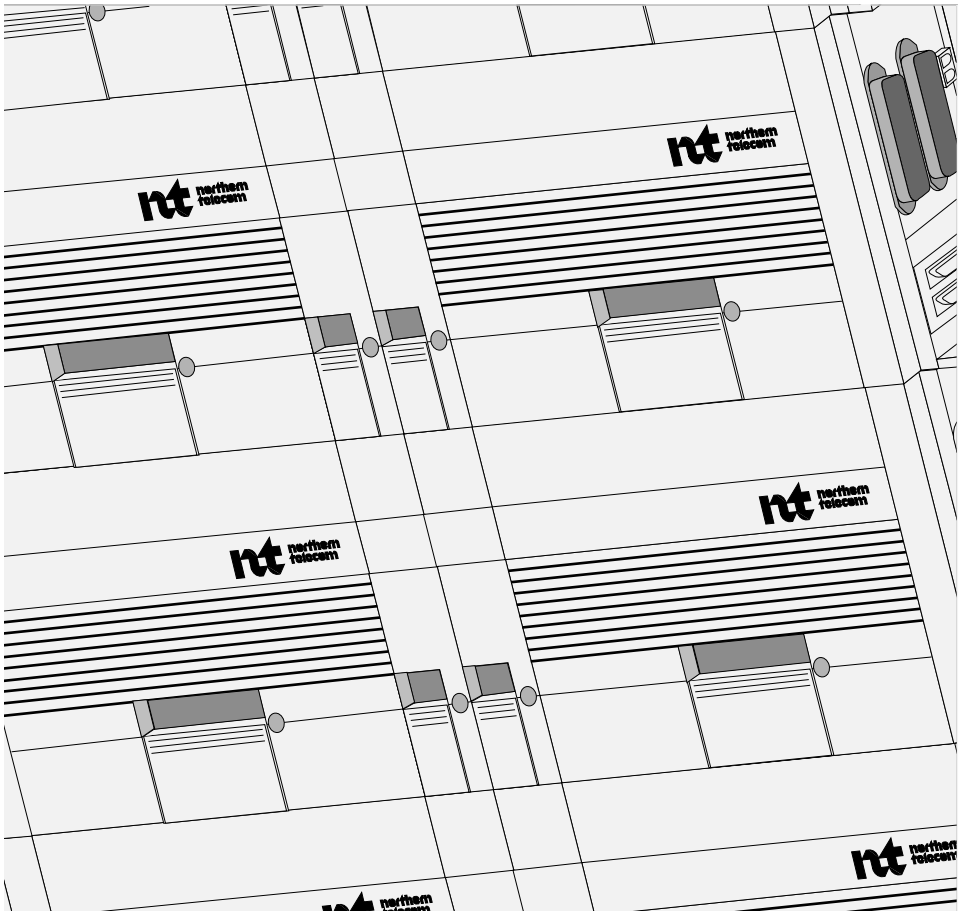
NT4K00LA **323-3001-200**

SONET Products

AccessNode

Site Installation Planning and Engineering

Issue 2.0 October 1999



NORTEL NETWORKS™

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Site Installation Planning and Engineering

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Standard AN12 01.01 release of the document.

November 1995

Standard AN11 02.01 release of the document.

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Standard AN10 02.01 release of the document.

December 1994

Standard AN08 release of the document.

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Reissue of AN07 standard.

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Standard AN07 release of the document.

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Contents

About this document

This document contains information you need to plan and engineer a site for the installation of AccessNode equipment. It also includes a planning overview of optical link network requirements, including the physical placement of outside plant fiber cables, and the method for engineering the transmission link-loss budget.

For additional planning information, see the current *Planning Guide.*

Audience

The users of this document should be experienced engineers who are familiar with the system requirements for installing telecommunications equipment.

How to use this document

The following table lists the installation topics contained in this document. Refer to any installation topic in the table.

Safety guidelines and warnings

This document contains notices that are designed to alert you about the risk of personal injury or of damage to equipment.

The following diagram show samples of the formats for danger and caution notices used in this document.

DANGER
Risk of personal injury
A danger notice warns you about a risk of personal injury.

CAUTION
Risk to service or equipment
A caution notice warns you about a risk of service interruption or of equipment damage.

To avoid personal injury, follow all danger warnings provided with this product, along with the safety procedures established by your company.

To avoid damage to equipment, or service interruptions, follow all caution warnings provided with this product, as well as the procedures established by your company.

Radio frequency emissions notice

The following regulatory notice applies to AccessNode equipment:

“This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a normal commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area may cause harmful interference, in which case the users are required to correct the interference at their own expense.”

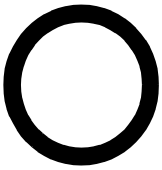
International electrical symbols on equipment

A number of International Electrotechnical Commission (IEC) symbols are used on AccessNode equipment. The labels and their meanings are as follows:

Power on

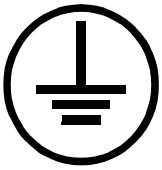
This symbol indicates that a main power on/off switch is in the on position.

Power off



This symbol indicates that a main power on/off switch is on the off position.

Protective grounding terminal



This symbol indicates the location of a terminal that must be connected to earth ground before you make any other connections to the equipment.

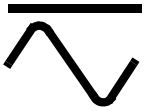
Alternating current

This symbol indicates the location of a terminal that supplies alternating current or to which a source of alternating current is applied.

Direct current

This symbol indicates the location of a terminal that supplies direct current or to which a source of direct current is applied.

Direct current and alternating current



This symbol indicates the location of a terminal that supplies direct current or alternating current, or to which a source of direct current or alternating current is applied.

Dangerous voltage

This symbol indicates the presence of a dangerous voltage inside an equipment enclosure. This voltage may be of sufficient magnitude to constitute a risk of injury due to electric shock for persons working on the equipment.

Abbreviations for the color of conductor insulation in cables

In this document, a uniform system of abbreviations is used to represent the colors of the conductor jackets used in equipment cables. These abbreviations take the form:

<pair_color> <group_marker_type> <group_marker_color>

Convention	Description		
<pair_color>	This is the background color of the conductor insulation which indicates the pair color.		
	BL	blue	(pair 1 of the binder group)
	O	orange	(pair 2 of the binder group)
	G	green	(pair 3 of the binder group)
	BR	brown	(pair 4 of the binder group)
	S	slate	(pair 5 of the binder group)
<group_marker_type>	This is the type of group marker used on the conductor insulation.		
	1	single dots spaced about 18 mm (3/4 in.) apart	
	2	two dots spaced about 3 mm (1/8 in.) apart with about 18 mm (3/4 in.) between each pair of dots	
	3	dashes about 3 mm (1/8 in.) long spaced about 18 mm (3/4 in.) apart	
	none	one colored stripe on conductor jacket	
<group_marker_color>	Is the color of the dot, dots or the stripe used as the group marker on the conductor insulation.		
	W	white	(binder group 1)
	R	red	(binder group 2)
	BK	black	(binder group 3)
	Y	yellow	(binder group 4)
	V	violet	(binder group 5)

For example, the abbreviation BL 2W (representing Pair 1 of the second 25-pair binder) means that the conductor has blue insulation with two white dots spaced 18 mm (3/4 in.) apart. The abbreviation BL W (representing Pair 1 of the first 25-pair binder) means that the conductor has blue insulation with a single white stripe.

References in this document

The engineering design, installation planning, and the actual installation must be completed in accordance with reference standards. Building locations for AccessNode equipment must meet the requirements of the Bellcore and Northern Telecom standards listed below.

Bellcore documents

- TR-EOP-000001, Section 4
- TR-TSY-000057, Issue 2, with Supplements 1 and 2 (TA-TSY-000057), Functional Criteria for Digital Loop Carrier Systems
- TR-EOP-000063, Network Equipment Building Systems (NEBS), Generic Equipment Requirements
- TA-TSY-000295, Isolated Ground Planes
- TA-NPL-000286, NEBS Generic Engineering Requirements, System Assembly and Cable Distribution
- TA-TSY-0000499 for Transport Systems Generic Requirements

Nortel Networks Standards

- Corporate Standard 4122.00, Grounding of Communication Systems

Other documents

- *Optical Interface Rates and Format Specifications*, T1.105, March 1988, as defined by ECSA committee T1X1.4.

This document also refers to the following documents in the AccessNode Northern Telecom Publication (NTP) suite for the current release.

Description, Volume 2A

- *Configuration and Equipment Description*, 323-3001-100
- *Signal Flow and Circuit Pack Description*, 323-3001-102

Description, Volume 2B

- *Line and Loop Testing Overview*, 323-3001-115
- *System Specifications*, 323-3001-180

Commissioning and Testing, Volume 3

Separately bound documents

- *Bay in Central Office Installation Manual—ABM*, 323-3001-201
- *Bay in Central Office Installation Manual—TBM*, 323-3001-202
- *Traffic and Bandwidth Engineering Information*, 323-3001-152

Installation planning overview

This chapter provides an overview of the AccessNode equipment bay packaging and outlines the factors you should consider when you plan the installation of an AccessNode mounted in bay frames.

> ***Note:*** For additional planning information, see the *Planning Guide*. For a detailed description of the equipment, see *Configuration and Equipment Description,* 323-3001-100, in *Description,* Volume 2A.

Chapter contents

This chapter contains the following information:

Equipment packaging

AccessNode equipment shelves are packaged in bays for installation at a central office or at a remote location.

These bays are compliant with virtual tributary bandwidth manager (VTBM) software feature requirements.

Bay layout

The bay frames can be equipped with the elements described below.

ABM and TBM bays

Bays can be equipped with two types of common-equipment shelves:

- access bandwidth manager (ABM) shelves which are used in central offices and in the equipment rooms at remote sites
- transport bandwidth manager (TBM) shelves which are used at central office sites only

Equipment shelves

Equipment shelves are available for the following bay heights:

- 2.2 m (7 ft)
- 2.5 m (9 ft)
- 3.5 m (11 ft 6 in.)

Frame extenders

You can increase the height of the 2.2 m (7 ft) bay by using one of two frame extenders. Table 1-1 lists the product engineering codes and heights of the frame extenders.

Table 1-1
Bay layout

This frame extender	Extends the frame this much	Which makes the frame this tall
NT7E71DA	0.6 m (2 ft)	2.8 m (9 ft)
NT7E71EA	1.5 m (4 ft 6 in.)	3.5 m (11 ft 6 in)

Numbering shelf positions

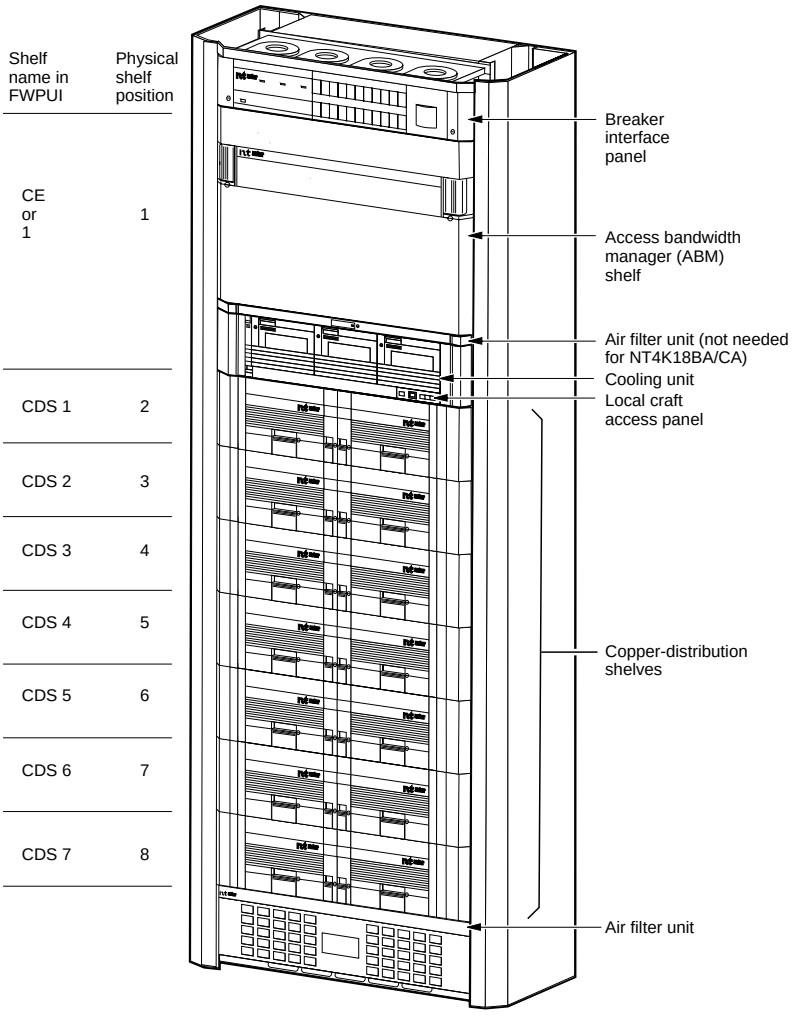
Shelf positions are numbered from top to bottom of the bay, as shown in Figure 1-1. The ABM shelf at the top of the bay is in position 1, the topmost copper-distribution shelf is in position 2, and so on down to the bottom of the bay. The cooling unit is considered to be part of the common equipment shelf, and therefore has the same shelf position number as the ABM shelf.

Copper-distribution shelves in bays are numbered from top to bottom as shown in Figure 1-1. The uppermost shelf is shelf 1 and the lowermost shelf is shelf 7.

Figure 1-1 shows a typical bay and shelf layout.

Figure 1-1
Typical bay and shelf layout

FW-10000



Bays equipped with ABM shelves

AccessNode bays equipped with access bandwidth manager (ABM) shelves are available in the configurations described on the next few pages.

AccessNode prewired 672-line configuration (NT4K01)

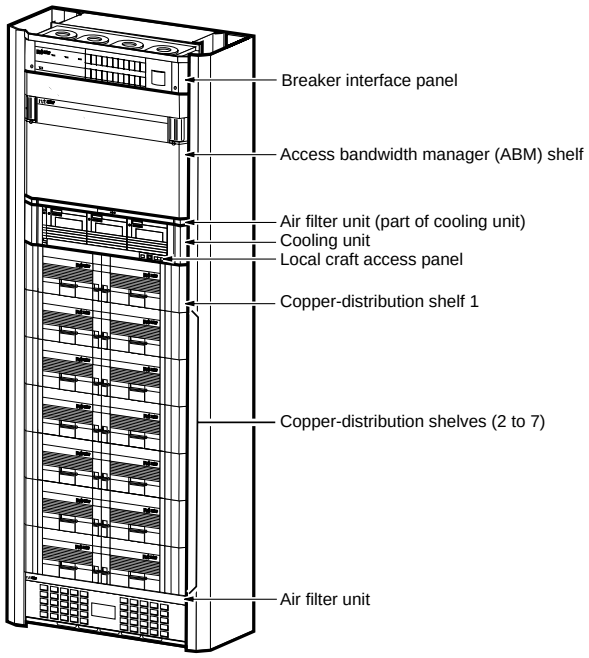
This equipment configuration contains an access bandwidth manager (ABM) shelf and seven prewired copper-distribution shelves. For an illustration of this configuration, see Figure 1-2 on page 1-4.

This configuration is available in three bay heights:

Product Engineering Code	Description
NT4K01BB	2.2 m (7 ft) bay
NT4K01FA	2.5 m (9 ft) bay
NT4K01GA	3.5 m (11 ft 6 in.) bay

Figure 1-2
Bay with ABM shelf, prewired 672-line copper distribution shelves (NT4K01)

FW-15257



Note: This illustration shows a 7 ft frame. Frames with heights of 9 ft and 11 ft 6 in. are also available. These frames are similar to the one shown, except that the frame rails extend higher above the breaker interface panel.

AccessNode add-drop start-up (NT4K02)

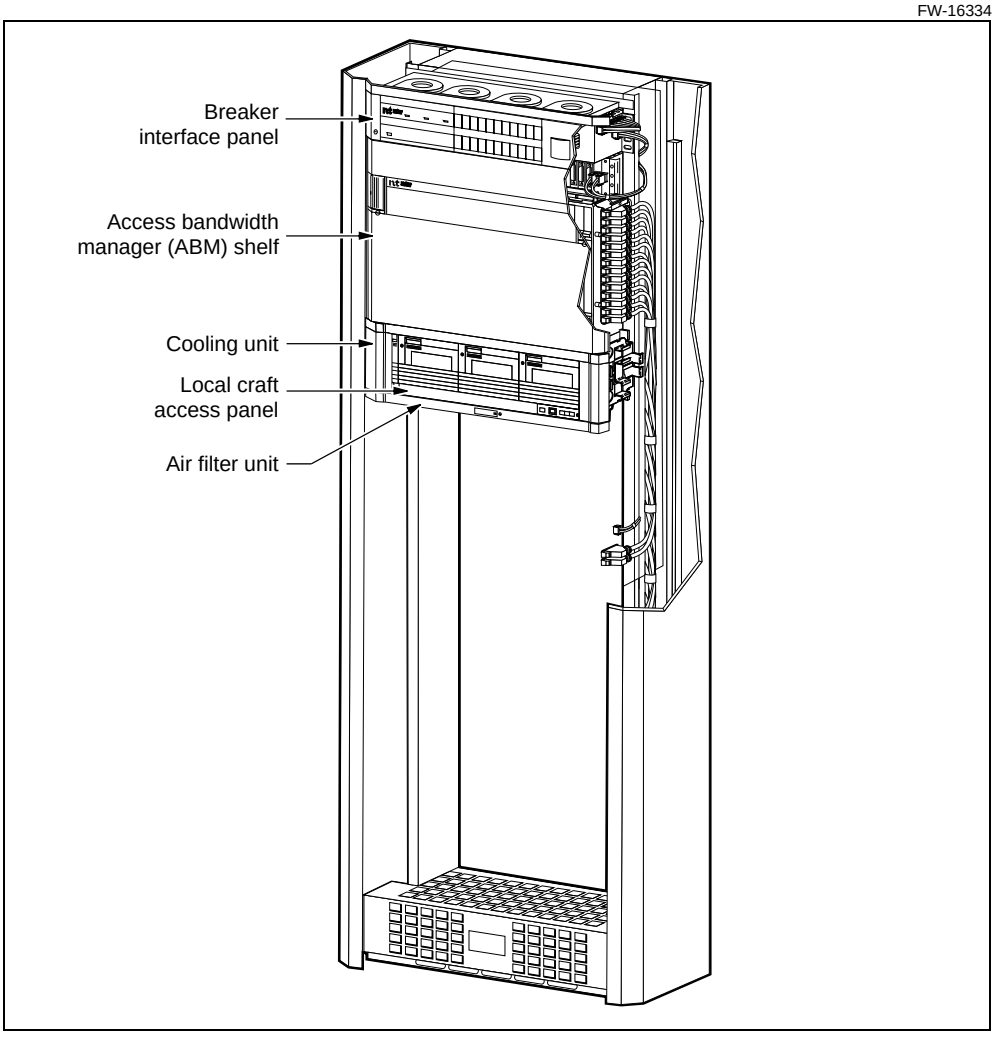
This equipment configuration contains an ABM shelf, and is prewired for the addition of up to seven copper-distribution shelves. For an illustration of this configuration, see Figure 1-3 on page 1-5.

This configuration is also available in three bay heights:

Product Engineering Code	**Description**
NT4K02BB	2.2 m (7 ft) bay
NT4K02FA	2.5 m (9 ft) bay
NT4K02GA	3.5 m (11 ft 6 in.) bay

Figure 1-3
Bay with ABM shelf, add-drop start-up (NT4K02)

FW-16334



AccessNode add-drop MUX, Access Bandwidth Manager configuration (NT4K01/03)

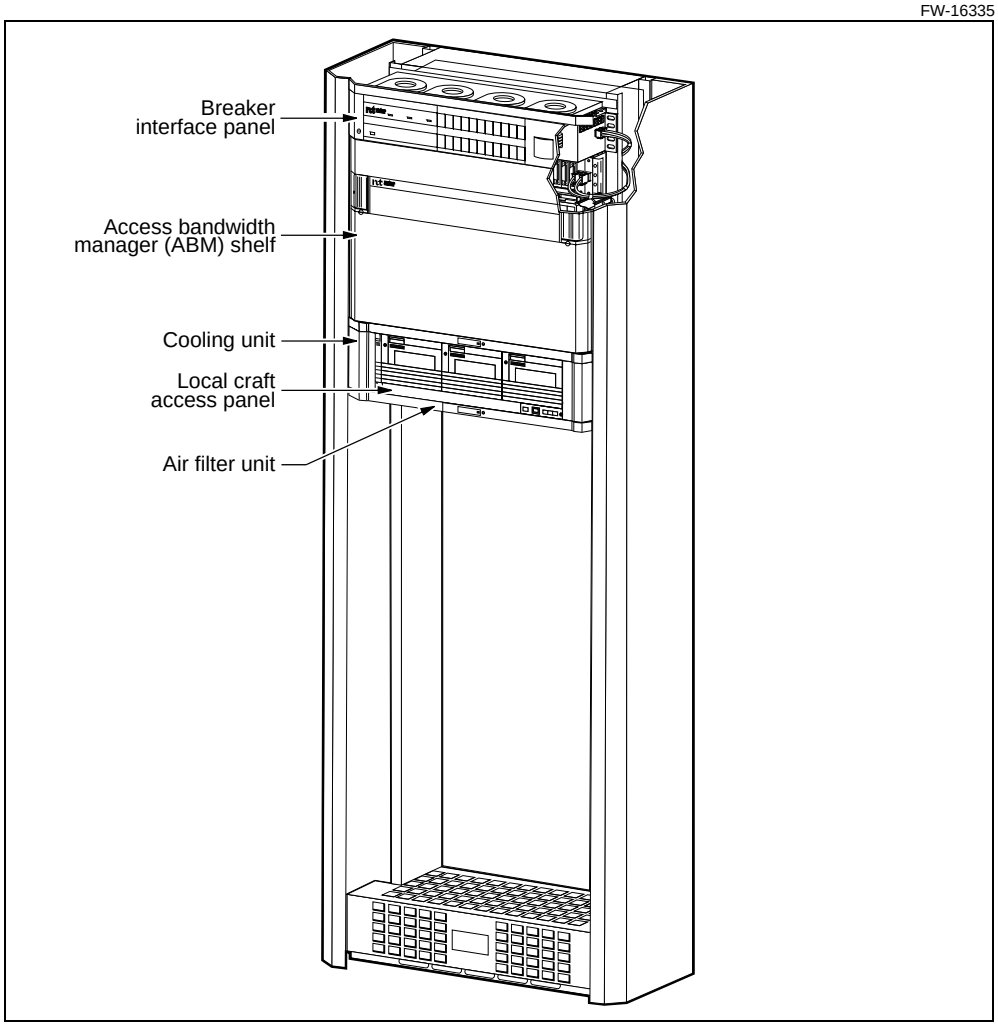
This equipment configuration contains an ABM shelf. For an illustration of this configuration, see Figure 1-4 on page 1-6.

This configuration is available in three bay heights:

Product Engineering Code	**Description**
NT4K03BB	2.2 m (7 ft) bay
NT4K01FA	2.5 m (9 ft) bay
NT4K01GA	3.5 m (11 ft 6 in.) bay

Figure 1-4
Bay with ABM shelf, add-drop MUX configuration (NT4K03)

FW-16335



Bays equipped with TBM shelves (NT7E78)

AccessNode bays equipped with TBM shelves are available in three bay heights and in standard and enhanced versions as listed in Table 1-2. For VTBM applications, the enhanced versions are used. The differences between the two versions are:

- The enhanced versions, NT7E78DA, DB, DC, and DD, all provide extra cooling capacity to meet VTBM cooling requirements.
- The enhanced single-shelf or two-shelf configurations are similar to the standard single-shelf and two-shelf configurations with one exception: the enhanced configurations use the NT4K18BA through-flow cooling units equipped with NT4K17BA enhanced cooling modules.
- The enhanced three-shelf configuration is similar to the standard three-shelf configuration with two exceptions: the enhanced configuration uses the NT4K18BA through-flow cooling units equipped with NT4K17BA enhanced cooling modules and uses the TBM shelf equipped with the NT4K19AC COP cooling unit in position 3.

For an illustration of a bay equipped with a single TBM shelf, see Figure 1-5 on page 1-9.

Table 1-2
Bays with TBM shelves

Type of bays	Product Engineering Code	Height	Number of TBM shelves
standard	NT7E78AA	2.2 m (7 ft)	1
standard	NT7E78AD	2.2 m (7 ft)	1
standard	NT7E78AB	2.2 m (7 ft)	2
standard	NT7E78AC	2.2 m (7 ft)	3
standard	NT7E78BA	2.5 m (9 ft)	1
standard	NT7E78BD	2.5 m (9 ft)	1
standard	NT7E78BB	2.5 m (9 ft)	2
standard	NT7E78BC	2.5 m (9 ft)	3
standard	NT7E78CA	3.5 m (11 ft 6 in.)	1
standard	NT7E78CD	3.5 m (11 ft 6 in.)	1
standard	NT7E78CB	3.5 m (11 ft 6 in.)	2
standard	NT7E78CC	3.5 m (11 ft 6 in.)	3

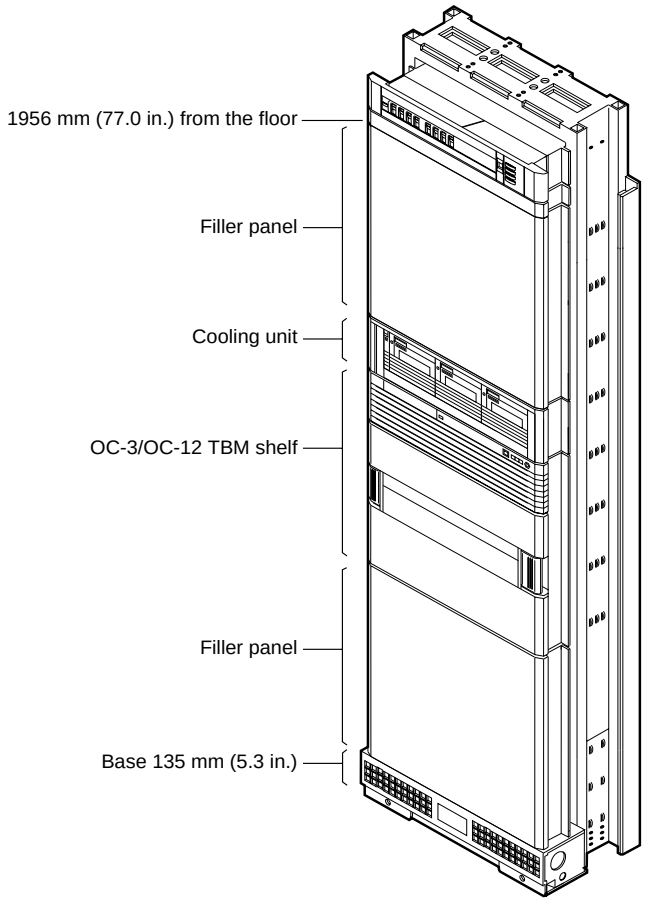
—continued—

Table 1-2 (continued)
Bays with TBM shelves

Type of bays	Product Engineering Code	Height	Number of TBM shelves
enhanced	NT7E78DA	2.2 m (7 ft)	1
enhanced	NT7E78DD	2.2 m (7 ft)	1
enhanced	NT7E78DB	2.2 m (7 ft)	2
enhanced	NT7E78DC	2.2 m (7 ft)	3
enhanced	NT7E78EA	2.2 m (7 ft)	1
enhanced	NT7E78ED	2.2 m (7 ft)	1
enhanced	NT7E78EB	2.2 m (7 ft)	2
enhanced	NT7E78EC	2.2 m (7 ft)	3
enhanced	NT7E78FA	2.2 m (7 ft)	1
enhanced	NT7E78FD	2.2 m (7 ft)	1
enhanced	NT7E78FB	2.2 m (7 ft)	2
enhanced	NT7E78FC	2.2 m (7 ft)	3
enhanced	NT7E78GA	2.2 m (7 ft)	1
enhanced	NT7E78GD	2.2 m (7 ft)	1
enhanced	NT7E78GB	2.2 m (7 ft)	2
enhanced	NT7E78GE	2.2 m (7 ft)	2
enhanced	NT7E78GC	2.2 m (7 ft)	3
—end—			

Figure 1-5
Bay with TBM shelf, single shelf configuration (NT7E78)

FW-15260



Note: This illustration shows a 7 ft frame. Frames with heights of 9 ft and 11 ft 6 in. are also available. These frames are similar to the one shown, except that the frame rails extend higher above the breaker interface panel.

Planning considerations

Consider the following factors when planning the installation of AccessNode equipment (including add-on equipment).

Site prerequisites

Depending on the configuration, the equipment packaging and the environment in which the equipment is being installed, see the designated chapter for site prerequisites, as follows.

Central office

See Chapter 2, “Central office prerequisites,” for installation prerequisites of bays in central offices.

Customer-located equipment prerequisites

See Chapter 3, “Customer-located equipment prerequisites,” for the installation prerequisites for customer-located bays in entrance rooms of large business buildings, in equipment rooms of smaller business buildings, or in floors of large buildings.

Power and ground distribution

In addition to the specific power requirements described in the chapters for each site prerequisite, see Chapter 4, “Power and ground distribution,” for the guidelines for power and ground distribution applicable to all AccessNode installations. Follow the guidelines to ensure integration of the AccessNode within shared power and ground environments of existing equipment systems.

Cabling requirements

Bays equipped with ABM shelves

Details for all external cabling (including power) common to bays or special cabinets that have access bandwidth manager shelves (ABM) are described in Chapter 5, “Cabling requirements for ABM bays.”

Bays equipped with TBM shelves

Details for all external cabling (including power) common to bays or special cabinets that have transport bandwidth manager shelves (TBM) are described in Chapter 6, “Cabling requirements for TBM bays.”

Tools and test apparatus required

Details for all tools common to installing bays or special cabinets are described in Chapter 7, “Tools and test apparatus requirements.”

Optical link network (outside plant) planning

The installation of the optical link network (outside-plant fiber cable) linking each AccessNode is the responsibility of the operating company. Optical link planning and engineering are described in Chapter 8 and Chapter 9.

Reference standards

The engineering design, installation planning, and the actual installation must be completed in accordance with the reference standards listed in the "References in this document" section on page xvi. Building locations for AccessNode equipment must meet the requirements of the Bellcore and Nortel Networks standards listed there.

Central office prerequisites

This chapter describes the prerequisites for planning the installation of AccessNode bay equipment in central offices, where the main switching equipment is located.

Note: Single-ended and DS1-fed systems eliminate the need for a fiber central office terminal (FCOT).

Chapter contents

This chapter contains the following information:

Central office bay assemblies

Central office bay assembly configurations include:

- AccessNode bandwidth manager (ABM) bays
- TransportNode bandwidth manager (TBM) bays
- Virtual tributary bandwidth manager (VTBM) bays

  Note: Refer to *Configuration and Equipment Description*, 323-3001-100, in *Description*, Volume 2A, for detailed VTBM feature information.

Environmental requirements

AccessNode bay equipment operates within specifications providing you install it in an environment that meets the requirements described in the following paragraphs.

For a description of the AccessNode specifications, see *System Specifications*, 323-3001-180, in *Description*, Volume 2B.

Ambient inlet temperature

For information on ambient inlet temperature, see *System Specifications*, 323-3001-180, in *Description*, Volume 2B.

Altitude

The following altitude range applies to the AccessNode equipment:

Operation state	Value
Operating	up to 4000 m (13,000 ft) above mean sea level
Storage and shipping	up to 15,000 m (50,000 ft) above mean sea level

Relative humidity

The following humidity range applies to network elements (except for OPC):

Operation state	Value
Operating	5% to 95% (not to exceed 3.6 kPa water vapor pressure over the normal operating temperature)
Storage and shipping	5% to 95% (not to exceed 5.3 kPa water vapor pressure for temperatures above +35° C)

The following relative humidity range applies to OPC:

Operation state	Value
Operating	20% to 90% (not to exceed 3.6 kPa water vapor pressure over the normal operating temperature of the OPC)
Storage and shipping	10% to 90% (not to exceed 5.3 kPa water vapor pressure for temperatures above +35° C for the OPC)

Atmospheric dust

AccessNode is designed with an air filter in the inlet of the bay that meets the ASHRAE 80% dust arrestance requirements.

Earthquake resistance

The equipment operation is seismic resistant for Zone 4 earthquake loading, in accordance with TR-EOP-000063, Network Equipment-Building Systems (NEBS), Section 4.5.

Power requirements

Power requirements include power and ground distribution, –48 V dc power, and commercial 120 V ac power.

Power and ground distribution

When engineering a specific equipment configuration, you must provide a power and grounding layout which should include the location of the following items:

- the batteries and the rectifier system
- the battery-distribution fuse bay (BDFB)
- the length and routes for dc and ac power cables
- a grounding plan which should include the locations of the following:
  - — the floor ground bars (FGBs)
  - — the vertical ground risers (VGRs), if used in your building
  - — the building principal ground (BPG), or the single point ground (SPG), if applicable

Note: The power and ground distribution requirements common to all AccessNode equipment installations are described in Chapter 4, “Power and ground distribution.”

–48 V dc power feed requirements

Direct current requirements for AccessNode bays equipped with access bandwidth manager (ABM) shelves or transport bandwidth manager (TBM) shelves are as follows.

Bays equipped with ABM shelves

AccessNode bays equipped with ABM shelves require four fused feeds. These feeds should come from a –48 V dc source for shelf logic power and talk-battery. The source voltage must be between –42.75 to –56 V dc, as referenced at the breaker interface panel (BIP) that is located at the top of each AccessNode bay. This source of –48 V dc power is the responsibility of the customer.

Voltage drops between the power source and the BIP must not exceed 1.0 V. To ensure that a 1.0 V drop is not exceeded, and to accommodate the typically expected currents, the main power cables supplied by Nortel Networks for connecting the dc power source to the BIP are 10.6 m (35 ft), 6 AWG. Cables longer than 10.6 m (35 ft) require site-specific engineering.

For a description of the requirements for the dc power cables see “–48 V dc battery cabling” on page 5-10 for ABM shelves and “–48 V dc battery cabling” on page 6-7 for TBM shelves.

Bays equipped with TBM shelves

AccessNode bays equipped with TBM shelves require two fused feeds from a source of –48 V dc for shelf logic power within the range of –42.75 to –56 V dc, as referenced at the breaker interface panel (BIP) located at the top of each AccessNode bay. The dc power source and the cables that feed dc to the BIP require site-specific engineering.

Under normal operating conditions, battery current for each feed will be less than 20 A.

Bays equipped with one or two TBM shelves can have battery feeds protected by 30 A fuses in the battery distribution fuse board.

Bays equipped with three TBM shelves must have battery feeds protected by 30 A, 40 A, or 50A fused depending on the cumulative power dissipation of all of the circuit packs in the bay. This number varies for each application and can be calculated by adding the power for all circuit packs, fans, and the BIP, as defined in this chapter and in Chapter 3, “Customer-located equipment prerequisites”.

The fusing must be selected by the following rules:

- bays consuming less than 1280 watts can use 30 A fuses
- bays consuming between 1280 and 1710 watts must use 40 A fuses
- bays consuming more than 1710 watts must use 50 A fuses

Voltage drops between the power source and the BIP must not exceed 1.0 V.

For a description of the requirements for the dc power cables see “–48 V dc battery cabling” on page 5-10 for ABM shelves and “–48 V dc battery cabling” on page 6-7 for TBM shelves.

dc power consumption

Table 2-1 lists the approximate power drain of AccessNode shelves and common-equipment.

Table 2-1
Shelf and common-equipment power drain

Item	Description	Power drain
ABM shelf common equipment	includes OC-3/OC12, protected optics, and protected common control	188 watts
	timing and cross-connect card (TXC)	26 watts
	ABM shelf options:	
	• operations controller (OPC)	52 watts
	• DS1/VT mapper (with 14 DS1s)	13 watts
	• DS3 mapper (with 3 DS3s)	16 watts
TBM shelf common equipment	includes OC12, protected optics, and protected common control	123 watts
	TBM shelf options:	
	• operations controller (OPC)	52 watts
	• DS1/VT mapper (with 14 DS1s)	13 watts
	• DS3 mapper (with 3 DS3s)	16 watts
	• STS-1 mapper (with 3 STS-1s)	16 watts
Copper-distribution shelf	Common equipment and power	45 watts
Fans (3)	cooling unit (one used per bay)	93 watts
Fans (8)	cooling unit (one used per bay)	65 watts

Table 2-2 lists the approximate power drain of AccessNode line cards.

Table 2-2
Line card power drain

Line card	Item	Power drain
2-wire Omega sink:	FXS, POTS, UVG at 6 CCS	0.58 watts
	FXS, POTS, UVG at 18 CCS	0.77 watts
	Coin at 6 CCS	0.71 watts
	Coin at 18 CCS	0.90 watts
	ETO/TO at 36 CCS	1.05 watts
2 -wire Omega source	DPO at 6 CCS	1.14 watts
	DPO at 18 CCS	2.04 watts

—continued—

Table 2-2 (continued)
Line card power drain

Line card	Item	Power drain
4-wire Omega	DDS, DS0DP at 36 CCS	1.99 watts
	FXO at from 0 to 36 CCS	1.93 watts
6 and 8-wire Omega	E&M, PLR, and TDM at from 0 to 36 CCS	2.52 watts
Key: CCS	Call hundred seconds	
DDS	Digital data services	
DS0DP	DS0 dataport service	
E&M	Ear and mouth	
PLR	Pulse link repeater	
FXO	Foreign exchange office	
POTS	Plain ordinary telephone service	
TDM	Tandem service	
UVG	Universal voice grade service	
—end—		

Commercial 120 V ac power

In central offices, 120 V ac (60 Hz) is required only as a customer option to wire utility outlets in the base of the bay (front access). See “Power (ac)”on page 4-6 for details of ac power distribution and the wiring of ac receptacles.

Power dissipation guidelines

For the guidelines to provision the AccessNode system with a mix of line cards and services that meets the power dissipation capability of the system, refer to *Traffic and Bandwidth Engineering*, 323-3001-152.

Floor space planning

When planning floor space for bay equipment, the following factors must be considered: floor loading requirements, equipment weight, equipment dimensions, equipment footprint, floor space requirements, cable length limits, and overhead cable drop considerations.

Floor loading

The building and equipment location for the installed equipment must meet the TR-EOP-000063, Network Equipment-Building Systems (NEBS) standard for a six-lineup floor plan. Use a floor loading of 730 kg/m^2 (150 lbs/ft^2) to determine the maximum allowable weight of a fully loaded frame.

Equipment weights

Weights of assembled equipment bays depend on the number of copper-distribution shelves installed. Table 2-3 lists equipment weights that can be used to calculate the weights of fully assembled bays.

Table 2-3
Equipment weights

Item		Weight	
Bay frame (empty)	2130 mm (84.0 in.) frame:	70 kg	(154 lb)
	2743 mm (108 in.) frame:	107 kg	(237 lb)
	3505 mm (138 in.) frame:	128 kg	(283 lb)
Common-equipment shelf (empty)		23 kg	(50 lb)
Common-equipment shelf (fully loaded)		46 kg	(102 lb)
Breaker interface panel		9.5 kg	(21 lb)
Copper-distribution shelf (no circuit packs)		14.6 kg	(32 lb)
Copper-distribution shelf (fully loaded)		24.5 kg	(54 lb)

Bay frame dimensions

Table 2-4 lists the bay frame dimensions.

Table 2-4
Bay frame dimensions

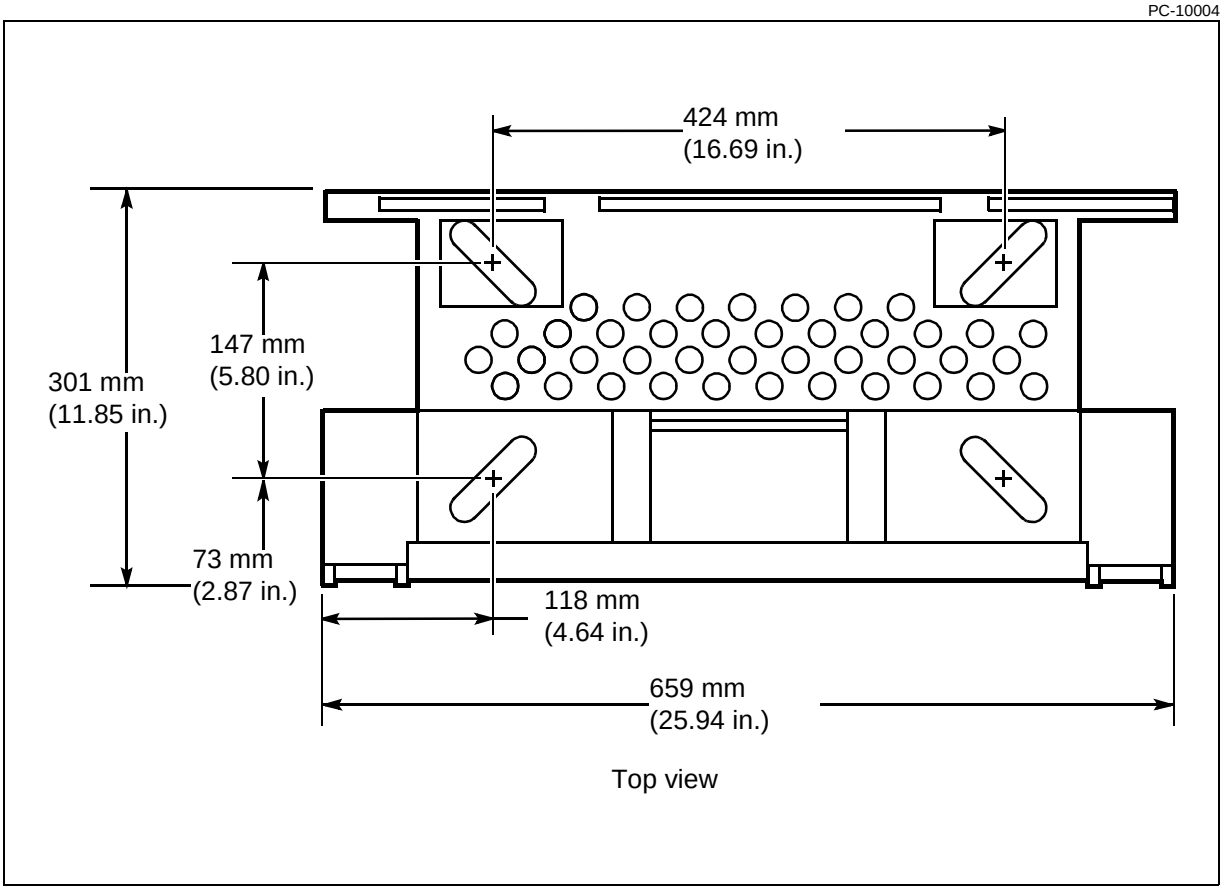
Frame	Dimension
width	659 mm (25.94 in.)
depth	305 mm (12.0 in.)
bay heights	The bay is available in three heights: 2130 mm (84.0 in.) 2743 mm (108 in.) 3505 mm (138 in.)
extender heights for the 2130 mm (84.0 in.) bay	
NT7E71DA extender	adds 0.61 m (2 ft)
NT7E71EA extender	adds 1.37 m (4.5 ft)
clearance between uprights	546 mm (21.5 in.)
horizontal mounting centers	566 mm (22.3 in.)
base height	130.8 mm (5.15 in.)
vertical mounting space	1.9 m (76.0 in.), excluding 25.4 mm (1.0 in.) for air filter panel

Bay footprint

The bay footprint is 659 mm (25.94 in.) wide and 301 mm (11.85 in.) deep, to allow for installation in a NEBS standard transmission bay lineup, as shown in Figure 2-1. It is recommended that the bay isolator pad be used in all installations. The isolator pad can also be used as the template for the bay footprint layout.

