CISCO SYSTEMS

Cisco 6160 Hardware Installation Guide

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C O N T E N T S

F I G U R E S

T A B L E S

Preface

This preface explains the audience, purpose, and organization of the *Cisco 6160 Hardware Installation Guide*. It also defines the conventions that are used to present instructions and information.

Audience

The *Cisco 6160 Hardware Installation Guide* is intended for use by central office (CO) technicians and maintenance personnel who are responsible for installing, configuring, and maintaining the Cisco 6160 system. A familiarity with telco products and networking systems is recommended.

Purpose

The *Cisco 6160 Hardware Installation Guide* describes how to set up, install, and troubleshoot the Cisco 6160 system. After completing the installation procedures covered in this guide, refer to the appropriate related documents to provision your Cisco 6160 system. For additional information on related documentation, see the "Related Documentation" section on page xvii.

Organization

The Cisco 6160 Hardware Installation Guide is organized as follows:

- Chapter 1, "Product Overview," provides an overview of the Cisco 6160 system.

- Chapter 2, "Preparing for Installation," provides the requirements necessary to prepare for the installation of the Cisco 6160 system.

- Chapter 3, "Installing a Cisco 6160 with a POTS Splitter Configuration," provides installation procedures for a Cisco 6160 with a POTS splitter configuration for *x*DSL data and voice traffic.

- Chapter 4, "Installing a Cisco 6160 Without a POTS Splitter Configuration," provides installation procedures for a Cisco 6160 without a POTS splitter for an *x*DSL data traffic.

- Chapter 5, "Troubleshooting," provides troubleshooting procedures for hardware and software conditions of the Cisco 6160 system.

- Chapter 6, "Upgrading and Maintaining the Cisco 6160 System," provides upgrade and maintenance procedures for the Cisco 6160 system.

- Appendix A, "Technical Specifications," provides the technical specifications for the Cisco 6160 system.

- Appendix B, "Cable and Port Mapping Specifications," provides a port mapping table for the Cisco 6160 subscriber connections and a cable standard telco color chart.

- Appendix C, "Connector and Pinout Specifications," provides information about connectors and pinouts for the Cisco 6160 system.

- Glossary.

Conventions

This publication uses the document conventions listed in this section.

Table 1   Font Conventions

Convention	Definition	Sample
boldface font	Commands and keywords are in **boldface**. Also used for names of some GUI elements.	This is similar to the UNIX **route** command.
italic font	Arguments for which you supply values are in *italics*. Also used for publication names and for emphasis	See the *Cisco 6160 Hardware Installation Guide* for further details.
`screen` font	Terminal sessions and information the system displays are in `screen` font.	`Are you ready to continue?  [Y]`
`boldface screen` font	Information you must enter is in `boldface screen` font.	Login: **root** Password: **<password>**
^	The symbol ^ represents the key labeled Ctrl.	^D—The key combination in a screen display means hold down the Control key while you press the D key.
[ ]	Elements in square brackets are optional. Also used for default responses to system prompts.	[**no**] **offset-list** {**in** | **out**} *offset*
{x | y | z}	Alternative keywords are grouped in braces and separated by vertical bars.	**offset-list** {**in** | **out**} *offset*
< >	Nonprinting characters such as passwords are in angle brackets.	`DSLAM>` `Password: <cisco123>`
({ })	Indicate a required choice.	**offset-list** {**in** | **out**} *offset*
([{ }])	Indicate a required choice within an optional element.	[{*letter\number*}**Enter**]

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

Tip   Means *the following information will help you solve a problem*. The tips information might not be troubleshooting or even an action, but could be useful information or information that might save time.

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

Warning   **Means *danger*. You are in a situation that could cause bodily injury. Before you work on any equipment, you must be aware of the hazards involved with electrical circuitry and be familiar with standard practices for preventing accidents. To see translated versions of the warning, refer to the *Regulatory Compliance and Safety* document that accompanied the device.**

Related Documentation

A complete list of all DSL product related documentation is available on the World Wide Web at http://www.cisco.com/univercd/cc/td/doc/product/dsl_prod/index.htm

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

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

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

Ordering Documentation

Most Cisco documentation is available only online at:

http://www.cisco.com/univercd/home/home.htm

You can order some printed Cisco documentation 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

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- You can submit your comments by mail. Write to the following address:

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

- If you are a registered Cisco.com user, you can submit comments electronically.

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  - To send your opinion of the DSL documentation, go to the following URL:

    http://www.cisco.com/univercd/cc/td/doc/product/dsl_prod/

    and click **here** at the top of the page in the sentence "Is this Cisco documentation helpful? Click here to give us your feedback." This displays a Documentation Survey that you can complete and submit to Cisco electronically.

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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.

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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.

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- Resolve technical issues with online support
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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.

Product Overview

This chapter provides an overview of the Cisco 6160 digital subscriber line (DSL) access multiplexer (DSLAM) and its related components, collectively known as the Cisco 6160 system. This chapter contains the following sections:

1.1 Introduction to the Cisco 6160 System

The Cisco 6160 system is part of the Cisco DSL product family that provides end-to-end service by carrying voice or data traffic, or both, between a subscriber's home or office, a central office (CO), and various networks beyond. The Cisco 6160 system sends and receives subscriber data (often Internet service) over existing copper telephone lines, concentrating all traffic onto a single high-speed trunk for transport to the Internet or a corporate intranet. Data is modulated by *x*DSL customer premises equipment (CPE) devices, which are connected to PCs or routers at the subscriber site. The data then travels over telephone lines to the Cisco 6160 system at the CO.

Note For detailed information on the various components in the Cisco DSL product family (including CO and CPE devices), see the "Related Documentation" section on page xvii.

The Cisco 6160 system uses asymmetric digital subscriber line (ADSL), ISDN digital subscriber line (IDSL), symmetrical digital subscriber line (SDSL), and single-pair high-speed digital subscriber line (SHDSL, also known as G.SHDSL), collectively known as *x*DSL, technologies to support up to 256 subscribers connected either directly to the chassis or through a plain old telephone service (POTS) splitter. Filters separate voice and data signals when subscribers are connected to the Cisco 6160 DSLAM through a POTS splitter chassis. Cables connected to the POTS splitter route digital data signals to line cards in the Cisco 6160 chassis and voice signals to the CO facility switching network.

The Cisco 6160 system includes the following hardware and software components:

- Cisco 6160 chassis. The following components will be installed in or on the chassis:
  - *x*DSL Transmission Unit—central office line cards (*x*TU-Cs)—quad-port flexi ATU-C line cards (4xflexis), quad-port STU-C line cards (4xSDSLs), octal-port DMT ATU-C line cards (8xDMTs), octal-port single-pair high-speed digital subscriber line, also known as symmetric high bit rate digital subscriber loop (G.SHDSL) line cards (8xG.SHDSLs), and octal-port ITU-C line cards (8xISDLs).

> **Note**   For line card intermixing information, see the "Line Card Intermixing" section on page 1-24.

- Second generation network interface (NI-2) cards—DS3+T1/E1 IMA, DS3/2DS3, OC-3c/2DS3, or OC-3c/OC-3c.

- Input/output (I/O) cards—DS3/2DS3+8xT1 IMA or DS3/2DS3 (I/O cards are located on the chassis backplane).

- Power entry modules (PEMs), which distribute power throughout the chassis.

- Blower tray.

- Air filter.

Figure 1-1 shows the location of the Cisco 6160 chassis components.

Figure 1-1   Cisco 6160 Chassis Components
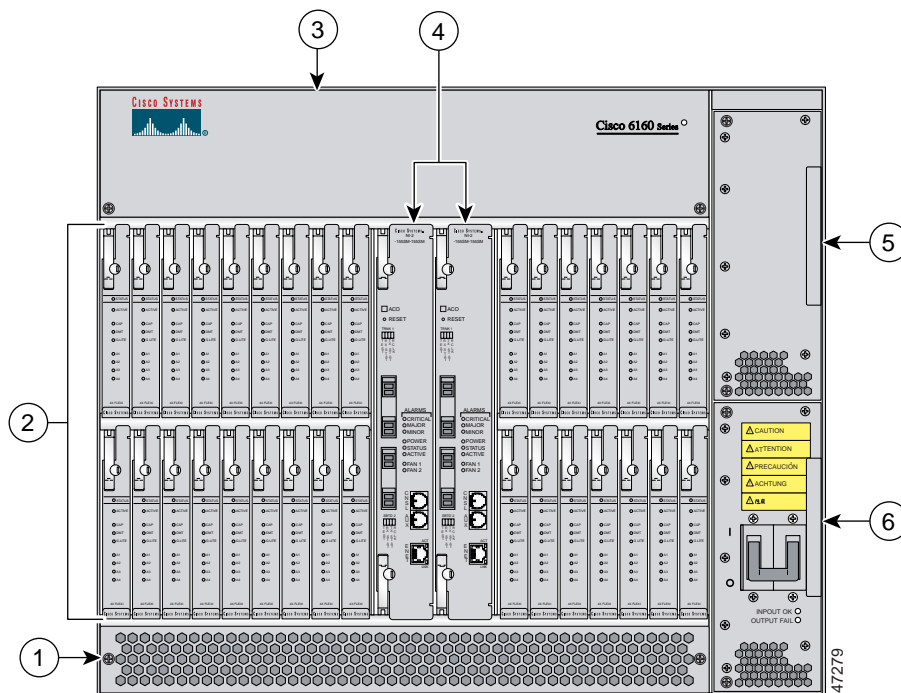
1	Air filter	4	NI-2 card (primary and secondary)
2	*x*TU-C line cards (slots 1 to 9 and 12 through 34)	5	Secondary PEM
3	Blower tray	6	Primary PEM

- POTS splitters (optional). The POTS splitter is a passive device that supports simultaneous voice (basic telephone service) and data services.

> **Note** POTS splitters are available from Cisco Ecosystem partners. Please verify the compatibility with your Cisco representative.
>
> For POTS splitter information, refer to the vendor documentation.

- Management software—Provisions and manages the Cisco 6160 system.
  - Cisco IOS—A command-line interface (CLI) that is available for network element provisioning.
  - Cisco DSL Manager (CDM)—An element management system designed to configure and manage the 6xxx series of Cisco IOS software-based DSLAMs through a graphical-user interface (GUI). CDM provides the following areas of network management: fault, configuration, performance, and security. CDM runs within the Cisco Element Manager Framework (EMF); both are installed on Sun workstations.

    Cisco EMF is based on an object model in which network elements or modules represent the managed entity. Each object is defined by a class and specific attributes. An object can represent a network element or a more abstract entity such as a link relationship, a network, or a container such as a site, shelf, or region.

> **Note** See the "Hardware Specifications" section on page A-1 for minimum software and network management release requirements per Cisco 6160 chassis component.

1.1.1 Features

The Cisco 6160 system includes the following features:

- Supports ADSL, IDSL, SDSL, and SHDSL.
- Carrierless amplitude and phase modulation (CAP) rate adaptive DSL (RADSL), ANSI T1.413 Discrete Multitone (DMT), G.DMT, G.SHDSL, and G.lite modem support.
- Terminates up to 256 ADSL, 256 IDSL, 128 SDSL, or 256 SHDSL subscriber lines.
- Network Equipment Building System (NEBS) compliant, 23-inch chassis.
- Network transmission connections.
  - DS3.
  - OC-3c.
  - T1.
  - T1 inverse multiplexing over ATM (IMA).
- Manageable through Cisco IOS or CDM.
- Subtending—Up to 13 Cisco 6160 chassis can be linked together (subtended) so that they are served by a single network trunk port, which supports up to 3328 *x*DSL subscribers.
- Building integrated timing supply (BITS) clock input.
- Facility alarm input.
- Supports the entire range of virtual channel identifier (VCI)/virtual path identifier (VPI) connections, and connections are not limited by memory.

- ATM Forum User-Network Interface (UNI) Versions 3.1/4.0 compliant.
- Nonblocking ATM switching architecture.
- Allows up to four ATM classes of service simultaneously.

1.1.2 Configurations

This guide details the installation steps for the following configurations:

- Cisco 6160 with a POTS splitter
- Cisco 6160 without a POTS splitter
- IMA
- Subtended network

1.1.2.1 Cisco 6160 with a POTS Splitter Configuration

The Cisco 6160 with a POTS splitter configuration supports up to 256 data subscribers through directly connected modems using *x*DSL technology. To increase subscribership, you can add additional chassis to your system.

This configuration can include the following hardware components:

- Cisco 6160 chassis
  - 8xIDSLs
  - 8xDMTs (configure as DMT or G.lite)
  - 4xflexis (configure as CAP, DMT, or G.lite)
  - DS3/2DS3, DS3+T1/E1 IMA, OC-3c/2DS3, or OC-3c/OC-3c NI-2 card(s)
  - DS3/2DS3+8xT1 IMA I/O card or DS3/2DS3 I/O card or
  - PEM(s)
  - Blower tray
- Third-party POTS splitter—Installed directly below the Cisco 6160 chassis

1.1.2.2 Cisco 6160 Without a POTS Splitter Configuration

The Cisco 6160 without a POTS splitter configuration supports up to 256 data subscribers through directly connected modems using *x*DSL technology. To increase subscribership, you can add additional chassis to your system.

This configuration can include the following hardware components:

- Cisco 6160 chassis
  - 8xIDSLs
  - 8xG.SHDSLs
  - 8xDMTs (configure as DMT or G.lite)
  - 4xSDSLs
  - 4xflexis (configure as CAP, DMT, or G.lite)
  - DS3/2DS3, DS3+T1/E1 IMA, OC-3c/2DS3, or OC-3c/OC-3c NI-2 card(s)

- DS3/2DS3+8xT1 IMA I/O card or DS3/2DS3 I/O card
- PEM(s)
- Blower tray

1.1.2.3 IMA Configuration

The DS3+T1/E1 IMA NI-2 card uses IMA technology to aggregate multiple low-speed links into one larger virtual trunk or IMA group. An inverse multiplexer appears to your ATM switch router as one logical pipe. IMA provides you with modular bandwidth to access the ATM network between T1 and DS3 rates. The Cisco 6160 allows you to combine up to eight T1 lines to form an IMA group.

IMA breaks up the ATM cell stream, distributes the cells over the multiple physical links of an IMA group, then recombines the cells into a single stream at the other end of the connection. The ATM cells are distributed in a round-robin fashion over the physical links of the IMA group, recombined at the receiving IMA group, and passed in their original form to the ATM layer (see Figure 1-2). Using the multiple links of an IMA group increases the logical link bandwidth to approximately the sum of the individual link rates. The physical links should be nominally the same length to avoid excessive intragroup delay. We recommend that all of the links in an IMA group be bundled together between the source and the destination.

Figure 1-2   Inverse Multiplexing and Recombining of ATM Cells Through IMA Groups
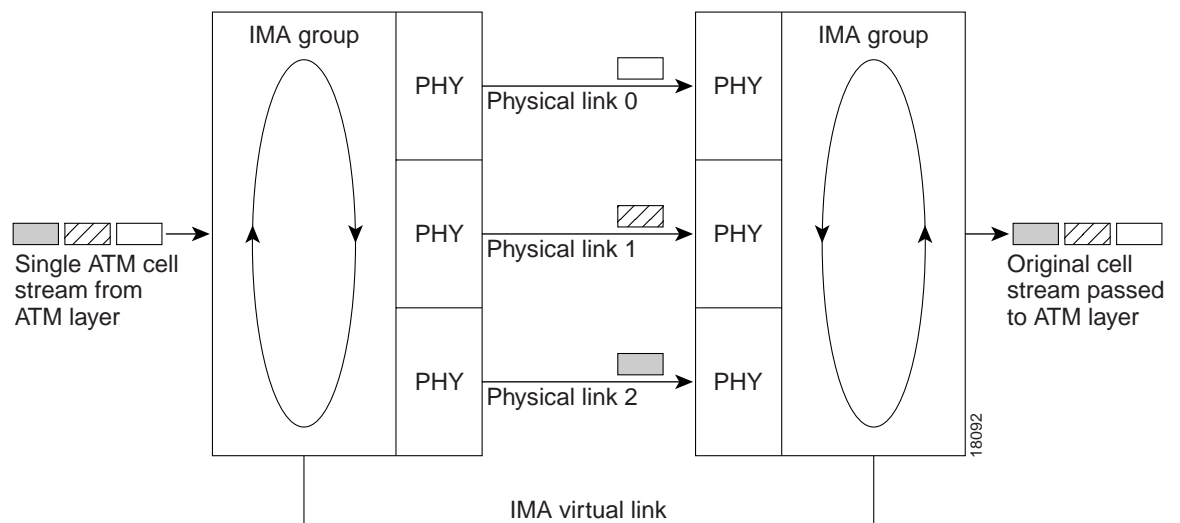
The DS3/2DS3+8xT1 IMA I/O cards have eight ports. You can use the eight ports on the DS3/2DS3+8xT1 IMA I/O cards as independent ATM links or in the IMA mode. The following bullets are examples of possible IMA groups, independent ATM links, and mixed modes. In examples of IMA groups, two links are assumed per group.

- Four IMA groups with any combination of eight links
- Three IMA groups and up to two independent ATM links
- Two IMA groups and up to four independent ATM links
- One IMA group and up to six independent ATM links
- No IMA group and up to eight independent ATM links

The T1 (1.544 Mbps) IMA port adapters provide trunk or subtend connectivity and are used for intercampus or wide-area links. The T1 IMA port adapters support unshielded twisted-pair (UTP) connectors. The order of assignment of links to an IMA group is not restricted.

The IMA group interfaces use a naming convention different from those used by the other interfaces in the system. IMA group interfaces are named with the convention *atm<slot>/ima<group>*, where *<slot>* is the slot number for the DS3+T1/E1 IMA NI-2 card and *<group>* is the IMA group number from 0 to 3. Table 1-1 lists the interface naming conventions.

Table 1-1   Interface Naming Conventions

Interface	Name
DS3 link	atm0/1
T1/E1 link 0	atm0/2
T1/E1 link 1	atm0/3
T1/E1 link 2	atm0/4
T1/E1 link 3	atm0/5
T1/E1 link 4	atm0/6
T1/E1 link 5	atm0/7
T1/E1 link 6	atm0/8
T1/E1 link 7	atm0/9
IMA group 0	atm0/ima0
IMA group 1	atm0/ima1
IMA group 2	atm0/ima2
IMA group 3	atm0/ima3

1.1.2.4 Subtended Network Configuration

A subtended network configuration

- Services and aggregates the data from one or more Cisco 6160 chassis into a subtending host system to take advantage of the data network interface on the subtending host chassis.

- Reduces the number of ATM edge-switch ports that are required to terminate the system.

- Supports a Cisco 6160 with a POTS splitter configuration and a Cisco 6160 without a POTS splitter configuration.

The term s*ubtending* refers to the host chassis, and s*ubtended* refers to the downstream chassis in a subtended network.

Note

A subtended network configuration supports the following features:

- Four arbitration priorities, one for each quality of service (QoS) level. The supported QoS service levels are

    - Constant bit rate (CBR) for rate-limited services that require guaranteed bandwidth and bounded delay

    - Variable bit rate real time (VBR-rt) for delay-sensitive voice and video services

    - Variable bit rate non real time (VBR-nrt) for high-priority data services

    - Unspecified bit rate (UBR) for low-priority data services

- Explicit forward congestion indication (EFCI) marking for available bit rate (ABR) service support.

- Guaranteed frame rate (GFR).

- Tree or daisy chain topology configurations for DS3 subtended Cisco 6160 chassis.

- Daisy chain topology configurations for OC-3c subtended Cisco 6160 chassis.

- Star topology configurations for T1 or T1 IMA group subtended Cisco 6160 chassis.

- Fair access to the trunk port for each subtended chassis.

- A network trunk port that operates as fast as any subtended link.

The NI-2 card provides one of the following types of subtended network connections:

- A high-speed OC-3c optical ATM interface that supports single-mode fiber (SMF) intermediate range

- A high-speed OC-3c optical ATM interface that supports multimode fiber (MMF) short range

- Up to eight T1 interfaces when you are using the DS3+T1/E1 IMA NI-2 card in conjunction with the DS3/2DS3+8xT1 IMA I/O card.

- Up to four IMA interfaces when you are using the DS3+T1/E1 IMA NI-2 card in conjunction with the DS3/2DS3+8xT1 IMA I/O card.

Note   The use of a T1 or T1 IMA group trunk disables the DS3 interface.

The following sections detail the different types of subtended network configurations:

1.1.2.4.1 Subtended Network Configuration with DS3+T1/E1 IMA NI-2 Cards

In a subtended network configuration using DS3+T1/E1 IMA NI-2 cards, you can subtend Cisco 6160 systems with the following network configurations:

- A DS3 trunk with

    - Up to eight individual T1 subtended interfaces, or

    - Up to four IMA groups, or

    - A combination of the two

- Eight T1 links which can be used as trunk or subtend interfaces or be combined into trunk or subtend T1 IMA groups.

  – A T1 IMA group or T1 UNI as the trunk, or

  – Up to seven individual T1 interfaces or up to four T1 IMA groups, or

  – A combination of the two

✎

Note   The use of a T1 or T1 IMA group trunk disables the DS3 interface.

Figure 1-3 shows an example of a subtended network with a star topology. The subtending host chassis in the middle of the star topology connects directly to the ATM switch. With a DS3 trunk, you can have up to eight subtended node chassis connected to the subtending host chassis.

Figure 1-3   Subtended Network Configuration Using DS3+T1/E1 IMA NI-2 Cards

✎
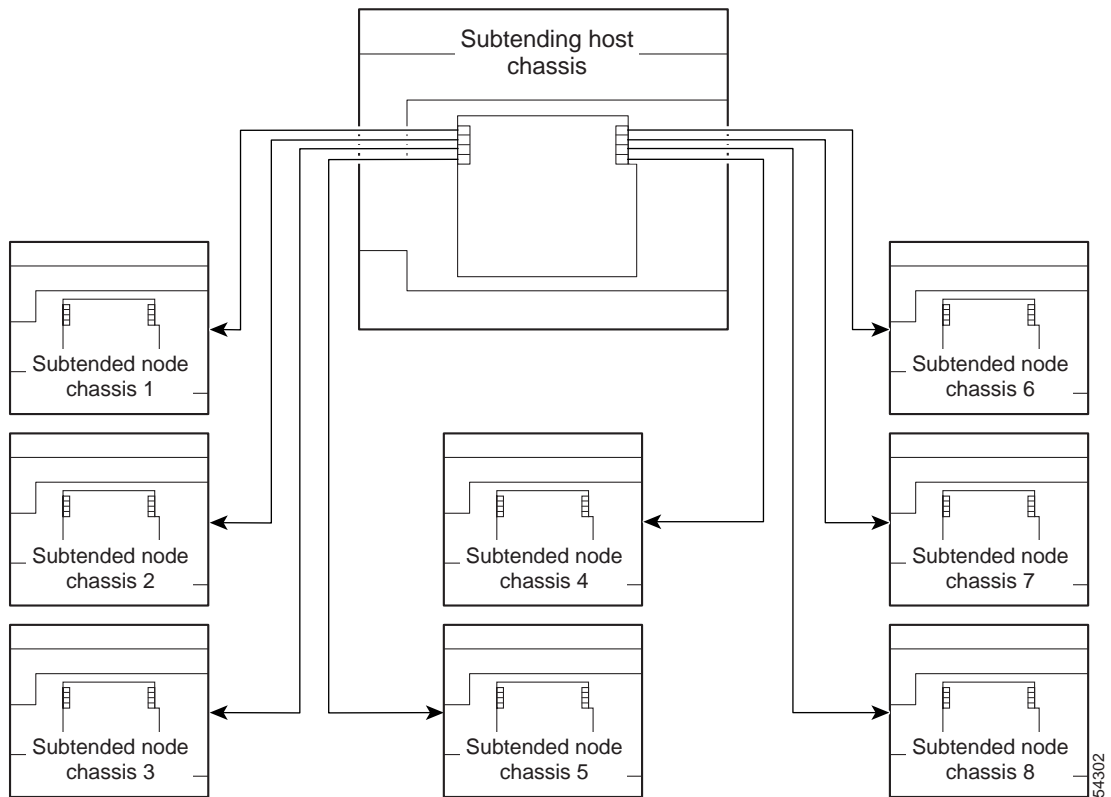
Note   Consult with your network architect or Cisco customer service representative for examples of other subtending topology configurations.

1.1.2.4.2 Subtended Network Configuration with DS3/2DS3 or OC-3c/2DS3 NI-2 Cards

In a subtended network configuration using DS3/2DS3 or OC-3c/2DS3 NI-2 cards, you can subtend a Cisco 6160 chassis to four tiers, with up to 12 subtended node chassis, all connecting through one subtending host chassis to the ATM backbone.

Figure 1-4 shows DS3-configured Cisco 6160 systems subtended in a combined subtending tree topology with daisy chain. The subtending host chassis at the top of the subtending tree connects directly to the ATM switch. The middle two Cisco 6160 chassis in the lowest level are daisy chained. TRNK 1 refers to the network trunk or the Cisco 6160 chassis subtended network interface. SBTD 2 and SBTD 3 refer to the two Cisco 6160 chassis subtended interfaces. You make network interface connections at the I/O card, which is installed on the Cisco 6160 chassis backplane.

Figure 1-4   Subtended Network Configuration Using DS3/2DS3 or OC-3c/2DS3 NI-2 Cards
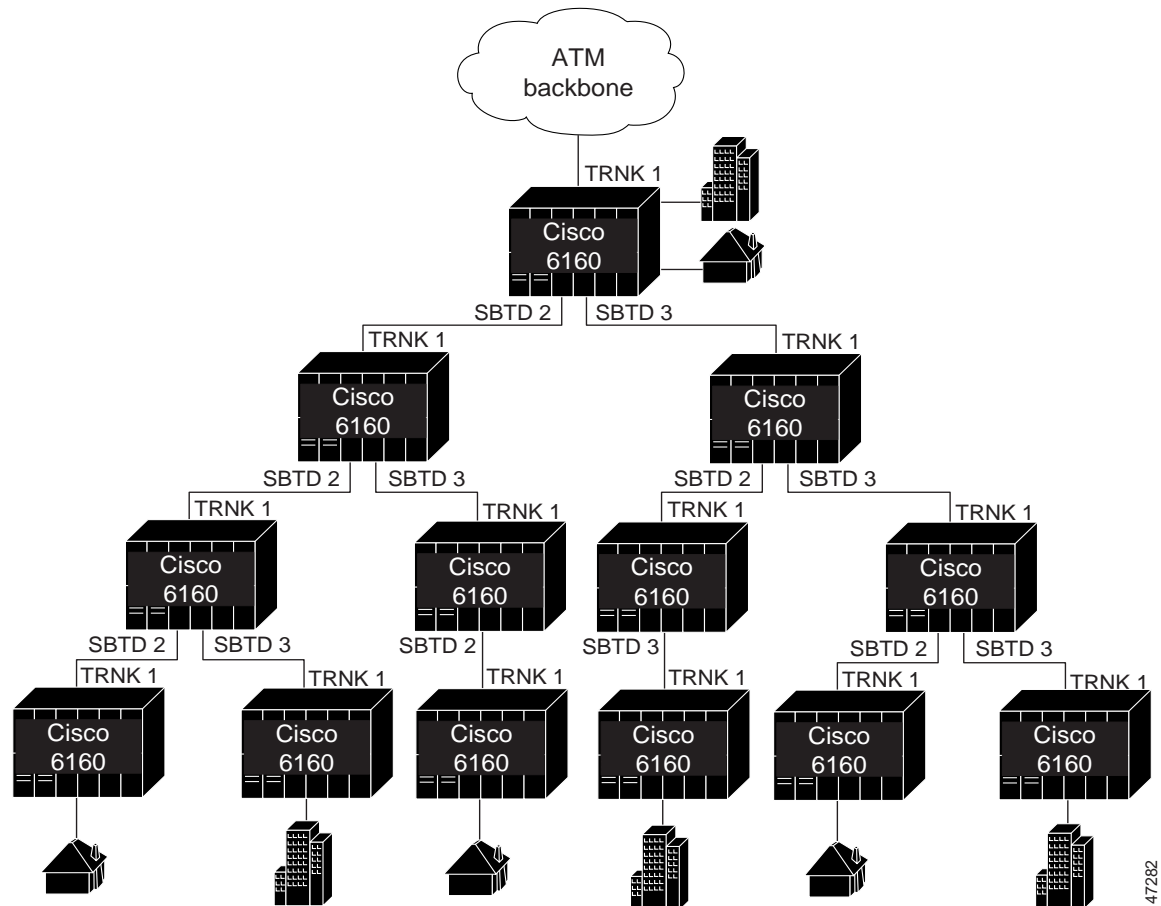
For each chassis in a subtended network configuration to have fair access to the shared trunk, the chassis must have a unique ID number. The subtending host chassis places this ID number in the GFC field of the ATM header of each cell; this ID number is then used to forward cells up the tree to the network trunk.

![Note] **Note**   You can subtend Cisco 6160 chassis with DS3/2DS3 or OC-3c/2DS3 NI-2 cards in a continuous daisy chain. However, a daisy-chained subtending topology is not optimal for data throughput for a Cisco 6160 chassis that uses DS3/2DS3 or OC-3c/2DS3 NI-2 cards.

Cisco IOS software does not manage the primary Cisco 6160 chassis and all subtended Cisco 6160 chassis as a single large Cisco 6160 system. Each Cisco 6160 chassis supports an independent Cisco IOS processor and MIBs.

1.1.2.4.3 Subtended Network Configuration with OC-3c/OC-3c NI-2 Cards

In a subtended network configuration using OC-3c/OC-3c NI-2 cards (SMF or MMF), you can subtend up to 12 OC-3c configured subtended node chassis in a daisy chain, all connecting through one subtending host chassis to the ATM backbone (see Figure 1-5).

Figure 1-5   Subtended Network Configuration Using OC-3c/OC-3c NI-2 Cards
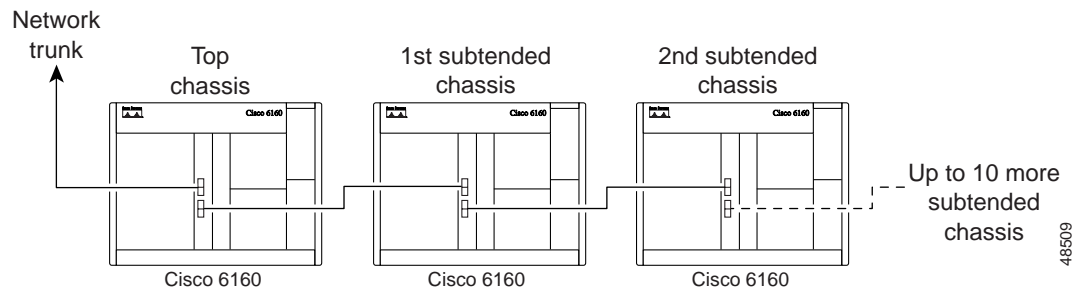
1.2 Cisco 6160 Chassis Overview

The Cisco 6160 system consists of circuitry and connections that reside within a chassis, an enclosure that allows modular insertion and removal of various field-replaceable units (FRUs).

Note   For hardware specifications for the Cisco 6160 chassis, see the "Cisco 6160 System Hardware Specifications" section on page A-2.

The following sections detail these Cisco 6160 hardware components:

- Backplane, page 1-11
- Chassis Card Compartment, page 1-13
- Line Cards, page 1-14
- NI-2 Cards, page 1-27
- I/O Cards, page 1-43
- PEM, page 1-52
- Blower Tray, page 1-54
- Air Filter, page 1-56

1.2.1 Backplane

Located on the back of the Cisco 6160 chassis, the backplane provides the following services:

- Interconnects the NI-2 card(s), I/O card, and line cards
- Connects the line cards with the subscriber connectors
- Distributes power, clocking, and other common signals to all the components

Figure 1-6 shows the Cisco 6160 backplane.

Figure 1-6   Cisco 6160 Backplane

1	PWR 1—Power terminal block connector.	5	Connectors JC1 through JC5.
2	BRKR 1—A terminal block connector used to wire alarm relays to external alarms.	6	I/O card connectors (P3 and P9)—Two 2-mm HM[1] modular connectors (male on the Cisco 6160 and female on the I/O card) are used to connect the I/O card.
3	PWR 2—Power terminal block connector. Use if a secondary (redundant) PEM is installed.	7	Connectors JC6 through JC11.
4	BRKR 2—A terminal block connector used to wire alarm relays to external alarms. Use if a secondary (redundant) PEM is installed.		

1.   HM = hard metric

The power terminal block connectors (PWR 1 and PWR 2) are equipped with a positive, negative, and ground receptacle. This connector receives the power connections from the external power source.

The breaker terminal block connectors (BRKR 1 and BRKR 2) are equipped with three contacts (common [CO], normally closed [NC], and normally open [NO]) that used to wire alarm relays to external alarms.

There are eleven 50-pin Champ connectors used to transfer data between the Cisco 6160 and the POTS splitter in a Cisco 6160 with POTS splitter configuration. In a Cisco 6160 without a POTS splitter configuration, the connectors are used to transfer data between the Cisco 6160 and the CPE equipment. Table 1-2 describes the Champ connectors and the corresponding slots in the Cisco 6160 chassis.

Table 1-2   Cisco 6160 Backplane Connectors and Slots

Champ Connector	Cisco 6160 Chassis Slots
JC1	Slots 1 to 3
JC2	Slots 4 to 6
JC3	Slots 7 to 9
JC4	Slots 12 to 14
JC5	Slots 15 to 17
JC6	Slots 18 and 34
JC7	Slots 19 to 21
JC8	Slots 22 to 24
JC9	Slots 25 to 27
JC10	Slots 28 to 30
JC11	Slots 31 to 33

1.2.2 Chassis Card Compartment

As shown in Figure 1-7, the Cisco 6160 card compartment houses

- 32 slots for line cards
- 2 slots for NI-2 cards
- 2 compartments for PEMs
- 1 compartment for a blower tray
- 1 compartment for an air filter

Figure 1-7   Cisco 6160 Chassis Compartments
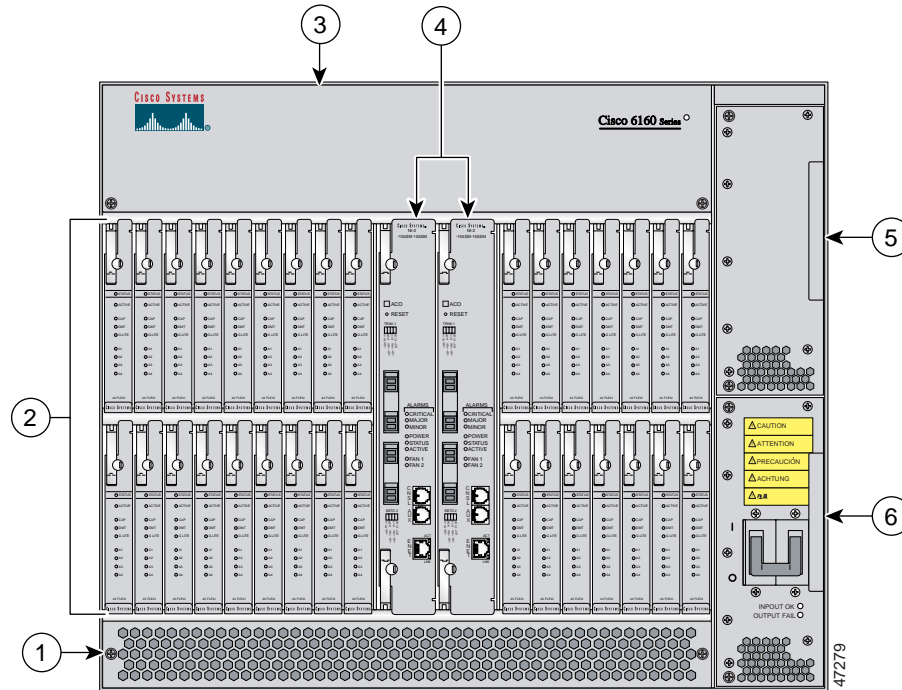
1	Air filter	**4**	NI-2 card (primary and secondary)
2	*x*TU-C line cards (slots 1 to 9 and 12 through 34)	**5**	Secondary PEM
3	Blower tray	**6**	Primary PEM

The Cisco 6160 chassis has 34 slots that hold line cards and NI-2 cards. Each card slot on a chassis is numbered along the top of the chassis. In this guide, the slot numbers are shown on the cards for easy reference and readability. These slots are referred to in subsequent sections of this chapter and elsewhere in this guide. Table 1-3 describes each card slot assignment for the Cisco 6160 chassis.

