CISCO SYSTEMS

Cisco 6400 Site Planning Guide

June 2002

Corporate Headquarters
Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134-1706
USA
http://www.cisco.com
Tel: 408 526-4000
        800 553-NETS (6387)
Fax: 408 526-4100

THE SPECIFICATIONS AND INFORMATION REGARDING THE PRODUCTS IN THIS MANUAL ARE SUBJECT TO CHANGE WITHOUT NOTICE. ALL STATEMENTS, INFORMATION, AND RECOMMENDATIONS IN THIS MANUAL ARE BELIEVED TO BE ACCURATE BUT ARE PRESENTED WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED. USERS MUST TAKE FULL RESPONSIBILITY FOR THEIR APPLICATION OF ANY PRODUCTS.

THE SOFTWARE LICENSE AND LIMITED WARRANTY FOR THE ACCOMPANYING PRODUCT ARE SET FORTH IN THE INFORMATION PACKET THAT SHIPPED WITH THE PRODUCT AND ARE INCORPORATED HEREIN BY THIS REFERENCE. IF YOU ARE UNABLE TO LOCATE THE SOFTWARE LICENSE OR LIMITED WARRANTY, CONTACT YOUR CISCO REPRESENTATIVE FOR A COPY.

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

The following information is for FCC compliance of Class B devices: The equipment described in this manual generates and may radiate radio-frequency energy. If it is not installed in accordance with Cisco's installation instructions, it may cause interference with radio and television reception. This equipment has been tested and found to comply with the limits for a Class B digital device in accordance with the specifications in part 15 of the FCC rules. These specifications are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation.

Modifying the equipment without Cisco's written authorization may result in the equipment no longer complying with FCC requirements for Class A or Class B digital devices. In that event, your right to use the equipment may be limited by FCC regulations, and you may be required to correct any interference to radio or television communications at your own expense.

You can determine whether your equipment is causing interference by turning it off. If the interference stops, it was probably caused by the Cisco equipment or one of its peripheral devices. If the equipment causes interference to radio or television reception, try to correct the interference by using one or more of the following measures:

• Turn the television or radio antenna until the interference stops.

• Move the equipment to one side or the other of the television or radio.

• Move the equipment farther away from the television or radio.

• Plug the equipment into an outlet that is on a different circuit from the television or radio. (That is, make certain the equipment and the television or radio are on circuits controlled by different circuit breakers or fuses.)

Modifications to this product not authorized by Cisco Systems, Inc. could void the FCC approval and negate your authority to operate the product.

The Cisco implementation of TCP header compression is an adaptation of a program developed by the University of California, Berkeley (UCB) as part of UCB's public domain version of the UNIX operating system. All rights reserved. Copyright © 1981, Regents of the University of California.

NOTWITHSTANDING ANY OTHER WARRANTY HEREIN, ALL DOCUMENT FILES AND SOFTWARE OF THESE SUPPLIERS ARE PROVIDED "AS IS" WITH ALL FAULTS. CISCO AND THE ABOVE-NAMED SUPPLIERS DISCLAIM ALL WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING, WITHOUT LIMITATION, THOSE OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT OR ARISING FROM A COURSE OF DEALING, USAGE, OR TRADE PRACTICE.

IN NO EVENT SHALL CISCO OR ITS SUPPLIERS BE LIABLE FOR ANY INDIRECT, SPECIAL, CONSEQUENTIAL, OR INCIDENTAL DAMAGES, INCLUDING, WITHOUT LIMITATION, LOST PROFITS OR LOSS OR DAMAGE TO DATA ARISING OUT OF THE USE OR INABILITY TO USE THIS MANUAL, EVEN IF CISCO OR ITS SUPPLIERS HAVE BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

CCIP, the Cisco *Powered* Network mark, the Cisco Systems Verified logo, Cisco Unity, Follow Me Browsing, FormShare, Internet Quotient, iQ Breakthrough, iQ Expertise, iQ FastTrack, the iQ Logo, iQ Net Readiness Scorecard, Networking Academy, ScriptShare, SMARTnet, TransPath, and Voice LAN are trademarks of Cisco Systems, Inc.; Changing the Way We Work, Live, Play, and Learn, Discover All That's Possible, The Fastest Way to Increase Your Internet Quotient, and iQuick Study are service marks of Cisco Systems, Inc.; and Aironet, ASIST, BPX, Catalyst, CCDA, CCDP, CCIE, CCNA, CCNP, Cisco, the Cisco Certified Internetwork Expert logo, Cisco IOS, the Cisco IOS logo, Cisco Press, Cisco Systems, Cisco Systems Capital, the Cisco Systems logo, Empowering the Internet Generation, Enterprise/Solver, EtherChannel, EtherSwitch, Fast Step, GigaStack, IOS, IP/TV, LightStream, MGX, MICA, the Networkers logo, Network Registrar, *Packet*, PIX, Post-Routing, Pre-Routing, RateMUX, Registrar, SlideCast, StrataView Plus, Stratm, SwitchProbe, TeleRouter, and VCO are registered trademarks of Cisco Systems, Inc. and/or its affiliates in the U.S. and certain other countries.

All other trademarks mentioned in this document or Web site are the property of their respective owners. The use of the word partner does not imply a partnership relationship between Cisco and any other company. (0203R)

Cisco 6400 Site Planning Guide
Copyright © 2002, Cisco Systems, Inc.
All rights reserved.

CONTENTS

GLOSSARY

INDEX

Cisco 6400 Site Planning Guide

About This Guide

This section outlines the objectives, intended audience, and organization of the *Cisco 6400 Site Planning Guide.* It also outlines the conventions used in this document in presenting the planning considerations and guidelines that you should take into account in preparing your site for installing the Cisco 6400 carrier-class broadband aggregator (referred to as the Cisco 6400 in this document).

Objectives

This publication presents information intended to help you prepare your site for installing the Cisco 6400. All additions or upgrades to the switch hardware or software image (firmware) that you order from the factory are accompanied by configuration notes that provide product-specific installation instructions and up-to-date product information.

Audience

This document is intended for personnel responsible for planning and preparing a site for the installation of a Cisco 6400. To use this publication effectively, you should be familiar with electronic circuitry and wiring practices and preferably have experience as an electronic or electromechanical technician.

Document Organization

This publication is organized as follows:

Chapter 1	Cisco 6400 Product Overview	Introduces the Cisco 6400 and describes the system features
Chapter 2	Site Planning Considerations	Discusses the points that a site planner should take into account in planning the site and preparing for the installation of a Cisco 6400 system
Appendix A	System Specifications	Provides specifications for the Cisco 6400 system
Appendix B	Cabling Specifications	Presents pinouts for the various interfaces used with the Cisco 6400
Appendix C	Glossary	Defines the terms and acronyms used in this document and elsewhere in the Cisco 6400 system user documentation

Document Conventions

Command descriptions use the following conventions:

boldface font	Commands and keywords are in **boldface**.
italic font	Arguments for which you supply values are in *italics*.
[ ]	Elements in square brackets are optional.
{ x	y	z }	Alternative keywords are grouped in braces and separated by vertical bars.
[x	y	z]	Optional alternative keywords are grouped in brackets and separated by vertical bars.
string	A nonquoted set of characters. Do not use quotation marks around the string, or the string will include the quotation marks.

Screen examples use the following conventions:

`screen` font	Terminal sessions and information the system displays are in `screen` font.
`boldface screen` font	Information you must enter is in `boldface screen` font.
`italic screen` font	Arguments for which you supply values are in `italic screen` font.
⟶	This pointer highlights an important line of text in an example.
^	The symbol ^ represents the key labeled Control—for example, the key combination ^D in a screen display means hold down the Control key while you press the D key.
< >	Nonprinting characters, such as passwords, are in angle brackets.
[ ]	Default responses to system prompts are in square brackets.
!, #	An exclamation point (!) or a pound sign (#) at the beginning of a line of code indicates a comment line.

Notes, Cautions, and Warnings are used in this document according to the following conventions:

Note Means *reader take note*. Notes contain helpful suggestions or references to material not covered in the publication.

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.**

Obtaining Documentation

The following sections explain how to obtain documentation from Cisco Systems.

World Wide Web

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

http://www.cisco.com

Translated documentation is available at the following URL:

http://www.cisco.com/public/countries_languages.shtml

Documentation CD-ROM

Cisco documentation and additional literature are available in a Cisco Documentation CD-ROM package, which is shipped with your product. The Documentation CD-ROM is updated monthly and may be more current than printed documentation. The CD-ROM package is available as a single unit or through an annual subscription.

Ordering Documentation

Cisco documentation is available in the following ways:

- Registered Cisco Direct Customers can order Cisco product documentation from the Networking Products MarketPlace:

  http://www.cisco.com/cgi-bin/order/order_root.pl

- Registered Cisco.com users can order the Documentation CD-ROM through the online Subscription Store:

  http://www.cisco.com/go/subscription

- Nonregistered Cisco.com users can order documentation through a local account representative by calling Cisco corporate headquarters (California, USA) at 408 526-7208 or, elsewhere in North America, by calling 800 553-NETS (6387).

Documentation Feedback

If you are reading Cisco product documentation on Cisco.com, you can submit technical comments electronically. Click **Leave Feedback** at the bottom of the Cisco Documentation home page. After you complete the form, print it out and fax it to Cisco at 408 527-0730.

You can e-mail your comments to bug-doc@cisco.com.

To submit your comments by mail, use the response card behind the front cover of your document, or write to the following address:

Cisco Systems
Attn: Document Resource Connection
170 West Tasman Drive
San Jose, CA 95134-9883

We appreciate your comments.

Obtaining Technical Assistance

Cisco provides Cisco.com as a starting point for all technical assistance. Customers and partners can obtain documentation, troubleshooting tips, and sample configurations from online tools by using the Cisco Technical Assistance Center (TAC) Web Site. Cisco.com registered users have complete access to the technical support resources on the Cisco TAC Web Site.

Cisco.com

Cisco.com is the foundation of a suite of interactive, networked services that provides immediate, open access to Cisco information, networking solutions, services, programs, and resources at any time, from anywhere in the world.

Cisco.com is a highly integrated Internet application and a powerful, easy-to-use tool that provides a broad range of features and services to help you to

- Streamline business processes and improve productivity
- Resolve technical issues with online support
- Download and test software packages
- Order Cisco learning materials and merchandise
- Register for online skill assessment, training, and certification programs

You can self-register on Cisco.com to obtain customized information and service. To access Cisco.com, go to the following URL:

http://www.cisco.com

Technical Assistance Center

The Cisco TAC is available to all customers who need technical assistance with a Cisco product, technology, or solution. Two types of support are available through the Cisco TAC: the Cisco TAC Web Site and the Cisco TAC Escalation Center.

Inquiries to Cisco TAC are categorized according to the urgency of the issue:

- Priority level 4 (P4)—You need information or assistance concerning Cisco product capabilities, product installation, or basic product configuration.
- Priority level 3 (P3)—Your network performance is degraded. Network functionality is noticeably impaired, but most business operations continue.

- Priority level 2 (P2)—Your production network is severely degraded, affecting significant aspects of business operations. No workaround is available.

- Priority level 1 (P1)—Your production network is down, and a critical impact to business operations will occur if service is not restored quickly. No workaround is available.

Which Cisco TAC resource you choose is based on the priority of the problem and the conditions of service contracts, when applicable.

Cisco TAC Web Site

The Cisco TAC Web Site allows you to resolve P3 and P4 issues yourself, saving both cost and time. The site provides around-the-clock access to online tools, knowledge bases, and software. To access the Cisco TAC Web Site, go to the following URL:

http://www.cisco.com/tac

All customers, partners, and resellers who have a valid Cisco services contract have complete access to the technical support resources on the Cisco TAC Web Site. The Cisco TAC Web Site requires a Cisco.com login ID and password. If you have a valid service contract but do not have a login ID or password, go to the following URL to register:

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

If you cannot resolve your technical issues by using the Cisco TAC Web Site, and you are a Cisco.com registered user, you can open a case online by using the TAC Case Open tool at the following URL:

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

If you have Internet access, it is recommended that you open P3 and P4 cases through the Cisco TAC Web Site.

Cisco TAC Escalation Center

The Cisco TAC Escalation Center addresses issues that are classified as priority level 1 or priority level 2; these classifications are assigned when severe network degradation significantly impacts business operations. When you contact the TAC Escalation Center with a P1 or P2 problem, a Cisco TAC engineer will automatically open a case.

To obtain a directory of toll-free Cisco TAC telephone numbers for your country, go to the following URL:

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

Before calling, please check with your network operations center to determine the level of Cisco support services to which your company is entitled; for example, SMARTnet, SMARTnet Onsite, or Network Supported Accounts (NSA). In addition, please have available your service agreement number and your product serial number.

Cisco 6400 Product Overview

The Cisco 6400 carrier-class broadband aggregator, referred to as the Cisco 6400, is a broadband concentrator that supports end-to-end asynchronous transfer mode (ATM) transmission services, Point-to-Point Protocol (PPP) termination services, and tunneling services.

The Cisco 6400 combines Cisco IOS ATM switching and routing capabilities in a modular and redundant manner to optimize and manage the aggregation of traffic from a variety of network access technologies.