Earthquake Zone-4 anchoring hardware, or standard nonearthquake zone anchoring, is included with each framework, as specified when the bays were ordered.

Figure 2-1
Bay footprint

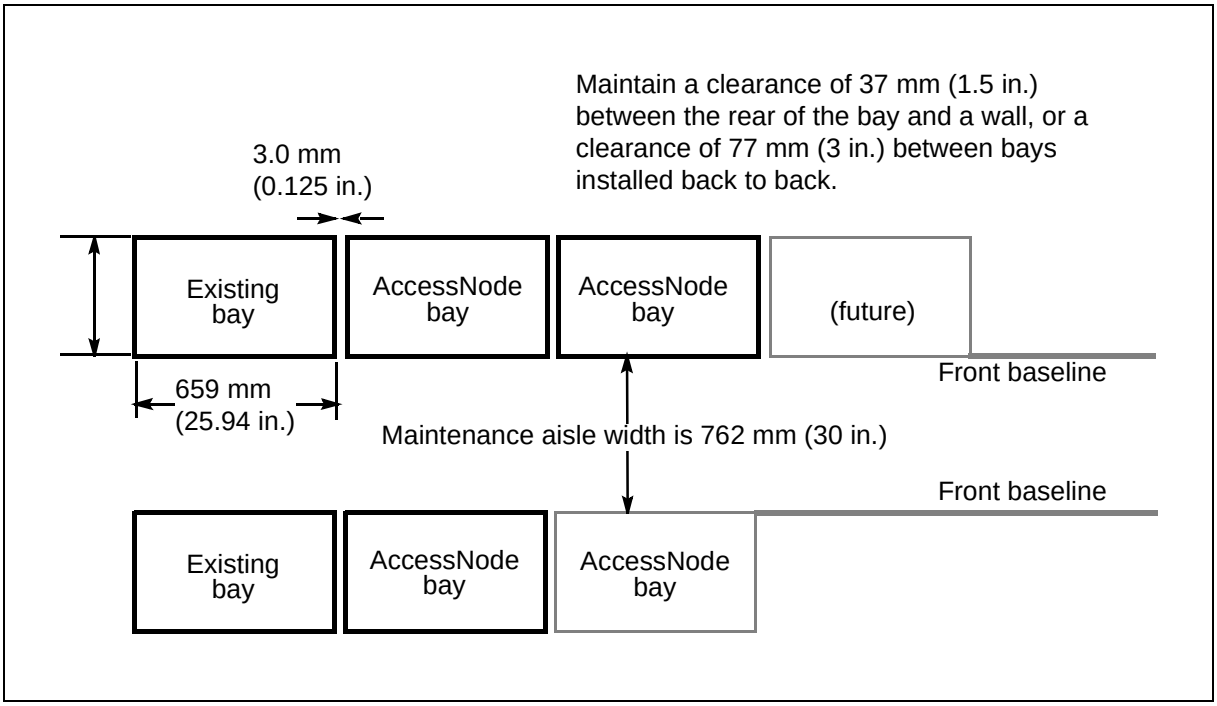


Floor space requirements

The floor space requirements for bay lineups are shown in Figure 2-2.

Note: When AccessNode bays are installed front to back (that is, so that the front of one faces the back of another) and they are set up to be rolled out of the lineup for maintenance access, leave at least six inches between the bays for proper air circulation.

Figure 2-2
Floor space requirements



Effects of cable length limits on equipment location

The following cable length limits can affect the location of the bays, relative to the location of the interfacing equipment.

DS1	Allow a maximum cable length of 200 m (655 ft) to interface the DSX-1 cross-connect.
Control network	Allow a maximum length of 122 m (400 ft) for end-to-end cabling (including shelf backplane tracks) when interconnecting two equipment shelves that coexist in same location, but that are intended to operated as one system.
VT and D-link	Allow a maximum cable length of 7.3 m (24 ft) to interconnect two access bandwidth manager shelves that coexist in the same location, but are intended to operate as one system.

Note: Complete details of cable requirements are described in Chapter 5, "Cabling requirements for ABM bays," and Chapter 6, "Cabling requirements for TBM bays."

Overhead cable drop hardware requirements

For central office installation sites, the overhead cable rack is the responsibility of the operating company. For bays taller than 7.0 ft, the bay requires auxiliary support, which attaches to the overhead rack.

Future expansion of cabling

The overhead cable rack density and cable routing management can be a determining factor for future expansion. Management of the overhead cable rack can include policies for sparing and route segregation of fiber, coaxial, VF, and power cabling. These policies should answer the following questions:

- Will overhead cable density be a problem if future cables are to be added?
- Will spare cables be preinstalled?

Future expansion of bay framework

Copper-distribution shelves can be added to an existing bay to complete the maximum seven shelves allowed.

Note: Copper-distribution shelves are installed on the bay with shelf number one located beneath the cooling unit and the others in sequence to the bottom of the bay.

Before a new copper-distribution shelf is added, the existing air filter located below the last equipment shelf must be removed and reinstalled beneath the last new shelf.

Bay growth in a transmission bay lineup is usually from left to right, but can depend on the existing bays in the equipment area. Where future bay space is planned, the floor plan should indicate the required blank space for each future bay within the lineup.

Cross-connect and distribution frame requirements

The AccessNode equipment requires interconnection with the following distribution frames or cross-connect equipment:

- main distribution frame (MDF) for VT/T1, alarms and test pairs cross-connect
- DXS-1 and DXS-3 cross-connect
- FiberManager frame for AccessNode in central office locations
- fiber patch panel tray for AccessNode in remote locations
- fiber outside plant interface (FOPI) in remote locations

Note: The outside plant cabinet includes the serving area interface (SAI) for terminating the external fiber, coaxial, and VF cables.

To minimize cable congestion, DS1 cables that are connected to the I/O cards in slots 40 to 42 of the I/O area of the TBM shelf are routed down the left side of the bay or cabinet. Cables to the DS1 cards in slots 43 and up are routed down the right side.

Guidelines for placing the OPC

To determine where to place the operations controller (OPC), you need to know the following:

- the configuration of the AccessNode
- the type of equipment to which the AccessNode is connecting
- the distance from network element to network element

There are three main items you should consider when deciding where to place the OPC:

- the distance from the OPC to the network element
- the type of shelves that are available to house the OPC
- the OPC placement options that are available for your AccessNode configuration and connecting equipment

Types of connections to the OPC

You can connect the OPC to a network element using CNET links, SONET links, or both. If you have a DS1-fed AccessNode, you can also connect the OPC to the network element using an OMC DS1 link.

You can connect the OPC to the network element using one of the two methods described in Table 2-5.

Table 2-5
OPC connection methods

If the network element is this far from the OPC	Then connect the OPC to the network element using this method
122 m (400 ft) or less	Connect the OPC using a control network (CNET) cable to one of the two following network elements: • the same network element that contains the OPC • another network element within 122 m (400 ft) of the OPC
more than 122 m (400 ft)	Locate a DS1 facility that is in one of the following two network elements: • the same network element as the OPC • another network element within 122 m (400 ft) of the OPC Connect the OPC to that DS1 facility using a CNET cable. Route the DS1 to one of the following elements: • the RFT • the DS1 facility to another network element that is within 122 m (400 ft) of the RFT

Where can you place an OPC for your configuration

You can place an OPC in the following locations:

Table 2-6
OPC placement options

If the AccessNode is in this configuration	Then you can place the OPC here
Fiber-fed systems (point-to-point, VTBM rings)	• in the system's FCOT • in another system's FCOT • in an OPC shelf
DS1-fed systems	• in another system's FCOT • in an OPC shelf • in an RFT • in an TransportNode
Single-ended systems	• in another system's FCOT • in an OPC shelf • in an TransportNode

Refer to *Configuration and Equipment Description*, 323-3001-100, in *Description*, Volume 2A for details and guidelines for OPC placement.

Site preparation

Preparation of the site prior to the installation of the equipment is necessary to ensure smooth and safe procedures.

Receiving and moving the equipment

All areas and passageways must be accessible to allow unhindered transport of crated bays from the receiving area to the area of installations. Any uneven floors must be prepared in advance to ensure smooth movement when transporting crated or uncrated bays.

Site preparation should ensure that the following procedures can be implemented, when moving, unloading, and unpacking the crated bays:

- Equipment must be kept vertical and moved by the bottom skid. If bays must be moved in the horizontal position, the bay must be positioned on one of the sides and never the front or back of the bay.
- Bays should be moved as close as possible to their installed location, before removing them from the pallets.
- Bays must be moved on the same level from the unloading area to the unpacking area.

CAUTION
Avoid structural stress when maneuvering uncrated bays
When handling and moving uncrated bays, exercise care to avoid strain, excessive shock, or vibrations, which might damage the equipment or warp the frame.

DANGER
Risk of injury when maneuvering uncrated bays
Uncrated bays that contain a single shelf are heavier at the top than they are at the bottom and can topple over, if mishandled. To reduce the risk of a bay toppling over, keep an uncrated bays upright at all times, and use two people to maneuver the bay.

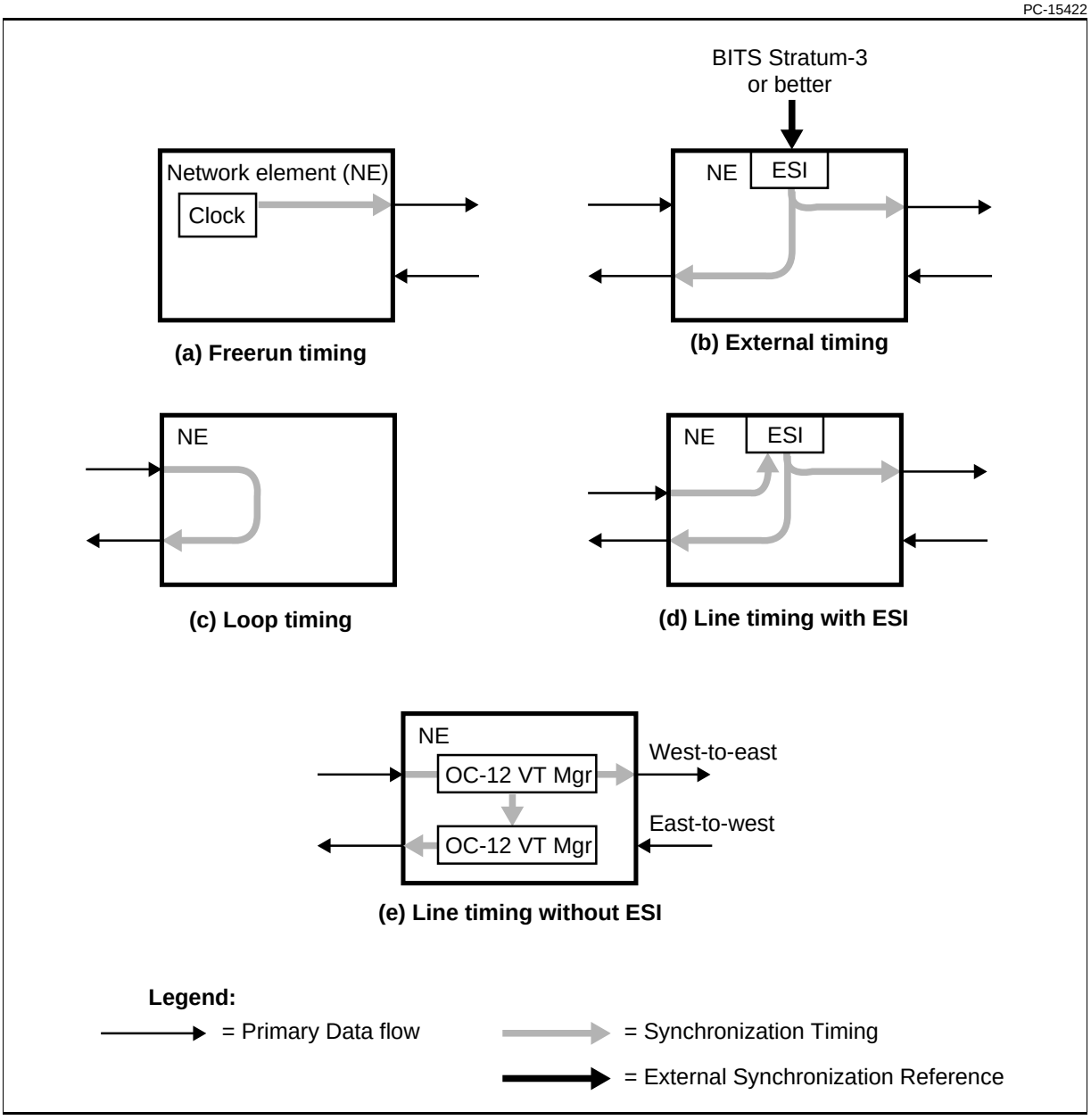
Timing guidelines

The next few pages highlight timing guidelines that you should consider when planning the installation of an AccessNode system. Figure 2-3 shows timing signal flows for various applications.

> ***Note:*** Reference *Configuration and Equipment Description*, 323-3001-100, in *Description*, Volume 2A for detailed synchronization information.

Figure 2-3
Flow of synchronization timing signals for various timing sources and applications

PC-15422



Use of a non-traffic-carrying DS1 as the timing reference source

If a timing reference from a BITS (Building Integrated Timing Supply) is not available for use as an input timing reference for external synchronization interface cards, you can use a dedicated non-traffic-carrying DS1 from a digital switch as a timing reference. Such a DS1 must meet the following requirements:

- It must not carry any traffic.
- It must have at least Stratum-3 accuracy.
- It must have a valid superframe format or valid extended superframe format.

Note: You cannot use a DS1 as a timing reference if that DS1 is a TR-08 A span because such a DS1 does not have the required framing format. This is because the A span carries TR-08 alarm and maintenance messages in the framing bits. For more information, see the description of the derived data link in Chapter 3 of *Signal Flow and Circuit Pack Description*, 323-3001-102, in *Description*, Volume 2A.

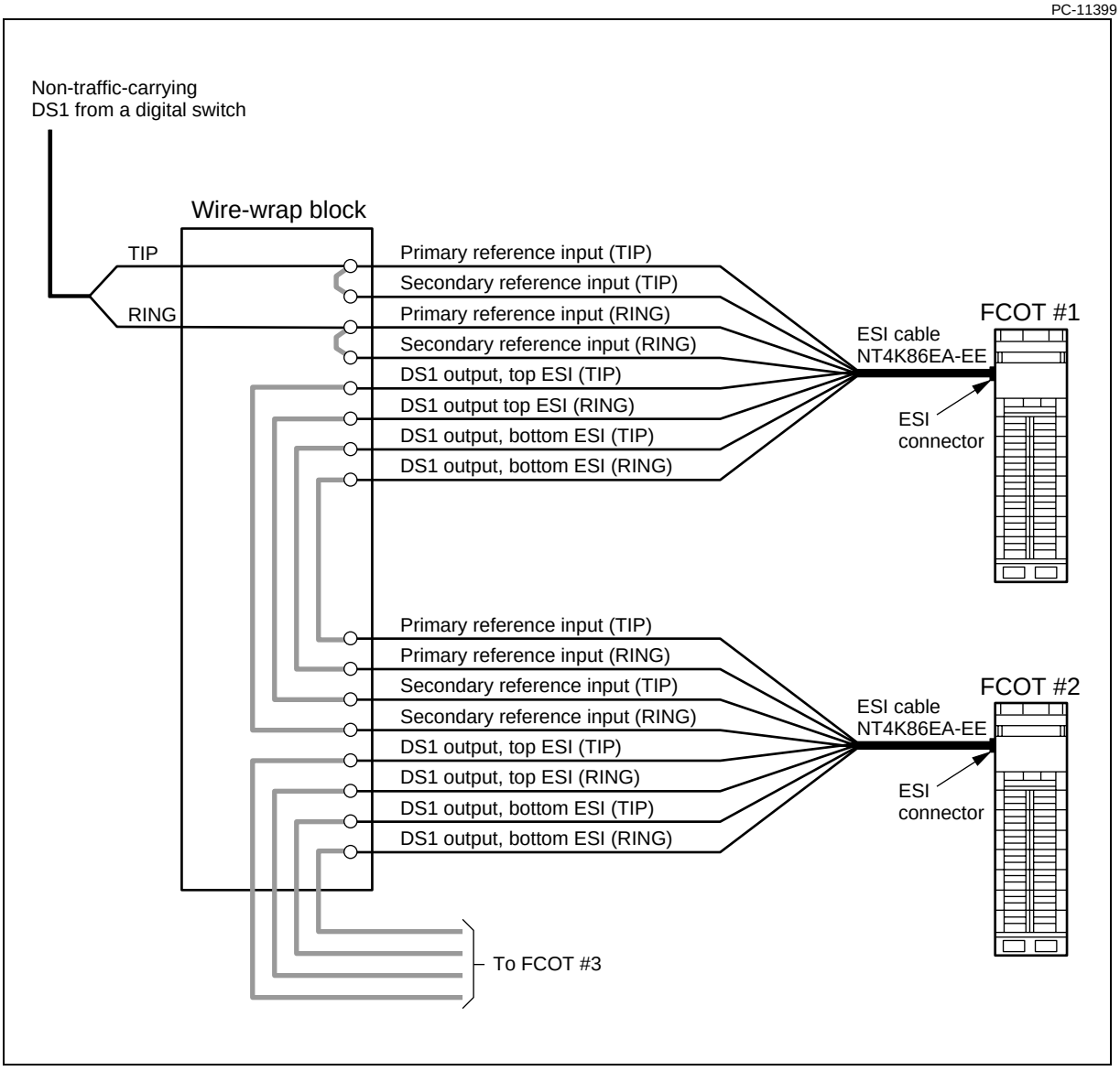
Daisy-chaining for timing multiple FCOTs from a single DS1

If you have multiple co-located FCOTs, you can derive timing for all the FCOTs from a single DS1 if you connect the ESI cables leading to the FCOTs in a daisy-chain pattern.

Figure 2-4 illustrates the connections needed to build the daisy chain.

Figure 2-4
Daisy-chain connections to time multiple FCOTs from a single DS1

PC-11399



Synchronization for the single-ended AccessNode

If the TransportNode network to which the single-ended AccessNode connects is synchronized from a stratum 1 timing source, you can synchronize the single-ended AccessNode by provisioning it as loop-timed or free-run.

If you select	Then the single-ended AccessNode
loop-timed	synchronizes to the incoming feeder
free-run	does not synchronize to any timing reference

Note: You cannot synchronize a single-ended RFT to an external BITS source using an ESI card.

To synchronize the TransportNode network elements to a stratum 1 timing source, all TBMs in a NWK ring should contain an ESI circuit pack. This circuit pack allows synchronization to a BITS clock. The VTBM ring is synchronized using an external reference at one or two nodes located at a central office (FCOT) and line timing at the other nodes (RFT).

Synchronization for the DS1-fed AccessNode

If the network to which the DS1-fed AccessNode connects is synchronized from a stratum 1 timing source, you can synchronize the DS1-fed AccessNode by provisioning it as DS1-timed or free-run.

If you select	Then the DS1-fed AccessNode
DS1-timed	synchronizes to the DS1 through the TXC circuit pack
free-run	does not synchronize to any timing reference

Synchronization for ring topologies

A fiber-fed AccessNode system with ring topology can be synchronized by using external time referencing on one or two nodes (with one or two ESI cards per node) per single ring.

Any remaining nodes should be line-timed, using the capabilities of the OC-12 VTBM circuit packs, and be set to auto synchronization. Each line-timed ring node can receive timing from either direction.

Customer-located equipment prerequisites

This chapter describes the prerequisites for planning the installation of AccessNode equipment located in customer buildings.

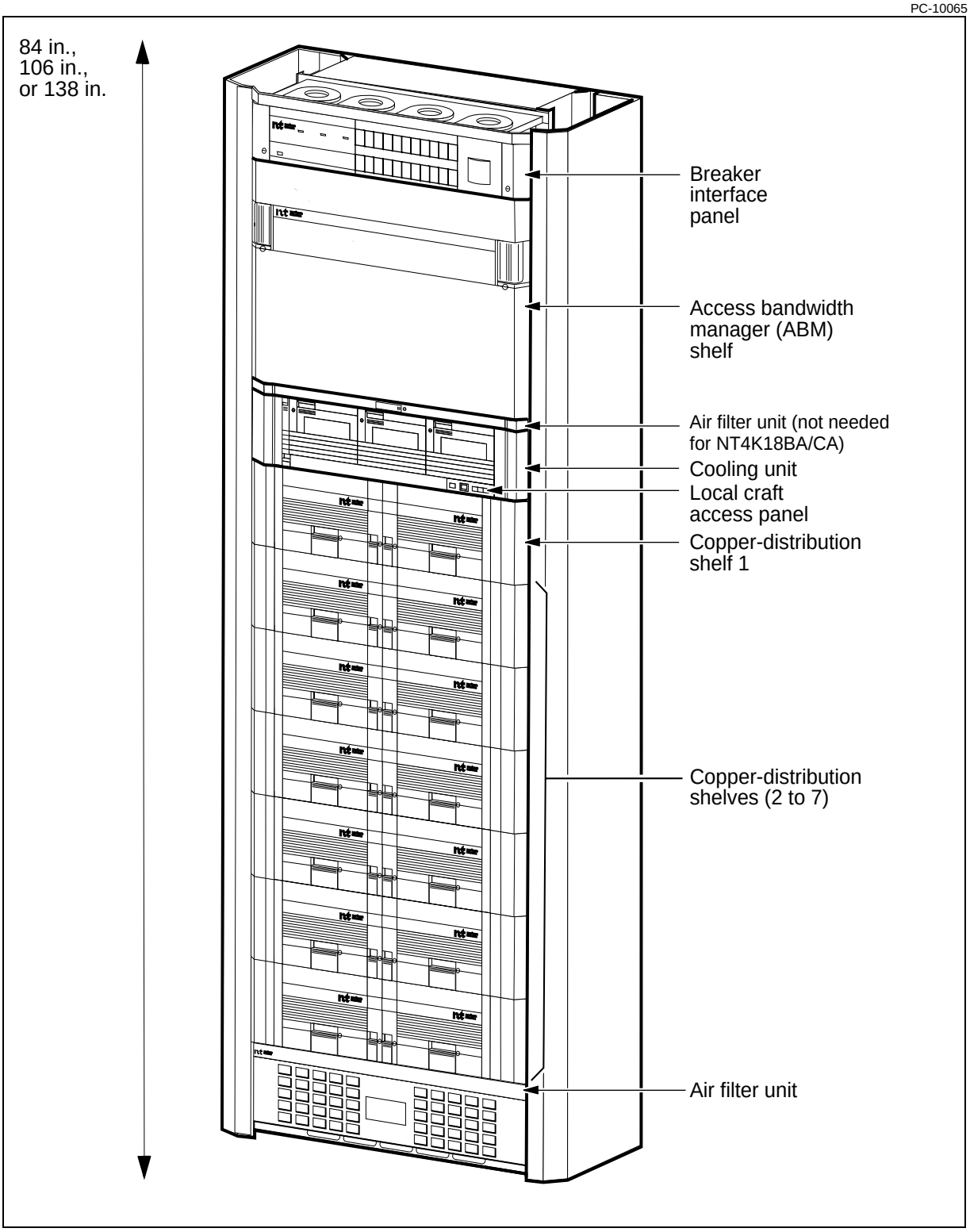
Customer-located equipment is designed to allow an operating company to locate AccessNode equipment on the premises of their customer. The customer-located equipment is packaged in bays for entrance rooms or equipment rooms as shown in Figure 3-1 on page 3-2.

Chapter contents

This chapter contains the following information:

Figure 3-1
Typical RFT bay layout for customer-located equipment

PC-10065



Customer-located equipment configurations

Customer-located equipment bays can be installed in entrance rooms, usually located in the basement of large business buildings. Entrance rooms most often contain the cable termination and splicing facilities, network interface equipment, and telecommunications equipment, allowing access only by telephone personnel and possibly building maintenance personnel.

The single-ended AccessNode and the DS1-fed AccessNode are described below.

Single-ended AccessNode

In the single-ended AccessNode configuration, the RFT connects directly to an OC-12 TransportNode ring. It connects through a SONET interface to a fiber multiplexer. The single-ended AccessNode also connects in a point-to-point configuration. The single-ended AccessNode does not need an FCOT.

Refer to *Configuration and Equipment Description*, 323-3001-100, in *Description*, Volume 2A for more information.

DS1-fed AccessNode

In the DS1-fed AccessNode configuration, the AccessNode RFT connects directly to one of the following interfaces:

- TR-08
- GR-303 MVI
- GR-303 DMS
- DS1 Tandem

The DS1-fed AccessNode does not need an FCOT.

Refer to *Configuration and Equipment Description*, 323-3001-100, in *Description*, Volume 2A for more information.

Virtual tributary bandwidth manager rings

Each network element in a virtual tributary bandwidth manager (VTBM) ring uses two OC-12 VTBM optical interface circuit packs to transmit and receive signals in both directions in the network.

Refer to *Configuration and Equipment Description*, 323-3001-100, in *Description*, Volume 2A for more information.

Environmental requirements

AccessNode bay equipment operates within specifications providing the following environmental conditions apply.

> ***Note:*** For complete AccessNode specifications, see *System Specifications,* 323-3001-180, in *Description,* Volume 2B.

Temperature

For operating temperature specifications, see *System Specifications,* 323-3001-180, in *Description,* Volume 2B.

Altitude

The following altitude range applies to the AccessNode bay equipment:

Operation state	Value
Operating	Up to 4000 m (13,000 ft) above mean sea level
Storage and shipping	Up to 15,000 m (50,000 ft) above mean sea level

Relative humidity

The following relative humidity range applies to FCOT and RFT terminals:

Operation state	Value
Operating	5% to 95% (not to exceed 3.6 kPa water vapor pressure over the normal operating temperature)
Storage and shipping	5% to 95% (not to exceed 5.3 kPa water vapor pressure for temperatures above +35° C)

The following relative humidity range applies to the OPC:

Operation state	Value
Operating	20% to 90% (not to exceed 3.6 kPa water vapor pressure over the normal operating temperature of the OPC)
Storage and shipping	10% to 90% (not to exceed 5.3 kPa water vapor pressure for temperatures above +35° C for the OPC)

Atmospheric dust

AccessNode is designed with an air filter in the inlet of the bay that meets the ASHRAE 80% dust arrestance requirements.

Thermal shock (cabinet)

AccessNode meets the thermal shock requirements of Bellcore TA-NWT-000487.

Mechanical shock

Vibration in the cabinet equipment area must be limited to a frequency range of 0.5 to 200 Hz and a G-force magnitude of 0.1 G, according to Bellcore TR-EOP-000063.

Earthquake resistance

AccessNode equipment installation can include optional earthquake mounting hardware (specific to bays or cabinets), to ensure normal operation when subjected to the Zone 4 earthquake loading, in accordance with Bellcore TR-EOP-000063, Section 4.5.

Power requirements

Power requirements include power and ground distribution, 48 V dc power, and commercial 120 V ac power.

Power and ground distribution

When engineering a specific equipment configuration, you must provide a power and grounding layout which should include the location of the following items:

- the batteries and the rectifier system
- the battery-distribution fuse bay (BDFB)
- the length and routes for dc and ac power cables
- a grounding plan which should include the locations of the following:
  - — the floor ground bars (FGBs)
  - — the vertical ground risers (VGRs), if used in your building
  - — the building principal ground (BPG) or the single point ground (SPG), if applicable

Note: The power and ground distribution requirements common to all AccessNode equipment installations are described in Chapter 4, “Power and ground distribution.”

–48 V dc power feed requirements

AccessNode bays require four fused feeds from a source of –48 V dc for shelf logic power and talk-battery, within the range of –42.75 to –56 V dc, as referenced at the breaker interface panel (BIP) located at the top of each AccessNode bay. This source of direct current power must be supplied by the customer.

Voltage drops between the power source and the BIP must not exceed 1.0 V. To ensure that a 1.0 V drop is not exceeded, and to accommodate the typically expected currents, the main power cables supplied by Nortel Networks for connecting the dc power source to the BIP are 10.6 m (35 ft), 6 AWG. Cables longer than 10.6 m (35 ft) are the responsibility of the customer.

Preconnectorized feeder cables are required, as described in "–48 V dc battery cabling" on page 5-10.

dc power consumption

Table 3-1 lists the approximate power drain of AccessNode shelves and common equipment.

Table 3-1
ABM and CDS shelf and common equipment power drain

Item	Description	Power drain
ABM shelf common equipment	includes OC-3/OC12, protected optics, and protected common control	176 watts
ABM shelf options	DS1/VT mapper (with 14 DS1s) DS3/STS mapper (with 3 DS3s)	13 watts 16 watts
Fans (3)	cooling unit (one used per bay)	93 watts
Fans (8)	cooling unit (one used per bay)	65 watts
Copper-distribution shelf	common equipment and power	45 watts

Table 3-2 lists the approximate power drain of AccessNode line cards.

Table 3-2
Line card power drain

Line card	Item	Power drain
2-wire Omega source	FXS, POTS, UVG at 3 CCS	0.80 watts
	FXS, POTS, UVG at 6 CCS	0.91 watts
	FXS, POTS, UVG at 18 CCS	1.36 watts
	Coin at 3 CCS	0.90 watts
	Coin at 6 CCS	1.09 watts
	Coin at 18 CCS	1.90 watts
	ETO/TO at 36 CCS	2.03 watts
	PLAR at 36 CCS	3.21 watts
	ISDN basic line rate at 36 CCS	1.75 watts
	EBS at 6 CCS	1.38 watts
	EBS at 18 CCS	1.51 watts
4-wire Omega	FXS at 6 CCS	2.23 watts
	FXS at 18 CCS	2.79 watts
	DDS, OCUDP at 36 CCS	2.81 watts
	DX at from 0 to 36 CCS	2.81 watts
2-wire Omega UVG	POTS, UVG at 3 CCS	0.80 watts
	POTS, UVG at 6 CCS	0.91 watts
	POTS, UVG at 18 CCS	1.36 watts
2-wire Epsilon	POTS at 3 CCS	0.66 watts
	POTS at 6 CCS	0.77 watts
	POTS at 18 CCS	1.23 watts
2-wire Omega sink	DPT at 6 CCS	0.58 watts
	DPT at 18 CCS	0.77 watts
6 and 8-wire Omega	E&M, PLR, and TDM from 0 to 36 CCS	2.52 watts
Manual ring-down	MRD at 36 CCS	0.75 watts

Key:

CCS	Call hundred seconds
DDS	Digital data services
DX	Duplex signaling
E&M	Ear and mouth
EBS	Electronic business services
ISDN	Integrated services digital network
PLR	Pulse link repeater
FX	Foreign exchange
FXS	Foreign exchange station
OCUDP	Office channel unit data port
POTS	Plain ordinary telephone service
TDM	Tandem service
UVG	Universal voice grade service

Commercial 120 V ac power

The entrance room in which the bay is installed must have at least two 120 V ac (60 Hz) receptacles, either along the walls of the room or installed as a customer option in the base of the bay. See “Power (ac)” on page 4-6 for a description of ac power distribution and the wiring of ac receptacles.

Power dissipation guidelines

For the guidelines to provision the AccessNode system with a mix of line cards and services that meets the power dissipation capability of the system, refer to *Traffic and Bandwidth Engineering Information*, 323-3001-152.

Floor space planning of entrance rooms for bays

Floor space planning requirements for customer-located bays in entrance rooms are as follows.

Entrance room requirements

The entrance room door access must be lockable and have a minimum height of 2.4 m (8 ft). The entrance room must be equipped with a minimum of two 120 V ac outlets. The recommended room size according to EIA 2072 and CSAT530 are based on the relative building size, as follows:

Building size	Room size
100,000 ft^2	3.6 m x 2 m (12 x 6.3 ft)
200,000 ft^2	3.6 m x 2.8 m (12 x 9.3 ft)
400,000 ft^2	3.6 m x 4 m (12 x 13 ft)
500,000 ft^2	3.6 m x 4.7 m (12 x 15.6 ft)
1,000,000 ft^2	3.6 m x 8.4 m (12 x 27.7 ft)

Floor loading for bay configuration

Use a floor loading of 730 kg/m^2 (150 lbs/ft^2) for the entrance room, to determine the maximum allowable weight of a fully loaded bay. The floor loading should be sufficient to bear both distributed and concentrated loading in accordance with EIA and CSA, as follows:

Duty	Distributed loading	Concentrated loading
Light	150 lbs/ft^2	2.7 $lbs/in.^2$
Medium	250 lbs/ft^2	4.4 $lbs/in.^2$
Heavy	350 lbs/ft^2/hr	5.6 $lbs/in.^2$

Equipment weights

Weights of assembled equipment bays depend on the number of copper-distribution shelves installed. Table 3-3 lists equipment weights that can be used to calculate the weights of fully assembled bays.

Table 3-3
AccessNode equipment weights

Item		Weight	
Bay frames (empty)			
	1130 mm (7 ft) frame:	70 kg	(154 lb)
	2743 mm (9 ft) frame:	107 kg	(235 lb)
	3505 mm (11 ft 6 in.) frame:	128 kg	(281 lb)
Equipment shelves			
Common-equipment shelf (empty)		23 kg	(50 lb)
Common-equipment shelf (fully loaded)		46 kg	(102 lb)
Cooling fan module (loaded)		16.8 kg	(37 lb)
8-fan cooling unit		13.6 kg	(30 lb)
Breaker interface panel		9.5 kg	(21 lb)
Copper-distribution shelf (no circuit packs)		14.6 kg	(32 lb)
Copper-distribution shelf (fully loaded)		24.5 kg	(54 lb)

Bay frame dimensions

Table 3-4 lists the AccessNode bay frame dimensions:

Table 3-4
AccessNode bay frame dimensions

Frame	Dimension
width	65.9 cm (25.94 in.)
depth	30.5 cm (12.2 in.)
height	The bay is available in three heights: 2.13 m (7 ft) 2.74 m (9 ft) 3.50 m (11 ft 6 in.) Two bay frame extenders are available to extend the height of a 2130 mm (7 ft) bay as follows: NT7E71DA extender 2.74 m (2 ft) NT7E71EA extender 3.50 m (4.5 ft)
clearance between uprights	54. 6 cm (21.5 in.)
horizontal mounting centers	56.6 cm (22.3 in.)
base height	13.0 cm (5.15 in.)
vertical mounting space	193 cm (76 in.), excluding 2.54 cm (1.0 in.) for air filter panel

Bay footprint

The bay footprint is a 65.89 cm (25.94 in.) wide and 30.10 cm (11.85 in.) deep, to allow for installation in a NEBS standard transmission bay lineup as shown in Figure 3-2. It is recommended that the bay isolator pad is used in all installations. This pad can also be used as the template for the bay footprint layout.

Earthquake Zone-4 anchoring hardware, or standard nonearthquake zone anchoring, is included with each framework, as specified when the bays were ordered.

Floor space requirements for bays

The floor space requirements for bay lineups are shown in Figure 3-3 and a typical AccessNode bay installation in an entrance room is shown in Figure 3-4 on page 3-13.

Note: When AccessNode bays are installed front to back (that is, so that the front of one faces the back of another) and they are set up to be rolled out of the lineup for local maintenance access, leave a minimum of 15.24 cm (6 in.) between the bays for proper air circulation.

Figure 3-2
Bay footprint

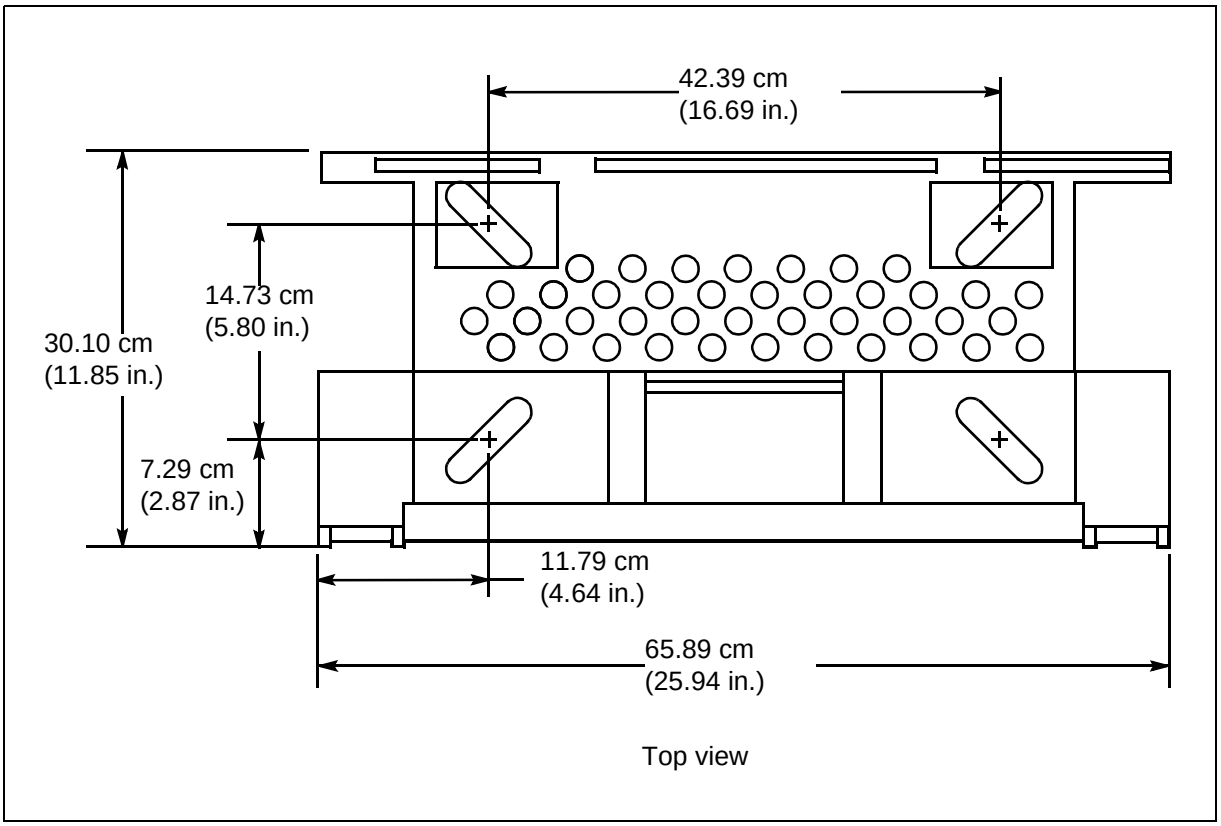
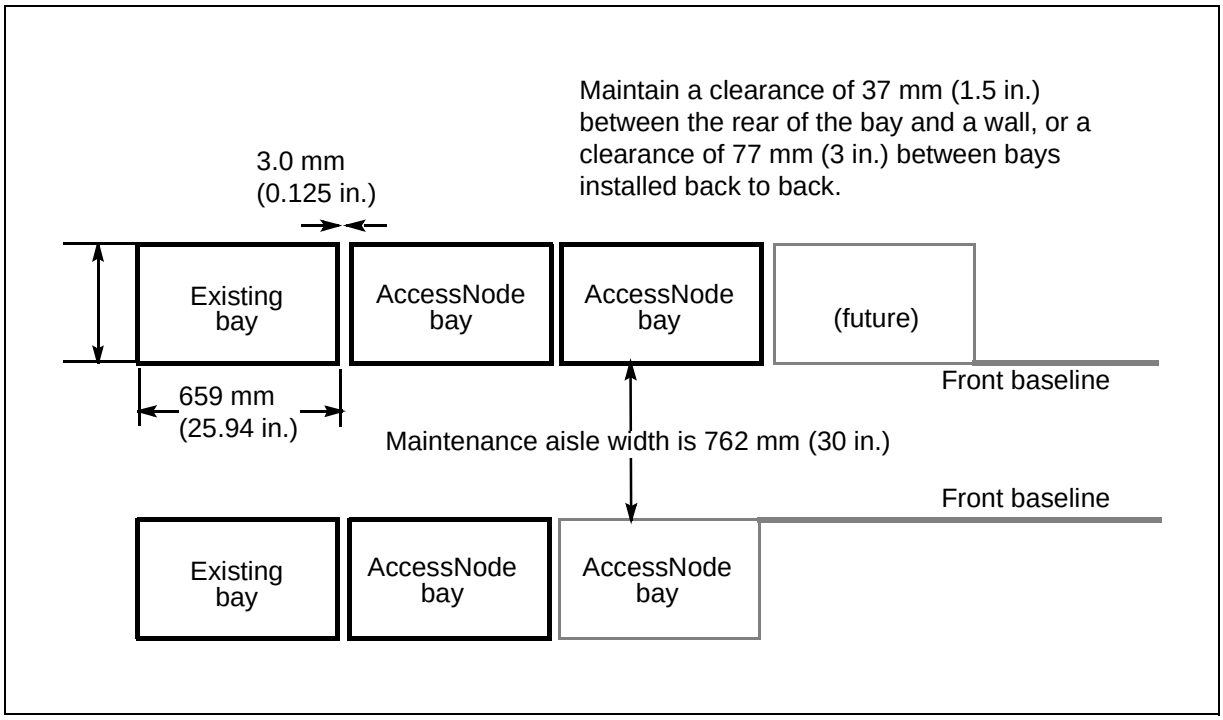


Figure 3-3
Floor space requirements for bays



Effects of cable length limits on equipment location

The following cable length limits can affect the location of the bays, relative to the location of the interfacing equipment.

