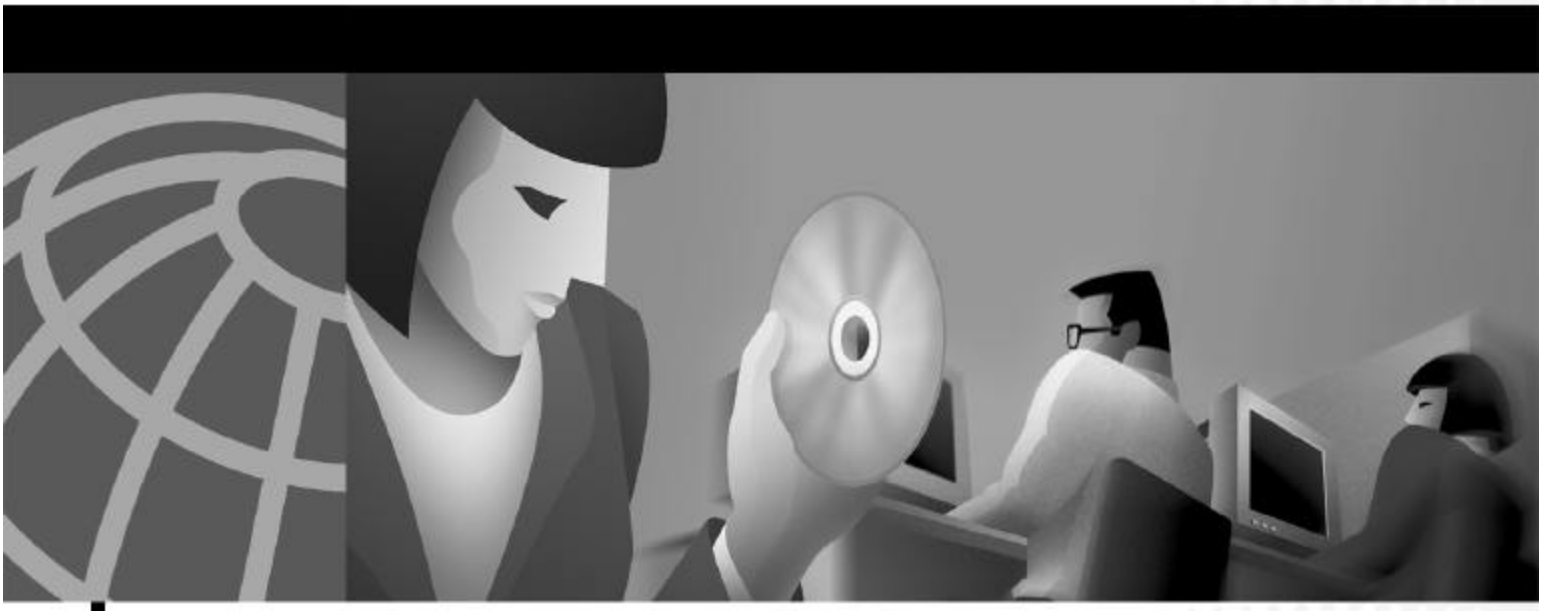

Cisco 6400 Hardware Installation and Maintenance Guide

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Cisco 6400 Hardware Installation and Maintenance Guide

Preface

Objectives

This installation guide describes the initial hardware installation and maintenance procedures for the Cisco 6400 carrier-class broadband aggregator. Use this document with the *Regulatory Compliance and Safety Information for the Cisco 6400*. After completing the installation procedures in this guide, use the following companion publications to completely configure your system:

- *Cisco 6400 Software Setup Guide*
- *Cisco 6400 Command Reference*

All additions or upgrades to the Cisco 6400 hardware or software image (firmware) ordered from the factory are accompanied by installation and configuration notes that provide product-specific installation instructions and up-to-date product information.

Audience

To use this publication, you should be familiar with Cisco switches, routers, cabling, electronic circuitry, and wiring practices and preferably have experience as an electronic or electromechanical technician. This document provides brief descriptions and examples of some software configuration and display commands. For comprehensive descriptions and examples of software configuration commands and the procedures for implementing them, refer to the *Cisco 6400 Software Setup Guide* and the *Cisco 6400 Command Reference*.

Organization

This publication is organized as follows:

Chapter 1	Hardware Description	Describes the chassis components and properties of the Cisco 6400 and provides a functional overview of the system.
Chapter 2	Preparing for Installation	Describes the procedure for unpacking the system and components, presents safety recommendations, and lists the tools required for the hardware installation.

Chapter 3	Installing the Cisco 6400	Provides instructions for installing the Cisco 6400 hardware and connecting the external network interface cables.
Chapter 4	Troubleshooting the Installation	Provides guidelines for troubleshooting the Cisco 6400 hardware installation.
Chapter 5	Maintaining the Cisco 6400	Provides maintenance procedures you might need to perform after you have installed the Cisco6400.
Appendix A	System Specifications	Describes the physical properties of the Cisco6400.
Appendix B	Configuration Worksheets	Includes instructions, examples, and blank worksheets used for the initial installation and subsequent maintenance of the Cisco 6400.
Glossary		Defines the acronyms and terms associated with the Cisco 6400 and xDSL technology.

Document Conventions

Cisco documentation part numbers used in this manual do not include the version number of the document, to avoid updating the manual each time a part number is changed. For example, the documentation part number for the *Regulatory Compliance and Safety Information for the Cisco6400* is 78-5789-xx.

Command descriptions use these conventions:

- Examples that contain system prompts denote interactive sessions, indicating the commands you should enter at the prompt. The system prompt indicates the current level of the EXEC command interpreter. For example, the prompt Switch# indicates that you are at the *privileged* level. Access to the privileged level usually requires a password. Refer to the related software configuration and reference publications for additional information.
- Commands and keywords are in **boldface** font.
- Arguments for which you supply values are in *italic* font.
- Elements in square brackets ([ ]) are optional.
- Alternative but required keywords are grouped in braces ({ }) and separated by vertical bars (|).

Examples use these conventions:

- Terminal sessions and sample console screen displays are in screen font.
- Information you enter is in **boldface screen** font.
- Nonprinting characters, such as passwords, are in angle brackets (< >).
- Default responses to system prompts are in square brackets ([ ]).
- An exclamation point (!) at the beginning of a line indicates a comment line.

Note Means *reader take note.* Notes contain helpful suggestions or references to material not contained in this manual.

Caution Means *reader be careful*. In this situation, you might do something that could result in equipment damage or loss of data.

Warning **This warning symbol means *danger*. You are in a situation that could cause bodily injury. Before you work on any equipment, be aware of the hazards involved with electrical circuitry and be familiar with standard practices for preventing accidents. To see translations of the warnings that appear in this publication, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Waarschuwing **Dit waarschuwingssymbool betekent gevaar. U verkeert in een situatie die lichamelijk letsel kan veroorzaken. Voordat u aan enige apparatuur gaat werken, dient u zich bewust te zijn van de bij elektrische schakelingen betrokken risico's en dient u op de hoogte te zijn van standaard maatregelen om ongelukken te voorkomen. Voor vertalingen van de waarschuwingen die in deze publicatie verschijnen, kunt u het document *Regulatory Compliance and Safety Information* (Informatie over naleving van veiligheids- en andere voorschriften) raadplegen dat bij dit toestel is ingesloten.**

Varoitus **Tämä varoitusmerkki merkitsee vaaraa. Olet tilanteessa, joka voi johtaa ruumiinvammaan. Ennen kuin työskentelet minkään laitteiston parissa, ota selvää sähkökytkentöihin liittyvistä vaaroista ja tavanomaisista onnettomuuksien ehkäisykeinoista. Tässä julkaisussa esiintyvien varoitusten käännökset löydät laitteen mukana olevasta *Regulatory Compliance and Safety Information* -kirjasesta (määräysten noudattaminen ja tietoa turvallisuudesta).**

Attention **Ce symbole d'avertissement indique un danger. Vous vous trouvez dans une situation pouvant causer des blessures ou des dommages corporels. Avant de travailler sur un équipement, soyez conscient des dangers posés par les circuits électriques et familiarisez-vous avec les procédures couramment utilisées pour éviter les accidents. Pour prendre connaissance des traductions d'avertissements figurant dans cette publication, consultez le document *Regulatory Compliance and Safety Information* (Conformité aux règlements et consignes de sécurité) qui accompagne cet appareil.**

Warnung **Dieses Warnsymbol bedeutet Gefahr. Sie befinden sich in einer Situation, die zu einer Körperverletzung führen könnte. Bevor Sie mit der Arbeit an irgendeinem Gerät beginnen, seien Sie sich der mit elektrischen Stromkreisen verbundenen Gefahren und der Standardpraktiken zur Vermeidung von Unfällen bewußt. Übersetzungen der in dieser Veröffentlichung enthaltenen Warnhinweise finden Sie im Dokument *Regulatory Compliance and Safety Information* (Informationen zu behördlichen Vorschriften und Sicherheit), das zusammen mit diesem Gerät geliefert wurde.**

Avvertenza **Questo simbolo di avvertenza indica un pericolo. La situazione potrebbe causare infortuni alle persone. Prima di lavorare su qualsiasi apparecchiatura, occorre conoscere i pericoli relativi ai circuiti elettrici ed essere al corrente delle pratiche standard per la prevenzione di incidenti. La traduzione delle avvertenze riportate in questa pubblicazione si trova nel documento *Regulatory Compliance and Safety Information* (Conformità alle norme e informazioni sulla sicurezza) che accompagna questo dispositivo.**

Advarsel **Dette varselsymbolet betyr fare. Du befinner deg i en situasjon som kan føre til personskade. Før du utfører arbeid på utstyr, må du vare oppmerksom på de faremomentene som elektriske kretser innebærer, samt gjøre deg kjent med vanlig praksis når det gjelder å unngå ulykker. Hvis du vil se oversettelser av de advarslene som finnes i denne publikasjonen, kan du se i dokumentet *Regulatory Compliance and Safety Information* (Overholdelse av forskrifter og sikkerhetsinformasjon) som ble levert med denne enheten.**

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¡Advertencia! **Este símbolo de aviso significa peligro. Existe riesgo para su integridad física. Antes de manipular cualquier equipo, considerar los riesgos que entraña la corriente eléctrica y familiarizarse con los procedimientos estándar de prevención de accidentes. Para ver una traducción de las advertencias que aparecen en esta publicación, consultar el documento titulado *Regulatory Compliance and Safety Information* (Información sobre seguridad y conformidad con las disposiciones reglamentarias) que se acompaña con este dispositivo.**

Varning! **Denna varningssymbol signalerar fara. Du befinner dig i en situation som kan leda till personskada. Innan du utför arbete på någon utrustning måste du vara medveten om farorna med elkretsar och känna till vanligt förfarande för att förebygga skador. Se förklaringar av de varningar som förkommer i denna publikation i dokumentet *Regulatory Compliance and Safety Information* (Efterrättelse av föreskrifter och säkerhetsinformation), vilket medföljer denna anordning.**

Obtaining Documentation

Cisco 6400 Documentation

For additional information about the Cisco 6400, refer to the following documents:

- *Cisco 6400 Site Planning Guide*
- *Cisco 6400 Software Setup Guide*
- *Regulatory Compliance and Safety Information for the Cisco 6400*
- *Cisco 6400 Installation and Replacement of Field-Replaceable Units*
- *Release Notes for the Cisco 6400*
- Cisco 6400 Software Features
- Software Notes for the Cisco 6400
- Hardware Notes for the Cisco 6400

The following sections provide sources for obtaining documentation from Cisco Systems.

World Wide Web

You can access the most current Cisco documentation on the World Wide Web at the following sites:

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Technical Assistance Center

The Cisco TAC website is available to all customers who need technical assistance with a Cisco product or technology that is under warranty or covered by a maintenance contract.

Contacting TAC by Using the Cisco TAC Website

If you have a priority level 3 (P3) or priority level 4 (P4) problem, contact TAC by going to the TAC website:

http://www.cisco.com/tac

P3 and P4 level problems are defined as follows:

- P3—Your network performance is degraded. Network functionality is noticeably impaired, but most business operations continue.
- P4—You need information or assistance on Cisco product capabilities, product installation, or basic product configuration.

In each of the above cases, use the Cisco TAC website to quickly find answers to your questions.

To register for Cisco.com, go to the following website:

http://www.cisco.com/register/

If you cannot resolve your technical issue by using the TAC online resources, Cisco.com registered users can open a case online by using the TAC Case Open tool at the following website:

http://www.cisco.com/tac/caseopen

Contacting TAC by Telephone

If you have a priority level 1(P1) or priority level 2 (P2) problem, contact TAC by telephone and immediately open a case. To obtain a directory of toll-free numbers for your country, go to the following website:

http://www.cisco.com/warp/public/687/Directory/DirTAC.shtml

P1 and P2 level problems are defined as follows:

- P1—Your production network is down, causing a critical impact to business operations if service is not restored quickly. No workaround is available.
- P2—Your production network is severely degraded, affecting significant aspects of your business operations. No workaround is available.

Hardware Description

This chapter describes the major components of the Cisco 6400 Carrier-Class Broadband Aggregator.

This chapter includes the following sections:

Note The illustrations in this guide depict the original Cisco 6400 chassis. Your chassis may appear or look slightly different.

Cisco 6400 Overview

The Cisco 6400 is a broadband concentrator that features Cisco end-to-end ATM services, Point-to-Point Protocol (PPP) termination, and tunneling. The Cisco6400 combines Cisco IOS ATM switching and routing capabilities in a modular, scalable, redundant, Network Equipment Building Systems/European Telecommunication Standards Institute (NEBS/ETSI)-compliant chassis.

Cisco 6400 Physical Description

This section includes detailed information about the following Cisco6400 components and features:

- Chassis:
  - Module Compartment
  - Blower Compartment
  - Power Entry Module (PEM) Compartment
  - Backplane
- Node Switch Processor (NSP)
- Node Route Processor (NRP)
- Node Line Card (NLC)

Chassis

The Cisco 6400 chassis, designed for mounting in 19-inch or 23-inch equipment racks, consists of the following:

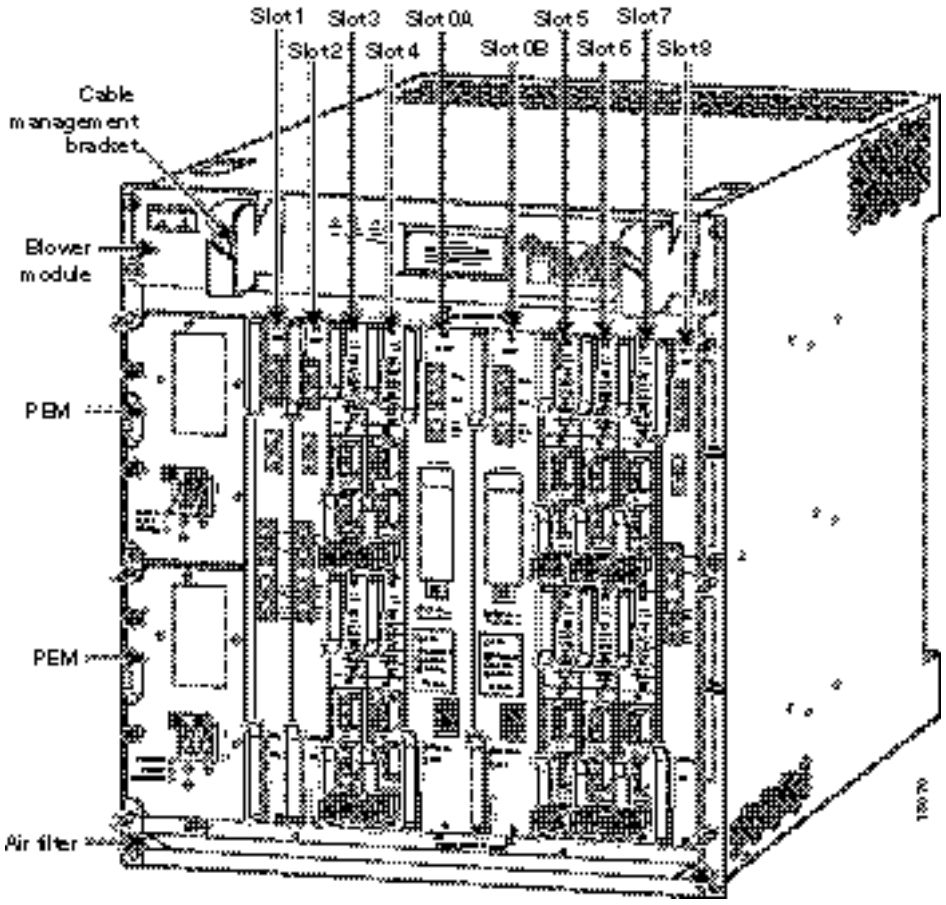
- Module Compartment
- Blower Module
- PEM Compartment
- Backplane

Module Compartment

The module compartment has ten slots: two central slots that are reserved for NSP cards, and eight slots that can accommodate a mixture of full-height NRP cards, and full-height and half-height NLCs. All cards support hot-swapping and redundancy. Figure1-1 shows a fully-loaded chassis with redundant cards and power entry modules (PEMs).

Note The NSP card supports hot-swapping. One NSP is required for the system to operate, so hot-swapping a nonredundant NSP will result in a system outage. A standby NSP in a redundant configuration can be hot-swapped without impacting system operation.

Figure1-1 Cisco 6400 Chassis—Front View

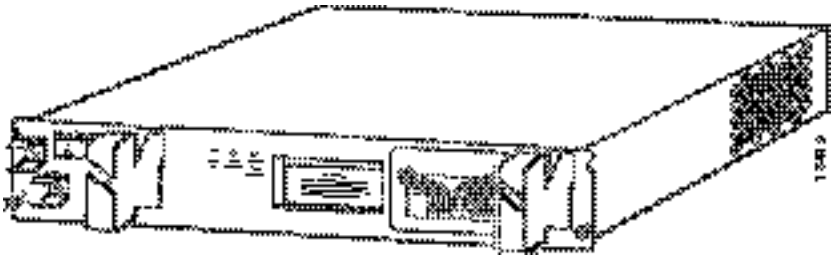


Blower Module

The blower module (Figure1-2) is located on the top of the chassis and is connected to the backplane. The module provides airflow throughout the system. The air intake is located at the bottom of the chassis, and there is an exhaust in the top rear of the chassis through the blower module. The blower module supports hot-swapping and can be replaced without interruption to system operation.

Note The system will shut down after two minutes if the blower module is removed and not replaced.

Figure1-2 Blower Module



Blower Module LEDs

Table1-1 describes the blower module LEDs on the front center panel.

Table1-1 Blower Module LEDs

LED	Status	Condition
Fans OK	Steady green	Fans are operational.
Single Fan Failure	Steady yellow	One fan has failed and alarms are triggered.
Multiple Fan Failure	Steady yellow	Two or more fans have failed and the system will shut down.

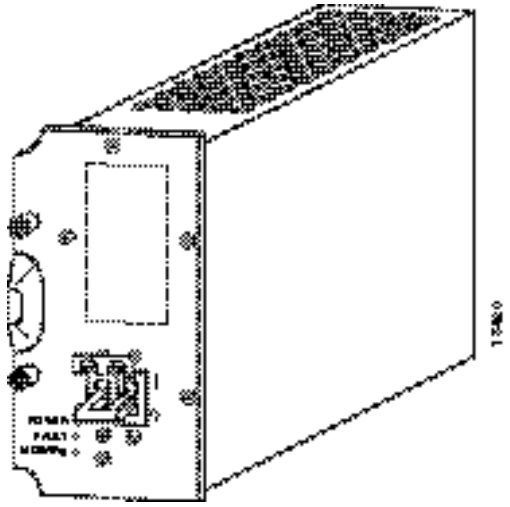
Power Entry Module

The DC PEM (Figure1-3) provides filtering, and supplies DC power to the chassis electronics. There are two PEM bays in the chassis; however, only one PEM is required. An additional PEM can be used for redundancy. The PEMs are located on the left side of the chassis and are installed from the front. Input source power (-48 VDC from building centralized power source) enters the chassis through screw terminals on the rear of the chassis and is supplied to the PEMs when they are plugged into the backplane.

The AC PEM (Figure1-4) provides power conversion directly from the facility VAC input power to the -48 VDC used internally in the Cisco 6400 chassis. AC power comes into the AC PEM through a power cord attached to the front faceplate.

Note The Cisco 6400 no longer features the AC-Input Power Shelf. If your Cisco 6400 chassis has an AC-Input Power Shelf and this component requires replacement, Cisco will send you the new AC PEM (Cisco part number PEM-PWR-AC=) to replace the older unit. If you want to use AC power as the sole input and your Cisco 6400 chassis contains DC PEMs, you must remove the DC PEMs and replace them with the AC PEMs. Instructions for removing and installing DC PEMs and AC PEMs are provided in Chapter5, “Maintaining the Cisco 6400.”

Figure1-3 DC Power Entry Module



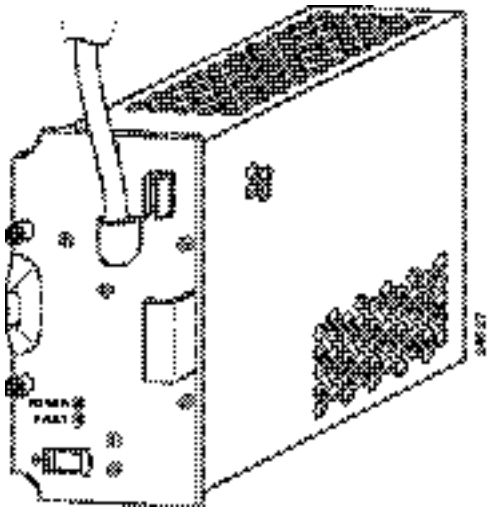
DC Power Entry Module LEDs

Table1-2 describes the LEDs located on the front panel of the PEM.

Table1-2 DC Power Entry Module LEDs

LED	Status	Condition
Power	Steady green	Power is available.
Fault	Steady yellow	The PEM has failed or is turned off.
Miswire	Steady yellow	Cables are attached incorrectly and should be reversed.

Figure1-4 AC Power Entry Module



AC Power Entry Module LEDs

Table1-3 describes the LEDs located on the front panel of the PEM.

Table1-3 Power Entry Module LEDs

LED	Status	Condition
Power	Steady green	Power is available.
Fault	Steady yellow	The PEM has failed or is turned off.

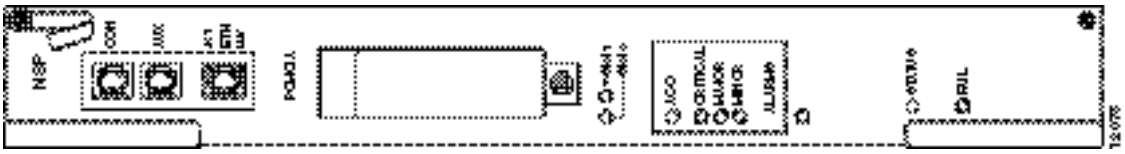
Backplane

The backplane is attached to the rear of the Cisco 6400 chassis and provides system interconnect.

Node Switch Processor

The Node Switch Processor (NSP) (Figure1-5) is the main system processor card in the Cisco 6400, residing in chassis slot 0A or 0B. The NSP contains the ATM switch engine and processor, and most memory components. The NSP runs the system software, which maintains and executes the management functions that control the system.

Figure1-5 NSP Faceplate



The NSP is a three-card module, which supports the following functions and features:

- 64-bit, 100-MHz RISC central processor unit (R4700)
- 64-MB parity-protected DRAM memory (upgradeable to 128 MB)
- 5-Gbps nonblocking ATM switch fabric:
  - CBR, VBR-RT, VBR-NRT, ABR, UBR, and GFR traffic classes
  - Per flow virtual connection (VC) or virtual path (VP) queuing with strict priority, rate, and weighted round-robin scheduling
  - Up to 32,000 point-to-point VCs
  - Up to 32,000 point-to-multipoint VC roots; up to 254 leaves per root
  - Dual leaky bucket usage parameter control (UPC) (ITU-T I.371/ATM Forum UNI compliant)
  - Early packet discard (EPD)/partial packet discard (PPD)
  - Per VC/VP CBR shaping
- 64,000 cells of shared ATM payload memory (parity-protected SRAM)
- Out-of-band ATM traffic management
- 8 MB boot Flash memory
- 512 KB NVRAM for storing system configuration information

- Console and auxiliary serial (EIA/TIA-232) ports
- Network management Ethernet (10BASE-T) port
- Dual PCMCIA card slots
- 1+1 NSP redundancy based on EHSA protocols
- Digital thermometers for monitoring temperature
- Custom-designed PLL to attentuate clock jitter, meeting jitter and wander requirements of the GR253 standard
- Network timing derived from any NLC interface
- Stratum 4 accuracy when internally timed

Node Switch Processor LEDs

The LEDs on the NSP indicate the module status conditions (Table1-4).

Table1-4 NSP Indicators

LED	Status	Condition
STATUS	Steady yellow Blinking yellow Steady green Blinking green Off	Cisco IOS software is not running. System is booting. NSP is active (primary). NSP is standby (secondary). NSP has no power.
FAIL	Yellow Off	NSP has failed. NSP has not failed.
ETH		
ACT (Activity)	Green Off	Packets are being transmitted and received. No activity.
LNK (Link)	Steady green Off	Port is operational. No carrier is detected.
PCMCIA Slot 0	Steady green	Slot is active.
PCMCIA Slot 1	Steady green	Slot is active.
ALARMS		
CRITICAL	Yellow Off	Alarm is active. No alarm is active.
MAJOR	Yellow Off	Alarm is active. No alarm is active.
MINOR	Yellow Off	Alarm is active. No alarm is active.

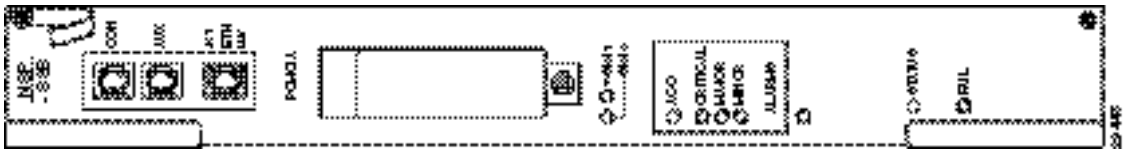
Optional Stratum 3 BITS Timing

The NSP with Stratum 3 BITS timing (NSP-S3B) supports the same functions and features as the standard NSP, as well as the following:

- Network timing derived from CO BITS or from any NLC interface
- Stratum 3 accuracy when internally timed

Figure1-6 shows the faceplate of the NSP with Stratum 3 BITS timing.

Figure1-6 NSP-S3B Faceplate



By default, the NSP-S3B functions exactly the same as the standard NSP. You must specifically configure the NSP-S3B to implement the Stratum 3 BITS timing features. All content in this document that refers to the NSP also applies to the NSP-S3B.

Dual PCMCIA Card Slots

The two PCMCIA card slots can be used to store Cisco IOS software or system configuration information on a PCMCIA disk memory card. The system can also boot from the software stored on the PCMCIA disk memory card.

Alarm Cut-Off Switch

The alarm cut-off (ACO) switch is located near the center of the NSP faceplate. Press the switch to turn off audible alarms. You can also disable audible alarms by using the command-line interface (CLI). For more information, refer to *Cisco 6400 Command Reference.*

Connectors

The NSP card has three ports with RJ-45 connectors:

- Console port—This asynchronous EIA/TIA-232 serial port can be used to connect the NSP to a terminal, for local administrative access. The RJ-45 connector for the console port is labeled CON.
- Auxiliary port—This asynchronous EIA/TIA-232 serial port can be used to connect the NSP to a modem for remote administrative access. The RJ-45 connector for the auxiliary port is labeled AUX.
- Ethernet port—This port can be used to connect the NSP to a 10BASE-T network management LAN. The RJ-45 connector for the Ethernet port is labeled ETH.

Console Port Signals

The console port is a serial EIA/TIA-232 interface. Table1-5 lists the signals for the console port connector.

Note The console port on the NSP does not support hardware flow control. To ensure proper operation, please configure any terminal equipment connected to the console port for no hardware flow control or no flow control.

Table1-5 Console Port Connector Signals

Pin	Signal	Direction	Description
1	RTS	–	Hard wired to pin 8
2	DTR	Output	Data terminal ready (for modem control)
3	TxD	Output	Transmit data
4	GND	–	Signal ground
5	GND	–	Signal ground
6	RxD	Input	Receive data
7	DSR	Input	Data set ready (for modem control)
8	CTS	–	Hard wired to pin 1

Auxiliary Port Signals

The auxiliary port supports hardware flow control and modem control. Table1-6 lists the signals for the auxiliary port connector.

Table1-6 Auxiliary Port Connector Signals

Pin	Signal	Direction	Description
1	RTS	Output	Request to send (hardware flow control)
2	DTR	Output	Data terminal ready (modem control)
3	TxD	Output	Transmit data
4	GND	–	Signal ground
5	GND	–	Signal ground
6	RxD	Input	Receive data
7	DSR	Input	Data set ready (modem control)
8	CTS	Input	Clear to send (hardware flow control)

Network Management Ethernet Port Signals

The network management Ethernet (NME) port provides out-of-band network management of the NSP. Table1-7 lists the signals for the NME port connector.

Table1-7 NME Port Connector Signals

Pin	Signal	Direction	Description
1	TxD+	Output	Transmit data +
2	TxD–	Output	Transmit data –
3	RxD+	Input	Receive data +
4	NC	–	No connection
5	NC	–	No connection
6	RxD–	Input	Receive data –
7	NC	–	No connection
8	NC	–	No connection

Node Route Processors

The node route processor (NRP) receives traffic from one or more NSP ATM switch ports, reassembles the ATM cells into packets, routes the packets, segments the routed packets, and sends them back to the ATM switch. The Cisco 6400 can contain multiple NRP modules, configured to operate independently or as redundant pairs (1+1). You can insert NRPs into slots 1 through 8 in the Cisco6400 chassis.

The Cisco 6400 supports two node route processors, designated as NRP-2SV and NRP-1:

- NRP-2SV—Provides a Gigabit Ethernet interface and sufficient processing capability for handling OC-12 rate of user traffic (Figure1-7).
- NRP-1— Incorporates a 100-Mbps Fast Ethernet interface for connecting into an IP network and has processing capability for OC-3 rate of user traffic (Figure1-8).

These two types of NRPs can be used together in any combination in a single Cisco 6400 chassis.

NRP-2SV Module

This section describes the hardware components for an NRP-2SV module.

Figure1-7 NRP-2SV Faceplate

Warning **Class 1 laser product. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

NRP-2SV LEDs

The LEDs on the NRP-2SV indicate port and module status (Table1-8).

Table1-8 NRP-2SV LED Indicators

LED	Status	Condition
STATUS	Steady green Blinking yellow Steady yellow Off	NRP-2SV is active. System is booting. Cisco IOS software is not running. NRP-2SV has no power.
FAIL	Steady yellow Off	NRP-2SV has failed. Normal operation.
GBIC		
TX	Blinking green Off	Packets are being transmitted. No activity.
RX	Blinking green Off	Packets are being received. No activity.
LNK	Steady green Off	Port is operational. No carrier is detected.

GBIC Port Cabling Specifications

Table1-9 lists the GBICs and their respective cable types and lengths.

Table1-9 GBIC Port Cabling Specifications

GBIC	Wavelength (nm)	Fiber Type	Core Size (microns)	Modal Bandwidth (MHz/km)	Cable Distance
1000BASE-SX 6400-GBIC-SX	850	MMF	62.5 62.5 50.0 50.0	160 200 400 500	722 ft (220 m) 902 ft (275 m) 1640 ft (500 m) 1804 ft (550 m)
1000BASE-LX/LH 6400-GBIC-LH	1300	MMF[1] SMF	62.5 50.0 50.0 8 to 10	500 400 500 —	1804 ft (550 m) 1804 ft (550 m) 1804 ft (550 m) 32,808 ft (10 km)

1. Mode-conditioning patch cord (CAB-GELX-625 or equivalent) is required. If you use an ordinary patch cord with MMF, 1000BASE-LX/LH GBICs, and a short link distance (tens of meters), this can cause transceiver saturation, resulting in a elevated bit error rate (BER). In addition, when you use the LX/LH GBIC with 62.5-micron diameter MMF, you must install a mode-conditioning patch cord between the GBIC and the MMF cable on both the transmit and receive ends of the link. The mode-conditioning patch cord is required for link distances greater than 984 ft (300 m).

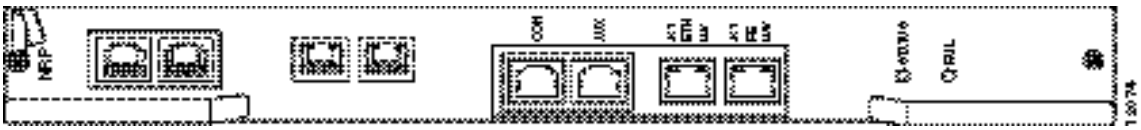
Alphanumeric Display

The NRP-2SV faceplate also has a four-digit alphanumeric display that indicates status information and error codes.

NRP-1 Module

This section describes the hardware components on the NRP-1 module.

Figure1-8 NRP-1 Faceplate



NRP-1 LEDs

The LEDs on the NRP-1 indicate port and module status (Table1-10).

Table1-10 NRP-1 LED Indicators

LED	Status	Condition
STATUS	Steady green Blinking green Steady yellow Blinking yellow Off	NRP is active (primary). NRP is standby (secondary). Cisco IOS software is not running. System is booting. NRP has no power.
FAIL	Steady yellow Off	NRP has failed. Normal operation.
ETH		
ACT (Activity)	Blinking green Off	Packets are being transmitted and received. No activity.
LNK (Link)	Steady green Off	Port is operational. No carrier is detected.
FE		
ACT (Activity)	Blinking green Off	Packets are being transmitted and received. No activity.
LNK (Link)	Steady green Off	Port is operational. No carrier is detected.

Connectors

The NRP-1 card has four ports with RJ-45 connectors:

- Console port—Asynchronous EIA/TIA serial port can be used to connect the NRP to a terminal for local administrative access. The RJ-45 connector for the console port is labeled CON.
- Auxiliary port—Asynchronous EIA/TIA serial port can be used to connect the NRP to a modem for remote administrative access. The RJ-45 connector for the auxiliary port is labeled AUX.
- Ethernet port—Can be used to connect the NRP to a 10BASE-T network management LAN. The RJ-45 connector for the Ethernet port is labeled ETH.
- Fast Ethernet port—Can be used to connect the NRP to a 100BASE-T LAN. The RJ-45 connector for the Fast Ethernet port is labeled FE.

Console Port Signals

The console port is a serial EIA/TIA-232 interface. Table1-11 lists the signals for the console port connector.

Table1-11 NRP-1 Console Port Connector Signals

Pin	Signal	Direction	Description
1	NC	–	No connection
2	DTR	Output	Data terminal ready (for modem control)
3	TxD	Output	Transmit data
4	GND	–	Signal ground
5	GND	–	Signal ground
6	RxD	Input	Receive data
7	DSR	Input	Data set ready
8	NC	–	No connection

Note The console port on the NRP does not support hardware flow control. To ensure proper operation, configure any terminal equipment connected to the console port for no hardware flow control or no flow control.

Auxiliary Port Signals

The auxiliary port supports hardware flow control and modem control. Table1-12 lists the signals for the auxiliary port connector.

Table1-12 Auxiliary Port Connector Signals

Pin	Signal	Direction	Description
1	RTS	Output	Request to send (for hardware flow control)
2	DTR	Output	Data terminal ready (for modem control)
3	TxD	Output	Transmit data
4	GND	–	Signal ground
5	GND	–	Signal ground
6	RxD	Input	Receive data
7	DSR	Input	Data set ready (for modem control)
8	CTS	Input	Clear to send (for hardware flow control)

Ethernet Port Signals

Table1-13 lists the signals for the Ethernet port connector.

Table1-13 Ethernet Port Connector Signals

Pin	Signal	Direction	Description
1	TxD+	Output	Transmit data +
2	TxD–	Output	Transmit data –
3	RxD+	Input	Receive data +
4	NC	–	No connection
5	NC	–	No connection
6	RxD–	Input	Receive data –
7	NC	–	No connection
8	NC	–	No connection

Fast Ethernet

Table1-14 lists the signals for the Fast Ethernet port connector.

Table1-14 Fast Ethernet Port Connector Signals

Pin	Signal	Direction	Description
1	TxD+	Output	Transmit data +
2	TxD–	Output	Transmit data –
3	RxD+	Input	Receive data +
4	NC	–	No connection
5	NC	–	No connection
6	RxD–	Input	Receive data –
7	NC	–	No connection
8	NC	–	No connection

Node Line Cards

The Cisco6400 supports three half-height and one full-height node line card (NLC) modules:

- OC-3/STM-1 SM half-height NLC (Figure1-9) has two 155-Mbps fiber-optic ports for single-mode intermediate reach connection of uplink and downlink interfaces.
- OC-3/STM-1 MM half-height NLC (Figure1-10) has two 155-Mbps fiber-optic ports for multimode connection on the front of each NLC.
- DS3 half-height NLC (Figure1-11) has two 45-Mbps bidirectional ports for connection to network services using coaxial cable.
- OC-12/STM-4 full-height NLC (Figure1-12) has one 622-Mbps fiber-optic port for the connection of uplink and downlink interfaces; single mode, intermediate reach.

The Cisco 6400 can contain multiple NLC modules, configured to operate independently or as redundant pairs. NLCs can be inserted into slots 1 through 8 (subslots 0 and 1) in the Cisco6400chassis.

The three types of NLC can be configured to support the following clocking options:

- Self-timing based on a Stratum 4 level clock
- Loop timing from the received data stream, which is ideal for public network connections
- Timing synchronized to the NSP network clock port; required for distribution of a single clock across a network

Figure1-9 OC-3/STM-1 SM NLC Faceplate

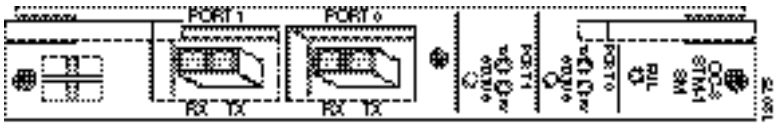
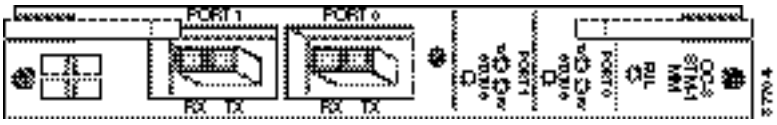


Figure1-10 OC-3/STM-1 MM NLC Faceplate



Warning **Class 1 laser product. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning **Because invisible radiation may be emitted from the aperture of the port when no fiber cable is connected, avoid exposure to radiation and do not stare into open apertures. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning **Invisible laser radiation present. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning Statement for Sweden

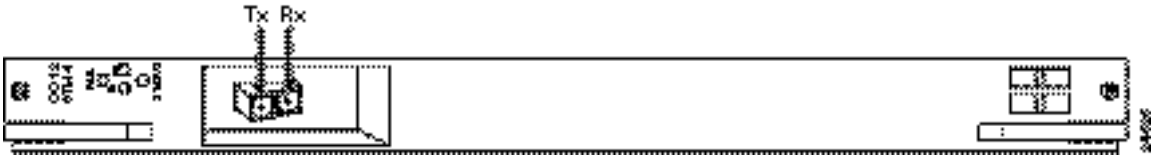
Varning! **Osynlig laserstrålning när denna del är öppen och förregleringen är urkopplad. Rikta inte blicken in mot strålen.**

Warning Statement for Finland

Varoitus **Alleviates ja suojalukitus ohitettaessa olet alttiina näkymättömälle lasersäteilylle. Äjä katso säteeseen.**

Figure1-11 DS3 NLC Faceplate

Figure1-12 OC-12/STM-4 NLC Faceplate



Warning **Class 1 laser product. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning **Because invisible radiation may be emitted from the aperture of the port when no fiber cable is connected, avoid exposure to radiation and do not stare into open apertures. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning **Invisible laser radiation present. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning Statement for Sweden

Varning! **Osynlig laserstrålning när denna del är öppen och förregleringen är urkopplad. Rikta inte blicken in mot strålen.**

Warning Statement for Finland

Varoitus **Alleviates ja suojalukitus ohitettaessa olet alttiina näkymättömälle lasersäteilylle. Äjä katso säteeseen.**

Node Line Card LEDs

The LEDs on the three types of NLC provide status and operational information about port connections (Table1-15 and Table1-16).

Table1-15 OC-3 and DS3 NLC LED Indicators

LED	Status	Condition
FAIL	Steady yellow Off	NLC has failed NLC is operational
PORT 0 (top connector)		
TX (transmit)	Green Off Steady yellow Flashing yellow	Transmit activity No traffic Far-end alarm Local loopback
RX (receive)	Green Off Steady yellow	Receive activity No traffic Loss of Signal
STATUS	Green Blinking green Off	Active (primary) Standby mode (secondary) No power
PORT 1 (bottom connector)		
TX (transmit)	Green Off Steady yellow Flashing yellow	Transmit activity No traffic Far-end alarm Local loopback
RX (receive)	Green Off Steady yellow	Receive activity No traffic Loss of Signal
STATUS	Steady green Blinking green Off	Active Standby mode No power

Table1-16 OC-12 NLC LED Indicators

LED	Status	Condition
FAIL	Steady yellow Off	OC-12/STM-4 NLC has failed OC-12/STM-4 NLC is operational
TX (transmit)	Green Off Steady yellow Flashing yellow	Transmit activity No traffic Far-end alarm Local loopback
RX (receive)	Green Off Steady yellow	Receive activity No traffic Loss of signal
STATUS	Green Blinking green Off	Active (primary) Standby mode (secondary) No power

Connectors

The OC-3/STM-1 SM NLC has two 155-Mbps Synchronous Optical Network (SONET) Synchronous Transport Signal level 3, concatenated/Synchronous Digital Hierarchy (STS-3c/SDH) ports used as uplink and downlink interfaces; single mode, intermediate reach.

The OC-3/STM-1 MM NLC has two 155-Mbps Synchronous Optical Network (SONET) Synchronous Transport Signal level 3, concatenated/Synchronous Digital Hierarchy (STS-3c/SDH) ports for multimode fiber connections used as uplink and downlink interfaces.

The DS3 has two 45-Mbps bidirectional ports. The line media is 75 ohms coaxial cable, one for Tx and one for Rx. The BNC connectors are physically located on the backplane. The maximum cable length is 450 feet (137.16 meters).

The OC-12/STM-4 has one 622-Mbps Synchronous Optical Network (SONET) Synchronous Transport Signal level 12, concatenated/Synchronous Digital Hierarchy (STS-12c/SDH) ports used as uplink and downlink interfaces; single mode, intermediate reach.

Preparing for Installation

This chapter provides safety information, instructions for checking the contents of the Cisco6400 carrier-class broadband aggregator shipping container, and directions for unpacking and repacking the Cisco 6400.

This chapter includes the following:

Note The illustrations in this guide depict the original Cisco 6400 chassis. Your chassis may appear or look slightly different.

Preinstallation Checklist

Completing these steps will help you prepare for the installation of the Cisco 6400.

Step 1 Review the guidelines in the section "Safety Recommendations."

Step 2 Unpack and check the contents of the shipping container against the unpacking instructions attached to the outside of the shipping container. Refer to the section "Unpacking and Repacking the System."

Step 3 Check that you have received all the system components you need to install the Cisco6400. Refer to the section "Checking System Components Prior to Installation."

Step 4 If you have to return or move the system to a different site, refer to the section "Unpacking and Repacking the System."

AppendixB, "Configuration Worksheets" contains forms to be used during the initial installation and subsequent maintenance of your Cisco6400. Copy the configuration worksheets and use them to record installation and configuration information. Retain these worksheets along with other records as part of the Site Log (also in AppendixB, "Configuration Worksheets").

Safety Recommendations

When installing the Cisco 6400, observe all caution and warning statements. For warning translations, refer to the *Regulatory Compliance and Safety Information for the Cisco 6400* (Cisco document number 78-5789-xx).

The following guidelines will help ensure your safety and protect the equipment. However, these guidelines may not cover all potentially hazardous situations you may encounter during system installation.

- The installation of the Cisco 6400 should comply with national and local electrical codes:
  - In the United States, the National Fire Protection Association (NFPA) 70, United States National Electrical Code
  - In Canada, the Canadian Electrical Code, part 1, CC22.1
  - In other countries, the International Electromechanical Commission (IEC) Recommendation 364, part 1 through part 7
- Review the safety warnings listed in *Regulatory Compliance and Safety Information for the Cisco 6400* (Cisco document number 78-5789-xx) that is supplied with your Cisco 6400, before installing, configuring, or performing maintenance on the system.
- Never attempt to lift the chassis by yourself; *two people are required* to lift the system.
- Always disconnect all power connections before installing or removing a chassis.
- Keep the chassis area clear and free of dust during and after installation.
- Keep tools and chassis components away from walk areas.
- Do not wear loose clothing, jewelry (including rings and chains), or other items that could get caught in the chassis. Fasten loose ties, scarves, sleeves, and other items before you start installation procedures.
- The Cisco 6400 operates safely when it is used in accordance with its marked electrical ratings and product usage instructions. The equipment grounding must meet local and national electrical codes.