Application Environment of the Cisco 6400

The Cisco 6400 is designed primarily for use in a telephone company central office (CO) transmission environment. Therefore, the Cisco 6400 meets Telcordia Network Equipment Building Systems (NEBS) and European Telecommunications Standards Institute (ETSI) requirements with regard to the following equipment specifications:

- Physical size
- Safety
- Electrical characteristics
- Temperature
- Humidity
- Shock and earthquake resistance

A Cisco 6400 can be installed (co-located) in the CO in the same rack as the transmission equipment. Alternatively, a Cisco 6400 can be remotely located to concentrate traffic from multiple locations, thus avoiding rack space limitations that might exist in the CO environment.

Major Components of the Cisco 6400

Figure 1-1 shows a Cisco 6400 that has been populated with a full complement of circuit boards and components. A Cisco 6400 system can contain the following:

- Two node switch processor cards (NSPs)—Can be installed in either or both of two dedicated slots (0A and 0B) in the middle of the Cisco 6400 chassis. One NSP is required for system operation; a second NSP provides fault tolerance.
- Node route processor cards (NRPs)—Can be installed in any one or all of the eight chassis slots numbered 1 to 8.

- Node line cards (NLCs)—Can be installed in any one or all of the eight chassis slots numbered 1 to 8. One full-height NLC or one or two half-height NLCs can be installed in each slot, for a maximum of 16 NLCs per system.

- Power entry modules (PEMs)—Can be installed in either or both of two dedicated bays in the left side of the Cisco 6400. One PEM is required for system operation; a second PEM provides power redundancy.

- Blower module—Installed in a dedicated bay at the top front of the Cisco 6400.

- Air filter assembly—Installed in a dedicated bay at the bottom front of the Cisco 6400.
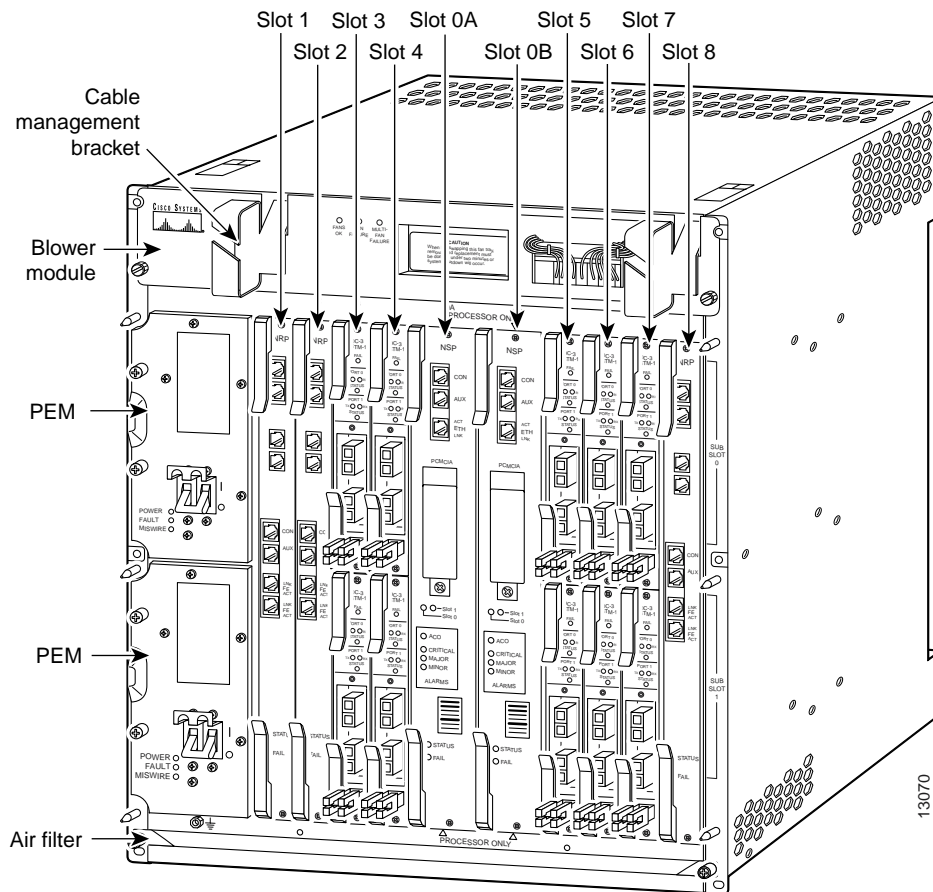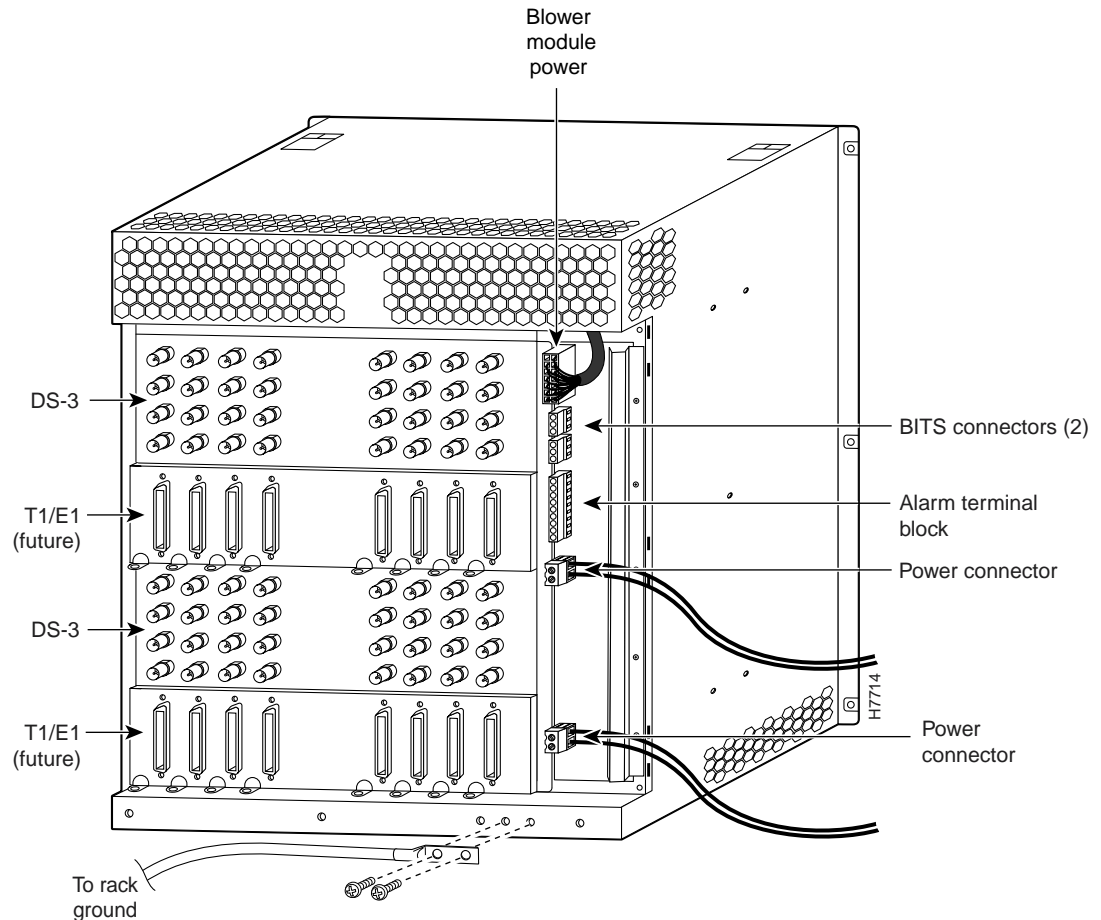
Figure 1-1   Front View of the Cisco 6400

Figure 1-2 shows a rear view of the Cisco 6400 chassis.

Figure 1-2   Rear View of the Cisco 6400 Using DC PEMs

The rear of the Cisco 6400 chassis incorporates the following connection facilities:

- Blower module power connector.

- Thirty-two pairs of DS3 coaxial connectors—One receive (RX) port and one transmit (TX) port per DS3 pair.

- Sixteen high-density T1/E1 connectors (not currently supported).

- Two building integrated timing supply (BITS) connectors—The bottom connector services the NSP-S3B in slot 0A of the Cisco 6400 chassis, and the top connector services the NSP-S3B in slot 0B of the Cisco 6400 chassis. (See Figure 1-2.)

- An alarm terminal block—Provides connectors for an external alarm monitoring system that can be used to sense three alarm conditions in the Cisco 6400 chassis:

    – Minor

    – Major

    – Critical

- Each alarm connector incorporates a normally closed (NC) contact, a common (COM) contact, and a normally open (NO) contact.

- Two power terminal blocks—One connector that is associated with the upper PEM bay (DC PWR 0) in the Cisco 6400 chassis, and one connector that is associated with the lower PEM bay (DC PWR 1) in the Cisco 6400 chassis. (See Figure 1-2.)

- System grounding connector—The second and third holes from the right at the bottom of the Cisco 6400 chassis are threaded to enable the attachment of a system grounding cable. (See Figure 1-2.)

Site Planning Considerations

This chapter explains how to plan your site for installation of the Cisco 6400 carrier-class broadband aggregator. The Cisco 6400 can be installed in any area that meets the specifications and requirements outlined in this chapter.

To ensure normal system operation and avoid potential post-installation problems, you should choose an appropriate location for your Cisco 6400 and prepare the site properly for installing equipment *prior to* system delivery.

Site Preparation Checklist

Complete the checklist in Table 2-1 several weeks before taking delivery of your Cisco 6400.

Table 2-1   Cisco 6400 Site Preparation Checklist

Checkoff Column	Task Description
	Choose a location for your Cisco 6400 that meets the requirements described in the "Site Selection Guidelines" section on page 2-2.
	Ensure that your site meets the power requirements described in the "Site Power Requirements" section on page 2-5.
	Determine the type of mounting to be used when installing the Cisco 6400, as described in the "Cisco 6400 Mounting Options" section on page 2-7.
	Ensure that the equipment rack in which you plan to install the Cisco 6400 meets the requirements described in the "Rack Selection Guidelines" section on page 2-8.
	Select an appropriate location for your equipment rack, as described in the "Rack Placement Guidelines" section on page 2-8.
	Install the Cisco 6400 in the equipment rack, as described in the "Cisco 6400 Installation Guidelines" section on page 2-9.
	Ensure that the Cisco 6400 chassis is fully enclosed prior to operation, as described in the "Integrity of Chassis Enclosure" section on page 2-12.
	Plan your network and Cisco 6400 interface connections, as described in the "Cabling Requirements" section on page 2-12.

Table 2-1   Cisco 6400 Site Preparation Checklist

Checkoff Column	Task Description
	Ensure that the Cisco 6400 chassis is properly grounded, as described in the "System Grounding Requirements" section on page 2-16.
	Observe proper safety and operating precautions during Cisco 6400 installation and operation, as described in the "Safety Guidelines" section on page 2-17.

Site Selection Guidelines

The Cisco 6400 is designed to run in the following conditions:

- Noncorrosive
- Relatively dust-free
- Dry
- Clean
- Well ventilated
- Air conditioned

You should consider all of these factors in selecting a suitable location for your Cisco 6400.

Site Environmental Requirements

Table 2-2 details the environmental requirements that your site should meet to ensure a proper operating environment for your Cisco 6400.

