temperature sensor readings by the cooling unit are suspended. As soon as a fan is removed from service (by unplugging or a failure), the remaining two fans speed up to compensate. The higher rpm is to be temporary, not to be sustained beyond two days. When two of the three fans are out of service, the temperature in the node rises rapidly.

The fabric card pair continues to measure the internal temperature of the node. Fabric pairs typically operate at different temperatures because of their position in the shelf assembly and the direction of cooling airflow. For a frame-mounted shelf assembly, the X (upper) fabric usually runs slightly warmer than the Y (lower) fabric. For a shelf assembly in a 23-inch wide EIA rack, the Y (lower) fabric tends to be warmer. Alarms for fabric temperature thresholds are generated per fabric.

The air temperature inside the shelf depends on the ambient room temperature and the heat dissipation of the processor cards. As the ambient room temperature or the heat dissipation increases, the air temperature inside the node increases. The rate of rising temperature with or without fans is different per switch. When the rise continues high enough, one or more FPs will degrade and can eventually fail. The rate of degradation depends on how many in-service cards are in the shelf, the types of cards, what services are configured on the cards, and how much traffic each card is handling.

Since both types of Multiservice Switch have a power rating of up to 150 watts per card slot, the air temperature rise within the shelf assembly may be as high as 10 degrees Celsius (50 degrees Fahrenheit) per cage (row of cards) with the cooling unit in service. When there is no power to the cooling unit, the temperature rise will be as high as 40 degrees Celsius (104 degrees Fahrenheit) per card cage. Since normal operating conditions are below 40 degrees Celsius (104 degrees Fahrenheit), the elevated temperature will result in service degradation. To determine how much your node configuration will affect service when the cooling unit is not powered (for example, when replacing the entire unit in order to replace a component), do the following.

Determine if the total heat dissipation of the node configuration will affect service when removing an entire cooling unit.

1 Calculate the total power consumption of the selection of cards in the shelf assembly. (This should already have been done to determine the size of power cable to your node. Otherwise refer to the power distribution and consumption tables in NN10600-125 *Nortel Networks Multiservice Switch 15000/20000 Planning Site Requirements*.)

2 Add up the power consumption of each card in the bottom cage and the one in the cage directly above it.

3 Compare the power consumption totals to the table Maximum shelf heat dissipation relative to ambient room temperature (page 110).

Maximum shelf heat dissipation relative to ambient room temperature

Ambient room temperature	Total power dissipation of all CPs and FPs	Combined power dissipation of card in bottom cage and the one above it
25 Celsius (77 Fahrenheit)	1350 watts	170 watts
30 Celsius (86 Fahrenheit)	1200 watts	150 watts
35 Celsius (95 Fahrenheit)	1040 watts	130 watts
40 Celsius (104 Fahrenheit)	900 watts	110 watts

In general, if the comparison of power consumptions exceeds either the value of total or combined power dissipation, when the cooling unit is not powered service will be affected. For optimum equipment performance and longevity, the node should be operated with three fans running at normal rpm with an ambient room temperature between 15 and 23 degrees Celsius (59 to 73.4 Fahrenheit) or less. Replacing hardware parts should be expedited to minimize the impact on rising heat dissipation inside the shelf.

The significant equipment temperature thresholds are as follows.

- At an increase of 3 degrees Celsius (37 Fahrenheit) for a fabric’s temperature reading since a fan failure alarm 7012 00510 was clocked, alarm 7002 0004 is generated to indicate the temperature rise.
- At 40 degrees Celsius (104 Fahrenheit) or higher inside the shelf, FPs can start to degrade their performance.
- At 55 degrees Celsius (131 Fahrenheit) for a fabric, high temperature alarm 7002 0003 is generated.
- At 55 to 70 degrees Celsius (131 to 161.6 Fahrenheit) inside a cooling unit, its three fans increase speed to the higher rpm.
- At 70 degrees Celsius (158 Fahrenheit) inside a cooling unit, shelf temperature alarm 7012 0059 is generated.
- At 72 degrees Celsius (161.6 Fahrenheit) inside a fabric card, the card automatically shuts down to protect itself. When both fabric cards reach

the threshold, the shelf reboots until the temperature sensors inside either fabric card drops below the 68 degrees Celsius (154.4 Fahrenheit).

For more information on the effects of temperature, refer to

- Hardware alarm definitions and behaviors (page 48)
- the environmental data and power dissipation in NN10600-125 *Nortel Networks Multiservice Switch 15000/20000 Planning Site Requirements*

Fans

The fans in the cooling units push or pull air across the surfaces of the processor cards and modules to keep them as cool as ambient room temperature allows. When a fan is mounted in a lower (rear) cooling unit, it pushes air. When the same fan is mounted in an upper (front) cooling unit, it pulls air.

Fan controllers

A fan controller controls the power supply to a fan, monitors the operation of the fan and its speed, and monitors the status of the remote temperature sensors. In the case of a failure, the controller sends an alarm signal to the alarm/BITS module and sends a status signal to the other fans, forcing them to change to the higher rpm speed.

Air filters

Each shelf assembly of a Multiservice Switch 15000 or Multiservice Switch 20000 has an air filter to prevent dust and other airborne contaminants from being drawn past the processor cards and modules by the cooling units. The filters also assist air flow by acting as air flow diffusers. The air filter for either an upper or a lower cooling unit is located at the bottom of each shelf assembly.

The figure Upper and lower cooling unit in a frame with air flow direction (page 108) shows the location of the air filter. The air filter is the same part number for all versions of cooling units.

The air filters must be installed in the frame assembly to ensure proper air flow across the shelf assembly. A Multiservice Switch should never be operated without air filters, except briefly during filter replacement. The fans should remain powered while the filter is being replaced.

The air filters must also be changed periodically so that the accumulation of dust is prevented from degrading performance or failing plug-in cards, fabric cards, or modules. For information about the frequency of replacing air filters and how to replace them, see the chapter of safety considerations and best practices, the section on equipment maintenance in NN10600-130 *Nortel Networks Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*.

Temperature sensors

A set of three temperature sensors monitor the exhaust air flow from each of the cooling units, as shown in the figure Upper and lower cooling unit in a frame with air flow direction (page 108). The sensors for the lower cooling unit are inside the unit itself, while the sensors for an upper cooling unit are on a sensor bracket assembly that is mounted in the air flow space above the shelf assembly. Each temperature sensor is mounted on a PCB. The temperature sensors are not linked directly to a specific fan and can monitor the air flow generated by multiple fans simultaneously.

The temperature sensors are linked to a temperature interface block, which provides bias to the sensors, monitors faults in the sensor circuit, and processes temperature information. If a temperature greater than 72 degrees Celsius (162 Fahrenheit) is detected, a HighTemp alarm is sent to the alarm/BITS module where the alarm is indicated. When a temperature less than 55 degrees Celsius (131 Fahrenheit) is detected, the fans operate at normal speeds. If a temperature between 55 and 72 degrees Celsius is detected, the fan speed changes to high-speed operation.

A built-in hysteresis prevents the fans from continuously toggling between lower and higher speeds at the temperature threshold.

Cooling unit LED indications

The each cooling unit is equipped with LEDs to indicate the unit's status. The table Cooling unit LED indications (page 112) lists the possible LED displays.

Cooling unit LED indications

LED display	Description
Green on	The unit is on and no fault is detected.
Red on	A fan fault has occurred: missing at least one fan or at least one temperature sensor has failed. A FANFAIL signal is sent to the alarm/BITS module, and the remaining fans' speed changes to high.
None on	The middle circuit breakers (for the cooling units) on both BIMs are turned off or there is no power to both BIMs for that shelf.

Cooling unit connections

For a description of the cooling unit power connectors, see Function of the BIP backplane power output connections (page 60).

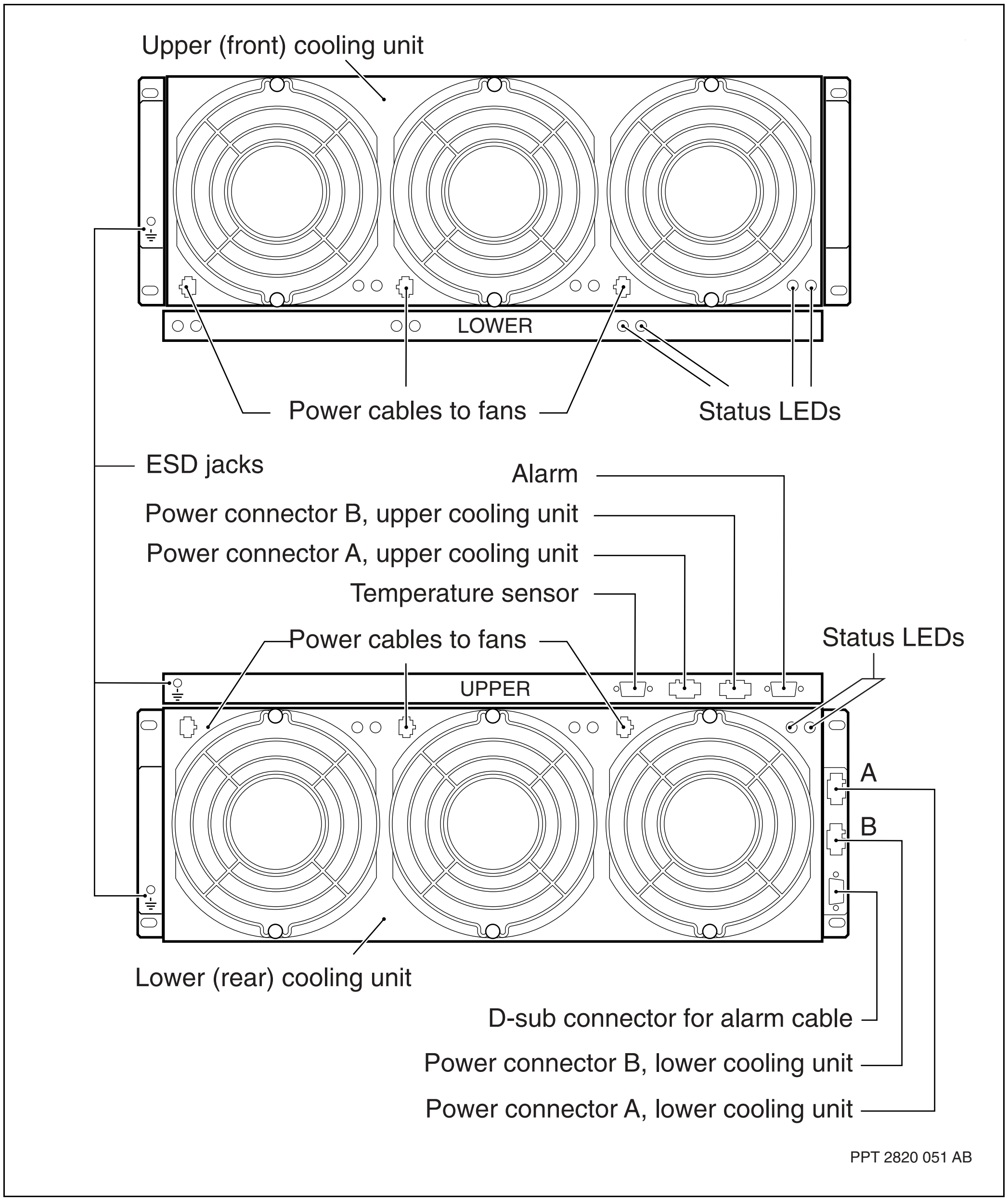
For the location of the internal connectors, see the figures:

- Parts inside a lower cooling unit NTHR51AA (bottom shown upside down) (page 105)

- Parts inside a lower cooling unit NTHR51AB (bottom shown upside down) (page 106)

For the location of the external connectors, see the figure External cooling unit cable connections (page 113).

External cooling unit cable connections



Control and function processors

This section describes the plug-in processor cards which support network management, node management, user services, and network clocking synchronization.

This section also briefly describes how processor cards support being upgraded or downgraded.

The location of the control and function processors (CPs and FPs) is shown in the figure A typical shelf assembly, front view (page 68).

For the list of capabilities of each FP, refer to the FP type in NN10600-551 *Nortel Networks Multiservice Switch 7400/15000/20000 FP Configuration Reference*.

Navigation

Connecting a Multiservice Switch node to another node

In order for Nortel Networks Multiservice Switch 15000 or Multiservice Switch 20000 nodes to interwork directly with another node, a connection must be established between a function processor (FP) on the node and an equivalent processor card on the other node.

Connecting two Multiservice Switch nodes

In order for a Nortel Networks Multiservice Switch node to interwork directly with another Multiservice Switch node, establish the connection between two FPs, one at either end, through a fanout panel.

If the other node is a Multiservice Switch 7480, the connection is described in Connecting nodes through Multiservice Switch 15000 VSS (page 116).

Cabling an FP, sparing panel, or fanout panel is described in NN10600-175 *Nortel Networks Multiservice Switch 7400 Hardware Installation, Maintenance, and Upgrade*.

A fanout panel must have BNC-to-BNC connectors so that the BNC ends of the FP cables connect at the fanout panel. For example, you can use the cable assemblies with PECs NTHR58, NTHR59, or NTHR60. The pinout mapping of BNC cables to a mini-coax on these cable assemblies are indicated for the cabling procedures in NN10600-175 *Nortel Networks Multiservice Switch 7400 Hardware Installation, Maintenance, and Upgrade*.

After the cable is connected and the FPs have been power tested and loaded with software, have the software operator configure the port or ports at each FP to be the same type of ATM trunk or ATM bearer services trunk. Choose the type of trunk that provides appropriate interworking capabilities. To configure trunks for inter-nodal communication, refer to NN10600-420 *Nortel Networks Multiservice Switch 7400/15000/20000 Operations: Trunking*.

Connecting nodes through Multiservice Switch 15000 VSS

The fiber link between a Multiservice Switch 15000 node and the Multiservice Switch 7480 node within a Nortel Networks Multiservice Switch 15000 Variable Speed Switch (VSS) can be made using an external OC-3 connection between OC-3 single-mode or multi-mode function processors (FPs). The fiber cable requires SC connectors at each end. You must provide the customized fiber cable and connectors.

If the OC-3 card pair has different reaches (SR, IR, or LR), see NN10600-175 *Nortel Networks Multiservice Switch 7400 Hardware Installation, Maintenance, and Upgrade* for how to determine when to use inline attenuators. You must provide your own attenuators.

The routing of the fiber link cable should go through, or beside, the fan cover grill. This route is preferred because it isolates the fiber link froth the other fiber cables. There is no problem with running the fiber link behind the Multiservice Switch 7480 if another route must be used.

The software configuring of Multiservice Switch 7400 series nodes and Multiservice Switch 15000 nodes is not the same. Any tools you use to configure the network must be able to adapt both sets of configuration commands.

Connecting Multiservice Switch 15000 or Multiservice Switch 20000 node to a SER 5500

The fiber link between a Nortel Networks Multiservice Switch 15000 or Multiservice Switch 20000 node to a SER 5500 can be made using an external OC-3 connection between a Multiservice Switch 15000 OC-3 function processor (FP) and a SER 5500 OC-3 line card. The fiber cable requires SC connectors at each end. You must provide the customized fiber cable and connectors.

Connecting a Multiservice Switch 15000 or Multiservice Switch 20000 node to an EdgeLink 100

Before installing the interface cables and connecting them, the EdgeLink 100 multiplexor must be mounted, and the Nortel Networks Multiservice Switch node DS3 function processor (FP) with BNC connectors must already be installed. The part number of the mux is NTPV02. For the installation of an EdgeLink 100, refer to Telco Systems' documentation, starting with the document *EdgeLink 100 Digital Multiplexer General Description,* section 825-102-001.

The EdgeLink interfaces to a DS3 function processor (FP) with BNC connectors mounted in a Nortel Networks Multiservice Switch 15000 or Multiservice Switch 20000 node, and to an RJ48 termination access panel. The RJ48 connections are either:

- 64-pin Cinch or wirewrap to an RJ48 T1 access panel with monitor jacks (part number A0718812)
- 64-pin Cinch or wirewrap to an RJ48 T1 access panel (part number A0718813)

The interface cables that connect an EdgeLink 100 to the Multiservice Switch node or Ethernet hub of a Multiservice Data Manager workstation are listed in the table Interface cables between Multiservice Switch 15000 or Multiservice Switch 20000 nodes and an EdgeLink 100 (page 117). Two cables are required, one for transmitting and one for receiving.

Interface cables between Multiservice Switch 15000 or Multiservice Switch 20000 nodes and an EdgeLink 100

Type and quantity	Part number	Length	Type of connector at EdgeLink	Type of connector at other end
DS1, two	A0718801, Telco Systems' AWX432G5	1.5 m (5 ft)	90-degree male 64-pin to 64-pin Amphenol/Cinch	RJ-48 termination or wirewrap
DS1, two	A0718802, Telco Systems' AWX432G15	4.6 m (15 ft)	90-degree male 64-pin to 64-pin Amphenol/Cinch	RJ-48 termination or wirewrap
DS1, two	A0718803, Telco Systems' AWX432G30	9.1 m (30 ft)	90-degree male 64-pin to 64-pin Amphenol/Cinch	RJ-48 termination or wirewrap
DS1, set of two	A0718779, Telco Systems' AXX432G5	1.5 m (5 ft)	90-degree male 64-pin Amphenol/Cinch to wirewrap	wirewrap at RJ-48 termination
DS1, set of two	A0718780, Telco Systems' AXX432G25	7.6 m (25 ft)	90-degree male 64-pin Amphenol/Cinch to wirewrap	wirewrap at RJ-48 termination
(1 of 2)				

Interface cables between Multiservice Switch 15000 or Multiservice Switch 20000 nodes and an EdgeLink 100 (continued)

Type and quantity	Part number	Length	Type of connector at EdgeLink	Type of connector at other end
DS1, set of two	A0718781, Telco Systems' AXX432G50	15.2 m (50 ft)	90-degree male 64-pin Amphenol/Cinch to wirewrap	wirewrap at RJ-48 termination
DS3, two	rated as 728A RG-6U or equivalent	custom	90-degree male-to-female BNC adapter for standard BNC male connector	male BNC on a DS3 FP
DS3, two	NTFP19AC	1 m (3.2 ft)	male BNC	male BNC on a DS3 FP
DS3, two	NTFP19AA	3 m (9.8 ft)	male BNC	male BNC on a DS3 FP
DS3, two	NTFP19AB	15 m (48.2 ft)	male BNC	male BNC on a DS3 FP
Ethernet	Telco Systems' AWX454G10 for standard LAN trunk cable IEEE 802.3	3 m (10 ft)	male RJ-45, eight-position modular	a male RJ-45 connector for a female connector on the hub that is linked to Multiservice Data Manager
(2 of 2)				

Blank processor card

A blank processor card is a dummy card that is used to fill an empty slot in the shelf assembly. The blank card protects the circuitry within the card cage and ensures proper air flow through the shelf assembly. If a card slot is going to be left empty for longer than a few minutes, a blank processor card must be installed to maintain the operating integrity of the node.

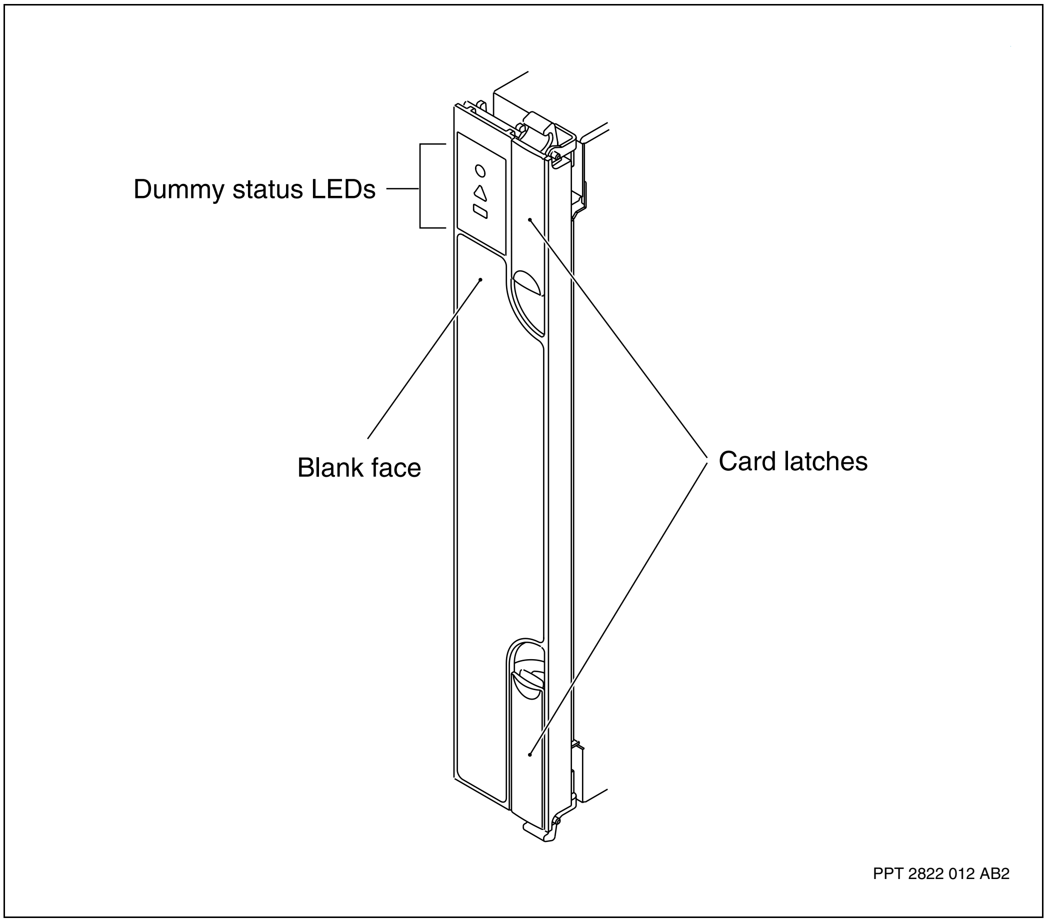
Having an empty slot while the node is powered up, especially when it is operating at full service, reduces the air flow through both cages of the shelf assembly and reduces the containment of EMI. Reducing the airflow means the ambient internal temperature rises towards the temperature shut-down thresholds of the fabric cards.

A shelf assembly is typically shipped with blank cards for installing in empty slots. For Nortel Networks Multiservice Switch 15000 or a shelf-based Multiservice Switch 20000 node, blank cards are shipped in a container. For a Multiservice Switch 20000 in a NEBS 2000 frame, blank cards are shipped in the slots in the transportation position, in the same way as the other processor cards. Blank cards have PEC NTHR64.

Attention: A blank card can be used in a CP slot, but it is not recommended to run a node without the second (backup) CP.

Blank processor cards were formerly referred to as filler cards, but the faceplate has always been labeled with BLANK. See the figure Faceplate of a blank processor card with PEC NTHR64 (page 120).

Faceplate of a blank processor card with PEC NTHR64



Control processors

A control processor (CP) card

- is either a CP2 or a more powerful CP3 which includes a Power PC processor, PQC ASICs for datapath frame forwarding, and larger disk storage. Both CPs perform the same functions, while a CP3 offers increased processing power and connection space.
- sequences FP startup
- downloads new software onto FPs
- performs memory-intensive tasks for services delivered by FPs
- manages and monitors the status of the FPs, the fabric cards, and other node hardware
- provides system timing for all other processor cards connected to the backplane
- monitors and processes alarms and the performance of real-time clocking to support building integrated timing supply (BITS) through
  - — an E1 BITS CP2 (NTHR35) or CP3 (NTHW08)
  - — a DS1 BITS CP2 (NTHR06) or CP3 (NTHW06)
- interfaces with Multiservice Data Manager workstation, or a text interface device, which is used for network operator access, network monitoring, provisioning, and maintenance

Attention: Text interface devices connect directly to a port on the faceplate of a CP. These devices are not connected during normal operation, and are only used for installation and debugging purposes.

- connects to Multiservice Data Manager workstations through a 10Base-T Ethernet port for CP2 or a 100Base-T port for CP3
- is half of a redundant pair in Nortel Networks Multiservice Switch 15000 and Multiservice Switch 20000 nodes. In the event that the active CP fails, the standby CP takes over

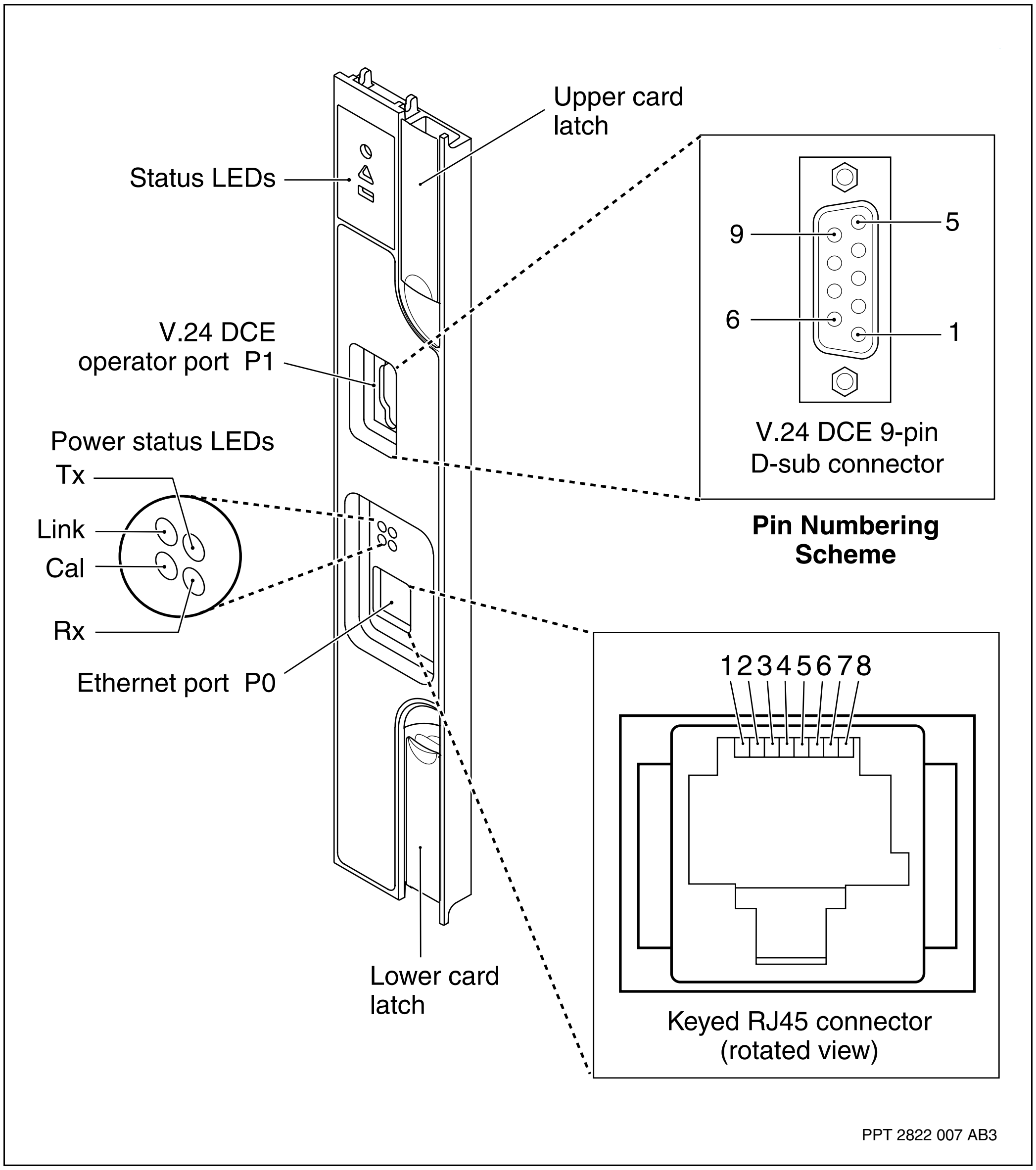
For CP2 connectors, see Faceplate of a CP2 with PEC NTHR06 or NTHR35 (page 122).

For CP3 connectors, see the figure Faceplate of a CP3 with PEC NTHW06 or NTHW08 (page 123).

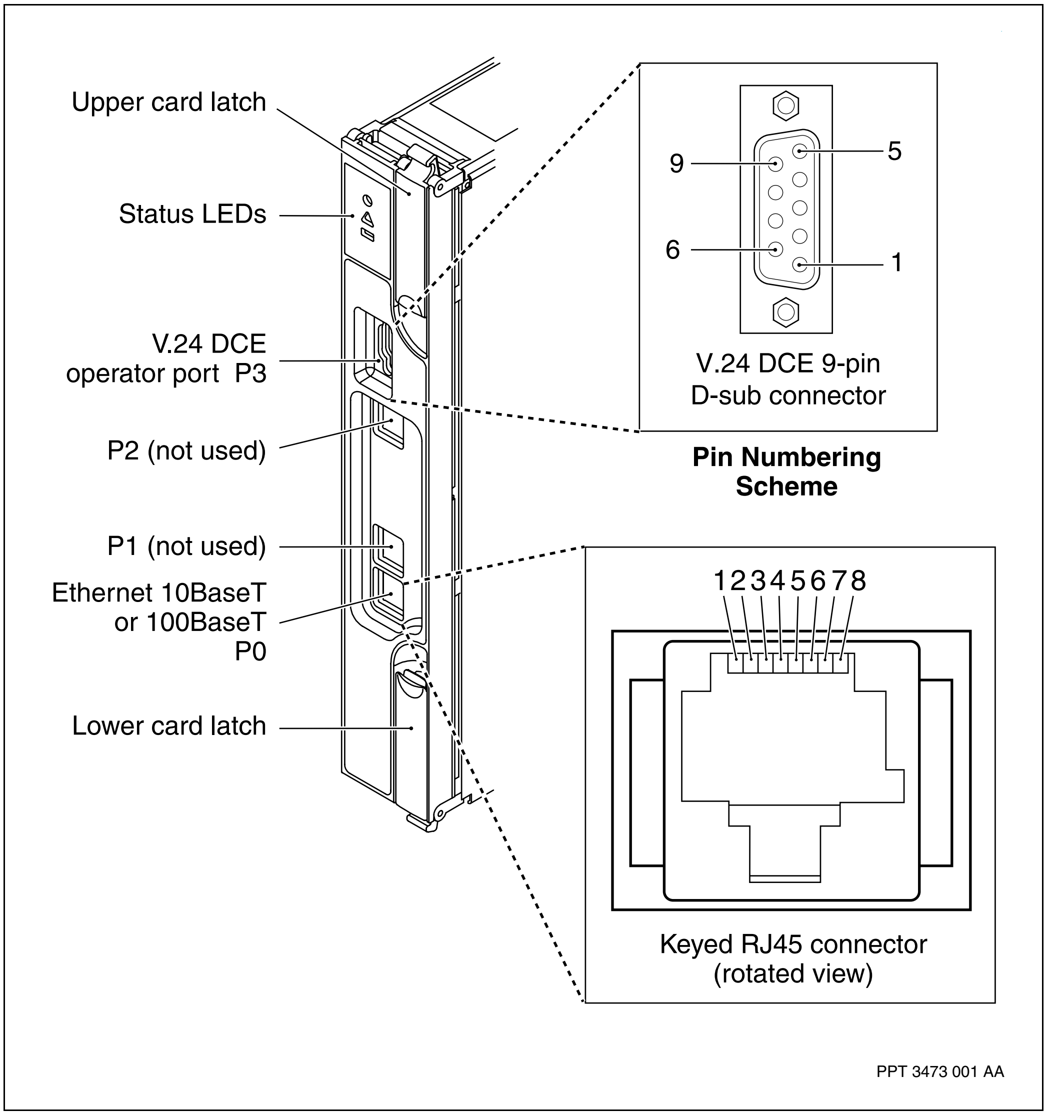
Attention: Earlier versions of the NTHW06 and NTHW08 CP3 cards include the unused P4 port connector. In later versions, this feature has been removed.

For the description of the LEDs on the faceplate, see Status LEDs of a CP (page 300).

Faceplate of a CP2 with PEC NTHR06 or NTHR35



Faceplate of a CP3 with PEC NTHW06 or NTHW08



Information about CPs is divided into these sections:

- CP hardware (page 124)
- CP software requirements (page 124)
- CP cables (page 125)
- Ethernet CP pinout and signal names (page 128)
- V.24 CP pinout and signal names (page 129)
- CP line rate (page 129)
- CP compliance with standards (page 129)

CP hardware

The CP consists of a motherboard, a memory daughter card, and a power supply daughter card, with a hard disk mounted on the motherboard.

The CP connects to the shelf backplane, providing an interface to both fabric cards. It performs activities associated with the fabric cards and routing data through the node.

The CP interface supports these functions

- disk interface
- stratum clock
- real-time clock (for example, for the time-of-day clock)
- shelf alarm circuitry
- external interfaces, including a V.24 DCE port for Multiservice Data Manager workstation connectivity, a 10Base-T Ethernet port for OAM of CP2, and 100Base-T Ethernet for OAM of CP3
- building integrated timing supply (BITS) from the alarm/BITS module (if connected to the site source)

The CP hard disk drive stores the Nortel Networks Multiservice Switch node software, configuration data, and spooled information.

CP software requirements

See the following tables for minimum software requirements of Nortel Networks Multiservice Switch 15000 and Multiservice Switch 20000 CPs:

CP minimum software requirements for Multiservice Switch 15000 CPs

Order code	CP part description and software version
NTHR06CA, NTHR35CA	CP2s are supported with PCR1.1 and later releases.
NTHW06AA, NTHW08AA	CP3s are supported with PCR1.3 and later releases.

CP minimum software requirements for Multiservice Switch 20000 CPs

Order code	CP part description and software version
NTHW06AA, NTHW08AA	CP3s are supported with PCR 3.1 and later releases provided each is migrated to the current PCR of the node.

CP cables

CPs in Nortel Networks Multiservice Switch 15000 and Multiservice Switch 20000 nodes are installed in slots 0 and 1. (Slots 0E and 1E are reserved for future development, and be filled with blank processor cards.) Each control processor card has CP marked on its faceplate. (A CP2 indicates CP2 while a CP3 indicates CP.)

The types of CP cables and their connectors depend on the kinds of terminations on the faceplate of the CP2 or CP3, and on the equipment at the other end. You must provide the cables and connectors to link a CP to Nortel Networks equipment, such as a local user interface terminal or a Multiservice Data Manager workstation communicating through a router or hub of a local area network (LAN), or to any other CPE termination.

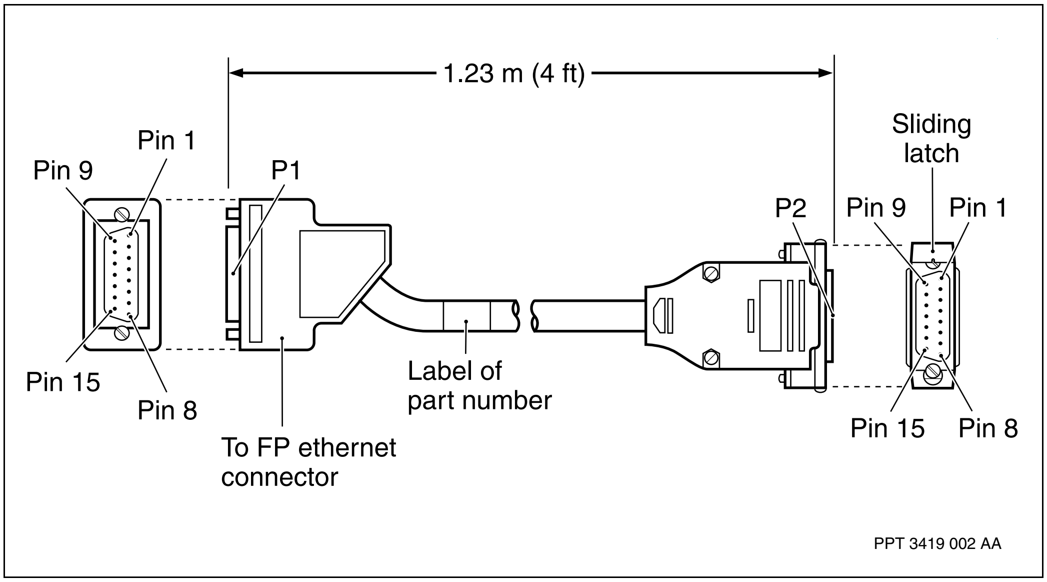
Prefabricated cables are available for any CP. Each CP3 is shipped with its own two cables. CP2 cables are available in optional kit NT0479, which includes cable assemblies NT0460 and NT0477 as shown in the figures CP2 Ethernet cable NT0460 (page 127) and CP2 Ethernet crossover cable NT0477 with RJ-45 connectors and ferrite bead (page 128). On a CP3, ports P1, P2, and P4 are not supported for use. The available cables for all other ports are described in the table Prefabricated CP cable assemblies (page 126).

Prefabricated CP cable assemblies

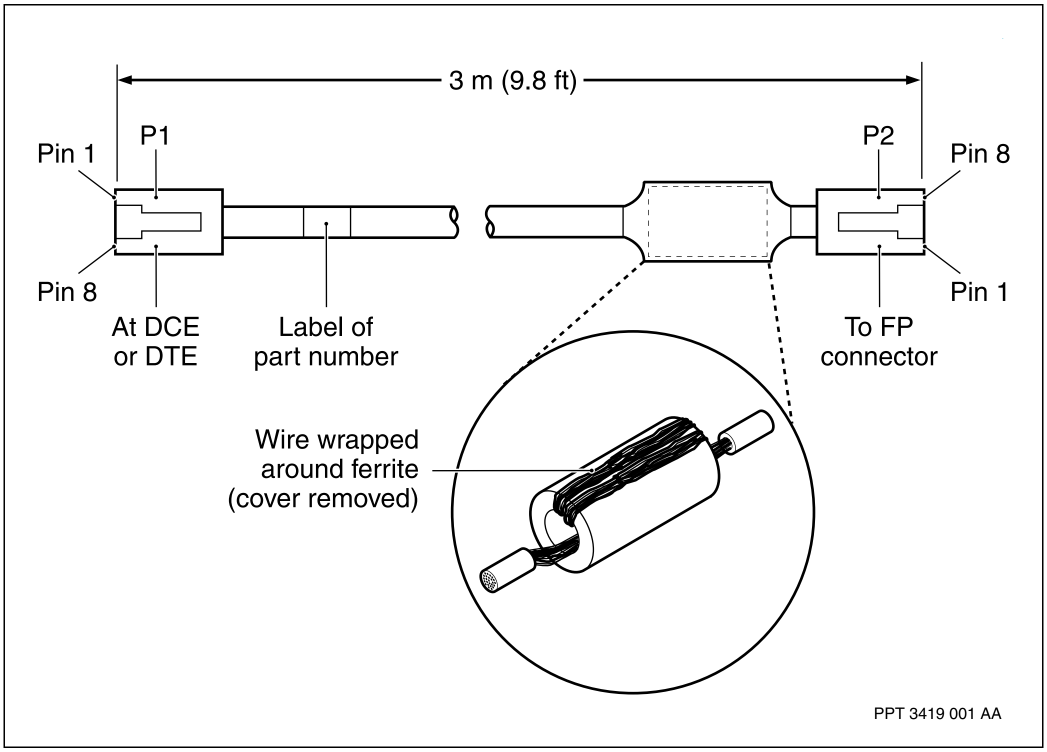
Part number	Description	Port number on type of CP	Examples of the far-end connection	Cable length
A0821568	Ethernet 100Base-T straight-through CAT 5 strand STP cable with RJ-45 connectors The above-mentioned cable assembly ships with the CP although the minimum shielding requirement is for a UTP cable.	P0 on CP3	the hub port that communicates with a Multiservice Data Manager	10 m (32.8 ft)
A0822236	null modem (Ethernet crossover) CAT 5 strand STP cable with RJ-45 connectors The above-mentioned cable assembly ships with the CP although the minimum shielding requirement is for a UTP cable.	P0 on CP3	an operator workstation	10 m (32.8 ft)
NT0460	Ethernet cable	P1 on CP2 or CP2E	an operator workstation with an RS232 serial port	1.2 m (4.0 ft)
928A	inline transceiver	with a CP2 Ethernet connection (as required)	________________	not relevant
NT0477	Ethernet crossover cable with RJ-45 connectors	P1 on CP2 or CP2E	the hub or router port that communicates with a Multiservice Data Manager	3 m (9.8 ft)
NTBP25	V.24 DEC operator port cable with 9-pin D-sub connectors, described in Specifications for a custom-made CP cable NTBP25 (page 128)	P1 on CP2, P3 on CP3, and/or the 9-pin DCE port on either CP in a Multiservice Switch 7400 node within a Multiservice Switch 15000 VSS	an operator workstation with a 9-pin D-sub connector for an RS232 serial port	4.5 m (15.0 ft)

The maximum length of 100Base-T Ethernet cable between a CP and the hub or router of a Multiservice Data Manager workstation, or directly to the workstation is 100 m (328 ft). Any equipment connected to the P0 Ethernet port must have a grounded RJ-45 connection so that both ends of the cable contact the grounding. The cable is already grounded at the CP3 end.

CP2 Ethernet cable NT0460



CP2 Ethernet crossover cable NT0477 with RJ-45 connectors and ferrite bead



Specifications for a custom-made CP cable NTBP25

You can make your own custom-length version of the NTBP25 cable assembly. You must consider the following requirements:

- RS232 4-pair CAT5 shielded operator cable
- V.24 DCE 9-pin D-sub pinout on both ends as indicated in the table V.24 connector pinouts (page 129)
- 0.205 mm^2 (24 AWG) thickness
- FT4 fire rating
- 30-m (50-ft) length

Ethernet CP pinout and signal names

The table Ethernet connector pinouts (page 128) lists the connector pinouts for the CP2 10BaseT Ethernet and the CP3 100BaseT Ethernet ports.

Ethernet connector pinouts

Pin numbers	Signal name
1	Tx +
2	Tx -
(1 of 2)	

Ethernet connector pinouts (continued)

Pin numbers	Signal name
3	Rx +
4	not used
5	not used
6	Rx -
7	not used
8	not used
(2 of 2)	

V.24 CP pinout and signal names

This table V.24 connector pinouts (page 129) lists the pinouts for the local operator port connector.

V.24 connector pinouts

Pin numbers	RS232-C pin numbers	V.24 signal	ITU-T signal number	Direction on DCE port
1	15	TSET	114	output
2	2	TXD	103	input
3	3	RXD	104	output
4	20	DTR	108	input
5	7	GND	102	not applicable
6	8	DCD (RSLD)	109	output
7	4	RTS	105	input
8	5	CTS (RFS)	106	output
9	17	RSET	115	output

CP line rate

The CP’s line rate supports asynchronous data transfer at 9.6 kbit/s.

CP compliance with standards

The V.24 port supports a subset of CCITT V.24 standards and can accommodate most interface devices.

Ethernet compliance with standards

The Ethernet FP complies with these standards and conventions:

- IEEE 802.3
- Digital/Intel/Xerox (DIX)

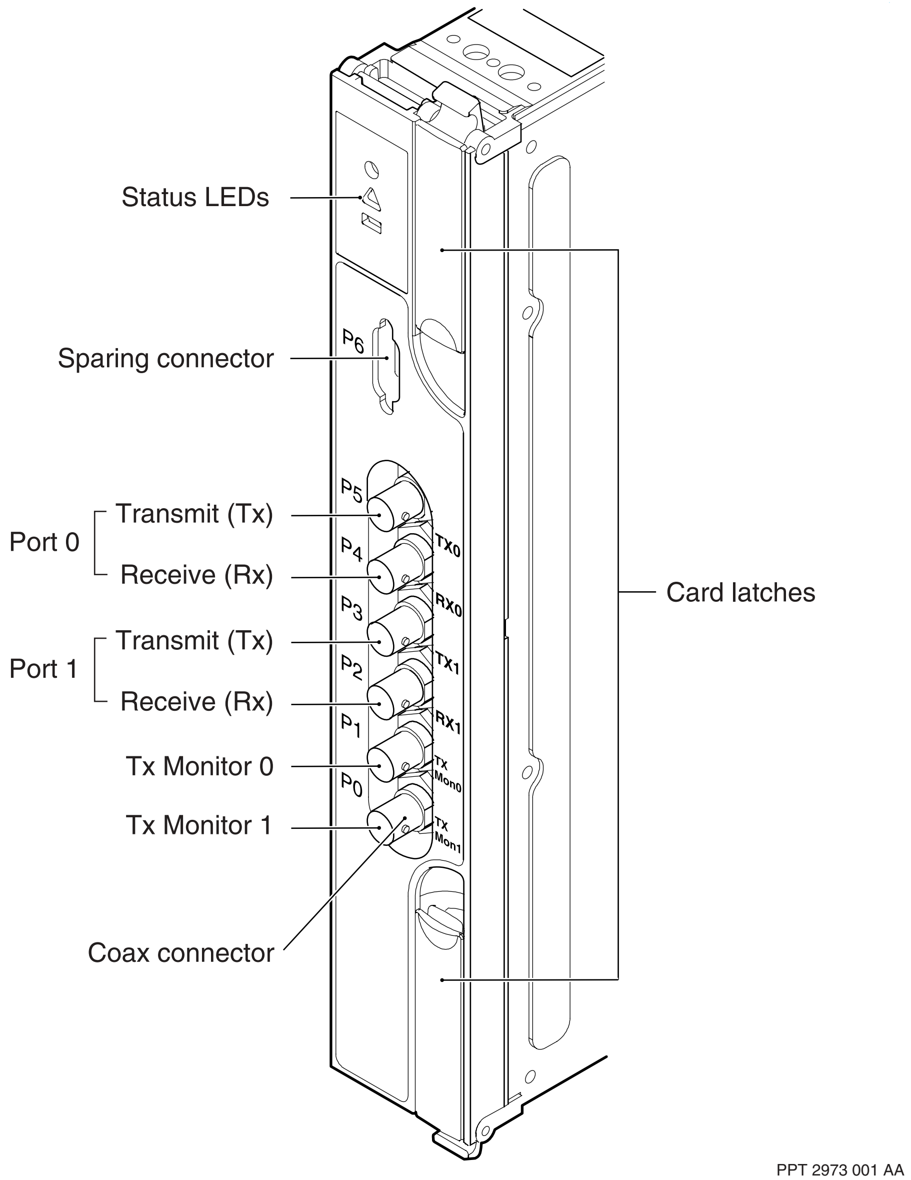
2-port DS3Ch TDM FP

For the interface information about the 2-port DS3 channelized time division multiplexing (TDM) FP, see:

- Faceplate of a 2-port DS3Ch TDM FP with PEC NTHW91 (page 132)
- 2-port DS3Ch TDM line connections (page 132)
- 2-port DS3Ch TDM cable assemblies (page 133)
- Assigning sparing panel connections for 2-port DS3C TDM FPs (page 134)

The software name (card type) of the NTHW91 is 2pDS3cAal.

Faceplate of a 2-port DS3Ch TDM FP with PEC NTHW91



2-port DS3Ch TDM line connections

You can connect the lines (ports) of this DS3 FP directly to the far end network equipment or another DS3 FP, or indirectly through the 3-port DS3, E3, or E1 one-for-one sparing panel identified by PEC NTFP99AA or the 12-port DS3 fanout panel NTHW52. Refer to Termination panels for FPs (page 242) for the description, function, and capabilities of the panel.

The connections can be made to equivalent non-Nortel Networks equipment provided the cabling criteria are met.

2-port DS3Ch TDM cable assemblies

The maximum cable length for DS3Ch lines to customer equipment is 137 m (450 ft). The distance between the FP and the sparing panel is part of the total length.

The table Cable assemblies for a DS3Ch TDM FP (page 133) lists the available prefabricated cables. The cable assemblies with standard male BNC connectors at both ends can be connected to either another FP, the NTFP99AA sparing panel, the NTHW52 fanout panel, or other compatible equipment.

Cable assemblies for a DS3Ch TDM FP

PEC	Description	Length
NTFP19AD	male straight BNC to male straight BNC	3.0 m (9.8 ft)
NTFP19AE	male straight BNC to male straight BNC	15 m (49 ft)
NTHR69	DB9 sparing control port	2.5 m (8 ft)
NTHR70	DB9 sparing control port	5 m (16 ft)
NTHR71	DB9 sparing control port	15 m (49 ft)

When a prefabricated interface cable from Nortel Networks is connected between a DS3 FP and a Nortel Networks termination panel, the connection is grounded.

You can custom make your own traffic port cables to connect the FP to the other end connections by using the specifications in the table Cable assembly parts for a 2-port DS3Ch TDM FP (page 133). The port connections are identified in the figure Faceplate of a 2-port DS3Ch TDM FP with PEC NTHW91 (page 132). Information about assigning port connections is described in the processor card cabling chapter of NN10600-130 *Nortel Networks Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*.

Cable assembly parts for a 2-port DS3Ch TDM FP

Item	Description
at the FP faceplate, male coax connector	75-ohm straight or right-angle crimp-on male BNC plug (connector)

(1 of 2)

Cable assembly parts for a 2-port DS3Ch TDM FP (continued)

Item	Description
cable NT-734 or comparable cable such as RG-59/U	75-ohm coaxial cable with double shielded construction
at the sparing panel faceplate, a male connector 28P387-1 (straight) or 28P388 (right-angle) made by Specialty Connector Company, or a comparable one	75-ohm straight or right-angle crimp-on male BNC plug (connector)
(2 of 2)	

You can custom make your own control port cable using the following specifications:

- tin-plated copper cable with 5 conductors at 7 strands of 32 AWG (0.0320 mm^2) wire for each conductor, with an aluminum polyester shield, covered by poly vinyl chloride insulation (for example, Beldon Wire and Cable part number 9535)
- a resultant cable size of 24 AWG (0.205 mm^2)
- a 45-degree downwards offset female DB9 connector with standard slotted fastening screws for the FP faceplate; see the orientation of the sparing D-sub connector in the figure Faceplate of a 2-port DS3Ch TDM FP with PEC NTHW91 (page 132) to determine the orientation of the downwards offset relative to the shape of the D
- a straight male DB9 connector with standard slotted fastening screws for the sparing panel faceplate

Refer to the inset of the control port in the figure Faceplate of a 2-port DS3Ch TDM FP with PEC NTHW91 (page 132). The PS is the power supply. Both ends of the cable have the same pinout, and the control port pinout is the same for all DS3 and E3 cards.

For more information, see Cables and cable management (page 265).

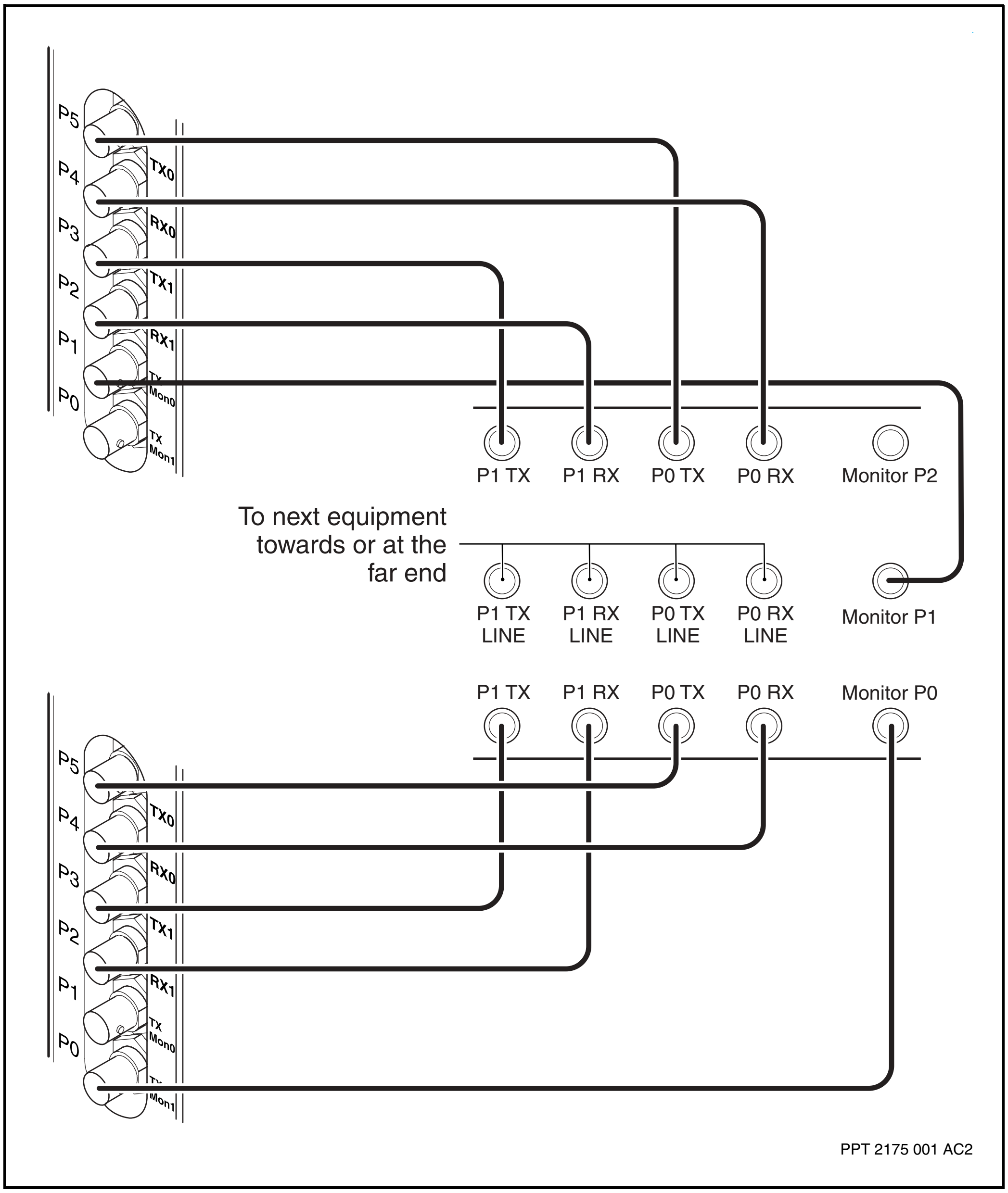
Assigning sparing panel connections for 2-port DS3C TDM FPs

The figure Cable connections between 2-port DS3C TDM FPs and a 3-port sparing panel NTFP99 (page 135) shows the connection endpoints between the spared FPs and their sparing panel. It also identifies the endpoints at the sparing panel from the far-end or next-hop CPE.

A sparing panel has a transmit (Tx) and receive (Rx) pair for each port. When cabling Nortel Networks Multiservice Switch FPs and sparing panels, do Tx-to-Tx and Rx-to-Rx for all equipment from the FP up to the far-end termination of the FP connection.

The sparing panel NTFP99 can also be deployed as a one-for-one fanout panel (or patch panel) provided the connections are to the Main Tx and Rx ports.

Cable connections between 2-port DS3C TDM FPs and a 3-port sparing panel NTFP99



4-port DS3Ch FR FP

For the interface information about the 4-port DS3Ch FR FP, see:

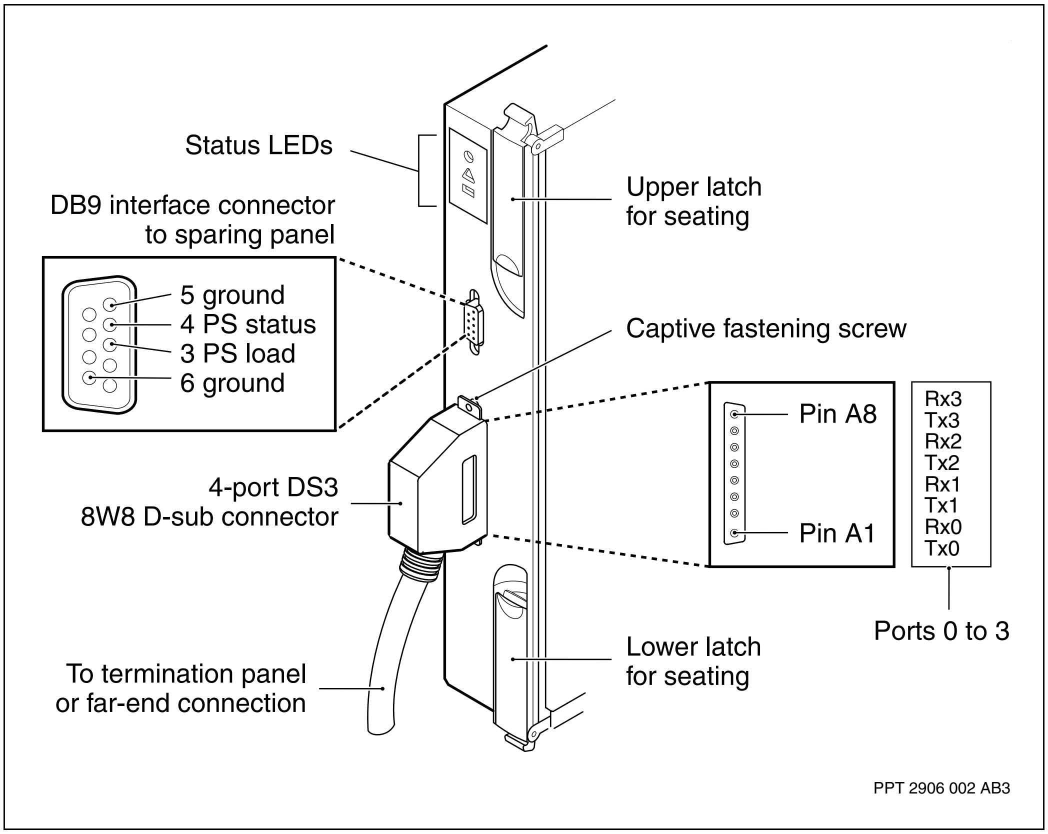
- 4-port DS3Ch FR identifiers (page 136)
- Faceplate of a 4-port DS3Ch FR FP with PEC NTHW88 or NTHW89 (page 137)
- 4-port DS3 FR FP line connections (page 137)
- 4-port DS3 FR FP cable assemblies (page 137)
- Assigning sparing panel connections for 4-port DS3 FPs (page 140)

4-port DS3Ch FR identifiers

FP name	PQC6v2 (also known as PQC2)	PQC12	Software name (card type)
4-port DS3 channelized	NTHR88	NTHR89	4pDS3Ch

When a specific PEC is not mentioned, assume the text applies to both PQC versions of the card.