Warning **Only trained and qualified personnel should be allowed to install or replace this equipment. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning **This unit is intended for installation in restricted access areas. A restricted access area is where access can only be gained by service personnel through the use of a special tool, lock and key, or other means of security, and is controlled by the authority responsible for the location. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning **This equipment is to be installed and maintained by service personnel only as defined by AS/NZS 3260 Clause 1.2.14.4 Service Personnel. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning **Before working on a chassis or working near power supplies, unplug the power cord on AC units; disconnect the power at the circuit breaker on DC units. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning **Do not touch the power supply when the power cord is connected. For systems with a power switch, line voltages are present within the power supply even when the power switch is off and the power cord is connected. For systems without a power switch, line voltages are present within the power supply when the power cord is connected. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Safely Lifting the Chassis

The fully configured system weighs approximately 130 pounds. The chassis is not intended to be moved frequently. Before you install the system, ensure that your site is properly prepared so you can avoid having to move the chassis later to accommodate power sources and network connections. For more information about site preparation, refer to the *Cisco 6400 Site Planning Guide*.

Two or more people are required to lift the chassis. Whenever you lift the chassis or any heavy object, follow these guidelines:

- Never attempt to lift the chassis by yourself. Because of the size and weight of the chassis, at least two persons are needed to safely lift and move it without causing injury or damaging the equipment.
- Ensure that your footing is solid, and balance the weight of the chassis between your feet.
- Lift the chassis slowly; never move suddenly or twist your body as you lift.
- Keep your back straight and lift with your legs, not your back. If you must bend down to lift the chassis, bend at the knees, not at the waist, to reduce the strain on your lower back muscles.
- Do not remove installed components from the chassis.
- Always disconnect all external cables before lifting or moving the chassis.

Warning **To prevent personal injury or damage to the chassis, never attempt to lift or tilt the chassis using the handles on modules (such as power supplies, fans or cards); these types of handles are not designed to support the weight of the unit. Lift the unit only by using handles that are an integral part of the chassis, or by grasping the chassis underneath its lower edge. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

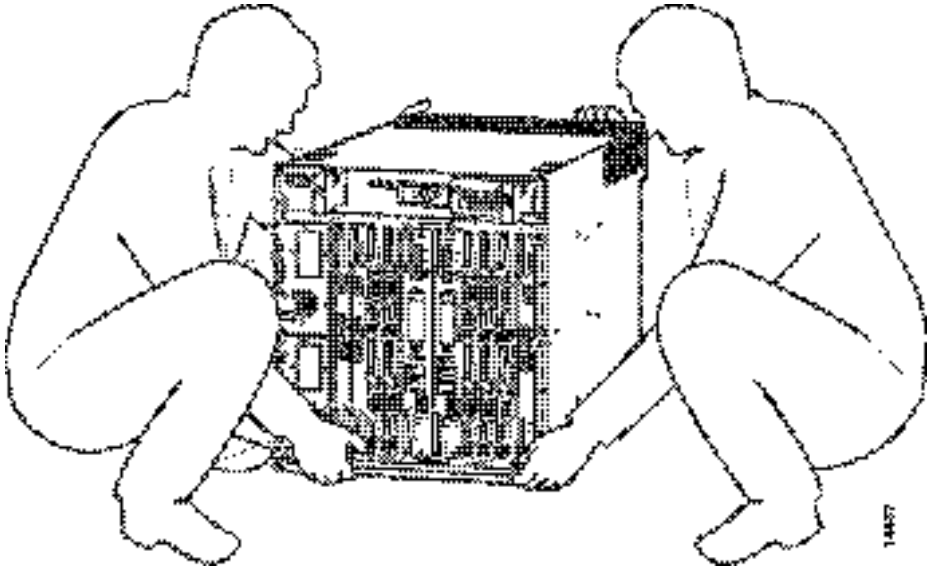
Warning **Two people are required to lift the chassis. To prevent injury, keep your back straight and lift with your legs, not your back. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

To safely lift the chassis:

Step 1 Each person should stand on either side of the chassis placing one hand in the air intake at the bottom front of the chassis.

Step 2 With the other hand, grasp the top rear of the chassis under the air exhaust and carefully lift the chassis as shown in Figure2-1.

Figure2-1 Lifting the Chassis



Safety with Electricity

All system components are redundant. They are designed to be removed and replaced while the system is operating without presenting an electrical hazard or damage to the system.

Follow these basic guidelines when you are working with any electrical equipment:

- Before beginning any procedures requiring access to the chassis interior, locate the emergency power-off switch for the room in which you are working.
- Disconnect all power and external cables before installing or removing a chassis.
- Do not work alone when potentially hazardous conditions exist.
- Never assume that power has been disconnected from a circuit; always check.
- Do not perform any action that creates a potential hazard to people or makes the equipment unsafe. Never install equipment that appears damaged.
- Carefully examine your work area for possible hazards such as moist floors, ungrounded power extension cables, and missing safety grounds.

In addition, use the guidelines that follow when working with any equipment that is disconnected from a power source but is still connected to telephone wiring or other network cabling.

- Never install telephone wiring during a lightning storm.

- Never install telephone jacks in wet locations unless the jack is specifically designed for wet locations.
- Never touch uninsulated telephone wires or terminals unless the telephone line has been disconnected at the network interface.
- Use caution when installing or modifying telephone lines.

Warning **Do not work on the system or connect or disconnect cables during periods of lightning activity. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning **Read the installation instructions before you connect the system to its power source. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Preventing Electrostatic Discharge Damage

Electrostatic discharge (ESD) damage, which occurs when electronic cards or components are improperly handled, can result in complete or intermittent failures. The node switch processor (NSP), node route processor (NRP), and node line card (NLC) each consist of a printed circuit card that is fixed in a metal carrier. Electromagnetic interference (EMI) shielding and connectors are integral components of the carrier. Although the metal carrier helps to protect the cards from ESD, use an antistatic strap whenever you handle the modules. Handle the carriers by the edges only; never touch the cards or connector pins.

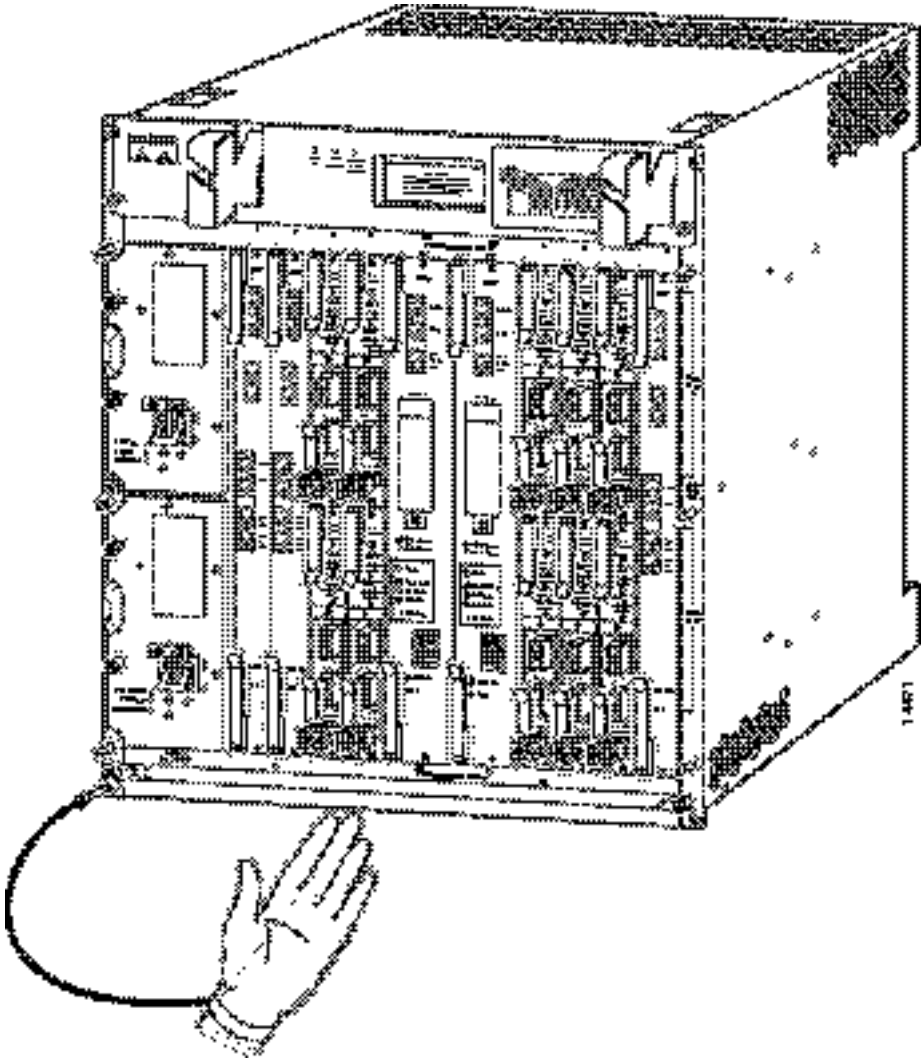
Caution Always tighten the captive installation screws on all system components when you are installing them. These screws prevent accidental removal of the module, provide proper grounding for the system, and help to ensure that the bus connectors are properly seated in the backplane.

Following are guidelines for preventing ESD damage:

- Always use an ESD-preventive wrist or ankle strap and ensure that it makes good skin contact.
- Before removing a card from the chassis, connect the equipment end of the strap to the ESD plug at the bottom of the chassis (Figure2-2) below the power entry modules (PEMs).
- Handle carriers by the faceplates and carrier edges only; avoid touching the card or any connector pins.
- When removing a card, place the removed module component-side-up on an antistatic surface or in a static-shielding bag. If the module will be returned to the factory, immediately place it in a static-shielding bag.
- Avoid contact between the modules and clothing. The wrist strap protects the card from ESD voltages on the body only; ESD voltages on clothing can still cause damage.

Caution For safety, periodically check the resistance value of the antistatic strap. The measurement should be between 1 and 10 megohms.

Figure2-2 Connecting an Electrostatic Discharge Wrist Strap



Unpacking and Repacking the System

The Cisco 6400 is shipped assembled in a cardboard box. Power cables, manuals, and other additional items are packaged in separate boxes.

Unpacking instructions are attached to the outside of the shipping container. To verify that you have received all of the required components, see the "Checking the Contents" section on page2-8.

Caution Static voltages as low as 30 volts can damage circuitry. Be sure to observe all standard anti-static procedures (for example, wear a grounding strap) when handling electronic equipment and components.

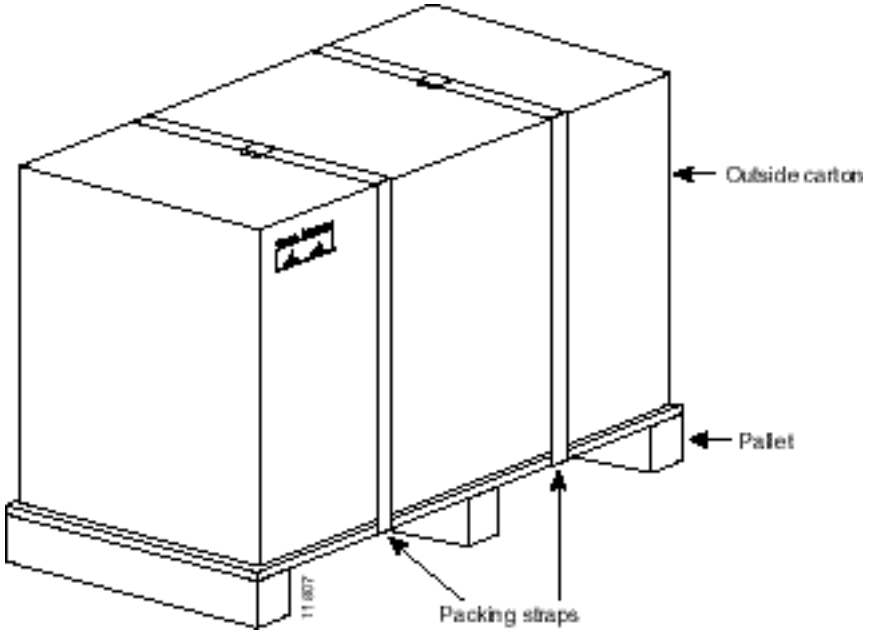
Unpacking the Cisco 6400

To unpack the Cisco 6400:

Step 1 Inspect all packing containers. If any damage or other signs of mishandling are evident, inform both the carrier and Cisco Systems.

Step 2 Remove strapping tape (Figure2-3) and any exterior covering from the pallet, and place the accessory boxes on a flat, solid surface where they can be unpacked separately.

Figure2-3 Cisco 6400 System Package



Note Do not discard the shipping containers after you have unpacked the system. Flatten the shipping cartons and store them with the pallet. You will need these containers if you want to move or ship the system in the future.

Step 3 Review chassis lifting guidelines in the section "Safely Lifting the Chassis" section on page2-3.

Step 4 Carefully remove the system chassis from its container.

Step 5 Open the boxes that contain the cables and documentation. (Do not use a knife to open these boxes.) Carefully inspect the items for damage.

Checking the Contents

Use the worksheets in AppendixB, "Configuration Worksheets" while checking the contents of the shipping container. The completed System Installation Checklist provides a record of components that you have ordered and received.

To verify the contents of the Cisco 6400 shipping container:

Step 1 Check the contents of the boxes containing accessory items. Verify that you have received all equipment listed in your order, including the following:

- System hardware and software documentation, if ordered
- Optional equipment that you ordered, such as PEMs, transceivers, or special connectors

Step 2 Check that all line cards are included in the shipment. Ensure that the configuration matches the packing list and that all of the interfaces are included.

Step 3 Complete the Port Configuration Worksheet in Appendix B, "Configuration Worksheets."

Repacking the System

If your system is damaged, you will need to repack it for return shipment. Use the original shipping containers. Figure2-4 shows an exploded view of the system and packing materials.

To return or move the Cisco6400 to a different location, follow these instructions for repacking the system, using the original packaging material:

Step 1 Place the bottom packing material section inside the bottom of the shipping container.

Step 2 Use at least two people to place the Cisco6400 chassis inside the container. Be sure that the chassis is positioned correctly before you lower it inside the container.

Step 3 Place the top packing material over the top of the Cisco6400 chassis.

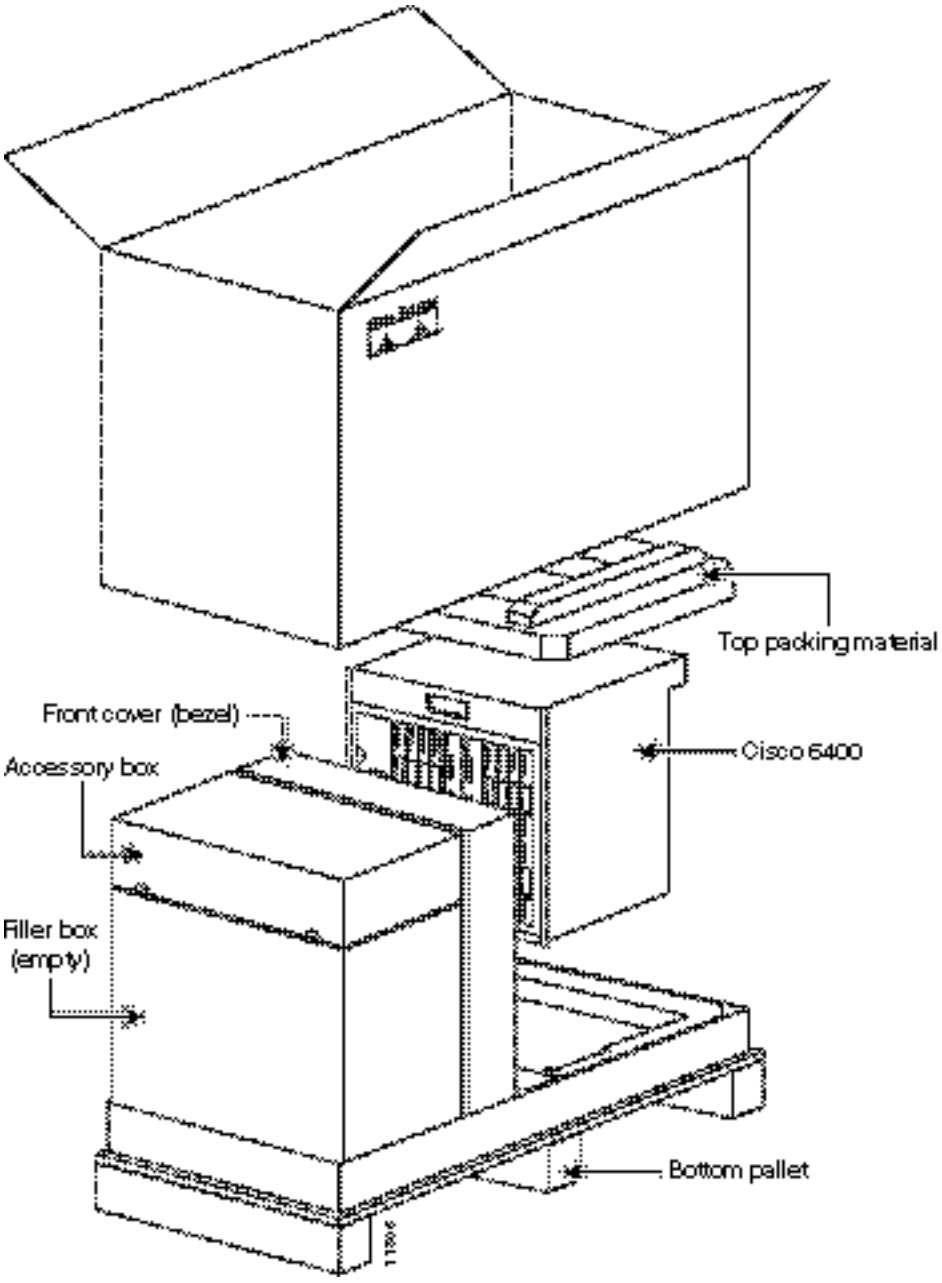
Step 4 Place both accessory boxes inside the cutouts in the top section of the packing material.

Step 5 Fold the outside carton down over the top of the accessory boxes and seal with packing tape. Figure2-3 shows the packaged Cisco 6400.

Step 6 Wrap two packaging straps tightly around the top and bottom of the package to hold the outside carton and the bottom pallet.

Note Do not use tape to hold the outside carton to the bottom pallet. You must use packaging straps.

Figure2-4 Cisco 6400 and Packing Material



Checking System Components Prior to Installation

Before beginning installation of your Cisco 6400, you should verify that you have received all hardware and documentation items listed on the shipping receipt or the bill of materials (BOM). Record information about your Cisco6400 using the worksheets in Appendix B, "Configuration Worksheets." You should also verify that you have all of the cables, connectors, and adapters required for your particular location.

Installing the Cisco 6400

This chapter describes the procedures for installing the Cisco 6400 carrier-class broadband aggregator in a rack, connecting the interface and power cables, and powering up the Cisco6400.

This chapter includes the following sections:

The sequence of procedures covers typical installations; you might need to modify these procedures if you have different site conditions. Recommended tools, equipment, and supplies are listed for each stage.

Note The illustrations in this guide depict the original Cisco 6400 chassis. Your chassis may appear or look slightly different, but the installation procedure is the same.

Installation Safety Guidelines

The following guidelines will help to ensure your safety and protect the equipment. This list does not cover all potentially hazardous situations.

- The installation of your Cisco 6400 should comply with national and local electrical codes:
  - In the United States, this means the National Fire Protection Association (NFPA) 70, United States National Electrical Code
  - In Canada, Canadian Electrical Code, part I, CC22.1
  - In other countries, International Electrotechnical Commission (IEC) 364, part 1 through part 7
- Review the safety warnings listed in the publication *Regulatory Compliance and Safety Information for the Cisco 6400,* which accompanied your Cisco6400, before installing, configuring, or performing maintenance on the product.
- Never attempt to lift an object that might be too heavy for you to lift safely by yourself.
- Always turn off all power supplies and unplug all power cables before opening the chassis.

- Always unplug the power cable before installing or removing a chassis.
- Keep the chassis area clear and dust free during and after installation.
- Keep tools and chassis components away from walk areas.
- Do not wear loose clothing, jewelry (including rings and chains), or other items that could get caught in the chassis.
- The Cisco 6400 AC PEM ships with a three-wire electrical grounding-type plug, which will fit into a grounding-type power outlet only. This is a safety feature. The equipment grounding should be in accordance with local and national electrical codes.
- The Cisco 6400 operates safely when it is used in accordance with its marked electrical ratings and product usage instructions.

Warning **Read the installation instructions before you connect the system to its power source. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning **Do not work on the system or connect or disconnect cables during periods of lightning activity. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning **To prevent personal injury or damage to the chassis, never attempt to lift or tilt the chassis using the handles on modules (such as power supplies, fans or cards); these types of handles are not designed to support the weight of the unit. Lift the unit only by using handles that are an integral part of the chassis, or by grasping the chassis underneath its lower edge. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning **Two people are required to lift the chassis. To prevent injury, keep your back straight and lift with your legs, not your back. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Mounting the Cisco 6400 Chassis

The Cisco 6400 chassis can be mounted in any of the following ways:

Note If your Cisco 6400 chassis has an AC power shelf, alternative mounting arrangements cannot be used. The Cisco 6400 chassis and the AC power shelf must be flush-mounted in a 19-inch rack, with the AC power shelf directly below the Cisco 6400. The Cisco 6400 chassis can never be mounted directly on the floor.

General Guidelines for Chassis Mounting

When installing the chassis in the rack, you should follow these guidelines:

- The Cisco 6400 chassis requires a minimum of 13 rack units (22.3 inches or 56.6 cm) of vertical rack space. You should measure the proposed rack location before mounting the equipment.
- Check the site location for factors such as accessibility, power, signal and network cable connections, and future growth.

Warning **To prevent bodily injury when mounting or servicing this unit in a rack, you must take special precautions to ensure that the system remains stable. The following guidelines are provided to ensure your safety:**

- This unit should be mounted at the bottom of the rack if it is the only unit in the rack.
- When mounting this unit in a partially filled rack, load the rack from the bottom to the top with the heaviest component at the bottom of the rack.
- If the rack is provided with stabilizing devices, install the stabilizers before mounting or servicing the unit in the rack.

To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.

Note The rack must be unobstructed. This kit is not suitable for use with racks other than those described in this manual, or with those that have obstructions, such as a power strip. Access to the system modules and power supplies must be unimpaired.

Recommended Tools, Equipment, and Supplies

The following tools and equipment are recommended as the minimum necessary for Cisco6400 installation:

- Number 2 Phillips screwdriver or flat-blade screwdriver
- Antistatic mat or antistatic foam
- An electrostatic discharge (ESD) grounding strap or the disposable ESD strap that shipped with the system

You might need additional tools and equipment to install associated equipment and cables. You might also require test equipment to check electronic and optical signal levels, power levels, and communications links.

Flush-Mounting in a 19-Inch Rack

The Cisco 6400 chassis can be flush-mounted in a 19-inch equipment rack using the rack mounting kit provided with your system. The chassis can be mounted with either the front or the rear chassis panel facing outward toward the aisle.

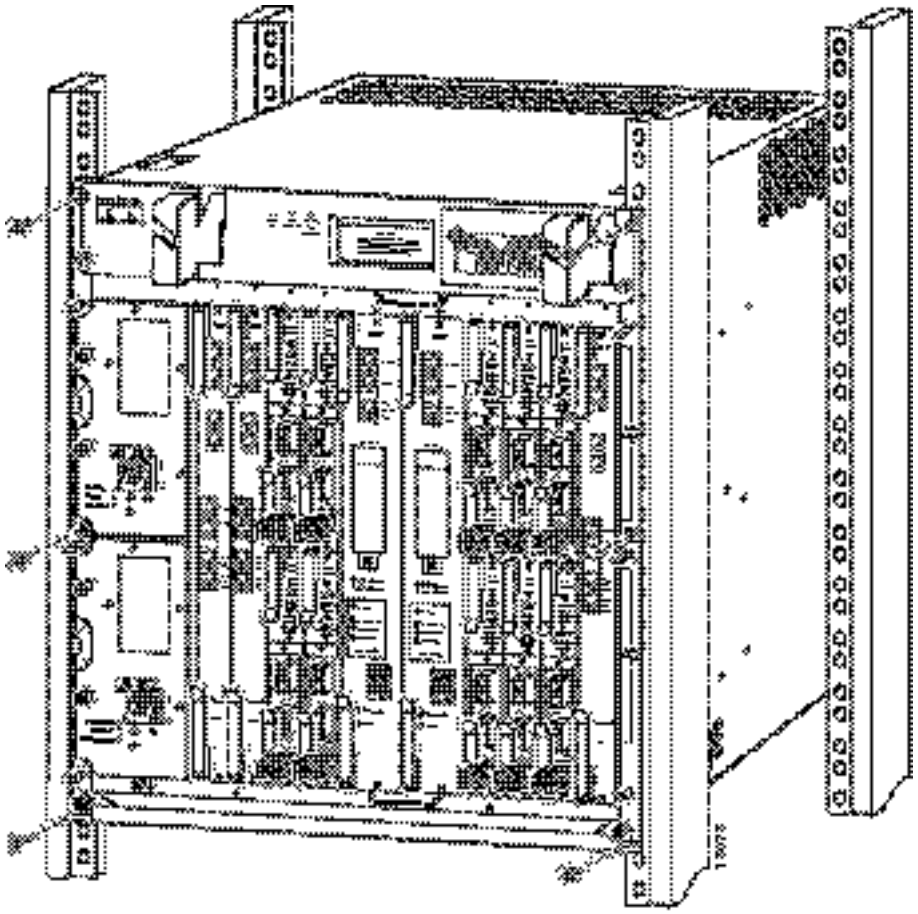
Note At least three people are required to mount the chassis: two persons to hold the unit, and one person to attach the screws. You should follow safe lifting practices when handling the Cisco 6400 chassis. See the "Safely Lifting the Chassis" section on page2-3.

To install the rack-mount and cable-management brackets on a Cisco 6400 for a flush rack-mount configuration:

Step 1 Place the Cisco 6400 chassis on a flat work surface and inspect it thoroughly for damage before mounting.

Step 2 Attach the mounting brackets so that the flanges that protrude to the sides are at the front of the chassis. Use three M5 screws per bracket (Figure3-1).

Figure3-1 Flush-Mounting Cisco 6400 Chassis in a 19-Inch Rack



Step 3 *Two people are required to perform this step.* A person should stand on either side of the chassis placing one hand in the air intake at the bottom front of the chassis. With the other hand grasp the top of the chassis under the air exhaust and carefully lift the chassis. Slowly lift the chassis in unison. To prevent injury, avoid sudden twists or moves.

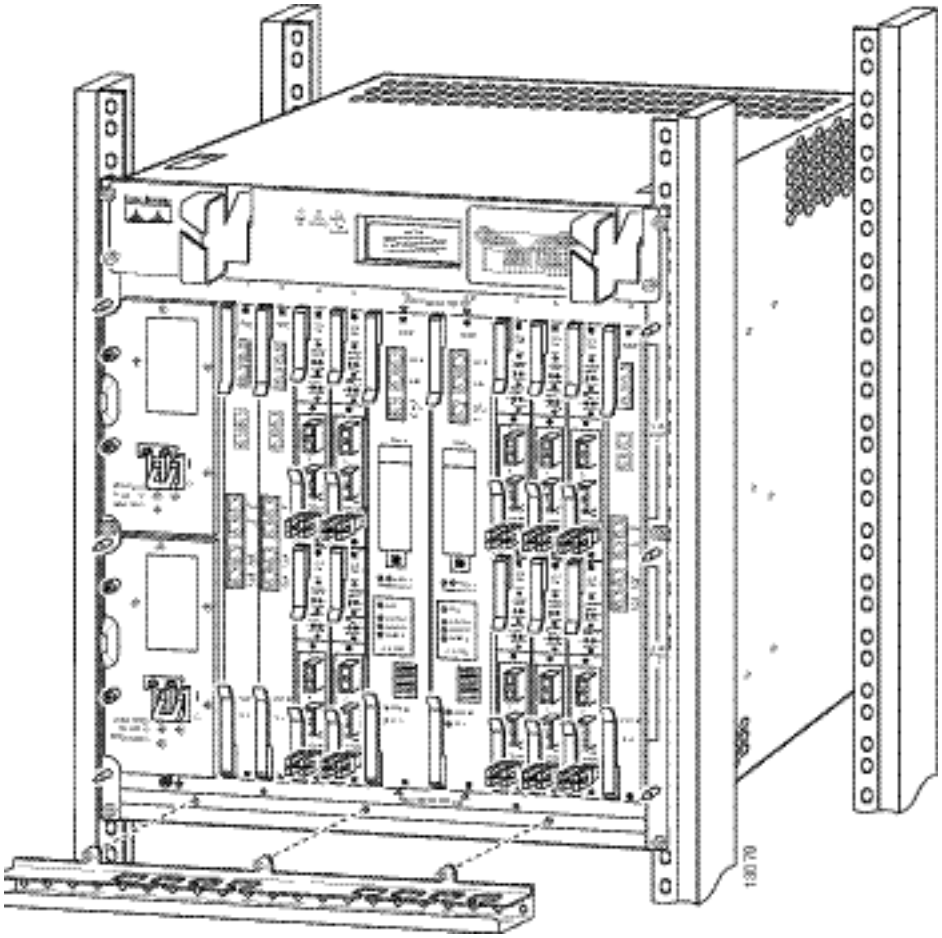
Step 4 To position the chassis in the rack, insert the rear of the chassis between the rack posts. Align the mounting holes on the front flanges of the chassis with the mounting holes in the equipment rack.

Step 5 A third person should insert the mounting screws through the elongated holes in the bracket and into the threaded holes in the mounting post.

Step 6 Attach the cable management bracket to the bottom of the chassis (Figure3-2).

Note The cable management bracket consists of two pieces (the cable guide and channel), but comes assembled. If you want to use just the cable guide, you can remove the channel by loosening the captive screws before attaching it to the chassis.

Figure3-2 Attaching Cable Management Bracket



Center-Mounting in a 19-Inch Rack

The Cisco 6400 chassis can be center-mounted in a 19-inch equipment rack using the adapter kit provided with your system. The chassis can be mounted with either the front or the rear chassis panel facing outward toward the aisle.

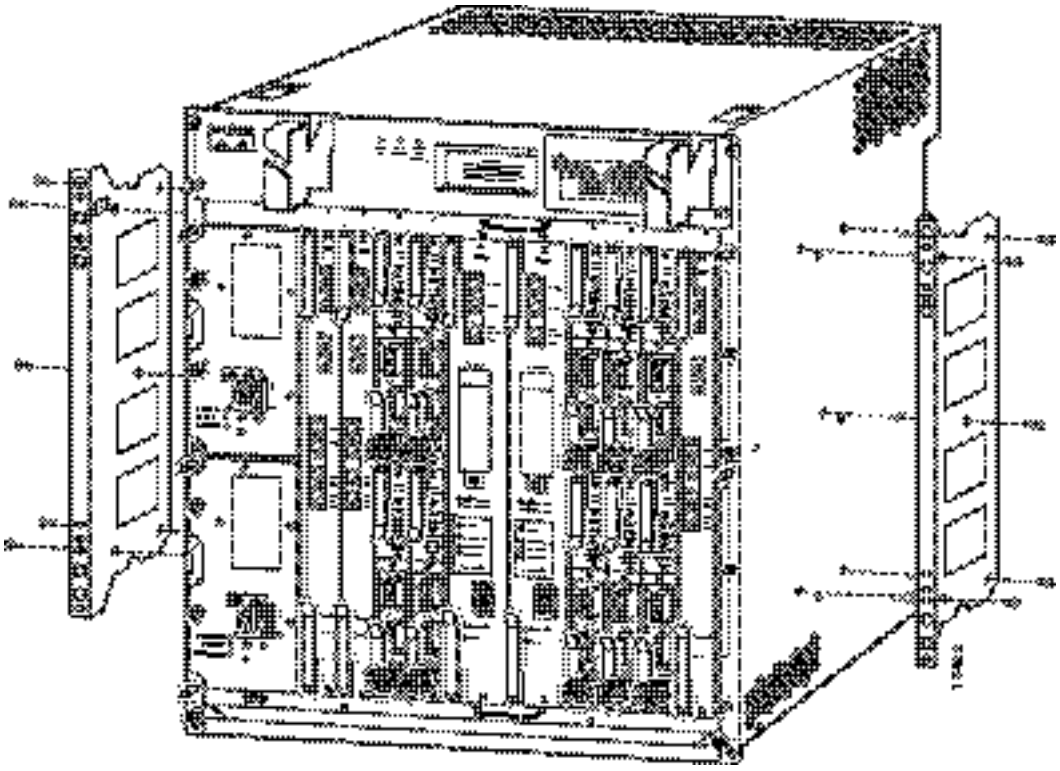
Note At least three people are required to mount the chassis: two persons to hold the unit, and one person to attach the screws. You should follow safe lifting practices when handling the Cisco 6400 chassis. See the "Safely Lifting the Chassis" section on page2-3.

To install the rack-mount and cable-management brackets on a Cisco 6400 for a center-mount configuration:

Step 1 Place the Cisco 6400 chassis on a flat work surface and inspect thoroughly for damage before mounting.

Step 2 Attach the optional mounting brackets to the chassis so that the flanges that protrude are at the middle of the chassis (Figure3-3).

Figure3-3 Attaching Optional Mounting Brackets for a 19-Inch Rack



Step 3 *Two people are required to perform this step.* A person should stand on either side of the chassis placing one hand in the air intake at the bottom front of the chassis. With the other hand, grasp the top of the chassis under the air exhaust and carefully lift the chassis. Slowly lift the chassis in unison. To prevent injury, avoid sudden twists or moves.

Step 4 To position the chassis in the rack, insert the rear of the chassis between the rack posts. Align the mounting holes on the front flanges of the chassis with the mounting holes in the equipment rack.

Step 5 A third person should insert the mounting screws through the elongated holes in the bracket and into the threaded holes in the mounting post (Figure3-4).

Step 6 Attach the cable management bracket to the bottom of the chassis (Figure3-5).

Note The cable management bracket consists of two pieces (the cable guide and channel), but comes assembled. If you want to use just the cable guide, you can remove the channel by loosening the captive screws before attaching it to the chassis.

Figure3-4 Center-Mounting Cisco 6400 Chassis in a 19-Inch Rack

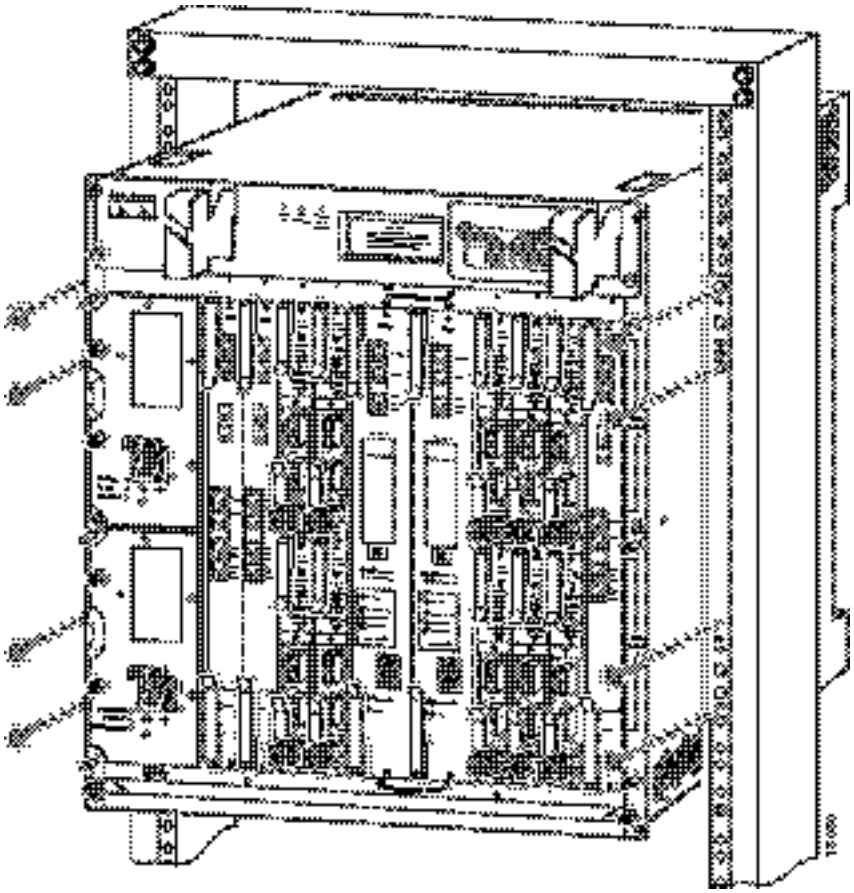
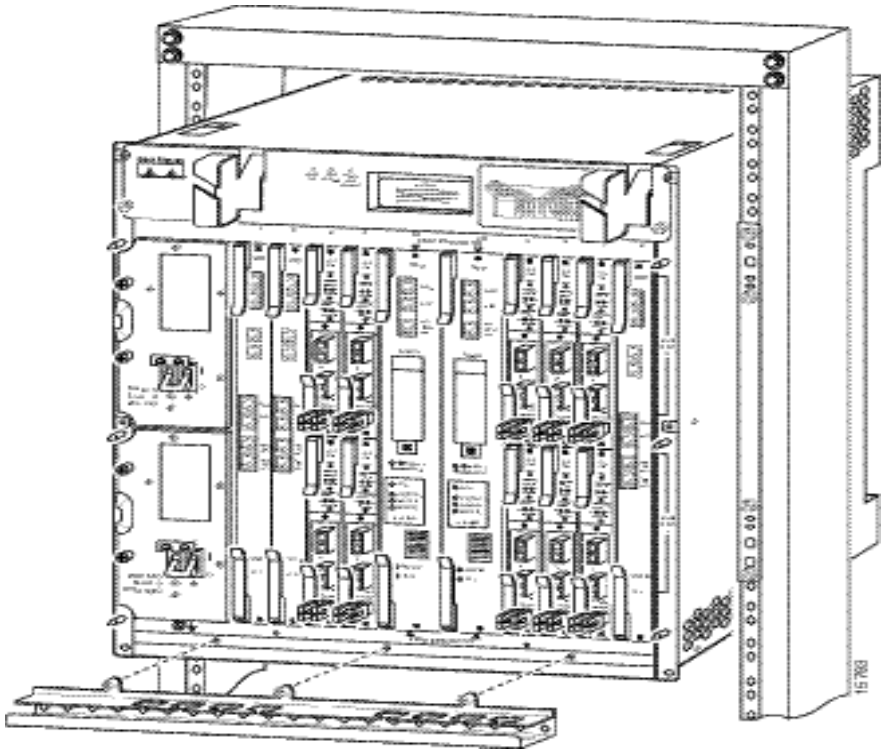


Figure3-5 Attaching Cable Management Bracket



Center-Mounting in a 23-Inch Rack

The Cisco 6400 chassis can be center-mounted in a 23-inch equipment rack using the optional mounting brackets.

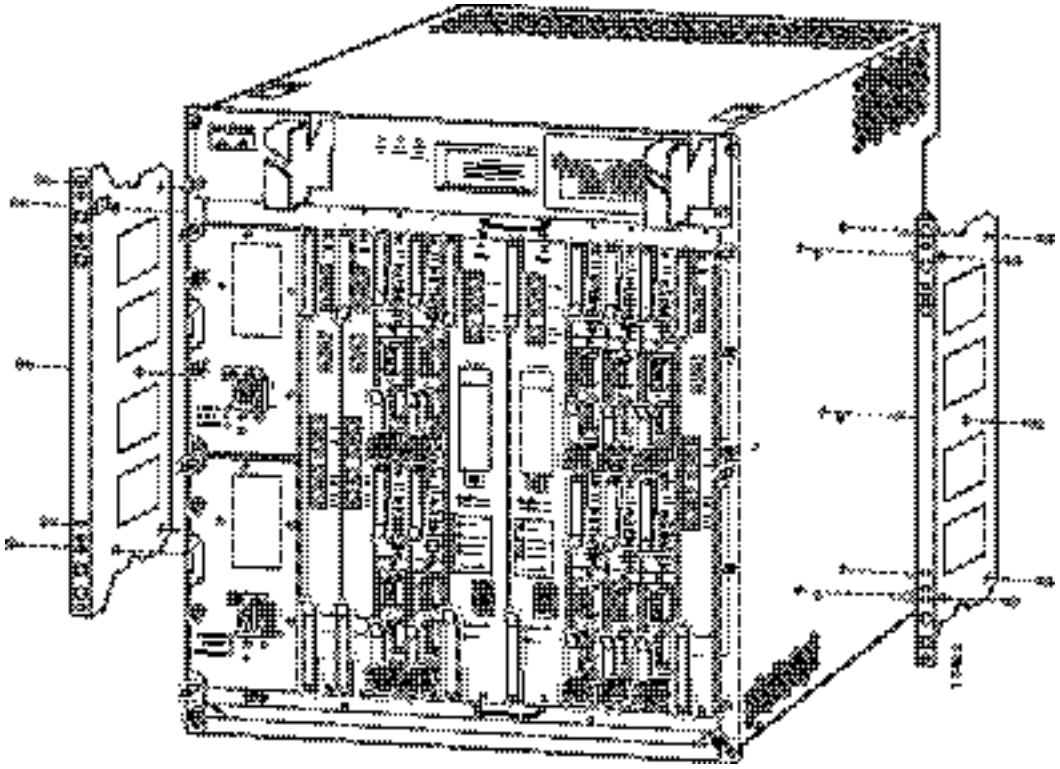
Note At least three people are required to mount the chassis: two persons to hold the unit, and one person to attach the screws. You should follow safe lifting practices when handling the Cisco 6400 chassis. See the "Safely Lifting the Chassis" section on page2-3.

To install the rack-mount and cable-management brackets on a Cisco 6400 for a center-mount configuration:

Step 1 Place the Cisco 6400 chassis on a flat work surface and inspect thoroughly for damage before mounting.

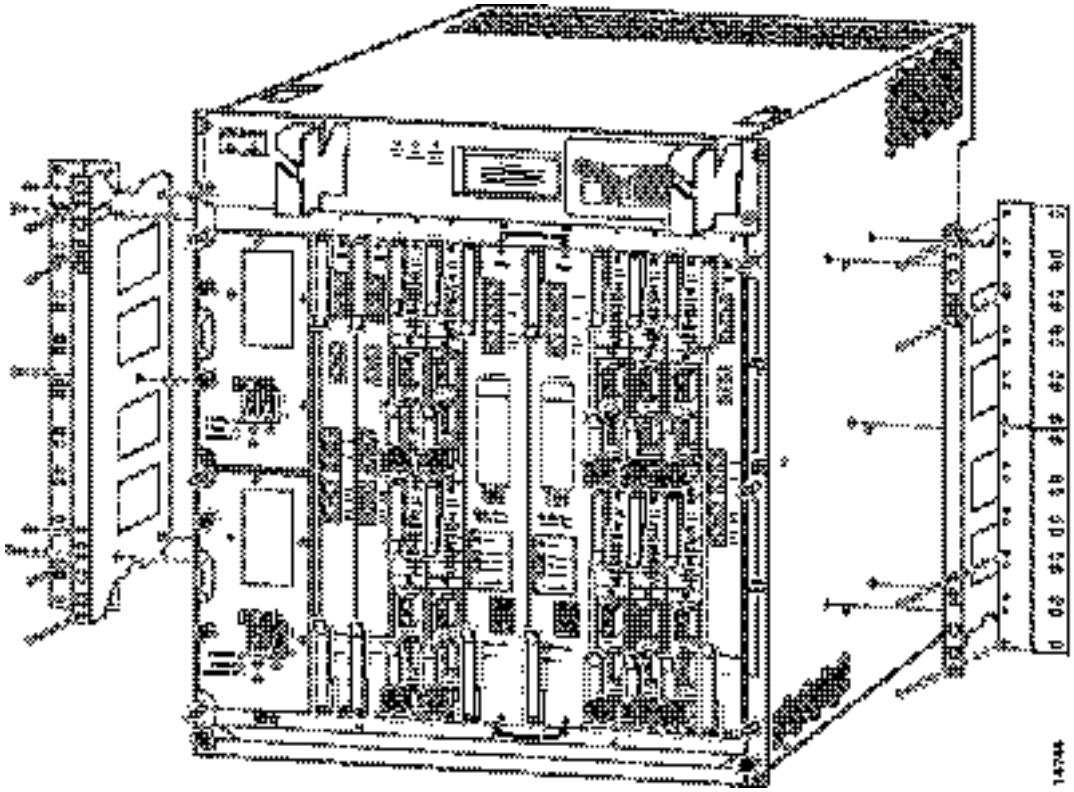
Step 2 Attach the optional mounting brackets to the middle of the chassis (Figure3-6).

Figure3-6 Attaching Optional Mounting Brackets for a 23-Inch Rack



Step 3 Attach the optional 23-inch bracket adapters to the chassis so that the flanges that protrude are at the middle of the chassis (Figure3-7).

Figure3-7 Attaching Flanges to Chassis in a 23-Inch Rack



Step 4 *Two people are required to perform this step.* A person should stand on either side of the chassis placing one hand in the air intake at the bottom front of the chassis. With the other hand, grasp the top of the chassis under the air exhaust and carefully lift the chassis. Slowly lift the chassis in unison. To prevent injury, avoid sudden twists or moves.

Step 5 To position the chassis in the rack, insert the rear of the chassis between the rack posts. Align the mounting holes on the front flanges of the chassis with the mounting holes in the equipment rack.

Step 6 A third person should insert the mounting screws through the elongated holes in the bracket and into the threaded holes in the mounting post (Figure3-8).

Step 7 Attach the cable management bracket to the bottom of the chassis (Figure3-9).

Note The cable management bracket consists of two pieces (the cable guide and channel), but comes assembled. If you want to use just the cable guide, you can remove the channel by loosening the captive screws before attaching it to the chassis.