Table 2-2   Cisco 6400 Environmental Requirements

| Characteristic	Minimum	Maximum
Temperature, ambient operating range at sea level (760 mm Hg)—in compliance with GR-63. Short-term operating temperature is limited to 55°C.	25°F (–4°C)	104°F (40°C)
Temperature, ambient nonoperating and storage	–40°F (–40°C)	167°F (75°C)
Relative humidity (RH), ambient (noncondensing) operating	5%	95%
Altitude, operating and nonoperating	–200 ft (–61 m)	10,000 ft (3048 m)
Vibration, operating	N/A	5 to 200 Hz, 0.5 g (1 oct./min)
Vibration, nonoperating	N/A	5 to 200 Hz, 0.5 g (1 oct./min)

Cisco 6400 Physical Characteristics

Knowing the physical characteristics of your Cisco 6400 can help you to choose an appropriate location for the system. Table 2-3 lists the dimensional and weight characteristics of the Cisco 6400, both as a standalone system and as packaged in a shipping crate ready for customer delivery. (See Figure 2-1)

Table 2-3   Cisco 6400 Physical Characteristics

Characteristic	Cisco 6400 Standalone Chassis	Cisco 6400 Packaged for Shipment
Height	21.75 in. (55.2 cm)	33 in. (83.8 cm)
Width	17.5 (44.5 cm)	24 in. (61 cm)
Depth	12 in. (30.5 cm)	33 in. (83.8 cm)
Weight of fully configured chassis	130 lb (59.02 kg)	160 lb (72.6 kg)

Figure 2-1   Cisco 6400 Packaged for Shipment
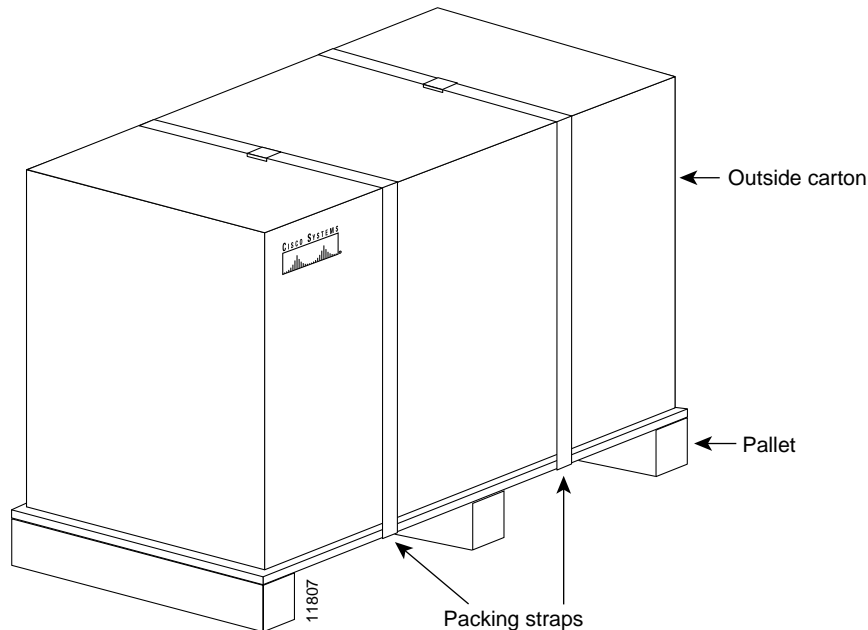
Figure 2-2   Cisco 6400 Chassis Footprint
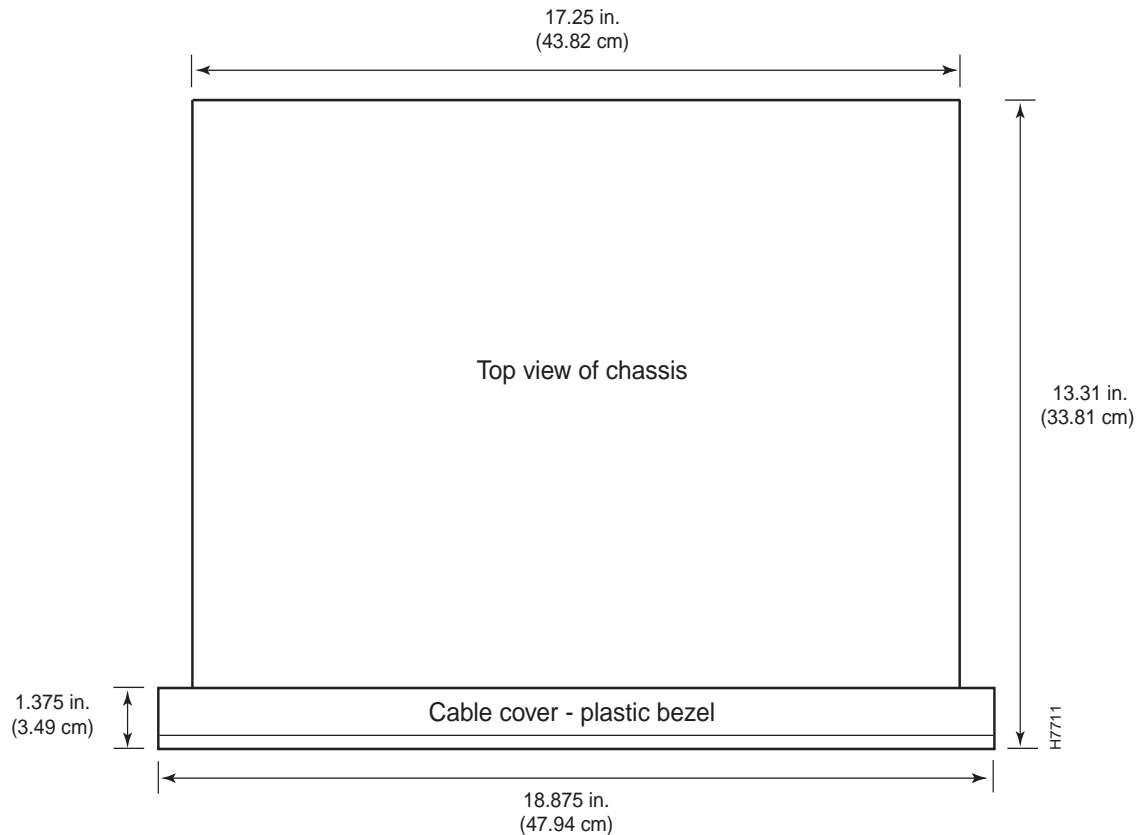
Floor Loading Considerations

You should ensure that the floor under the telco rack in which you plan to install the Cisco 6400 (together with any other equipment) is capable of supporting the combined weight of the rack and all other installed equipment.

Using Table 2-4, you can calculate the approximate total weight of your Cisco 6400, as ordered for delivery. Add the weight of each individual component in Table 2-4, as appropriate, to the weight of the empty chassis (which includes the cable cover).

For additional information about floor loading requirements, consult the document *GR-63-CORE, Network Equipment-Building System (NEBS) Requirements: Physical Protection.*

Table 2-4   Cisco 6400—Weight of Individual Components

System Element	Weight
Empty chassis, with cable cover (plastic bezel)	37.80 lb (17.16 kg)
Power Entry Module AC PEM DC PEM	 10.90 lb (4.95 kg) 6.20 lb (2.81 kg)
Blower module	10.95 lb (4.97 kg)

Table 2-4   Cisco 6400—Weight of Individual Components

System Element	Weight
Node switch processor (NSP) card	8.00 lb (3.63 kg)
Node route processor (NRP) card	5.00 lb (2.27 kg)
Line card carrier	2.00 lb (0.91 kg)
Node line card (NLC): OC-3/STM-1 DS3 OC-12/STM-4	 1.85 lb (0.84 kg) 1.85 lb (0.84 kg) 5.00 lb (2.27 kg)
Line card carrier with two NLCs installed	5.70 lb (2.59 kg)
Approximate total weight of fully populated chassis	130.00 lb (59.02 kg)

Site Power Requirements

Either a centralized DC source or an AC source can power the Cisco 6400. For DC sources, the Cisco 6400 can be configured with a DC PEM. For AC sources, the Cisco 6400 can be configured with either an AC PEM, or a DC PEM used in conjunction with the Cisco 6400 AC power shelf.

Each Cisco 6400 requires a dedicated branch circuit. If you equip your Cisco 6400 with dual power feeds, you should provide an independent power source for each cord. Doing so avoids compromising the power redundancy feature of the system.

⚠

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.**

The following notice applies to every Cisco 6400:

This device complies with FCC Rules, Part 15. Operation is subject to the following conditions:

- This device may not cause harmful interference.
- This device must accept any interference that may be received, including interference that may cause undesired operation.

Cisco 6400 Electrical Characteristics

Table 2-5 lists the power consumption and heat dissipation characteristics of Cisco 6400 components. This information is useful in assessing the need for additional air conditioning capacity in your site.

Table 2-5   Cisco 6400 Power/Heat Dissipation Characteristics

System Configuration	Power Consumption	Heat Dissipation
Base system with AC power	400W	1367 Btu/hr
Redundant base system with AC power	550W	1879 Btu/hr
Base system with DC power	335W	1145 Btu/hr
Redundant base system with DC power	445W	1528 Btu/hr

Table 2-5   Cisco 6400 Power/Heat Dissipation Characteristics

System Configuration	Power Consumption	Heat Dissipation
Optional components: Redundant NSP NRP NLC Redundant PEM	125W 100W 25W 10W	427 Btu/hr 342 Btu/hr 85 Btu/hr 34 Btu/hr
Maximum system power consumption and heat dissipation	1200W	4098 Btu/hr

Table 2-6 outlines the electrical specifications of the DC PEM for the Cisco 6400.

Table 2-6   Cisco 6400 DC Power Ratings

Characteristic	Description
Input connections	Supports up to two separate –48 VDC input feeds by means of 2-position terminal blocks built into the Cisco 6400 backplane
DC input voltage	–48 VDC/–60 VDC
DC input current rating	Maximum power budget: 20A @ –48 VDC
Power consumption	1200W maximum
Heat dissipation	4098 Btu/hr maximum

Table 2-7 outlines the electrical specifications of the AC PEM for the Cisco 6400.

Table 2-7   Cisco 6400 AC PEM Power Ratings

Characteristic	Description
AC inlet power connector	IEC 320 C20
AC input voltage	100 - 240 VAC, 50/60 Hz, single phase
AC input current	15 - 7A
Power consumption	1400W maximum
Heat dissipation	4760 Btu/hr maximum

Table 2-8 outlines the electrical specifications of the optional AC power shelf that you can use for powering your Cisco 6400 in lieu of the DC input power distribution system in the Central Office (CO) environment. The AC power shelf provides the required –48 VDC source voltage for the DC PEM.

Table 2-8   Cisco 6400 AC Power Shelf Power Ratings

Characteristic	Description
AC inlet power connector	IEC 320 C20
AC input voltage	200 - 240 VAC, 50/60 Hz, single phase
AC input current	6A

Table 2-8   Cisco 6400 AC Power Shelf Power Ratings

Characteristic	Description
Power consumption	1400W maximum
Heat dissipation	4760 Btu/hr maximum

Electromagnetic Interference Considerations

When signal wires are run for any significant distance, two types of interference can be induced on the wires:

- Radio frequency interference (RFI)
- Electromagnetic interference (EMI)

Strong EMI, especially when caused by lightning or nearby radio transmitters, can destroy the signal drivers and receivers in the Cisco 6400 and even create an electrical hazard by conducting power surges through power lines into installed equipment.

Note   To prevent or remedy interference problems, you may need to consult RFI/EMI experts.

If signal wires exceed recommended cabling distances, or if signal wires pass between buildings, you should give special consideration to the effect that a lightning strike in your vicinity might have on electrical equipment.

The electromagnetic pulse (EMP) generated by lightning or other high-energy phenomena can couple enough energy into unshielded conductors to damage or destroy electronic equipment. If you have previously experienced such problems, you should consult with RFI/EMI experts to ensure that you have adequate electrical surge suppression and shielding of signal cables in your Cisco 6400 operating environment.

Most data centers cannot avoid the infrequent, but potentially catastrophic, problems described above without using pulse meters and other special equipment. Identifying and resolving such potential problems can consume substantial time and money. Nevertheless, you should ensure that you have a properly grounded and shielded electrical environment, paying special attention to the need for electrical surge suppression.

Cisco 6400 Mounting Options

The Cisco 6400 can be mounted in the following ways:

- Flush-mounting in a 19-inch equipment rack
- Center-mounting in a 19-inch equipment rack
- Center-mounting in a 23-inch equipment rack
- Alternate mounting arrangements, such as shelf mounting

> **Note** Alternate mounting arrangements cannot be used when the Cisco 6400 chassis is used with its optional AC power shelf. When used with the AC power shelf, 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 can never be mounted on the floor.

For a detailed description of the mounting options for the Cisco 6400, refer to the *Cisco 6400 Hardware Installation and Maintenance Guide.*

Rack Selection Guidelines

Cisco recommends that you obtain an equipment rack that has the following characteristics:

- NEBS compliant, 19-inch (48.3 cm) wide rack; or NEBS compliant 23-inch (58.4 cm) wide rack.

  To center-mount a Cisco 6400 in a 23-inch telco rack, an optional 19-inch/23-inch Rack Adapter Kit (Part Number C6400-23Adpt-Set=) is required. Use your standard ordering procedures to obtain this kit from Cisco.

  For a description of this hardware and the rack mounting procedure, refer to the *Cisco 6400 Hardware Installation and Maintenance Guide.*

- RETMA hole patterns in the mounting rails. Required mounting hardware (screws, clip nuts, and dress washers) are shipped with your Cisco 6400. If the rack in which you plan to install your Cisco 6400 has metric-threaded rails, you must provide your own metric mounting hardware.

- Leveling feet.

- Perforated top (for ventilation).

- Open bottom.

- Solid side panels.

- Front and rear doors (optional)—If present, the doors must be fully louvered to ensure adequate ventilation.

> **Note** Ensure rack stability when you are installing your Cisco 6400. The rack/Cisco 6400 combination should comply with UL Standard 1950, Par. 4.1.1 and IEC 950, 4.1.1. You should install heavy equipment at or near the bottom of the rack to lower the center of gravity and enhance rack stability.

If you already have an equipment rack that meets these basic requirements, you should review its present location at your site, giving full consideration to the Cisco 6400 installation guidelines and requirements provided in this document.

Rack Placement Guidelines

You should allow at least 3 to 4 feet of clearance in front of the rack for normal system maintenance and for removing and inserting the following Cisco 6400 components:

- Node switch processors (NSPs)

- Node route processors (NRPs)

- Node line cards (NLCs)

- Power entry modules (PEMs)
- Fan assembly

Cisco 6400 Installation Guidelines

These guidelines are based on the assumption that you will be mounting your Cisco 6400 in a standard telco rack.