Table 1-3   Cisco 6160 Card Slot Assignments

Card Slot	Card Assignment
1 to 9	4xflexis, 4xSDSLs[1], 8xDMTs, 8xG.SHDSLs[1], or 8xIDSLs
10	NI-2 card
11	Secondary (redundant) NI-2 card
12 to 34	4xflexis, 4xSDSLs, 8xDMTs, 8xG.SHDSLs, or 8xIDSLs

1.   4xSDSLs and G.SHDSLs can be used only in a Cisco 6160 without a POTS splitter configuration.

Note   For line card intermixing information, see the "Line Card Intermixing" section on page 1-24

1.2.3 Line Cards

The following sections provide details about the Cisco 6160 line cards.

- 8xIDSL Overview, page 1-14
- 8xG.SHDSL Overview, page 1-16
- 8xDMT Overview, page 1-18
- 4xSDSL Overview, page 1-20
- 4xflexi Overview, page 1-22
- Line Card Intermixing, page 1-24

1.2.3.1 8xIDSL Overview

The 8xIDSL

- Supports 2B1Q line encoding.
- Supports eight IDSL modem connections, or four connections when the chassis limits the number of tip and ring connectors.
- Supports configured data rates (56 kbps, 64 kbps, 128 kbps, and 144 kbps).
- Supports multiple Frame Relay and PPP encapsulations.
- Provides a DCE interface.

The Cisco 6160 chassis can include up to 32 8xIDSLs for a total of 256 IDSL modem connections.

Note   For hardware specifications for the 8xIDSL, see the "8xIDSL Specifications" section on page A-3.

For line card intermixing information, see the "Line Card Intermixing" section on page 1-24.

Figure 1-8 shows a close-up of the 8xIDSL faceplate.

Figure 1-8   8xIDSL Faceplate
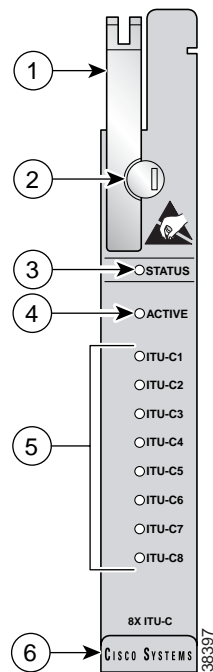
1	Ejector lever	**4**	ACTIVE LED
2	Locking tab	**5**	Modem port status LEDs
3	STATUS LED	**6**	Extraction tab

Table 1-4 describes LEDs on the 8xIDSL.

Table 1-4   8xIDSL LEDs

LED	State	Function
STATUS	Green slow blinking	No errors, but no connection established.
	Green fast blinking	The image download is in progress.
	Green solid	NI-2 communication established.
	Red	The self-test or line card has failed.
	Off	The ITU-C line card has a power failure.
ACTIVE	Green solid	The line card is activated.
	Off	The line card is not in service.
ITU-C 1	Green solid	Modem 1 is trained.
	Green blinking	Training is in progress for modem 1.
	Off	Modem 1 is idle.

Table 1-4   8xIDSL LEDs (continued)

LED	State	Function
ITU-C 2	Green solid	Modem 2 is trained.
	Green blinking	Training is in progress for modem 2.
	Off	Modem 2 is idle.
ITU-C 3	Green solid	Modem 3 is trained.
	Green blinking	Training is in progress for modem 3.
	Off	Modem 3 is idle.
ITU-C 4	Green solid	Modem 4 is trained.
	Green blinking	Training is in progress for modem 4.
	Off	Modem 4 is idle.
ITU-C 5	Green solid	Modem 5 is trained.
	Green blinking	Training is in progress for modem 5.
	Off	Modem 5 is idle.
ITU-C 6	Green solid	Modem 6 is trained.
	Green blinking	Training is in progress for modem 6.
	Off	Modem 6 is idle.
ITU-C 7	Green solid	Modem 7 is trained.
	Green blinking	Training is in progress for modem 7.
	Off	Modem 7 is idle.
ITU-C 8	Green solid	Modem 8 is trained.
	Green blinking	Training is in progress for modem 8.
	Off	Modem 8 is idle.

1.2.3.2 8xG.SHDSL Overview

The 8xG.SHDSL

- Supports eight G.SHDSL modem connections.

- Supports trellis coded pulse amplitude modulation (TC-PAM) line encoding.

- Converts G.SHDSL modulation from the line into digital data streams to and from the NI-2 card.

- Supports fixed and adaptive rate modes

- Has deployment guidelines when used in the Cisco 6160 system, see Figure 1-13 on page 1-26.

Note For hardware specifications for the 8xG.SHDSL, see the "8xG.SHDSL Specifications" section on page A-4.

For line card intermixing information, see the "Line Card Intermixing" section on page 1-24.

Figure 1-9 shows a close-up of the 8xG.SHDSL faceplate.

Figure 1-9   8xG.SHDSL Faceplate
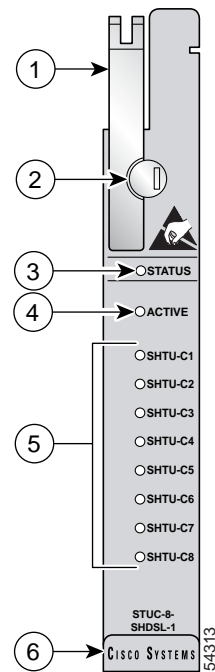
1	Ejector lever	**4**	ACTIVE LED
2	Locking tab	**5**	Modem port status LEDs
3	STATUS LED	**6**	Extraction tab

Table 1-5 describes LEDs on the 8xG.SHDSL.

Table 1-5   8xG.SHDSL LEDs

LED	State	Function
STATUS	Green slow blinking	No errors, but no connection established.
	Green fast blinking	The image download is in progress.
	Green solid	NI-2 communication established.
	Red	The self-test or line card has failed.
	Off	The SHTU-C line card has a power failure.
ACTIVE	Green solid	The line card is activated.
	Off	The line card is not in service.
SHTU-C1	Green solid	Modem 1 is trained.
	Green blinking	Training is in progress for modem 1.
	Off	Modem 1 is idle.

Table 1-5   8xG.SHDSL LEDs (continued)

LED	State	Function
SHTU-C2	Green solid	Modem 2 is trained.
	Green blinking	Training is in progress for modem 2.
	Off	Modem 2 is idle.
SHTU-C3	Green solid	Modem 3 is trained.
	Green blinking	Training is in progress for modem 3.
	Off	Modem 3 is idle.
SHTU-C4	Green solid	Modem 4 is trained.
	Green blinking	Training is in progress for modem 4.
	Off	Modem 4 is idle.
SHTU-C5	Green solid	Modem 5 is trained.
	Green blinking	Training is in progress for modem 5.
	Off	Modem 5 is idle.
SHTU-C6	Green solid	Modem 6 is trained.
	Green blinking	Training is in progress for modem 6.
	Off	Modem 6 is idle.
SHTU-C7	Green solid	Modem 7 is trained.
	Green blinking	Training is in progress for modem 7.
	Off	Modem 7 is idle.
SHTU-C8	Green solid	Modem 8 is trained.
	Green blinking	Training is in progress for modem 8.
	Off	Modem 8 is idle.

1.2.3.3 8xDMT Overview

The 8xDMT

- Supports eight ADSL modem connections.
- Converts ADSL modulation from the line into digital data streams to and from the NI-2 card.
- Negotiates the line rate with the CPE when it trains and bases the rate on line quality and distance.

If provisioned, the 8xDMT rate adapts to the maximum bit rate negotiable on the line. The maximum bit rate settings are provisioned in the management software.

The chassis can include up to 32 8xDMTs for a total of 256 ADSL modem connections.

Note   For hardware specifications for the 8xDMT, see the "8xDMT Specifications" section on page A-5.

For line card intermixing information, see the "Line Card Intermixing" section on page 1-24.

Figure 1-10 shows a close-up of the 8xDMT faceplate.

Figure 1-10   8xDMT Faceplate
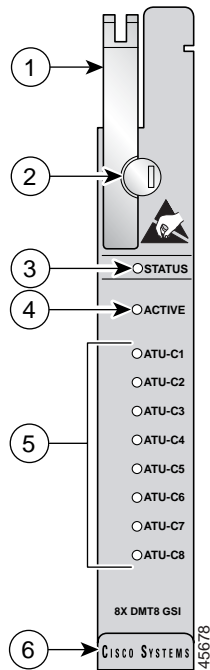
1	Ejector lever	**4**	ACTIVE LED
2	Locking tab	**5**	Modem port status LEDs
3	STATUS LED	**6**	Extraction tab

Table 1-6 describes LEDs on the 8xDMT.

Table 1-6   8xDMT LEDs

LED	State	Function
STATUS	Green slow blinking	No errors, but no connection established.
	Green fast blinking	The image download is in progress.
	Green solid	NI-2 communication established.
	Red	The self-test or line card has failed.
	Off	The ATU-C line card has a power failure.
ACTIVE	Green solid	The line card is activated.
	Off	The line card is not in service.
ATU-C 1	Green solid	Modem 1 is trained.
	Green blinking	Training is in progress for modem 1.
	Off	Modem 1 is idle.

Table 1-6   8xDMT LEDs (continued)

LED	State	Function
ATU-C 2	Green solid	Modem 2 is trained.
	Green blinking	Training is in progress for modem 2.
	Off	Modem 2 is idle.
ATU-C 3	Green solid	Modem 3 is trained.
	Green blinking	Training is in progress for modem 3.
	Off	Modem 3 is idle.
ATU-C 4	Green solid	Modem 4 is trained.
	Green blinking	Training is in progress for modem 4.
	Off	Modem 4 is idle.
ATU-C 5	Green solid	Modem 5 is trained.
	Green blinking	Training is in progress for modem 5.
	Off	Modem 5 is idle.
ATU-C 6	Green solid	Modem 6 is trained.
	Green blinking	Training is in progress for modem 6.
	Off	Modem 6 is idle.
ATU-C 7	Green solid	Modem 7 is trained.
	Green blinking	Training is in progress for modem 7.
	Off	Modem 7 is idle.
ATU-C 8	Green solid	Modem 8 is trained.
	Green blinking	Training is in progress for modem 8.
	Off	Modem 8 is idle.

1.2.3.4 4xSDSL Overview

The 4xSDSL

- Supports four SDSL modem connections.
- Supports 2B1Q line encoding.
- Transports ATM data at rates of up to 1168 kbps over a single twisted pair of copper wire.
- Converts SDSL modulation from the line into digital data streams to and from the NI-2 card.

The negotiated bit rate is the lower of the following rates:

- Provisioned bit rate set for the 4xSDSL in the management software
- Assigned bit rate at the CPE

The chassis can include up to 32 4xSDSLs for a total of 128 SDSL modem connections.

Note For hardware specifications for the 4xSDSL, see the "4xSDSL Specifications" section on page A-6.

For line card intermixing information, see the "Line Card Intermixing" section on page 1-24.

The edge connector key, located on the rear of the 4xSDSL, connects the 4xSDSL to the backplane of the chassis. Two edge connector keys are available for the 4xSDSL: one has six notches and one has seven notches. You can only install the edge connector key with seven notches in the Cisco 6160.

Figure 1-11 shows a close-up of the 4xSDSL faceplate.

Figure 1-11   4xSDSL Faceplate
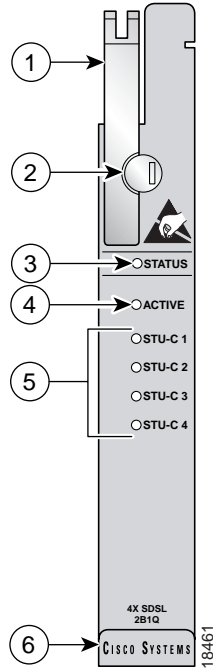
1	Ejector lever	**4**	ACTIVE LED
2	Locking tab	**5**	Modem port status LEDs
3	STATUS LED	**6**	Extraction tab

Table 1-7 describes the LEDs on the 4xSDSL.

Table 1-7   4xSDSL LEDs

LED	State	Function
STATUS	Green slow blinking	No errors, but no connection established.
	Green fast blinking	The image download is in progress.
	Green solid	NI-2 communication established.
	Red	The self-test or line card has failed.
	Off	The STU-C line card has a power failure.
ACTIVE	Green solid	The line card is activated.
	Off	The line card is not in service.

Table 1-7   4xSDSL LEDs (continued)

LED	State	Function
STU-C 1	Green solid	Modem 1 is trained.
	Green blinking	Training is in progress for modem 1.
	Off	Modem 1 is idle.
STU-C 2	Green solid	Modem 2 is trained.
	Green blinking	Training is in progress for modem 2.
	Off	Modem 2 is idle.
STU-C 3	Green solid	Modem 3 is trained.
	Green blinking	Training is in progress for modem 3.
	Off	Modem 3 is idle.
STU-C 4	Green solid	Modem 4 is trained.
	Green blinking	Training is in progress for modem 4.
	Off	Modem 4 is idle.

1.2.3.5 4xflexi Overview

The 4xflexi

- Supports four ADSL modem connections.
- Supports CAP, DMT, or G.lite line encoding.
- Converts ADSL modulation from the line into digital data streams to and from the NI-2 card.
- Negotiates the line rate with the CPE when it trains and bases the rate on line quality and distance.

If provisioned, the 4xflexi rate adapts to the maximum bit rate negotiable on the line. The maximum bit rate settings are provisioned in the management software.

Note   For hardware specifications for the 4xflexi, see the "4xflexi Specifications" section on page A-6.

For line card intermixing information, see the "Line Card Intermixing" section on page 1-24.

The Cisco 6160 chassis can include up to 32 4xflexis for a total of 128 ADSL modem connections.

The edge connector key, located on the rear of the 4xflexi, connects the 4xflexi to the backplane of the chassis. Two edge connector keys are available for the 4xflexi: one has six notches and one has seven notches. You can only install the edge connector key with seven notches in the Cisco 6160.

Figure 1-12 shows a close-up of the 4xflexi faceplate.

Figure 1-12   4xflexi Faceplate
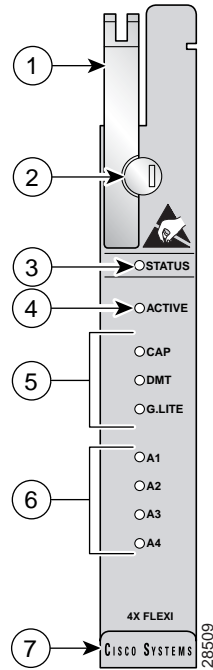
1	Ejector lever	**5**	Line card mode LEDs
2	Locking tab	**6**	Modem port status LEDs
3	STATUS LED	**7**	Extraction tab
4	ACTIVE LED		

Table 1-8 describes the LEDs on the 4xflexi.

Table 1-8   4xflexi LEDs

LED	State	Function
STATUS	Green slow blinking	No errors, but no connection established.
	Green fast blinking	The image download is in progress.
	Green solid	NI-2 communication established.
	Red	The self-test or line card has failed.
	Off	The ATU-C line card has a power failure.
ACTIVE	Green solid	The line card is activated.
	Off	The line card is not in service.
CAP	Green solid	The line card is in CAP mode.
	Off	The line card is not in CAP mode.

Table 1-8   4xflexi LEDs (continued)

LED	State	Function
DMT	Green solid	The line card is in DMT mode.
	Off	The line card is not in DMT mode.
G.LITE	Green solid	The line card is in G.lite mode.
	Off	The line card is not in G.lite mode.
A1	Green solid	Modem 1 is trained.
	Green blinking	Training is in progress for modem 1.
	Off	Modem 1 is idle.
A2	Green solid	Modem 2 is trained.
	Green blinking	Training is in progress for modem 2.
	Off	Modem 2 is idle.
A3	Green solid	Modem 3 is trained.
	Green blinking	Training is in progress for modem 3.
	Off	Modem 3 is idle.
A4	Green solid	Modem 4 is trained.
	Green blinking	Training is in progress for modem 4.
	Off	Modem 4 is idle.

1.2.3.6 Line Card Intermixing

The Cisco 6160 chassis supports line card intermixing. The following sections will use the terms *halves* and *quadrants*. The Cisco 6160 chassis consists of two halves

- First half—Slots 1 to 9 and slots 19 to 27
- Second half—Slots 12 to 18 and slots 28 to 34

The Cisco 6160 chassis consists of four quadrants

- Quadrant 1—Slots 1 to 9
- Quadrant 2—Slots 12 to 18
- Quadrant 3—Slots 19 to 27
- Quadrant 4—Slots 28 to 34

The following sections detail the line card intermixing guidelines for the Cisco 6160.

1.2.3.6.1 Guidelines for Intermixing *x*DSL Line Cards

Mixing line cards of different modulation types in the same quadrant of any Cisco DSLAM is prohibited. Different modulation types are allowed in the same half of a chassis with the exceptions of slots 18 and 34 in the Cisco 6160 beginning with Cisco IOS release 12.2(7)DA. Mixing line cards of the same modulation type (for example, 4xFlexiDMT and 8xDMT line cards) in a quadrant is allowed.

> ✎
>
> **Note**   For 8xG.SHDSL-specific intermixing guidelines, see either the "Guidelines for Intermixing 8xG.SHDSLs—Cisco IOS Release 12.1(7)DA2, 12.2(1b)DA, and 12.2(5)DA" section on page 1-25 or "Guidelines for Intermixing 8xG.SHDSLs—Cisco IOS Release 12.1(7)DA2, 12.2(1b)DA, and 12.2(5)DA" section on page 1-25.

1.2.3.6.2 Guidelines for Intermixing 8xG.SHDSLs—Cisco IOS Release 12.1(7)DA2, 12.2(1b)DA, and 12.2(5)DA

The Cisco 6160 chassis can be fully populated with 8xG.SHDSLs while retaining QoS, as long as the upstream bandwidth is provisioned at a maximum of 5 Mbps for even ports and a maximum of 5 Mbps for odd ports per line card. Once an 8xG.SHDSL is installed in a chassis quadrant, no ADSL line cards can be installed in that same quadrant.

> ✎
>
> **Note**   Due to spectral compatibility limitations in the right side configuration of the Cisco 6160 chassis, line card slots 18 and 34 should be configured as specified in Table 1-9.

1.2.3.6.3 Guidelines for Intermixing 8xG.SHDSLs—Cisco IOS Release 12.2(7)DA and Later

The Cisco 6160 chassis supports up to 16 8xG.SHDSLs installed per chassis while retaining QoS. Once an 8xG.SHDSL is installed in a quadrant, no ADSL line cards can be installed in that same quadrant.

Figure 1-13 illustrates the optimal deployment of 8xG.SHDSLs and quadrant intermixing of ADSL line cards in the Cisco 6160 chassis. For example

- If 4 8xG.SHDSLs are installed in the left side of the chassis, only 25 ADSL line cards can be installed in the remaining quadrants.

- If 4 8xG.SHDSLs are installed in the right side of the chassis, only 23 ADSL line cards can be installed in the remaining chassis quadrants.

> ✎
>
> **Note**   Random cell loss may occur if the guidelines for 8xG.SHDSL deployment in a system are exceeded.

Figure 1-13   8xG.SHDSL and ADSL Line Card Intermixing in the Cisco 6160 Chassis
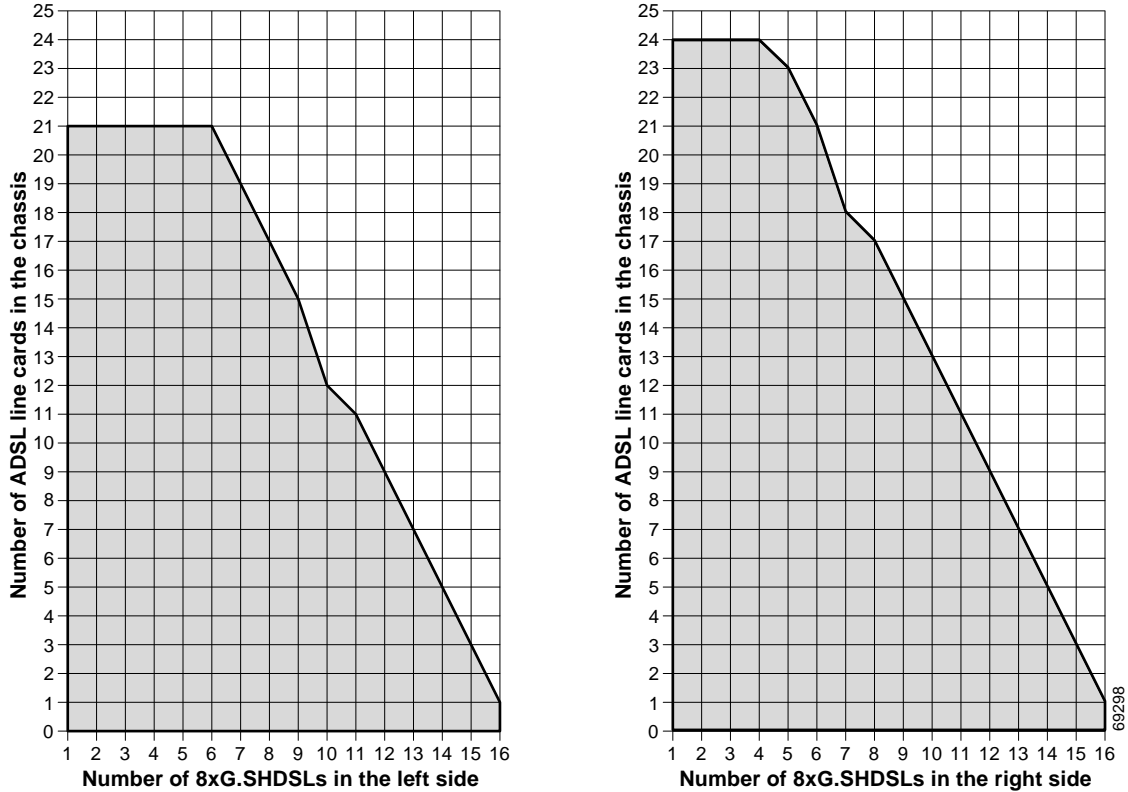
1.2.3.6.4 Guidelines for Intermixing 8xG.SHDSLs—Cisco IOS Release 12.2(12)DA and Later for NI2-155SM-155SM2 or NI2-155MM-155MM2 Only

This section describes intermixing in Cisco IOS Release 12.2(12)DA and later for NI2-155SM-155SM2 or NI2-155MM-155MM2 only. All other NI2s, including NI2-155SM-155SM and NI2-155MM-155MM, follow guidelines as described in the "Guidelines for Intermixing 8xG.SHDSLs—Cisco IOS Release 12.2(7)DA and Later" section on page 1-25.

The Cisco 6015, Cisco 6160, and Cisco 6260 can be fully populated with 8xG.SHDSLs while retaining QoS.

- In the Cisco 6160 and Cisco 6260, once an 8xG.SHDSL is installed in a chassis quadrant, no other type of line card can be installed in that same quadrant.

- In the Cisco 6015, intermixing is limited to chassis halves.

✎ **Note** In order to provision 18.5 Mbps per line card in a chassis fully populated with 8xG.SHDSLs, an OC-3c/OC-3c single-mode fiber (SMF) or multi-mode fiber (MMF) NI-2 card (NI2-155SM-155SM2 and NI2-155MM-155MM2) must be installed in the chassis.

Due to spectral compatibility limitations in the right side configuration of the Cisco 6160 chassis, line card slots 18 and 34 should be configured as specified in Table 1-9.

Table 1-9   Cisco 6160 Right Side Configuration Guidelines

Slot 18	Slot 34	Configuration
8xG.SHDSL	8xG.SHDSL	Supported
8xG.SHDSL	ADSL	Not supported
8xG.SHDSL	Empty	Supported
ADSL	ADSL	Not supported
ADSL	8xG.SHDSL	Not supported
ADSL	Empty	Supported

1.2.4 NI-2 Cards

The NI-2 card is a system processor module that includes the following features:

- Connects to the *x*TU-C line cards through point-to-point serial data buses on the backplane.
- Contains the ATM switch fabric.
- Supports subtending of as many as 12 subtended node chassis. See the "Subtended Network Configuration" section on page 1-6 for detailed information about subtending.
- Provides visual and audible operating status alerts.
- Provides CO facility alarm relay contact interfaces and an alarm cut-off (ACO) button.
- Is manageable through Cisco IOS software or CDM.
- Provides Cisco IOS-based ATM QoS.

Table 1-10 shows each Cisco 6160 NI-2 card type, the physical name of the card as it appears on the NI-2 card faceplate, and the hardware configuration of each NI-2 card type.

Table 1-10   NI-2 Card Hardware Configuration

NI-2 Card Type	NI-2 Card Faceplate Label	Hardware Configuration	
Identified in This Guide	Printed on NI-2 Card Faceplate	Trunk/Uplink (Quantity)	Subtending Interface/ Downlink (quantity)
DS3+T1/E1 IMA[1]	DS3+T1/E1 IMA	• DS3 coaxial (1)[2] or • T1 link or T1 IMA group (1)	• T1 link (8) or • T1 IMA group (maximum of 4)[2]
DS3/2DS3	DS3/E3-DS3/E3	DS3/E3 coaxial (1)[2]	DS3/E3 coaxial (2)[2]
OC-3c/2DS3 SMF	OC3 SM/2XDS3	OC-3c (1)	DS3 coaxial (2)[2]
OC-3c/2DS3 MMF	OC3 MM/2XDS3	OC-3c (1)	DS3 coaxial (2)[2]
OC-3c/OC-3c SMF	155SM-155SM	OC-3c (1)	OC-3c (1)
OC-3c/OC-3c MMF	155MM-155MM	OC-3c (1)	OC-3c (1)
OC-3c/OC-3c SMF	155SM-155SM2	OC-3c (1)	OC-3c (1)
OC-3c/OC-3c MMF	155MM-155MM2	OC-3c (1)	OC-3c (1)

1. Use only with the DS3/2DS3+8xT1 I/O card (part number 6160-1-I/O-2=).

2. All network trunk and subtend connectors for this card are located on the I/O card.

The following sections provide details about the Cisco 6160 NI-2 cards.

1.2.4.1 DS3+T1/E1 IMA NI-2 Card Overview

This section provides the following information about the DS3+T1/E1 IMA NI-2 card:

1.2.4.1.1 Features

In addition to the features described in the "NI-2 Cards" section on page 1-27, the DS3+T1/E1 IMA NI-2 card

- Provides the following interfaces:
  - DS3.
  - T1.
  - T1 IMA group.

> ✎
> **Note** Trunk and subtend connectors for this NI-2 card is located on the I/O card (DS3/2DS3+8xT1 IMA).

- Controls timing through an internal clock or BITS interface, or from an ATM interface (DS3 or T1).

> ✎
> **Note** The BITS interface is connected through the I/O card located on the back of the chassis.

- Controls redundancy.
- Supports the aggregation of up to 12 subtended node chassis that are configured for T1 or T1 IMA group operation in a daisy-chain, tree, or star topology.

> ✎
> **Note** For hardware specifications for the DS3+T1/E1 IMA NI-2 card, see the "DS3+T1/E1 IMA NI-2 Card Specifications" section on page A-7.

1.2.4.1.2 Faceplate Features

Figure 1-14 shows a close-up of the DS3+T1/E1 IMA NI-2 card faceplate.

Figure 1-14   DS3+T1/E1 IMA NI-2 Card Faceplate

1	Ejector lever	**7**	Card status LED group
2	Locking tab	**8**	Fan alarm LED group
3	ACO button	**9**	CNSL—An RJ-45 receptacle that provides a serial connection to a system console.

4	Maintenance RESET port	10	AUX—An RJ-45 receptacle that provides connection to an auxiliary device (such as a modem) used to remotely configure the system.
5	Interface status LED groups: DS3 1, T1/E1 2, T1/E1 3, T1/E1 4, T1/E1 5, T1/E1 6, T1/E1 7, T1/E1 8, and T1/E1 9. These groups show the status of the trunk and subtend connections on the I/O module or I/O card	11	ENET—An RJ-45 10BaseT receptacle that complies with Ethernet standards and that provides connection to a system Ethernet.
6	System alarm LED group		

Table 1-11 describes the LED group indicators and their functions.

Table 1-11   DS3+T1/E1 IMA NI-2 Card LED Group Indicators

LED Group	LED	State	Function
Interface status LED (**5** in Figure 1-14)	TEST	Amber solid	Cisco IOS detects that an obtrusive test (loopback) is active on this interface.
		Off	Cisco IOS does not detect obtrusive test activity.
	RX[1] STAT	Amber solid	The receiver detects a physical layer problem.
		Off	The receiver does not detect a physical layer problem.
	TX[2] STAT	Amber solid	The transmitter detects a physical layer problem.
		Off	The transmitter does not detect a physical layer problem.
	RCLK[3]	Green solid	Hardware detects an incoming clock signal.
		Off	Hardware does not detect an incoming clock signal.
System alarm (**6** in Figure 1-14)	CRITICAL	Red	A critical alarm is active.
	MAJOR	Red	A major alarm is active.
	MINOR	Amber	A minor alarm is active.
Card status (**7** in Figure 1-14)	POWER	Green	The NI-2 card has power.
	STATUS	Green	The operational status of the NI-2 card. • On—There are no internal faults or problems. • Off—The NI-2 card has not booted properly, or a problem is preventing normal operation.
	ACTIVE	Green	The NI-2 card is operating as the active NI-2 card in the chassis.
Fan alarm (**8** in Figure 1-14)	FAN 1	Red	The fan module or fan tray is not operational and is in alarm mode.
	FAN 2	—	This LED on the NI-2 card is inactive and is always off.

Table 1-11   DS3+T1/E1 IMA NI-2 Card LED Group Indicators (continued)

LED Group	LED	State	Function
ENET interface LED (**11** in Figure 1-14)	ACT	Green solid or blinking	The Ethernet interface is active.
		Off	The Ethernet interface is inactive.
	LNK	Green solid	The Ethernet link is connected and enabled.

1. RX = receive

2. TX = transmit

3. RCLK = receive clock

1.2.4.2 DS3/2DS3 NI-2 Card Overview

This section provides the following information about DS3/2DS3 NI-2 cards:

- Features, page 1-32

- Faceplate Features, page 1-33

1.2.4.2.1 Features

In addition to the features described in the "NI-2 Cards" section on page 1-27, the DS3/2DS3 NI-2 card

- Provides the network DS3 WAN trunk interface through Bayonet-Neill-Concelman (BNC) connectors located on the I/O card.

- Provides two DS3 subtend interfaces through BNC connectors located on the I/O card.

- Controls timing and redundancy.

Note   The BITS interface is connected through the I/O card located on the back of the chassis.

- Supports the aggregation of up to 12 subtended node chassis that are configured for DS3 operation in a tree topology.

Note   For hardware specifications for the DS3/2DS3 NI-2 card, see the "DS3/2DS3 NI-2 Card Specifications" section on page A-9.

1.2.4.2.2 Faceplate Features

Figure 1-15 shows a close-up of the DS3/2DS3 NI-2 card faceplate.

Figure 1-15   DS3/2DS3 NI-2 Card Faceplate

1	Ejector lever	**7**	Card status LED group
2	Locking tab	**8**	Fan alarm LED group
3	ACO button	**9**	CNSL—An RJ-45 receptacle that provides a serial connection to a system console.

4	Maintenance RESET port	**10**	AUX—An RJ-45 receptacle that provides connection to an auxiliary device (such as a modem) used to remotely configure the system.
5	Interface status LED groups: Trunk 1 (TRNK 1), Subtend 2 (SBTD 2), and Subtend 3 (SBTD 3). These groups show the status of the trunk and subtend connections on the I/O card or I/O module.	**11**	ENET—An RJ-45 10BaseT receptacle that complies with Ethernet standards and that provides connection to a system Ethernet.
6	System alarm LED group		

Table 1-12 describes the LED group indicators and their functions.

Table 1-12   DS3/2DS3 NI-2 Card LED Group Indicators

LED Group	LED	State	Function
Interface status LED (**5** in Figure 1-15)	TEST	Amber solid	Cisco IOS detects that an obtrusive test (loopback) is active on this interface.
		Off	Cisco IOS does not detect obtrusive test activity.
	RX STAT	Amber solid	The receiver detects a physical layer problem.
		Off	The receiver does not detect a physical layer problem.
	TX STAT	Amber solid	The transmitter detects a physical layer problem.
		Off	The transmitter does not detect a physical layer problem.
	RCLK	Green solid	Hardware detects an incoming clock signal.
		Off	Hardware does not detect an incoming clock signal.
System alarm (**6** in Figure 1-15)	CRITICAL	Red	A critical alarm is active.
	MAJOR	Red	A major alarm is active.
	MINOR	Amber	A minor alarm is active.
Card status (**7** in Figure 1-15)	POWER	Green	The NI-2 card has power.
	STATUS	Green	The operational status of the NI-2 card. • On—There are no internal faults or problems. • Off—The NI-2 card has not booted properly, or a problem is preventing normal operation.
	ACTIVE	Green	The NI-2 card is operating as the active NI-2 card in the chassis.
Fan alarm (**8** in Figure 1-15)	FAN 1	Red	The fan module or fan tray is not operational and is in alarm mode.
	FAN 2	—	This LED on the NI-2 card is inactive and is always off.

Table 1-12   DS3/2DS3 NI-2 Card LED Group Indicators (continued)

LED Group	LED	State	Function
ENET interface LED (**11** in Figure 1-15)	ACT	Green solid or blinking	The Ethernet interface is active.
		Off	The Ethernet interface is inactive.
	LNK	Green solid	The Ethernet link is connected and enabled.

1.2.4.3 OC-3c/2DS3 NI-2 Card Overview

This section provides the following information about OC-3c/2DS3 NI-2 cards:

- Features, page 1-35
- Faceplate Features, page 1-36

1.2.4.3.1 Features

In addition to the features that are described in the "NI-2 Cards" section on page 1-27, the OC-3c/2DS3 NI-2 card

- Provides the network OC-3c WAN trunk interface through connectors located on the NI-2 card faceplate. The following two versions of the OC-3c/2DS3 NI-2 card are available to support the WAN trunk interface:
    - Single-mode fiber (SMF) intermediate range.
    - Multimode fiber (MMF) short range.
- Provides two DS3 subtend interfaces through BNC connectors located on the I/O card.
- Controls timing and redundancy.

> **Note**   The BITS interface is connected through the I/O card located on the back of the chassis.

- Supports the aggregation of up to 12 subtended node chassis configured for DS3 operation in a tree configuration.

> **Note**   For hardware specifications for the OC-3c/2DS3 NI-2 card, see the "OC-3c/2DS3 NI-2 Card Specifications" section on page A-10.

1.2.4.3.2 Faceplate Features

Figure 1-16 shows a close-up of the OC-3c/2DS3 NI-2 card faceplate.