Figure3-8 Center-Mounting the Cisco 6400 Chassis in a 23-Inch Rack

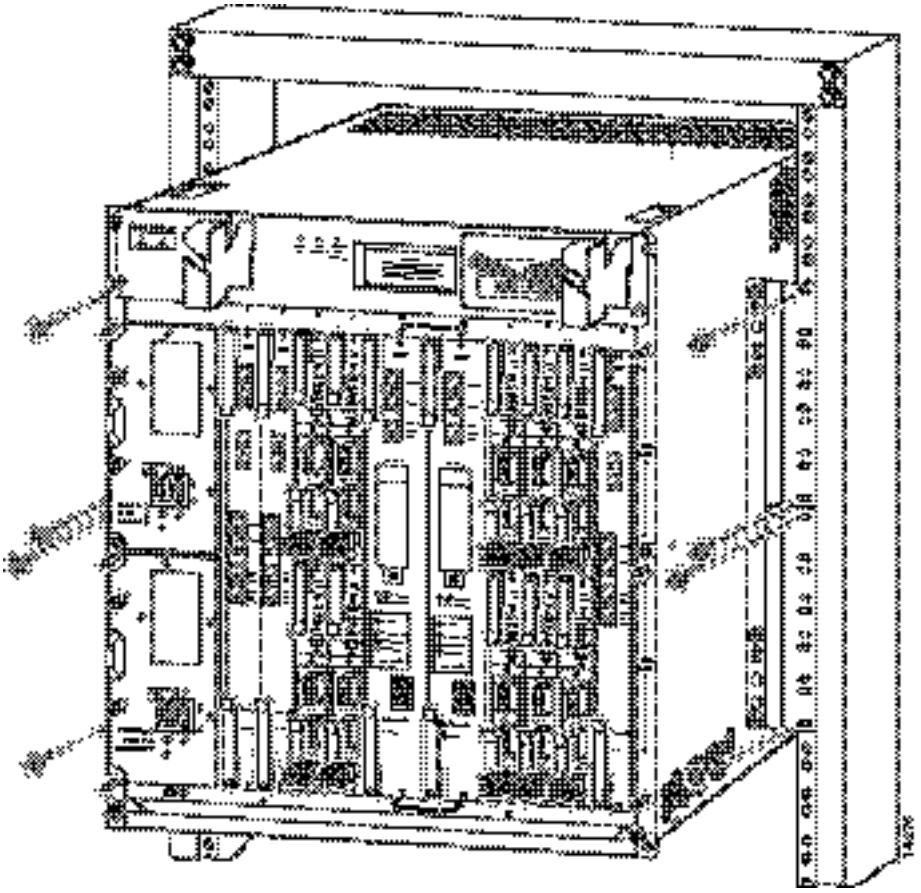
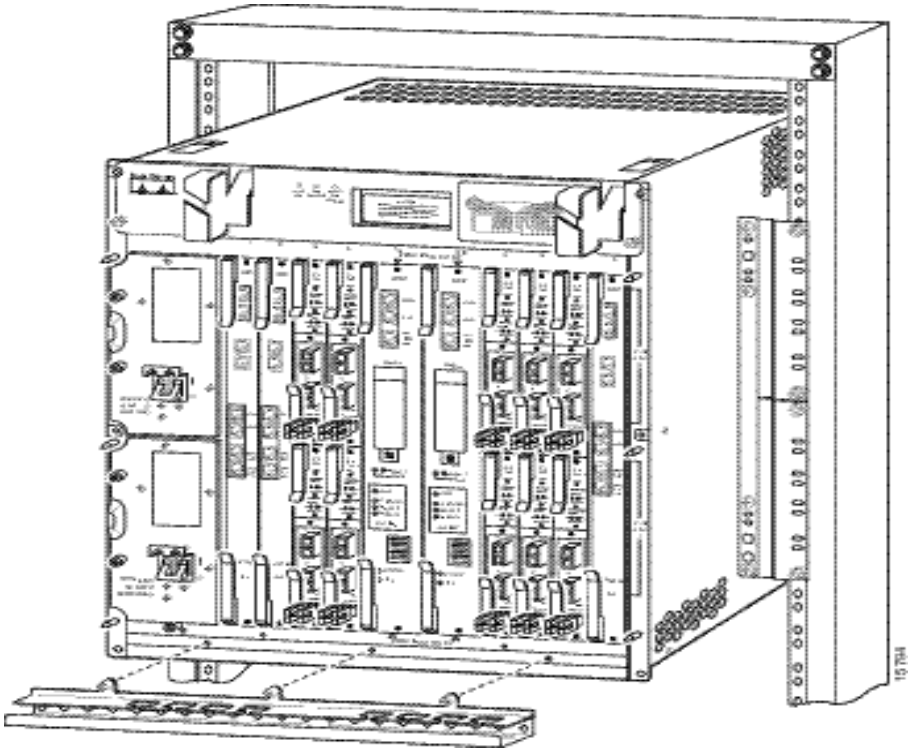


Figure3-9 Attaching the Cable Management Bracket



Alternative Mounting Arrangements

You can mount the Cisco 6400 chassis in alternative locations, such as on an equipment shelf or in a cabinet. You might need special brackets or holders to secure the equipment.

Note You might need to provide additional cooling and ventilation if you mount the Cisco 6400 chassis in a cabinet.

Note If your Cisco 6400 chassis has an AC power shelf, you cannot use alternative mounting arrangements. The Cisco 6400 chassis and the AC power shelf must be flush-mounted in a 19-inch rack, with the AC power shelf directly below the Cisco 6400. The Cisco 6400 chassis can never be mounted directly on the floor.

Inspecting the Chassis and Plugin Units

After the chassis has been mounted, you should inspect the system. At the front of the chassis, check the ejector levers and ensure that the cards are securely installed. Tighten any captive installation screws that are loose on the cards. Ensure that your path to the rack is unobstructed.

Connecting System Ground

This section provides procedures for connecting the Cisco 6400 chassis to earth ground. This procedure is required for all DC-powered installations, and any AC-powered installation where compliance with Bellcore grounding requirements is necessary. Make sure you have the recommended tools and supplies available (Table3-1).

Warning **When installing the unit, the ground connection must always be made first and disconnected last. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning **Never defeat the ground conductor or operate the equipment in the absence of a suitably installed ground conductor. Contact the appropriate electrical inspection authority or an electrician if you are uncertain that suitable grounding is available. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Recommended Tools and Supplies

Table3-1 lists tools, equipment, and supplies you will need when you connect the system ground to the chassis.

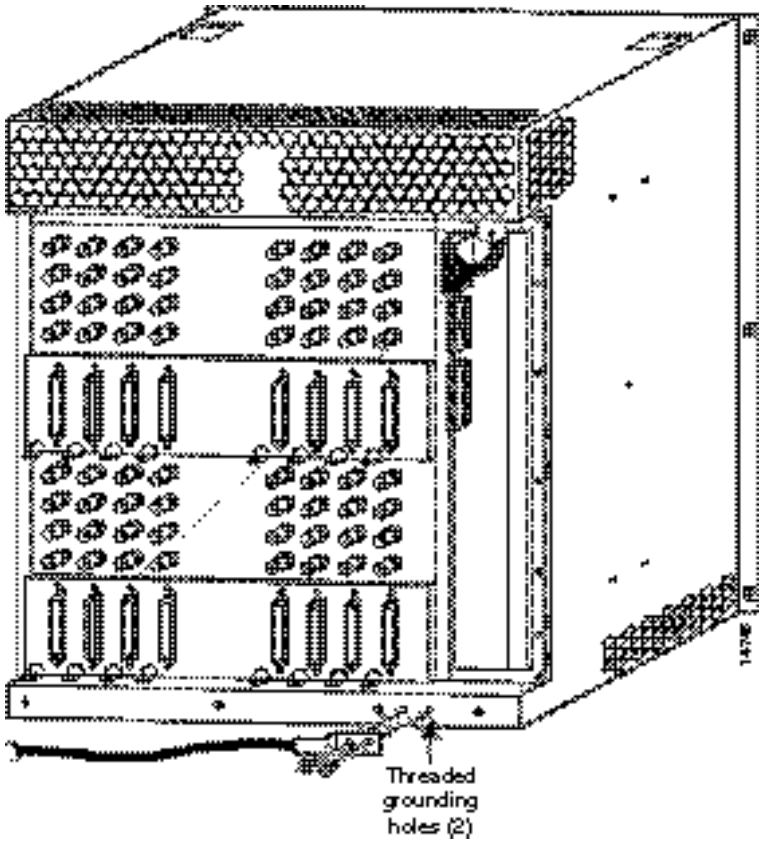
Table3-1 Recommended Tools and Supplies for Connecting System Ground

Quantity	Description	Comments
1	Number 2 Phillips screwdriver	
1	Wire stripping tool	
1	Crimping tool	Must fit diameter of grounding lugs.
2	2-hole grounding lugs Must fit no. 6 stranded, no. 6 weld, or 37/24 flex cables. Each lug has two holes, centered 0.625 in. (15.87 mm) apart and accepts M5 screws.	Recommended types: Panduit no. LCD6-10-AL Thomas & Betts no. 54204 Burndy no. YA8CL2TC10
Varies	Grounding wire	6 AWG, 0.204 in. (5.18 mm) recommended.
2	M5 PEM screws with captive, locking washers	Included in accessory kit shipped with Cisco 6400 chassis.
Varies	Screws to attach ground wire to grounding point at site	Part requirements depend on location.

Connecting the Grounding Lug and Cable to Grounding Receptacle

This section describes the procedure for connecting system ground to the Cisco 6400 chassis. Figure3-10 illustrates a typical ground connection for the system.

Figure3-10 Connecting System Ground to the Cisco 6400



To attach the grounding lug and cable to the grounding receptacle on the Cisco 6400:

Step 1 Ensure power is Off.

Step 2 Use a wire stripping tool to remove approximately 3/4 inch (2 cm) of the covering from the end of the grounding wire.

Step 3 Insert the stripped end of the grounding wire in the open end of the grounding lug.

Step 4 Use a crimping tool to secure the grounding wire in the open end of the grounding lug.

Step 5 Locate the two grounding threaded holes at the bottom rear of the Cisco 6400.

Step 6 Place the grounding lug against the threaded holes.

Step 7 Insert the two M5 screws from the accessory kit through the holes in the lug and the threaded holes in the chassis. Use the cross-slotted screwdriver to tighten the screws and secure the grounding lug firmly to the chassis.

Step 8 Prepare the other end of the grounding wire for connection to an appropriate grounding point in your site.

Connecting System DC Power

In this procedure, you connect the Cisco 6400 to a –48 VDC power source. Before beginning the procedure, connect the chassis to earth ground as described in the previous section.

The power connectors are pillar terminals on the backplane. For full power redundancy, the two sets of power connectors, labeled A and B, must be connected to separate power sources. If you do not require power redundancy, you can use only one set of terminals—either the A terminals or the B terminals. (Do not use one of each.)

Warning **Connect the unit only to a DC power source that complies with the Safety Extra-Low Voltage (SELV) requirements in IEC 60950 based safety standards. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning **Before working on equipment that is connected to power lines, remove jewelry (including rings, necklaces, and watches). Metal objects will heat up when connected to power and ground and the heat can cause serious burns or weld the metal object to the terminals. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning **This unit might have more than one power supply connection. All connections need to be removed to de-energize the unit. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning **Use copper conductors only. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning **A readily accessible two-poled disconnect device must be incorporated in the fixed wiring. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning **This product requires short-circuit (overcurrent) protection, to be provided as part of the building installation. Install only in accordance with national and local wiring regulations. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning **Care must be given to connecting units to the supply circuit so that wiring is not overloaded. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Recommended Tools and Supplies

Table3-2 lists the tools and supplies that you will need to connect the Cisco 6400 chassis to system power sources.

Table3-2 Recommended Tools and Supplies for ConnectingSystem Power

Quantity	Description	Comments
1	Flat-blade screwdriver	
1	Wire stripping tool	
2 or 4 (length varies)	10 AWG (minimum) wire cables	Cables must reach from the Cisco 6400 chassis to the power source. Two cables are needed for a single power source. Four cables are needed for two independent power sources. The cable to be connected to the Cisco 6400 chassis needs to have insulation stripped back not more than 0.394 in. (10 mm).

Connecting the Cisco 6400 Chassis to a System Power Source

To attach the DC power source on the Cisco 6400:

Step 1 Ensure power is Off.

Warning **Before performing any of the following procedures, ensure that power is removed from the DC circuit. To ensure that all power is OFF, locate the circuit breaker on the panel board that services the DC circuit, switch the circuit breaker to the OFF position, and tape the switch handle of the circuit breaker in the OFF position. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

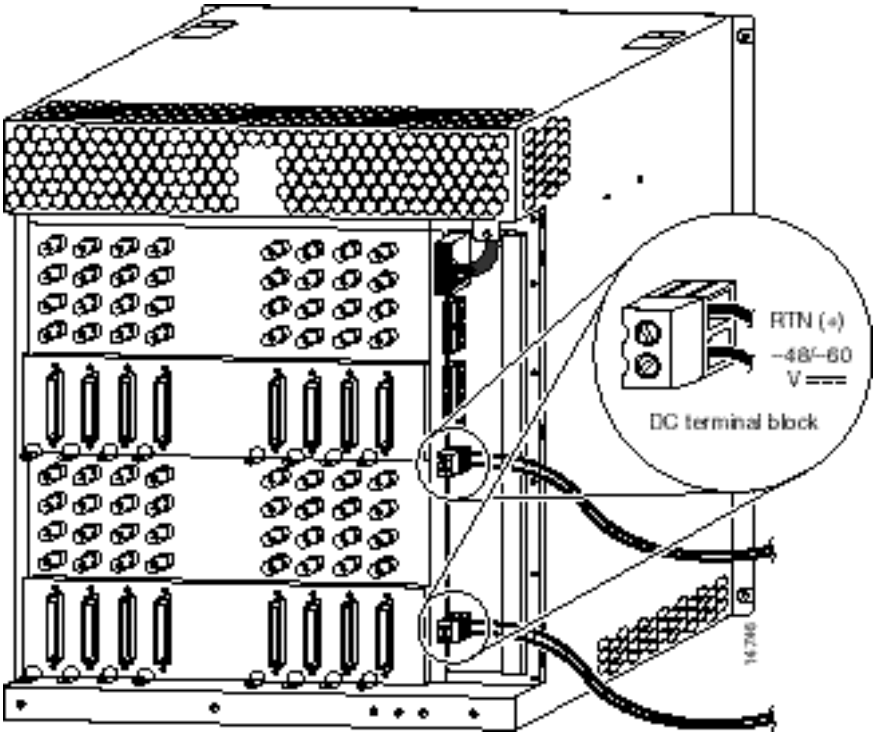
Step 2 Remove rear cover.

Step 3 Strip no more than 0.394 in. (10 mm) of insulation off the end of the power cables (Figure3-11).

Figure3-11 Stripping Insulation

Step 4 Use a flat-blade screwdriver to connect the DC power lead from the first external power source to the DC terminal block labeled (–) 48V A. Figure3-12 illustrates typical DC power lead connections for the system.

Figure3-12 DC Power Connections



Note Apply a torque of approximately 7 inch-pounds on the DC terminal connector. Do not exceed the maximum torque of 10 inch-pounds.

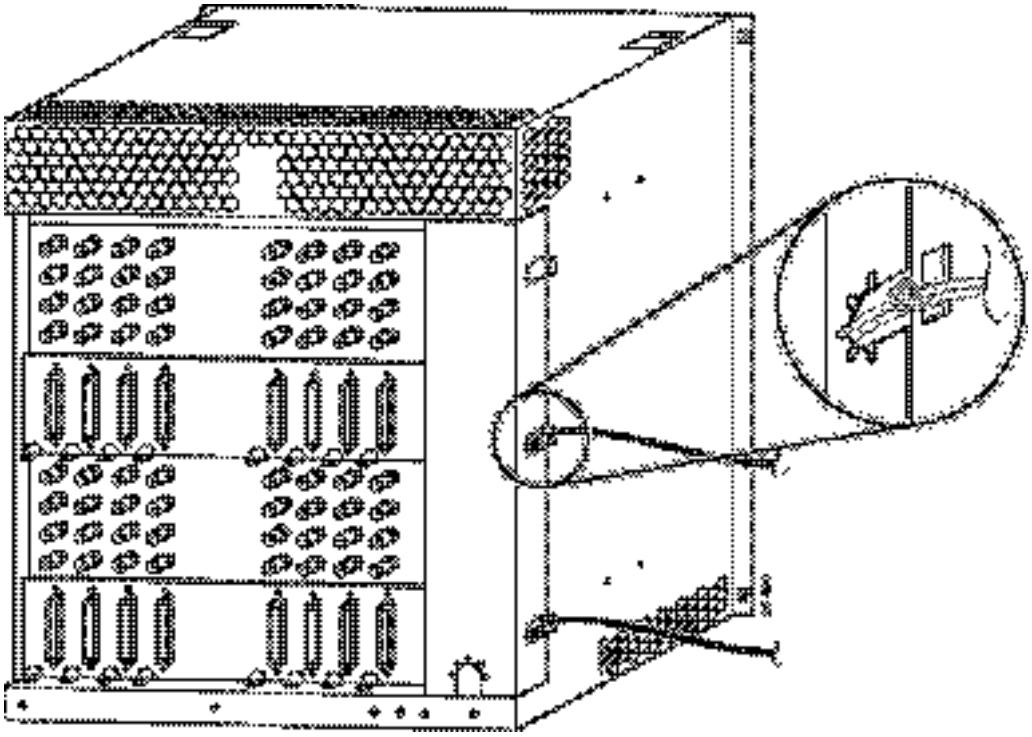
Step 5 Connect the return wire (RTN) to the terminal labeled (+) 48V RTN A.

Step 6 Connect the DC power lead from the second external power source, if you are using one, to the DC terminal block labeled (–) 48V B.

Step 7 Connect the second return wire (RTN) to the terminal labeled (+) 48V RTN B.

Step 8 Secure the power cabling to the Cisco 6400 chassis by feeding a tie wrap through the slot on the side of the chassis and binding the cables (Figure3-12).

Figure3-13 DC Power Connections with Rear Cover



Step 9 Replace the rear cover, making sure that the power cables exit through the holes on the side of the cover (Figure3-13).

Warning **Secure all power cabling when installing this unit to avoid disturbing field-wiring connections. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Step 10 Check to see if the power entry module (PEM) units have been installed. If they have not, insert the primary PEM and the secondary PEM (if used) in the lower slot.

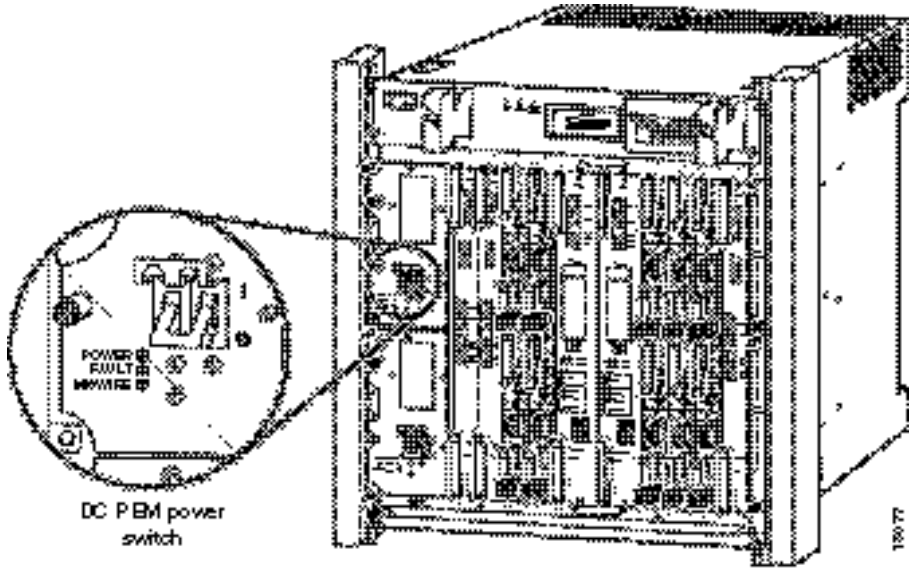
Warning **After wiring the DC power supply, remove the tape from the circuit breaker switch handle and reinstate power by moving the handle of the circuit breaker to the ON position. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Step 11 Turn On power to the DC circuit.

Step 12 At the front of the chassis, flip the circuit breakers on the DC PEM units (or the power enable switch on the AC PEM units) to the ON (|) position (Figure3-14).

If the power is properly connected, the PEM power LED is green, indicating that power is available to the chassis.

Figure3-14 Cisco 6400 DC Power Entry Module Power Switches



Connecting System AC Power

The Cisco 6400 can be powered directly from the facility VAC input by using the AC PEM, or (if your chassis has an AC-Input Power Shelf) by using the AC power shelf in conjunction with the DC PEM. This section describes the AC PEM installation.

Warning **The device is designed to work with TN power systems. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

AC Input Power Cables

The AC PEM is provided with an IEC 320 250V, 20A power cord with a male type connector (16A rating for Europe) for the attachment of power cords used throughout the world.

Caution The 20A connector on the AC PEM is incompatible with the 15A power strips that are used in most equipment racks. Wiring codes prevent the AC-input power cable from being used with the power strips in equipment racks.

Note The AC power cord that connects to the PEM power cord and then to the building VAC is not shipped with the Cisco 6400. You must order this power cord separately.

There are five styles of AC-input power supply power cords available (differing in plug type); make sure you have the correct style for your site. (See Figure3-15 and Table3-4.) All AC-input power supply cords measure 14 feet (4.3 m).

Cisco recommends that you:

- Install an uninterruptible power source where possible.
- Install proper grounding to avoid damage from lightning and power surges. (See the "Connecting System Ground" section on page3-13.)

Table3-3 lists the nominal and acceptable value ranges for source AC power.

Table3-3 Source AC Power Specifications

Specifications	Nominal Value	Acceptable Range
AC input voltage	100 to 240 VAC, single phase	90 to 255 VAC
AC input line frequency	50/60 Hz	47 to 63 Hz
AC input current	15 A @100 VAC 7 A @240 VAC	—

Figure3-15 shows power plugs and receptacles used in North America.

Figure3-15 AC Power Cord Connectors and Plugs and Receptacles

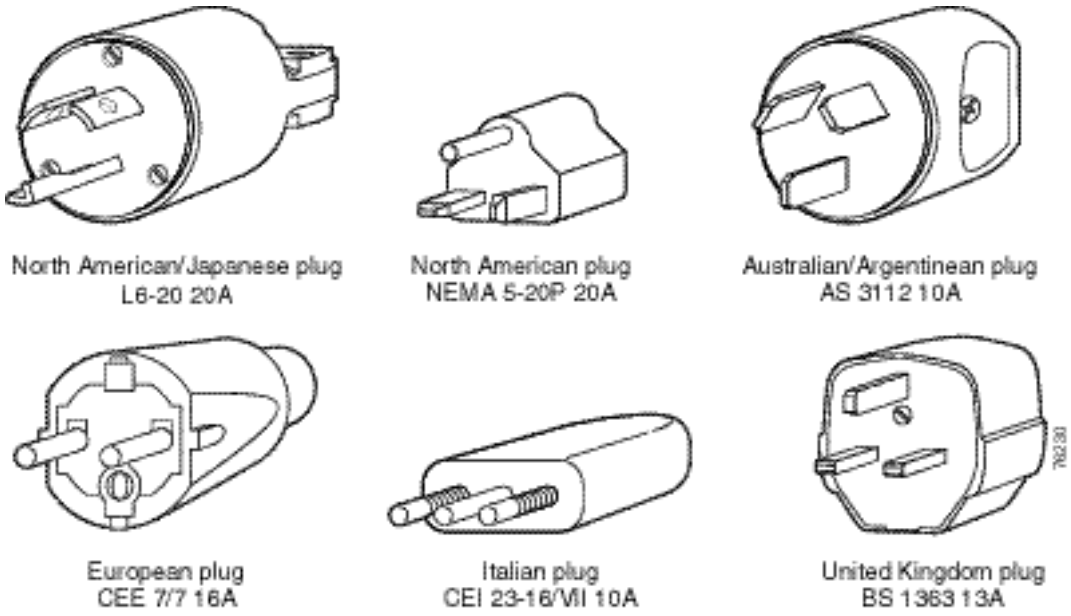


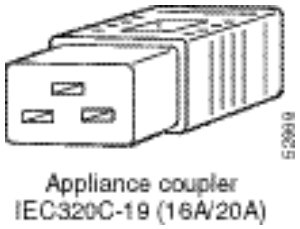
Table3-4 AC Power Cord Options

Label	Description	Plug (Facility End of Cord)	Receptacle (Router End of Cord)	Product Number
North American	250 VAC, 60 Hz AC power cord	NEMA L6-20, 20A	IEC 320-C19	CAB-AC-6CK-TWLK
Japanese	100 VAC, 50/60 Hz AC power cord	NEMA L6-20, 20A	IEC 320-C19	CAB-DS-ACJ-TWLK

Table3-4 AC Power Cord Options (continued)

Label	Description	Plug (Facility End of Cord)	Receptacle (Router End of Cord)	Product Number
North American	120 VAC, 60 Hz AC power cord	NEMA 5-20P, 20A	IEC 320-C19	CAB-DS-120VAC
Australian	240 VAC, 50 Hz AC power cord	AS 312, 10A	IEC 320-C19	CAB-DS-ACA
Argentinean	220 VAC, 50 Hz AC power cord	AS 312, 10A	IEC 320-C19	CAB-DS-ACR
European	230 VAC, 50 Hz AC power cord	CEE 7/7, 16A	IEC 320-C19	CAB-DS-ACE
Italian	220 VAC, 50 Hz AC power cord	CEI 23-16/VII, 10A	IEC 320-C19	CAB-DS-ACI
United Kingdom	240 VAC, 50 Hz AC power cord	BS 1363, 13A	IEC 320-C19	CAB-DS-ACU

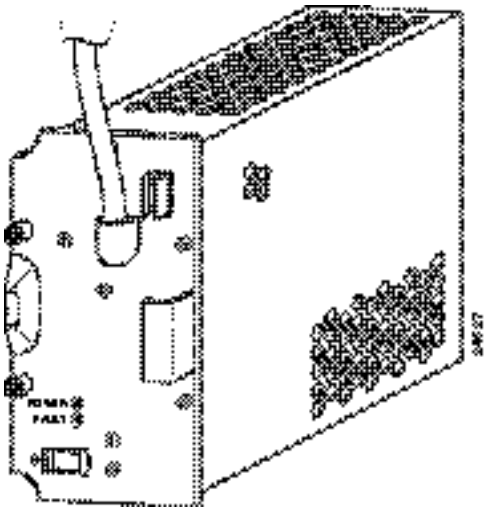
Figure3-16 AC Receptacle — Router End of AC Power Cord



Removing and Replacing an AC Power Supply

This section describes procedures for removing and installing an AC power entry module (PEM) plug-in unit in the Cisco 6400 chassis (Figure3-17).

Figure3-17 AC Power Entry Module



There are two PEM power bays in the system for redundancy. The PEM power bays are located at the front left side of the chassis. The top bay is wired to power circuit A; the bottom bay is wired to power circuit B. (The circuits are identified at the power terminals on the backplane.)

Warning **Before working on equipment that is connected to power lines, remove jewelry (including rings, necklaces, and watches). Metal objects will heat up when connected to power and ground and can cause serious burns or weld the metal object to the terminals. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Removing an AC Power Entry Module

If you remove a redundant AC PEM, the chassis continues to operate normally. If you plan to remove the only operating PEM from a chassis, you should first power down the Cisco 6400. Refer to the procedure in the "Powering Down the System" section on page5-8.

To remove a PEM from the Cisco 6400 chassis:

Step 1 Turn Off the Power Enable switch on the AC PEM you are removing.

Step 2 Unplug the cable.

Step 3 Unscrew the retaining screws on the AC PEM faceplate.

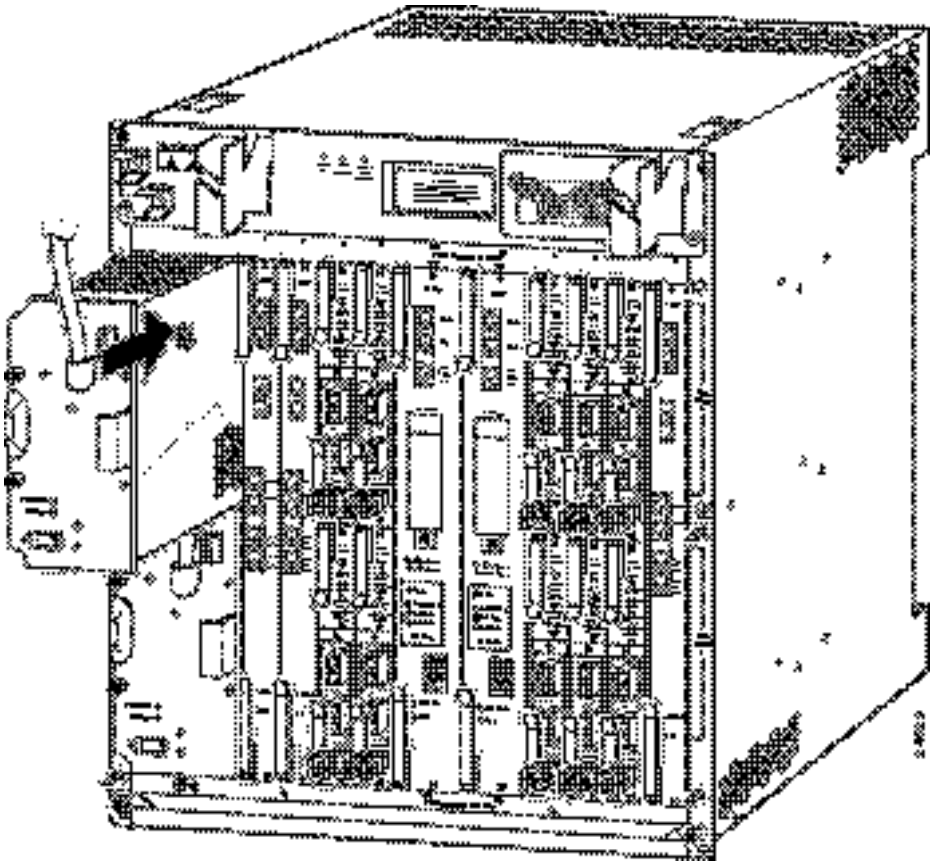
Step 4 Grasp the AC PEM by the handle on the faceplate and pull it out of the chassis.

Caution Always install a filler panel over an empty PEM power bay to protect the connectors from contamination and to ensure proper air flow.

Installing an AC Power Entry Module

Figure3-18 shows an AC PEM unit being installed in the Cisco 6400 chassis. You can insert a PEM unit into the Cisco 6400 without powering down the system.

Figure3-18 Installing an AC Power Entry Module



To install an AC PEM in the Cisco 6400 chassis:

Step 1 Ensure that the Power Enable switch on the AC PEM is turned to Off.

Step 2 Align the PEM and insert it into the power bay.

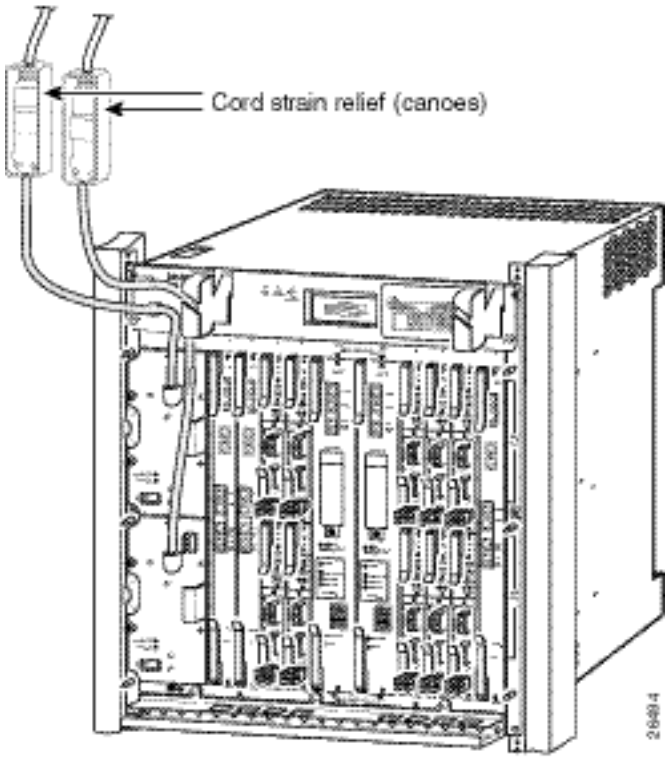
Step 3 Firmly push the PEM all the way into the power bay to ensure that the power connectors mate.

Step 4 Tighten the captive screws on the faceplate of the PEM to secure the PEM to the chassis.

Step 5 Plug in the AC power cable.

Step 6 Secure the AC power cable connection with the cord strain relief (canoe) (Figure3-19).

Figure3-19 AC Power Entry Module Power Cord Connections



Step 7 If the chassis is connected to power, turn the Power Enable switch on the AC PEM to On. The green POWER LED on the faceplate turns on to indicate that the AC PEM is providing power to the chassis. The yellow FAULT LED will go out.

Powering On the Cisco 6400

After installing your AC PEM, start up the system by powering on the following components:

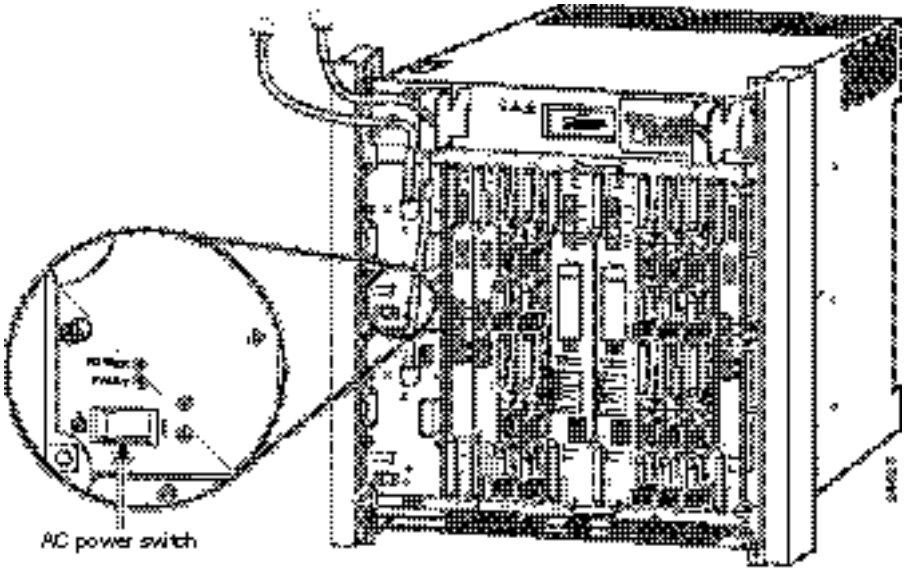
- Cisco 6400
- AC PEM

To power on the system:

Step 1 Power On the facility main circuit breaker.

Step 2 Power ON (|) the power switches located on each Cisco 6400 PEM front panel (Figure3-20). A green power LED on each PEM should light.

Figure3-20 Cisco 6400 AC Power Entry Module Power Switches



Connecting the Building Integrated Timing Supply

If your system includes an NSP with Stratum 3 BITS timing (NSP-S3B), you can use a T1/E1 timing source to provide network synchronization. The rear of the chassis provides two terminal blocks for redundant BITS connections. For wire-wrap connections (Figure3-21), use the appropriate tool for the size of the header to make the wire-wrap connection on the L-connector header. If you prefer not to use the L-connector headers, remove them by loosening the three screws on the terminal block and sliding the header out. Then, connect the wires directly to the terminal blocks (Figure3-22).

The bottom terminal block (labeled A) services the NSP-S3B in slot 0A of the chassis. The top terminal block (labeled B) services the NSP-S3B in slot 0B. The terminals for each BITS connection are labeled negative (–), ground (GND), and positive (+). To connect the BITS to the Cisco 6400:

Step 1 Remove the rear cover (Figure3-12).

Step 2 Strip approximately 0.3 in (8 mm) of insulation from the end of each wire in the T1/E1 cable.

Step 3 Connect each wire of the T1/E1 cable to the L-connector header or directly to the BITS terminal block:

- **a.** Connect the positive signal wire to the positive (+) terminal.
- **b.** Connect the negative signal wire to the negative (–) terminal.
- **c.** Connect the cable shield or ground wire to the ground (GND) terminal.

Step 4 If the system contains a second NSP-S3B, repeat Steps 2 and 3 for the second terminal block.

Step 5 Secure the BITS cabling to the Cisco 6400 chassis by feeding a tie wrap through the slot on the side of the chassis and binding the cables.

Step 6 Replace the rear cover, making sure that the T1/E1 cables exit through the holes on the side of the cover (Figure3-12).

Figure3-21 BITS Connectors with L-Connectors on the Cisco 6400

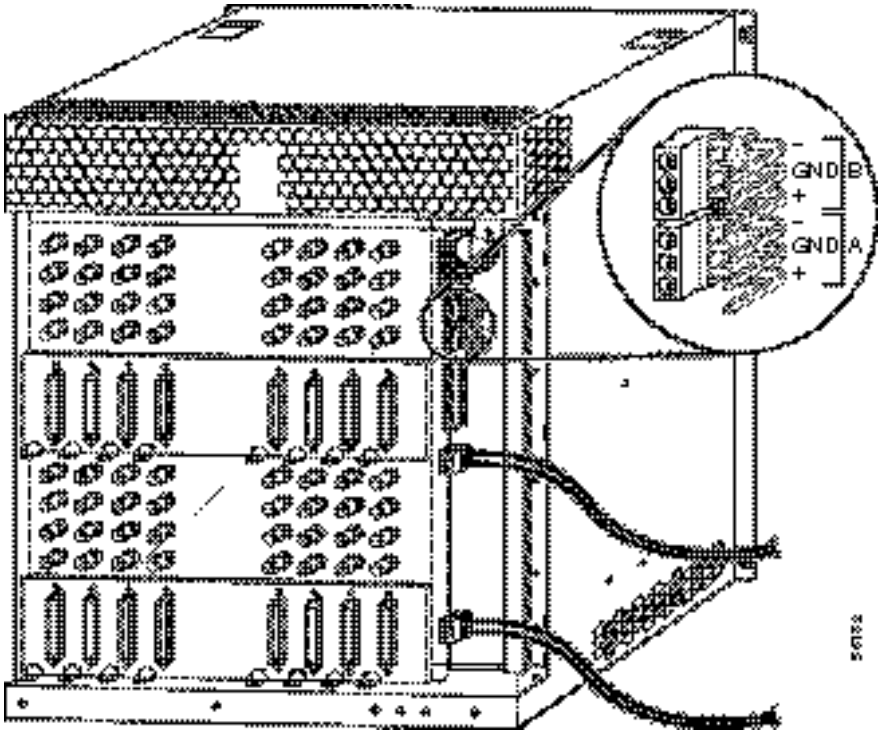
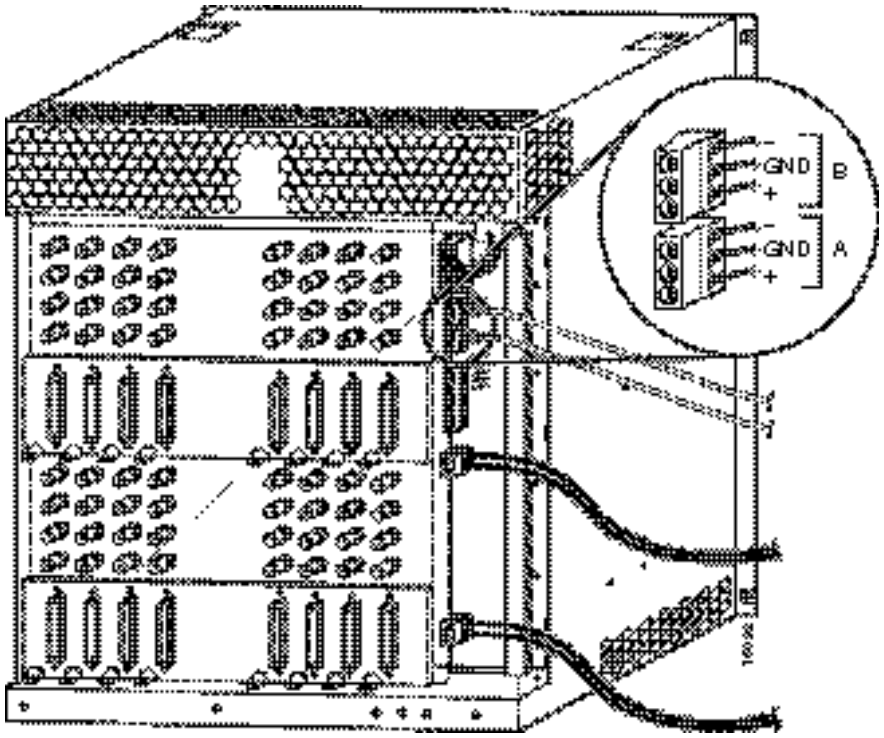


Figure3-22 Attaching BITS Connectors without L-Connector Headers



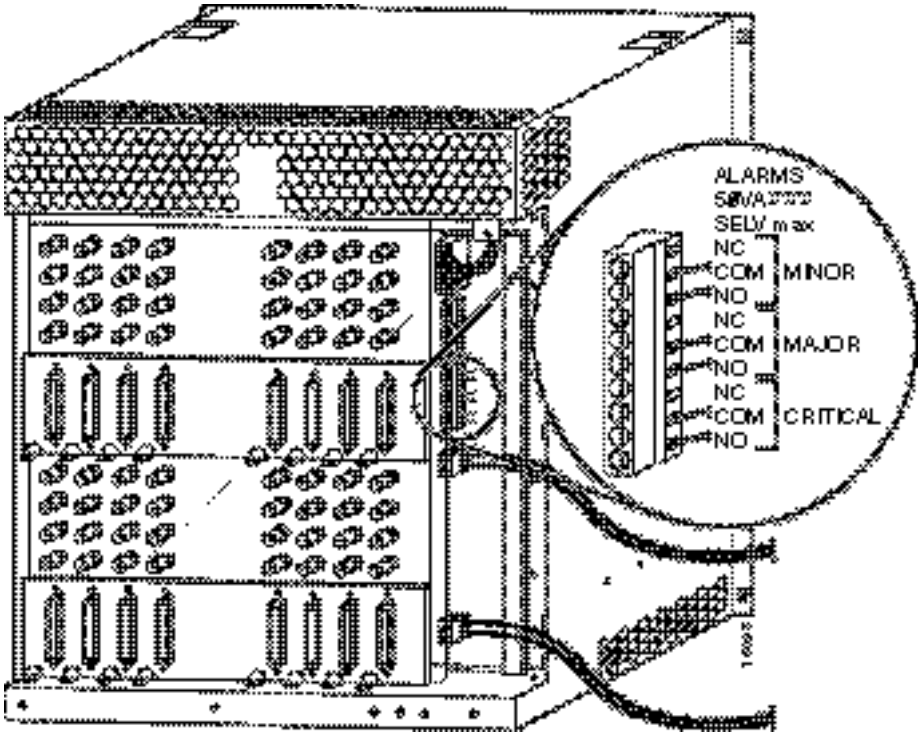
Connecting Alarm Indicators

The Cisco 6400 provides relay contacts for customer-supplied audible or visual alarm indicators. Relay contacts are provided for three levels of severity:

- Minor—Conditions not affecting the system operation (informational)
- Major—Conditions affecting system operation that should be investigated
- Critical—Conditions affecting system operation that require immediate attention

The alarm terminal block is located at the rear of the Cisco 6400 chassis (Figure3-23). Each alarm level has three terminals: normally closed (NC), common (COM), and normally open (NO).

Figure3-23 Alarm Terminal Block on the Cisco 6400



To connect an alarm indicator to the Cisco 6400:

Step 1 Remove the rear cover. (See Figure3-12.)

Step 2 Strip approximately 0.3 in (8 mm) of insulation from the end of each alarm indicator wire.

Step 3 Use a flat-blade screwdriver to connect the alarm indicator wires to the alarm terminal block:

a. Connect one wire to the common (COM) terminal.

b. Connect the other wire to the NC or NO terminal.

Note If you wire the Cisco 6400 in series with other equipment for the alarm indicators, use the normally closed (NC) terminal. If you wire the Cisco 6400 in parallel with other equipment, use the NO terminal.

Step 4 Repeat Steps 2 and 3 for any remaining alarm indicators.

Step 5 Secure the alarm wiring to the Cisco 6400 chassis by feeding a tie wrap through the slot on the side of the chassis and binding the cables.

Step 6 Replace the rear cover, making sure that the alarm wires exit through the holes on the side of the cover (Figure3-12).

Connecting a Terminal to the Console Port

Each Cisco 6400 NSP and NRP-1 module includes an asynchronous serial (EIA/TIA-232) console port. The RJ-45 connector corresponding to this console port is labeled CON. Using the console cable kit (included with the Cisco 6400), you can connect this port to most types of terminal equipment. The console cable kit contains:

- One RJ-45 to RJ-45 rollover cable
- One RJ-45 to DB-25 (female) adapter, labeled “Terminal”
- One RJ-45 to DB-9 (female) adapter, also labeled “Terminal”

Note A rollover cable reverses pins from end to end, connecting pin 1 (at one end) to pin 8 (at the other), pin 2 to pin 7, pin 3 to pin 6, and so on. Therefore, you can identify a rollover cable by comparing the two modular ends of the cable. Hold the cable ends in your hand, side-by-side, with the tabs at the back. The wire connected to the pin on the outside (left) of the left plug (pin 1) should be the same color as the wire connected to the pin on the outside (right) of the right plug (pin 8).