Faceplate of a 4-port DS3Ch FR FP with PEC NTHW88 or NTHW89



4-port DS3 FR FP line connections

You can connect the NTHR88 or NTHR89 directly to the far-end network equipment or another DS3 FP, or indirectly through a termination panel. Termination panels include the 12-port fanout panel NTHW52 or the one-for-six 12-port sparing panel NTQS31. Refer to the Termination panels for FPs (page 242) for the description, function, and capabilities of the panels.

The connections can also be made to equivalent non-Nortel Networks equipment provided the cabling criteria are met.

4-port DS3 FR FP cable assemblies

The maximum cable distance for DS3 lines to customer premises equipment (CPE) is 137 m (450 ft). The distance between the FP and the termination panel is part of the total length.

The table Cable assemblies for a 4-port DS3 FR FP (page 138) lists the available prefabricated cables.

Cable assemblies for a 4-port DS3 FR FP

PEC	Description	Length
NTHR58	DS3 male 8W8 mini-coax to male BNC	2.5 m (8 ft)
NTHR59	DS3 male 8W8 mini-coax to male BNC	5 m (16 ft)
NTHR60	DS3 male 8W8 mini-coax to male BNC	15 m (49 ft)
NTHR72	DS3 male 8W8-to-8W8 male mini-coax	2.5 m (8 ft)
NTHR73	DS3 male 8W8-to-8W8 male mini-coax	5 m (16 ft)
NTHR74	DS3 male 8W8-to-8W8 male mini-coax	15 m (49 ft)
NTHR69	DS3 DB9 sparing control port	2.5 m (8 ft)
NTHR70	DS3 DB9 sparing control port	5 m (16 ft)
NTHR71	DS3 DB9 sparing control port	15 m (49 ft)

When a prefabricated interface cable from Nortel Networks is connected between a DS3 FP and a Nortel Networks termination panel, the connection is grounded.

You can custom make your own control port cable using the following specifications:

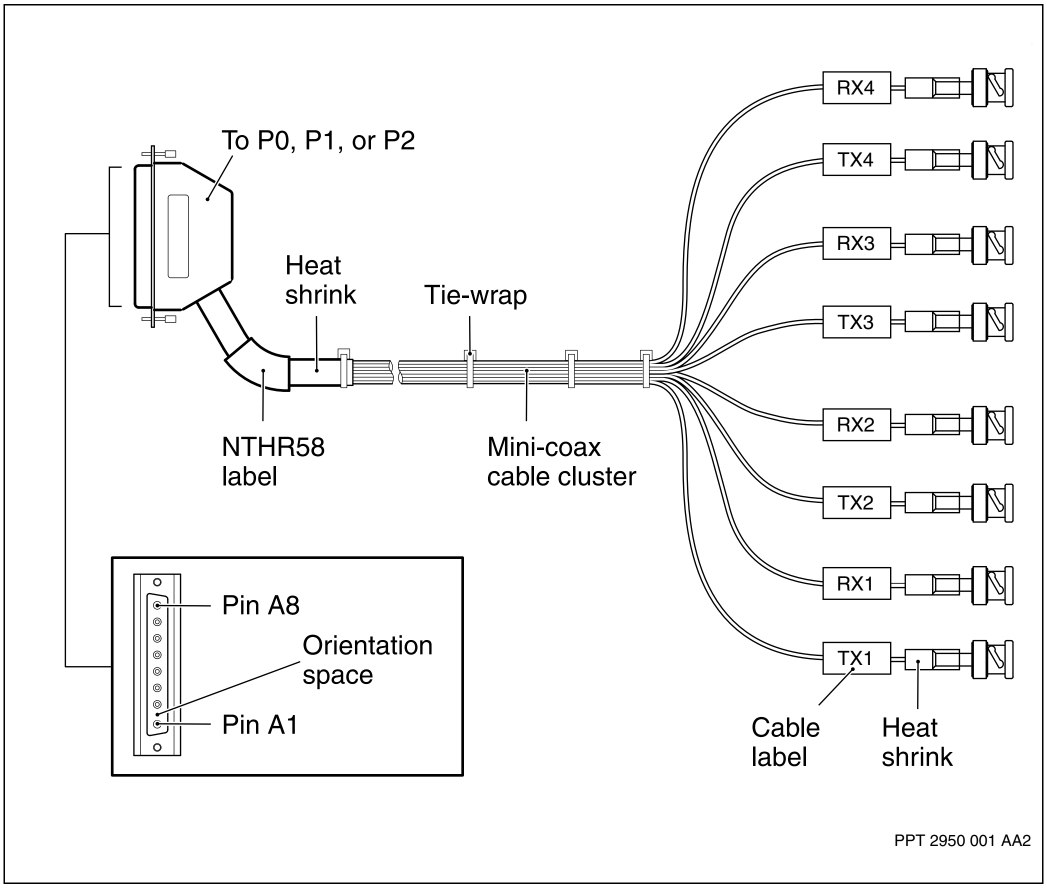
- tin-plated copper cable with 5 conductors at 7 strands of 32 AWG (0.0320 mm^2) wire for each conductor, with an aluminum polyester shield, covered by poly vinyl chloride insulation (for example, Beldon Wire and Cable part number 9535)
- a resultant cable size of 24 AWG (0.205 mm^2)
- a 45-degree downwards offset female DB9 connector with standard slotted fastening screws for the FP faceplate; see the orientation of the sparing D-sub connector in the figure Faceplate of a 4-port DS3Ch FR FP with PEC NTHW88 or NTHW89 (page 137) to determine the orientation of the downwards offset relative to the shape of the D
- a straight male DB9 connector with standard slotted fastening screws for the sparing panel faceplate

Refer to the inset of the control port in the figure Faceplate of a 4-port DS3Ch FR FP with PEC NTHW88 or NTHW89 (page 137). The PS is the power supply. Both ends of the cable have the same pinout, and the control port pinout is the same for all DS3 and E3 cards.

The pinout of the traffic ports is shown in the figures Faceplate of a 4-port DS3Ch FR FP with PEC NTHW88 or NTHW89 (page 137) and Labels of mini-coax and BNC cable connections on a 4-port NTHR58 cable assembly

(page 139), and in the table Mapping an 8W8 and BNC cable to a termination panel from a DS3Ch FR FP (page 140). Information about assigning port connections is described in the processor card cabling chapter of NN10600-175 *Nortel Networks Multiservice Switch 7400 Hardware Installation, Maintenance, and Upgrade*.

Labels of mini-coax and BNC cable connections on a 4-port NTHR58 cable assembly



Mapping an 8W8 and BNC cable to a termination panel from a DS3Ch FR FP

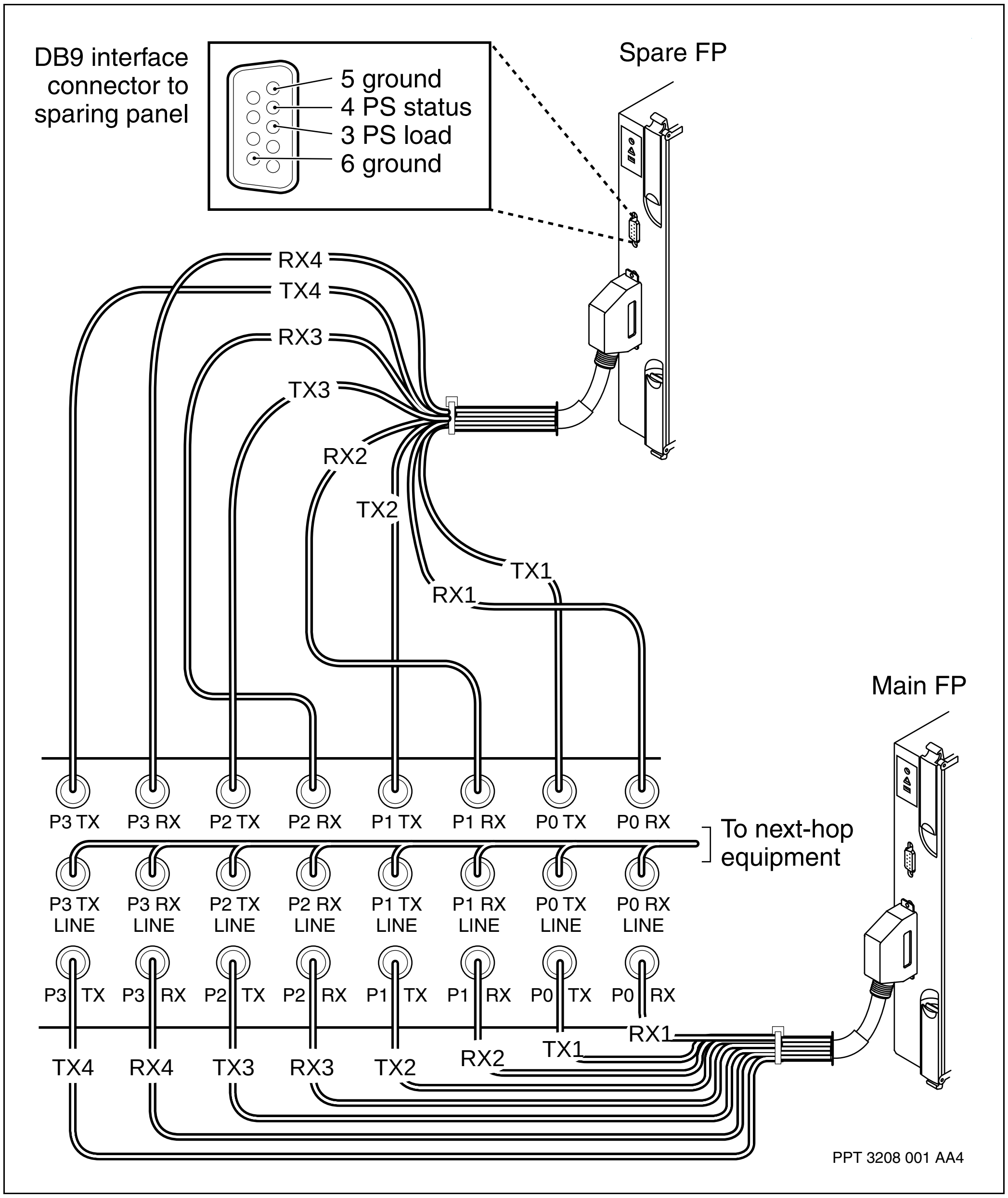
Port on faceplate	8W8 pin function	8W8 pin number	BNC label provided	Suggested BNC connection label at the sparing or fanout panel
P0	Rx 4	A8	RX4	<node_id>/<fp_slot_no>/P0/Rx4
	Tx 4	A7	TX4	<node_id>/<fp_slot_no>/P0/Tx4
	Rx 3	A6	RX3	<node_id>/<fp_slot_no>/P0/Rx3
	Tx 3	A5	TX3	<node_id>/<fp_slot_no>/P0/Tx3
	Rx 2	A4	RX2	<node_id>/<fp_slot_no>/P0/Rx2
	Tx 2	A3	TX2	<node_id>/<fp_slot_no>/P0/Tx2
	Rx 1	A2	RX1	<node_id>/<fp_slot_no>/P0/Rx1
	Tx 1	A1	TX1	<node_id>/<fp_slot_no>/P0/Tx1

Assigning sparing panel connections for 4-port DS3 FPs

A sparing panel has a transmit (Tx) and receive (Rx) pair for each port. When cabling Nortel Networks Multiservice Switch FPs and sparing panels, do Tx-to-Tx and Rx-to-Rx for all equipment from the FP up to the far-end termination of the FP connection.

The figure 8W8-to-BNC cable connections between two 4-port DS3s and sparing panel NTHR79 (page 141) shows the connection endpoints between the spared FPs and identifies the endpoints at the sparing panel from the far-end or next-hop CPE, such as an EdgeLink 100.

8W8-to-BNC cable connections between two 4-port DS3s and sparing panel NTHR79



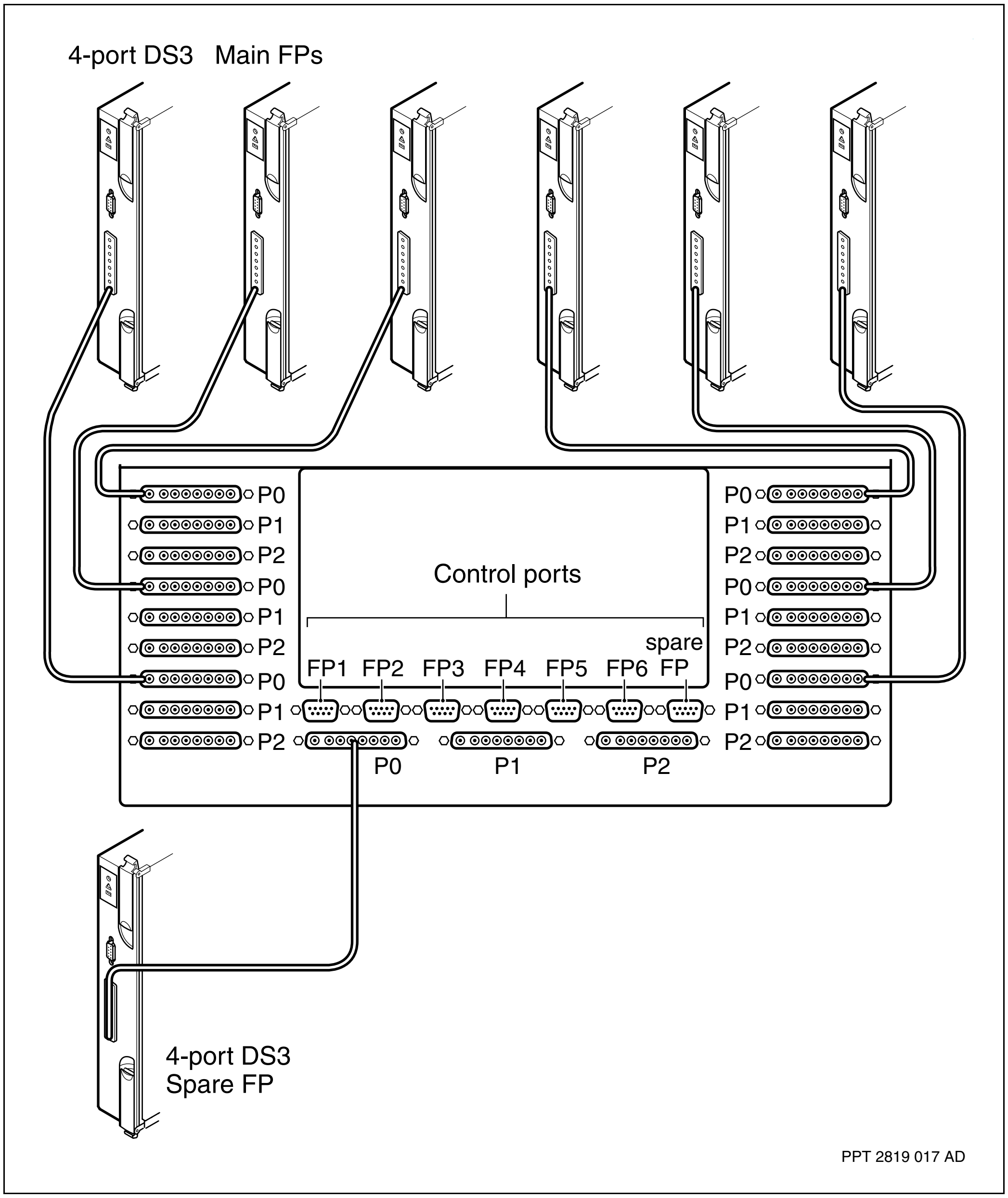
Up to six 4-port DS3 FPs can be spared by a seventh DS3 in a one-for-n configuration using the 12-port DS3 sparing panel NTQS31. Any of the DS3 FPs that support one-for-n sparing can be connected to the NTQS31. The following cabling criteria must be met.

- Each cable assembly must have an 8W8 connector at the sparing panel end. The prefabricated cable assemblies that can be used with the DS3 FPs are identified in each FP description in this chapter.
- All FPs must be in the same shelf, that is, share the same CPs.

- All FPs must connect to the same 8W8 port number on the sparing panel, for example, the figure 8W8-to-BNC cable connections between two 4-port DS3s and sparing panel NTHR79 (page 141) shows all connections on port zero (P0).
- If less than six DS3s are spared, the cabling on the sparing panel must be sequential from top to bottom on the sparing panel, then left to right without skipping a port connection.
- The sequence of FPs in a node do not necessarily have to be cabled in the same sequence to the sparing panel. For example, the figure 8W8-to-BNC cable connections between two 4-port DS3s and sparing panel NTHR79 (page 141) shows that the first FP is connected to the third sparing panel port number and the third FP is connected to the first sparing panel port number. It is logical to connect cables in sequence from their position in the card cage and in sequence on the sparing panel so that software configurations are easier to assign and identify.
- The software configuration (provisioning) of the one-for-n sparing must identify the correct slot and port numbers of each card relative to the sparing panel. No sparing panel port number can be skipped in favor of a subsequent connection.

The figure 8W8-to-BNC cable connections between two 4-port DS3s and sparing panel NTHR79 (page 141) is an example of connections. The control port cable connections are omitted to clearly indicate the traffic port connections.

Cable connections between seven 4-port DS3s each with 8W8s and sparing panel NTQS31



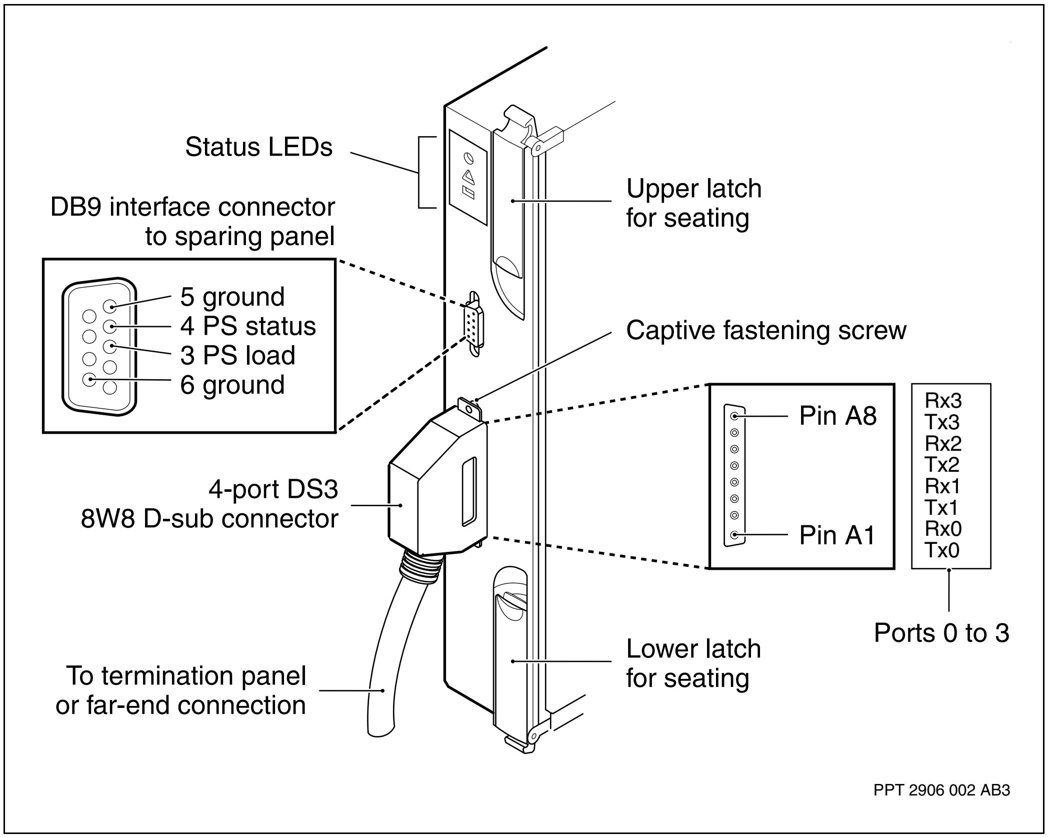
4-port DS3Ch ATM FP with IMA

For the interface information about the 4-port DS3Ch ATM FP with IMA, see:

- Faceplate of a 4-port DS3Ch ATM FP with PEC NTHR31 (page 144)
- 4-port DS3Ch ATM FP with IMA line connections (page 144)
- 4-port DS3Ch ATM FP with IMA cable assemblies (page 145)

The software name (card type) of the NTHR31 is 4pDS3ChAtm.

Faceplate of a 4-port DS3Ch ATM FP with PEC NTHR31



4-port DS3Ch ATM FP with IMA line connections

You can connect the lines (ports) of this DS3 FP directly to the far end network equipment or another DS3 FP, or indirectly through a termination panel. Termination panels include the 12-port fanout panel NTHW52, the one-for-six 12-port sparing panel NTQS31, or the one-for-one 4-port sparing panel NTHR79. Refer to Termination panels for FPs (page 242) for the description, function, and capabilities of the panels.

The connections can also be made to equivalent non-Nortel Networks equipment provided the cabling criteria are met.

4-port DS3Ch ATM FP with IMA cable assemblies

The maximum cable distance for DS3 lines to customer premises equipment (CPE) is 137 m (450 ft). The distance between the FP and the termination panel is part of the total length.

The table Cable assemblies for a 4-port DS3Ch ATM FP with IMA (page 145) lists the available prefabricated cables.

Cable assemblies for a 4-port DS3Ch ATM FP with IMA

PEC	Description	Length
NTHR58	DS3 male 8W8 mini-coax to male BNC	2.5 m (8 ft)
NTHR59	DS3 male 8W8 mini-coax to male BNC	5 m (16 ft)
NTHR60	DS3 male 8W8 mini-coax to male BNC	15 m (49 ft)
NTHR72	DS3 male 8W8-to-8W8 male mini-coax	2.5 m (8 ft)
NTHR73	DS3 male 8W8-to-8W8 male mini-coax	5 m (16 ft)
NTHR74	DS3 male 8W8-to-8W8 male mini-coax	15 m (49 ft)
NTHR69	DS3 DB9 sparing control port	2.5 m (8 ft)
NTHR70	DS3 DB9 sparing control port	5 m (16 ft)
NTHR71	DS3 DB9 sparing control port	15 m (49 ft)

When a prefabricated interface cable from Nortel Networks is connected between a DS3 FP and a Nortel Networks termination panel, the connection is grounded.

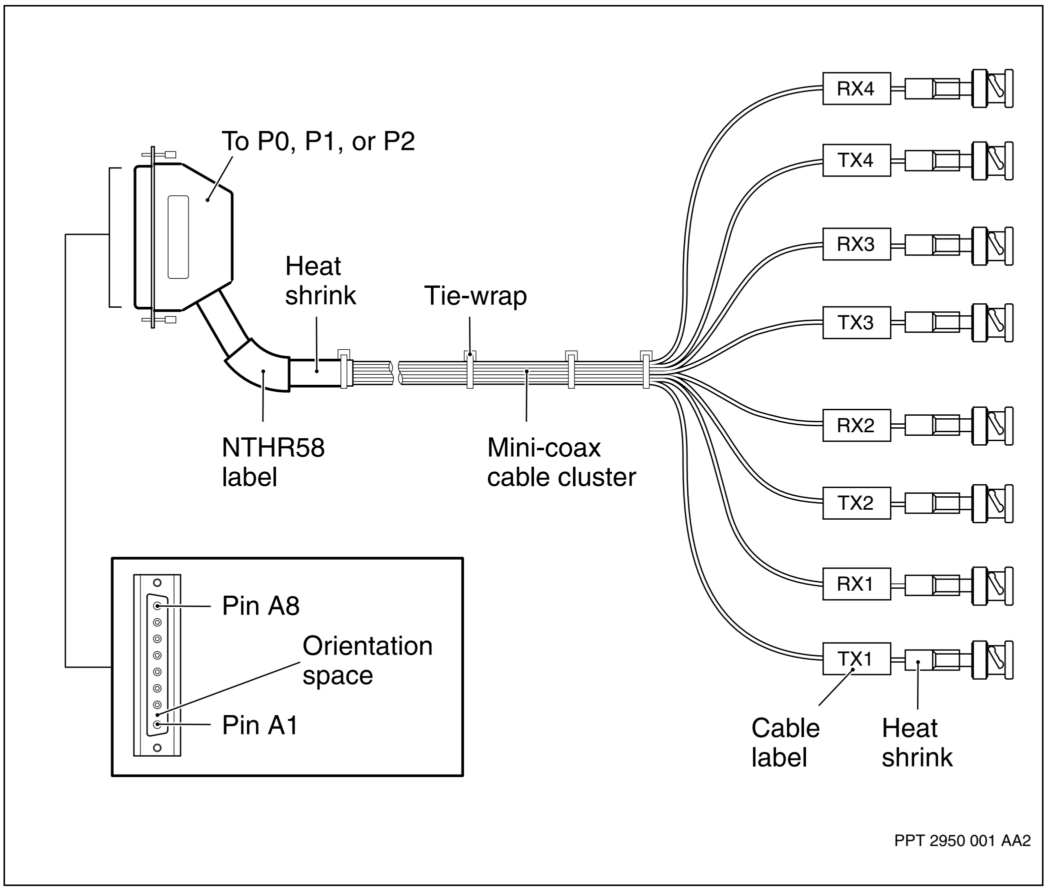
You can custom make your own control port cable using the following specifications:

- tin-plated copper cable with 5 conductors at 7 strands of 32 AWG (0.0320 mm^2) wire for each conductor, with an aluminum polyester shield, covered by poly vinyl chloride insulation (for example, Beldon Wire and Cable part number 9535)
- a resultant cable size of 24 AWG (0.205 mm^2)
- a 45-degree downwards offset female DB9 connector with standard slotted fastening screws for the FP faceplate; see the orientation of the sparing D-sub connector in the figure Faceplate of a 4-port DS3Ch ATM FP with PEC NTHR31 (page 144) to determine the orientation of the downwards offset relative to the shape of the D
- a straight male DB9 connector with standard slotted fastening screws for the sparing panel faceplate

Refer to the inset of the control port in the figure Faceplate of a 4-port DS3Ch ATM FP with PEC NTHR31 (page 144). The PS is the power supply. Both ends of the cable have the same pinout, and the control port pinout is the same for all DS3 and E3 cards.

The pinout of the traffic ports is shown in the figures Faceplate of a 4-port DS3Ch ATM FP with PEC NTHR31 (page 144) and Labels of mini-coax and BNC cable connections on a 4-port NTHR58 cable assembly (page 146), and in the table Mapping an 8W8 and BNC cable to a termination panel from a DS3Ch ATM FP (page 147). Information about assigning port connections is described in the processor card cabling chapter in NN10600-130 *Nortel Networks Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*.

Labels of mini-coax and BNC cable connections on a 4-port NTHR58 cable assembly



Mapping an 8W8 and BNC cable to a termination panel from a DS3Ch ATM FP

Port on faceplate	8W8 pin function	8W8 pin number	BNC label provided	Suggested BNC connection label at the sparing or fanout panel
P0	Rx 4	A8	RX4	<node_id>/<fp_slot_no>/P0/Rx4
	Tx 4	A7	TX4	<node_id>/<fp_slot_no>/P0/Tx4
	Rx 3	A6	RX3	<node_id>/<fp_slot_no>/P0/Rx3
	Tx 3	A5	TX3	<node_id>/<fp_slot_no>/P0/Tx3
	Rx 2	A4	RX2	<node_id>/<fp_slot_no>/P0/Rx2
	Tx 2	A3	TX2	<node_id>/<fp_slot_no>/P0/Tx2
	Rx 1	A2	RX1	<node_id>/<fp_slot_no>/P0/Rx1
	Tx 1	A1	TX1	<node_id>/<fp_slot_no>/P0/Tx1

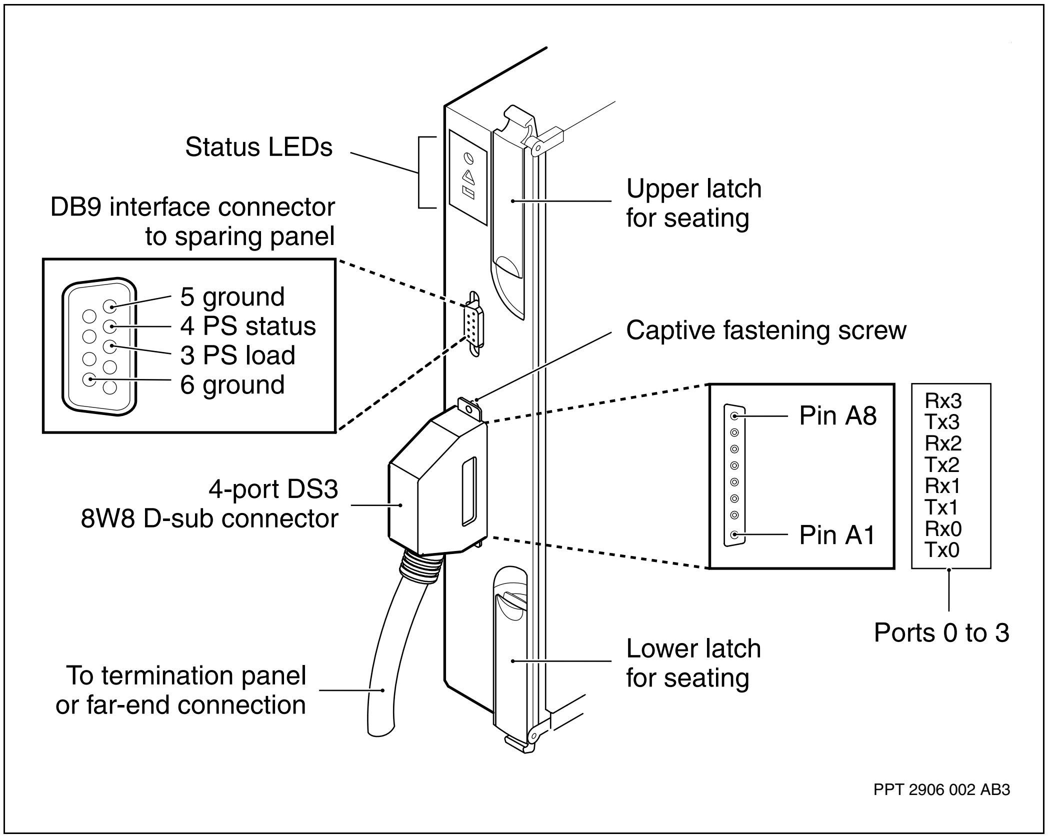
4-port DS3Ch FP with AAL1 CES

For the interface information about the 4-port DS3Ch FP with AAL1 CES, see:

- Faceplate of a 4-port DS3Ch FP with AAL1 CES with PEC NTHR91 (page 148)
- 4-port DS3Ch FP with AAL1 CES line connections (page 148)
- 4-port DS3Ch FP with AAL1 CES cable assemblies (page 149)

The software name (card type) of the NTHR91 is 4pDS3ChAal1.

Faceplate of a 4-port DS3Ch FP with AAL1 CES with PEC NTHR91



4-port DS3Ch FP with AAL1 CES line connections

You can connect the lines (ports) of this DS3 FP directly to the far end network equipment or another DS3 FP, or indirectly through a termination panel. Termination panels include the 12-port fanout panel NTHW52, the one-for-six 12-port sparing panel NTQS31, or the one-for-one 4-port sparing panel NTHR79. Refer to Termination panels for FPs (page 242) for the description, function, and capabilities of the panels.

The connections can also be made to equivalent non-Nortel Networks equipment provided the cabling criteria are met.

4-port DS3Ch FP with AAL1 CES cable assemblies

The maximum cable distance for DS3 lines to customer premises equipment (CPE) is 137 m (450 ft). The distance between the FP and the termination panel is part of the total length.

The table Cable assemblies for a 4-port DS3Ch FP with AAL1 CES (page 149) lists the available prefabricated cables.

Cable assemblies for a 4-port DS3Ch FP with AAL1 CES

PEC	Description	Length
NTHR58	DS3 male 8W8 mini-coax to male BNC	2.5 m (8 ft)
NTHR59	DS3 male 8W8 mini-coax to male BNC	5 m (16 ft)
NTHR60	DS3 male 8W8 mini-coax to male BNC	15 m (49 ft)
NTHR72	DS3 male 8W8-to-8W8 male mini-coax	2.5 m (8 ft)
NTHR73	DS3 male 8W8-to-8W8 male mini-coax	5 m (16 ft)
NTHR74	DS3 male 8W8-to-8W8 male mini-coax	15 m (49 ft)
NTHR69	DS3 DB9 sparing control port	2.5 m (8 ft)
NTHR70	DS3 DB9 sparing control port	5 m (16 ft)
NTHR71	DS3 DB9 sparing control port	15 m (49 ft)

When a prefabricated interface cable from Nortel Networks is connected between a DS3 FP and a Nortel Networks termination panel, the connection is grounded.

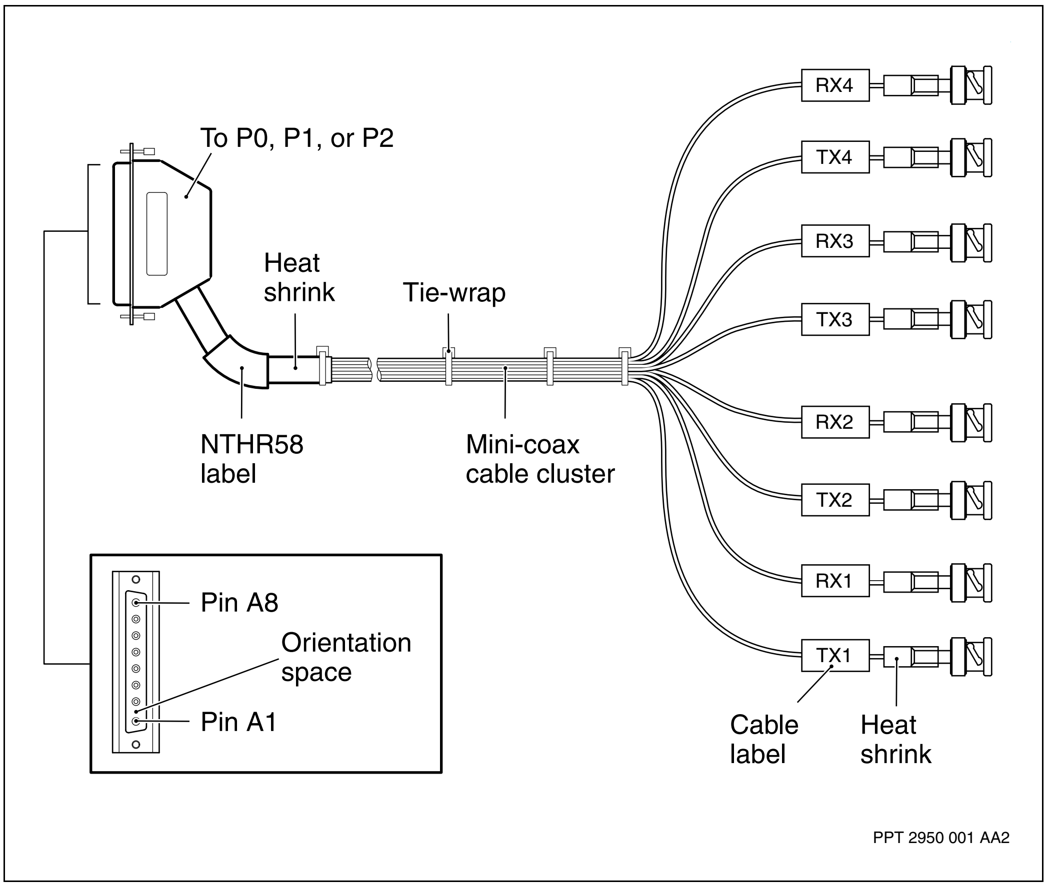
You can custom make your own control port cable using the following specifications:

- tin-plated copper cable with 5 conductors at 7 strands of 32 AWG (0.0320 mm^2) wire for each conductor, with an aluminum polyester shield, covered by poly vinyl chloride insulation (for example, Beldon Wire and Cable part number 9535)
- a resultant cable size of 24 AWG (0.205 mm^2)
- a 45-degree downwards offset female DB9 connector with standard slotted fastening screws for the FP faceplate; see the orientation of the sparing D-sub connector in the figure Faceplate of a 4-port DS3Ch FP with AAL1 CES with PEC NTHR91 (page 148) to determine the orientation of the downwards offset relative to the shape of the D
- a straight male DB9 connector with standard slotted fastening screws for the sparing panel faceplate

Refer to the inset of the control port in the figure Faceplate of a 4-port DS3Ch FP with AAL1 CES with PEC NTHR91 (page 148). The PS is the power supply. Both ends of the cable have the same pinout, and the control port pinout is the same for all DS3 and E3 cards.

The pinout of the traffic ports is shown in the figures Faceplate of a 4-port DS3Ch FP with AAL1 CES with PEC NTHR91 (page 148) and Labels of mini-coax and BNC cable connections on a 4-port NTHR58 cable assembly (page 150), and in the table Mapping an 8W8 and BNC cable to a termination panel from a DS3Ch FP (page 151). Information about assigning port connections is described in the processor card cabling chapter in NN10600-130 *Nortel Networks Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*.

Labels of mini-coax and BNC cable connections on a 4-port NTHR58 cable assembly



Mapping an 8W8 and BNC cable to a termination panel from a DS3Ch FP

Port on faceplate	8W8 pin function	8W8 pin number	BNC label provided	Suggested BNC connection label at the sparing or fanout panel
P0	Rx 4	A8	RX4	<node_id>/<fp_slot_no>/P0/Rx4
	Tx 4	A7	TX4	<node_id>/<fp_slot_no>/P0/Tx4
	Rx 3	A6	RX3	<node_id>/<fp_slot_no>/P0/Rx3
	Tx 3	A5	TX3	<node_id>/<fp_slot_no>/P0/Tx3
	Rx 2	A4	RX2	<node_id>/<fp_slot_no>/P0/Rx2
	Tx 2	A3	TX2	<node_id>/<fp_slot_no>/P0/Tx2
	Rx 1	A2	RX1	<node_id>/<fp_slot_no>/P0/Rx1
	Tx 1	A1	TX1	<node_id>/<fp_slot_no>/P0/Tx1

12-port DS3 FP

For the interface information about the 12-port DS3 FP, see:

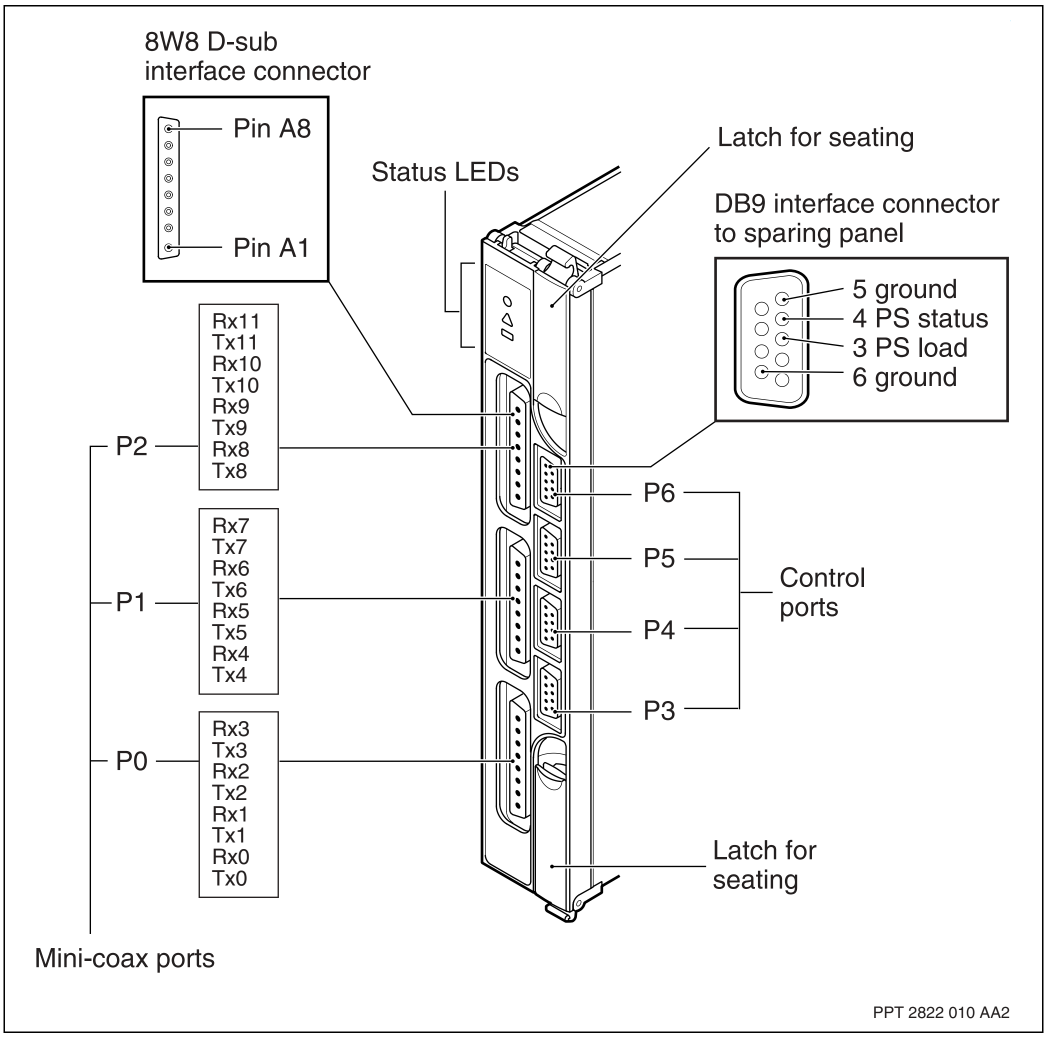
- Faceplate of a 12-port DS3 FP with PEC NTHR23 (page 152)

  The figure includes the mapping of port numbers to connector pins. Information on assigning port connections is described in NN10600-130 *Nortel Networks Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*.

- 12-port DS3 FP line connections (page 153)
- 12-port DS3 FP cable assemblies (page 153)

The software name (card type) of the NTHR23 is 12pDS3Atm. The DS version of this card shares the same PEC and software name.

Faceplate of a 12-port DS3 FP with PEC NTHR23



12-port DS3 FP line connections

You can connect the lines (ports) of this DS3 FP directly to the far end network equipment or another DS3 FP, or indirectly through the 12-port fanout panel NTHW52 or the one-for-six 12-port sparing panel NTQS31. Refer to Termination panels for FPs (page 242) for the description, function, and capabilities of the panels.

The connections can also be made to equivalent non-Nortel Networks equipment provided the cabling criteria are met.

When connecting a DS3 to a fanout panel, up to three DS3 8W8-to-BNC cable assemblies are required. When connecting a DS3 to a one-for-six sparing panel, up to three DS3 8W8-to-8W8 mini-coax cable assemblies are required from each FP. To operate the sparing panel, a single DS3 DB9 sparing control cable assembly is required.

12-port DS3 FP cable assemblies

Nortel Networks Multiservice Switch 15000 and Multiservice Switch 20000 nodes use mini-coax cables that are high-density 75-ohm BNC cables with 8W8 and BNC connectors. Each 8W8 connector is D-shaped with eight connections, four pairs of transmit (Tx) and receive (Rx) connections for four ports. Each 12-port DS3 FP accommodates three 8W8 connectors, labeled P0, P1, and P2. (Some 4-port DS3s have only one 8W8 connector.) The other end of the cable can have either

- another 8W8 connector intended for connection with sparing panel NTQS31
- a corresponding series of 8 standard BNCs intended for connection with a fanout panel (for example, NTHW52)

The maximum cable distance for DS3 lines to customer premises equipment (CPE) is 137 m (450 ft). The distance between the FP and the sparing panel or fanout panel is part of the total length.

Attention: The insertion loss of the mini-coax cables is approximately double that of standard NT-734 cable, which will affect the maximum cable distance.

A 12-port DS3 uses three 4-port cable assemblies and three control port cables.

The table Cable assemblies for a DS3 FP (page 154) lists the available prefabricated cables.

Cable assemblies for a DS3 FP

PEC	Description	Length
NTHR58	DS3 male 8W8 mini-coax to male BNC	2.5 m (8 ft)
NTHR59	DS3 male 8W8 mini-coax to male BNC	5 m (16 ft)
NTHR60	DS3 male 8W8 mini-coax to male BNC	15 m (49 ft)
NTHR72	DS3 male 8W8-to-8W8 male mini-coax	2.5 m (8 ft)
NTHR73	DS3 male 8W8-to-8W8 male mini-coax	5 m (16 ft)
NTHR74	DS3 male 8W8-to-8W8 male mini-coax	15 m (49 ft)
NTHR69	DS3 DB9 sparing control port	2.5 m (8 ft)
NTHR70	DS3 DB9 sparing control port	5 m (16 ft)
NTHR71	DS3 DB9 sparing control port	15 m (49 ft)

When a prefabricated interface cable from Nortel Networks is connected between a DS3 FP and a Nortel Networks termination panel, the connection is grounded.

You can custom make your own control port cable using the following specifications:

- tin-plated copper cable with 5 conductors at 7 strands of 32 AWG (0.0320 mm^2) wire for each conductor, with an aluminum polyester shield, covered by poly vinyl chloride insulation (for example, Beldon Wire and Cable part number 9535)
- a resultant cable size of 24 AWG (0.205 mm^2)
- a 45-degree downwards offset female DB9 connector with standard slotted fastening screws for the FP faceplate; see the orientation of the sparing D-sub connector in the figure Faceplate of a 12-port DS3 FP with PEC NTHR23 (page 152) to determine the orientation of the downwards offset relative to the shape of the D
- a straight male DB9 connector with standard slotted fastening screws for the sparing panel faceplate

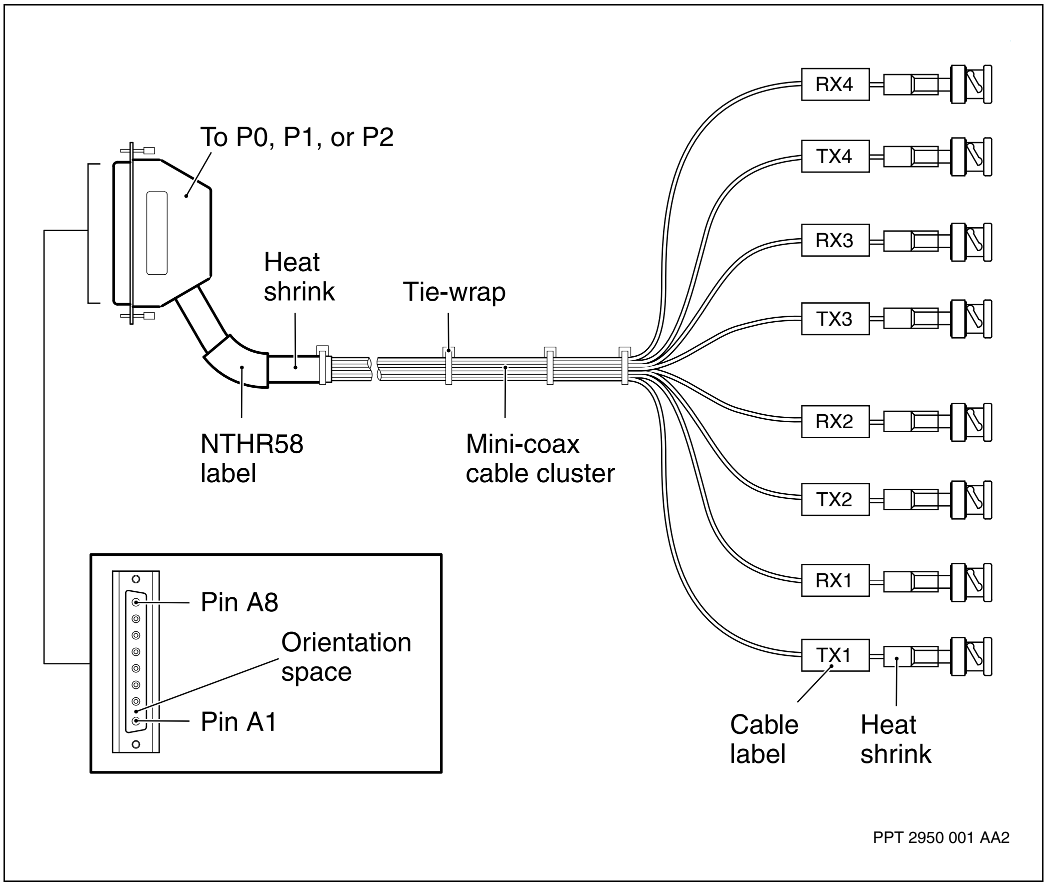
Refer to the inset of the control port in the figure Faceplate of a 12-port DS3 FP with PEC NTHR23 (page 152). The PS is the power supply. Both ends of the cable have the same pinout, and the control port pinout is the same for all DS3 and E3 cards.

For the mapping of traffic port numbers to connector pins, see the figures Faceplate of a 12-port DS3 FP with PEC NTHR23 (page 152) and Labels of mini-coax and BNC cable connections on a 4-port NTHR58 cable assembly

(page 155), and the table Mapping an 8W8 and BNC cable to a termination panel from a 12-port DS3 FP (page 156). Information about assigning port connections is described in the processor card cabling chapter in NN10600-130 *Nortel Networks Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*.

Attention: Unlike Multiservice Switch 7400 series FP faceplates, Multiservice Switch 15000 and Multiservice Switch 20000 FP faceplates have their ports numbered from bottom to top. The reversal is required to accommodate the downward cable management.

Labels of mini-coax and BNC cable connections on a 4-port NTHR58 cable assembly



Mapping an 8W8 and BNC cable to a termination panel from a 12-port DS3 FP

Port on faceplate	8W8 pin function	8W8 pin number	BNC label provided	Suggested BNC connection label at the sparing or fanout panel
P2	Rx 4	A8	RX4	<node_id>/<fp_slot_no>/P0/Rx4
	Tx 4	A7	TX4	<node_id>/<fp_slot_no>/P0/Tx4
	Rx 3	A6	RX3	<node_id>/<fp_slot_no>/P0/Rx3
	Tx 3	A5	TX3	<node_id>/<fp_slot_no>/P0/Tx3
	Rx 2	A4	RX2	<node_id>/<fp_slot_no>/P0/Rx2
	Tx 2	A3	TX2	<node_id>/<fp_slot_no>/P0/Tx2
	Rx 1	A2	RX1	<node_id>/<fp_slot_no>/P0/Rx1
	Tx 1	A1	TX1	<node_id>/<fp_slot_no>/P0/Tx1
P1	Rx 4	A8	RX4	<node_id>/<fp_slot_no>/P0/Rx4
	Tx 4	A7	TX4	<node_id>/<fp_slot_no>/P0/Tx4
	Rx 3	A6	RX3	<node_id>/<fp_slot_no>/P0/Rx3
	Tx 3	A5	TX3	<node_id>/<fp_slot_no>/P0/Tx3
	Rx 2	A4	RX2	<node_id>/<fp_slot_no>/P0/Rx2
	Tx 2	A3	TX2	<node_id>/<fp_slot_no>/P0/Tx2
	Rx 1	A2	RX1	<node_id>/<fp_slot_no>/P0/Rx1
	Tx 1	A1	TX1	<node_id>/<fp_slot_no>/P0/Tx1
P0	Rx 4	A8	RX4	<node_id>/<fp_slot_no>/P0/Rx4
	Tx 4	A7	TX4	<node_id>/<fp_slot_no>/P0/Tx4
	Rx 3	A6	RX3	<node_id>/<fp_slot_no>/P0/Rx3
	Tx 3	A5	TX3	<node_id>/<fp_slot_no>/P0/Tx3
	Rx 2	A4	RX2	<node_id>/<fp_slot_no>/P0/Rx2
	Tx 2	A3	TX2	<node_id>/<fp_slot_no>/P0/Tx2
	Rx 1	A2	RX1	<node_id>/<fp_slot_no>/P0/Rx1
	Tx 1	A1	TX1	<node_id>/<fp_slot_no>/P0/Tx1

Assigning sparing panel connections for a 12-port DS3 or E3 FP

Logically assign a connection from a specific slot on an FP to a specific connection on the sparing panel, and align it with a connection to each connection of all equipment between the sparing panel and the far-end final termination of the FP connection. Choose the sparing panel connections before doing the cabling procedure. Record each port connection at the faceplate of all equipment on a site record and on labels for the cables and panels. Some sparing panel faceplates have writable labels for each connection.

A sparing panel has a transmit (Tx) and receive (Rx) pair for each port. When cabling Nortel Networks Multiservice Switch FPs and sparing panels, do Tx-to-Tx and Rx-to-Rx for all equipment from the FP up to the far-end termination of the FP connection.

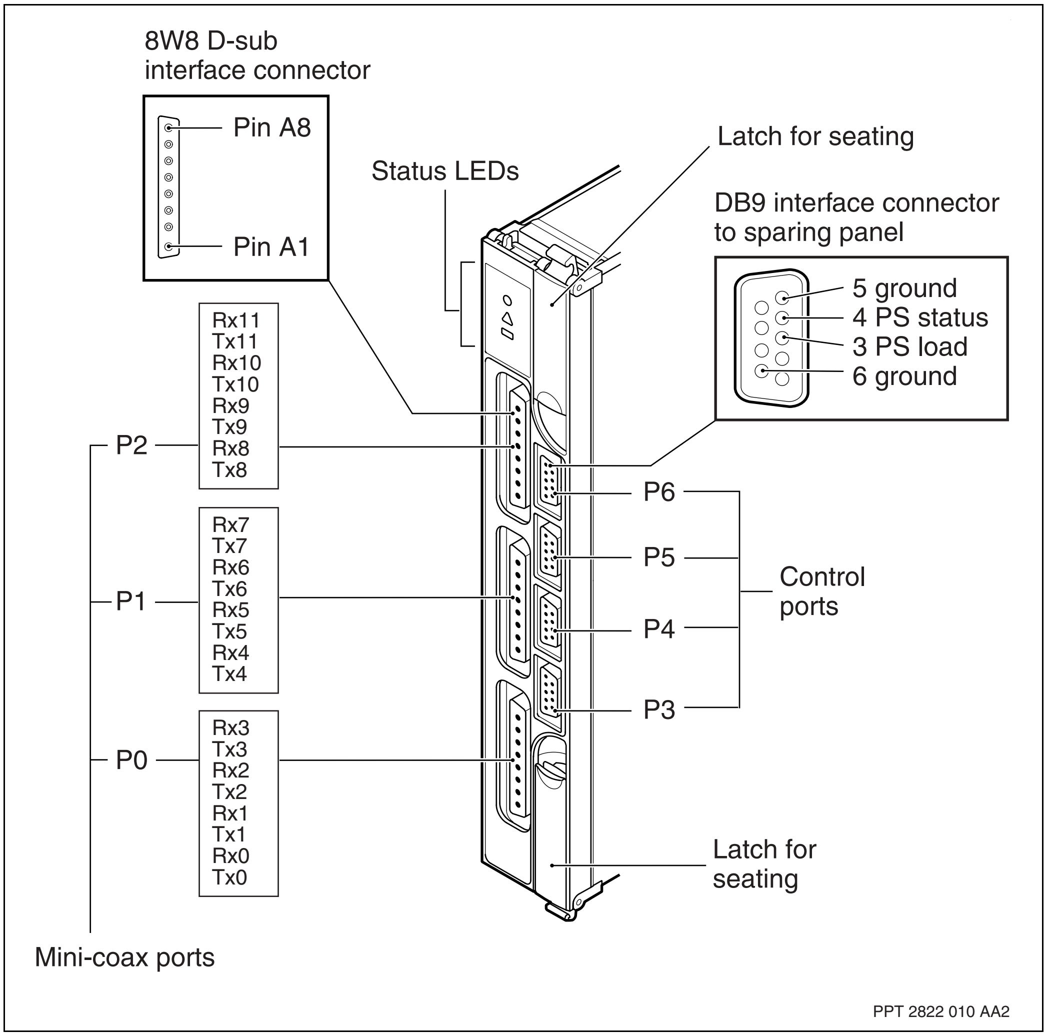
For the 12-port and 4-port cards that have the 8W8 mini-coax D-sub connectors on the faceplate, the actual port numbers are not indicated on the other end of the prefabricated signaling cables. The other end can be another 8W8 or a cluster of 8 BNC cables numbered 1 to 8. The pattern of pin (port) numbering is the same for all mini-coax connectors. Use the following to determine the port-to-port connections:

- the figure Labels of mini-coax and BNC cable connections on a 4-port NTHR58 cable assembly (page 139)
- the figure Port mappings of the 8W8 cable connections of a 12-port DS3 or E3 FP (page 158)
- the table Mapping an 8W8 and BNC cable to a termination panel from a DS3Ch FR FP (page 140)

Note that BNC 1 to 8 labels correspond to 8W8 pins A1 to A8 respectively, but the actual port number depends on whether the cable is plugged into P0, P1, or P2. In the figure Port mappings of the 8W8 cable connections of a 12-port DS3 or E3 FP (page 158), the port mappings of P0 apply to any of the 4-port FPs with the 8W8 mini-coax D-sub connectors.