Figure 1-16   OC-3c/2DS3 NI-2 Card Faceplate
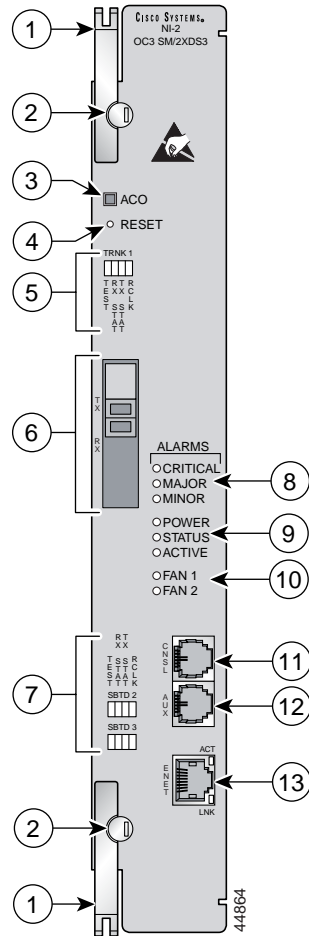
1	Ejector lever	**8**	System alarm LED group
2	Locking tab	**9**	Card status LED group
3	ACO button	**10**	Fan alarm LED group
4	Maintenance RESET port	**11**	CNSL—An RJ-45 receptacle that provides a serial connection to a system console.

5	Interface status LED group: Trunk 1 (TRNK 1). This group shows the status of the OC-3c network trunk connection.	12	AUX—An RJ-45 receptacle that provides connection to an auxiliary device (such as a modem) used to remotely configure the system.
6	An optical interface connector pair. This connector pair is for network trunk interface TX and RX data optical cables.	13	ENET—An RJ-45 10BaseT receptacle that complies with Ethernet standards and that provides connection to a system Ethernet.
7	Two interface status LED groups: Subtend 2 (SBTD 2) and Subtend 3 (SBTD 3). These LED groups monitor the DS3 subtend connections on the I/O card.		

Table 1-13 describes the LED group indicators and their functions.

Table 1-13   OC-3c/2DS3 NI-2 Card LED Group Indicators

LED Group	LED	State	Function
Interface status LED (**5** and **7** in Figure 1-16)	TEST	Amber solid	Cisco IOS detects that an obtrusive test (loopback) is active on this interface.
		Off	Cisco IOS does not detect obtrusive test activity.
	RX STAT	Amber solid	The receiver detects a physical layer problem.
		Off	The receiver does not detect a physical layer problem.
	TX STAT	Amber solid	The transmitter detects a physical layer problem.
		Off	The transmitter does not detect a physical layer problem.
	RCLK	Green solid	Hardware detects an incoming clock signal.
		Off	Hardware does not detect an incoming clock signal.
System alarm (**8** in Figure 1-16)	CRITICAL	Red	A critical alarm is active.
	MAJOR	Red	A major alarm is active.
	MINOR	Amber	A minor alarm is active.
Card status (**9** in Figure 1-16)	POWER	Green	The NI-2 card has power.
	STATUS	Green	The operational status of the NI-2 card. • On—There are no internal faults or problems. • Off—The NI-2 card has not booted properly, or a problem is preventing normal operation.
	ACTIVE	Green	The NI-2 card is operating as the active NI-2 card in the chassis.
Fan alarm (**10** in Figure 1-16)	FAN 1	Red	The fan module or fan tray is not operational and is in alarm mode.
	FAN 2	—	This LED on the NI-2 card is inactive and is always off.

Table 1-13   OC-3c/2DS3 NI-2 Card LED Group Indicators (continued)

LED Group	LED	State	Function
ENET interface LED (**13** in Figure 1-16)	ACT	Green solid or blinking	The Ethernet interface is active.
		Off	The Ethernet interface is inactive.
	LNK	Green solid	The Ethernet link is connected and enabled.

1.2.4.4 OC-3c/OC-3c NI-2 Card Overview

This section provides the following information about OC-3c/OC-3c NI-2 cards:

- Features, page 1-38
- Faceplate Features, page 1-39

1.2.4.4.1 Features

In addition to the features described in the "NI-2 Cards" section on page 1-27, the OC-3c/OC-3c NI-2 card

- Provides the network OC-3c WAN trunk interface through connectors located on the NI-2 card faceplate. The following two versions of the OC-3c/OC-3c NI-2 card are available to support the WAN trunk interface:
  - SMF intermediate range.
  - MMF short range.
- Provides an OC-3c subtend interface through optical connectors located on the NI-2 card faceplate.
- Controls timing and redundancy.

Note The BITS interface is connected through the I/O card located on the back of the chassis.

- Supports the aggregation of up to 12 subtended node chassis configured for OC-3c operation in a daisy chain configuration.

Note For hardware specifications for the OC-3c/OC-3c NI-2 card, see the "OC-3c/OC-3c NI-2 Card Specifications" section on page A-11.

1.2.4.4.2 Faceplate Features

Figure 1-17 shows a close-up of the OC-3c/OC-3c NI-2 card faceplate.

Figure 1-17   OC-3c/OC-3c NI-2 Card Faceplate
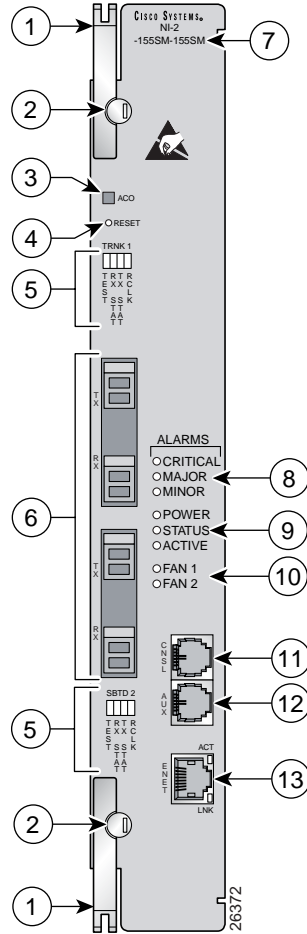
1	Ejector lever.	**7**	Model number
2	Locking tab.	**8**	System alarm LED group.
3	ACO button.	**9**	Card status LED group.
4	Maintenance RESET port.	**10**	Fan alarm LED group.

5	Interface status LED groups: Trunk 1 (TRNK 1) and Subtend 2 (SBTD 2). These groups show the status of the trunk and subtend connections.	**11**	CNSL—An RJ-45 receptacle that provides a serial connection to a system console.
6	Two optical interface connector pairs: Trunk 1 (TRNK 1) and Subtend 2 (SBTD 2) • TRNK 1—This connector pair is for network trunk interface TX and RX data optical cables. On a subtended node chassis, these network trunk interface TX and RX cables connect to SBTD 2 on the subtending host chassis. • SBTD 2—This connector pair is for subtended node chassis TX and RX data optical cables.	**12**	AUX—An RJ-45 receptacle that provides connection to an auxiliary device (such as a modem) used to remotely configure the system.
		13	ENET—An RJ-45 10BaseT receptacle that complies with Ethernet standards and that provides connection to a system Ethernet.

Table 1-14 describes the LED group indicators and their functions.

Table 1-14   OC-3c/OC-3c NI-2 Card LED Group Indicators

LED Group	LED	State	Function
Interface status LED (**5** in Figure 1-17)	TEST	Amber solid	Cisco IOS detects that an obtrusive test (loopback) is active on this interface.
		Off	Cisco IOS does not detect obtrusive test activity.
	RX STAT	Amber solid	The receiver detects a physical layer problem.
		Off	The receiver does not detect a physical layer problem.
	TX STAT	Amber solid	The transmitter detects a physical layer problem.
		Off	The transmitter does not detect a physical layer problem.
	RCLK	Green solid	Hardware detects an incoming clock signal.
		Off	Hardware does not detect an incoming clock signal.
System alarm (**7** in Figure 1-17)	CRITICAL	Red	A critical alarm is active.
	MAJOR	Red	A major alarm is active.
	MINOR	Amber	A minor alarm is active.
Card status (**8** in Figure 1-17)	POWER	Green	The NI-2 card has power.
	STATUS	Green	The operational status of the NI-2 card. • On—There are no internal faults or problems. • Off—The NI-2 card has not booted properly, or a problem is preventing normal operation.
	ACTIVE	Green	The NI-2 card is operating as the active NI-2 card in the chassis.

Table 1-14   OC-3c/OC-3c NI-2 Card LED Group Indicators (continued)

LED Group	LED	State	Function
Fan alarm (**9** in Figure 1-17)	FAN 1	Red	The fan module or fan tray is not operational and is in alarm mode.
	FAN 2	—	This LED on the NI-2 card is inactive and is always off.
ENET interface LED (**12** in Figure 1-17)	ACT	Green solid or blinking	The Ethernet interface is active.
		Off	The Ethernet interface is inactive.
	LNK	Green solid	The Ethernet link is connected and enabled.

1.2.4.5 Network Clocking Overview

The NI-2 card receives its network timing signal from any one of the following sources:

- BITS clock. When a BITS clock serves as the network timing signal source, the chassis receives a clock signal through designated pins on the I/O card and distributes the signal through the chassis backplane.

- Internal clock.

- DS3, OC-3c, or T1 network trunk interface. An NI-2 card synchronizes with the network timing source and provides a clock reference signal to line cards in the chassis and to subtended node chassis.

1.2.4.6 Redundancy Overview

The following forms of redundancy are available for the Cisco 6160 system:

- NI-2 card cold redundancy, which allows a standby NI-2 card to take over system operations in the event of a complete failure of the active NI-2 card.

- Automatic protection switching (APS) link redundancy, which provides recovery from a cut fiber or the failure of an OC-3c optical transmitter or optical receiver interface on an NI-2 card. APS redundancy is available on OC-3c/2DS3 NI-2 card trunk interfaces and OC-3c/OC-3c NI-2 card trunk and subtend interfaces.

Note   Line card redundancy is not supported.

1.2.4.6.1 NI-2 Card Cold Redundancy

NI-2 card cold redundancy requires that two NI-2 cards be installed in the chassis. The primary card is installed in slot 10 of the chassis, and the secondary card is installed in slot 11. Either the primary or the secondary NI-2 card can serve as the active NI-2 card. The interface types must be the same for both the primary and secondary NI-2 cards.

During steady-state operations, one NI-2 card functions as the active unit, and the other functions as the standby unit. The active NI-2 card displays a green ACTIVE LED. In an active state, the NI-2 card

- Has full Ethernet, auxiliary port, and console access

- Communicates with line cards

- Has full access to the environmental monitoring subsystem

- Has access to the optical interfaces on the standby NI-2 card

- Allows remote access to the file system of the standby NI-2 card

The standby NI-2 card plays a minimal role during steady-state operations. In a standby state, the NI-2 card

- Receives configuration changes from the active NI-2 card (when the cards are configured for synchronization)

- Has no Ethernet, auxiliary port, or console access

- Does not communicate with line cards

- Has no access to the environmental monitoring subsystem

- Generates only APS alarms, which are reported via the active card

For management purposes, the primary and secondary NI-2 cards appear as one element. The cards share one IP address.

Note   For information on NI-2 card cold redundancy switchover conditions, refer to the *Upgrading DSLAMs for NI-2 Card and APS Link Redundancy* document.

1.2.4.6.2 APS Link Redundancy

APS link redundancy provides recovery from a cut fiber or the failure of an OC-3c optical transmitter or receiver interface on an NI-2 card. APS link redundancy is available on OC-3c/2DS3 NI-2 card trunk interfaces and OC-3c/OC-3c NI-2 card trunk and subtend interfaces.

The working link is the fiber connection between the ATM switch and the primary NI-2 card installed in slot 10 of the chassis. The protection link is the fiber connection between the ATM switch and the secondary NI-2 card installed in slot 11 of the chassis. When the fiber or optical ports on the active NI-2 card fail, that card remains active but is able to use the fiber or optical ports on the standby NI-2 card.

APS protocol information is carried over the protection link connected to the secondary NI-2 card in slot 11. The standby NI-2 card continually reports Synchronous Optical Network (SONET) state information to the active NI-2 card.

APS link redundancy is nonrevertive. For example, after a switchover from the working to the protective link occurs, the active NI-2 card switches back to the working fiber only if manually forced through a CLI command or if a failure condition occurs on the protection link. However, if a failure condition occurs on the protection link while the working link is still in a failed state, a switch back to the working link does not occur.

Note   For information on APS link redundancy switchover conditions, refer to the *Upgrading DSLAMs for NI-2 Card and APS Link Redundancy* document.

1.2.4.6.3 Redundancy in Subtended Configurations

NI-2 card redundancy is supported in a DS3 subtend tree or in an OC-3c subtend daisy-chain if both the subtending host chassis and the subtended node chassis have primary and secondary NI-2 cards installed. An NI-2 card failure on a node in a subtend tree or daisy-chain temporarily interrupts traffic to all subtended node chassis.

APS link redundancy is supported in subtending configurations only if the subtending host chassis has a secondary (redundant) OC-3c/OC-3c or OC-3c/2DS3 NI-2 card installed.

Note   For more information about subtending and subtended network configurations, see the "Subtended Network Configuration" section on page 1-6.

1.2.5 I/O Cards

Table 1-15 lists the Cisco 6160 I/O cards and NI-2 card compatibility.

Table 1-15   I/O Card and NI-2 Card Compatibility

I/O Card	NI-2 Card			
	DS3+T1/E1 IMA	DS3/2DS3	OC-3c/2DS3	OC-3c/OC-3c
DS3/2DS3+8xT1 IMA	Yes	Yes	Yes	Yes
DS3/2DS3	No	Yes	Yes	Yes

The following sections provide details about the Cisco 6160 I/O cards.

- DS3/2DS3+8xT1 IMA I/O Card Overview, page 1-43
- DS3/2DS3 I/O Card Overview, page 1-48

1.2.5.1 DS3/2DS3+8xT1 IMA I/O Card Overview

This section provides the following information about DS3/2DS3+8xT1 IMA I/O cards

- Features, page 1-43
- DS3/2DS3+8xT1 IMA I/O Card Wire-Wrap Pins, page 1-46s

1.2.5.1.1 Features

A DS3/2DS3+8xT1 IMA I/O card

- Provides the following trunk and subtending interfaces:
  - Up to three DS3.
  - Up to eight T1.
  - Up to eight T1 IMA group.

Note   For more information on IMA group interfaces, refer to the *T1/E1 Inverse Multiplexing Over ATM* feature module.

- Provides, when used with the OC-3c/OC-3c NI-2 card, one network OC-3c WAN trunk interface and one OC-3c subtend interface through connectors located on the NI-2 card faceplate.

- Provides five rows of six wire-wrap pins located on the right side of the DS3/2DS3+8xT1 IMA I/O card that support central office alarm relay interfaces (visual and audible) between the NI-2 card and the subscriber and BITS clock input circuits.

- Supports up to 12 additional subtended node chassis, configured for DS3, T1, or T1 IMA operation.

Note For hardware specifications for the DS3/2DS3+8xT1 IMA I/O card, see the "DS3/2DS3+8xT1 IMA I/O Card Specifications" section on page A-12.

Figure 1-18 shows a close-up of the DS3/2DS3+8xT1 IMA I/O card with the EMI cover installed.

Figure 1-18   DS3/2DS3+8xT1 IMA I/O Card with the EMI Cover
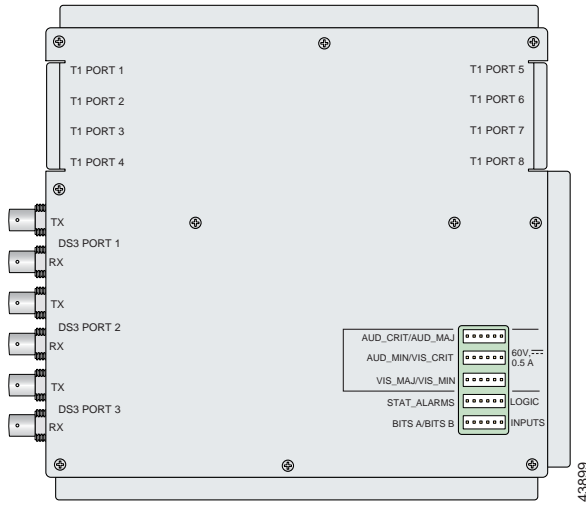
Figure 1-19 shows a close-up of the DS3/2DS3+8xT1 IMA I/O card without the EMI cover installed.

Figure 1-19   DS3/2DS3+8xT1 IMA I/O Card Without the EMI Cover
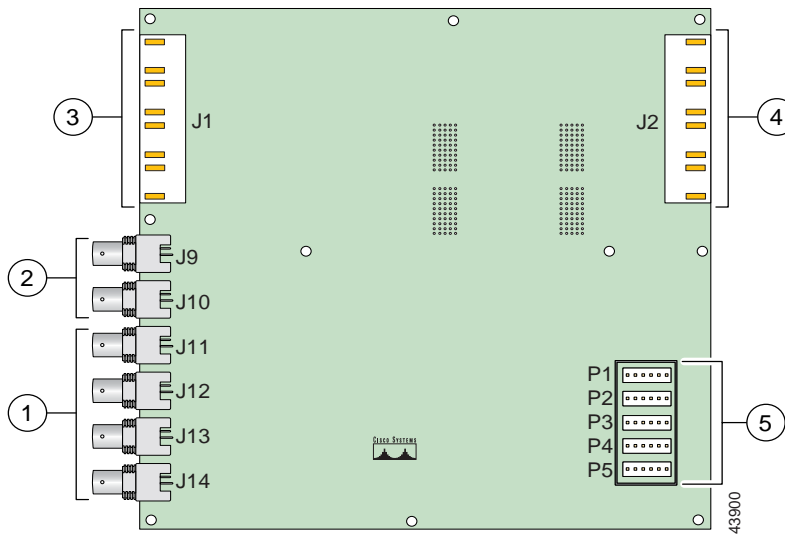
1	DS3 downstream subtend interface connectors (Port 2 and Port 3)	**4**	Four RJ-48c receptacles for T1 interfaces (T1 Port 5 through Port 8)
2	DS3 trunk interface or upstream subtend interface connectors (Port 1)	**5**	Wire wrap connectors that support central office alarm relay interfaces and BITS clock input circuits
3	Four RJ-48c receptacles for T1 interfaces (T1 Port 1 through Port 4)		

Note   For pinouts of the RJ-48c receptacles, see the Pin Assignments for the RJ-48c Receptacles, page 4.

The DS3/2DS3+8xT1 IMA I/O card provides three sets of two vertically paired DS3 75-ohm BNC coaxial cable connectors that are located on the left side of the DS3/2DS3+8xT1 IMA I/O card. Each set of port connectors has both a TX connector and a RX connector. Table 1-16 lists the DS3 BNC connector sets in relation to the NI-2 cards available for the Cisco 6160 chassis.

Table 1-16   DS3/2DS3+8xT1 IMA I/O Card BNC Connector Set Functions with the NI-2 Cards

NI-2 Card	Chassis configuration	DS3 BNC Connector Sets		
		Port 1	**Port 2**	**Port 3**
DS3+T1/E1 IMA	Subtending host chassis	DS3 Trunk interface (optional). You can also use any T1 receptacle connector for the T1 or T1 IMA trunk interface.	Not in use. Use the T1 receptacle connectors for T1 or T1 IMA subtend interfaces.	
	Subtended node chassis	Not in use. Use the T1 receptacle connectors for T1 or T1 IMA subtend interfaces.		
DS3/2DS3	Subtending host chassis	Trunk interface.	Downstream subtend interface.	
	Subtended node chassis	Upstream subtend interface.	Downstream subtend interface.	
OC-3c/2DS3	Subtending host chassis	Not in use.	Downstream subtend interface.	
	Subtended node chassis	Upstream subtend interface.	Downstream subtend interface.	
OC-3c/OC-3c	Subtending host chassis	Not in use. The trunk and subtend interfaces are located on the NI-2 card.		
	Subtended node chassis	Not in use. The trunk and subtend interfaces are located on the NI-2 card.		

The DS3/2DS3+8xT1 IMA I/O card is delivered installed and attached to the two 2-mm HM card connectors, P3 and P9, on the chassis backplane (see Figure 1-20). The DS3/2DS3+8xT1 IMA I/O card is shown with the metal EMI cover installed.

Figure 1-20   DS3/2DS3+8xT1 IMA I/O Card Location on the Cisco 6160 Chassis Backplane
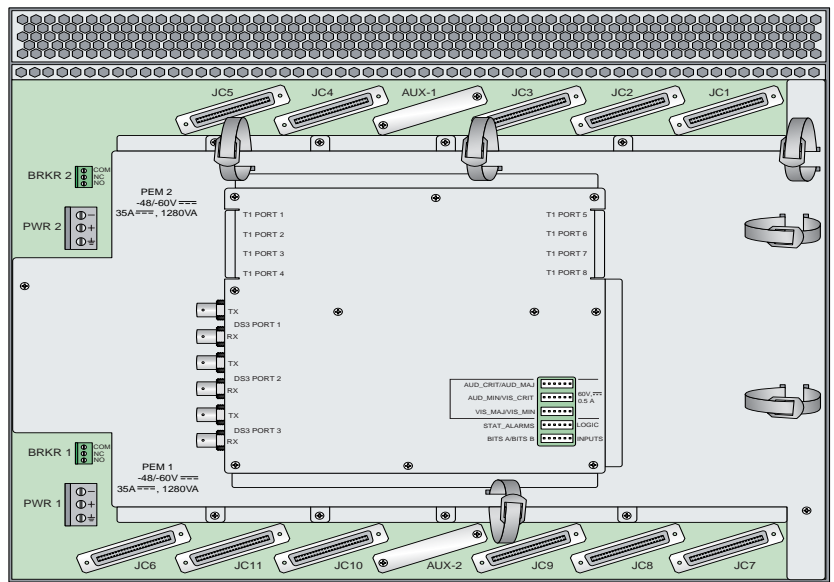
1.2.5.1.2 DS3/2DS3+8xT1 IMA I/O Card Wire-Wrap Pins

There are 30 wire-wrap pins located on the right side of each DS3/2DS3+8xT1 IMA I/O card that support

• Central office alarm relay interfaces (visual and audible) between the NI-2 card and the subscriber.

• BITS clock input circuits.

• Wire wrap and socket type connections. A six-pin connector, Molex 26-03-3061, can be used to mate with each of the five headers.

Note   The relay for the circuit-breaker trip alarm is wired through the small green terminal blocks on the rear of the chassis, not through the wire-wrap connector.

Both the alarm relays and the BITS clock connections are optional. If you connect the alarm relays, they transmit critical, major, and minor alarms to a separate, external alarm device. The alarm device uses a bell, light, or some other signal to alert service personnel to the change in system status. If you connect the BITS interface, the Cisco 6160 can receive a clock signal from a T1 line.

Figure 1-21 shows a close-up of the wire-wrap pins.

Figure 1-21   DS3/2DS3+8xT1 IMA I/O Card Wire-Wrap Pins Close-Up
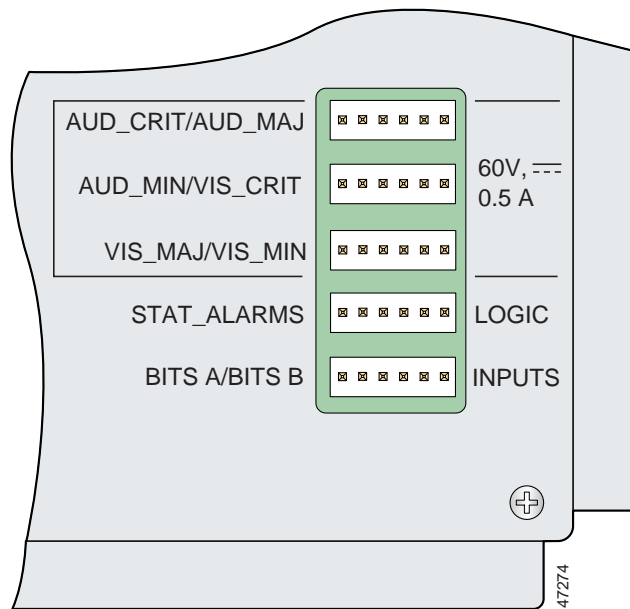
These pins support the following alarm functions:

- Visual critical
- Visual major
- Visual minor
- Audible critical
- Audible major
- Audible minor
- Remote alarm cut off
- Reserved (several pins are reserved for future specification)

Alarm pins are wired to both NI-2 cards, however, only one NI-2 card manages the alarms. The ACO switch that is located on the NI-2 card faceplate shuts off the audible alarms generated by the Cisco 6160 system software.

One of the alarm relay functions provided by the wire-wrap connector is an ACO circuit that you can wire to your external alarm device. To use this feature, connect the alarm device so that it can close the contact between pin 5 and pin 6 in the STAT_ALARMS row.

The connector also provides contacts for the following features, all of which can be used (or not used) separately:

- Audible alarms—Wire pins whose signals begin with AUD
- Visible alarms—Wire pins whose signals begin with VIS
- BITS clock—Wire pins whose signals begin with RX_BITS

Note There is one set of contacts for audible alarms and one set for visual alarms. You can use either or both sets of contacts.

You can wire the alarm relay contacts as normally open (NO) or normally closed (NC); however, the ACO circuit can be wired as NO only. Use common (CO) pins for both the NO and NC wiring methods.

Wiring Method	Pins to Use
Normally open	Pin 2 in rows P1, P2, P3 (NO) Pin 5 in rows P1, P2, P3, P4 (NO) Pin 1 in rows P1, P2, P3 (CO) Pin 4 in rows P1, P2, P3 (CO) Pin 6 in row P4 (GND[1])
Normally closed	Pin 3 in rows P1, P2, P3 (NC) Pin 6 in rows P1, P2, P3 (NC) Pin 1 in rows P1, P2, P3 (CO) Pin 4 in rows P1, P2, P3 (CO)

1. GND = ground

Note For more information on how the wire-wrap pins map to the alarms, see the "DS3/2DS3+8xT1 IMA I/O Card Wire-Wrap Pin Mapping" section on page C-2.

The BITS pins on Cisco 6160 DS3/2DS3+8xT1 IMA I/O card are slot specific. BITS_A pins are assigned to slot 11 and BITS_B pins are assigned to slot 10. Each BITS clock input is independent and terminated at 100 ohms.

1.2.5.2 DS3/2DS3 I/O Card Overview

This section provides the following information about DS3/2DS3 I/O cards

- Features, page 1-43
- DS3/2DS3+8xT1 IMA I/O Card Wire-Wrap Pins, page 1-46s

1.2.5.2.1 Features

A DS3/2DS3 I/O card

- Provides one DS3 trunk interface and two DS3 subtend interfaces.
- Provides, when used with the OC-3c/OC-3c NI-2 card, one network OC-3c WAN trunk interface and one OC-3c subtend interface through connectors located on the NI-2 card faceplate.
- Provides five rows of six wire-wrap pins located on the right side of the DS3/2DS3 I/O card that support central office alarm relay interfaces (visual and audible) between the NI-2 card and the subscriber and BITS clock input circuits.
- Supports up to 12 additional subtended node chassis, configured for DS3 operation.

Note   For hardware specifications for the DS3/2DS3 I/O card, see the "DS3/2DS3 I/O Card Specifications" section on page A-12.

Figure 1-22 shows a close-up of the DS3/2DS3 I/O card with the EMI cover installed.

Figure 1-22   DS3/2DS3 I/O Card with the EMI Cover
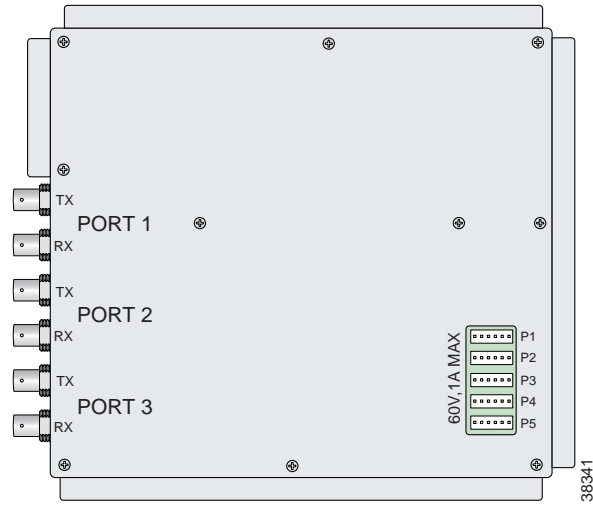
Figure 1-23 shows a close-up of the DS3/2DS3 I/O card without the EMI cover installed.

Figure 1-23   DS3/2DS3 I/O Card Without the EMI Cover
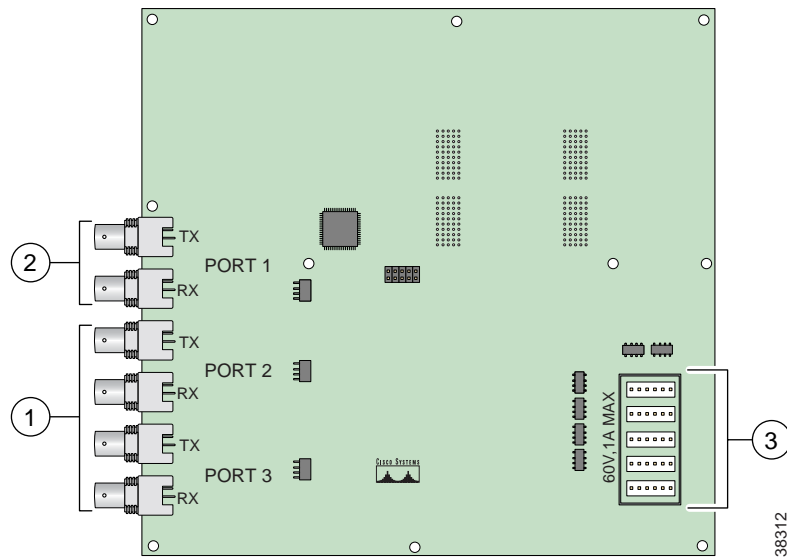
1	DS3 downstream subtend interface connectors (Port 2 and Port 3)	**3**	Wire wrap connectors that support central office alarm relay interfaces and BITS clock input circuits
2	DS3 trunk interface or upstream subtend interface connectors (Port 1)		

The DS3/2DS3 I/O card provides three sets of two vertically paired DS3 75-ohm BNC coaxial cable connectors that are located on the left side of the DS3/2DS3 I/O card. Each set of port connectors has both a TX connector and a RX connector. Table 1-17 lists the DS3 BNC connector sets in relation to the NI-2 cards available for the Cisco 6160 chassis.

Table 1-17   DS3/2DS3 I/O Card BNC Connector Set Functions with the NI-2 Cards

NI-2 Card	Chassis configuration	DS3 BNC Connector Sets		
		Port 1	**Port 2**	**Port 3**
DS3/2DS3	Subtending host chassis	Trunk interface.	Downstream subtend interface.	
	Subtended node chassis	Upstream subtend interface.	Downstream subtend interface.	
OC-3c/2DS3	Subtending host chassis	Not in use.	Downstream subtend interface.	
	Subtended node chassis	Upstream subtend interface.	Downstream subtend interface.	
OC-3c/OC-3c	Subtending host chassis	Not in use. The trunk and subtend interfaces are located on the NI-2 card.		
	Subtended node chassis	Not in use. The trunk and subtend interfaces are located on the NI-2 card.		

The DS3/2DS3 I/O card is delivered installed and attached to the two 2-mm HM card connectors, P3 and P9, on the chassis backplane (see Figure 1-24). The DS3/2DS3 I/O card is shown with the metal EMI cover installed.

Figure 1-24   DS3/2DS3 I/O Card Location on the Cisco 6160 Chassis Backplane
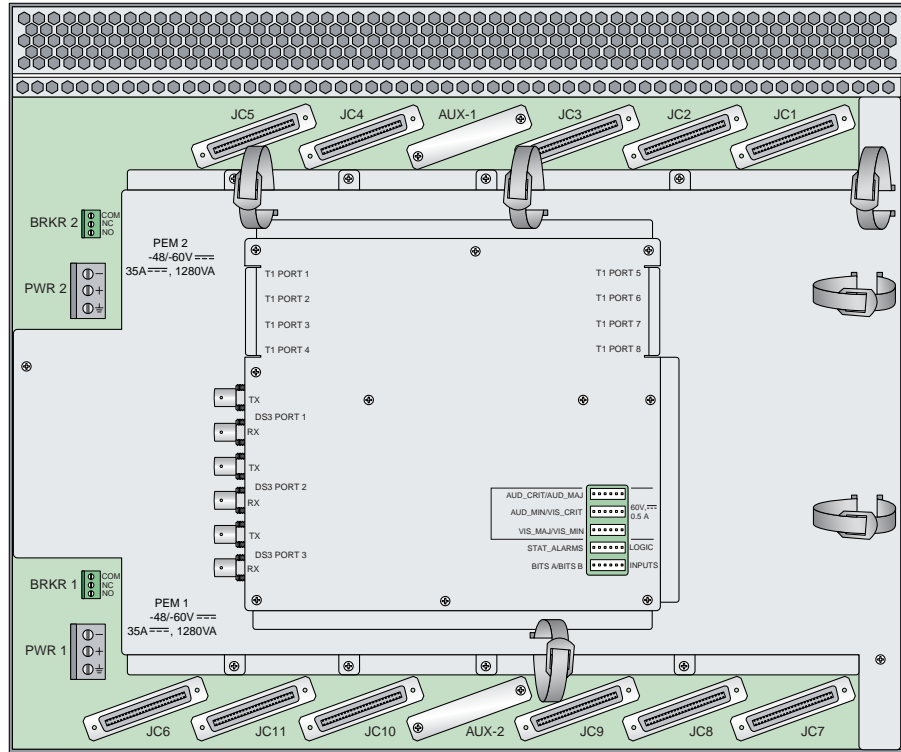
1.2.5.2.2 DS3/2DS3 I/O Card Wire-Wrap Pins

There are 30 wire-wrap pins located on the right side of each DS3/2DS3 I/O card that support

- Central office alarm relay interfaces (visual and audible) between the NI-2 card and the subscriber.
- BITS clock input circuits.
- Wire wrap and socket type connections. A six-pin connector, Molex 26-03-3061, can be used to mate with each of the five headers.

Note   The relay for the circuit-breaker trip alarm is wired through the small green terminal blocks on the rear of the chassis, not through the wire-wrap connector.

Both the alarm relays and the BITS clock connections are optional. If you connect the alarm relays, they transmit critical, major, and minor alarms to a separate, external alarm device. The alarm device uses a bell, light, or some other signal to alert service personnel to the change in system status. If you connect the BITS interface, the Cisco 6160 can receive a clock signal from a T1 line.

One of the alarm relay functions provided by the wire-wrap connector is an ACO circuit that you can wire to your external alarm device. To use this feature, connect the alarm device so that it can close the contact between pin 5 and pin 6 in row P4.

The connector also provides contacts for the following features, all of which can be used (or not used) separately:

- Audible alarms—Wire pins whose signals begin with AUD
- Visible alarms—Wire pins whose signals begin with VIS
- Power alarms—Wire pins whose signals begin with PEM
- BITS clock—Wire pins whose signals begin with RX_BITS

Note There is one set of contacts for audible alarms and one set for visual alarms. You can use either or both sets of contacts.

You can wire the alarm relay contacts as NO or NC; however, the ACO circuit can be wired as NO only. Use CO pins for both the NO and NC wiring methods.

Wiring Method	Pins to Use
Normally open	Pin 2 in rows P1, P2, P3 (NO) Pin 5 in rows P1, P2, P3, P4 (NO) Pin 1 in rows P1, P2, P3 (CO) Pin 4 in rows P1, P2, P3 (CO) Pin 6 in row P4 (GND)
Normally closed	Pin 3 in rows P1, P2, P3 (NC) Pin 6 in rows P1, P2, P3 (NC) Pin 1 in rows P1, P2, P3 (CO) Pin 4 in rows P1, P2, P3 (CO

Note For more information on how the wire-wrap pins map to the alarms, see the "DS3/2DS3 I/O Card Wire-Wrap Pin Mapping" section on page C-4.