Note There is no console port on the NRP-2SV module. If you have NRP-2SV modules installed in your Cisco 6400 chassis, the functionality of the console port is managed by the NSP module.

To connect a terminal to the console port on a Cisco 6400 NSP or NRP-1:

Step 1 Configure your terminal equipment to match the console port settings. The default settings for all Cisco6400 console ports are:

- 9600 baud
- 8 data bits
- No parity generation or checking
- 1 stop bit
- No flow control

Step 2 Connect one end of the RJ-45 rollover cable to the RJ-45 port labeled CON on the Cisco 6400 NSP or NRP-1 module.

Step 3 Connect the other end of the RJ-45 rollover cable to the RJ-45-to-DB-25 adapter labeled “Terminal.” If your terminal comes equipped with a DB-9 serial connector, use the RJ-45-to-DB-9 adapter labeled “Terminal” instead of the DB-25 adapter.

Step 4 Plug the DB-25 or DB-9 (female) side of the adapter into your terminal equipment to complete the connection.

Connecting Signal System and Network Management Interfaces

The Cisco 6400 has connections to both the external signal system (the data network) and the internal Ethernet management network. Both types of connections are discussed in the following paragraphs.

The internal Ethernet management network connections are made through the NSP module on the front panel of the Cisco 6400 system.

Note The following installation procedures do not cover cable preparation. You will need to obtain all cables prior to installation. Label each cable end with its destination.

External Cabling Guidelines

Use these guidelines to connect external cabling to the Cisco 6400 system:

- Make certain that you connect the correct interface types by visually checking the connections before starting the system.
- Whenever possible, avoid crossing high-power lines with interface cables. This reduces the chance of interference.
- Verify all cabling limitations (particularly distance) before applying power to the system.

Connecting the Signal System

The external signal system connections are made through the front panel to the various NLC modules, or through the connectors on the rear of the Cisco 6400 chassis.

OC-3/STM-1 NLC Interface

The OC-3/STM-1 NLC has two ports for single-mode intermediate reach fiber connections. Each port provides an interface to the ATM switching fabric for transmitting and receiving data at rates up to 155 Mbps bidirectionally.

Warning **Class 1 laser product. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning **Invisible laser radiation present. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning **Because invisible radiation may be emitted from the aperture of the port when no fiber cable is connected, avoid exposure to radiation and do not stare into open apertures. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning Statement for Sweden

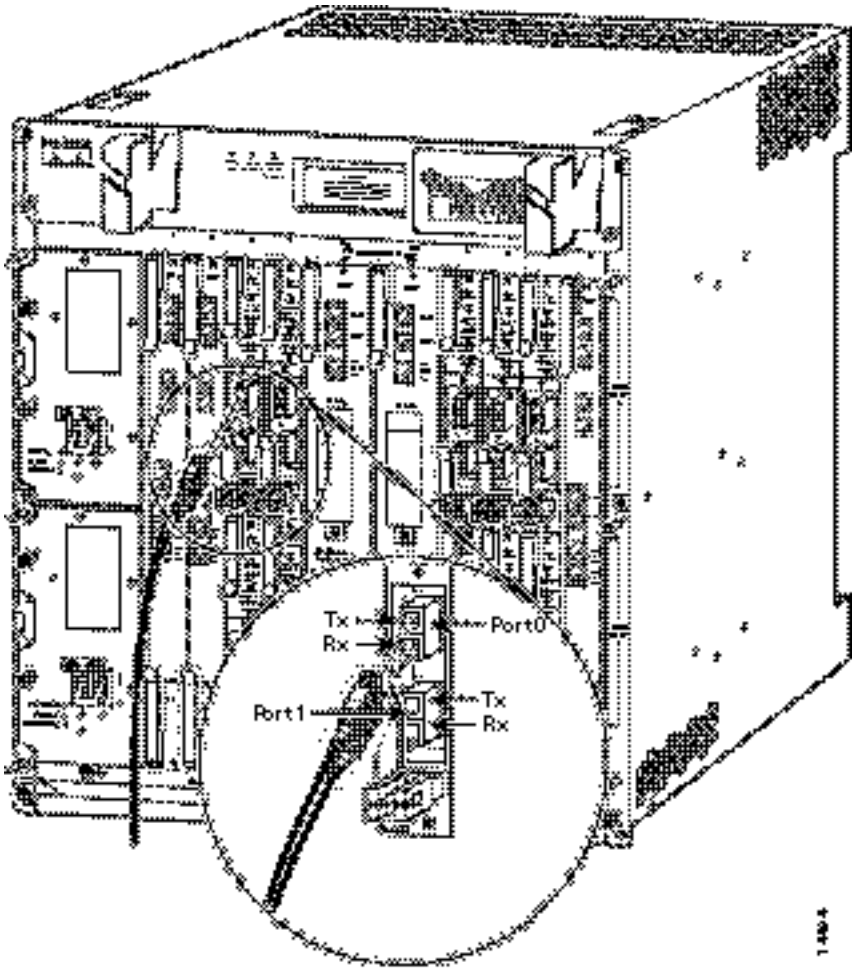
Varning! **Osynlig laserstrålning när denna del är öppen och förregleringen är urkopplad. Rikta inte blicken in mot strålen.**

Warning Statement for Finland

Varoitus **Alleviates ja suojalukitus ohitettaessa olet alttiina näkymättömälle lasersäteilylle. Äjä katso säteeseen.**

Figure3-24 illustrates a typical connection of the OC-3 fiber-optic cable to the OC-3/STM-1 NLC ports.

Figure3-24 Connecting OC-3 Cable to the OC-3/STM-1 NLC



To make this connection:

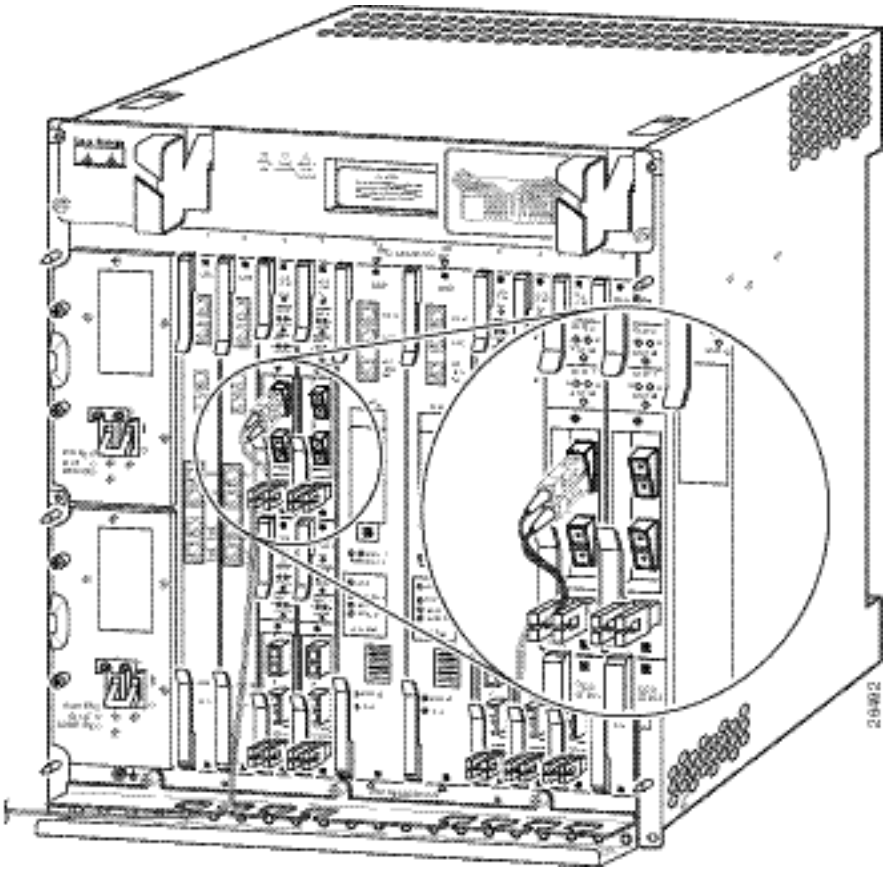
Step 1 Read and understand the preceding warnings.

Step 2 Remove the protective cap from the OC-3/STM-1 fiber optic cable.

Step 3 Attach the OC-3 fiber optic cable to the NLC OC-3 port receptacles (Figure3-24).

Step 4 Use Figure3-25 as a guideline for suggested cable management for the OC-3/STM-1 fiber optic cable.

Figure3-25 OC-3 Fiber Optic Cable Management

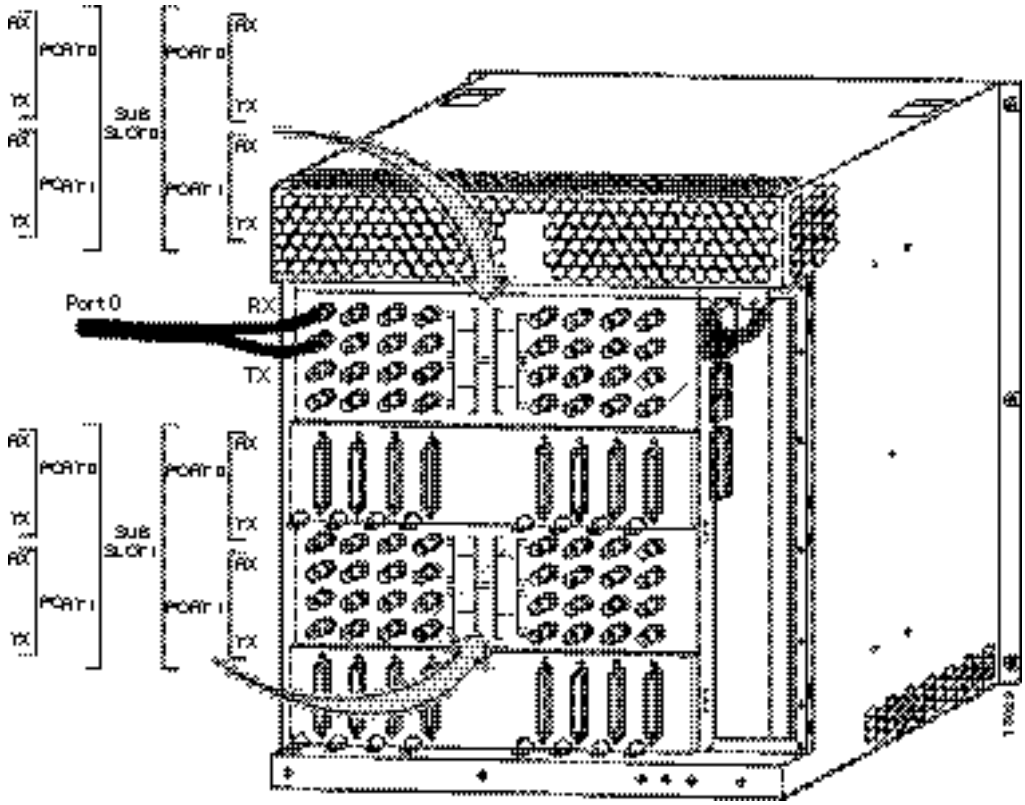


DS3 Node Line Card Interface

The DS3 NLC has two ports that connect to the ATM switching fabric using 75-ohm single or bundled coaxial cables with bayonet-style twist-lock (BNC) connectors attached to the back of the chassis for each DS3 port (Figure3-26).

Warning **The DS3 ports are not intended to be connected to cables that run outside the building where it is installed. For any connections outside the building, the DS3 ports must be connected to a network termination unit (NTU). NTU devices should comply with appropriate national safety standards such as UL 1950, CSA 950, EN 60950, IEC 950, and AS 3260. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Figure3-26 Connecting Cables to a DS3 Node Line Card



OC-12/STM-4 Node Line Card Interface

The OC-12/STM-4 NLC has one port for single-mode intermediate reach fiber connections. The port provides an interface to the ATM switching fabric for transmitting and receiving data at rates up to 622 Mbps bidirectionally.

Warning **Class 1 laser product. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning **Invisible laser radiation present.To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning **Because invisible radiation may be emitted from the aperture of the port when no fiber cable is connected, avoid exposure to radiation and do not stare into open apertures. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning Statement for Sweden

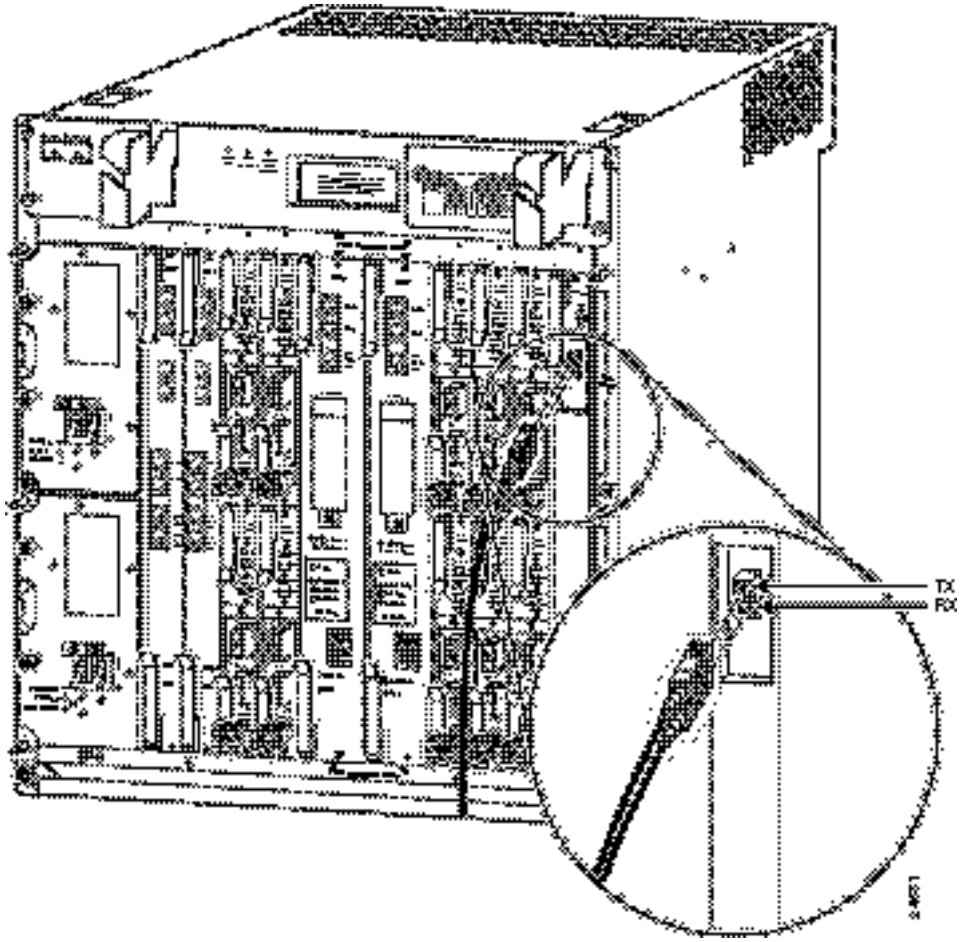
Varning! **Osynlig laserstrålning när denna del är öppen och förregleringen är urkopplad. Rikta inte blicken in mot strålen.**

Warning Statement for Finland

Varoitus **Alleviates ja suojalukitus ohitettaessa olet alttiina näkymättömälle lasersäteilylle. Äjä katso säteeseen.**

Figure3-27 illustrates a typical connection of the OC-12 fiber-optic cable to the OC-12/STM-4 NLC ports.

Figure3-27 Connecting OC-12 Cable to the OC-12/STM-4 NLC



To make this connection:

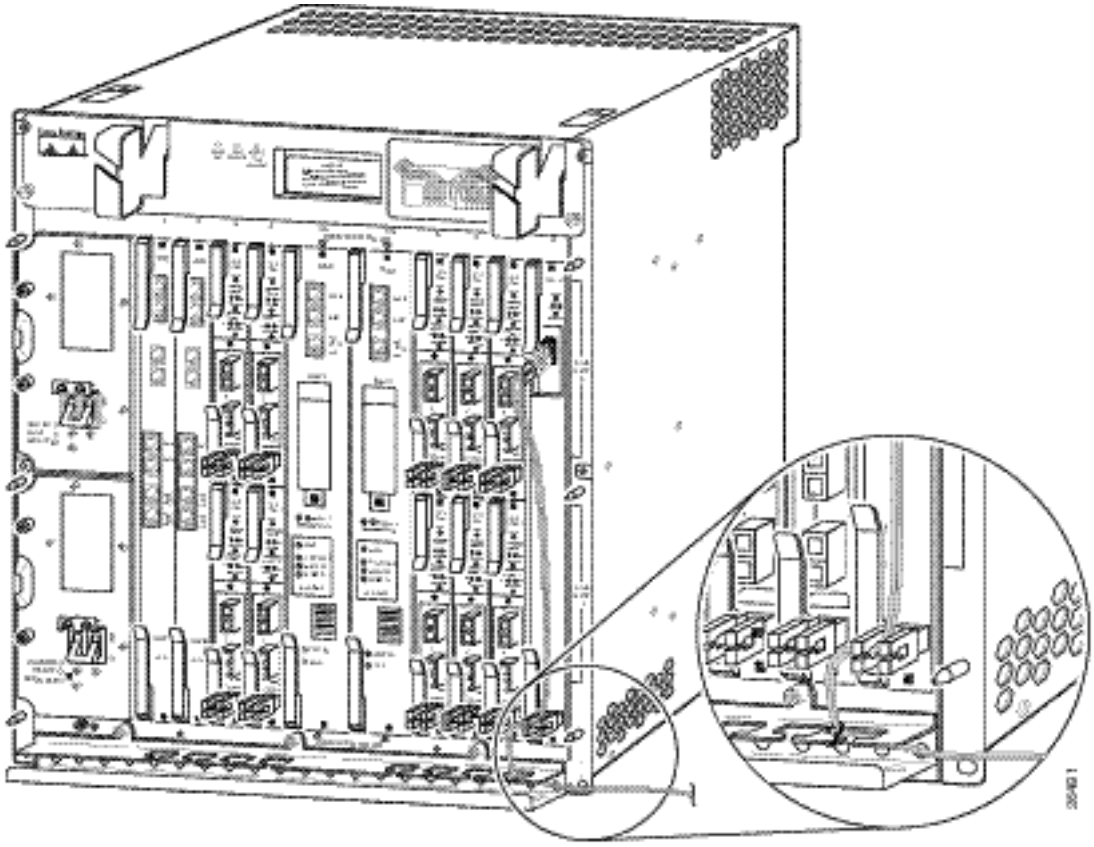
Step 1 Read and understand the preceding warnings.

Step 2 Remove the protective cap from the OC-12/STM-4 fiber-optic cable.

Step 3 Attach the OC-12 fiber-optic cable to the NLC OC-12 port receptacles (Figure3-27).

Step 4 Use Figure3-28 as a guideline for suggested cable management for the OC-12/STM-4 fiber-optic cable.

Figure3-28 OC-12 Fiber-Optic Cable Management



Connecting to a 10BASE-T Ethernet Network

Each Cisco 6400 NSP or NRP provides Ethernet ports for connection to a network management Ethernet LAN. In order to make this connection, you need the following additional equipment (not included):

- An Ethernet hub (such as a Cisco Micro Hub)
- An Ethernet cable that meets the following specifications:
  - RJ-45 (male) to RJ-45 (male) straight-through cable
  - 100-ohm Category 3, 4, or 5, no longer than 328 feet (100 meters)

Note Cisco Systems does not supply Category 5 UTP cables; these cables are available commercially.

Note You can identify a straight-through Ethernet cable either by using a cable tester or by making a visual inspection. To make a visual inspection, hold the two ends of a cable side-by-side, with the tab for each at the back. The wire connected to the left-most pin (pin 1) on one connector should be the same color as the wire connected to the left-most pin on the other connector. The same rule applies to pins 2 through 8 on each connector. The color of the wire attached to a pin on one connector should match the color of the wire attached to the corresponding pin on the other connector.

To connect the NSP or NRP-1 on your Cisco 6400 to a 10BASE-T Ethernet LAN:

Step 1 Connect one end of the Ethernet cable to the RJ-45 port on the NSP (or NRP-1) faceplate, labeled ETH.

Step 2 Connect the other end of the Ethernet cable to any unoccupied port on the Ethernet hub.

Step 3 Check the LNK (Link) LED on the NSP (or NRP) faceplate, next to the ETH (Ethernet) port. This LED is on (steady green) if the NSP (or NRP) is correctly connected to the 10BASE-T Ethernet LAN.

Connecting to a Fast Ethernet Network

The Cisco 6400 NRP-1 provides a Fast Ethernet port. In order to make this connection, you need the following additional equipment (not included):

- A Fast Ethernet hub (FE)
- A Fast Ethernet UTP cable that meets the following specifications:
  - RJ-45 (male) to RJ-45 (male) straight-through cable
  - 100-ohm Category 5 cable not longer than 328 feet (100 meters)

Note Cisco Systems does not supply Category 5 UTP cables; these cables are available commercially.

Note If the Cisco 6400 is used in an environment where lightning-induced transients are likely to couple to the signal lines, we highly recommend use of shielded interconnection cables for the FE ports. In addition, use of shielded interconnection cables for the FE ports is required to meet Bellcore GR1089 CORE Section 4.5.9 and ETSI section 5.2.2.2 (intrabuilding lightning surge).

Note You can identify a straight-through Ethernet cable either by using a cable tester or by making a visual inspection. To make a visual inspection, hold the two ends of a cable side by side, with the tab for each at the back. The wire connected to the left-most pin (pin 1) on one connector should be the same color as the wire connected to the left-most pin on the other connector. The same rule applies to pins 2 through 8 on each connector. The color of the wire attached to a pin on one connector should match the color of the wire attached to the corresponding pin on the other connector.

The RJ-45 port on the NRP is configurable for 10/100-Mbps full-duplex or half-duplex operation (half-duplex is the default) and supports IEEE 802.3, Ethernet, and IEEE 802.3u interfaces compliant with 10/100BASE-T specifications.

To connect the NRP on your Cisco 6400 to a Fast Ethernet LAN:

Step 1 Connect one end of the cable to the RJ-45 port on the NRP faceplate, labeled FE.

Step 2 Connect the other end of the cable to any unoccupied port on the Fast Ethernet hub or switch.

Step 3 Check the LNK (Link) LED on the NRP faceplate, next to the FE port. This LED lights (steady green) if the NRP is correctly connected to the Fast Ethernet LAN.

Connecting the Gigabit Ethernet Interface on the NRP-2SV Module

The Gigabit Ethernet Interface Connector (GBIC) port on the NRP-2SV has one fiber-optic interface port for connection of uplink and downlink interfaces. The port uses a GBIC that supports gigabit Ethernet rates on a variety of gigabit Ethernet interface types (SX and LX/LH). For a list of qualified GBICs and cable lengths, see Table1-9 on page1-12.

Warning **Class 1 laser product. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning **Invisible laser radiation present. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning **Because invisible radiation may be emitted from the aperture of the port when no fiber cable is connected, avoid exposure to radiation and do not stare into open apertures. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning Statement for Sweden

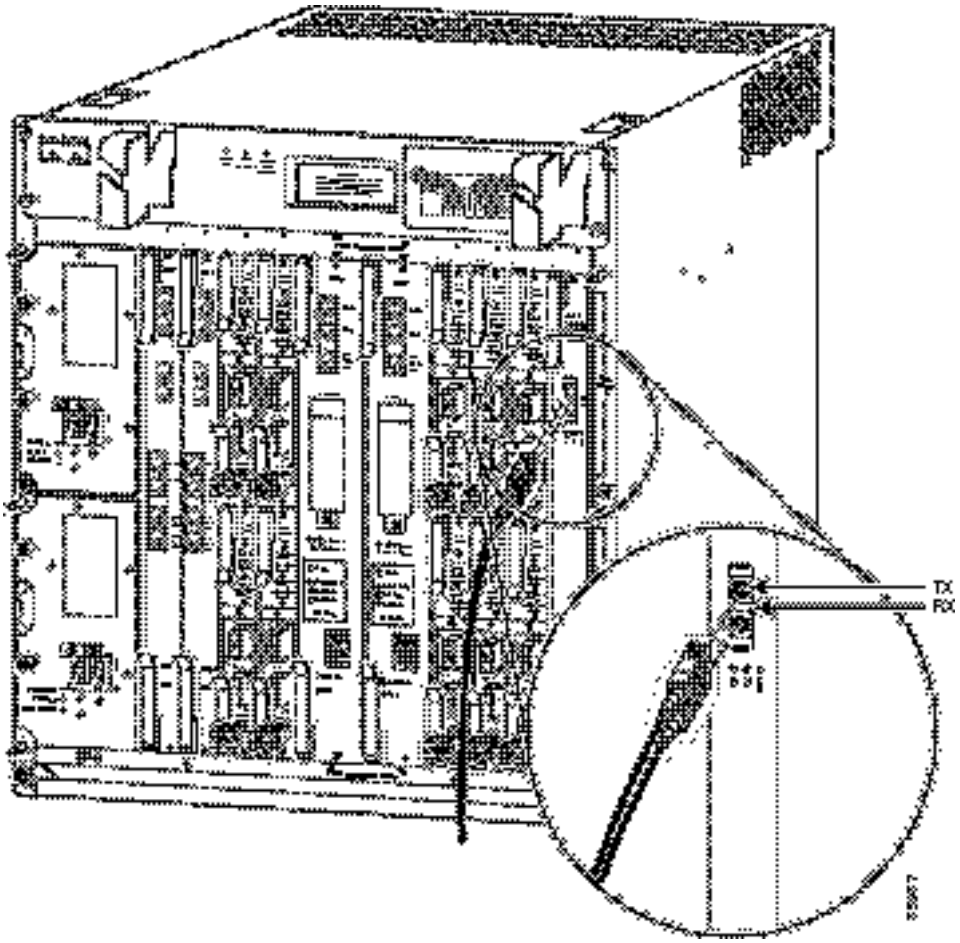
Varning! **Osynlig laserstrålning när denna del är öppen och förregleringen är urkopplad. Rikta inte blicken in mot strålen.**

Warning Statement for Finland

Varoitus **Alleviates ja suojalukitus ohitettaessa olet alttiina näkymättömälle lasersäteilylle. Äjä katso säteeseen.**

Figure3-29 illustrates a typical connection of the fiber-optic cable to the GBIC port.

Figure3-29 Connecting the Fiber-Optic Cable to the GBIC Interface Port



To make this connection:

Step 1 Read and understand the preceding warnings.

Step 2 Remove the protective cap from the GBIC fiber-optic cable.

Step 3 Attach the fiber-optic cable to the NRP-2SV port receptacle. Note the arrows on the port: The arrow pointing out from the chassis is TX; the arrow pointing in to chassis is RX (Figure3-29).

Step 4 Connect the other end of the cable to any unoccupied fiber-optic port on the hub or switch.

Step 5 Check the LNK (Link) LED on the NRP-2SV faceplate, next to the GBIC port. This LED lights (steady green) if the NRP-2SV is correctly connected to the LAN.

For more information about the Gigabit Interface Converter, refer to the document *Gigabit Interface Converter Installation Instructions for the Cisco 6400 NRP-2SV Module* (Cisco document number78-12263-xx).

Starting the System

When all of the interfaces are connected, check all the connections and then complete these steps:

Step 1 Check the following components to make sure they are secure:

- Each card is inserted all the way into its slot, and all the captive installation screws are tightened.
- All network interface cable connections are secured.
- Each PEM is inserted all the way into its slot, and the captive installation screws are tightened.
- All power-supply cables are securely connected.
- The blower module is fully inserted.

Step 2 Check the external power connections; the PEMs should still be off. When two supplies are present, make sure that the cord for the second PEM is connected to an external power connection different from the one to which the first PEM is connected.

Step 3 Turn the PEM switch(es) on. The PEM green power indicator LEDs should light.

Step 4 Check that the Fan OK LED on the blower module is on.

Step 5 While the system initializes, the status LED on the NSP is blinking (yellow) until the boot is complete.

During the boot process, the NLC Fail LED remains lit (yellow), and all other LEDs (Status, TX, and RX LEDs) remain off until the boot is completed.

When the system boot is complete (it takes several seconds), the NSP begins to initialize the cards. During this initialization, the LEDs on each card flash on and off in different patterns. The status LED on each card stays on when initialization is completed, and the console screen displays a script and system banner similar to the following (this is only a sample; your screen will not match exactly):

```
        Restricted Rights Legend

Use, duplication, or disclosure by the Government is
subject to restrictions as set forth in subparagraph
(c) of the Commercial Computer Software - Restricted
Rights clause at FAR sec. 52.227-19 and subparagraph
(c) (1) (ii) of the Rights in Technical Data and Computer
Software clause at DFARS sec. 252.227-7013.

        cisco Systems, Inc.
        170 West Tasman Drive
        San Jose, California 95134-1706



Cisco Internetwork Operating System Software

IOS (tm) C6400 Software (C6400S-WP-M), Version 12.0(5)DB
Copyright (c) 1986-1999 by cisco Systems, Inc.
Compiled Tue 18-May-99 15:00 by jdoe
Image text-base: 0x60010908, data-base: 0x6069A000


FPGA VERSION: 97/11/25 22:11:51 1383107375 /rhino/fpga/fc_abr_fc3/xil/abr_fpga_r.bit
98/02/24 17:11:36 1332837880 /rhino/fpga/fc_stat_fpga/xilinx/stat_fpga_r.bit
97/11/13 10:03:51 1059421866 /rhino/fpga/fc_traffic_fc3/xil/upc_fpga.bit
97/08/06 13:09:19  288278431 /rhino/fpga/fc_netclk/xilinx/pll_cntl_r.bit

Initializing FC-PFQ hardware ... done.
cisco C6400S (R4600) processor with 131072K bytes of memory.
R4700 CPU at 100Mhz, Implementation 33, Rev 1.0
Last reset from s/w peripheral
2 Ethernet/IEEE 802.3 interface(s)
11 ATM network interface(s)
507K bytes of non-volatile configuration memory.

107520K bytes of ATA PCMCIA card at slot 0 (Sector size 512 bytes).
8192K bytes of Flash internal SIMM (Sector size 256K).


Press RETURN to get started!

Switch>
```

The Cisco 6400 should be operating correctly and transferring data.

Note If the rommon> prompt appears, your system requires a manual boot to recover.

Your installation is now complete. Refer to the *Cisco 6400 Software Setup Guide* for additional software configuration information.

Troubleshooting the Installation

This chapter provides general information for troubleshooting hardware faults during installation of the Cisco 6400 carrier-class broadband aggregator. For information about troubleshooting the software, refer to the *Cisco 6400 Software Setup Guide*.

This chapter includes the following sections:

General Troubleshooting Information

If you encounter a problem after you have installed the Cisco 6400, you should perform a few basic troubleshooting procedures on your equipment before contacting customer service. These simple checks involve answering the following questions:

- Are the ports properly configured? Refer to the *Cisco 6400 Software Setup Guide* for configuration instructions.
- Are power leads and data cables firmly connected at both ends?
- Are all cards firmly seated and securely screwed to the chassis?
- Are the blower module and PEMs properly connected and secured to the chassis?

Note Check the release notes for more information on how to solve problems. Release notes can be found on Cisco.com. See the "Obtaining Documentation" section on pagexiii.

Reference Materials

Refer to the following materials:

- Cisco 6400 documents:
  - *Cisco 6400 Software Setup Guide*
  - *Cisco 6400 Command Reference*
  - *Regulatory Compliance and Safety Information for the Cisco 6400 (78-5789-xx)*
  - *Cisco 6400 Site Planning Guide (78-5782-xx)*
- Site log and equipment installation and maintenance records. (See Appendix B, "Configuration Worksheets.")

Recommended Tools and Test Equipment

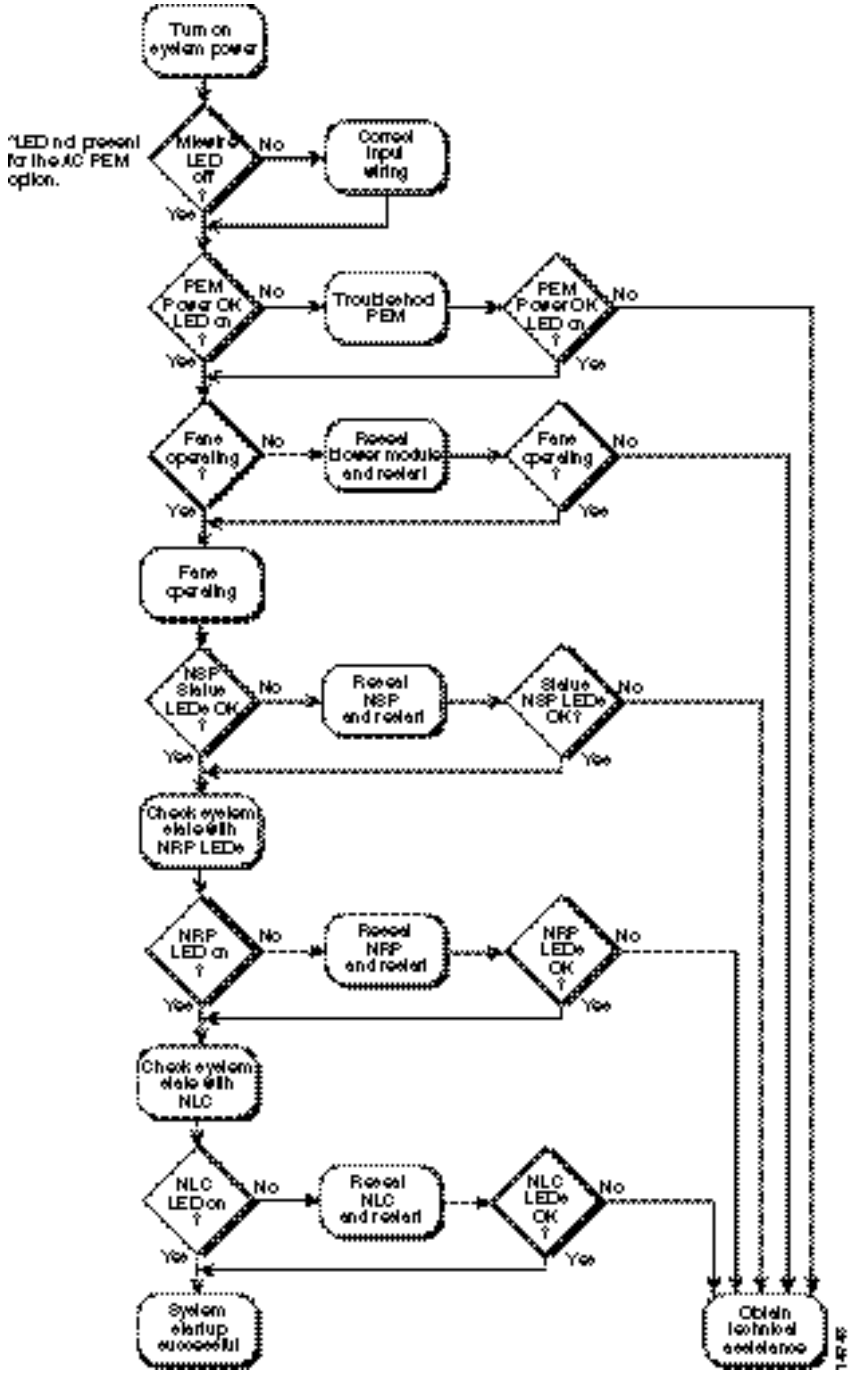
To perform general maintenance and troubleshooting tasks on the Cisco 6400, you should have the following:

- Small and medium Number 2 Phillips and flat-blade screwdrivers
- Voltage tester
- Optical fiber test equipment

Troubleshooting Flowchart

Figure4-1 is a flowchart to help you determine which component of your Cisco 6400 has malfunctioned. The decimal numbers in the following figure refer to the sections in this chapter where the various system elements are discussed.

Figure4-1 Troubleshooting Flowchart



General System Diagnostics

If an error is detected during a system powerup or hardware reset, the red NSP STATUS LED lights. The watchdog timer or software warm-start functions may run minimum diagnostics.

If any failures occur during the power-on sequence, forward a copy of the output to the Cisco technical assistance center (TAC) for diagnosis. To contact TAC, refer to the "Obtaining Technical Assistance" section on pagexiv

Confirming the Hardware Installation

Use the **show hardware** command to display the hardware components installed. These components can include:

- Node line cards (NLCs)
- Node route processors (NRPs)
- Central processing unit (CPU)

The following example shows output from the **show hardware** command (this is only a sample; your output will not match exactly):

```
Switch# show hardware

6400 named santa-2a-16, Date: 23:29:23 UTC Tue Jan 4 2000
Feature Card's FPGA Download Version: 0

Slot Ctrlr-Type    Part No.  Rev  Ser No  Mfg Date   RMA No. Hw Vrs  Tst EEP

8/0  155SM NLC     73-2890-02 02 09691183 Jul 20 98 00-00-00   1.0     0   2
1/1  155SM NLC     73-2892-02 02 09591457 Jul 20 98 00-00-00   1.0     0   2
0/0  CPU card      73-2996-02 02 09165973 Jul 20 98 00-00-00   2.0     0   2
0/1  FC-PFQ        73-2281-04 A0 08783319 Apr 25 98 00-00-00   4.1     0   2

DS1201 Backplane EEPROM:
 Model  Ver.  Serial  MAC-Address  MAC-Size  RMA  RMA-Number   MFG-Date
------- ---- -------- ------------ --------  ---  ----------  -----------
C6400    2   100001   00107BA9C600   128     0    0          Jul 20 1998
```

Displaying System Information

Use the **show version** and **show environment** commands to display the following Cisco 6400 information:

- Fan operation
- Temperature levels and alarms
- System status
- Modem status
- System uptime since last restart (in days, hours, minutes, and seconds)
- System name

Example

The following example shows output of the **show version** command (this is only a sample; your output will not match exactly):

```
Switch# show version
Cisco Internetwork Operating System Software
IOS (tm) 6400 Software (c6400r-g4p5-mz), Version 12.0(5)DC.....
Copyright (c) 1986-1999 by cisco Systems, Inc.
Compiled Tue 07-Oct-99 04:53 by jdoe
Image text-base: 0x60010910, data-base: 0x604E6000

ROM: System Bootstrap, Version XX.X(X.X.WAX.0) [integ 1.4.WAX.0], RELEASE SOFTWARE

Switch uptime is 2 weeks, 2 days, 39 minutes
System restarted by power-on
System image file is "bootflash:6400-wp-mz.112-8.0.1.FWA4.0.16", booted via bootflash

cisco NSP (R4700) processor with 65536K bytes of memory.
R4700 processor, Implementation 33, Revision 1.0
Last reset from power-on
1 Ethernet/IEEE 802.3 interface(s)
20 ATM network interface(s)
123K bytes of non-volatile configuration memory.

8192K bytes of Flash internal SIMM (Sector size 256K).
Configuration register is 0x2101

Switch#
```

Example

The following example shows output of the **show environment** command (this is only a sample; your output will not match exactly):

```
Switch# show environment

Temperature normal:chassis inlet measured at 27C/80F
Temperature normal:chassis core measured at 33C/91F
Fan:                            OK
Power Entry Module 0 status:            OK

Switch#
```

Configuration Problems

Configuration problems generally develop when the system is first installed, when the system configuration is changed, or when new equipment is added to the network and is not configured properly.

You should carefully review the port configuration information contained in your site log records, and verify that the physical equipment configuration matches the internal software configuration. By reviewing the port configuration information, you can determine whether any changes are needed to equipment and cabling in the central office or outside plant facilities.

Electrical Problems

Electrical problems are divided into two categories:

- Site electrical problems
- Cisco 6400 internal electrical problems

Site Electrical Problems

Site electrical problems can include:

- Improperly grounded equipment, particularly equipment racks and power grounds
- Fluctuating voltage, which can result from excessive power drains caused by other equipment (such as air conditioning units)
- Cable corrosion or defective power panels, circuit breakers or fuses, or cable connections
- Undersized power cables or excessive power cable lengths
- Excessive power demand on backup power systems or batteries when alternate power sources are used

Cisco 6400 Electrical Problems

Cisco 6400 electrical problems can include:

- Improperly grounded equipment, particularly equipment racks and power grounds
- Improper power cable connections to the Cisco 6400
- Improper installation of the power entry module (PEM) units in the system
- Improper installation of other plug-in units
- Circuit breakers that have tripped or that are defective
- Defective PEM units

Automatic Power-Down

The Cisco 6400 powers down when the temperature exceeds a specified threshold. If that happens, you should identify and correct the cause of the overheating before repowering the system.

If the blower module is unplugged for two minutes, the Cisco 6400 powers down automatically.

Signal Input/Output Problems

Signal input and output problems can occur at any point in the network and can be caused by mechanical defects in the cables, poor connections, or lack of signal caused by other equipment failures.

Refer to your site log and other facility records to check signal connections for your facility.

Checking Node Connections with the Ping Command

You can use the **ping** command to confirm network connections between the switch and another node on the network. The **ping** command sends Internet Control Message Protocol (ICMP) echo request packets out, and receives a confirmation if the connection is good. The **ping** command format is:

ping *host [packet_size] [packet_count]*

Fiber-Optic Connections

An optical signal I/O problem can be caused by:

- Use of an incorrect type of fiber. Be sure to use single-mode fiber for a single-mode interface and multimode fiber for a multimode interface.
- Defective fiber.
- Transmit (TX) and Receive (RX) fibers that are reversed.
- Insufficient power budget on the optical link.
- Receiver overload on the optical link.

Evaluating the Power Budget

The power budget (PB) is the maximum possible amount of power transmitted. The following equation shows the calculation of the power budget:

PB = PTmin – PRmin

Where:
PTmin = Minimum transmitter power
PRmin = Minimum receiver sensitivity

Insufficient power budget occurs when the power margin (PM) is less than 0. PM is equal to the power budget minus the link loss (LL).

PM = PB – LL

Three factors contribute to link loss:

- Fiber attenuation (single-mode) 0.5 dB/km
- Connector 0.5 dB
- Splice 0.5 dB

Note These are typical values; refer to the manufacturer's documentation for the actual values.

Receiver Overload

Receiver overload can occur when (PRmax – (PTmax – LL)) is less than 0, where PRmax is maximum receiver power and PTmax is maximum transmitter power. To prevent overloading the receiver, you can use an attenuator on the link between any single-mode SONET transmitter and the receiver. Doing so should increase the value of LL.

Note Refer to Appendix A, "System Specifications" for fiber-optic power levels for the OC-3/STM-1 and the OC-12/STM-4 NLCs.

Ethernet Connections

If an Ethernet connection on your Cisco 6400 fails to work properly, and the corresponding LNK (Link) LED is not lit (steady green), check for the following problems:

- Visually check that an Ethernet cable is connected to the correct Ethernet port on the Cisco 6400, and that the other end of the cable is connected to a functional Ethernet hub.
- Check whether you are using the correct type of cable. The cable must meet the specifications given in the section "Connecting to a 10BASE-T Ethernet Network."
- The cable might be bad or broken. Replace the cable with a known, reliable straight-through Ethernet cable and check if the LNK LED comes on.
- Make sure the NSP module has booted up properly by checking the Status LED on its faceplate. This LED should be steady green. If necessary, remove and reinsert the module and boot it up again. Also, make sure the Ethernet hub you are using is powered up and operational.
- It is also possible that the Ethernet port might be functioning properly, but the LNK LED itself is broken. Check the Ethernet port (by trying to ping over it, for example) to determine if the problem is due to a bad LNK LED or if the Ethernet link itself is broken.

If the LNK LED is lit (steady green), but the Ethernet port does not seem to be working properly, make sure that the port in question is configured properly and is not administratively shut down. If you have a working console connection, complete the following steps:

Step 1 At the switch prompt, enter **show int ether0/0/0**. If the port is administratively down, enter these commands to enable it:

```
Switch> configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.

Switch(config-if)# int eth0/0/0

Switch(config-if)# no shut

Switch(config-if)# exit

Switch(config)# exit

Switch#
```

Step 2 Check that the Ethernet port in question has a valid IP address assigned to it.

For more information about configuring Ethernet ports, refer to the *Cisco 6400 Software Setup Guide*.

If the cable, connections, power, and configuration all check out, and you still cannot connect to the Ethernet port on the module, replace the module in question. If the problem persists, contact Cisco TAC for further assistance. See the "Obtaining Technical Assistance" section on pagexiv.

Console Port Serial Connections

If the console screen connected to a Cisco 6400 console port appears frozen or fails to work properly, check for the following problems:

- Check the console cable and make sure it is properly connected to the correct console port on the Cisco 6400 system at one end and to your terminal equipment at the other end.
- Verify that you are using the right type of cable and adapter. For information about pin-out connections, refer to Chapter 1, "Hardware Description," and for installation instructions, refer to Chapter3, "Installing the Cisco 6400."
- Make sure the cable is not defective or broken. Replace the cable with another high quality cable if possible, and check to see if the console port starts working.
- Check that your terminal equipment is configured with the correct settings for the console port. The default console port settings are:
  - 9600 baud
  - 8 data bits
  - 1 stop bit
  - No parity
  - No flow control
- Check the LEDs on the NSP faceplate to make sure that the node switch processor (NSP) and the node router processor (NRP) module containing the console port have powered up properly. If necessary, remove and reinsert each module to power it up again. Also, make sure the terminal equipment is working properly.
- If the cable, connections, power, and terminal settings check out and you still cannot connect to the console port on the module, replace the module in question. If the problem persists, contact CiscoTAC for further assistance. Refer to the "Obtaining Technical Assistance" section on pagexiv .

Field-Replaceable Units

Information about the Cisco 6400 field-replaceable units (FRUs) is given in the following sections:

General Troubleshooting Tips for Field-Replaceable Units

All Cisco 6400 FRUs are hot swappable. Procedures for removing and replacing the FRUs can be found in the *Cisco 6400 Installation and Replacement of Field-Replaceable Units.*

Table4-1 lists general FRU fault symptoms and recommendations.