The 12-port DS3 or E3 sparing panel NTQS31 can operate as a fanout panel for up to six DS3 or E3 FPs with 8W8 connectors, that is, with no sparing.

Port mappings of the 8W8 cable connections of a 12-port DS3 or E3 FP



Mapping of 8W8 and BNC connectors for ports P0, P1, and P2

Port on faceplate	8W8 pin function	8W8 pin number	BNC label provided	Suggested BNC connection label at the sparing or fanout panel
P2	Rx 11	A8	BNC 8	<node_id>/<fp_slot_no>/P2/Rx11/A-BNC8
	Tx 11	A7	BNC 7	<node_id>/<fp_slot_no>/P2/Tx11/A-BNC7
	Rx 10	A6	BNC 6	<node_id>/<fp_slot_no>/P2/Rx10/A-BNC6
	Tx 10	A5	BNC 5	<node_id>/<fp_slot_no>/P2/Tx10/A-BNC5
	Rx 9	A4	BNC 4	<node_id>/<fp_slot_no>/P2/Rx9/A-BNC4
	Tx 9	A3	BNC 3	<node_id>/<fp_slot_no>/P2/Tx9/A-BNC3
	Rx 8	A2	BNC 2	<node_id>/<fp_slot_no>/P2/Rx8/A-BNC2

(1 of 2)

Mapping of 8W8 and BNC connectors for ports P0, P1, and P2 (continued)

Port on faceplate	8W8 pin function	8W8 pin number	BNC label provided	Suggested BNC connection label at the sparing or fanout panel
	Tx 8	A1	BNC 1	<node_id>/<fp_slot_no>/P2/Tx8/A-BNC1
P1	Rx 7	A8	BNC 8	<node_id>/<fp_slot_no>/P1/Rx7/A-BNC8
	Tx 7	A7	BNC 7	<node_id>/<fp_slot_no>/P1/Tx7/A-BNC7
	Rx 6	A6	BNC 6	<node_id>/<fp_slot_no>/P1/Rx6/A-BNC6
	Tx 6	A5	BNC 5	<node_id>/<fp_slot_no>/P1/Tx6/A-BNC5
	Rx 5	A4	BNC 4	<node_id>/<fp_slot_no>/P1/Rx5/A-BNC4
	Tx 5	A3	BNC 3	<node_id>/<fp_slot_no>/P1/Tx5/A-BNC3
	Rx 4	A2	BNC 2	<node_id>/<fp_slot_no>/P1/Rx4/A-BNC2
	Tx 4	A1	BNC 1	<node_id>/<fp_slot_no>/P1/Tx4/A-BNC1
P0	Rx 3	A8	BNC 8	<node_id>/<fp_slot_no>/P0/Rx3/A-BNC8
	Tx 3	A7	BNC 7	<node_id>/<fp_slot_no>/P0/Tx3/A-BNC7
	Rx 2	A6	BNC 6	<node_id>/<fp_slot_no>/P0/Rx2/A-BNC6
	Tx 2	A5	BNC 5	<node_id>/<fp_slot_no>/P0/Tx2/A-BNC5
	Rx 1	A4	BNC 4	<node_id>/<fp_slot_no>/P0/Rx1/A-BNC4
	Tx 1	A3	BNC 3	<node_id>/<fp_slot_no>/P0/Tx1/A-BNC3
	Rx 0	A2	BNC 2	<node_id>/<fp_slot_no>/P0/Rx0/A-BNC2
	Tx 0	A1	BNC 1	<node_id>/<fp_slot_no>/P0/Tx0/A-BNC1

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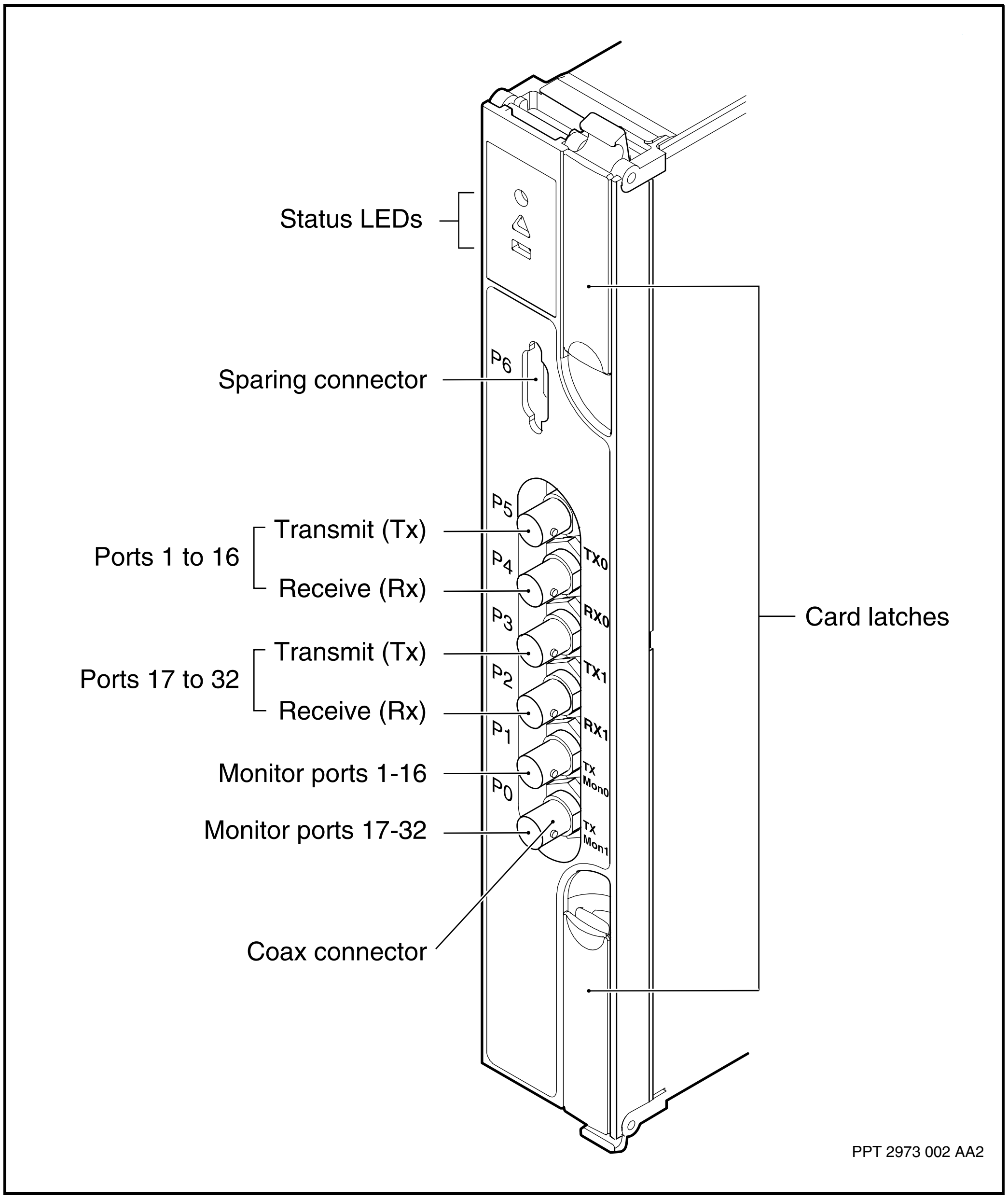
32-port E1 TDM FP

For the interface information about the 32-port E1 time division multiplexing (TDM) FP, see:

- Faceplate of a 32-port E1 TDM with PEC NTHW92 (page 161)
- 32-port E1 TDM line connections (page 161)
- 32-port E1 TDM cable assemblies (page 162)
- Assigning sparing panel connections for 32-port E1 TDM FPs (page 163)

The software name (card type) of the NTHW92 is 32pE1Aal.

Faceplate of a 32-port E1 TDM with PEC NTHW92



32-port E1 TDM line connections

You can connect the lines (ports) of this E3 FP directly to the far end network equipment or another E3 FP, or indirectly through

- a multiport aggregate device identified by PEC NT0486
- the 3-port DS3, E3, or E1 one-for-one sparing panel NTFP99AA
- the 12-port DS3 fanout panel NTHW52

Refer to Termination panels for FPs (page 242) for the description, function, and capabilities of the types of panels.

The connections can be made to equivalent non-Nortel Networks equipment provided the cabling criteria are met.

32-port E1 TDM cable assemblies

The maximum cable length for lines between the FP and the multiport aggregate device is 350 m (1150 ft). The distance between the FP and the sparing panel is part of the total length. The insertion loss of a cable must not exceed 12 dB measured at 17184 kHz.

The table Cable assemblies for a 32-port TDM FP (page 162) lists the available prefabricated cables. The cable assemblies with standard male BNC connectors at both ends can be connected to either another FP, the NTFP99AA sparing panel, the NTHW52 fanout panel, or other compatible equipment.

Cable assemblies for a 32-port TDM FP

PEC	Description	Length
NTFP19AD	male straight BNC to male straight BNC	3.0 m (9.8 ft)
NTFP19AE	male straight BNC to male straight BNC	15 m (49 ft)
NTHR69	DB9 sparing control port	2.5 m (8 ft)
NTHR70	DB9 sparing control port	5 m (16 ft)
NTHR71	DB9 sparing control port	15 m (49 ft)

When a prefabricated interface cable from Nortel Networks is connected between a E1 FP and a Nortel Networks termination panel, the connection is grounded.

You can custom make your own traffic port cables to connect the FP to the other end connections by using the specifications in the table Cable assembly parts for a 32-port E1 TDM FP (page 163). The port connections are identified in the figure Faceplate of a 32-port E1 TDM with PEC NTHW92 (page 161).

Cable assembly parts for a 32-port E1 TDM FP

Item	Description
at the FP faceplate, a male coax connector	75-ohm straight or right-angle crimp-on male BNC plug (connector)
cable NT-734 or comparable cable such as RG-59/U	75-ohm coaxial cable with double shielded construction
at the sparing panel faceplate, a male connector 28P387-1 (straight) or 28P388 (right-angle) made by Specialty Connector Company, or a comparable one	75-ohm straight or right-angle crimp-on male BNC plug (connector)

You can custom make your own control port cable using the following specifications:

- tin-plated copper cable with 5 conductors at 7 strands of 32 AWG (0.0320 mm^2) wire for each conductor, with an aluminum polyester shield, covered by poly vinyl chloride insulation (for example, Beldon Wire and Cable part number 9535)
- a resultant cable size of 24 AWG (0.205 mm^2)
- a 45-degree downwards offset female DB9 connector with standard slotted fastening screws for the FP faceplate; see the orientation of the sparing D-sub connector in the figure Faceplate of a 32-port E1 TDM with PEC NTHW92 (page 161) to determine the orientation of the downwards offset relative to the shape of the D
- a straight male DB9 connector with standard slotted fastening screws for the sparing panel faceplate

Refer to the inset of the control port in the figure Faceplate of a 32-port E1 TDM with PEC NTHW92 (page 161). Both ends of the cable have the same pinout, and the control port pinout is the same for all DS3 and E3 cards.

For more information, see Cables and cable management (page 265).

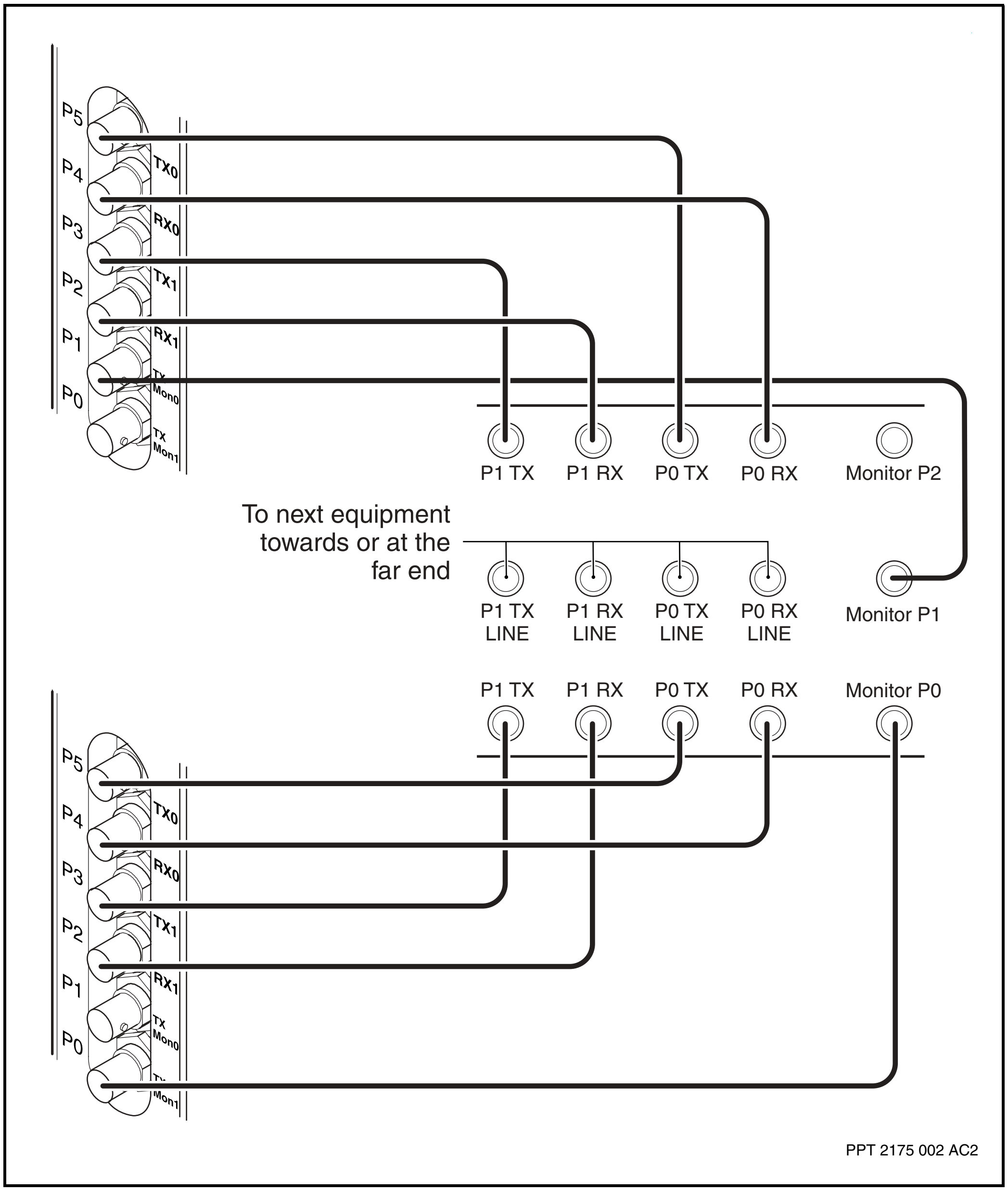
Assigning sparing panel connections for 32-port E1 TDM FPs

The 32-port E1 TDM function processor uses a sparing panel to support one-for-one sparing and multiport aggregate devices for customer equipment connections. The figure Cable connections between two 32-port E1 TDM FPs and a 3-port sparing panel NTFP99 (page 164) shows the connection endpoints between the spared FPs and their sparing panel. It also identifies the endpoints at the sparing panel from the far-end or next-hop CPE, in this case from a multiport aggregate device.

A sparing panel has a transmit (Tx) and receive (Rx) pair for each port. When cabling Nortel Networks Multiservice Switch FPs and sparing panels, do Tx-to-Tx and Rx-to-Rx for all equipment from the FP up to the far-end termination of the FP connection.

The sparing panel NTFP99 can also be deployed as a one-for-one fanout panel (or patch panel) provided the connections are to the Main Tx and Rx ports Main.

Cable connections between two 32-port E1 TDM FPs and a 3-port sparing panel NTFP99



12-port E3 ATM FP

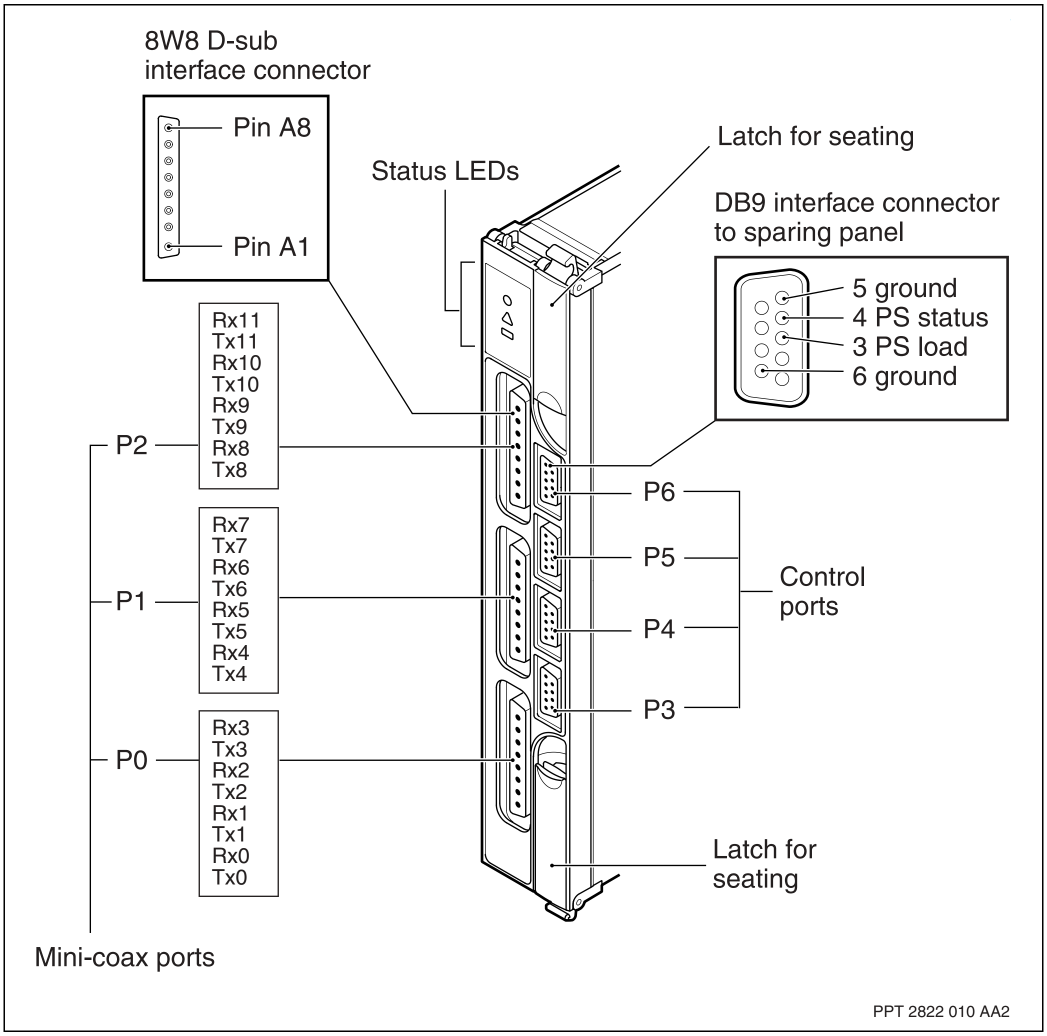
For the interface information about the 12-port E3 ATM FP, see:

- Faceplate of a 12-port DS3 FP with PEC NTHR23 (page 152)

  The figure includes the mapping of port numbers to connector pins. Information on assigning port connections is described in NN10600-130 *Nortel Networks Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*.
- 12-port E3 FP line connections (page 166)
- 12-port E3 FP cable assemblies (page 166)

The software name (card type) of the NTHR23 is 12pDS3Atm. The DS version of this card shares the same PEC and software name.

Faceplate of a 12-port E3 FP with PEC NTHR25



12-port E3 FP line connections

You can connect the lines (ports) of this E3 FP directly to the far end network equipment or another E3 FP, or indirectly through the 12-port fanout panel NTHW52 or the one-for-six 12-port sparing panel NTQS31. Refer to Termination panels for FPs (page 242) for the description, function, and capabilities of the panels.

The connections can also be made to equivalent non-Nortel Networks equipment provided the cabling criteria are met.

When connecting a E3 to a fanout panel, up to three E3 8W8-to-BNC mini-coax cable assemblies are required. When connecting a E3 to a one-for-six sparing panel, up to three E3 8W8-to-8W8 mini-coax cable assemblies are required from each FP. To operate the sparing panel, a single E3 DB9 sparing control cable assembly is required.

12-port E3 FP cable assemblies

Nortel Networks Multiservice Switch 15000 and Multiservice Switch 20000 nodes use mini-coax cables that are high-density 75-ohm BNC cables with 8W8 and BNC connectors. Each 8W8 connector is D-shaped with eight connections, four pairs of transmit (Tx) and receive (Rx) connections for four ports. Each 12-port E3 accommodates three 8W8 connectors, labeled P0, P1, and P2. (A 4-port E3 has only one 8W8 connector.) The other end of the cable can have either

- another 8W8 connector intended for connection with sparing panel NTHR39
- a corresponding series of 8 standard BNCs intended for connection with a fanout panel (for example, NTHW52)

The maximum cable length for unbalanced E3 lines to customer premises equipment (CPE) is 350 m (1148 ft). The distance between the FP and the sparing panel or fanout panel is part of the total length.

The insertion loss of a cable must not exceed 12 dB measured at 17184 kHz. For example, for NT-734 cable, an insertion loss of 12 dB at 17184 kHz is about 350 m (1148 ft) of cable.

Attention: The insertion loss of the mini-coax cables is approximately double that of standard NT-734 cable, which will affect the maximum cable distance.

A 12-port E3 uses three 4-port cable assemblies and three control port cables.

The table Cable assemblies for an E3 FP (page 167) lists the available prefabricated cables.

Cable assemblies for an E3 FP

PEC	Description	Length
NTHR58	E3 male 8W8 mini-coax to male BNC	2.5 m (8 ft)
NTHR59	E3 male 8W8 mini-coax to male BNC	5 m (16 ft)
NTHR60	E3 male 8W8 mini-coax to male BNC	15 m (49 ft)
NTHR72	E3 male 8W8-to-8W8 male mini-coax	2.5 m (8 ft)
NTHR73	E3 male 8W8-to-8W8 male mini-coax	5 m (16 ft)
NTHR74	E3 male 8W8-to-8W8 male mini-coax	15 m (49 ft)
NTHR69	E3 DB9 sparing control port	2.5 m (8 ft)
NTHR70	E3 DB9 sparing control port	5 m (16 ft)
NTHR71	E3 DB9 sparing control port	15 m (49 ft)

When a prefabricated interface cable from Nortel Networks is connected between a E3 FP and a Nortel Networks termination panel, the connection is grounded.

You can custom make your own control port cable using the following specifications:

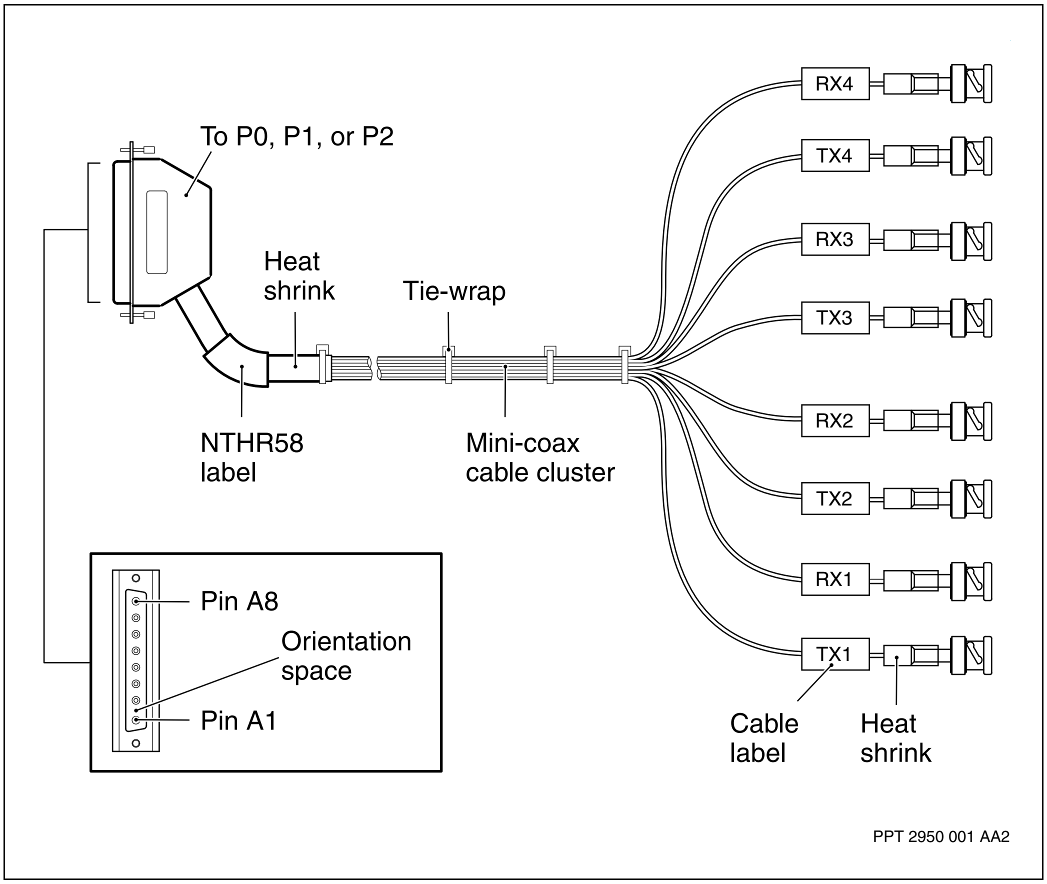
- tin-plated copper cable with 5 conductors at 7 strands of 32 AWG (0.0320 mm^2) wire for each conductor, with an aluminum polyester shield, covered by poly vinyl chloride insulation (for example, Beldon Wire and Cable part number 9535)
- a resultant cable size of 24 AWG (0.205 mm^2)
- a 45-degree downwards offset female DB9 connector with standard slotted fastening screws for the FP faceplate; see the orientation of the sparing D-sub connector in the figure Faceplate of a 12-port E3 FP with PEC NTHR25 (page 165) to determine the orientation of the downwards offset relative to the shape of the D
- a straight male DB9 connector with standard slotted fastening screws for the sparing panel faceplate

Refer to the inset of the control port in the figure Faceplate of a 12-port E3 FP with PEC NTHR25 (page 165). The PS is the power supply. Both ends of the cable have the same pinout, and the control port pinout is the same for all DS3 and E3 cards.

For the mapping of traffic port numbers to connector pins, see the figures and Labels of mini-coax and BNC cable connections on a 4-port NTHR58 cable assembly (page 168), and in the table Mapping an 8W8 and BNC cable to a termination panel from a 12-port E3 FP (page 168). Information about assigning port connections is described in the processor card cabling chapter in NN10600-130 *Nortel Networks Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*.

Attention: Unlike Multiservice Switch 7400 series FP faceplates, Multiservice Switch 15000 and Multiservice Switch 20000 FP faceplates have their ports numbered from bottom to top. The reversal is required to accommodate the downward cable management.

Labels of mini-coax and BNC cable connections on a 4-port NTHR58 cable assembly



Mapping an 8W8 and BNC cable to a termination panel from a 12-port E3 FP

Port on faceplate	8W8 pin function	8W8 pin number	BNC label provided	Suggested BNC connection label at the sparing or fanout panel
P2	Rx 4	A8	RX4	<node_id>/<fp_slot_no>/P0/Rx4
	Tx 4	A7	TX4	<node_id>/<fp_slot_no>/P0/Tx4

(1 of 2)

Mapping an 8W8 and BNC cable to a termination panel from a 12-port E3 FP (continued)

Port on faceplate	8W8 pin function	8W8 pin number	BNC label provided	Suggested BNC connection label at the sparing or fanout panel
	Rx 3	A6	RX3	<node_id>/<fp_slot_no>/P0/Rx3
	Tx 3	A5	TX3	<node_id>/<fp_slot_no>/P0/Tx3
	Rx 2	A4	RX2	<node_id>/<fp_slot_no>/P0/Rx2
	Tx 2	A3	TX2	<node_id>/<fp_slot_no>/P0/Tx2
	Rx 1	A2	RX1	<node_id>/<fp_slot_no>/P0/Rx1
	Tx 1	A1	TX1	<node_id>/<fp_slot_no>/P0/Tx1
P1	Rx 4	A8	RX4	<node_id>/<fp_slot_no>/P0/Rx4
	Tx 4	A7	TX4	<node_id>/<fp_slot_no>/P0/Tx4
	Rx 3	A6	RX3	<node_id>/<fp_slot_no>/P0/Rx3
	Tx 3	A5	TX3	<node_id>/<fp_slot_no>/P0/Tx3
	Rx 2	A4	RX2	<node_id>/<fp_slot_no>/P0/Rx2
	Tx 2	A3	TX2	<node_id>/<fp_slot_no>/P0/Tx2
	Rx 1	A2	RX1	<node_id>/<fp_slot_no>/P0/Rx1
	Tx 1	A1	TX1	<node_id>/<fp_slot_no>/P0/Tx1
P0	Rx 4	A8	RX4	<node_id>/<fp_slot_no>/P0/Rx4
	Tx 4	A7	TX4	<node_id>/<fp_slot_no>/P0/Tx4
	Rx 3	A6	RX3	<node_id>/<fp_slot_no>/P0/Rx3
	Tx 3	A5	TX3	<node_id>/<fp_slot_no>/P0/Tx3
	Rx 2	A4	RX2	<node_id>/<fp_slot_no>/P0/Rx2
	Tx 2	A3	TX2	<node_id>/<fp_slot_no>/P0/Tx2
	Rx 1	A2	RX1	<node_id>/<fp_slot_no>/P0/Rx1
	Tx 1	A1	TX1	<node_id>/<fp_slot_no>/P0/Tx1
(2 of 2)				

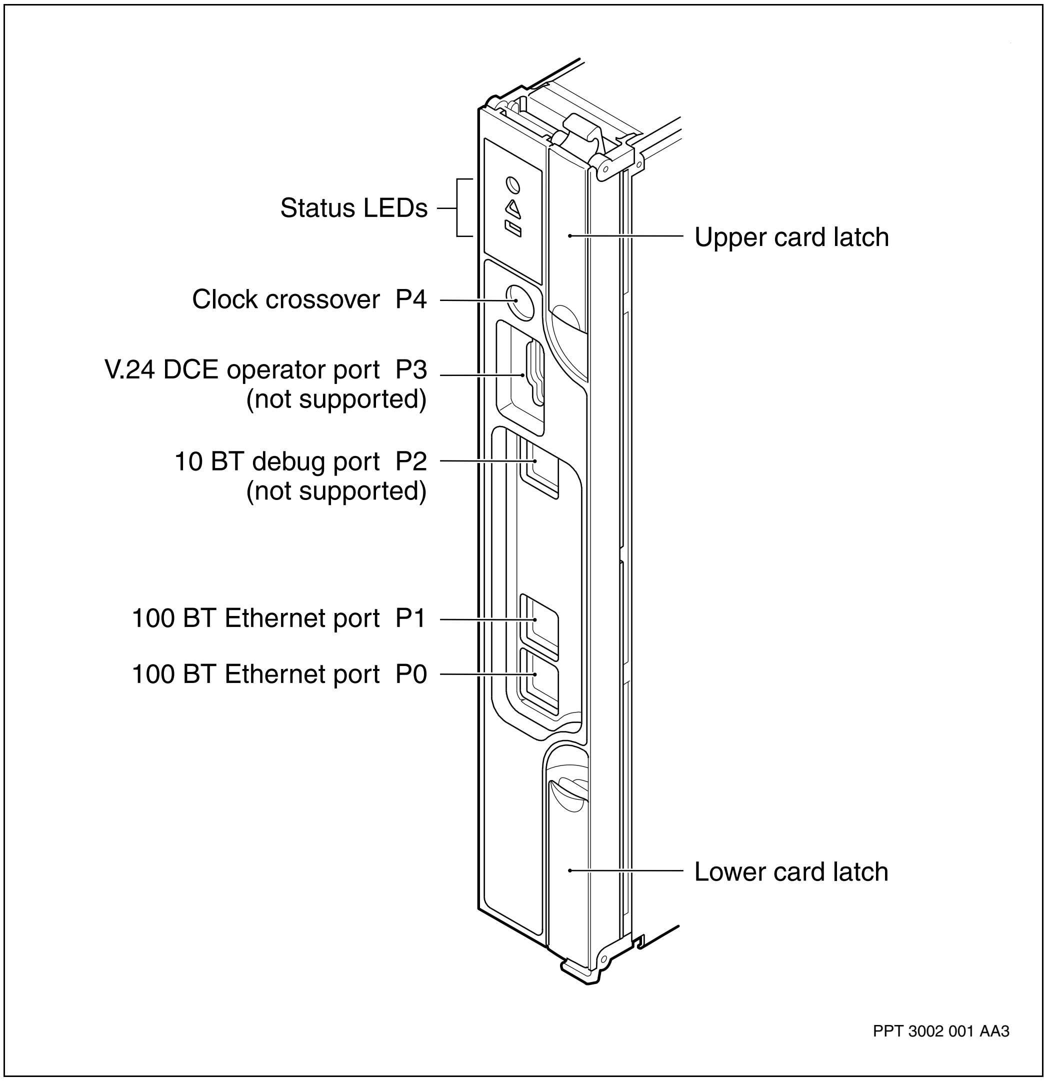
2-port general processor with disk

For the interface information about the 2-port GP with disk (2-port GPDsk), see:

- Faceplate of a 2-port GPDsk with PEC NTHW10 (page 170)
- 2-port GPDsk components (page 171)
- 2-port GPDsk pinout and signal names (page 171)
- 100BaseT Ethernet cable assembly (page 171)

The software name (card type) of the NTHW10 is 2pGPDsk.

Faceplate of a 2-port GPDsk with PEC NTHW10



2-port GPDsk components

The 2pGPDsk consists of a motherboard, a memory daughter card, and a power supply daughter card, with a hard disk mounted on the motherboard.

The 2pGPDsk connects to the shelf backplane, providing an interface to both fabric cards.

2-port GPDsk pinout and signal names

See the table Ethernet connector pinouts (page 128) for the faceplate connection assignments. The pinouts apply to both 10BaseT and 100BaseT connectors.

Attention: The 10Base-T Ethernet debug port is not supported.

Ethernet connector pinouts

Pin number	Signal name
1	Tx +
2	Tx -
3	Rx +
4	not used
5	not used
6	Rx -
7	not used
8	not used

100BaseT Ethernet cable assembly

The minimum grade of cable required for a 100BaseT Ethernet port is Category 5 unshielded twisted pair (UTP). Some installations may require a higher grade cable (for example, Enhanced Category 5 UTP cabling) to overcome cross-talk, immunity, and other noise problems.

Attention: In order to meet Class B electromagnetic compatibility (EMC) requirements, use shielded twisted pair (STP) cabling.

4-port Gigabit Ethernet FP

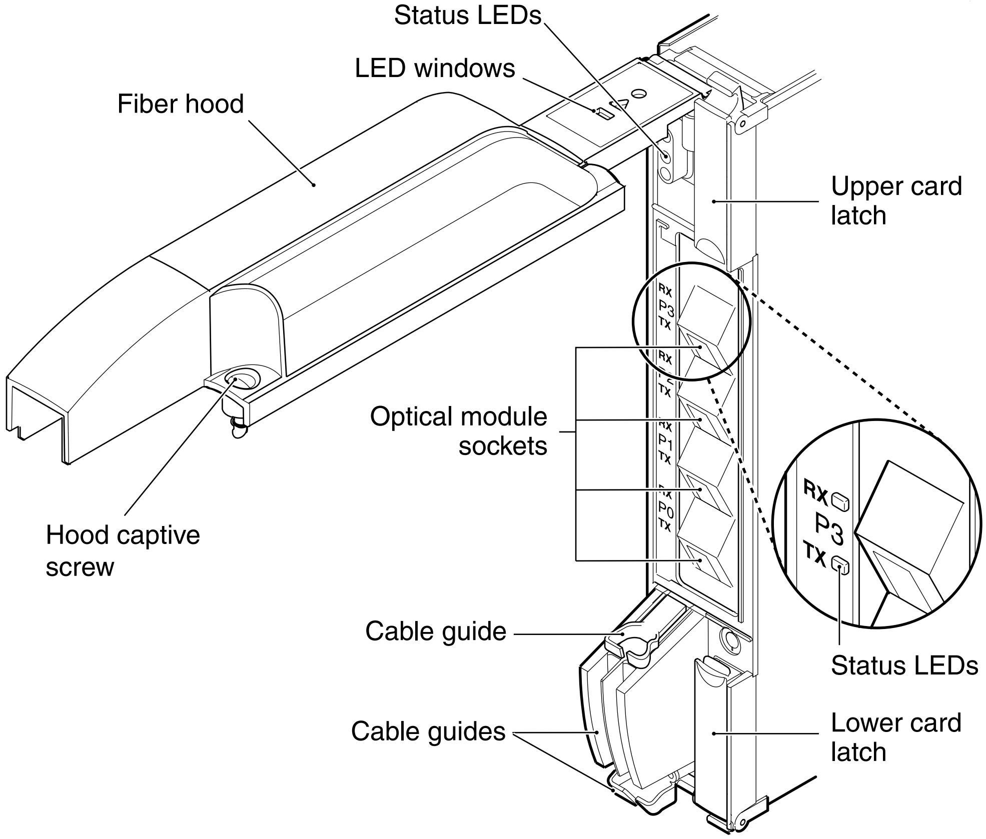
The 4-port Gigabit Ethernet (4pGe) FP provides four full-duplex Gigabit Ethernet ports (also known as optical module sockets). Separately ordered small form-factor pluggable (SFP) optical transceiver modules are required to provide optical signal reception and transmission. The 4pGe requires that an SFP module be plugged into each of its four optical module sockets (ports) in order for the card to operate. For the general description of what an SFP is, see SFP optical modules (page 239).

For the interface information about the 4-port Gigabit Ethernet FP, see:

- Faceplate of a 4-port Gigabit Ethernet FP with PEC NTHW49 (page 173); for the description of the port LEDs on the faceplate, see Status LEDs of the Ethernet ports on an NTHW49 (page 302)
- 4-port Gigabit Ethernet cable assemblies (page 173)
- Custom-making an LC cable assembly for an NTHW49 (page 174)
- SFP modules for an NTHW49 (page 175)

The software name (card type) of the NTHW49 is 4pGe.

Faceplate of a 4-port Gigabit Ethernet FP with PEC NTHW49



4-port Gigabit Ethernet cable assemblies

With a 4-port Gigabit Ethernet card (NTHW49), use single-mode (SM) or multimode duplex fiber cable with small-form duplex LC connectors at the FP end. Each port on the card requires a small-form pluggable (SFP) module that plugs into the faceplate. The fiber cable plugs into the SFP. The version of SFP that you chose determines the type of fiber cable (SM or MM) that you will need. Refer to SFP modules for an NTHW49 (page 175).

The signal distance with the gigabit Ethernet ports is described in Custom-making an LC cable assembly for an NTHW49 (page 174).

Optional retrofit kit NTPS40 is available to add a stick-on fiber cable management guide to the faceplate of the FP. Versions of the FP prior to PCR 6.1 GA do not have the guide installed at the factory.

Custom-making an LC cable assembly for an NTHW49

The sum of cable losses and connection losses from the FP to the far end termination depends on the installed and software-configured type of SFP optical transceiver. For a 1000BASE-SX SFP module, MM cable and connection losses must not exceed 7.5 dB. For a 1000BASE-LX SFP module, SM cable and connection losses must not exceed 10.5 dB. The losses in a transmission path from the fiber cable, splices, and connectors determine the distance that the FP can send a signal.

Make an LC cable assembly for an optical module for an NTHW49 FP using the following specifications:

- mutlimode (MM) fiber or single-mode (SM) fiber, depending on the type of optical module already installed
- duplex fiber cables (recommended to facilitate lesser cable densities) with color-coded halves
- a core diameter of 50 microns or 62.5 microns for MM, and 9 microns for SM
- a cladding diameter of 125 microns
- a maximum MM cable length for 50 microns is 550 m (1,804 ft.) and for 62.5 microns is 275 m (902.27 ft.)
- a maximum SM cable length is 10 km (6.2 miles)
- duplex LC connectors at the FP end, and any other fiber connector you choose at the far end from the FP
- attenuation between end-points is not required for LX optical modules using single-mode cable
- see the figure The LC cable assembly with duplex connectors and duplex cables (page 196) for the limitations of lengths of the cable neck parts

SFP modules for an NTHW49

More than one version of small-form pluggable (SFP) modules can be used per NTHW49 FP. The type of fiber cable must match the version of module, and all modules interface with small-form LC connectors.

The PEC versions of SFP modules that can be used with the NTHW49 are:

- NTTP01AB, 1000BASE-SX for multimode (MM) fiber cables for short reach (SR) up to 0.55 km (0.31 mi) when using 50/125 fiber or up to 0.275 km (0.17 mi) when using 62.5/125 fiber, and with a nominal wavelength of 850 nm
- NTTP01CB, 1000BASE-LX for single-mode (SM) fiber cables for intermediate reach (IR) up to 10 km (6.25 mi) and with a nominal wavelength of 1310 nm

The general description and purpose of SFPs is in SFP optical modules (page 239).

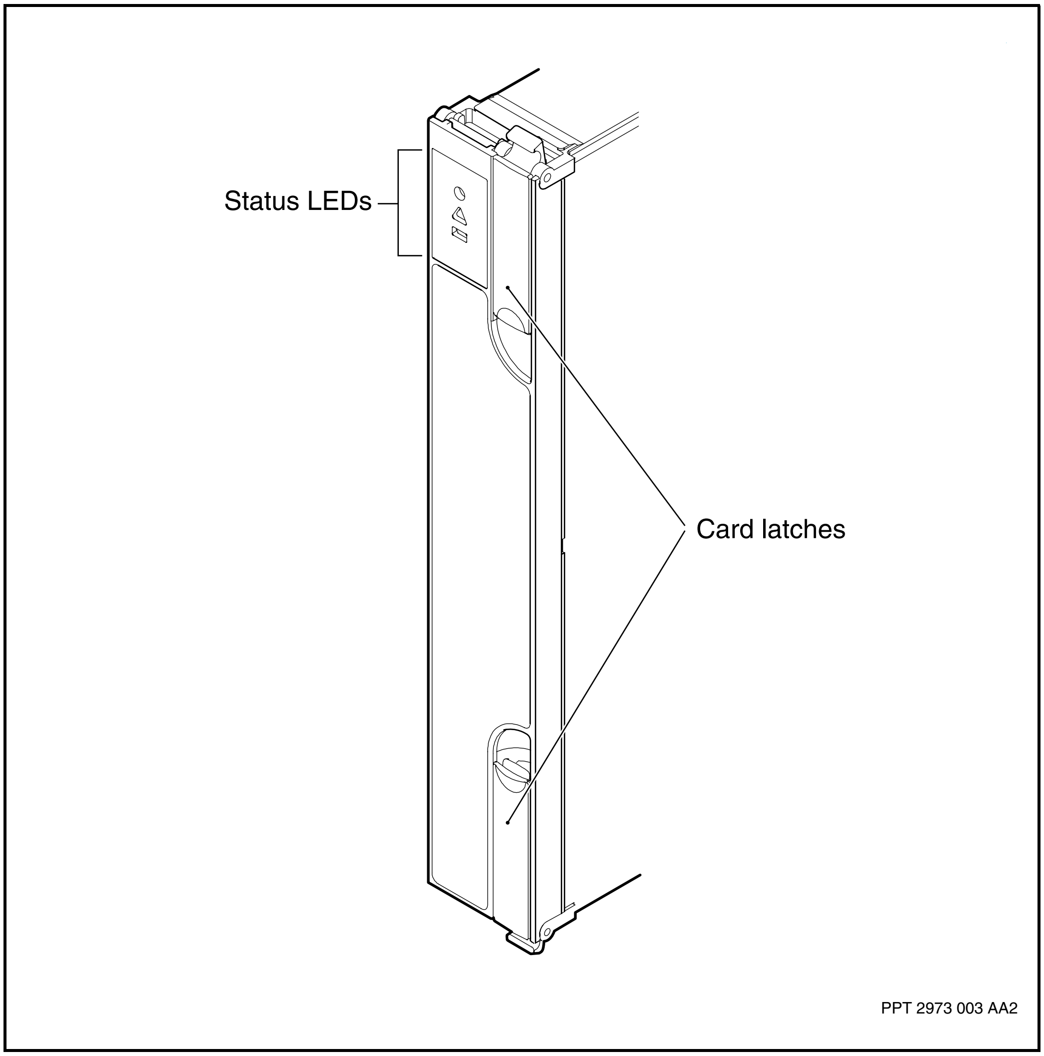
6-module packet server FP

The 6-module packet server service processor is a FP that provides extensive computing power through its six PCI mezzanine cards (PMC). Initially, the wireless service radio network controller (RNC) interface node uses the packet server FP to support radio bearer processing and protocol conversion. Using the capabilities of the packet server, Nortel Networks Multiservice Switch 15000 and Multiservice Switch 20000 nodes support the development of wireless internet. In the future, other CPU-intensive applications will develop new uses for the card.

The product engineering code (PEC) of the 6-module packet server FP is NTHW18. The software name of the FP is 6mPktServSP.

See the figure Faceplate of a 6-module packet server service processor with PEC NTHW18 (page 177).

Faceplate of a 6-module packet server service processor with PEC NTHW18



For more information on the 6mPktServSP FP, see these sections

- 6mPktServSP components (page 177)
- 6mPktServSP sparing (page 178)
- 6mPktServSP configuration (page 178)

6mPktServSP components

The 6mPktServSP FP consists of

- a motherboard containing two PMCs, the ATM management hardware, and the processor block
- a PCI PMC daughter card containing four PMCs and the ATM segmentation and reassembly (SAR) processors

- a PUPS daughter card containing the 3.3 V and 5 V point-of-use power supplies (PUPS)

The 6mPktServSP connects to the shelf backplane, providing an interface to both fabric cards. The 6mPktServSP FP has no external ports.

In the wireless RNC application, the 6mPktServSP FP supports these functions

- high-touch bearer processing
- radio protocol handling
- macro-diversity handover
- ATM adaptation layer protocol conversion

6mPktServSP sparing

There is no sparing arrangement for the 6mPktServSP FP in its current usage. It is the responsibility of the application running on the FP to arrange software sparing. In the case of the wireless RNC interface node application, the master PMC module in the shelf, which is called the PMC Manager (PMC-M), has a standby PMC-M module. The standby PMC-M takes over the master functions if the main PMC-M fails.

6mPktServSP configuration

The 6mPktServSP FP has no external connections or ports that need configuration. The card type value <cardtype> for the FP is *6mPktServSP*.

4-port MR POS and ATM FP

The 4-port multi-rate (MR) packet over SONET (POS) and asynchronous transfer mode (ATM) function processor (FP) requires control processor 3 (CP3) cards in the same shelf to enable operation.

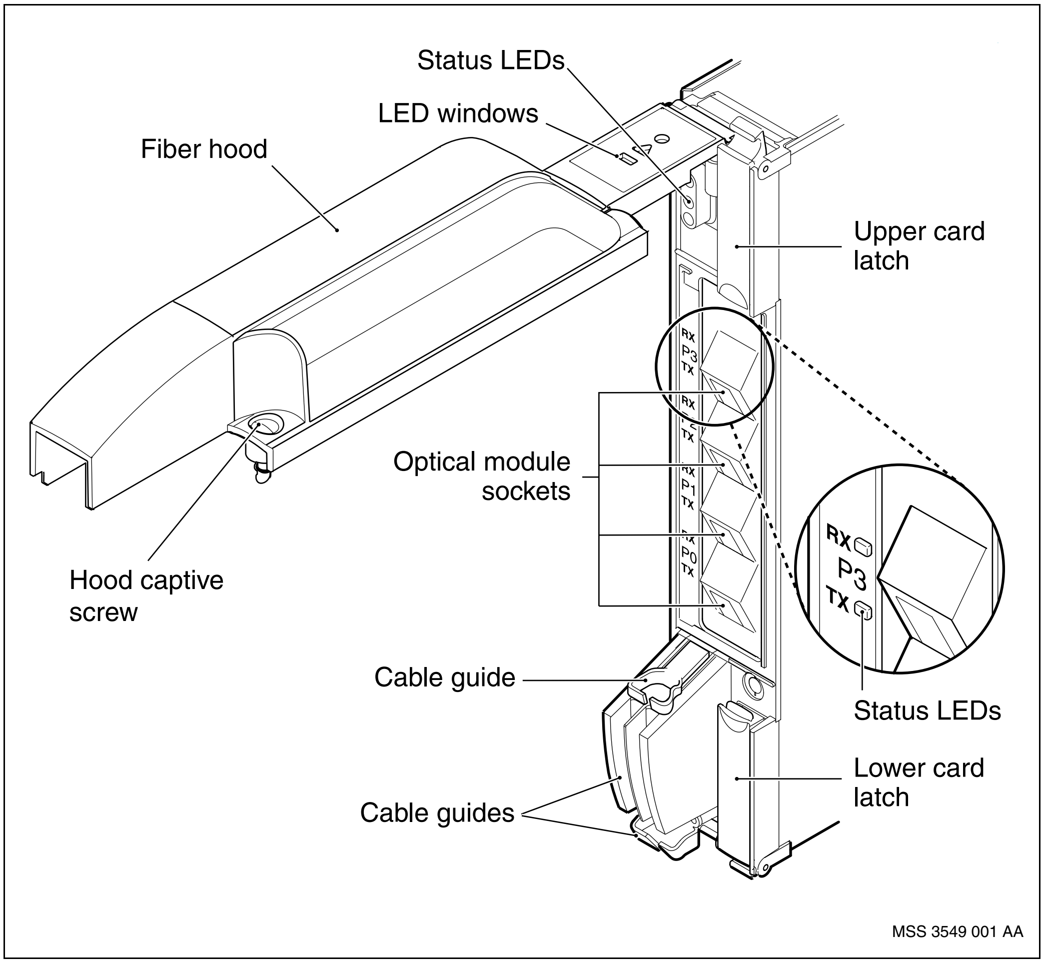
For the interface information about the 4-port MR POS ATM FP, see:

- Identifiers of the 4-port MR POS and ATM FP (page 179)
- Faceplate of a 4-port MR POS and ATM FP with PEC NTHW46 (page 180)
- Cable assemblies for a 4-port MR POS and ATM FP (page 181)
- SFP modules for an NTHW46 (page 181)
- Optical interface characteristics for a 4-port MR POS and ATM FP (page 181)

Identifiers of the 4-port MR POS and ATM FP

FP	PEC	Software name (card type)
4-port MR POS and ATM	NTHW46	4pMRPosAtm

Faceplate of a 4-port MR POS and ATM FP with PEC NTHW46



Cable assemblies for a 4-port MR POS and ATM FP

Use only single-mode (SM) fiber cable with the 4-port MR POS and ATM FP. You must provide the cable with attached connectors.

The single-mode fiber cable must have a core diameter of 9 microns and cladding diameter of 125 microns. The attenuation is less than 0.5 dB/km at 1300 nm.

The sum of cable splice losses and connector losses from the FP to customer premises equipment (CPE) must not exceed 12 dB for IR-1 SFP optical modules and 24 dB for LR-1 SFP optical modules. The losses in a transmission path determine the distance the FP can send a signal. The maximum reach of IR-1 and LR-1 optical interfaces is 15 to 20 km and 40 km, respectively, for single-mode cable, depending on the losses due to splices and connectors.

SFP modules for an NTHW46

More than one version of SFP module can be used per FP. The type of fiber cable must match the version of module, and all modules interface with small-form LC connectors. The PEC versions of SFP modules that can be used with the NTHW46 are:

- NTTP04CF for SM cables for intermediate reach (IR-1/S-4.1) up to 15 km (9.3 mi) and with a nominal wavelength of 1310 nm
- NTTP05EF for SM cables for long reach (LR-1/L-4.1) up to 40 km (24.8 mi) and with a nominal wavelength of 1310 nm

The general description and purpose of SFPs is in SFP optical modules (page 239).

The descriptions of cable assemblies are in Cable assemblies for an NTHW44 (page 200) and Cable specifications for custom-making LC cable assemblies (page 205).

Optical interface characteristics for a 4-port MR POS and ATM FP

The optical interface characteristics for the 4-port MR POS and ATM FP (NTHW46) are shown in the following tables:

- 4-port MR POS and ATM FP general interface characteristics (page 182)
- Transmit characteristics of an NTHW46 with SM OC-12 IR-1/S-4.1 SFP modules (page 182)
- Receive characteristics of an NTHW46 with SM OC-12 IR-1/S-4.1 SFP modules (page 182)
- Transmit characteristics of an NTHW46 with SM OC-12 LR-1/L-4.1 SFP modules (page 183)

- Receive characteristics of an NTHW46 with SM OC-12 LR-1/L-4.1 SFP modules (page 183)

4-port MR POS and ATM FP general interface characteristics

General optical interface characteristics	
Faceplate connector	SFP duplex LC (duplex small-form factor pluggable LC transceiver for duplex fiber cables)
Bit rate	622 Mbit/s per port, simultaneously (when configured with OC-12/STM-4 SFP optical modules)
Line encoding	Binary non-return-to-zero (NRZ)

Transmit characteristics of an NTHW46 with SM OC-12 IR-1/S-4.1 SFP modules

Transmit characteristics	Minimum	Maximum	Unit
Emission wavelength	1293	1334	nm
Attenuation	0	12	dB
Maximum dispersion	not applicable	46	ps/nm
Maximum RMS Spectral width	not applicable	2.5	nm
Mean transmission power	-15	-8	dBm
Minimum extinction ratio	8.2	not applicable	dB
Eye pattern mask	Compliant with ITU-T G.957 and Telcordia GR-253		
Side node suppression ratio (SSR)	not applicable	not applicable	

Receive characteristics of an NTHW46 with SM OC-12 IR-1/S-4.1 SFP modules

Receive characteristics	Minimum	Maximum	Unit
Receive laser power	-28	-8	dBm
Optical path power penalty	not applicable	1	dB
Maximum received reflectance	not applicable	not applicable	

Transmit characteristics of an NTHW46 with SM OC-12 LR-1/L-4.1 SFP modules

Transmit characteristics	Minimum	Maximum	Unit
Emission wavelength	1280	1335	nm
Attenuation	10	24	dB
Maximum dispersion	not applicable	92	ps/nm
Maximum RMS Spectral width	not applicable	2	nm
Mean transmission power for single mode (SM) long reach (IR)	-3	2	dBm
Minimum extinction ratio	10	not applicable	dB
Eye pattern mask	Compliant with ITU-T G.957 and Telcordia GR-253		
Side node suppression ratio (SSR)	30	not applicable	

Receive characteristics of an NTHW46 with SM OC-12 LR-1/L-4.1 SFP modules

Receive characteristics	Minimum	Maximum	Unit
Receive laser power	-28	-8	dBm
Optical path power penalty	not applicable	1	dB
Maximum received reflectance	not applicable	-14	

4-port OC-3/STM-1 ATM FPs

For the interface information about the 4-port OC-3/STM-1 ATM FP, see:

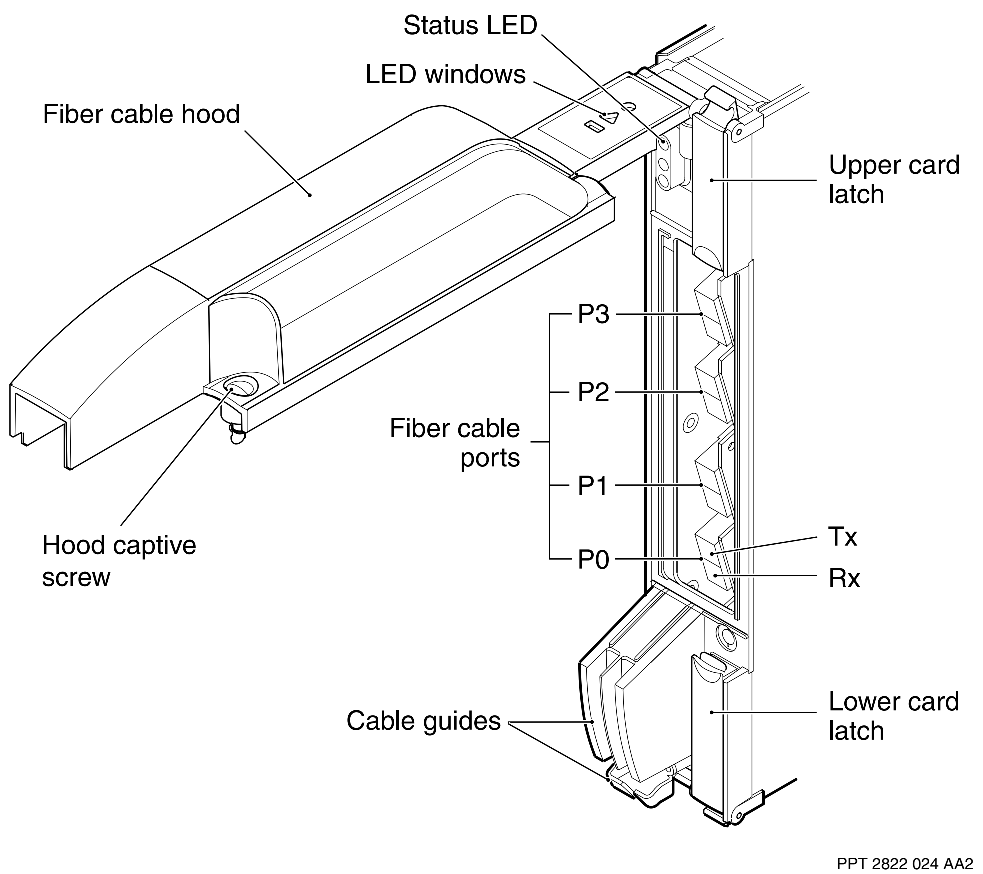
- 4-port OC-3/STM-1 FP identifiers (page 184)
- Faceplate of a 4-port OC-3/STM-1 ATM FP (page 185)
- 4-port OC-3/STM-1 ATM FP cable assembly (page 185)
- 4-port OC-3/STM-1 ATM FP optical interface characteristics (page 186)

4-port OC-3/STM-1 FP identifiers

FP name	PEC of PQC6v2 (or PQC2)	PEC of PQC12	Software name (card type)
4-port OC-3/STM-1 multimode ATM	NTHR17	NTHW05	4pOC3MmAtm
4-port OC-3/STM-1 single-mode intermediate reach ATM	NTHR21	NTHW15	4pOC3SmIr
The CA vintage or higher is required to support hitless software migration and equipment protection features.			