The BITS pins on Cisco 6160 DS3/2DS3 I/O card are slot specific. BITS_A pins are assigned to slot 11 and BITS_B pins are assigned to slot 10. Each BITS clock input is independent and terminated at 100 ohms.

1.2.6 PEM

The Cisco 6160 chassis is equipped with one or two –48VDC PEMs, which distribute direct current (DC) power within the chassis. The Cisco 6160 needs only one active PEM to operate; if two PEMs are installed, a secondary PEM serves as a hot backup to the first PEM.

Each PEM should be connected to a single DC power source. For full power redundancy, two PEMs must be installed and connected to two separate DC power sources.

The primary Cisco 6160 PEM is located in the bottom right slot of the Cisco 6160 chassis. If you have a redundant system, a secondary PEM is located in the top right slot of the chassis. Figure 1-7 shows the location of the PEMs in the Cisco 6160 chassis.

The PEM provides the following features:

- Redundancy, when a secondary PEM is installed. Either the primary or secondary PEM can serve as the active PEM. If the active PEM fails, the standby PEM powers up and becomes active.
- A maximum of 1200 watts of –48VDC power to the Cisco 6160 backplane connector.
- System earth ground bond integrity.
- Circuit breaker control handles, which are accessible from the front panel.
- Circuit breaker auxiliary alarm contacts, which remotely signal the status of the tripped breaker.
- Reverse polarity protection.
- Internal cooling fans.

Note   For hardware specifications for the PEM, see the "PEM Specifications" section on page A-13.

Figure 1-25 shows a close-up of the PEM faceplate.

Figure 1-25   PEM Faceplate
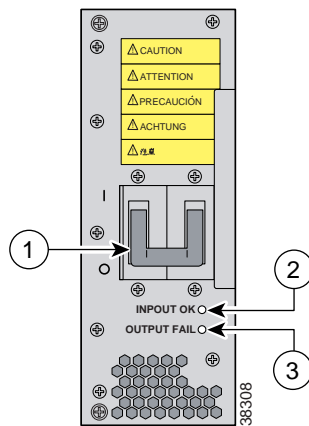
1	Two-position circuit breaker. The positions are Off (0) and On (1).	**3**	OUT FAIL LED.
2	INPUT OK LED.		

Note   To power down a Cisco 6160 that has two PEMs installed, you must flip the circuit breakers on *both* PEMs to the Off (0) position.

Table 1-18 describes the LEDs on the PEM.

Table 1-18   PEM LEDs

LED	State	Function
INPUT OK	Green	–48VDC power is available to the chassis.
	Off	The PEM has a power failure.
OUT FAIL	Red	One or both of the following conditions exists: • The PEM is not distributing power to the chassis. • The PEM is not distributing power to its cooling fans.

1.2.7 Blower Tray

The Cisco 6160 chassis is equipped with a blower tray, which provides forced air cooling required by all Cisco 6160 system circuit cards.

The Cisco 6160 blower tray is located in the top slot above the *x*TU-C line cards and NI-2 cards. Figure 1-7 shows the location of the blower tray in the Cisco 6160 chassis.

The blower tray

- Is hot swappable.

- Contains four blowers in each assembly unit.

- Is accessible from the front of the Cisco 6160.

- Has adequate system cooling with a single blower failure.

- Has two speeds, which are controlled by the NI-2 card. By default, it runs run at the lower speed. The blower speed increases when

    – The system senses high temperatures within the chassis.

    – One or more blowers fail.

    The blower speed returns to normal (low speed) when

    – Temperatures within the chassis fall to acceptable levels.

    – All four blowers are operating normally.

- Contains a front panel LED to indicate status of operation.

Note For hardware specifications for the blower tray, see the "Blower Tray Specifications" section on page A-13.

Caution The blowers must run continuously. The system might suffer thermal damage if the blowers stop for more than five minutes.

Figure 1-26 shows a close-up of the blower tray faceplate.

Figure 1-26   Blower Tray Faceplate

Table 1-19 describes the LED on the blower tray.

Table 1-19   Blower Tray LED

State	Function
Green	The blower tray is operating normally.
Red	One or more blowers have failed. Replace the blower tray.
Off	One of the following has occurred: • The blower tray is receiving no power. • The blower tray LED is broken. • The blower tray has failed.

1.2.8 Air Filter

An air filter is located at the bottom of the chassis (see Figure 1-7 for location). The air filter must be removed and cleaned periodically. Once a month (or more often in dusty environments), examine the air filter and clean or replace it if it is dirty. Keep a log recording the date that the filter was cleaned or replaced.

See the "Air Filter Maintenance" section on page 6-36 for complete instructions on cleaning and replacing the air filter. Figure 1-27 shows the location of the air filter and the protective bezel that covers it.

Figure 1-27   Air Filter

1	Protective bezel	2	Air filter
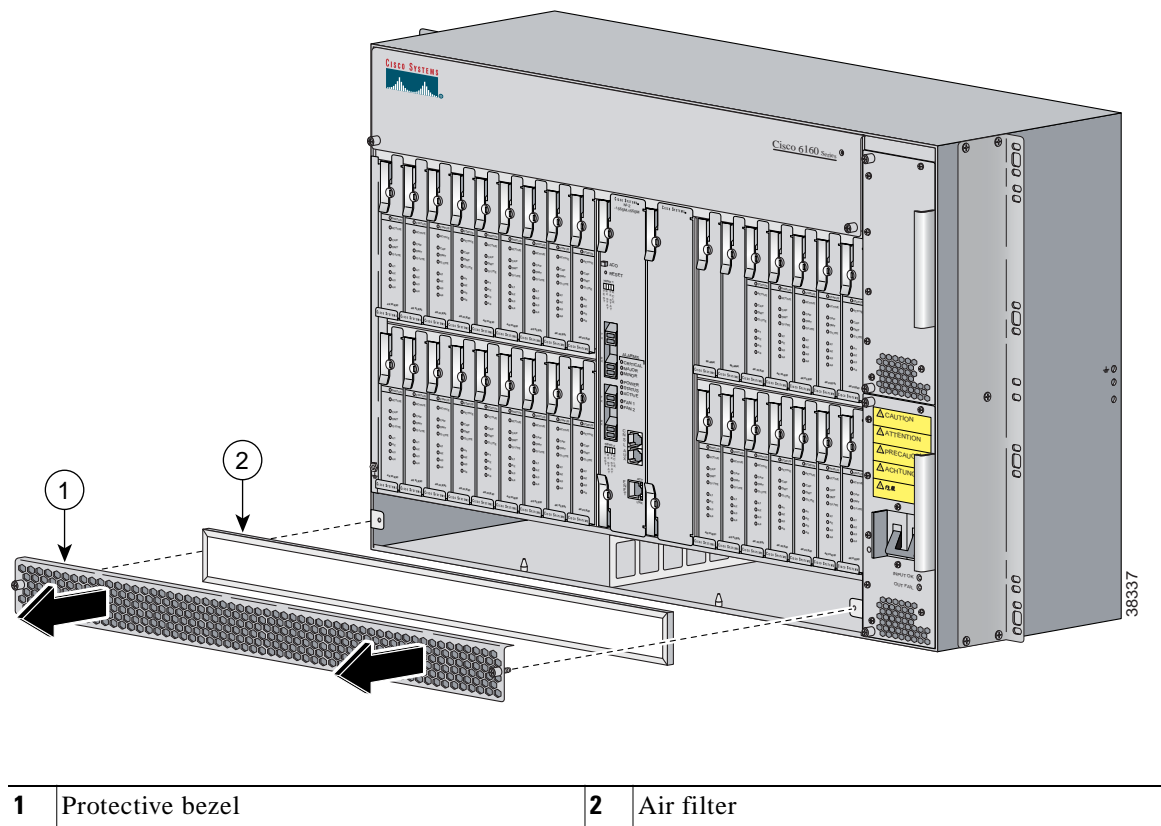
1.3 Management Software

You can provision and manage the Cisco 6160 system through the following management software:

- Cisco IOS—A CLI that is available for network element provisioning.

- Cisco CDM—An element management system designed to configure and manage the 6xxx series of Cisco IOS software-based DSLAMs through a graphical-user interface (GUI). CDM provides the following areas of network management: fault, configuration, performance, and security. CDM runs within the Cisco Element Manager Framework (EMF); both are installed on Sun workstations.

Cisco EMF is based on an object model in which network elements or modules represent the managed entity. Each object is defined by a class and specific attributes. An object can represent a network element or a more abstract entity such as a link relationship, a network, or a container such as a site, shelf, or region.

Note   If your network contains multiple Sun workstations, you must dedicate one workstation as the server and all additional workstations as clients. The server should be the repository and distributor of database information from which the clients request information. The client workstations allow multiple users to monitor the managed network.

Note   See the Hardware Specifications, page A-1 for minimum software and network management release requirements per Cisco 6160 chassis component.

The Cisco 6160 includes CO alarm LED indicators and relays that indicate system status. You can wire CO facility alarm relay contacts for either normally open or normally closed operation. The supported alarms that are generated by the management software are:

- CRITICAL—A critical alarm condition is indicated when the CRITICAL LED in the NI-2 card faceplate lights.
    - When a critical alarm occurs, the critical visual and audible alarm relays are activated.
    - A critical alarm affects many or all subscribers that are connected to the node. (For example, failure of the NI-2 card or the trunk can cause a critical alarm.)
    - Critical alarms clear after you fix the condition that triggered the alarm.
    - Audible alarms are turned off when you press the ACO button on the NI-2 card faceplate or clear the alarm in the Cisco IOS software.

- MAJOR—A major alarm condition is indicated when the MAJOR LED in the NI-2 card faceplate lights.
    - When a major alarm occurs, the major visual and audible alarm relays are also activated.
    - Several subscribers that are connected to the node are affected.
    - Major alarms clear after you fix the condition that triggered the alarm.
    - Audible alarms are turned off when you press the ACO button on the NI-2 card faceplate or clear the alarm in the Cisco IOS software.

- MINOR—A minor alarm condition is indicated when the MINOR LED in the NI-2 card faceplate lights.
    - When a minor alarm occurs, the minor visual and audible alarm relays are also activated.
    - A small number of subscribers that are connected to the node are affected.
    - Minor alarms clear after you fix the condition that triggered the alarm.
    - Audible alarms are turned off when you press the ACO button on the NI-2 card faceplate or clear the alarm in the Cisco IOS software.

Visual and audible alarm relay contacts can be wired from the Cisco 6160 to CO alarm devices (remote lights or bells) located anywhere within the facility.

The visual and audible alarm relays are located on the I/O card, but the NI-2 card hardware operates them.

For more information on alarms that are generated in the management software, see Chapter 5, "Troubleshooting."

Preparing for Installation

This chapter provides the requirements that are necessary to prepare for the installation of the Cisco 6160 system.

This chapter contains the following sections:

- Safety Requirements, page 2-1
- Site Requirements, page 2-10
- Required Tools and Equipment, page 2-16
- Unpacking the Cisco 6160 System, page 2-18
- Verifying Contents, page 2-19
- Inspecting for Damage, page 2-19

⚠️

Caution   Before you begin the installation procedures, read the entire chapter for important information and safety warnings.

2.1 Safety Requirements

This section describes safety requirements for the Cisco 6160 system. Before you install the Cisco 6160 system, ensure that all the criteria in this section are met. This section describes the following safety requirements:

- Safety Guidelines, page 2-1
- Maintaining Safety with Electricity, page 2-7
- Preventing Electrostatic Discharge Damage, page 2-8
- General Maintenance Guidelines, page 2-9

2.1.1 Safety Guidelines

Before working on the equipment, be aware of standard safety guidelines and the hazards that are involved in working with electrical circuitry to prevent accidents. Adhere to the following cautions and warnings and those throughout the guide for safe and hazard-free installation.

Follow these guidelines to ensure general safety:

- Keep the equipment area clear and dust-free during and after installation.

- Keep tools away from walk areas where you and others could fall over them.

- Do not wear loose clothing that could get caught in the chassis. Fasten ties or scarves and roll up shirt sleeves.

- Wear safety glasses if you are working under conditions that might be hazardous to your eyes.

- Do not perform any action that makes the equipment unsafe or creates a potential hazard to yourself or others.

⚠
Caution   Before you start the installation procedures, read the entire chapter for important information and safety warnings.

⚠
Caution   Proper ESD protection is required whenever you handle Cisco equipment. Installation and maintenance personnel should be properly grounded by means of grounding straps to eliminate the risk of ESD damage to the equipment. Equipment is subject to ESD damage whenever it is removed from the chassis.

⚠
Caution   Be careful when you remove the standoff screws and reinsert the screws into the screw holes on the backplane so that the backplane circuitry does not become damaged.

⚠
Caution   Installing the cards in the chassis with the power leads reversed can damage the line cards.

⚠
Caution   If fuses are already installed in the fuse and alarm panel, remove them. You can replace the fuses after the system is installed. Do not power up the system while you install and connect the system.

⚠
Caution   If the power connections are improperly made and power is applied while the cards are installed, the cards and chassis could be damaged.

⚠
Caution   It is important that the chassis cooling fans run continuously.

⚠
Caution   Any card that is only partially connected to the backplane can disrupt system operation.

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

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

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

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

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

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

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

Aviso   **Este símbolo de aviso indica perigo. Encontra-se numa situação que lhe poderá causar danos físicos. Antes de começar a trabalhar com qualquer equipamento, familiarize-se com os perigos relacionados com circuitos eléctricos, e com quaisquer práticas comuns que possam prevenir possíveis acidentes. Para ver as traduções dos avisos que constam desta publicação, consulte o documento *Regulatory Compliance and Safety Information* (Informação de Segurança e Disposições Reguladoras) que acompanha este dispositivo.**

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

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

Warning   **Before opening the chassis, disconnect the telephone-network cables to avoid contact with telephone-network voltages.**

Warning   **Do not work on the system or connect or disconnect cables during periods of lightning activity.**

Warning   **Read the installation instructions before you connect the system to its power source.**

Warning   **Before working on a chassis or working near power supplies, unplug the power cord on AC units; disconnect the power at the circuit breaker on DC units.**

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

This unit should be mounted at the bottom of the rack if it is the only unit in the rack.

When mounting this unit in a partially filled rack, load the rack from the bottom to the top with the heaviest component at the bottom of the rack.

If the rack is provided with stabilizing devices, install the stabilizers before mounting or servicing the unit in the rack.

Warning   The ports labeled "Ethernet," "10BaseT," "Token Ring," "Console," and "AUX" are safety extra-low voltage (SELV) circuits. SELV circuits should only be connected to other SELV circuits. Because the BRI circuits are treated like telephone-network voltage, avoid connecting the SELV circuit to the telephone network voltage (TNV) circuits.

Warning   Class 1 laser product.

Warning   Do not stare into the beam or view it directly with optical instruments.

Warning   This unit is intended for installation in restricted access areas. A restricted access area is where access can only be gained by service personnel through the use of a special tool, lock and key, or other means of security, and is controlled by the authority responsible for the location.

Warning   When installing the unit, always make the ground connection first and disconnect it last.

Warning   This equipment is to be installed and maintained by service personnel only as defined by AS/NZS 3260 Clause 1.2.14.3 Service Personnel.

Warning   A readily accessible two-poled disconnect device must be incorporated in the fixed wiring.

Warning   To reduce the risk of fire, use only No. 26 AWG or larger telecommunication line cord.

Warning   Never defeat the ground conductor or operate the equipment in the absence of a suitably installed ground conductor. Contact the appropriate electrical inspection authority or an electrician if you are uncertain that suitable grounding is available.

Warning   During this procedure, wear grounding wrist straps to avoid ESD damage to the card. Do not directly touch the backplane with your hand or any metal tool, or you could shock yourself.

Warning   Use copper conductors only.

Warning   Blank faceplates and cover panels serve three important functions: they prevent exposure to hazardous voltages and currents inside the chassis; they contain electromagnetic interference (EMI) that might disrupt other equipment; and they direct the flow of cooling air through the chassis. Do not operate the system unless all cards, faceplates, front covers, and rear covers are in place.

Cisco 6160 Hardware Installation Guide

Warning   **Only trained and qualified personnel should be allowed to install, replace, or service this equipment.**

Warning   **Connect the unit only to DC power source that complies with the Safety Extra-Low Voltage (SELV) requirements in IEC 60950 based safety standards.**

Warning   **Do not use this product near water; for example, near a bathtub, washbowl, kitchen sink or laundry tub, in a wet basement, or near a swimming pool.**

Warning   **Never install telephone wiring during an electrical storm.**

Warning   **Never install telephone jacks in wet locations unless the jack is specifically designed for wet locations.**

Warning   **Never touch uninsulated telephone wires or terminals unless the telephone line has been disconnected at the network interface.**

Warning   **Use caution when installing or modifying telephone lines.**

Warning   **Avoid using a telephone (other than a cordless type) during an electrical storm. There may be a remote risk of electric shock from lightning.**

Warning   **Do not use a telephone to report a gas leak in the vicinity of the leak.**

Warning   **Ultimate disposal of this product should be handled according to all national laws and regulations.**

Warning   **To prevent personal injury or damage to the chassis, never attempt to lift or tilt the chassis using the handles on the port adapters; these types of handles are not designed to support the weight of the unit. Lift the unit only by grasping the chassis underneath its lower edge.**

Warning   **This equipment needs to be grounded. Use a green and yellow 14 AWG ground wire to connect the host to earth ground during normal use.**

Warning   **This is a Class A product based on the standard of the Voluntary Control Council for Interference by Information Technology Equipment (VCCI). If this equipment is used in a domestic environment, radio disturbance may arise. When such trouble occurs, the user may be required to take corrective actions.**

Warning   **The DS3 ports are not intended to be connected to cables that run outside the building where it is installed. For any connections outside the building, the DS3 ports must be connected to a network termination unit (NTU). NTU devices should comply with appropriate national safety standards such as UL 1950, CSA 950, EN 60950, IEC 950, and AS 3260.**

Warning   **This product requires short-circuit (overcurrent) protection, to be provided as part of the building installation. Install only in accordance with national and local wiring regulations.**

Warning   **High-performance devices on this card can get hot during operation. To remove the card, hold it by the faceplate and bottom edge. Allow the card to cool before touching any other part of it or before placing it in an antistatic bag.**

Warning   **Do not reach into a vacant slot or chassis while you install or remove a module or a fan. Exposed circuitry could constitute an energy hazard.**

2.1.2 Maintaining Safety with Electricity

Follow these guidelines when working on equipment that is powered by electricity:

- Locate the emergency power-off switch for the room in which you are working. Then, if an electrical accident occurs, you can act quickly to turn off the power.
- Disconnect all power by removing the fuses from the fuse and alarm panel before:
  - Installing or removing a chassis
  - Working near power supplies
- Do not work alone if potentially hazardous conditions exist.
- Never assume that power is disconnected from a circuit; always check the circuit.
- Look carefully for possible hazards in your work area, such as moist floors, ungrounded power extension cables, frayed power cords, and missing safety grounds.
- If an electrical accident occurs, proceed as follows:
  - Use caution; do not become a victim yourself.
  - Turn off power to the system.
  - If possible, send another person to get medical aid. Otherwise, assess the condition of the victim and then call for help.
  - Determine if the person needs rescue breathing or external cardiac compressions; then, take appropriate action.

2.1.3 Preventing Electrostatic Discharge Damage

Proper ESD protection is required whenever you handle Cisco equipment. ESD damage, which can occur when electronic cards or components are improperly handled, results in complete or intermittent failures. Use an antistatic strap when you handle any card or component.

Follow these guidelines to prevent ESD damage:

- Always use an ESD ankle or wrist strap and ensure that the wrist strap makes good skin contact.
- Connect the equipment end of the strap to the ESD jack on the front left side of the chassis, as shown in Figure 2-1.
- When you install a component, use available ejector levers or captive installation screws to properly seat the bus connectors in the backplane or midplane. These devices prevent accidental removal, provide proper grounding for the system, and help ensure that bus connectors are properly seated.
- When you remove a component, use available ejector levers or captive installation screws to release the bus connectors from the backplane or midplane.
- Handle the I/O card by the edges only; avoid touching the printed circuit boards or connectors.
- Avoid touching the printed circuit boards or connectors on the NI-2 cards or line cards.
- Place a removed component board-side-up on an antistatic surface or in a static-shielding container. If you plan to return the component to the factory, immediately place it in a static-shielding container.
- Avoid contact between the printed circuit boards and clothing. The wrist strap protects components from ESD voltages on the body only; ESD voltages on clothing can still cause damage.

⚠
Caution   Periodically check the resistance value of the antistatic strap. Ensure that the measurement is between 1 and 10 megohms.

Figure 2-1   Cisco 6160 ESD Jack Location
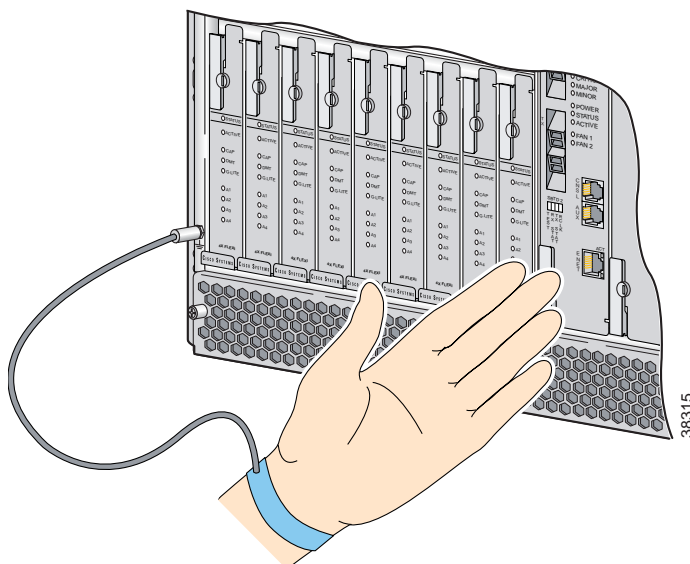
2.1.4 General Maintenance Guidelines

This section covers the following topics:

- Hot Swapping Cards, page 2-9
- Hot Swapping Blower Trays and PEMs, page 2-9
- Installation and Replacement Suggestions, page 2-10

2.1.4.1 Hot Swapping Cards

Hot swapping allows you to remove and replace cards without disconnecting the system power. The Cisco 6160 chassis supports hot swapping for the following cards:

- Quad-port flexi ATU-C (4xflexi), quad-port STU-C (4xSDSL), octal-port DMT ATU-C (8xDMT), octal-port ITU-C (8xIDSL), and octal-port G.SHDSL SHTU-C (8xG.SHDSL) line cards—When the system detects that you have added or removed a line card, it automatically runs diagnostic and discovery routines and acknowledges the presence or absence of the line card. If you remove and replace a line card with one of the same type, the newly installed line card receives the same provisioning as the original card. The system resumes operation without any operator intervention.

> **Note** Hot swapping line cards interrupts service for the subscribers assigned to that line card.

- DS3+T1/E1 IMA, DS3/2DS3, OC-3c/2DS3, or OC-3c/OC-3c NI-2 cards—Hot swapping active NI-2 cards interrupts service for the entire system until the NI-2 card is replaced or until a redundant NI-2 takes over system operations. However, you can hot swap standby NI-2 cards without interrupting service.

2.1.4.2 Hot Swapping Blower Trays and PEMs

The following sections detail the hot swapping guidelines for the blower tray and power entry module (PEM).

> **Caution** Only a trained technician should install and remove the PEM and blower tray.

2.1.4.2.1 Blower Trays

The blower tray supports hot swapping. Hot swapping allows you to remove the blower tray without disconnecting the system power. You do not need to power down the Cisco 6160 to replace the blower tray. However, if you must remove the blower tray from an operating Cisco 6160, replace it within five minutes. If that is not possible, power down the system to avoid thermal damage.

2.1.4.2.2 PEMs

The PEM is not hot swappable if there is only one PEM installed in the chassis. If you remove the only operating PEM from the chassis, power down the system before you begin. Removing the only operating PEM from the chassis will interrupt service for the entire system until you replace the PEM.

The PEM is hot swappable if there is a secondary PEM installed in the chassis. If the active PEM is removed, the standby PEM becomes the active PEM and the system continues to operate.

2.1.4.3 Installation and Replacement Suggestions

The following examples list recommended installation and replacement practices for the Cisco 6160 system cards.

⚠
Caution   Any card that is only partially connected to the backplane can disrupt system operation.

- Do not force the line card into its slot. This action can damage the pins on the backplane if they are not aligned properly with the line card.

- Ensure that the line card is straight and not at an angle when you install the line card in the slot. Installing the line card at an angle can damage the line card. Use the guide rails to install the line card correctly.

- Fully depress the ejector tabs to ensure that the line card connector mates with the backplane correctly. Firmly seat the line card in the slot.

- Do not force the I/O card onto the chassis connectors. Ensure that the I/O card is straight and parallel to the chassis when you install the module onto the connectors. The pins on the connectors can be damaged if the I/O card is not installed correctly.

- Firmly press on the I/O card to ensure that the connectors mate with the chassis correctly.

2.2 Site Requirements

This section describes requirements for the site at which the Cisco 6160 system is to be installed. Before you install the Cisco 6160 system, ensure that all the criteria in this section are met. This section includes the following information:

- Environmental Requirements, page 2-10

- Power Requirements, page 2-13

- Rack-Mounting Requirements, page 2-15

2.2.1 Environmental Requirements

Proper operation of the Cisco 6160 system depends on a proper environment. Before you install the Cisco 6160 system, ensure that all the criteria in this section are met. This section describes the following environmental requirements:

- Temperature, Altitude, and Humidity, page 2-11

- Ventilation, page 2-11

- Space, page 2-12

2.2.1.1 Temperature, Altitude, and Humidity

The Cisco 6160 system can tolerate a wide range of temperatures. Table 2-1 provides the Cisco recommendations for temperature, altitude, and humidity conditions in a central office (CO) environment.

Table 2-1   CO Operating Environment Requirements

Environmental Specifications	Description
Temperature	41 to 104°F (5 to 40°C)—Operating 23 to 131°F (–5 to 55°C)—Short-term operating
Altitude	–197 to 13,124 feet (–60 to 4,000 meters)
Humidity	5 to 90% (noncondensing)

Warning   **To prevent the system from overheating, do not operate it in an area that exceeds the maximum recommended ambient temperature of 104°F (40°C).**

2.2.1.2 Ventilation

The following practices ensure proper ventilation for the Cisco 6160 system:

- Chassis placement—Leave one rack unit (RU) under each Cisco 6160 chassis for cabling needs and the intake plenum.
- Blower tray installation—A blower tray must be installed in the Cisco 6160 chassis.
- POTS splitter location—POTS splitters do not dissipate heat and should be positioned at the bottom of the rack.

The main air intake vents are located at the bottom front of the chassis, as indicated in Figure 2-2. The intake vent for each PEM is located at the bottom of the PEM front panel. All air exhaust vents are located on the rear of the chassis at the top. Do not obstruct the intake and exhaust vents in any way.

Figure 2-2   Air Flow Through Intake and Exhaust Vents on the Chassis
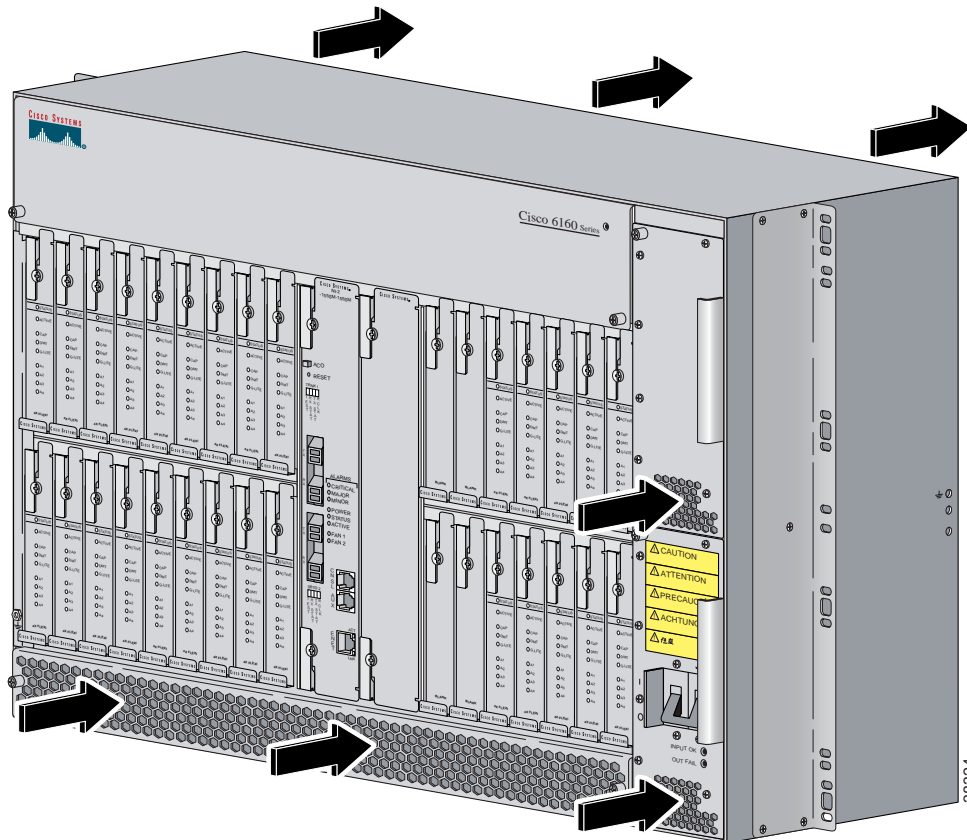
2.2.1.3 Space

You can install a combination of these Cisco 6160 system components in a standard seven-foot rack:

* Cisco 6160 chassis—A maximum of three chassis is allowed per rack.
* Third-party POTS splitter—Required in a Cisco 6160 with POTS splitter configuration.

Depending on your configuration type, plan accordingly so that the CO rack accommodates your needs. Use Table 2-2 to calculate the rack space necessary for your Cisco 6160 system configuration. The total amount of rack space should not exceed 42 RUs. If your total configuration exceeds 42 RUs, either replan your configuration or use more than one rack to house the Cisco 6160 system components.

Table 2-2   Rack Space Calculation for Cisco 6160 System Configurations

Line	Instructions	Calculation
Cisco 6160 with a POTS Splitter Configuration		
1	Total number of Cisco 6160 chassis in the rack—Maximum is three chassis per rack (include subtending host and subtended node chassis)	
2	Total number of third-party POTS splitters in the rack	
3	Number of RUs required for each POTS splitter[1]	
4	Multiply line 2 by line 3 to determine the total POTS splitter space requirement	
5	Multiply 11 RUs by the total number of Cisco 6160 chassis on line 1	
6	Multiply 1 RU by the total number of Cisco 6160 chassis on line 1[2]	
7	**Add lines 4 through 6 to obtain the total number of RUs needed for a Cisco 6160 with a POTS splitter configuration.**	
Cisco 6160 Without a POTS Splitter Configuration		
8	Total number of Cisco 6160 chassis in the rack—Maximum is three chassis per rack (include subtending host and subtended node chassis)	
9	Multiply 11 RUs by the total number of Cisco 6160 chassis on line 8	
10	Multiply 1 RU by the total number of Cisco 6160 chassis on line 8[2]	
11	**Add lines 9 and 10 to obtain the total number of RUs needed for a Cisco 6160 without a POTS splitter configuration.**	

1. See the documentation that accompanied the third-party POTS splitter to determine the number of RUs required. One RU is equal to 1.75 inches (4.45 cm.).

2. One RU is recommended for cabling needs and the intake plenum.

2.2.2 Power Requirements

The CO power source or rectifier supplies external power to the system as –48VDC from the fuse and alarm panel. The nominal voltage is –48VDC, the minimum operating value is –40.5VDC, and the maximum operating value is –75VDC

Power connections from the fuse and alarm panel are wired to the power terminal block connectors on the Cisco 6160 backplane. The power terminal block connectors are located behind each corresponding PEM. The PWR 1 terminal block connector is for the primary PEM and the PWR 2 terminal block connector is for the secondary (redundant) PEM. Only one power connection is necessary for system operation.

Note Before you connect the system to a power source, verify that the power source is properly grounded and that it falls within the internal power supply rating.

The typical power required for your Cisco 6160 system will depend on your configuration type. Use Table 2-3 to calculate the power required for each of the Cisco 6160 system components and the total power required for the system.

Warning   **Only a DC power source that is isolated from AC mains with reinforced insulation, and that complies with the other safety extra-low voltage (SELV) requirements in UL1950, CSA 950 3rd Edition, EN 60950, and IEC950, can be connected to a Cisco 6160 system. This requirement ensures that in a catastrophic power source fault condition, hazardous voltages are not present on power terminals and connectors.**

Table 2-3   Power Calculation for the Cisco 6160 System

Step	Instructions	Calculation
1	If you are using 8xIDSLs, multiply 5.5W by the total number of 8xIDSLs installed in the chassis.	
2	If you are using 8xG.SHDSLs, multiply 16.5W by the total number of 8xG.SHDSLs installed in the chassis.	
3	If you are using 8xDMTs, multiply 24W by the total number of 8xDMTs installed in the chassis.	
4	If you are using 4xSDSLs, multiply 9W by the total number of 4xSDSLs installed in the chassis.	
5	If you are using 4xflexis in G.lite mode, multiply 13W by the total number of 4xflexis (G.lite mode) installed in the chassis.	
6	If you are using 4xflexis in DMT mode, multiply 17.5W by the total number of 4xflexis (DMT mode) installed in the chassis.	
7	If you are using 4xflexis in CAP mode, multiply 13.5W by the total number of 4xflexis (CAP mode) installed in the chassis.	
8	Multiply 33.5W by the number of NI-2 cards installed in the chassis.	
9	Enter 60W for the PEM. Add 6W if a second PEM is installed in the chassis.	
10	Enter 104W for the fan tray.	
11	Add lines 1 through 10. This is the typical power required for the Cisco 6160.	

2.2.3 Rack-Mounting Requirements

Warning   **Two people are required to lift the chassis. Grasp the chassis underneath the lower edge and lift with both hands. To prevent injury, keep your back straight and lift with your legs, not your back.**

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

—This unit should be mounted at the bottom of the rack if it is the only unit in the rack.

—When mounting this unit in a partially filled rack, load the rack from the bottom to the top with the heaviest component at the bottom of the rack.

—If the rack is provided with stabilizing devices, install the stabilizers before mounting or servicing the unit in the rack.

We recommend that you mount the Cisco 6160 system in a rack. Ensure that vertical hole spacing on the rack rails meets standard EIA-310-C requirements—1 inch (2.54 cm) spacing. All portions of the rack should be equal to or less than the NEBS maximum allowances of 12 inches (30.48 cm) in depth.

When you install the Cisco 6160 system in a rack, be sure to allow enough room to access the backplane of the unit for wiring and cabling purposes. The majority of the Cisco 6160 connectors are located on the backplane.

2.3 Required Tools and Equipment

Table 2-4 lists the tools and equipment you need to install and connect the Cisco 6160 system.

Table 2-4   *Tool and Equipment Requirements Checklist*

Check	Tools and Equipment
	Hardware Components and Cables

	Cisco 6160 chassis, which will have the following components already installed:
	
	 • Line cards (one or more types):
	   – 8xIDSL.
	   – 8xG.SHDSL.
	   – 8xDMT.
	   – 4xSDSL.
	   – 4xflexi.
	 • One of the following NI-2 cards:
	   – DS3+T1/E1 IMA.
	   – DS3/2DS3.
	   – OC-3c/2DS3 SMF[1] or MMF[2].
	   – OC-3c/OC-3c SMF or MMF.
	 • One of the following I/O cards:
	   – DS3/2DS3+8xT1 I/O card.
	   – DS3/2DS3 I/O card.
	