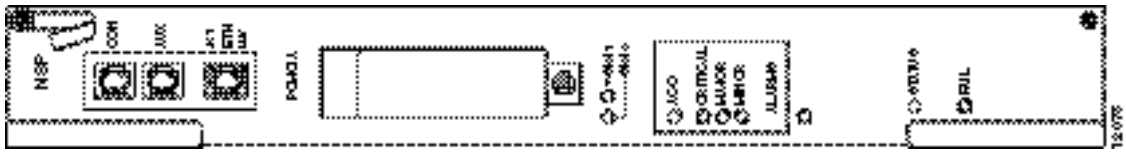
Table4-1 General FRU Troubleshooting

Symptom	Recommended Action
System fails to come up.	1. Check the STATUS LEDs on all modules and cards, and the power LEDs on the PEMs. If none are on, see Table4-14 on page4-25 (DC PEM) and Table4-16 on page4-26 (AC PEM). 2. If the system has power, check the FAIL LED on the NSP. If the FAIL LED is steady yellow, see Table4-3 on page4-12. 3. Check the blower module and ensure that it is fully inserted. 4. Ensure that all FRUs are properly inserted.
System experiences a critical alarm. (Critical LED on NSP lights yellow.)	Enter the **show facility-alarm status** command at the console.
System experiences a major alarm. (Major LED on NSP lights yellow.)	Enter the **show facility-alarm status** command at the console.
System experiences a minor alarm. (Minor LED on NSP lights yellow.)	Enter the **show facility-alarm status** command at the console.
You cannot establish a console or Telnet connection to the system.	For information about troubleshooting Ethernet connections, refer to the "Ethernet Connections" section on page4-8. For information about troubleshooting the console port serial connections, refer to the "Console Port Serial Connections" section on page4-9.
System overheats.	Troubleshoot the blower module (Table4-12 on page4-24).
System experiences a power problem.	Troubleshoot the PEM(s), referring to the PEM section of this table and to Table4-14 on page4-25 (DC PEM) and Table4-16 on page4-26 (AC PEM).

NSP Module Faults

Figure4-2 shows the NSP indicators and connectors on the faceplate.

Figure4-2 NSP Faceplate



NSP LEDs

Table4-2 describes the LEDs on the NSP faceplate.

Table4-2 NSP LED

LED	Status	Condition
STATUS	Steady yellow Blinking yellow Steady green Blinking green Off	Cisco IOS is not running. System is booting. NSP is active (primary). NSP is standby (secondary). NSP has no power.
FAIL	Yellow Off	NSP has failed. NSP has not failed.
ETH		
ACT (Activity)	Green Off	Packets are being transmitted and received. No activity.
LNK (Link)	Steady green Off	Port is operational. No carrier is detected.
PCMCIA Slot 0 PCMCIA Slot 1	Steady green Steady green	Slot is active. Slot is active.
ALARMS		
CRITICAL	Yellow Off	Alarm is active. No alarm is active.
MAJOR	Yellow Off	Alarm is active. No alarm is active.
MINOR	Yellow Off	Alarm is active. No alarm is active.

Table4-3 lists the NSP fault indications and recommended actions.

Table4-3 NSP Module Fault Indications and Actions

Symptom	Recommended Action
STATUS LED is not lit.	**1.** Check LEDs on other modules and cards. If none are lit, refer to Table4-13 on page4-25 and Table4-15 on page4-26. **2.** If LEDs on other modules and cards are lit, remove the card from its slot and check for bent or broken pins on the backplane. Return the card to its slot and screw it firmly into place. **3.** Replace the card. **Note** You can store a node's software and configuration files in NVRAM and on a PCMCIA Flash card. If the files are stored on a PCMCIA card, you can move the PCMCIA card from the faulty NSP to the replacement NSP before you install the replacement NSP. This enables the new NSP to initialize itself without resetting other cards. If the new NSP must read the chassis configuration from NVRAM, it resets all the cards in the chassis. Refer to *Cisco 6400 Installation and Replacement of Field-Replaceable Units* for complete instructions on replacing NSPs and other cards. **4.** If the problem persists, contact Cisco TAC.
FAIL LED is yellow, indicating that the NSP failed.	Reinsert the NSP. If the problem persists, contact Cisco TAC. Refer to the "Obtaining Technical Assistance" section on pagexiv.

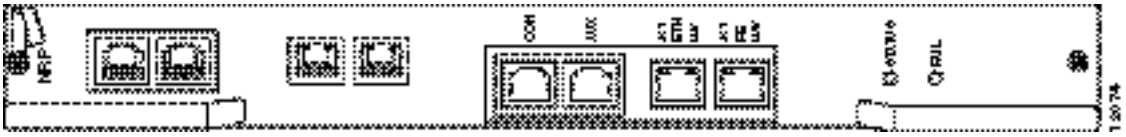
Table4-3 NSP Module Fault Indications and Actions (continued)

The NSP comes up, but you cannot establish a console or Telnet connection to the system.	1. Ensure that the terminal settings are properly set. For information about terminal settings, refer to the "Connecting a Terminal to the Console Port" section on page3-29. 2. If you still cannot connect, check the console cable. Is it firmly connected? Is it the right kind of cable with proper connectors? Refer to Chapter 1, "Hardware Description" to check pinouts. 3. If the cable checks out and you cannot connect to the NSP, reinsert the module. If the problem persists, replace the NSP. 4. If you achieve a console connection, enter: **show int ether 0/0/0.** If the port is administratively down, enter these commands to enable it: Switch> **configure terminal** Enter configuration commands, one per line. End with CNTL/Z. Switch(config-if)# **int eth0/0/0** Switch(config-if)# **no shut** Switch(config-if)# **exit** Switch(config)# **exit** Switch# 5. Enter **show log** to review console messages recorded in the system log.
Card cannot be fully inserted into its slot.	Ensure that you are using slot 0A or 0B for the NSP module.

NRP-1 Module Faults

Figure4-3 shows the NRP-1 indicators and connectors on the faceplate.

Figure4-3 NRP-1 Faceplate



NRP-1 LEDs

Table4-4 describes the LEDs on the NRP-1 faceplate.

Table4-4 NRP-1 LED Indicators

LED	Status	Condition
STATUS	Steady green Blinking green Steady yellow Blinking yellow Off	NRP-1 is active (primary). NRP-1 is standby (secondary). Cisco IOS software is not running. System is booting. NRP-1 has no power.
FAIL	Steady yellow Off	NRP-1 has failed. Normal operation.
ETH		
ACT (Activity)	Blinking green Off	Packets are being transmitted and received. No activity.
LNK (Link)	Steady green Off	Port is operational. No carrier is detected.
FE		
ACT (Activity)	Blinking green Off	Packets are being transmitted and received. No activity.
LNK (Link)	Steady green Off	Port is operational. No carrier is detected.

Table4-5 lists the NRP-1 module fault indications and recommended actions.

Table4-5 NRP-1 Module Fault Indications and Actions

Symptom	Recommended Action
STATUS LED is not lit.	1. Check LEDs on other modules. If none are lit, see Table4-13 on page4-25 (DC PEM) and Table4-15 on page4-26 (AC PEM). 2. If power LEDs on other modules and cards are lit, reinsert the NRP. 3. If the problem persists, replace the module or contact Cisco TAC.
FAIL LED is yellow, indicating that the NRP failed.	Reinsert the NRP. If the problem persists, contact Cisco TAC.
Module cannot be fully inserted into its slot.	Inspect connectors on both the card and the backplane, looking for bent pins or other damage. Use slots 1 to 8 (slots 0A and 0B are reserved for NSP modules).
Module experiences problems in one slot but operates normally in another.	Contact Cisco TAC.

NRP-2SV Module Faults

Figure4-4 shows the NRP-2SV indicators and connectors on the faceplate.

Figure4-4 NRP-2SV Faceplate

Warning **Class 1 laser product. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning **Invisible laser radiation present. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning **Because invisible radiation may be emitted from the aperture of the port when no fiber cable is connected, avoid exposure to radiation and do not stare into open apertures. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning Statement for Sweden

Varning! **Osynlig laserstrålning när denna del är öppen och förregleringen är urkopplad. Rikta inte blicken in mot strålen.**

Warning Statement for Finland

Varoitus **Alleviates ja suojalukitus ohitettaessa olet alttiina näkymättömälle lasersäteilylle. Äjä katso säteeseen.**

NRP-2SV LEDs

The LEDs on the NRP-2SV indicate port and module status (Table4-6).

Table4-6 NRP-2SV LED Indicators

LED	Status	Condition
STATUS	Steady green Blinking yellow Steady yellow Off	NRP-2SV is active. System is booting. Cisco IOS software is not running. NRP-2SV has no power.
FAIL	Steady yellow Off	NRP-2SV has failed. Normal operation.
GBIC		
TX	Blinking green Off	Packets are being transmitted. No activity.
RX	Blinking green Off	Packets are being received. No activity.
LNK	Steady green Off	Port is operational. No carrier is detected.

Alphanumeric Display

The NRP-2SV faceplate also has a four-digit alphanumeric display that indicates status information and error codes.

OC-3/STM-1 Single-Mode and Multimode NLCs and DS3 NLC Faults

Figure4-5 shows the OC3/STM-1 single-mode NLC indicators and connectors on the faceplate.

Figure4-5 OC-3/STM-1 Single-Mode NLC Faceplate

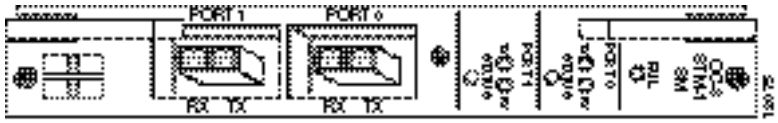
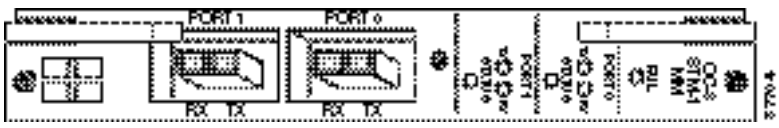


Figure4-6 shows the OC3/STM-1 multimode NLC indicators and connectors on the faceplate.

Figure4-6 OC-3/STM-1 Multimode NLC Faceplate



Warning **Class 1 laser product. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning **Invisible laser radiation present. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning **Because invisible radiation may be emitted from the aperture of the port when no fiber cable is connected, avoid exposure to radiation and do not stare into open apertures. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning Statement for Sweden

Varning! **Osynlig laserstrålning när denna del är öppen och förregleringen är urkopplad. Rikta inte blicken in mot strålen.**

Warning Statement for Finland

Varoitus **Alleviates ja suojalukitus ohitettaessa olet alttiina näkymättömälle lasersäteilylle. Äjä katso säteeseen.**

Figure4-7 shows the DS3 NLC indicators and connectors on the faceplate.

Figure4-7 DS3 NLC Faceplate

Table4-7 describes the LEDs on the OC-3/STM-1 and DS3 NLC faceplates.

Table4-7 OC-3/STM-1 and DS3 NLC LED Indicators

LED	Status	Condition
FAIL	Steady yellow Off	OC-3/STM-1 NLC has failed OC-3/STM-1 NLC is operational
PORT 0 (top connector)		
TX (transmit)	Green Off Steady yellow Flashing yellow	Transmit activity No traffic Far end alarm Local loopback
RX (receive)	Green Off Steady yellow	Receive activity No traffic Loss of signal
STATUS	Green Blinking green Off	Active (primary) Standby mode (secondary) No power
PORT 1 (bottom connector)		
TX (transmit)	Green Off Steady yellow Flashing yellow	Transmit activity No traffic Far end alarm Local loopback
RX (receive)	Green Off Steady yellow	Receive activity No traffic Loss of signal
STATUS	Steady green Blinking green Off	Active Standby mode No power

Table4-8 lists the OC-3/STM-1 and DS3 NLC fault indications and recommended actions.

Table4-8 NLC Fault Indications and Recommended Actions

Symptom	Recommended Action
STATUS LED is not lit.	1. Check LEDs on other cards. If none are lit, see Table4-14 on page4-25. 2. If LEDs on other cards are lit, remove the card from its slot and check for bent or broken pins on both the card and the backplane. Return the card to its slot and screw it firmly into place. 3. Replace the card. 4. If the problem persists with a new card, contact Cisco TAC.
FAIL LED is lit.	1. Check STATUS LED on the NSP, if it is not lit, refer to the "NSP Module Faults" section on page4-11. 2. Reinsert the NLC. If the FAIL LED lights up, replace the NLC. 3. If the problem persists, contact Cisco TAC.

Table4-8 NLC Fault Indications and Recommended Actions (continued)

Symptom	Recommended Action
Interface fails to come up.	1. Enter the command **show int atm** *slot/sub-slot/port*. The results tell you about the interface status. If the trunk is administratively down, use the **no shut** config command to bring it up. 2. Use the **loopback** command to run an OC-3/DS3 loopback test. If the card fails the loopback test, reinsert the card. Refer to *Cisco6400 Command Reference* for more information about the **loopback** command. 3. If your cable is too long or if your optical signal passes through too many connectors, signal attenuation will cause signal quality problems. Check cable length and number of connectors. 4. Check that the transmit (TX) and receive (RX) connectors are not reversed on the NLC. 5. Check optical connectors for damage or for scratches on the optical surface. Replace connectors if necessary. 6. Check optical connectors for dirt on the optical surface. If a connector is dirty, clean it by blowing compressed air from a distance of 3 inches (8 cm). You can also clean the connectors on most cables with an alcohol-moistened, lint-free wipe. Check the cable manufacturer cleaning instructions first. To prevent problems caused by dirty or damaged connectors, keep any unused optical connector covered with its protective cap. 7. For more information about fiber optic connections, refer to the "Fiber-Optic Connections" section on page4-7.
Card cannot be fully inserted into its slot.	1. Visually inspect connectors on both the card and the backplane, looking for bent pins or other damage. 2. Ensure the full-height NLC carrier is properly inserted and fastened.

OC-12/STM-4 Single-Mode NLC Faults

Figure4-8 shows the OC-12/STM-4 NLC indicators and connectors on the faceplate.

Figure4-8 OC-12/STM-4 NLC Faceplate

Warning **Class 1 laser product. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning **Invisible laser radiation present. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning **Because invisible radiation may be emitted from the aperture of the port when no fiber cable is connected, avoid exposure to radiation and do not stare into open apertures. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning Statement for Finland

Varoitus **Alleviates ja suojalukitus ohitettaessa olet alttiina näkymättömälle lasersäteilylle. Äjä katso säteeseen.**

Warning Statement for Sweden

Varning! **Osynlig laserstrålning när denna del är öppen och förregleringen är urkopplad. Rikta inte blicken in mot strålen.**

Table4-9 describes the LEDs on the OC-12/STM-4 NLC faceplate.

Table4-9 OC-12/STM-4 NLC LED Indicators

LED	Status	Condition
FAIL	Steady yellow Off	OC-12/STM-4 NLC failed OC-12/STM-4 NLC operational
TX (transmit)	Green Off Steady yellow Flashing yellow	Transmit activity No traffic Far end alarm Local loopback
RX (receive)	Green Off Steady yellow	Receive activity No traffic Loss of signal
STATUS	Green Blinking green Off	Active (primary) Standby mode (secondary) No power

Table4-10 lists the OC-12/STM-4 NLC fault indications and recommended actions.

Table4-10 OC-12/STM-4 NLC Fault Indications and Recommended Actions

Symptom	Recommended Action
STATUS LED is not lit.	1. Check LEDs on other cards. If none are lit, see Table4-14 on page4-25 (DCPEM) and Table4-15 on page4-26 (AC PEM). 2. If LEDs on other cards are lit, remove the card from its slot and check for bent or broken pins on both the card and the backplane. Return the card to its slot and screw it firmly into place. 3. Replace the card. 4. If the problem persists with a new card, contact Cisco TAC.
FAIL LED is lit.	1. Check STATUS LED on the NSP, if it is not lit, refer to the "NSP Module Faults" section on page4-11. 2. Reinsert the NLC. If the FAIL LED is lit, replace the NLC. 3. If the problem persists, contact Cisco TAC.

Table4-10 OC-12/STM-4 NLC Fault Indications and Recommended Actions (continued)

Symptom	Recommended Action
Interface fails to come up.	1. Enter the command **show int atm** *slot/sub-slot/port*. The port will always be 0. The results tell you about the interface status. If the trunk is administratively down, use the **no shut** config command to bring it up. 2. Use the **loopback** command to run an OC-12 loopback test. If the card fails the loopback test, reinsert the card. Refer to *Cisco6400 Command Reference* for more information about the **loopback** command. 3. If your cable is too long or if your optical signal passes through too many connectors, signal attenuation will cause signal quality problems. Check cable length and number of connectors. 4. Check that the transmit (TX) and receive (RX) connectors are not reversed on the NLC. 5. Check optical connectors for damage or for scratches on the optical surface. Replace connectors if necessary. 6. Check optical connectors for dirt on the optical surface. If a connector is dirty, clean it by blowing compressed air from a distance of 3 inches (8 cm). You can also clean the connectors on most cables with an alcohol-moistened, lint-free wipe. Check the cable manufacturer cleaning instructions first. To prevent problems caused by dirty or damaged connectors, keep any unused optical connector covered with its protective cap. 7. For more information about fiber optic connections, refer to the "Fiber-Optic Connections" section on page4-7.
Card cannot be fully inserted into its slot.	1. Visually inspect connectors on both the card and the backplane, looking for bent pins or other damage. 2. Ensure the full-height NLC carrier is properly inserted and fastened.

Note Because the OC-12 has a single port, a second OC-12 module is required for an exernal loopback test. Contact Cisco TAC for more information.

Blower Module Faults

Figure4-9 shows the blower module front panel and its indicators.

Figure4-9 Blower Module

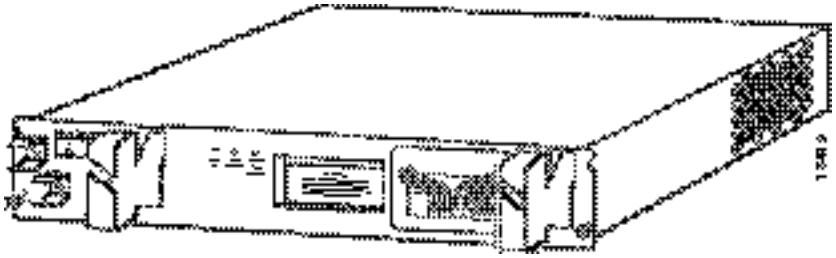


Table4-11 describes the blower module LEDs located on the front center panel.

Table4-11 Blower Module LEDs

LED	Status	Condition
FANS OK	Steady green	Fans are operational.
SINGLE FAN FAILURE	Steady yellow	Failure has occurred and alarms are triggered.
MULTI-FAN FAILURE	Steady yellow	Redundant fan has failed and the system will shut down.

Table4-12 lists the blower module fault indications and recommended action.

Table4-12 Blower Module Fault Indications and Recommended Actions

Symptom	Recommended Action
Green LED on blower module fails to go on.	1. Make sure the blower module is fully inserted into the chassis. 2. Check input power connections. If connections are loose or reversed, the chassis does not receive power and fans do not run. 3. Replace the blower module.
Fans run but the system overheats.	1. Make sure that all intake and exhaust vents on the front and rear of the chassis are free of blockages. 2. Make sure that the ambient temperature and other environmental factors in the system area are within the ranges specified in AppendixA, “System Specifications.” 3. Make sure all cards and blank faceplates are in place. The cooling system cannot operate effectively unless the chassis is fully enclosed. 4. Check the air filter, and if necessary clean or replace it. 5. Reduce the ambient temperature.

Power Entry Module Faults

Figure4-10 shows the DC PEM and its indicators.

Figure4-10 DC PEM

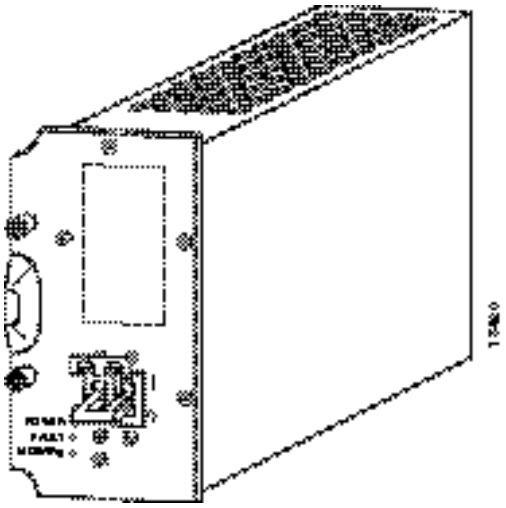


Table4-13 describes the DC PEM LEDs located on the bottom front panel.

Table4-13 DC Power Entry Module LEDs

LED	Status	Condition
POWER	Steady green	Power is available.
FAULT	Steady yellow	The PEM has failed or is turned off.
MISWIRE	Steady yellow	Cables are wired incorrectly and should be reversed.

Table4-14 lists the DC PEM fault indications and recommended actions.

Table4-14 DC PEM Fault Indications and Recommended Actions

Symptom	Recommended Action
Green LED on PEM fails to go on.	1. Make sure the circuit breaker on the PEM is turned on. 2. Make sure the PEM is properly seated and screwed in place. 3. Make sure power leads are properly connected to power connectors on the backplane. If connections are loose or their polarity is reversed, chassis does not receive power. 4. Check the power source. 5. Move the PEM to the other PEM slot. If the PEM still fails, replace it.

Table4-14 DC PEM Fault Indications and Recommended Actions (continued)

PEM experiences problems in one slot but operates normally in the other.	1. Ensure that the input power to both slots is correct. 2. If the problem persists, contact Cisco TAC.

Figure4-11 shows the AC PEM and its indicators.

Figure4-11 AC Power Entry Module

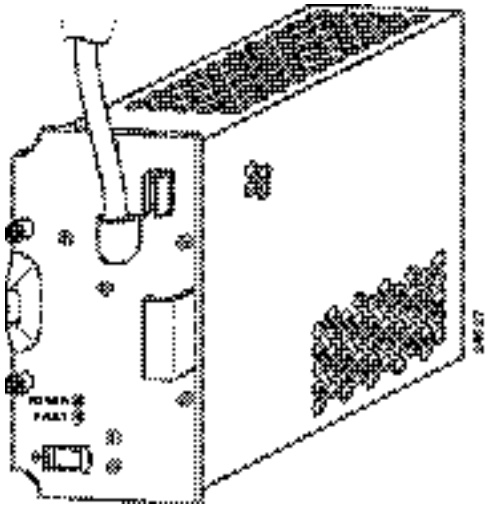


Table4-15 describes the AC PEM LEDs located on the bottom front panel.

Table4-15 AC Power Entry Module LEDs

LED	Status	Condition
POWER	Steady green	Power is available.
FAULT	Steady yellow	The PEM has failed or is turned off.

Table4-16 lists the AC PEM fault indications and recommended actions.

Table4-16 AC PEM Fault Indications and Recommended Actions

Symptom	Recommended Action
Green LED on PEM fails to go on.	1. Make sure the power enable switch to the PEM is turned on. 2. Make sure the PEM is properly seated and screwed in place. 3. Make sure the power cable is plugged in properly. 4. Check the power source. 5. Move the PEM to the other PEM slot. If the PEM still fails, replace it.

Table4-16 AC PEM Fault Indications and Recommended Actions

PEM experiences problems with one cable but operates normally with the other.	1. Ensure that the input power on the cable is correct. 2. If the problem persists, contact Cisco TAC. Refer to the "Obtaining Technical Assistance" section on page xiv.

Maintaining the Cisco 6400

This chapter provides maintenance information for the Cisco 6400 carrier-class broadband aggregator. All cards, modules, and components support online insertion and removal (often referred to as hot-swapping). Hot-swapping allows you to remove, replace, and rearrange cards without turning off the system power. When the system detects that a card or module is added or removed, it automatically runs diagnostic and discovery routines, acknowledges the presence or absence of the card or module, and resumes system operation without any operator intervention.

Note If you are a network administrator and need personal technical assistance with a Cisco product that is under warranty or covered by a maintenance contract, refer to the "Obtaining Technical Assistance" section on pagexiv.

Note The illustrations in this guide depict the original Cisco 6400 chassis. Your chassis may appear or look slightly different.

Contents

This document includes the following sections:

Tools and Equipment Required

You need the following tools and equipment to remove and replace modules. If you need additional equipment, see the "Obtaining Technical Assistance" section on pagexiv.

- One number 2 Phillips screwdriver and one flat-blade screwdriver
- Electrostatic discharge (ESD) grounding strap (disposable ESD strap provided with system)

General Safety Precautions and Maintenance Guidelines

General Safety Precautions

ESD, EMI, and Safety Precautions

Caution Static voltages as low as 30 volts can cause latent damage to circuitry. Be sure to observe all standard anti-static procedures (for example, wear a grounding strap) when handling electronic equipment and components.

Warning **Blank faceplates (filler panels) serve three important functions: they prevent exposure to hazardous voltages and currents inside the chassis; they contain electromagnetic interference (EMI) that might disrupt other equipment; and they direct the flow of cooling air through the chassis. Do not operate the system unless all cards and faceplates are in place. Translations of this warning can be found in the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Laser Safety Precautions

Warning **Class 1 laser product. Translations of this warning can be found in the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning **Because invisible radiation may be emitted from the aperture of the port when no fiber cable is connected, avoid exposure to radiation and do not stare into open apertures. Translations of this warning can be found in the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning **Invisible laser radiation present. Translations of this warning can be found in the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning Statement for Sweden

Varning! **Osynlig laserstrålning när denna del är öppen och förregleringen är urkopplad. Rikta inte blicken in mot strålen.**

Warning Statement for Finland

Varoitus **Alleviates ja suojalukitus ohitettaessa olet alttiina näkymättömälle lasersäteilylle. Äjä katso säteeseen.**

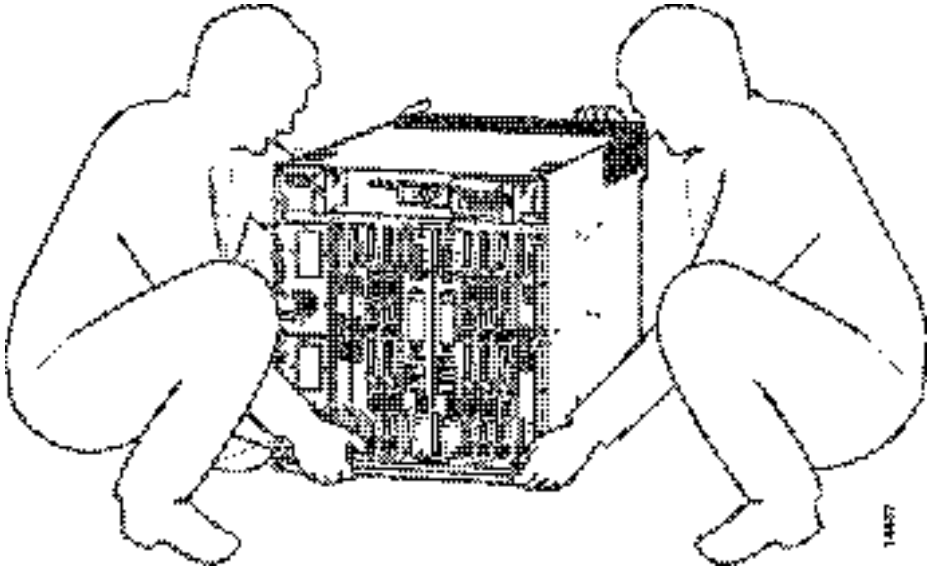
Lifting and Reaching Safety Precautions

Warning **To prevent personal injury or damage to the chassis, never attempt to lift or tilt the chassis using the handles on modules (such as power supplies, fans, or cards); these types of handles are not designed to support the weight of the unit. Lift the unit only by using handles that are an integral part of the chassis, or by grasping the chassis underneath its lower edge. Translations of this warning can be found in the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning **Two people are required to lift the chassis. To prevent injury, keep your back straight and lift with your legs, not your back. Translations of this warning can be found in the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Figure5-1 shows the proper way to lift the Cisco 6400 chassis.

Figure5-1 Lifting the Cisco 6400 Chassis



Hot-Swapping Modules and Line Cards

The Cisco 6400 system has a hot-swap feature that allows you to install and remove modules andline cards while the system is operating. With hot swapping, you do not need to power down the system.

When unconfigured node line cards (NLCs) are installed for the first time, the system identifies them as present but unconfigured. Read the instructions for initial interface configurations in the *Cisco 6400 Software Setup Guide.*

If a card or module similar to the one that was removed is reinserted into a slot, the Cisco 6400 automatically configures its ports and brings it online up to the port count of the original card.

Note You must administratively shut down the card or module; otherwise alarms are activated.

Caution To avoid erroneous failure messages, allow at least 15 seconds for the system to reinitialize. Note the current configuration of all interfaces before you remove or insert another card.

Plug-In Module or Card Replacement Suggestions

The following are examples of recommended module and card insertion practices:

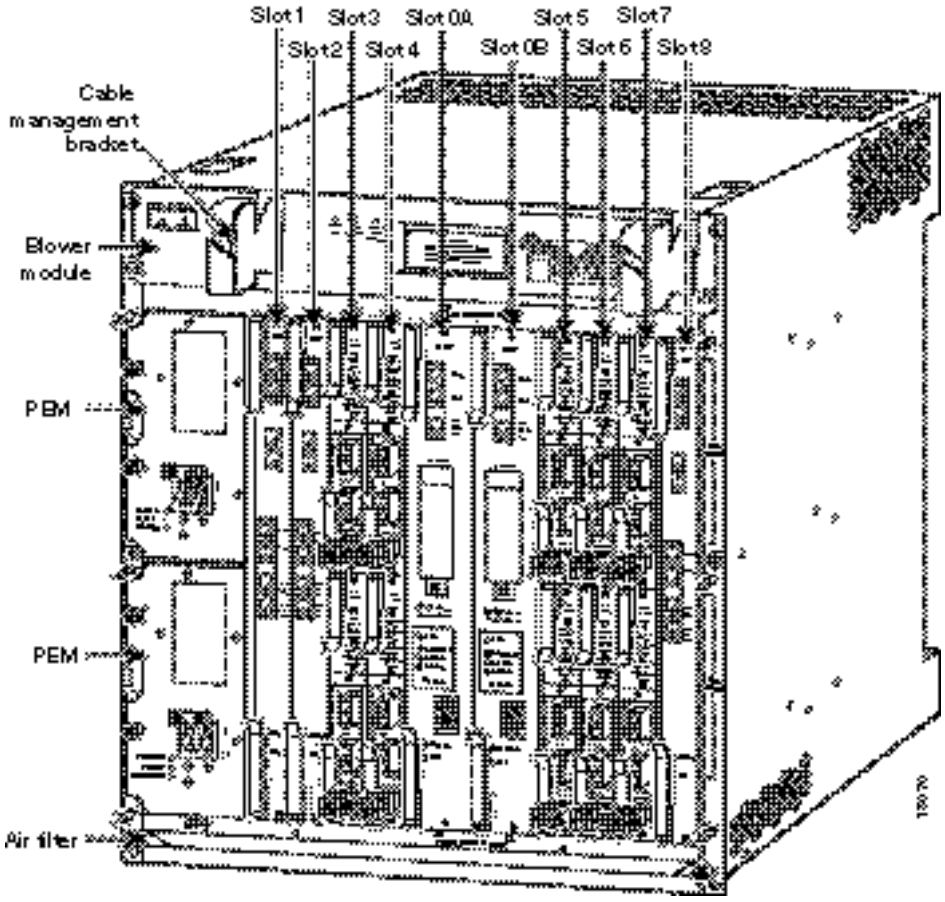
- Do not force the faceplate into its slot. This action can damage the pins on the backplane if they are not aligned properly with the module or card.
- Fully depress the ejector levers to ensure that the card connector mates with the backplane correctly. Ensure that the card or module is firmly seated in the slot.
- Use the installation screws (top and bottom of carrier) to secure the module or card firmly in place in the chassis.

Note Any module that is only partially connected to the backplane can disrupt system operation.

Cisco 6400 System Component Identification

Figure5-2 identifies the major components of the Cisco 6400 system. Card slots 1 through 8 can contain a combination of node route processor (NRP) and node line card (NLC) modules; only node switch processor (NSP) modules can be inserted into card slots 0A and 0B.

Figure5-2 Cisco 6400 System Components—Front View



Replacing the Front Cover

Note The Cisco 6400 no longer ships with the plastic front cover that was included in shipments made before June 2002. This section covering removal and replacement procedures is included only for reference purposes.

Removing the Front Cover

To remove the front cover, first remove the bezel plugs:

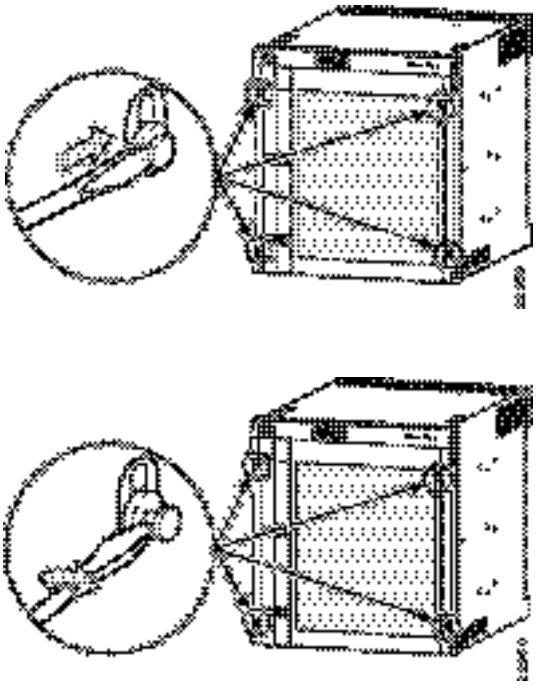
Step 1 Insert the tip of a flat-blade screwdriver into the indentation between the top and bottom of the plug.

Step 2 Rotate the screwdriver blade 90 degrees, pushing out the top of the plug (Figure5-3).

Step 3 Remove the plug with your fingers.

Step 4 Then firmly grasp the cover with both hands, lift upward as far as possible (about one inch), and pull forward.

Figure5-3 Removing Bezel Plugs



Note The cover is secured by four posts. Avoid bending or twisting cables and connectors.

Installing the Front Cover

To install the front cover:

Step 1 Line up the hole in each corner of the cover with the four posts on the chassis (Figure5-4).

Step 2 Gently but firmly push the cover onto the posts and slide downward to secure.

Step 3 Insert one of the bezel plugs into a corner hole, below the post.

Step 4 When the plug is lined up in the hole (Figure5-5), use your thumb to gently but firmly press on the top of the plug until the top collapses against the bottom.

Step 5 Repeat Steps 3 and 4 for the remaining three corners. Avoid bending or twisting cables and connectors.

Figure5-4 Installing the Front Cover

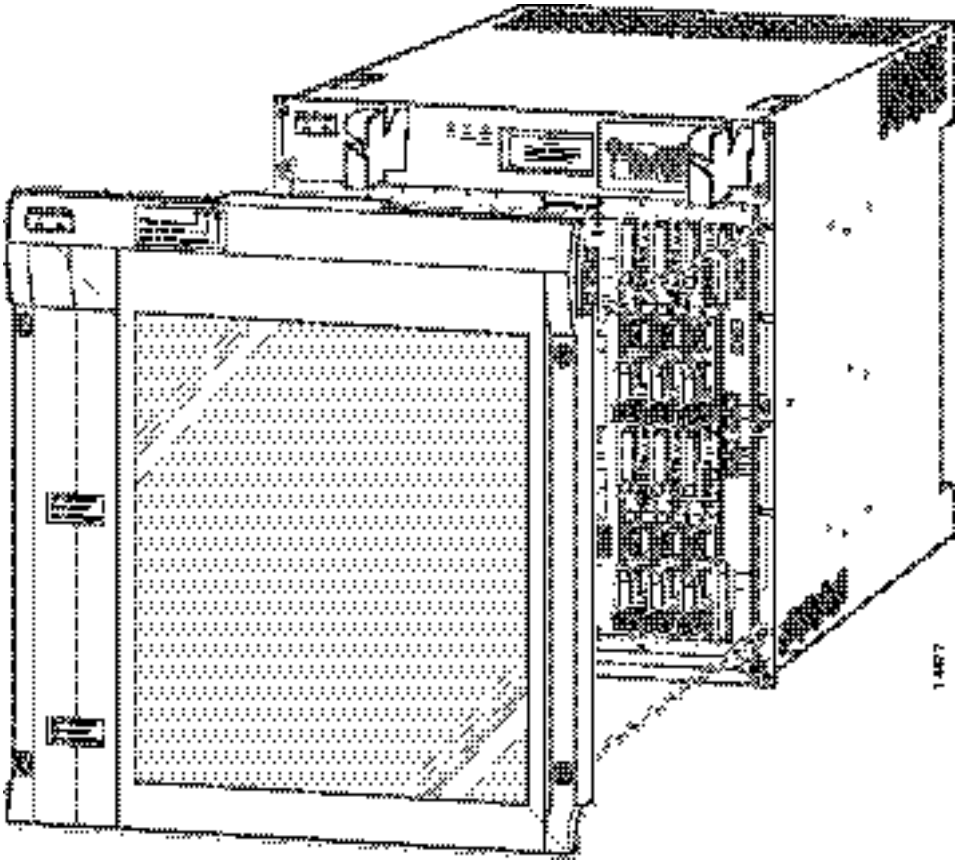
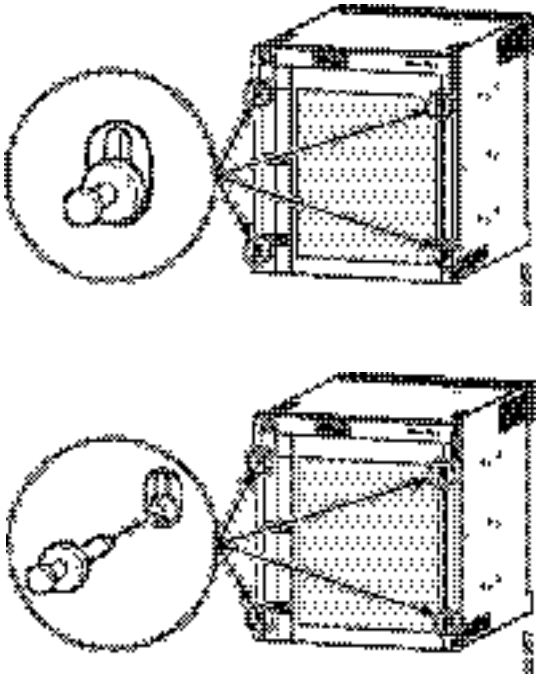


Figure5-5 Installing Bezel Plugs



Powering Down the System

To power down the Cisco 6400 system:

Step 1 Notify appropriate personnel that you plan to shut down the Cisco 6400 system and that this will result in total loss of service. Appropriate personnel includes the regional alarm or network monitoring center, central office personnel, and key customers.

Step 2 Before shutting down the Cisco 6400, use the **copy** command to save any configuration changes to NVRAM and also to a PCMCIA card. (Refer to the *Cisco 6400 Command Reference* for instructions on using the **copy** command.)

Step 3 Complete all copy or write operations involving Flash media (PCMCIA slots or boot Flash) before you power down the Cisco 6400.

Step 4 To power down the Cisco 6400, turn off the switch on all PEMs (your system can be configured with one or two PEMs).

Backing Up the PCMCIA Card

We recommend that you create a duplicate PCMCIA card that contains the current boot software image and the current software configuration. You can use the duplicate to recover from a major system failure with less disruption. If you have a backup PCMCIA card, you can use that card to load a new node switch processor (NSP) module and avoid a time-consuming reconfiguration process. For instructions on creating a backup PCMCIA card, refer to *Cisco 6400 Software Setup Guide*.

Maintaining the Air Filter

The Cisco 6400 automatically powers down if the system overheats. If the blower module's air filters are too dirty or clogged, the system might have insufficient air flow and might overheat.

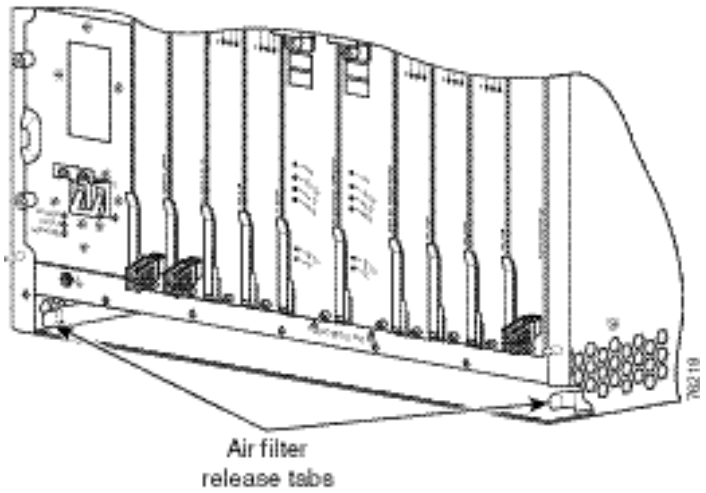
You should replace the Cisco 6400 air filters every six months. In certain environments, you might have to replace the air filter more frequently.

Removing the Air Filter

The Cisco 6400 ships with either a screw-type or tab-type air filter.

To remove a tab-type air filter, press the release tabs on each side of the chassis to release the air filter and slide it out of the chassis. (See Figure5-6.)

Figure5-6 Tab-type Air Filter Release Tabs



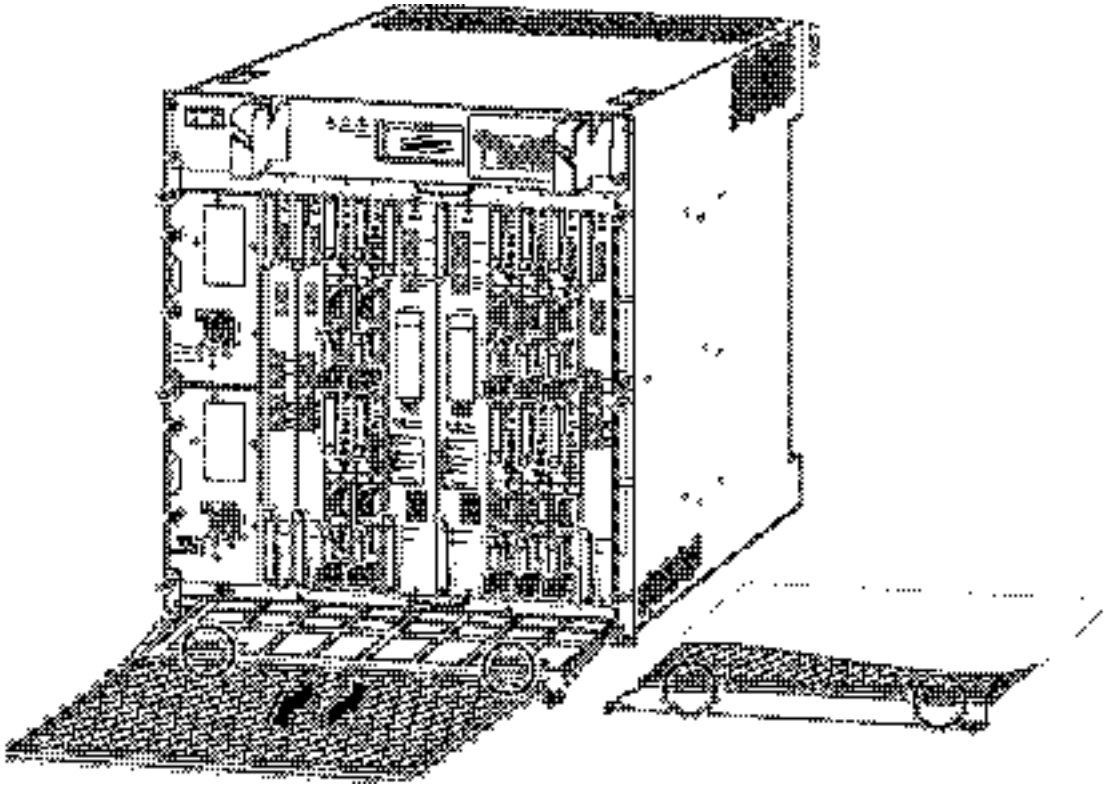
To remove a screw-type air filter, refer to Figure5-7 and perform the following steps.

Step 1 Locate the filter tray at the bottom front of the chassis, below the plug-in modules. Use a number 2 Phillips screwdriver to unlock the filter tray.

Step 2 Gently pull the filter toward you to remove it from the chassis.

Step 3 If you are replacing the filter, discard the old filter and go to the section "Replacing the Air Filter."

Figure5-7 Removing a Screw-type Air FIlter from the Chassis

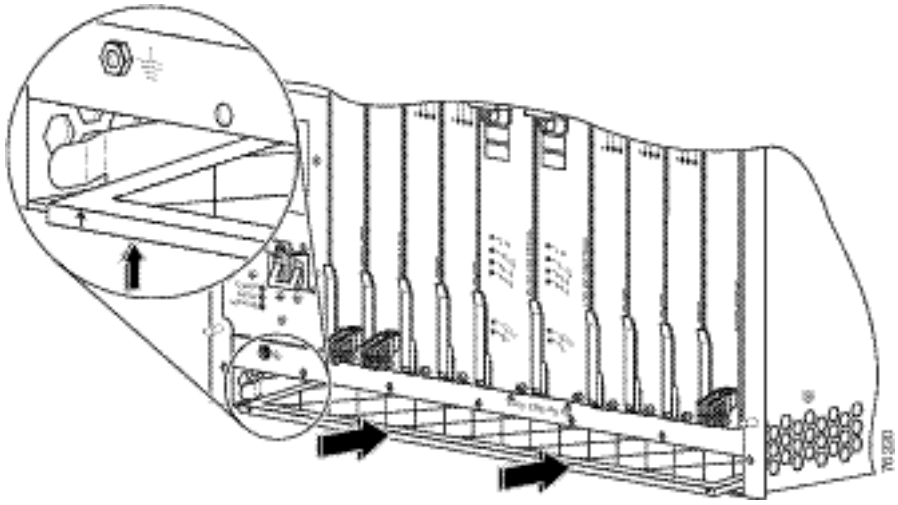


Replacing the Air Filter

The Cisco 6400 ships with either a screw-type or tab-type air filter.