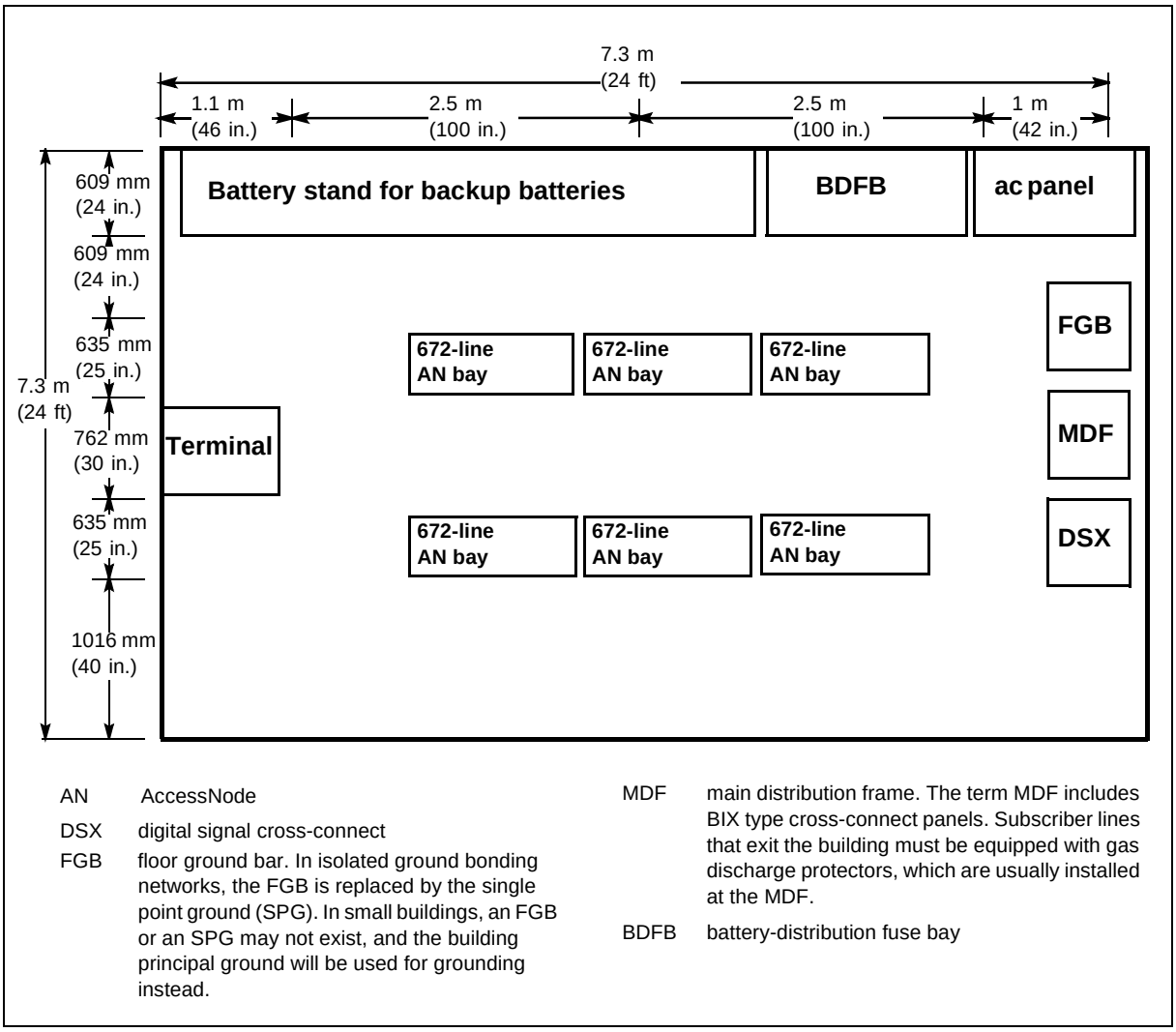
DS1	Allow a maximum cable length of 200 m (655 ft) to interface the DSX-1 cross-connect.
VT and D-link	Allow a maximum cable length of 7.3 m (24 ft) to interconnect two access bandwidth manager shelves that coexist in the same location, but are intended to operate as one system.

Note: Complete details of cable requirements are described in Chapter 5, "Cabling requirements for ABM bays."

Overhead cable drop hardware requirements

For installation sites, the overhead cable rack will be the responsibility of the operating company.

Figure 3-4
Typical entrance room floor space for bays



AN AccessNode

DSX digital signal cross-connect

FGB floor ground bar. In isolated ground bonding networks, the FGB is replaced by the single point ground (SPG). In small buildings, an FGB or an SPG may not exist, and the building principal ground will be used for grounding instead.

MDF main distribution frame. The term MDF includes BIX type cross-connect panels. Subscriber lines that exit the building must be equipped with gas discharge protectors, which are usually installed at the MDF.

BDFB battery-distribution fuse bay

Considerations for future expansion

This section lists considerations for future expansion of bay framework and cabling.

Bay growth in a transmission bay lineup is usually from left to right, but can depend on the existing bays in the equipment area. Where future bay space is planned, the floor plan should indicate the required blank space for each future bay within the lineup.

Future expansion of bay framework

Copper-distribution shelves can be added to an existing bay to complete the maximum seven shelves allowed.

> ***Note:*** Copper-distribution shelves are installed on the bay with shelf number one located beneath the cooling unit and the others in sequence to the bottom of the bay.

Future expansion of cabling

The overhead cable rack density and cable routing management can be a determining factor for future expansion. Management of the overhead cable rack can include policies for sparing and route segregation of fiber, coaxial, VF, and power cabling. These policies should answer the following questions:

- Will overhead cable density be a problem if future cables are to be added?
- Will spare cables be preinstalled?

Site preparation

Preparation of the site prior to the installation of the equipment is necessary to ensure smooth and safe procedures.

Receiving and moving the equipment

All areas and passageways must be accessible to allow unhindered transport of crated bays and cabinets from the receiving area to the area of installations. Any uneven floors must be prepared in advance to ensure smooth movement when transporting crated or uncrated bays and cabinets.

Site preparation should ensure that the following procedures can be implemented, when moving, unloading, and unpacking the crated bays:

- Equipment must be kept vertical, and moved by the bottom skid. If bays must be moved in the horizontal position, the bay must be positioned on one of the sides and never the front or back of the bay.

  Note: Complete details of cable requirements are described in Chapter 5, "Cabling requirements for ABM bays."

- Bays and cabinets must be moved on the same level from the unloading area to the unpacking area.

CAUTION
Avoid structural stress when maneuvering uncrated bays
When handling and moving uncrated bays, exercise care to avoid strain, excessive shock, or vibrations, which might damage the equipment or warp the frame.

DANGER
Risk of injury when maneuvering uncrated bays
Uncrated bays that contain a single shelf are heavier at the top than they are at the bottom and can topple over if mishandled. To reduce the risk of a bay toppling over, keep uncrated bays upright at all times, and use two people to maneuver a bay.

Power and ground distribution

This chapter provides the requirements for distribution of dc and ac power and ground, common to all AccessNode configurations.

Chapter contents

This chapter contains the following information:

Power (dc)

Power (dc) requirements for the AccessNode equipment in bays are described in the following sections.

Protection against transient voltages

Transient voltages that appear differentially between the –48 V dc battery and battery return must be less than 5 V/ms. Transients greater than this are likely to occur when lightning strikes more than 20 subscriber lines connected to an AccessNode system and the lines exit the building.

To provide protection against voltage transients caused by lightning strikes on up to 100 subscriber lines, extra filtering must be provided at the battery distribution fuse bay (BDFB).

This filtering consists of connecting capacitors across the talk battery and ground at the battery distribution fuse bay (BDFB). For systems with subscriber lines that do not exit the building, installation of capacitors is not required.

When capacitors are required, two are normally used if the BDFB is fed with redundant power feeds. The value of the capacitors depends on the distance between the BDFB and the battery-rectifier system. Use the following procedure to determine the capacitor values.

1 Calculate the theoretical capacitor value using the following formula:

$C=10d^2$

where: C = uF

d = distance in meters

2 Use the formula in step 1 or 33 000 uF as the capacitor value, whichever is the greater.

The BDFB must be equipped with a battery return ground bar that is insulated from the frame ground of the BDFB.

Main power cables for bays equipped with ABM shelves

Nortel Networks manufactures main power cables with lengths of up to 10.7 m (35 ft). The cables are preconnectorized at one end for connection to the breaker interface panel (BIP) of the AccessNode equipment. Longer cables are the responsibility of the customer.

Four battery and return circuits, 1, 2, 3, and 4, must be grouped together for a continuous connection between the external –48 V dc BDFB and the BIP or dc distribution panel in AccessNode. For the BIP input and output power distribution, see Figure 4-1 on page 4-3.

Battery return cables are referenced to ground through the BDFB battery return bar, which is referenced to the frame ground bar (FGB) in grounding environments consisting of a common bonding network (CBN), or to the single point ground (SPG) in grounding environments consisting of an isolated bonding network (IBN).

See “Grounding schemes” on page 4-9 for a description of CBN and IBN grounding environments.

Main power cable color coding in bays equipped with ABM shelves

The conductor color codes for the battery and return cables is as follows:

- Battery (-): red
- Return (+): white or black

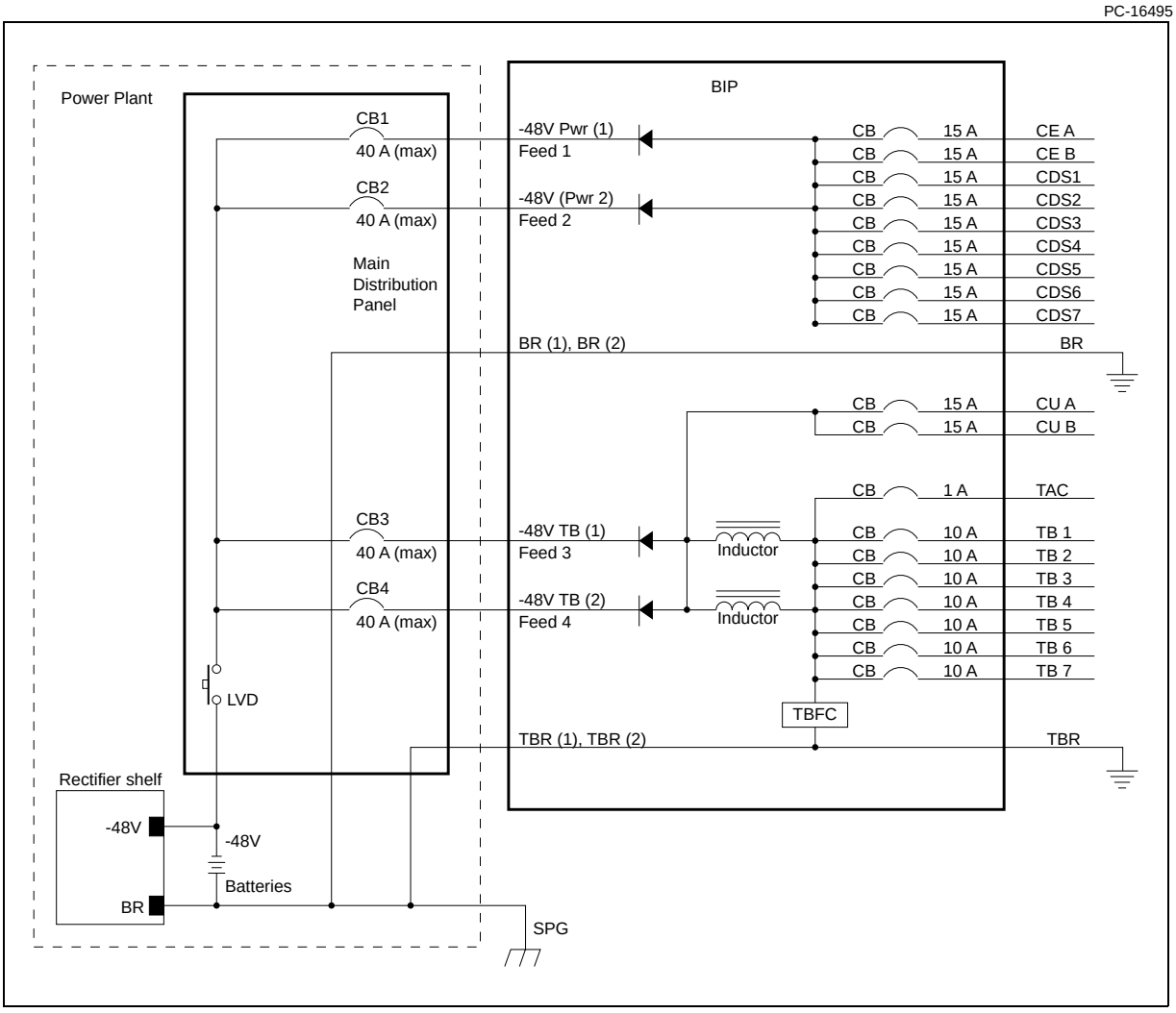
Cables should be designated at the point of origination and destination with sufficient details, indicating the system (bay location) and the battery and return circuit (1, 2, 3, and 4).

Power redundancy in bays equipped with ABM shelves

As shown in Figure 4-1, feeds 1 and 2 serve the common-equipment shelf with redundancy, and 3 and 4 serve the cooling unit with redundancy. Feeder voltage drop in bays equipped with ABM shelves

A minimum size of 6 AWG for the battery and return cables is required to ensure that the voltage drop from the BDFB to the BIP does not exceed 1.0 V dc, and to accommodate the maximum current limits.

Figure 4-1
BIP power input and distribution schematic for bays equipped with ABM shelves



Main power cables for bays equipped with TBM shelves

Main power cables for connecting power to the breaker interface panel (BIP) of an AccessNode bay equipped with a transport bandwidth manager (TBM) shelf are the responsibility of the customer.

Two battery and return circuits, 1 and 2, must be grouped together for a continuous connection between the external –48 V dc BDFB and the BIP or dc distribution panel in AccessNode. For the BIP input and output power distribution, see Figure 4-2 on page 4-5.

Battery return cables are referenced to ground through the BDFB battery return bar, which is referenced to the frame ground bar (FGB) in grounding environments consisting of a common bonding network (CBN), or to the single point ground (SPG) in grounding environments consisting of an isolated bonding network (IBN).

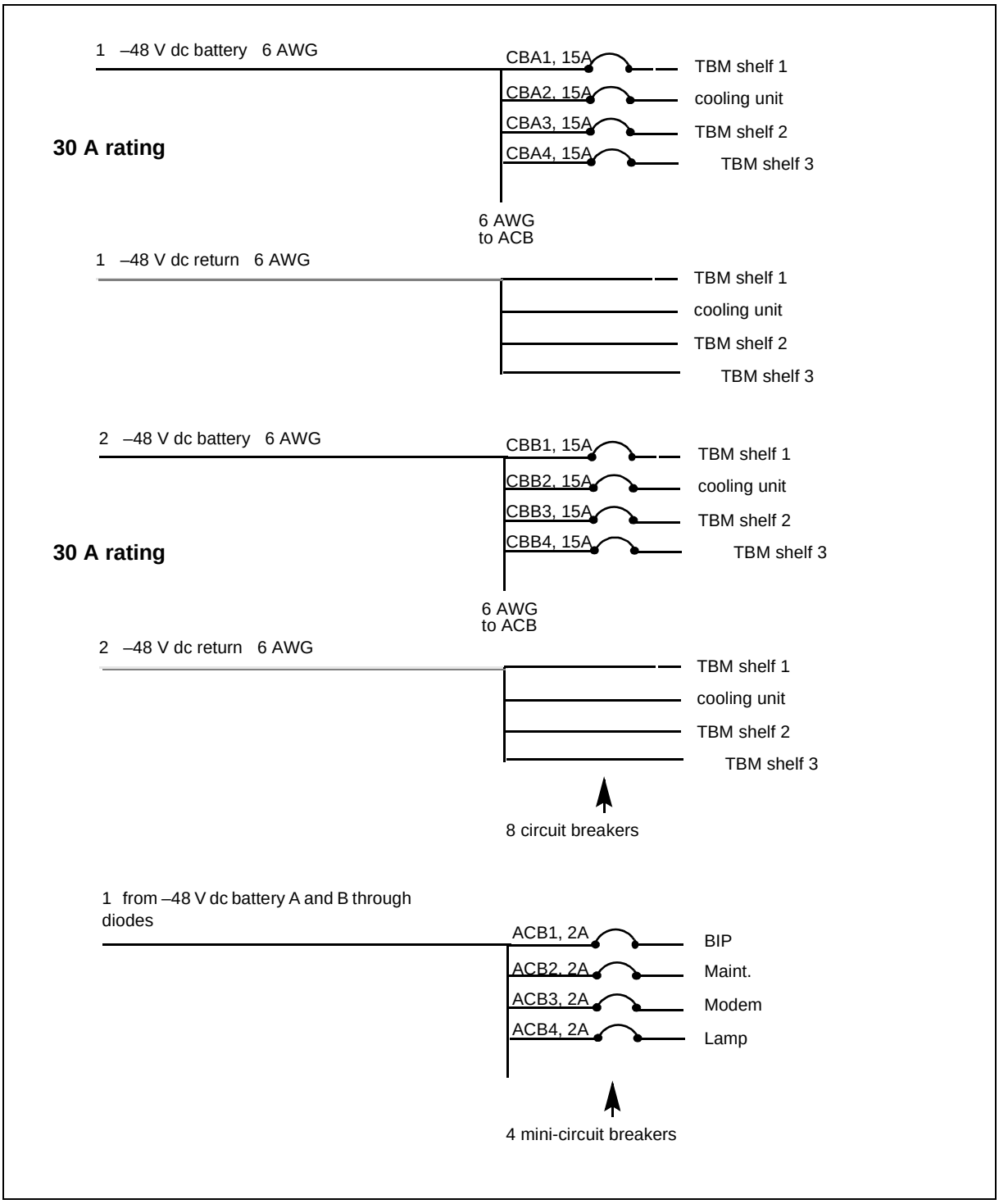
See for a description of CBN and IBN grounding environments.

Power redundancy in bays equipped with TBM shelves

As shown in Figure 4-2, feeds 1 and 2 serve the TBM with redundant power feeds.

> ***Note:*** To ensure uninterrupted service, bays must be equipped with dual power feeds to the TBM shelve(s) and the cooling unit.

Figure 4-2
BIP input and power distribution schematic, bays with TBM shelves



Power (ac)

Power (ac) requirements for the AccessNode equipment are as follows.

Power distribution

For common bonding network (CBN) grounding environments, Nortel Networks recommends that you use a dedicated ac panel for feeding communication equipment and utility receptacles. For isolated bonding network (IBN) grounding environments, you must use a dedicated ac panel for feeding communication equipment and utility receptacle.

The sizes of ac entrance and distribution feed cables must conform with information given in national electrical codes, as follows:

- For the United States: Table 250-94 of the National Electrical Code (NEC)
- For Canada: Table 17 of the Canadian Electrical Code (CEC)

Unless otherwise specified by the operating company or local electrical codes, the preferred wiring is metal-clad flexible cable.

The ac distribution panel and cabling must be installed by a licensed electrician in accordance with the national and local codes.

Utility receptacles (ac)

Utility ac receptacles can be installed on the AccessNode bays or on the walls of the installation room, and can be of one of the two following types:

- standard receptacle for 3 conductors (Neutral, Line 1, and Line 2) and ac equipment ground (ACEG). Use insulated metal-clad cable with 4 conductors: L1, L2, N, and ACEG
- isolated-ground receptacle (orange) for 4 conductors (L1, L2, N, and dedicated ACEG). Use insulated metal-clad cable with 5 conductors: L1, L2, N, dedicated ACEG and ACEG.

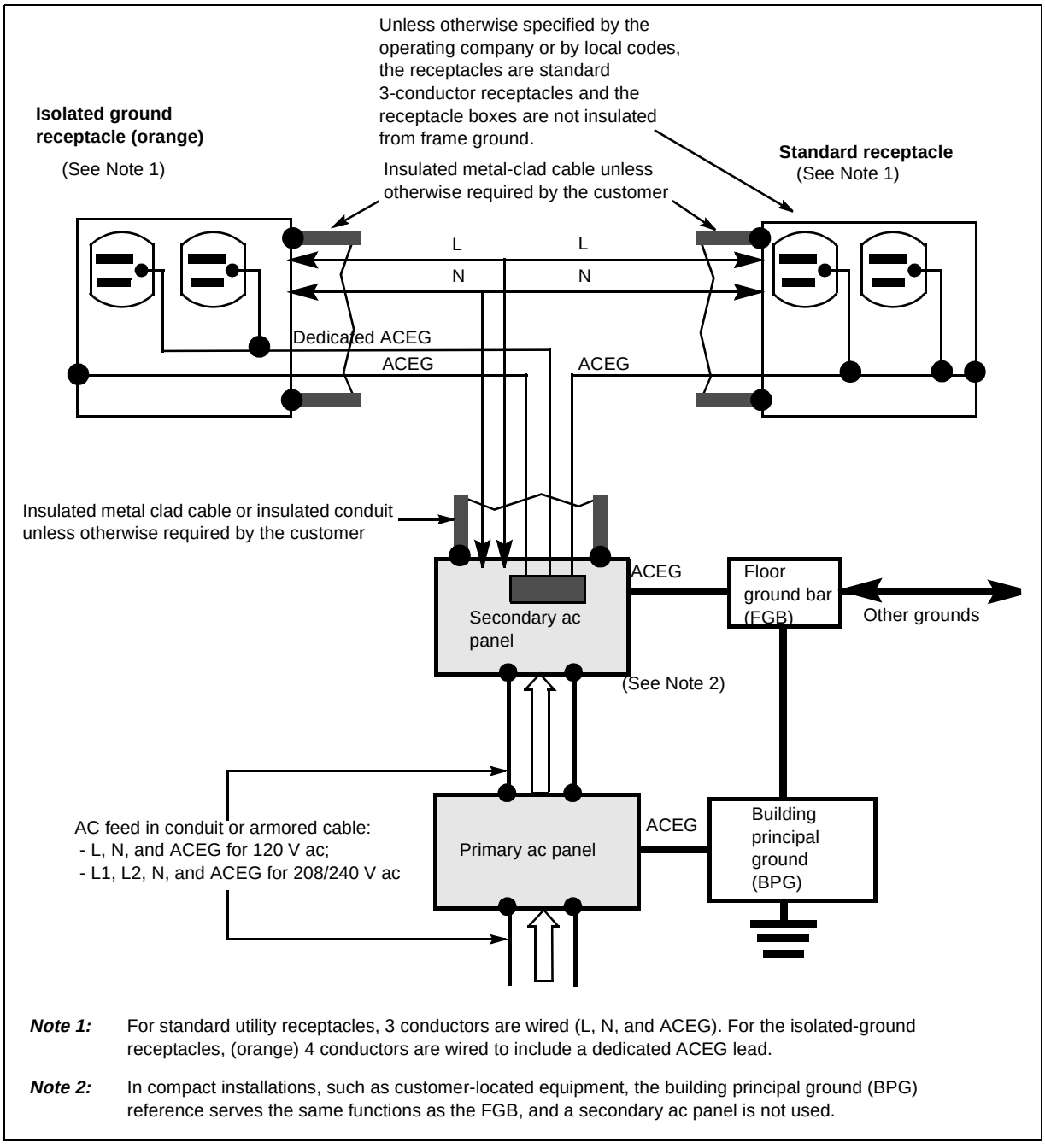
Boxes for receptacles installed on the bays can either be bolted directly to the bays or can be mounted on insulators to isolate them from frame ground.

Unless otherwise specified by the operating company or by local codes, the preferred method is to use standard 3-conductor receptacles, and when the receptacles are mounted on the bays, to use receptacle boxes that are not isolated from frame ground.

Receptacles in a CBN

In a CBN, receptacles on the bays or on the walls of the installation room should be bonded to the same floor ground bar (FGB) as the AccessNode. For an illustration of the grounding scheme for ac receptacles in a CBN, see Figure 4-3.

Figure 4-3
Power (ac) distribution and utility receptacle ground wiring scheme for a CBN environment



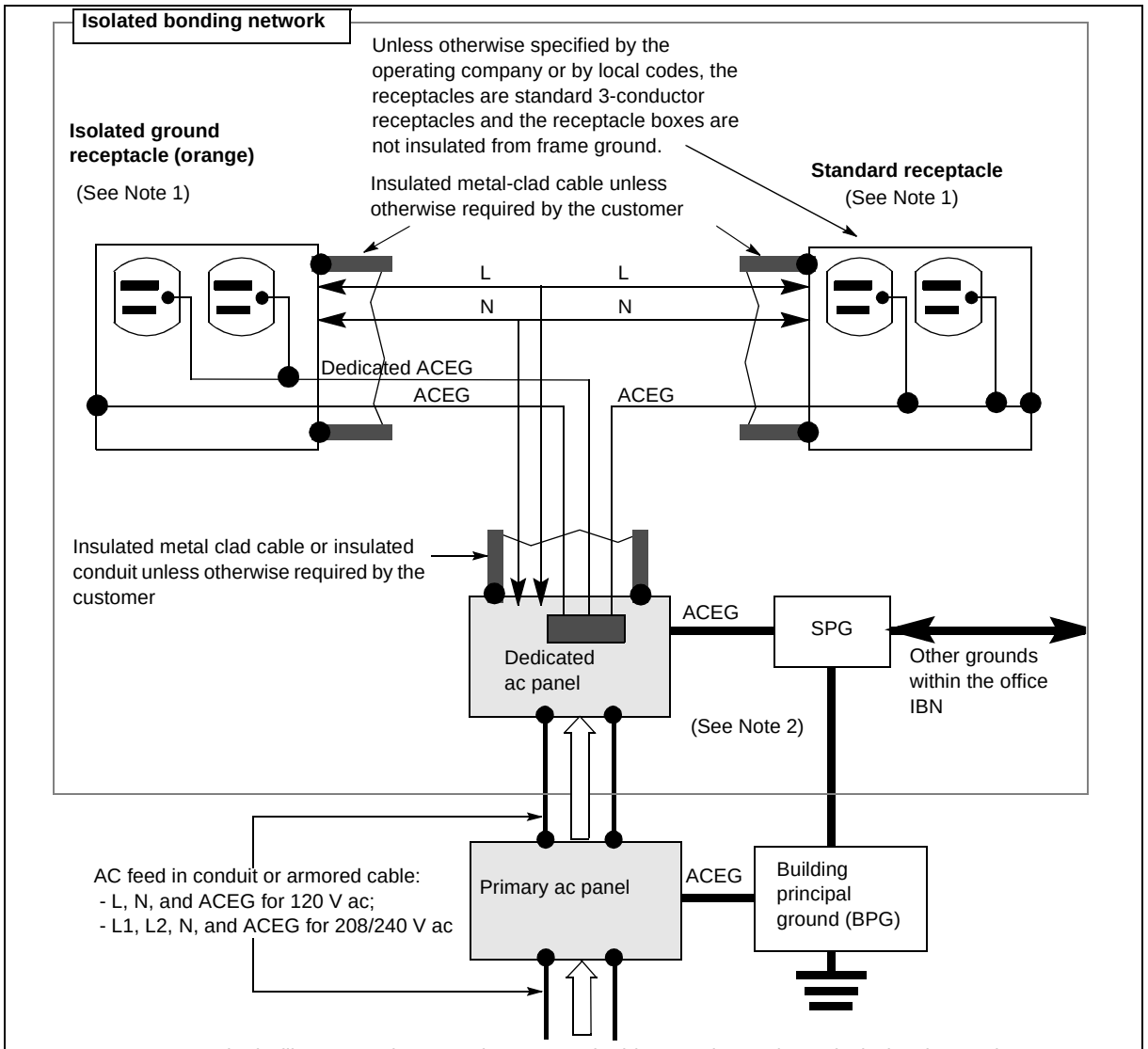
Note 1: For standard utility receptacles, 3 conductors are wired (L, N, and ACEG). For the isolated-ground receptacles, (orange) 4 conductors are wired to include a dedicated ACEG lead.

Note 2: In compact installations, such as customer-located equipment, the building principal ground (BPG) reference serves the same functions as the FGB, and a secondary ac panel is not used.

Receptacles in an IBN

In an IBN, Nortel Networks recommends that you bond the utility receptacles that are mounted on the bays to the SPG. For an illustration of the grounding scheme for ac receptacles in an IBN, see Figure 4-4. Also, you should bond receptacles that are mounted on the walls of the installation room within 2 m (7 ft) of the bays to the SPG. If they are not bonded to the SPG, the receptacles must be further than 2 m (7 ft) from the bays.

Figure 4-4
Power (ac) distribution and utility receptacle ground wiring scheme for an IBN environment



Note 1: For standard utility receptacles, 3 conductors are wired (L, N, and ACEG). For the isolated-ground receptacles (orange) 4 conductors are wired to include a dedicated ACEG lead.

Note 2: In compact installations, such as customer-located equipment, the building principal ground (BPG) reference serves the same functions as the SPG, and the ac primary panel is also the dedicated panel within the isolated bonding network (IBN).

Grounding schemes

With the use of line interface cards and external copper access lines, large transient currents caused by certain events, such as lightning storms, and ac or dc power line faults, can be expected to flow through the shared system grounds. The resulting disturbances can affect AccessNode and any other interconnected systems. Therefore, it is important that the shared grounding scheme, involving battery leads, ac grounding, logic ground, and frame ground, be installed correctly.

> ***Note 1:*** On all external lines, first-order protection is required, as provided by gas discharge tube or carbon block protection.
>
> ***Note 2:*** Installation according to the NT Corporate Standard 4122.00, "Grounding of Communication Systems," is mandatory.

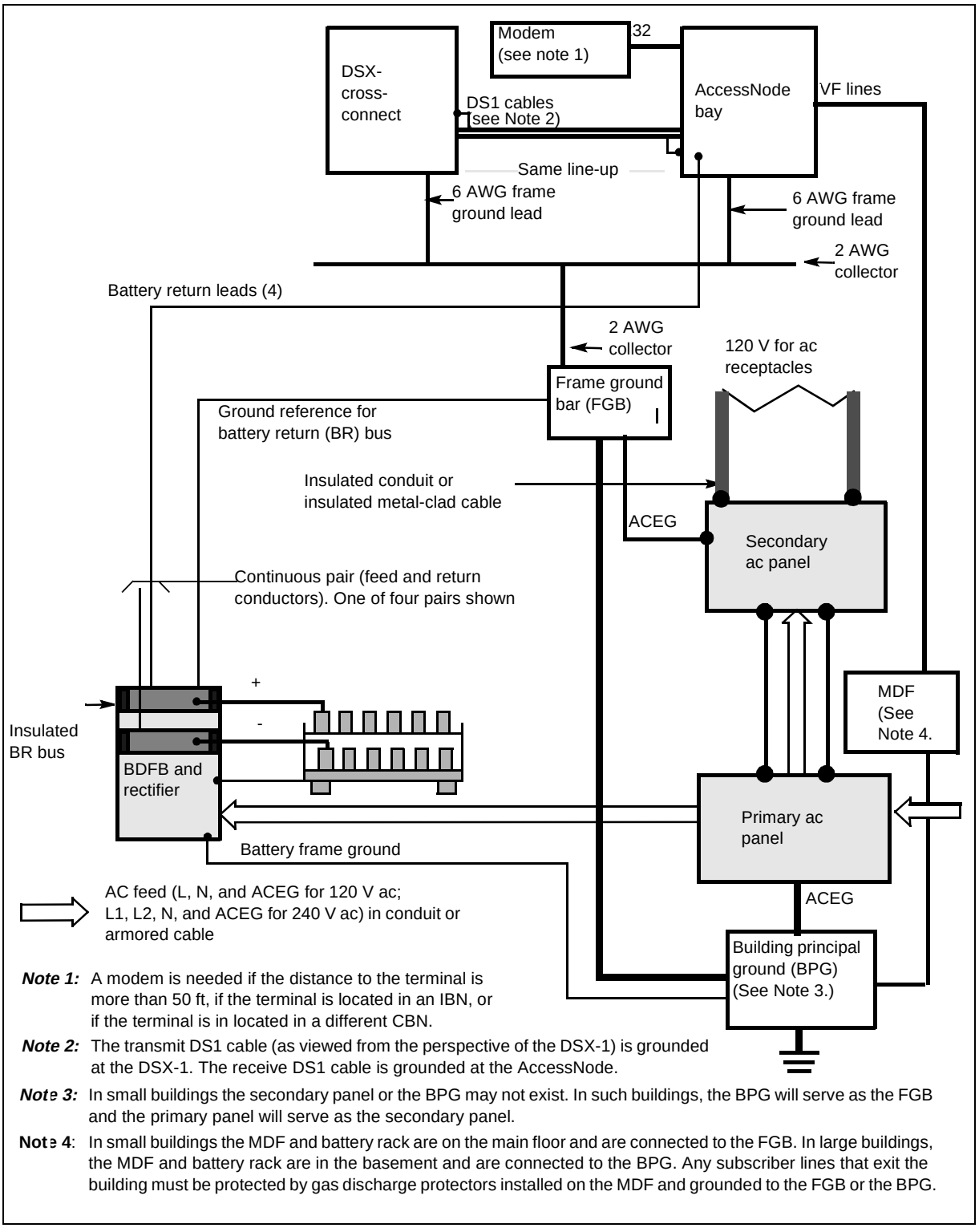
AccessNode equipment can be installed in a common bonding network (CBN) or in an isolated bonding (IBN) network. A CBN is the most common grounding network used with transmission equipment.

When the system is to be installed at a site with existing equipment, use the grounding scheme that suits the existing grounding network at the site; that is, use a CBN scheme in an existing CBN and an IBN scheme in an existing IBN. When the system is being installed by itself at a new site, a CBN is preferred because cables containing ground will interface with another transmission system, which is usually in a CBN.

See the following illustrations for schematics of AccessNode equipment in CBN and IBN grounding environments:

Type of network	Location	See
CBN	central office	Figure 4-5 on page 4-10
	remote site	Figure 4-6 on page 4-11
IBN	central office	Figure 4-7 on page 4-12
	remote site	Figure 4-8 on page 4-13

Figure 4-5
The use of common bonding networks in central office locations



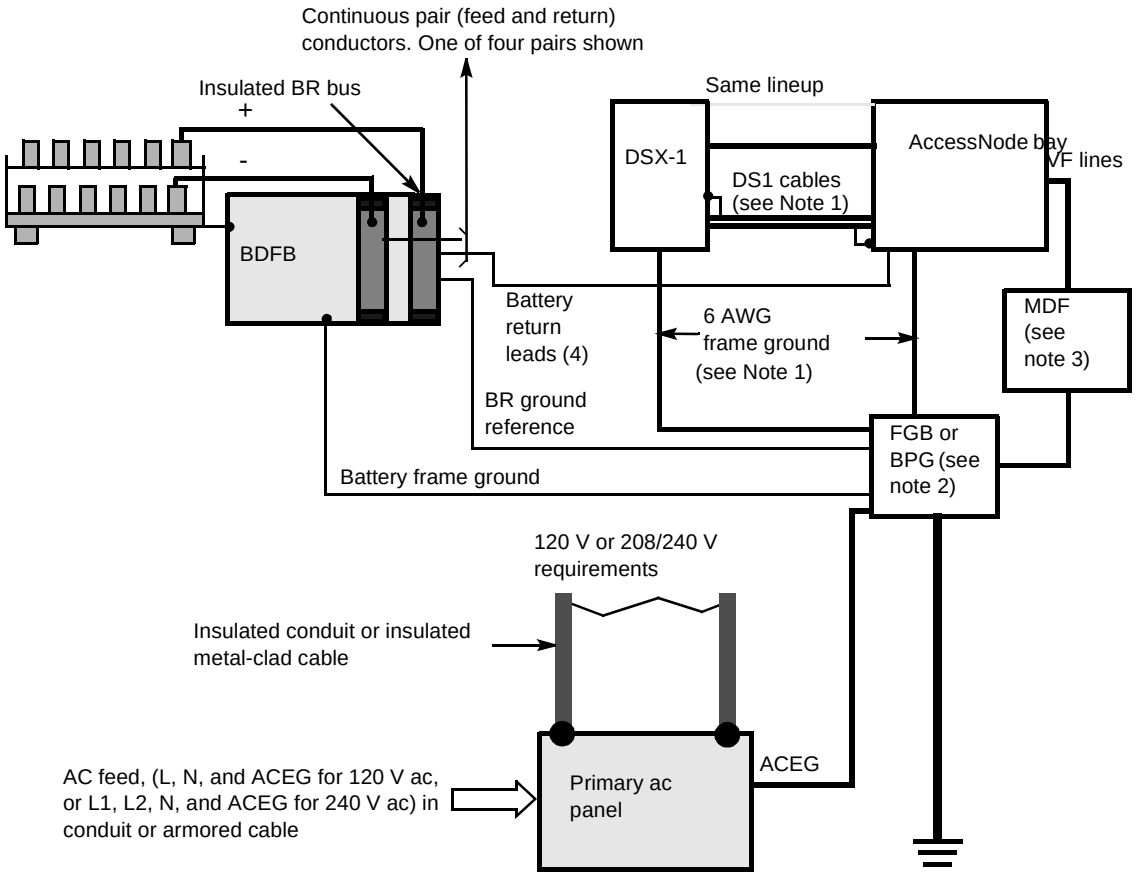
Note 1: A modem is needed if the distance to the terminal is more than 50 ft, if the terminal is located in an IBN, or if the terminal is in located in a different CBN.

Note 2: The transmit DS1 cable (as viewed from the perspective of the DSX-1) is grounded at the DSX-1. The receive DS1 cable is grounded at the AccessNode.

Note 3: In small buildings the secondary panel or the BPG may not exist. In such buildings, the BPG will serve as the FGB and the primary panel will serve as the secondary panel.

Note 4: In small buildings the MDF and battery rack are on the main floor and are connected to the FGB. In large buildings, the MDF and battery rack are in the basement and are connected to the BPG. Any subscriber lines that exit the building must be protected by gas discharge protectors installed on the MDF and grounded to the FGB or the BPG.