When a specific identifier is not mentioned, the text applies to both PQC versions of the card.

Faceplate of a 4-port OC-3/STM-1 ATM FP



4-port OC-3/STM-1 ATM FP cable assembly

The fiber mode type must be the same as the FP mode type. You must provide the cable with attached connectors. Use single-mode (SM) fiber cable with single-mode FPs and multimode (MM) fiber cable with multimode FPs.

Multimode fiber cable must conform to ANSI/E1A/T1A-568. The multimode fibre cable must have a core diameter of 62.5 microns and a cladding diameter of 125 microns. The modal bandwidth is at least 500 MHz-km and the attenuation is less than 1.0 dB/km at 1300 nm.

Single-mode fiber cable must have a core diameter of 9 microns and a cladding diameter of 125 microns. The attenuation is less than 0.5 dB/km at 1300 nm.

The OC-3 uses standard duplex SC connectors.

The sum of cable losses and connector losses from the FP to customer premises equipment (CPE) must not exceed 10 dB for multimode cable and 12 dB for single-mode cable. The losses in a transmission path determine the distance the FP can send a signal. The maximum distance from the FP to CPE is 2 km for multimode cable and 15 to 20 km for single-mode cable, depending on the losses due to splices and connectors.

4-port OC-3/STM-1 ATM FP optical interface characteristics

The optical interface characteristics for the 4-port OC-3/STM-1 ATM single-mode (SM) intermediate reach (IR) and multimode (MM) FP are shown in these tables

- 4-port OC-3/STM-1 ATM general interface characteristics (page 186)
- 4-port OC-3/STM-1 ATM SM IR FP transmit characteristics (page 186)
- 4-port OC-3/STM-1 ATM SM IR FP receive characteristics (page 187)
- 4-port OC-3/STM-1 ATM MM FP transmit characteristics (page 187)
- 4-port OC-3/STM-1 ATM MM FP receive characteristics (page 187)

4-port OC-3/STM-1 ATM general interface characteristics

General optical interface characteristics	
Faceplate connector	dual SC transceiver for simplex cable connectors
Bit rate	155.520 Mbit/s
Line encoding	binary non-return-to-zero (NRZ)

4-port OC-3/STM-1 ATM SM IR FP transmit characteristics

Transmit characteristic	Value
Emission wavelength	1261 to 1360 nm
Attenuation	0 to 12 dB
Maximum dispersion	96 ps/nm
Maximum RMS spectral width	7.7 nm
Mean transmission power	-15 to -8 dBm
Minimum extinction ratio	8.2 dB
Eye pattern mask	Compliant with ITU G.957 Fig 2, ANSI T1E1.2/94-002R1-Fig 10, TA-253 Issue 8 Fig 4-2
Side node suppression ratio (SSR)	not applicable

4-port OC-3/STM-1 ATM SM IR FP receive characteristics

Receive characteristic	Value
Maximum receive power (average)	-8 dBm
Minimum receive power (average)	-28 dBm
Optical path power penalty	1 dB
Maximum received reflectance	not applicable

4-port OC-3/STM-1 ATM MM FP transmit characteristics

Transmit characteristic	Value
Emission wavelength	1270 to 1380 nm
Attenuation	0 to 10 dB
Maximum dispersion	18 ps/nm
Maximum RMS spectral width	80 nm
Mean transmission power	-20 to -14 dBm
Minimum extinction ratio	8.2 dB
Eye pattern mask	not applicable
Side node suppression ratio (SSR)	not applicable

4-port OC-3/STM-1 ATM MM FP receive characteristics

Receive characteristic	Value
Maximum receive power (average)	-14 dBm
Minimum receive power (average)	-30 dBm
Optical path power penalty	1 dB
Maximum received reflectance	not applicable

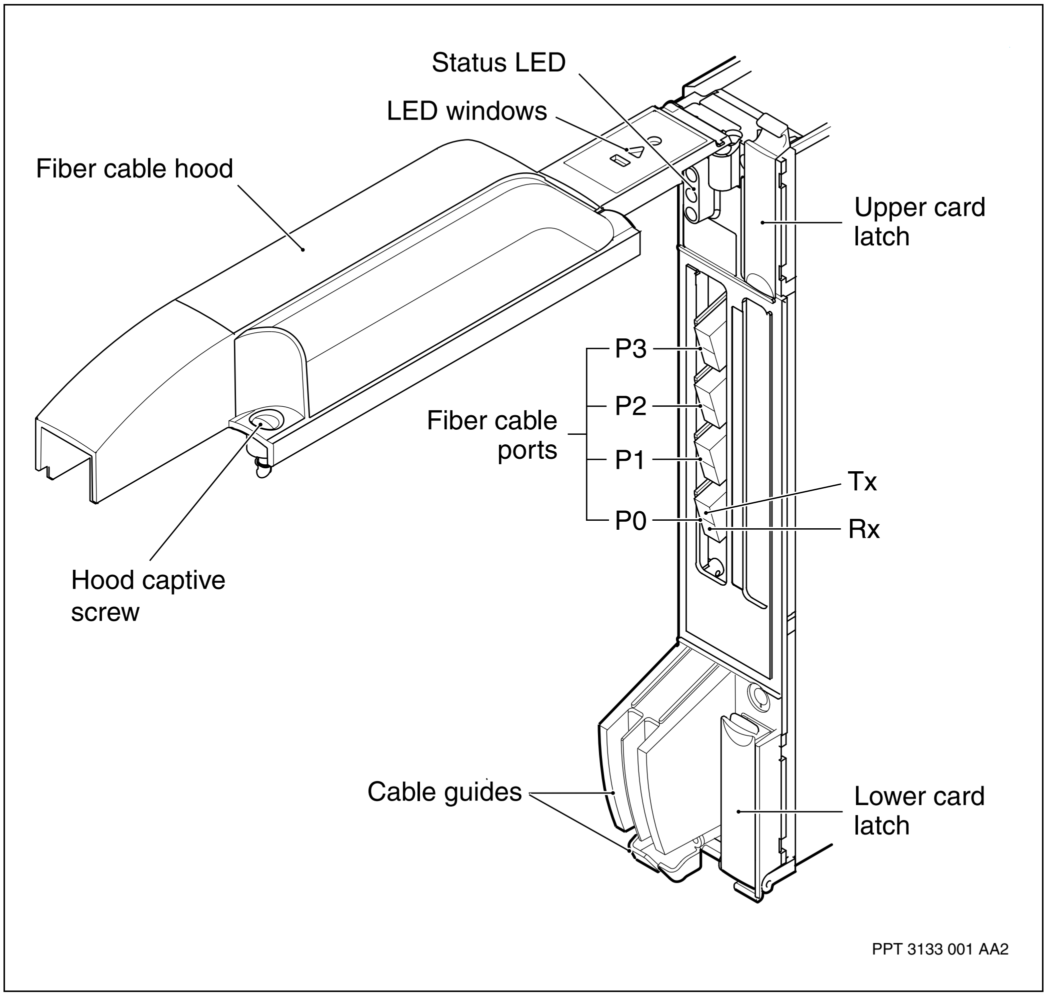
4-port OC-3/STM-1Ch TDM/CES FP

For the interface information about the 4-port OC-3/STM-1 channelized FP with time division multiplexing (TDM) for circuit emulation services (CES), see:

- Faceplate of a 4-port OC-3/STM-1Ch TDM/CES FP with PEC NTHW70 (page 188)
- 4-port OC-3/STM-1Ch TDM/CES FP cable assembly (page 188)
- 4-port OC-3/STM-1Ch TDM/CES FP optical interface characteristics (page 189)

The software name (card type) of the NTHW70 is 4pOC3ChSmIr.

Faceplate of a 4-port OC-3/STM-1Ch TDM/CES FP with PEC NTHW70



4-port OC-3/STM-1Ch TDM/CES FP cable assembly

Use only single-mode (SM) fiber cable with the 4-port OC-3/STM-1Ch TDM/CES FP. You must provide the cable with attached connectors.

Single-mode fiber cable must have a core diameter of 9 microns and a cladding diameter of 125 microns. The attenuation is less than 0.5 dB/km at 1300 nm.

The 4-port OC-3/STM-1Ch TDM/CES FP uses standard duplex SC connectors.

The sum of cable losses and connector losses from the FP to customer premises equipment (CPE) must not exceed 12 dB for single-mode cable. The losses in a transmission path determine the distance the FP can send a signal. The maximum distance from the FP to CPE is 15 to 20 km for single-mode cable, depending on the losses due to splices and connectors.

4-port OC-3/STM-1Ch TDM/CES FP optical interface characteristics

The optical interface characteristics for the 4-port OC-3/STM-1Ch single-mode (SM) TDM/CES FP are shown in these tables

- 4-port OC-3/STM-1Ch TDM/CES FP general interface characteristics (page 189)
- 4-port OC-3/STM-1Ch TDM/CES FP transmit characteristics (page 189)
- 4-port OC-3/STM-1Ch TDM/CES FP receive characteristics (page 190)

4-port OC-3/STM-1Ch TDM/CES FP general interface characteristics

General optical interface characteristics	
Faceplate connector	dual SC transceiver for simplex cable connectors
Bit rate	155.520 Mbit/s
Line encoding	binary non-return-to-zero (NRZ)

4-port OC-3/STM-1Ch TDM/CES FP transmit characteristics

Transmit characteristic	Value
Emission wavelength	1260 nm to 1360 nm
Attenuation	0 to 12 dB
Maximum dispersion	96 ps/nm
Maximum RMS spectral width	7.7 nm
Mean transmission power	-15 to -8 dBm
Minimum extinction ratio	8.2 dB
(1 of 2)	

4-port OC-3/STM-1Ch TDM/CES FP transmit characteristics (continued)

Transmit characteristic	Value
Eye pattern mask	Compliant with ITU G.957 Fig 2, ANSI T1E1.2/94-002R1-Fig 10, TA-253 Issue 8 Fig 4-2
Side node suppression ratio (SSR)	not applicable
(2 of 2)	

4-port OC-3/STM-1Ch TDM/CES FP receive characteristics

Receive characteristic	Value
Maximum receive power (average)	-8 dBm
Minimum receive power (average)	-31 dBm
Optical path power penalty	not applicable
Maximum received reflectance	not applicable

16-port OC-3/STM-1 ATM FP with MT-RJ connectors

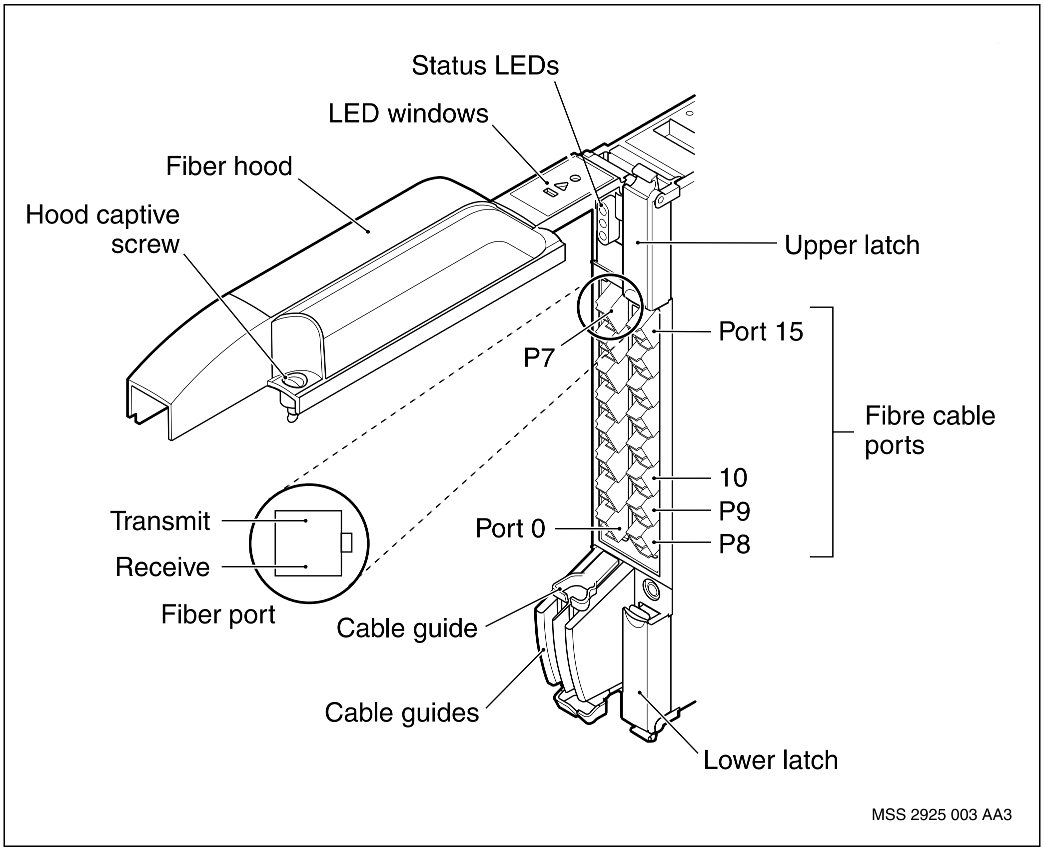
For the interface information about the 16-port OC-3/STM-1 FP with MT-RJ connectors, see:

- the figure Faceplate of a 16-port OC-3/STM-1 ATM FP with MT-RJ connectors with PEC NTHW21 (page 191)

  If your card has PEC NTHW31, see 16-port OC-3/STM-1 ATM FP with LC connectors (page 194)
- Cable assemblies for an NTHW21 (page 191)
- Optical interface characteristics for an NTHW21 (page 192)

The software name (card type) of the NTHW21 is 16pOC3SmIrAtm.

Faceplate of a 16-port OC-3/STM-1 ATM FP with MT-RJ connectors with PEC NTHW21



Cable assemblies for an NTHW21

The fiber mode type must be the same as the FP mode type. You must provide the cable with attached connectors.

With an NTHW21 FP, use single-mode (SM) fiber cable with a core diameter of 9 microns and a cladding diameter of 125 microns. The attenuation is less than 0.5 dB/km at 1300 nm.

Use SM MT-RJ female (non-pinned) connectors at the FP end. Both the transmit and the receive ports are in the same connector.

The sum of cable losses and connector losses from the FP to the far end termination must not exceed 12 dB for SM cable. The losses in a transmission path determine the distance the FP can send a signal. The maximum distance from the FP to the far end is 15 to 20 km for SM cable, depending on the losses due to splices and connectors.

Optional retrofit kit NTPS40 is available to add a stick-on fiber cable management guide to the faceplate of the FP. Versions of the FP prior to PCR 6.1 GA do not have the guide installed at the factory.

Optical interface characteristics for an NTHW21

The optical interface characteristics for a 16-port OC-3/STM-1 single-mode (SM) intermediate reach (IR) FP with MT-RJ connectors that has PEC NTHW21 are shown in these tables:

- General interface characteristics for an NTHW21 (page 192)
- Transmit characteristics for an NTHW21 (page 192)
- Receive characteristics for an NTHW21 (page 193)

General interface characteristics for an NTHW21

General optical interface characteristics	
Faceplate connector	duplex MT-RJ male (pinned) transceiver
Bit rate	155.520 Mbit/s
Line encoding	binary non-return-to-zero (NRZ)

Transmit characteristics for an NTHW21

Transmit characteristic	Value
Emission wavelength	1261 nm to 1360 nm
Attenuation	0 to 12 dB
Maximum dispersion	96 ps/nm
Maximum RMS spectral width	7.7 nm
Mean transmission power	-15 to -8 dBm
(1 of 2)	

Transmit characteristics for an NTHW21 (continued)

Transmit characteristic	Value
Minimum extinction ratio	8.2 dB
Eye pattern mask	Compliant with ITU G.957 Fig 2, ANSI T1E1.2/94-002R1-Fig 10, TA-253 Issue 8 Fig 4-2
Side node suppression ratio (SSR)	not applicable
	(2 of 2)

Receive characteristics for an NTHW21

Receive characteristic	Value
Maximum receive power (average)	-8 dBm
Minimum receive power (average)	-28 dBm
Optical path power penalty	1 dB
Maximum received reflectance	not applicable

16-port OC-3/STM-1 ATM FP with LC connectors

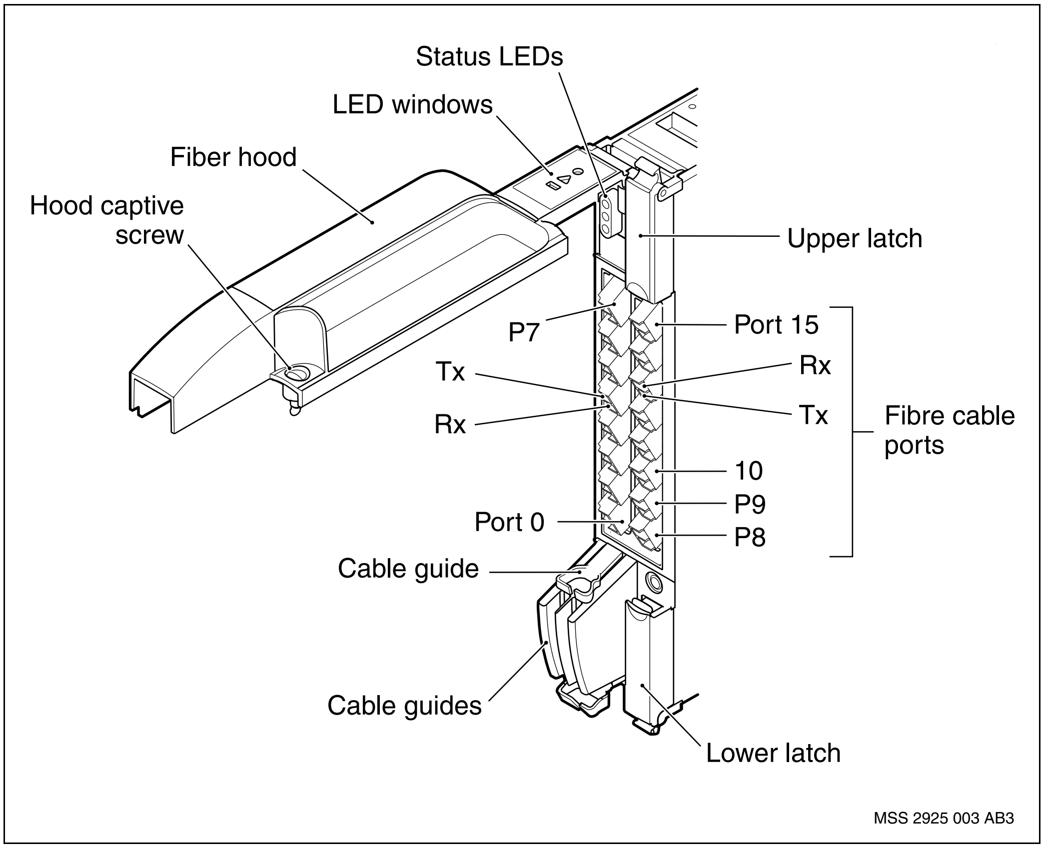
For the interface information about the 16-port OC-3/STM-1 FP with LC connectors, see:

- Faceplate of a 16-port OC-3/STM-1 ATM FP with LC connectors with PEC NTHW31 (page 194)

  If your card has PEC NTHW21, see 16-port OC-3/STM-1 ATM FP with MT-RJ connectors (page 191).
- Cable assemblies for an NTHW31 (page 194)
- Optical interface characteristics for an NTHW31 (page 196)

The software name (card type) of the NTHW31 is 16pOC3SmIrAtm.

Faceplate of a 16-port OC-3/STM-1 ATM FP with LC connectors with PEC NTHW31



Cable assemblies for an NTHW31

With an NTHW31 FP, use single-mode (SM) fiber cable with small-form LC connectors at the FP end.

The sum of cable losses and connector losses from the FP to the far end termination must not exceed 12 dB for SM cable. The losses in a transmission path determine the distance the FP can send a signal. The maximum distance from the FP to the far end is 15 to 20 km for SM cable, depending on the losses due to splices, repeaters, and connectors.

You must custom make your cable assemblies. Follow the specifications in Cable specifications for custom-making an LC cable assembly (page 229).

Optional retrofit kit NTPS40 is available to add a stick-on fiber cable management guide to the faceplate of the FP. Versions of the FP prior to PCR 6.1 GA do not have the guide installed at the factory.

Cable specifications for custom-making LC cable assemblies

Make an LC cable assembly using the following specifications. Refer also to the figure The LC cable assembly with duplex connectors and duplex cables (page 196).

- Use single-mode (SM) fiber with a core diameter of 9 microns and a cladding diameter of 125 microns.
- Use duplex fiber cables to provide lesser cable volumes and easier cable management under the hood.
- The outside diameter of one SM cable must not exceed 1.6 mm (0.0629 inch). The combined outside width of two cables zipped together to make a duplex cable must not exceed 3.2 mm (0.1259 inch) as shown in the figure The LC cable assembly with duplex connectors and duplex cables (page 196). The thinner cable allows the fiber hood on the faceplate to close over the entire cluster of cables without pinching them and can allow the duplex cable to be ravelled onto the tray of a fiber management unit (NTHW50).

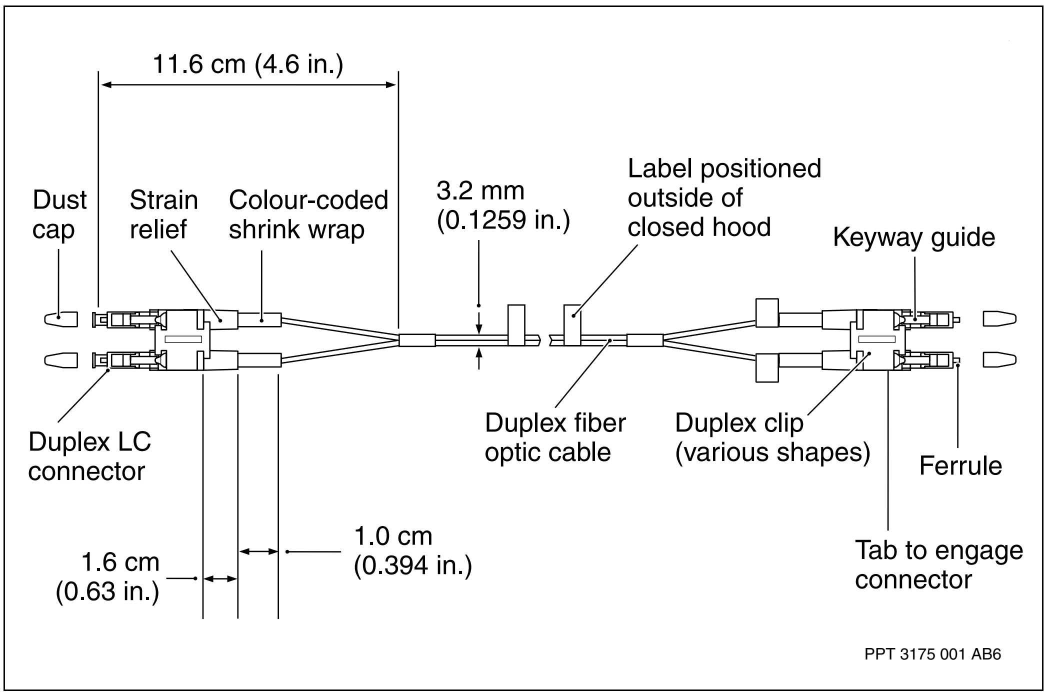
Attention: Ladder rackable cable (especially at 3.0 mm) cannot be used.

- Use duplex small-form LC connectors at the FP end especially since the Tx and Rx transceivers are opposite on each side of the faceplate, and any other fiber connector you choose at the next hop from the FP.
- Use color-coded shrink wrap at the connectors to indicate parallel Tx and Rx connections of the ends. The total length of the shrink wrap should not exceed 2.6 cm (1.0 inch). The shrink wrap should extend from the rear of the connector through the strain relief (neck reinforcement) with up to 1.0 cm (0.394 in.) exposed, as indicated in the figure The LC cable assembly with duplex connectors and duplex cables (page 196).
- After each connector, add a stiff strain relief no longer than 1.6 cm (0.63 in.), as indicated in the figure The LC cable assembly with duplex

connectors and duplex cables (page 196). Applying a coating of resilient gap filler between the cable and the strain relief is determined by the manufacturer of the cable assembly.

- The combined measurements of connector, strain relief, and shrink wrap must accommodate the curve of the hood on the FP faceplate so that the hood can be closed without pinching any cables.
- Cables should be manufactured and verified to comply with Telcordia GR-326 specifications.
- If required, use an attenuation less than 0.5 dB/km at 1300 nm.

The LC cable assembly with duplex connectors and duplex cables



Optical interface characteristics for an NTHW31

The optical interface characteristics for a 16-port OC-3/STM-1 ATM single-mode (SM) intermediate reach (IR) FP with LC connectors that has PEC NTHW31 are shown in these tables:

- General interface characteristics for an NTHW31 (page 197)
- Transmit characteristics for an NTHW31 (page 197)
- Receive characteristics for an NTHW31 (page 197)

General interface characteristics for an NTHW31

General optical interface characteristics	
Faceplate connector	duplex small-form LC transceiver for duplex fiber cables
Bit rate	155.54 Mbit/s
Line encoding	binary non-return-to-zero (NRZ)

Transmit characteristics for an NTHW31

Transmit characteristic	Minimum	Maximum	Unit
Emission wavelength	1261	1360	nm
Attenuation	0	12	dB
Maximum dispersion	96	96	ps/nm
Maximum RMS spectral width	not applicable	7.7	m
Mean transmission power	-15	-8	dBm
Minimum extinction ratio	8.2	not applicable	dB
Eye pattern mask	Compliant with ITU G.957 Fig 2, ANSI T1E1.2/94-002R1-Fig 10, TA-253 Issue 8 Fig 4-2		
	Compliant with ITU G.957 and Telcodia TR-NWT-000253		
Side node suppression ratio (SSR)	not applicable	not applicable	

Receive characteristics for an NTHW31

Receive characteristic	Minimum	Maximum	Unit
Receive power (average)	-28	-8	dBm
Receive sensitivity at eye center (average)		-31.8	dBm
Receive sensitivity at window edge (average)		-31	dBm
Receive power (average)	-28	-8	dBm
Optical path power penalty	1	1	dB
Maximum received reflectance	not applicable	not applicable	

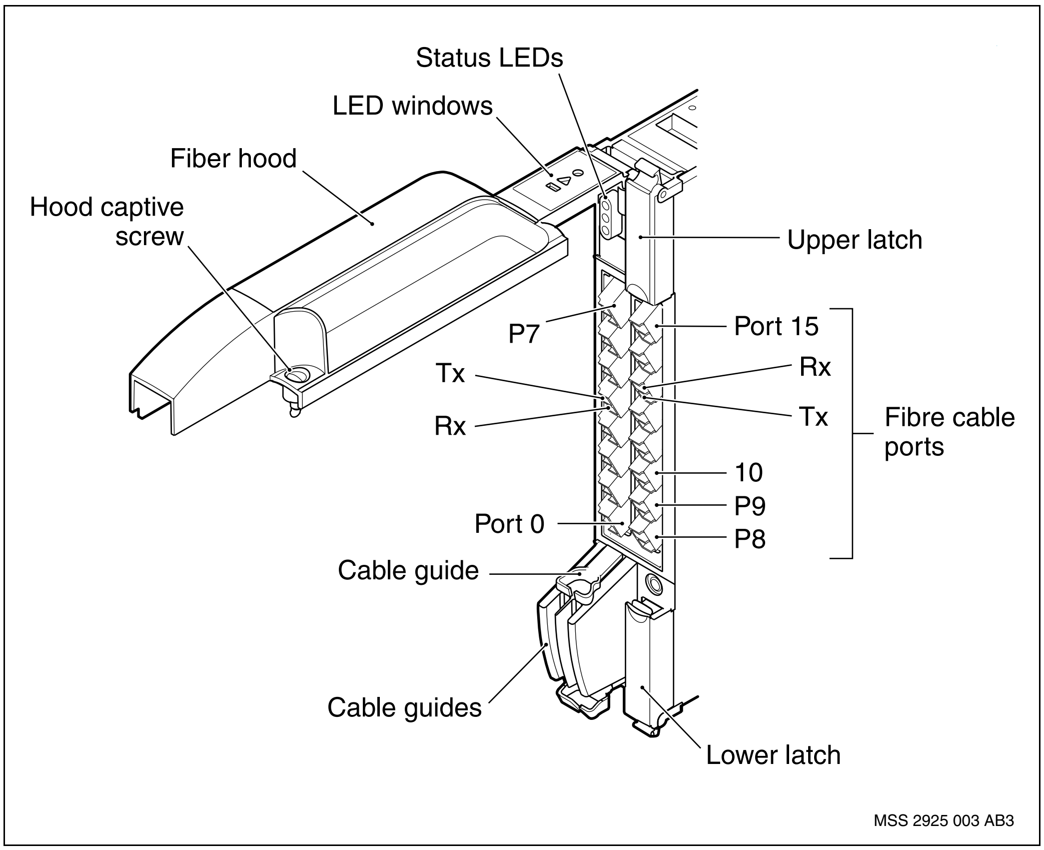
16-port OC-3/STM-1 ATM FP with OAM cell conversion

For the interface information about the 16-port OC-3/STM-1 ATM FP with OAM cell conversion (and LC connectors), see:

- Faceplate of a 16-port OC-3/STM-1 ATM FP with OAM cell conversion with PEC NTHW24 (page 198)
- Cable assemblies for an NTHW24 (page 198)

The software name (card type) of the NTHW24 is 16pOC3SmIrAtm.

Faceplate of a 16-port OC-3/STM-1 ATM FP with OAM cell conversion with PEC NTHW24



Cable assemblies for an NTHW24

With an NTHW24 FP, the cable assembly specifications are the same as described in Cable assemblies for an NTHW31 (page 194).

Cable specifications for custom-making LC cable assemblies

The specifications to make an LC cable assembly are the same as described in Cable assemblies for an NTHW31 (page 194).

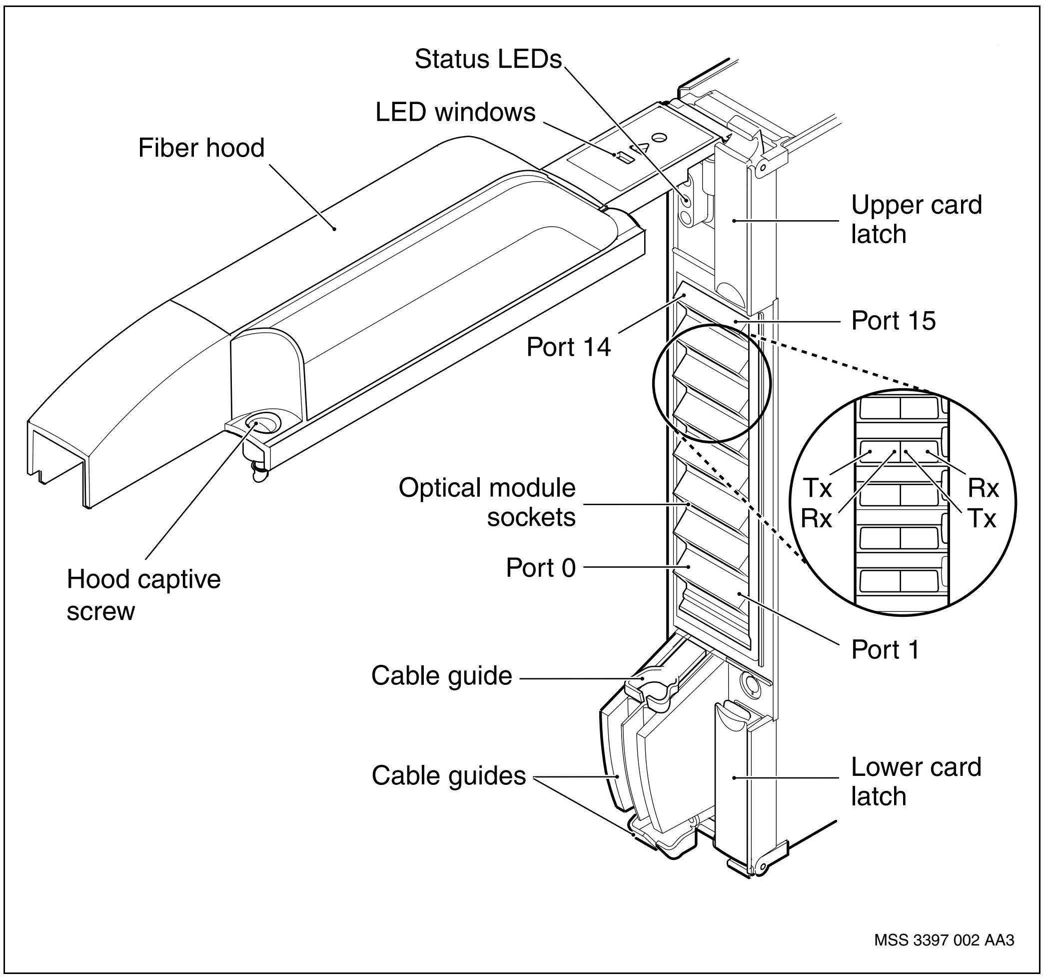
16-port OC-3/STM-1 POS and ATM FP

The 16-port OC-3/STM-1 packet over SONET (POS) and asynchronous transfer mode (ATM) function processor (FP) requires control processor 3 (CP3) cards in the same shelf to enable operation. For the interface information about the 16-port OC-3/STM-1 POS and ATM FP, see:

- Faceplate of a 16-port OC-3/STM-1 POS and ATM FP with PEC NTHW44 (page 199)
- Cable assemblies for an NTHW44 (page 200)
- SFP modules for an NTHW44 (page 202)
- Cable specifications for custom-making LC cable assemblies (page 205)
- Optical interface characteristics for an NTHW44 (page 202)

The software name (card type) of the NTHW44 is 16pOC3PosAtm.

Faceplate of a 16-port OC-3/STM-1 POS and ATM FP with PEC NTHW44



Cable assemblies for an NTHW44

With the NTHW44 card, use single-mode (SM) or multimode (MM) duplex fiber cable with small-form duplex LC connectors at the FP end. Each port on the card requires a small-form pluggable (SFP) module that plugs into the faceplate. The fiber cable plugs into the SFP. The version of SFP that you chose determines the type of fiber cable (SM or MM) that you will need. Refer to SFP modules for an NTHW44 (page 202).

When dual NTHW44 cards are configured in software for Y-protection, see Specifications for Y-splitter cable assemblies for Y-protection (page 206).

The sum of cable losses and connection losses from the FP to the far end termination depends on the installed and software-configured type of SFP optical transceiver. For an OC-3 SR-0 SFP module, MM cable and connection losses must not exceed 10 dB. For an OC-3 IR-1/S-1.1 SFP module, SM cable and connection losses must not exceed 12 dB. For an OC-3 LR-1/L-1.1 SFP module, SM cable and connection losses must be between 10 to 28 dB, and if less than 10 dB the connection needs an optical attenuator. The losses in a transmission path from the fiber cable, splices, and connectors determine the distance the FP can send a signal.

You must custom make your cable assemblies. Follow the specifications in Cable specifications for custom-making LC cable assemblies (page 205).

Optional retrofit kit NTPS40 is available to add a stick-on fiber cable management guide to the faceplate of the FP. Versions of the FP prior to PCR 6.1 GA do not have the guide installed at the factory.

Cable specifications for custom-making female MT-RJ to male LC cable assemblies

Make a female MT-RJ to male LC cable assembly using the following specifications. Refer to the figure The MT-RJ-to-LC cable assembly with duplex connector and MT-RJ-to-MT-RJ adapter (page 202).

- Use single-mode (SM) fiber with a core diameter of 9 microns and a cladding diameter of 125 microns.
- Use duplex fiber cables to provide lesser cable volumes and easier cable management under the hood.
- The outside diameter of one SM cable must not exceed 1.6 mm (0.0629 inch). The combined outside width of two cables zipped together to make a duplex cable must not exceed 3.2 mm (0.1259 inch) as shown in the figure The MT-RJ-to-LC cable assembly with duplex connector and MT-RJ-to-MT-RJ adapter (page 202). The thinner cable allows the fiber hood on the faceplate to close over the entire cluster of cables without pinching them and can allow the duplex cable to be wound onto the tray of a fiber management unit (NTHW50).

Attention: Ladder rackable cable (especially at 3.0 mm) cannot be used.

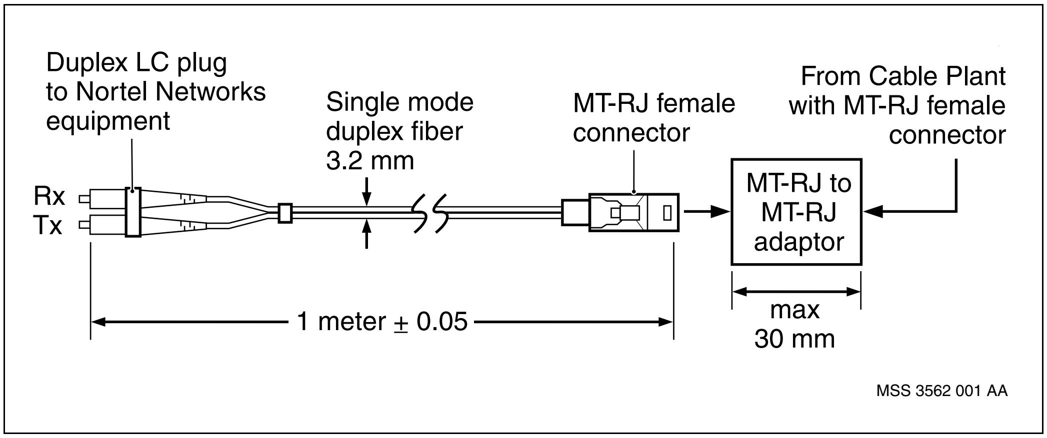
- Use duplex small-form LC connectors at the FP end especially since the Tx and Rx transceivers are opposite on each side of the faceplate, and any other fiber connector you choose at the next hop from the FP.
- After each connector, add a stiff strain relief no longer than 1.6 cm (0.63 in.), as indicated in the figure The MT-RJ-to-LC cable assembly with duplex connector and MT-RJ-to-MT-RJ adapter (page 202). Applying a coating of resilient gap filler between the cable and the strain relief is determined by the manufacturer of the cable assembly.
- The combined measurements of connector and strain relief must accommodate the curve of the hood on the FP faceplate so that the hood can be closed without pinching any cables.
- Cables should be manufactured and verified to comply with Telcordia GR-326 specifications.
- If required, use an attenuation less than 0.5 dB/km at 1300 nm.

The sum of cable losses and connector losses from the FP to the far end termination must not exceed 12 dB for SM cable. The losses in a transmission path determine the distance the FP can send a signal. The maximum distance from the FP to the far end is 15 to 20 km for SM cable, depending on the losses due to splices and connectors.

On the distribution frame side of the cable assembly, use SM MT-RJ female (non-pinned) connectors. Both the transmit and the receive ports are in the same connector.

The fiber mode type must be the same as the SFP mode type. You can have single-mode and multimode SFP modules on the same FP. You must provide the cable with attached connectors.

The MT-RJ-to-LC cable assembly with duplex connector and MT-RJ-to-MT-RJ adapter



SFP modules for an NTHW44

More than one version of SFP module can be used per FP. The type of fiber cable must match the version of module, and all modules interface with small-form LC connectors. The PEC versions of SFP modules that can be used with the NTHW44 are:

- NTTP02AD for MM fiber cables for short reach (SR-0) up to 2 km (1.2 mi) and with a nominal wavelength of 1310 nm
- NTTP02CD for SM cables for intermediate reach (IR-1/S-1.1) up to 15 km (9.3 mi) and with a nominal wavelength of 1310 nm
- NTTP02ED for SM cables for long reach (LR-1/L-1.1) up to 40 km (24.8 mi) and with a nominal wavelength of 1310 nm

The general description and purpose of SFPs is in SFP optical modules (page 239).

Optical interface characteristics for an NTHW44

The optical interface characteristics for a 16-port OC-3/STM-1 POS and ATM FP that has PEC NTHW44 are shown in these tables:

- Transmit characteristics for an NTHW44 with MM SR-0 SFP modules (page 203)
- Receive characteristics for an NTHW44 with MM SR-0 SFP modules (page 203)
- Transmit characteristics for an NTHW44 with SM IR-1/S-1.1 SFP modules (page 204)
- Receive characteristics for an NTHW44 with SM IR-1/S-1.1 SFP modules (page 204)
- Transmit characteristics for an NTHW44 with SM LR-1/L-1.1 SFP modules (page 204)

- Receive characteristics for an NTHW44 with SM LR-1/L-1.1 SFP modules (page 205)

General interface characteristics for an NTHW44

General optical interface characteristics	
Faceplate connector	SFP duplex LC (duplex small-form LC transceiver for duplex fiber cables)
Bit rate	155.52 Mbit/s per port simultaneously
Line encoding	binary non-return-to-zero (NRZ)

Transmit characteristics for an NTHW44 with MM SR-0 SFP modules

Transmit characteristic	Minimum	Maximum	Unit
Emission wavelength	1270	1380	nm
Attenuation	0	10	dB
Maximum dispersion	not applicable	18	ps/nm
Maximum RMS spectral width	not applicable	80	nm
Mean transmission power for multimode (MM)	-20	-14	dBm
Extinction ratio	8.2	not applicable	dB
Eye pattern mask	not applicable	not applicable	
Side node suppression ratio (SSR)	not applicable	not applicable	

Receive characteristics for an NTHW44 with MM SR-0 SFP modules

Receive characteristic	Minimum	Maximum	Unit
Receive power for single-mode intermediate reach (IR)	-30	-14	dBm
Optical path power penalty	not applicable	1	dB
Maximum received reflectance	not applicable	not applicable	

Transmit characteristics for an NTHW44 with SM IR-1/S-1.1 SFP modules

Transmit characteristic	Minimum	Maximum	Unit
Emission wavelength	1261	1360	nm
Attenuation	0	12	dB
Maximum dispersion	not applicable	96	ps/nm
Maximum RMS spectral width	not applicable	7.7	nm
Mean transmission power for single-mode (SM) intermediate reach (IR)	-15	-8	dBm
Minimum extinction ratio	8.2	not applicable	dB
Eye pattern mask	Compliant with ITU G.957 Fig 2, ANSI T1E1.2/94-002R1-Fig 10, TA-253 Issue 8 Fig 4-2		
Side node suppression ratio (SSR)	not applicable	not applicable	

Receive characteristics for an NTHW44 with SM IR-1/S-1.1 SFP modules

Receive characteristic	Minimum	Maximum	Unit
Receive power for single-mode intermediate reach (IR)	-28	-8	dBm
Optical path power penalty	not applicable	1	dB
Maximum received reflectance	not applicable	not applicable	

Transmit characteristics for an NTHW44 with SM LR-1/L-1.1 SFP modules

Transmit characteristic	Minimum	Maximum	Unit
Emission wavelength	1263	1360	nm
Attenuation	10	28	dB
Maximum dispersion	not applicable	not applicable	ps/nm
Maximum RMS spectral width	not applicable	not applicable	
Mean transmission power for single-mode (SM) long reach (LR)	-5	0	dBm
Minimum extinction ratio	10	not applicable	dB
Eye pattern mask	Compliant with Telcordia GR-253-CORE and ITU G.957		
Side node suppression ratio (SSR)	30	not applicable	dB

Receive characteristics for an NTHW44 with SM LR-1/L-1.1 SFP modules

Receive characteristic	Minimum	Maximum	Unit
Receive power for single-mode (SM) long reach (LR)	-34	-10	dBm
Optical path power penalty	not applicable	1	dB
Maximum received reflectance	not applicable	not applicable	

Cable specifications for custom-making LC cable assemblies

Make an LC cable assembly using the following specifications. Refer also to the figure The LC cable assembly with duplex connectors and duplex cables (page 206).

- Use multimode (MM) fiber with a core diameter of 50 microns or 62.5 microns and a cladding diameter of 125 microns.
- Use single-mode (SM) fiber with a core diameter of 9 microns and a cladding diameter of 125 microns.
- Use duplex fiber cables to provide lesser cable volumes and easier cable management under the hood.
- The outside diameter of one SM cable must not exceed 1.6 mm (0.0629 inch). The combined outside width of two cables zipped together to make a duplex cable must not exceed 3.2 mm (0.1259 inch) as shown in the figure The LC cable assembly with duplex connectors and duplex cables (page 196). The thinner cable allows the fiber hood on the faceplate to close over the entire cluster of cables without pinching them and can allow the duplex cable to be ravelled onto the tray of a fiber management unit (NTHW50).

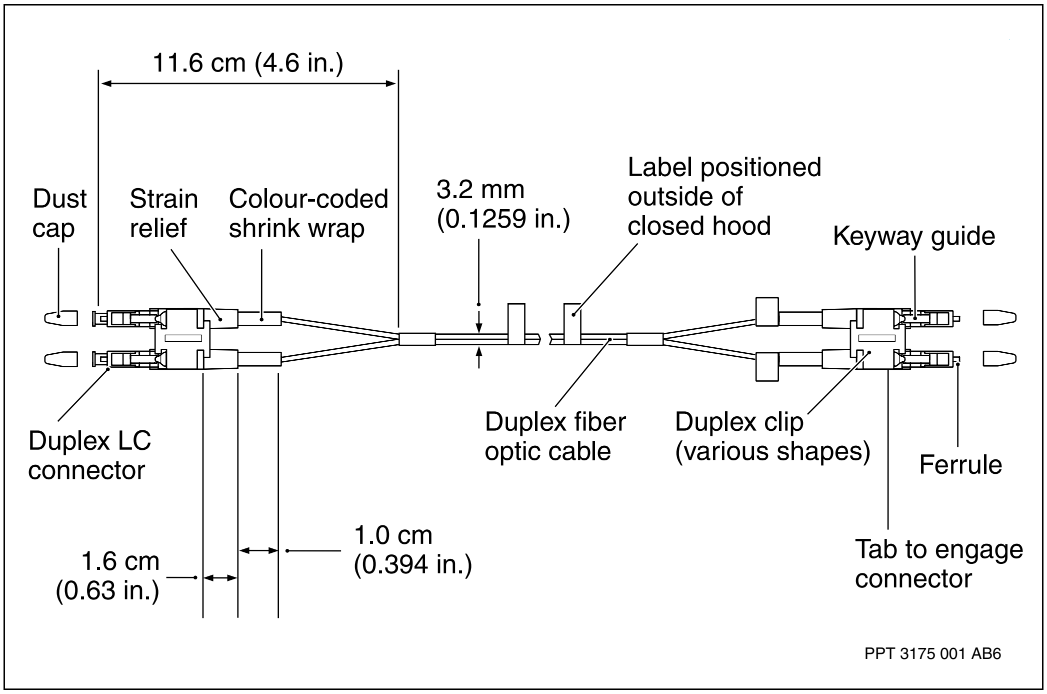
Attention: Ladder rackable cable (especially at 3.0 mm) cannot be used.

- Use duplex small-form LC connectors at the FP end especially since the Tx and Rx transceivers are side-by-side in the faceplate, and any other fiber connector you choose at the next hop from the FP.
- Use color-coded shrink wrap at the connectors to indicate parallel Tx and Rx connections of the ends. The total length of the shrink wrap should not exceed 2.6 cm (1.0 inch). The shrink wrap should extend from the rear of the connector through the strain relief (neck reinforcement) with up to 1.0 cm (0.394 in.) exposed, as indicated in the figure The LC cable assembly with duplex connectors and duplex cables (page 196).
- After each connector, add a stiff strain relief no longer than 1.6 cm (0.63 in.), as indicated in the figure The LC cable assembly with duplex connectors and duplex cables (page 196). Applying a coating of resilient

gap filler between the cable and the strain relief is determined by the manufacturer of the cable assembly.

- The combined measurements of connector, strain relief, and shrink wrap must accommodate the curve of the hood on the FP faceplate so that the hood can be closed without pinching any cables.
- Cables should be manufactured and verified to comply with Telcordia GR-326 specifications.

The LC cable assembly with duplex connectors and duplex cables



Specifications for Y-splitter cable assemblies for Y-protection

A fiber optical Y-splitter cable connects two adjacent NTHW44 FPs to a single fiber optical interface at the far end. See the figure The connection setup of a fiber optical duplex Y-splitter cables used for Y-protection (page 208). The far end can be:

- another NTHW44 in a Nortel Networks Multiservice Switch 15000 or Multiservice Switch 20000 node
- an OC-3 in any other Multiservice Switch node
- a non-Multiservice Switch card

You must use Y-splitter cables that have been made according to the following specifications, criteria, and considerations.

- Use the same specifications as listed in Cable specifications for custom-making LC cable assemblies (page 205) except you can only use the duplex single-mode (SM) type. At the FP end of the cables, you must use small-form LC connectors. At the single end of the cable (the far end from the FPs), the connectors are determined by whatever type of optical interface you have for that port. Nortel Networks does not support mixing single-mode and multimode at opposite ends of a connection. If you must have MM at the far end:

— keep the total distance of the path less than 100 m (328 ft)

— use an appropriate attenuator on the receive (Rx) port (see NN10600-130 *Nortel Networks Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade* for the procedure for handling attenuators)

- Use only the small-form pluggable (SFP) optical module with PEC NTTP02CD, as described in SFP modules for an NTHW44 (page 202). Refer also to the figure An example of a fiber optical duplex Y-splitter cable assembly used for Y-protection (page 209).
- The Y-splitter cable coupler must provide an equal split of the optical signals, where each split signal meets or exceeds physical layer requirements for intermediate reach (IR) under Telcordia GR253. The legs of the cable after the split must be equal in length.
- The position of the coupler on each cable relative to all three ends of the cable is critical for having effective cable management. Plan the length of each installed cable especially between the port on the installed FP and along the absolute cable path up to the nearest cable management bracket so that its coupler:

— will not reside under an FP hood or anywhere across the front of the shelf

— will not reside in a drawer of the fiber management unit (NTHW50)

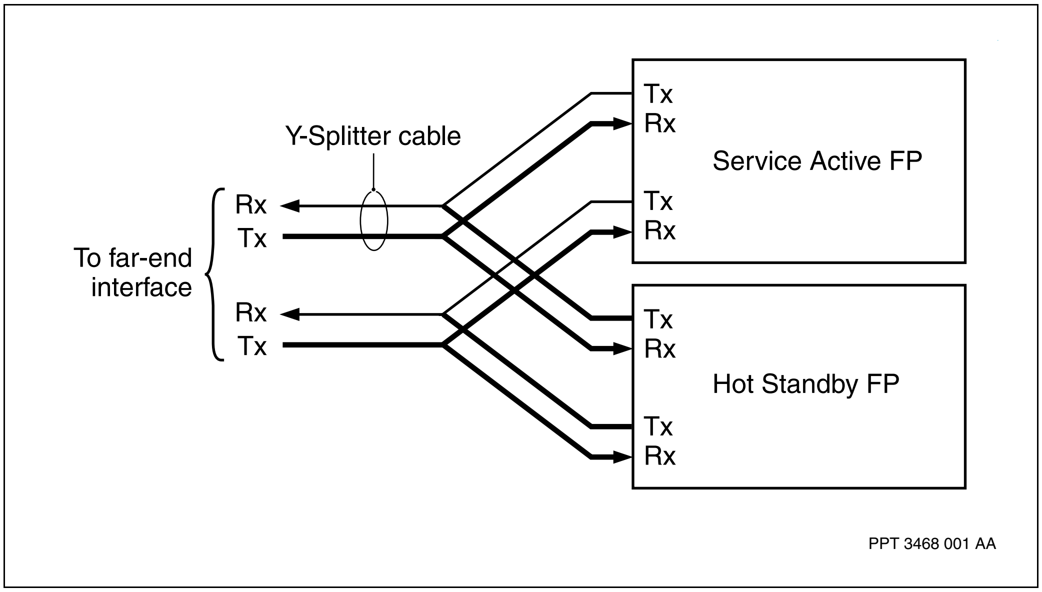
— resides on the side of the NEBS 2000 frame or equivalent mounting apparatus, or beyond, but not through or on any of the cable management brackets

- You must address appropriate power budgeting of the FP lasers when mixing single-mode (SM) and multimode (MM) signals. The attenuation for the Y-splitter cable cannot exceed 10 db when multimode is receiving from single-mode. When connecting optical interface cards, Nortel Networks does not recommend mixing single-mode and multimode, especially when a distance greater than 100 m (328 ft) causes various kinds of signal degradations.

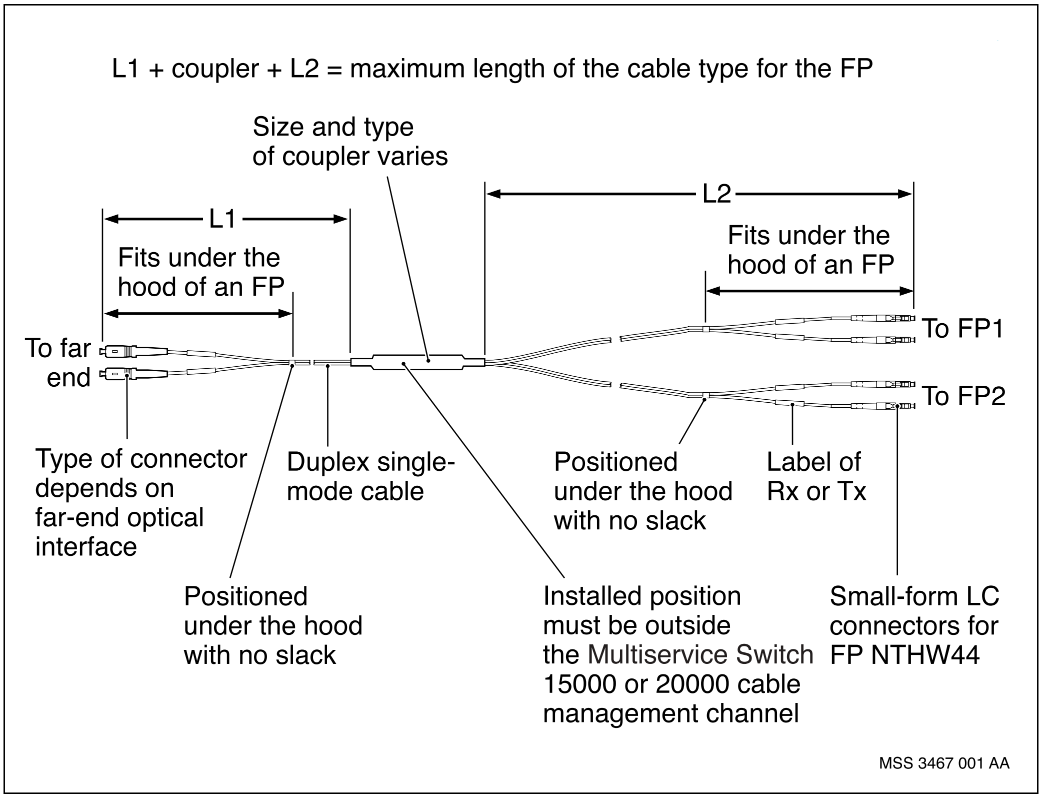
Attention: Since the coupler (splitter) typically attenuates the signal, you must also address the power budgeting between SM interfaces throughout the connection.