To install a new tab-type air filter, slide the new filter all the way into the chassis and lift it up until it snaps into place. The directional arrows located on the metal frame of the filter should be pointing up. (See Figure5-8.)

Figure5-8 Inserting a Tab-Type Air Filter



To install a new screw-type air filter, refer to Figure5-7 and perform the following steps:

Step 1 Hold the air filter with the arrows (located on the metal frame) facing up.

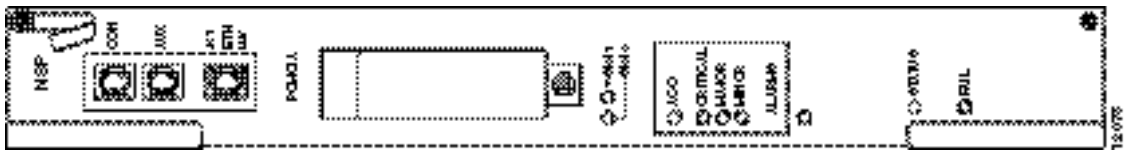
Step 2 Slide the air filter into the bottom tray of the chassis.

Step 3 Secure the tray by tightening the retaining screws.

Replacing an NSP Module

The Cisco 6400 can contain one or two NSP modules, which are located in slots 0A and 0B (in the middle of the chassis). Figure5-9 shows the NSP faceplate.

Figure5-9 NSP Faceplate



Caution Removing an active NSP in a redundant configuration causes a switchover. Removing an active NSP in a nonredundant configuration causes a system shutdown.

Removing the NSP Module

To remove an NSP module:

Step 1 Attach a ground strap to your wrist.

Step 2 Unscrew the upper and lower retaining screws.

Step 3 Disconnect any cables connected to the NSP module that you are about to remove.

Step 4 Grasp the upper and lower extraction levers. Pull up on the upper lever while pushing down on the lower lever. This action disengages the module from the connectors on the backplane.

Step 5 Slide the NSP module out of the slot.

Step 6 Place the NSP module on an antistatic surface. If the module will be out of the chassis for several minutes or longer, put it in a static-shielding bag or in a box lined with antistatic material.

Step 7 Install another NSP module or a blank faceplate in the empty slot.

Warning **Blank faceplates (filler panels) serve three important functions: they prevent exposure to hazardous voltages and currents inside the chassis; they reduce electromagnetic interference (EMI) that might disrupt other equipment; and they direct the flow of cooling air through the chassis. Do not operate the system unless all cards and faceplates are in place. Translations of this warning can be found in the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Installing the NSP Module

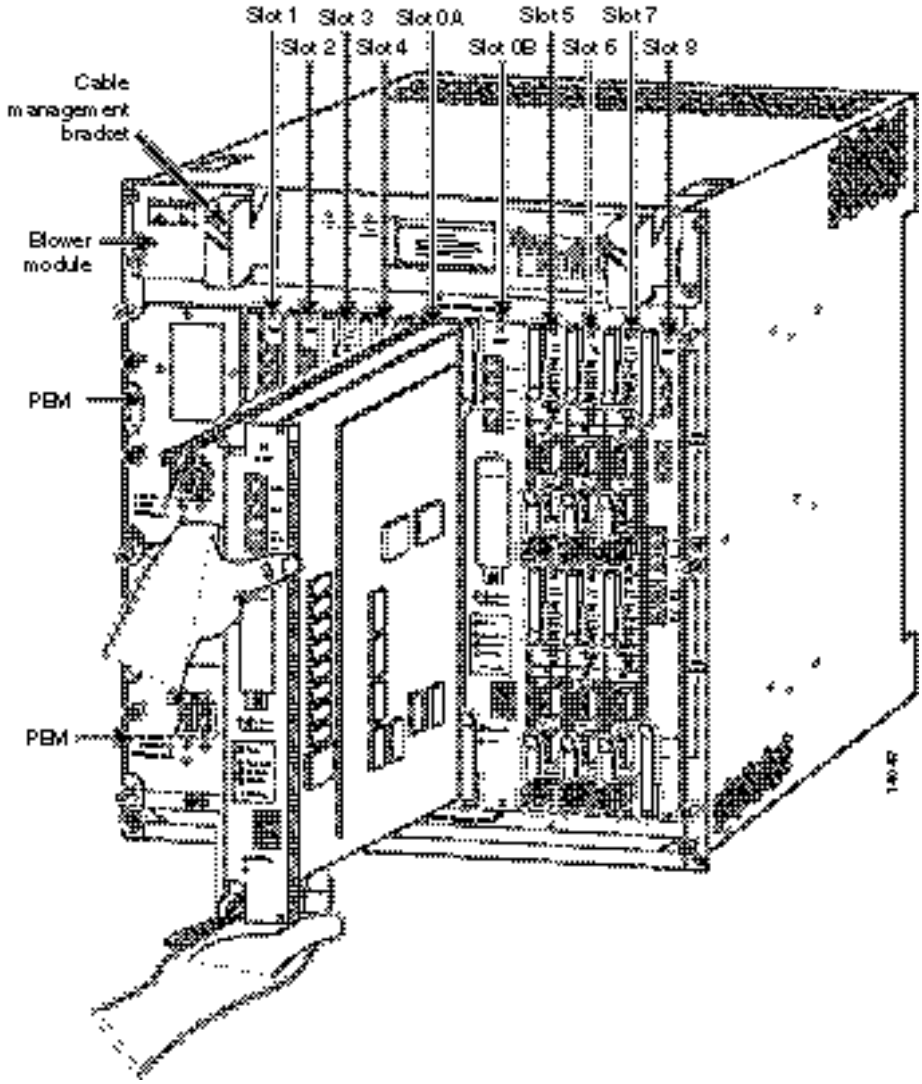
The NSP module can be inserted only in slot 0A or 0B. To install an NSP module in the Cisco 6400 chassis:

Step 1 Remove the blank filler panel from the selected slot, if a blank panel is present.

Step 2 Hold the NSP module vertically, with the NSP faceplate toward you and the backplane connectors away from you. Ensure that the module is right side up by noting the lettering on the faceplate.

Step 3 Carefully align the upper and lower edges of the NSP carrier with the upper and lower guides in the chassis (Figure5-10).

Figure5-10 Inserting an NSP into the Chassis



Caution To ensure that the NSP module mates properly with all backplane connector pins, the card length and card slots have been designed with very close tolerances. To slide the module into the slot requires gentle pressure with each hand, at the top and bottom of the faceplate.

Step 4 Gently slide the module into the slot until it makes contact with the backplane.

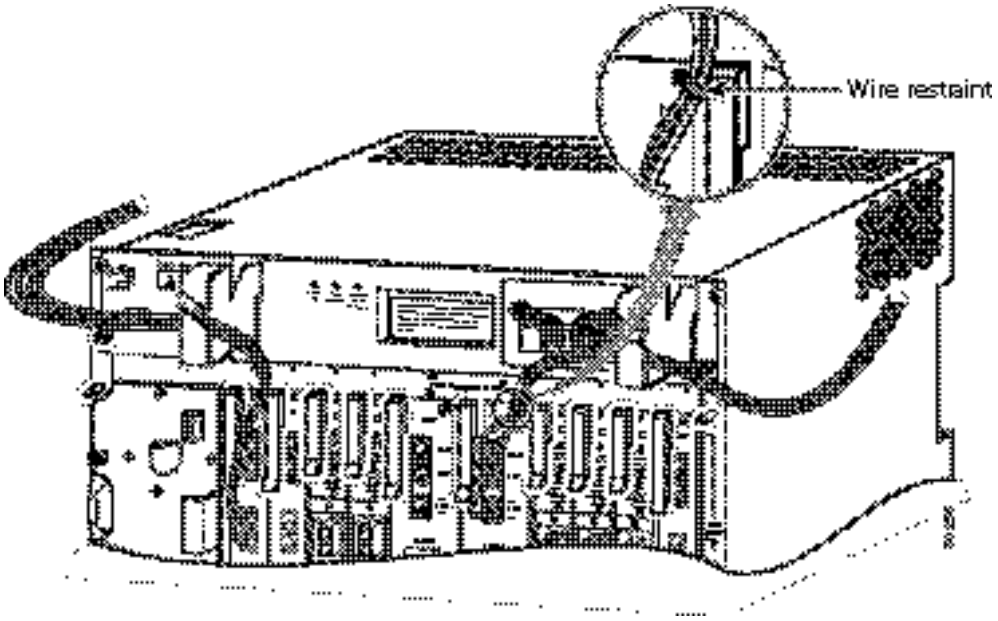
Step 5 Press the upper lever down and the lower lever up at the same time.

Step 6 Secure the card by tightening the upper and lower retaining screws.

Step 7 Connect the cables.

Step 8 Pull the cables across the wire restraint and bend the restraint upward to trap the cables (Figure5-11).

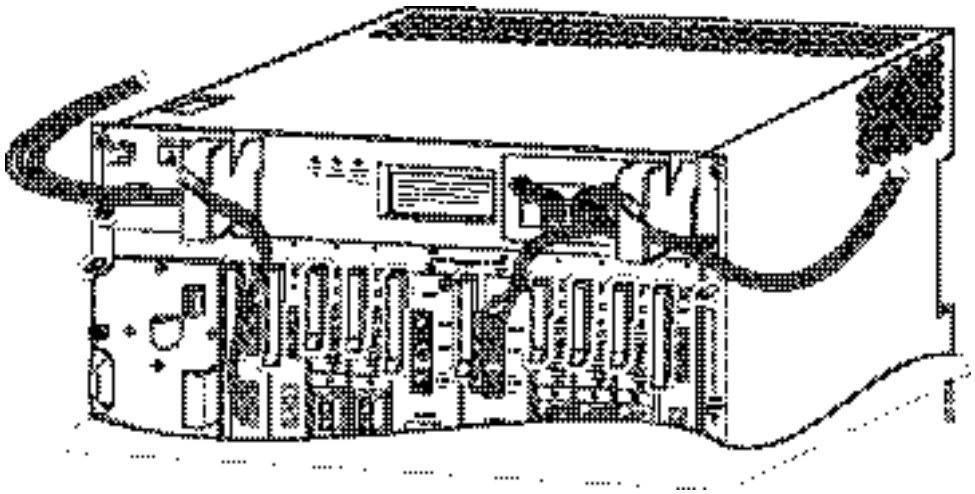
Figure5-11 Wire Restraint on the NSP



Step 9 Route the cables through the cable management bracket, creating a 20-inch (or larger) service loop (Figure5-12).

Note A minimum 20-inch loop is critical to hot swapping the blower.

Figure5-12 Routing the NSP Cables Through the Cable Management Bracket



Step 10 Install blank filler panels to cover any unused slots. Like cards and modules, each filler panel is held in place by two retaining screws.

Replacing an NSP Module PCMCIA Card

There are two PCMCIA slots in the NSP module. To replace a PCMCIA card:

Step 1 Unscrew the locking fastener on the bottom of the PCMCIA slot cover.

Step 2 Lift the cover and press the eject button on the PCMCIA slot for the card you are removing. The card ejects.

Step 3 Remove the PCMCIA card and insert the new card. Push firmly to seat the new PCMCIA card.

Step 4 Close the cover and tighten the locking fastener.

Note If you seat a PCMCIA Type II card in Slot 0, you cannot use Slot 1. However, if you seat a Type I card in Slot 0, you can insert either a Type I or Type II card in Slot 1.

Replacing an NSP Module SIMM

General SIMM Information

SIMMs are sensitive components that are susceptible to ESD damage. Handle SIMMs by the edges only; avoid touching the memory modules, pins, or traces (the metal *fingers* along the connector edge of the SIMM).

Caution To upgrade DRAM, you must install identical SIMMs in both DRAM SIMM connectors.

The default DRAM configuration is 64 MB, contained in two 32-MB SIMMs. The DRAM can be increased to 128 MB by adding two more 32-MB SIMMs. The amount of DRAM required on the NSP module is determined by the number of active physical and logical ports (virtual path tunnels) and the expected number of active switched virtual channels (SVCs) through the switch.

In a 64-MB DRAM configuration, the two accessible SIMM sockets (U51 and U63) are empty. To upgrade to 128-MB DRAM, youmust purchase an upgrade kit from Cisco and insert the SIMMs into the two empty sockets.

Note You must use SIMMs obtained from Cisco Systems.

Removing NSP Module SIMMs

To remove the existing SIMMs:

Step 1 Attach an ESD-preventive wrist strap between you and an unpainted chassis surface.

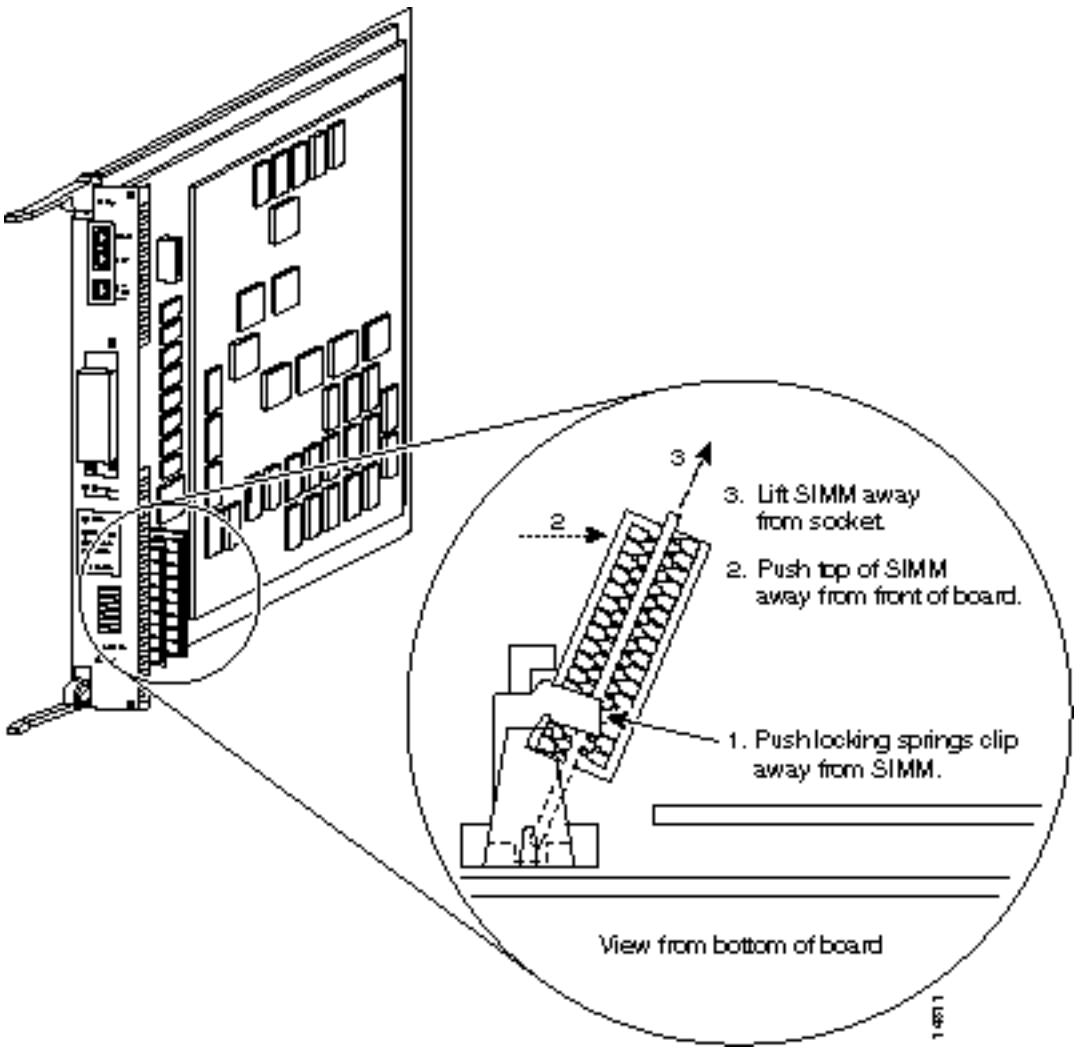
Step 2 Disconnect the console and auxiliary cables from the NSP module.

Step 3 Loosen the captive installation screws on the NSP module.

Step 4 Place the NSP on an antistatic mat or pad. Position the NSP so that the faceplate is away from you and the edge connector is toward you.

Step 5 Locate the SIMMs. The DRAM SIMMs occupy sockets U51 and U63 (Figure5-13).

Figure5-13 Removing an NSP SIMM Module



Step 6 Release the spring clips from the SIMM that you wish to remove and lift the SIMM from the socket (Figure5-13).

Step 7 When both ends of the SIMM are released from the socket, use your thumb and forefinger to grasp the ends of the SIMM and pull the SIMM completely out of the socket. Handle the edges of the SIMM only; avoid touching the memory module, pins, or metal traces (fingers) along the socket edge.

Step 8 Place the SIMM in an antistatic bag to protect it from ESD damage.

Step 9 Repeat steps 5 through 8 for the remaining SIMMs, as required for your upgrade.

Installing an NSP SIMM Module

To replace a SIMM module:

Step 1 Keep the NSP in the same orientation as in the previous procedure (with the handle facing away and the edge connector toward you).

Step 2 Remove a new SIMM from the antistatic bag.

Caution Handle SIMMs by the card edges only. SIMMs are sensitive components that can short out if mishandled.

Step 3 Hold the SIMM component side up with the connector edge (the metal fingers) closest to you.

Step 4 Hold the sides of the SIMM between your thumb and middle finger, with your forefinger against the far edge, opposite the connector edge (Figure5-13).

Step 5 Tilt the SIMM to approximately the same angle as the socket, and insert the entire connector edge into the socket. Insert the first SIMM in the socket farther from you.

Caution When inserting SIMMs, use firm but not excessive pressure. If you damage a socket, you must return the NSP to the factory for repair.

Step 6 Gently push the SIMM into the socket until the spring clips snap over the ends of the SIMM. If necessary, rock the SIMM gently back and forth to seat it properly.

Step 7 Repeat Steps 2 through 6 for the remaining SIMM. Insert the second SIMM in the socket closer to you.

Step 8 When both SIMMs are replaced, check all four alignment holes (two on each SIMM) and ensure that each spring retainer is visible. If it is not, the SIMM is not seated properly. If a SIMM appears misaligned, carefully remove it and reseat it in the socket. Push the SIMM firmly back into the socket until the retainer springs snap into place.

Verifying SIMM Operation

If the system fails to boot properly, or if the console terminal displays a checksum or memory error, check the following:

- Ensure that all SIMMs are installed correctly. Check the SIMMs by looking straight down on them and then observe them at eye level. The SIMMs should both be aligned at the same angle and should be at the same height. If one SIMM appears to stick out or rests in the socket at an angle different from the other, remove the SIMM and reinsert it. Replace the NSP and reboot the system for another installation check.
- Each DRAM SIMM bank must contain SIMMs of the same size and speed, or the system does not operate. Contact Cisco Systems to order the NSP DRAM upgrade package. Other vendors' parts might not work properly. (To contact Cisco Systems, see the "Obtaining Technical Assistance" section on pagexiv.)

If the system fails to restart properly after several attempts, contact a service representative for assistance. Before you contact Cisco Systems, make note of any error messages, unusual LED states, or any other indications that might help identify the problem.

Replacing an NRP Module

NRP modules can be installed in slots 1 through 8 in the Cisco 6400 chassis. The procedure for replacing an NRP module is basically the same for the NRP-1 and NRP-2SV modules. The only difference is that for the NRP-1, the attached cables are directed up to wire restraints; and for the NRP-2SV, the cable is directed down to cable management brackets. This is clarified in Step 8 in the "Installing an NRP-2SV Module" section.

Removing an NRP Module

To remove an NRP module from the Cisco 6400 chassis:

Step 1 Attach an ESD-preventive wrist strap.

Step 2 Disconnect any cables connected to the NRP module that you are about to remove.

Step 3 Unfasten the upper and lower retaining screws.

Step 4 Grasp the upper and lower extraction levers. Pull up on the upper lever while pushing down on the lower lever. This action disengages the NRP carrier from the connectors on the backplane.

Step 5 Slide the module out of the slot.

Step 6 Place the NRP module on an antistatic surface. If it will be out of the chassis for several minutes or longer, put it in a static-shielding bag or in a box lined with antistatic material.

Step 7 Insert another NRP module or a blank faceplate in the empty slot.

Warning **Blank faceplates (filler panels) serve three important functions: they prevent exposure to hazardous voltages and currents inside the chassis; they reduce electromagnetic interference (EMI) that might disrupt other equipment; and they direct the flow of cooling air through the chassis. Do not operate the system unless all cards and faceplates are in place. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Installing an NRP-2SV Module

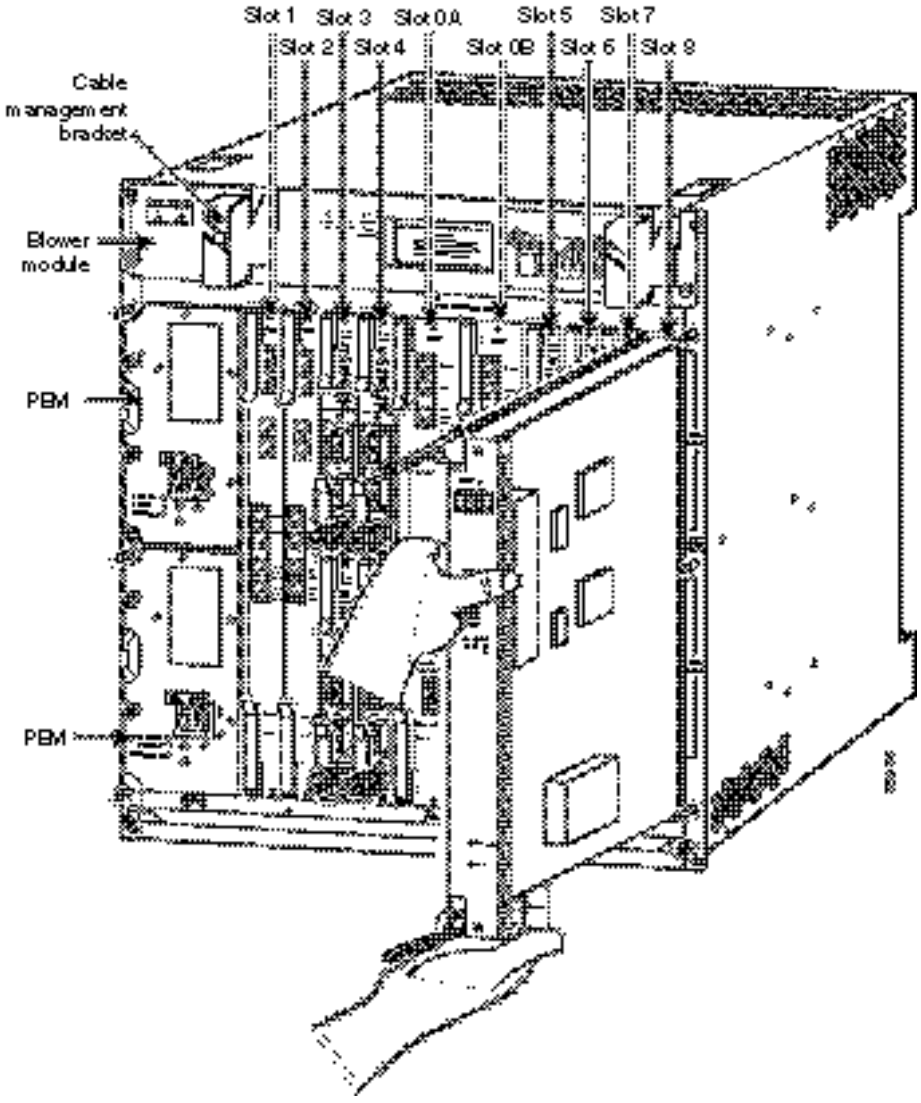
To install an NRP-2SV module in the Cisco 6400 chassis:

Step 1 Remove the blank filler panel from the selected slot if a blank panel is present.

Step 2 Hold the NRP-2SV module vertically with the NRP-2SV faceplate toward you and the backplane connectors away from you. Ensure that the module is right side up by noting the lettering on the faceplate.

Step 3 Carefully align the upper and lower edges of the NRP-2SV carrier with the upper and lower guides in the chassis. See Figure5-14 for an example of inserting an NRP-2SV module in the chassis.

Figure5-14 Inserting an NRP-2SV into the Chassis



The following warnings apply to the NRP-2SV module.

Warning **Class 1 laser product. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning **Because invisible radiation may be emitted from the aperture of the port when no fiber cable is connected, avoid exposure to radiation and do not stare into open apertures. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning **Invisible laser radiation present. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning Statement for Sweden

Varning! **Osynlig laserstrålning när denna del är öppen och förregleringen är urkopplad. Rikta inte blicken in mot strålen.**

Warning Statement for Finland

Varoitus **Alleviates ja suojalukitus ohitettaessa olet alttiina näkymättömälle lasersäteilylle. Äjä katso säteeseen.**

Caution To ensure that the NRP-2SV module connects properly with all backplane connector pins, the card length and card slots have been designed with very close tolerances. To slide the module into the slot requires gentle pressure with each hand at the top and bottom of the faceplate.

Step 4 Gently slide the NRP module into the slot until it makes contact with the backplane.

Step 5 Press the upper lever down and the lower lever up at the same time.

Step 6 Secure the carrier by tightening the upper and lower retaining screws.

Step 7 Connect the cables.

Step 8 For an NRP-1 module, follow the first step; for an NRP-2SV module, go to the second step:

- For an NRP-1 module, pull the cables across the wire restraint and bend the restraint upward to trap the cables (Figure5-15). Route the cables through the cable management bracket, creating a 20-inch (or larger) service loop (Figure5-16).

  Note A minimum 20-inch loop is critical to hot swapping the blower.

- For an NRP-2SV module, direct the cable down (Figure5-17).

Figure5-15 Pulling Wires Across the Wire Restraint on the NRP-1 Module

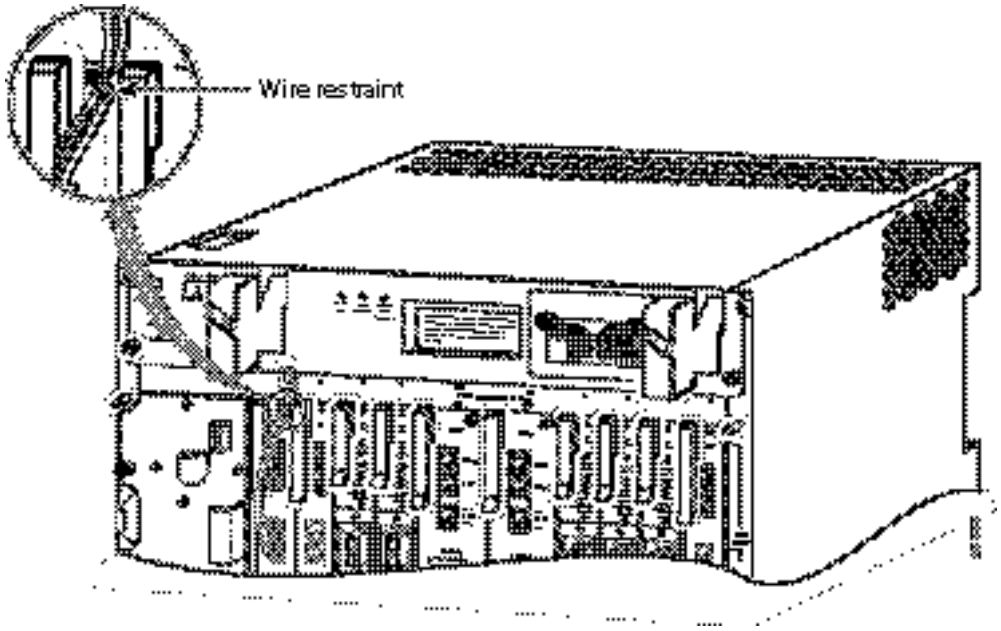


Figure5-16 Routing the NRP-1 Cables Through the Cable Management Bracket

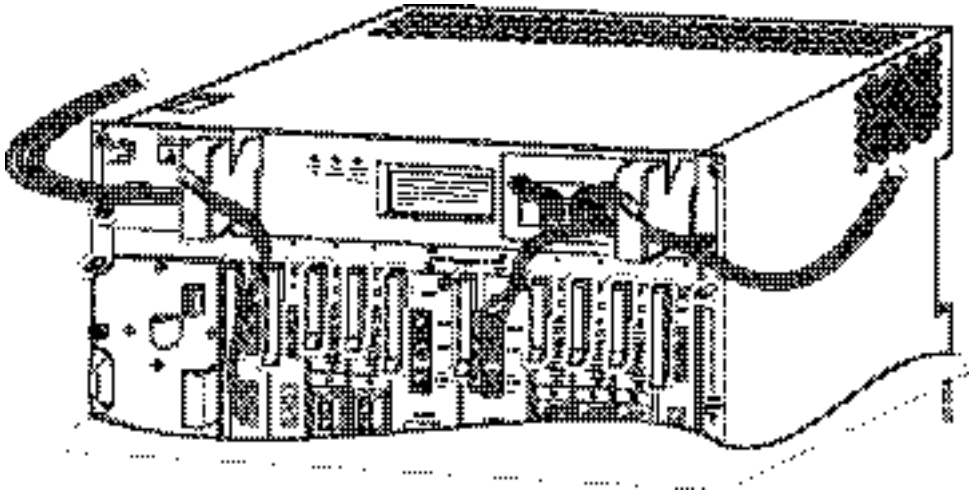
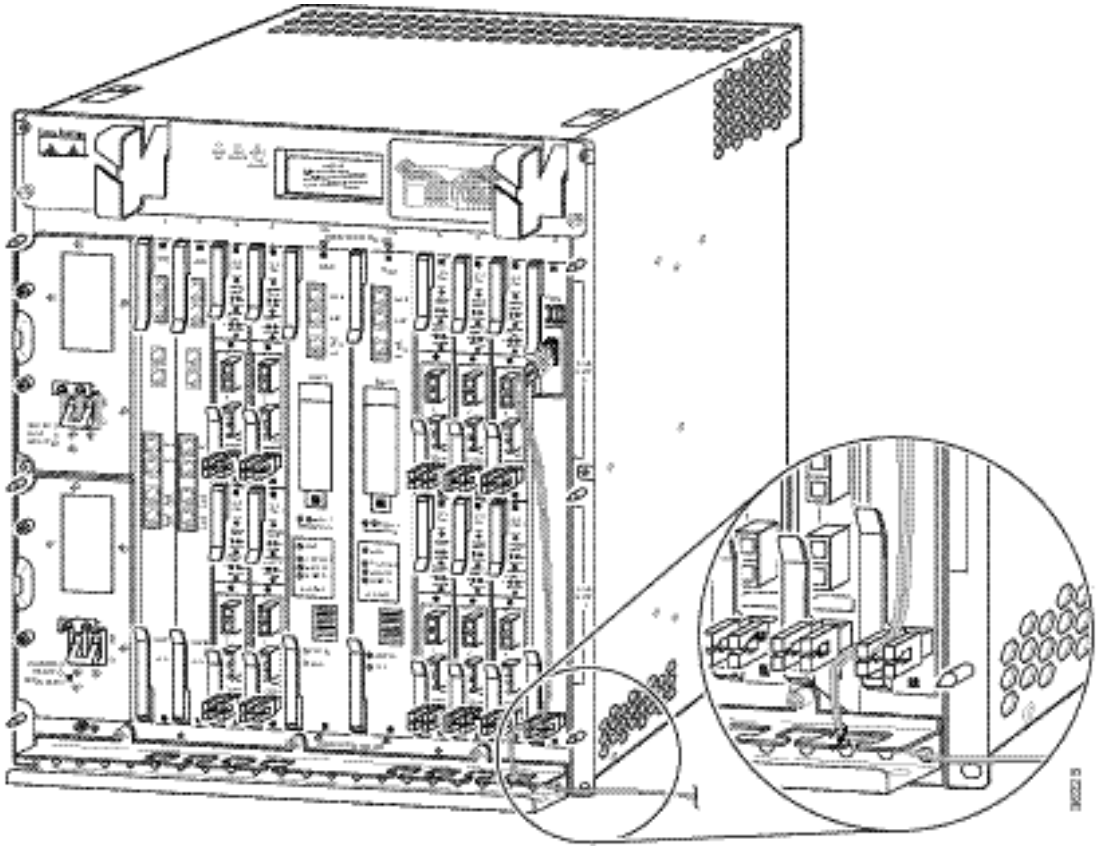


Figure5-17 NRP-2SV Fiber-Optic Cable Management



Step 9 Install blank filler panels to cover any unused slots. Use two retaining screws to secure each filler panel.

Replacing an NRP-1 Module SIMM

This section describes how to remove and replace an NRP-1 SIMM module.

General SIMM Information

SIMMs are sensitive components that are susceptible to ESD damage. Handle SIMMs by the edges only; avoid touching the memory modules, pins, or traces (the metal "fingers" along the connector edge of the SIMM).

Figure5-18 shows the locations of the DRAM and Flash SIMMs on the NRP-1 module. The procedures for removing, installing, and verifying the DRAM and Flash SIMMs are identical.

Caution To upgrade DRAM, you must install identical SIMMs in both DRAM SIMM connectors.

NRP-1 Memory Description

The default DRAM configuration is 64 MB, contained in two 32-MB SIMMs. The DRAM can be increased to 128 MB by replacing them with two 64-MB SIMMs. The amount of DRAM required on the NRP-1 module is determined by the number of routed and bridged sessions the NRP-1 is configured to handle.

The default Flash configuration is 8 MB, but you can upgrade to a 16-MB Flash SIMM. The amount of Flash memory required on the NRP-1 module is determined by the number and sizes of images and configuration files stored in Flash memory.

To upgrade either DRAM or Flash memory on the NRP-1 module, you must purchase an upgrade kit from Cisco Systems and replace the current SIMMs.

Note You must use SIMMs obtained from Cisco Systems.

Removing an NRP-1 Module SIMM

To remove the SIMM from the Cisco 6400 chassis:

Step 1 Attach an ESD-preventive wrist strap between you and an unpainted chassis surface.

Step 2 Disconnect the signal and control cables from the NRP.

Step 3 Loosen the captive installation screws on the NRP module and remove the module from the chassis.

Step 4 Place the NRP module on an antistatic mat or pad. Position the NRP module so that the faceplate is away from you, and the edge connector is toward you.

Step 5 Locate the SIMMs on the NRP module (Figure5-18).

Step 6 Release the spring clips from the SIMM that you wish to remove and lift the SIMM from the socket (Figure5-19).

Step 7 When both ends of the SIMM are released from the socket, use your thumb and forefinger to grasp the ends of the SIMM and pull the SIMM completely out of the socket. Handle the edges of the SIMM only; avoid touching the memory module, pins, or metal traces (fingers) along the socket edge.

Step 8 Place the SIMM in an antistatic bag to protect it from ESD damage.

Figure5-18 NRP-1 Module SIMMs

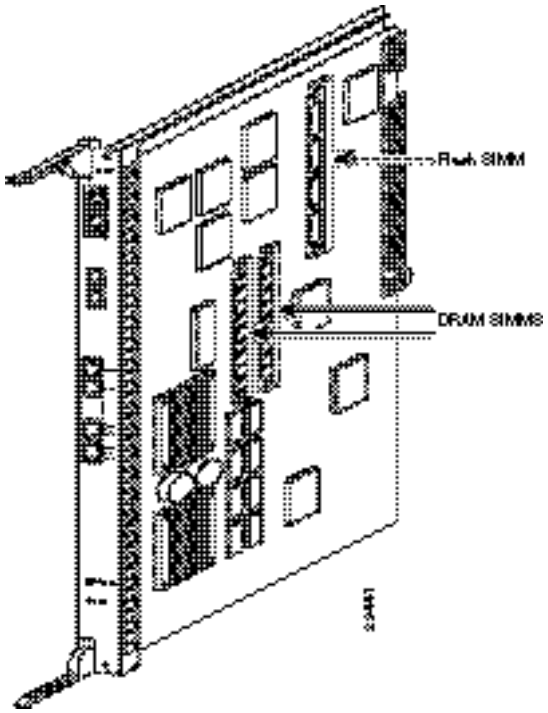
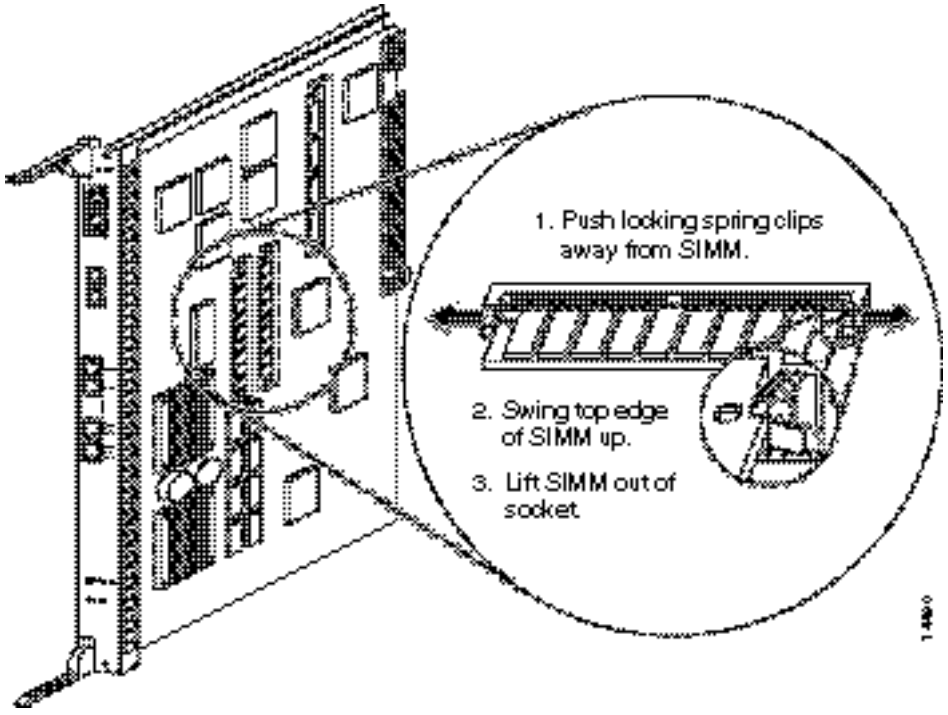


Figure5-19 Removing the NRP-1 Module SIMM



Installing the NRP-1 Module SIMM

To replace the SIMM:

Step 1 Keep the NRP in the same orientation as in the previous procedure (with the handle facing away and the edge connector toward you).

Step 2 Remove a new SIMM from the antistatic bag.

Caution Handle SIMMs by the card edges only. SIMMs are sensitive components that can short out if mishandled.

Step 3 Hold the SIMM component side up with the connector edge (the metal fingers) closest to you.

Step 4 Hold the sides of the SIMM between your thumb and middle finger, with your forefinger against the far edge, opposite the connector edge.

Step 5 Tilt the SIMM to approximately the same angle as the socket, and insert the entire connector edge into the socket. If you are installing the DRAM SIMMs, insert the first DRAM SIMM in the socket farther from you.

Caution When inserting SIMMs, use firm but not excessive pressure. If you damage a socket, you must return the NRP to the factory for repair.

Step 6 Gently push the SIMM into the socket until the spring clips snap over the ends of the SIMM. If necessary, rock the SIMM gently back and forth to seat it properly.

Step 7 Repeat steps 2 through 6 for each remaining new SIMM.

Step 8 For each SIMM you installed, check both alignment holes and ensure that each spring retainer is visible. If it is not, the SIMM is not seated properly. If a SIMM appears misaligned, carefully remove it and reseat it in the socket. Push the SIMM firmly back into the socket until the retainer springs snap into place.

Verifying SIMM Operation

If the system fails to boot properly, or if the console terminal displays a checksum or memory error, check the following:

- Ensure that all SIMMs are installed correctly. Check the SIMMs by looking straight down on them and then observe them at eye level. The SIMMs should both be aligned at the same angle and should be at the same height. If a SIMM appears to stick out or rests in the socket at an angle different from the others, remove the SIMM and reinsert it. Reinstall the NRP module and reboot the system for another installation check.
- Ensure that the DRAM SIMMs are the same size and speed.

If the system fails to restart properly after several attempts, contact a service representative for assistance. Before you contact Cisco Systems, make note of any error messages, unusual LED states, or any other indications that might help identify the problem.

Replacing an NRP-2SV Dual Inline Memory Module

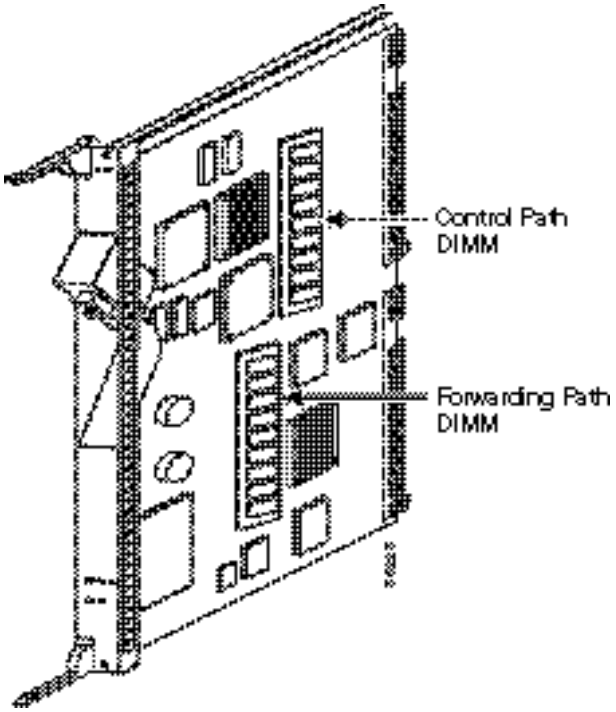
This section describes how to remove and replace an NRP-2SV dual inline memory module (DIMM). There are two DRAMs on the NRP-2SV module: The control path DIMM and the forwarding path DIMM.

General DIMM Information

DIMMs are sensitive components that are susceptible to ESD damage. Handle DIMMs by the edges only; avoid touching the memory modules, pins, or traces (the metal "fingers" along the connector edge of the DIMM).

Figure5-20 shows the location of the DIMMs on the NRP-2SV module.

Figure5-20 NRP-2SV Module DIMM



Each of these DIMMs is 512 MB. (Older models may have 256 MB. An upgrade kit is available from Cisco Systems, Inc.) The amount of DRAM required on the NRP-2 module is determined by the number of routed and bridged sessions the NRP-2 is configured to handle.

There is no Flash memory on the NRP-2SV module.

Note You must use DIMMs obtained from Cisco Systems.

Removing an NRP-2SV Module DIMM

To remove a DIMM:

Step 1 Attach an ESD-preventive wrist strap between you and an unpainted chassis surface.

Step 2 Disconnect the cables from the NRP-2SV.

Step 3 Loosen the captive installation screws on the NRP-2SV module and remove it from the chassis.

Step 4 Place the NRP-2SV on an antistatic mat or pad. Position the NRP-2SV module, so that the faceplate is away from you and the edge connector is toward you.

Step 5 Locate the DIMMs on the NRP-2SV module (Figure5-20).

Note Be sure to note the orientation of the DIMM in the socket. The card is notched so that it can be inserted only one way to align the notches on the DIMM with the socket. When you insert the new NRP-2SV, align the new DIMM the same as the old DIMM to avoid damaging the unit and to ensure proper operation.

Step 6 Pull the levers on the socket to the "outside" to release the DIMM, and then lift the DIMM from the socket.

Step 7 When both ends of the DIMM are released from the socket, use your thumb and forefinger to grasp the ends of the DIMM and pull the DIMM completely out of the socket. Handle the edges of the DIMM only; avoid touching the memory module, pins, or metal traces (fingers) along the socket edge.

Step 8 Place the DIMM in an antistatic bag to protect it from ESD damage.

Installing the NRP-2SV Module DIMM

To replace the DIMM:

Step 1 Keep the NRP-2SV in the same orientation as in the previous procedure (with the handle facing away and the edge connector toward you).

Step 2 Remove a new DIMM from the antistatic bag.

Caution Handle DIMMs by the card edges only. DIMMs are sensitive components that can be shorted by mishandling.

Step 3 Align the new DIMM to the same orientation the old DIMM was in when you removed it from the socket.

Step 4 Hold the sides of the DIMM between your thumb and middle finger, with your forefinger against the far edge, opposite the connector edge.

Step 5 Align the two notches on the DIMM with the socket and insert the connector edge into the socket.

Step 6 Gently push the DIMM into the socket until the notches on the DIMM align with the levers on the socket. The DIMM will "click" into place. The DIMM is "self-locking" when properly seated.

Caution When inserting DIMMs, use firm but not excessive pressure. If you damage a socket, you must return the NRP-2SV to the factory for repair.

Verifying DIMM Operation

If the system fails to boot properly, or if the console terminal displays a checksum or memory error, ensure that the DIMM is installed correctly. Check by looking straight down on the DIMM and then observe it at eye level. Reinstall the NRP-2SV module and reboot the system for another installation check.