	 Note The I/O card should ship with an EMI cover, screws, standoff screws, and washers.
	
	 • PEM(s).
	 • Blower tray.
	 • Blank faceplates, as necessary.

	Third-party POTS splitters can be installed in a Cisco 6160 with a POTS splitter configuration. Please verify the compatibility with your Cisco representative.

	Telco cables with Champs connectors for the following configurations:
	
	 • Cisco 6160 with a POTS splitter configuration.
	   – Cisco 6160 to third-party POTS splitter connections.
	   – Third-party POTS splitter to MDF[3] connections.
	 • Cisco 6160 without POTS splitter connections.
	   – Cisco 6160 to MDF.
	
	 Note See Appendix B, "Cable and Port Mapping Specifications" for a port mapping table for the subscriber connections. Refer to the third-party POTS splitter documentation for cable specifics.

Table 2-4   Tool and Equipment Requirements Checklist (continued)

Check	Tools and Equipment
	Wire for the following connections: • T1 or T1 IMA trunk—Industry standard T1 twisted-pair wire (use two-pair stock only). • T1 or T1 IMA subtend—RJ-48 to RJ-48 industry standard T1 twisted-pair wire (use two-pair stock only). • BITS[4] clock interface—24 to 26 AWG[5] twisted-pair wire. • Alarm contacts—24 to 26 AWG twisted-pair wire. • Ground the Cisco 6160 chassis—8 AWG or larger, green or green and yellow striped, copper solid or stranded. • Ground the POTS splitter, as necessary—Refer to the vendor documentation for wire specifications. • Cisco 6160 chassis power connections—12 AWG black and red copper solid or stranded.
	Coaxial cable for a DS3 connection—Type 734A, type 735A, or equivalent.
	Fiber cable for OC-3c connections—SMF or MMF, as appropriate.
	7Console and auxiliary cables—Unshielded RJ-45 serial cable that complies with the EIA/TIA-232 standard and provides connection to a system console.
	Ethernet connection—Cat 5 UTP[6] or Cat 5 STP[7] cable with an RJ-45 connector that complies with Ethernet standards.
	Necessary equipment for ESD protection—Required whenever you handle Cisco equipment, which includes the chassis and modules.
	Tools
	No 1 3/16-inch flat-head screwdriver.
	A Phillips-head screwdriver.
	Wire stripper.
	Wire-wrapping tool, optional.
	Grounding lug crimping tool, as necessary.
	Mounting screws—To mount the Cisco 6160 and POTS splitter to the rack.
	Ring lugs (5/8-inch or 3/4-inch) for the grounding wire. **Note** The hole in the ring lug should be large enough for the screw to pass through.
	Metric measuring tape or ruler.
	Marking pen.
	Tie wraps, as necessary.

Table 2-4   Tool and Equipment Requirements Checklist (continued)

Check	Tools and Equipment
	Software Components
	Cisco IOS or CDM[8].
	Note See Appendix A, "Technical Specifications" for minimum software and network management release requirements per Cisco 6160 chassis component.

1. SMF = single-mode fiber
2. MMF = multimode fiber
3. MDF = main distribution frame
4. BITS = building integrated timing supply
5. AWG = American Wire Gauge
6. UTP = unshielded twisted pair
7. STP = shielded twisted pair.
8. CDM = Cisco DSL Manager

Warning   **Only trained and qualified personnel should be allowed to install, replace, or service this equipment.**

2.4 Unpacking the Cisco 6160 System

Each Cisco 6160 system chassis is securely packaged in a shipping box. The Cisco 6160 ships with the line cards and the NI-2 card(s) installed in the chassis.

Caution   Proper ESD protection is required whenever you handle Cisco equipment. Installation and maintenance personnel should be properly grounded by means of grounding straps to eliminate the risk of ESD damage to the equipment. Equipment is subject to ESD damage whenever it is removed from the chassis.

Warning   **Two people are required to lift the chassis. Grasp the chassis underneath the lower edge and lift with both hands. To prevent injury, keep your back straight and lift with your legs, not your back.**

To unpack the Cisco 6160 system, complete the following steps:

Step 1   Inspect the packing containers. If any damage or other signs of mishandling are evident, inform both the local freight carrier and Cisco before unpacking. Your freight carrier can provide you with the procedures necessary to file a claim for damages.

Step 2   Carefully open the box.

Step 3   Remove all packing material.

Step 4   Remove the chassis from the box.

Step 5   Carefully open the additional boxes and remove the packing material.

Step 6   Open the accessory kits and boxes that contain the cables, documentation, and management software. Do not use a knife to open these boxes.

2.5 Verifying Contents

To verify that all equipment, cables, documentation, and other items are received, compare the packing list to your shipment and to your order. If any items are missing or you need additional information, contact the Cisco Technical Assistance Center (TAC) at

- 800 553-2447
- 408 526-7209
- tac@cisco.com

2.6 Inspecting for Damage

After you verify that all of the equipment is included, carefully examine the assemblies, cards, and cables for any damage resulting from shipping. If you suspect any damage from shipping, contact your local freight carrier for procedures on damage claims.

If you observe any physical defects in the items you ordered, obtain standard warranty service by delivering the defective part, accompanied by a copy of the dated proof-of-purchase, to the Cisco Systems Corporate Service Center or an Authorized Cisco Systems Service Center during the applicable warranty period. Contact the Cisco TAC for the location of your nearest service center.

See the back of the title page for the Cisco Systems warranty information for hardware and software products.

Installing a Cisco 6160 with a POTS Splitter Configuration

This chapter provides installation procedures for a Cisco 6160 with a POTS splitter configuration for *x*DSL data and voice traffic.

Note The installation procedures in this chapter apply to a Cisco 6160 system shipped with the individual hardware components preinstalled. For information about installing or replacing field-replaceable units (FRUs) in the Cisco 6160 chassis, see Chapter 6, "Upgrading and Maintaining the Cisco 6160 System."

Warning **Only trained and qualified personnel should be allowed to install, replace, or service this equipment.**

Caution Before you begin the installation procedures, read the entire chapter for important information and safety warnings.

Note Before installing and cabling the equipment, be aware of standard safety practices and the hazards involved in working with electrical circuitry to prevent accidents. See the "Safety Requirements" section on page 2-1 for cautions and warnings that are necessary to ensure a safe and hazard-free installation.

To see translations of the warnings that appear in this publication, refer to the *Regulatory Compliance and Safety Information for the Cisco 6160 System* document that accompanied this product.

Note See the "Cisco 6160 with a POTS Splitter Configuration" section on page 1-4 for more information about configuration components.

3.1 Installation Checklist

When you install a Cisco 6160 with a POTS splitter configuration, be sure that you follow the installation procedures in the proper sequence. Table 3-1 is a checklist of the installation steps in the order in which they should occur. Detailed installation instructions are located in the sections following Table 3-1.

Caution Proper ESD protection is required whenever you handle Cisco equipment. Installation and maintenance personnel should be properly grounded by means of grounding straps to eliminate the risk of ESD damage to the equipment. Equipment is subject to ESD damage whenever it is removed from the chassis.

Table 3-1   Installation Checklist—Cisco 6160 with a POTS Splitter Configuration

Check	Installation Procedure
	1. Stabilize and measure the rack space.
	2. Install the third-party POTS splitter(s) in the rack.
	3. Install the Cisco 6160 chassis in the rack.
	4. Install blank faceplates in the open line card slots.
	5. Ground the Cisco 6160 chassis.
	6. Ground the third-party POTS splitter.
	7. Connect the Cisco 6160 chassis to the third-party POTS splitter.
	8. Attach the Cisco 6160 power connections.
	9. Connect the alarm contacts (optional).
	10. Connect the BITS clock (optional).
	11. Connect the third-party POTS splitter to the MDF[1] or to the cross connect, as necessary.
	12. Apply power to the system.
	13. Connect the subtending host chassis to the subtended node chassis.
	14. Connect the NI-2 card(s) to the network.
	15. Connect the Ethernet to the management network.
	16. Connect a console terminal.
	17. Connect the auxiliary port (optional).
	18. Complete the initial configuration.

1. MDF = main distribution frame

3.2 Installation Procedures

The following sections detail the installation procedures for a Cisco 6160 with a POTS splitter configuration.

3.2.1 Stabilize and Measure the Rack Space

For the rack to remain stable, you must install your Cisco 6160 system components from the bottom to the top of the rack. Before you install any of the components, calculate the total rack space required to install your system. The required rack space depends on the number of Cisco 6160 chassis and POTS splitters that you plan to use. The number of components increases if you plan to install a subtended network.

✎
Note   See Table 2-2 on page 2-13 to determine the total rack necessary for your configuration.

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

—This unit should be mounted at the bottom of the rack if it is the only unit in the rack.

—When mounting this unit in a partially filled rack, load the rack from the bottom to the top with the heaviest component at the bottom of the rack.

—If the rack is provided with stabilizing devices, install the stabilizers before mounting or servicing the unit in the rack.

⚠
Warning   **Two people are required to lift the chassis. Grasp the chassis underneath the lower edge and lift with both hands. To prevent injury, keep your back straight and lift with your legs, not your back.**

If you plan to expand your system to include more chassis in the future, allow space in the rack for additions during the initial installation, keeping in mind the weight distribution and stability of the rack.

3.2.2 Install the Third-Party POTS Splitter

For installation procedures to install the third-party POTS splitter in the rack, refer to the appropriate vendor documentation.

3.2.3 Install the Cisco 6160 Chassis

Complete the following steps to install the Cisco 6160 chassis:

⚠️

Warning   **Two people are required to lift the chassis. Grasp the chassis underneath the lower edge and lift with both hands. To prevent injury, keep your back straight and lift with your legs, not your back.**

Step 1   Connect a grounding strap to the ESD grounding jack. See the "Preventing Electrostatic Discharge Damage" section on page 2-8 for the ESD grounding jack location on the Cisco 6160 chassis.

Step 2   Check the ear brackets on the sides of the chassis and reinstall them, if necessary. Ear brackets can be installed in two ways:

- Mid-mount, as shown in Figure 3-1—The ear brackets are installed in this position in the factory.

- Front mount, as shown in Figure 3-2.

Figure 3-1   Mid-Mount Option for Ear Brackets
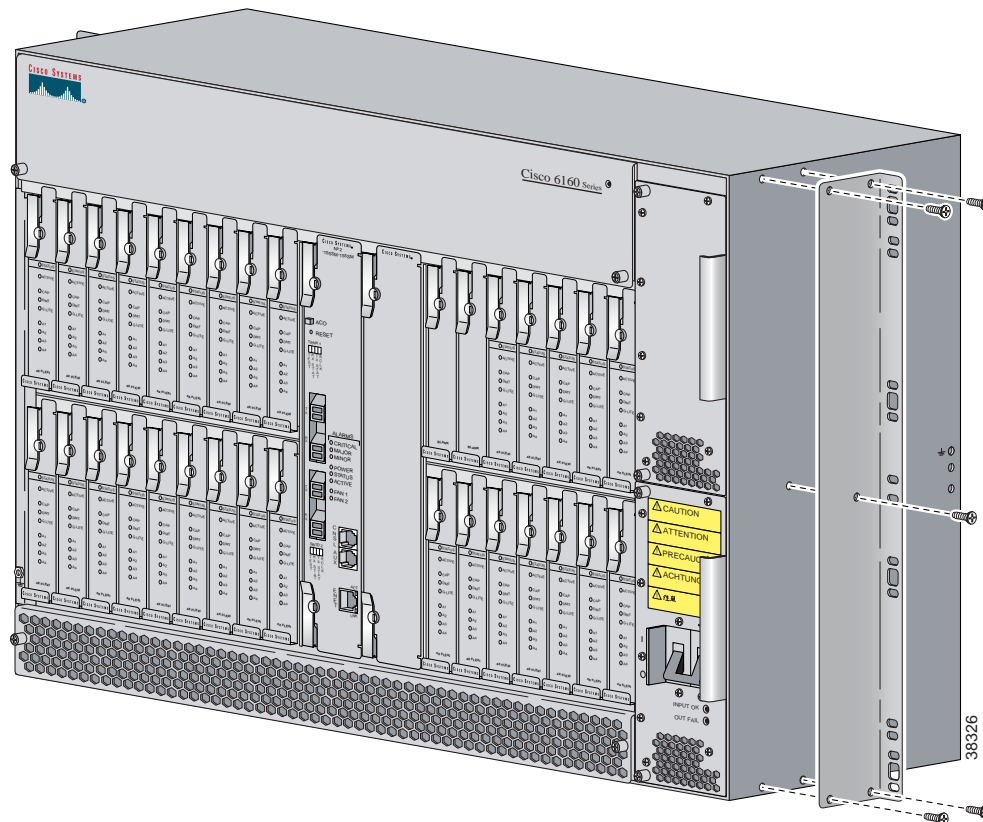
Figure 3-2   Front Mount Option for Ear Brackets
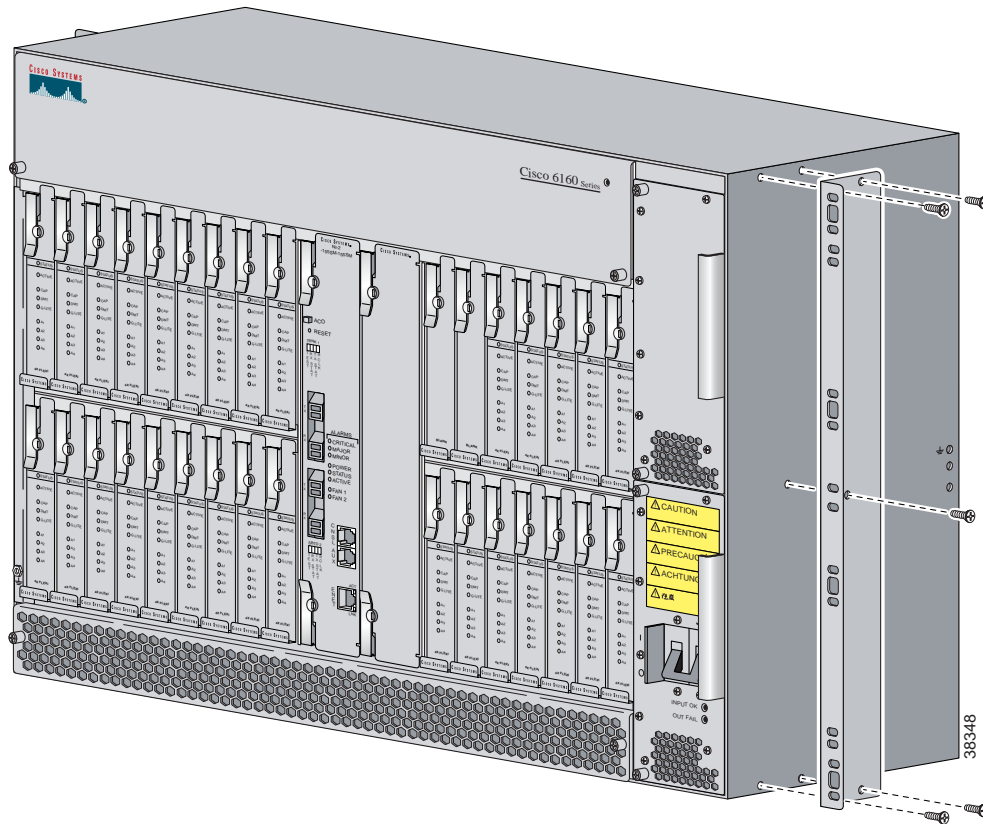
Step 3   Carefully lift the chassis from the bottom and place it above the POTS splitter in the rack.

Step 4   Use four mounting screws and a Phillips-head screwdriver to bolt the Cisco 6160 in the rack.

Step 5   Repeat Step 2 through Step 4 for each Cisco 6160 chassis as necessary.

3.2.4 Install the Blank Faceplates

Blank faceplates should occupy any empty line card slots in Cisco 6160 chassis. Blank faceplate installation is similar to line card installation.

Warning   **Blank faceplates and cover panels serve three important functions: they prevent exposure to hazardous voltages and currents inside the chassis; they contain electromagnetic interference (EMI) that might disrupt other equipment; and they direct the flow of cooling air through the chassis. Do not operate the system unless all cards, faceplates, and covers are in place.**

Complete the following steps to install blank faceplates in the Cisco 6160:

Step 1   Vertically align the blank faceplate edges with the guides at the top and bottom of the slot.

Step 2   Lift up on the ejector lever and gently apply pressure to the bottom of the faceplate while pushing the blank faceplate into the slot.

Step 3   Push on the faceplate to fully seat the blank faceplate.

Step 4   Press down on the ejector lever to secure the faceplate.

3.2.5 Ground the Cisco 6160

This section describes two ways to ground the Cisco 6160 chassis.

- Ground the Cisco 6160 Using a Grounding Lug, page 3-6
- Ground the Cisco 6160 from the Power Terminal Block Connector, page 3-8

3.2.5.1 Ground the Cisco 6160 Using a Grounding Lug

Warning   **When you are installing or replacing the Cisco 6160 chassis, the ground connection must always be made first and disconnected last.**

Note   The grounding lug is not provided by Cisco. Use either a 5/8-inch or 3/4-inch lug to ground the Cisco 6160 chassis.

To ensure adequate earth ground for the system, complete the following steps to ground the Cisco 6160 chassis using a grounding lug:

Step 1   Verify that power in the direct current (DC) circuit is off.

Step 2   Measure enough wire to connect the Cisco 6160 to the grounding point at your site or to the rack.

Note   See Table 2-4 for wire specifications.

Step 3   Use a wire stripper to remove the casing from both ends of the grounding wire. The manufacturer of the grounding lug might have a specific recommendation on the length of wire to be stripped.

Step 4   Insert the stripped end of the grounding wire into the open end of the grounding lug. Be careful not to leave any wire strands outside the lug.

Step 5   Use the crimping tool to compress the lug onto the wire.

Step 6   Verify the quality of the crimp by inspecting it and tugging gently on the wire.

Step 7   Locate the three grounding holes on the Cisco 6160 side panel. Figure 3-3 shows how to ground the Cisco 6160 chassis using a grounding lug.

Figure 3-3   Grounding the Cisco 6160 Chassis Using the Grounding Lug—Backplane View
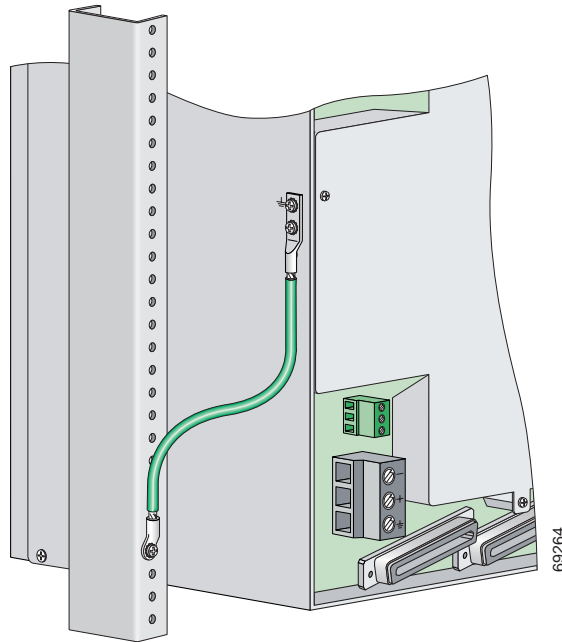
Step 8   Match the holes in the grounding lug to the appropriately spaced pair of grounding holes on the side of the chassis. Use the top two holes for a 5/8-inch lug. Use the bottom two holes for a 3/4-inch lug.

Step 9   Insert the screws through the holes in the lug and the chassis.

Step 10   Use a Phillips-head screwdriver to tighten the screws and secure the grounding lug firmly to the chassis.

Step 11   Connect the other end of the grounding wire to an appropriate grounding point at your site or to the rack (see Figure 3-3). To connect the grounding wire to the rack, complete the following steps:

  a.   Remove all paint or oxidation from the rack at the point of the grounding connection.

  b.   Use a 3/16-inch flat-head screwdriver to loosen the grounding screw on the rack.

  c.   Connect the wire to a ring lug (large enough for the rack screw to fit through).

  d.   Use a 3/16-inch flat-head screwdriver and the screw to attach the ring lug to the rack.

  e.   Tighten the grounding screw on the rack over the ring lug.

Step 12   Repeat Step 1 through Step 11 for each Cisco 6160 chassis being installed.

3.2.5.2 Ground the Cisco 6160 from the Power Terminal Block Connector

⚠

Warning   **When you are installing or replacing the Cisco 6160 chassis, the ground connection must always be made first and disconnected last.**

To ensure adequate earth ground for the system, complete the following steps to attach the grounding wire to the power terminal block connector on the Cisco 6160 backplane:

Step 1   Verify that power in the DC circuit is off.

Step 2   Measure enough wire to connect the Cisco 6160 to the grounding point at your site or to the rack.

✎

Note   See Table 2-4 for wire specifications.

Step 3   Use a wire stripper to remove the casing from both ends of the grounding wire.

Step 4   Identify the correct power terminal block on the backplane of the Cisco 6160. The PWR 1 connector is used if you have a primary power entry module (PEM) installed in the chassis. The PWR 2 connector is used if you have a secondary (redundant) PEM installed in the chassis. Figure 3-4 shows the location of the PWR 1 and PWR 2 power terminal block connectors.

Figure 3-4   Cisco 6160 Backplane

1	PWR 1—Power terminal block connector.	5	Connectors JC1 through JC5.
2	BRKR 1—A terminal block connector used to wire alarm relays to external alarms.	6	I/O card connectors (P3 and P9).
3	PWR 2—Power terminal block connector. Use if a secondary (redundant) PEM is installed.	7	Connectors JC6 through JC11.
4	BRKR 2—A terminal block connector used to wire alarm relays to external alarms. Use if a secondary (redundant) PEM is installed.		

Step 5 Use a flat-head screwdriver and a counterclockwise motion to open the grounding terminal connector on the power terminal block. This step ensures that the correct opening is presented for the wires. (See Figure 3-5.)

Figure 3-5   Positioning the Power and Ground Terminals to Accept Wires
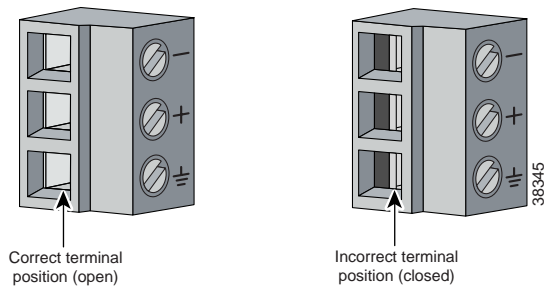
Correct terminal
position (open)

Incorrect terminal
position (closed)

Step 6 Insert one end of the grounding wire into the grounding receptacle, which is the bottom receptacle in the power terminal block connector (Callout 3 in Figure 3-6). The stripped part of the wire must be fully inserted into the terminal block so that no bare wire is exposed.

Figure 3-6   Inserting the Grounding and Power Wires into the Power Terminal Block Connector
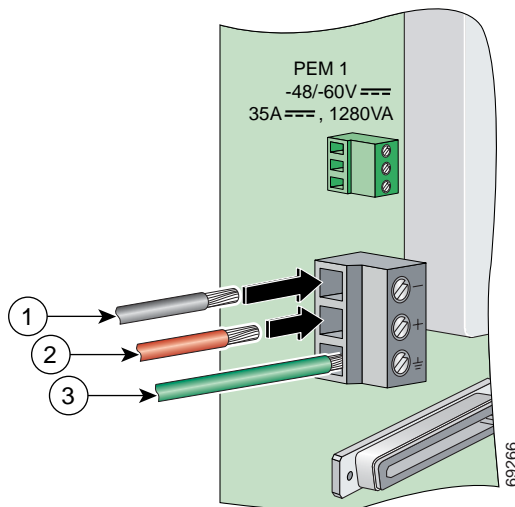
PEM 1
-48/-60V ===
35A ===, 1280VA

1	Power lead wire connection	3	Grounding wire connection
2	Battery return wire connection		

Step 7 Verify that no wire strands are left outside the connector.

Step 8   Use the flat-head screwdriver and a clockwise motion to tighten the ground screw in the power terminal block connector. Pull gently on the wire to ensure that it is held firmly in place. Figure 3-7 shows how to ground the Cisco 6160 chassis from the power terminal block connector.

Figure 3-7   Grounding the Cisco 6160 Chassis from the Power Terminal Block Connector—Backplane View
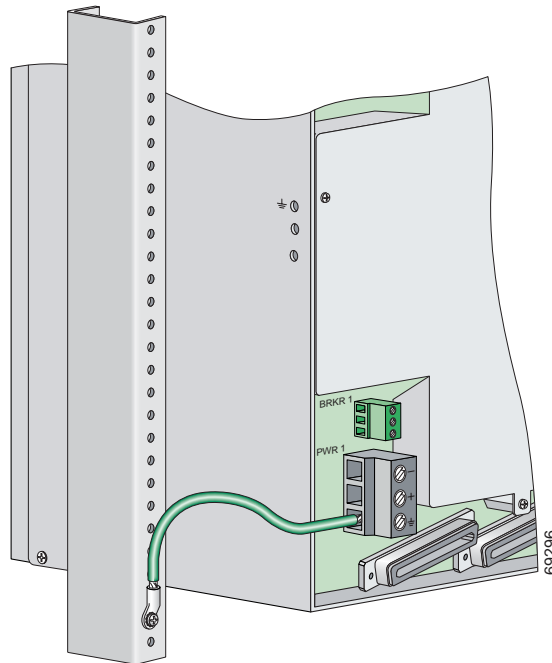
Step 9   Connect the other end of the grounding wire to an appropriate grounding point at your site or to the rack. (see Figure 3-7). To connect the grounding wire to the rack, complete the following steps:

a.   Remove all paint or oxidation from the rack at the point of the grounding connection.

b.   Use a 3/16-inch flat-head screwdriver to loosen the grounding screw on the rack.

c.   Connect the wire to a ring lug (large enough for the rack screw to fit through).

d.   Use a 3/16-inch flat-head screwdriver and the screw to attach the ring lug to the rack.

e.   Tighten the grounding screw on the rack over the ring lug (see Figure 3-7).

Step 10   If you are connecting two power sources to the Cisco 6160 system, repeat Step 1 through Step 9 for the second power terminal block.

Step 11   Repeat Step 1 through Step 10 for each Cisco 6160 chassis being installed.

3.2.6 Ground the Third-Party POTS Splitter

For wire specifications and grounding procedures for each third-party POTS splitter, refer to the appropriate vendor documentation.

Note   Do not ground the components in a rack by chaining them together.

3.2.7 Connect the Cisco 6160 to the Third-Party POTS Splitter

For cabling procedures for each third-party POTS splitter, refer to the appropriate vendor documentation.

3.2.8 Attach the Cisco 6160 Power Connections

⚠️
Caution   To prevent the system from powering up, do not install the fuses at this time. If the fuses are already installed in the fuse and alarm panel, remove them. You can replace the fuses after the system is installed and connected.

✎
Note   For full power redundancy, each terminal block must be connected to a separate power source. If you do not require power redundancy, you can wire a single terminal block, or connect both terminal blocks to a single power source.

Do not power the components in the rack by chaining them together.

⚠️
Warning   **The illustration shows the DC power supply terminal block. Wire the DC power supply as illustrated. The proper wiring sequence is ground to ground, positive to positive, and negative to negative. The ground wire must always be connected first and disconnected last. The fuse and alarm panel and wires are not provided by Cisco.**

Complete the following steps to connect power to the system:

Step 1   Verify that power in the DC circuit is off.

Step 2   Identify the correct power terminal block on the backplane of the Cisco 6160. The PWR 1 connector is used if you have a primary PEM installed in the chassis. The PWR 2 connector is used if you have a secondary (redundant) PEM installed in the chassis. Figure 3-4 shows the location of the PWR 1 and PWR 2 power terminal block connectors.

Step 3   Use a flat-head screwdriver and a counterclockwise motion to open the positive and negative terminal connectors on the power terminal block.This step ensures that the correct opening is presented for the wires. (See Figure 3-8.)

Figure 3-8   Positioning the Power and Ground Terminals to Accept Wires
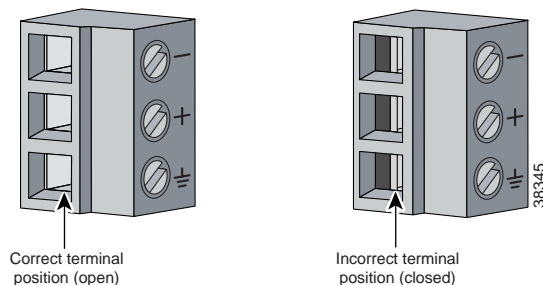
Correct terminal
position (open)

Incorrect terminal
position (closed)

Step 4   Insert the battery return wire from the first external power source into the receptacle labeled + (positive) on the appropriate power terminal block (Callout 2 in Figure 3-9). The stripped part of the wire must be fully inserted so that no bare wire is exposed.

Figure 3-9   Inserting the Grounding and Power Wires into the Power Terminal Block Connector

1	Power lead wire connection	**3**	Grounding wire connection
2	Battery return wire connection		

Step 5   Verify that no wire strands are left outside the connector.

Step 6   Use a flat-head screwdriver and a clockwise motion to tighten the terminal screw over the wire.

Step 7   Insert the power lead from the first battery –48VDC power source into the receptacle labeled – (negative) on the appropriate power terminal block (Callout 1 in Figure 3-9). The stripped part of the wire must be fully inserted so that no bare wire is exposed.

Step 8   Verify that no wire strands are left outside the connector.

Step 9   Use a flat-head screwdriver and a clockwise motion to tighten the terminal screw over the wire.

Step 10   If you are connecting a second power source, repeat Step 2 through Step 9 to wire the second power terminal block.

Step 11   Thread tie wraps through the small cutouts in the side of the chassis next to each terminal block and tie down the wires using the tie wraps.

Step 12   Repeat Step 1 through Step 11 for each Cisco 6160 chassis being installed.

3.2.9 Connect the Alarm Contacts

Note   This step is optional.

Complete the following steps to connect an external alarm device to the wire-wrap pins on the I/O card:

Note   The relay for the circuit-breaker trip alarm is wired through the small green terminal blocks (BRKR 1 and BRKR 2) on the chassis backplane and not through the wire-wrap connector.

Caution   Use extreme caution when wire-wrapping the pin connections for the STAT_ALARMS and BITS_A/BITS_B pins. Incorrect wire connections will cause damage to the equipment.

Step 1   Measure wire long enough to connect the appropriate pin to the external alarm device. See Table 2-4 for wire specifications.

Note   See the "I/O Cards" section on page 1-43 for an illustration of the pinouts that are located on the I/O card. See Appendix C, "Connector and Pinout Specifications," for pinout descriptions.

Step 2   Use a wire stripper to remove the casing from both ends of the wire.

Step 3   Use a wire-wrapping tool to attach the wire to the appropriate pin.

Step 4   Use a wire-wrapping tool to attach the other end of the wire used in Step 3 to the external alarm device.

Step 5   Repeat Step 1 through Step 4 to wire wrap all necessary pins.

Step 6   Repeat Step 1 through Step 5 for each Cisco 6160 chassis being installed.

3.2.10 Connect the BITS Clock Contacts

Note This step is optional.

Complete the following steps to connect the BITS clock to the wire-wrap pins on the I/O card:

Caution Use extreme caution when wire-wrapping the pin connections for the STAT_ALARMS and BITS_A/BITS_B pins. Incorrect wire connections will cause damage to the equipment.

Step 1 Measure wire long enough to connect the appropriate pin on the I/O card to the BITS clock. See Table 2-4 for wire specifications.

Note See the "I/O Cards" section on page 1-43 for an illustration of the pinouts that are located on the I/O card. See Appendix C, "Connector and Pinout Specifications," for pinout descriptions.

Step 2 Use a wire stripper to remove the casing from both ends of the wire.

Step 3 Use a wire-wrapping tool to attach the wire to the appropriate pins for the slot in which the primary NI-2 card is installed.

Note The BITS pins on I/O cards are slot specific. BITS_A pins are assigned to slot 11 and BITS_B pins are assigned to slot 10. Each BITS clock input is independent and terminated at 100 ohms.

Step 4 Use a wire-wrapping tool to attach the other end of the wire used in Step 3 to the BITS clock.

Step 5 Repeat Step 1 through Step 4 to wire wrap the appropriate pins for a secondary (redundant) NI-2 card.

Step 6 Repeat Step 1 through Step 5 for each Cisco 6160 chassis being installed.

3.2.11 Connect the Third-Party POTS Splitter to the MDF or to the Cross Connect

For procedures about connecting the third-party POTS splitter to the MDF or to the cross connect, refer to the appropriate vendor documentation.

3.2.12 Apply the Power

Complete the following steps to apply power to the Cisco 6160 system:

⚠️
Caution   If the power connections are improperly made and power is applied while the cards are installed, the cards and chassis could be damaged.

Step 1   Verify that the power connections from the Cisco 6160 terminal block(s) to the power source are wired as shown in Figure 3-9.

Step 2   Apply power to the system using one of the following methods:

- Install the fuses in the fuse and alarm panel.
- Reinsert the fuses in the fuse and alarm panel, if you removed them in the "Attach the Cisco 6160 Power Connections" section on page 3-12.
- Turn on the breakers in the fuse and alarm panel.

Step 3   Check the polarity of the –48VDC connections to each chassis by attaching a voltmeter with the minus lead on –48RTN and the plus lead on –48V_A or –48V_B. Ensure that the meter reads between –40VDC and –60VDC. If your voltmeter shows a positive voltage, the power inputs might be reversed. If the voltmeter shows a negative voltage that is out of the –40VDC to –60VDC range, check the power supply for failure or check for a blown fuse in the fuse and alarm panel.

Step 4   Set the circuit breaker on the PEM to the ON (1) position.

If the power is properly connected, the INPUT OK LED on the front of the PEM(s) will be green. You will also hear the blowers start to turn. A slight delay in blower startup is normal. If these events do not occur, repeat Step 1 through Step 4.

Step 5   Repeat Step 1 through Step 4 for each Cisco 6160 chassis being installed.

3.2.13 Connect the Subtending Host Chassis to the Subtended Node Chassis

If you are installing a subtended network, this section provides installation procedures for the following subtending connections:

- DS3 Subtending Connections, page 3-17
- OC-3c Subtending Connections, page 3-19
- T1 or T1 IMA Subtending Connections, page 3-20

If you are not installing a subtended network, proceed to the "Connect the NI-2 Card to the Network" section on page 3-22.

🔑
Tip   Cisco recommends that you label each data cable at both ends to identify its destination.

> **Note**   For more information on a subtended network configuration, see the "Subtended Network Configuration" section on page 1-6.
>
> The term *subtending* refers to the host chassis, and *subtended* refers to the downstream chassis in a subtended network.
>
> Cisco does not provide the cables for the subtending connections. See Table 2-4 for cable specifications.

3.2.13.1 DS3 Subtending Connections

Complete the following steps to connect the DS3 subtending connections:

> **Note**   For more information about DS3 subtending connections, see the "Subtended Network Configuration with DS3/2DS3 or OC-3c/2DS3 NI-2 Cards" section on page 1-9.

Step 1   Verify that the DS3/2DS3 or OC-3c/2DS3 NI-2 card is installed in slot 10 (or slot 11, if a secondary NI-2 card is installed for redundancy) of the Cisco 6160 chassis to ensure that the DS3 NI-2 card connections are active.

> **Note**   See the "Redundancy in Subtended Configurations" section on page 1-42 for more information about redundant configurations.

Step 2   On the subtending host chassis backplane, attach one end of a coaxial cable to the TX BNC connector for DS3 Port 2 on the I/O card.