The Cisco 6400 is equipped with an internal blower module that draws ambient air into the unit from the bottom front and sides of the chassis and exhausts it out the top rear and sides of the chassis. (See Figure 2-3.) This ambient airflow pattern through the Cisco 6400 must be maintained at all times to ensure normal system operation and to prevent overtemperature conditions within the chassis.

To minimize the potential for thermal problems, you should place the chassis in the rack so that the air intake at the bottom front of the enclosure (see Figure 2-3) is not near the exhaust vents of other equipment. Similarly, you should ensure that the Cisco 6400 exhaust vent at the top rear of the enclosure (see Figure 2-3) is not near the air intake of other adjacent equipment.

Figure 2-3   Path of Cooling Air through the Cisco 6400
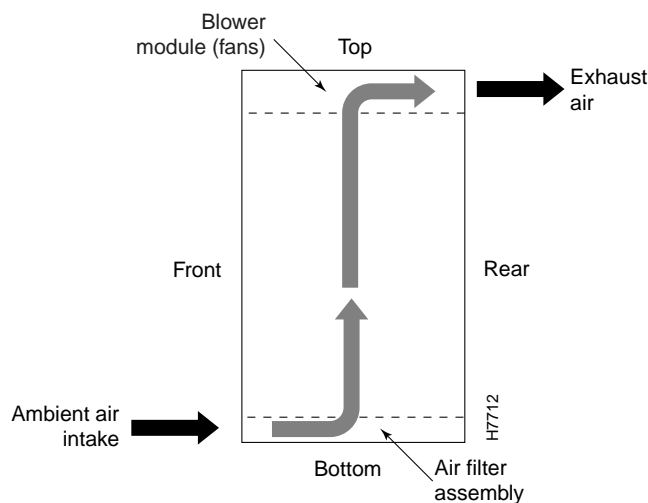
Side panels can be installed in a rack that is housing a Cisco 6400 without posing potential overheating problems for the system, but the air intake on the bottom front of the chassis and the exhaust vents at the top rear of the chassis should not otherwise be blocked or restricted.

If the ambient air being drawn into the chassis is blocked, restricted, or too warm, an overtemperature condition can occur within the system. Under extreme conditions, an internal environmental monitoring facility will shut down the system to protect its internal circuitry.

Overtemperature conditions within the Cisco 6400 can occur under any of the following circumstances:

- The rack housing the Cisco 6400 does not permit adequate ventilation.
- The exhaust air from adjacent equipment is being drawn into the Cisco 6400.
- The Cisco 6400 is installed at the top of an unventilated rack.

A temperature or humidity level that approaches the limits specified in Table 2-1 should be regarded as a potential problem. To help ensure normal system operation following Cisco 6400 installation, you should anticipate and correct any potential environmental anomalies before the system is delivered.

Rack Mounting Considerations

You should observe the following guidelines when installing the Cisco 6400 in a telco rack:

- Avoid installing the Cisco 6400 in an overly congested rack.

  The ambient air intake for the Cisco 6400 chassis is located at the bottom front of the enclosure. (See Figure 2-3.) The exhaust vent is located at the top rear of the enclosure.

  This pattern of airflow through the chassis enables multiple Cisco 6400s to be mounted in a rack with little or no vertical separation between them. However, the presence of other equipment in the rack with different airflow patterns should be taken into account in determining the best placement of your Cisco 6400. For example, you should ensure that exhaust air from other equipment in the same or an adjacent rack is not directed toward the ambient air intake at the bottom front of the Cisco 6400.

- Take into account any other equipment installed in the rack and the routing of associated interface cables for the equipment.

  Ensure that cables from other equipment will not obstruct the flow of cooling air through the Cisco 6400 or impair access to its installed components.

  Route interface cables away from any installed field-replaceable units (FRUs), if possible, so that you do not need to disconnect cables from the Cisco 6400 FRUs to perform equipment maintenance or upgrades.

  You should also take into account the interface cables associated with the Cisco 6400 and how such cables should be arranged in the presence of interface cables for other equipment installed in the same or an adjacent rack.

- Install the heaviest equipment at or near the bottom of the rack to ensure the lowest possible center of gravity for all the equipment in the rack.

- Ensure that the equipment shelf, if you plan to use one, is constructed to accommodate the weight and dimensions of the Cisco 6400.

  Refer to Figure 2-2 for the chassis footprint that you must take into account if you plan to use a customized shelf for rack-mounting the Cisco 6400.

- Mount the Cisco 6400 at the bottom of the rack if it is the only piece of equipment to be installed in the rack.

- If stabilizing devices are available for the rack in which you plan to install the Cisco 6400, secure them before rack-mounting the system.

In addition to the guidelines outlined above, review the precautions for avoiding overtemperature conditions in the "System Ventilation Precautions" section on page 2-20.

For additional information about the proper placement of electronic equipment in your site, consult the document *GR-63-CORE, Network Equipment-Building System (NEBS) Requirements: Physical Protection.*
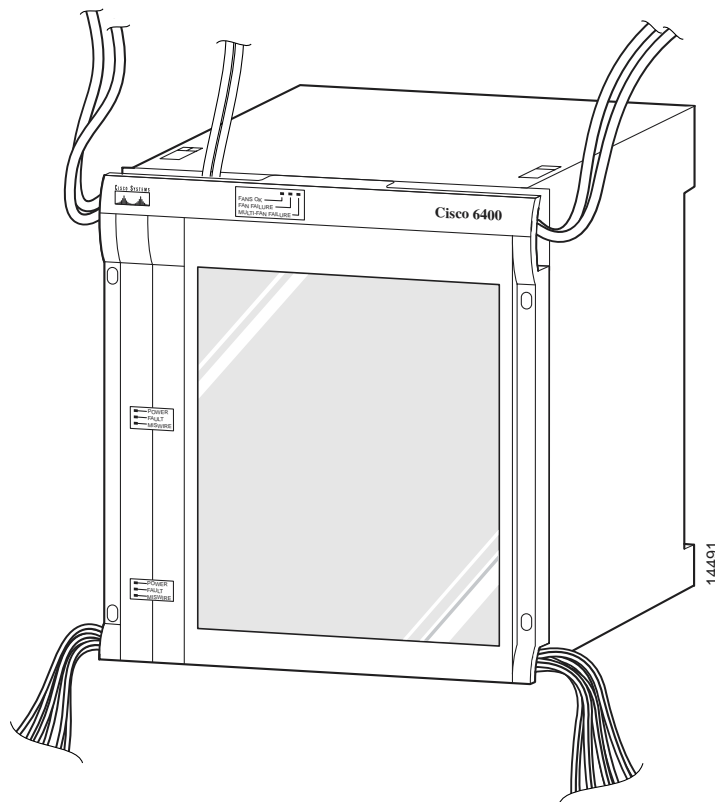
Routing of Interface Cables

When you choose a rack location for installing your Cisco 6400, take into account the following cable routing requirements:

- Connectivity to the console (CON) and AUX (modem) ports on the node switch processor (NSP) card and the node route processor (NRP) card

- Connectivity to the 10BaseT Ethernet (ETH) port and the 100BaseT Fast Ethernet (FE) port on the NRP card; connectivity to the Ethernet (ETH) port on the NSP card

- Connectivity to the ATM ports on OC-3/STM-1, DS3 and OC-12/STM-4 node line cards (NLCs)

- Connectivity of Cisco 6400 components to associated equipment in the central office (CO), that is, connectivity to equipment in the same rack or adjacent racks, or connectivity to the CO backbone network

Figure 2-4 shows a Cisco 6400 with interface cables of various types routed through openings in the cable cover (smoked plastic bezel) attached to the front of the chassis. This cover not only dresses the front of the Cisco 6400, but also helps you neatly arrange the interface cables and keep them securely connected to chassis components.

Figure 2-4   Typical Interface Cable Routing in the Cisco 6400

The interface cable layout in your Cisco 6400 might differ from that shown in Figure 2-4, depending on the circuit boards installed in the chassis and the termination points of associated interface cables.

Although obscured from view in Figure 2-4 by the cable cover, cable management brackets attached to the top front and bottom front of the Cisco 6400 chassis help you to neatly arrange all of the interface cables attached to individual circuit boards. Figure 1-1 shows the location and physical configuration of these cable management brackets.

Cisco recommends using the top cable management bracket for managing the appropriate interface cables for the console (CON), auxiliary (AUX), 10BaseT (Ethernet), and 100BaseT (Fast Ethernet) ports on NSP cards and NRP cards. Cisco also recommends that you leave a service loop in the interface cables at the top corners of the chassis (see Figure 2-4) so that the cables will not interfere with the insertion or removal of the blower module.

Cisco recommends using the bottom cable management bracket for managing the interface cables associated with the fiber-optic ports on node line cards (NLCs).

For additional information about cable routing requirements within your site, consult the document *GR-63-CORE, Network Equipment-Building System (NEBS) Requirements: Physical Protection.*

For instructions on how to remove the top cable management bracket to service the blower module, refer to the *Cisco 6400 Hardware Installation and Maintenance Guide.*

Integrity of Chassis Enclosure

The Cisco 6400 is designed to operate with all circuit boards, slot filler panels, covers, and components in place and securely attached. When thus secured, an enclosure is formed that accomplishes the following:

- Limits access to hazardous voltages and currents inside the chassis

- Confines electromagnetic interference (EMI) within the chassis

- Helps maintain the proper flow of cooling air through the chassis

Air flow disturbances within the chassis can cause thermal overloading of electronic components and induce system failures.

Caution   Do not operate the Cisco 6400 without securing all line cards, bulkheads, slot filler panels, covers, and components to the chassis. You should operate the system so as to limit access to hazardous voltages and currents, prevent EMI radiation outside the chassis, and maintain the flow of cooling air through the chassis.

Cabling Requirements

This section outlines the cabling requirements for your Cisco 6400.

Before installing the Cisco 6400, you should have all interface cables and any additional required interface equipment on hand.

If you intend to build your own interface cables, you can refer to the cable pinouts detailed in Appendix B, "Cabling Specifications."

Determining Cable Distances

The extent of your network and the distances between network interface connections depend in part on the following factors:

- Signal type

- Signal speed

- Transmission medium

The distance and rate limits referenced in the following sections are the IEEE-recommended maximum speeds and distances for signaling purposes. You should use this information as a guideline in planning your network connections *prior to* Cisco 6400 installation.

Setting Up Ethernet and Fast Ethernet Connections

The maximum distances for Ethernet and Fast Ethernet network segments and connections depend on the type of transmission cable being used. The terms *10BaseT* and *100BaseT* are industry shorthand nomenclature for the following:

- 10 Mbps transmission rate (*10*), or 100Mbps transmission rate (*100*)

- Using baseband technology (*Base*)

- By means of twisted pair wires (*T*)

Table 2-9 shows the maximum transmission distances between stations for Ethernet and Fast Ethernet connections.

Table 2-9   Ethernet and Fast Ethernet Maximum Transmission Distances

Transceiver Speed	Cable Type	Transmission Mode	Maximum Distance between Stations
10 Mbps	Category 3	Full and half duplex	328 feet (100 meters)
100 Mbps	Category 5	Full and half duplex	328 feet (100 meters)

Setting Up Fiber-Optic Connections

The specifications for single-mode, fiber-optic transmissions are outlined in Table 2-10 and Table 2-11.

Table 2-10   OC-3 Fiber-Optic Transmission Characteristics

Characteristic	Permissible Value
Transmitter output power	–14 to –8 dBm
Receiver sensitivity	–32.5 to –8 dBm
Wavelength	1261 to 1360 nm
Maximum span	9 miles (14.5 km)

Table 2-11   OC-12 Fiber-Optic Transmission Characteristics

Characteristic	Permissible Value
Transmitter output power	–15 to –8 dBm
Receiver sensitivity	–28 to –8 dBm
Wavelength	1261 to 1360 nm
Maximum span	9 miles (14.5 km)

Estimating the Power Budget

Statistical models can determine the power budget more accurately than the worst-case method. Determining the link loss with statistical methods requires accurate knowledge of variations in the data link components.

Statistical power budget analysis is beyond the scope of this publication. For further information about estimating the power budget, you can refer to the following:

- User-Network Interface (UNI) Forum specifications
- ITU-T standards
- Equipment specifications

Note The International Telecommunications Union Telecommunications Standardization Sector (ITU-T) carries out the functions of the former Consultative Committee for International Telegraph and Telephone (CCITT).

Refer to the following publications for more information on determining attenuation and power budget:

- T1E1.2/92-020R2 ANSI, the Draft American National Standard for Telecommunications entitled Broadband ISDN Customer Installation Interfaces: Physical Layer Specification
- AT&T Technical Note, TN89-004LWP, Power Margin Analysis

Approximating the Module Power Margin

In a worst-case estimate of power margin (PM) for single-mode transmissions, the following assumptions are made:

- Minimum transmitter power (PT)
- Maximum link loss (LL)
- Minimum receiver sensitivity (PR)

The worst-case analysis provides a margin of error, although not all parts of an actual system will operate at worst-case levels.