Figure 4-6
The use of common bonding networks in remote locations

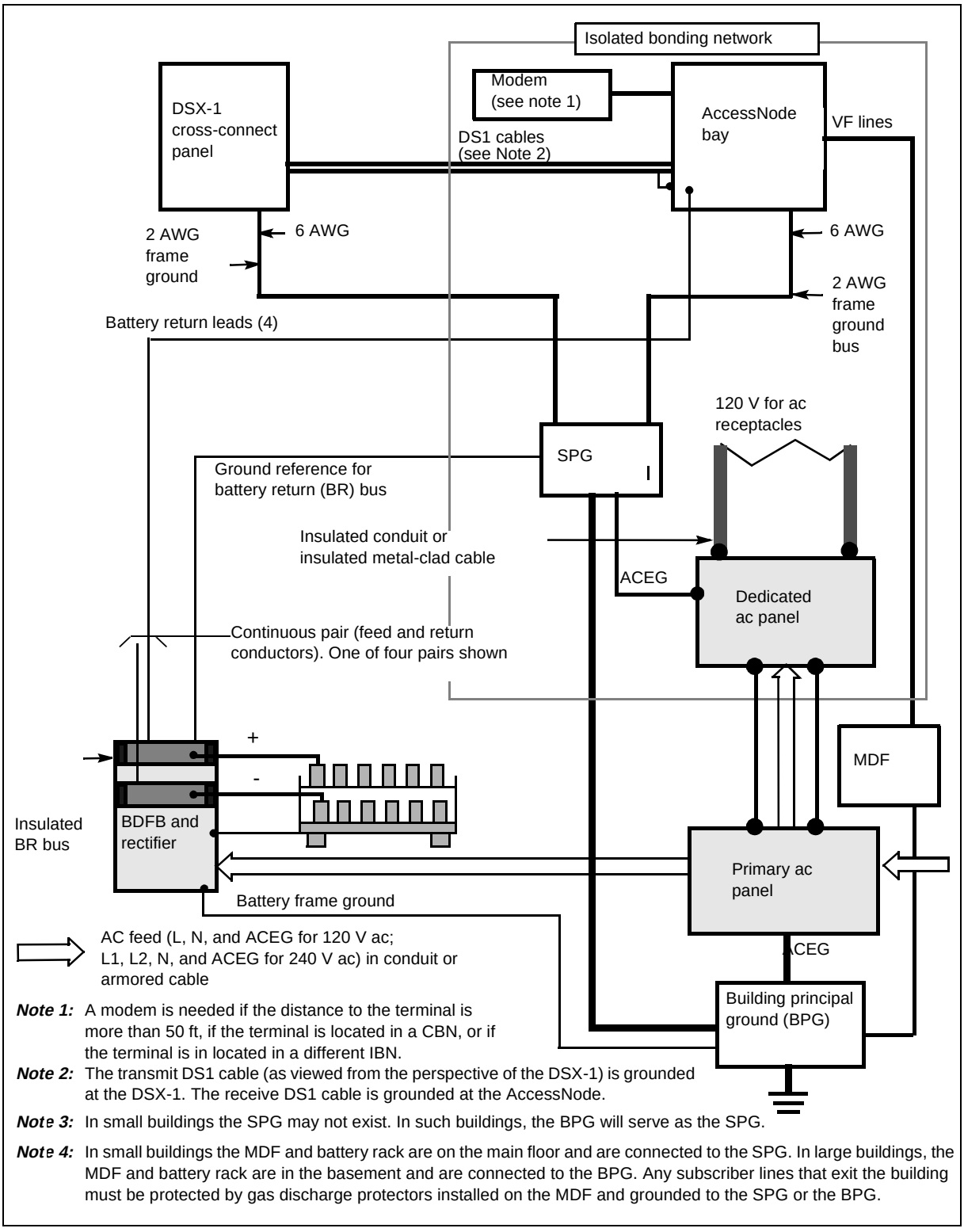


Note 1: The transmit DS1 cable (as viewed from the perspective of the DSX-1) is grounded at the DSX-1. The receive DS1 cable is grounded at the AccessNode.

Note 2: In small buildings, the floor ground bar (FGB) does not exist. Instead, the building principle ground (BPG) serves the same function.

Note 3: In small installations, an interconnect panel can serve the same purpose as the main distribution frame (MDF). Any subscriber lines that exit the building must be protected by gas discharge protectors installed on the MDF and grounded to the FGB or the BPG.

Figure 4-7
The use of isolated bonding networks in central office locations



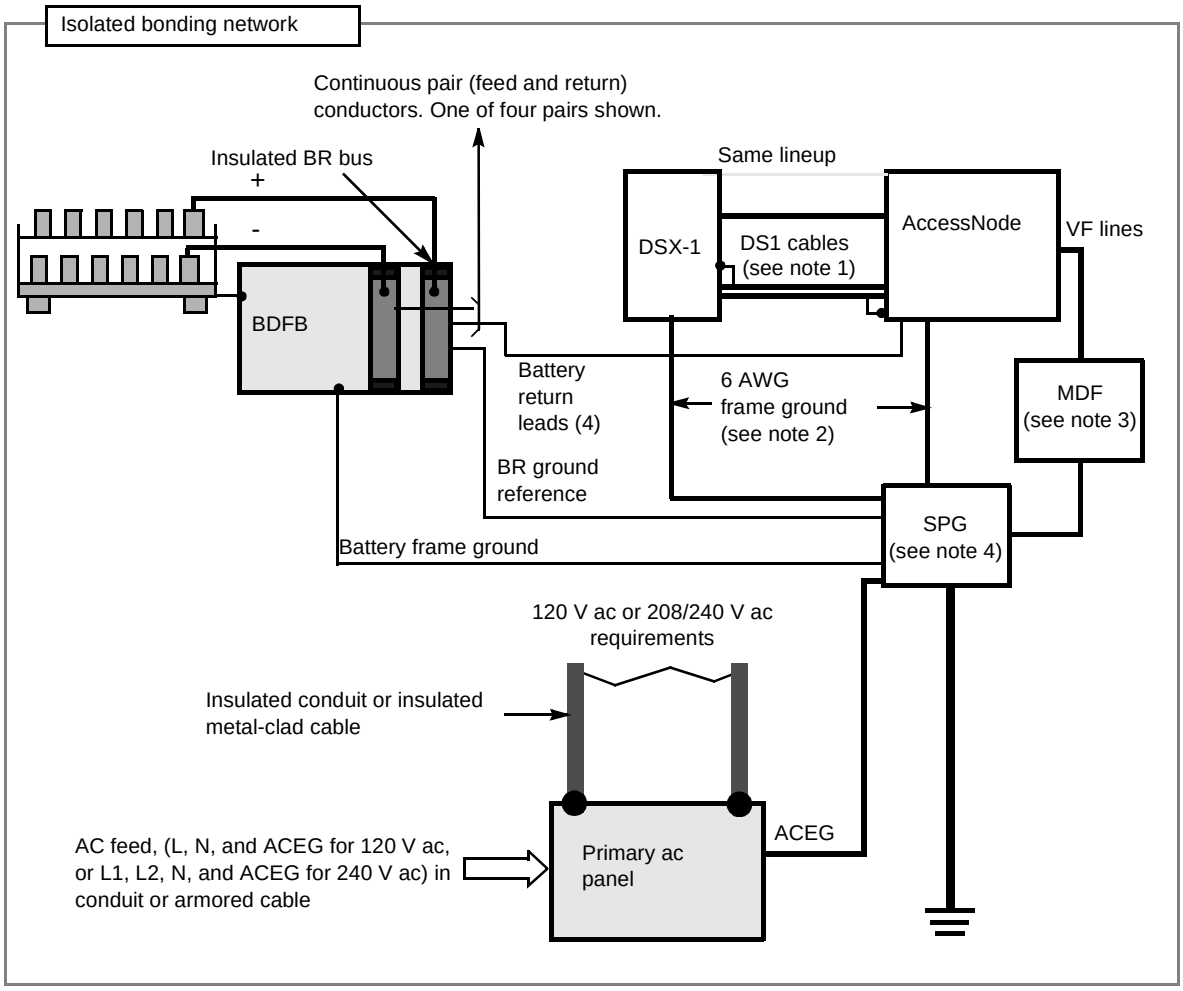
Note 1: A modem is needed if the distance to the terminal is more than 50 ft, if the terminal is located in a CBN, or if the terminal is in located in a different IBN.

Note 2: The transmit DS1 cable (as viewed from the perspective of the DSX-1) is grounded at the DSX-1. The receive DS1 cable is grounded at the AccessNode.

Note 3: In small buildings the SPG may not exist. In such buildings, the BPG will serve as the SPG.

Note 4: In small buildings the MDF and battery rack are on the main floor and are connected to the SPG. In large buildings, the MDF and battery rack are in the basement and are connected to the BPG. Any subscriber lines that exit the building must be protected by gas discharge protectors installed on the MDF and grounded to the SPG or the BPG.

Figure 4-8
The use of isolated bonding networks in remote locations



Note 1: The transmit DS1 cable (as viewed from the perspective of the DSX-1) is grounded at the DSX-1. The receive DS1 cable is grounded at the AccessNode.

Note 2: When all the equipment bays (including battery distribution) are in the same lineup, as in most remote locations, or where the SPG is more than 16 meters (53 ft) away, the individual frame grounds of up to six frames can be connected to a single 2 AWG conductor ground bus, which is routed to the SPG.

Note 3: In small installations, an interconnect panel can serve the same purpose as the main distribution frame (MDF). Any subscriber lines that exit the building must be protected by gas discharge protectors installed on the MDF and grounded to the SPG or the BPG.

Note 4: In small buildings, the building principal ground (BPG) serves the same function as the single-point ground (SPG).

dc conductors

The battery and return cables, which are red for battery and black or white for return must be the same gauge, and grouped together for a continuous pair connection between the –48 V dc source and the AccessNode equipment. In the BDFB, the "return" conductors connect to an insulated battery-return (BR) bus.

Utility ac receptacles

For standard utility receptacles (brown, ivory or gray), 3 conductors are wired (L, N, and ACEG). For isolated ground receptacles (orange), 4 conductors are wired to include a dedicated ACEG lead. The ACEG leads and the metal conduit or insulated metal-clad cable must be wired as shown in Figure 4-3 on page 4-7 for a CBN and in Figure 4-4 on page 4-8 for an IBN.

The receptacles must connect to the office grounding scheme according to the one of the following figures:

Table 4-1
Grounding network locations

Type of grounding network	Location	See
CBN	central office	Figure 4-5 on page 4-10
	remote site	Figure 4-6 on page 4-11
IBN	central office	Figure 4-7 on page 4-12
	remote site	Figure 4-8 on page 4-13

Logic ground

The logic ground for an ABM shelf is referenced to the frame ground.It uses frame ground to interface with external systems and cable shielding. CDS line card logic and analog circuit grounds are referenced to talk battery return. The talk battery return provides the required interface with the tip and ring voltages of the line cards.

The following equipment isolates frame ground and power feeds (battery and battery return):

- DC-DC converters
- isolation transformers
- optical devices

The isolation prevents high current paths and return paths through the frame ground.

Frame ground

Each frame ground connects to the FGB in a CBN as shown in Figure 4-5 on page 4-10 or Figure 4-6 on page 4-11, or to the SPG in an IBN as shown in Figure 4-7 on page 4-12 or Figure 4-8 on page 4-13. The cable used to perform this connection has a minimum gauge of 6 AWG.

If the FGB or SPG is more than 16 m (53 ft) away, or if a lineup of bays is to be connected to a frame common bus, a 2 AWG conductor must be used to connect to the FGB or SPG.

The general requirements for frame grounding are as follows:

- Bay frameworks are installed with isolation pads placed between the base of the frame and the floor, regardless of floor mounting method.
- The conductor size and insulation rating must accommodate the maximum expected dc or ac fault current, or transient current.
- The resistance of the frame ground conductor must be less than 20 milliohms.
- No dc current more than 10 mA for each frame is diverted to frame ground, except for transient fault currents when a fuse blows.

Miscellaneous frame grounds

In the IBN scheme, the ground requirements for RS-232 and DS1 cable connections must be treated differently than for the CBN, as follows:

- RS-232C cables must be connected through an external modem for ground isolation. In CBN, the RS-232 can be connected directly.
- DS1 cables are grounded at the transmit-end of the cable only.

Grounding and battery isolation

AccessNode equipment can be installed in office configurations that comply with the following IBN standards:

- Nortel Networks CS 4122 (Corporate Grounding Standard)
- Bellcore GR-1089-CORE

IBN configurations

IBN configurations completely separate the –48 V battery and battery return (BR) from frame ground and logic ground. IBN configurations achieve the separation by the following methods:

- isolating framework from unintentional contact with ground
- isolating communication links to other equipment and systems

In addition, the dc power system is configured so that the following conditions are met:

- The BR has only one point of ground reference.
- The point of ground reference is no more than one floor away from the equipment and systems that it powers.

CBN configurations

In CBN configurations, the BR may contact the frame ground at several points in the network, allowing battery return current to flow over frame ground conductors. Separation between battery returns and equipment grounds is not well controlled.

In all cases follow operating company guidelines and Nortel Networks NTPs to maintain the integrity of isolation.

Internal grounding and battery isolation

Although local power supplies for AccessNode equipment are referenced to frame ground, minimal or no current flows into frame ground. For all loads except supply monitoring circuits, AccessNode uses converter transformers and optical coupling devices to isolate the incoming power (–48 V and BR) from the converter outputs or frame ground. You may observe minimal current flow (less than 3 ma) for supply monitor circuits. These circuits check for power and ground connections in the system.

In the common equipment shelves for both access bandwidth manger (ABM) and transport bandwidth manager (TBM) shelves, the –48 V and BR inputs feed dc isolated point-of-use power supply (PUPS) modules. PUPS generates local power for each circuit pack. Copper distribution shelves (CDS) receive power from a copper distribution shelf power converter (CDSP), which is an isolated converter.

Note 1: DS2 and other coaxial cable shielding terminate on the common system/shelf ground.

Note 2: RS-232C grounding pins connect to the common system/shelf ground.

Cable racks for IBN

All cable racks associated with equipment within the IBN must be bonded to the equipment framework, as follows:

- This bonding must not create conductive paths between isolated groups of equipment.
- Bridges between two isolated lineups must be bonded to the framework of one lineup and isolated from the other.
- These cable racks must be isolated from any other grounding connections.

Other cable racks that are not part of the equipment in the IBN system must be separated by a distance of at least 2 m (6 ft), otherwise they must be bonded to the SPG.

Cabling requirements for ABM bays

This chapter describes the cabling requirements for access bandwidth manager (ABM) bays used in the AccessNode system.

Chapter contents

This chapter contains the following information:

Intershelf cable connections for ABM bays

Figure 5-1 and Figure 5-2 show the intershelf cables used in AccessNode systems equipped with ABM shelves. These cables are installed at the factory.

Figure 5-1
Intershelf cables for ABM bays (multiplexer configuration)

PC-16518

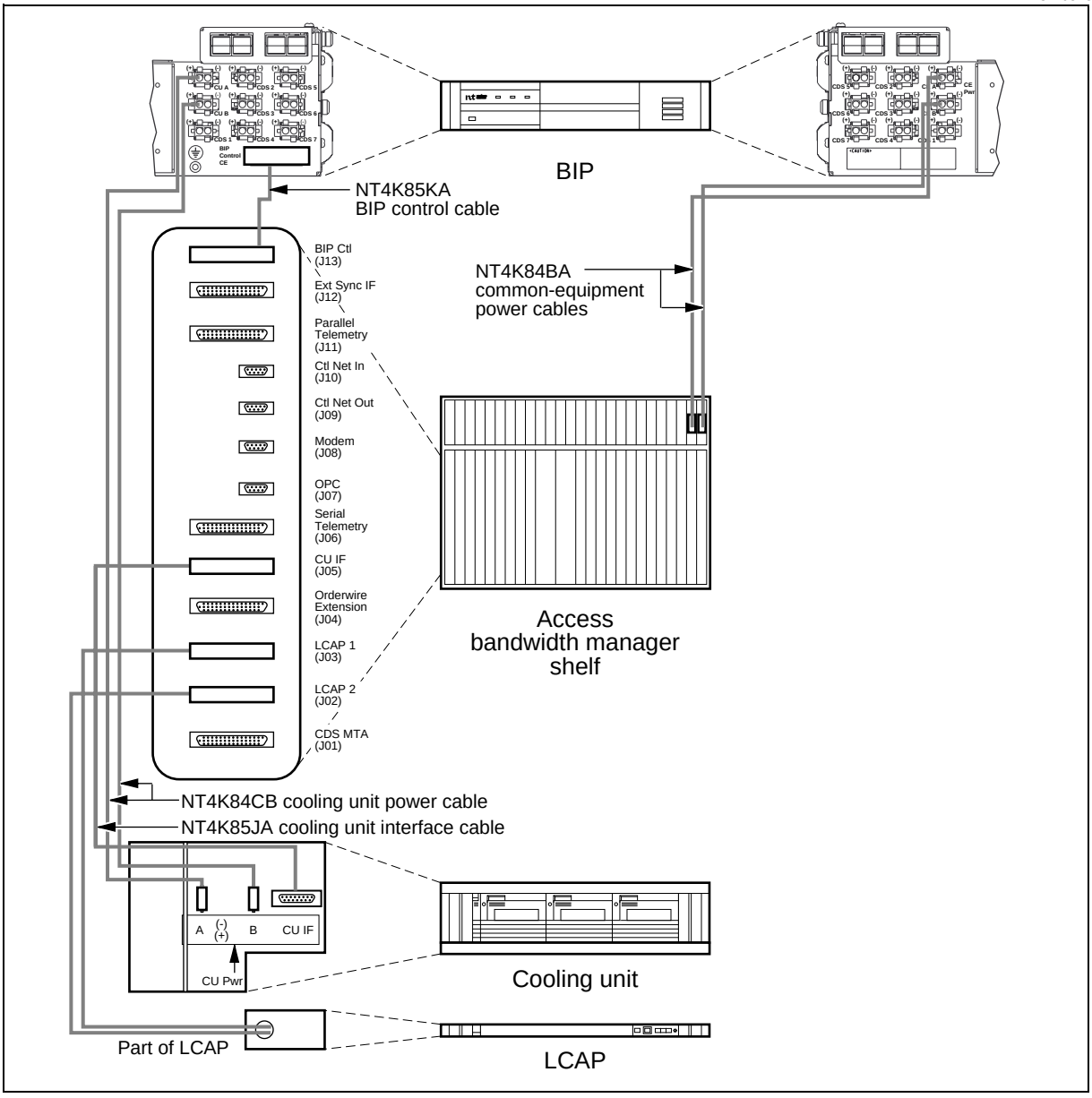
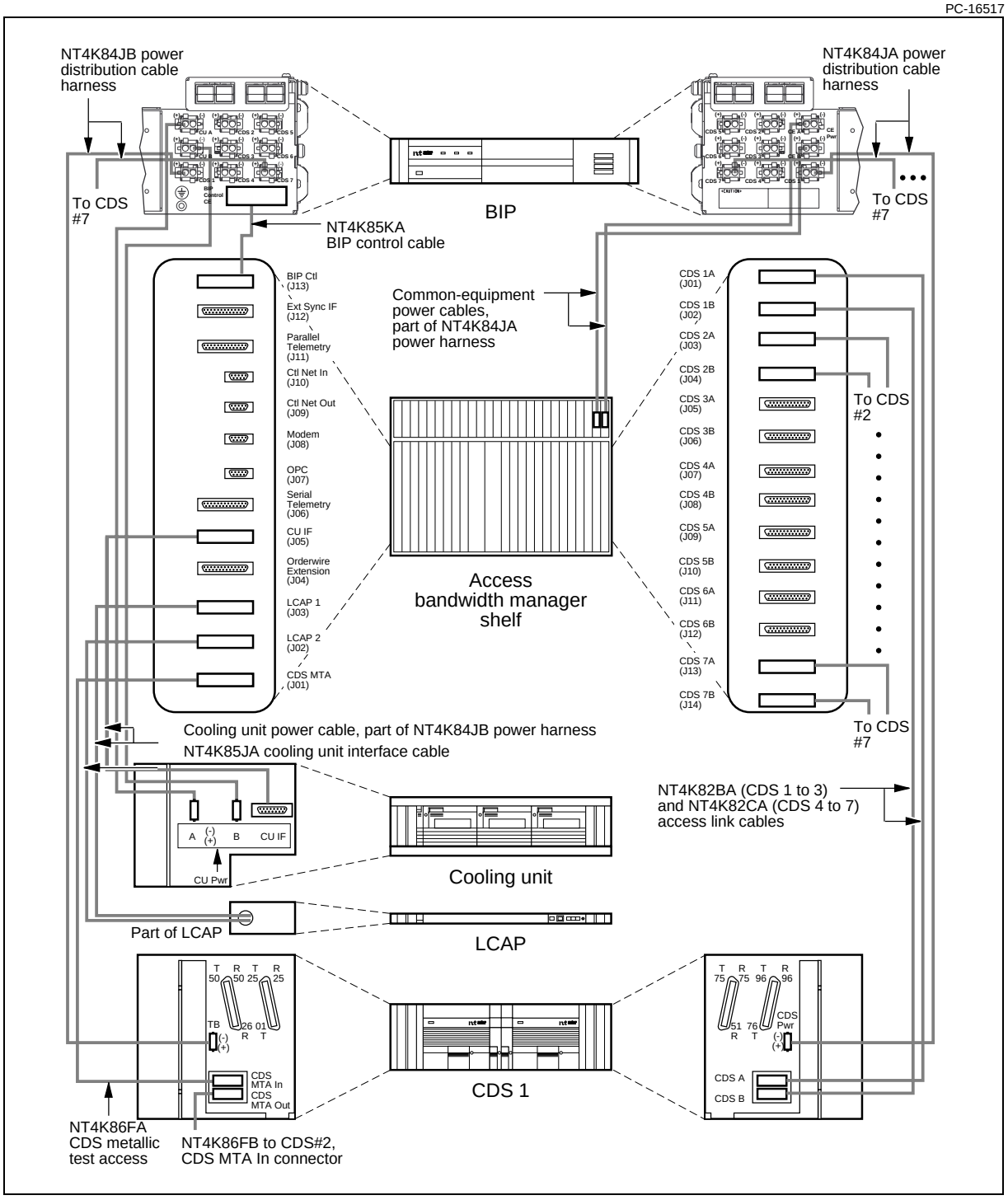


Figure 5-2
Intershelf cables for ABM bays and copper-distribution shelves

PC-16517



External cable connections for ABM bays

Figure 5-3 and Figure 5-4 show the external cables used in these systems. The external cables are connected to the system at the installation site.

Figure 5-3
External cables for ABM bays (multiplexer configuration)

PC-16515

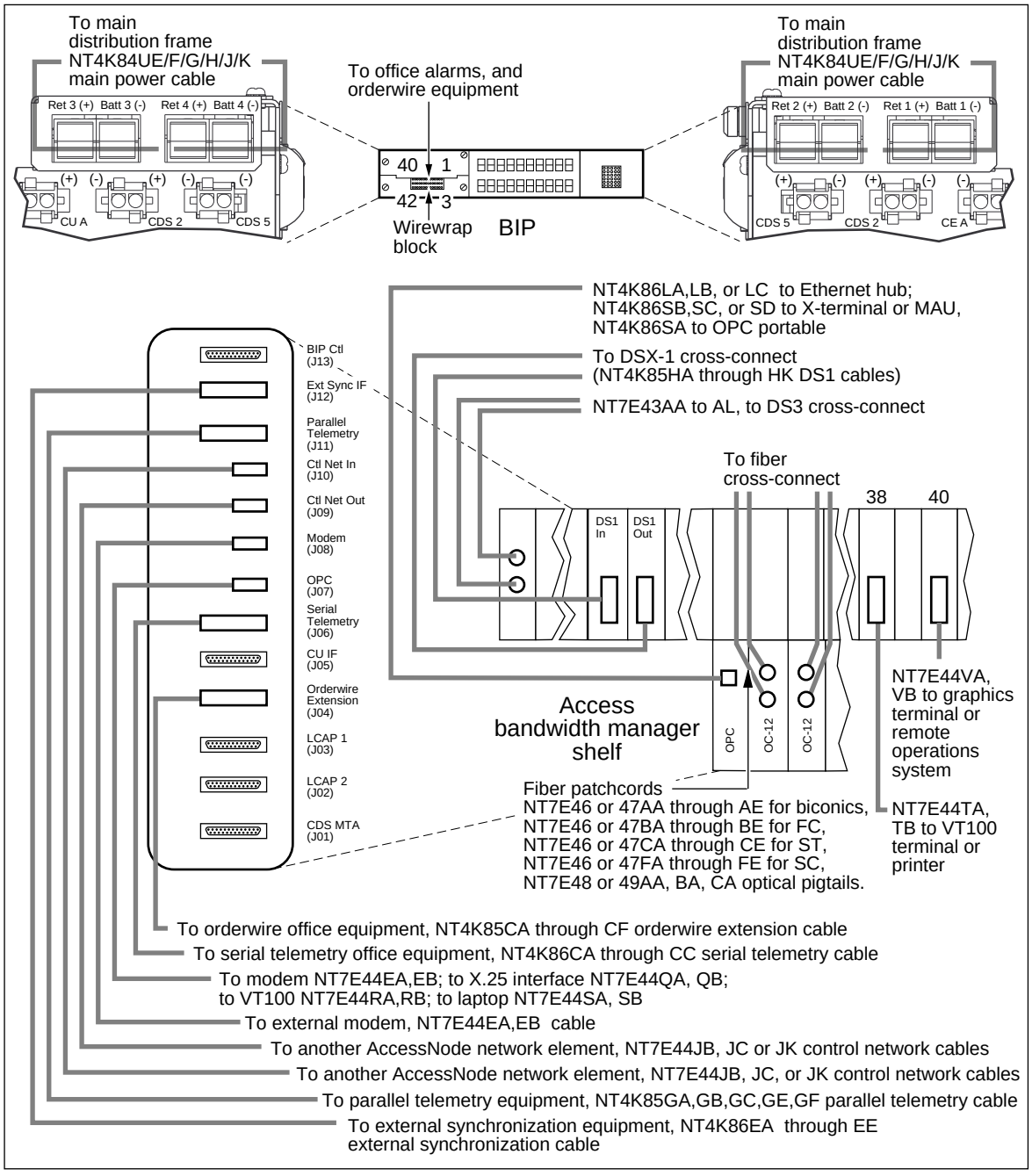
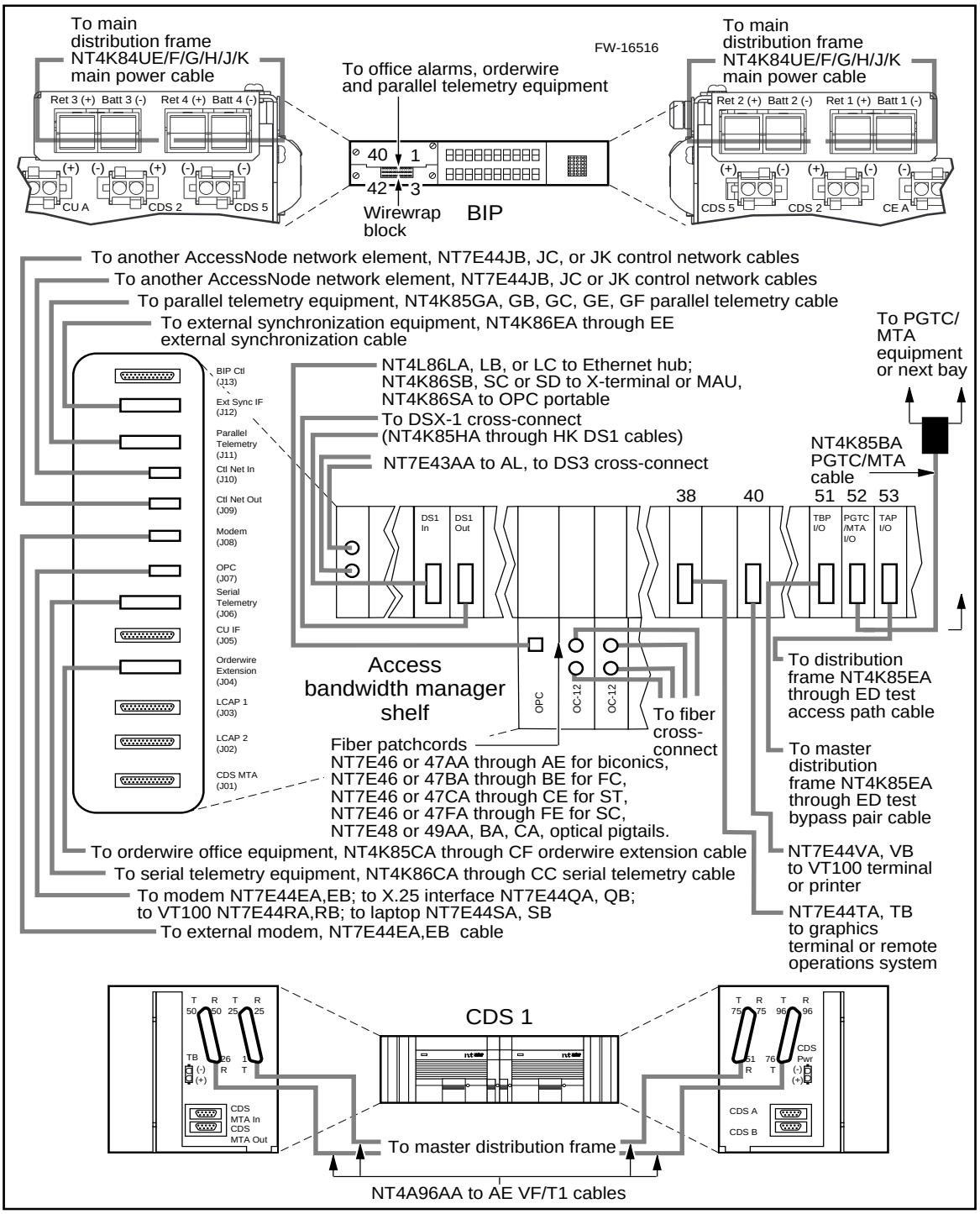


Figure 5-4
External cables for ABM bays and copper-distribution shelves



Restrictions for DMS Access in a DS1-fed system

There are several distance restrictions for DFAs or AccessNode Express host digital terminals (HDTs) that are connected to a DMS-10NA switch using DMS-X communications protocol.

Table 5-1 shows the distance restrictions.

Table 5-1
Distance restrictions for DMS Access

The maximum distance between the	Is
DFA or AccessNode Express host digital terminal (HDT) and the DMS-10NA switch	150 miles, which is determined by the DMS-X communications protocol
HDT and the voice modules	164 miles
AccessNode line card and the customer premise equipment (CPE)	dependent upon the grade of wire that is run to the customer site. For example, AccessNode line cards support a maximum resistance of 1900 ohms, including both the loop resistance and the phone set resistance. For 24 gauge wire that has a resistance of approximately 52 ohms per 1,000 feet, the maximum distance between the line card and the CPE is approximately 28,000 feet.

Restrictions for DMS-X Interface to APC-100 in a DS1-fed system

There are several distance restrictions for DFAs or AccessNode Express host digital terminals (HDTs) that are connected to an APC-100 switch using DMS-X communications protocol.

Table 5-2 shows the distance restrictions.

Table 5-2
Distance restrictions for DMS Access

The maximum distance between the	Is
DFA or AccessNode Express host digital terminal (HDT) and the APC-100 switch	150 miles, which is determined by the DMS-X communications protocol
HDT and the voice modules	164 miles
AccessNode line card and the customer premise equipment (CPE)	dependent upon the grade of wire that is run to the customer site. For example, AccessNode line cards support a maximum resistance of 1900 ohms, including both the loop resistance and the phone set resistance. For 24 gauge wire that has a resistance of approximately 52 ohms per 1,000 feet, the maximum distance between the line card and the CPE is approximately 28,000 feet.

Wire-wrap connections to the BIP for ABM shelves

The wire-wrap connections from the wire-wrap block in the BIP provide a parallel connection for some of the external cable connections made to the access bandwidth manager (ABM) shelf, as follows:

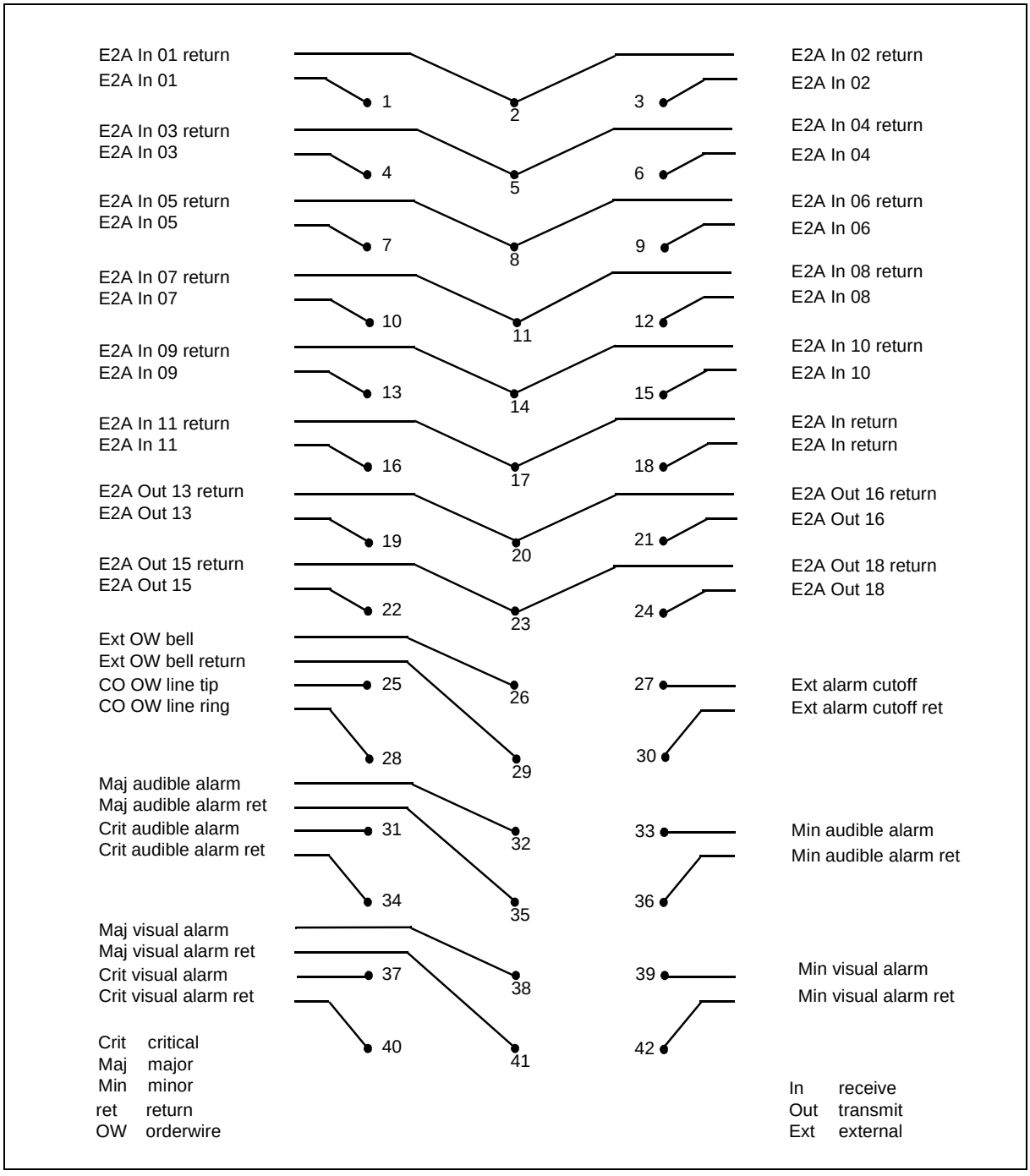
- equipment alarms
- a subset of E2A parallel telemetry inputs 01 to 11
- a subset of E2A parallel telemetry outputs 15 to 18
- external control of the ACO function
- central office orderwire line
- extension of the orderwire bell

Connections are wired to the wire-wrap block using a wire-wrap cable (twisted pairs, 22-, 24-, or 26 AWG solid wire) with 42 conductors. This cable is supplied by the customer.

Wire-wrap pin out detail

The wire-wrap block pins are configured in three rows of 14 pins each. The pin-out detail is shown in the Figure 5-5.

Figure 5-5
Wire-wrap pin-out details



Note: Wire-wrap pin field is rotated 90° clockwise on the NT4K14BA BIP.

Power cable requirements

Cable requirements for commercial ac power and –48 V dc power are as follows.

Commercial power cabling

The commercial ac power source terminates in an ac distribution panel (supplied by the customer). This power source and the panel must conform to the national and local electrical codes, and the recommended office ground scheme described in Chapter 4, "Power and ground distribution." The location of the distribution panel, relative to the AccessNode equipment, determines the length of conduit and wiring required to feed rectifier and battery power plants, and any ac utility receptacles, if required.

Recommended sizes of ac entrance and distribution feed cables must conform with information described in national electrical codes, as follows:

- For USA: Table 250-94 in National Electrical Code (NEC)
- For Canada: Table 17 in Canadian Electrical Code (CEC)

The subsequent ac power panel wiring must be completed by a qualified electrician.

Cabling of ac receptacles in bays

Receptacles can be equipped in the front base of a bay, if required as a customer-selected option. It is recommended that standard electrical receptacles in boxes bolted to the bays be used, unless otherwise required by the customer. Insulated metal-clad cable, supplied by the customer, is preferred for cabling ac receptacles, as follows:

- Insulated metal-clad cable, 12 AWG, 3-conductor cable for standard receptacles (brown, gray or ivory)
- Insulated metal-clad cable, 12 AWG, 4-conductor for isolated-ground receptacles (orange)

When installing ac receptacles in the base of the bay framework, the insulated metal-clad cable must be routed on the left side of the framework. The length of cable must reach the base of the bay with sufficient slack to allow placement of the cable in the most recessed part of the bay framework channel, to minimize crowding of other signal cables placed in the same bay.

When a single ac feed is used to feed more than one bay in a lineup, the ac cable is routed to the left side of the first bay, terminated in the receptacle box, and the cable extended up the right side of the first bay and down the left of the next adjacent bay to be terminated in its receptacle box.

If local codes allow, and if the customer prefers, the ac cable can be extended from the right side of the receptacle box, through the base horizontally and terminated in the receptacle box of each adjacent bay.

–48 V dc battery cabling

For bay equipment, –48 V dc is cabled from an external power plant which is supplied by the customer. The external power plant must supply –48 V dc from a 30 A rated BDFB fuses (for NT4K14AB BIP), to supply each AccessNode bay as follows:

Note: For NT4K14BA BIP the maximum BDFB fuse size should not exceed 40 Amps.

In bays equipped with access bandwidth manager (ABM) shelves, four battery and return pairs are required, for connection to BIP connectors 1, 2, 3, and 4, as shown in Figure 5-6.

Note: The NT4K14BA BIP may operate from two feeds only (one feed on each side of the BIP).

Cables for bays with ABM shelves

For bays equipped with ABM shelves, Nortel Networks supplies these cables for providing power to the breaker interface panel:

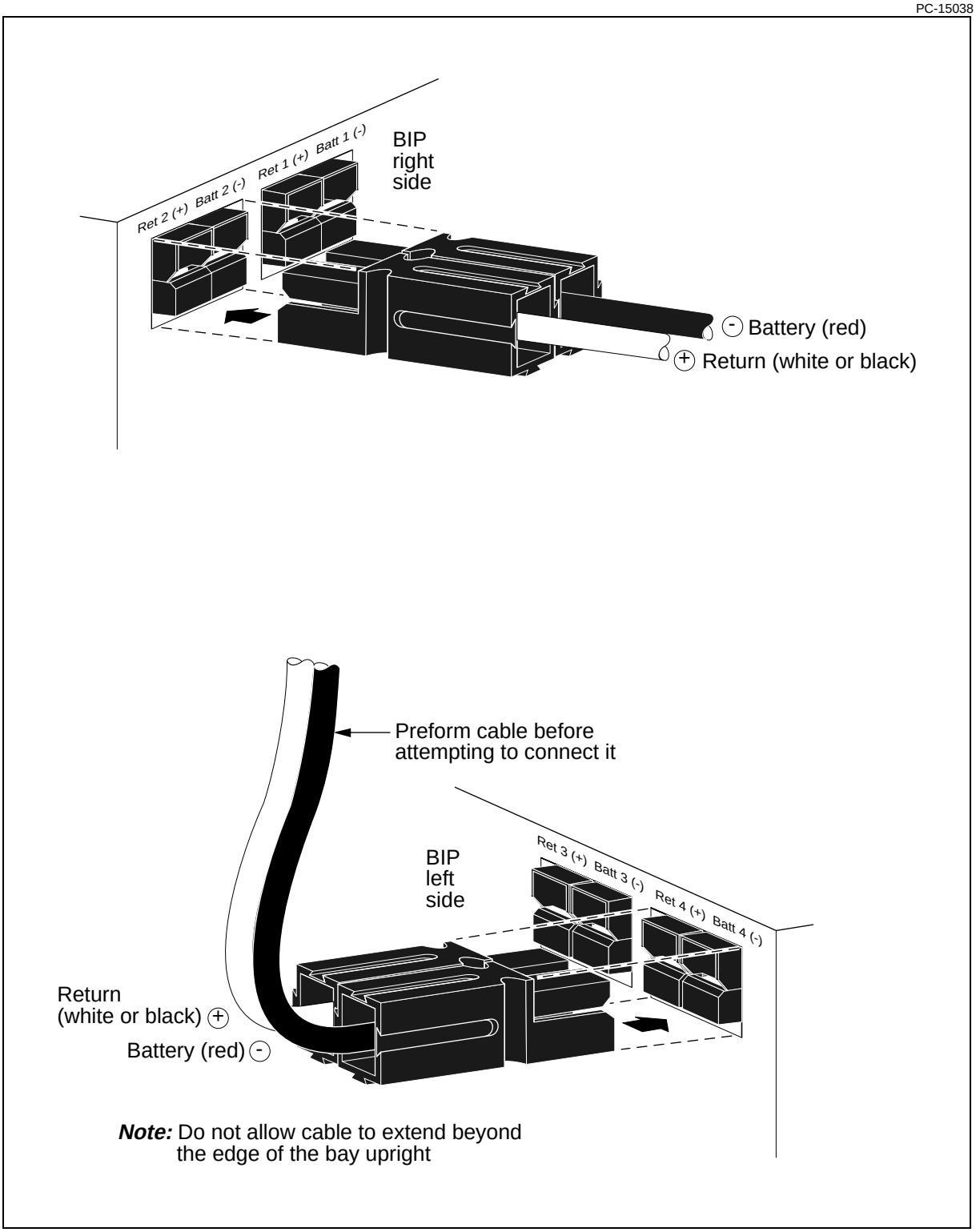
PEC Code	Cable length	Conductor colors
NT4K84UE	10.7 m (35 ft)	red-white
NT4K84UF	4.5 m (15 ft)	red-white
NT4K84UG	10.7 m (35 ft)	red-black
NT4K84UH	4.5 m (15 ft)	red-black
Note: Optional red-white cables NT4K84UJ (15.25m (50 ft.) and NT4K84UK (30.5m (100 ft.) are available.		

All these cables are 6 AWG CSA/UL listed cable. Customers choose the cable to use based on the length needed and the conductor color preference. Cables longer than 10.7 m (35 ft) are the responsibility of the customer.