> **Note**   See Table 2-4 for cable specifications. See Figure 1-19 or Figure 1-23 for DS3 port connector locations.

Figure 3-10 shows the cabling for a DS3 subtended network configuration.

Figure 3-10   Cabling for DS3 Subtended Network Configuration

Step 3   On the first subtended node chassis backplane, attach the end of the coaxial cable used in Step 2 to the RX BNC for DS3 Port 1 on the I/O card.

Step 4   On the subtending host chassis backplane, attach one end of a coaxial cable to the RX BNC connector for DS3 Port 2 on the I/O card.

Step 5   On the first subtended node chassis backplane, attach the end of the coaxial cable used in Step 4 to the TX BNC connector for DS3 Port 1 on the I/O card.

Step 6   On the subtending host chassis backplane, attach one end of a coaxial cable to the TX BNC connector for DS3 Port 3 on the I/O card.

Step 7   On the first subtended node chassis backplane, attach the end of the coaxial cable used in Step 6 to the RX BNC for DS3 Port 1 on the I/O card.

Step 8   On the subtending host chassis backplane, attach one end of a coaxial cable to the RX BNC connector for DS3 Port 3 on the I/O card.

Step 9   On the first subtended node chassis backplane, attach the end of the coaxial cable used in Step 8 to the TX BNC connector for DS3 Port 1 on the I/O card.

Step 10   Repeat Step 2 through Step 9 for each subtending host chassis.

3.2.13.2 OC-3c Subtending Connections

Complete the following steps to connect the OC-3c subtending connections:

Warning   **Do not stare into the beam or view it directly with optical instruments.**

Note   For more information about OC-3c subtending connections, see the "Subtended Network Configuration with OC-3c/OC-3c NI-2 Cards" section on page 1-10.

Step 1   Verify that the OC-3c/OC-3c NI-2 card is installed in slot 10 (or slot 11, if a secondary NI-2 card is installed for redundancy) of the Cisco 6160 chassis to ensure that the OC-3c NI-2 card connections are active.

Note   See the "Redundancy in Subtended Configurations" section on page 1-42 for more information about redundant configurations.

Step 2   Attach a cable to the SBTD 2 RX optical interface connector on the subtending host chassis OC-3c/OC-3c NI-2 card to the TRNK 1 TX optical interface connector on the subtended node chassis OC-3c/OC-3c NI-2 card.

Figure 3-11 shows the cabling for an OC-3c subtended network configuration.

Note   See Table 2-4 for cable specifications. See Figure 1-17 for OC-3c connector locations.

Figure 3-11   Cabling for OC-3c Subtended Network Configuration

Step 3   Attach a cable to the SBTD 2 TX optical interface connector on the subtending host chassis OC-3c/OC-3c NI-2 card to the TRNK 1 RX optical interface connector on the subtended node chassis OC-3c/OC-3c NI-2 card. (See Figure 3-11.)

Step 4   To establish APS link redundancy repeat Step 2 and Step 3 for a secondary OC-3c/OC-3c NI-2 card.

Step 5   Repeat Step 1 through Step 4 for each subtending host chassis.

3.2.13.3 T1 or T1 IMA Subtending Connections

Complete the following steps to connect the TI or TI IMA subtending connections:

✎
Note   For more information about T1 or T1 IMA subtending connections, see the "Subtended Network Configuration with DS3+T1/E1 IMA NI-2 Cards" section on page 1-7.

Step 1   Verify that the DS3+T1/E1 IMA NI-2 card is installed in slot 10 (or slot 11, if a secondary NI-2 card is installed for redundancy) and the DS3/2DS3+8xT1 IMA I/O card is installed on the chassis backplane.

✎
Note   See the "Redundancy in Subtended Configurations" section on page 1-42 for more information about redundant configurations.

Step 2   Connect one end of an RJ-48 cable to one of the RJ-48c receptacles on the DS3/2DS3+8xT1 IMA I/O card located on the subtending host chassis backplane.

Figure 3-12 shows the cabling for a T1 or T1 IMA subtended network configuration.

✎
Note   See Table 2-4 for cable specifications. See Figure 1-19 for T1 interface locations.

Figure 3-12   Cabling for T1 or T1 IMA Subtended Network Configuration
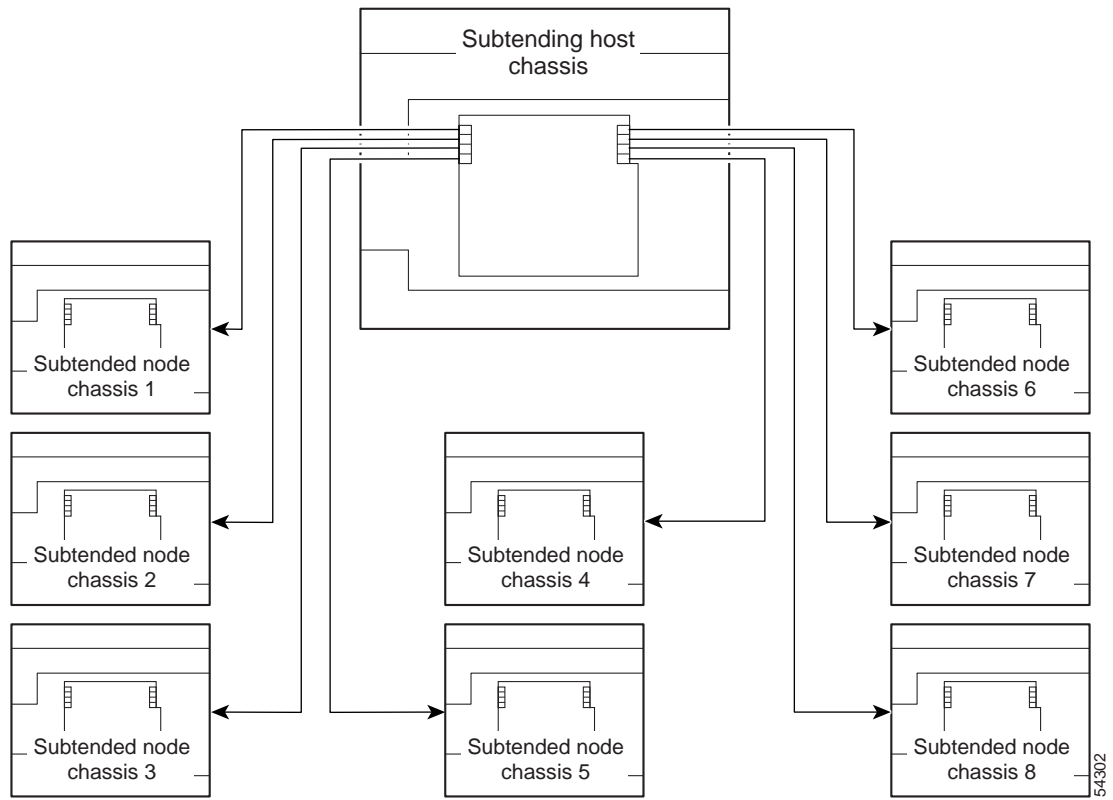
Step 3   Connect the other end of the cable used in Step 2 to one of the RJ-48c receptacles on the DS3/2DS3+8xT1 IMA I/O card located on the subtended node chassis backplane.

Step 4   Repeat Step 1 through Step 3 for each subtending host chassis.

> **Note**   Verify that the RJ-48 cable pinouts connect transmit to receive and receive to transmit. For more information on the RJ-48c receptacle pinouts, see the "Pinouts for the DS3/2DS3+8xT1 IMA I/O Card RJ-48c Receptacles" section on page C-4.

3.2.14 Connect the NI-2 Card to the Network

This section provides installation procedures for the following network connections:

- DS3 Network Connections, page 3-22
- OC-3c Network Connections, page 3-23
- T1 or T1 IMA Network Connections, page 3-23

Tip   Cisco recommends that you label each data cable at both ends to identify its destination.

Note   Cisco does not provide the cables for the network connections. See Table 2-4 for cable specifications.

3.2.14.1 DS3 Network Connections

Complete the following steps to connect the DS3 network connections:

Step 1   Verify that the DS3/2DS3 or DS3+T1/E1 IMA NI-2 card is installed in slot 10 (or slot 11, if a secondary NI-2 card is being installed for redundancy) of the Cisco 6160 chassis to ensure that the DS3 NI-2 card connections are active.

Note   See the "Redundancy in Subtended Configurations" section on page 1-42 for more information about redundancy configurations.

Step 2   Attach one end of a coaxial cable to the TX BNC connector for DS3 Port 1 on the I/O card.

Note   See Table 2-4 for cable specifications. See Figure 1-19 or Figure 1-23 for DS3 port connector locations.

Step 3   Attach the end of the cable that you used in Step 2 to the ATM switch.

Step 4   Attach one end of a coaxial cable to the RX BNC connector for DS3 Port 1 on the I/O card.

Step 5   Attach the end of the cable that you used in Step 4 to the ATM switch.

Step 6   Reboot the system to reassociate the system MAC address.

Step 7   Repeat Step 1 through Step 6 for each Cisco 6160 chassis being installed.

3.2.14.2 OC-3c Network Connections

Complete the following steps to connect the OC-3c network connections:

Warning   **Do not stare into the beam or view it directly with optical instruments.**

Step 1   Verify that the OC-3c/OC-3c or OC-3c/2DS3 NI-2 card is installed in slot 10 (or slot 11, if a secondary NI-2 card is being installed for redundancy) of the Cisco 6160 chassis to ensure that the OC-3c NI-2 connections are active.

Note   See the "Redundancy in Subtended Configurations" section on page 1-42 for more information about redundancy configurations.
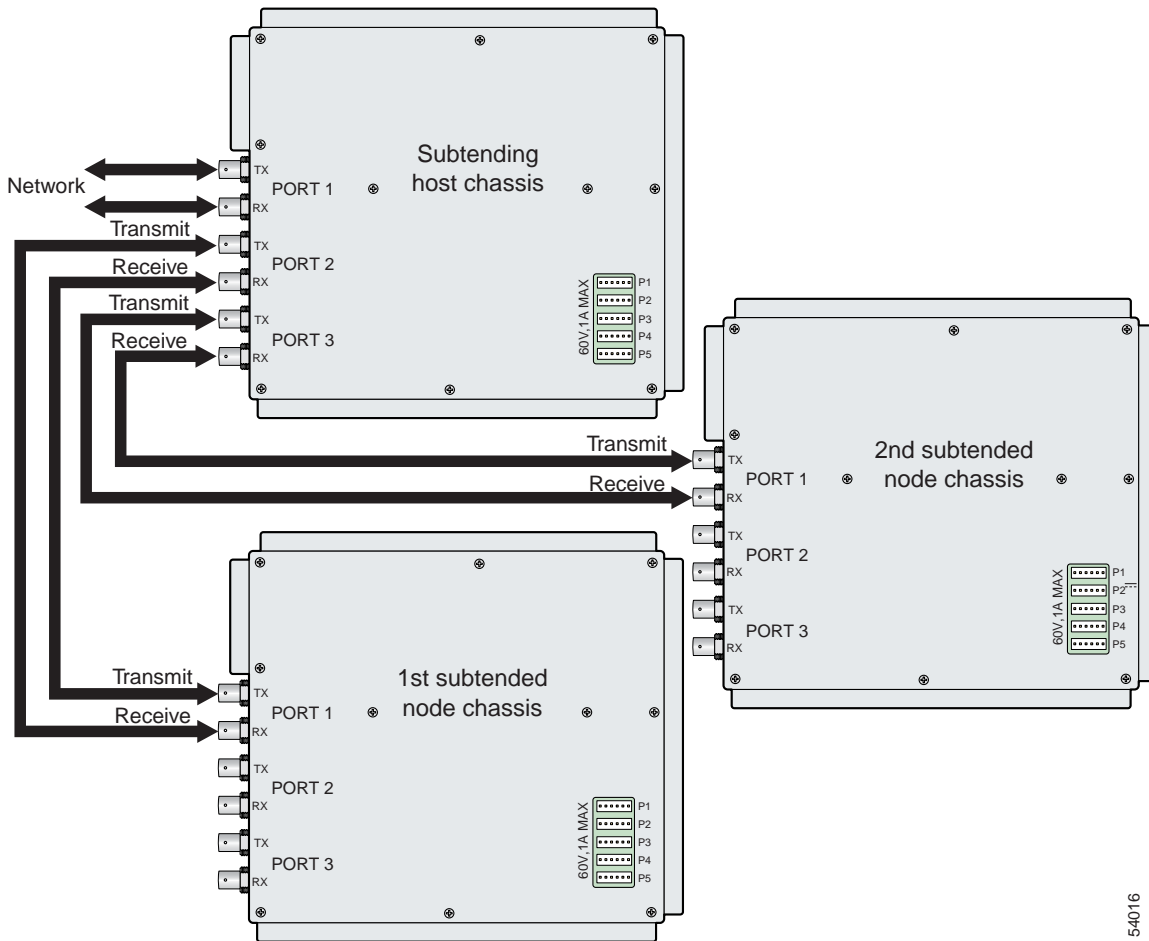
Step 2   Attach the receive cable from the ATM switch to the TRNK 1 TX optical interface connector on the OC-3c/OC-3c or OC-3c/2DS3 NI-2 card.

Note   See Figure 1-16 or Figure 1-17 or OC-3c connector locations.

Step 3   Attach the transmit cable from the ATM switch to the TRNK 1 RX optical interface connector on the OC-3c/OC-3c or OC-3c/2DS3 NI-2 card.

Step 4   To establish APS link redundancy repeat Step 2 and Step 3 for a secondary OC-3c/OC-3c or OC-3c/2DS3 NI-2 card.

Step 5   Reboot the system to reassociate the system MAC address.

Step 6   Repeat Step 1 through Step 5 for each Cisco 6160 chassis being installed.

3.2.14.3 T1 or T1 IMA Network Connections

Complete the following steps to connect the T1 or T1 IMA network connections:

Note   See the "IMA Configuration" section on page 1-5 for more information on how to configure an IMA network connection.

Step 1   Verify that you have a DS3+T1/E1 IMA NI-2 card is installed in slot 10 (or slot 11, if a secondary NI-2 card is installed for redundancy) and the DS3/2DS3+8xT1 IMA I/O card is installed on the chassis backplane.

Note   See the "Redundancy in Subtended Configurations" section on page 1-42 for more information about redundant configurations.

Step 2   Connect one end of an RJ-48 cable to one of the RJ-48c receptacles on the DS3/2DS3+8xT1 IMA I/O card. If you have a subtended network configuration installed, this connection must be made from the DS3/2DS3+8xT1 IMA I/O card in the subtending host chassis.

> **Note**   See Table 2-4 for cable specifications. See Figure 1-19 for T1 interface locations.

Step 3   Connect the other end of the cable used in Step 2 to the ATM switch.

Step 4   Repeat Step 1 through Step 3 for each Cisco 6160, as necessary.

> **Note**   Verify that the RJ-48 cable pinouts connect transmit to receive and receive to transmit. For more information on the RJ-48c receptacle pinouts, see the "Pinouts for the DS3/2DS3+8xT1 IMA I/O Card RJ-48c Receptacles" section on page C-4.

3.2.15 Connect the Ethernet to the Management Network

Complete the following steps to connect the Ethernet to the management network:

> **Warning**   **The ports labeled "ENET," "CNSL," and "AUX" are safety extra-low voltage (SELV) circuits. SELV circuits should be connected only to other SELV circuits. Because the DSL circuits are treated like telephone-network voltage, avoid connecting the SELV circuit to the telephone network voltage (TNV) circuits.**

> **Tip**   Cisco recommends that you label each data cable at both ends to identify its destination.

Step 1   Connect an Ethernet cable to the RJ-45 10BaseT receptacle (ENET) on the NI-2 card faceplate.

> **Note**   See Table 2-4 for cable specifications.

Step 2   Connect the other end of the Ethernet cable to the management network (for example, a LAN).

3.2.16 Connect the Console Terminal

Connect a VT100-compatible terminal to the system console port (CNSL) on the NI-2 card faceplate. Connect the terminal to a power source and set it up using the values that are shown in Table 3-2.

Table 3-2   Terminal Settings

Baud rate	9600 (transmit and receive)
Character size	8 bits
Parity	None

Table 3-2   Terminal Settings (continued)

Stop bits	1
Flow control	None

Warning   **The ports labeled "ENET," "CNSL," and "AUX" are safety extra-low voltage (SELV) circuits. SELV circuits should be connected only to other SELV circuits. Because the DSL circuits are treated like telephone-network voltage, avoid connecting the SELV circuit to the telephone network voltage (TNV) circuits.**

3.2.17 Connect the Auxiliary Port

Note   This step is optional.

Connect a terminal, a modem, or another serial device to the RJ-45 auxiliary port (AUX) on the NI-2 card faceplate.

Warning   **The ports labeled "ENET," "CNSL," and "AUX" are safety extra-low voltage (SELV) circuits. SELV circuits should be connected only to other SELV circuits. Because the DSL circuits are treated like telephone-network voltage, avoid connecting the SELV circuit to the TNV circuits.**

Tip   Cisco recommends that you label each data cable at both ends to identify its destination.

3.2.18 Complete Initial Configuration

When you turn on the Cisco 6160 for the first time, the System Configuration Dialog appears on the console screen. The System Configuration Dialog guides you through the initial configuration process. (You can run the dialog at any time by entering the **setup** command in privileged EXEC mode.)

When you complete the dialog, the system displays the configuration command script that you have created. It then offers you three options:

```
[0] Go to the IOS command prompt without saving this config.
[1] Return back to the setup without saving this config.
[2] Save this configuration to nvram and exit.
```

If you enter **2**, the configuration is saved and used. If you answer **0** or **1,** the configuration you created is not saved. Enter **1** if you wish to discard the configuration and restart the System Configuration Dialog.

3.2.18.1 Before You Begin

Complete the following steps before you run the System Configuration Dialog.

Step 1   Determine the IP address for the Ethernet interface.

Step 2   If you plan to configure in-band management, also determine the IP address for the ATM interface that will be used for in-band management (ATM0/0).

Step 3   Find out what the password strategy is for your environment. The System Configuration Dialog prompts you for three passwords, plus an SNMP community string. The three types of password required are enable secret, enable, and virtual terminal.

Step 4   Choose a name for the Cisco 6160. (This step is optional.)

3.2.18.2 Using the System Configuration Dialog

When you power up a Cisco 6160 for the first time, you are offered the option of running the System Configuration Dialog. The System Configuration Dialog offers two configuration options: basic management setup and extended setup.

- Choose basic management setup if you want to use the System Configuration Dialog to configure the passwords and the Ethernet interface only, and then use the management station or the command line interface to configure the remaining Cisco 6160 interfaces.

- Choose extended setup if you want to use the System Configuration Dialog to configure all of the Cisco 6160 interfaces.

An example of the use of each option follows the "Interface Numbering" section on page 3-26.

3.2.18.2.1 Interface Numbering

The System Configuration Dialog and the command line interface use the following interface numbering scheme:

- Interfaces whose names begin with "ATM0" (ATM0/1, ATM0/2, and so forth) are NI-2 card WAN interfaces. ATM0/0 is the ATM switch interface with the processor (sometimes referred to as the ASP interface, for ATM switch/processor). There is no need to configure ATM0/0 unless you plan to use in-band management. ATM0/1 is the trunk port. ATM0/2 and ATM0/3 (if present) are subtending interfaces. For DS3+T1 with a DS3 WAN interface, ATM0/1 is the trunk port. ATM0/2 through ATM0/9 are subtending interfaces. For a T1 WAN interface using a DS3+T1/E1 IMA NI-2 card, one port from ATM0/2 through ATM0/9 can be the trunk, while the other seven can be subtending interfaces. For IMA group interfaces DS3+T1/E1 IMA NI-2 card, one port from ATM0/ima0 through ATM0/ima3 can be the trunk port, with the other three being possible subtending interfaces.

- Interfaces whose names begin with "ATM1" through "ATM34" are line card interfaces. (ATM10 and ATM11, which would indicate the NI-2 slots, are omitted.)

- Ethernet0/0 is the interface for the LAN that connects the Cisco 6160 to its management system.

For line card interfaces, the number before the slash indicates the slot number. The number after the slash indicates the interface or port number. For example, ATM6/4 is port 4 in slot 6.

3.2.18.2.2 Basic Management Setup Example

This is the basic management setup example:

```
        --- System Configuration Dialog ---

Would you like to enter the initial configuration dialog? [yes/no]: y
At any point you may enter a question mark '?' for help.
Use ctrl-c to abort configuration dialog at any prompt.
Default settings are in square brackets '[]'.

Basic management setup configures only enough connectivity
for management of the system, extended setup will ask you
to configure each interface on the system

Would you like to enter basic management setup? [yes/no]: y

Configuring global parameters:

  Enter host name [DSLAM]:

  The enable secret is a password used to protect access to
  privileged EXEC and configuration modes. This password, after
  entered, becomes encrypted in the configuration.
  Enter enable secret: beansoup

  The enable password is used when you do not specify an
  enable secret password, with some older software versions, and
  some boot images.
  Enter enable password: beansoup
% Please choose a password that is different from the enable secret
  Enter enable password: lab1

  The virtual terminal password is used to protect
  access to the router over a network interface.
  Enter virtual terminal password:
% No defaulting allowed
  Enter virtual terminal password: lab

  Configure SNMP Network Management? [yes]: y
    Community string [public]:


Current interface summary

Any interface listed with OK? value "NO" does not have a valid configuration

Interface            IP-Address      OK? Method Status                Protocol
ATM0/0               unassigned      NO  unset  up                    up
Ethernet0/0          unassigned      NO  unset  up                    up
ATM0/1               unassigned      NO  unset  down                  down
ATM0/2               unassigned      NO  unset  down                  down

Enter interface name used to connect to the
management network from the above interface summary: Ethernet0/0

Configuring interface Ethernet0/0:
  Configure IP on this interface? [yes]: y
    IP address for this interface: 172.27.144.141
    Subnet mask for this interface [255.255.0.0] :
    Class B network is 172.27.0.0, 16 subnet bits; mask is /16
```

```
The following configuration command script was created:

hostname DSLAM
enable secret 5 $1$pR/1$0zH7ohDaUKNML3SC2.RF5.
enable password lab1
line vty 0 4
password lab
snmp-server community public
!
no ip routing

!
interface ATM0/0
no ip address
!
interface Ethernet0/0
no shutdown
ip address 172.27.144.141 255.255.0.0
!
interface ATM0/1
shutdown
no ip address
!
interface ATM0/2
shutdown
no ip address
!
end


[0] Go to the IOS command prompt without saving this config.
[1] Return back to the setup without saving this config.
[2] Save this configuration to nvram and exit.

Enter your selection [2]: 2
% Shutdown not allowed for ATM0/0.
Building configuration...
Use the enabled mode 'configure' command to modify this configuration.


Press RETURN to get started!
```

3.2.18.2.3 Extended Setup Example

This is the extended setup example:

```
        --- System Configuration Dialog ---

Continue with configuration dialog? [yes/no]: yes

At any point you may enter a question mark '?' for help.
Use ctrl-c to abort configuration dialog at any prompt.
Default settings are in square brackets '[]'.


Basic management setup configures only enough connectivity
for management of the system, extended setup will ask you
to configure each interface on the system

Would you like to enter basic management setup? [yes/no]: no

First, would you like to see the current interface summary? [yes]: yes
```

```
Interface              IP-Address      OK? Method Status                 Protocol
ATM0/0                 70.0.0.2        YES NVRAM  up                     up
Ethernet0/0            172.27.32.156   YES NVRAM  up                     up
ATM0/1                 unassigned      YES unset  down                   down
ATM0/2                 unassigned      YES unset  administratively down  down
ATM18/0                unassigned      YES unset  initializing           down
ATM18/1                unassigned      YES unset  initializing           down
ATM18/2                unassigned      YES unset  initializing           down
ATM18/3                unassigned      YES unset  initializing           down
ATM21/0                unassigned      YES unset  administratively down  down
ATM21/1                unassigned      YES unset  administratively down  down
ATM21/2                unassigned      YES unset  administratively down  down
ATM21/3                unassigned      YES unset  administratively down  down
ATM26/0                unassigned      YES unset  down                   down
ATM26/1                unassigned      YES unset  down                   down
ATM26/2                unassigned      YES unset  down                   down
ATM26/3                unassigned      YES unset  down                   down

Configuring global parameters:

  Enter host name [DSLAM]: sw-ni2-2

  The enable secret is a password used to protect access to
  privileged EXEC and configuration modes. This password, after
  entered, becomes encrypted in the configuration.
  Enter enable secret: lqb

  The enable password is used when you do not specify an
  enable secret password, with some older software versions, and
  some boot images.
  Enter enable password [lab]: lab

  The virtual terminal password is used to protect
  access to the router over a network interface.
  Enter virtual terminal password [lab]:
  Configure SNMP Network Management? [no]:
  Configure IP? [yes]:
    Configure IGRP routing? [yes]: no

Configuring interface parameters:

Do you want to configure ATM0/0  interface? [yes]:
  Configure IP on this interface? [yes]:
    IP address for this interface [70.0.0.2]:
    Subnet mask for this interface [255.0.0.0] :
    Class A network is 70.0.0.0, 8 subnet bits; mask is /8

Do you want to configure Ethernet0/0  interface? [yes]:
  Configure IP on this interface? [yes]:
    IP address for this interface [172.27.32.156]:
    Subnet mask for this interface [255.255.0.0] :
    Class B network is 172.27.0.0, 16 subnet bits; mask is /16

Do you want to configure ATM0/1  interface? [yes]:
  Configure IP on this interface? [no]:

Do you want to configure ATM0/2  interface? [no]:

Do you want to configure ATM18/0  interface? [yes]:
  Configure IP on this interface? [no]:

Do you want to configure ATM18/1  interface? [yes]:
  Configure IP on this interface? [no]:
```

```
Do you want to configure ATM18/2  interface? [yes]:
  Configure IP on this interface? [no]:

Do you want to configure ATM18/3  interface? [yes]:
  Configure IP on this interface? [no]:

Do you want to configure ATM21/0  interface? [no]:

Do you want to configure ATM21/1  interface? [no]:

Do you want to configure ATM21/2  interface? [no]:

Do you want to configure ATM21/3  interface? [no]:

Do you want to configure ATM26/0  interface? [yes]:
  Configure IP on this interface? [no]:

Do you want to configure ATM26/1  interface? [yes]:
  Configure IP on this interface? [no]:

Do you want to configure ATM26/2  interface? [yes]:
  Configure IP on this interface? [no]:

Do you want to configure ATM26/3  interface? [yes]:
  Configure IP on this interface? [no]:

The following configuration command script was created:

hostname sw-ni2-2
enable secret 5 $1$12Lo$vGKa1wlRcNyw06j1bgGQd0
enable password lab
line vty 0 4
password lab
no snmp-server

!
ip routing
!
interface ATM0/0
ip address 70.0.0.2 255.0.0.0
!
interface Ethernet0/0
ip address 172.27.32.156 255.255.0.0
!
interface ATM0/1
no ip address
!
interface ATM0/2
shutdown
no ip address
!
interface ATM18/0
no ip address
!
interface ATM18/1
no ip address
!
interface ATM18/2
no ip address
!
interface ATM18/3
no ip address
!
```

```
interface ATM21/0
shutdown
no ip address
!
interface ATM21/1
shutdown
no ip address
!
interface ATM21/2
shutdown
no ip address
!
interface ATM21/3
shutdown
no ip address
!
interface ATM26/0
no ip address
!
interface ATM26/1
no ip address
!
interface ATM26/2
no ip address
!
interface ATM26/3
no ip address
!
end


[0] Go to the IOS command prompt without saving this config.
[1] Return back to the setup without saving this config.
[2] Save this configuration to nvram and exit.

Enter your selection [2]:2
Building configuration...
Use the enabled mode 'configure' command to modify this configuration.


Press RETURN to get started!
```

Note To configure your system, refer to the appropriate software or network management configuration guides.

Installing a Cisco 6160 Without a POTS Splitter Configuration

This chapter provides installation procedures for installing a Cisco 6160 without a POTS splitter for *x*DSL data traffic.

Note The installation procedures in this chapter apply to a Cisco 6160 system shipped with the individual hardware components preinstalled. For information about installing or replacing field-replaceable units (FRUs) in the Cisco 6160 chassis, see Chapter 6, "Upgrading and Maintaining the Cisco 6160 System."

Warning **Only trained and qualified personnel should be allowed to install, replace, or service this equipment.**

Caution Before you begin the installation procedures, read the entire chapter for important information and safety warnings.

Note Before installing and cabling the equipment, be aware of standard safety practices and the hazards involved in working with electrical circuitry to prevent accidents. See the "Safety Requirements" section on page 2-1 for all cautions and warnings that you need to ensure a safe and hazard-free installation.

To see translations of the warnings that appear in this publication, refer to the *Regulatory Compliance and Safety Information for the Cisco 6160 System* document that accompanied this product.

Note See the "Cisco 6160 Without a POTS Splitter Configuration" section on page 1-4 for more information about configuration components.

4.1 Installation Checklist

When you install a Cisco 6160 without a POTS splitter configuration, be sure that you follow the installation procedures in the proper sequence. Table 4-1 is a checklist of the installation steps in the order in which they should occur. Detailed installation instructions are located in the sections following Table 4-1.

Caution   Proper ESD protection is required whenever you handle Cisco equipment. Installation and maintenance personnel should be properly grounded by means of grounding straps to eliminate the risk of ESD damage to the equipment. Equipment is subject to ESD damage whenever it is removed from the chassis.

Table 4-1   Installation Checklist—Cisco 6160 Without POTS Splitter Configuration

Check	Installation Procedure
	1. Stabilize and measure the rack space.
	2. Install the Cisco 6160 chassis in the rack.
	3. Install blank faceplates in the open line card slots.
	4. Ground the Cisco 6160 chassis.
	5. Attach the Cisco 6160 power connections.
	6. Connect the alarm contacts (optional).
	7. Connect the BITS clock (optional).
	8. Connect the Cisco 6160 chassis to the MDF.[1]
	9. Apply power to the system.
	10. Connect the subtending host chassis to the subtended node chassis.
	11. Connect the NI-2 card(s) to the network.
	12. Connect the Ethernet to the management network.
	13. Connect a console terminal.
	14. Connect the auxiliary port (optional).
	15. Complete the initial configuration.

1. MDF = main distribution frame

4.2 Installation Procedures

The following sections detail the installation procedures for a Cisco 6160 without a POTS splitter configuration.

4.2.1 Stabilize and Measure the Rack Space

For the rack to remain stable, you must install your Cisco 6160 system components from the bottom to the top of the rack. Before you install any of the components, calculate the total rack space required to install your system. The required rack space depends on the number of Cisco 6160 chassis that you plan to use. The number of chassis increases if you plan to install a subtended network.

Note   See Table 2-2 on page 2-13 to determine the total rack space necessary for your configuration.

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

—This unit should be mounted at the bottom of the rack if it is the only unit in the rack.

—When mounting this unit in a partially filled rack, load the rack from the bottom to the top with the heaviest component at the bottom of the rack.

—If the rack is provided with stabilizing devices, install the stabilizers before mounting or servicing the unit in the rack.

Warning   **Two people are required to lift the chassis. Grasp the chassis underneath the lower edge and lift with both hands. To prevent injury, keep your back straight and lift with your legs, not your back.**

If you plan to expand your system to include more chassis in the future, allow space in the rack for additions during the initial installation, keeping in mind the weight distribution and stability of the rack.

4.2.2 Install the Cisco 6160 Chassis

Complete the following steps to install the Cisco 6160 chassis:

Warning   **Two people are required to lift the chassis. Grasp the chassis underneath the lower edge and lift with both hands. To prevent injury, keep your back straight and lift with your legs, not your back.**

Step 1   Connect a grounding strap to the ESD grounding jack. See the "Preventing Electrostatic Discharge Damage" section on page 2-8 for the ESD grounding jack location on the Cisco 6160 chassis.

Step 2   Check the ear brackets on the sides of the chassis and reinstall them, if necessary. Ear brackets can be installed in two ways:

- Mid-mount, as shown in Figure 4-1—The ear brackets are installed in this position in the factory.
- Front mount, as shown in Figure 4-2.

Figure 4-1   Mid-Mount Option for Ear Brackets
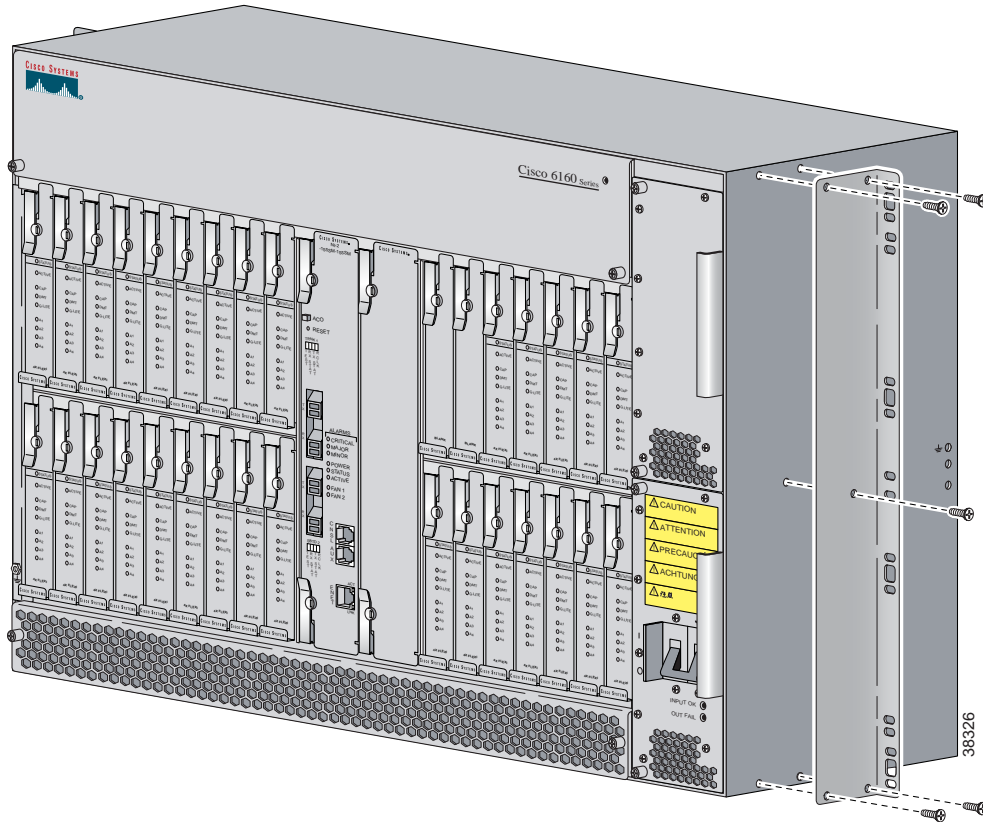
Figure 4-2   Front Mount Option for Ear Brackets
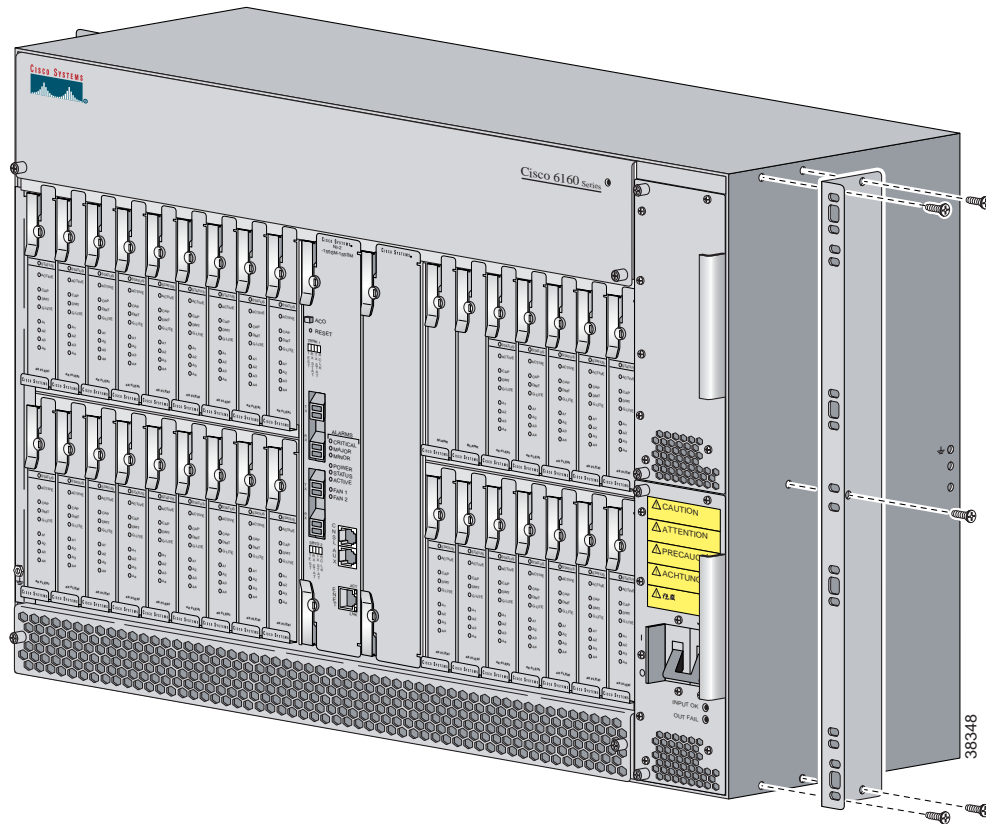
Step 3   Carefully lift the chassis from the bottom and place it in position in the rack.