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

PB = PT – PR

PB = – 14 dBm – 32.5 dBm

PB = 18.5 dB

The power margin is equal to the power budget, minus the link loss:

PM = PB – LL

When the power margin is calculated, the result should be greater than zero to ensure that the link will work. A result of less than zero indicates that there is not enough power to operate the receiver.

Table 2-12 lists the factors that contribute to link loss and the estimate of the link-loss value attributable to each factor.

Table 2-12   Estimating Link Loss

Link Loss Factor	Estimate of Link Loss Value
Connector	0.5 dB
Splice	0.5 dB
Fiber attenuation	0.5 dB/km

Table 2-13 lists the link attenuation and dispersion limit for a typical fiber-optic link.

Table 2-13   Typical Fiber-Optic Link Attenuation and Dispersion Limits

Characteristic	Single-Mode Fiber
Attenuation	0.5 dB
Dispersion limit	No limit

Single-Mode Power Budgeting

The power budget (PB) for single-mode, fiber optic transmission is equal to the maximum possible amount of power transmitted.

Below is an example of single-mode, power budget calculations with sufficient power for transmission, based on the following variables:

- Length of single-mode link is 12 kilometers (km)
- Eight connectors
- Three splices

Given these variables, you can estimate the power margin as follows:

PM = PB – LL

PM = 18.5 dB – 12 km (0.5 dB/km) – 8 (0.5 dB) – 3 (0.5 dB)

PM = 18.5 dB – 6 dB – 4 dB – 1.5 dB

PM = 7.0 dB

The 7.0 dB value indicates that this link would have sufficient power for transmission.

Setting Up Serial Connections

Serial signals travel a limited distance at any given baud rate—the slower the baud rate, the greater the distance of the connection.

Table 2-14 shows the relationship between the baud rate and the distance of EIA/TIA-232 signals.

Table 2-14   Baud Rate Versus Transmission Distance

Baud Rate (bps)	Distance (feet)	Distance (meters)
2400	200	60
4800	100	30

Table 2-14   Baud Rate Versus Transmission Distance

Baud Rate (bps)	Distance (feet)	Distance (meters)
9600	50	15
19,200	25	7.6
38,400	12	3.7
56,000	8.6	2.6

System Grounding Requirements

The bottom rear edge of the Cisco 6400 enclosure (see Figure 2-5) contains six threaded holes that are used as follows:

- The rightmost threaded hole is used for attaching a jumper ground wire between the optional AC power shelf and the Cisco 6400 chassis. This is a single-hole grounding lug.

- The second and third threaded holes from the right provide a system grounding connection for the Cisco 6400. These holes accommodate a 2-hole lug for firmly securing the grounding wire in place and preventing it from twisting.

- The three leftmost threaded holes are used to attach the safety cover of the optional AC power shelf to the Cisco 6400 chassis.

- The AC PEM includes the safety ground in the AC cable. Additional facility grounds may be added to the rear 2-hole lug as required for the site grounding plan. (See .)

You should complete this grounding connection before applying power to the Cisco 6400.

Note   The Cisco 6400 is compatible with customer sites that use either isolated or common bonding networks.

Figure 2-5   System Grounding Holes on the Cisco 6400 Enclosure
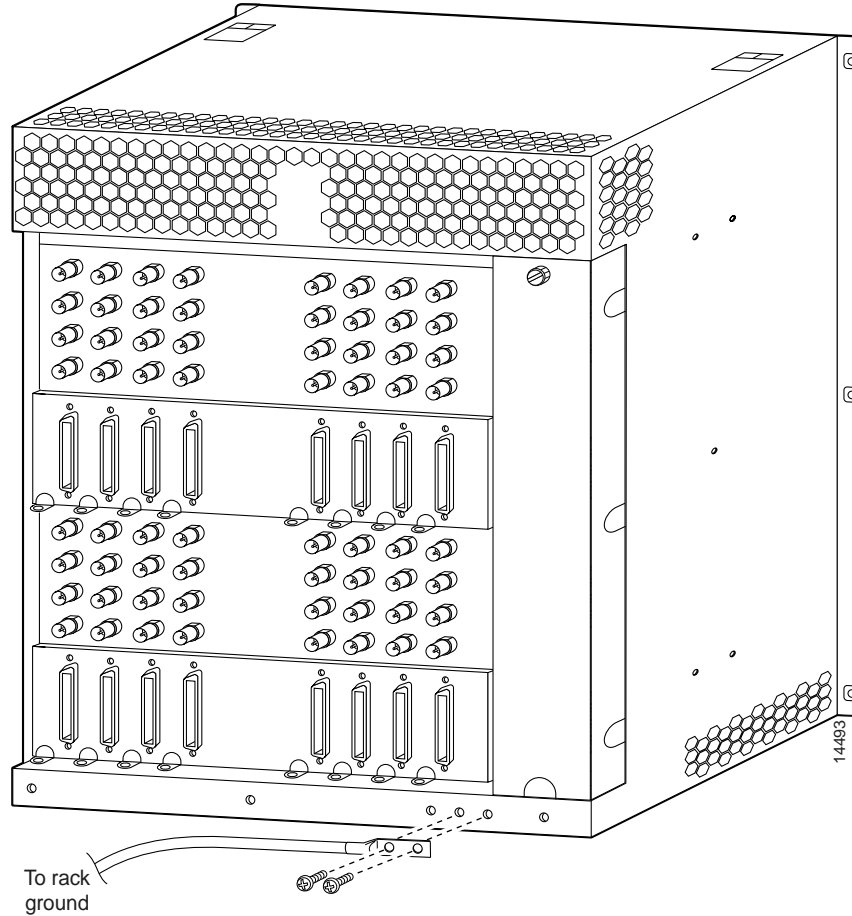
Safety Guidelines

This section alerts you to important safety and operating precautions that you should keep in mind during the installation and operation of your Cisco 6400.

Lifting Precautions

A Cisco 6400 chassis that is populated with two PEMs and a full complement of circuit boards weighs approximately 130 pounds (59.02 kg). You should exercise extreme care in lifting and moving the Cisco 6400.

⚠ **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 the lower edge.**

Warning   **Two people are required to lift the chassis. To prevent injury, keep your back straight and lift with your legs, not your back.**

Cisco recommends that two individuals lift the Cisco 6400 when it is to be moved within your site or to be installed in an equipment rack. Figure 2-6 illustrates the proper lifting techniques for handling the Cisco 6400.

In grasping the Cisco 6400 from the front, you should first remove the bottom cable management bracket (if present), remove the air filter assembly (if present), and insert your hand into the air intake opening.

In grasping the rear of the Cisco 6400, you should place your other hand beneath the exhaust vent at the top rear of the enclosure to support the weight of the chassis.

Figure 2-6   Proper Lifting Techniques for Handling the Cisco 6400
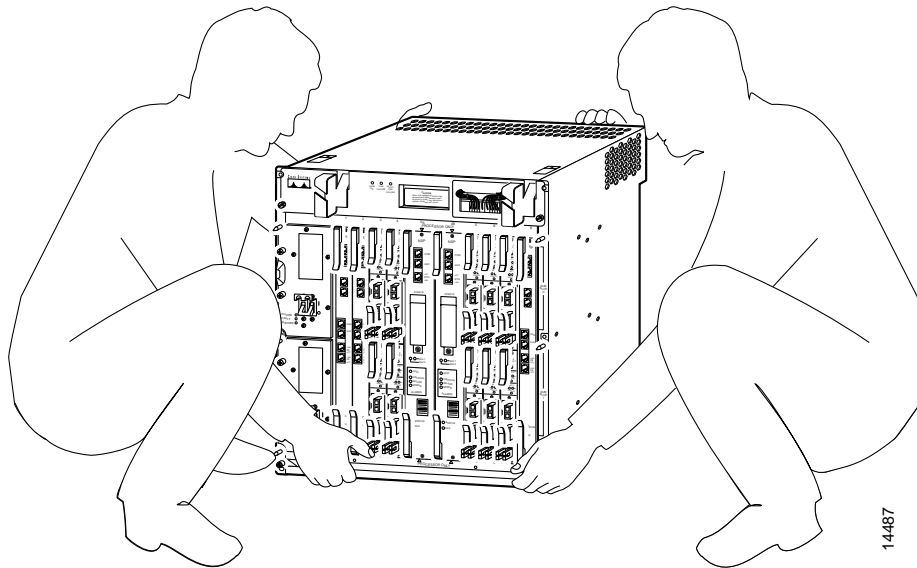
Operating Precautions

Keep the following precautions in mind when you plan equipment locations, perform system maintenance, or remove/install Cisco 6400 components:

- The Cisco 6400 environmental monitor continuously checks the interior environment of the Cisco 6400 and provides warnings for high temperature conditions.

    If warning messages are displayed, take immediate action to identify the cause and correct the problem. Use the **show environment** command regularly on the NSP to check the internal status of the Cisco 6400.

- Keep the front of the Cisco 6400 free from obstructions and away from the exhaust air of other installed equipment.

    Electrical equipment generates heat, and ambient room temperature alone might not be sufficient to keep equipment within acceptable operating temperatures.

- Follow proper electrostatic discharge (ESD) prevention procedures when you are installing and/or removing Cisco 6400 components.

To prevent ESD damage to Cisco 6400 components, always wear an ESD wrist strap connected to the ESD socket on the front of the Cisco 6400 when you are installing or removing circuit boards. (See Figure 2-7.)

The discharge of static electricity during the handling of Cisco 6400 circuit boards can cause immediate or intermittent system failure.

- Ensure that chassis panels, circuit boards, and slot filler panels are in place, seated firmly, and secured.

The fan assembly directs cooling air throughout the interior of the Cisco 6400. An unsecured or missing slot filler panel can cause cooling air to be misdirected, reducing the flow of cooling air across installed circuit boards.

Figure 2-7   Using an ESD Wrist Strap
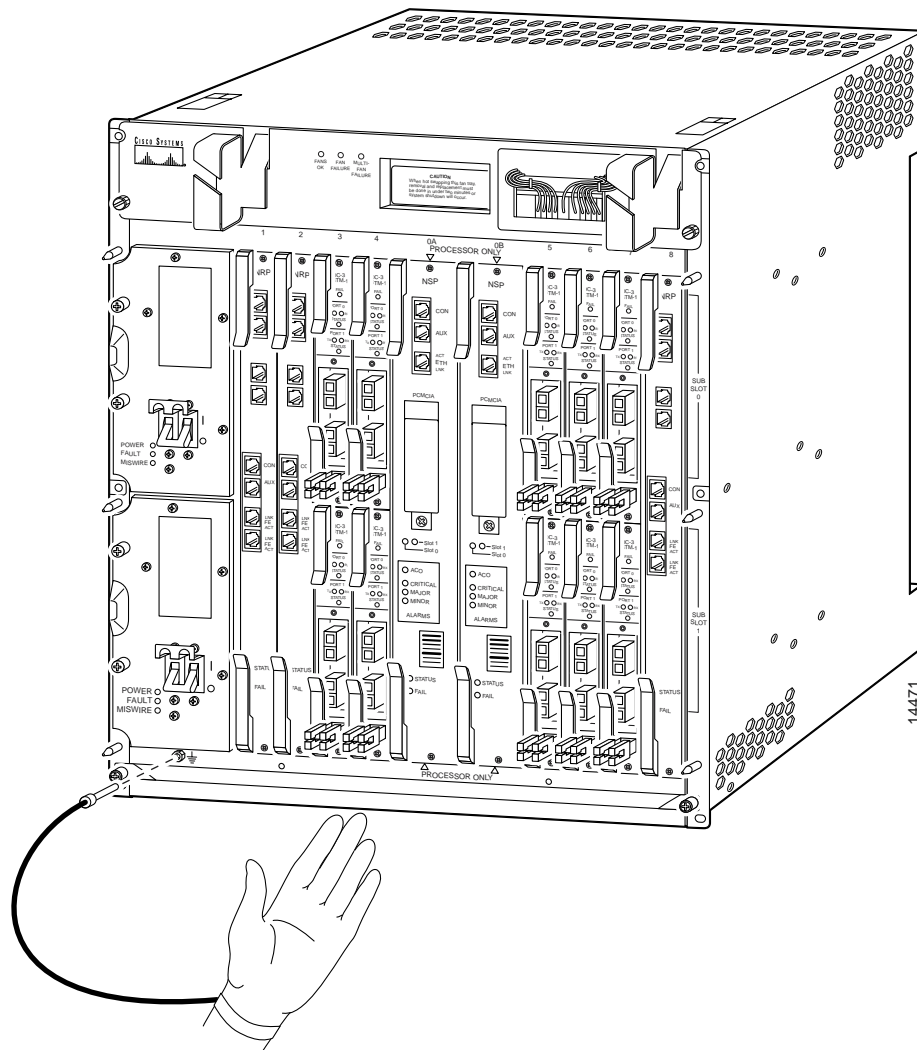
System Ventilation Precautions

When installing the Cisco 6400 in an equipment rack, you should observe the following precautions to avoid internal overtemperature conditions:

- Install the chassis in an enclosed rack only if the rack has adequate ventilation or an exhaust fan. Whenever possible, use an open rack for installing the Cisco 6400.