If the system fails to restart properly after several attempts, contact a service representative for assistance. Before you contact Cisco Systems, make note of any error messages, unusual LED states, or any other indications that might help identify the problem.

Installing or Replacing a Half-Height Node Line Card

The Cisco6400 supports three half-height node line card (NLC) modules:

- OC-3/STM-1 SM NLC (see Figure5-21)
- OC-3/STM-1 MM NLC (see Figure5-22)
- DS3 45-Mbps bidirectional NLC (see Figure5-23)

To install a half-height NLC module in the Cisco 6400 chassis, you must do the following:

a. Install a full-height carrier module in the chassis.

b. Mount the NLC module on a full-height carrier module.

The carrier module can accommodate two half-height NLCs.

Because the NLCs support different media and interface types, configuration commands used with the cards can vary according to type. For complete NLC configuration information, refer to these documents:

- *Cisco 6400 Software Setup Guide*
- *Cisco 6400 Command Reference*
- *Release Notes for Cisco 6400 for Cisco IOS Release 12.x (Information for the latest release and for previous releases is available on Cisco.com.)*

Figure5-21 OC-3/STM-1 SM NLC Faceplate

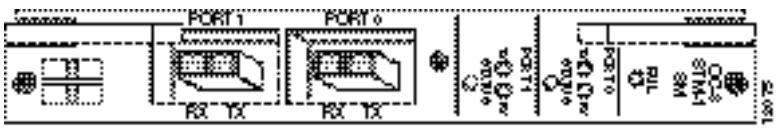
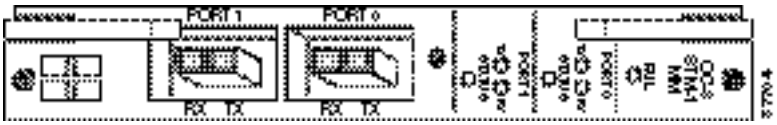


Figure5-22 OC-3/STM-1 MM NLC Faceplate



Warning **Class 1 laser product. Translations of this warning can be found in the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning **Because invisible radiation may be emitted from the aperture of the port when no fiber cable is connected, avoid exposure to radiation and do not stare into open apertures. Translations of this warning can be found in the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning **Invisible laser radiation present. Translations of this warning can be found in the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning Statement for Sweden

Varning! **Osynlig laserstrålning när denna del är öppen och förregleringen är urkopplad. Rikta inte blicken in mot strålen.**

Warning Statement for Finland

Varoitus **Alleviates ja suojalukitus ohitettaessa olet alttiina näkymättömälle lasersäteilylle. Äjä katso säteeseen.**

Figure5-23 DS3 NLC Faceplate

Installing a Full-Height NLC Carrier in the Chassis

The full-height carrier module is used to accommodate one or two half-height NLCs. To install a carrier into the Cisco 6400 chassis:

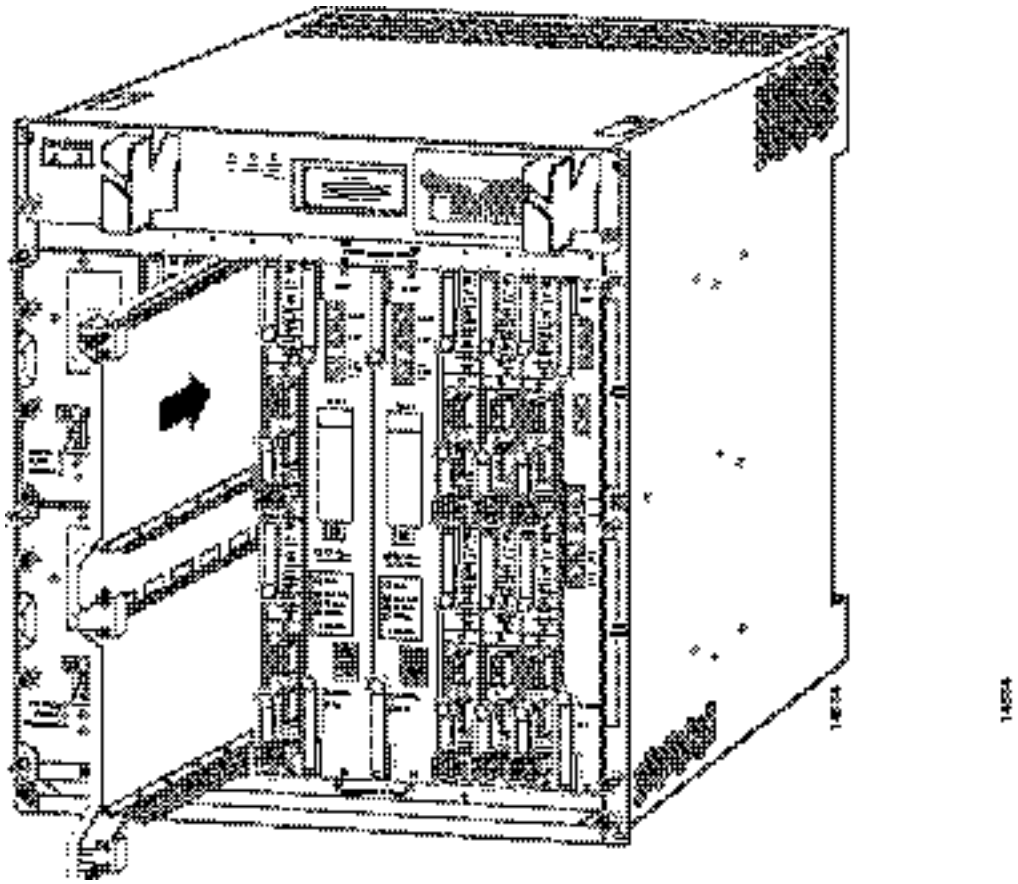
Step 1 Attach an ESD-preventive wrist strap.

Step 2 Remove the filler panel, if one is present.

Step 3 While holding the carrier module vertically, align the upper and lower edges with the slot and gently slide the carrier module into the slot until it makes contact with the backplane (Figure5-24).

Step 4 Tighten the upper and lower retaining screws to secure the carrier module.

Figure5-24 Installing a Full-Height Carrier Module for Half-Height NLCs



Installing a Half-Height Node Line Card

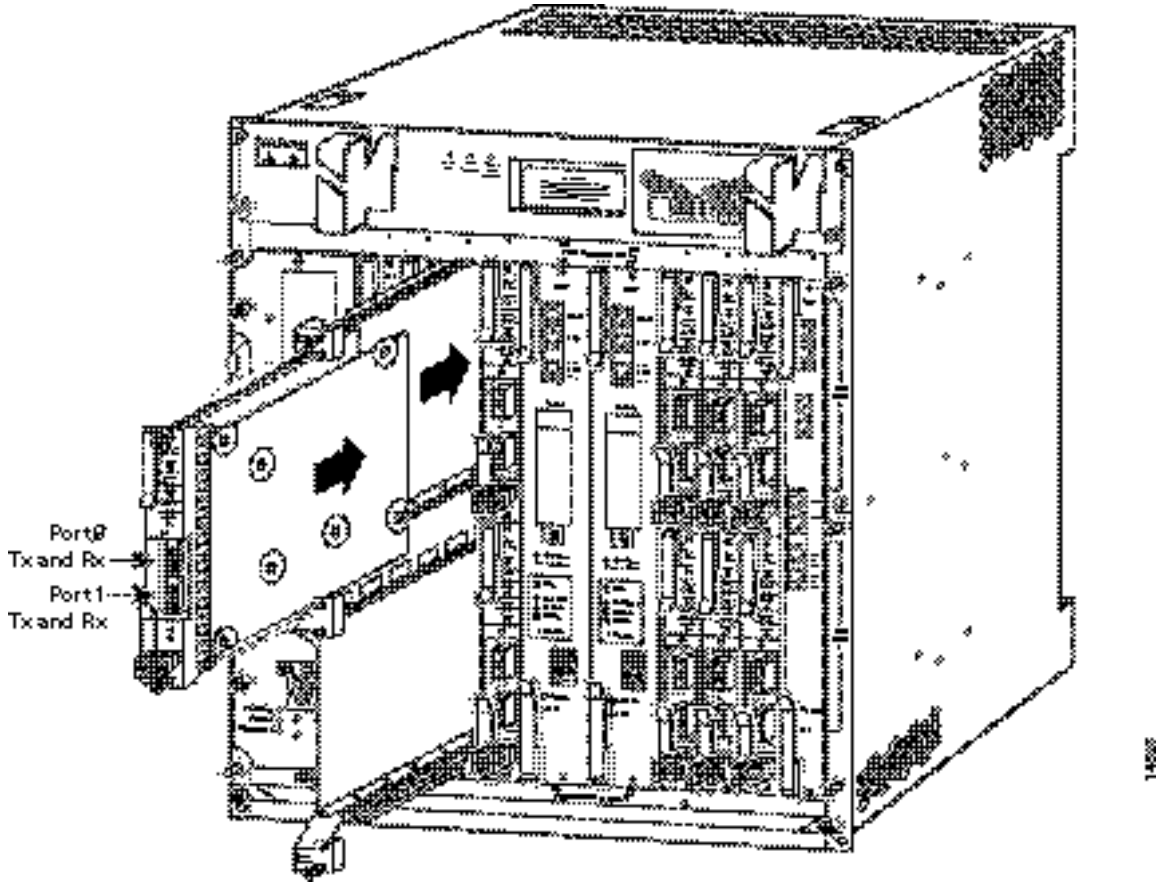
To install a half-height NLC in the Cisco 6400 chassis:

Step 1 Install a full-height NLC carrier in the Cisco 6400 chassis as described in the "Installing a Full-Height NLC Carrier in the Chassis" section on page5-30.

Step 2 Hold the NLC vertically, with the module faceplate toward you and backplane connectors away from you. Ensure that the card is right side up by noting the lettering of the faceplate.

Step 3 Carefully align the upper and lower edges of the NLC with the upper and lower guides in the full-height carrier (Figure5-25).

Figure5-25 Installing a Half-Height NLC



Caution To ensure that the card mates properly with all backplane connector pins, the card length and card slots have been designed with very close tolerances. To slide the card into the slot requires gentle pressure with each hand, at the top and bottom of the faceplate.

Step 4 Gently slide the NLC into the carrier module until it makes contact with the backplane.

Step 5 Press the upper lever down and the lower lever up at the same time. (This action electrically connects the card to the backplane.)

Step 6 Secure the carrier module by tightening the upper and lower retaining screws.

Step 7 Install blank filler panels to cover any unused slots. Like cards, each filler panel is held in place by two retaining screws.

Connecting Cables to the Half-Height NLC

After you install the half-height NLC, you must connect the cables as described in this section.

OC-3/STM-1 Node Line Card

Cable connections are the same for the OC-3/STM-1 SM NLC and OC-3/STM-1 MM NLC. However:

- The OC-3/STM-1 SM NLC has two ports for *single-mode intermediate reach* fiber connection on the front of each NLC.
- The OC-3/STM-1 MM NLC has two ports for *multimode* fiber connection on the front of each NLC.

Each port provides an interface to the ATM switching fabric for transmitting and receiving data at rates up to 155 Mbps bidirectionally. Install the fiber-optic cables as shown in Figure5-26.

Figure5-26 Connecting Cables to an OC-3/STM-1 NLC

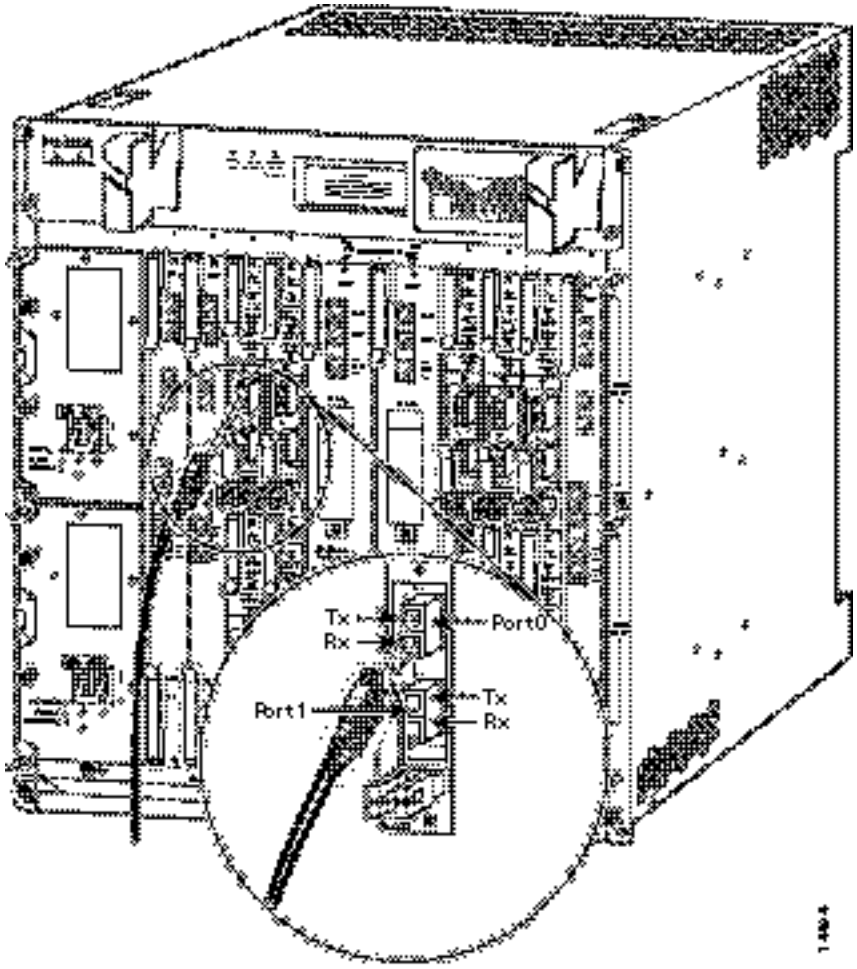
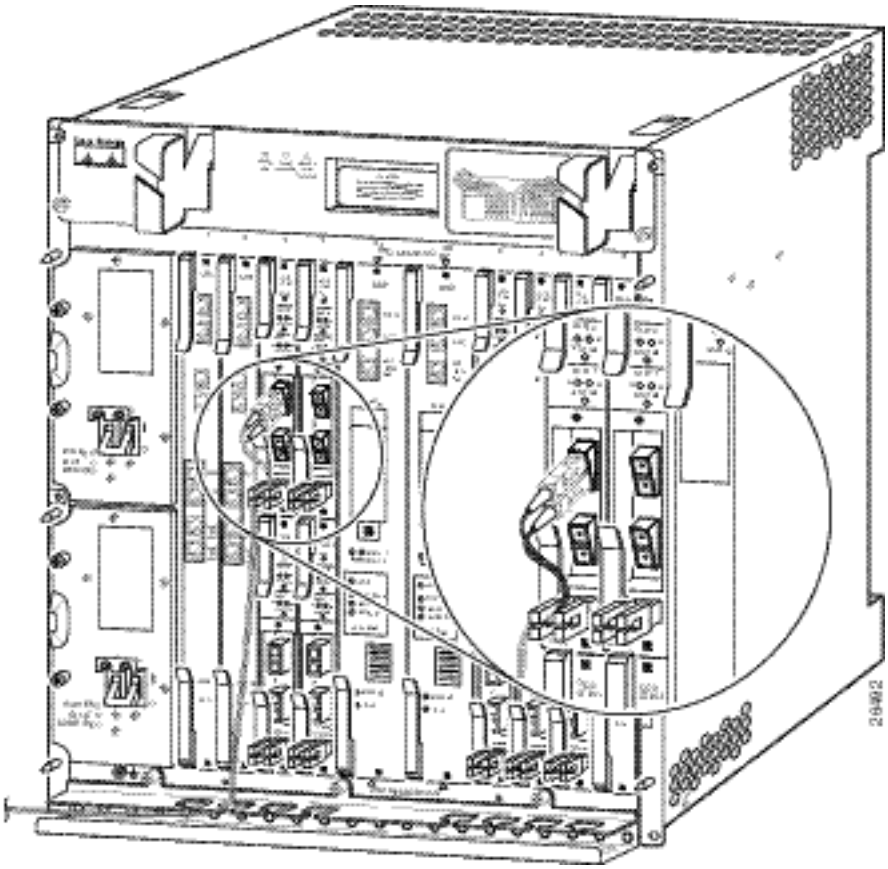


Figure5-27 shows suggested cable management for the OC-3/STM-1 SM (single mode) and OC-3/STM-1 MM (multimode) fiber-optic cable.

Figure5-27 OC-3 Fiber-Optic Cable Management

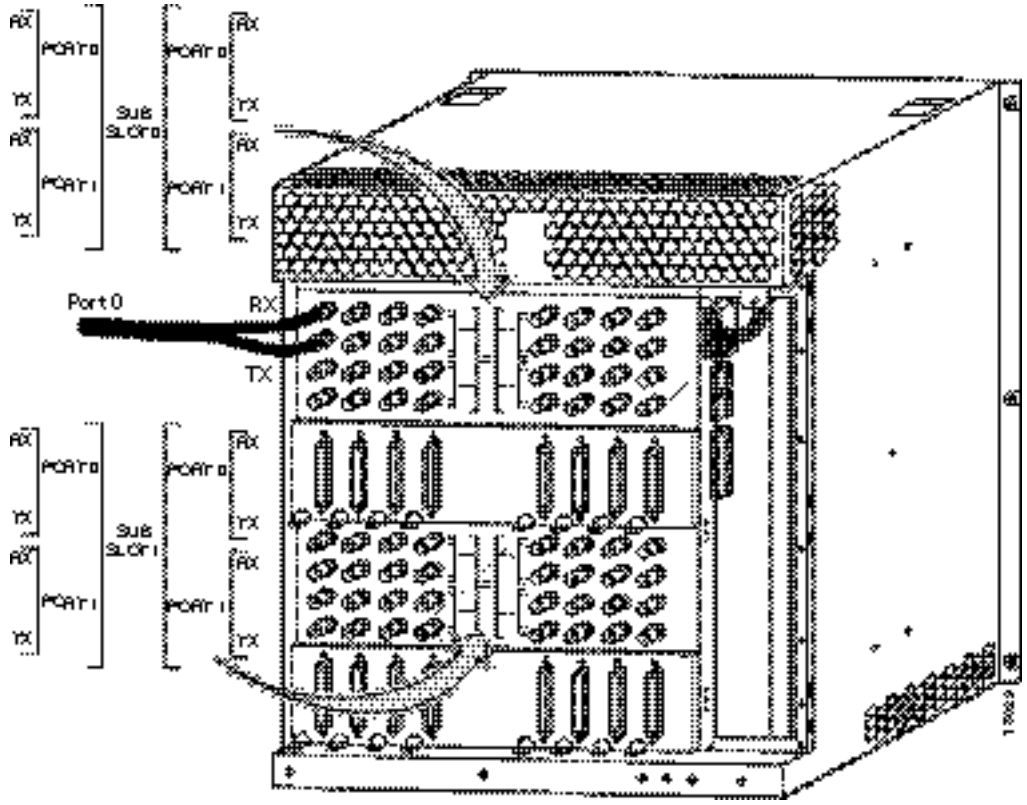


DS3 Node Line Card

The cable connections for the DS3 NLC are different from those for the OC-3 NLCs. The DS3 NLC has two ports that connect to the ATM switching fabric using 75-ohm single or bundled coaxial cables with bayonet-style twist-lock (BNC) connectors attached to the back of the chassis for each DS3 port (Figure5-28).

Warning **The DS3 ports are not intended to be connected to cables that run outside the building where it is installed. For any connections outside the building, the DS3 ports must be connected to a network termination unit (NTU). NTU devices should comply with appropriate national safety standards such as UL 1950, CSA950, EN 60950, IEC 950, and AS 3260. Translations of this warning can be found in the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Figure5-28 Connecting Cables to a DS3 Node Line Card



Removing a Half-Height NLC

To remove a half-height NLC from the Cisco 6400 chassis:

Step 1 Attach an ESD-preventive strap between you and the chassis surface.

Step 2 Remove any connections to the modules. Be sure to cover any fiber-optic connections to prevent contamination from moisture or dirt.

Step 3 Loosen the two (top and bottom) cross-slotted screws securing the NLC metal carrier to the full-height carrier.

Step 4 Grasp the two lever handles on the NLC, and gently pull the handles away from the carrier unit to loosen the unit.

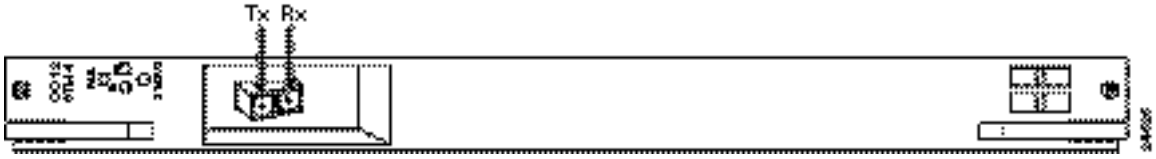
Step 5 Carefully slide the NLC out of the full-height carrier. Avoid damaging the connectors on the rear of the plug-in unit.

Step 6 Place the NLC on an antistatic surface.

Installing or Replacing a Full-Height Node Line Card

The Cisco6400 supports one full-height NLC module: OC-12/STM-4 NLC (Figure5-29). The full-height NLC is premounted on its carrier.

Figure5-29 OC-12 NLC Faceplate



Warning **Class 1 laser product. Translations of this warning can be found in the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning **Because invisible radiation may be emitted from the aperture of the port when no fiber cable is connected, avoid exposure to radiation and do not stare into open apertures. Translations of this warning can be found in the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning **Invisible laser radiation present. Translations of this warning can be found in the *Regulatory Compliance and Safety Information* document that accompanied this device.Class 1 laser product. Translations of this warning can be found in the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning **Because invisible radiation may be emitted from the aperture of the port when no fiber cable is connected, avoid exposure to radiation and do not stare into open apertures. Translations of this warning can be found in the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning **Invisible laser radiation present. Translations of this warning can be found in the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning Statement for Sweden

Varning! **Osynlig laserstrålning när denna del är öppen och förregleringen är urkopplad. Rikta inte blicken in mot strålen.**

Warning Statement for Finland

Varoitus **Alleviates ja suojalukitus ohitettaessa olet alttiina näkymättömälle lasersäteilylle. Äjä katso säteeseen.**

Installing a Full-Height NLC

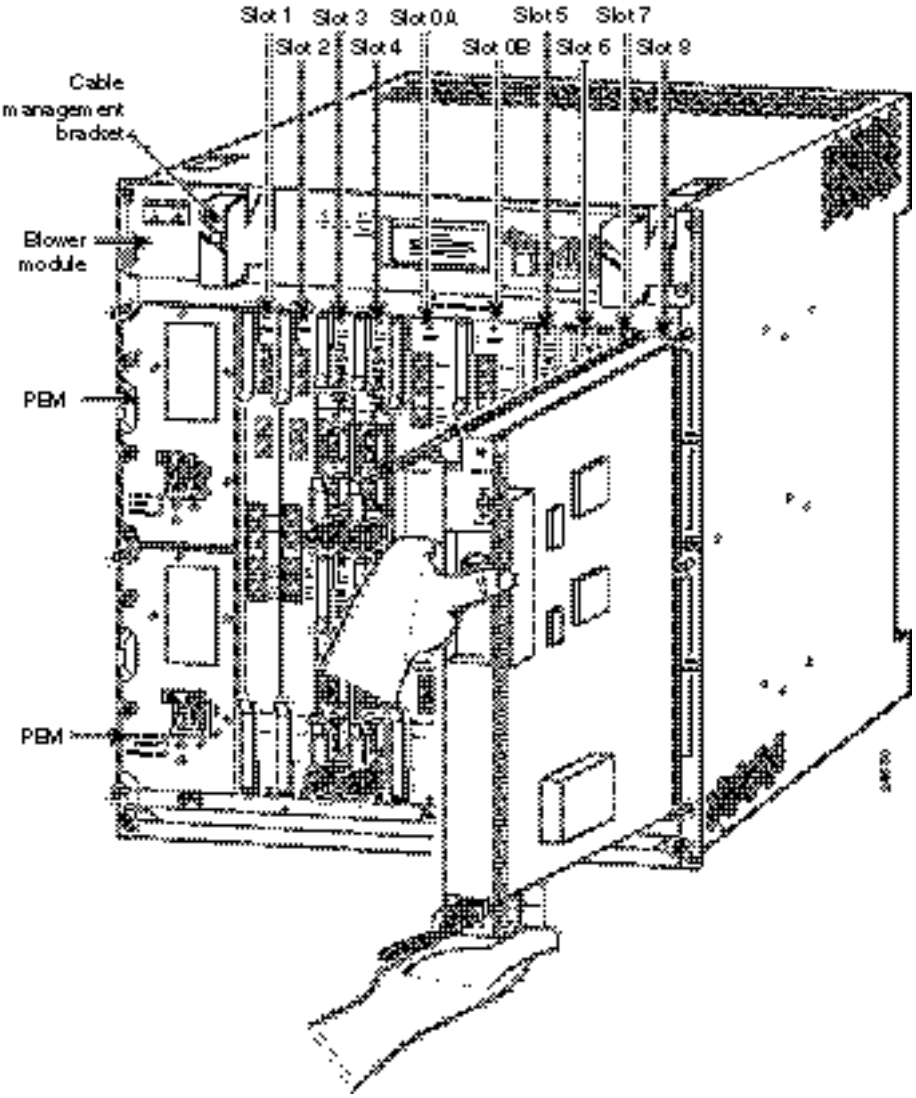
To install a full-height NLC in the Cisco 6400 chassis:

Step 1 Remove the blank filler panel from the selected slot, if a blank panel is present.

Step 2 Hold the NLC module vertically, with the NLC faceplate toward you and the backplane connectors away from you. Ensure that the module is right side up by noting the lettering on the faceplate.

Step 3 Carefully align the upper and lower edges of the NLC carrier with the upper and lower guides in the chassis. Figure5-30 shows how to insert a module in the chassis.

Figure5-30 Installing a Full-Height NLC



Caution To ensure that the NLC module mates properly with all backplane connector pins, the module length and module slots have been designed with very close tolerances. To slide the module into the slot requires gentle pressure with each hand, at the top and bottom of the faceplate.

Step 4 Gently slide the NLC module into the slot until it makes contact with the backplane.

Step 5 Press the upper lever down and the lower lever up at the same time.

Step 6 Secure the carrier by tightening the upper and lower retaining screws.

Step 7 Connect the cables.

Step 8 Install blank filler panels to cover any unused slots. Use two retaining screws to secure each filler panel.

Connecting Cables to the Full-Height NLC

The OC-12/STM-4 NLC has one port for single-mode intermediate reach fiber connection on the front of each NLC. This port provides an interface to the ATM switching fabric for transmitting and receiving data at rates up to 622 Mbps bidirectionally. Install the fiber-optic cables (Figure5-31).

Figure5-31 Connecting Cables to an OC-12 Node Line Card

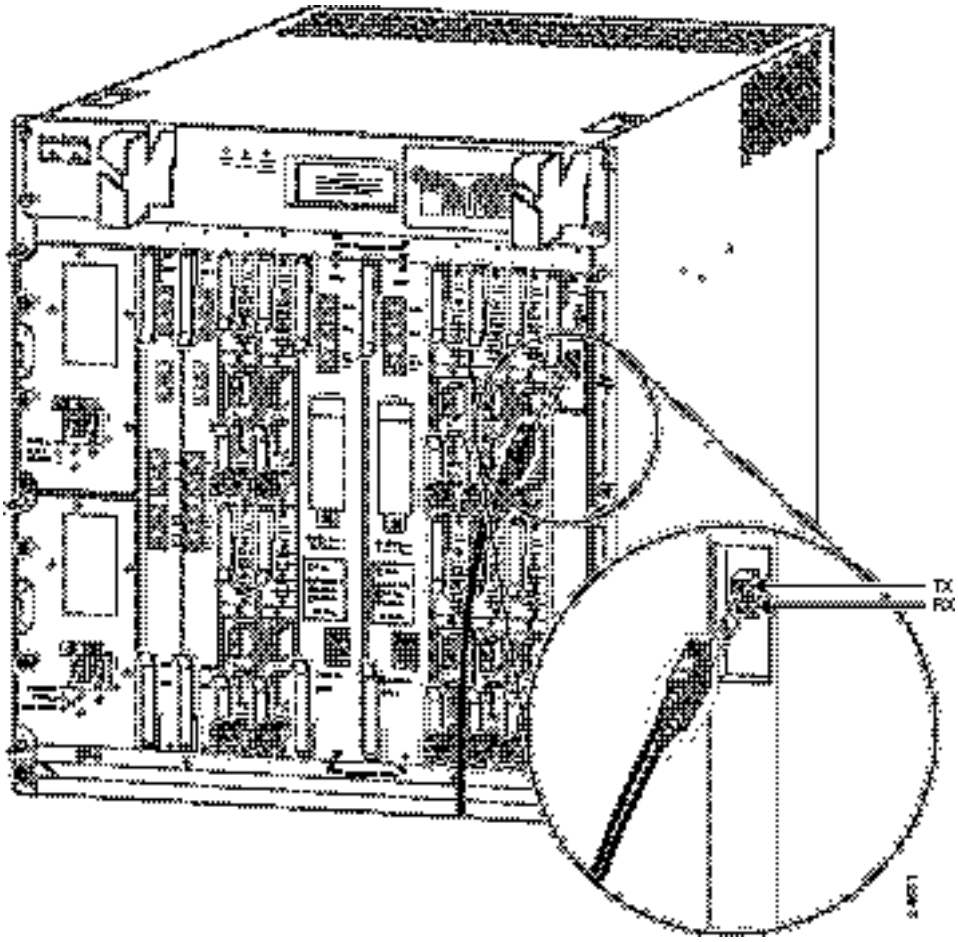
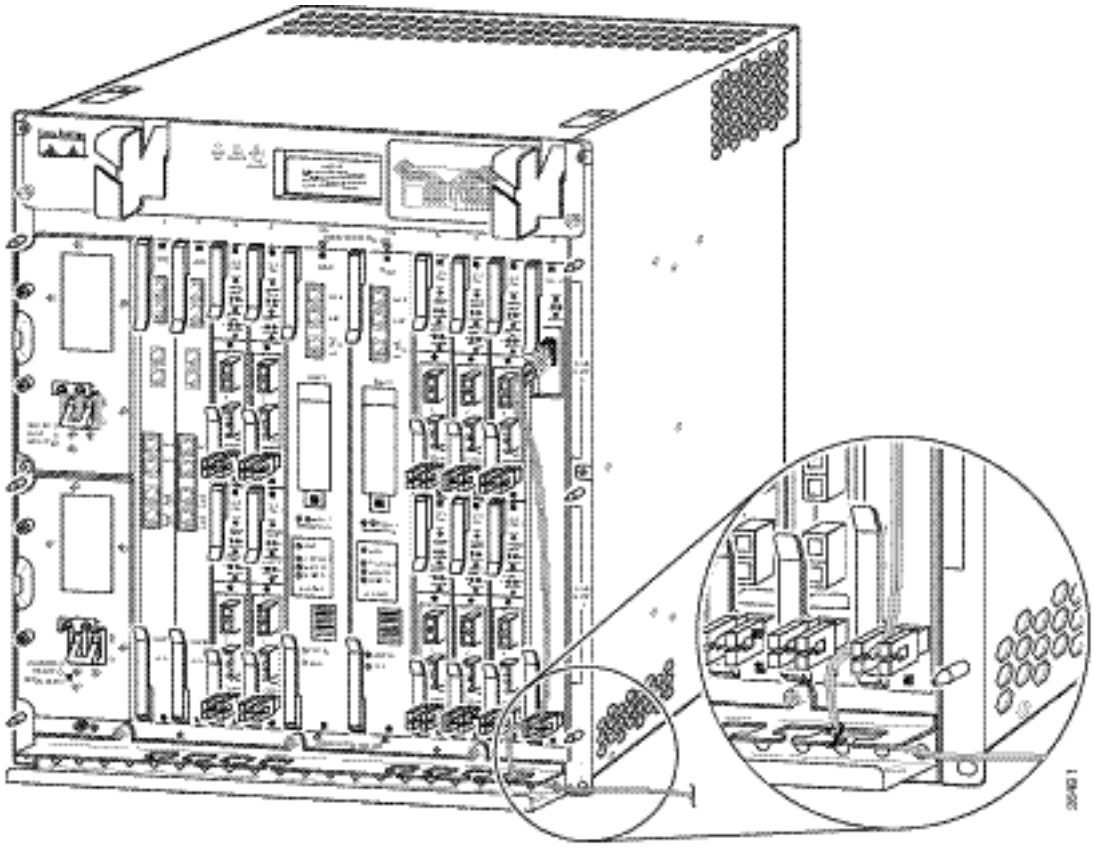


Figure5-32 shows suggested cable management for the OC-12/STM-4 fiber-optic cable.

Figure5-32 OC-12 Fiber-Optic Cable Management



Removing a Full-Height Node Line Card

To remove a full-height NLC from the Cisco 6400 chassis:

Step 1 Attach an ESD-preventive strap between you and the chassis surface.

Step 2 Disconnect any cables connected to the NLC module that you are about to remove.

Step 3 Unfasten the upper and lower retaining screws.

Step 4 Grasp the upper and lower extraction levers. Pull up on the upper lever while pushing down on the lower lever. This action disengages the NLC carrier from the connectors on the backplane.

Step 5 Slide the module out of the slot.

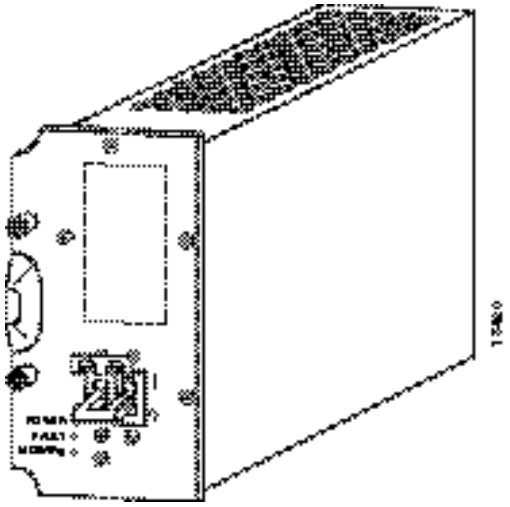
Step 6 Place the NLC module on an antistatic surface. If the module will be out of the chassis for several minutes or longer, put it in a static-shielding bag or in a box lined with antistatic material.

Step 7 Insert another NLC module or a blank faceplate in the empty slot.

Replacing a DC Power Entry Module

This section describes procedures for removing and installing a DC power entry module (PEM) plug-in unit in the Cisco 6400 chassis (Figure5-33).

Figure5-33 DC Power Entry Module



There are two PEM power bays in the system for redundancy. The PEM power bays are located at the front left side of the chassis:

- The top bay is wired to power circuit A
- The bottom bay is wired to power circuit B

Note The circuits are identified at the power terminals on the backplane.

The PEMs meet critical safety, isolation, and EMC requirements associated with the connection of the CO DC-input power distribution system.

Warning **Before working on equipment that is connected to power lines, remove jewelry (including rings, necklaces, and watches). Metal objects will heat up when connected to power and ground and can cause serious burns or weld the metal object to the terminals. Translations of this warning can be found in the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Removing a DC Power Entry Module

If you remove a redundant DC PEM, the chassis continues to operate normally. If you plan to remove the only operating PEM from a chassis, you must first power down the Cisco 6400 system. Refer to the procedure in the "Powering Down the System" section on page5-8.

To remove a PEM from the Cisco 6400 chassis:

Step 1 Ensure that the circuit breaker on the DC PEM you are removing is turned Off.

Step 2 Unscrew the retaining screws on the DC PEM faceplate.

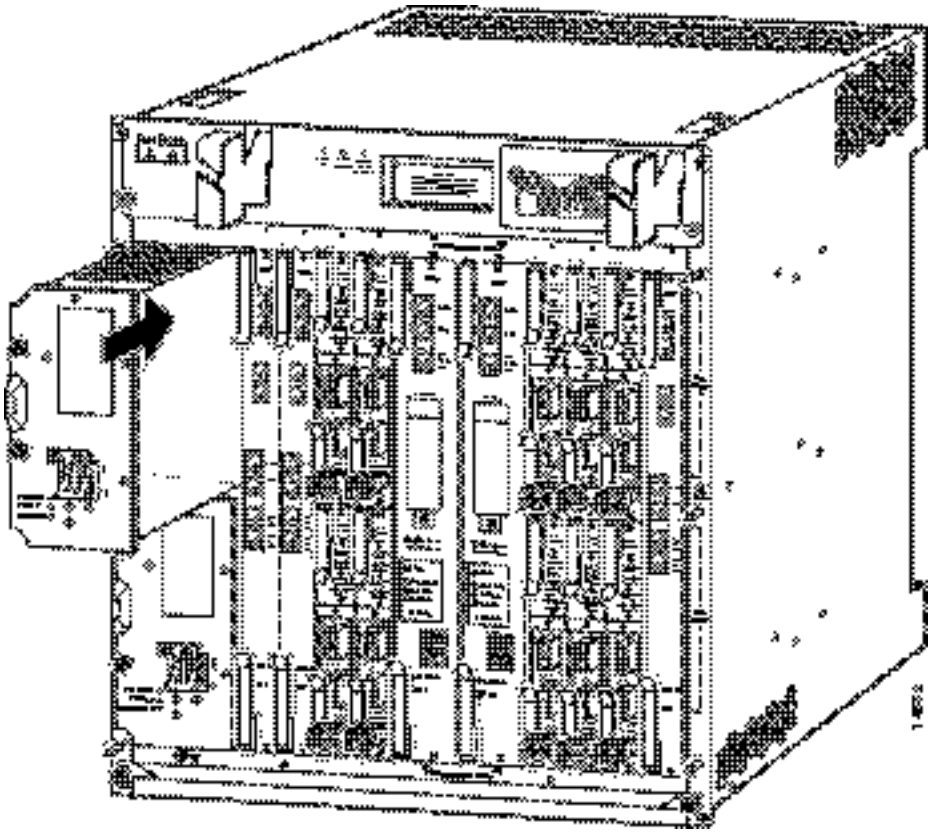
Step 3 Grasp the DC PEM by the handle on the faceplate and pull it out of the chassis.

Caution Always install a filler panel over an empty PEM power bay to protect the connectors from contamination and to ensure proper air flow.

Installing a DC Power Entry Module

Figure5-34 shows a DC PEM unit being installed in the Cisco 6400 chassis. You can insert a PEM unit into the Cisco 6400 without powering down the system.

Figure5-34 Installing a DC Power Entry Module



To install a DC PEM in the Cisco 6400 chassis:

Step 1 Ensure that the circuit breaker on the DC PEM is turned to Off.

Step 2 Align the PEM and insert it into the power bay.

Step 3 Firmly push the PEM all the way into the power bay to ensure that the power connectors mate.

Step 4 Tighten the captive screws on the faceplate of the PEM to secure the PEM to the chassis.

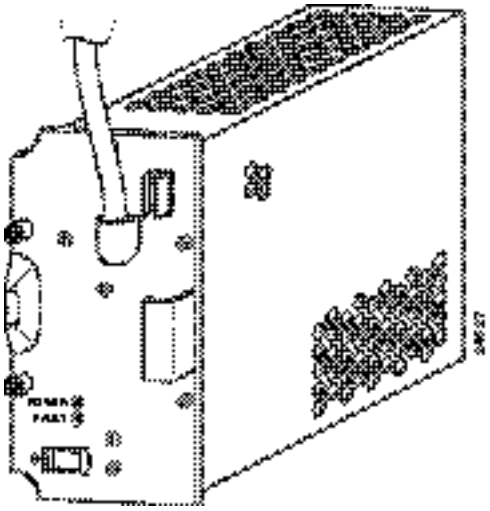
Step 5 If the chassis is connected to power, turn the circuit breaker on the DC PEM to On. The green POWER LED on the faceplate turns on to indicate that the DC PEM is providing power to the chassis. The yellow FAULT LED goes out.

Note If the miswire LED is on, reverse the connections on the DC PEM.

Replacing an AC Power Entry Module

This section describes procedures for removing and installing an AC power entry module (PEM) plug-in unit in the Cisco 6400 chassis (Figure5-35).

Figure5-35 AC Power Entry Module



There are two PEM power bays in the system for redundancy. The PEM power bays are located at the front left side of the chassis:

- The top bay is wired to power circuit A
- The bottom bay is wired to power circuit B

Note The circuits are identified at the power terminals on the backplane.

Warning **Before working on equipment that is connected to power lines, remove jewelry (including rings, necklaces, and watches). Metal objects will heat up when connected to power and ground and can cause serious burns or weld the metal object to the terminals.Translations of this warning can be found in the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Removing an AC Power Entry Module

If you remove a redundant AC PEM, the chassis continues to operate normally. If you plan to remove the only operating PEM from a chassis, you must first power down the Cisco 6400 system. Refer to the procedure in the "Powering Down the System" section on page5-8.

To remove a PEM from the Cisco 6400 chassis:

Step 1 Turn OFF the power enable switch on the AC PEM you are removing.

Step 2 Unplug the AC power cable.

Step 3 Unscrew the retaining screws on the AC PEM faceplate.

Step 4 Grasp the AC PEM by the handle on the faceplate and pull it out of the chassis.

Caution Always install a filler panel over an empty PEM power bay to protect the connectors from contamination and to ensure proper air flow.

Installing an AC PEM

Figure5-36 shows an AC PEM unit being installed in the Cisco 6400 chassis. You can insert a PEM unit into the Cisco 6400 without powering down the system.

To install an AC PEM in the Cisco 6400 chassis:

Step 1 Ensure that the power enable switch on the AC PEM is turned to Off.

Step 2 Align the PEM and insert it into the power bay.

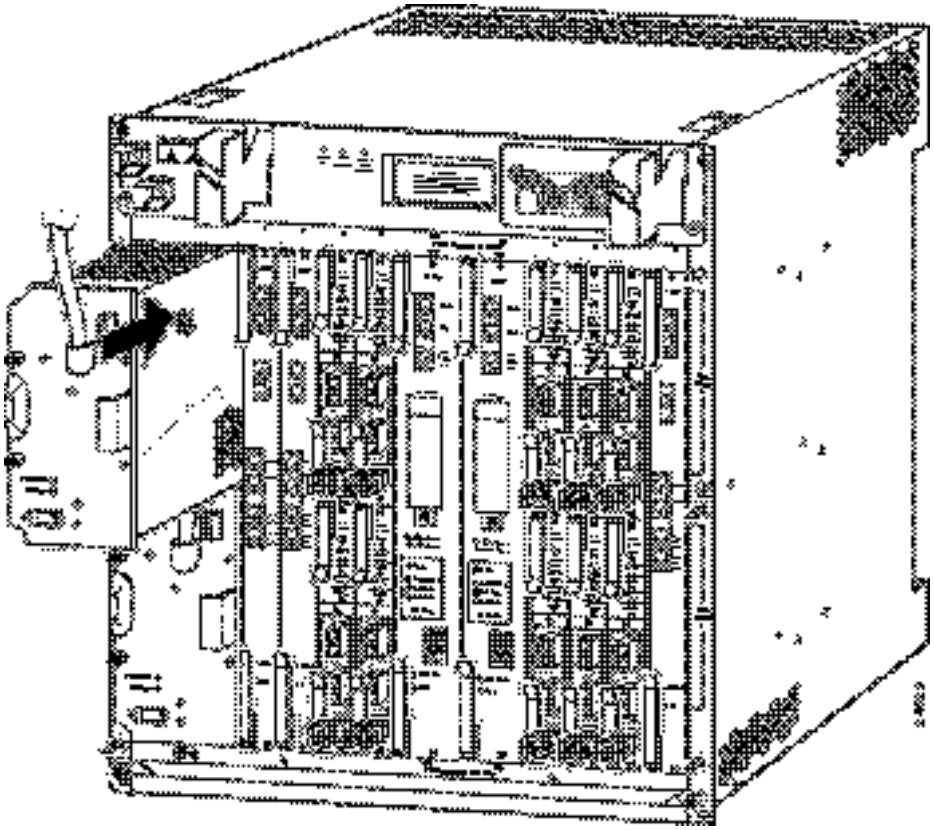
Step 3 Firmly push the PEM all the way into the power bay to ensure that the power connectors mate.

Step 4 Tighten the captive screws on the faceplate of the PEM to secure the PEM to the chassis.

Step 5 Plug in the AC power cable.

Step 6 Turn the power enable switch on the AC PEM to On. The green POWER LED on the faceplate turns on to indicate that the AC PEM is providing power to the chassis. The yellow FAULT LED goes out.

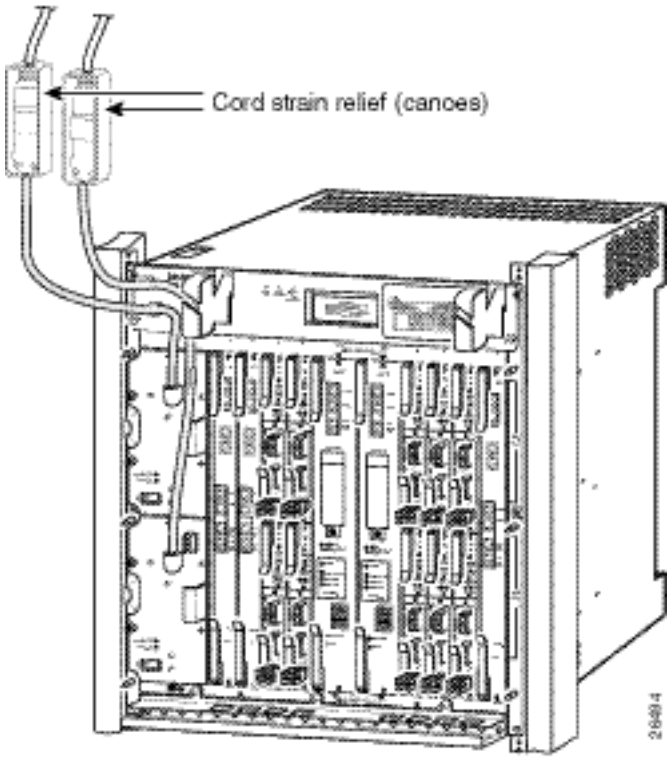
Figure5-36 Installing an AC Power Entry Module



Note When a single PEM is used, it should be installed in the top slot.