The behavior of FPs when cabled with Y-splitter cable assemblies is described in NN10600-550 *Nortel Networks Multiservice Switch 7400/15000/20000 Common Configuration Procedures*, in the section about understanding Y-protection for dual FPs.

The connection setup of a fiber optical duplex Y-splitter cables used for Y-protection



An example of a fiber optical duplex Y-splitter cable assembly used for Y-protection



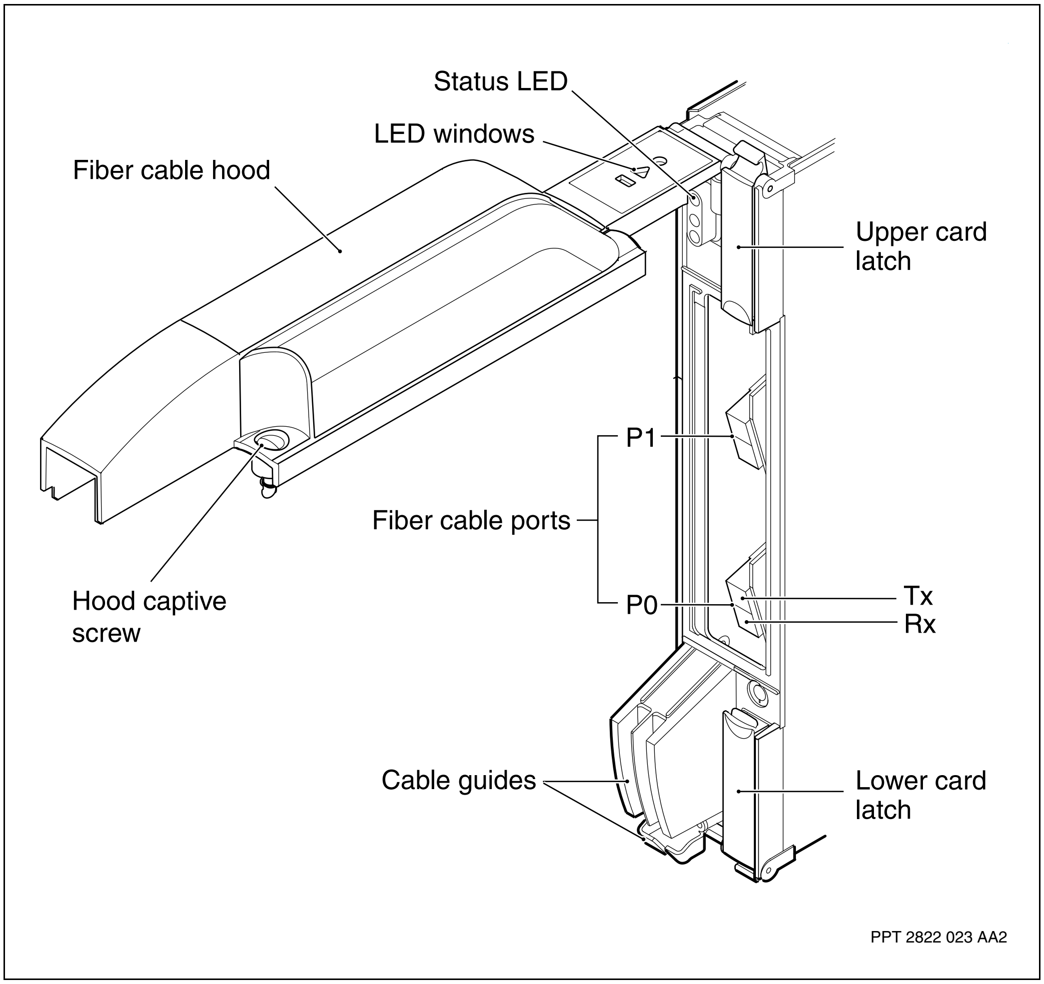
1-port OC-12/STM-4 FP

For the interface information about the 1-port OC-12/STM-4 FP, see:

- Faceplate of a 1-port OC-12/STM-4 FP with PEC NTHR29 (page 210)
- 1-port OC-12/STM-4 FP cable assembly (page 210)
- 1-port OC-12/STM-4 FP optical interface characteristics (page 211)

The software name (card type) of the NTHR29 is 1pOC12SmLrAtm.

Faceplate of a 1-port OC-12/STM-4 FP with PEC NTHR29



1-port OC-12/STM-4 FP cable assembly

Use only single-mode (SM) fiber cable with the 1-port OC-12/STM-4 long reach (LR) FP. You must provide the cable with attached connectors.

The SM fiber cable must have a core diameter of 9 microns and cladding diameter of 125 microns. The attenuation is less than 0.5 dB/km at 1300 nm.

The FP uses standard duplex SC connectors.

The sum of cable splice losses and connector losses from the FP to customer premises equipment (CPE) must not exceed 12 dB for SM cable. The losses in a transmission path determine the distance the FP can send a signal. The maximum distance from the FP to CPE is up to 40 km for SM cable, depending on the losses due to splices and connectors.

1-port OC-12/STM-4 FP optical interface characteristics

The optical interface characteristics for the 1-port OC-12/STM-4 single-mode (SM) long reach (LR) FP are shown in these tables

- 1-port OC-12/STM-4 FP general interface characteristics (page 211)
- 1-port OC-12/STM-4 SM LR FP transmit characteristics (page 211)
- 1-port OC-12/STM-4 SM LR FP receive characteristics (page 212)

1-port OC-12/STM-4 FP general interface characteristics

General optical interface characteristics	
Faceplate connector	dual SC transceiver for simplex cable connectors
Bit rate	622 Mbit/s
Line encoding	Binary non-return-to-zero (NRZ)

1-port OC-12/STM-4 SM LR FP transmit characteristics

Transmit characteristics	Value
Emission wavelength	1280 to 1335 nm
Attenuation	0 - 12 dB
Maximum dispersion	not applicable
Maximum RMS spectral width	1 nm (full spectral width at 20 dB)
Mean transmission power	+2 to -3 dBm
Minimum extinction ratio	10 dB
Eye pattern mask	Compliant with ITU G.957 Fig 2, ANSI T1E1.2/94-002R1-Fig 10, TA-253 Issue 8 Fig 4-2
Side node suppression ratio (SSR)	30 dB

1-port OC-12/STM-4 SM LR FP receive characteristics

Receive characteristics	Value
Maximum receive power (average)	-8 dBm
Minimum receive power (average)	-28 dBm
Optical path power penalty	1 dB
Maximum received reflectance	-14 dB

4-port OC-12/STM-4 ATM FP

For the interface information about the 4-port OC-12/STM-4 ATM FP, see:

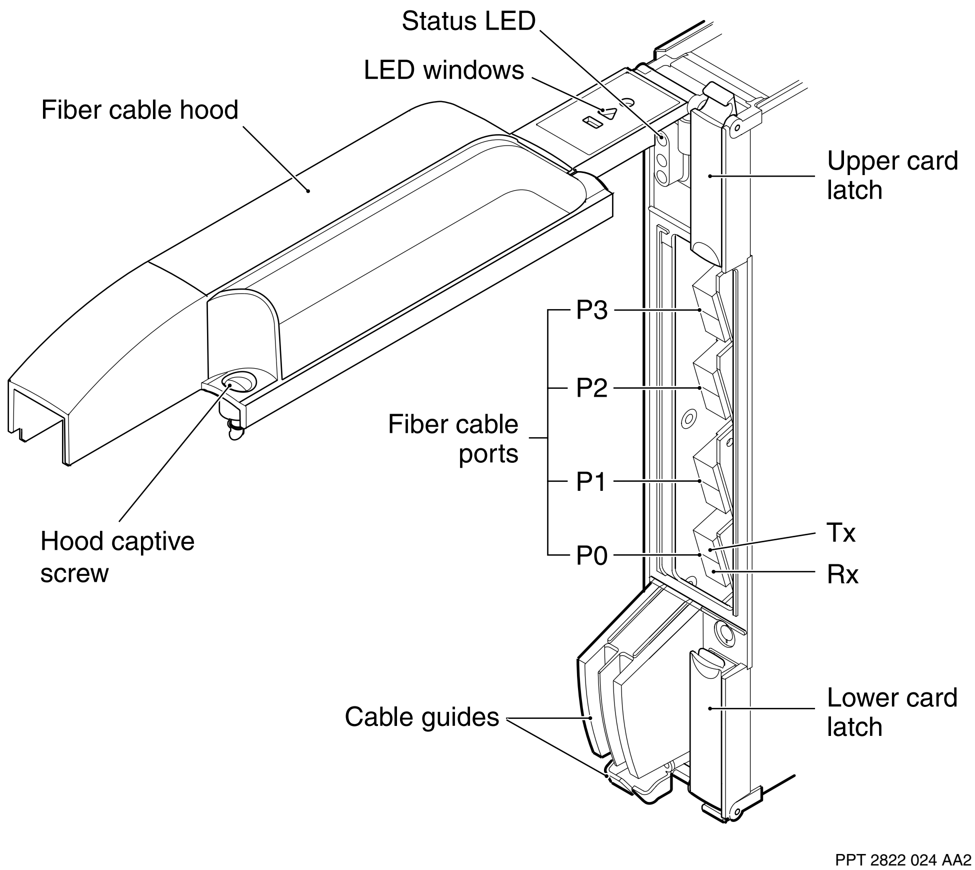
- 4-port OC-12/STM-4 ATM identifiers (page 213).
- Faceplate of a 4-port OC-12/STM-4 ATM FP with PEC NTHW11 or NTHW86 (page 214)
- 4-port OC-12/STM-4 ATM FP cable assembly (page 214)
- 4-port OC-12/STM-4 ATM FP optical interface characteristics (page 215)

4-port OC-12/STM-4 ATM identifiers

FP	PQC6v2 (also known as PQC2)	PQC12	Software name (card type)
4-port OC-12/STM-4	NTHW11	NTHW86	4pOC12SmIrAtm

When a specific PEC is not mentioned, assume the text applies to both PQC versions of the card.

Faceplate of a 4-port OC-12/STM-4 ATM FP with PEC NTHW11 or NTHW86



4-port OC-12/STM-4 ATM FP cable assembly

Use only single-mode (SM) fiber cable with the 4-port OC-12/STM-4 ATM FP. You must provide the cable with attached connectors.

The single-mode fiber cable must have a core diameter of 9 microns and cladding diameter of 125 microns. The attenuation is less than 0.5 dB/km at 1300 nm.

The OC-12 uses standard duplex SC connectors.

The sum of cable splice losses and connector losses from the FP to customer premises equipment (CPE) must not exceed 12 dB for single-mode cable. The losses in a transmission path determine the distance the FP can send a signal. The maximum distance from the FP to CPE is 15 to 20 km for single-mode cable, depending on the losses due to splices and connectors.

4-port OC-12/STM-4 ATM FP optical interface characteristics

The optical interface characteristics for the 4-port OC-12/STM-4 ATM single-mode (SM) intermediate reach (IR) FP are shown in these tables

- 4-port OC-12/STM-4 ATM FP general interface characteristics (page 215)
- 4-port OC-12/STM-4 SM IR ATM FP transmit characteristics (page 215)
- 4-port OC-12/STM-4 SM IR ATM FP receive characteristics (page 215)

4-port OC-12/STM-4 ATM FP general interface characteristics

General optical interface characteristics	
Faceplate connector	dual SC transceiver for simplex cable connectors
Bit rate	622 Mbit/s
Line encoding	Binary non-return-to-zero (NRZ)

4-port OC-12/STM-4 SM IR ATM FP transmit characteristics

Transmit characteristics	Minimum	Maximum	Unit
Transmission laser power	-15	-8	dBm
Emission wavelength (center) nominal 1310 nm	1274	1356	nm
Maximum optical path attenuation	0	12	dB
Maximum dispersion	not applicable	not applicable	
Spectral width	not applicable	2.5	nm
Extinction ratio	8.2	not applicable	dB
SONET eye pattern mask	Compliant with Telcordia GR-253 and ITU-T G.957		
Jitter generation	Compliant with Telcordia GR-253 and ITU-T G.958		
Side node suppression ratio (SSR)	not applicable	not applicable	

4-port OC-12/STM-4 SM IR ATM FP receive characteristics

Receive characteristics	Minimum	Maximum	Unit
Receive laser power	-28	-8	dBm
Sensitivity	not applicable	-28	dBm
Overload	-8	not applicable	dBm

(1 of 2)

4-port OC-12/STM-4 SM IR ATM FP receive characteristics (continued)

Receive characteristics	Minimum	Maximum	Unit
Center wavelength	1261	1580	nm
Optical path power penalty	not applicable	1	dB
Maximum received reflectance	not applicable	-27	dB
Jitter tolerance	Compliant with Telcordia GR-253 and ITU-T G.958		
(2 of 2)			

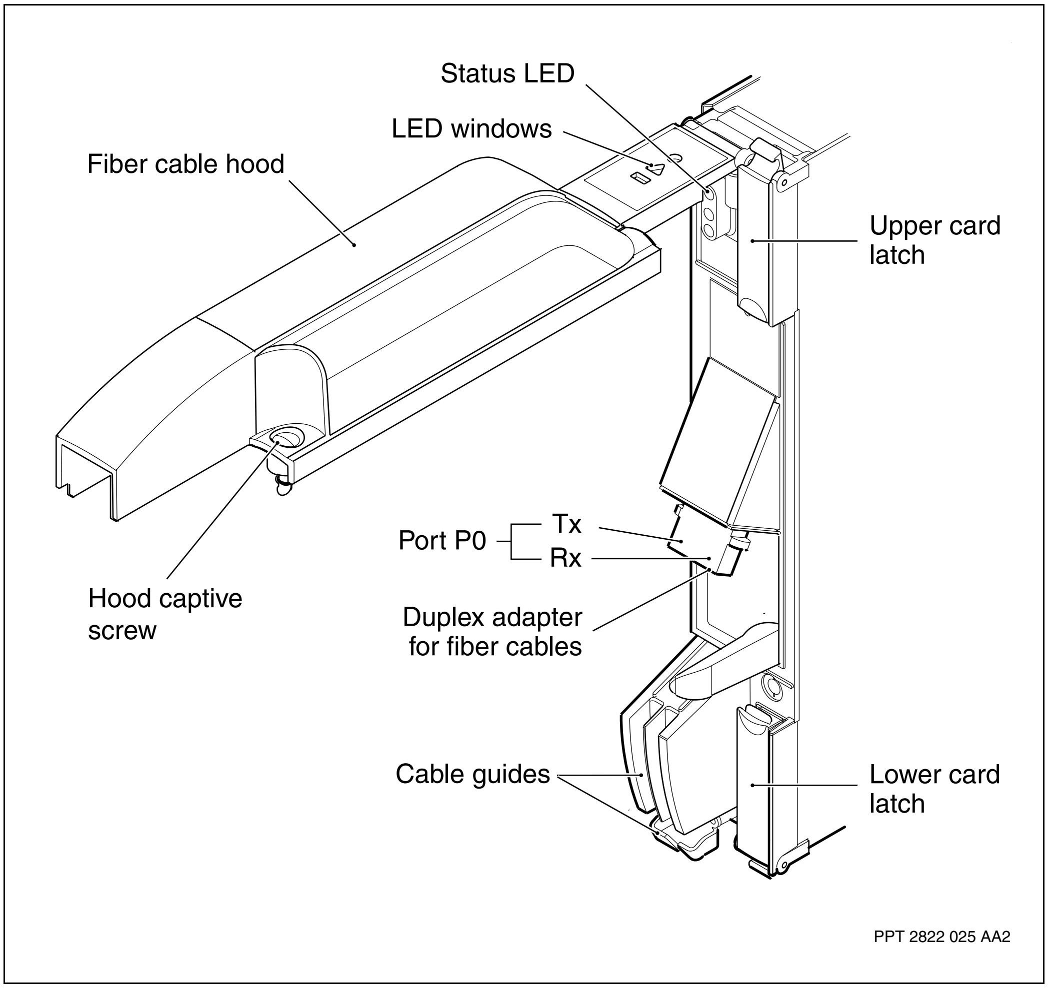
1-port OC-48/STM-16 ATM FP with APS

For the interface information about the 1-port OC-48/STM-16 FP with APS, see:

- Faceplate of a 1-port OC-48/STM-16 ATM FP with APS with PEC NTHW01 (page 217)
- 1-port OC-48/STM-16 ATM FP with APS cable assembly (page 217)
- 1-port OC-48/STM-16 ATM FP with APS optical interface characteristics (page 218)

The software name (card type) of the NTHW01 is 1pOC48ChSmIrAtm.

Faceplate of a 1-port OC-48/STM-16 ATM FP with APS with PEC NTHW01



1-port OC-48/STM-16 ATM FP with APS cable assembly

Use only single-mode (SM) fiber cable with the 1-port OC-48/STM-16 ATM FP with APS. You must provide the cable with attached connectors.

The single-mode fiber cable must have a core diameter of 9 microns and cladding diameter of 125 microns. The attenuation is less than 0.5 dB/km at 1300 nm.

The OC-48/STM-16 ATM FP uses standard duplex SC connectors.

The sum of cable splice losses and connector losses from the FP to customer premises equipment (CPE) must not exceed 12 dB for single-mode intermediate-reach cable. The losses in a transmission path determine the distance the FP can send a signal. The maximum distance from the FP to CPE is typically less than 34 km (21 miles) for single-mode intermediate reach cable with 0.35 dB/km fiber, and depending on the losses due to splices and connectors.

1-port OC-48/STM-16 ATM FP with APS optical interface characteristics

The optical interface characteristics for the 1-port OC-48/STM-16 ATM FP with APS are shown in these tables

- 1-port OC-48/STM-16 ATM FP general interface characteristics (page 218)
- 1-port OC-48/STM-16 ATM FP transmit characteristics (page 218)
- 1-port OC-48/STM-16 ATM FP receive characteristics (page 219)

1-port OC-48/STM-16 ATM FP general interface characteristics

General optical interface characteristics	
Faceplate connector	duplex SC adapter
Bit rate	2.488 Gbit/s
Line encoding	binary non-return-to-zero (NRZ)

1-port OC-48/STM-16 ATM FP transmit characteristics

Transmit characteristics	**Minimum**	**Maximum**	**Unit**
Emission wavelength	1260	1360	nm
Attenuation	0	12	dB
Maximum dispersion	n/a	n/a	
Spectral width	n/a	n/a	
Mean transmission power (launch)	-5.0	0.0	dBm
Extinction ratio	8.2		dB

(1 of 2)

1-port OC-48/STM-16 ATM FP transmit characteristics (continued)

Transmit characteristics	Minimum	Maximum	Unit
SONET eye pattern mask	Compliant with Telcordia GR-253 and ITU-T G.957		
Jitter generation	Compliant with Telcordia GR-253 and ITU-T G.958		
Side node suppression ratio (SSR)	n/a	n/a	
(2 of 2)			

1-port OC-48/STM-16 ATM FP receive characteristics

Receive characteristics	Minimum	Maximum	Unit
Sensitivity		-18	dBm
Overload	0.0		dBm
Optical path power penalty		1	dB
Received reflectance		-27	dB
Jitter tolerance and transfer	Compliant with Telcordia GR-253 and ITU-T G.958		

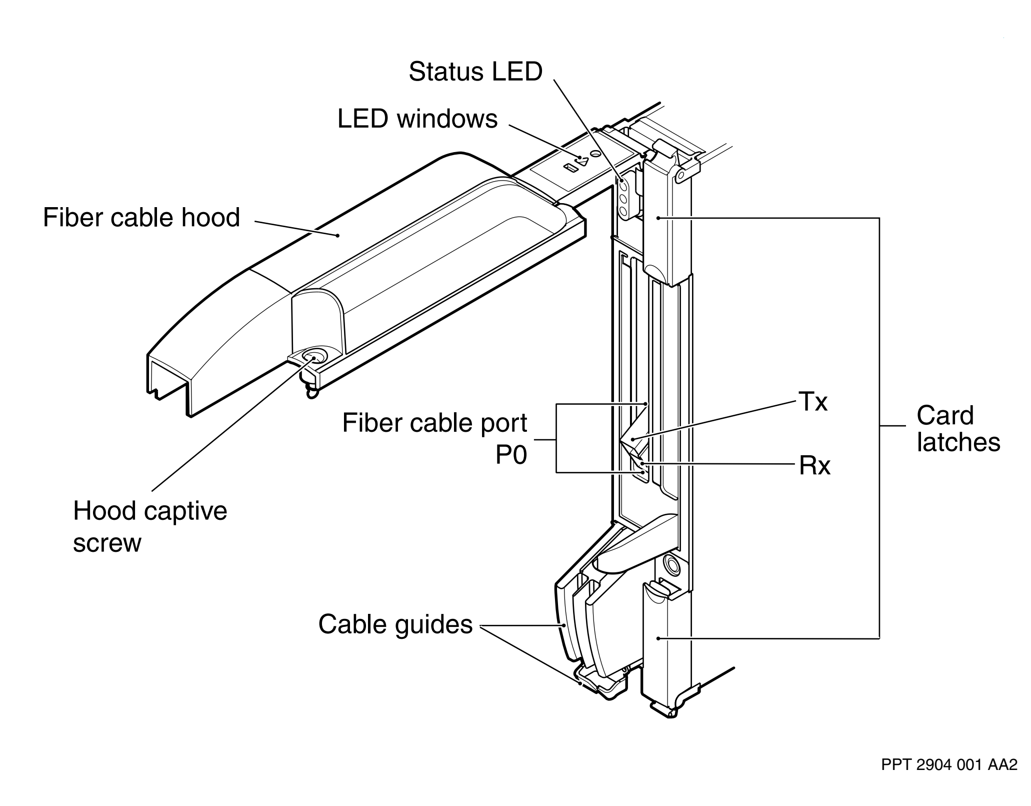
1-port STM-1Ch FP

For the interface information about the 1-port STM-1 FP, see:

- Faceplate of a 1-port STM-1 FP with PEC NTHR83 (page 220)
- 1-port STM-1 FP cable assembly (page 220)
- 1-port STM-1 FP optical interface characteristics (page 221)

The software name (card type) of the NTHR83 is 1pSTM1ChSmIr.

Faceplate of a 1-port STM-1 FP with PEC NTHR83



1-port STM-1 FP cable assembly

Use only single-mode (SM) fiber cable with the 1-port STM-1 FP. You must provide the cable with attached connectors.

The single-mode fiber cable must have a core diameter of 9 microns and a cladding diameter of 125 microns. The attenuation is less than 0.5 dB/km at 1300 nm.

The sum of cable losses and connector losses from the FP to customer premises equipment (CPE) must not exceed 12 dB for single-mode cable. The losses in a transmission path determine the distance the FP can send a signal. The maximum distance from the FP to CPE is 15 to 20 km for single-mode cable, depending on the losses due to splices and connectors.

1-port STM-1 FP optical interface characteristics

The optical interface characteristics for the 1-port STM-1 single-mode (SM) intermediate reach (IR) FP are shown in these tables

- 1-port STM-1 FP general interface characteristics (page 221)
- 1-port STM-1 SM IR FP transmit characteristics (page 221)
- 1-port STM-1 SM IR FP receive characteristics (page 222)

1-port STM-1 FP general interface characteristics

General optical interface characteristics	
Faceplate connector	simplex single-mode SC transceiver
Bit rate	155.520 Mbit/s
Line encoding	Binary non-return-to-zero (NRZ)

1-port STM-1 SM IR FP transmit characteristics

Transmit characteristic	Value
Emission wavelength	1261 to 1360 nm
Attenuation	0 to 12 dB
Maximum dispersion	96 ps/nm
Maximum RMS spectral width	7.7 nm
Mean transmission power	-15 to -8 dBm
Minimum extinction ratio	8.2 dB
Eye pattern mask	Compliant with ITU G.957 Fig 2, ANSI T1E1.2/94-002R1-Fig 10, TA-253 Issue 8 Fig 4-2
Side node suppression ratio (SSR)	not applicable

1-port STM-1 SM IR FP receive characteristics

Receive characteristic	Value
Maximum receive power (average)	-8 dBm
Minimum receive power (average)	-28 dBm
Optical path power penalty	1 dB
Maximum received reflectance	not applicable

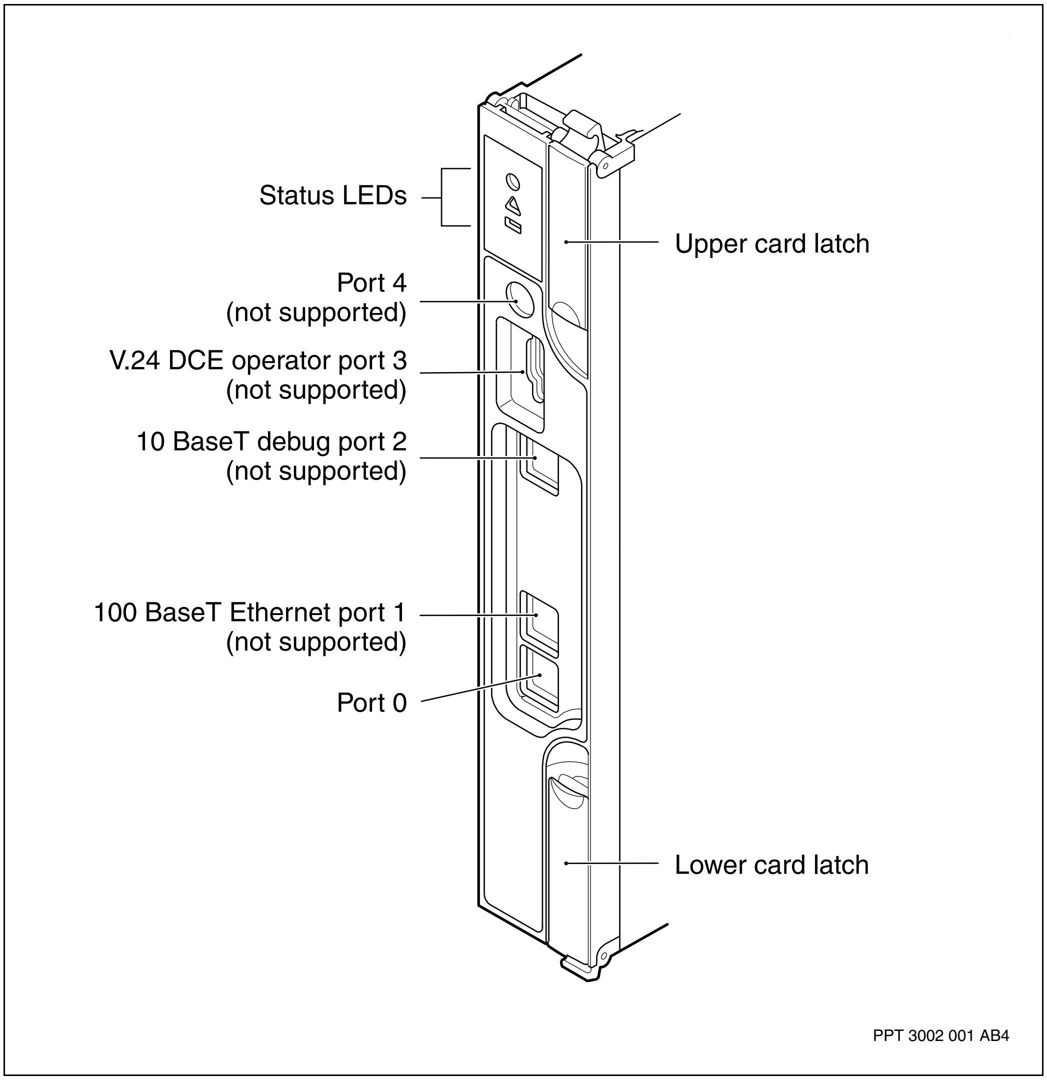
VPN extender card

The VPN extender card (VpnXc) is a processor card for IP services. IP services use the VpnXc to provide enhanced IP-VPN scalability without impacting the multi-service performance of Nortel Networks Multiservice Switch 15000 or Multiservice Switch 20000 nodes. The VPN extender card is used to host all the virtual routers (VRs) that support IP-VPN services. The VPN extender card allows IP-VPN services to scale well beyond the capabilities of a CP only scenario.

The product engineering code (PEC) of the VPN extender card for a Multiservice Switch 15000 or Multiservice Switch 20000 is NTHW30.

See the figure Faceplate of a VPN extender card with PEC NTHW30 (page 224).

Faceplate of a VPN extender card with PEC NTHW30



See these sections for more information on the VPN extender card

- VpnXc components (page 225)
- VpnXc configuration (page 225)
- VpnXc sparing (page 225)
- VpnXc compliance with standards (page 226)

VpnXc components

The VPN extender card consists of a motherboard, a memory daughter card, and a power supply daughter card, with a hard disk mounted on the motherboard.

Attention: The hard drive on the VpnXc is for future use and is not supported.

The VpnXc connects to the shelf backplane, providing an interface to both fabric cards.

The VpnXc interface supports these functions

- 16 Mbyte FLASH memory
- 512 Mbyte DRAM memory

Attention: The VPN extender card has a 10Base-T Ethernet debug port and two 100Base-T Ethernet ports that are for future use and are not supported.

VpnXc configuration

The VPN extender card has no external connections or ports that require configuration. The card type value <cardtype> is *VpnExtender* or *VpnXc* for the VPN extender card. For more information on configuring Nortel Networks Multiservice Switch 15000 or Multiservice Switch 20000 FPs, see NN10600-550 *Nortel Networks Multiservice Switch 7400/15000/20000 Common Configuration Procedures*.

VpnXc sparing

The VPN extender card supports equipment protection with one-for-one sparing. This FP requires no cabling, therefore, you must provision sparing. The redundant pair of VPN extender cards do not need to be installed in adjacent slots.

For more information, see NN10600-550 *Nortel Networks Multiservice Switch 7400/15000/20000 Common Configuration Procedures*.

VpnXc compliance with standards

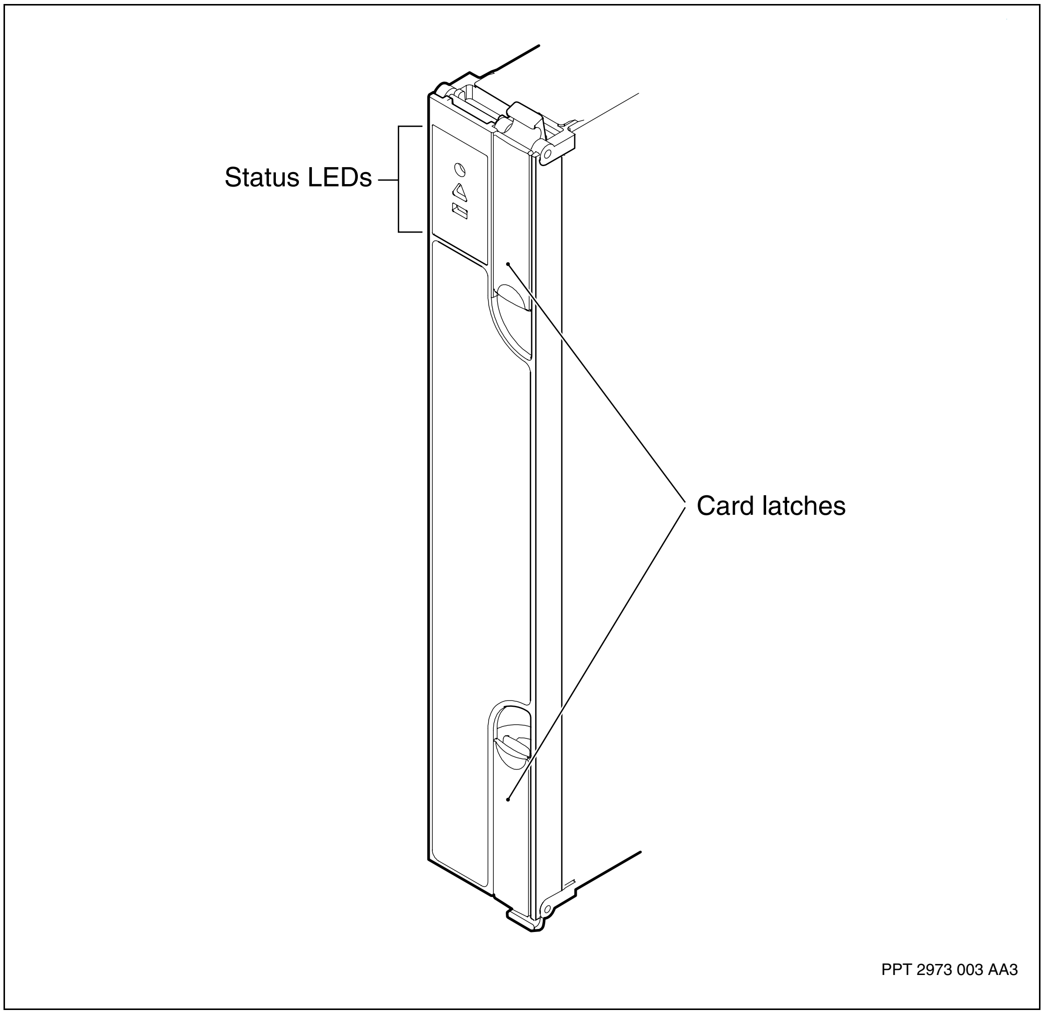
The VPN extender card is compliant with ISO 8601 and Nortel Networks Corporate Standard 1805.00.

Voice services processor 2 (VSP2) FP

For the interface information about the VSP 2, see Faceplate of a VSP2 FP with PEC NTHW87 (page 227). No cables connect to a VSP2.

The software name (card type) of the NTHW87 is VSP2.

Faceplate of a VSP2 FP with PEC NTHW87



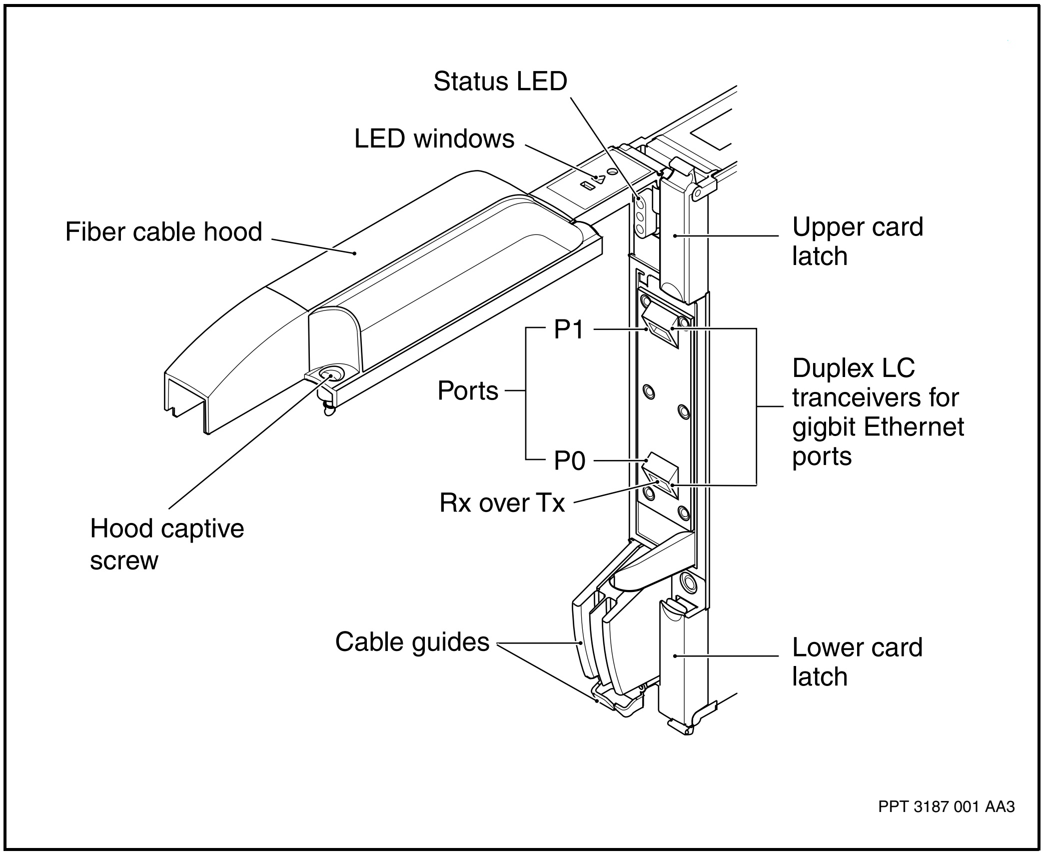
Voice services processor 3 (VSP3) FP

For the interface information about the VSP3, see:

- Faceplate of a VSP3 FP with PEC NTHW84 (page 228)
- VSP3 line connections (page 228)
- VSP3 cable assemblies (page 229)
- VSP3 sparing (page 230)
- Equipment to interface VSP3 Ethernet ports (page 231)

The software name (card type) of the NTHW84 is 2pGeMmSrVsp3.

Faceplate of a VSP3 FP with PEC NTHW84



VSP3 line connections

The VSP3 card has virtual ports that communicate over the backplane of the node, and has two gigabit Ethernet (gigE) ports. You can use either the virtual ports or the gigE ports to communicate with an Internet Protocol (IP) local area network (LAN). Using the gigE ports enables having a direct Ethernet port connection to an IP network without needing an Ethernet card as an interface.

The VSP3 can receive signals over the backplane from an ATM interfacing card in the same shelf, or directly through the gigE ports. Signals can arrive on the TDM port on the TDM card in the same shelf as the VSP3, and leave through the gigE ports. The VSP3 always needs a TDM card and a packet port (such as the gigE ports) in the same shelf.

The gigE ports are used with the Media Gateway base voice-over-IP features (for example, *vgslpGigE* and *vgslpG729GigE*). When both VSP3 gigabit ports are cabled, all IP packets pass through the ports, including voice, call server protocol, primary rate interface (PRI) using Q.921, and V5.2 backhaul signaling.

VSP3 cable assemblies

With the NTHW84 card, use duplex multimode (MM) fiber cable with duplex LC small-form connectors at the FP end and any other fiber connector at the other end.

The VSP3 card has two gigabit Ethernet ports on the faceplate. One port is the standby of the other. For an example, see the figure An example duplex LC-to-LC cable assembly (page 230). You must custom make each cable assembly according to the specifications in Cable specifications for custom-making an LC cable assembly (page 229).

The sum of cable losses and connector losses from the FP to the far end termination must not exceed 7.5 dB for MM cable. The losses in a transmission path determine the distance the FP can send a signal. The signal distance with the gigabit Ethernet ports is described in Cable specifications for custom-making an LC cable assembly (page 229).

Cable specifications for custom-making an LC cable assembly

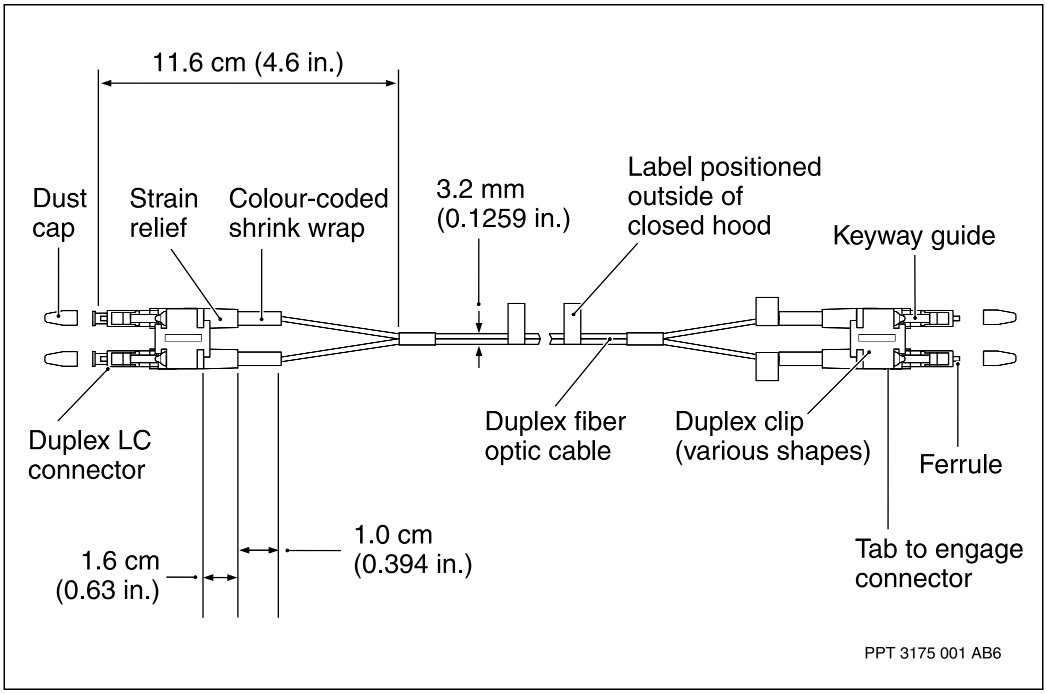
Make an LC cable assembly for an NTHW84 card using the following specifications

- mutlimode (MM) fiber
- duplex fiber cables (recommended to facilitate lesser cable densities) with color-coded halves
- a core diameter of 50 microns or 62.5 microns
- a cladding diameter of 125 microns (the same for either core diameter)
- a maximum cable length for 50 microns at 550 m (1,804 ft.) and for 62.5 microns is 275 m (902.27 ft.)
- duplex small-form LC connectors at the FP end, and any other fiber connector you choose at the far end from the FP
- the signal strength reaching the port must be between -3 dbm and -17 dbm.

- attenuation between end-points is not required

Strip back the outside cable sheath to accommodate the curve under the hood of the FP faceplate, and to accommodate attaching the connector according to the manufacturer's instructions for the connector.

An example duplex LC-to-LC cable assembly



VSP3 sparing

The sparing of a VSP3 can be configured from the end that the virtual ports or gigabit Ethernet ports connect to. The sparing for VSP3 cards is different from the usual Nortel Networks Multiservice Switch method of equipment protection because

- it depends on the hardware and software configuration of the far-end equipment that the card connects to
- the gigabit Ethernet port sparing is hot protection whereby the standby port takes over without dropping active calls when a link failure occurs on the active gigabit Ethernet port

The following hardware sparing configurations are supported

- one-for-one (formerly 1:1) or one-for-n (formerly 1:n) inter-card port sparing, where n is up to 7
- one-for-one intra-card port sparing, that is, one gigabit Ethernet port spares the other on the same card, and by default the port that comes into service first is automatically the active port

- no port sparing for the two gigabit Ethernet ports such that each is operating independently (the default)

For details about the hardware sparing setup, see the section about VSP3 far-end interfacing equipment in NN10600-130 *Nortel Networks Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*.

Equipment to interface VSP3 Ethernet ports

When using the virtual ports of the a voice services processor 3 (VSP3) function processor (FP) card, no cabling from the FP faceplate is required. The virtual ports communicate through the backplane of the Nortel Networks Multiservice Switch node.

When using the gigabit Ethernet ports to access an Internet Protocol (IP) network, the FP must be cabled to various kinds of far-end equipment. The interfacing equipment depends on what you want the VSP3 to do. For a further description of the card functionality, see NN10600-551 *Nortel Networks Multiservice Switch 7400/15000/20000 FP Configuration Reference*.

The interfacing equipment also determines the method of sparing VSP3 cards. This section provides

- VSP3 far-end interfacing equipment (page 231)
- Sparing a VSP3 at the far-end (page 232)

VSP3 far-end interfacing equipment

When using the gigabit Ethernet ports, the ports must be cabled from the FP faceplate to the far-end equipment. The equipment that can interface the gigabit Ethernet ports of a VSP3 must have the following specifications for one-for-one or one-for-n sparing.

- a router that
  - — transmits 1000Base-SX short wavelength laser (at 770 to 860 nm) over multimode (MM) cable
  - — bridges connections
  - — connects other IP subnets
  - — has VRRP (or an equivalent protocol) for router sparing
  - — for example, provides both bridging and VRRP routing capabilities within the same chassis by bridging through configured port-based VLANs, as with a Multiservice Switch 8600
- each port connected to a Layer 2 bridge to form part of an Ethernet local area network (LAN)
- Ethernet ports of the VSP3 cards are within the same LAN (although not necessarily to the same physical bridge)

When the VSP3 is unspared, a direct point-to-point connection to a router which does not support bridging is possible

- each directly-connected VSP3 is placed in a separate IP subnet
- the far-end must support auto-negotiation

For an example configuration, refer to the figure Example of spared VSP3 cards in a LAN hardware configuration (page 234).

Sparing a VSP3 at the far-end

The sparing of a VSP3 can be configured through the far-end equipment that its gigabit Ethernet ports connect to. The intra-card sparing capability protects the gigabit Ethernet ports from loss of traffic provided both ports are configured for sparing and the far-end setup criteria are met. The inter-card sparing capability protects the VSP cards through configured 1-for-one (1:1) or one-for-n (1:n) sparing. However, during a switchover between cards, traffic is lost. Combining the sparing of the cards and the gigabit ports provides fast switchover for link failures and cold switchover for VSP3 cards.

The setup sparing for VSP3 cards involves the following.

- It depends on the hardware and software configuration of the far-end equipment that the card connects to.
- The gigabit Ethernet port sparing is hot protection whereby the standby port takes over without dropping active calls when a link failure occurs on the active gigabit Ethernet port.

The criteria for the hardware sparing configurations are as follows:

- for one-for-one (1:1) or one-for-n (1:n) inter-card port sparing:
  - — the active and the standby cards reside in the same node
  - — the cards are cabled to the same LAN (or VLAN), as are all devices within an IP subnet
  - — the cards belong to the same protection group as designated by software configuration
  - — the active and standby ports belong to the same IP subnet
  - — one card is configured as the Spare and each other card is configured as a Main
  - — up to nn cards in the same Nortel Networks Multiservice Switch 15000 or Multiservice Switch 20000 node are configured for sparing, where nn is 14 FP slots minus however many TDM cards share the shelf, and the far-end supports sparing that many VSP3s
- for one-for-one (1:1) intra-card port sparing:

  - the VSP3 software has been configured to enable the sparing and both are configured under the same logical processor (LP)
  - both gigabit Ethernet ports are connected to the same LAN or subnet
- for no card sparing between VSP3s, connect the VSP3

Attention: Configure both Ethernet ports for sparing at the same time. If you configure only one of the two Ethernet ports on a VSP3 card, and you wish to add the second one later, then configure the second port for sparing and physically connect it. The newly added port becomes the standby. The only method to trigger a manual switchover between two spared gigabit Ethernet ports is to delete the configuration of the active port, thereby forcing a switchover to the standby. Traffic is lost during the switchover. To provide a standby for the newly active port, then configure the formerly active port again. It automatically becomes the standby.

A switchover from the active to the standby VSP3 card occurs provided:

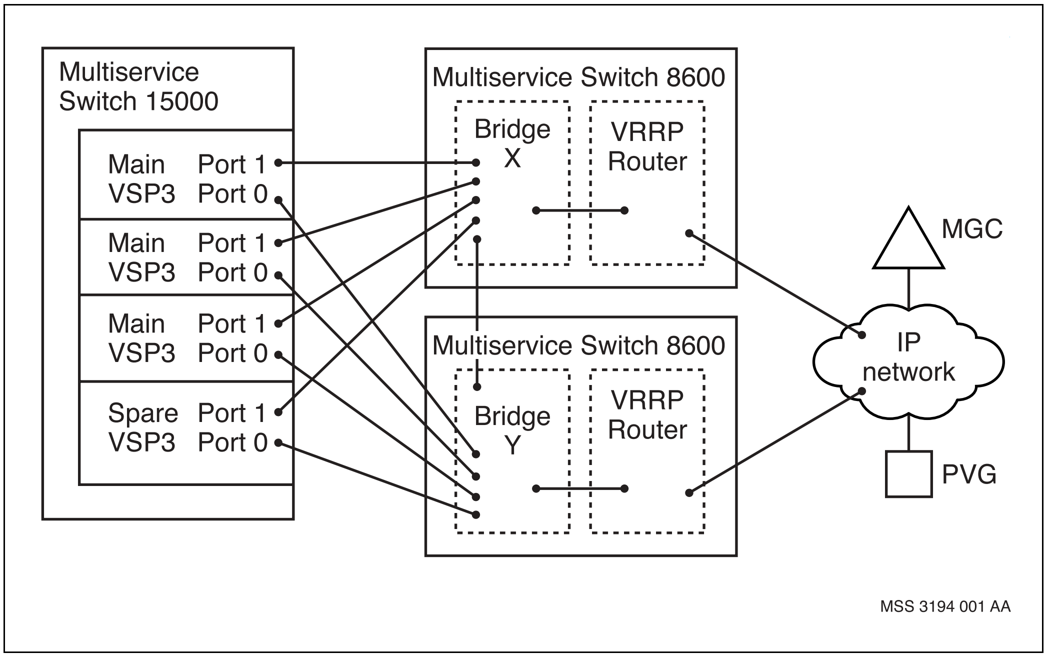
- the attribute *switchoverOnFailure* under the component *IpInterface* is enabled (for the description of components, see NN10600-060 *Nortel Networks Multiservice Switch 7400/15000/20000 Component Reference*)
- the Media Gateway application is without an active port for the continuous period specified by the attribute *switchoverHoldoffTime* under the component *IpInterface*
- at least one of the gigabit Ethernet ports has been active since the VSP3 card started up after a reboot or a switchover (which also stops the VSP3 from constantly resetting or switching over when the ports are disconnected or have failed)
- the standby card is in service at the time a switchover is attempted

Cable the sparing connections between each VSP3 and the far-end according to the capabilities of the far-end equipment. For an example of cable connections, refer to the figure Example of spared VSP3 cards in a LAN hardware configuration (page 234).

After powering up both ends of the VSP3 connection, the Ethernet port that comes up first automatically becomes the active port, and the second one (if configured for sparing) becomes the standby.

Once both ports are in service, the switchover occurs automatically when the far-end detects a loss of signal from the active Ethernet port.

Example of spared VSP3 cards in a LAN hardware configuration



Voice services processor 3 with optical TDM interface (VSP3-o) FP

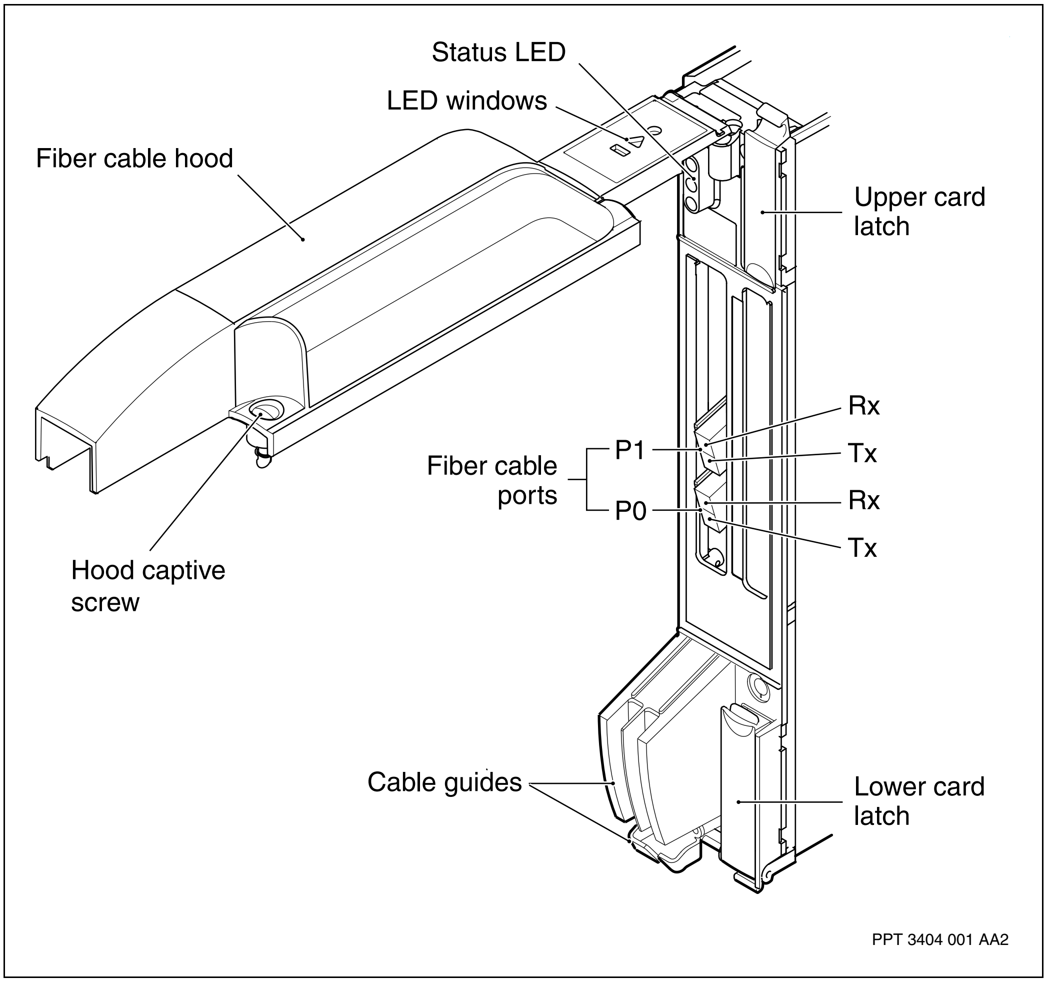
The voice services processor 3 with optical TDM interface (VSP3-o) FP card is supported in Media Gateway (MG) cards in a Nortel Networks Multiservice Switch 15000 or Multiservice Switch 20000 node.

For the interface information about the VSP3-o FP card, see:

- Faceplate of a VSP3-o FP card with PEC NTHW77 (page 235)
- VSP3-o FP line connections (page 236)
- VSP3-o FP cable assembly (page 236)
- VSP3-o FP optical interface characteristics (page 236)
- VSP3-o FP sparing (page 237)

The software name (card type) of the NTHW77 is 2pOC3ChSmIrVsp3.

Faceplate of a VSP3-o FP card with PEC NTHW77



VSP3-o FP line connections

The VSP3-o FP card has two OC-3/STM-1 optical TDM ports. Only one of the two OC-3/STM-1 optical TDM ports (ports 0 and 1) is an active port that communicates with the TDM network. The VSP3-o FP card only supports internal TDM traffic through the active port 0 of the two OC-3/STM-1 optical TDM ports on the same VSP3-o FP card. Other TDM FP cards are not supported by the VSP3-o FP card.

The VSP3-o FP card can receive IP-routed traffic over the backplane from a 4-port gigabit Ethernet FP card or an ATM IP FP card in the same Nortel Networks Multiservice Switch node, and send the traffic to the TDM network through the active port 0 of the two OC-3/STM-1 optical TDM ports on the VSP3-o FP card. TDM signals can arrive on the active port 0 of the two OC-3/STM-1 optical TDM ports on the VSP3-o FP card, and leave through the 4-port gigabit Ethernet FP card to the IP network.

The VSP3-o FP card can receive ATM-routed traffic over the backplane from an ATM FP card in the same shelf, and send the traffic to the TDM network through the active port 0 of the two OC-3/STM-1 optical TDM ports on the VSP3-o FP card. TDM signals can arrive on the active port 0 of the two OC-3/STM-1 optical TDM ports on the VSP3-o FP card, and leave through the ATM FP card to the ATM network.

VSP3-o FP cable assembly

Use only single-mode (SM) fiber cable with the VSP3-o FP card. You must provide the cable with attached connectors.

Single-mode fiber cable must have a core diameter of 9 microns and a cladding diameter of 125 microns. The attenuation is less than 0.5 dB/km at 1300 nm.

The VSP3-o FP card uses standard duplex LC connectors.

The sum of cable losses and connector losses from the FP to customer premises equipment (CPE) must not exceed 12 dB for single-mode cable. The losses in a transmission path determine the distance the FP can send a signal. The maximum distance from the FP to CPE is 15 to 20 km for single-mode cable, depending on the losses due to splices and connectors.