Step 4   Use four mounting screws and a Phillips-head screwdriver to bolt the Cisco 6160 in the rack.

Step 5   Repeat Step 2 through Step 4 for each Cisco 6160 chassis as necessary.

4.2.3 Install the Blank Faceplates

Blank faceplates should occupy any empty line card slots in Cisco 6160 chassis. Blank faceplate installation is similar to line card installation.

Warning   **Blank faceplates and cover panels serve three important functions: they prevent exposure to hazardous voltages and currents inside the chassis; they contain electromagnetic interference (EMI) that might disrupt other equipment; and they direct the flow of cooling air through the chassis. Do not operate the system unless all cards, faceplates, and covers are in place.**

Complete the following steps to install blank faceplates in the Cisco 6160:

Step 1   Vertically align the blank faceplate edges with the guides at the top and bottom of the slot.

Step 2   Lift up on the ejector lever and gently apply pressure to the bottom of the faceplate while pushing the blank faceplate into the slot.

Step 3 Push on the faceplate to fully seat the blank faceplate.

Step 4 Press down on the ejector lever to secure the faceplate.

4.2.4 Ground the Cisco 6160

This section describes two ways to ground the Cisco 6160 chassis.

- Ground the Cisco 6160 Using a Grounding Lug, page 4-6
- Ground the Cisco 6160 from the Power Terminal Block Connector, page 4-8

4.2.4.1 Ground the Cisco 6160 Using a Grounding Lug

Warning **When you are installing or replacing the Cisco 6160 chassis, the ground connection must always be made first and disconnected last.**

Note The grounding lug is not provided by Cisco. Use either a 5/8-inch or 3/4-inch lug to ground the Cisco 6160 chassis.

To ensure adequate earth ground for the system, complete the following steps to ground the Cisco 6160 chassis using a grounding lug:

Step 1 Verify that power in the direct current (DC) circuit is off.

Step 2 Measure enough wire to connect the Cisco 6160 to the grounding point at your site or to the rack.

Note See Table 2-4 for wire specifications.

Step 3 Use a wire stripper to remove the casing from both ends of the grounding wire. The manufacturer of the grounding lug might have a specific recommendation on the length of wire to be stripped.

Step 4 Insert the stripped end of the grounding wire into the open end of the grounding lug. Be careful not to leave any wire strands outside the lug.

Step 5 Use the crimping tool to compress the lug onto the wire.

Step 6 Verify the quality of the crimp by inspecting it and tugging gently on the wire.

Step 7   Locate the three grounding holes on the Cisco 6160 side panel. Figure 4-3 shows how to ground the Cisco 6160 chassis using a grounding lug.

Figure 4-3   Grounding the Cisco 6160 Chassis Using the Grounding Lug—Backplane View
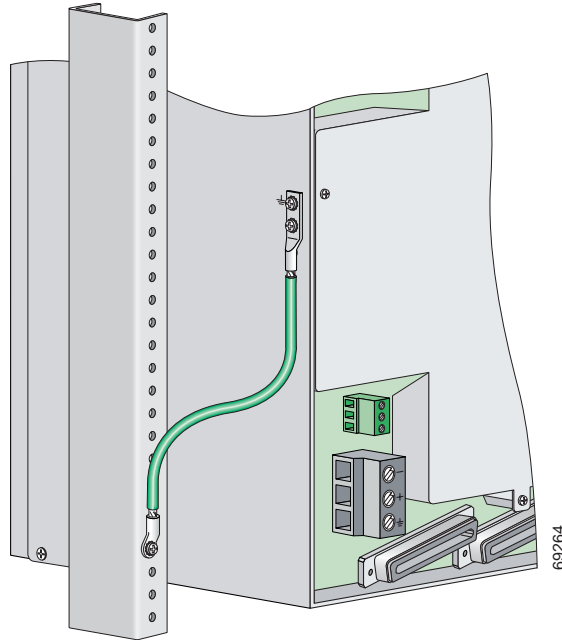
Step 8   Match the holes in the grounding lug to the appropriately spaced pair of grounding holes on the side of the chassis. Use the top two holes for a 5/8-inch lug. Use the bottom two holes for a 3/4-inch lug.

Step 9   Insert the screws through the holes in the lug and the chassis.

Step 10   Use a Phillips-head screwdriver to tighten the screws and secure the grounding lug firmly to the chassis.

Step 11   Connect the other end of the grounding wire to an appropriate grounding point at your site or to the rack (see Figure 4-3). To connect the grounding wire to the rack, complete the following steps:

   a.   Remove all paint or oxidation from the rack at the point of the grounding connection.

   b.   Use a 3/16-inch flat-head screwdriver to loosen the grounding screw on the rack.

   c.   Connect the wire to a ring lug (large enough for the rack screw to fit through).

   d.   Use a 3/16-inch flat-head screwdriver and the screw to attach the ring lug to the rack.

   e.   Tighten the grounding screw on the rack over the ring lug.

Step 12   Repeat Step 1 through Step 11 for each Cisco 6160 chassis being installed.

4.2.4.2 Ground the Cisco 6160 from the Power Terminal Block Connector

Warning   **When you are installing or replacing the Cisco 6160 chassis, the ground connection must always be made first and disconnected last.**

To ensure adequate earth ground for the system, complete the following steps to attach the grounding wire to the power terminal block connector on the Cisco 6160 backplane:

Step 1   Verify that power in the DC circuit is off.

Step 2   Measure enough wire to connect the Cisco 6160 to the grounding point at your site or to the rack.

Note   See Table 2-4 for wire specifications.

Step 3   Use a wire stripper to remove the casing from both ends of the grounding wire.

Step 4   Identify the correct power terminal block on the backplane of the Cisco 6160. The PWR 1 connector is used if you have a primary power entry module (PEM) installed in the chassis. The PWR 2 connector is used if you have a secondary (redundant) PEM installed in the chassis. Figure 4-4 shows the location of the PWR 1 and PWR 2 power terminal block connectors.

Figure 4-4   Cisco 6160 Backplane

1	PWR 1—Power terminal block connector.	5	Connectors JC1 through JC5.
2	BRKR 1—A terminal block connector used to wire alarm relays to external alarms.	6	I/O card connectors (P3 and P9).
3	PWR 2—Power terminal block connector. Use if a secondary (redundant) PEM is installed.	7	Connectors JC6 through JC11.
4	BRKR 2—A terminal block connector used to wire alarm relays to external alarms. Use if a secondary (redundant) PEM is installed.		

Step 5   Use a flat-head screwdriver and a counterclockwise motion to open the grounding terminal connector on the power terminal block. This step ensures that the correct opening is presented for the wires. (See Figure 4-5.)

Figure 4-5   Positioning the Power and Ground Terminals to Accept Wires
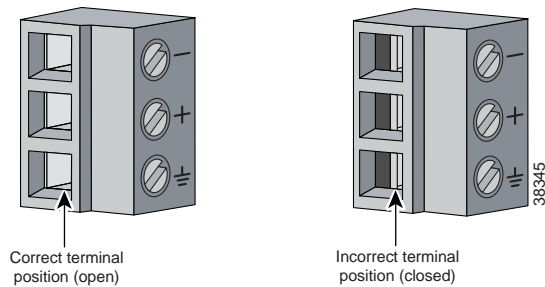
Correct terminal
position (open)

Incorrect terminal
position (closed)

Step 6   Insert one end of the grounding wire into the grounding receptacle, which is the bottom receptacle in the power terminal block connector (Callout 3 in Figure 4-6). The stripped part of the wire must be fully inserted into the terminal block so that no bare wire is exposed.

Figure 4-6   Inserting the Grounding and Power Wires into the Power Terminal Block Connector
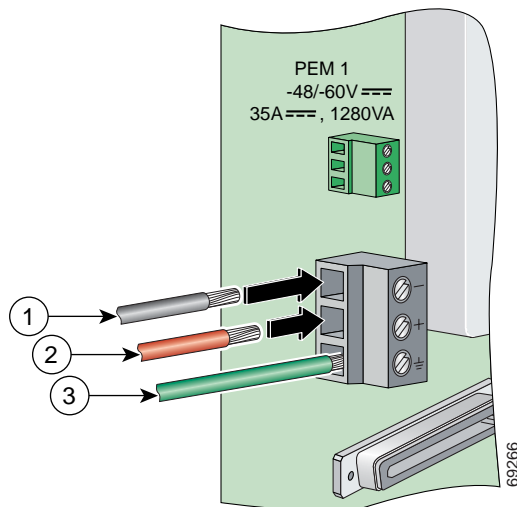
1	Power lead wire connection	3	Grounding wire connection
2	Battery return wire connection		

Step 7   Verify that no wire strands are left outside the connector.

Step 8   Use the flat-head screwdriver and a clockwise motion to tighten the ground screw in the power terminal block connector. Pull gently on the wire to ensure that it is held firmly in place. Figure 4-7 shows how to ground the Cisco 6160 chassis from the power terminal block connector.

Figure 4-7   Grounding the Cisco 6160 Chassis from the Power Terminal Block Connector—Backplane View
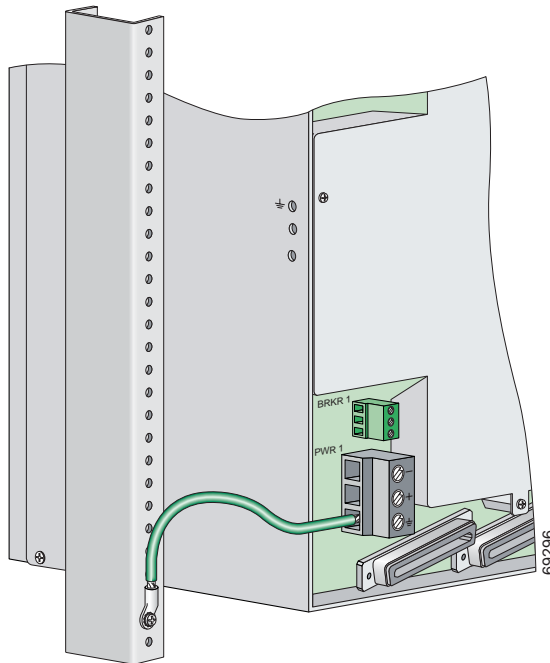
Step 9   Connect the other end of the grounding wire to an appropriate grounding point at your site or to the rack. (see Figure 4-7). To connect the grounding wire to the rack, complete the following steps:

   a.   Remove all paint or oxidation from the rack at the point of the grounding connection.

   b.   Use a 3/16-inch flat-head screwdriver to loosen the grounding screw on the rack.

   c.   Connect the wire to a ring lug (large enough for the rack screw to fit through).

   d.   Use a 3/16-inch flat-head screwdriver and the screw to attach the ring lug to the rack.

   e.   Tighten the grounding screw on the rack over the ring lug (see Figure 4-7).

Step 10   If you are connecting two power sources to the Cisco 6160 system, repeat Step 1 through Step 9 for the second power terminal block.

Step 11   Repeat Step 1 through Step 10 for each Cisco 6160 chassis being installed.

4.2.5 Attach the Cisco 6160 Power Connections

⚠️
Caution   To prevent the system from powering up, do not install the fuses at this time. If the fuses are already installed in the fuse and alarm panel, remove them. You can replace the fuses after the system is installed and connected.

✎
Note   For full power redundancy, each terminal block must be connected to a separate power source. If you do not require power redundancy, you can wire a single terminal block, or connect both terminal blocks to a single power source.

Do not power the components in the rack by chaining them together.

⚠️
Warning   **The illustration shows the DC power supply terminal block. Wire the DC power supply as illustrated. The proper wiring sequence is ground to ground, positive to positive, and negative to negative. The ground wire must always be connected first and disconnected last. The fuse and alarm panel and wires are not provided by Cisco.**

Complete the following steps to connect power to the system:

Step 1   Verify that power in the DC circuit is off.

Step 2   Identify the correct power terminal block on the backplane of the Cisco 6160. The PWR 1 connector is used if you have a primary PEM installed in the chassis. The PWR 2 connector is used if you have a secondary (redundant) PEM installed in the chassis. Figure 4-4 shows the location of the PWR 1 and PWR 2 power terminal block connectors.

Step 3   Use a flat-head screwdriver and a counterclockwise motion to open the positive and negative terminal connectors on the power terminal block. This step ensures that the correct opening is presented for the wires. (See Figure 4-8.)

Figure 4-8   Positioning the Power and Ground Terminals to Accept Wires
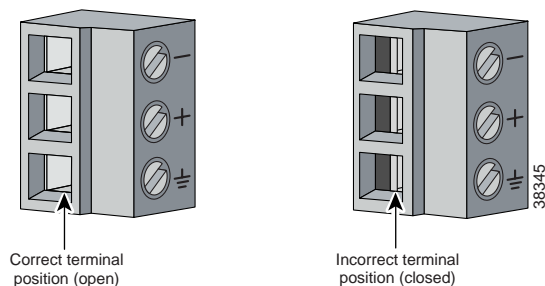
Correct terminal
position (open)

Incorrect terminal
position (closed)

Step 4 Insert the battery return wire from the first external power source into the receptacle labeled + (positive) on the appropriate power terminal block (Callout 2 in Figure 4-9). The stripped part of the wire must be fully inserted so that no bare wire is exposed.

Figure 4-9   Inserting the Grounding and Power Wires into the Power Terminal Block Connector

| **1**	Power lead wire connection	**3**	Grounding wire connection
2	Battery return wire connection		

Step 5 Verify that no wire strands are left outside the connector.

Step 6 Use a flat-head screwdriver and a clockwise motion to tighten the terminal screw over the wire.

Step 7 Insert the power lead from the first battery –48VDC power source into the receptacle labeled – (negative) on the appropriate power terminal block (Callout 1 in Figure 4-9). The stripped part of the wire must be fully inserted so that no bare wire is exposed.

Step 8 Verify that no wire strands are left outside the connector.

Step 9 Use a flat-head screwdriver and a clockwise motion to tighten the terminal screw over the wire.

Step 10 If you are connecting a second power source, repeat Step 2 through Step 9 to wire the second power terminal block.

Step 11 Thread tie wraps through the small cutouts in the side of the chassis next to each terminal block and tie down the wires using the tie wraps.

Step 12 Repeat Step 1 through Step 11 for each Cisco 6160 chassis being installed.

4.2.6 Connect the Alarm Contacts

> **Note**   This step is optional.

Complete the following steps to connect an external alarm device to the wire-wrap pins on the I/O card:

> **Note**   The relay for the circuit-breaker trip alarm is wired through the small green terminal blocks (BRKR 1 and BRKR 2) on the chassis backplane and not through the wire-wrap connector.

> **Caution**   Use extreme caution when wire-wrapping the pin connections for the STAT_ALARMS and BITS_A/BITS_B pins. Incorrect wire connections will cause damage to the equipment.

Step 1   Measure wire long enough to connect the appropriate pin to the external alarm device. See Table 2-4 for wire specifications.

> **Note**   See the "I/O Cards" section on page 1-43 for an illustration of the pinouts that are located on the I/O card. See Appendix C, "Connector and Pinout Specifications," for pinout descriptions.

Step 2   Use a wire stripper to remove the casing from both ends of the wire.

Step 3   Use a wire-wrapping tool to attach the wire to the appropriate pin.

Step 4   Use a wire-wrapping tool to attach the other end of the wire used in Step 3 to the external alarm device.

Step 5   Repeat Step 1 through Step 4 to wire wrap all necessary pins.

Step 6   Repeat Step 1 through Step 5 for each Cisco 6160 chassis being installed.

4.2.7 Connect the BITS Clock Contacts

Note This step is optional.

Complete the following steps to connect the BITS clock to the wire-wrap pins on the I/O card:

Caution Use extreme caution when wire-wrapping the pin connections for the STAT_ALARMS and BITS_A/BITS_B pins. Incorrect wire connections will cause damage to the equipment.

Step 1 Measure wire long enough to connect the appropriate pin on the I/O card to the BITS clock. See Table 2-4 for wire specifications.

Note See the "I/O Cards" section on page 1-43 for an illustration of the pinouts that are located on the I/O card. See Appendix C, "Connector and Pinout Specifications," for pinout descriptions.

Step 2 Use a wire stripper to remove the casing from both ends of the wire.

Step 3 Use a wire-wrapping tool to attach the wire to the appropriate pins for the slot in which the primary NI-2 card is installed.

Note The BITS pins on I/O cards are slot specific. BITS_A pins are assigned to slot 11 and BITS_B pins are assigned to slot 10. Each BITS clock input is independent and terminated at 100 ohms.

Step 4 Use a wire-wrapping tool to attach the other end of the wire used in Step 3 to the BITS clock.

Step 5 Repeat Step 1 through Step 4 to wire wrap the appropriate pins for a secondary (redundant) NI-2 card.

Step 6 Repeat Step 1 through Step 5 for each Cisco 6160 chassis being installed.

4.2.8 Connect the Cisco 6160 to the MDF

Use the cables described in Table 2-4 to connect the eleven Champ connectors located on the Cisco 6160 backplane to the MDF. This connection is for *x*DSL data flow between the Cisco 6160 system and the MDF.

Note For additional information about the Cisco 6160 backplane connectors, see the "Backplane" section on page 1-11.

4.2.9 Apply the Power

Complete the following steps to apply power to the Cisco 6160 system:

⚠️
Caution If the power connections are improperly made and power is applied while the cards are installed, the cards and chassis could be damaged.

Step 1 Verify that the power connections from the Cisco 6160 terminal block(s) to the power source are wired as shown in Figure 4-9.

Step 2 Apply power to the system using one of the following methods:

- Install the fuses in the fuse and alarm panel.
- Reinsert the fuses in the fuse and alarm panel, if you removed them in the "Attach the Cisco 6160 Power Connections" section on page 4-12.
- Turn on the breakers in the fuse and alarm panel.

Step 3 Check the polarity of the –48VDC connections to each chassis by attaching a voltmeter with the minus lead on –48RTN and the plus lead on –48V_A or –48V_B. Ensure that the meter reads between –40VDC and –60VDC. If your voltmeter shows a positive voltage, the power inputs might be reversed. If the voltmeter shows a negative voltage that is out of the –40VDC to –60VDC range, check the power supply for failure or check for a blown fuse in the fuse and alarm panel.

Step 4 Set the circuit breaker on the PEM to the ON (1) position.

If the power is properly connected, the INPUT OK LED on the front of the PEM(s) will be green. You will also hear the blowers start to turn. A slight delay in blower startup is normal. If these events do not occur, repeat Step 1 through Step 4.

Step 5 Repeat Step 1 through Step 4 for each Cisco 6160 chassis being installed.

4.2.10 Connect the Subtending Host Chassis to the Subtended Node Chassis

If you are installing a subtended network, this section provides installation procedures for the following subtending connections:

- DS3 Subtending Connections, page 4-17
- OC-3c Subtending Connections, page 4-19
- T1 or T1 IMA Subtending Connections, page 4-20

If you are not installing a subtended network, proceed to the "Connect the NI-2 Card to the Network" section on page 4-22.

Tip Cisco recommends that you label each data cable at both ends to identify its destination.

Note   For more information on a subtended network configuration, see the "Subtended Network Configuration" section on page 1-6.

The term *subtending* refers to the host chassis, and *subtended* refers to the downstream chassis in a subtended network.

Cisco does not provide the cables for the subtending connections. See Table 2-4 for cable specifications.

4.2.10.1 DS3 Subtending Connections

Complete the following steps to connect the DS3 subtending connections:

Note   For more information about DS3 subtending connections, see the "Subtended Network Configuration with DS3/2DS3 or OC-3c/2DS3 NI-2 Cards" section on page 1-9.

Step 1   Verify that the DS3/2DS3 or OC-3c/2DS3 NI-2 card is installed in slot 10 (or slot 11, if a secondary NI-2 card is installed for redundancy) of the Cisco 6160 chassis to ensure that the DS3 NI-2 card connections are active.

Note   See the "Redundancy in Subtended Configurations" section on page 1-42 for more information about redundant configurations.

Step 2   On the subtending host chassis backplane, attach one end of a coaxial cable to the TX BNC connector for DS3 Port 2 on the I/O card.

Note   See Table 2-4 for cable specifications. See Figure 1-19 or Figure 1-23 for DS3 port connector locations.

Figure 4-10 shows the cabling for a DS3 subtended network configuration.

Figure 4-10   **Cabling for DS3 Subtended Network Configuration**

Step 3   On the first subtended node chassis backplane, attach the end of the coaxial cable used in Step 2 to the RX BNC for DS3 Port 1 on the I/O card.

Step 4   On the subtending host chassis backplane, attach one end of a coaxial cable to the RX BNC connector for DS3 Port 2 on the I/O card.

Step 5   On the first subtended node chassis backplane, attach the end of the coaxial cable used in Step 4 to the TX BNC connector for DS3 Port 1 on the I/O card.

Step 6   On the subtending host chassis backplane, attach one end of a coaxial cable to the TX BNC connector for DS3 Port 3 on the I/O card.

Step 7   On the first subtended node chassis backplane, attach the end of the coaxial cable used in Step 6 to the RX BNC for DS3 Port 1 on the I/O card.

Step 8   On the subtending host chassis backplane, attach one end of a coaxial cable to the RX BNC connector for DS3 Port 3 on the I/O card.

Step 9 On the first subtended node chassis backplane, attach the end of the coaxial cable used in Step 8 to the TX BNC connector for DS3 Port 1 on the I/O card.

Step 10 Repeat Step 2 through Step 9 for each subtending host chassis.

4.2.10.2 OC-3c Subtending Connections

Complete the following steps to connect the OC-3c subtending connections:

⚠️
Warning   **Do not stare into the beam or view it directly with optical instruments.**

✎
Note   For more information about OC-3c subtending connections, see the "Subtended Network Configuration with OC-3c/OC-3c NI-2 Cards" section on page 1-10.

Step 1 Verify that the OC-3c/OC-3c NI-2 card is installed in slot 10 (or slot 11, if a secondary NI-2 card is installed for redundancy) of the Cisco 6160 chassis to ensure that the OC-3c NI-2 card connections are active.

✎
Note   See the "Redundancy in Subtended Configurations" section on page 1-42 for more information about redundant configurations.

Step 2 Attach a cable to the SBTD 2 RX optical interface connector on the subtending host chassis OC-3c/OC-3c NI-2 card to the TRNK 1 TX optical interface connector on the subtended node chassis OC-3c/OC-3c NI-2 card.

Figure 4-11 shows the cabling for an OC-3c subtended network configuration.

✎
Note   See Table 2-4 for cable specifications. See Figure 1-17 for OC-3c connector locations.

Figure 4-11   Cabling for OC-3c Subtended Network Configuration

Step 3 Attach a cable to the SBTD 2 TX optical interface connector on the subtending host chassis OC-3c/OC-3c NI-2 card to the TRNK 1 RX optical interface connector on the subtended node chassis OC-3c/OC-3c NI-2 card. (See Figure 4-11.)

Step 4   To establish APS link redundancy repeat Step 2 and Step 3 for a secondary OC-3c/OC-3c NI-2 card.

Step 5   Repeat Step 1 through Step 4 for each subtending host chassis.

4.2.10.3 T1 or T1 IMA Subtending Connections

Complete the following steps to connect the TI or TI IMA subtending connections:

Note   For more information about T1 or T1 IMA subtending connections, see the "Subtended Network Configuration with DS3+T1/E1 IMA NI-2 Cards" section on page 1-7.

Step 1   Verify that the DS3+T1/E1 IMA NI-2 card is installed in slot 10 (or slot 11, if a secondary NI-2 card is installed for redundancy) and the DS3/2DS3+8xT1 IMA I/O card is installed on the chassis backplane.

Note   See the "Redundancy in Subtended Configurations" section on page 1-42 for more information about redundant configurations.
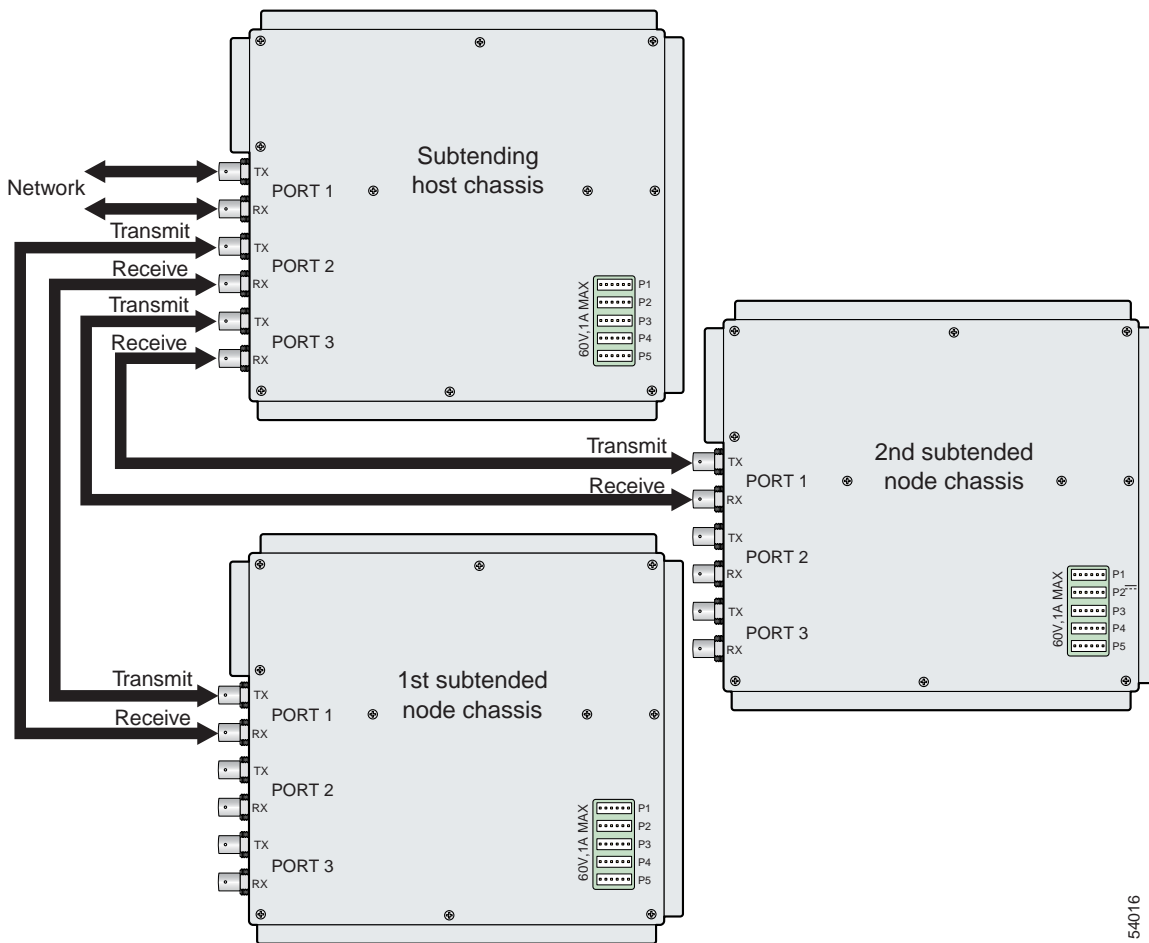
Step 2   Connect one end of an RJ-48 cable to one of the RJ-48c receptacles on the DS3/2DS3+8xT1 IMA I/O card located on the subtending host chassis backplane.

Figure 4-12 shows the cabling for a T1 or T1 IMA subtended network configuration.

Note   See Table 2-4 for cable specifications. See Figure 1-19 for T1 interface locations.

Figure 4-12   Cabling for T1 or T1 IMA Subtended Network Configuration
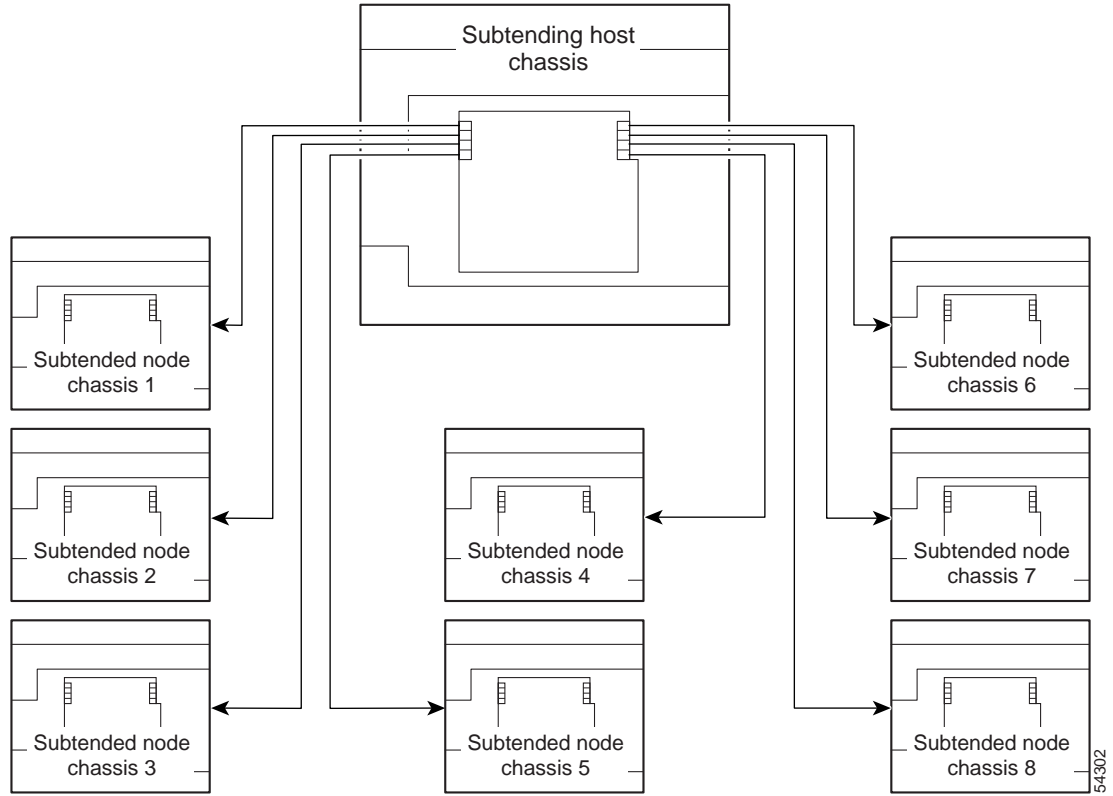
Step 3   Connect the other end of the cable used in Step 2 to one of the RJ-48c receptacles on the DS3/2DS3+8xT1 IMA I/O card located on the subtended node chassis backplane.

Step 4   Repeat Step 1 through Step 3 for each subtending host chassis.

Note   Verify that the RJ-48 cable pinouts connect transmit to receive and receive to transmit. For more information on the RJ-48c receptacle pinouts, see the "Pinouts for the DS3/2DS3+8xT1 IMA I/O Card RJ-48c Receptacles" section on page C-4.

4.2.11 Connect the NI-2 Card to the Network

This section provides installation procedures for the following network connections:

- DS3 Network Connections, page 4-22
- OC-3c Network Connections, page 4-23
- T1 or T1 IMA Network Connections, page 4-23

Tip   Cisco recommends that you label each data cable at both ends to identify its destination.

Note   Cisco does not provide the cables for the network connections. See Table 2-4 for cable specifications.

4.2.11.1 DS3 Network Connections

Complete the following steps to connect the DS3 network connections:

Step 1   Verify that the DS3/2DS3 or DS3+T1/E1 IMA NI-2 card is installed in slot 10 (or slot 11, if a secondary NI-2 card is being installed for redundancy) of the Cisco 6160 chassis to ensure that the DS3 NI-2 card connections are active.

Note   See the "Redundancy in Subtended Configurations" section on page 1-42 for more information about redundancy configurations.

Step 2   Attach one end of a coaxial cable to the TX BNC connector for DS3 Port 1 on the I/O card.

Note   See Table 2-4 for cable specifications. See Figure 1-19 or Figure 1-23 for DS3 port connector locations.

Step 3   Attach the end of the cable that you used in Step 2 to the ATM switch.

Step 4   Attach one end of a coaxial cable to the RX BNC connector for DS3 Port 1 on the I/O card.

Step 5   Attach the end of the cable that you used in Step 4 to the ATM switch.

Step 6   Reboot the system to reassociate the system MAC address.

Step 7   Repeat Step 1 through Step 6 for each Cisco 6160 chassis being installed.

4.2.11.2 OC-3c Network Connections

Complete the following steps to connect the OC-3c network connections:

Warning   **Do not stare into the beam or view it directly with optical instruments.**

Step 1   Verify that the OC-3c/OC-3c or OC-3c/2DS3 NI-2 card is installed in slot 10 (or slot 11, if a secondary NI-2 card is being installed for redundancy) of the Cisco 6160 chassis to ensure that the OC-3c NI-2 connections are active.

Note   See the "Redundancy in Subtended Configurations" section on page 1-42 for more information about redundancy configurations.

Step 2   Attach the receive cable from the ATM switch to the TRNK 1 TX optical interface connector on the OC-3c/OC-3c or OC-3c/2DS3 NI-2 card.

Note   See Figure 1-16 or Figure 1-17 or OC-3c connector locations.

Step 3   Attach the transmit cable from the ATM switch to the TRNK 1 RX optical interface connector on the OC-3c/OC-3c or OC-3c/2DS3 NI-2 card.

Step 4   To establish APS link redundancy repeat Step 2 and Step 3 for a secondary OC-3c/OC-3c or OC-3c/2DS3 NI-2 card.

Step 5   Reboot the system to reassociate the system MAC address.

Step 6   Repeat Step 1 through Step 5 for each Cisco 6160 chassis being installed.

4.2.11.3 T1 or T1 IMA Network Connections

Complete the following steps to connect the T1 or T1 IMA network connections:

Note   See the "IMA Configuration" section on page 1-5 for more information on how to configure an IMA network connection.

Step 1   Verify that you have a DS3+T1/E1 IMA NI-2 card is installed in slot 10 (or slot 11, if a secondary NI-2 card is installed for redundancy) and the DS3/2DS3+8xT1 IMA I/O card is installed on the chassis backplane.