The NT4K84U* cables consist of one 6 AWG red conductor for –48 V dc battery, and one 6 AWG white or black conductor for return. Four cables are required to connect power from the BDFB to the BIP. The conductors are preconnectorized at one end only, for connection to the matching BIP connectors. See Figure 5-6.

Figure 5-6
BIP battery feeder connections for bays equipped with ABM shelves

PC-15038



Grounding requirements for external signal cables

All signal-carrying cables are subject to the grounding requirements described in Chapter 4, “Power and ground distribution,” and to the following rules:

- Equipment frames that require significant interconnecting cables must be clustered together in the same lineup, or at least within the same area.
- Cables must be routed in grounded cable troughs.
- RS-232 connections must be connected through an external modem for ground isolation under any of the following conditions:
  - — the terminal is more than 12.6 m (50 ft) from the bay
  - — the terminal is located in a different grounding network or in a grounding network of a different type
- VF cables that exit the building in which the AccessNode is installed must be protected by a gas discharge protectors at the main distribution frame. The protectors must be referenced to single point building ground (SPG) in integrated bonding network (IBN) grounding networks or to the floor ground bar (FGB) in common bonding network (CBN) grounding networks. In small buildings, the SPG or FGB may not exist, in which case the building principle ground (BPG) is to be used for this purpose.
- Shielded cables such as the ESI cable must be connected to equipment bonded to the same ground point as the TBM shelf or the ABM shelf.
- Interconnections between clusters of equipment frames, or frames not within the same bonding network must be:
  - — routed through the grounded ducts if in a CBN or between two CBNs
  - — routed through the SPG if entering or exiting an IBN, so that cable shields or other ground leads may be referenced to the SPG. This requires the use of a transmission ground reference device as defined in Nortel Networks Corporate Standard 4122.00

Grounding external signal cables in an IBN

Interconnection between clusters of equipment frames, or frames not within the same lineup or the same IBN, must be routed through the SPG for decoupling.

Types of external signal cables for ABM bays

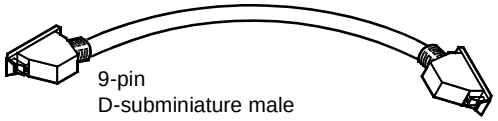
The following pages describe the external cables used on bays equipped with access bandwidth manager (ABM) shelves.

Control network cable

The control network permits communication between the major processing cards in access bandwidth manager (ABM) shelves located at the same site. This type of communication provides the ability to link operations, administration and maintenance (OAM and P) functions between multiple AccessNode ABM shelves. Control network cables are used to daisy-chain the control network bus between ABM shelves. Table 5-3 lists the cable's pinouts.

Note: The control network cables can only be connected between ABM shelves that are bonded to the same ground point.

NT7E44JB, JC, JK



2-pair, twisted, 24 AWG stranded wires with shielding, connectorized at both ends in the following lengths:

1 m	(3.2 ft)	NT7E44JB
5 m	(16.4 ft)	NT7E44JC
10 m	(32.0 ft)	NT7E44JK

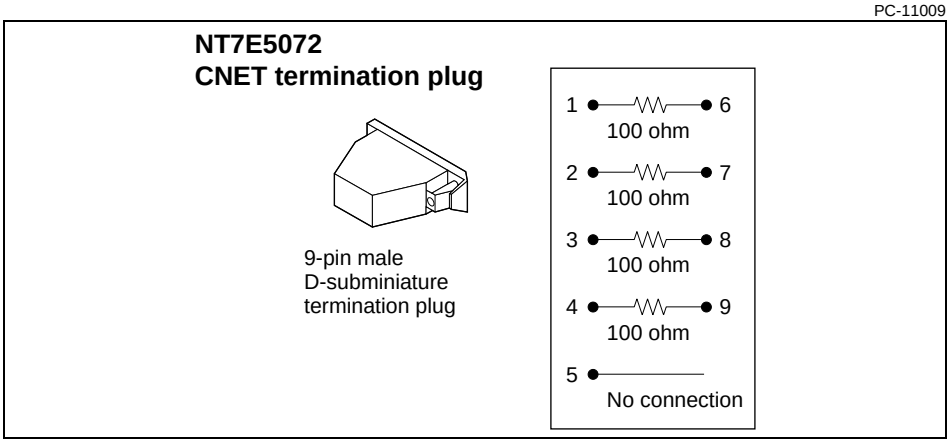
Table 5-3
Pinouts for NT7E44JB, JC, and JK cables

Pins on MTA In connector	Signal	Pins on MTA Out connector	Signal
1	no connection	1	no connection
2	no connection	2	no connection
3	XCN2N	3	XCN2N
4	XCN1N	4	XCN1N
5	no connection	5	no connection
6	no connection	6	no connection
7	no connection	7	no connection
8	XCN2P	8	XCN2P
9	XCN1P	9	XCN1P

Control network termination plug

A termination plug is required at both ends of the control network daisy chain bus. When either of the two control network connectors on the access bandwidth manager (ABM) shelf are not cabled, a termination plug must be attached to the ABM shelf connector.

PC-11009

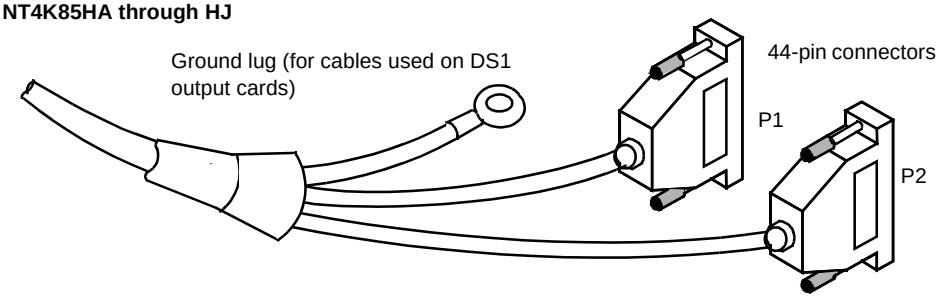


DS1 signal cable - DS1 I/O

The DS1 cable connects the 1.544 Mb/s signals of two DS1 Input or two DS1 Output cards on the access bandwidth manager (ABM) shelf to the office DSX-1 cross-connect.

PC-10002

NT4K85HA through HJ



NT-613 30 pair, twisted 22 AWG solid wires with overall shielding. One end is split (15 pairs each) and connected to two 44-pin connectors (terminating 14 pairs each). For cables used on DS1 output connectors, a ground lug wire provides connection of the outer shield to the ABM shelf frame ground. The ground lug wire is not used for DS1 input connectors. The DS1 cable is available in the following lengths:

15 m (50 ft)	NT4K85HH
30 m (100 ft)	NT4K85HA
46 m (150 ft)	NT4K85HB
61 m (200 ft)	NT4K85HJ
76 m (250 ft)	NT4K85HC
107 m (350 ft)	NT4K85HD
137 m (450 ft)	NT4K85HE
168 m (550 ft)	NT4K85HF
198 m (650 ft)	NT4K85HG

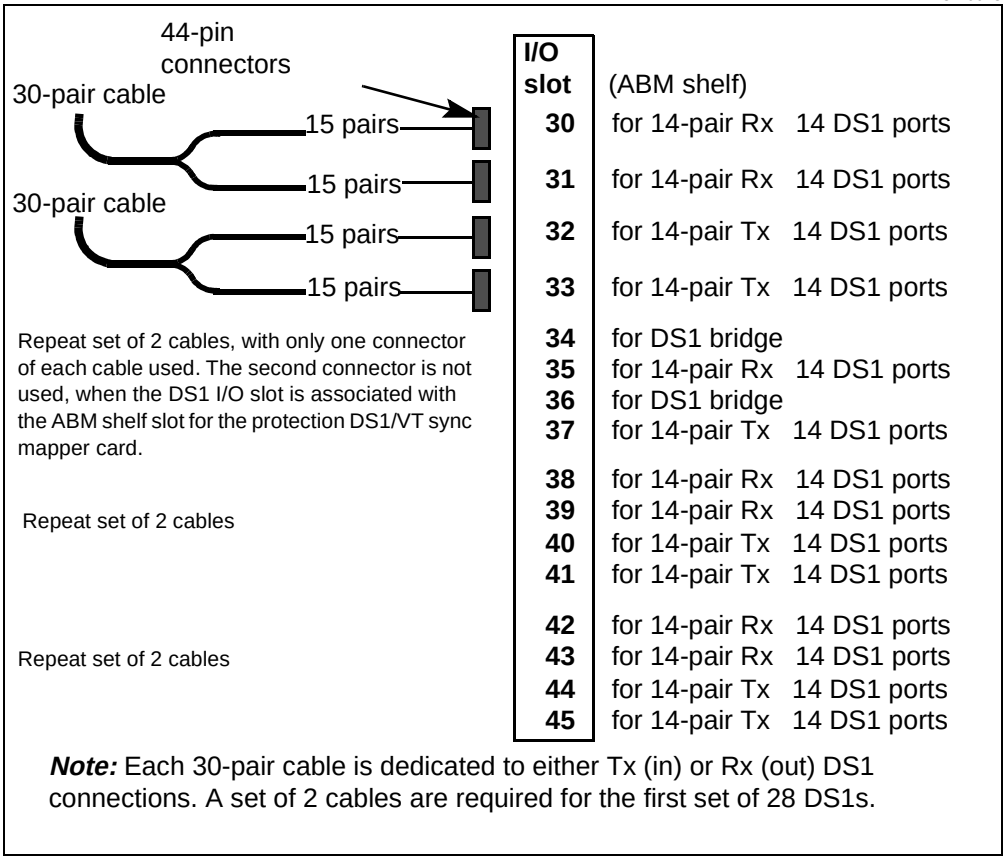
Each split-end cable is dedicated to either two DS1 input cards (14 DS1s each), or two DS1 output cards (14 DS1s each). A set of 2, 4, 6, 8, or 10 cables can be used for connection with 4, 8, 12, 14, 16, or 18 I/O cards, for a maximum of 126 DS1 lines. This number of lines is only possible when an OPC module is not installed in the ABM shelf. When the OPC module is installed, the ABM shelf supports a maximum of 42 DS1s.

> ***Note:*** For information on planning your DS1/DS3 mapper layout, see *Commissioning and Testing*, Volume 3.

Figure 5-7 shows the connection of DS1s to the I/O area of the ABM shelf.

Figure 5-7
DS1 connections to the I/O area of the ABM shelf

PC-10013



Note: Each 30-pair cable is dedicated to either Tx (in) or Rx (out) DS1 connections. A set of 2 cables are required for the first set of 28 DS1s.

To minimize cable congestion, DS1 cables that are connected to the I/O cards in slots 40 to 42 of the I/O area of the ABM shelf, are routed down the left side of the bay. Cables to the DS1 cards in slots 43 and up are routed down the right side.

On cables that connect to DS1 input cards, the ground lug at the I/O shelf end of the cable is not used. The unused ground lug is cut off, and the cut end is folded back on itself and protected against shorting with heat-shrinkable tubing. The ground lug at the DSX-1 panel end of the cable is connected to a ground point on the DSX-1 panel. See Table 5-4 and Table 5-5.

On cables that connect to DS1 output cards, the opposite is true. The ground lug at the DSX-1 panel is not used. The unused ground lug is cut off, and the cut end is folded back on itself and protected against shorting with heat-shrinkable tubing. The ground lug at the I/O shelf end of the cable is connected to a ground point on the ABM shelf.

The length of NT-613 cable to the DSX-1 cross-connect must not exceed 200 m (655 ft.).

Table 5-4
Pin-outs for connector P1 of DS1 cables

Connector P1						
Connector pin		**Pair or**	**Color of pair**			
Ring	**Tip**	**DS1 No.**	**Ring**		**Tip**	
31	16	1	BL	1W	W	1 BL
32	17	2	O	1W	W	1O
33	18	3	G	1W	W	1G
34	19	4	BR	1W	W	1BR
35	20	5	S	1W	W	1S
36	21	6	BL	1R	R	1BL
37	22	7	O	1R	R	1O
38	23	8	G	1R	R	1G
39	24	9	BR	1R	R	1BR
40	25	10	S	1R	R	1S
41	26	11	BL	1BK	BK	1BL
42	27	12	O	1BK	BK	1O
43	28	13	G	1BK	BK	1G
44	29	14	BR	1BK	BK	1BR
-	30	-				

Note 1: Pins 1 to 15 and pin 30 of connector P1 are not connected, and pairs 29 and 30 are not used.

Note 2: The tip lead is the positive (+) and the ring lead is negative (-).

Table 5-5
Pin-outs for connector P2 of DS1 cables

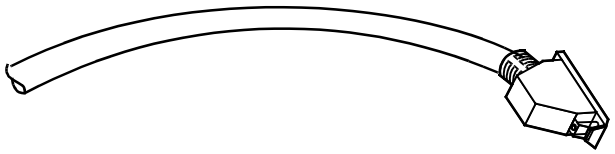
Connector P2						
Connector pin		**Pair or**	**Color of pair**			
Ring	**Tip**	**DS1 No.**	**Ring**		**Tip**	
31	16	15	S	1BK	BK	1 S
32	17	16	BL	1Y	Y	1BL
33	18	17	O	1Y	Y	1O
34	19	18	G	1Y	Y	1G
35	20	19	BR	1Y	Y	1BR
36	21	20	S	1Y	Y	1S
37	22	21	BL	1V	V	1BL
38	23	22	O	1V	V	1O
39	24	23	G	1V	V	1G
40	25	24	BR	1V	V	1BR
41	26	25	S	1V	V	1S
The following pairs are contained within a blue binder						
42	27	26	BL	1W	W	1BL
43	28	27	O	1W	W	1O
44	29	28	G	1W	W	1G
-	30	-				
Note 1: Pins 1 to 15 and pin 30 of connector P2 are not connected, and pairs 29 and 30 are not used. ***Note 2***: The tip lead is the positive (+) and the ring lead is negative (-).						

External synchronization cable (optional)

External synchronization interface card (ESI) is required in the FCOT in a point-to-point fiber-fed system that serves a GR-303 application, a TR08 application, or digital data services. Systems at remote sites are synchronized to the network and do not require external synchronization. Typically, in a VTBM ring, the ESI card is required in one or two nodes located at the FCOT. Other nodes are synchronized using line timing. The cable connects clock signals from an external synchronization interface, such as the building integrated timing supply (BITS) or a DS1 interface, to the external synchronization connector on the left side of the ABM shelf.

Note: The ESI cable can only be connected between equipment that is bonded to the same ground point.

NT4K86EA through EE



25-pin
D-subminiature male

6-pair, twisted, 22 AWG solid wires with shielding, connectorized at one end only for connection to the ABM shelf, in the following lengths:

15 m	(50 ft)	NT4K86EB
30 m	(100 ft)	NT4K86EA
61 m	(200 ft)	NT4K86EC

Table 5-6 lists the pin-outs for the NT4K86EA through EE cables.

Table 5-6
Pin-outs for NT4K86EA through EE cables

Pin	Signal	Color
1	Primary reference input (Tip)	W 1BL
2		not used
3	Secondary reference input (Tip)	W 1O
4		not used
5	DS1 output (Tip), top ESI	W 1G
6		not used
7	DS1 output (Tip), bottom ESI	W 1BR
8		not used
9		not used
10		not used
11		not used
12		not used
13		not used
14	Primary reference input (Ring)	BL 1W

—continued—

Table 5-6 (continued)
Pin-outs for NT4K86EA through EE cables

Pin	Signal	Color
15		not used
16	Secondary reference input (Ring)	O 1W
17		not used
18	DS1 output (Ring), top ESI	G 1W
19		not used
20	DS1 output (Ring), bottom ESI	BR 1W
21		not used
22		not used
23		not used
24		not used
25		not used
	—end—	

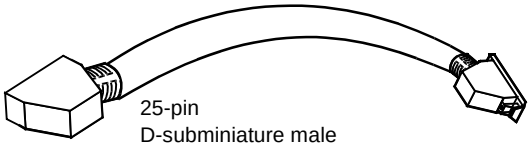
Modem cable

The modem cable provides access for a remote data terminal equipment (DTE), such as a modem, a VT-100-type terminal, or a printer. To maintain ground isolation, the cable must be connected to an external modem (standard 25-pin connector), located within the grounding network. The data terminal equipment (DTE) connection shares the same port as the hand-held terminal (HHT) connection that is accessible on the front of the local craft access panel (LCAP). Only one device can be active at any particular time.

If you are connecting directly to the DTE without going through a modem (for example, connecting to a printer or VT100-type terminal), you must install an NT7E44MA null modem adaptor between the NT7E44EA, EB cable and the DTE.

> ***Note:*** When the DTE is being connected to the ABM shelf without using a modem, the DTE must be bonded to the same ground point as the ABM shelf.

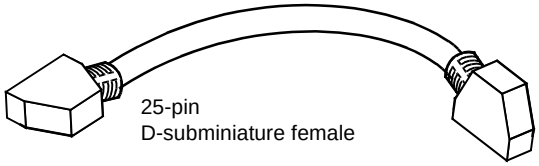
NT7E44EA or EB



4-pair, twisted, 26 AWG solid wires with shielding, connectorized at both ends. One end connects to the 9-pin connector on the ABM shelf and the other end is for connection to a 25-pin connector of a remote modem. This cable is available in the following lengths:

5 m	(15 ft)	NT7E44EA
20 m	(66 ft)	NT7E44EB

NT7E44MA null modem adaptor



4-pair, 26 AWG solid wire connectorized at both ends. One end connects to the male connector on the NT7E44 cable and the other end connects directly to the terminal or printer.

Table 5-7 lists the pin-outs for the NT7E44EA and EB cables.

Table 5-7
Pin-outs for the NT7E44EA and EB cables

25-pin connectors		9-pin connectors
Pin	**Signal**	**Pin**
1	not used	
2	Tx	3
3	Rx	2
4	RTS	7
5	CTS	8
6	DSR	6
7	signal ground	5
8	DCD	1
9 to 19	not used	

—continued—

Table 5-7 (continued)
Pin-outs for the NT7E44EA and EB cables

25-pin connectors		9-pin connectors
Pin	**Signal**	**Pin**
20	DTR	4
21 to 25	not used	
Note: Pin 9 is not used on the 9-pin connector.		

Table 5-8 lists the pin-outs for the NT7E44MA null modem adapter.

Table 5-8
Pin-outs for the NT7E44MA null modem adaptor

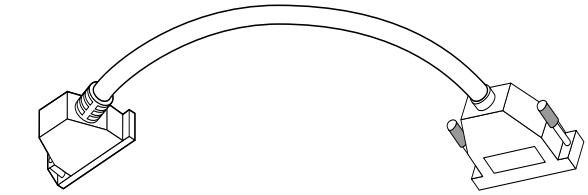
25-pin connectors	25-pin connectors
Pin	**Pin**
1	1
2	3
3	2
4	5
5	4
6	20
8	20
20	6
20	8
Note: Pins 9 to 19 and 21 to 25 are connected in a one-to-one pattern. That is, pin 9 connects to pin 9, pin 10 connects to pin 10, and so on.	

OPC cables that connect to the I/O area of the ABM shelf

The following table lists the OPC cables that connect to I/O cards in the I/O area of the ABM shelf.

Product engineering code	Port	Slot in I/O area	Use
NT7E44TA, TB	2	38	EIA 530 synchronous interface for a graphics terminal or a remote operations system
NT7E44VA, VB	3	40	Asynchronous RS232 interface for a VT100 terminal or a printer.

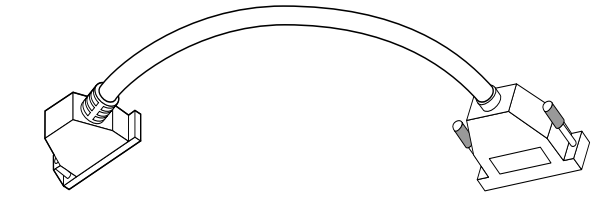
NT7E44TA or TB



25-conductor, twisted, 24 AWG stranded wires with shielding, connectorized at both ends. One end connects to the 25-pin connector on the I/O card in slot 38,and the other end connects to a 25-pin connector of an EIA-530 interface on a graphics terminal or on a remote operations system. This cable is available in the following lengths:

5 m (16 ft) NT7E44TA
20 m (66 ft) NT7E44TB

NT7E44VA or VB



10-conductor, twisted, 24 AWG stranded wires with shielding, connectorized at both ends. One end connects to the 25-pin connector on the I/O card in slot 40, and the other end connects to a 25-pin connector of a VT-100 terminal or a printer. This cable is available in the following lengths:

5 m (16 ft) NT7E44VA
20 m (66 ft) NT7E44VB

Table 5-9 lists the pin-outs for the NT7E44TA and TB cables. Table 5-10 lists the pin-outs for the NT7E44VA and VB cables.

Table 5-9
Pin-outs for the NT7E44TA and TB cables

25-pin male connector at the terminal or the remote operations system		25-pin male connector at slot 38 of the I/O area
Pin	**Signal**	**Pin**
1	shield	1
2	Tx	2
3	Rx	3
4	RTS	4
5	CTS	5
6	DSR	6
7	signal ground	7
8	DCD	8
9	RxClk-	9
10	CD-	10
11	not used	not used
12	TxClk-	12
13	CTS-	13
14	Tx-	14
15	TxClk	15
16	Rx-	16
17	RxClk	17
18	LL	18
19	RTS-	19
20	DTR	20
21	RL	21
22	DSR-	22
23	DTR-	23
24	not used	not used
25	not used	not used

Table 5-10
Pin-outs for the NT7E44VA and VB cables

25-pin male connector at the terminal or the remote operations system		25-pin male connector at slot 38 of the I/O area
Pin	**Signal**	**Pin**
1	shield	1
2	Tx	3
3	Rx	2
4	RTS	8
5	CTS	20
6	DSR	20
7	signal ground	7
8	CD	4
9	RxClk-	not used
10	CD-	not used
11	not used	not used
12	TxClk-	not used
13	CTS-	not used
14	Tx-	not used
15	TxClk	not used
16	Rx-	not used
17	RxClk	not used
18	LL	not used
19	RTS-	not used
20	DTR	5 and 6
21	RL	not used
22	DSR-	not used
23	DTR-	not used
24	not used	not used
25	not used	not used

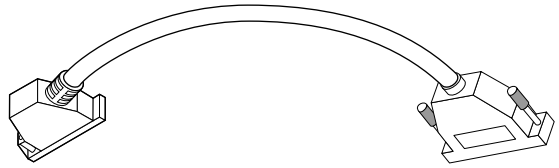
OPC cables that connect to the SIL

The following table lists the OPC cables that connect to the OPC connector (J07) on the side interconnect left (SIL) panel of an access bandwidth manager (ABM) shelf, and the purpose for which these cables are used.

Note: OPC cables can only be connected to equipment that is bonded to the same ground point as the ABM shelf.

PEC	Use
NT7E44EA, EB	Asynchronous RS232 interface for a modem to OPC, 9600 baud
NT7E44RA, RB	Asynchronous RS232 interface for VT-100 terminal or a printer
NT7E44QA, QB	X25 synchronous interface for a graphics terminal or a remote operations system
NT7E44SA, SB	Asynchronous RS232 interface for Toshiba laptop computer

NT7E44EA, EB



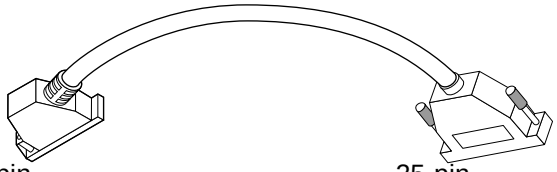
25-pin
D-subminiature male

9-pin
D-subminiature male

10-conductor, twisted, 24 AWG stranded wires with shielding, connectorized at both ends. One end connects to the 9-pin connector on the ABM shelf and the other end is for connection to a 25-pin connector of a remote modem. This cable is available in the following lengths:

5 m	(15 ft)	NT7E44EA
20 m	(66 ft)	NT7E44EB

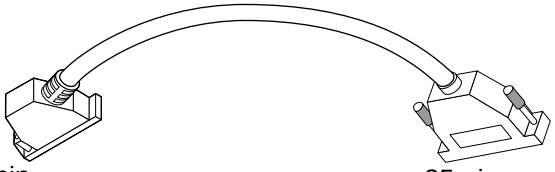
NT7E44RA, RB



10-conductor, twisted, 24 AWG stranded wires with shielding. One end connects to the 9-pin connector on the ABM shelf and the other end connects to a 25-pin connector on a VT-100 terminal or on a printer. This cable is available in the following lengths:

5 m	(16 ft)	NT7E44RA
20 m	(66 ft)	NT7E44RB

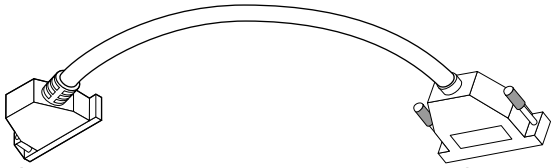
NT7E44QA, QB



10-conductor, twisted, 24 AWG stranded wires with shielding. One end connects to the 9-pin connector on the TBM shelf and the other end connects to a 25-pin connector of an EIA-530 interface on a graphics terminal or on a remote operations system. This cable is available in the following lengths:

5 m	(16 ft)	NT7E44QA
20 m	(66 ft)	NT7E44QB

NT7E44SA or SB



10-conductor, twisted, 24 AWG stranded wires with shielding. One end connects to the 9-pin connector on the TBM shelf and the other end connects to a 9-pin connector of an RS232 interface on a Toshiba laptop computer. This cable is available in the following lengths:

5 m	(16 ft)	NT7E44SA
20 m	(66 ft)	NT7E44SB

Table 5-11 lists the pin-outs for the NT7E44EA and EB cables.

Table 5-11
Pin-outs for the 25-pin connector on NT7E44EA, EB

25-pin connector		9-pin connector
Pin	**Signal**	**Pin**
1	not used	
2	Tx	3
3	Rx	2
4	RTS	7
5	CTS	8
6	DSR	6
7	signal ground	5
8	DCD	1
9 to 19	not used	
20	DTR	4
21 to 25	not used	

Table 5-12 lists the pin-outs for the NT7E44RA and RB cables.

Table 5-12
Pin-outs for the 25-pin connector on NT7E44RA, RB

9-pin connector Pin	25-pin connector Pin (Note 3)
1 (Note 1)	4
2	2
3	3
4 (Note 1)	5
4	6
5	7
6	20
7	8
8	20
9 (Note 2)	N/C

Note 1: If you are connecting a North American version of a DEC VT320 or a DEC VT420 terminal, you must short pin 1 (DCD) to pin 4 (DTR) on the 9-pin connector of this cable. If you are connecting an international version of these terminals, the cable can be used without any modification.

Note 2: Pin 9 on the 9-pin connector is not used.

Note 3: In the 25-pin connector, only the pins indicated have connections. All other pins are not connected (NC).

Table 5-13 lists the pin-outs for the NT7E44QA and QB cables.

Table 5-13
Pin-outs for the 25-pin connector on NT7E44QA, QB

9-pin connector Pin (Note 1)	25-pin connector Pin (Note 2)
1	17
2	3
3	2
4	20
5	7
6	15
7	4
8	5
9 (N/C)	N/C

Note 1: Pin 9 is not connected (N/C) on the 9-pin connector.

Note 2: In the 25-pin connector, only the pins indicated have connections. All other pins are not connected (NC).

Table 5-14 lists the pin-outs for the NT7E44SA and SB cables.

Table 5-14
Pin-outs for cables NT7E44SA, SB

9-pin connector (male) Pin	9-pin connector (female) Pin
1	4
2	3
3	2
4	1
4	6
5	5
6	4
7	8
8	7
9 (N/C)	9 (N/C)

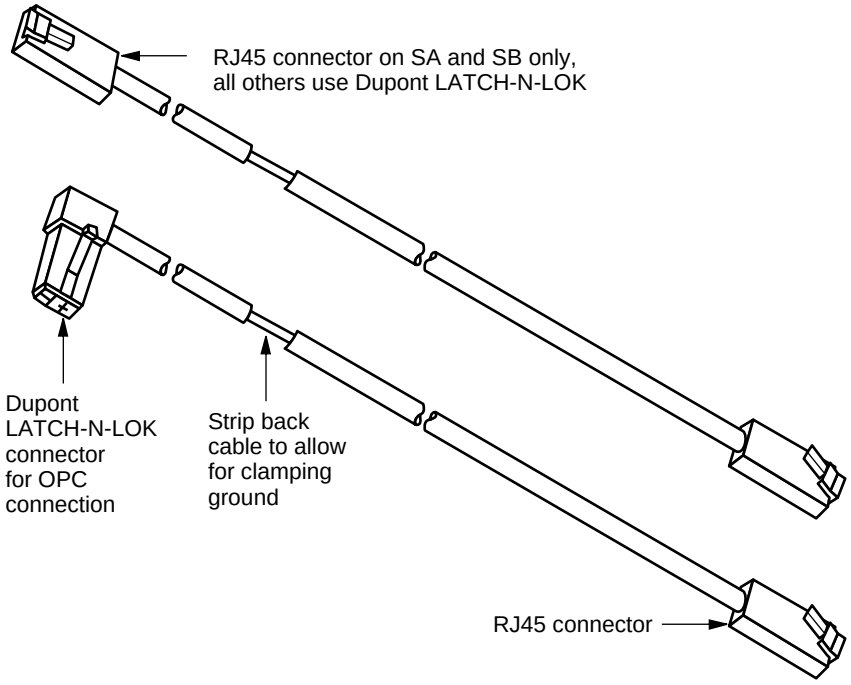
OPC Ethernet cable kit

The OPC Ethernet cable attaches to the faceplate of the OPC module and connects the OPC module to an Ethernet hub, an X-terminal, an MAU, or a portable OPC terminal.

Note: OPC Ethernet cables can only be connected to equipment that is bonded to the same ground point as the ABM shelf.

PC-10348

NT4K86LA, LB, LC and NT4K86SA, SB, SC, SD



Shielded cable, terminated at the OPC-end with a Dupont LATCH-N-LOK connector, and at the terminal-end with an RJ45 connector. The cables, their lengths and uses are as follows:

Length	PEC	Uses
20 m (60 ft)	NT4K86LA	MAU or Ethernet LAN
40 m (120 ft)	NT4K86LB	MAU or Ethernet LAN
100 m (300 ft)	NT4K86LC	MAU or Ethernet LAN
5 m (15 ft)	NT4K86SA	X-terminal or portable OPC
20 m (60 ft)	NT4K86SB	X-terminal or portable OPC
40 m (120 ft)	NT4K86SC	X-terminal
100 m (300 ft)	NT4K86SD	X-terminal

The location of the stripped area of the cable jacket shown in the previous figure depends on the location of the OPC module. To reduce manufacturing costs that would result from stocking a number of variants with different placement of the stripped area, the cable jacket is field stripped during installation. The procedure for stripping the cable jacket is contained in 323-3001-201, *Bay in Central Office Installation Manual—ABM*.

Table 5-15 lists the pin-outs for the NT7E86LA, LB, and LC cables.

Table 5-15
Pin-outs for NT4K86LA, LB, and LC cables

OPC module faceplate connector		RJ45 connector	
Signal	**Pin**	**Pin**	**Signal**
Tx +	1	1	Tx +
Tx -	2	2	Tx -
Rx -	5	6	Rx -
Rx +	6	3	Rx +

Table 5-16 lists the pin-outs for the NT7E86SA, SB, SC, and SD cables.

Table 5-16
Pin-outs for NT4K86SA, SB, SC, and SD

OPC module faceplate connector		RJ45 connector	
Signal	**Pin**	**Pin**	**Signal**
Tx +	1	3	Rx +
Tx -	2	6	Rx -
Rx -	5	2	Tx -
Rx X	6	1	Tx +

Optical patch cords

Fiber patch cords (single-mode overall jacketed cable with or without miniature variable optical attenuators [MVOA]), connect the 600 Mb/s optical signals between the access bandwidth manager (ABM) shelf and an external fiber patch panel, or cross-connect equipment such as the Fiber Manager Frame (FMF) available from Nortel Networks.

For installations in which there are short distances between the bay and the terminal, MVOAs are required at the receive end of the OC-3 or OC-12 interface units. When variable optical attenuators are required, they are stored in a miniature variable optical attenuator storage assembly located at the right side of the cooling unit. For the instructions to determine if optical attenuators are required, see *Commissioning and Testing*, Volume 3.

The bay is also equipped with a fiber storage tray assembly which can be use to store up to 5 m (15 ft) of excess fiber on up to eight patch cords.

Table 5-17 lists the optical patch cords for the ABM shelf.

Table 5-17
Optical patch cords

PEC	Length (in meters)	Connector type
NT7E46AA NT7E46AB NT7E46AC NT7E46AD NT7E46AE	5 10 15 20 30	Biconic-biconic
NT7E46BA NT7E46BB NT7E46BC NT7E46BD NT7E46BE	5 10 15 20 30	FC-FC
NT7E46CA NT7E46CB NT7E46CC NT7E46CD NT7E46CE	5 10 15 20 30	ST-ST
NT7E46FA NT7E46FB NT7E46FC NT7E46FD NT7E46FE	5 10 15 20 30	SC-SC

Table 5-18 lists the optical patch cords with MVOAs.

Table 5-18
Optical patch cords with MVOAs

PEC	Length (in meters)	Connector type
NT7E47AA NT7E47AB NT7E47AC NT7E47AD NT7E47AE	5 10 15 20 30	Biconic-biconic
NT7E47BA NT7E47BB NT7E47BC NT7E47BD NT7E47BE	5 10 15 20 30	FC-FC
NT7E47CA NT7E47CB NT7E47CC NT7E47CD NT7E47CE	5 10 15 20 30	ST-ST
NT7E47FA NT7E47FB NT7E47FC NT7E47FD NT7E47FE	5 10 15 20 30	SC-SC

Table 5-19 lists the optical pigtails for the ABM shelf.

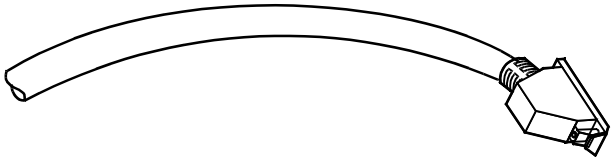
Table 5-19
Optical pigtails

PEC	Length (in meters)	Connector type
NT7E48AA NT7E48BA NT7E48CA NT7E48FA	20 20 20 20	Biconic FC ST SC
NT7E49AA NT7E49BA NT7E49CA NT7E49FA	20 20 20 20	Biconic (MVOA) FC (MVOA) ST (MVOA) SC (MVOA)

Orderwire extension cable

The orderwire extension cable connects orderwire circuits from the left connector of the access bandwidth manager (ABM) shelf to the office orderwire network. Orderwire circuits allow maintenance technicians to communicate between sites.

NT4K85CA, CB, CC CE and CF



25-pin D-subminiature

12-pair, twisted, 26 AWG solid wires connectorized at one end for connection to the ABM shelf, and the other end free for customer termination to the intended office equipment. This cable is available in the following lengths:

15 m	(50 ft)	NT4K85CE
30 m	(100 ft)	NT4K85CA
61 m	(200 ft)	NT4K85CB
91 m	(300 ft)	NT4K85CC
122 m	(400 ft)	NT4K85CF

Table 5-20 lists the pin-outs for the NT4K85CA, CB, CC, CE, and CF cables.

Table 5-20
Pin-outs for the NT4K85CA, CB, CC, CE, and CF cables

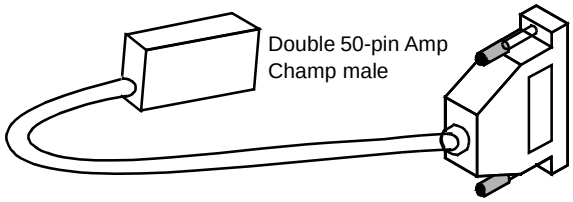
Signal	Pin	Pair	Color
2W OW jack Tip	1	1	W
2W OW jack Ring	2	1	BL
4W OW handset T	3	2	W
4W OW handset T1	4	2	O
4W OW handset R	5	3	W
4W OW handset R1	6	3	G
4W OW handset S	7	4	W
4W OW handset S1	8	4	BR
Brdcst Call	9	5	W
Bell Ext OW	10	5	S
Bell (return)	11	6	R
LED Loc OW	12	6	BL
LED Exp OW	13	7	R
Select Loc OW	14	7	O
Select Exp OW	15	8	R
Common Return	16	8	G
Common Return	17	jumpered to 16	
4W Loc OW T input	18	9	R
4W Loc OW R input	19	9	BR
4W Loc OW T1 output	20	10	R
4W Loc OW R1 output	21	10	S
4W Exp OW T input	22	11	BK
4W Exp OW R input	23	11	BL
4W Exp OW T1 output	24	12	BK
4W Exp OW R1 output	25	12	O

Pair gain test controller/metallic test access cable

The pair gain test controller/metallic test access (PGTC/MTA) cable is required only at the central switching office location, and only when copper-distribution shelves are equipped at the remote location. The PGTC facility is used in conjunction with the test bypass pairs (TBP) for metallic test access to the subscriber's loop at a remote site. The PGTC/MTA cable connects between the I/O card area of the access bandwidth manager (ABM) shelf and the office PGTC or MTA equipment. PGTC is not supported for VTBM rings.

The PGTC/MTA cable provides a double 50-pin Champ connector to facilitate office cabling.

NT4K85BA



25-pair, twisted, 24 AWG solid wires, 1.2m (4 ft) long, connectorized at one end with a 44-pin D-subminiature male for connection to the ABM shelf I/O PGTC/MTA card, and the other end with a double Amp Champ male connector for connection to the office PGTC or MTA equipment.

The double 50-pin Champ connector at the end of the PGTC/MTA cable allows a common *in* and *out* daisy-chain connection. The double connector end of the assembly is intended to locate in the overhead cable rack for customer connection.

Note: A customer's cable of 25-pair, twisted, 24 AWG solid wires, is required to interconnect between the double 50-pin Champ connector of the PGTC/MTA cable assembly and the office PGTC or MTA equipment.

Table 5-21 lists the pin-outs for the NT4K85BA cable.

Table 5-21
Pin-outs for the NT4K85BA cable

Signal	Pin	Pair	Color		Signal	Pin	Pair	Color	
1 Ring	1	1	BL	1W	1 Tip	26	1	W	1BL
2 Ring	2	2	O	1W	2 Tip	27	2	W	1O
3 Ring	3	3	G	1W	3 Tip	28	3	W	1G
4 Ring	4	4	BR	1W	4 Tip	29	4	W	1BR
2 Sleeve	5	5	S	1W	1 Sleeve	30	5	W	1S
4 Sleeve	6	6	BL	1R	3 Sleeve	31	6	R	1BL
2 OH	7	7	O	1R	1 OH	32	7	R	1O
4 OH	8	8	G	1R	3 OH	33	8	R	1G
2 Proceed	9	9	BR	1R	1 Proceed	34	9	R	1BR
4 Proceed	10	10	S	1R	3 Proceed	35	10	R	1S
2 Lock	11	11	BL	1BK	1 Lock	36	11	BK	1BL
4 Lock	12	12	O	1BK	3 Lock	37	12	BK	1O
		13	NC				38	NC	
		14	NC				39	NC	
		15	NC				40	NC	
		16	NC				41	NC	
T Mjr		17	G	1BK	Tst Alm	42	42	BK	1G
		18	NC				43	NC	
		19	NC				44	NC	
		20	NC				45	NC	
		21	NC				46	NC	
Sezby		22	BR	1BK	Seize	47	47	BK	1BR
		23	NC				48	NC	
		24	NC				49	NC	
		25	NC				50	NC	

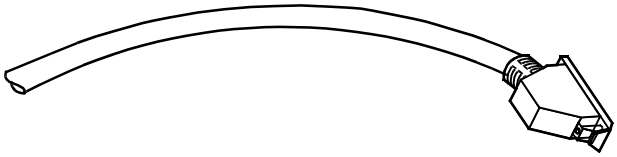
NC = no connection

Parallel telemetry cable

The parallel telemetry cable connects E2A parallel telemetry inputs and outputs from the parallel telemetry connector of the access bandwidth manager (ABM) shelf to the office cross-connect.

Each of the 18 telemetry outputs on the shelf is a signal distribution point capable of reporting alarm status information. Outputs connect to external systems, such as surveillance and control of transmission systems (SCOTS) and telecommunication alarm surveillance and control (TASC). Each of the inputs is a scan point, polled every 500 ms to detect changes to the input state (loop closure, battery, or ground). Each of the inputs is provisionable for its active state as a minor, major, or critical alarm.

NT7E44UA



44-pin
D-subminiature male

25-pair, twisted, 26 AWG solid wires connectorized at one end for to the transport bandwidth manager shelf in 20 m (66 ft.) lengths.

Note: The parallel telemetry inputs (IN 01 to IN 11) and outputs (OUT 15 to OUT 18) have parallel access with the wire-wrap block pin detail in the BIP.

Table 5-22 lists the pin-outs for the NT7E44UA cable.