VSP3-o FP optical interface characteristics

The optical interface characteristics for the VSP3-o FP card are shown in these tables

- VSP3-o FP general interface characteristics (page 237)
- VSP3-o FP transmit characteristics (page 237)
- VSP3-o FP receive characteristics (page 237)

VSP3-o FP general interface characteristics

General optical interface characteristics	
Faceplate connector	dual LC transceiver for simplex cable connectors
Bit rate	155.520 Mbit/s
Line encoding	binary non-return-to-zero (NRZ)

VSP3-o FP transmit characteristics

Transmit characteristic	Value
Emission wavelength	1260 nm to 1360 nm
Attenuation	0 to 12 dB
Maximum dispersion	96 ps/nm
Maximum RMS spectral width	7.7 nm
Mean transmission power	-15 to -8 dBm
Minimum extinction ratio	8.2 dB
Eye pattern mask	Compliant with ITU G.957 Fig 2, ANSI T1E1.2/94-002R1-Fig 10, TA-253 Issue 8 Fig 4-2
Side node suppression ratio (SSR)	not applicable

VSP3-o FP receive characteristics

Receive characteristic	Value
Maximum receive power (average)	-8 dBm
Minimum receive power (average)	-31 dBm
Optical path power penalty	not applicable
Maximum received reflectance	not applicable

VSP3-o FP sparing

The sparing of a VSP3-o FP card can be configured from the end that the virtual ports connect to. The sparing for VSP3-o FP cards is different than the usual Nortel Networks Multiservice Switch method of equipment protection because

- it depends on the hardware and software configuration of the far-end equipment that the card connects to

The following hardware sparing configurations are supported

- one-for-one (formerly 1:1)

For details about the hardware sparing setup, see NN10600-130 *Nortel Networks Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*.

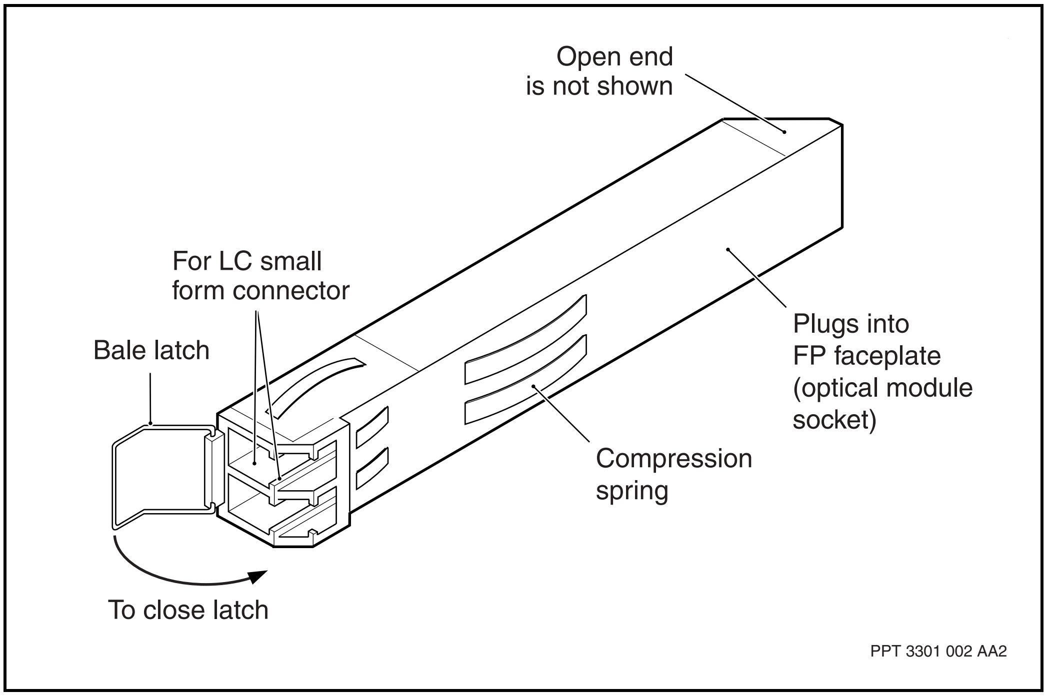
SFP optical modules

A small-form factor pluggable (SFP) optical transceiver module is a device that transmits and receives an optical signal to and from an optical fiber. Each device handles either single-mode (SM) or multimode (MM) fiber cable with small-form LC connectors plugged into it. The other end of the SFP plugs into the optical module socket (known as a port in software terms) on the faceplate of various FPs, for example:

- the 4-port Gigabit Ethernet (NTHW49)
- the 16-port OC-3/STM-1 POS and ATM (NTHW44)
- the 4-port MR POS and ATM (NTHW46)

See the figure A typical SFP optical module (page 239). When the SFPs are cabled, the hood of the faceplate closes over them as with any other non-SFP optical FP.

A typical SFP optical module



Using SFPs means having SM or MM or a combination of both fibers interfacing the ports of the same FP. By replacing an SFP with a different version, you can change the type of fiber connection without having to change the FP. The FPs with optical module sockets can handle signals from either SM or MM fibers.

The bale latch on the SFP optical module ensures that the SFP optical module cannot be removed from the FP until unplugging the fiber.

Each version of optical module uses a specific wavelength laser to transmit and receive data over a fiber optic cable. The wavelengths are matched to the type of fiber cable it accommodates and to the strength of the laser, namely short reach (SR), intermediate reach (IR), or long reach (LR).

When an in-service SFP fails or the inserted SFP does not match what the socket is configured for in software, alarm 7011 5480 is generated.

An SFP module can be safely removed or inserted without powering off the FP.

Attention: The SFP optical modules are separately ordered units and should be tracked as separate products in all respects, including repair and return. If an SFP optical module fails, only the failed SFP optical module should be returned and not the FP. If the FP fails, its SFP optical modules must be removed from the FP before returning the FP.

For more information on fiber cabling, see SFP optical module cable assemblies (page 240).

To install or replace an SFP optical module, see NN10600-130 *Nortel Networks Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*.

The port on the FP must be configured in software to match the type of module that plugs into it. To configure an Ethernet, SONET, or SDH port to use an SFP optical module, see NN10600-550 *Nortel Networks Multiservice Switch 7400/15000/20000 Common Configuration Procedures*.

For information about the SFPs that are available for the FPs that can accommodate them, see the description of the FP in this chapter.

SFP optical module cable assemblies

With an SFP optical transceiver module, use duplex single-mode (SM) or multimode (MM) fiber optic cables with duplex LC connectors at the FP end and any other fiber connector at the other end. Only an SM optical fiber cable (two 9/125 micron SMF) should be used with an SM SFP optical module. Only an MM optical fiber cable (two 62.5/125 MMF or two 50/125 MMF) should be used with an MM SFP optical module.

Additional information about LC cables is provided in the description of each type of FP that uses them.

Optical module compliances

The SFP optical transceiver modules comply with the following:

- ANSI TI.646, SONET specification
- IEEE802.3-2002
- ITU-T G.957, Optical Interfaces for Equipment and Systems Relating to SDH
- LASER Safety FDA Class 1 as per FDA 21, Chapter 1, Sub-chapter J, Part 1040.10 dated 4-1-03
- LASER Safety IEC Class 1 as per IEC 60825-1 Edition 1.2 dated 2001-08
- Telcordia GR-253-CORE, SONET Transport Systems

Termination panels for FPs

The termination panels available for a Nortel Networks Multiservice Switch 15000 or Multiservice Switch 20000 node include fanout panels and sparing panels. These termination panels interconnect equipment to the function processors (FPs) installed in the node.

When a NEBS 2000 frame or equivalent mounting apparatus houses a single Multiservice Switch, termination panels can be attached to the empty portion of the mounting apparatus. In frames containing two nodes, a separate mounting apparatus is required. The 19-inch wide sparing panels that are used with Multiservice Switch FPs can be mounted to a NEBS 2000 frame using the adapter brackets from kit NTHW14.

The type of cable and connector that is available as prefabricated cable assemblies and the cable specifications that are required to custom make your own are provided in the description of each FP that uses the panel. FP descriptions are in Control and function processors (page 114).

The installation of each termination panel and its cables can be found in NN10600-130 *Nortel Networks Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*.

The replacement of each termination panel or one of its cables can be found in NN10600-130 *Nortel Networks Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*.

Navigation

Basic functionality and operation of a sparing panel

The purpose of a sparing panel for Nortel Networks Multiservice Switch 15000 or Multiservice Switch 20000 node is to provide space to allow equipment protection to one or more FPs of the same type that are connected to the far end of an FP connection. The FPs connected to the same sparing panel must be compatible vintages for equipment protection to occur. A sparing panel is a patch panel with a mechanical relay. Software tells the relay when to change the active traffic path from one FP to another. Some sparing panels can operate as a patch panel (or fanout panel) without sparing.

Of all the FPs connected to a sparing panel, one must be designated in software as the Spare FP and all other FPs connected to the same panel must be designated as Main FPs. The Spare FP is the standby FP for one or more FPs. When a sparing panel supports only one Main FP, it provides one-for-one equipment protection. When a sparing panel supports more than one Main FP, it provides one-for-n equipment protection, where n is the quantity of Main FPs backed up by the one Spare.

The control processor (CP) software controls which FP or FPs actively use the sparing panel and which one does not or is on standby. When a Main FP fails, the active CP identifies which Main FP has failed, and instructs the sparing panel to change the relay contacts from the failed FP to the standby FP. The Spare FP becomes an active FP carrying traffic.

A subsequent switchover cannot occur until the failed FP is replaced and returned to service. For any Multiservice Switch FP in a one-for-one or one-for-n configuration, the replacement FP automatically becomes the standby card and remains standby even if it was previously the active card. If you want to restore the active path to the replaced FP you must do it manually using the appropriate software commands. The switchback behavior for a one-for-n configuration depends on the software attribute for revertive equipment protection.

It is expected that you will test a replaced FP while it is on standby, then verify the operation of the sparing panel.

Some traffic loss occurs between the start of the switchover and the instant traffic runs through the mate. The amount of loss depends on

- the amount of traffic passing through the FP at the time of the switchover
- whether the FP supports hot, warm, or cold equipment protection (sparing)
- what services the FP supports, for example a DS3 with IMA can take longer than other cards

- how much configuration (provisioning) is on the FP, for example, with one-for-n sparing, the card that fails cannot be predicted so the configuration cannot be loaded onto the spare card until the failed FP is identified, and traffic or services cannot run on the card until it is loaded
- how fast the mechanical relay is for the specific type of sparing panel (all the values are in milliseconds)

To determine how much time a switchover can take, monitor the duration for your particular configuration of services and the amount of traffic passing through.

When disconnecting cables from the standby FP that uses a sparing panel, traffic is unaffected provided the active mate remains in service. If you accidently disconnect an active cable, traffic is lost through that connection until the cable is re-connected.

For information on configuring the software to facilitate DS3 or E3 sparing, see NN10600-550 *Nortel Networks Multiservice Switch 7400/15000/20000 Common Configuration Procedures*. For the procedures to install, replace or redeploy a sparing panel, see NN10600-130 *Nortel Networks Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*. For the description and running of card tests, see NN10600-520 *Nortel Networks Multiservice Switch 7400/15000/20000 Fault and Performance Management: Troubleshooting*.

Common characteristics of a sparing panel

All Multiservice Switch sparing panels share the following common characteristics. Each characteristic applies to each sparing panel in this chapter unless otherwise specified.

A status LED lights to indicate whether the Main or the Spare FP is actively carrying traffic. Whether the switchover is triggered manually or automatically by the system, a status LED on the sparing panel indicates the active FP. When a switchover occurs due to a failed FP or an FP upgrade, putting the replacement FP in service does not automatically cause a switchback of activity.

There is a transmit (Tx) and receive (Rx) pair of connectors per port. The connections between the sparing panel, the electrical FPs, and all equipment up to the far-end connection are intended to be Tx-to-Tx and Rx-to-Rx with Multiservice Switch equipment. When the Tx-to-Rx combinations get crisscrossed between an FP, a termination panel, and the far-end termination, the effect of one error nullifying another can establish a workable connection. It is important that you label the connection information of each Tx and Rx connection onto the end of the cable at each break in the cable path.

The row of ports labelled Pn beside Main on the sparing panel are to be connected to the same Pn ports on the Main FP. Similarly, the row of Spare Pn ports are to be connected to the same Pn ports on the Spare FP.

The line ports are to be connected from the other-end equipment to the FP, such as

- another FP of the same type in a compatible vintage
- an EdgeLink 100 multiplexor
- a multi-port aggregate device
- other customer premises equipment (CPE) that is compatible with DS3 technology

The monitor ports are used for connecting test equipment to the sparing panel to monitor traffic through the ports of the Main or Spare FP, or the line equipment. Using these ports is your option. Connecting these ports or not has no effect on the operation of the sparing panel.

The 19-inch wide sparing panels that are to be mounted on the 21-inch wide NEBS 2000 frame require the optional adapter brackets from kit NTHW14.

The location of the sparing panel relative to the FPs and the far-end equipment determines the length of cables required. The density of cables may obstruct air flow that is required to keep the system at a nominal operating temperature.

Power source of a sparing panel

A sparing panel requires power to light the status LEDs and to enable software to change its on-board mechanical relay (or relays) from one FP to another. A sparing panel receives power through at least one control port cable, but connecting all control port cables eliminates intermediate or transitory LED statuses. When power reaches the sparing panel for a power up, whether or not traffic is passing through the sparing panel, the Main LED lights. If the standby FP was active at the time power was lost, the Main connection on the sparing panel will automatically change the traffic over to its Spare connection. The Spare LED lights to confirm it is active.

If both LEDs are dark, there is not power supply to the sparing panel. When the power supply is lost the switchover relay either stays at or automatically changes to the Main FP as the default position. If the Main FP was active, that is, already controlling the traffic, then no traffic is lost, traffic continues to and from the sparing panel, and without power a switchover of the traffic to the standby (Spare) FP can no longer occur. If the Main was active, loss of power makes the sparing panel operate as a one-for-one fanout panel. If the standby FP was active, traffic is lost until the sparing panel is powered again.

Loss of power to the sparing panel can be caused by unplugging one end of all control port cables, unseating all FPs, or disrupting any leg of power input to both FPs. Without power

- both status LEDs are dark
- traffic can continue through the main connections (behaving as a patch panel or a one-for-one fanout panel)
- traffic cannot continue through the spare connections
- a switchover to the spare FP cannot occur

When both FPs are in-service and power to the sparing panel resumes

- the LED is lit for the active FP connection
- for Multiservice Switch 15000 and Multiservice Switch 20000 FPs, the status of active traffic through the sparing panel always aligns with the status of traffic through the FP pair
- an automatic or manual switchover to the mate can occur provided it is in service

Basic functionality and operation of a fanout panel

Fanout panels act as a cable distribution system that provides any of the following functions, depending on the functional processor (FP) they support. Fanout panels can

- provide a break-out (or fanout) for customer equipment connections so that each port of an FP has its own termination point and access
- provide media conversion
- act as a concentrator, reducing the number of cables that are attached to the front of a Multiservice Switch 15000 or Multiservice Switch 20000
- provide a common grounding point for cables
- determine the type of connection (DCE or DTE) depending on which connector is used

The connections between the fanout panel, the FPs, and all equipment up to the far-end connection are intended to be Tx-to-Tx and Rx-to-Rx with Multiservice Switch equipment. When the Tx-to-Rx combinations get crisscrossed between an FP, a termination panel, and the far-end termination, the effect of one error nullifying another can establish a workable connection. It is important that you label the connection information of each Tx and Rx connection onto the end of the cable at each break in the cable path.

Fanout panels do not operate by software or require power. A fanout panel is effectively a fan-in or fan-out patch panel. Some Multiservice Switch sparing panels automatically become a one-for-one fanout panel when power is cut off.

12-port DS3 or E3 fanout panel NTHW52

The 12-port DS3 or E3 fanout panel NTHW52 is intended as a termination point between customer premises equipment such as a network interface and these DS3 or E3 function processors (FPs)

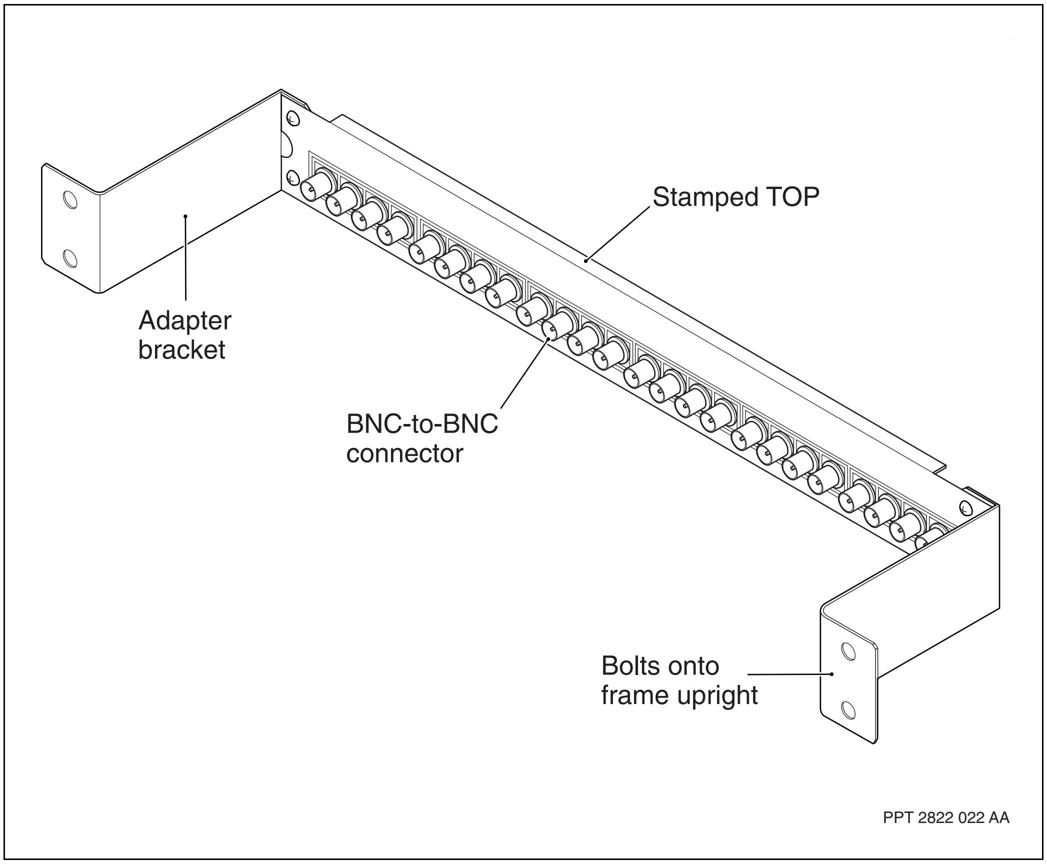
- NTHR23, the 12-port DS3 FP (page 152)
- NTHR25, the 12-port E3 ATM FP (page 165)
- NTHR31, the 4-port DS3Ch ATM FP with IMA (page 144)
- NTHR88 or NTHR89, the 4-port DS3Ch FR FP (page 136)
- NTHR91, the 4-port DS3Ch FP with AAL1 CES (page 148)
- NTHW91, the 2-port DS3Ch TDM FP (page 131)
- NTHW92, the 32-port E1 TDM FP (page 160)

The NTHW52 has standard coax BNC-to-BNC connections, and allows a transition from BNC connections to high-density 8W8 mini-coax connections on the FPs. See the figure A 12-port DS3 or E3 fanout panel NTHW52 (page 249).

The NTHW52 requires no software or power to operate.

For the size of the panel, see the table Dimensions of fanout and sparing panels (page 262).

A 12-port DS3 or E3 fanout panel NTHW52



Assigning the fanout panel cable connections

Fanout panel connection assignments are specific to the FP and the fanout panel being used. Determine your fanout panel connections from Assigning 12-port DS3 or E3 fanout panel connections (page 249).

The sparing panel NTFP99 or NTHR79 can also be deployed as a one-for-one fanout panel (or patch panel) provided the connections are to the Main Tx and Rx ports. Refer to the figures in

- Assigning sparing panel connections for 2-port DS3C TDM FPs (page 134)
- Assigning sparing panel connections for 32-port E1 TDM FPs (page 163)

Assigning 12-port DS3 or E3 fanout panel connections

Logically assign a connection from a specific slot on an FP to a specific connection on the fanout panel, and align it with a connection to each connection of all equipment between the fanout panel and the far-end final termination of the FP connection.

The 12-port fanout panel has 24 connectors, a transmit (Tx) and receive (Rx) pair for each port. When cabling Nortel Networks Multiservice Switch FPs and sparing panels, do Tx-to-Tx and Rx-to-Rx for all equipment from the FP up to the far-end termination of the FP connection.

The 12-port fanout panel can support three 4-port DS3 or E3 cards from any shelves.

The sparing panel NTFP99 or NTHR79 can also be deployed as a one-for-one fanout panel (or patch panel) provided the connections are to the Main Tx and Rx ports.

12-port DS3 or E3 sparing panel NTQS31

The 12-port DS3 or E3 sparing panel NTQS31 is a patch panel that can fan out connections to and from the network and also provide one-for-six sparing (back up). That is, when up to seven FPs from the same shelf are interconnected through a one-for-six sparing panel, one of the FPs can spare the other six.

The FPs that can use the NTQS31 as a fanout or a sparing panel include

- NTHR23, the 12-port DS3 FP (page 152)
- NTHR25, the 12-port E3 ATM FP (page 165)
- NTHR31, the 4-port DS3Ch ATM FP with IMA (page 144)
- NTHR88 or NTHR89, the 4-port DS3Ch FR FP (page 136)
- NTHR91, the 4-port DS3Ch FP with AAL1 CES (page 148)
- NTHW91, the 2-port DS3Ch TDM FP (page 131)
- NTHW92, the 32-port E1 TDM FP (page 160)

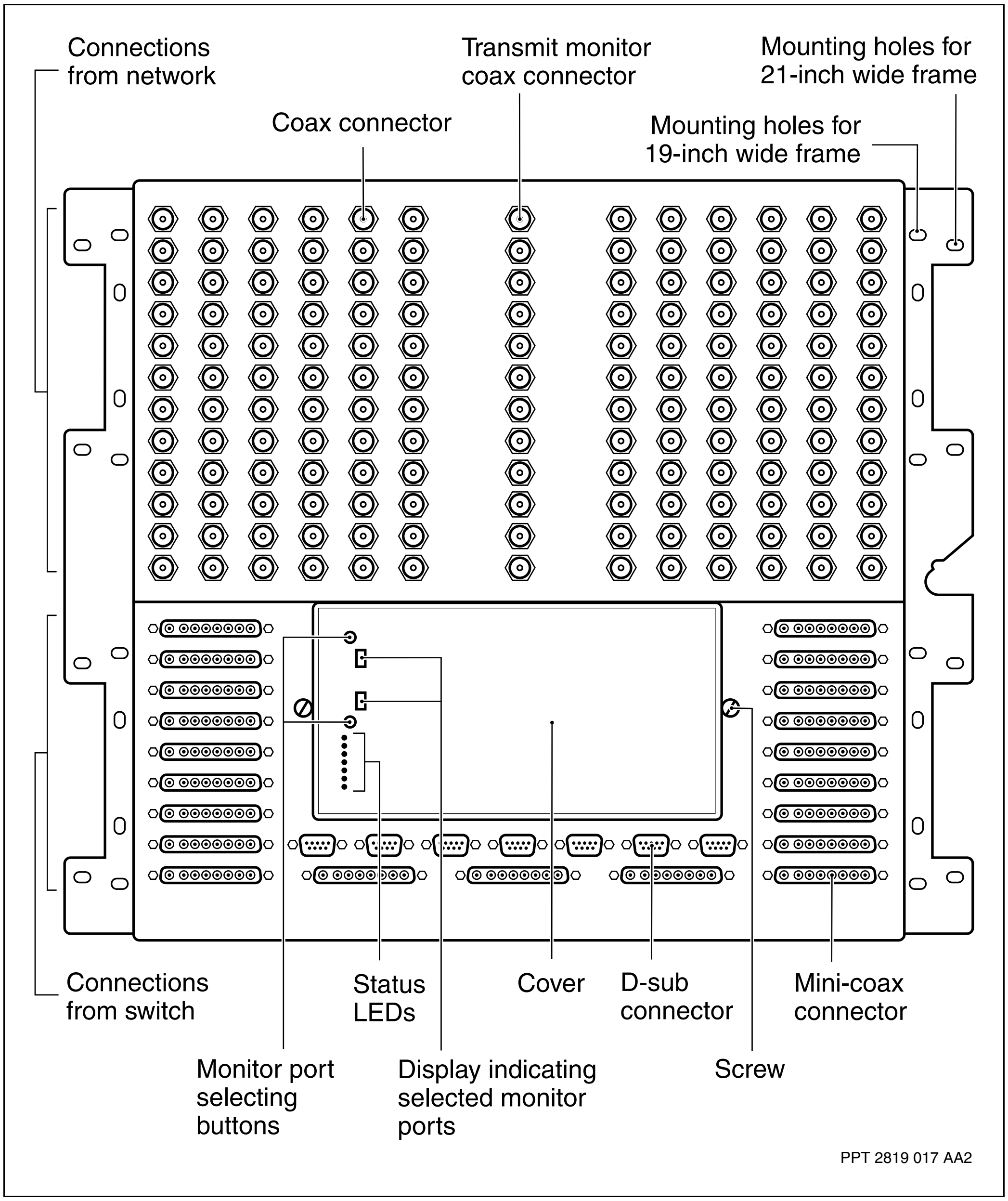
In addition to the sparing panel information provided in Basic functionality and operation of a sparing panel (page 243), the NTQS31 has the following distinguishing characteristics.

When the 12-port DS3 or E3 sparing panel is used with 4-port FPs, you must logically assign the same Pn ports on the panel to the Pn ports on the FP. For example, if P0 on the first FP is connected to sparing panel P1, then P0 of all other FPs in the same sparing group must be connected to the other sparing panel P1s. This is made clear in the FP cabling procedures of NN10600-130 *Nortel Networks Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*.

The faceplate has standard female BNC connectors for the signaling ports, standard female DB9 connectors for the control ports, and proprietary female 8W8 D-sub mini-coax connectors from the FPs. See the figure A 12-port DS3 or E3 one-for-six fanout sparing panel NTQS31 (page 252).

The size of the panel is in the table Dimensions of fanout and sparing panels (page 262). Although the NTQS31 is designed for a 21-inch wide mounting apparatus, it has a second set of mounting holes to enable fastening it to the rails of a Multiservice Switch 7400 19-inch wide cabinet.

A 12-port DS3 or E3 one-for-six fanout sparing panel NTQS31



Testing a transmit port on the NTQS31

The one-for-six sparing panel also has the hardware capability for monitoring any transmit port on a specific FP. (No software is involved in monitoring.) The transmit monitor provides access to the transmit (Tx) signal of a port for monitoring by customer premises test equipment, for example, to verify the initial setup of confidence checking. If the external test equipment indicates a problem, then the DS3 or E3 FP and the cable to the port must be tested.

The monitoring signal is 25 dB lower than the transmit signal so that the transmission is insignificantly affected.

Selection of the FP and transmit port must be done at the panel by two push buttons located above the sparing status LEDs on the control module. FP numbers are 1 to 6. Port numbers are indicated in hexadecimal from 0 (zero) to b. The FP and port numbers each have their own LED display beside the selection buttons.

4-port DS3 sparing panel NTHR79

The 4-port DS3 sparing panel NTHR79 provides one-for-one sparing for these FPs

- NTHR31, the 4-port DS3Ch ATM FP with IMA (page 144)
- NTHR91, the 4-port DS3Ch FP with AAL1 CES (page 148)

In addition to the sparing panel information provided in Basic functionality and operation of a sparing panel (page 243), the NTHR79 has the following distinguishing characteristics.

The NTHR79 is rated Class B for electromagnetic interference (EMI).

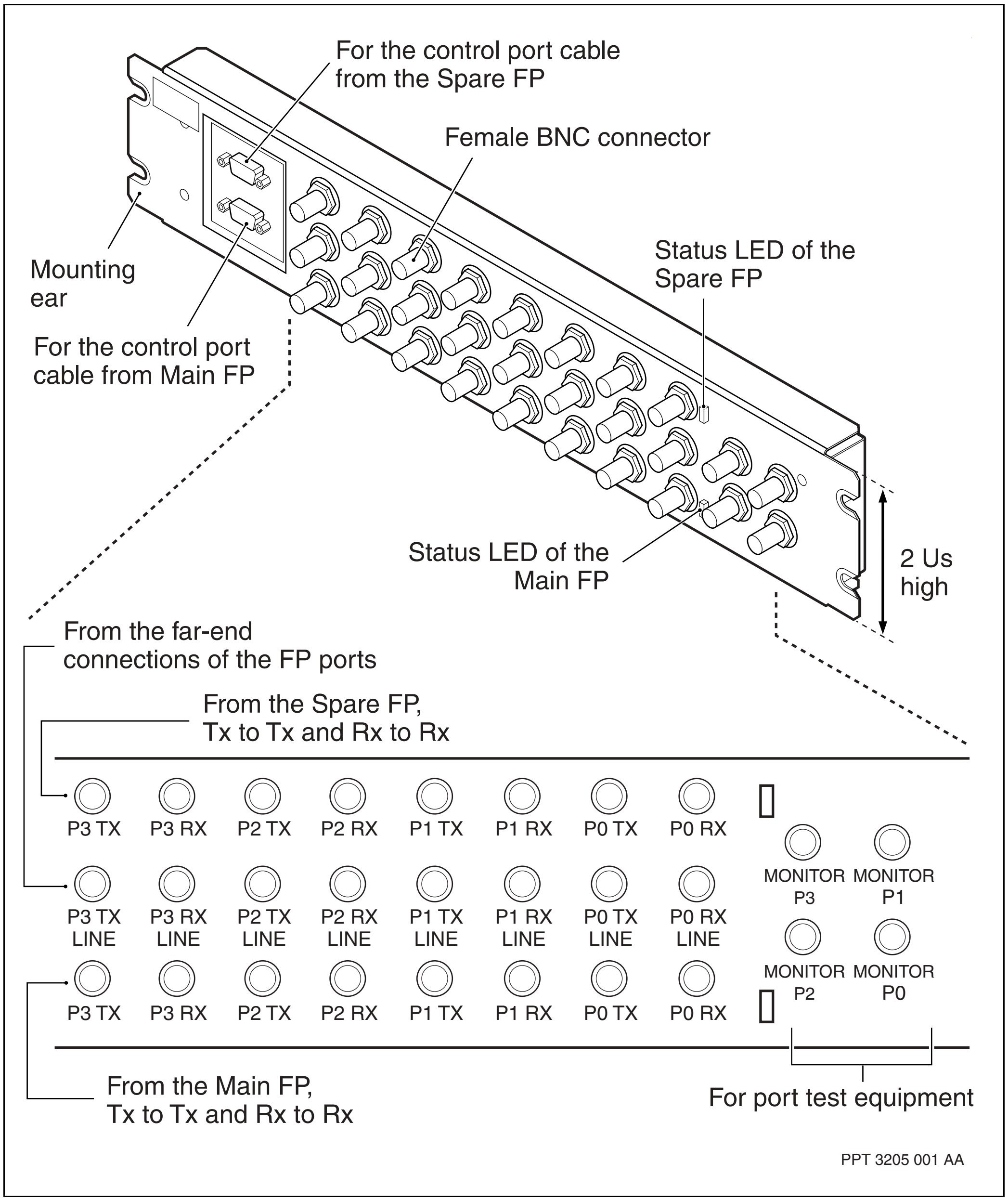
The NTHR79 can be used as a patch panel without sparing (like a one-for-one fanout panel) for one DS3 card provided the signaling and control port cables are connected to the respective Main ports on the sparing panel.

The faceplate has standard female BNC connectors for the signaling ports and female DB9 connectors for the control ports. The monitor ports are also 75-ohm BNC connectors. See the figure A 4-port DS3 one-for-one 19-inch sparing panel NTHR79 (page 255).

To facilitate more effective cable management, the faceplate includes spaces for writing port connection information.

The size of the panel is in the table Dimensions of fanout and sparing panels (page 262).

A 4-port DS3 one-for-one 19-inch sparing panel NTHR79



3-port DS3, E3, or E1 sparing panel NTFP99AA

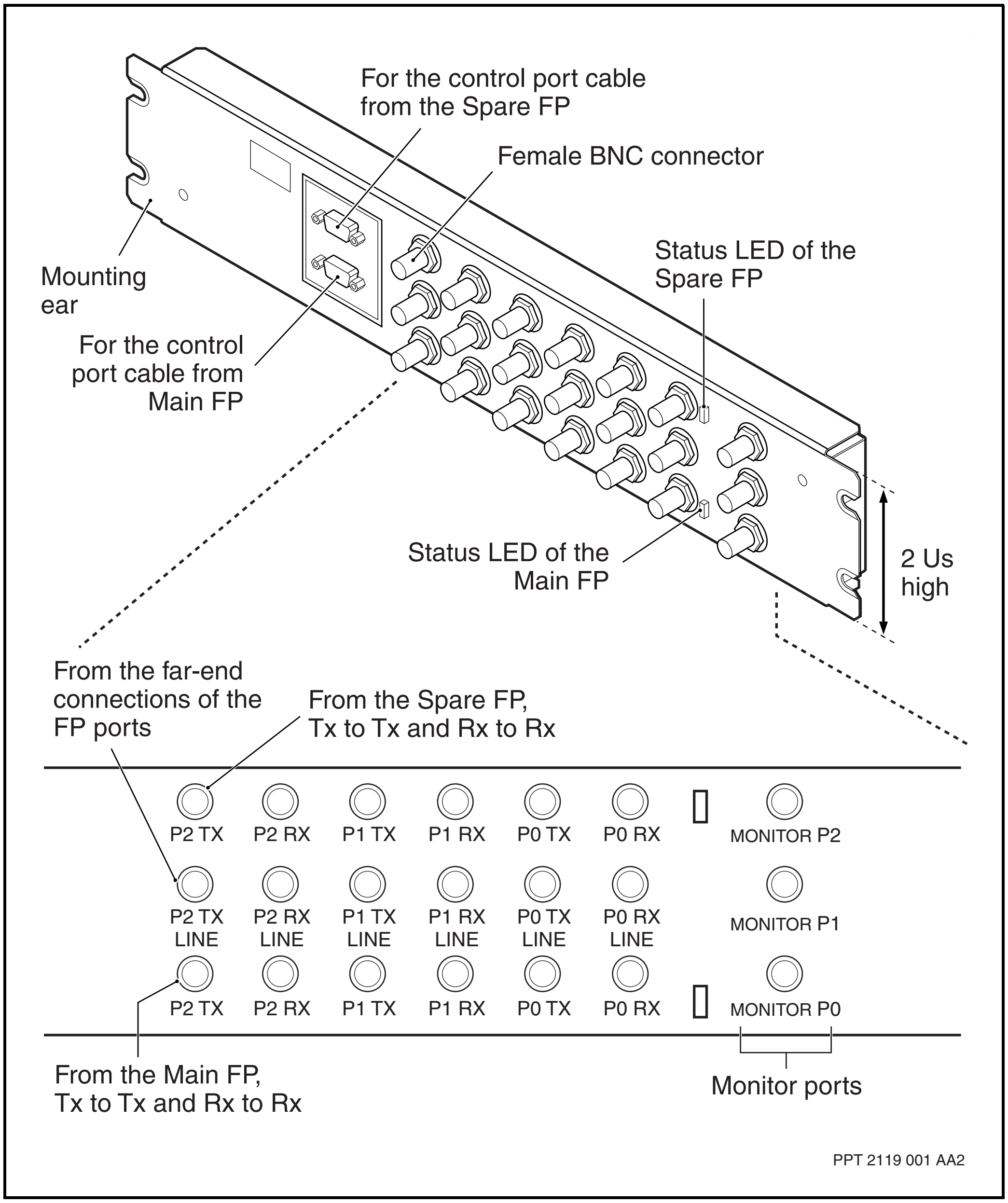
A 3-port DS3, E3, or E1 sparing panel NTFP99AA provides one-for-one sparing to the

- NTHW91, the 2-port DS3Ch TDM FP (page 131)
- NTHW92, the 32-port E1 TDM FP (page 160)

In addition to the sparing panel information provided in Basic functionality and operation of a sparing panel (page 243), the NTFP99AA has the following distinguishing characteristics.

The NTFP99AA has standard coax BNC-to-BNC connections. See the figure A 3-port DS3, E3, or E1 one-for-one 19-inch sparing panel NTFP99AA (page 257).

A 3-port DS3, E3, or E1 one-for-one 19-inch sparing panel NTFP99AA



For the size of the panel, see the table Dimensions of fanout and sparing panels (page 262).

The NTFP99AA can be used as a patch panel without sparing (like a one-for-one fanout panel) for one DS3 card provided the signaling and control port cables are connected to the respective Main ports on the sparing panel.

Multiport aggregate device for a 32-port E1 TDM

The 32-port E1 TDM FP uses a multiport aggregate device to break out the ports of the FP. Each multiport aggregate device provides individual access for 16 E1 ports. To break out all of the ports of a 32-port E1 TDM FP, you need two multiport aggregate devices.

The PECs of the multiport aggregate devices are

- NT0486 for the balanced
- NT0421 for the unbalanced

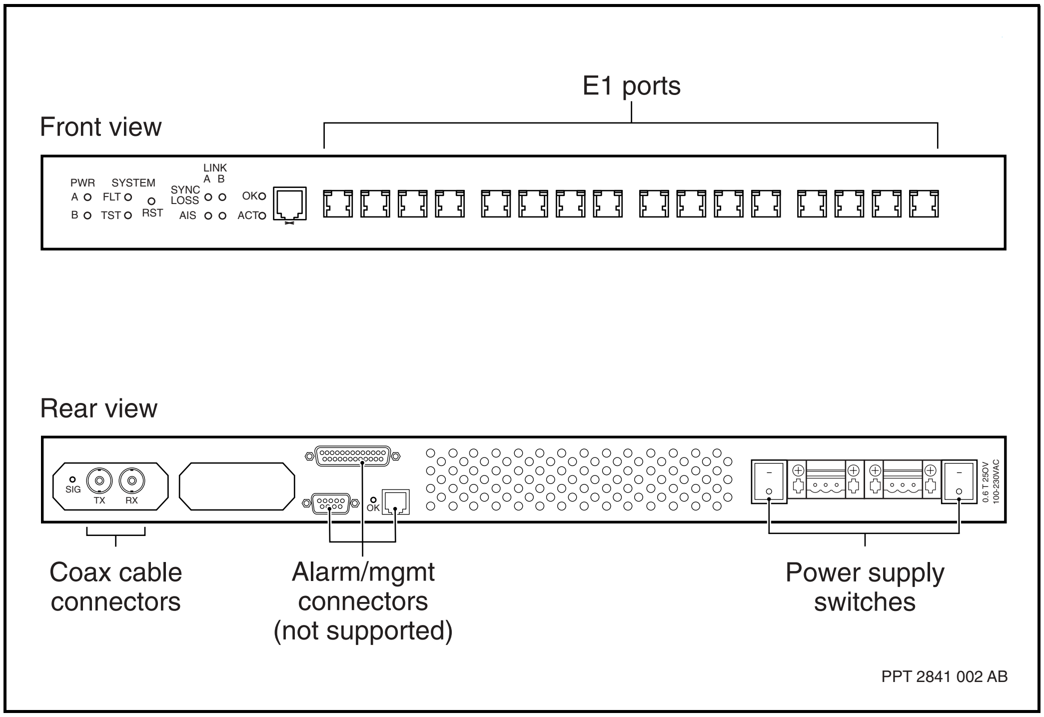
The multiport aggregate device mounts in a Nortel Networks Multiservice Switch or seismic cabinet, or a standard 19 inch rack. See the figure Balanced multiport aggregate device (page 259) or Unbalanced multiport aggregate device (page 259).

To add a multiport aggregate device to a NEBS 2000 frame, you also need adapter bracket kit NTHW14.

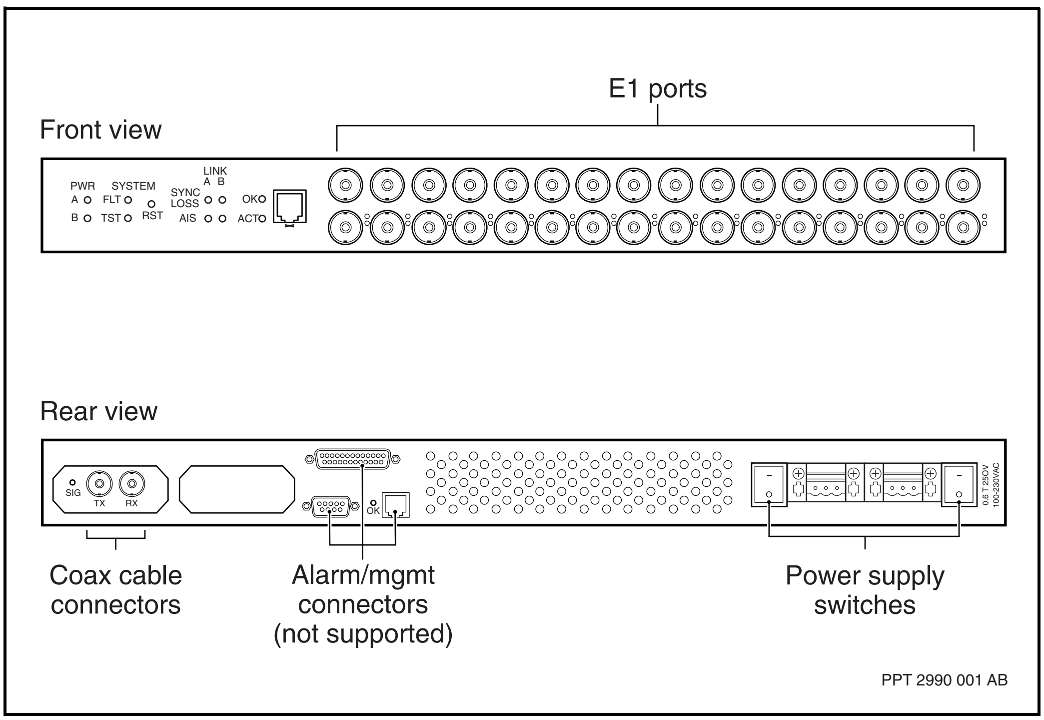
For more information about the multiport aggregate device, see

- Multiport aggregate device connections and cabling (page 260)
- Multiport aggregate device power and grounding requirements (page 260)
- Multiport aggregate device LEDs (page 260)
- Multiport aggregate device alarms (page 261)

Balanced multiport aggregate device



Unbalanced multiport aggregate device



Multiport aggregate device connections and cabling

The multiport aggregate device provides coaxial (unbalanced) connections between the device and the FP or termination panel and RJ-45 (120 ohm) connections or coaxial connections for each of the E1 ports. See the table E1 RJ-45 connector pinouts (page 260).

The maximum cable length for E1 lines to customer equipment is 183 m (600 ft). The E1 balanced and unbalanced interface connections comply with ITU-T Recommendation G.703.

E1 RJ-45 connector pinouts

Pin number	Signal name
1	Receive (tip)
2	Receive (ring)
3	Frame ground
4	Transmit (ring)
5	Transmit (tip)
6	Frame ground
7	not connected
8	not connected

Multiport aggregate device power and grounding requirements

The multiport aggregate device contains two dc power supplies. When both power supplies are operational, they share power consumption for the device. If one of the power supplies fails, the remaining power supply provides power for the device.

The dc power source must be within the range of -36 to -72 V dc. Maximum power consumption is 20 Watts. The dc power feeds into the system must be protected with an external circuit breaker or fuse, with appropriate voltage ratings and regulatory approvals. The disconnect device must be external to the cabinet or rack and reside in the same room.

You must supply your own power cables. Power cables must be properly grounded.

Multiport aggregate device LEDs

The SYNC LOSS LED for link A indicates a loss of frame (LOF) or loss of signal (LOS) condition on the link between the device and the FP. The SIG LED on the rear of the device is lit when the device is receiving a signal from the FP. You can use the SIG LED for link A in conjunction with the SYNC LOSS LED to distinguish between LOS and LOF. The AIS LED for link A indicates that alarm indication signal is being received from the device.

A pair of LEDs for each E1 port indicate loss of signal (LOS) and alarm indication signal (AIS) conditions.

Multiport aggregate device alarms

If a power supply for the multiport aggregate device fails, it reports the condition to the Nortel Networks Multiservice Switch node, and the node raises the alarm. E1 alarms from customer equipment are reported to the node through the E1 signal. E1 alarm conditions include AIS, LOF, and remote alarm indication (RAI) conditions.

In the event of an E1 LOS condition, the node sets LOF, RAI, and AIS alarm conditions on the affected ports. There is no distinction between LOS and LOF.

If the link between the FP and the multiport aggregate device fails, the node raises alarms on the affected 16 E1 ports.

Dimensions of the termination panels

The table Dimensions of fanout and sparing panels (page 262) includes the specifications for all available fanout and sparing panels, sorted by product engineering code (PEC). When a panel that is less than 21 inches wide (W) is to be installed in the NEBS 2000 frame, each panel requires adapter brackets from the kit NTHW14. The installation procedure of each termination panel explains how to install the brackets, see NN10600-130 *Nortel Networks Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*.

Dimensions of fanout and sparing panels

PEC of panel	Description of termination panel	Outside dimensions (height x width x depth)
NT0421 or NT0486	multiport aggregate device	4.4 H x 43.2 W x 26.8 D cm 1.7 H x 17.0 W x 10.5 D in. (1 unit high)
NTFP99AA	3-port DS3, E3, or E1 one-for-one sparing panel	8.8 H x 48.26 W x 3.0 D cm 3.5 H x 19.0 W x 1.18 D in.
NTHR79	4-port DS3 one-for-one sparing panel	8.89 H x 48.26 W x 1.9 D cm 3.5 H x 19.0 W x 0.75 D in. (2 units high)
NTHW52	a 12-port DS3 or E3 fanout panel	4.44 H x 53.34 W x 1.9 D cm 1.75 H x 21.0 W x 0.75 D in.
NTQS31	a 12-port DS3 or E3 one-for-six fanout sparing panel (comprised of NTHR37, NTHR39, NTHR42, and NTHR43)	44.45 H x 53.34 W x 10.92 cm 17.5 H x 21.0 W x 4.3 D in. Note: there are also holes for mounting it in a Multiservice Switch 7400 19-inch cabinet.

Understanding sparing panel replacement

A sparing panel is typically not pre-installed before shipment. One or more terminations panels can be installed in a NEBS 2000 frame on the front or rear uprights, provided there is no more than one switch installed in the frame. The number and types of termination panels that can be fastened to a NEBS 2000 frame depends on the size of the panel and the density of its cables. For frames with two switches installed, an alternate mounting apparatus must be used.

Any of the Multiservice Switch panels can be mounted in a 21-inch wide NEBS 2000 frame, a 19-inch wide Multiservice Switch 7480 cabinet, or a 23-inch wide EIA frame. The method of installation is the same for all. The difference in the installations is whether adapter brackets are used. For example, to install the 19-inch wide termination panels in a NEBS 2000 frame, you need the adapter brackets of kit NTHW14.

The NTHW52 is pre-assembled, including two adapter brackets fastened by four Phillips screws to the panel mounting ears. Also, a fanout panel is unpowered (has no status LEDs) and ungrounded.

The NTHW52 can be mounted in a 21-inch wide NEBS 2000 frame, a 19-inch wide Multiservice Switch 7480 cabinet, or a 23-inch wide EIA frame. Decide whether you must:

- use the attached adapter brackets with the NEBS 2000 frame
- remove the adapter brackets with a 19-inch wide Multiservice Switch 7400 cabinet
- replace the adapter brackets with your own set to accommodate a 23-inch EIA frame

Consider the position for all panels being mounted to the frame. All panels must have separate mounting holes except when sharing for cable management brackets. Up to 28 panels can be accommodated by one frame, 14 on the front and 14 on the rear. For more than one panel, position them butting against each other and installing the first 1 from the bottom of the frame.

If the frame already has one Multiservice Switch, or a switch might be added later, ensure that there is enough room to mount the panel using the chosen top holes. Measure only the panel sides.

For frames with one switch, the sparing or fanout panels must be installed on only the rear uprights.

The method of installation is the same for all types of mounting apparatus. Use the installation procedure as a guide for fastening the sparing panel into other types of mounting apparatus.

When installing fanout panels on both sides of a frame or rack, consider installing them on one side, cabling it, then installing them on the second side. You need access to the rear of each panel to cable it. Depending on available space, you may have to cable the rear of each panel before fastening it to the uprights.

You can use any of the Multiservice Switch 7400 19-inch DS1 or E1 sparing panels with packet voice gateway (PVG) function processor (FP) cards.

Although the NTQS31 is designed for a 21-inch wide mounting apparatus, it has a second set of mounting holes to enable fastening it to the adjustable rails of Multiservice Switch 7400 19-inch wide cabinet. The cabinet accommodates having the mounting ears extend beyond the vertical uprights.

At the front or rear of the NEBS 2000 frame or equivalent mounting apparatus, determine where on the 2 uprights that the top mounting holes of the panel are to be. Count holes from the top or bottom (whichever is shorter) on both uprights to ensure a level installation. Consider the following criteria, then mark the holes.

- For frames with one switch, install the sparing panel on only the rear uprights and facing into the frame.
- Determine the position for all panels being mounted to the frame, including those that might be mounted later for equipment expansions. All panels must have separate mounting holes except when sharing bolts with cable management brackets.
- Determine whether the sparing panel faces into the frame or out of it. For example, an outwardly facing sparing panel with coax cables that have straight connectors will exceed the perimeter of the NEBS 2000 footprint.
- For 1 or more panels, determine the impact of the cable density that will be connected to each faceplate. Assess the accessibility to the faceplate especially to read cable connection information, especially if panels are to be installed on both sides of the frame. Confirm the routing path that the cables must follow to the FPs and the other end of the FP connection can safely accommodate the density of cables. Choose an optimum access and the least congested route.

Cables and cable management

In this document, descriptions of the cables used for a Nortel Networks Multiservice Switch 15000 or Multiservice Switch 20000 system are divided into two categories:

- power cables for operating the system
- telecom signaling cables for connecting the node to other telecom equipment

Although the power cables and telecom cables can share cable management hardware and methods of use, the planning, installation, and replacement of each type of cable is managed separately.

Managing power cables

The hardware and method involved in managing power cables is included with the planning information for preparing a site to accommodate the switch hardware. For power cable specifications, requirements, and limitations, see NN10600-125 *Nortel Networks Multiservice Switch 15000/20000 Planning Site Requirements*.

For power cable installation, management, and replacement, see NN10600-130 *Nortel Networks Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*.

Managing telecom cables

Managing telecom cables usually means installing the hardware and then connecting cables to it. With a Nortel Networks Multiservice Switch 15000 or Multiservice Switch 20000, there is optional hardware that facilitates easier, quicker, safer, more efficient, and more organized methods of cabling. For example, before marking the footprint of the frame onto the floor in preparation for anchoring it, you must consider where optional equipment is located for cabling the system.

WARNING
Risk of equipment damage by improper grounding
All metallic telecom equipment interfaces must be connected only to intra-building or non-exposed wiring or cabling.

When a prefabricated interface cable from Nortel Networks is connected between a DS3 FP and a Nortel Networks termination panel, the connection is grounded.

The cable management hardware and method involved in managing telecom cables includes:

- Basic cable management brackets for low-density cabling (page 266)
- Cable management brackets for high-density cabling (page 269)
- Hardware to manage fiber cable slack near the node (page 273)
- Cabling a card with or without a termination panel (page 277)

Basic cable management brackets for low-density cabling

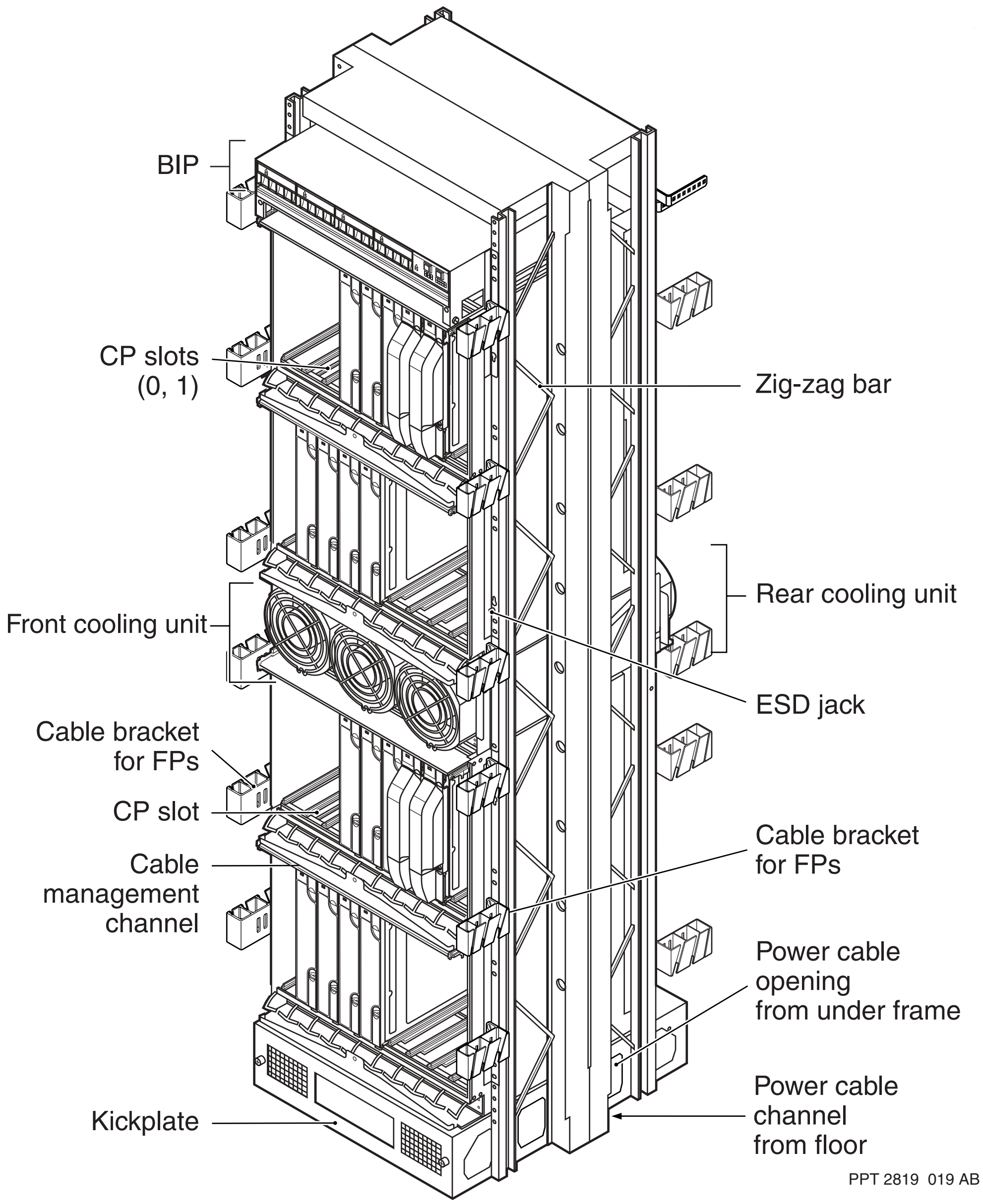
When a Nortel Networks Multiservice Switch 15000 or Multiservice Switch 20000 node is mounted in a NEBS 2000 frame, the basic cable management brackets are already installed on the frame. If a shelf-based node is shipped for installation into a mounting apparatus other than the NEBS 2000 frame, basic cable management brackets are shipped without being installed.