- A ventilation system for a closed rack that is too powerful may prevent adequate cooling of the Cisco 6400 by creating negative pressure and redirecting the airflow away from the air intake at the bottom front of the chassis. If possible, operate the Cisco 6400 using an open rack.

- The use of baffles inside an enclosed rack can help keep the Cisco 6400 cool.

- Equipment near the bottom of a rack may generate excessive heat that can rise into the equipment above, potentially causing overtemperature conditions in such equipment.

System Specifications

Table A-1 lists the system specifications for the Cisco 6400 carrier-class broadband aggregator.

Table A-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 NLC: 7.0 in. x 1.2 in. x 10.0 in. (17.7 cm x 3.0 cm 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) (See *Cisco 6400 Hardware Installation and Maintenance Guide, Appendix D* for AC power shelf ratings)
AC current rating (input)	15A @ 100 VAC, 7A @ 240 VAC, using AC PEM (See *Cisco 6400 Hardware Installation and Maintenance Guide, Appendix D* for AC power shelf ratings)

Table A-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, 20 MB FlashDisk card (C6400-NSP-1) Upgradeable to 128 MB DRAM (MEM-NSP-128M) Upgradeable with 350 MB Flash disk (MEM-NSP-FD350)
Node route processor (NRP)	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)
Full-height node line card (NLC) carrier module	Carrier module for 2 half-height NLCs with covers for empty slots installed (C6400-CARRIER)
OC-3/STM-1 NLC	NLC with 2 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 Transmit Receive	1261 to 1360 nm^4 Minimum: −14.0 dBm Maximum: −8.0 dBm Minimum: −32.5 dBm Maximum: −8.0 dBm
DS3 NLC	NLC with 2 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 1 SONET STS-12c/SDH STM-4 single-mode intermediate reach fiber ports, SC connector (NLC-1OC12-SM)

Table A-1   Cisco 6400 Specifications (continued)

Description	Specifications
Fiber-optic power levels: OC-12 single-mode intermediate reach Output center wavelength Transmit Receive	 1261 to 1360 nm Minimum: −15.0 dBm[5] Maximum: −8.0 dBm Minimum: −28.0 dBm Maximum: −8.0 dBm
NSP interface ports	RJ-45 IEEE 802.3 Ethernet 10BaseT 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

Table A-1   Cisco 6400 Specifications (continued)

Description	Specifications
Maximum station-to-station cabling distance	10BaseT Ethernet—Category 3-5 UTP: 328 ft (100 m) ATM single-mode—8/125-micron single-mode fiber: 9 miles (15 km)
Agency Approvals	Safety: UL 1950, CSA-C22.2 No. 950-95, EN60950, ACA TS001, AS/NZS 3260, IEC 950, NOM 019, Laser Safety: 21CRF1040, Subchapter J, EN60825-1, EN60825-2
	Emission: 47CFR15 Class A (FCC), CISPR22 Class B, EN55022 Class B, AS/NZS 3548 Class B, ICES-003 Class B, VCCI Class B, BSMI (CNS 13438) Class B, 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
	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, use of shielded interconnection cables for the 100BaseT ports is highly recommended. In addition, use of shielded interconnection cables for the 100BaseT ports is required to meet Bellcore GR1089 CORE Section 4.5.9 and ETSI section 5.2.2.2 (intrabuilding lightning surge).

Cabling Specifications

This appendix shows the cards that can be inserted into appropriate slots in the front of the Cisco 6400 carrier-class broadband aggregator chassis and summarizes the pinouts for the associated ports and interface cables. It also shows other important connection facilities that are built into the backplane of the Cisco 6400.

Node Switch Processor

Figure B-1 shows the Cisco 6400 node switch processor (NSP).

Figure B-1   Cisco 6400 NSP Card
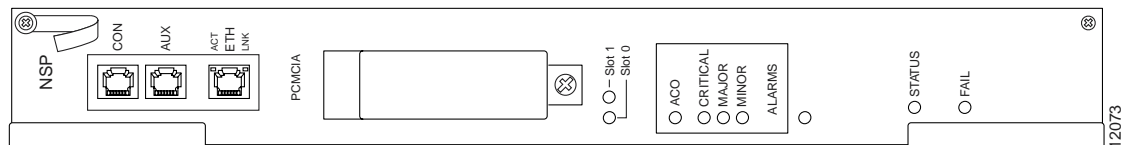
NSP Console Port

The NSP console (CON) port is a serial EIA/TIA-232 interface. Table B-1 lists the signals for this connector.

Table B-1   NSP CON 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

> **Note** The NSP console port 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.

NSP Auxiliary Port

The NSP auxiliary (AUX) port supports hardware flow control and modem control. Table B-2 lists the signals for this connector.

Table B-2   NSP AUX 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)

NSP Network Management Ethernet Port

The NSP network management Ethernet (ETH) port provides for out-of-band network management for the NSP. Table B-3 lists the signals for this connector.

Table B-3   NSP ETH 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 Processor

Figure B-2 shows the Cisco 6400 node route processor (NRP).

Figure B-2   Cisco 6400 NRP Card
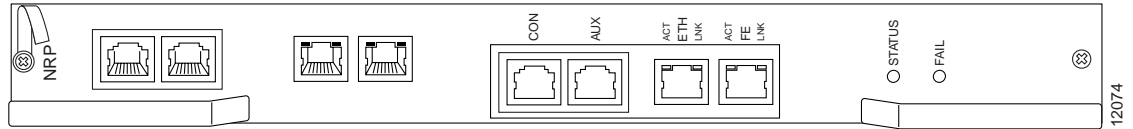
NRP Console Port

The NRP console (CON) port is a serial EIA/TIA-232 interface. Table B-4 lists the signals for this connector.

Table B-4   NRP CON 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 NRP console port 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.

NRP Auxiliary Port

The NRP auxiliary (AUX) port supports hardware flow control and modem control. Table B-5 lists the signals for this connector.

Table B-5   NRP AUX 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)

Table B-5   NRP AUX Port Connector Signals

Pin	Signal	Direction	Description
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)

NRP Network Manangement Ethernet Port

The NRP network management Ethernet (ETH) port provides for out-of-band network management for the NRP. Table B-6 lists the signals for this connector.

Table B-6   NRP ETH 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

NRP Fast Ethernet Port

The Fast Ethernet (FE) port can be used to connect the NRP to a 100BaseT LAN. Table B-7 lists the signals for this connector.

Table B-7   NRP FE 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 –

Table B-7   NRP FE Port Connector Signals

Pin	Signal	Direction	Description
7	NC	—	No connection
8	NC	—	No connection

Note   The 100BaseT (FE) port on the NRP does not meet the requirements of Bellcore GR 1089 Core, Section 4.5.9 (intrabuilding lightning surge) with unshielded twisted pair cabling attached. Therefore, if the Cisco 6400 is used in an environment where lightning-induced transients are likely to couple to the signal lines, the use of shielded interconnection cables for the 100BaseT port is required.

OC-3 Node Line Card

Figure B-3 shows the Cisco 6400 OC-3 node line card (NLC).

Figure B-3   Cisco 6400 OC-3 NLC Card
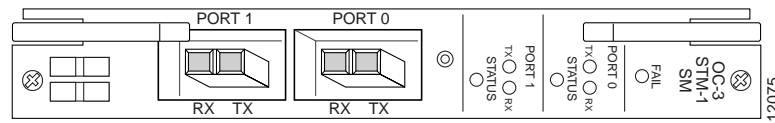
OC-3 Node Line Card Interface Cable

Figure B-4 shows the fiber-optic interface cable for the OC-3/STM-1 NLC used with the Cisco 6400.

Figure B-4   Fiber-Optic Interface Cable for Cisco 6400 OC-3 NLC
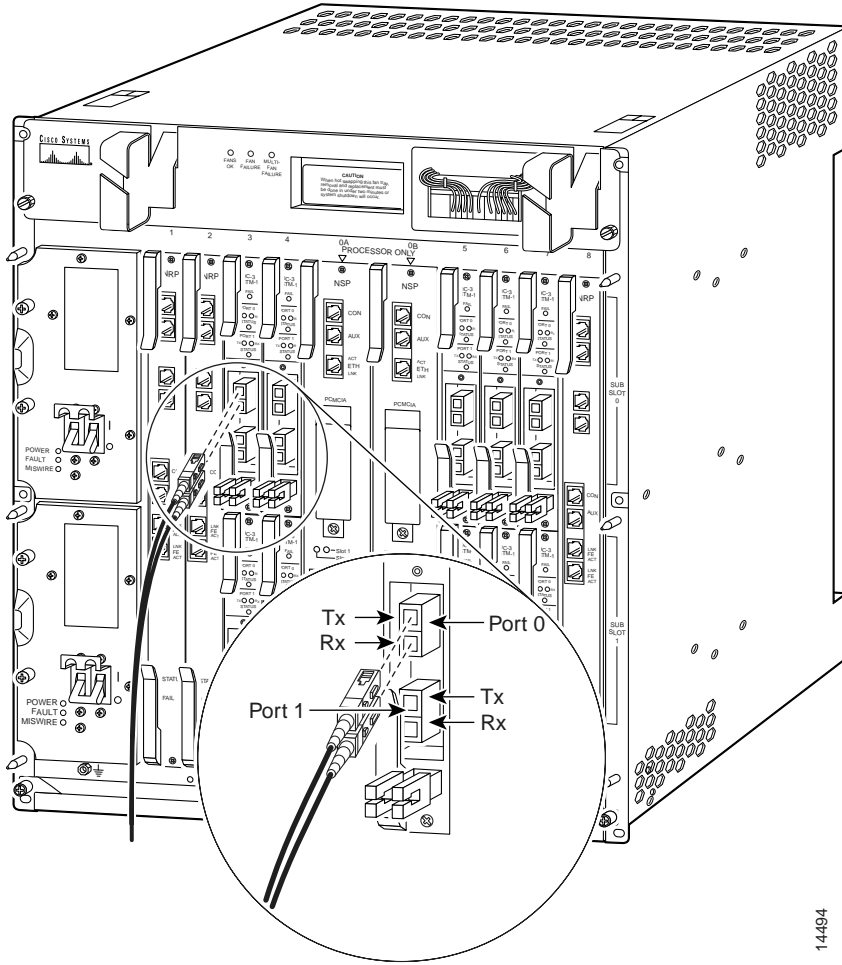
Figure B-5 shows suggested cable management for the OC-3/STM-1 fiber-optic cable.

Figure B-5   OC-3 Fiber-Optic Cable Management
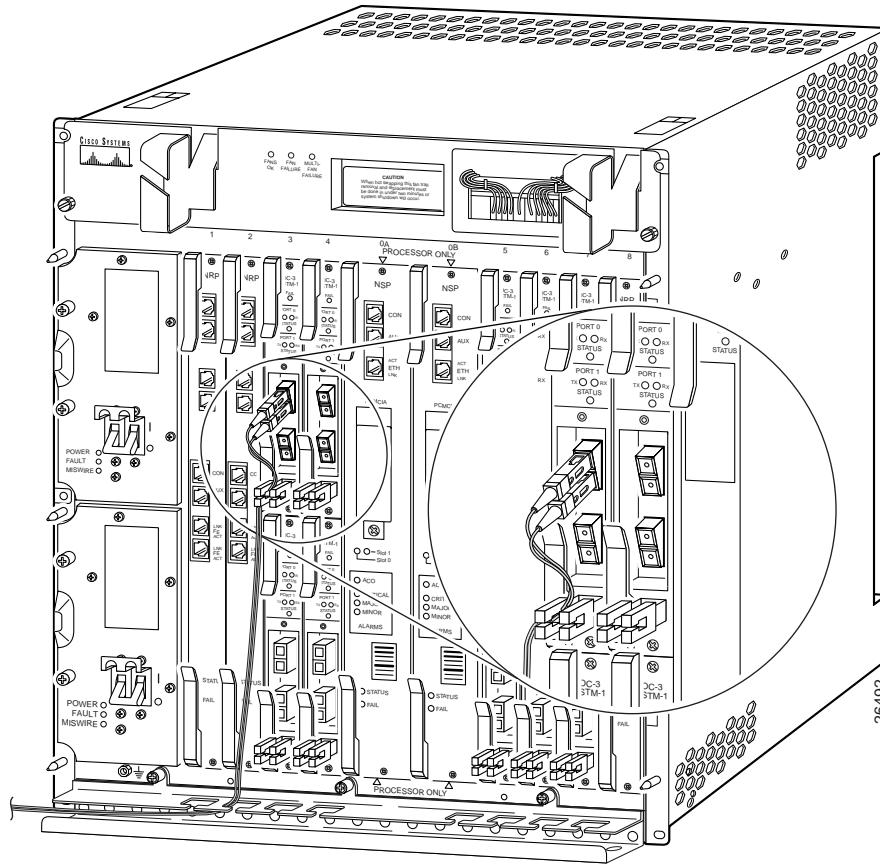
DS3 Node Line Card

Figure B-6 shows the Cisco 6400 DS3 NLC (in a horizontal orientation).