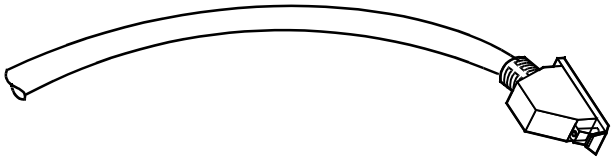
Table 5-22
Pin-outs for the NT7E44UA cable

Signal	Pin	Pair	Color		Signal	Pin	Pair	Color	
OUT 01	1	1	BL	1W	IN 03	23	12	O	1BK
OUT 02	2	1	W	1BL	IN 04	24	12	BK	1O
OUT 03	3	2	O	1W	IN 05	25	13	G	1BK
OUT 04	4	2	W	1O	IN 06	26	13	BK	1G
OUT 05	5	3	G	1W	IN 07	27	14	BR	1BK
OUT 06	6	3	W	1G	IN 08	28	14	BK	1BR
OUT 07	7	4	BR	1W	IN 09	29	15	S	1BK
OUT 08	8	4	W	1BR	IN 10	30	15	BK	1S
OUT 09	9	5	S	1W	IN 11	31	16	BL	1Y
OUT 10	10	5	W	1S	IN 12	32	16	Y	1BL
OUT 11	11	6	BL	1R	IN 13	33	17	O	1Y
OUT 12	12	6	R	1BL	IN 14	34	17	Y	1O
OUT 13	13	7	O	1R	IN 15	35	18	G	1Y
OUT 14	14	7	R	1O	IN 16	36	18	Y	1G
OUT 15	15	8	G	1R	IN 17	37	19	BR	1Y
OUT 16	16	8	R	1G	IN 18	38	19	Y	1BR
OUT 17	17	9	BR	1R	IN 19	39	20	S	1Y
OUT 18	18	9	R	1BR	IN 20	40	20	Y	1S
OUT Return	19	10	S	1R	IN 21	41	21	BL	1V
OUT Return	20	10	R	1S	IN 22	42	21	V	1BL
IN 01	21	11	BL	1BK	IN Return	43	22	O	1V
IN 02	22	11	BK	1BL	IN Return	44	22	V	1O
Note: Signals IN 12 to IN 22 are for future use.									

Serial telemetry cable

The serial telemetry cable connects telemetry byte-oriented serial (TBOS) RS-422 signals from the left connector of the access bandwidth manager (ABM) shelf to external E2A alarm processing remote (APR) office equipment. The serial telemetry provides alarm points controlled by the external E2A APR equipment.

NT4K86CA, CB, CC



25-pin
D-subminiature male

8-pair, twisted, 26 AWG solid wires connectorized at one end for connection to the ABM shelf, and the other end free for customer termination to the E2A alarm processing remote (APR). This cable is available in the following lengths.

16 m	(50 ft)	NT4K86CB
30 m	(100 ft)	NT4K86CA
61 m	(200 ft)	NT4K86CC

Table 5-23 lists the pin-outs for the NT4K86CA, CB, and CC cables.

Table 5-23
Pin-outs for NT4K86CA, CB, and CC cables

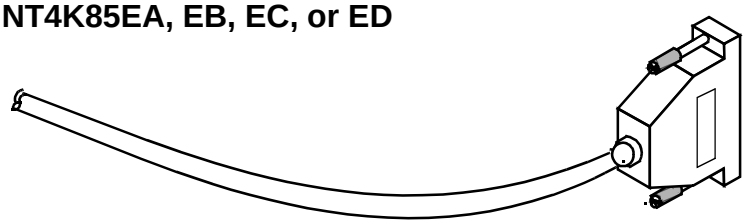
Signal	Pin	Pair	Color		Signal	Pin	Pair	Color	
	1		NC		Port 2 Tx-	14	7	O	1R
	2		NC		Port 2 Tx+	15	7	O	2R
	3		NC		Port 2 Rx+	16	1	BL	2W
Port 2 Rx-	4	1	BL	1W	Port 1 Rx+	17	2	O	2W
Port1 Rx-	5	2	O	1W	Port 1 Tx+	18	3	G	2W
Port 1 Tx-	6	3	G	1W		19		NC	
	7		NC			20		NC	
	8		NC		future	21	8		
	9		NC		future	22	8		
	10		NC		future	23	4		
future	11				future	24	5		
future	12				future	25	6		
future	13								
NC = no connection									

Test access path cable (TAP function)

The test access path cable provides access to the metallic test access unit (MTAU), when a Universal application is interfacing an analog switch, for the testing of subscriber loops at the remote site. This testing is done in conjunction with a TBP or TAP card at the central office, or with the metallic test access (MTA) in integrated S/DMS SuperNode offices.

The TAP cable connects from the I/O card area of the access bandwidth manager (ABM) shelf to the office MDF, for cross-connection to the appropriate interface pairs.

NT4K85EA, EB, EC, or ED



44-pin
D-subminiature male

25-pair, twisted., 26 AWG solid wires connectorized one end for connection to the ABM shelf TAP I/O card. This cable is available in the following lengths:

15 m	(50 ft)	NT4K85ED
30 m	(100 ft)	NT4K85EA
61 m	(200 ft)	NT4K85EB
91 m	(300 ft)	NT4K85EC

Table 5-24 lists the pin-outs for the NT4K85EA, EB, EC, or ED cables.

Table 5-24
Pin-outs for NT4K85EA, EB, EC and ED cables

Signal	Pin	Pair	Color		Signal	Pin	Pair	Color	
1 A in R	1	1	BL	1W	3 C Out R	23	12	O	1BK
1 A in T	2	1	W	1BL	2 C Out T	24	12	BK	1O
1 A Out R	3	2	O	1W	MTA R	25	13	G	1BK
1 A Out T	4	2	W	1O	MTA T	26	13	BK	1G
1 B In R	5	3	G	1W	RDT TBP R	27	14	BR	1BK
1 B In T	6	3	W	1G	RDT TBP T	28	14	BK	1BR
1 B Out R	7	4	BR	1W	Ext TBP R	29	15	S	1BK
1 Out T	8	4	W	1BR	Ext TBP T	30	15	BK	1S
1 C In R	9	5	S	1W	NC	31		NC	
1 C In T	10	5	W	1S	NC	32		NC	
1 C Out R	11	6	BL	1R	NC	33		NC	
1 C Out T	12	6	R	1BL	NC	34		NC	
2 A In R	13	7	O	1R	NC	35		NC	
2 A In T	14	7	R	1O	NC	36		NC	
2 A Out R	15	8	G	1R	NC	37		NC	
2 A Out T	16	8	R	1G	NC	38		NC	
2 B In R	17	9	BR	1R	NC	39		NC	
2 B In T	18	9	R	BR	NC	40		NC	
2 B Out R	19	10	S	1R	NC	41		NC	
2 B Out T	20	10	R	1S	NC	42		NC	
2 C In R	21	11	BL	1BK	NC	43		NC	
2 C In T	22	11	BK	1BL	NC	44		NC	

NC = no connection

The following explains some of the symbols used in the Signal column:
1 = external TAP1 connection; 2 = external TAP2 connection
A = T, R pair; B = T1, R1 pair; C = E/M pair

Examples:
1 B In R = external TAP1, T1 R1 pair, towards the line card, Ring lead
2 A Out T = external TAP2, T-R pair towards the loop (drop), Tip lead

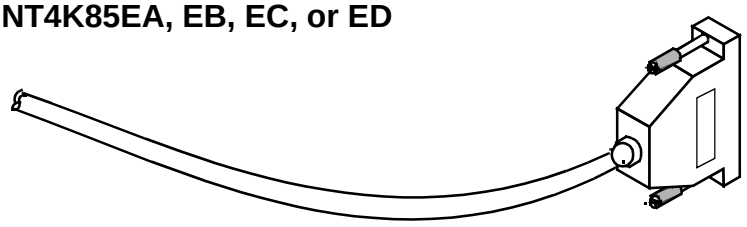
Note: When connecting the R-TEC signature module—the Test Bus Termination Unit (TBTU)— for line and loop testing, the MTA R and MTA T pins (pins 25 and 26) on the TAP I/O card are used. Refer to *Line and Loop Testing Overview*, 323-3001-115 in Description, Volume 2B for additional information about line and loop testing equipment.

Test access path cable (TBP function)

The test bypass pairs cable is required only at the central switching office location, and only when copper-distribution shelves are equipped at the remote location. The TBP facility is used in conjunction with the PGTC/MTA card for metallic test access of the subscriber's loop at the remote site. The TBP facility consists of six 2W circuits, each with an inhibit lead to prevent seizure of the same 2W circuit by other systems.

The TBP test bypass pairs cable connects 22 pairs from the I/O card area of the access bandwidth manager (ABM) shelf to the office MDF for cross-connect to the appropriate interface pairs.

NT4K85EA, EB, EC, or ED



44-pin
D-subminiature male

25-pair, twisted 26 AWG solid wires connectorized one end for connection to the ABM shelf TAP I/O card. This cable is available in the following lengths:

15 m	(50 ft)	NT4K85ED
30 m	(100 ft)	NT4K85EA
61 m	(200 ft)	NT4K85EB
91 m	(300 ft)	NT4K85EC

Table 5-25 lists the pin-outs for the NT4K85EA, EB, EC, or ED cables.

Table 5-25
Pin-outs for NT4K85EA, EB, EC, and ED cables

Signal	Pin	Pair	Color	Signal	Pin	Pair	Color
Bypass 1R	1	1	BL 1W	NC	23	12	NC
Bypass 1T	2	1	W 1BL	NC	24	12	NC
Bypass 2R	3	2	O 1W	NC	25	13	NC
Bypass 2T	4	2	W 1O	NC	26	13	NC
Bypass 3R	5	3	G 1W	NC	27	14	NC
Bypass 3T	6	3	W 1G	NC	28	14	NC
Bypass 4R	7	4	BR 1W	NC	29	15	NC

—continued—

Table 5-25 (continued)
Pin-outs for NT4K85EA, EB, EC, and ED cables

Signal	Pin	Pair	Color		Signal	Pin	Pair	Color
Bypass 4T	8	4	W	1BR	NC	30	15	NC
Bypass 5R	9	5	S	1W	NC	31		NC
Bypass 5T	10	5	W	1S	NC	32		NC
Bypass 6R	11	6	BL	1R	NC	33		NC
Bypass 6T	12	6	R	1BL	NC	34		NC
NC	13	7	NC		NC	35		NC
NC	14	7	NC		NC	36		NC
NC	15	8	NC		NC	37		NC
NC	16	8	NC		NC	38		NC
Inhibit 1	17	9	BR	1R	NC	39		NC
Inhibit 2	18	9	R	1BR	NC	40		NC
Inhibit 3	19	10	S	1R	NC	41		NC
Inhibit 4	20	10	R	1S	NC	42		NC
Inhibit 5	21	11	BL	1BK	NC	43		NC
Inhibit 6	22	11	BK	1BL	NC	44		NC
NC = no connection								
—end—								

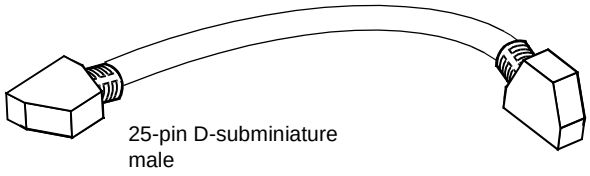
User interface cable for the LCAP

The user interface cable allows the temporary connection of a printer, a VT-100 terminal, or a modem to the User Interface Port 2 connector on the faceplate of the local craft access panel (LCAP).

Note: When a modem is not used, the equipment to be connected must be bonded to the same ground point as the ABM shelf.

If you are connecting the LCAP to a modem, you must connect an NT7E44MB null modem adaptor between the NT7E44FA, FB cable and the modem or printer.

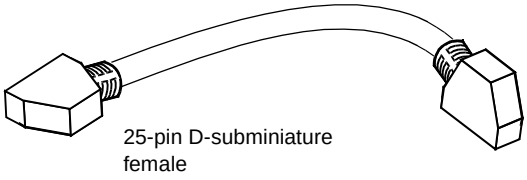
NT7E44FA and FB



4-pair, twisted, 26 AWG solid wires with shielding, connectorized at both ends. One end connects to the 25-pin connector on the faceplate of the LCAP and the other end is for connection to a 25-pin connector of a VT-100 terminal. This cable is available in the following lengths:

5 m (16 ft)	NT7E44FA
20 m (66 ft)	NT7E44FB

NT7E44MB null modem adaptor for connection to a modem



4-pair, 26 AWG solid wire connectorized at both ends. One end connects to the male connector on the NT7E44FA or FB cable and the other end connects directly to the modem.

Pin-outs for NT7E44FA, FB cables

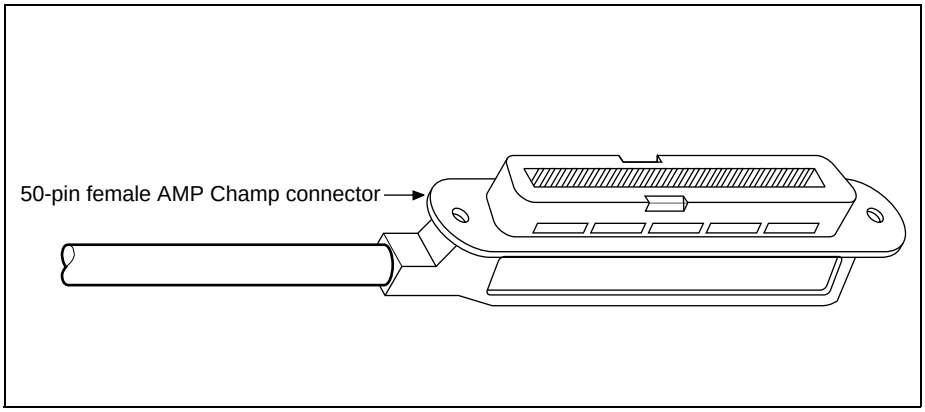
This cable has a “straight-through” construction. Pin 1 on one male connector is connected to pin 1 on the other male connector, pin 2 is connected to pin 2, and so on. Table 5-26 lists the pin-outs for the NT7E44FA and FB cables.

Table 5-26
Pin-outs for NT7E44FA and FB cables

Pin on 25-pin male connector	Color code	Signal	Pin on second 25-pin male connector
1	BK	not used	1
2	BR	Rx	2
3	R	Tx	3
4	O	RTS	4
5	Y	CTS	5
6	G	DSR	6
7	BL	signal ground	7
8	V	DCD	8
9 to 19	not connected	not used	9 to19
20	W BK BR stripes	DTR	20
21 to 25	not connected	not connected	21 to 25

VF copper cable

Two 50-pair VF copper cables (supplied by Nortel Networks) are required for each copper-distribution shelf, to provide access for 96 VF subscriber lines (POTS or special services, switched and nonswitched). The 50-pair VF cable has a “Y” end with two 25-pair connectors (50-pin AMP Champ) attached.



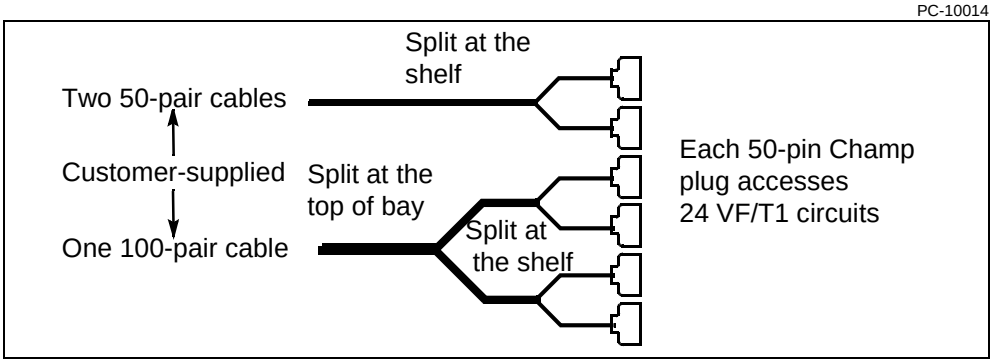
The two 50-pair VF copper cables are routed to four 50-pin connectors on the copper-distribution shelf (two on the left and two on the right).

The cables come in the following lengths:

Length requirement (in feet)	**VF cable type**
50’	NT4K85PA
100’	NT4K85PB
150’	NT4K85PC
200’	NT4K85PD
250’	NT4K85PE
300’	NT4K85PF

If customer supplied 100-pair or 50-pair cables are used, the cables must be split as shown in the following illustration, to allow 50 pairs (1 to 50) routed to the left side of the copper-distribution shelf, and 50 pairs (51 to 96 plus 4spares) routed to the right side. At each side of the copper-distribution shelf, the 50 pairs are split and connectorized into two 25-pair (50-pin) Champ plugs (with bail-lock latching). A VF connector kit containing four 50-pin Champ plugs (with bail-lock latching) is available from Nortel Networks for customer connectorization.

PC-10014



For the full complement of seven copper-distribution shelves, a maximum of 14 50-pair preconnectorized cables (28 25-pair cables, or seven 100-pair cables) are required to connect all 672 VF lines. Table 5-27 on page 5-51 lists the pin-outs for the NT4K85PA through PF cables.

Table 5-27
Pin-outs for 25-pair connectors (P1 and P2) on 50-pair VF cables

Cable pair on		RING		TIP	
Connector P1	**Connector P2**	**Connector Pin #**	**Wire Color**	**Connector Pin #**	**Wire Color**
1	26	1	BL/WHT	26	WHT/BL
2	27	2	OR/WHT	27	WHT/OR
3	28	3	GN/WHT	28	WHT/GN
4	29	4	BN/WHT	29	WHT/BN
5	30	5	SL/WHT	30	WHT/SL
6	31	6	BL/RD	31	RD/SL
7	32	7	OR/RD	32	RD/OR
8	33	8	GN/RD	33	RD/GN
9	34	9	BN/RD	34	RD/BN
10	35	10	SL/RD	35	RD/SL
11	36	11	BL/BK	36	BK/BL
12	37	12	OR/BK	37	BK/OR
13	38	13	GN/BK	38	BK/GN
14	39	14	BN/BK	39	BK/BN
15	40	15	SL/BK	40	BK/SL
16	41	16	BL/YE	41	YE/BL
17	42	17	OR/YE	42	YE/OR
18	43	18	GN/YE	43	YE/GN
19	44	19	BN/YE	44	YE/BN
20	45	20	SL/YE	45	YE/SL
21	46	21	BL/VT	46	VT/BL
22	47	22	OR/VT	47	VT/OR
23	48	23	GN/VT	48	VT/GN
24	49	24	BN/VT	49	VT/BN
25	50	25	SL/VT	50	VT/SL

CAUTION
Risk of damage to equipment
During initial setup of AccessNode, Nortel Networks recommends that the equipment side remains disconnected from the outside plant subscriber loops (at the protection modules) until the line cards are installed and powered up.

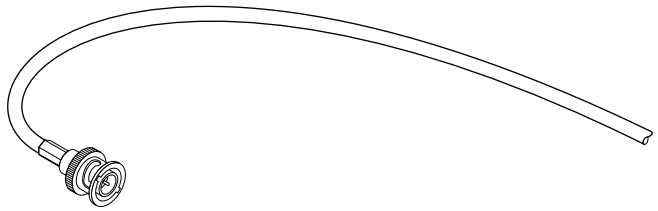
For example, when using five-pin protector modules, pull the modules out slightly to the first detent position so that the outside plant pairs remain protected, but the CDS VF cables remain disconnected from the subscriber loop.

DS3 cables

The DS3 cable connects the signals of DS3 input or DS3 output cards on the access bandwidth manager (ABM) shelf to the office DSX-3 cross-connect.

FW10068

NT7E43AA through AH, and NT7E43AJ through AL



NT-734-E coaxial cables preconnectorized at one end with a BNC connector. These cables are available in the following lengths:

5 m (16.4 ft)	NT7E43AA
10 m (32.8 ft)	NT7E43AB
20 m (65.6 ft)	NT7E43AC
30 m (98.4 ft)	NT7E43AD
40 m (131.1 ft)	NT7E43AE
50 m (163.9 ft)	NT7E43AF
60 m (196.7 ft)	NT7E43AG
75 m (245.9 ft)	NT7E43AH
80 m (262.3 ft)	NT7E43AJ
100 m (327.9 ft)	NT7E43AL
140 m (459 ft)	NT7E43AK

It is recommended that you use a Schleuniger coaxial stripper tool Model HZ207A (Tool room number T00067) and BNC connector kit (Tool room number K000702) when installing BNC connectors in the field.

Note: For information on planning your DS1/DS3 mapper layout, see *Commissioning and Testing*, Volume 3.

Cabling requirements for TBM bays

This chapter describes the cabling requirements for transport bandwidth manager (TBM) bays used in the AccessNode system.

Chapter contents

This chapter contains the following information:

Intershelf cable connections for TBM bays

Figure 6-1 and Figure 6-2 show the intershelf cables used in AccessNode TBM bays. These cables are installed at the factory.

Figure 6-1
Intershelf cables for TBM bays (standard bays)

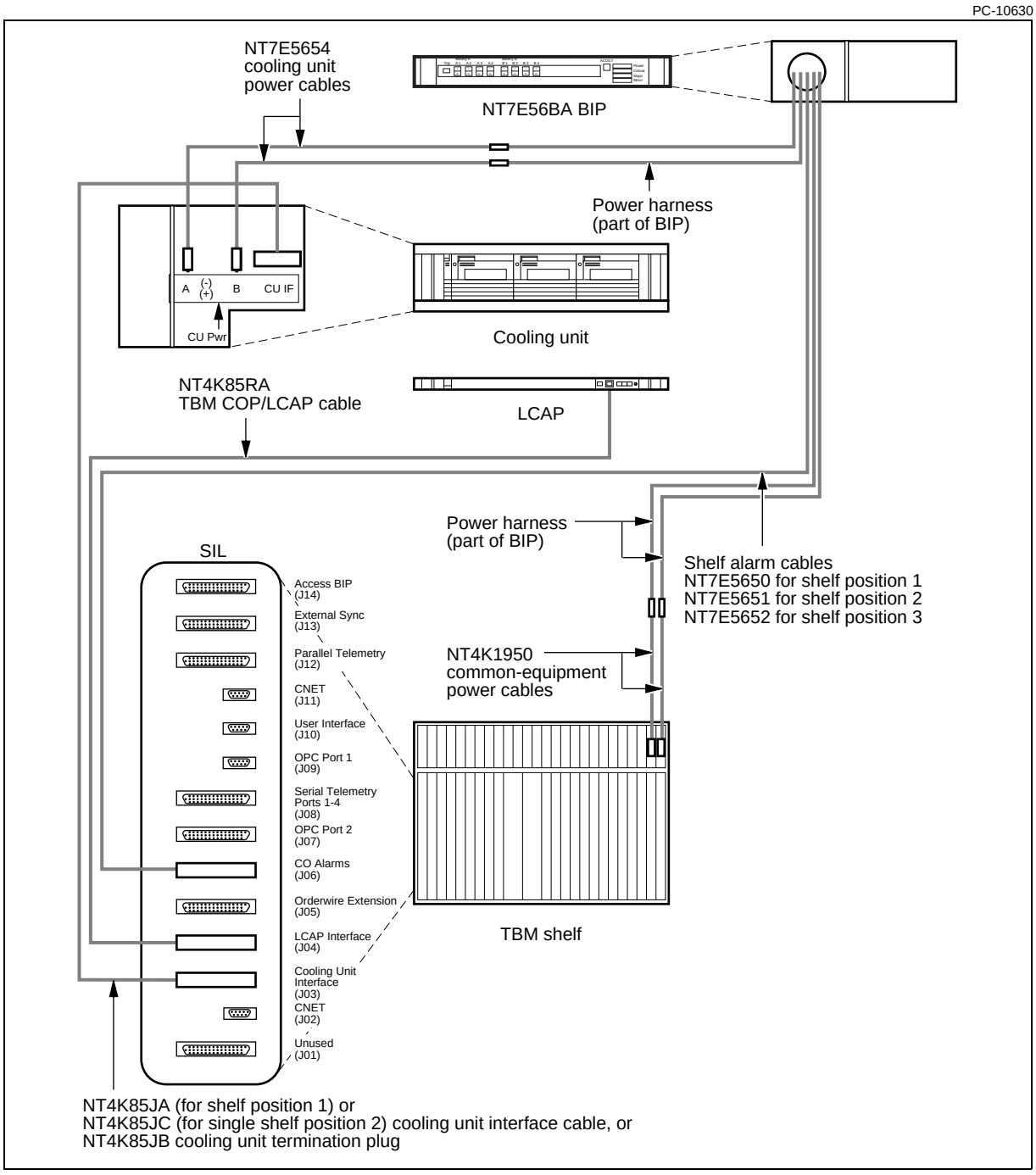
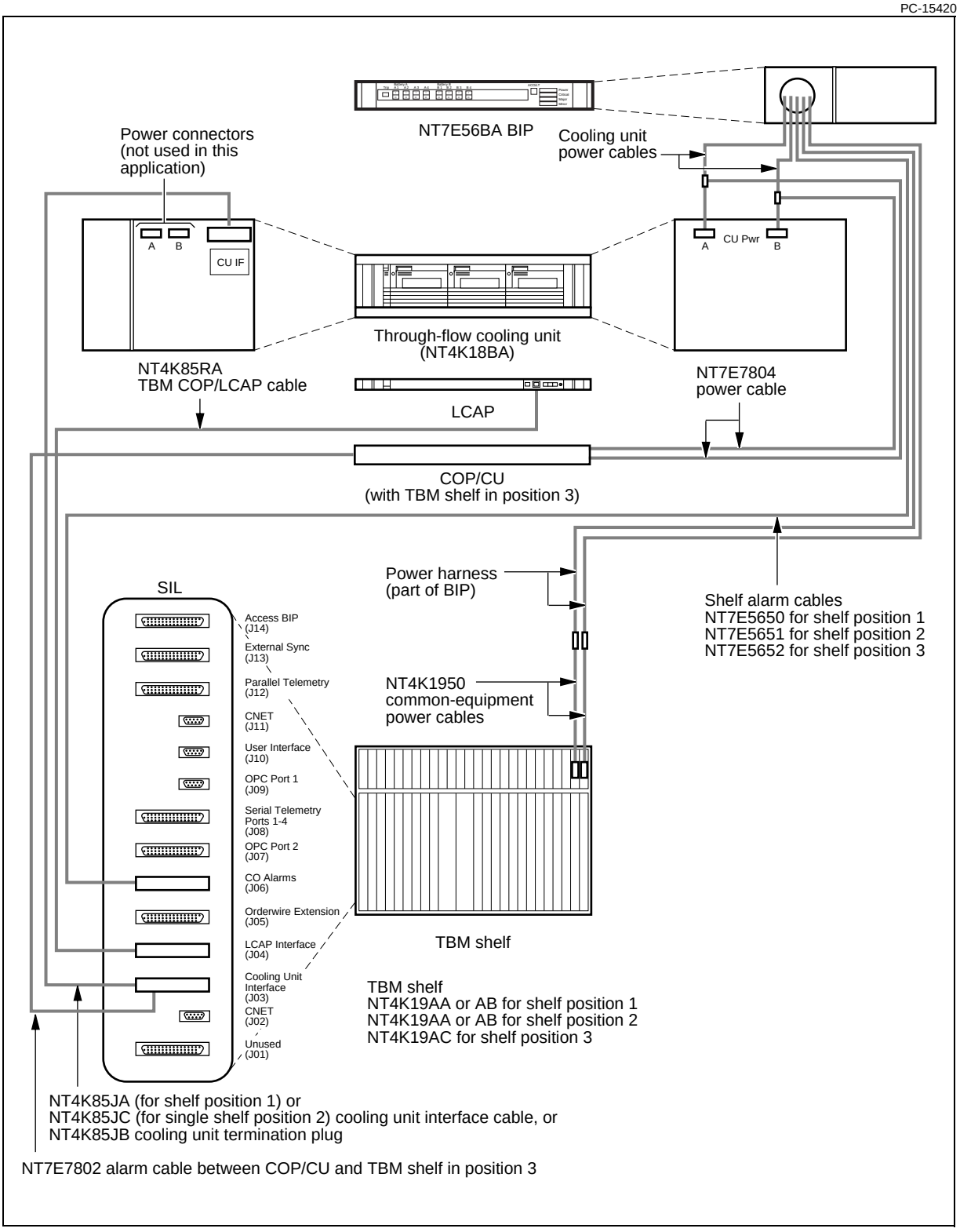


Figure 6-2
Intershelf cables for TBM bays (enhanced bays)

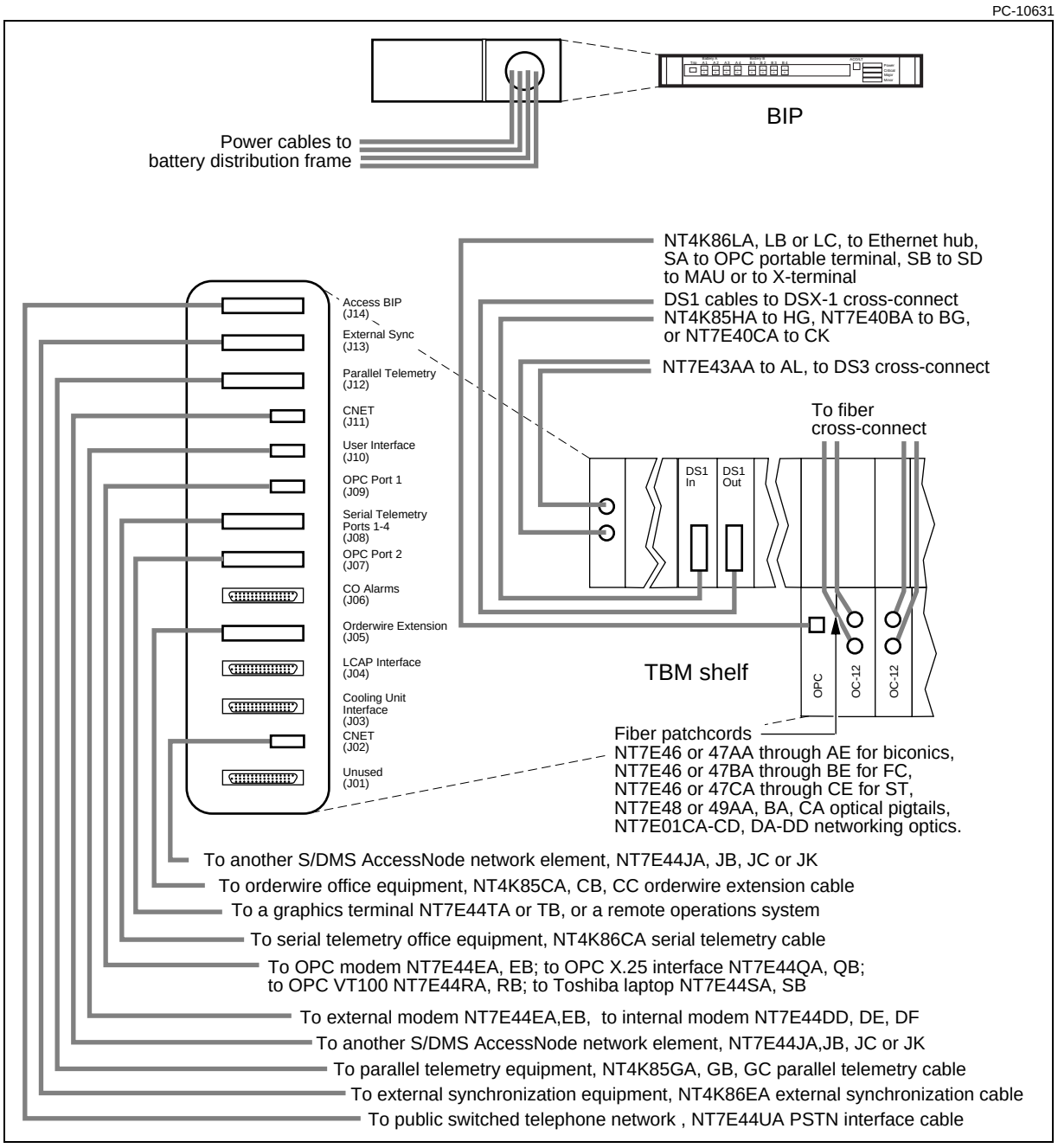
PC-15420



External cable connections for TBM bays

Figure 6-3 shows the external cables used in these systems. The external cables are connected to the system at the installation site.

Figure 6-3
External cables for TBM bays



Wire-wrap connections to the BIP for TBM shelves

The wire-wrap connections from the wire-wrap field inside the BIP provide connections for office alarms. Connections are wired to the wire-wrap field using a wire-wrap cable (twisted pairs, 2-, 24-, or 26- AWG). This cable is supplied by the customer.

Pin-out detail

The pin-out detail for the wire-wrap field is shown in Figure 6-4.

Figure 6-4
Pin-out detail for the BIP

PC-10256

E1 ● Visual Critical NC	E2 ● Visual Critical NC	E3 ● Visual Major NC	E4 ● Visual Major NC	E5 ● Visual Minor NC	E6 ● Visual Minor NC	E7 ● Audible Critical NC	E8 ● Audible Critical NC	E9 ● Audible Major NC	E10 ● Audible Major NC	E11 ● Audible Minor NC	E12 ● Audible Minor NC
E13 ● Visual Critical COM	E14 ● Visual Critical COM	E15 ● Visual Major COM	E16 ● Visual Major COM	E17 ● Visual Minor COM	E18 ● Visual Minor COM	E19 ● Audible Critical COM	E20 ● Audible Critical COM	E21 ● Audible Major COM	E22 ● Audible Major COM	E23 ● Audible Minor COM	E24 ● Audible Minor COM
E25 ● Visual Critical NO	E26 ● Visual Critical NO	E27 ● Visual Major NO	E28 ● Visual Major NO	E29 ● Visual Minor NO	E30 ● Visual Minor NO	E31 ● Audible Critical NO	E32 ● Audible Critical NO	E33 ● Audible Major NO	E34 ● Audible Major NO	E35 ● Audible Minor NO	E36 ● Audible Minor NO
E37 ● Battery Return	E38 ● Battery Return	E39 ● Battery Return	E40 ● Battery Return	E41 ● Remote ACO Note 2	E42 ● Remote ACO Note 2	E43 ● Battery Return	E44 ● Battery Return	E45 ● Battery Return	E46 ● Battery Return	E47 ● Battery Return	E48 ● Battery Return

Legend:

ACO = Alarm cutoff

COM = Common connection

NC = Normally closed connection when there is no alarm condition.

NO = Normally open connection when there is no alarm condition.

Note 1: Common connections (com) pins are actually shorted together. For example, pins E13 and E14, E15 and E16, E17 and E18, and so on, are physically shorted together.

Note 2: When either pin E41 or E42 is momentarily connected to battery return, an ACO of the audible alarm is acivated. Audible alarm points can be cut off by momentary application of a ground to either remote ACO input.

Power cable requirements

Cable requirements for commercial ac power and –48 V dc power are as follows.

Commercial power cabling

The commercial ac power source terminates in an ac distribution panel (supplied by the customer). This power source and the panel must conform to the national and local electrical codes, and the recommended office ground scheme described in Chapter 4, "Power and ground distribution." The location of the distribution panel, relative to the AccessNode equipment, determines the length of conduit and wiring required to feed rectifier and battery power plants, and any ac utility receptacles, if required.

Recommended sizes of ac entrance and distribution feed cables must conform with information described in national electrical codes, as follows:

- For USA: Table 250-94 in National Electrical Code (NEC)
- For Canada: Table 17 in Canadian Electrical Code (CEC)

The subsequent ac power panel wiring must be completed by a qualified electrician.

Cabling of ac receptacles in bays

Receptacles can be equipped in the front base of a bay, if required as a customer-selected option. It is recommended that standard electrical receptacles in boxes bolted to the bays be used, unless otherwise required by the customer. Insulated metal-clad cable, supplied by the customer, is preferred for cabling ac receptacles, as follows:

- Insulated metal-clad cable, 12 AWG, 3-conductor cable for standard receptacles (brown, gray or ivory)
- Insulated metal-clad cable, 12 AWG, 4-conductor for isolated-ground receptacles (orange)

When installing ac receptacles in the base of the bay framework, the insulated metal-clad cable must be routed on the left side of the framework. The length of cable must reach the base of the bay with sufficient slack to allow placement of the cable in the most recessed part of the bay framework channel, to minimize crowding of other signal cables placed in the same bay.

When a single ac feed is used to feed more than one bay in a lineup, the ac cable is routed to the left side of the first bay, terminated in the receptacle box, and the cable extended up the right side of the first bay and down the left of the next adjacent bay to be terminated in its receptacle box.

If local codes allow, and if the customer prefers, the ac cable can be extended from the right side of the receptacle box, through the base horizontally and terminated in the receptacle box of each adjacent bay.

–48 V dc battery cabling

For bay equipment, –48 V dc is cabled from an external power plant which is supplied by the customer. The external power plant must supply –48 V dc from a 30 A rated BDFB fuses, to supply each AccessNode bay as follows:

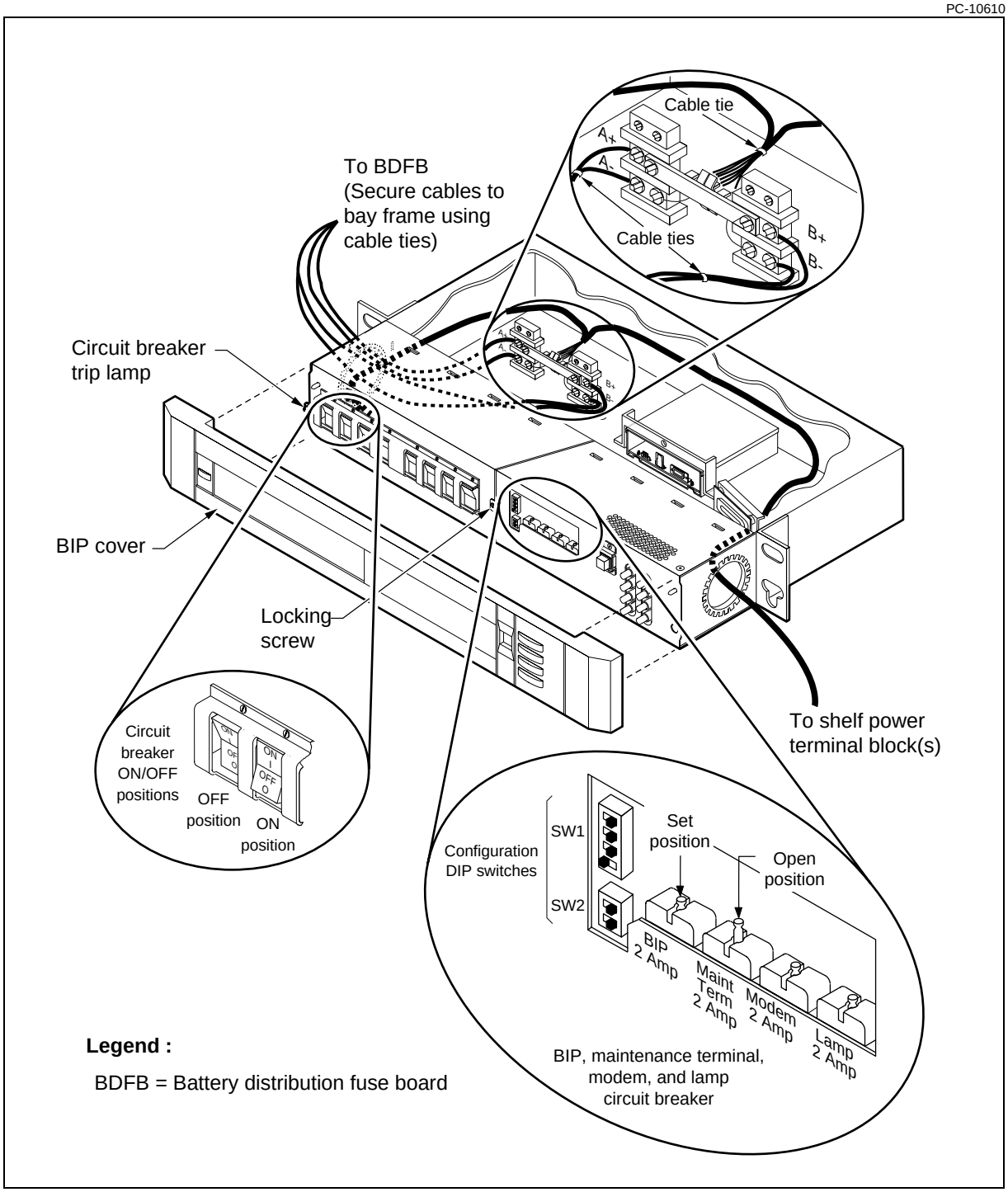
In bays equipped with transport bandwidth manager (TBM) shelves, two battery and return pairs are required for connection to the A+, A-, B+, and B-terminals on the BIP as shown in Figure 6-5.

Cables for bays with TBM shelves

For bays equipped with TBM shelves, the power cables that supply power to the BIP are the responsibility of the customer. A conductor size must be chosen that is large enough to ensure that the voltage drop between the dc power source and the BIP is less than 1.0 V dc.

Figure 6-5
BIP battery feeder connections for bays equipped with TBM shelves

PC-10610



Grounding requirements for external signal cables

All signal-carrying cables are subject to the grounding requirements described in Chapter 4, “Power and ground distribution,” and to the following rules:

- Equipment frames that require significant interconnecting cables must be clustered together in the same lineup, or at least within the same area.
- Cables must be routed in grounded cable troughs.
- RS-232 connections must be connected through an external modem for ground isolation under any of the following conditions:
  - — the terminal is more than 12.6 m (50 ft) from the bay
  - — the terminal is located in a different grounding network or in a grounding network of a different type
- VF cables that exit the building in which the AccessNode is installed must be protected by gas discharge protectors at the main distribution frame. The protectors must be referenced to the single point building ground (SPG) in isolated bonding network (IBN) grounding networks or to the floor ground bar (FGB) in common bonding network (CBN) grounding networks. In small buildings, it is possible that the SPG or the FGB does not exist, in which case the building principle ground (BPG) is used for this purpose.
- Shielded cables, such as the ESI cable, must be connected to equipment bonded to the same ground point as the TBM shelf or the ABM shelf.
- Interconnections between clusters of equipment frames, or frames not within the same bonding network, must be routed as follows:
  - — through the grounded ducts, if in a CBN or between two CBNs
  - — through the SPG, if entering or exiting an IBN, so that cable shields or other ground leads can be referenced to the SPG. This requires the use of a transmission ground reference device, as defined in Nortel Networks Corporate Standard 4122.00.