A basic cable management bracket is a plastic bracket with three segregated sections. All switch hardware packages have 28 plastic cable management brackets and two metal brackets at the upper rear of each NEBS 2000 frame. The metal brackets (P0879577) have two fingers each and are intended for the heavier and thicker electrical cables being routed up to a cable trough. (When power cables are routed down through the floor, they are to be fastened to the zig-zag bars of the frame, not the basic or optional cable management brackets.) See the figures

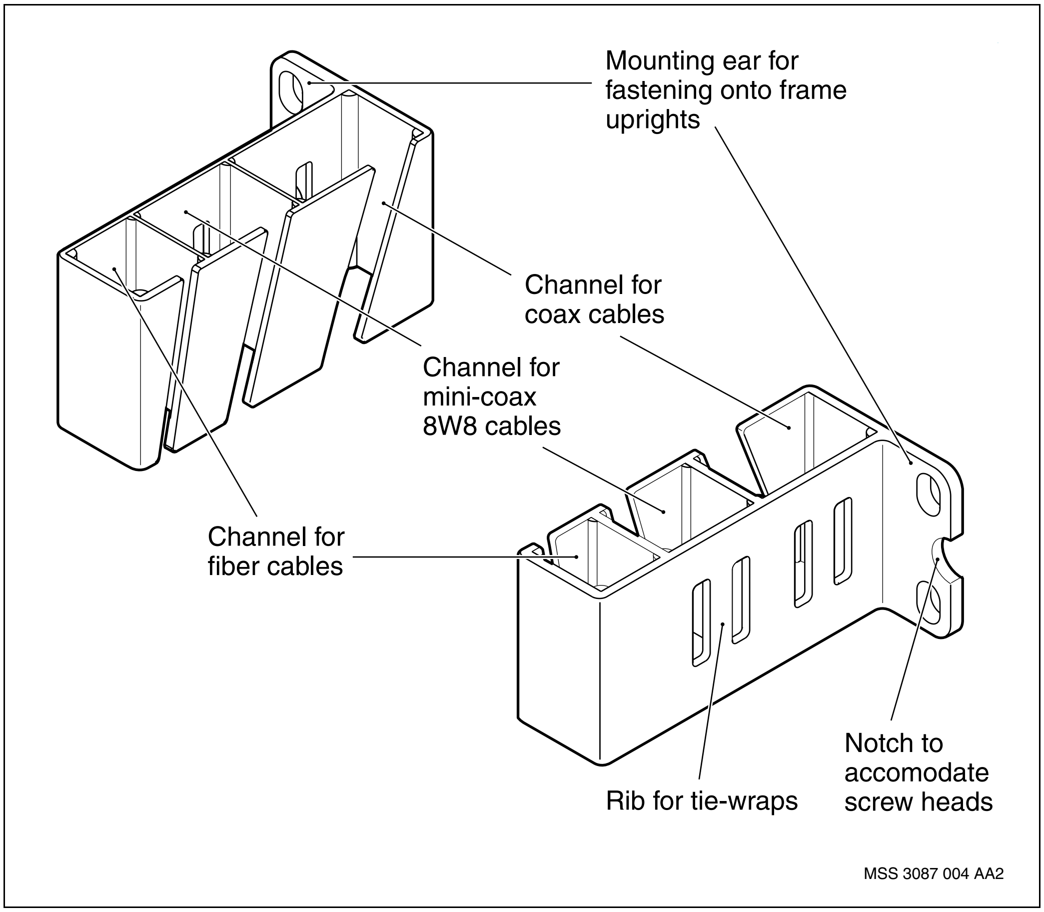
- Metal and plastic cable management brackets on a NEBS 2000 frame (page 267)
- A plastic cable management bracket P0937935 (page 268)

With any node hardware package, sufficient cable management brackets are provided to ensure tight and neat cable dressing for low-density cabling of fiber and mini-coax cables. For node configurations that have higher density cabling, optional hardware is available. See High-density cable management brackets (page 269).

Metal and plastic cable management brackets on a NEBS 2000 frame



A plastic cable management bracket P0937935



Cable management brackets for high-density cabling

High-density cable management must be done on a NEBS 2000 frame when the number of cables exceeds the capacity of the basic cable management brackets. See NN10600-125 *Nortel Networks Multiservice Switch 15000/20000 Planning Site Requirements* to determine if you need low, high, or very high density cable management.

The optional cable management hardware that accommodates higher-density cable management for one or two nodes in a frame includes

- paired plastic brackets as described in High-density cable management brackets (page 269)
- the extended cable management brackets as described in Very high-density cable management brackets (page 270)

You can use sets of the optional cable management brackets for one or two nodes in a NEBS 2000 frame as follows:

- a set of high-density brackets on one or both sides of the frame
- a set of extended cable management brackets on one or both sides of the frame to accommodate very high-density mini-coax or standard coax cabling
- a set of high-density brackets and a set of extended cable management on the same side of the frame

See NN10600-125 *Nortel Networks Multiservice Switch 15000/20000 Planning Site Requirements* to the determine the optional hardware required to manage your cable density.

The location, and quantity of FPs in one or two nodes, determine if the FP cables must be routed to the left or right side of the frame, and up or down the side of the frame. For more information, see NN10600-130 *Nortel Networks Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*, the section on choosing card slots. Use this information to identify where optional cable management brackets should be installed on the frame.

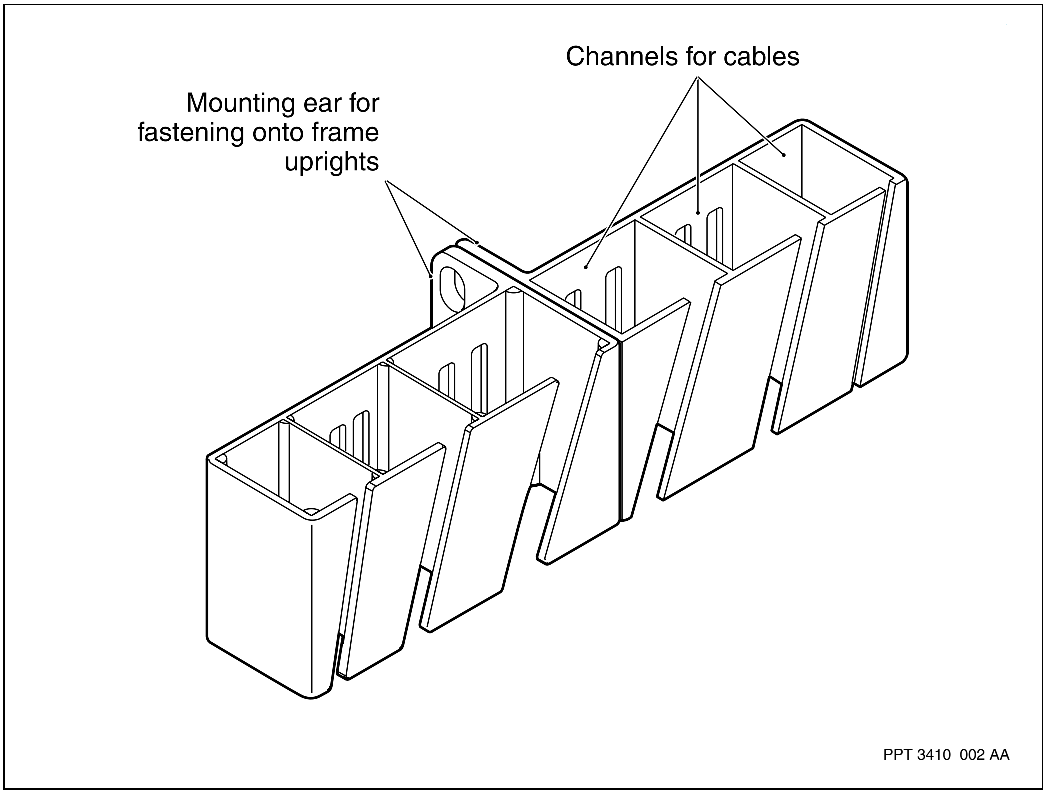
High-density cable management brackets

The high-density cable brackets double the capacity of the basic brackets by pairing them back-to-back as shown in the figure High-density cable management bracket pair (page 270). The second plastic brackets can be added onto the frame at any time and use the original bracket mounting holes. These brackets replace the single basic plastic brackets as shown in the figure A plastic cable management bracket P0937935 (page 268) or replace all but two of the older two-finger metal brackets as shown in the figure Metal and plastic cable management brackets on a NEBS 2000 frame (page 267).

Each high-density cable management bracket (part number P0937935) accommodates fiber or mini-coax cables, or both. Document NN10600-130 *Nortel Networks Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade* indicates how many cables of each kind fit through each bracket, and how to calculate how many your node(s) in a NEBS 2000 frame, need.

When cable densities exceed the capacity of the high-density cable management brackets, you may need to use the optional coax brackets described in Very high-density cable management brackets (page 270).

High-density cable management bracket pair

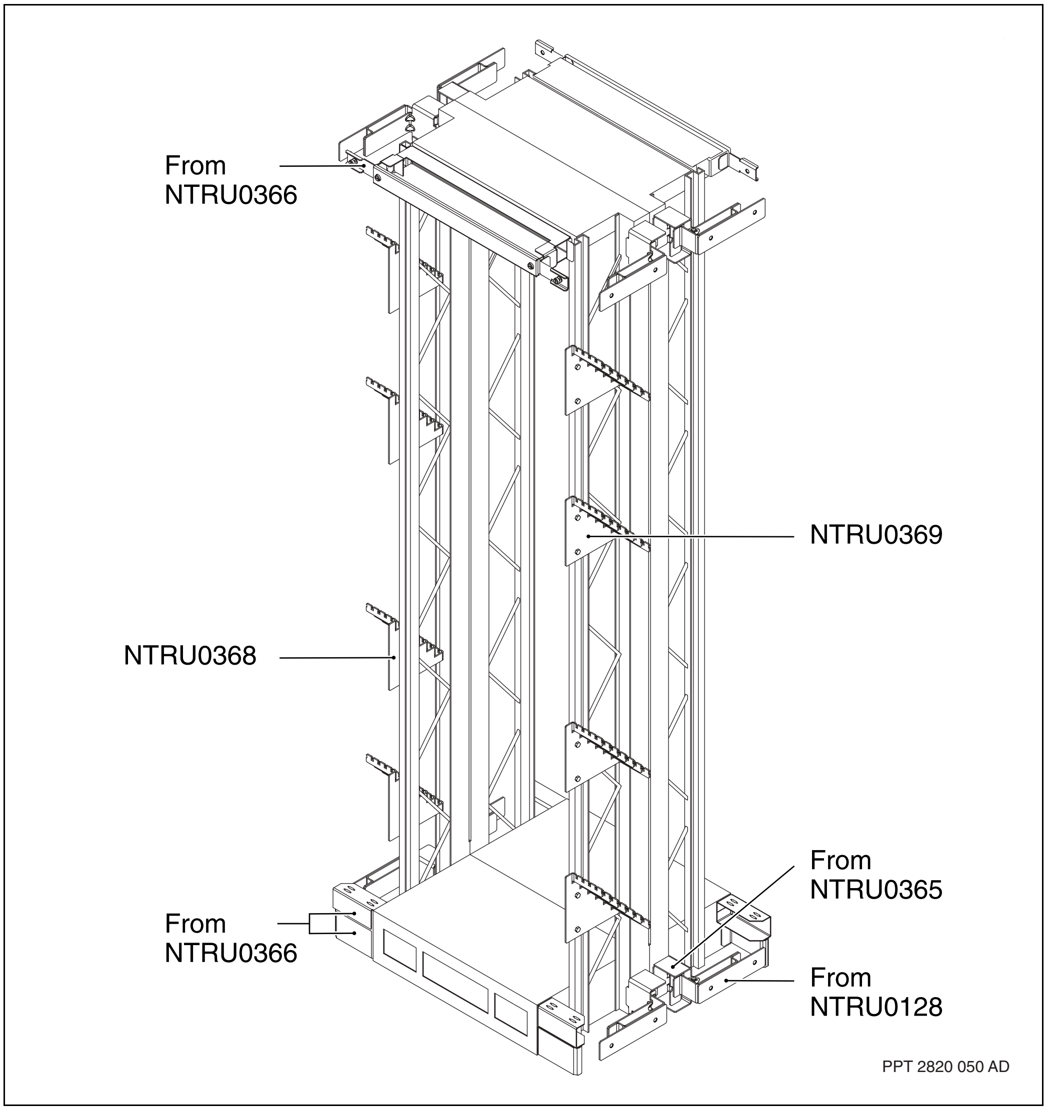


Very high-density cable management brackets

The very high-density cable management brackets are the optional extended cable management brackets for coax cables that can be mounted along all or part of one or both sides of a frame as shown in the figure A NEBS 2000 frame with extended cable management brackets and side panel brackets (page 271). Up to four brackets fit on each side of a frame. The bracket installation procedure identifies where the brackets are fastened to the frame. The brackets must be mounted onto the frame before it is anchored to the floor unless enough unobstructed space is kept available to add the brackets later.

See NN10600-125 *Nortel Networks Multiservice Switch 15000/20000 Planning Site Requirements* to plan the frame footprint to include space for the brackets.

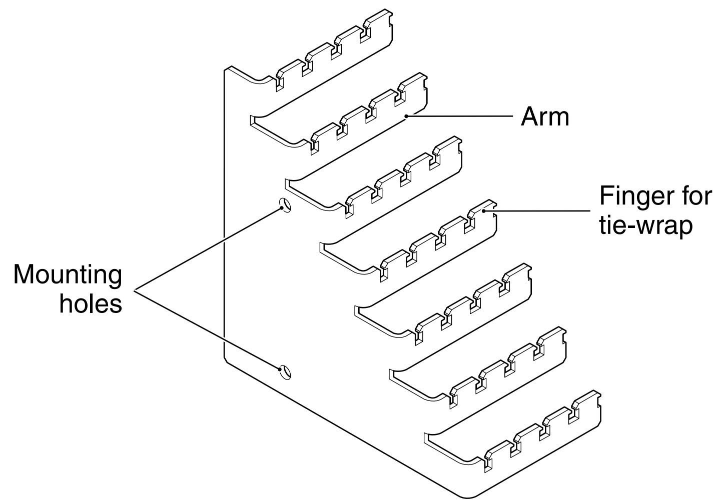
A NEBS 2000 frame with extended cable management brackets and side panel brackets



The extended cable management brackets accommodate only standard coax or the proprietary 8W8 mini-coax cables from Nortel Networks. A bracket for the left side of the frame (while facing the front of the node) has part number NTRU0368 while the right side has NTRU0369 as shown in the figure An extended cable management bracket for the right side of a NEBS 2000 frame (page 272).

Document NN10600-125 *Nortel Networks Multiservice Switch 15000/20000 Planning Site Requirements* indicates how many cables of type fit onto each bracket. Document NN10600-130 *Nortel Networks Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade* includes the task flows to show how the installation procedure is to be done, and how to efficiently bundle the cables onto the brackets. The effect of this bundling is described in Location of specific FP cables in a bundle (page 275).

An extended cable management bracket for the right side of a NEBS 2000 frame



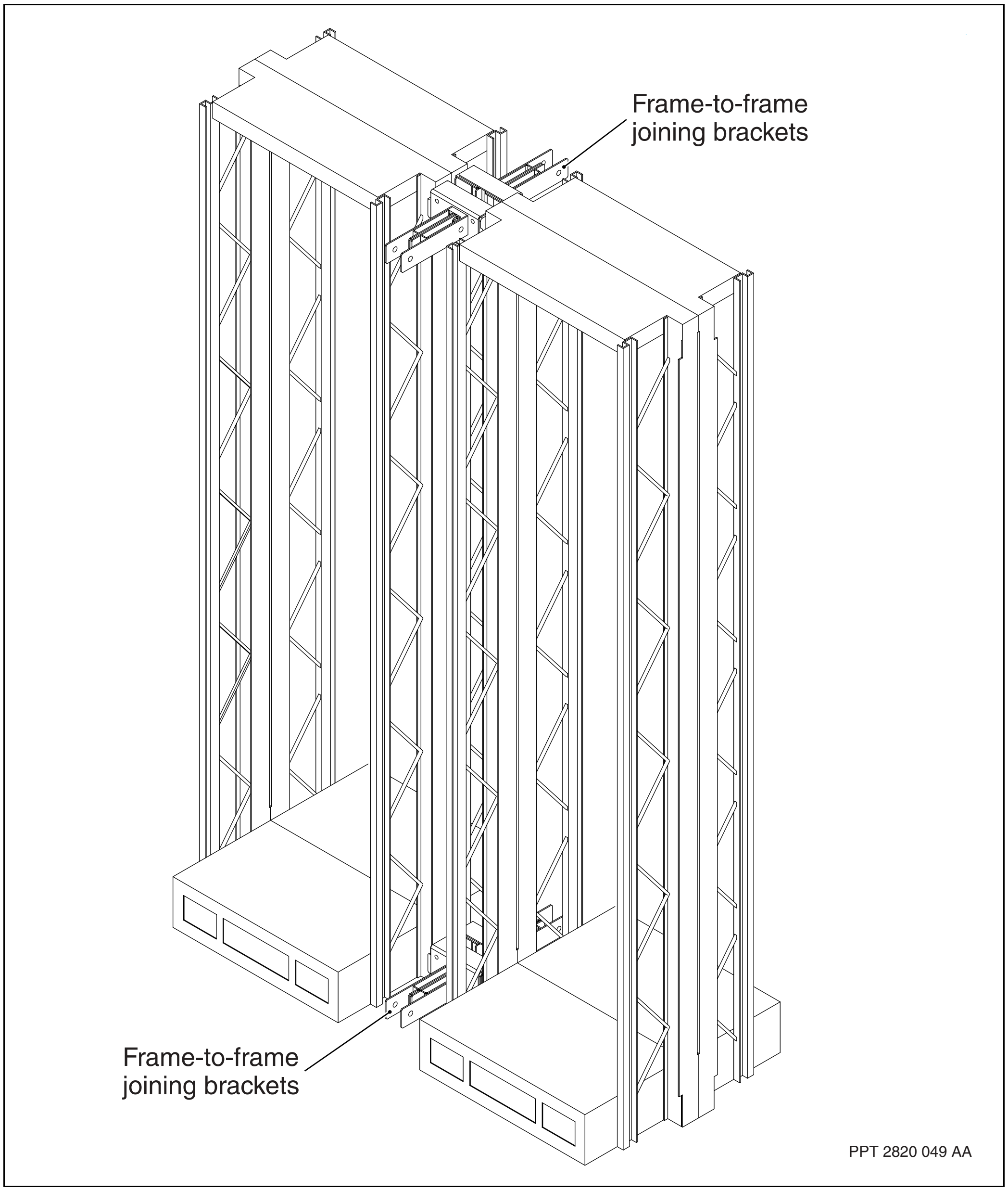
PPT 3397 001 AA

The hardware kits that appropriately space parallel sets of extended cable management brackets between two joined frames have these product engineering codes (PECs):

- NTRU0128 for side panel mounting brackets
- NTRU0365 for frame spacer brackets
- NTRU0366 for cable covers (front or rear panels)

To ensure that cable extension brackets fit between two Nortel Networks frames and allow space for the addition or removal of FP cables, the minimum distance between the frames is determined by adding optional joining brackets. See the figure Frame-to-frame joining brackets (page 273).

Frame-to-frame joining brackets



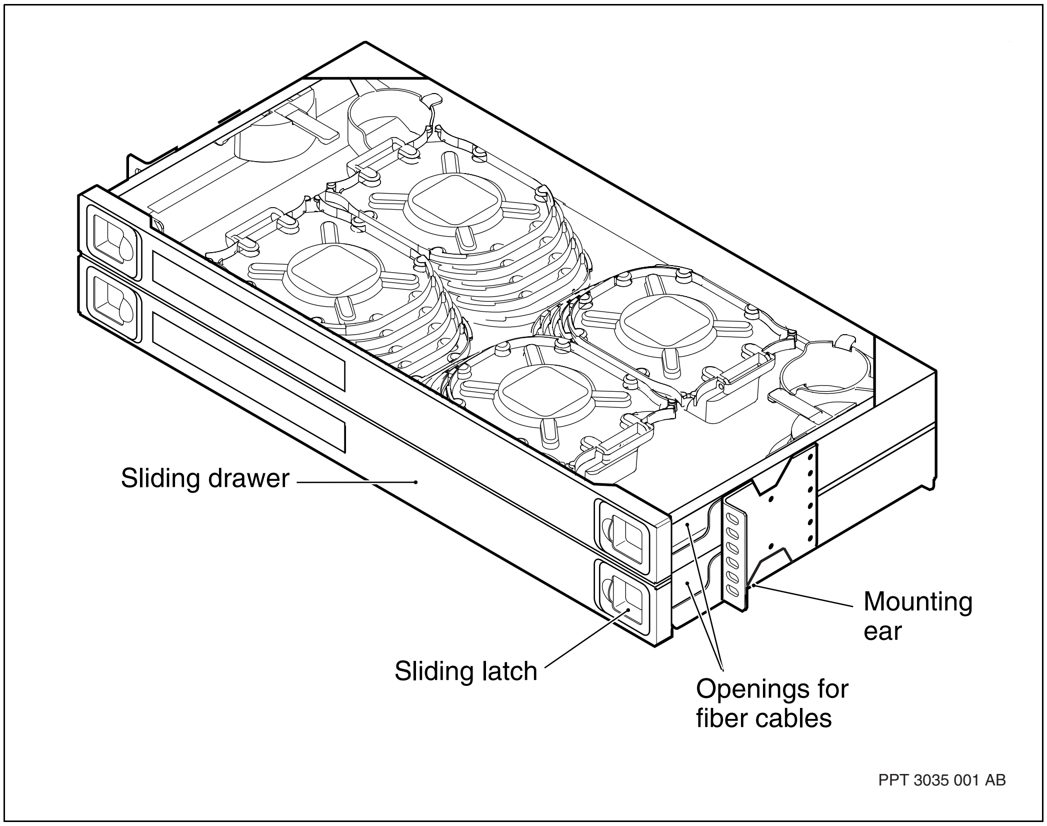
Hardware to manage fiber cable slack near the node

Fiber cable slack can be managed near a Nortel Networks Multiservice Switch 15000 or Multiservice Switch 20000 node by installing one or more optional dual-drawer fiber management units in a NEBS 2000 frame or equivalent close to the node.

The fiber management unit is manufactured by ADC. The unit includes two latched drawers with 20 fiber trays each. See the figure A dual-drawer fiber management unit NTHW50 (page 274). Each tray accommodates up to 2 m

(6.5 ft.) of one single-mode or multi-mode fiber cable with the appropriate bend radius. The fiber unit has mounting ears to fit a 21-inch (53.34-cm) wide frame or rack. Blank labels are included on each tray so that the origination and destination can be recorded. Each drawer is labeled Fiber manager. Fiber cables are routed in and out of the unit through the sides.

A dual-drawer fiber management unit NTHW50



Location of specific FP cables in a bundle

During initial installation or when a control processor (CP) or function processor (FP) is added to a node, the cable connections are labeled as well as the bundle into which all cables of an FP are tie-wrapped. Tracing a single cable for replacement is difficult unless you know which bundle the cable is in. Have the network operator identify which FP has the signaling problem so that you can trace the cable from end-port to end-port.

When the extended cable management brackets are used on both sides of a NEBS 2000 frame, up to 700 cables can be routed from two Nortel Networks Multiservice Switch 15000 nodes fully provisioned with 12-port FPs. When replacing a CP or an FP cable, use the tables Position of each FP cable bundle on right-side extended cable brackets (page 275) and Position of each FP cable bundle on left-side extended cable brackets (page 275) to locate the labeled cable bundle that holds the cable to be replaced.

Attention: Slot 8 is omitted from the tables because it was intended to house an OC card.

Position of each FP cable bundle on right-side extended cable brackets

Lower shelf slot numbers	Lower shelf slot numbers	Upper shelf slot numbers	Upper shelf slot numbers
15	7	15	7
14	6	14	6
13	5	13	5
12	4	12	4
11	3	11	3
10	2	10	2
9	1	9	1
Note: slot 1 of the shelf may contain a CP instead of an FP.			

Position of each FP cable bundle on left-side extended cable brackets

Upper shelf slot numbers	Upper shelf slot numbers	Lower shelf slot numbers	Lower shelf slot numbers
15	7	15	7
14	6	14	6
13	5	13	5

(1 of 2)

Position of each FP cable bundle on left-side extended cable brackets

Upper shelf slot numbers	Upper shelf slot numbers	Lower shelf slot numbers	Lower shelf slot numbers
12	4	12	4
11	3	11	3
10	2	10	2
9	1	9	1
Note: slot 1 of the shelf may contain a CP instead of an FP.			
(2 of 2)			

Cabling a card with or without a termination panel

The information about custom-made or prefabricated cable assemblies for a plug-in card or a termination panels is provided with the description of each control processor (CP) or function processor (FP) card. Each description lists the optional prefabricated cable assemblies and includes the specifications for type of cable and connector, and includes the port pinouts of the faceplate connections.

In general, cabling a Nortel Networks Multiservice Switch card port to a termination panel port means doing Tx-to-Tx and Rx-to-Rx connections for the entire end-to-end connection path. You can also determine the appropriate Tx-to-Rx combinations depending whether the signal is exiting one unit and entering the other provided the pattern of combinations is the same for the entire end-to-end connection path. When the Tx-to-Rx combinations get criss-crossed between an FP, a termination panel, and the far-end termination, the effect of one error nullifying another can establish a workable connection. It is important that you label the connection information of each Tx and Rx connection onto the end of the cable at each break in the cable path.

Specific cabling information for the plug-in CPs and FPs is included in Control and function processors (page 114).

Specific cabling information for the fanout and sparing panels of the DS3 cards is included in Termination panels for FPs (page 242).

Preparing OC or STM fiber distribution cables

The fiber distribution cables connect the ports on the function processors (FPs) to a termination port. The customer must supply the fiber distribution cables for a Nortel Networks Multiservice Switch 15000 or Multiservice Switch 20000 node.

The fiber cable connectors for Multiservice Switch 15000 or Multiservice Switch 20000 FPs are the LC, MT-RJ, or SC type. Choosing the type of cable and connectors for a fiber optic FP depends on the terminations at both ends. You must provide the cables and connectors that link the FPs to the far end. The 16-port OC-3/STM-1 cards have either LC or MT-RJ connectors. See the figures A duplex cable assembly with LC-to-LC connectors (page 279) and Cable assembly with an MT-RJ fiber connector and a duplex SC connector (page 280).

Handling any system cable is described in NN10600-130 *Nortel Networks Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*.

Single-mode FPs at both ends can operate with either multimode or single-mode fiber cables. The difference in performance depends on the length of fiber cable. Multimode FPs at both ends can operate with only multimode cables.

The length of a fiber cable is determined from the exact path of fiber from its port on an FP to its termination port. The path depends on

- where the FP is located in the NEBS 2000 frame (the node, the shelf, and the slot)
- which way along the cable management channel on the nodes that the cables continue their path; fiber cables can go in either direction
- if the cabling is routed along the side of the frame (or equivalent mounting apparatus) under the floor or through an overhead trough
- if there is an optional fiber management unit NTHW50 for slack control
- if you use a fiber patch panel between the termination ends
- what the angle of connection is at each termination port
- where the far-end termination port is located

Determine the length of a fiber cable from an FP by measuring the exact path from each port on the faceplate to its termination port.

Attention: If using a metal tape measure, avoid contacting live power cables or connections.

Remove any cable slack resulting from cautious cable cutting before fastening the second connector to the cable. Otherwise, install and cable a fiber management unit NTHW50 as described in NN10600-130 *Nortel Networks Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*.

To prepare FP distribution cables, follow procedure Preparing OC or STM fiber distribution cables (page 278).

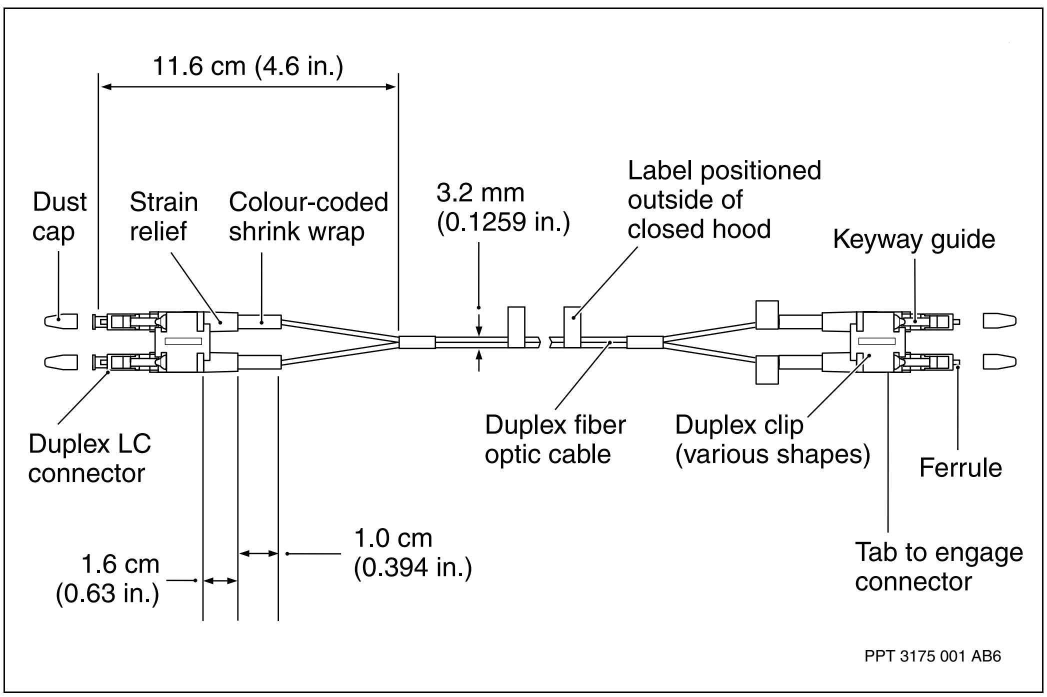
LC fiber cables and connectors

The small form LC transceiver on the faceplate of a 16-port OC-3/STM-1 FP accommodates simplex or duplex single-mode fiber connectors. For an example of a cable assembly, see the figure A duplex cable assembly with LC-to-LC connectors (page 279).

Handling fiber cables is described in NN10600-130 *Nortel Networks Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*.

Some FPs have small form pluggable (SFP) optical modules that plug into the FP faceplate, and interface the LC cable connectors. For information about SFPs, see SFP optical modules.

A duplex cable assembly with LC-to-LC connectors

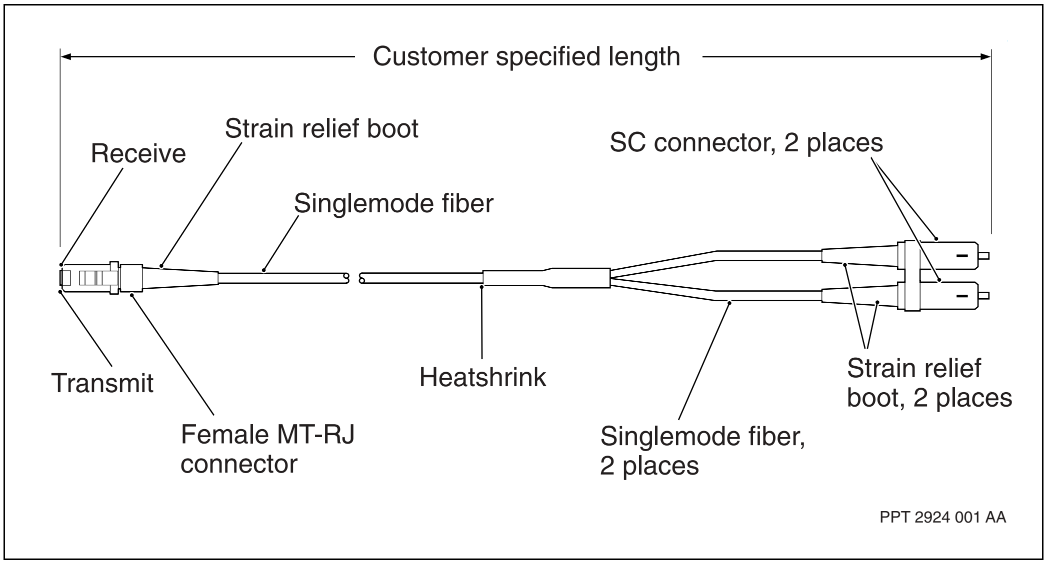


MT-RJ fiber cables and connectors

The MT-RJ connector accommodates two fibers. One fiber carries the transmit signal and the other fiber carries the receive signal. The cable is a 3-mm (1/8-inch) jacketed fiber-optic cable with two strands of single-mode fiber in it. See the figure Cable assembly with an MT-RJ fiber connector and a duplex SC connector (page 280). Ensure that the manufacturer of the cable identifies which SC connector is to transmit and which is to receive.

Handling fiber cables is described in NN10600-130 *Nortel Networks Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*.

Cable assembly with an MT-RJ fiber connector and a duplex SC connector



Preparing coax distribution cables

Cards requiring coax connections at the faceplate of FPs or a termination panel can be provided by Nortel Networks in prefabricated cable assemblies or must be provided by you. To custom make your own cables for a specific type of FP, refer to the cable assembly specifications in Control and function processors (page 114). Use the specifications to make your cables. If the FP description does not list cable assembly parts, you must use the appropriate prefabricated cable assemblies.

The specialized mini-coax distribution cables for the 4-port DS3 and 12-port DS3 or E3 cards are available from Nortel Networks in prefabricated assemblies. These cables have special 8W8 connectors at the FP end to accommodate dense cabling at the faceplate of the cards. The other end of the FP cable can be standard coax or mini-coax 8W8.

The PEC of all available FP distribution cables is in the tables

- Prefabricated FP control port cables for connecting to a sparing panel (page 281)
- Prefabricated 75-ohm cables for connecting FPs to a sparing panel (page 281)
- Prefabricated DS3 or E3 cables connecting FPs to an NTHW52 (page 282)

Attention: There is no control cable between an FP and an NTHW52.

Prefabricated FP control port cables for connecting to a sparing panel

PEC	Description	Length
NTHR69	DB9 sparing control port	2.5 m (8.2 ft)
NTHR70	DB9 sparing control port	5.0 m (16.4 ft)
NTHR71	DB9 sparing control port	15 m (49.2 ft)

Prefabricated 75-ohm cables for connecting FPs to a sparing panel

PEC	Description	Length
NTFP19AD	male straight BNC to male straight BNC	3.0 m (9.8 ft)
NTFP19AE	straight male BNC to straight male BNC	15 m (49 ft)
NTHR58	male 8W8 mini-coax to male BNC	2.5 m (8.2 ft)
(1 of 2)		

Prefabricated 75-ohm cables for connecting FPs to a sparing panel (continued)

PEC	Description	Length
NTHR59	male 8W8 mini-coax to male BNC	5.0 m (16.4 ft)
NTHR60	male 8W8 mini-coax to male BNC	15 m (49.2 ft)
NTHR69	DS3 or E3 male D-sub to male D-sub	2.5 m (8.2 ft)
NTHR70	DS3 or E3 male D-sub to male D-sub	5.0 m (16.4 ft)
NTHR71	DS3 or E3 male D-sub to male D-sub	15 m (49.2 ft)
NTHR72	male 8W8-to-8W8 mini-coax	2.5 m (8.2 ft)
NTHR73	male 8W8-to-8W8 mini-coax	5.0 m (16.4 ft)
NTHR74	male 8W8-to-8W8 mini-coax	15 m (49.2 ft)
For the mapping of 8W8 connector pins to the BNC connectors for software port numbering, see Assigning sparing panel connections for a 12-port DS3 or E3 FP (page 156).		
(2 of 2)		

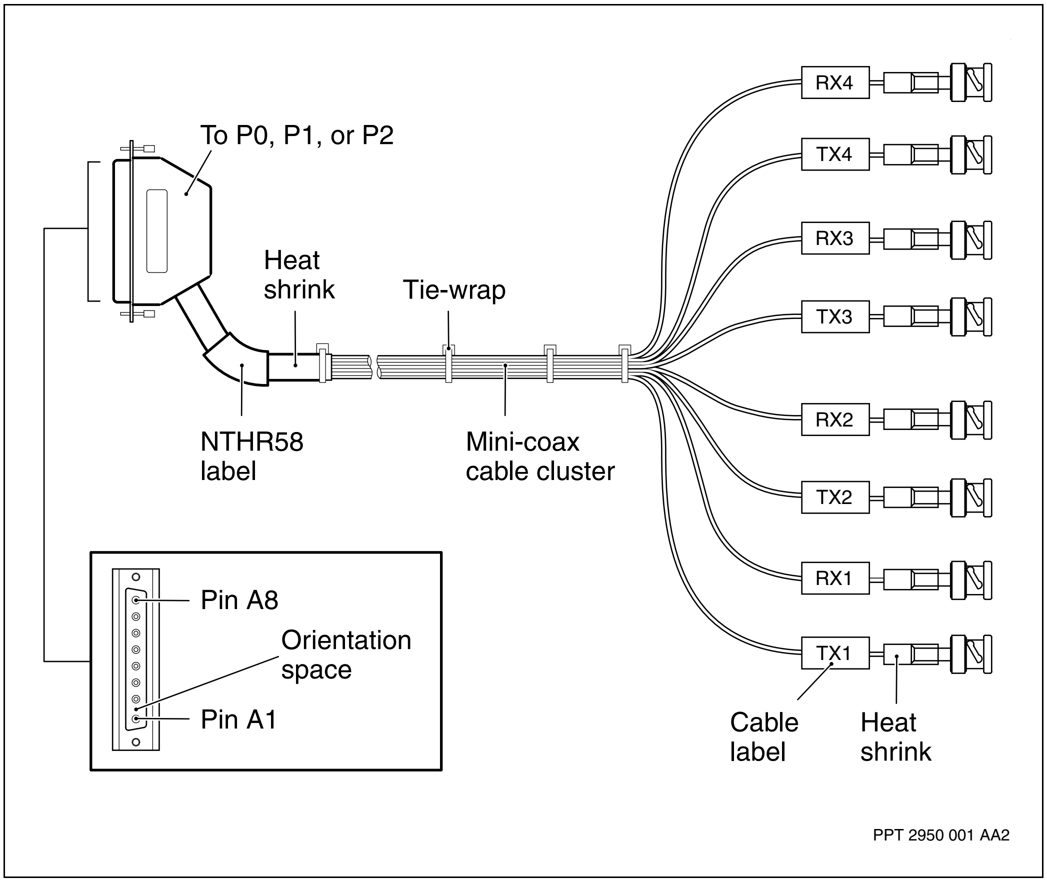
Prefabricated DS3 or E3 cables connecting FPs to an NTHW52

PEC	Description	Length
NTFP19AD	straight male BNC to straight male BNC	2.5 m (8.2 ft)
NTFP19AE	straight male BNC to straight male BNC	15 m (49.2 ft)
NTHR58	male 8W8 mini-coax to male BNC	2.5 m (8.2 ft)
NTHR59	male 8W8 mini-coax to male BNC	5.0 m (16.4 ft)
NTHR60	male 8W8 mini-coax to male BNC	15 m (49.2 ft)
For the mapping of 8W8 connector pins to the BNC connectors for software port numbering, see Assigning the fanout panel cable connections (page 249).		

Attention: When the FPs have more than four ports each or the total number of FP connections per shelf is 64 or more, the optional extended cable management brackets must be installed.

The cable assembly NTHR58 has the same connector pattern and labels when connected to any of the three ports on a 12-port DS3 or E3 faceplate. The position of the cable at P0, P1, or P2 determines the port mapping between the 8W8 connections at the faceplate and the BNC connectors at a sparing panel or fanout panel at the other end. Use the figure Labels of mini-coax and BNC cable connections on an NTHR58 cable assembly (page 283) to label the cables at the FP end and at the BNC end.

Labels of mini-coax and BNC cable connections on an NTHR58 cable assembly



Preparing control port cables

For the hardware configurations involving sparing panels, the control port cables are available from Nortel Networks in prefabricated assemblies. Refer to the table Prefabricated FP control port cables for connecting to a sparing panel (page 281).

You can custom make your own control port cable using the specifications described in the section on cable assemblies for each type of FP in Control and function processors (page 114). The control port pinout is the same for all DS3 or E3 cards.

Handling alarm cables

A Nortel Networks Multiservice Switch 15000 or Multiservice Switch 20000 node has internal alarm cables installed at the time of shipping, and can have had external alarms added for the site. Internal alarm cables connect the breaker interface panel (BIP) on a NEBS 2000 frame to the node, while external alarm cables connect the BIP to site alarms such as a LED or end-of-aisle lamp. The internal alarm cables for a second switch are typically included even if it was not installed.

Cables are mounted in exclusive bundles on different paths against the frame of the node. The electrical current from power cables can interfere with the transmission of signals over coax, therefore the power and alarm cables follow different paths.

There is no bend radius recommendation for electrical cable, however, observe a 4-cm (1.5-inch) bend radius for 1/0 AWG cable. Any cable connected to the BIP must be flexible enough to do right-angle bends with cracking its sheath.

When routing the alarm cables, keep them away from the battery return (positive) and battery (negative) cable pairs. Otherwise, the cables can behave like antennas that transmit electromagnetic interference (EMI).

Prefabricated DS3 or E3 cable assemblies

The mini-coax cables for the 4-port DS3, 12-port DS3, or 12-port E3 have special 8W8 connectors at the FP end to accommodate dense cabling at the faceplate of the cards. The other end of the FP cable can be standard coax or mini-coax 8W8. The cables that connect FPs to various termination panels are available from Nortel Networks.

The PEC of each cable is in the tables

- Prefabricated FP cable assemblies to a fanout panel NTHW52 (page 284)
- Prefabricated FP cable assemblies to a one-for-six sparing panel NTHR37 (page 285)
- Prefabricated FP cable assemblies to the control ports on an NTHR37 (page 285)

Prefabricated FP cable assemblies to a fanout panel NTHW52

PEC	Description	Length
NTHR58	DS3 or E3 mini-coax 8W8 to BNC cable	2.5 m (8.2 feet)
(1 of 2)		

Prefabricated FP cable assemblies to a fanout panel NTHW52 (continued)

PEC	Description	Length
NTHR59	DS3 or E3 mini-coax 8W8 to BNC cable	5.0 m (16.4 feet)
NTHR60	DS3 or E3 mini-coax 8W8 to BNC cable	15 m (49.2 feet)
	(2 of 2)	

Prefabricated FP cable assemblies to a one-for-six sparing panel NTHR37

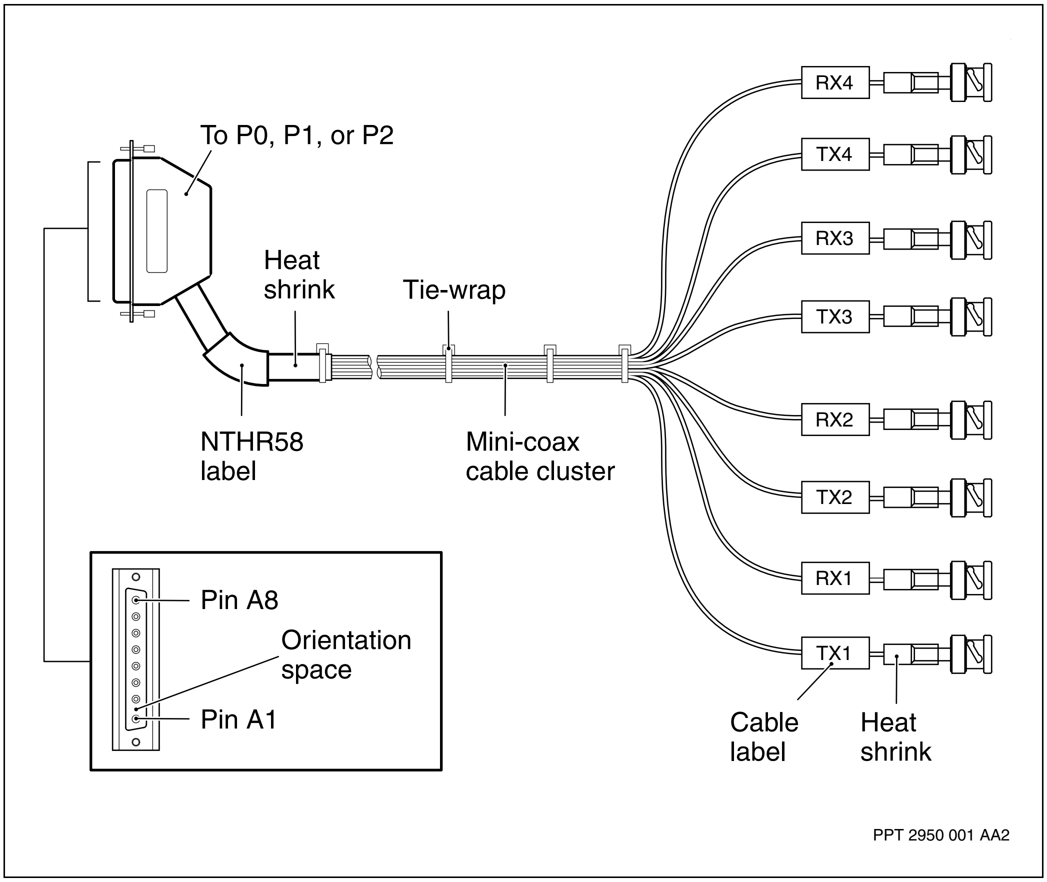
PEC	Description	Length
NTHR72	DS3 or E3 mini-coax 8W8 to 8W8 cable	2.5 m (8.2 feet)
NTHR73	DS3 or E3 mini-coax 8W8 to 8W8 cable	5.0 m (16.4 feet)
NTHR74	DS3 or E3 mini-coax 8W8 to 8W8 cable	15 m (49.2 feet)

Prefabricated FP cable assemblies to the control ports on an NTHR37

PEC	Description	Length
NTHR69	DS3 or E3 D-sub to D-sub cable	2.5 m (8.2 feet)
NTHR70	DS3 or E3 D-sub to D-sub cable	5.0 m (16.4 feet)
NTHR71	DS3 or E3 D-sub to D-sub cable	15 m (49.2 feet)

Check your site records to identify which BNC connectors map to CPE at the fanout or sparing panel. The cable assemblies that are identified by PECs NTHR58, NTHR59, and NTHR60 have numbered labels distinguishing each BNC connector from 1 to 8. The ports of the mini-coax connectors at the other end of each cable assembly are not visibly numbered, however, the pattern of pin numbering is the same for all mini-coax connectors. The mini-coax pin at the end of the D-sub nearest the exiting cluster of mini-coax cables is numbered 1, while the pin furthest from the cluster is numbered 8. See the figure Pinouts of mini-coax and BNC cable connections of an NTHR58 (page 286).

Pinouts of mini-coax and BNC cable connections of an NTHR58



Using status indicator LEDs and sounds

The status of hardware equipment in a Nortel Networks Multiservice Switch nods is indicated by a system of colored and shaped LEDs. A lit LED indicates one status in one color. On the same type of part or assembly, the LED is always in the same position relative to its mates. While the equipment is powered, there is always one LED that is lit.

The status of most of the hardware equipment in Multiservice Switch nodes can also be checked in software. See NN10600-520 *Nortel Networks Multiservice Switch 7400/15000/20000 Fault and Performance Management: Troubleshooting* for descriptions and procedures for verifying hardware status.

The number of LEDs for hardware status varies between parts. For the descriptions and locations of the LEDs, see the appropriate section.

Navigation

Follow-me LEDs

For the status of any equipment to be indicated, the equipment must be powered. If no LEDS are lit it means there is no electrical power. After the equipment is powered, one LED is always lit. The likelihood of both LEDs failing at the same time due to natural aging (as opposed to an impact) is greater than 99.999%.

The status colors of lit LEDs are:

- green rectangle, indicating normal operation
- amber triangle, indicating a major or minor problem
- red circle, indicating the part is out of service but powered, or an intermediate startup stage from being installed due to an initial installation, a maintenance replacement, or an upgrade

To determine what to do when a lit LED is other than green, see:

- What to do when a lit red LED is detected (page 288)
- What to do when a lit amber LED is detected (page 288)
- Hierarchy of LEDs and sounds (page 289)

The procedures in NN10600-520 *Nortel Networks Multiservice Switch 7400/15000/20000 Fault and Performance Management: Troubleshooting* can help with determining why a LED may not be green.

What to do when a lit red LED is detected

When a lit red LED is detected on a card, the card is powered but out of service. For a card that was previously operating normally, determine if it is the only available one in the node, or if it has an available spare to maintain operation.

- If it is the only card (no spare), service is down. Replace it immediately.
- If it is spared, the active card has no backup. Replace it soon.

See the appropriate replacement procedure for the type of card.

What to do when a lit amber LED is detected

When a lit amber LED is detected on a card, there is no traffic running on it. After powering up a card, amber indicates a startup mode. Wait for the LED on the card to change from amber to green or red. For a card that was previously operating normally (the LED was solid green), amber indicates the card has received new software. Either the software is invalid for that card, or the card is must be replaced with a compatible type or version of card.

See the appropriate replacement procedure for the type of card.

Hierarchy of LEDs and sounds

A lit red LED or an audible alarm always indicates a critical problem. A part with a lit red LED must always be addressed before a part with a lit amber LED. When more than one critical problem occurs, some parts must be addressed before others so that the impact of out-of-service parts is minimized and further problems are prevented. The sequence for addressing trouble depends on:

- how the ambient temperature of the room affects the capability of the remaining fans to keep the node nominally cool
- if the node has an in-service spare to back up the failed part (for example, a fabric card, a CP, an FP, a PIM, a BIM)
- if the replacement part is readily available for the node

For example, in a hypothetical scenario with a node that is redundantly configured, when there is a relatively simultaneous failure of a load-sharing fabric card, the active CP, an unspared FP, and a fan fail in a room at 35 degrees Celsius (95 Fahrenheit), the sequence of repair is:

1 the fan, because determining if the failure is the result of the fan or its controller, and replacing the unit is the longest maintenance task; meanwhile the ambient temperature inside the node will rise towards the point when another part can fail or have service degradation

2 the fabric card, because although its failure triggers an automatic takeover of its load by the mate thereby maintaining service; losing a fabric card when there is no backup mate effectively causes the entire node to be out of service

3 the CP, because although its failure triggered an automatic switchover of the spare CP to become active, and all other FP traffic continues to be processed on that cage, losing a CP while there is no backup causes serious service degradation even though the node continues to handle existing traffic

4 the FP, because reduced capacity is less important than maintaining the backups that impact greater portions of the node or its service performance

Status LEDs of a BIP alarm module

The BIP alarm module has LEDs on its faceplate to indicate the status of the node(s), which includes:

- a red and a green LED for its own status
- pairs of minor, major, and critical LEDs, one set above the other (under the LED Test button), indicating the severity of the problem on the upper and the lower node
- ten LEDs (below the ACO button) acting as one large follow-me indicator

See the figure Location of the alarm module status LEDs (page 291). To clearly observe which LEDs are lit and their color, you must stand directly in front of the faceplate. Unlike the other parts of a node that have one LED per color, each LED of the alarm module cluster shows one of the three status colors. The colors are green, amber, and red.

In a startup mode after installation and powering up, the LEDs cycle from solid red to solid green.

When the BIP is powered from an MFA150 system of ac rectifiers and at least one of the rectifiers fails or is switched off, the test LEDs indicate amber if at least one CP is connected.

After normal operation when a lit LED is not green, do the procedure What to do when a lit red LED is detected (page 288) or What to do when a lit amber LED is detected (page 288).

For the alarms that cause LEDs to light, see Hardware alarm definitions and behaviors (page 48).

Testing the LEDs

Testing the operation of LEDs on a node has no effect on the node's performance. During the test, all of the LEDs remain lit (amber) at the same time for about 10 seconds. If none of the LEDs is lit, it means there are no CPs installed in the node.

If a LED does not light, then one or more of the following conditions is occurring:

- the green LED is burned out, and the software can verify if the part is actually operational
- there is a problem in a cable assembly or a connection between the BIP and the PIMs
- there is a problem with one of the power feeds to the BIP, but this also means that a series of hardware LEDs should not be lit

- there is a problem in the node backplane

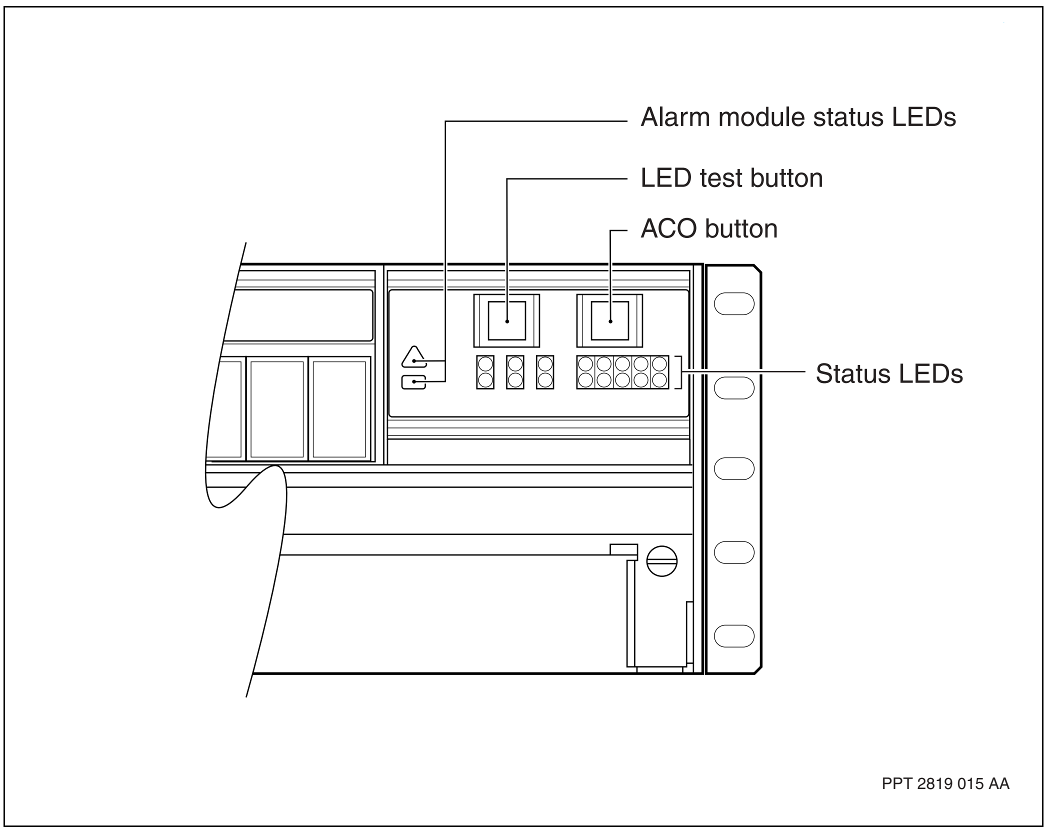
When the BIP is the power distribution unit for a Nortel Networks Multiservice Switch 15000 node, pressing the LED test button verifies the operation of the LEDs on the alarm module.

When the BIP is the power distribution unit for a Multiservice Switch 20000 node, pressing the LED test button verifies the operation of the LEDs for other hardware by lighting all of them on:

- the BIMs and alarm module of the BIP
- the cooling unit or units
- the fabric cards in one or both nodes

The PIM LEDs are indicators of power on or off and are not included in the LED tests.

Location of the alarm module status LEDs



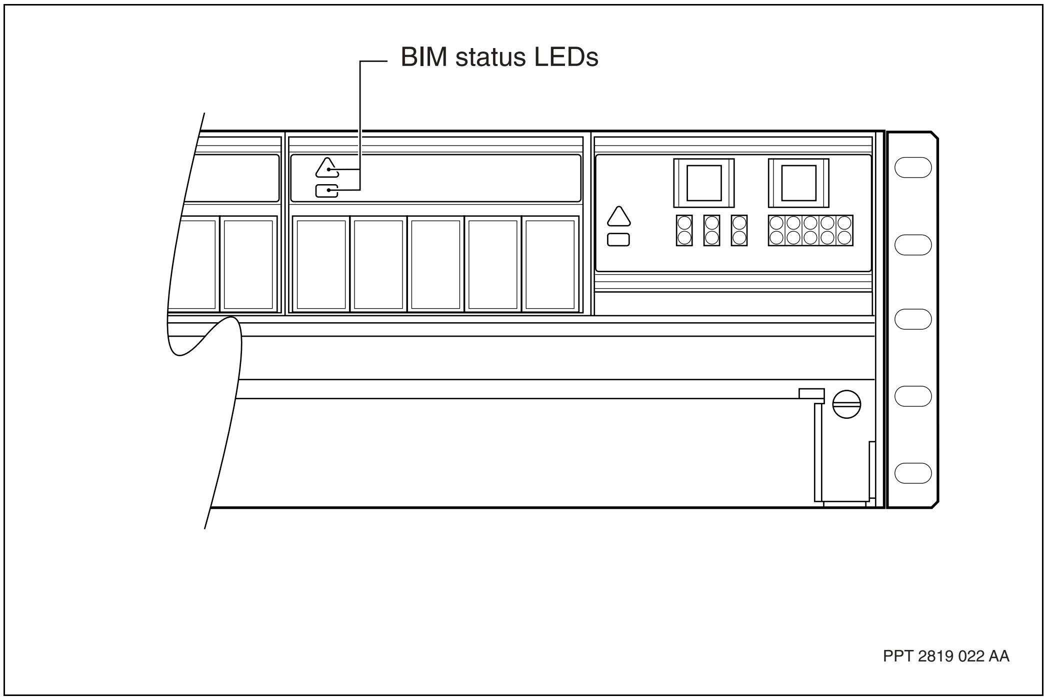
Status LEDs of a BIM

Each breaker interface module (BIM) has two LEDs on its faceplate, which indicate the status of electrical power received by a node. See the figure Location of BIM status LEDs (page 292). The colors of BIM status are green (rectangle) or red (triangle).

In a startup mode after installation and powering up, the LEDs cycle from solid red to solid green.

After normal operation when a lit LED is not green, do What to do when a lit red LED is detected (page 288).