Figure5-37 shows suggested power cord connections for the AC PEM.

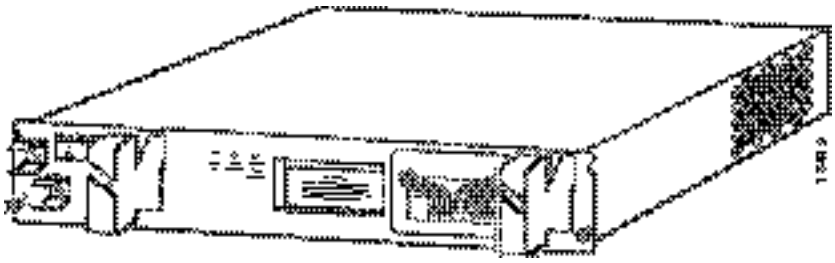
Figure5-37 AC PEM Power Cord Connections



Replacing the Blower Module

This section describes procedures for removing and installing the blower module in the Cisco 6400 chassis. The blower module is located in the top part of the chassis, above the plug-in modules and cards. Figure5-38 shows the blower module.

Figure5-38 Blower Module



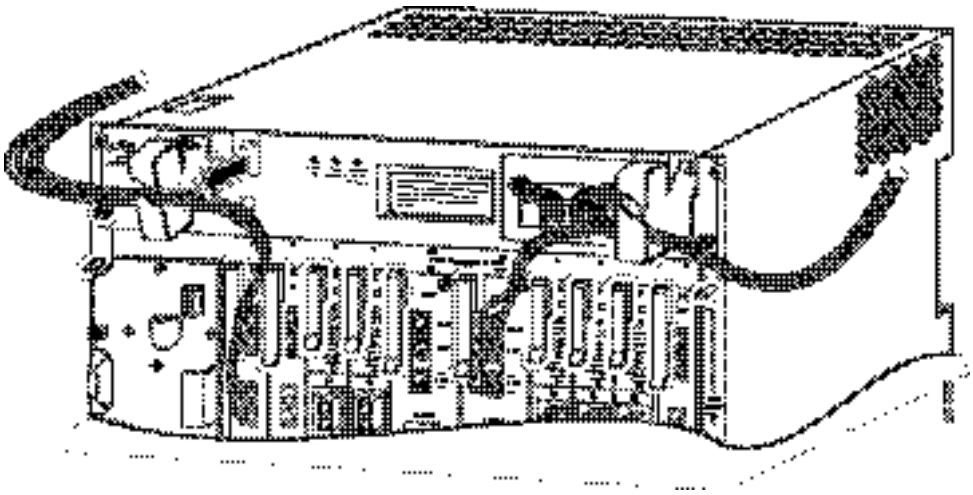
Removing the Blower Module

To remove the blower module from the Cisco 6400 chassis:

Step 1 If you are using AC PEMs, remove the AC power cords from the clips on the blower module.

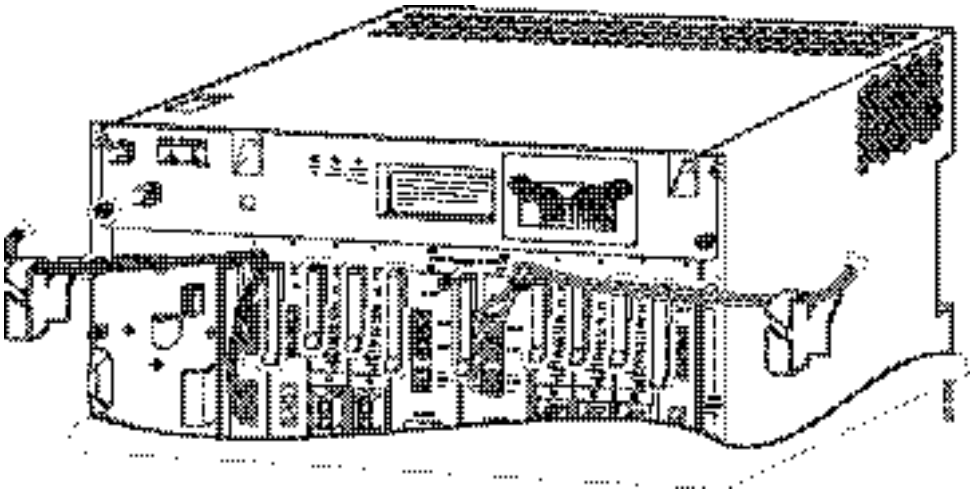
Step 2 Detach the cable management brackets (Figure5-39).

Figure5-39 Detaching a Cable Management Bracket



Step 3 Fold the loaded brackets to either side of the Cisco 6400 chassis, leaving the cables attached. The 20-inch service loop will allow you to pull the cables out of the way of the blower (Figure5-40).

Figure5-40 Folding Cables and Brackets away from the Blower



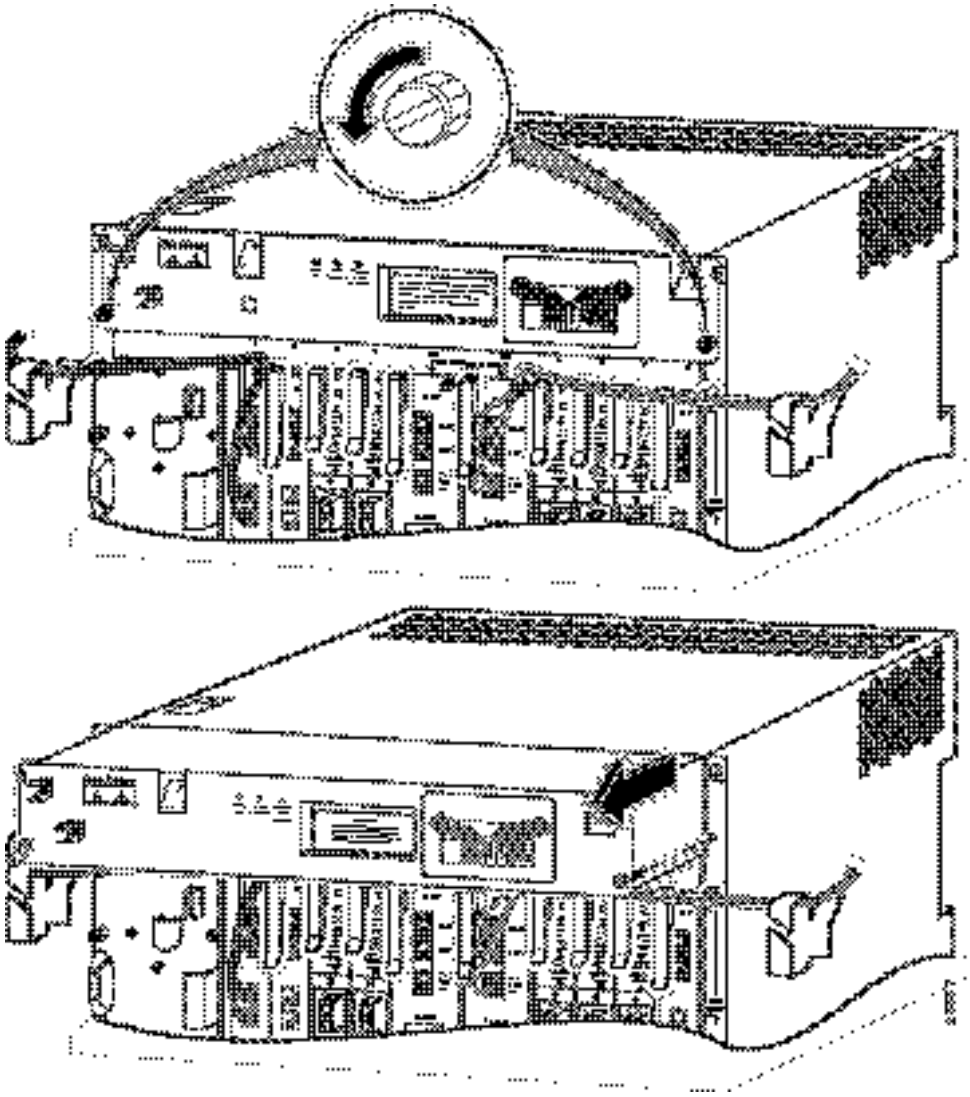
Step 4 Remove the two screws on the front of the blower module (Figure5-41).

Step 5 Carefully slide the blower out of the chassis.

Step 6 Place the blower module on a flat work surface.

Caution If the blower module is removed for longer than two minutes, the Cisco 6400 system automatically shuts down.

Figure5-41 Removing the Blower Module

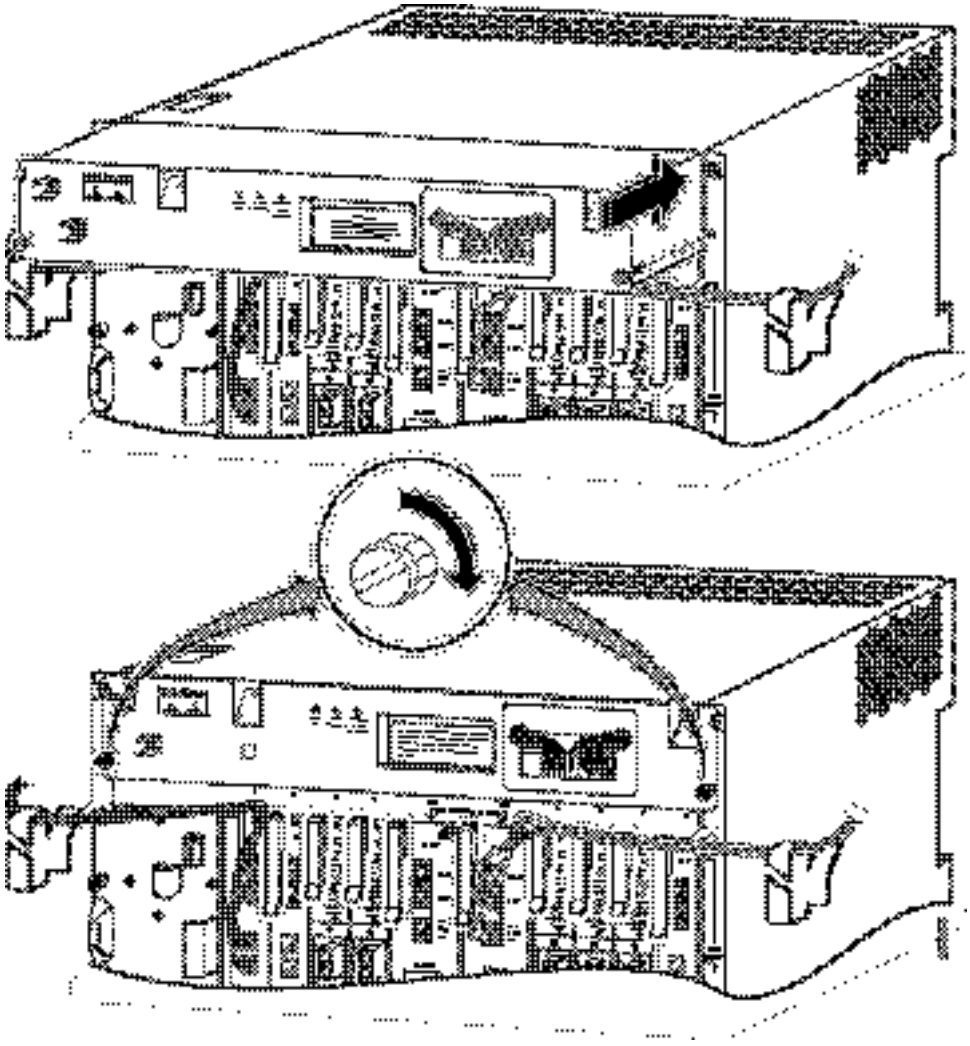


Installing the Blower Module

To replace the blower module:

Step 1 Slide the new blower module in until the rear connector engages (Figure5-42).

Figure5-42 Installing the Blower Module

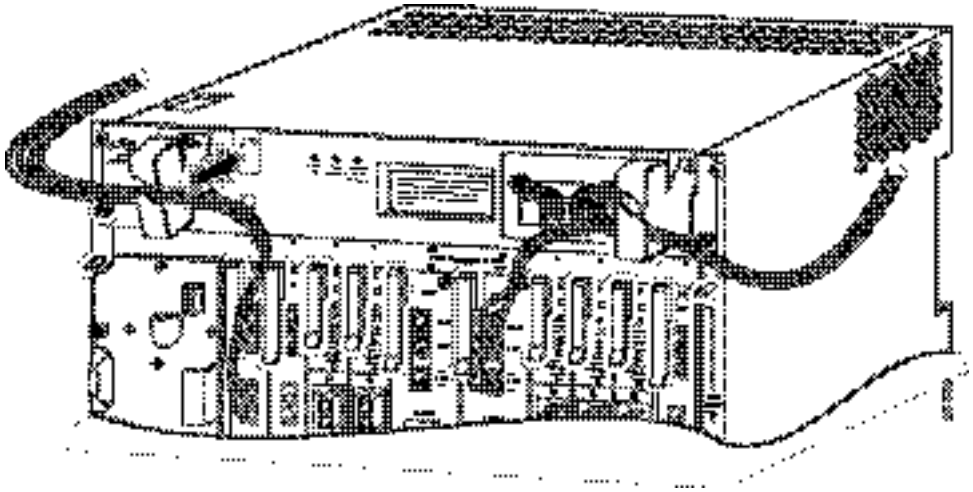


Step 2 Tighten the screws that secure the blower module to the chassis.

Step 3 Reattach the loaded cable brackets, reestablishing the service loops (Figure5-43).

Step 4 Check the front panel of the blower module to make sure the FANS OK LED is On and both FAN FAILURE LEDs are Off.

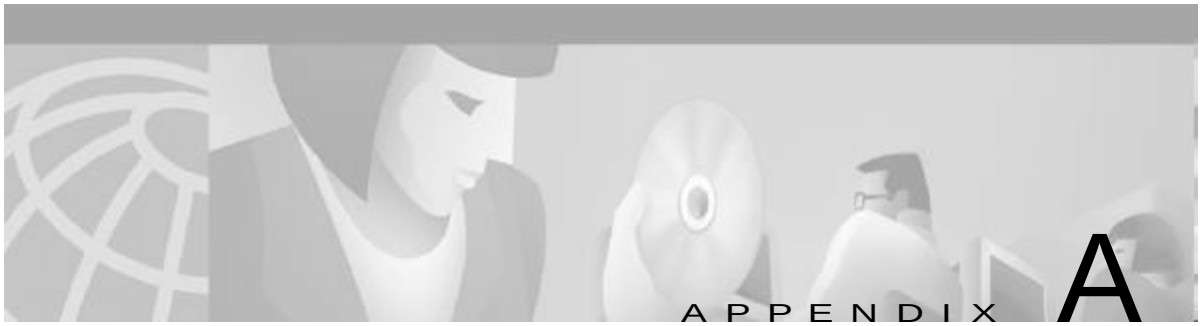
Figure5-43 Reattaching the Cable Management Brackets



Verifying Plug-In Module and Component Installation

After you perform a replacement procedure, verify that any new plug-in module or component is installed correctly. To verify the installation, check the status of the interfaces:

- If this item is a replacement card, use the **show configuration** or **show atm interface** [*slot_num*/*mod_num*/*port_num*] command to verify that the system acknowledges the new interfaces and that they are online.
- Refer to *Cisco 6400 Software Setup Guide* and *Cisco 6400 Command Reference* for all software instructions and information.



System Specifications

Table A-1 lists specifications for the Cisco 6400 carrier-class broadband aggregator.

TableA-1 Cisco 6400 Specifications

Description	Specifications
Switch capacity	5 Gbps[1] shared memory, nonblocking switch fabric 65,536 cells of ATM cell buffers
Software images	Default image PNNI and plug-and-play capacity
Dimensions (H x W x D)	21.75 in. x 17.5 in. x 12.0 in. (55.2 cm x 44.4 cm x 30.4 cm) standard 19-in. rack mount Chassis depth with optional cable cover is 13.75 in. (34.9 cm) NSP: 16.0 in. x 2.0 in. x 10.0 in. (40.6 cm x 5.0 cm x 25.4 cm) NRP: 16.0 in x 1.2 in x 10.0 in (40.6 cm x 3.0 cm x 25.4 cm) OC-3/STM-1 (SM and MM) NLC : 7.0 in. x 1.2 in. x 10.0 in. (17.7 cm x 3.0cm x 25.4 cm) DS3 NLC: 7.0 in. x 1.2 in. x 10.0 in. (17.7 cm x 3.0 cm x 25.4 cm) OC-12/STM-4 NLC: 16.0 in. x 1.2 in. x 10.0 in. (40.6 cm x 3.0 cm x 25.4 cm)
Weight	Chassis minimum configuration (1 NSP, 1 PEM): 80 lb (37 kg) Chassis fully configured (2 NSPs, 6 NRPs, 4 OC-3/STM-1 or 4 DS3 or 2 OC-12/STM-4 NLCs, and 2 PEMs): 130 lb (59 kg)
Input power requirement	1200W maximum (PEM-PWR-DC) (DC version) 1400W maximum (PEM-PWR-AC) (AC version)
Power dissipation	1200W maximum, 900W typical with maximum configuration
Heat dissipation	1200W (3768 Btu[2]/hr) (DC version) 1400W (4760 Btu/hr) (AC version)
DC input voltage range	– 40.5 to – 72 VDC (rated – 48/– 60 VDC)
DC current rating (input)	Maximum power budget: 20A @ – 48 VDC
AC input voltage range	90 to 255 VAC (rated 100 to 240 VAC using AC PEM)
AC current rating (input)	15A @ 100 VAC, 7A @ 240 VAC, using AC PEM

TableA-1 Cisco 6400 Specifications (continued)

Description	Specifications
Airflow	140 cfm[3] through the system blower module 200 cfm through the system blower module when the exhaust temperature exceeds 40°C
Operating temperature range	25 to 104°F (–4 to 40°C) Short-term operating temperature is limited to 131°F (55°C) in compliance with Bellcore GR-63
Nonoperating temperature range	– 40 to 167°F (– 40 to 75°C)
Humidity	5 to 95%, noncondensing
Altitude	– 200 to 10,000 ft (– 61 to 3048 m)
Interface timing	Loop timing, network timing derived from any NLC interface, Stratum 4 accuracy when internally timed. NSP-S3B also allows network timing from CO BITS, Stratum 3 accuracy when internally timed.
Node switch processor (NSP)	64 MB DRAM, 8 MB Flash memory, 32 MB FlashDisk card (MEM-NSP-FD32M) Upgradeable to 128 MB DRAM (MEM-NSP-128M) Upgradeable with 350 MB Flash disk (MEM-NSP-FD350)
Node route processor 1 (NRP-1)	64 MB DRAM, 8 MB Flash memory (C6400-NRP-1) Upgradeable to 128 MB DRAM (MEM-NRP-128M) Upgradeable to 16 MB Flash memory (MEM-NRP-FS16M)
Node route processor 2 (NRP-2SV)	512 MB DRAM (C6400-NRP-2SV)
Full-height node line card (NLC) carrier module	Carrier module for two half-height NLCs with covers for empty slots installed (C6400-CARRIER)
OC-3/STM-1 SM NLC	NLC with two SONET STS-3c/SDH STM-1 single-mode intermediate reach fiber ports, SC connectors (NLC-2OC3-SM)
Fiber-optic power levels:	
OC-3 single-mode intermediate reach	
Output center wavelength	1261 to 1360 nm[4]
Transmit	Minimum: – 14.0 dBm Maximum: – 8.0 dBm
Receive	Minimum: – 32.5 dBm Maximum: – 8.0 dBm
OC-3/STM-1 MM NLC	NLC with two SONET STS-3c/SDH STM-1 multimode fiber ports, SC connectors (NLC-2OC3-MM)
OC-3 multimode	
Output center wavelength	1270 to 1380 nm
Transmit	Minimum: – 20.0 dBm Maximum: – 14.0 dBm

TableA-1 Cisco 6400 Specifications (continued)

Description	Specifications
Receive	Minimum: – 30.0 dBm Maximum: – 14.0 dBm
DS3 NLC	NLC with two coaxial cable connections with BNC connectors (NLC-2DS3-BNC) Maximum station-to-station cabling distance is 450 ft (137 m)
OC-12/STM-4 NLC	NLC with one SONET STS-12c/SDH STM-4 single-mode intermediate reach fiber ports, SC connector (NLC-1OC12-SM)
Fiber-optic power levels:	
OC-12 single-mode intermediate reach	
Output center wavelength	1261 to 1360 nm
Transmit	Minimum: – 15.0 dBm Maximum: - 8.0 dBm
Receive	Minimum: – 28.0 dBm Maximum: – 8.0 dBm

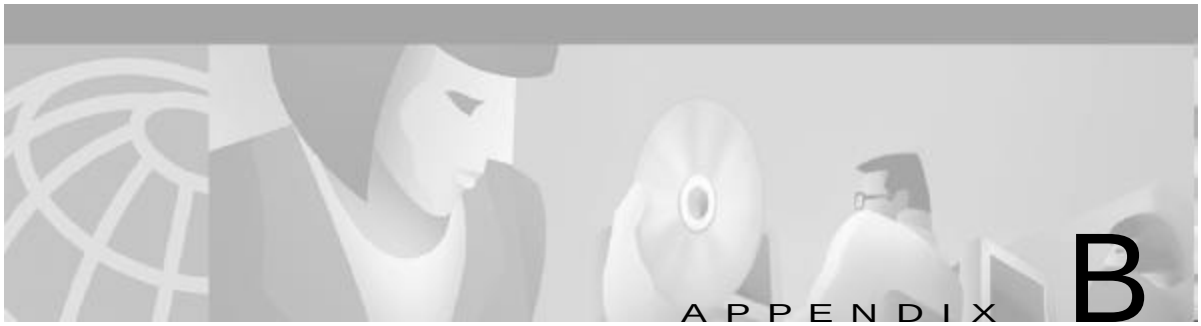
Gigabit Ethernet Interface Options	1000BASE-SX GBIC, multimode, standardized for Cisco 6400 (WS-G5484) 1000BASE-LH GBIC, single mode, stardardized for Cisco 6400 (WS-G5486)
NSP interface ports	RJ-45 IEEE 802.3 Ethernet 10BASE-T RJ-45 auxiliary (AUX) port for modem access RJ-45 console (CON) port for terminal access
ATM connections	32,000 point-to-point, 2048 point-to-multipoint (maximum)
Network management	Port TX and RX LEDs, switch and common equipment status LEDs Port snooping and connection steering Multiple standard and enterprise MIBs Text-based command-line interface based on familiar router interface Standard Cisco IOS security capabilities: password and TACACS, Telnet, TFTP, BOOTP, LAN Emulation client, RFC 1577 *Classical IP over ATM client (for management access)*
Mean time between failures	17 years per RIN

TableA-1 Cisco 6400 Specifications (continued)

Description	Specifications
Maximum station-to-station cabling distance	10BASE-T Ethernet—Category 3-5 UTP: 328 ft (100 m) ATM single-mode—8/125-micron single-mode fiber: 9 miles (15 km) ATM multimode—62.5/125-micron multimode fiber: 1.2 miles (2 km)
Agency Approvals	Safety: UL 1950, CSA-C22.2 No. 950-95, EN60950, ACA TS001, AS/NZS 3260, IEC950, NOM 019 Laser Safety: 21CRF1040, Subchapter J, EN60825-1, EN60825-2 Emission: 47CFR15 Class A (FCC), CISPR22 Class B, EN55022 Class A, AS/NZS 3548 Class B, ICES-003 Class B, VCCI Class B, BSMI (CNS 13438) ClassB, IEC1000-3-2, IEC1000-3-3 Immunity: EN61000-4-2/IEC-61000-4-2 EN61000-4-3/IEC-61000-4-3 EN61000-4-4/IEC-61000-4-4 EN61000-4-5/IEC-61000-4-5 EN61000-4-6/IEC-61000-4-6 EN61000-4-11/IEC-61000-4-11 EN61000-3-2/IEC-61000-3-2 Bellcore: GR-63-CORE, GR-1089-CORE, SR-3580 NEBS Level 3 ETSI: EN 300 386-2

1. Gbps = gigabits per second
2. Btu = British thermal units
3. cfm = cubic feet per minute
4. nm = nanometers

Note If the Cisco 6400 is used in an environment where lightning-induced transients are likely to couple to the signal lines, Cisco Systems recommends the use of shielded interconnection cables for the 100BASE-T ports. In addition, use of shielded interconnection cables for the 100BASE-T ports is required to meet Bellcore GR1089 CORE Section 4.5.9 and ETSI section 5.2.2.2 (intrabuilding lightning surge).



Configuration Worksheets

This appendix includes checklists, instructions, examples, and blank worksheets used for the initial installation and subsequent maintenance of the Cisco 6400 carrier-class broadband aggregator. The checklists, worksheets, and site log provide reference and history information that can be useful when you are troubleshooting the Cisco 6400.

This appendix includes the following items:

Make copies of the worksheets provided here. Complete them and keep them for future reference.

Cisco 6400 Installation Checklist

Use the Cisco 6400 Installation Checklist provided here to verify that you have all the information you need to install and configure the Cisco 6400, and that all the components are installed and operating correctly. Each task in the Cisco 6400 installation checklist should be verified by the person performing the installation and then dated for the permanent site record.

Task	Verified By	Date
Date Cisco 6400 was received		
System and all components are unpacked		
Accessories verified		
Chassis components verified		
Safety recommendations reviewed		
Cisco 6400 Installation Checklist copied		
Site log copied and information entered		
Site power voltages verified		
Site environmental specs verified		
IP address assigned		
Required tools available		
Network connection equipment available		
System mounted in rack		
NSP installed and operational		
PEM installed and operational		
All ejector levers checked		
Captive installation screws on cards and PEMs tightened		
Interface cables and devices connected		
Node attached to console port		
System boot successful		
Redundant NSP card installed and operational (optional)		
NRP card installed and operational (optional)		
OC-3C NLC installed and operational (optional)		

Cisco 6400 Component Checklist

Use the Cisco 6400 component checklist to verify that all hardware accessories and documentation needed have been received before you begin the installation process.

Each component in the Cisco 6400 component checklist should be verified by the person unpacking the equipment and kept for the permanent site record.

Component	Description	Received
Chassis	Switch chassis	
Accessories Box		
Power cables	One power cable for each PEM received (may be shipped separately)	
Other optional equipment	Additional cards ordered	
	Ethernet transceiver	
Documentation	Unpacking Instructions	
	Cisco 6400 Hardware Installation and Maintenance Guide	
	Cisco 6400 Site Planning Guide	
	Regulatory Compliance and Safety Information for the Cisco 6400	
	Software license agreement	
System Components		
Node switch processor (NSP) card	Individually boxed	
PEM	Individually boxed	
Other equipment		

Port Configuration Worksheet

Use the port configuration worksheet during the software configuration process. The person configuring the system should keep the worksheet for the permanent site record.

System Name: _____

IP Address: _____

Location: _____

Serial Number: _____

Slot/Subslot	Port Number	Card Type	Name	Speed
Slot A		NSP		
Slot B				
Slot 1/Subslot 0	0			
	1			
Slot 1/Subslot 1	0			
	1			
Slot 2/Subslot 0	0			
	1			
Slot 2/Subslot 1	0			
	1			
Slot 3/Subslot 0	0			
	1			
Slot 3/Subslot 1	0			
	1			
Slot 4/Subslot 0	0			
	1			
Slot 4/Subslot 1	0			
	1			
Slot 5/Subslot 0	0			
	1			
Slot 5/Subslot 1	0			
	1			
Slot 6/Subslot 0	0			
	1			
Slot 6/Subslot 1	0			
	1			
Slot 7/Subslot 0	0			
	1			

Slot/Subslot	Port Number	Card Type	Name	Speed
Slot 7/Subslot 1	0			
	1			
Slot 8/Subslot 0	0			
	1			
Slot 8/Subslot 1	0			
	1			

Site Log

Use the site log for Cisco 6400 maintenance. A detailed description of actions performed and symptoms observed should be completed by the person performing the maintenance and kept as part of the permanent site record.

Date	Description of Action Performed or Symptom Observed	Initials

Quick Installation Worksheet

The installation and configuration of the Cisco 6400 can be separated into specific steps. If you complete each step described in the quick installation worksheet, following the instructions provided in this publication, Cisco 6400 installation should be successful. If the Cisco 6400 does not function properly at the first attempt, you can use the worksheet to systematically check that each step was performed correctly.

Copy the quick installation worksheet and initial each procedure as it is completed. Each task in the worksheet should be verified by the person performing the installation and dated for the permanent site record.

Task	Completed	Date
Complete switch installation checklist		
Complete switch component checklist		
Complete port configuration worksheets		
Rack-mount the switch		
Connect cables		
Connect power cables		
Switch power on		
Configure IP address (optional)		
Configure ATM address (optional)		
Configure line [aux/console]		
Configure SNMP		
Set clock (optional)		
Test the configuration		
Store configuration		

Numerics

10BASE-T 10-Mbps baseband Ethernet specification for using two pairs of twisted-pair cabling (Category 3, 4, or 5): one pair for transmitting data and one pair for receiving data. 10BASE-T, which is part of the IEEE 802.3 specification, has a distance limit of approximately 100 meters per segment.

100BASE-T 100-Mbps baseband Fast Ethernet specification for unshielded twisted-pair wiring. Based on the IEEE802.3 standard.

A

AAL ATM adaptation layer. Service-dependent sublayer of the data link layer. The AAL accepts data from different applications and presents it to the ATM layer in the form of 48-byte ATM payload segments. AALs consist of two sublayers, CS and SAR. AALs differ regarding the source-destination timing used, whether they use CBR or BVR, and whether they are used for connection-oriented or connectionless mode data transfer. See *AAL5.*

AAL5 ATM adaptation layer 5. One of four AALs recommended by the ITU-T. AAL5 supports connection-oriented VBR services, and is used primarily for the transfer of classical IP over ATM and LANE traffic.

ABR Available bit rate. QoS class defined by the ATM Forum, which is used for connections that do not require timing relationships between source and destination. ABR offers no guarantees in terms of cell loss or delay, providing only best-effort service.

ADSL Asymmetric digital subscriber line. ADSL delivers downstream data at rates ranging from 1.5 Mbps to 9 Mbps, and upstream bandwidth ranges from 16 kbps to 640 kbps. ADSL transmissions work at distances up to 18,000 feet over a single copper twisted pair.

ATM Asynchronous Transfer Mode. International standard for cell relay in which multiple service types (such as voice, video, and data) are conveyed in fixed-length (53-byte) cells. Fixed-length cells allow cell processing to occur in hardware, thereby reducing transit delays. ATM is used in high-speed transmission media such as E3, SONET, and T3.

B

bandwidth The difference between the highest and lowest frequencies available for network signals. The term is also used to describe the rated throughput capacity of a given network medium or protocol.

Bellcore Bell Communications Research, Inc., now known as Telcordia Technologies, Inc. Organization that performs research and development on behalf of the RBOCs and sets telephony standards (in the United States).

BITS Building Integrated Timing Supply. A single building master timing supply that supplies DS1 and DS0 level timing throughout an office.

bootflash Separate Flash memory device used primarily to store the Cisco IOS boot helper image, operational Cisco IOS images, and system configuration information.

boot helper For the NSP or the NRP, the boot helper loads a full-function, operational Cisco IOS image. Also referred to as "rxboot."

BOOTP Bootstrap protocol. Protocol used by a network node to determine the IP address of its Ethernet interfaces, so that network booting can proceed.

C

CCO Cisco Connection Online.

Cisco 6400 Cisco 6400 carrier-class broadband aggregator. An ATM-based multilayer switch/router optimized for aggregating and managing access shelves.

Cisco IOS software Cisco IOS software allows centralized, integrated, and automated installation and management of internetworks and supports a wide variety of protocols, media, services, and platforms.

CLI Command-line interface. An interface that allows you to interact with the operating system by entering commands and optional arguments. Compare with *GUI*.

CO Central Office. Local telephone company office to which all local loops in a given area connect and in which circuit switching of subscriber lines occurs.

D

DNS Domain name server. The part of the distributed database system for resolving a fully qualified domain name into the four-part Internet Protocol (IP) number used to route communications across the Internet.

downlink A network connection between the Cisco 6400 chassis and an aggregated modem shelf.

DRAM Dynamic random access (read/write) memory.

DS0 Digital signal level 0. Framing specification used in transmitting digital signals at 64 kbps. Twenty-four DS0s equal one DS1.

D

DS1 Digital signal level 1. Framing specification used in transmitting digital signals at 1.544 Mbps on a T1 facility. Twenty-four DS0s equal one DS1.

DS3 Digital signal level 3. Framing specification used for transmitting digital signals at 44.736 Mbps on a T3 facility.

DSL Digital subscriber loop. A public network technology that delivers high bandwidth data transmisssion over conventional copper wire.

DUART Dual Universal Asynchronous Receiver/Transmitter.

E

E1 Wide-area digital transmission scheme used predominantly in Europe. It carries data at a rate of 2.048 Mbps. Compare with *T1*.

EHSA Enhanced high system availability. A processor redundancy scheme that reduces switchover time by requiring that the redundant processor be running in standby mode.

EIA Electronic Industries Association. Group that specifies electrical transmission standards. The EIA and TIA have developed numerous well-known communications standards, including EIA/TIA-232 and EIA/TIA-449. See also *TIA*.

EMI Electromagnetic interference. Interference by electromagnetic signals that can cause reduced data integrity and increased error rates on transmission channels.

ESD Electrostatic discharge. Discharge of stored static electricity that can damage electronic equipment and impair electrical circuitry, resulting in complete or intermittent failures.

Ethernet Baseband LAN specification originated by Xerox Corporation and developed jointly by Xerox, Intel, and Digital Equipment Corporation. Ethernet networks use CSMA/CD and run over a variety of cable types at 10 Mbps. Ethernet is similar to the IEEE 802.3 series of standards. See also *10BASE-2*, *10BASE-T*, and *Fast Ethernet*.

ETSI European Telecommunication Standards Institute. An organization that proposes telecommunication standards for Europe.

F

Fast Ethernet Any of a number of 100-Mbps Ethernet specifications. Fast Ethernet offers a speed ten times that of the 10BASE-T Ethernet specification, while preserving frame format, MAC mechanisms, and maximum transmission unit (MTU). Based on an extension of the IEEE 802.3 specification. See also *100BASE-T*.

FRU Field-replaceable unit—applies to the Cisco 6400 components that can be replaced in the field, including the NLC, NSP, NRP, and PME units, as well as the blower fans.

F

FTP File Transfer Protocol. The set of standards that allow you to exchange complete files across different computer hosts. Using an FTP client, you can search for files and retrieve them from software archives on the Internet.

full-duplex Transmission in two directions simultaneously, or technically, bidirectional, simultaneous two-way communications.

G

Gbps Gigabits per second.

H

half-duplex A circuit designed for data transmission in both directions, but not at the same time.

I

ILMI Interim Local Management Interface. ATM specification for incorporating network-management capabilities into the ATM UNI.

IP Internet Protocol. Network layer protocol in the TCP/IP stack offering a connectionless internetwork service. IP provides features for addressing, type-of-service specification, fragmentation and reassembly, and security. Documented in RFC 791.

IP over ATM Suite used to send IP datagram packets between nodes on the Internet.

ITU-T International Telecommunication Union Telecommunication Standardization Sector. International body that develops worldwide standards for telecommunications technologies. The ITU-T carries out the functions of the former CCITT.

L

L2TP Layer 2 Tunneling Protocol. Protocol allowing PPP sessions to be tunnelled across an arbitrary medium to a “home gateway” at an ISP or corporation. The Cisco 6400 aggregates user PPP sessions into L2TP tunnels.

LAC L2TP (or local) access concentrator. Aggregates user PPP sessions into L2TP tunnels for transport to upstream LNS. The Cisco 6400 is a LAC.

LED Light emitting diode. Semiconductor device that emits light produced by the conversion of electrical energy. Status lights on hardware devices are typically LEDs.

LNS L2TP Network Server. Device at the ISP or corporation terminating the L2TP tunnels and PPP sessions. May be an NRP or equivalent.

M

MAC Media Access Control. Lower of the two sublayers of the data link layer defined by the IEEE. The MAC sublayer handles access to shared media.

MIB Management Information Base. Database of network management information that is used and maintained by a network management protocol such as SNMP or CMIP. The value of a MIB object can be changed or retrieved through use of SNMP or CMIP commands, usually through a GUI network management system. MIB objects are organized in a tree structure that includes public (standard) and private (proprietary) branches.

multimode fiber An optical fiber that provides a transmission medium for multiple lightwaves simultaneously.

N

NEBS Network Equipment Building Systems. A standard set of physical and electrical requirements for telecommunications equipment intended for installation in the telephone company Central Office environment. NEBS requirements are specified in various Bellcore documents.

NLC Node line card. One of the component cards used in the Cisco 6400. These cards provide the interfaces for moving data into and out of the Cisco 6400 system. They can be used as either uplink or downlink interfaces. Different types of line cards support different transmission protocols and data rates.

NME Network Management Ethernet. The local area network used to control and manage equipment in a Central Office and branch locations. The NME (ETH) port on the NSP and NRP is an RJ-45 connector for a 10BASE-T port.

NRP Node route processor. One of the component modules used in the Cisco 6400. This module is the Layer 3 element for the Cisco 6400 responsible for implementing the routing function.

NSP Node switch processor. One of the component modules used in the Cisco 6400. This module is responsible for all ATM switching and control functions within the Cisco 6400.

NVRAM Nonvolatile RAM. RAM that retains its contents when a unit is powered off.

O

OAM cell Operations, Administration, and Maintenance cell. ATM Forum specification for cells used to monitor virtual circuits.

OC Optical carrier. A series of physical protocols (OC-1, OC-2, OC-3, and so on), defined for SONET optical signal transmissions. OC signal levels put STS frames onto fiber-optic lines at a variety of speeds. The base rate is 51.84 Mbps (OC-1). See also *SONET*, *STS-1*, *STS-3c* and *STS-12c*.

P

PCMCIA Personal Computer Memory Card International Association. Refers to a standard used for credit-card sized computer peripherals. Type I devices are very thin memory cards: Type II devices include thicker memory cards, as well as most modems and interfaces; and Type III devices are used for disk drives and thicker components.

PEM Power entry module. There are two types of power entry modules, AC PEM and DC PEM.

The AC PEM converts the incoming AC power to the correct intermediate DC voltage used by the logic cards and modules within the system. The AC PEM also filters the line cable to meet EMC requirements.

The DC PEM filters the incoming –48 VDC to meet EMC requirements. It also provides miswiring protection and internal fault isolation.

ping Packet internet groper. ICMP echo message and its reply. Often used in IP networks to test whether a network device destination can be reached from the source.

PNNI 1. Private Network-Network Interface. ATM Forum specification for distributing topology information among switches and clusters of switches. It is used to compute paths through the network.

2. Private Network Node Interface. ATM Forum specification for signaling to establish point-to-point and point-to-multipoint connections across an ATM network. The protocol is based on the ATM UNI specification with additional features for source routing, crankback, and alternate routing of call setup requests.

PPP Point-to-Point Protocol. Provides host-to-network and switch-to-switch connections over synchronous and asynchronous circuits, allowing one or more user sessions to be tunnelled across a medium. Includes provisions for security and protocol negotiation.

PSTN Public Switched Telephone Network. General term referring to the variety of telephone networks and services in place worldwide.

PVC Permanent virtual circuit. PVCs save bandwidth associated with circuit establishment and tear-down in situations where certain virtual circuits must exist all the time. Called a *permanent virtual connection* in ATM terminology.

O

QoS Quality of service. Measure of performance for a transmission system that reflects its transmission quality and service availability.

R

ROMMON Read only memory (ROM) Monitor. Basic system initialization sequence at system power up.

S

SAR Segmentation and reassembly. One of the two sublayers of the AAL common port convergence sublayer (CPCS). It is responsible for dividing (at the source) and reaassembling (at the destination) the PDUs passed from the CS. The SAR sublayer takes the PDUs processed by the CS and, after dividing them into 48-byte pieces of payload data, passes them to the ATM layer for further processing.

SDH Synchronous Digital Hierarchy. European standard that defines a set of rate and format standards that are transmitted by means of optical signals over fiber. SDH has a basic rate of 155.52 Mbps, designated as STM-1.

SIMM Single in-line memory module. Used for DRAM and Flash memory in the Cisco6400.

single-mode fiber An optical fiber that provides a transmission medium for one primary light wave mode.

SLIP Serial Line Interface Protocol. A version of IP that runs over serial links, allowing IP communications over the administrative interface.

SNMP Simple Network Management Protocol. Network management protocol used almost exclusively in TCP/IP networks. SNMP provides a means to monitor and control network devices, and to manage configurations, statistics collection, performance, and security.

SONET Synchronous Optical Network. SONET is an optical interface standard with transmission rates that range from 51.84 Mbps to 13.22 Gbps. It was created to provide the flexibility needed to transport many digital signals with different capacities, and to provide a design standard for manufacturers. SONET allows interworking of transmission products from multiple vendors.

SRAM Static random-access memory.

STM-1 Synchronous Transport Module level 1. One of a number of SDH formats that specifies the frame structure for the 155.52-Mbps lines used to carry ATM cells.

STM-4 Synchronous Transport Module level 4. The SDH format that specifies the frame structure for the 622.08-Mbps lines used to carry ATM cells.

Stratum 3 A precision timing reference that provides a free-run accuracy of +/- 4.6 PPM (parts per million), pull-in capability of 4.6 PPM, and holdover stability of less than 255 slips during first day. Full description can be found in the Bellcore document GR-253-CORE.

Stratum 4 A precision timing reference that provides a free-run accuracy of +/- 32 PPM (parts per million) and pull-in capability of 32 PPM. No holdover stability required. Full description can be found in the Bellcore document GR-253-CORE.

STS-1 Synchronous Transport Signal level 1. Basic building block signal of SONET, operating at 51.84 Mbps.

STS-3c Synchronous Transport Signal level 3, concatenated. SONET format that specifies the frame structure for the 155.52-Mbps lines used to carry ATM cells.

STS-12c Synchronous Transport Signal level 12, concatenated. SONET format that specifies the frame structure for the 622.08-Mbps lines used to carry ATM cells.

SVC Switched virtual circuit. Virtual circuit that is dynamically established on demand and is torn down when transmission is complete. Called a *switched virtual connection* in ATM terminology.

T

T1 Digital WAN carrier facility. T1 transmits DS1-formatted data at 1.544 Mbps through the telephone switching network, using AMI or B8ZS coding.

T3 Digital WAN carrier facility. T3 transmits DS3-formatted data at 44.736 Mbps through the telephone switching network.

TACACS Terminal Access Controller Access Control System. Authentication protocol that provides access authentication and related services. User passwords are administered in a central database rather than in individual routers, providing an easily scalable network security solution.

TCP Transmission Control Protocol. Connection-oriented transport layer protocol that provides reliable full-duplex data transmission. TCP is part of the TCP/IP protocol stack.

TCP/IP Transmission Control Protocol/Internet Protocol. Common name for the suite of protocols developed to support the construction of worldwide internetworks.

telco Abbreviation for telephone company.

Telnet Standard terminal emulation protocol in the TCP/IP protocol stack. Telnet is used for remote terminal connections, enabling users to log into remote systems and use resources as if they were connected to a local system.

TFTP Trivial File Transfer Protocol. Simplified version of FTP that allows files to be transferred from one computer to another over a network.

TIA Telecommunications Industry Association. Organization that develops standards relating to telecommunications technologies. See also *EIA*.

trunk Physical and logical connection between two switches across which network traffic travels. A backbone is composed of a number of trunks.

tunneling Architecture that is designed to provide the services necessary to implement any standard point-to-point encapsulation scheme.

U

UDP User Datagram Protocol. Enables an application (such as an SNMP agent) on one system to send a datagram to an application (a network management station using SNMP) on another system. It uses IP to deliver datagrams. UDP/IP protocol suites are used by TFTP.

UNI User-Network Interface. ATM Forum specification that defines an interoperability standard for the interface between ATM-based products (a router or an ATM switch) located in a private network and the ATM switches located within the public carrier networks. Also used to describe similar connections in Frame Relay networks. UNI versions include UNI3.0, UNI3.1, and UNI4.0.

uplink A network connection between a system and a WAN. Also known as a trunk.

UTP Unshielded twisted-pair cable.

V

VCI Virtual channel identifier. The 16-bit field in the header of an ATM cell. The VCI, together with the VPI, is used to identify the next destination of a cell as it passes through a series of ATM switches.

VPI Virtual path identifier. An 8-bit field in the header of an ATM cell. The VPI, together with the VCI, identifies the next destination of a cell as the cell passes through a series of ATM switches. The function of the VPI is similar to that of the DLCI in Frame Relay.

W

WAN Wide-area network. Data communications network that serves users across a broad geographic area and often uses transmission devices provided by common carriers.

X

xDSL Various types of digital subscriber lines. Examples include ADSL, HDSL, and VDSL.

Numerics

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