Grounding external signal cables in an IBN

Interconnection between clusters of equipment frames, or frames not within the same lineup or the same IBN, must be routed through the SPG for decoupling.

Types of external signal cables for TBM bays

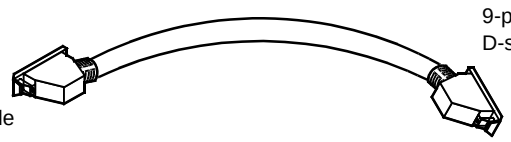
The following pages describe the external cables used on bays equipped with transport bandwidth manager (TBM) shelves.

Control network cable

The control network permits communication between the major processing cards in TBM shelves located at the same site. This type of communication provides the ability to link operations, administration and maintenance (OAM and P) functions between multiple AccessNode TBM shelves. Control network cables are used to daisy-chain the control network bus between TBM shelves. Table 6-1 lists the pin-outs for the NT7E44JA, JB, LC, or JK cables.

Note: Control network cables can only be connected between TBM shelves that are bonded to the same ground points.

NT7E44JA, JB, JC, JK



2-pair, twisted, 24 AWG stranded wires with shielding, connectorized at both ends in the following lengths:

0.3 m	(1 ft)	NT7E44JA
1 m	(3.2 ft)	NT7E44JB
5 m	(16.4 ft)	NT7E44JC
10 m	(32 ft)	NT7E44JK

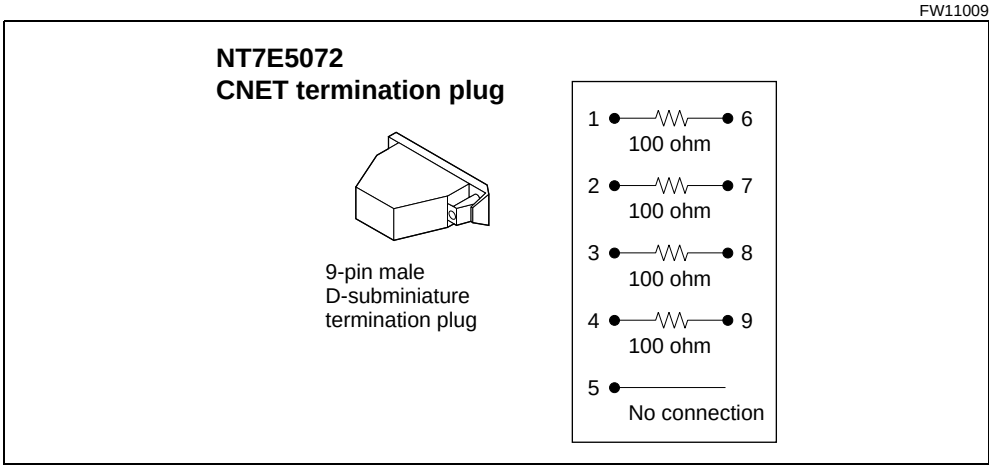
Table 6-1
Pin-outs for NT7E44JA, JB, LC, or JK cables

Pins on MTA In connector	Signal	Pins on MTA Out connector	Signal
1	no connection	1	no connection
2	no connection	2	no connection
3	XCN2N	3	XCN2N
4	XCN1N	4	XCN1N
5	no connection	5	no connection
6	no connection	6	no connection
7	no connection	7	no connection
8	XCN2P	8	XCN2P
9	XCN1P	9	XCN1P

Control network termination plug

A termination plug is required at both ends of the control network daisy chain bus. When either of the two control network connectors on the transport bandwidth manager (TBM) shelf are not cabled, a termination plug must be attached to the TBM shelf connector.

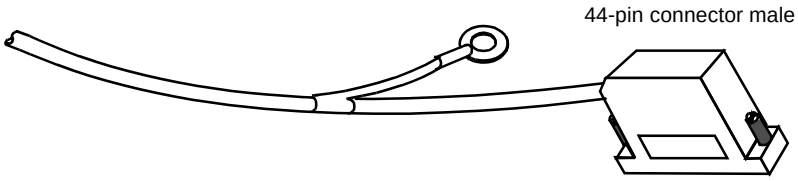
FW11009



DS1 signal cable

The DS1 cable connects the 1.544 Mb/s signals of a DS1 input or a DS1 output card on the transport bandwidth manager (TBM) shelf to the office DSX-1 cross-connect.

NT7E40BA-BH, BJ-BN, BP
NT7E40CA-CH, CJ, CK



14 pair, twisted 22- or 26 AWG solid wires with overall shielding. One end is connectorized (connector P1) for connection to a DS1 input card or to a DS1 output card on the TBM shelf. For cables used on DS1 output cards, a ground lug wire provides connection of the outer shield to the TBM shelf frame ground. The ground lug wire is not used for DS1 input cards. The DS1 cable is available in the following wire gauges and cable lengths:

Wire gauge	Length	Product engineering code	Description
22	7 m (24 ft)	NT7E40BL	608, 14 pair
22	15 m (49 ft)	NT7E40BA	608, 14 pair
22	30 m (95 ft)	NT7E40BM	608, 14 pair
22	45 m (148 ft)	NT7E40BB	608, 14 pair
22	60 m (197 ft)	NT7E40BN	608, 14 pair
22	75 m (246 ft)	NT7E40BC	608, 14 pair
22	90 m (300 ft)	NT7E40BP	608, 14 pair
22	106 m (345 ft)	NT7E40BD	608, 14 pair
22	120 m (390 ft)	NT7E40BQ	608, 14 pair
22	137 m (446 ft)	NT7E40BE	608, 14 pair
22	153 m (497 ft)	NT7E40BR	608, 14 pair
22	168 m (546 ft)	NT7E40BF	608, 14 pair
22	182 m (591 ft)	NT7E40BS	608, 14 pair
22	198 m (643 ft)	NT7E40BG	608, 14 pair
26	7 m (24 ft)	NT7E40CG	1249C, 14 pair
26	15 m (49 ft)	NT7E40CA	1249C, 14 pair
26	30 m (95 ft)	NT7E40CH	1249C, 14 pair
26	45 m (148 ft)	NT7E40CB	1249C, 14 pair
26	60 m (197 ft)	NT7E40CJ	1249C, 14 pair
26	75 m (246 ft)	NT7E40CC	1249C, 14 pair
26	90 m (300 ft)	NT7E40CK	1249C, 14 pair
26	106 m (345 ft)	NT7E40CD	1249C, 14 pair
26	120 m (390 ft)	NT7E40CL	1249C, 14 pair
26	137 m (446 ft)	NT7E40CE	1249C, 14 pair

Note: For information on planning your DS1/DS3 mapper layout, see *Commissioning and Testing,* Volume 3.

Each cable carries 14 DS1 transmit channels or 14 DS1 receive channels. Two cables are required to carry the transmit and receive channels for 14 DS1s. To minimize cable congestion, DS1 cables that are connected to the I/O cards in slots 40 to 42 of the I/O area of the TBM shelf, are routed down the left side of the bay or cabinet. Cables to the DS1 cards in slots 43 and up are routed down the right side.

On cables that connect to DS1 input cards, the ground lug at the I/O shelf end of the cable is not used. The unused ground lug is cut off, and the cut end is folded back on itself and protected against shorting with heat-shrinkable tubing. The ground lug at the DSX-1 panel end of the cable is connected to a ground point on the DSX-1 panel.

On cables that connect to DS1 output cards, the opposite is true. The ground lug at the DSX-1 panel is not used. The unused ground lug is cut off, and the cut end is folded back on itself and protected against shorting with heat shrinkable tubing. The ground lug at the I/O shelf end of the cable is connected to a ground point on the ABM shelf.

The length of NT-613 cable to the DSX-1 cross-connect must not exceed 200 m (655 ft). Table 6-2 lists the pin-outs for the DS1 cables.

Table 6-2
Pin-outs for the DS1 cables (P1)

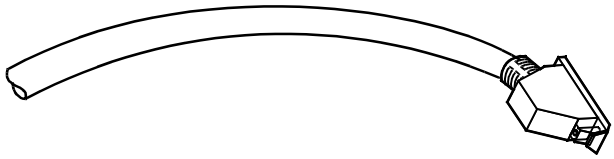
Connector pin		Pair or	Color of pair			
Ring	**Tip**	**DS1 No.**	**Ring**		**Tip**	
31	16	1	BL	W	W	BL
32	17	2	O	W	W	O
33	18	3	G	W	W	G
34	19	4	BR	W	W	BR
35	20	5	S	W	W	S
36	21	6	BL	R	R	BL
37	22	7	O	R	R	O
38	23	8	G	R	R	G
39	24	9	BR	R	R	BR
40	25	10	S	R	R	S
41	26	11	BL	BK	BK	BL
42	27	12	O	BK	BK	O
43	28	13	G	BK	BK	G
44	29	14	BR	BK	BK	BR
-	30	-				
Note: The tip lead is the positive (+) and the ring lead is negative (-).						

External synchronization cable (optional)

External synchronization interface card (ESI) is required in the FCOT in a point-to-point fiber-fed system that serves a GR-303 application, a TR08 application, or Digital Data services. Typically, in a VTBM ring the ESI card is required in one or two nodes located at the central office (FCOT). Other nodes are synchronized using line timing. Systems at remote sites are synchronized to the network and do not require external synchronization. The cable connects clock signals from an external synchronization interface (ESI), such as the building integrated timing supply (BITS) or a DS1 interface, to the external synchronization connector on the left side of the transport bandwidth manager (TBM) shelf.

Note: The ESI cable can only be connected to equipment that is bonded to the same ground point as the TBM shelf. Table 6-3 lists the pin-outs for the NT4K86EA through EE cables.

NT4K86EA through EE



25-pin
D-subminiature male

6-pair, twisted, 22 AWG solid wires with shielding, connectorized at one end only for connection to the TBM shelf, in the following lengths:

15 m	(50 ft)	NT4K86EB
30 m	(100 ft)	NT4K86EA
61 m	(200 ft)	NT4K86EC
91 m	(300 ft)	NT4K86ED
182 m	(600 ft)	NT4K86EE

Table 6-3
Pin-outs for the NT4K86EA through EE cables

Signal	Pin	Color
Primary reference input (Tip)	1	W 1BL
	2	not used
Secondary reference input (Tip)	3	W 1O
	4	not used
DS1 output (Tip), top ESI	5	W 1G
	6	not used
DS1 output (Tip), bottom ESI	7	W 1BR
	8	not used
	9	not used
	10	not used
	11	not used
	12	not used
	13	not used
Primary reference input (Ring)	14	BL 1W
	15	not used
Secondary reference input (Ring)	16	O 1W
	17	not used
DS1 output (Ring), top ESI	18	G 1W
	19	not used
DS1 output (Ring), bottom ESI	20	BR 1W
	21	not used
	22	not used
	23	not used
	24	not used
	25	not used

Modem cable, external modem

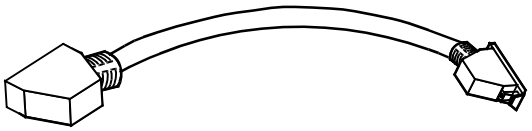
The external modem cable provides access for a remote data terminal equipment (DTE), such as a modem, a VT-100-type terminal, or a printer. To maintain ground isolation, the cable must be connected to an external modem (standard 25-pin connector), located within the IBN. The data terminal equipment (DTE) connection shares the same port as the hand-held terminal (HHT) connection that is accessible on the front of the local craft access panel (LCAP). Only one device can be active at any particular time.

If you are connecting directly to the DTE without going through a modem, you must install an NT7E44MA null modem adaptor between the NT7E44EA or EB cable and the DTE.

> ***Note:*** When a modem is not used, the equipment to be connected must be bonded to the same ground point as the TBM shelf.

Table 6-4 lists the pin-outs for the NT7E44EA and EB cables.

NT7E44EA, EB



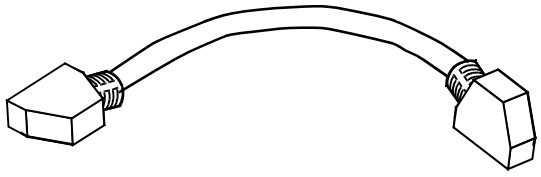
25-pin
D-subminiature male

9-pin
D-subminiature male

10-conductor, twisted, 24 AWG stranded wires with shielding, connectorized at both ends. One end connects to the 9-pin connector on the TBM shelf and the other end is for connection to a 25-pin connector of a remote modem. This cable is available in the following lengths:

5 m (	15 ft)	NT7E44EA
20 m	(60 ft)	NT7E44EB

NT7E44MA null modem adaptor for direct connection to a printer, or a VT-100-type terminal



25-pin
D-subminiature female

25-pin
D-subminiature female

4-pair, 26 AWG solid wire connectorized at both ends. One end connects to the male connector on the NT7E44 cable and the other end connects directly to the terminal or printer.

Table 6-4
Pin-outs for the NT7E44EA and EB cables

25-pin connectors		**9-pin connectors**
Pin	**Signal**	**Pin**
1	not used	
2	Tx	3
3	Rx	2
4	RTS	7
5	CTS	8
6	DSR	6
7	signal ground	5
8	DCD	1
9 to 19	not used	
20	DTR	4
21 to 25	not used	
Note: Pin 9 is not used on the 9-pin connector.		

Modem cable, integral modem

The integral modem cable (NT7E44DD through DF) is used for connecting User Interface Port 1 on a TBM shelf to an integral modem located inside the breaker interface panel (BIP). The integral modem provides remote access for a remote data terminal equipment (DTE), such as a VT100-type terminal.

NT7E44DD, DE, and DF used for integral modems

9-pin
D-subminiature male

9-pin
D-subminiature male

4-pair, twisted, 26-AWG stranded wires with shielding, connectorized at both ends. One end connects to the 9-pin connector on the transport bandwidth manager (TBM) shelf and the other end is for connection to a 9-pin connector on the integral modem. The PEC for the cable to be used depends on the location of the TBM shelf, as follows:

TBM shelf in position 1 use NT7E44DD
(topmost TBM shelf)
TBM shelf in position 2use NT7E44DE
TBM shelf in position 3use NT7E44DF

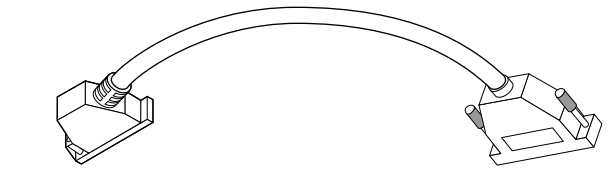
OPC cables that connect to the SIL

The following table lists the OPC cables that connect to the OPC Port 1 connector on the left side of a TBM shelf, and describes the purpose for which these cables are used.

Note: The OPC cables can only be connected to equipment that is bonded to the same ground point as the TBM shelf.

Connector	PEC	Use
OPC Port 1	NT7E44EA, EB	Asynchronous RS232 interface for a modem to OPC, 9600 baud
	NT7E44QA, QB	X25 synchronous interface for a graphics terminal or a remote operations system
	NT7E44RA, RB	Asynchronous RS232 interface for VT-100 terminal or a printer
	NT7E44SA, SB	Asynchronous RS232 interface for a Toshiba laptop computer.
OPC Port 2	NT7E44XA, XB	EIA-530 interface for a graphics terminal or a remote operations system

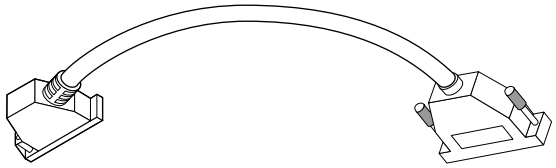
N7E44EA, EB



10-conductor, twisted, 24 AWG stranded wires with shielding, connectorized at both ends. One end connects to the 9-pin connector on the TBM shelf and the other end is for connection to a 25-pin connector of a remote modem. This cable is available in the following lengths:

5 m	(15 ft)	NT7E44EA
15 m	(50 ft)	NT7E44EB

NT7E44RA, RB



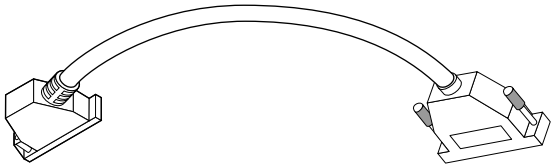
9-pin
D-subminiature

25-pin
D-subminiature

10-conductor, twisted, 24 AWG stranded wires with shielding. One end connects to the 9-pin connector on the TBM shelf and the other end connects to a 25-pin connector on a VT-100 terminal or on a printer. This cable is available in the following lengths:

5 m	(16 ft)	NT7E44RA
20 m	(65 ft)	NT7E44RB

NT7E44QA, QB



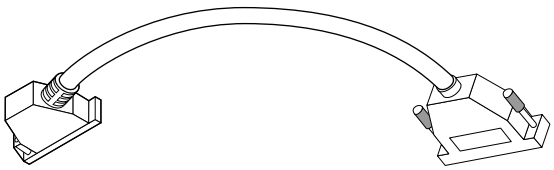
9-pin
D-subminiature

25-pin
D-subminiature

10-conductor, twisted, 24 AWG stranded wires with shielding One end connects to the 9-pin connector on the TBM shelf and the other end connects to a 25-pin connector of an EIA-530 interface on a graphics terminal or on a remote operations system. This cable is available in the following lengths:

5 m	(16 ft)	NT7E44QA
20 m	(65 ft)	NT7E44QB

NT7E44SA or SB



9-pin
D-subminiature

25-pin
D-subminiature

10-conductor, twisted, 24 AWG stranded wires with shielding. One end connects to the 9-pin connector on the TBM shelf and the other end connects to a 9-pin connector of an RS232 interface on a Toshiba laptop computer. This cable is available in the following lengths:

5 m	(16 ft)	NT7E44SA
20 m	(65 ft)	NT7E44SB

NT7E44XA or XB

25-pin
D-subminiature male with slide latch

25-pin
D-subminiature male with screw lock

Twisted pair 26 AWG wires with shielding, connectorized at both ends. One end connects to the 25-pin OPC port 2 connector (J07) on the SIL, and the other end connects to a 25-pin connector of an EA-530 interface. This cable is available in the following lengths:

5 m	(16 ft)	NT7E44XA
20 m	(66 ft)	NT7E44XB

Table 6-5 lists the pin-outs for the NT7E44EA, EB.

Table 6-5
Pin-outs for the 25-pin connector on NT7E44EA, EB

25-pin connector		**9-pin connector**
Pin	**Signal**	**Pin**
1	not used	
2	Tx	3
3	Rx	2
4	RTS	7
5	CTS	8
6	DSR	6
7	signal ground	5
8	DCD	1
9 to19	not used	
20	DTR	4
21 to 25	not used	

Table 6-6 lists the pin-outs for the NT7E44RA, RB.

Table 6-6
Pin-outs for the 25-pin connector on NT7E44RA, RB

25-pin connector		9-pin connector	
Pin	**Signal**	**Pin**	
1	not used		
2	Tx	2	
3	Rx	3	
4	RTS	1	(Note 1)
5	CTS	4	(Note 1 and Note 2)
6	DSR	4	(Note 2)
7	signal ground	5	
8	DCD	7	
9 to19	not used		
20	DTR (Note 3)	6	
20	DTR (Note 3)	8	
21 to 25	not used	9	(Note 4)

Note 1: If you are connecting a North American version of a DEC VT320 or a DEC VT420 terminal, you must short pin 1 (DCD) to pin 4 (DTR) on the 9-pin connector of this cable. If you are connecting an international version of these terminals, the cable can be used without any modification.

Note 2: Pin 4 on the 9-pin connector is connected to pin 5 and pin 6 on the 25-pin connector.

Note 3: Pin 20 on the 25-pin connector is connected to pin 6 and pin 8 on the 9-pin connector.

Note 4: Pin 9 on the 9-pin connector is not used.

Table 6-7 lists the pin-outs for the NT7E44QA, QB.

Table 6-7
Pin-outs for the 25-pin connector on NT7E44QA, QB

25-pin connector		**9-pin connector**
Pin	**Signal**	**Pin**
1	not used	
2	Tx	3
3	Rx	2
4	RTS	7
5	CTS	8
6	DSR	not connected to this end of the cable
7	signal ground	5
8	DCD	not connected to this end of the cable
9 to14	not used	
15	TxCLK	6
16	not used	
17	RxCLK	1
18 and 19	not used	
20	DTR	4
21 to 25	not used	9 (Note)

Note: Pin 9 is not used on the 9-pin connector.

Table 6-8 lists the pin-outs for the NT7E44SA, SB.

Table 6-8
Pin-outs for cables NT7E44SA, SB

9-pin connector at laptop		**9-pin connector at ABM shelf**	
Pin	**Signal**	**Pin**	
1	DCD	4	(Note 1)
2	Rx	3	
3	Tx	2	
4	DTR (Note 2)	6	
4	DTR (Note 2)	1	
5	signal ground	5	
6	DSR	4	(Note 1)
7	RTS	8	
8	CTS	7	
9	not used	9	(Note 3)

Note 1: Pin 4 at the ABM shelf end of the cable connects to pins 1 and 6 at the laptop end of the cable.

Note 2: Pin 4 at the laptop end of the cable connects to pins 1 and 6 at the ABM shelf end of the cable.

Note 3: Pin 9 at the ABM shelf end of the cable is not used.

Table 6-9 lists the pin-outs for the NT7E44XA, XB.

Table 6-9
Pinouts for NT7E44XA and XB

Connector for OPC Port 2 (J07)		**25-pin male connector at the terminal or the remote operations system**	
P1 pin	**Color**	**P2 pin**	**Signal**
2 14	W-BL BL-W	2 14	TXD TXDN
3 16	W-O O-W	3 16	RXD RXDN
4 19	W-GN GN-W	4 19	RTS RTSN
5 13	W-BR BR-W	5 13	CTS CTSN
6 22	W-SL SL-W	6 22	DSR DSRN
8 10	R-BL BL-R	8 10	CD CDN
17 9	R-O O-R	17 9	RXCLK RXCLKN
15 12	R-GN GN-R	15 12	TXCLK TXCLKN
20 23	R-BR BR-R	20 23	DTR DTRN
18 21	R-SL SL-R	18 21	LL RL
11 24	BK-BL BL-BK	11 24	NC in SIL NC in SIL
25 7 (Note 1, 2) 1 (Note 2)	BK-O BK-GN SHIELD (Note 3)	25 7 NC	NC in SIL LGND FGND

Note 1: The signal ground pin 7 is connected as specified in EIA RS-422-A and EIA-530. Foreign ground currents will be conducted into the TBM bay as a result, but this connection is required to reduce common mode voltage differences. Observe normal precautions when connecting to equipment in another ground zone.

Note 2: Pins 1, 7, and 25 are not twisted pairs.

Note 3: The shield is connected at the DTE only. This provides shielding at the TBM end of the cable to meet EMI requirements without providing undesirable ground connections between office ground zones.

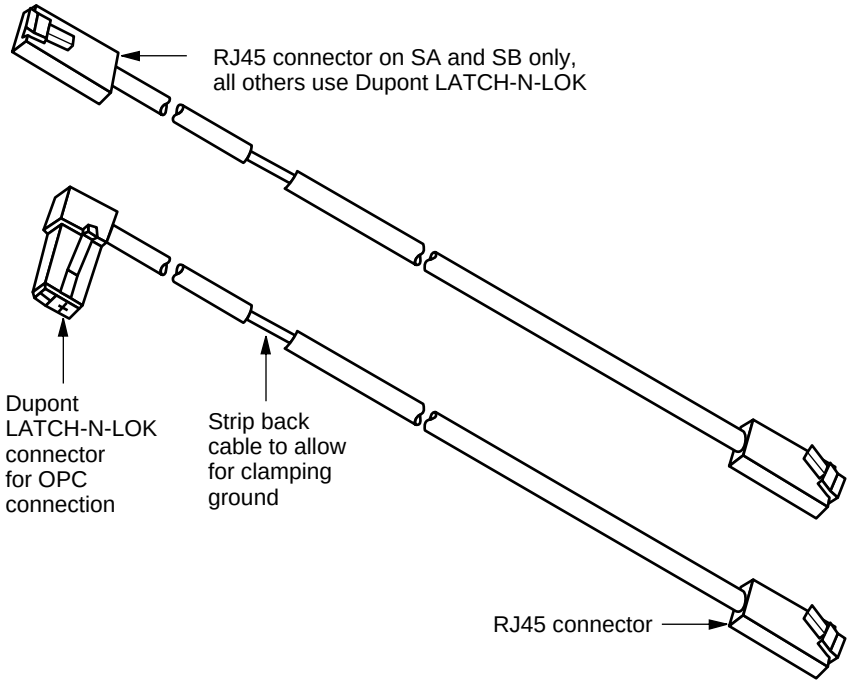
OPC Ethernet cable kit

The OPC Ethernet cable attaches to the faceplate of the OPC module and connects the OPC module to an Ethernet hub, an X-terminal, a multiple access unit (MAU), or a portable OPC terminal.

Note: OPC Ethernet cables can only be connected to equipment that is bonded to the same ground point as the ABM shelf.

PC-10348

NT4K86LA, LB, LC and NT4K86SA, SB, SC, SD



Shielded cable, terminated at the OPC-end with a Dupont LATCH-N-LOK connector, and at the terminal-end with an RJ45 connector. The cables, their lengths and uses are as follows:

Length	PEC	Uses
20 m (60 ft)	NT4K86LA	MAU or Ethernet LAN
40 m (120 ft)	NT4K86LB	MAU or Ethernet LAN
100 m (300 ft)	NT4K86LC	MAU or Ethernet LAN
5 m (15 ft)	NT4K86SA	X-terminal or portable OPC
20 m (60 ft)	NT4K86SB	X-terminal or portable OPC
40 m (120 ft)	NT4K86SC	X-terminal
100 m (300 ft)	NT4K86SD	X-terminal

The location of the stripped area of the cable jacket shown in the previous figure depends on the location of the OPC module. To reduce manufacturing costs that would result from stocking a number of variants with different placement of the stripped area, the cable jacket is field stripped during installation. The procedure for stripping the cable jacket is contained in *Bay in Central Office Installation Manual—ABM,* 323-3001-201.

Table 6-10 lists the pin-outs for the NT4K86LA, LB, and LC cables.

Table 6-10
Pin-outs for NT4K86LA, LB, and LC cables

OPC module faceplate connector		RJ45 connector	
Signal	**Pin**	**Pin**	**Signal**
Tx +	1	1	Tx +
Tx -	2	2	Tx -
Rx -	5	6	Rx -
Rx +	6	3	Rx +

Table 6-11 lists the pin-outs for the NT4K86SA, SB, SC, and SD cables.

Table 6-11
Pin-outs for NT4K86SA, SB, SC, and SD

OPC module faceplate connector		RJ45 connector	
Signal	**Pin**	**Pin**	**Signal**
Tx +	1	3	Rx +
Tx -	2	6	Rx -
Rx -	5	2	Tx -
Rx X	6	1	Tx +

Optical patch cords

Fiber patch cords (single-mode overall jacketed cable with or without miniature variable optical attenuators [Mvoa]), connect the 600 Mb/s optical signals between the transport bandwidth manager (TBM) shelf and an external fiber patch panel, or cross-connect equipment such as the Fiber Manager Frame (FMF) available from Nortel Networks.

Table 6-12 lists the product engineering codes for the optical patch cords.

Table 6-12
Optical patch cords

PEC	Length (in meters)	Connector type
NT7E46AA NT7E46AB NT7E46AC NT7E46AD NT7E46AE	5 10 15 20 30	Biconic-biconic
NT7E46BF NT7E46BA NT7E46BB NT7E46BC NT7E46BD NT7E46BE	3 5 10 15 20 30	FC-FC
NT7E46CF NT7E46CA NT7E46CB NT7E46CC NT7E46CD NT7E46CE	3 5 10 15 20 30	ST-ST
NT7E46FA NT7E46FB NT7E46FC NT7E46FD NT7E46FE	5 10 15 20 30	SC-SC

Table 6-13 lists the product engineering codes for the optical patch cords with miniature variable optical attenuators and the optical pigtails with and without miniature variable optical attenuators.

Optical patch cords and pigtails with miniature variable optical attenuators install at the receiver of the OC-12 optical interface. To each TBM shelf, four fiber cables are required for primary transport, and eight optional cables for secondary and tributary transport access.

Fiber patch cords are routed inside a horizontal channel of the TBM shelf to the right side of the bay upright. They are then encased in spiral-wrap tubing for protection. Typically, a 13 mm (0.5 in.) tubing accommodates 4 to 14 fiber patch cords. The length of split tubing corresponds to the length required for the fiber cabling.

Table 6-13
Optical patch cords with miniature variable optical attenuators

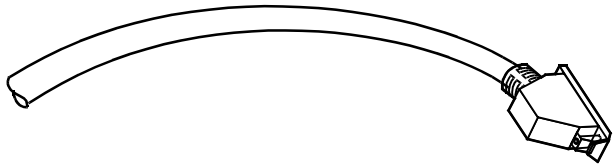
PEC	Length (in meters)	Connector type
Optical patch cords with miniature variable optical attenuators		
NT7E47AA NT7E47AB NT7E47AC NT7E47AD NT7E47AE	5 10 15 20 30	Biconic-biconic
NT7E47BA NT7E47BB NT7E47BC NT7E47BD NT7E47BE	5 10 15 20 30	FC-FC
NT7E47CA NT7E47CB NT7E47CC NT7E47CD NT7E47CE	5 10 15 20 30	ST-ST
NT7E47FA NT7E47FB NT7E47FC NT7E47FD NT7E47FE	5 10 15 20 30	SC-SC
Optical pigtails		
NT7E48AA NT7E48BA NT7E48CA NT7E48FA	20 20 20 20	Biconic FC ST SC
NT7E49AA NT7E49BA NT7E49CA NT7E49FA	20 20 20 20	Biconic (MVOA) FC (MVOA) ST (MVOA) SC (MVOA)

Orderwire extension cable

The orderwire cable connects orderwire circuits from the left connector of the transport bandwidth manager (TBM) shelf to the office orderwire network. Orderwire circuits allow maintenance technicians to communicate between sites.

Table 6-14 lists the pin-outs for the NT4K85CA, CB, CC, CE, and CF cables.

NT4K85CA, CB, CC, CE and CF



25-pin
D-subminiature male

12-pair, twisted, 26 AWG solid wires connectorized at one end for connection to the TBM shelf, and the other end free for customer termination to the intended office equipment. This cable is available in the following lengths:

15 m	(50 ft)	NT4K85CE
30 m	(100 ft)	NT4K85CA
61 m	(200 ft)	NT4K85CB
91 m	(300 ft)	NT4K85CC
122 m	(400 ft)	NT4K85CF

Table 6-14
Pin-outs for the NT4K85CA, CB, CC, CE, and CF cables

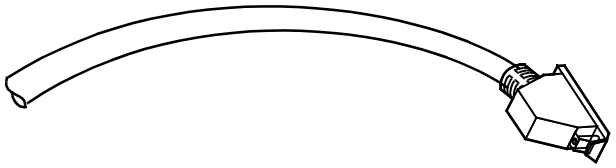
Signal	Pin	Pair	Color
2W OW jack Tip	1	1	W
2W OW jack Ring	2	1	BL
4W OW handset T	3	2	W
4W OW handset T1	4	2	O
4W OW handset R	5	3	W
4W OW handset R1	6	3	G
4W OW handset S	7	4	W
4W OW handset S1	8	4	BR
Brdcst Call	9	5	W
Bell Ext OW	10	5	S
Bell (return)	11	6	R
LED Loc OW	12	6	BL
LED Exp OW	13	7	R
Select Loc OW	14	7	O
Select Exp OW	15	8	R
Common Return	16	8	G
Common Return	17	jumpered to 16	
4W Loc OW T input	18	9	R
4W Loc OW R input	19	9	BR
4W Loc OW T1 output	20	10	R
4W Loc OW R1 output	21	10	S
4W Exp OW T input	22	11	BK
4W Exp OW R input	23	11	BL
4W Exp OW T1 output	24	12	BK
4W Exp OW R1 output	25	12	O

Parallel telemetry cable

The parallel telemetry cable connects E2A parallel telemetry inputs and outputs from the parallel telemetry connector of the transport bandwidth manager (TBM) shelf to the office cross-connect.

Each of the 18 telemetry outputs on the shelf is a signal distribution point capable of reporting alarm status information. Outputs connect to external systems, such as surveillance and control of transmission systems (SCOTS) and telecommunication alarm surveillance and control (TASC). Each of the inputs is a scan point, polled every 500 ms to detect changes to the input state (loop closure, battery, or ground). Each of the inputs is provisionable for its active state as a minor, major, or critical alarm.

NT4K85GA, GB, GC, GE, and GF



44-pin
D-subminiature male

25-pair, twisted, 26 AWG solid wires connectorized at one end for connection to the TBM shelf, in the following lengths:

15 m	(50 ft)	NT4K85GE
30 m	(100 ft)	NT4K85GA
61 m	(200 ft)	NT4K85GB
91 m	(300 ft)	NT4K85GC
122 m	(400 ft)	NT4K85GF

Table 6-15 lists the pin-outs for the NT4K85GA, GB, GC, GE, and GF cables.

Note: The parallel telemetry inputs (IN 01 to IN 11) and outputs (OUT 15 to OUT 18) have parallel access with the wire-wrap block pin detail in the BIP.

Table 6-15
Pin-outs for the NT4K85GA, GB, GC, GE, and GF cables

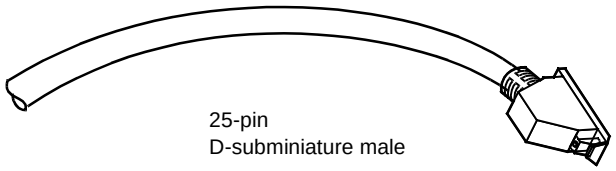
Signal	Pin	Pair	Color		Signal	Pin	Pair	Color	
OUT 01	1	1	BL	1W	IN 03	23	12	O	1BK
OUT 02	2	1	W	1BL	IN 04	24	12	BK	1O
OUT 03	3	2	O	1W	IN 05	25	13	G	1BK
OUT 04	4	2	W	1O	IN 06	26	13	BK	1G
OUT 05	5	3	G	1W	IN 07	27	14	BR	1BK
OUT 06	6	3	W	1G	IN 08	28	14	BK	1BR
OUT 07	7	4	BR	1W	IN 09	29	15	S	1BK
OUT 08	8	4	W	1BR	IN 10	30	15	BK	1S
OUT 09	9	5	S	1W	IN 11	31	16	BL	1Y
OUT 10	10	5	W	1S	IN 12	32	16	Y	1BL
OUT 11	11	6	BL	1R	IN 13	33	17	O	1Y
OUT 12	12	6	R	1BL	IN 14	34	17	Y	1O
OUT 13	13	7	O	1R	IN 15	35	18	G	1Y
OUT 14	14	7	R	1O	IN 16	36	18	Y	1G
OUT 15	15	8	G	1R	IN 17	37	19	BR	1Y
OUT 16	16	8	R	1G	IN 18	38	19	Y	1BR
OUT 17	17	9	BR	1R	IN 19	39	20	S	1Y
OUT 18	18	9	R	1BR	IN 20	40	20	Y	1S
OUT Return	19	10	S	1R	IN 21	41	21	BL	1V
OUT Return	20	10	R	1S	IN 22	42	21	V	1BL
IN 01	21	11	BL	1BK	IN Return	43	22	O	1V
IN 02	22	11	BK	1BL	IN Return	44	22	V	1O

Note: Signals IN 12 to IN 22 are for future use.

Serial telemetry cable

The serial telemetry cable connects telemetry byte-oriented serial (TBOS) RS-422 signals from the left connector of the transport bandwidth manager (TBM) shelf to external E2A alarm processing remote (APR) office equipment. The serial telemetry provides alarm points controlled by the external E2A APR equipment.

NT4K86CA, CB, CC



8-pair, twisted, 26 AWG solid wires, connectorized at one end for connection to the TBM shelf, and the other end free for customer termination to the E2A alarm processing remote (APR). This cable is available in the following lengths:

15 m	(50 ft)	NT4K86CB
30 m	(100 ft)	NT4K86CA
61 m	(200 ft)	NT4K86CC

Table 6-16 lists the pin-outs for the NT4K86CA, CB, and CC cables.

Table 6-16
Pin-outs for the NT4K86CA, CB, and CC cables

Signal	Pin	Pair	Color		Signal	Pin	Pair	Color	
	1		NC		Port 2 Tx-	14	7	O	1R
	2		NC		Port 2 Tx+	15	7	O	2R
	3		NC		Port 2 Rx+	16	1	BL	2W
Port 2 Rx-	4	1	BL	1W	Port 1 Rx+	17	2	O	2W
Port 2 Rx-	5	2	O	1W	Port 1 Tx+	18	3	G	2W
Port 1 Tx-	6	3	G	1W		19		NC	
	7		NC			20		NC	
	8		NC		future	21	8		
	9		NC		future	22	8		
	10		NC		future	23	4		
future	11				future	24	5		
future	12				future	25	6		
future	13								

NC = no connection

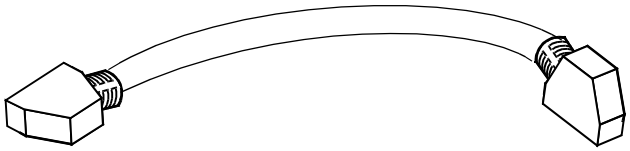
User interface cable for the LCAP

The user interface cable allows the temporary connection of a printer, a VT-100-type terminal, or a modem to the User interface Port 2 connector on the faceplate of the local craft access panel (LCAP).

> ***Note:*** When a modem is not used, the equipment to be connected must be bonded to the same ground point as the TBM shelf.

If you are connecting the LCAP to a modem, you must connect an NT7E44MB null modem adaptor between the NT7E44FA, FB cable and the modem or printer.

NT7E44FA and FB



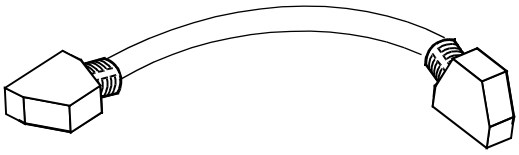
25-pin
D-subminiature male

25-pin
D-subminiature male

4-pair, twisted, 26 AWG solid wires with shielding, connectorized at both ends. One end connects to the 25-pin connector on the faceplate of the LCAP and the other end is for connection to a 25-pin connector of a VT-100 terminal. This cable is available in the following lengths:

5 m	(16 ft)	NT7E44FA
20 m	(66 ft)	NT7E44FB

NT7E44MB null modem adaptor for connection to a modem



25-pin
D-subminiature female

25-pin
D-subminiature female

4-pair, 26 AWG solid wire connectorized at both ends. One end connects to the male connector on the NT7E44FA or FB cable and the other end connects directly to the modem.

Pin-outs for NT7E44FA, FB cables

This cable has a “straight-through” construction. Pin 1 on one male connector is connected to pin 1 on the other male connector, pin 2 is connected to pin 2, and so on.

Table 6-17 lists the pin-outs for the NT7E44FA and FB cables.

Table 6-17
Pin-outs for the NT7E44FA and FB cables

Pin on 25-pin male connector	Color code	Signal	Pin on second 25-pin male connector
1	BK	not used	1
2	BR	Rx	2
3	R	Tx	3
4	O	RTS	4
5	Y	CTS	5
6	G	DSR	6
7	BL	signal ground	7
8	V	DCD	8
9 to19	not connected	not used	9 to19
20	W BK BR stripes	DTR	20
21 to 25	not connected	not connected	21 to 25

DS3 cables

The DS3 cable connects the signals of DS3 Input or DS3 Output cards on the transport bandwidth manager (TBM) shelf to the office DSX-3 cross-connect. These cables are also used for STS-1.

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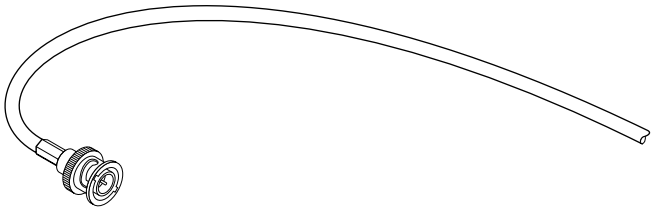
NT7E43AA through AH, and NT7E43AJ through AL



NT-734-E coaxial cables preconnectorized at one end with a BNC connector. These cables are available in the following lengths:

5 m	(16.4 ft)	NT7E43AA
10 m	(32.8 ft)	NT7E43AB
20 m	(65.6 ft)	NT7E43AC
30 m	(88.4 ft)	NT7E43AD
40 m	(131.1 ft)	NT7E43AE
50 m	(163.9 ft)	NT7E43AF
60 m	(196.7 ft)	NT7E43AG
75 m	(245.9 ft)	NT7E43AH
80 m	(262.3 ft)	NT7E43AJ
100 m	(327.9 ft)	NT7E43AL
140 m	(459.0 ft)	NT7E43AK

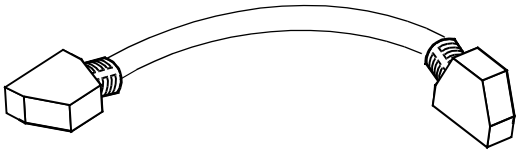
It is recommended that you use a Schleuniger coaxial stripper tool Model HZ207A (Tool room number T00067) and BNC connector kit (Tool room number K000702) when installing BNC connectors in the field.

Note: For information on planning your DS1/DS3 mapper layout, see *Commissioning and Testing,* Volume 3.

TBM shelf alarm cables (TBM intershelf cables)

Each TBM shelf contains alarm cables that are factory wired to the BIP. These cables carry internal alarm information from the shelf for display at the BIP.