Figure B-6   Cisco 6400 DS3 NLC Card
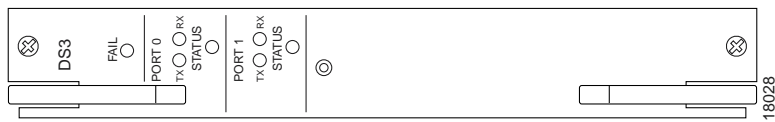
DS3 Node Line Card Interface Cable

Figure B-7 shows the coaxial interface cable for the DS3 NLC used with the Cisco 6400.

Figure B-7   Coaxial Interface Cable for Cisco 6400 DS3 NLC
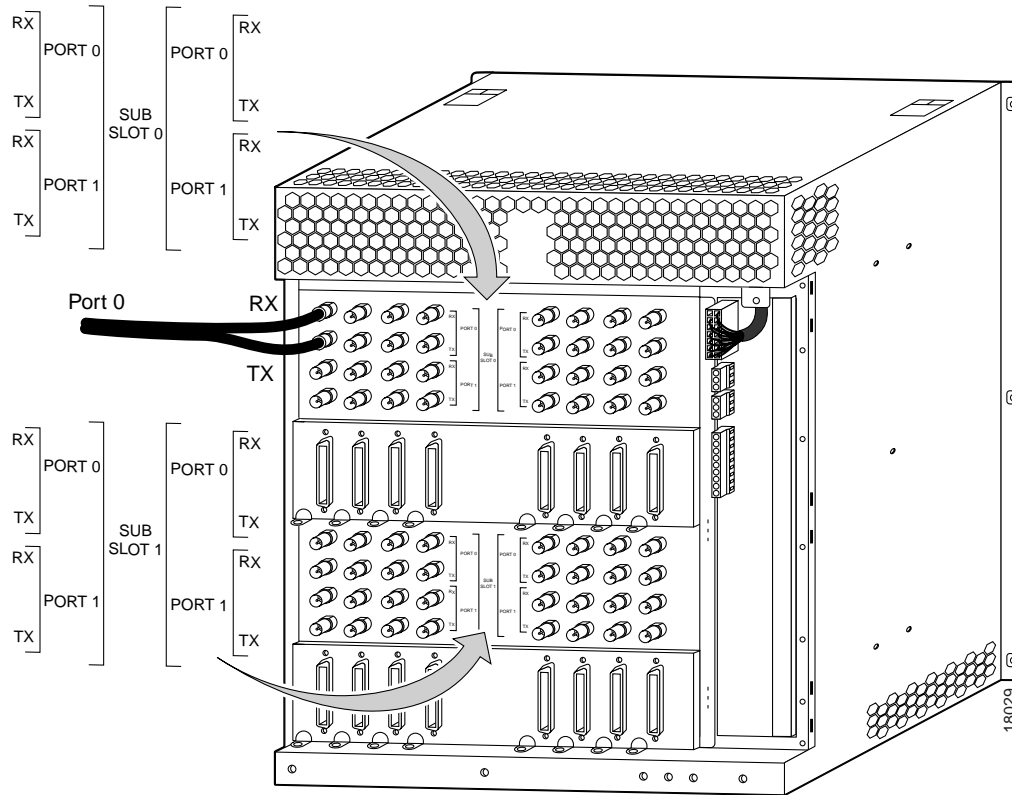
OC-12 Node Line Card

Figure B-8 shows the Cisco 6400 OC-12 NLC (in a horizontal orientation).

Figure B-8   Cisco 6400 OC-12 NLC Card

OC-12 Node Line Card Interface Cable

Figure B-9 shows the fiber-optic interface cable for the OC-12/STM-4 NLC used with the Cisco 6400.

Figure B-9   Fiber-Optic Interface Cable for Cisco 6400 OC-12 NLC
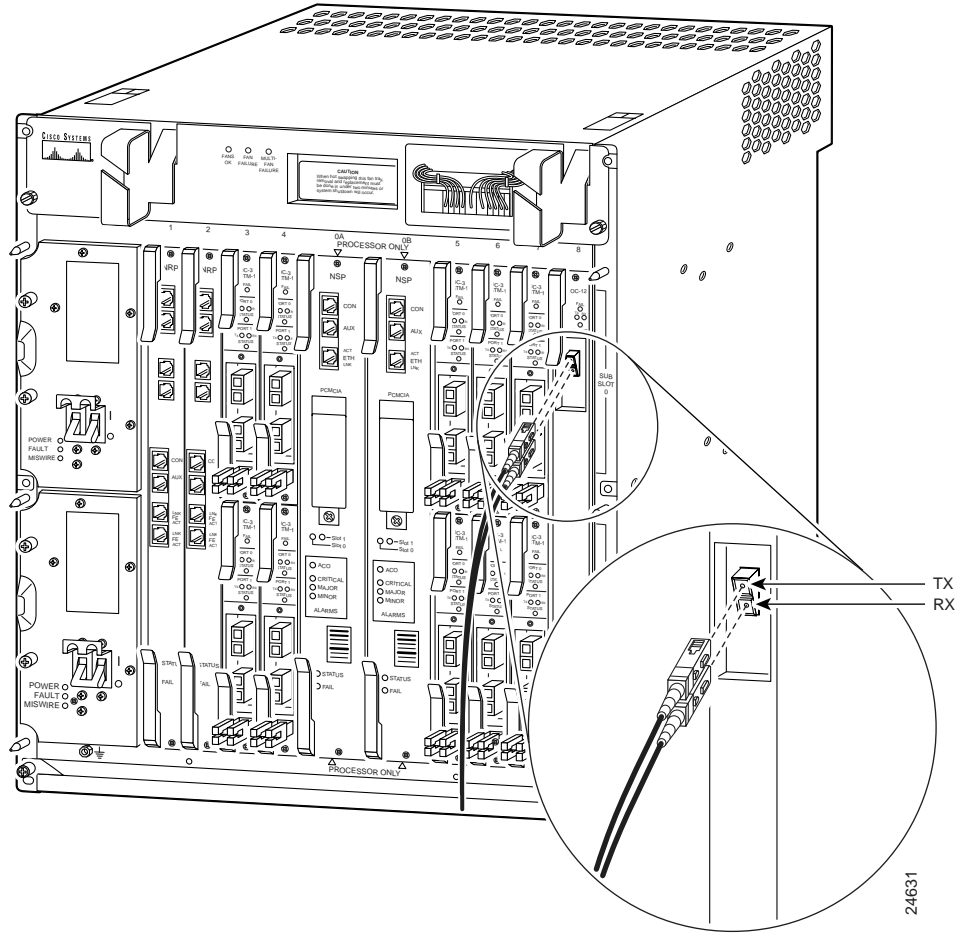
Figure B-10 shows suggested cable management for the OC-12/STM-4 fiber-optic cable.

Figure B-10   OC-12 Fiber-Optic Cable Management
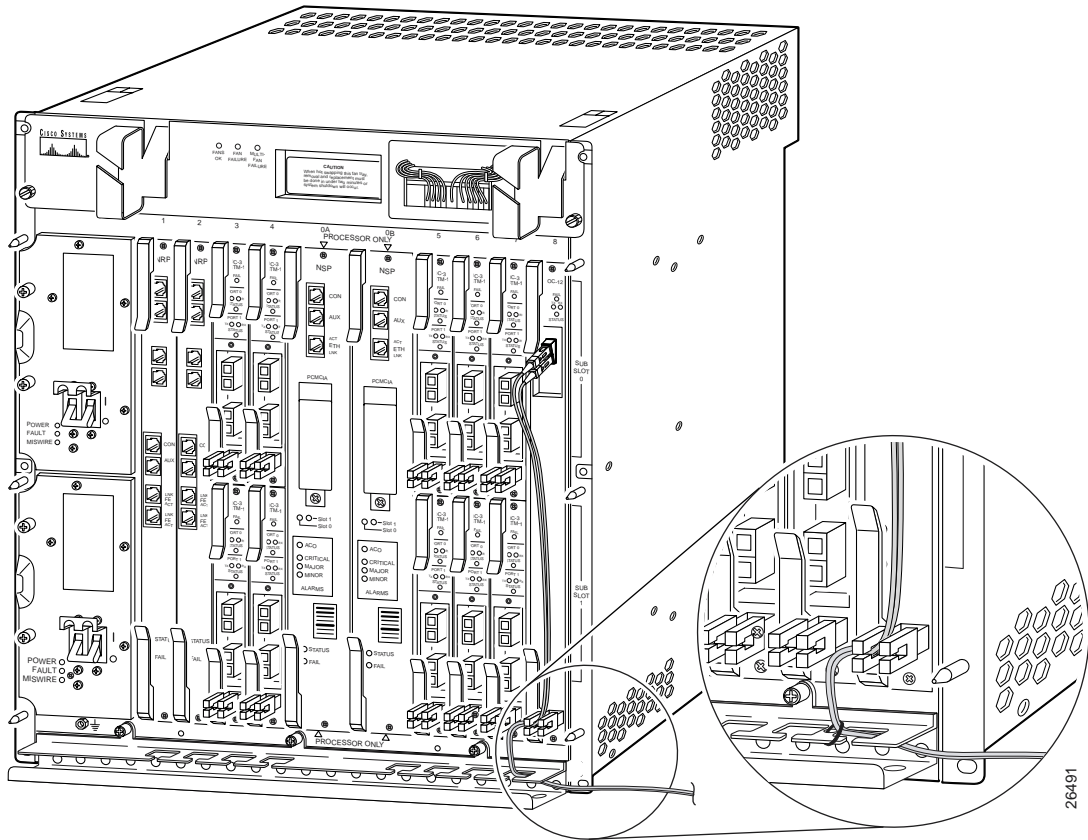
BITS Terminal Blocks on the Cisco 6400 Chassis

Figure B-11 shows the Building Integrated Timing Supply (BITS) terminal blocks on the Cisco 6400 chassis. The bottom BITS terminal block (labeled A) is associated with the NSP-S3B in slot 0A of the Cisco 6400 chassis (see Figure 1-1); the top BITS terminal block (labeled B) is associated with the NSP-S3B in slot 0B of the chassis.

Figure B-11   BITS Terminal Blocks on the Cisco 6400
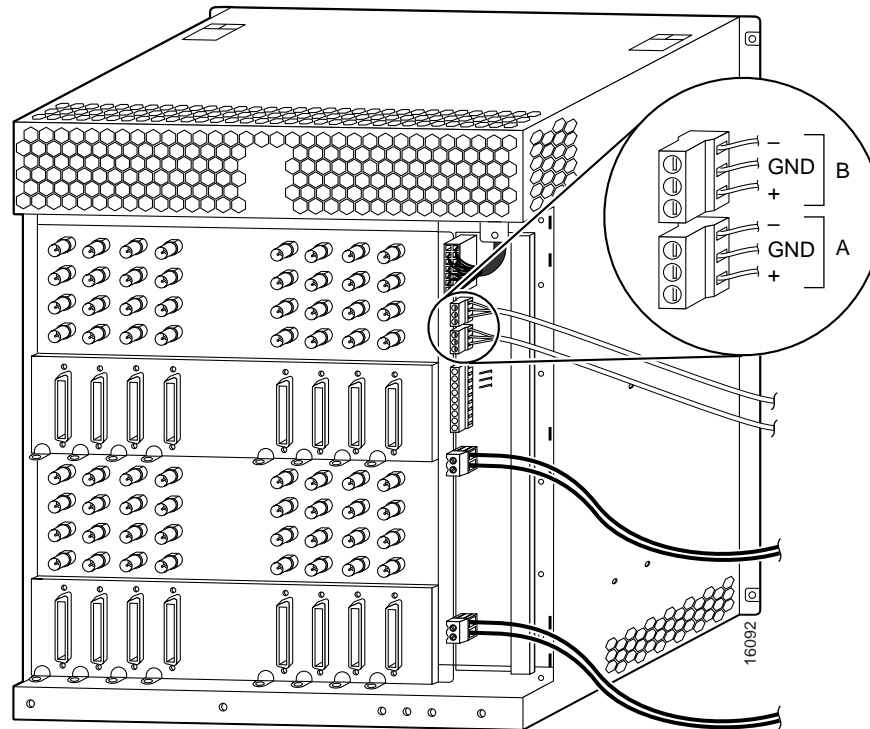
Note   In North America, the positive connection is known as *tip*, and the negative connection is known as *ring*.

Alarm Terminal Block on the Cisco 6400

Figure B-12 shows the external alarm monitoring terminal block on the Cisco 6400. This facility accommodates the attachment of a customer-supplied external alarm monitoring facility to alert site personnel to the existence of an alarm condition in the Cisco 6400.