Location of BIM status LEDs



Status LEDs of a PIM

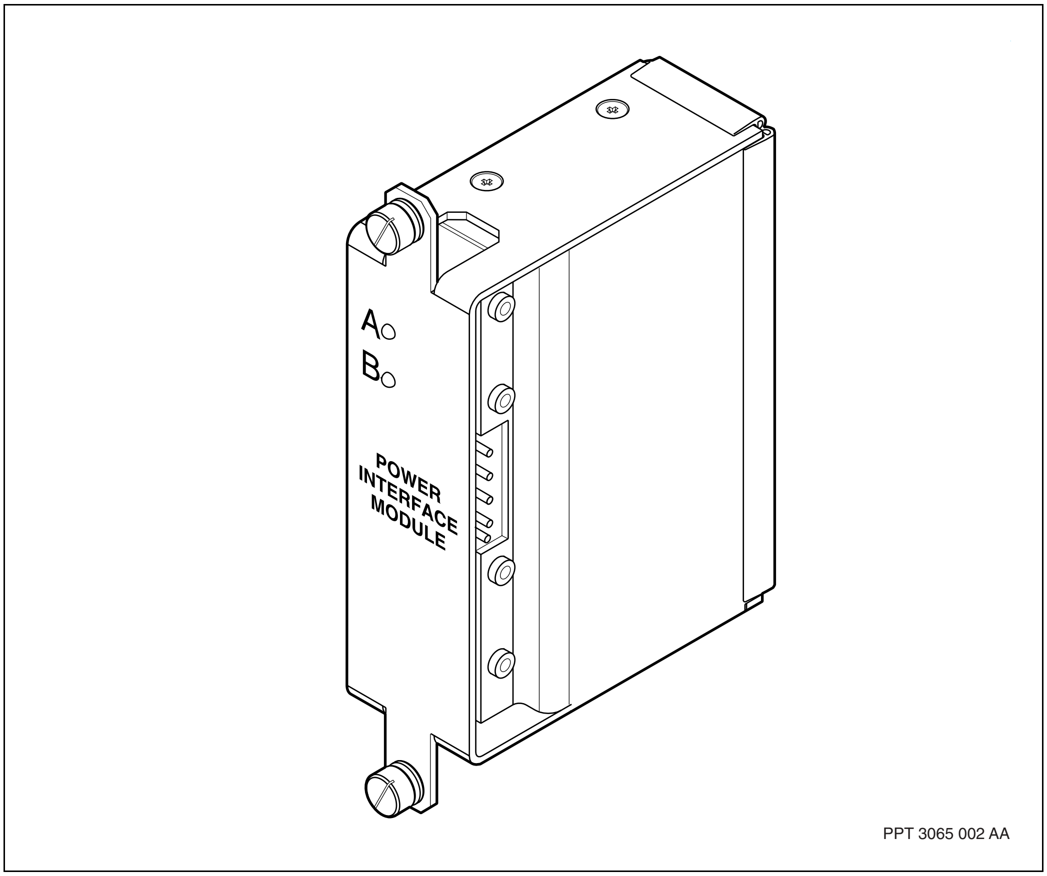
Each power interface module (PIM) in a Nortel Networks Multiservice Switch 15000 or Multiservice Switch 20000 receives power from either the A or B feed, depending on where it connects to the shelf assembly. The LED labelled A indicates the incoming power from power feed A through the BIP, and B indicates the same for power feed B. See the table Power LED status indicators for each PIM (page 293).

Power LED status indicators for each PIM

LED color	Mode	Meaning
green	solid	power is on for the slots powered by the PIM
off		power is off because of one or more of the following: • the breaker on the BIM that distributes power to it is off (O is pressed in) • the cable from the BIP to the PIM is disconnected at one or both ends • the power input to the BIP is off or missing for the indicated A or B feed • the BIM is missing or defective • the LED is burned out

Each PIM of a Multiservice Switch 20000 node has two LEDs on its faceplate, which indicate the status of electrical power it receives from the BIP. See the figure Location of PIM status LEDs for feeds A and B (page 294).

Location of PIM status LEDs for feeds A and B



Status LEDs of a fabric

Each fabric card at the rear of a Multiservice Switch has LEDs to indicate the status of operation. There are two LEDs on each fabric card, one red and one green. Only one LED is lit to indicate the status of the fabric when the node hardware is powered up.

Fabric card LEDs are described in:

- Status LEDs of fabric cards in a Multiservice Switch 15000 (page 295)
- Status LEDs of fabric cards in a Multiservice Switch 20000 (page 296)

Status LEDs of fabric cards in a Multiservice Switch 15000

During normal operation the circular lit LED is solid green. See the figure Location of fabric card status LEDs in a Multiservice Switch 15000 (page 296).

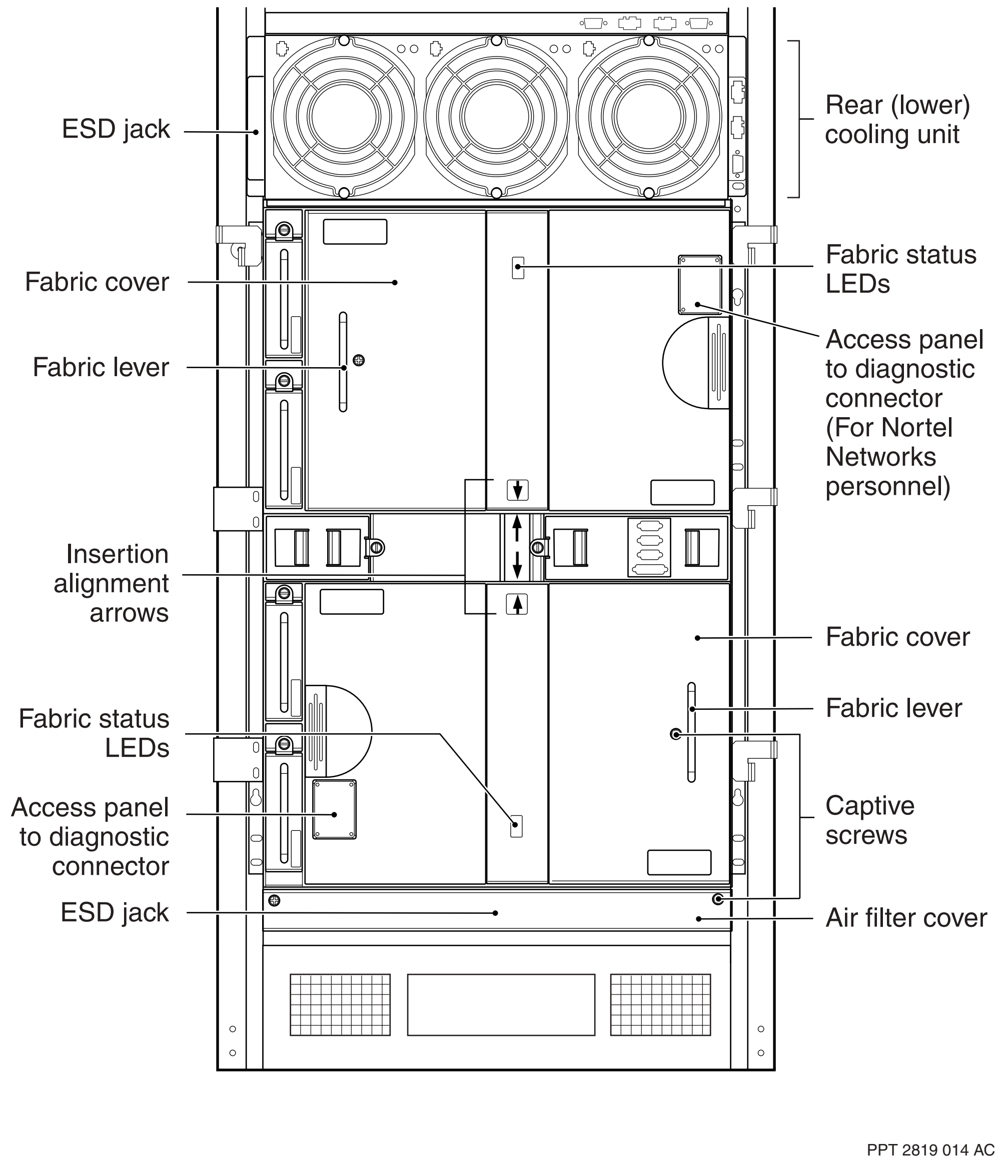
In a startup mode after installation and powering up, the LEDs cycle from solid red to solid green. (There is no amber status.) Both LEDs must be solid green for normal operation to occur.

When a fabric card is disabled by the system because of faults, the LED turns red. A red LED can be caused by more than disabling, which means a fabric card with a red LED can still be transmitting data. Similarly, a fabric card with a green LED might be prevented from transmitting data.

When a fabric card is locked by force in software, it shows solid green (unlike a CP or an FP).

After normal operation when the LED is not green, do What to do when a lit red LED is detected (page 288).

Location of fabric card status LEDs in a Multiservice Switch 15000



Status LEDs of fabric cards in a Multiservice Switch 20000

During normal operation, the rectangular LED is solid green. See the figure Location of fabric card status LEDs in a Multiservice Switch 20000 (page 298).

In a startup mode after installation and powering up, the LEDs cycle from solid red to solid green even if the firmware has not yet been loaded.

When the LED is red, the fabric card status is one of the following:

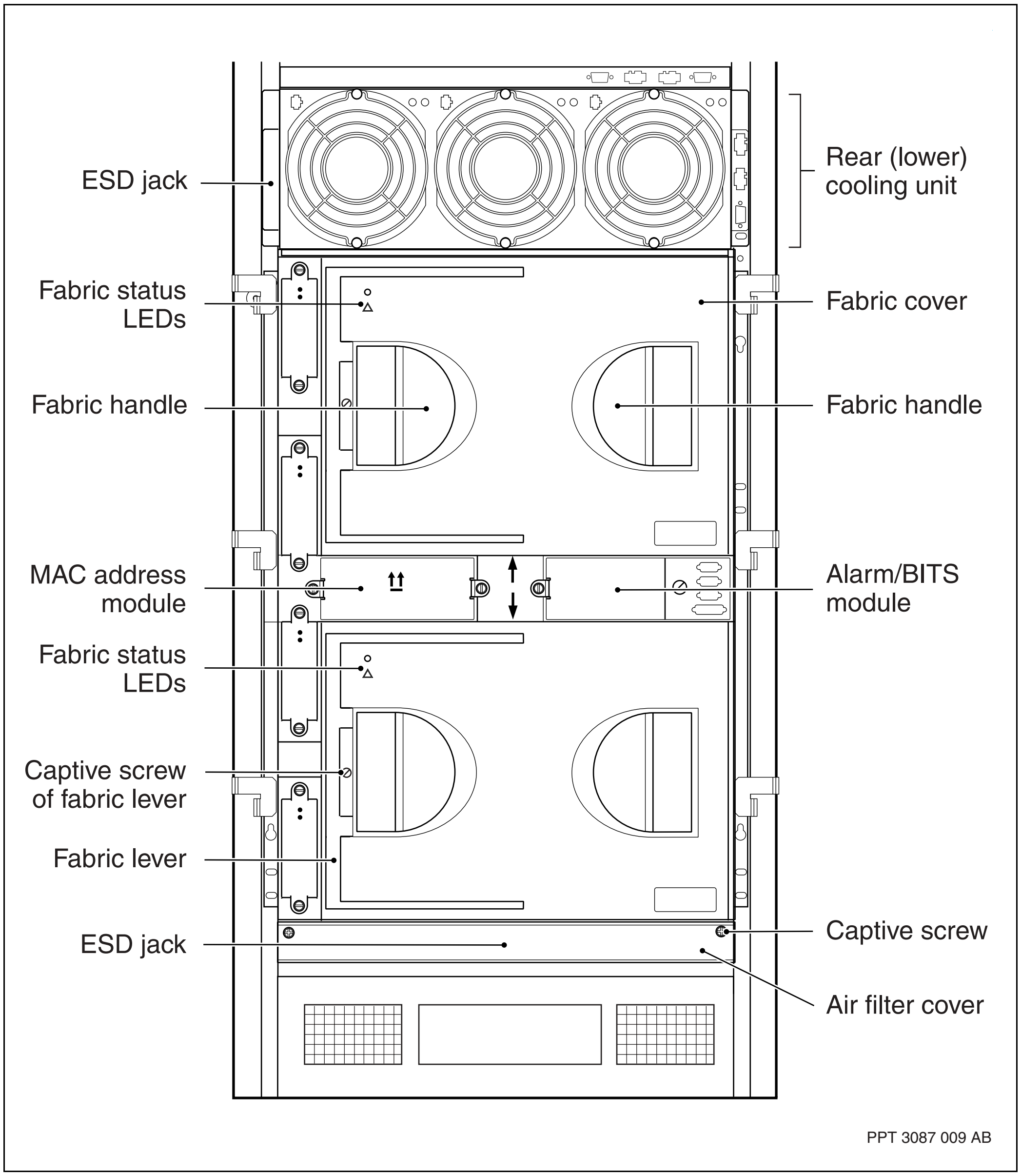
- on the fabric card, the captive screw on the lever has not been fastened, which depresses a switch to reset the fabric card
- the card has failed and was automatically disabled by the system
- has partially failed (may be green instead)
- is unseated
- is being reset
- is being initialized

When the LED is green, the fabric card status is one of the following:

- is locked by force in software (unlike a CP or an FP)
- has failed partially and cannot transmit data

After normal operation when the LED is not green, see What to do when a lit red LED is detected (page 288) or What to do when a lit amber LED is detected (page 288).

Location of fabric card status LEDs in a Multiservice Switch 20000



Status LEDs of a CP or an FP card

The control processors (CPs) and function processors (FPs) on the front of a Nortel Networks Multiservice Switch 15000 or Multiservice Switch 20000 node, each have a column of three LEDs. The sequence from top to bottom is red (circle), amber (triangle), and green (rectangle). See the figure Location of the common CP or FP card status LEDs (page 300).

The CPs and some FPs also have other status LEDs for card-specific functionality.

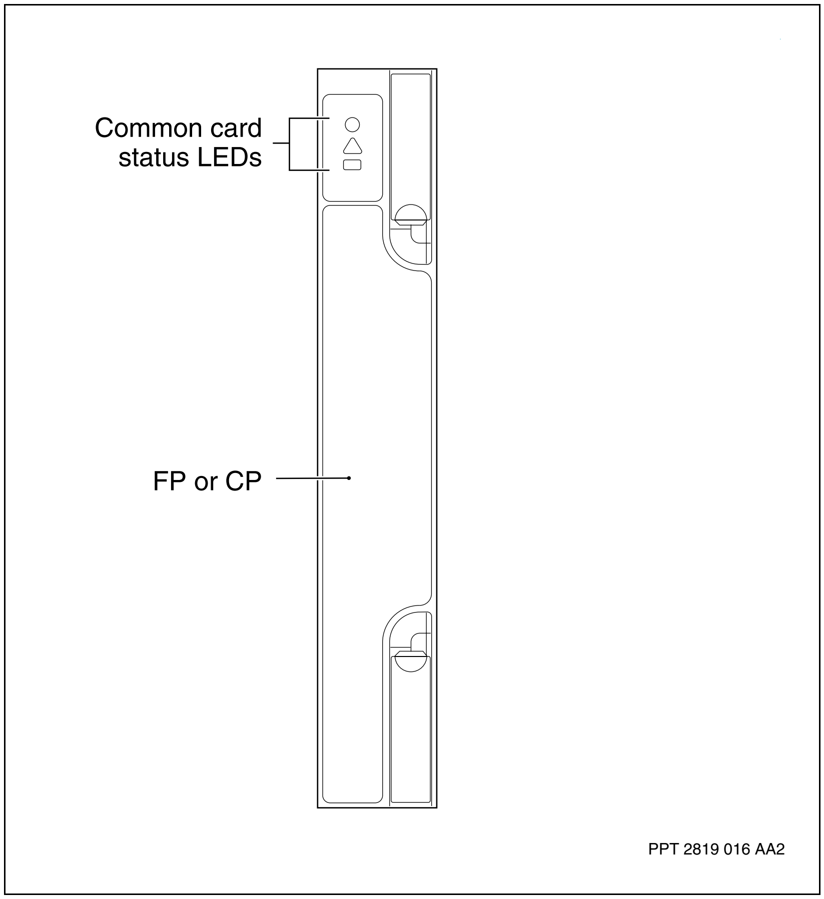
When a CP or an FP is locked by force in software, the LED shows solid red.

During normal operation of a CP or an FP when a lit LED is not green, see What to do when a lit red LED is detected (page 288) or What to do when a lit amber LED is detected (page 288).

More card-specific information is provided in:

- Status LEDs of a CP (page 300)
- Status LEDs of an FP (page 301)
- Status LEDs of the Ethernet ports on an NTHW49 (page 302)

Location of the common CP or FP card status LEDs



Status LEDs of a CP

For a CP in a startup mode after installation, the common LEDs light in sequence from:

1. solid red, indicating powering up or after power-up, or is being reset or restarted; during solid red, the hardware and fabric card backplane is tested and initialized; if there is a problem, the CP reboots and remains solid red
2. flashing red, indicating that initializing and testing the fabric card backplane has passed and the CP software is loading
3. fast flashing red, indicating software is downloading
4. solid amber, indicating the software is not yet loaded or configured for that CP
5. slow flashing green, indicating the software has been loaded and the applications are being initialized

6 fast flashing green, indicating the hardware and software is on standby as the redundant (back-up or inactive) CP, or the module is ready to be put into service by the software

7 solid green, indicating power is on, software is loaded, the CP is in service operating normally, and is the active CP

Attention: While both CPs are amber, the FPs cannot reach solid green.

A spare CP in startup mode after being configured in software and after the main CP has already been installed shows a flashing green indication.

A CP3 card has two LEDs on each 100Base-T port. The LEDs are integrated into the RJ-45 jack. Behaviour of these LEDs is as follows:

- solid green link LED: link is present
- flashing green link LED: either Tx or Rx activity is detected
- ‘off’ yellow Collision LED: no collision has been detected
- flashing yellow Collision LED: a collision has been detected

Status LEDs of an FP

For an FP in a startup mode after installation, powering up, and software configuration, and after at least one CP is installed, the common LEDs progress in relative sequence. The sequence is not fixed because the status of an individual card or the rate of self-test differs between card types. The relative sequence of LEDs is from:

1 solid green, confirming initial power up

2 solid red, indicating a reset or restart to test hardware; if there is a problem, the FP reboots; if the FP stays solid red after 30 seconds, it is faulty

3 slow flashing red, indicating the software is initializing for a reset or is loading firmware which causes a reset to run the self-test again (solid red)

4 fast flashing red, indicating software is downloading

5 solid amber, indicating the card is not faulty but cannot operate because the slot is configured for another type of card

6 slow flashing green, indicating the software has been loaded, and the FP is being initialized

7 fast flashing green, indicating the hardware and software is on standby (an inactive spare) or the FP is ready to be put into service by the software

8 solid green, indicating power is on, software is loaded, and the card is active, in service, and operating normally; some FPs show a solid green LED while software loading is still completing (for example, a VSP3) but the overlap is very brief

Attention: If the FP has not yet been configured in the software, the LED cycle is solid green to solid red, then alternating between flashing red and flashing green.

While operational, an electrical FP indicates it is active by showing a solid green LED. Its standby mate shows a fast flashing green LED.

While operational, an optical FP indicates it is active by showing a solid green LED. An optical FP does not have a true standby mate. When dual-FPs are configured for AnnexB, LAPS, or Y-protection, both cards show solid green LEDs regardless if all active ports that are providing service (as opposed to being on hot standby) are on only one card.

When an FP is undergoing software migration, that is, a change of software, the LED shows fast-flashing green.

Status LEDs of the Ethernet ports on an NTHW49

The 4-port Gigabit Ethernet function processor (FP), also known as the 4pGe or NTHW49, has transmit (Tx) and receive (Rx) LEDs to the left of each of its four optical module sockets (“ports” in software). See the figure The Ethernet port status LEDs of an NTHW49 (page 303).

Provided the card slot has been configured (provisioned) correctly for the NTHW49, and the card is installed with the correct small form-factor pluggable (SFP) optical transceiver modules, the typical behavior of the port status LEDs is as follows.

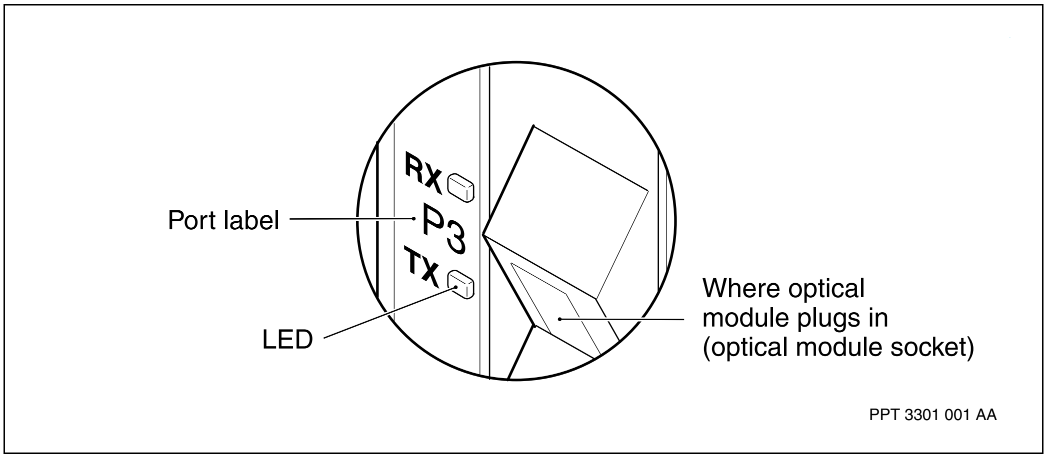
- Both LEDs are unlit when the card is initially powered up.
- Both LEDs light solid green when the port software is initialized and all alarms related to the port and its SFP modules have cleared.
- When traffic passes through the transmit portion of the port, its LED flashes green. When traffic passes through the receive portion of the port, its LED flashes green. The Tx LASER is on and the Rx fiber is lit.
- Both LEDs are lit during an Ethernet port test, and are unlit after the test until the port is unlocked. When the port test includes Tx or Rx traffic, the respective LEDs flash.
- When one LED is lit and the other is not, the LED itself has failed. Traffic will continue to flow through that portion of the port.

When the card is powered, both LEDs are unlit when:

- the port is locked
- an alarm has been generated against the port, for example, SFP alarm 7011 5480, loss of signal (LOS), a hardware failure, or an auto-negotiation alarm
- the card or port is not correctly configured in software

To determine the operational status of the Ethernet port, especially if a LED is unlit, see the procedures in NN10600-550 *Nortel Networks Multiservice Switch 7400/15000/20000 Common Configuration Procedures*, to display the status of an installed SFP module.

The Ethernet port status LEDs of an NTHW49



Status LEDs of a sparing panel

Each sparing panel has a column of 7 LEDs, one for each DS3 or E3 FP card. See the figure Location of status LEDs for sparing panel NTQS31 (page 305).

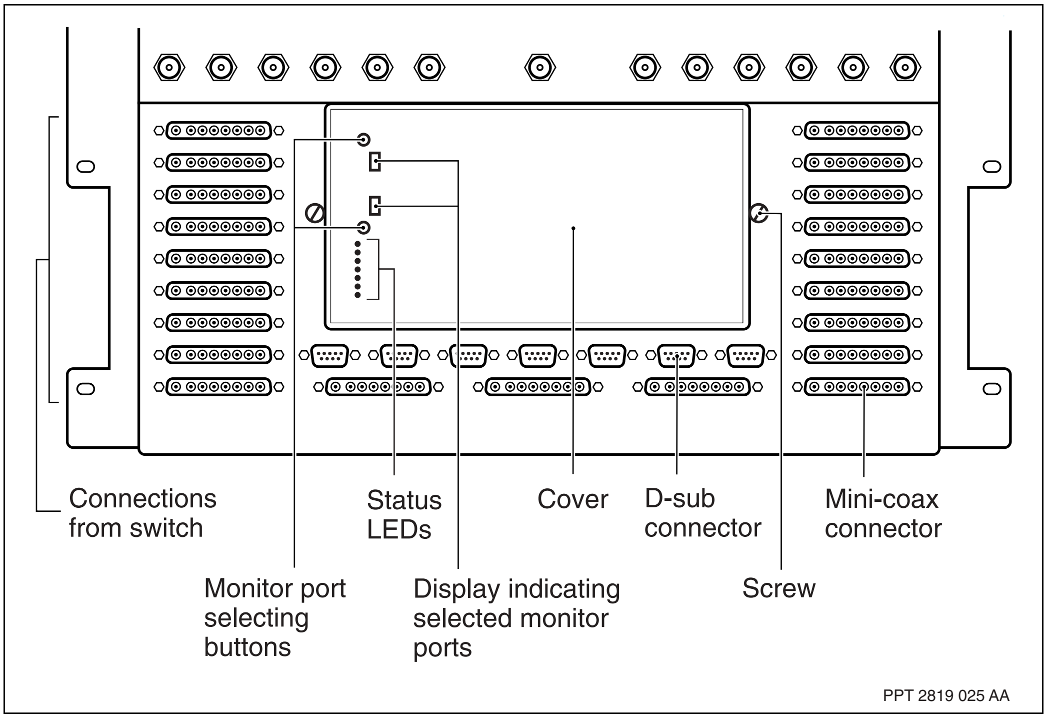
Each LED is a tri-colored LED to indicate the sparing status of the FP. See the table LED statuses of a DS3 or E3 sparing panel (page 304).

LED statuses of a DS3 or E3 sparing panel

LED color	Normal FP	Spare FP
off	the associated FP is not detected	the associated FP is not detected
red	the FP is connected but communication is not established	the FP is connected but communication is not established
amber	the spare FP is carrying traffic for this FP	the spare FP is not in use or traffic from the FP is looped back (normal operation)
green	the FP is carrying traffic (normal operation)	the spare FP is carrying traffic for one of the main FPs

In a startup mode after installation and powering up, the LED for each cabled FP cycles from solid red to solid green. If the software configuration is not completed for each FP connection on the sparing panel, the LEDs remain red.

Location of status LEDs for sparing panel NTQS31



Status LEDs of a cooling unit fan

The status LEDs for each fan in both the front and rear cooling units, are located on the front of the NEBS 2000 frame, so that the status of the rear (lower) fans can be determined easily. The rear cooling unit's LEDs are duplicated at the front and back of a Nortel Networks Multiservice Switch 15000 or Multiservice Switch 20000. The LEDs are labeled with G and R to distinguish between green and red.

For a cooling unit in a startup mode after installation and powering up, the LEDs cycle in sequence from solid red to solid green.

During normal operation when a lit LED is not green, assess the impact of the ambient room temperature on a node being cooled by two fans and see What to do when a lit red LED is detected (page 288).

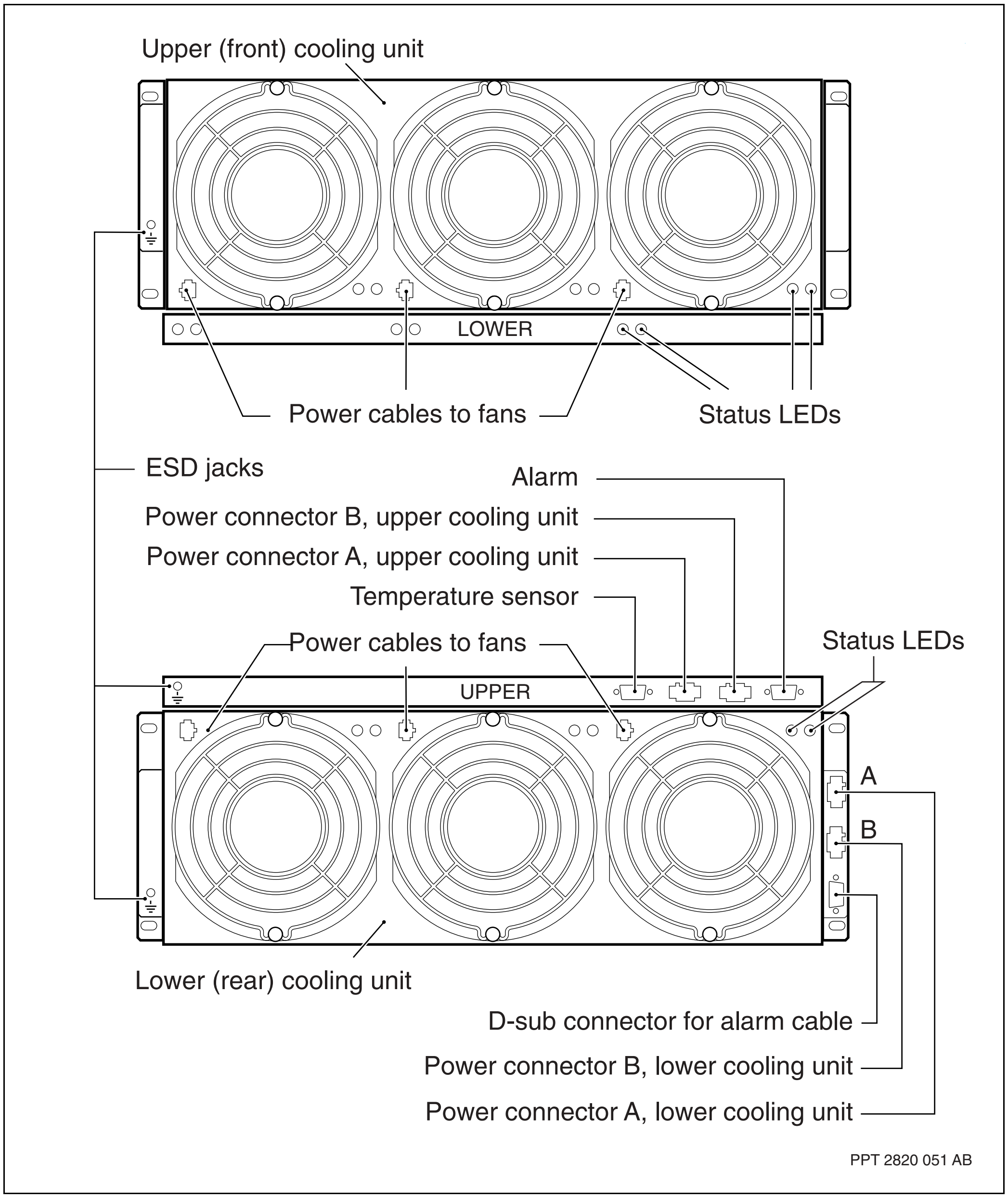
If the fan LED is off after the fan or its controller has been replaced, verify the in-line 4 A fast-acting fuse between the controller and its input power has not blown. If so, replace the controller because the fuse is soldered in.

When a fan fail occurs, major software alarm 7012 0051 is generated and both the major and minor hardware alarm lights are lit. For information on hardware alarms, see Hardware alarm definitions and behaviors (page 48).

Upon a fan failure:

- the fan trouble indicator light goes from green to red
- the frame-level alarm indicator displays a minor and a major alarm
- a major software alarm is raised at the network management console
- additional software alarms are raised if the shelf temperature rises above the shut down temperature. Fabric temperature is monitored and alarm alarm 7002 0004 is generated if the fabric temperature has increased 3 degrees Celsius (37 Fahrenheit)
- the fan trouble indicator light goes from green to red
- the frame-level alarm indicator continues to display a minor and a major alarm unless something else has changed
- fan failures should be attended to immediately before one or both fabrics automatically shut down or, alternately, within 48 hours.

Location of fan controller status LEDs



Turning off the audible alarm

Turn off an audible alarm by pressing the ACO button on the alarm module. See the figure Location of the alarm module status LEDs (page 291).

Field replaceable units

Each Nortel Networks Multiservice Switch contains hardware parts that are field replaceable units (FRUs). The FRUs are uniquely identified by either a product engineering code (PEC) or a part number. Part numbers from a non-Nortel Networks manufacturer are indicated.

Service replaceable units (SRUs) are included in the lists as FRUs.

The PECs or part numbers that are shared by a Multiservice Switch 15000 and Multiservice Switch 20000, or are unique to either switch, are listed together in tables under the same equipment groups. An individual part that is unique to one type of switch, is identified as such.

The lists of FRUs are intended as a way of identifying what a hardware part is, especially since part numbers are put on them more often than names. For the current available parts or versions of parts, contact your Nortel Networks sales representative (account prime).

Procedures throughout this document refer to part numbers. Some of the part numbers can only be ordered through a parts kit. If the part number or the name of a part is not listed here as an FRU, and you need to replace it, contact your Nortel Networks sales representative for further information.

Any backplane cannot be changed in the field because of the difficulty to change it or the downtime to key portions of the whole system. To replace a backplane, for example, because of bent pins, the hardware assembly they are part of must be replaced. Hardware assemblies with backplanes include the BIP, cooling unit, fabric, or shelf.

The FRUs are grouped into these sections:

- FRUs that plug into or get screwed onto a switch or frame (page 309)
- FRUs for an MFA150 system of ac rectifiers (page 322)

FRUs that plug into or get screwed onto a switch or frame

The field replaceable units (FRUs) that plug into the BIP, shelf assembly, or the cooling unit, or get screwed onto the NEBS 2000 frame are grouped in the following tables or sections:

- FP cards, SFP modules, and termination panels (page 310)
- Control processor (CP) cards (page 312)
- CP and FP signalling cable assemblies and mounting equipment (page 312)
- Custom-made cable assemblies (page 313)
- Prefabricated cable assemblies (page 313)
- Spare parts kit NTQS29AA for a Multiservice Switch 15000 (page 314)
- Spare parts kit NTQS29AB for a Multiservice Switch 15000 (page 314)
- Spare parts kit NTQH29AA for a Multiservice Switch 20000 (page 315)
- Spare parts kit NTQH29AB for a Multiservice Switch 20000 (page 315)
- Spare parts kit NTQH29AC for a Multiservice Switch 20000 (page 315)
- Spare parts kit NTQH29AD for a Multiservice Switch 20000 (page 316)
- Cooling unit parts for the AA versions (page 316)
- Cooling unit parts for the AB versions (page 317)
- BIP parts for a Multiservice Switch 15000 (page 317)
- BIP parts for a Multiservice Switch 20000 (page 318)
- NEBS 2000 frame accessories and other filler hardware (page 318)
- All other plug-in or screw-on parts for a Multiservice Switch 15000 (page 320)
- All other plug-in or screw-on parts for a Multiservice Switch 20000 (page 320)
- All other plug-in or screw-on parts for a Multiservice Switch 15000 or Multiservice Switch 20000 (page 321)
- Interface cables for interworking between an EdgeLink 100 and a Multiservice Switch 15000 or Multiservice Switch 20000 (page 321)

FP cards, SFP modules, and termination panels

The following function processors (FPs), small-form factor pluggable (SFP) optical modules, and the FP termination panels are FRUs (sorted by PEC):

- NT0486, balanced DC multiport aggregate device
- NT0421, unbalanced DC multiport aggregate device
- NTFP99AA, 3-port one-for-one sparing panel (from Multiservice Switch 7400 hardware) for two 2-port DS3 TDM FPs or two 2-port E1 TDM FPs
- NTHR17, OC3/STM-1, 4-port, multimode
- NTHR21, OC3/STM-1, 4-port, single-mode intermediate reach
- NTHR23, DS3, 12-port
- NTHR25, E3, 12-port
- NTHR29, OC-12/STM-4, 1-port, single-mode long range
- NTHR31, DS3, 4-port, channelized IMA
- NTHR37, sparing panel module for DS3 or E3 (see NTQS31)
- NTHR39, sparing panel relay module for DS3 or E3 (see NTQS31)
- NTHR42, sparing panel control module for DS3 or E3 (see NTQS31)
- NTHR79, DS3, 4-port one-for-one sparing panel
- NTHR83, STM-1, 1-port, channelized single-mode intermediate reach
- NTHR88, DS3, 4-port, channelized frame relay
- NTHR89, DS3, 4-port, channelized frame relay
- NTHR91, DS3, 4-port, channelized ATM CES
- NTHW01, OC-48/STM-16, 1-port single-mode intermediate reach ATM with APS
- NTHW05, OC-3/STM-1, 4-port, multimode
- NTHW10, general processor with disk, 2-port
- NTHW11, OC-12/STM-4, 4-port, single-mode intermediate reach ATM
- NTHW15, OC-3/STM-1, 4-port, single-mode intermediate reach
- NTHW18, 6-module packet server service processor
- NTHW21, OC3/STM-1, 16-port, ATM single-mode (SM) intermediate reach (IR) with MT-RJ connectors
- NTHW30, VPN extender card
- NTHW31, OC3/STM-1, 16-port, ATM single-mode (SM) intermediate reach (IR) with LC connectors

- NTHW44, OC-3/STM-1 POS and ATM, 16-port
- NTHW46, Multirate POS and ATM, 4-port
- NTHW49, Gigabit Ethernet, 4-port
- NTHW52, fanout panel for 12-port DS3 or E3
- NTHW70, OC-3/STM-1Ch, 4-port, single-mode intermediate reach TDM or CES
- NTHW77, voice services processor 3 with optical TDM (VSP3-o)
- NTHW84, voice services processor 3 (VSP3)
- NTHW86, OC-12/STM-4, 4-port, single-mode intermediate reach ATM
- NTHW87, voice services processor 2 (VSP2)
- NTHW91, DS3, 2-port, channelized TDM
- NTHW92, E1, 32-port, TDM
- NTQS31, sparing panel for DS3 or E3 (includes NTHR37, NTHR39, and NTHR42)
- NTTP01AB SFP 1000BASE-SX reach in an NTHW49 with up to 550 m (1,804.6 ft or 0.34 mi) with 50/125 multimode (MM) fiber cables or up to 275 m (902.3 ft) with 62.5/125 MM fiber cables
- NTTP01CB SFP 1000BASE-LX with extended reach in an NTHW49 of up to 10 km (6.25 mi) with single-mode (SM) fiber cables
- NTTP02AD SFP in an NTHW44 with multimode (MM) short reach (SR-0) cables up to 2 km (1.25 mi)
- NTTP02CD SFP in an NTHW44 with single-mode (SM) intermediate reach (IR-1) cables up to 15 km (9.3 mi)
- NTTP02ED SFP in an NTHW44 with single-mode (SM) long reach (LR-1) cables up to 40 km (24.8 mi)
- NTTP04CF SFP in an NTHW46 with single-mode (SM) intermediate reach (IR-1) cables up to 15 km (9.3 mi)
- NTTP05EF SFP in an NTHW46 with single-mode (SM) long reach (LR-1) cables up to 40 km (24.8 mi)

Control processor (CP) cards

The following CP cards field replaceable units (FRUs):

- NTHR06, CP2 with DS1 BITS interface (Multiservice Switch 15000)
- NTHR35, CP2 with E1 BITS interface (Multiservice Switch 15000)
- NTHW06, CP3 with DS1 BITS interface (Multiservice Switch 15000)
- NTHW06CA, CP3 with DS1 BITS interface (Multiservice Switch 20000)
- NTHW08, CP3 with E1 BITS interface (Multiservice Switch 15000 or Multiservice Switch 20000)

CP and FP signalling cable assemblies and mounting equipment

Order code	Part description
NT0479	CP Ethernet cable kit for CP2, CP2E, or CP3
NTBP25	CP cable for DCE V.24 RS232 local operator port
NTFP19AD	DS3 or E3 straight male BNC to straight male BNC cable assembly, 3.0 m (9.8 ft)
NTFP19AE	DS3 or E3 straight male BNC to straight male BNC cable assembly, 15 m (49 ft)
NTHW50	fiber management unit, dual drawer
NTHR58	fanout or sparing panel DS3 or E3 mini-coax 8W8 to BNC cable assembly, 2.5 m (8.2 feet)
NTHR59	fanout or sparing panel DS3 or E3 mini-coax 8W8 to BNC cable assembly, 5.0 m (16.4 feet)
NTHR60	fanout or sparing panel DS3 or E3 mini-coax 8W8 to BNC cable assembly,15 m (49.2 feet)
NTHR69	sparing panel DS3 or E3 DB9 D-sub to D-sub control cable assembly, 2.5 m (8.2 feet)
NTHR70	sparing panel DS3 or E3 DB9 D-sub to D-sub control cable assembly, 5.0 m (16.4 feet)
NTHR71	sparing panel DS3 or E3 DB9 D-sub to D-sub control cable assembly, 15 m (49.2 feet)
NTHR72	sparing panel DS3 or E3 8W8 to mini-coax 8W8 cable assembly, 2.5 m (8.2 feet)
NTHR73	sparing panel DS3 or E3 8W8 to mini-coax 8W8 cable assembly, 5.0 m (16.4 feet)
NTHR74	sparing panel DS3 or E3 8W8 to mini-coax 8W8 cable assembly,15 m (49.2 feet)
NTRU0368	cable management bracket, extended, left side

(1 of 2)

CP and FP signalling cable assemblies and mounting equipment (continued)

Order code	Part description
NTRU0369	cable management bracket, extended, right side
P0879577	cable management bracket, metal, left or right side, front or rear uprights
P0937935	cable management bracket, moulded plastic, left or right side, front or rear uprights or adapter brackets
P0918821	adapter bracket, left (L) front (long), for a shelf-based node
P0918822	adapter bracket, right (R) front (long), for a shelf-based node
P0918823	adapter bracket, left (L) rear (short), for a shelf-based node
P0918824	adapter bracket, right (R) rear (short), for a shelf-based node
(2 of 2)	

Custom-made cable assemblies

Order code	Part description
not applicable	alarm/BITS cables to J3 or J4 from site source except for E1 unbalanced in the table Prefabricated cable assemblies (page 313)
not applicable	any fiber optic cable with SC connectors
See also Prefabricated cable assemblies (page 313).	

Prefabricated cable assemblies

Order code	Part description
not applicable	for CP or FP faceplate cables, see the table CP and FP signalling cable assemblies and mounting equipment (page 312)
A0834149	power-and-ground cable assembly, ETSI
A0834143	power-and-ground cable assembly, polyvalent
P0940531	external alarm cable assembly between BIP J2 and MFA150 controller card TB2
NTHR75	alarm/BITS cables for E1 unbalanced to J3 or J4 from site source
NTHR55	alarm/BITS to J2 on lower node and Alarm on lower cooling unit and to J2 on upper node and Alarm on upper cooling unit
NTHR56	alarm/BITS to J1 on lower node and P7 on the BIP
NTHR57	cooling unit alarm cable assembly, lower or upper
NTHR66	cooling unit power cable assembly, lower or upper
(1 of 2)	

Prefabricated cable assemblies (continued)

Order code	Part description
NTHR54	power interface module (PIM) cable assembly to the lower node
NTPN81	kit to convert NTPN13 to an E1 unbalanced version, includes cable assembly and balun adapter 460
	(2 of 2)

Spare parts kit NTQS29AA for a Multiservice Switch 15000

Order code	Part description
A0778937	air filter, medium arrestance @ 25 ppi
A0758423	fan assembly, upper or lower, any position
NTHR10AA	fan controller
NT6C60PA	breaker interface module (BIM), 20-amp, for BIP NT6C61 or NT6C62
NT6C60PB	alarm module for BIP NT6C61 or NT6C62
NTHR15	power interface module (PIM)
NPS50332-1	wrist strap with velcro and 10 feet of coiled cord

Spare parts kit NTQS29AB for a Multiservice Switch 15000

Order code	Part description
A0778937	10 air filters, medium arrestance @ 25 ppi
A0522179	fan assembly, upper or lower, middle position
A0522182	fan assembly, upper or lower, side (end) position
NTHR10AB	fan controller
NT6C60PA	breaker interface module (BIM), 20-amp, for BIP NT6C61 or NT6C62
NT6C60PB	alarm module for BIP NT6C61 or NT6C62
NTHR15	power interface module (PIM)
NPS50332-1	wrist strap with velcro and 10 feet of coiled cord

Spare parts kit NTQH29AA for a Multiservice Switch 20000

Order code	Part description
A0778937	air filter, medium arrestance @ 25 ppi
A07548423	fan assembly, upper or lower, side (end) position
NTHR10AA	fan controller
NT6C67PA	breaker interface module (BIM), 25-amp, for BIP AP6C67 or AP6C68
NT6C60PB	alarm module for BIP AP6C67 or AP6C68
NTPN15AA	power interface module (PIM)
WS1A2C10B1	wrist strap

Spare parts kit NTQH29AB for a Multiservice Switch 20000

Order code	Part description
A0778937	10 air filters, medium arrestance @ 25 ppi
A07548423	fan assembly, upper or lower, side (end) position
NTHR10AA	fan controller
NT6C67PA	breaker interface module (BIM), 25-amp, for BIP AP6C67 or AP6C68
NT6C60PB	alarm module for BIP AP6C67 or AP6C68
NTPN15AA	power interface module (PIM)
NTPN81AA	cable assembly for BITS unbalanced E1 for NTPN13
WS1A2C10B1	wrist strap

Spare parts kit NTQH29AC for a Multiservice Switch 20000

Order code	Part description
A0778937	air filter, medium arrestance @ 25 ppi
A0522182	fan assembly, upper or lower, side (end) position
A0522179	fan assembly, upper or lower, middle position
NTHR10AB	fan controller
NT6C67PA	breaker interface module (BIM), 25-amp, for BIP AP6C67 or AP6C68
NT6C60PB	alarm module for BIP AP6C67 or AP6C68

(1 of 2)

Spare parts kit NTQH29AC for a Multiservice Switch 20000 (continued)

Order code	Part description
NTPN15AA	power interface module (PIM)
NTPN11AA	MAC address module
WS1A2C10B1	wrist strap
(2 of 2)	

Spare parts kit NTQH29AD for a Multiservice Switch 20000

Order code	Part description
A0778937	air filter, medium arrestance @ 25 ppi
A0522182	fan assembly, upper or lower, side (end) position
A0522179	fan assembly, upper or lower, middle position
NTHR10AB	fan controller
NT6C67PA	breaker interface module (BIM), 25-amp, for BIP AP6C67 or AP6C68
NT6C60PB	alarm module for BIP AP6C67 or AP6C68
NTPN15AA	power interface module (PIM)
NTPN11AA	MAC address module
NTPN81AA	cable assembly for BITS unbalanced E1 for NTPN13
WS1A2C10B1	wrist strap

Cooling unit parts for the AA versions

Order code	Part description
A0778937	air filter, medium arrestance
NTHR51AA	cooling unit, lower (rear)
NTHR52AA	cooling unit, upper (front)
A0758423	fan assembly for an NTHR51AA or NTHR52AA, any position
NTHR10AA	fan controller
NTCC8938 (or A0647397)	temperature sensor assembly, upper or lower cooling unit (Rotron Maltese 24 V dc)
(1 of 2)	

(continued)Cooling unit parts for the AA versions

Order code	Part description
NTHR68AA	temperature sensor bracket assembly used with an NTHR52AA
See also the table Spare parts kit NTQS29AA for a Multiservice Switch 15000 (page 314).	
(2 of 2)	

Cooling unit parts for the AB versions

Order code	Part description
A0778937	air filter, medium arrestance
NTHR51AB	cooling unit, lower (rear)
NTHR52AB	cooling unit, upper (front in a NEBS 2000 frame or 23-inch EIA rack)
A0522179	fan assembly for NTHR51AB or NTHR52AB, middle position only (Dyna Ace 24 V dc)
A0522182	fan assembly for NTHR51AB or NTHR52AB, either side (end) position (Dyna Ace 24 V dc)
NTHR10AB	fan controller
NTHR68AB	temperature sensor bracket assembly used with NTHR52AB
A0521944	temperature sensor assembly for an NTHR68AB or an NTHR51AB
A0521940	temperature sensor on an NTHR10AB in an NTHR51AB
See also the table Spare parts kit NTQS29AB for a Multiservice Switch 15000 (page 314).	

BIP parts for a Multiservice Switch 15000

Order code	Part description
NT6C62	breaker interface panel (BIP) with two 20-amp BIMs
NT6C61	breaker interface panel (BIP) with four 20-amp BIMs
NT6C60PB	BIP alarm module
NT6C60PA	BIP breaker interface module (BIM) with 20-amp breakers; also referred to as a breaker module
(1 of 2)	

BIP parts for a Multiservice Switch 15000 (continued)

Order code	Part description
NTHR15	power interface module (PIM) in shelf assembly
Note: See also these tables:	
• Spare parts kit NTQS29AA for a Multiservice Switch 15000 (page 314)	
• Spare parts kit NTQS29AB for a Multiservice Switch 15000 (page 314)	
• all those in FRUs for an MFA150 system of ac rectifiers (page 322)	
(2 of 2)	

BIP parts for a Multiservice Switch 20000

Order code	Part description
AP6C68	breaker interface panel (BIP) with two 25-amp breaker interface modules (BIMs)
AP6C67AA	breaker interface panel (BIP) with four 25-amp breaker interface modules (BIMs)
NT6C60PB	BIP alarm module
AP6C67PA	BIP breaker interface module (BIM) with 25-amp breakers; also referred to as a breaker module
NTPN15	power interface module (PIM) in shelf assembly
See also the tables in FRUs for an MFA150 system of ac rectifiers (page 322).	

NEBS 2000 frame accessories and other filler hardware

Order code	Part description
A0502620	anchor kit with 2 Hilti HSI-I *65 anchors and 120 mm threaded rods
NTHR64	blank processor card for a shelf assembly to replace an FP; also referred to as a filler module, especially for ordering
NTHR78	junction box kit
NTHR76	shelf filler panel kit, front of frame, 1000 mm or 3.3 feet
NTHR77	shelf filler panel kit, rear of frame, 800 mm or 2.6 feet
NTHW51	top cover (panel) kit, brandlining (has words)
NTHW53	top cover (panel) kit, brandlining with illuminating LED
NTPX4050	side panel kit, extended size
(1 of 2)	

NEBS 2000 frame accessories and other filler hardware (continued)

Order code	Part description
NTQS37AA	door extension kit for a NEBS 2000 frame (NTPX4060) door mounting hardware kit (NTRU0192) two vented lockable doors (each NTRU0423)
NTQS37AB	door extension kit for a NEBS 2000 frame (NTPX4060) door mounting hardware kit (NTRU0192) two vented lockable doors (each NTRU0423) top cover illuminated brandline upgrade (NTPN53AA)
NTRU0120	cable cover kit
NTRU0128	side panel kit, regular size
NTRU0185	top frame bracket
NTRU0302	raised floor threaded rod kit with 745 mm (29.33 in.) threaded rod
NTRU0325	threaded rod kit with 30-inch threaded rod for zones 1 or 2
NTRU0327	anchor kit for raised floors or not
NTRU0328	anchor kit for non-raised floor application
NTRU0365	frame spacer brackets kit
NTRU0366	cable cover kit (front or rear panel kit used with extended cable management brackets)
NTRU0370	frame spacer junction kit
NTRU04	frame, NEBS 2000
P0887704	BIM filler for a BIP
Anchor kits NTRU0302 and NTRU0328 are intended to replace kits NTRU0325 and NTRU0327.	

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Shelf assemblies for a Multiservice Switch 15000

Order code	Part description
NTHR50	shelf assembly
NTHW99	shelf assembly with these plug-ins included:
	NTHR11, the MAC address module
	NTHR12, NTHR13, or NTHR14, the alarm/BITS module
	NTHR15, the power interface module (PIM)

Shelf assemblies for a Multiservice Switch 20000

Order code	Part description
NTPN70	shelf assembly
NTPN77	shelf assembly with these plug-ins included:
	NTPN11, the MAC address module
	NTPN12 or NTPN13, the alarm/BITS module
	NTPN15, the power interface module (PIM)

All other plug-in or screw-on parts for a Multiservice Switch 15000

Order code	Part description
NTHR11	MAC address module
	Attention: When a MAC address module must be replaced, it changes the unique hard-coded node number of the Multiservice Switch 15000. Therefore the entire node must be re-configured in software. Ensure that you are familiar with the task flow in NN10600-130 *Nortel Networks Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade* for MAC address module replacement.
NTHR12	alarm/BITS module for balanced DS1 (shielded twisted pair)
NTHR13	alarm/BITS module for balanced E1 (shielded twisted pair)
NTHR14	alarm/BITS module for unbalanced E1 (coax)
NTHR16	fabric card

All other plug-in or screw-on parts for a Multiservice Switch 20000

Order code	Part description
NTPN11	MAC address module
NTPN12	alarm/BITS module for balanced DS1 (shielded twisted pair)
NTPN13	alarm/BITS module for balanced E1 (shielded twisted pair) or unbalanced E1 with kit NTPN81
NTPN02	70 Gbit/s fabric card

All other plug-in or screw-on parts for a Multiservice Switch 15000 or Multiservice Switch 20000

Order code	Part description
NTHW85	adaptor bracket kit for mounting a SER 5500 into a NEBS 2000 frame
A0378999	wrist strap, antistatic

Interface cables for interworking between an EdgeLink 100 and a Multiservice Switch 15000 or Multiservice Switch 20000

Type	Part number	Length	Type of connector at EdgeLink	Type of connector at other end
DS1	A0718801	1.5 m (5 ft)	90-degree male 64-pin to 64-pin Amphenol/Cinch	RJ-48 termination or wirewrap
DS1	A0718802	4.6 m (15 ft)	90-degree male 64-pin to 64-pin Amphenol/Cinch	RJ-48 termination or wirewrap
DS1	A0718803	9.1 m (30 ft)	90-degree male 64-pin to 64-pin Amphenol/Cinch	RJ-48 termination or wirewrap
DS1	A0718779	1.5 m (5 ft)	90-degree male 64-pin Amphenol/Cinch to wirewrap	wirewrap at RJ-48 termination
DS1	A0718780	7.6 m (25 ft)	90-degree male 64-pin Amphenol/Cinch to wirewrap	wirewrap at RJ-48 termination
DS1	A0718781	15.2 m (50 ft)	90-degree male 64-pin Amphenol/Cinch to wirewrap	wirewrap at RJ-48 termination
DS3	NTFP19AC	1 m (3.2 ft)	male BNC	male BNC on a DS3 FP
DS3	NTFP19AA	3 m (9.8 ft)	male BNC	male BNC on a DS3 FP
DS3	NTFP19AB	15 m (48.2 ft)	male BNC	male BNC on a DS3 FP

FRUs for an MFA150 system of ac rectifiers

The following tables list the field replaceable units (FRUs) for an MFA150 system of ac rectifiers to power a Multiservice Switch 15000 or Multiservice Switch 20000:

- Relay racks for an MFA150 power system (page 322)
- Isolation kits for an MFA150 power system (page 322)
- Cables and lugs per ac circuit breaker for an MFA150 power system (page 323)
- Spare and repair parts for an MFA150 power system (page 323)
- Circuit breakers on the controller of an MFA150 (page 323)

Relay racks for an MFA150 power system

Order code	Description
NT6C40CH	214 cm (7 ft) by 59 cm (23 in) standard (199 cm (78 in) MTG) with floor anchoring kit
NT6C40CF	122 cm (4 ft) by 59 cm (23 in), seismic zone 4 free standing (107 cm (42 in) MTG), with floor anchoring kit
NT6C40DE	214 cm (7 ft) by 59 cm (23 in) seismic zone 4 free standing/ flush mount (199 cm (78 in) MTG) with floor anchoring kit
NT6C40BF	214 cm (7 ft) by 59 cm (23 in) seismic E/W bracing (199 cm (78 in) MTG) with floor anchoring kit and overhead or wall rack bracing kit
NT6C43BB	64 cm (25 in) by 59 cm (23 in) wall mounted framework (56 cm (22 in) MTG) The wall mount enclosure is 54 cm (21 in) deep by 64 cm (25 in) high and provides only 54 cm (21 in) of mounting space.

Isolation kits for an MFA150 power system

Order code	Description
P0729926	Isolation kit for relay rack NT6C40CH
P0736042	Isolation kit for relay rack NT6C40BF
P0744873	Isolation kit for seismic free-standing racks

Cables and lugs per ac circuit breaker for an MFA150 power system

Circuit breaker	Distance between the controller and BIP	Cable size	Lug on the controller	Cable part number	Lug on the BIP
30 A	25 m (75 ft)	6 AWG dc cable	A0315080	R0118718	A0381005
60 A	11 m (35 ft)	6 AWG dc cable	A0315080	R0118718	A0381005
	17 m (55 ft)	4 AWG dc cable	A0355545	R0118733	A0686331
	27 m (90 ft)	2 AWG dc cable	A0360815	R0118734	A0698478
100 A	17 m (55 ft)	2 AWG dc cable	A0360815	R0118734	A0698478
Each lug on the BIP must be 2-hole, 90-degree offset, with narrow tongue to fit under the insulation boot.					

Spare and repair parts for an MFA150 power system

Order code	Description
A0614339	RC sense fuse (1-1/3A) for the ALL NT6C28 panel
P0834732	Air filter kit for the Helios rectifier 25/48
NT6C14PF	Alarm circuit pack for NT6C28CP panel
NT6C14PG	Meter circuit pack for NT6C28CP panel
P0710139	Fan assembly for Helios rectifier 25/48
P0710139	Helios rectifier 25/48
B0257258	Rectifier shelf kit
B0257267	Control and distribution panel

Circuit breakers on the controller of an MFA150

Current rating (Amperes)	Mid-trip version
30	P0743232
60	P0878236
100	P0878240

Nortel Networks Multiservice Switch 15000/20000

Hardware Description

Publication: NN10600-120
Document status: Standard
Document issue: sPCR6.1S1
Document date: February 2005
Product release: sPCR6.1
Job function: Product Fundamentals
Type: NTP
Language type: U.S. English

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