NT7E5650, NT7E5651, and NT7E5652 internal TBM shelf alarm cables to BIP



25-pin
D-subminiature female

25-pin
D-subminiature female

4-pair, 26 AWG solid wire connectorized at both ends. One end connects to the male connector on the TBM shelf connector and the other end connects directly to the BIP.

These cables are used as follows:

- NT7E5650 is used for TBM shelf 1.
- NT7E5651 is used for TBM shelf 2.
- NT7E5652 is used for TBM shelf 3.

Note: When using the NT7E56CA BIP, one NT7E5681 split cable replaces the three BIP alarm cables (NT7E5650, NT7E5651, NT7E5652) used with the NT7E56AA/AB/BA BIPs.

Table 6-18 shows the pin assignments for the TBM shelf alarm cables.

Table 6-18
TBM shelf alarm cable pin assignments

P1 pin	Color	P2 pin	Color
1	BL	1	BL
2	BR	2	BR
3	GR	3	GR
4	R	4	R
5	Y	5	Y
6	BL	6	BL
7	V	7	V
8	SL	8	SL
9	OR	9	OR
10	W	10	W
11	W-BK	11	W-BK
12	W-BR	12	W-BR
13	W-G	13	W-G
14	W-R	14	W-R
15	W-Y	15	W-Y
16	W-BL	16	W-BL
17	W-V	17	W-V
18	W-S	18	W-S
19	W-O	19	W-O
20	W-BK-BR	20	W-BK-BR
21	W-BK-S	21	W-BK-S
22	W-BK-R	22	W-BK-R
23	W-BR	23	W-BR
24	W-BK-BL	24	W-BK-BL
25	W-BK-O	25	W-BK-O

Table 6-19 shows the signal assignments for the TBM shelf alarm cables

Table 6-19
TBM shelf alarm signal assignments

Pin	Alarm type	Signal
20	Critical alarm	Normally open
19	Critical alarm	Commonly closed
7	Critical alarm	Normally closed
17	Major alarm	Normally open
4	Major alarm	Commonly closed
16	Major alarm	Normally closed
25	Critical alarm	Normally open
24	Critical alarm	Commonly closed
13	Critical alarm	Normally closed
12	Major alarm	Normally open
23	Major alarm	Commonly closed
11	Major alarm	Normally closed

Tools and test apparatus requirements

This chapter lists the tools, materials, and test apparatus required for installation of AccessNode equipment include the following items.

Tools

Certain tools, materials and test equipment are required for the installation of the AccessNode bays and cabinets. Use the following list of required tools, materials, and test equipment as an aid to assist you in planning for the installation.

- cable cutters
- chalk line
- cotton gloves and safety goggles
- crimping tool (Thomas-Betts, or equivalent)
- combination wrench, 3/4 in.
- extra-deep socket, 19 mm (0.75 in.)—specific to M12 anchoring
- extra-deep socket, 16 mm (0.625 in.)—specific to standard anchoring
- frame mover
- hex nut drivers (set)
- hammer, ball peen type, 2 lbs
- hammer, claw type
- lacing needle, for cable lacing
- masonry drill bit, size 18 mm (0.71 in.)—specific to M12 anchoring
- masonry drill bit, size 16 mm (0.625 in.)—specific to standard anchoring
- measuring tape, 15 m (50 ft)
- pliers, side cutting
- pliers, needle nose
- roto hammer drill, Hilti TE-52
- rubber bulb
- socket wrench, 1/2 in. drive

- spirit level, 610 mm (24 in.)
- square, steel 406 x 610 mm (16 x 24 in.)
- star drill
- string or twine
- tin snips, 10 in.
- torque wrench, 1/2 in. drive
- vacuum cleaner

For connecting BNC connectors to RG-59U coaxial cables, the following tools are required:

- crimping tool, Coaxion 220190-1, or equivalent
- crimping die set, Coaxion 220189-7, or equivalent

For connecting AMP Champ connectors to customer-supplied VF cables, the following tool is required:

- crimping tool, AMP Champ MI-1 equipped withlacing fixture 230328 for 180 degree wire dress, or equivalent

Materials

- cable ties
- masonite sheet
- roll of adhesive tape
- shims, 1/16 and 1/8 in.
- optical patch cord kit, for joining optical patch cords

Test equipment

- digital multimeter, used during the dc power installation

Optical link planning overview

This chapter gives an overview of the components and general requirements for an optical link network. The operating company is responsible for the procurement and installation of the optical link network feeder and distribution fiber cables.

Chapter contents

This chapter contains the following information:

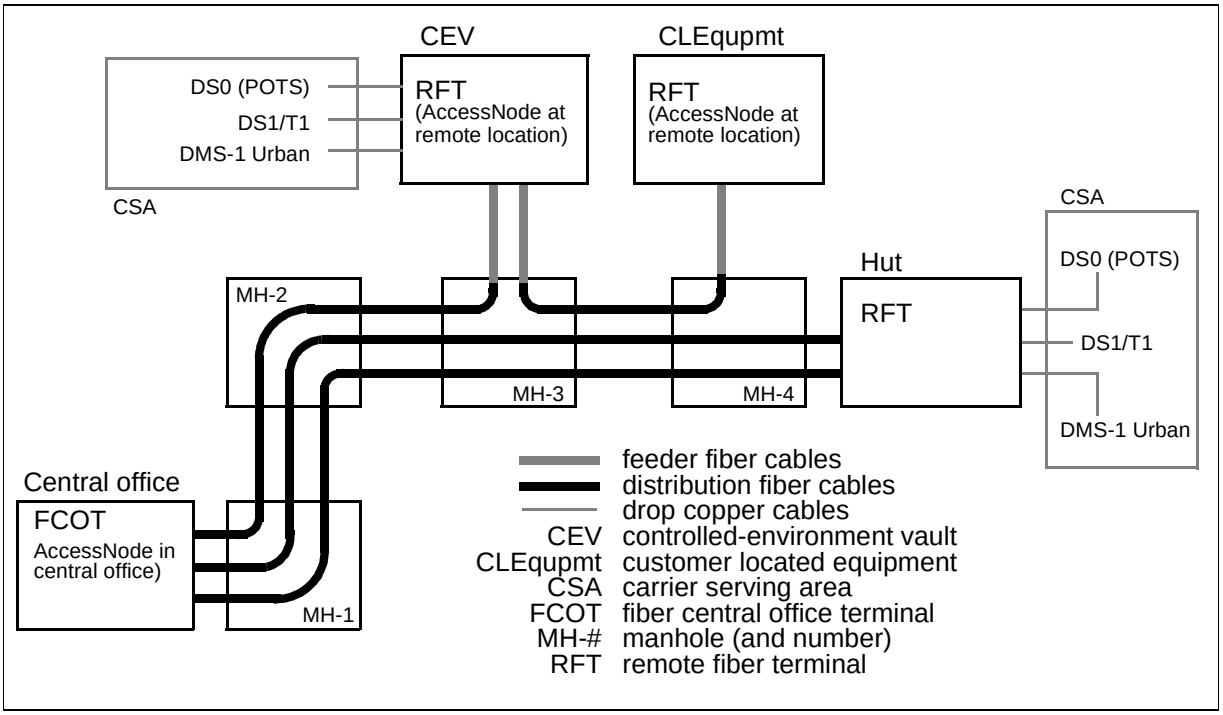
AccessNode optical link components

Typical components of optical links on the AccessNode include the following:

- fiber central office terminal (FCOT), the AccessNode at the switching office
- RFTs, the remote AccessNodes
- feeder cables and distribution cables providing the optical links between AccessNodes
- drop copper cables linking the RFTs and customer equipment (DMS-1 Urban, plain old telephone service [POTS], and DS1/T1 services)

Figure 8-1 shows a schematic diagram of typical AccessNode optical links.

Figure 8-1
Typical optical link



Fiber cable requirements

OC-3 and OC-12 fiber cable links must be single-mode, while OC-1 fiber cable links can be single- or multi-mode. All fiber cabling must be rated for operation at 1310 nm, and must meet the transmission requirements of AccessNode as explained in Chapter 9, “Optical link engineering”.

The system engineering plans must identify the number of optical feeder cables and distribution cables required (including protection switching channel), and the length of each one, for the following links:

- FCOT to RFT
- between RFTs (if applicable)

Interface equipment

Fiber cables terminate at various types of equipment supplied by either Nortel Networks or other manufacturers, as follows:

- fiber cross-connect bay at the central office location, and in a controller environment vault (CEV) or hut location
- fiber splice tray at any location where the quantity of terminating fibers are few, or where space is restricted, as in outside-plant cabinets

Fiber cable handling requirements

CAUTION
Potential equipment damage
Take care to avoid damage while handling and placing fiber cables. Avoid sharp bends and take precautions to prevent crushing the cable during placement. Any such damage may alter the high-capacity transmission characteristics, to the extent that the cable may have to be replaced.

Bridge the cable with 38 mm x 191 mm (2 in.by 8 in.) planks when it is placed on the ground at locations where it is subject to crushing, for example, in front of driveway entrances or at road crossings.

Do not exceed the maximum pulling tension and maximum bending radius. Typical values are as follows:

- The pulling tension for the cables is 1800 N to 2700 N (400 to 600 pounds-force).
- The bending radius should not be less than 10 times the outside diameter (10 x OD) during static state, or 16 times the outside diameter (16 x OD) during a dynamic state.

Route planning

The optical link engineering plans require that you be familiar with the route, type of terrain, depth and type of soil to be encountered. The outside-plant engineer and the construction manager should jointly survey the cable route to obtain an accurate assessment of the route environment.

Fiber cable placement procedures and materials

Fiber cable placement is the responsibility of the operating company. Personnel involved in placing underground optical fiber cables must be familiar with the standard procedures of the operating company that describe rodding and cleaning ducts, pneumatic wiring, underground placing equipment, and splice closures.

Personnel involved in burying optical fiber cables must be familiar with standard company practices on buried cable placement, precautions for placement, and back-filling procedures.

Using pulling eyes

Underground cable sections require an appropriate pulling eye at one end for a unidirectional pull, or at both ends for a bidirectional pull. If cables are supplied without pulling eyes, the correct pulling eye must be available for attachment by the installers.

Wiring an unoccupied duct

Wiring an unoccupied duct should be done in advance of the cable placement operation so that obstructions can be cleared in time for cable placement.

Where cable ducts are significantly larger than the diameter of the cable being placed, more than one length of cable can be pulled at the same time, providing the pulling eyes are staggered to reduce the overall outside diameter.

Wiring an occupied duct

Usually optical fiber cable can be placed in an occupied duct if the clearance between the existing cable and the inside duct wall is greater than 38 mm (1.5 in.).

Using subducts

Subducts are not recommended, except in unusual situations, such as the following:

- older ducts with known obstructions
- ducts in which larger cables will be placed

If subducts are required, they must be installed prior to placing the fiber cables. Also, ensure that the pulling hardware is small enough to clear the inner dimensions of the subduct.

The recommended subduct material is 32 mm (1.25 in.) inside diameter (ID), 75 psi medium density #2305 polyethylene pipe. Two of these can be placed in a 102 mm (4.0 in.) inside diameter (ID) duct. Other 32 mm (1.25 in.) inside diameter (ID) subducts are also acceptable.

Placing cable

You need to know the size and length of cable required, and the fiber assignment for each leg of the link. You must also know the overall route distribution, so you can identify which fibers are assigned for a specific link leg.

Using the example shown in Figure 8-2, the following details would be identified:

- the number of fibers and their assignment for feeder cables between the central office (CO) and the CEV (“A”), feeder cables between the CEV and the customer-located equipment (“B”), feeder cables between the CO and the MH-4 (“C”), and the distribution cables between MH-4 and the hut (“D”).
- the length of feeder cables A, B, and C, and distribution cables D.

- the reel-end splice locations.
- which underground cable sections require either a bidirectional or unidirectional pulling technique.

  Note: Any sections having lengths of over 2 km (6560 ft), or with over 180 degrees of total bending radius, should be pulled bidirectionally. Ducts in poor condition or with known obstructions should also be pulled bidirectionally.

Figure 8-2
Typical optical link feeder cable pull technique

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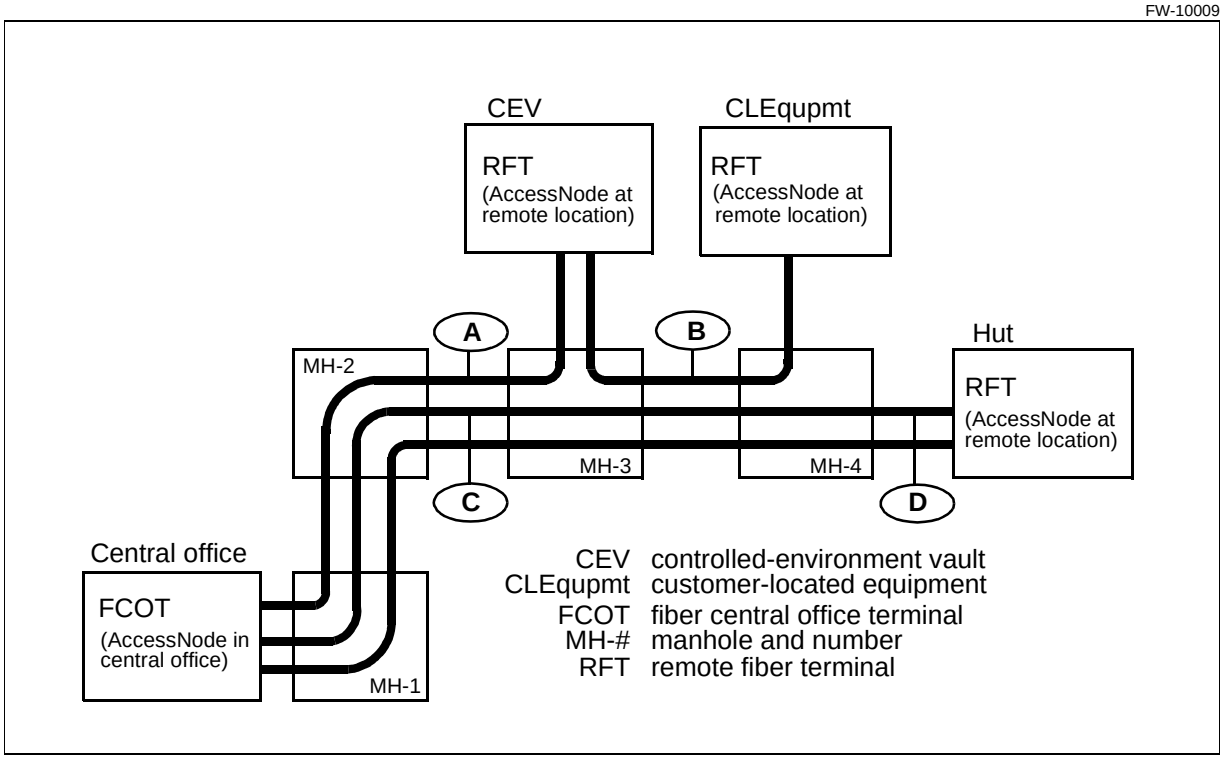


Unidirectional pulling example

Place the cable reels for cables A and C at manhole 1 (MH-1), and make the first pull from MH-4. Stop the pull when it reaches MH-3 and detach cable A, and attach cable B from its reel placed at MH-3, to complete the pull through to MH-4. Sufficient length of cable remaining on the reels at MH-1 allows the cables to be pulled into the central office.

Bidirectional pulling example

Place the cable reel at the selected midpoint (at MH-2) and complete the pull to MH-4. Unreel the remaining cable at MH-2 and lay it on the ground in a figure-eight pattern. Make the second pull from MH-2 to MH-1, with an additional length of cable at MH-1 to allow for the cables to be pulled into the central office.

Potential hazards

The following paragraphs, warnings, and cautions for handling optical fiber products and fiber cables are intended to complement the safety procedures of the operating company.

Pulling fiber cabling

DANGER

Do not enter a pull-through manhole until after the pulling attachment has passed through.

When working in an underground environment, observe all the standard operating-company safety precautions.

Optical fiber radiation

DANGER

Avoid visual eye contact with any laser device output or open end of any optical fiber.

The radiation from laser devices or opened optical fiber cables can cause serious eye damage.

The emitted light wavelength from any open-ended optical fiber or laser device output (including test apparatus) may not necessarily be visible to the human eye and, therefore, must never be considered absent at any time when the optical path is opened. The manufacture of laser products requires the device to be classified into Class I, II, III, or IV depending upon the characteristics of the laser radiation emitted. Class I is the lowest level, which represents no hazard to safety or health, whereas Class IV represents the greatest hazard.

AccessNode is classified as Class I when the system is connected in normal operation, but when the optical path is opened intentionally or accidentally, or when test apparatus are being used, the emitted radiation is Class IIIb, which can cause serious damage to eyes if visual contact is made with the emitted light.

Safety rules and precautions

The following paragraphs list safety rules and precautions for maintenance testing and optical fiber splicing.

Maintenance testing

Follow these safety rules during maintenance testing:

- Follow the safety precautions recommended by the operating company.
- Avoid direct exposure to fiber optical connector ends where the laser signal can be accessed.

- Place a dust cap over the end of any opened fiber connector.
- Follow the manufacturer's instructions when using an optical test set. Misalignment and wrong settings may result in hazardous radiation.

Optical fiber splicing

Follow these safety rules when splicing of the optical fiber path, whether in the course of normal operations or in case of accidental breakage of the fiber:

DANGER

Optical fibers can splinter and enter the eye.

Wear protective eye glasses when handling optical fiber and avoid hand-to-eye contact to prevent small bits of glass from entering the eye. Seek medical help if there is any suspicion of a glass chip having entered the eye.

- Follow the safety precautions recommended by the operating company.
- When splicing fibers, ensure that the laser source of the system, or any test apparatus connected to the optical path, is shut off. Test sets should not even be connected, to avoid accidental turning on of the test apparatus during splicing of the fiber.
- Use optical instruments recommended by the operating company, if it is required to view the fiber during the splicing procedure.
- Wear protective eye glasses when handling optical fibers.
- Avoid hand-to-eye contact when handling optical fibers. Wipe your hands with a hand-tissue paper to ensure that no glass chips are present.
- Place all fiber cuttings or splinters in a safe container. Use tweezers or sticky tape instead of bare fingers to pick up glass pieces.
- Place a dust cap over the end of any opened fiber connector.
- Avoid direct exposure to fiber optical ends where the laser signal can be accessed.
- Follow the manufacturer's instructions when using an optical test set. Misalignment and wrong settings may result in hazardous radiation.

Optical link engineering

This chapter provides the method for engineering standard single-mode 1310 nm optical link for network elements.

Chapter contents

This chapter contains the following information:

Optical interface specifications

AccessNode OC-12, OC-3 and OC-1 equipment modules comply with the SONET optical interface specifications as defined by ECSA committee T1X1.4 in *Optical Interface Rates and Format Specifications*, T1.105, March 1988.

This chapter explains how to engineer standard single-mode 1310 nm optical link for network elements using the following circuit packs:

- OC-1 interface circuit packs
- OC-3 optical interface circuit packs
- OC-12 optical interface circuit packs
- OC-12 virtual tributary bandwidth manager (VTBM) circuit packs

In each case, the optical link reach is strictly loss-limited, and not dispersion limited, when using the specified standard single-mode optical fiber.

The optical interface specifications for the OC-12, OC-3, and OC-1 modules are presented in the following tables:

- Table 9-1 on page 9-3 shows the specifications for the short-reach and long-reach versions of the OC-1 optical interface circuit pack.
- Table 9-2 on page 9-4 shows the specifications for the intermediate-reach and long-reach versions of the OC-3 optical interface circuit pack (NT7E01).
- Table 9-3 on page 9-5 shows the specifications for the intermediate-reach and long-reach versions of the OC-12 optical interface circuit pack (NT7E02).
- Table 9-4 on page 9-6 shows the specifications for the intermediate-reach and long-reach versions of the OC-12 VTBM optical interface circuit pack.
- Table 9-5 on page 9-7 shows the Bellcore specifications for the intermediate-reach and long-reach versions of the OC-12 VTBM optical interface circuit pack.

Refer to *System Specifications*, 323-3001-180, in *Description*, Volume 2B, for full optical specifications.

The specification parameters presented in Table 9-1, Table 9-2, Table 9-3, Table 9-4, and Table 9-5 represent the worst cases for each type of module, which include connector losses, aging, equipment impairments due to implementation, and temperature degradation, at the maximum link bit-error rate (BER) of 10^{-10} for OC-12 and OC-3, and a maximum link BER of 10^{-12} for OC-1.

Table 9-1 lists the specifications for the OC-1 optical interface circuit pack.

Table 9-1
Specifications for OC-1 optical interface circuit pack (NT2A11, NT2A12, NT2A13)

Specification	**Long-reach (LR) models NT2A11HA/KA NT2A12HA/KA NT2A13HA/KA**	**Short-reach (SR) models NT2A11BA/EA NT2A12BA/EA NT2A13BA/EA**
Optical line rate	OC-1 (51.84 Mb/s)	OC-1 (51.84 Mb/s)
Wavelength of operation	1300 nm	1300 nm
Minimum transmitter power ($P_{T\ min}$)	–11.5 dBm	–24.5 dBm
Maximum transmitter power ($P_{T\ max}$)	–11.0 dBm	–23.5 dBm
Minimum receiver power ($P_{R\ min}$)	–36.5 dBm	–36.5 dBm
Maximum receiver power ($P_{R\ max}$)	–2.0 dBm	–2.0 dBm
Receiver damage level	N/A	N/A
Guaranteed system gain ($G = P_{T\ min} - P_{R\ min}$)	25.0 dB	12.0 dB

Note 1: Overload level is the maximum received optical power for which the OC-1 BER of 10^{-12} and all jitter tolerance specifications are met.The overload level (-2.0 dBm) for the OC-1 module is well above the maximum output power of the transmitter. No miniature variable optical attenuators (mVOAs) are required for the OC-1 module as no saturation will occur.

Note 2: The OC-1 transmitter can operate into a receiver which is a non-Nortel Networks OC-1 Access Module receiver, and similarly, the OC-1 receiver can accept signals from a non-Nortel Networks OC-1 Access Module transmitter. However, the full OC-1 link specifications may not necessarily be met when Nortel Networks and non-Nortel Networks OC-1 equipment are interworking over the same link.

Note 3: The long-reach (laser) OC-1 module supports single-mode fiber only. Both multi-mode and single-mode fibers are supported with the short-reach (LED) module.

Table 9-2 lists the specifications for the OC-3 optical interface circuit pack.

Table 9-2
Specifications for OC-3 interface optical circuit pack (NT7E01)

Specification	Long-reach (LR) models NT7E01CA/CB/CC/CD	Intermediate-reach (IR) models NT7E01DA/DB/DC/DD
Optical line rate	OC-3 (155.52 Mb/s)	OC-3 (155.52 Mb/s)
Wavelength of operation	1310 nm	1310 nm
Minimum transmitter power ($P_{T\ min}$)	–5.0 dBm	–15.0 dBm
Maximum transmitter power ($P_{T\ max}$)	0.0 dBm	–8.0 dBm
Minimum receiver power ($P_{R\ min}$)	–34.0 dBm	–28.0 dBm
Maximum receiver power ($P_{R\ max}$)	–10.0 dB	–8.0 dB
Receiver damage level	N/A	N/A
Guaranteed system gain ($G = P_{T\ min} - P_{R\ min}$)	29.0 dB	13.0 dB
Note: Overload level is the maximum received optical power for which the OC-3 BER of 10^{-10} and all jitter tolerance specifications are met. An mVOA can be required at the OC-3 receiver end depending on the link loss.		

Table 9-3 lists the specifications for the OC-12 optical interface circuit pack.

Table 9-3
Specifications for OC-12 optical circuit pack (NT7E02)

Specification	**Long-reach (LR) models NT7E02KA/KB/KC/KD**	**Intermediate-reach (IR) models NT7E02LA/LB/LC/LD**
Optical line rate	OC-12 (622.08 Mb/s)	OC-12 (622.08 Mb/s)
Wavelength of operation	1310 nm	1310 nm
Minimum transmitter power ($P_{T\ min}$)	–3.0 dBm	–4.5 dBm
Maximum transmitter power ($P_{T\ max}$)	+2.0 dBm	+1.5 dBm
Minimum receiver power ($P_{R\ min}$)	–32.0 dBm	–24.5 dBm
Maximum receiver power ($P_{R\ max}$)	–7.0 dBm	–4.0 dBm
Receiver damage level	–6.0 dBm	N/A
Guaranteed system gain ($G = P_{T\ min} – P_{R\ min}$)	29.0 dB	20.0 dB
Note: Overload level is the maximum received optical power for which the OC-12 BER of 10^{-10} and all jitter tolerance specifications are met. For NT7E02 long-reach models, received optical power must not exceed the following safe level: **-6.0 dBm**. A miniature variable optical attenuator (mVOA) can be required at the OC-12 receiver end depending on the link loss.		

Table 9-4 lists the Nortel Networks-to-Nortel Networks proprietary specifications for the OC-12 VTBM optical interface circuit pack.

Table 9-4
Nortel Networks-to-Nortel Networks proprietary specifications for OC-12 VTBM optical circuit pack (NT7E05)

Specification	Long-reach (LR) models NT7E05AB/AC/AD NT7E05AF/AG/AH	Intermediate-reach (IR) models NT7E05BB/BC/BD NT7E05BF/BG/BH
Optical line rate	OC-12 (622.08 Mb/s)	OC-12 (622.08 Mb/s)
Wavelength of operation	1310 nm	1310 nm
Minimum transmitter power ($P_{T\ min}$)	–1.5 dBm	–15.0 dBm
Maximum transmitter power ($P_{T\ max}$)	+2.0 dBm	–8.0 dBm
Minimum receiver power ($P_{R\ min}$)	–29.5 dBm	–28.0 dBm
Maximum receiver power ($P_{R\ max}$)	–8.0 dBm	–8.0 dBm
Receiver damage level	N/A	N/A
Guaranteed system gain ($G = P_{T\ min} – P_{R\ min}$)	28.0 dB	13.0 dB

Note 1: Overload level is the maximum received optical power for which the OC-12 BER of $10E^{-10}$ and all jitter tolerance specifications are met. An mVOA can be required at the OC-12 receiver end depending on the link loss.

Note 2: The Nortel Networks-to-Nortel Networks proprietary values apply if Nortel Networks equipment is in use at each end.

Note 3: Fiber patch cords without mVOAs are required on the receive end of OC-12 VTBM intermediate reach optical circuit packs for use with normal traffic. Fiber patch cords with mVOAs are used with intermediate-reach models only when testing the optical circuit packs.

Table 9-5 lists the Bellcore midspan-meet specifications for the OC-12 VTBM optical interface circuit pack.

Table 9-5
Bellcore midspan-meet specifications for OC-12 VTBM optical circuit pack (NT7E05)

Specification	**Long-reach (LR) models NT7E05AB/AC/AD NT7E05AF/AG/AH**	**Intermediate-reach (IR) models NT7E05BB/BC/BD NT7E05BF/BG/BH**
Optical line rate	OC-12 (622.08 Mb/s)	OC-12 (622.08 Mb/s)
Wavelength of operation	1310 nm	1310 nm
Minimum transmitter power ($P_{T\ min}$)	–3.0 dBm	–15.0 dBm
Maximum transmitter power ($P_{T\ max}$)	+2.0 dBm	–8.0 dBm
Minimum receiver power ($P_{R\ min}$)	–28.0 dBm	–28.0 dBm
Maximum receiver power ($P_{R\ max}$)	–8.0 dBm	–8.0 dBm
Receiver damage level	N/A	N/A
Guaranteed system gain ($G = P_{T\ min} – P_{R\ min}$)	25.0 dB	13.0 dB

Note 1: Overload level is the maximum received optical power for which the OC-12 BER of $10E^{-10}$ and all jitter tolerance specifications are met. An mVOA can be required at the OC-12 receiver end depending on the link loss.

Note 2: The Bellcore midspan-meet proprietary values apply if equipment other than Nortel Networks is in use.

Note 3: Fiber patch cords without mVOAs are required on the receive end of OC-12 VTBM intermediate reach optical circuit packs for use with normal traffic. Fiber patch cords with mVOAs are used with intermediate-reach models only when testing the optical circuit packs.

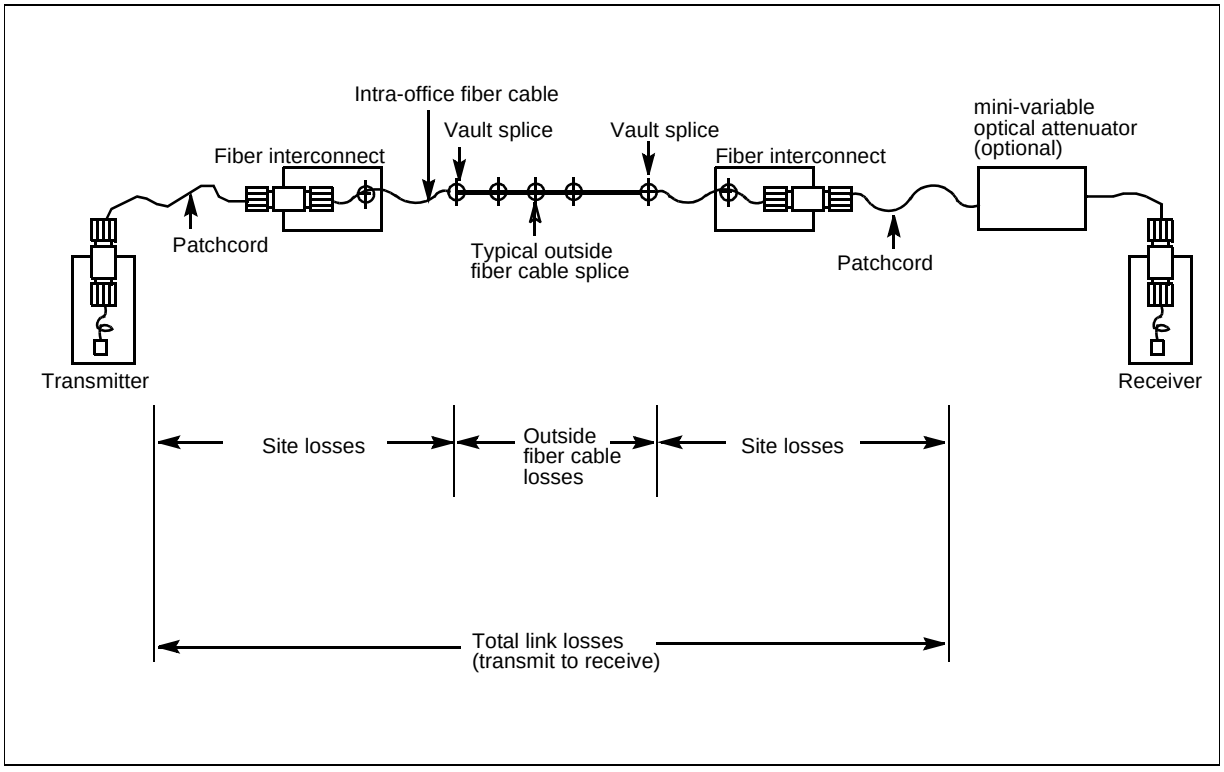
Engineering the optical link

To ensure proper operation of the OC-12 and OC-3 systems at the predetermined BER 10^{-10} level, and the OC-1 system at the predetermined BER 10^{-12} level, a link-loss budget must be calculated using the following criteria:

- system gain
- customer unallocated link margin
- connector losses (number of connectors times the loss for each connector)
- intra-office cable losses (if any)
- splice losses (number of splices multiplied by the loss for each splice)
- temperature loss allowance for aerial span (length in kilometers times 0.1 dB for each kilometer for temperatures between –30 and +70°C)
- fiber cable loss (loss/km multiplied by the link length in kilometers)

The link-loss budget calculation criteria are shown in Figure 9-1.

Figure 9-1
Typical optical network link-loss components



System gain

As noted in Table 9-1, Table 9-2, Table 9-3, Table 9-4, and Table 9-5, the system gain for the OC-12, OC-3, and OC-1 modules are as follows:

- OC-12 (long-reach) = 29 dB
- OC-12 (intermediate-reach) = 20 dB
- OC-12 VTBM (long-reach) = 25 dB (midspan meet)
  or 28 dB (Nortel Networks-to-Nortel Networks proprietary)
- OC-12 VTBM (intermediate-reach) = 13 dB
  (midspan meet or Nortel Networks-to-Nortel Networks proprietary)
- OC-3 (long-reach) = 29 dB
- OC-3 (intermediate-reach) = 13 dB
- OC-1 (long-reach) = 25 dB
- OC-1 (short-reach) = 12 dB

Customer unallocated link margin

The unallocated link margin is typically 2 dBs assigned as a margin for network link anomalies. The system gain budget equals the system gain minus the unallocated link margin.

Connector losses

All S/DMS OC-12, OC-3 and OC-1 optical interfaces and patchcords use low-reflection connectors. OC-12 and OC-3 optical interfaces and patchcords use biconic (SPA), ST-PC and FC-PC connectors. OC-1 optical interfaces and patchcords use ST-PC and FC-PC connectors.

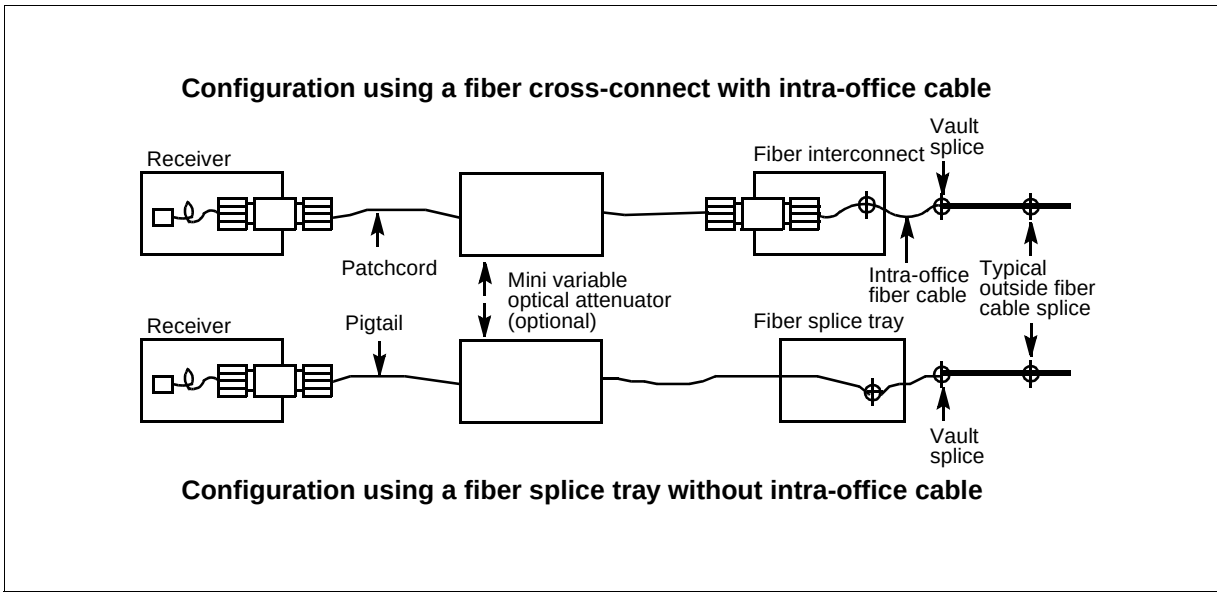
These connectors typically exhibit a return loss of 38 dB for SPA connectors, and better than 40 dB for ST-PC and FC-PC connectors.

> ***Note:*** Although low-reflection connectors and patchcords are not a requirement for a network, their use throughout the network minimizes reflection penalties and provides consistency. In addition, if a cutover to a higher-bit-rate system occurs (for example, OC-12 to OC-48), it is not necessary to upgrade the existing fiber links.

Intra-office cable losses

Intra-office fiber cable can be used in some site facilities depending on whether a fiber splice tray or fiber cross-connect panel is close to the external outside fiber cable, as shown in Figure 9-2.

Figure 9-2
Fiber configuration diagrams with and without intra-office cable



Splice losses

The number of known or planned splices plus the number of future maintenance splices (see “Estimating the number of splices” on page 9-11) are multiplied by the splice loss (typically 0.2 dB).

Estimating the number of splices

If it is not possible to determine the number of splices precisely, the following formula can be used:

$$N_S = \frac{l_t}{l_r} + 1 + N_E + N_F$$

where

N_S is the calculated total number of splices, rounded to the next integer.

l_t is the span length in kilometers, rounded up to the next integer.

l_r is the standard reeled cable length in kilometers, rounded up to the next integer.

N_E is the number of extra splices required by physical outside-plant configuration (that is, fiber cross-connect and vault splices for aerial to buried transition).

N_F is the number of future maintenance splices (see note)

Note: Maintenance splices are usually calculated on the basis of two for each existing or planned splice, but the link engineer may balance the decision accordingly for larger network links that have a larger number of existing splices.

Temperature loss allowance

If aerial cable is included in the optical link network, a temperature loss allowance must be calculated as part of the link losses. For temperatures between −30 and +70°C, calculate 0.1 dB of loss for each kilometer of aerial cable.

Fiber cable losses

Knowing the maximum allowable unit loss (dB/km) for the fiber cable used (aerial and underground) allows a greater latitude in the selection of outside-plant cable. The allowable fiber cable loss is determined from the results of link-loss budget calculation, as detailed in “Calculating a link-loss budget” on page 9-12.

Calculating a link-loss budget

This calculation is intended to arrive at the maximum allowable fiber cable attenuation (dB/km), to allow the choice of cable having a unit loss (dB/km) that is equal to or less than the calculated requirement, as well as meeting the required transmission specifications.

Sample calculation of a link-loss budget

This sections presents a sample calculation of a link-loss budget. Figure 9-3 on page 9-13 shows a sample calculation of a link-loss budget using the link-loss budget summary sheet.

Table 9-6 presents the parameter values used in the sample calculation of a link-loss budget. The full calculation is shown on the summary sheet presented in Figure 9-3 on page 9-13.

Table 9-6
Calculation of a link-loss budget

Calculation parameter	Sample calculation value
Item 1, system gain	OC-12 single mode, long reach, system gain of 29.0 dB for the specified BER 10^{-10} level.
Item 2, customer unallocated link margin	2.0 dB
Item 6, splice losses	Eight outside cable splices (one every 6 km of cable), plus two cross-connect, two vault splices and six maintenance splices, for a total of 18 splices.
Item 9, connector losses	Two connectors (one at each end), with typical loss of 0.5 dB each.
Item 10, intra-office cable losses	Aerial cable the entire link length of 45 km (28 miles) between Centerville and Midtown, terminating in a vault at both ends.
Item 13, temperature loss allowance	Temperature loss allowance for aerial cable: 0.1 dB/km.
Item 17, maximum allowable fiber attenuation	**0.4 dB/km**

Optical link-loss budget records

You should complete a link-loss budget summary sheet for each optical link between any two AccessNode sites. A blank summary sheet, as shown in Figure 9-4 on page 9-14, can be duplicated and used for this purpose.

Figure 9-3
Link-loss budget summary sheet (sample)

Project: Telconet Issue: 1

System section: Site A Centerville Site B Midtown

Prepared by: John Smith Date: April 1996

Transmit equipment: S/DMS OC-12 BER level: BER 10^{-10}

Operation wavelength: 1310 nm Optics reach: long reach

Item	Description	Values	Totals
	System gain budget		
1	System gain	29.0 dB	
2	Customer unallocated link margin loss	2.0 dB	
3	System gain budget (item 1 minus item 2)		27.0 dB
	Link-loss summary		
4	Number of splices	18 splices	
5	Loss for each splice	0.2 dB/splice	
6	Splice losses (item 4 times item 5)		3.6 dB
7	Number of connectors	2 connectors	
8	Loss for each connector	0.5 dB/connector	
9	Connector losses (item 7 times item 8)		1.0 dB
10	Intra-office cable loss		0.0 dB
11	Temperature loss for each km of aerial cable	0.1 dB	
12	Aerial cable span length	45 km	
13	Temperature loss allowance (item 11 times item 12)		4.5 dB
14	Subtotal of link losses (item 6 + 9 + 10 + 13)		9.1 dB
15	Loss allowable for outside fiber cable (item 3 minus item 14)		17.9 dB
	Maximum allowable fiber cable attenuation		
16	Total link length	45 km	
17	Maximum allowable fiber cable attenuation (item 15 divided by item 16)		0.40 dB/km

Figure 9-4
Blank link-loss budget summary sheet

Project: _____ Issue: _____

System section: Site A _____ Site B _____

Prepared by: _____ Date: _____

Transmit equipment: _____ BER level: _____

Operation wavelength: _____ Optics reach: _____

Item	Description	Values	Totals
	System gain budget		
1	System gain	_____ dB	
2	Customer unallocated link margin loss	_____ dB	
3	System gain budget (item 1 minus item 2)		_____ dB
	Link-loss summary		
4	Number of splices	_____ splices	
5	Loss for each splice	_____ dB/splice	
6	Splice losses (item 4 times item 5)		_____ dB
7	Number of connectors	_____ connectors	
8	Loss for each connector	_____ dB/connector	
9	Connector losses (item 7 times item 8)		_____ dB
10	Intra-office cable loss		_____ dB
11	Temperature loss for each km of aerial cable	_____ dB	
12	Aerial cable span length	_____ km	
13	Temperature loss allowance (item 11 times item 12)		_____ dB
14	Subtotal of link losses (item 6 + 9 + 10 + 13)		_____ dB
15	Loss allowable for outside fiber cable (item 3 minus item 14)		_____ dB
	Maximum allowable fiber cable attenuation		
16	Total link length	_____ km	
17	Maximum allowable fiber cable attenuation (item 15 divided by item 16)		_____ dB/km

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AccessNode

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