Figure B-12   Alarm Terminal Block on the Cisco 6400
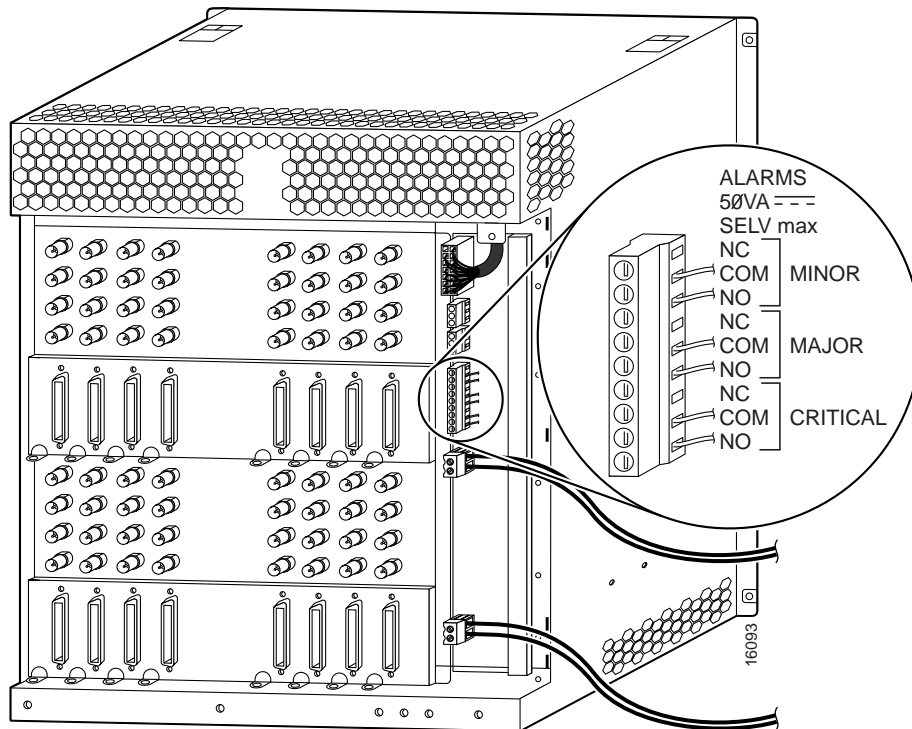
Note   Figure B-12 shows the wiring configuration for normally open (NO) alarm relays. If you wire the Cisco 6400 in series with other equipment for the alarm indicators, use the normally closed (NC) terminal. If you wire the Cisco 6400 in parallel with other equipment, use the NO terminal.

Cisco 6400 DC Power Terminal Blocks

Figure B-13 shows the location of two identical system power terminal blocks on the rear of the Cisco 6400 chassis. These terminal blocks are associated with the power entry module (PEM) bays in the front of the chassis (see Figure 1-1). The upper terminal block services the top PEM bay; the lower terminal block services the bottom PEM bay.

Figure B-13   DC Power Terminal Blocks on the Cisco 6400
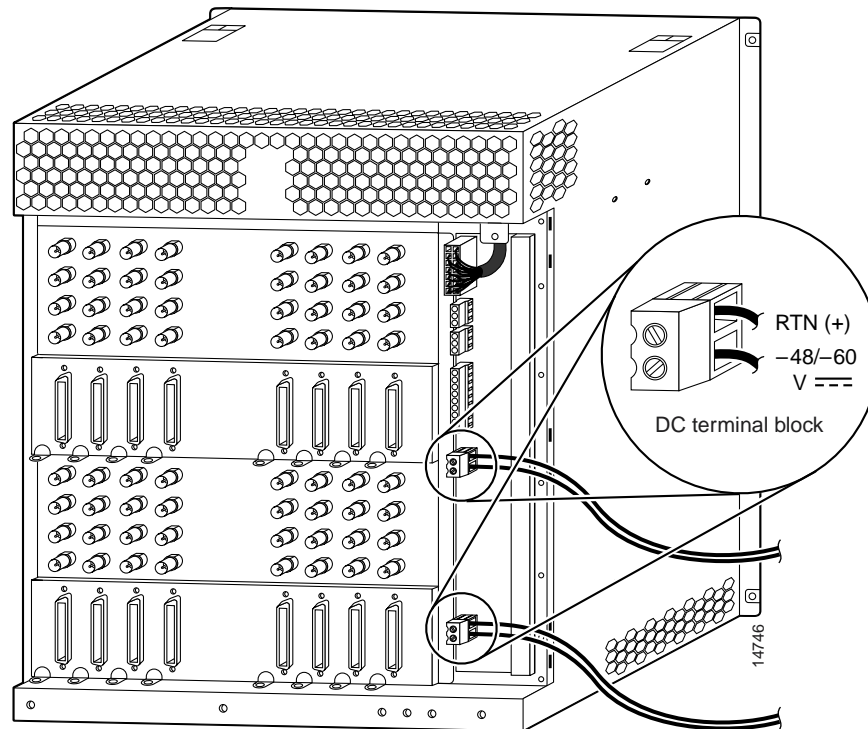
Note   Do not exceed the maximum torque of 10 inch-pounds on the DC connector.

Figure B-14 shows the DC power conections with the rear cover installed.

Figure B-14   DC Power Connections with Rear Cover
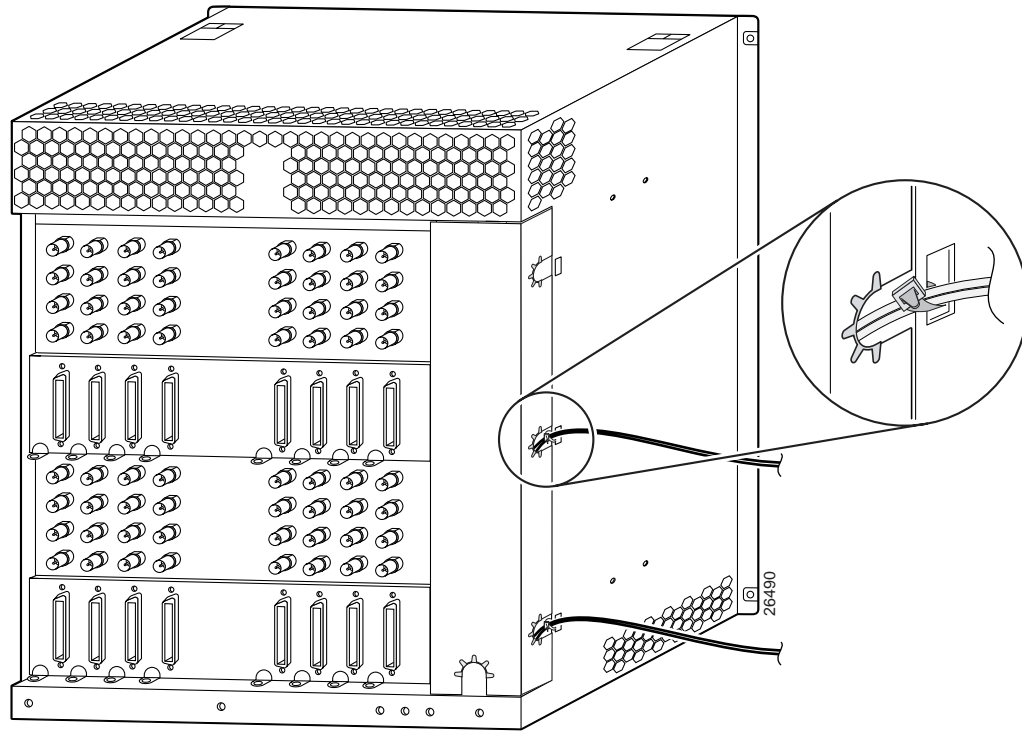
Cisco 6400 AC Power Connection on the AC PEM

Figure B-15 shows the location of the AC power cable connection on the AC PEM.

Figure B-15   AC Power Connection on the Cisco 6400

Cord strain relief (canoes)

26494
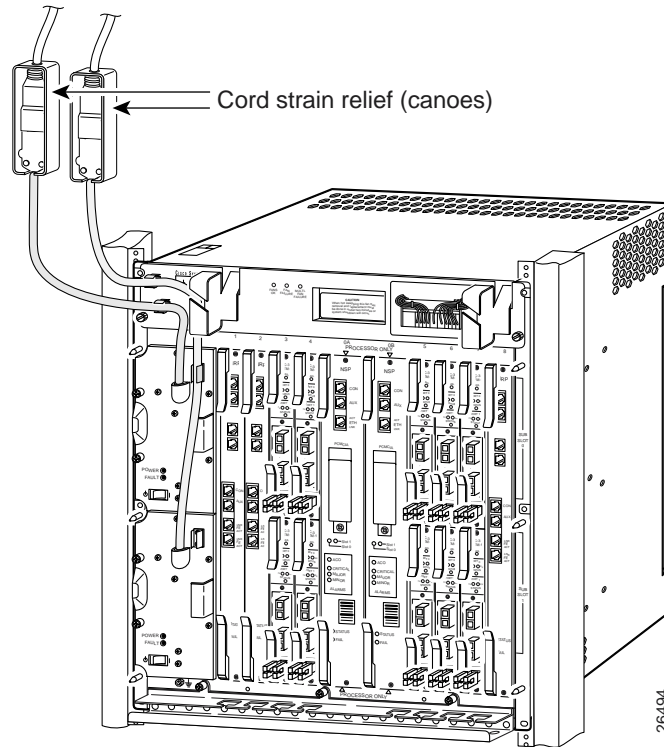
Cisco 6400 System Grounding Connection

Figure B-16 shows the system grounding connection for the Cisco 6400.

Figure B-16   System Grounding Connection for the Cisco 6400

Threaded
grounding
holes (2)
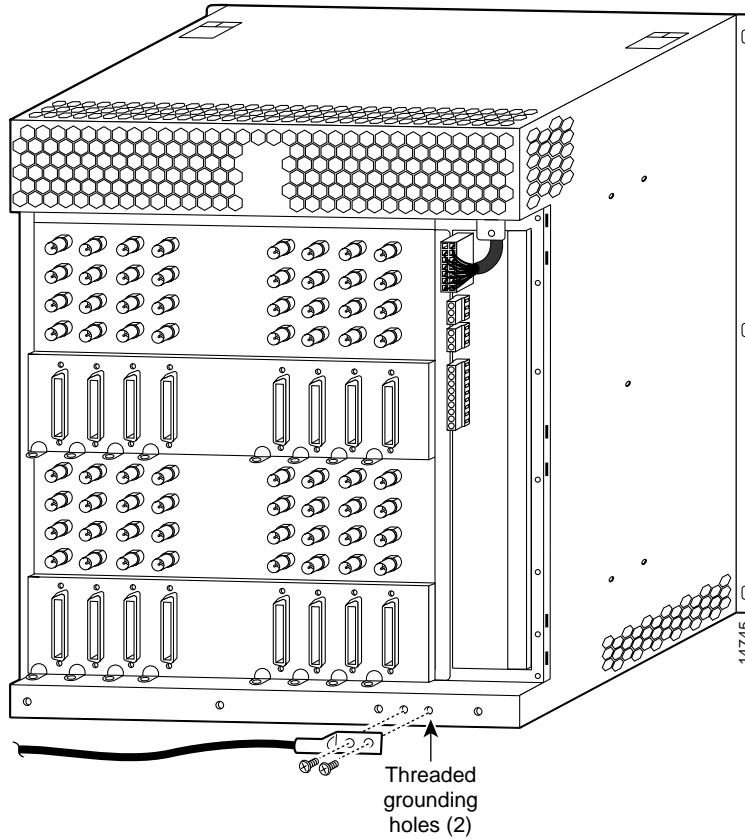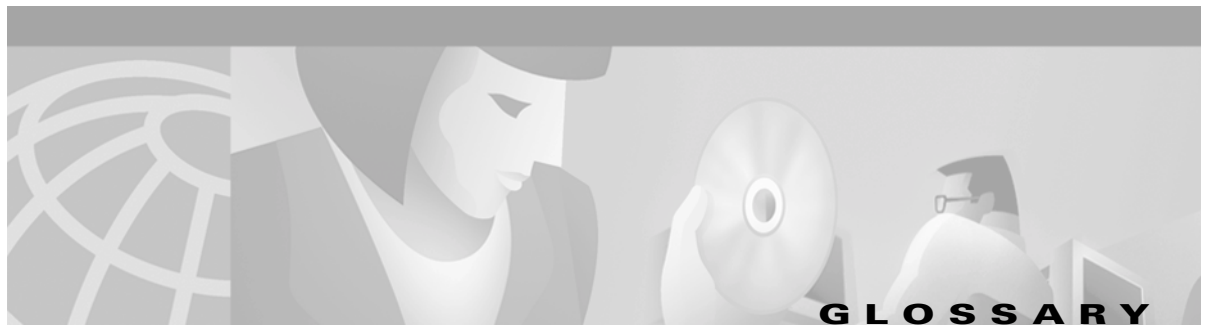
Numerics

10BaseT 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. 10BaseT, which is part of the IEEE 802.3 specification, has a distance limit of approximately 100 meters per segment.

100BaseT 100-Mbps baseband Fast Ethernet specification for unshielded twisted-pair wiring. Based on the IEEE 802.3 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).

B

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 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.

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.

D

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 *10Base2*, *10BaseT*, 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 10BaseT 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 *100BaseT*.

FRU   Field-replaceable unit. Term applied 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.

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 broadband aggregator. 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 10BaseT 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 DC PEM filters the incoming –48 VDC to meet EMC requirements. It also provides miswiring protection and internal fault isolation.

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.

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.

Q

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 Cisco 6400.

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.

INDEX