Note   See the "Redundancy in Subtended Configurations" section on page 1-42 for more information about redundant configurations.

Step 2   Connect one end of an RJ-48 cable to one of the RJ-48c receptacles on the DS3/2DS3+8xT1 IMA I/O card. If you have a subtended network configuration installed, this connection must be made from the DS3/2DS3+8xT1 IMA I/O card in the subtending host chassis.

> **Note** See Table 2-4 for cable specifications. See Figure 1-19 for T1 interface locations.

Step 3 Connect the other end of the cable used in Step 2 to the ATM switch.

Step 4 Repeat Step 1 through Step 3 for each Cisco 6160, as necessary.

> **Note** Verify that the RJ-48 cable pinouts connect transmit to receive and receive to transmit. For more information on the RJ-48c receptacle pinouts, see the "Pinouts for the DS3/2DS3+8xT1 IMA I/O Card RJ-48c Receptacles" section on page C-4.

4.2.12 Connect the Ethernet to the Management Network

Complete the following steps to connect the Ethernet to the management network:

> **Warning** **The ports labeled "ENET," "CNSL," and "AUX" are safety extra-low voltage (SELV) circuits. SELV circuits should be connected only to other SELV circuits. Because the DSL circuits are treated like telephone-network voltage, avoid connecting the SELV circuit to the telephone network voltage (TNV) circuits.**

> **Tip** Cisco recommends that you label each data cable at both ends to identify its destination.

Step 1 Connect an Ethernet cable to the RJ-45 10BaseT receptacle (ENET) on the NI-2 card faceplate.

> **Note** See Table 2-4 for cable specifications.

Step 2 Connect the other end of the Ethernet cable to the management network (for example, a LAN).

4.2.13 Connect the Console Terminal

Connect a VT100-compatible terminal to the system console port (CNSL) on the NI-2 card faceplate. Connect the terminal to a power source and set it up using the values that are shown in Table 4-2.

Table 4-2   Terminal Settings

Baud rate	9600 (transmit and receive)
Character size	8 bits
Parity	None

Table 4-2   Terminal Settings (continued)

Stop bits	1
Flow control	None

Warning   **The ports labeled "ENET," "CNSL," and "AUX" are safety extra-low voltage (SELV) circuits. SELV circuits should be connected only to other SELV circuits. Because the DSL circuits are treated like telephone-network voltage, avoid connecting the SELV circuit to the telephone network voltage (TNV) circuits.**

4.2.14 Connect the Auxiliary Port

Note   This step is optional.

Connect a terminal, a modem, or another serial device to the RJ-45 auxiliary port (AUX) on the NI-2 card faceplate.

Warning   **The ports labeled "ENET," "CNSL," and "AUX" are safety extra-low voltage (SELV) circuits. SELV circuits should be connected only to other SELV circuits. Because the DSL circuits are treated like telephone-network voltage, avoid connecting the SELV circuit to the TNV circuits.**

Tip   Cisco recommends that you label each data cable at both ends to identify its destination.

4.2.15 Complete Initial Configuration

When you turn on the Cisco 6160 for the first time, the System Configuration Dialog appears on the console screen. The System Configuration Dialog guides you through the initial configuration process. (You can run the dialog at any time by entering the **setup** command in privileged EXEC mode.)

When you complete the dialog, the system displays the configuration command script that you have created. It then offers you three options:

```
[0] Go to the IOS command prompt without saving this config.
[1] Return back to the setup without saving this config.
[2] Save this configuration to nvram and exit.
```

If you enter **2**, the configuration is saved and used. If you answer **0** or **1,** the configuration you created is not saved. Enter **1** if you wish to discard the configuration and restart the System Configuration Dialog.

4.2.15.1 Before You Begin

Complete the following steps before you run the System Configuration Dialog.

Step 1 Determine the IP address for the Ethernet interface.

Step 2 If you plan to configure in-band management, also determine the IP address for the ATM interface that will be used for in-band management (ATM0/0).

Step 3 Find out what the password strategy is for your environment. The System Configuration Dialog prompts you for three passwords, plus an SNMP community string. The three types of password required are enable secret, enable, and virtual terminal.

Step 4 Choose a name for the Cisco 6160. (This step is optional.)

4.2.15.2 Using the System Configuration Dialog

When you power up a Cisco 6160 for the first time, you are offered the option of running the System Configuration Dialog. The System Configuration Dialog offers two configuration options: basic management setup and extended setup.

- Choose basic management setup if you want to use the System Configuration Dialog to configure the passwords and the Ethernet interface only, and then use the management station or the command line interface to configure the remaining Cisco 6160 interfaces.

- Choose extended setup if you want to use the System Configuration Dialog to configure all of the Cisco 6160 interfaces.

An example of the use of each option follows the "Interface Numbering" section on page 4-26.

4.2.15.2.1 Interface Numbering

The System Configuration Dialog and the command line interface use the following interface numbering scheme:

- Interfaces whose names begin with "ATM0" (ATM0/1, ATM0/2, and so forth) are NI-2 card WAN interfaces. ATM0/0 is the ATM switch interface with the processor (sometimes referred to as the ASP interface, for ATM switch/processor). There is no need to configure ATM0/0 unless you plan to use in-band management. ATM0/1 is the trunk port. ATM0/2 and ATM0/3 (if present) are subtending interfaces. For DS3+T1 with a DS3 WAN interface, ATM0/1 is the trunk port. ATM0/2 through ATM0/9 are subtending interfaces. For a T1 WAN interface using a DS3+T1/E1 IMA NI-2 card, one port from ATM0/2 through ATM0/9 can be the trunk, and the other seven can be subtending interfaces. For IMA group interfaces DS3+T1/E1 IMA NI-2 card, one port from ATM0/ima0 through ATM0/ima3 can be the trunk port, with the other three being possible subtending interfaces.

- Interfaces whose names begin with "ATM1" through "ATM34" are line card interfaces. (ATM10 and ATM11, which would indicate the NI-2 slots, are omitted.)

- Ethernet0/0 is the interface for the LAN that connects the Cisco 6160 to its management system.

For line card interfaces, the number before the slash indicates the slot number. The number after the slash indicates the interface or port number. For example, ATM6/4 is port 4 in slot 6.

4.2.15.2.2 Basic Management Setup Example

This is the basic management setup example:

```
            --- System Configuration Dialog ---

Would you like to enter the initial configuration dialog? [yes/no]: y
At any point you may enter a question mark '?' for help.
Use ctrl-c to abort configuration dialog at any prompt.
Default settings are in square brackets '[]'.

Basic management setup configures only enough connectivity
for management of the system, extended setup will ask you
to configure each interface on the system

Would you like to enter basic management setup? [yes/no]: y

Configuring global parameters:

  Enter host name [DSLAM]:

  The enable secret is a password used to protect access to
  privileged EXEC and configuration modes. This password, after
  entered, becomes encrypted in the configuration.
  Enter enable secret: beansoup

  The enable password is used when you do not specify an
  enable secret password, with some older software versions, and
  some boot images.
  Enter enable password: beansoup
% Please choose a password that is different from the enable secret
  Enter enable password: lab1

  The virtual terminal password is used to protect
  access to the router over a network interface.
  Enter virtual terminal password:
% No defaulting allowed
  Enter virtual terminal password: lab

  Configure SNMP Network Management? [yes]: y
    Community string [public]:


Current interface summary

Any interface listed with OK? value "NO" does not have a valid configuration

Interface            IP-Address       OK? Method Status                 Protocol
ATM0/0               unassigned       NO  unset  up                     up
Ethernet0/0          unassigned       NO  unset  up                     up
ATM0/1               unassigned       NO  unset  down                   down
ATM0/2               unassigned       NO  unset  down                   down

Enter interface name used to connect to the
management network from the above interface summary: Ethernet0/0

Configuring interface Ethernet0/0:
  Configure IP on this interface? [yes]: y
    IP address for this interface: 172.27.144.141
    Subnet mask for this interface [255.255.0.0] :
    Class B network is 172.27.0.0, 16 subnet bits; mask is /16
```

```
The following configuration command script was created:

hostname DSLAM
enable secret 5 $1$pR/1$0zH7ohDaUKNML3SC2.RF5.
enable password lab1
line vty 0 4
password lab
snmp-server community public
!
no ip routing

!
interface ATM0/0
no ip address
!
interface Ethernet0/0
no shutdown
ip address 172.27.144.141 255.255.0.0
!
interface ATM0/1
shutdown
no ip address
!
interface ATM0/2
shutdown
no ip address
!
end


[0] Go to the IOS command prompt without saving this config.
[1] Return back to the setup without saving this config.
[2] Save this configuration to nvram and exit.

Enter your selection [2]: 2
% Shutdown not allowed for ATM0/0.
Building configuration...
Use the enabled mode 'configure' command to modify this configuration.


Press RETURN to get started!
```

4.2.15.2.3 Extended Setup Example

This is the extended setup example:

```
        --- System Configuration Dialog ---

Continue with configuration dialog? [yes/no]: yes

At any point you may enter a question mark '?' for help.
Use ctrl-c to abort configuration dialog at any prompt.
Default settings are in square brackets '[]'.


Basic management setup configures only enough connectivity
for management of the system, extended setup will ask you
to configure each interface on the system

Would you like to enter basic management setup? [yes/no]: no
```

```
First, would you like to see the current interface summary? [yes]: yes

Interface          IP-Address      OK? Method Status              Protocol
ATM0/0             70.0.0.2        YES NVRAM  up                  up
Ethernet0/0        172.27.32.156   YES NVRAM  up                  up
ATM0/1             unassigned      YES unset  down                down
ATM0/2             unassigned      YES unset  administratively down down
ATM18/0            unassigned      YES unset  initializing        down
ATM18/1            unassigned      YES unset  initializing        down
ATM18/2            unassigned      YES unset  initializing        down
ATM18/3            unassigned      YES unset  initializing        down
ATM21/0            unassigned      YES unset  administratively down down
ATM21/1            unassigned      YES unset  administratively down down
ATM21/2            unassigned      YES unset  administratively down down
ATM21/3            unassigned      YES unset  administratively down down
ATM26/0            unassigned      YES unset  down                down
ATM26/1            unassigned      YES unset  down                down
ATM26/2            unassigned      YES unset  down                down
ATM26/3            unassigned      YES unset  down                down

Configuring global parameters:

  Enter host name [DSLAM]: sw-ni2-2

  The enable secret is a password used to protect access to
  privileged EXEC and configuration modes. This password, after
  entered, becomes encrypted in the configuration.
  Enter enable secret: lqb

  The enable password is used when you do not specify an
  enable secret password, with some older software versions, and
  some boot images.
  Enter enable password [lab]: lab

  The virtual terminal password is used to protect
  access to the router over a network interface.
  Enter virtual terminal password [lab]:
  Configure SNMP Network Management? [no]:
  Configure IP? [yes]:
    Configure IGRP routing? [yes]: no

Configuring interface parameters:

Do you want to configure ATM0/0  interface? [yes]:
  Configure IP on this interface? [yes]:
    IP address for this interface [70.0.0.2]:
    Subnet mask for this interface [255.0.0.0] :
    Class A network is 70.0.0.0, 8 subnet bits; mask is /8

Do you want to configure Ethernet0/0  interface? [yes]:
  Configure IP on this interface? [yes]:
    IP address for this interface [172.27.32.156]:
    Subnet mask for this interface [255.255.0.0] :
    Class B network is 172.27.0.0, 16 subnet bits; mask is /16

Do you want to configure ATM0/1  interface? [yes]:
  Configure IP on this interface? [no]:

Do you want to configure ATM0/2  interface? [no]:

Do you want to configure ATM18/0  interface? [yes]:
  Configure IP on this interface? [no]:
```

```
Do you want to configure ATM18/1  interface? [yes]:
  Configure IP on this interface? [no]:

Do you want to configure ATM18/2  interface? [yes]:
  Configure IP on this interface? [no]:

Do you want to configure ATM18/3  interface? [yes]:
  Configure IP on this interface? [no]:

Do you want to configure ATM21/0  interface? [no]:

Do you want to configure ATM21/1  interface? [no]:

Do you want to configure ATM21/2  interface? [no]:

Do you want to configure ATM21/3  interface? [no]:

Do you want to configure ATM26/0  interface? [yes]:
  Configure IP on this interface? [no]:

Do you want to configure ATM26/1  interface? [yes]:
  Configure IP on this interface? [no]:

Do you want to configure ATM26/2  interface? [yes]:
  Configure IP on this interface? [no]:

Do you want to configure ATM26/3  interface? [yes]:
  Configure IP on this interface? [no]:

The following configuration command script was created:

hostname sw-ni2-2
enable secret 5 $1$12Lo$vGKa1wlRcNyw06j1bgGQd0
enable password lab
line vty 0 4
password lab
no snmp-server
!
ip routing
!
interface ATM0/0
ip address 70.0.0.2 255.0.0.0
!
interface Ethernet0/0
ip address 172.27.32.156 255.255.0.0
!
interface ATM0/1
no ip address
!
interface ATM0/2
shutdown
no ip address
!
interface ATM18/0
no ip address
!
interface ATM18/1
no ip address
!
interface ATM18/2
no ip address
!
interface ATM18/3
no ip address
```

```
!
interface ATM21/0
shutdown
no ip address
!
interface ATM21/1
shutdown
no ip address
!
interface ATM21/2
shutdown
no ip address
!
interface ATM21/3
shutdown
no ip address
!
interface ATM26/0
no ip address
!
interface ATM26/1
no ip address
!
interface ATM26/2
no ip address
!
interface ATM26/3
no ip address
!
end


[0] Go to the IOS command prompt without saving this config.
[1] Return back to the setup without saving this config.
[2] Save this configuration to nvram and exit.

Enter your selection [2]:2
Building configuration...
Use the enabled mode 'configure' command to modify this configuration.


Press RETURN to get started!
```

Note   To configure your system, refer to the appropriate software or network management configuration guides.

CHAPTER **5**

Troubleshooting

This chapter explains how to isolate faults in the Cisco 6160 system. Most problems in a Cisco 6160 system can be traced to one of the system field-replaceable units (FRUs), which include the following:

- *x*DSL Transmission Unit—central office (*x*TU-C) line cards
  - Quad-port flexi ATU-C line card (4xflexi)
  - Quad-port STU-C line card (4xSDSL)
  - Octal-port DMT ATU-C line card (8xDMT)
  - Octal-port single-pair high-speed digital subscriber line, also known as symmetric high bit rate digital subscriber loop (G.SHDSL) line card (8xG.SHDSL)
  - Octal-port ITU-C line card (8xISDL)
- Second generation network interface (NI-2) cards
  - DS3+T1/E1 IMA
  - DS3/2DS3
  - OC-3c/2DS3
  - OC-3c/OC-3c
- I/O cards
  - DS3/2DS3+8xT1 IMA
  - DS3/2DS3
- Power entry module (PEM)
- Blower tray
- Air filter

⚠ **Warning** **Only trained and qualified personnel should be allowed to install, replace, or service this equipment.**

This chapter consists of three major sections:

- System-Wide Problems, page 5-3: Troubleshooting problems that affect the entire system.
- FRU-Specific Problems, page 5-8: Troubleshooting faults that affect subsystems.
- Alarms, page 5-16: Descriptions of alarms that can signal problems or help with troubleshooting.

5.1 Hot-Swappable FRUs

All Cisco 6160 FRUs are hot swappable, except:

- The I/O card(s)
- The PEM, if only one PEM is operating

However, hot swapping some FRUs causes an interruption in service. See Table 5-1.

Table 5-1   Service Interruptions Caused by Replacing FRUs

FRU	Does Hot Swapping Interrupt Service?	Notes
xDSL line cards	Yes	Service is interrupted only for subscribers served by that line card.
NI-2 card	Yes	Hot swapping active NI-2 cards will interrupt service for the entire system until the NI-2 card is replaced or the redundant NI-2 takes over system operations. You can hot swap standby NI-2 cards without interrupting service.
I/O card	See next column.	You must turn off system power to replace the I/O card. Note that the MAC address is stored on the I/O card.
PEM	See next column.	You can replace a PEM without interrupting service if another PEM in the chassis continues to operate normally.
Blower tray	No	—
Air filter	No	—

5.2 Basic Checks

Before using the troubleshooting tables in this chapter, make the following basic checks:

- Are the ports properly configured? Refer to these sources for configuration instructions:
    - *Configuration Guide for Cisco DSLAMs with NI-2*
    - *Command Reference for Cisco DSLAMs with NI-2*
    - *ATM Switch Router Software Configuration Guide*
    - *ATM Switch Router Command Reference Guide*
    - Cisco IOS Release 12.x information on the World Wide Web
      http://www.cisco.com/univercd/cc/td/doc/product/dsl_prod/ios_dsl/index.htm
- Are power leads and data cables firmly connected at both ends?
- Are all cards firmly seated and locked in the chassis?
- Are the I/O card, PEMs, and blower tray properly installed and secured to the chassis?

5.3 Contacting the Cisco TAC for Help

In certain situations, the troubleshooting tables in this chapter direct you to contact the Cisco Technical Assistance Center (TAC) for help. If you have a maintenance contract or if your hardware is under warranty, call the TAC at +1 800 553 2447 (North America only), +1 408 526 7209, or visit this URL for a worldwide list of TAC regional telephone numbers:

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

5.4 System-Wide Problems

This section offers suggestions for problems that affect the entire Cisco 6160 system.

Symptom	Steps to Take
System fails to come up.	1. Check the POWER LED on the NI-2 card, the STATUS LEDs on the line cards, and the INPUT OK LED on each PEM. If all LEDs are off, or if the red OUT FAIL LED on either PEM is on, troubleshoot the PEMs. See the "PEM Problems" section on page 5-15.
	2. If any green LEDs are on, the system has power. Check the STATUS LED on the NI-2 card. If the STATUS LED is off, see the "I/O Card Problems" section on page 5-14.
	3. If the Cisco 6160 is set to boot from a remote device over the network, make sure the remote device is up, that its network connection is solid, and that the remote device contains the boot file. (The Cisco 6160 tries to boot over the network for a configured period, usually 5 to 15 minutes. If it is unable to boot over the network, it will eventually boot from bootflash.)
	4. Try to establish a console connection to the Cisco 6160. If you cannot connect, see the steps in the "You cannot establish a console or Telnet connection to the system." section on page 5-4.
	5. If you achieve a console connection:
	– Examine the command prompt. If the prompt says `rommon 1>`, the problem could be in Flash memory, in bootflash, in an incorrectly set boot configuration register, or in an incorrect file name in a **boot system** command in the startup-config file. Refer to the *Configuration Guide for Cisco DSLAMs with NI-2* for information on setting and interpreting configuration registers, configuring Flash memory, and editing the startup-config file.
	To get out of the ROM monitor, enter **dir flash:**. In the resulting display, find the name of the software image. Then enter **boot flash:***imagename*, replacing *imagename* with the name of the software image. The system boots from Flash.
	– If you see a normal Cisco IOS prompt, which usually contains the name of the system (default is `DSLAM>`), enter **show oir status**. If the results indicate that the card is loading software, wait a few minutes for the port to come back up.

Symptom	Steps to Take (continued)
You cannot establish a console or Telnet connection to the system.	1. For a console problem, check the terminal settings against the list of settings in the "Connect the Console Terminal" section on page 3-24. 2. For a Telnet problem: – If you are connecting to the Cisco 6160 through the Ethernet interface, check the configuration of your LAN for both the Cisco 6160 and the Telnet source. – If you are connecting to the Cisco 6160 through an ATM interface, make sure that PVCs are set up between the two devices and that the map-list is correctly configured. Enter the command **show running-config** to display this information. – If the Telnet source and the Cisco 6160 are on different networks, make sure static routes are configured at both ends so that the two devices can communicate. To check, use the **ping** command to ping each device from the other (that is, ping the Cisco 6160 from the Telnet source, and ping the Telnet source from the Cisco 6160). Alternatively, ping your default gateways from each end of the connection. 3. For both console and Telnet problems: – Check the cabling and connectors between the terminal or Telnet source and the Cisco 6160. See Appendix C, "Connector and Pinout Specifications" to check pinouts. – Press the **Reset** button on the NI-2 card faceplate to reset the card. – If the problem persists, replace the NI-2 card.
System experiences a critical, major, or minor alarm.	1. Enter the command **show facility-alarm status**. Note the affected slot and port, if any, and the description of the problem. 2. If no slot number is indicated, enter **show environment all** and examine the results for an indication of which FRU is at fault. See the "FRU-Specific Problems" section on page 5-8 for instructions on troubleshooting that FRU. 3. If ATM0/0, ATM0/1, ATM0/2, or ATM0/3 is indicated: – Enter a **show int** command for the interface (for example, **show int atm0/1**). Results could indicate a SONET problem (Loss of Signal, for example). See the "I/O Card Problems" section on page 5-14 for instructions on troubleshooting the NI-2 card. – Enter **show controllers** commands for all trunk and subtending ports. (The ports are atm0/1, atm0/2, and, in a DS3 system, atm0/3.) For example, **show controllers atm0/1**. In the resulting display, check that the framing mode is set to the same value on this interface as at the other end of the connection. Also check that cell payload scrambling is on (DS3 interfaces only). 4. If a line card slot is indicated, consult the "NI-2 Card Problems" section on page 5-12.

Symptom	Steps to Take (continued)
A trunk or subtending port fails to come up (DS3 or OC-3c).	**1.** Verify that the trunk port selection is correct.
	2. Check the cable connections at both ends. See the "Port Mapping Table" section on page B-1 to check pinouts.
	3. To check the interface status and configuration, enter **show interface atm** *slot#/port#*. Check the following in the resulting display:
	– If the port Admin Status is down, enter the commands below to correct the problem, replacing slot/port ID atm 0/1 with your slot/port ID: ``` DSLAM> configure terminal Enter configuration commands, one per line. End with CNTL/Z. DSLAM(config-if)# int atm 0/1 DSLAM(config-if)# no shutdown DSLAM(config-if)# ```
	– If the port IF Status is down, check for disconnected or faulty cables. (Optical cables connect to the NI-2 card; DS3 coaxial cables connect to the I/O card on the back of the chassis.)
	– If the Line Protocol is down, the line protocol software processes might have determined that the line is unusable. Try swapping the cable. Another possibility is that clocking might be misconfigured, or the clocking source might have failed.
	– Check the CRC field. The presence of many CRC errors but not many collisions is an indication of excessive noise. If the number is too high (greater than 0.5 to 2 percent of total traffic on the interface), check the cables to determine if any are damaged.
	If you need more information on interface configuration, refer to the *Configuration Guide for Cisco DSLAMs with NI-2* and the *ATM Switch Router Software Configuration Guide*.
	4. For a DS3 interface: enter **show controllers atm***slot#/port#*. Check the following in the resulting display:
	– Framing mode must be the same at both ends of the connection.
	– Cell payload scrambling must be on at both ends of the connection.
	5. Check the status and configuration of the interface at the far end.
	6. If you need to run a loopback test, do the following:
	– In interface configuration mode, enter **loopback diagnostic** (or **loopback line**).
	– Set the external test equipment to loop data through the Cisco 6160 port.
	– Obtain loopback results from your external test equipment.
	– Enter **no loopback diagnostic** (or **no loopback line**) to take the port out of loopback mode.
	7. In interface configuration mode, reset the trunk port by executing the **shutdown** command followed by the **no shutdown** command.
	8. Replace the NI-2 card.
	9. If the problem with an DS3 interface persists, troubleshoot the I/O card. See the "I/O Card Problems" section on page 5-14.

Symptom	Steps to Take (continued)
A trunk or subtending port fails to come up (T1/E1).	1. Verify that the trunk port selection is correct.
	2. Check the cable connections at both ends. See the "Port Mapping Table" section on page B-1 to check pinouts.
	3. To check the interface status and configuration, enter **show interface atm** *slot#/port#*. Check the following information in the resulting display:
	– If the port Admin Status is down, enter the commands below to correct the problem, replacing slot/port ID atm 0/2 with your slot/port ID:
	``` DSLAM> configure terminal Enter configuration commands, one per line. End with CNTL/Z. DSLAM(config-if)# int atm 0/2 DSLAM(config-if)# no shutdown DSLAM(config-if)# ```
	– If the port IF Status is down, check for disconnected or faulty wire. T1/E1 twisted pair wire connects to the I/O card.
	– If the Line Protocol is down, the line protocol software processes might have determined that the line is unusable; try swapping the cable. Another possibility is that clocking might be misconfigured, or the clocking source might have failed.
	– Check the CRC field. The presence of many CRC errors but not many collisions is an indication of excessive noise. If the number is too high (greater than 0.5 to 2 percent of total traffic on the interface), check the cables to determine if any are damaged.
	If you need more information on interface configuration, refer to the *Configuration Guide for Cisco DSLAMs with NI-2* and the *ATM Switch Router Software Configuration Guide*.
	4. Enter **show controllers atm***slot#/port#*. Check the following information in the resulting display:
	– Framing mode must be the same at both ends of the connection.
	– Line coding must be the same at both ends of the connection (T1/E1).
	– Cell payload scrambling must be on at both ends of the connection.
	5. Check the status and configuration of the interface at the far end.
	6. If you need to run a loopback test to troubleshoot the T1/E1 links, do the following:
	– In interface configuration mode, enter **loopback diagnostic** (or **loopback line**).
	– Set the external test equipment to loop data through the Cisco 6015 port.
	– Obtain loopback results from your external test equipment.
	– Enter **no loopback diagnostic** (or **no loopback line**) to take the port out of loopback mode.
	7. In interface configuration mode, reset the trunk port by executing the **shutdown** command followed by the **no shutdown** command.
	8. Replace the NI-2 card.
	9. If the problem with a T1/E1 interface persists, troubleshoot the I/O card. See the "I/O Card Problems" section on page 5-14.

Symptom	Steps to Take (continued)
A trunk or subtending port fails to come up (T1/E1 IMA).	1. Before checking IMA interface problems, troubleshoot the T1/E1 links that are configured in the IMA group, as described in the previous section. Verify that the links are up. 2. Check an IMA interface status with **show ima interface atm0/ima**X command, where *X* is the IMA interface ID. Look at the following items in the resulting display: – MinNumLinks (minimum number of links) should be equal to or below the number of links you have configured in your IMA group. You can change the minimum number of links parameter from 1 to 8 in the IMA group. – NeTxClkMode (near end transmit clock mode) should match the FeTxClkMode (far end transmit clock mode), which will be either ctc or itc. Both sides of the IMA link must use the same IMA clock mode. – DiffDelayMaxObs (maximum observed differential delay) should be less than DiffDelayMax (maximum differential delay configured for the group). If the differential delay observed is more than the maximum allowed, one or more links will not be allowed in the IMA group. Configure more allowable differential delay (up to 69 ms in T1, 55 ms in E1) using T1/E1 lines with less differential delay, or reconfigure similarly-delayed lines into IMA groups if possible. – The IMA Link Information table shows the interfaces configured in your IMA group, the near end and far end receive state, and any IMA alarms received at the near end. The NeRxState and FeRxState must both be active for each line to be active in the IMA group. The whole IMA group will be up when the number of active links on both sides are equal to or greater than the minimum number of configured links (MinNumLinks) for that IMA group. 3. It can take several seconds for an IMA group to synchronize between two IMA systems. Wait several minutes after configuring or reconfiguring a group to allow the synchronization to occur. 4. If synchronization does not occur in any one link or in the group after several minutes, or links cannot be successfully added to an active group, and the above IMA parameters have been checked and are found to be correct, clear the interface with a **clear interface atm0/ima**X command. This will reset the IMA group and start the IMA synchronization process again with all links in the group. 5. To check the interface status and configuration, enter **show interface atm** *slot#/imagroup#*. Check the following information in the resulting display: – If the port Admin Status is down, enter the commands below to correct the problem, replacing slot/port ID atm0/ima2 with your slot/port ID: ``` DSLAM> configure terminal Enter configuration commands, one per line. End with CNTL/Z. DSLAM(config-if)# int atm0/ima2 DSLAM(config-if)# no shutdown DSLAM(config-if)# ``` If you need more information on interface configuration, refer to the *Configuration Guide for Cisco DSLAMs with NI-2* and the *ATM Switch Router Software Configuration Guide*.

Symptom	Steps to Take (continued)
	6. In interface configuration mode, reset the port by executing the **shutdown** command followed by the **no shutdown** command.
	7. Replace the NI-2 card.
	8. If the problem with a T1/E1 interface persists, troubleshoot the I/O card. See the "I/O Card Problems" section on page 5-14.
System overheats	Troubleshoot the blower tray. See the "Blower Tray and Air Filter Problems" section on page 5-16.
System experiences a clocking problem	Troubleshoot the NI-2 card. See the "NI-2 Card Problems" section on page 5-12.
System experiences a power problem	Troubleshoot the PEMs. See the "Alarms" section on page 5-16.

5.5 FRU-Specific Problems

The following sections describe symptoms that might occur and the steps that you need to take if you experience problems with any Cisco 6160 FRU.

5.5.1 *x*TU-C Line Card Problems

Use the following table to diagnose and troubleshoot any problems with the *x*TU-C line cards.

Note If you need to remove or replace an *x*TU-C line card, see Chapter 6, "Upgrading and Maintaining the Cisco 6160 System" for instructions.

Symptom	Steps to Take
All LEDs are off.	**1.** Check the POWER LED on the NI-2 card and the INPUT OK LEDs on the PEMs. If none of the LEDS are lit, or if the red OUT FAIL LED on either PEM is lit, troubleshoot the PEM—see the "Alarms" section on page 5-16.
	2. If the NI-2 card POWER LED is off, remove the card from its slot and check for bent or broken pins on both the card and the backplane. If you find damaged pins on the card, replace it. If you find damaged pins on the backplane, contact the Cisco TAC.

Symptom	Steps to Take (continued)
All ports on a card fail to come up (modems do not train). STATUS LED might be red, indicating that the line card failed to boot or failed its power-on self test.	1. Enter the **show ipc nodes** command to find out whether there is a communication problem between the line card and the NI-2 card. There should be an entry in the resulting display for each line card ("SMB IP Slot *n*") and for the NI-2 card ("IPC Master"). If there is an entry for each card, go to Step 4. 2. If one or more cards are not listed, enter **show oir status**. If the resulting display indicates that the card in question is loading new code, wait a few minutes and reenter the command. (Usually, 2 to 3 minutes is long enough to wait.) The card status should change to `running`. 3. Enter the command **show dsl int atm** *slot#/port#*. If the status says `Microcode downloading`, wait 10 minutes. When the download is complete, the card reboots and comes up normally. 4. Check the ALARM LEDs on the NI-2 card or enter **show facility-alarm status** to determine the alarm status of the system. If any alarms are indicated, see the "System-Wide Problems" section on page 5-3 for instructions on how to troubleshoot alarms. 5. Enter the command **show dsl status** and examine the results to ensure that the card is configured to be in its current slot. (In the Names column, the slot number appears as part of the port ID. For example, in ATM19/2, the slot number is 19. Nothing is displayed for slots that are not configured.) If necessary, use the **slot** command to update the configuration, or move the card to the correct slot. If the line card is a 4xflexi, it will not function unless you use the **slot** command to configure either CAP or DMT operation. 6. Reset the line card by disconnecting it from the backplane and reseating it in its slot. 7. Install the card in another slot. 8. If the problem persists, replace the line card.
Port fails to come up (modems do not train), or port LED flashes continuously.	1. Enter the command **show dsl int atm** *slot#/port#* to display the port configuration. Check the display to ensure that the port is properly provisioned. Make sure the port is configured to be running ("no shutdown" or IOS admin state = up). Also check the line status; if this reads "No CPE detected," troubleshoot the CPE device and the loop as described in the "You suspect a problem with the CPE or the subscriber loop." section on page 5-10. 2. In interface configuration mode, reset the port by executing the **shutdown** command followed by the **no shutdown** command. 3. Connect the subscriber to another port on the Cisco 6160. If the modems do not train, troubleshoot the CPE device and the loop as described in the "You suspect a problem with the CPE or the subscriber loop." section on page 5-10. If the modems train, go to the next step to troubleshoot the port that failed. 4. To test the modem on the line card, enter **dsl test atm***slot#/port#* **self**. Results are displayed automatically after a few seconds. If the modem fails the test, replace the line card.

Symptom	Steps to Take (continued)
You suspect a problem with the CPE or the subscriber loop.	1. Disconnect the local loop and replace it with a test setup that consists of a modem or CPE that is known to work, and a few thousand feet of wire. If the modems train over the shorter distance, the problem lies in the local loop or in the CPE. See the steps that follow. If the modems do not train, the port is probably at fault. Replace the line card.
	2. Make sure that the CPE at the subscriber site is powered up.
	3. Make sure that the CPE is compatible with the Cisco 6160, and that the software version running on the CPE is compatible with the software version running on the Cisco 6160.
	4. Power cycle the CPE. When you turn the power on, the WAN Link LED on the CPE should blink. If the LED does not blink, check the CPE configuration—if the interface is shut down, bring it up.
	5. Perform a continuity check to find out if the cabling to the CPE is connected and intact. For example, if there is a phone on the line, check for a dial tone.
	6. If there is no POTS, check DC resistance by shorting tip and ring at the remote end.
	7. Make sure there are no load coils on the local loop.
	8. Check the length of the local loop; is it too long? The maximum length range is 15,000 to 25,000 feet (4572 to 7620 meters). Within that range, wire gauge, crosstalk, and multiple bridge taps reduce the distance over which the modems can train.
	9. Check the length of the local loop; is it too short? DMT modems train best over loops of several thousand feet. In a test situation with a loop just a few feet in length, the modems might fail to train. Add wire to the loop.
	10. Replace the CPE.

Symptom	Steps to Take (continued)
Modems train at a low bit rate, modems retrain continuously, or the line experiences too many errors. **Note** These steps apply to *x*TU-C line cards in DMT mode.	**1.** Enter the command **show dsl int atm***slot#/port#* to display the port configuration. Check the display to ensure that the port is properly provisioned. Look in particular for these statistics: – Attenuation: typically this is 20 to 50 dB. If the attenuation value is higher than 50 dB, it might be depressing the bit rate. Repair or replace the cables and connectors in the loop. – SNR margin: 3 to 6 dB is optimum. Use the **dmt margin** command to adjust SNR margin. – Correction ratio: under DSL Statistics, look at the Received Superframes and Corrected Superframes values. A ratio of more than 1 corrected superframe for every 10 superframes received is too high. One or more of these adjustments might correct the problem: increase the SNR margin using the **dmt margin** command; increase error correction using the **dmt check-bytes** command; or increase interleaving using the **dmt interleaving-delay** command. – Errored seconds: a rate of 10 to 20 errored seconds per minute or more is likely to cause retraining. (1 or 2 errored seconds every 15 minutes is a good rate.) See the steps that follow on crosstalk and impulse noise for suggestions on how to compensate. – CRC errors: normal rates vary system by system. If the CRC error rate is higher than usual, it might cause excessive retraining. See the steps that follow on crosstalk and impulse noise for suggestions on how to compensate. **2.** Crosstalk is caused by interference between services in adjacent cables. It affects random bits rather than chunks of data; upstream and downstream traffic can be affected differently. If crosstalk is increasing the bit error rate (BER), you can compensate in several ways: – Reduce the bit rate using the **dmt bitrate** command. (See the *Command Reference for Cisco DSLAMs with NI-2* for information on the **dmt bitrate** command.) – Increase the SNR margin using the **dmt margin** command. (See the *Command Reference for Cisco DSLAMs with NI-2* for information on the **dmt margin** command.) – Turn on or increase error correction. Use the **dmt check-bytes** command. If the codeword size is not set to auto, you might need to use the **dmt codeword-size** command to adjust the codeword setting. (See the *Command Reference for Cisco DSLAMs with NI-2* for information on these commands.) **3.** If you experience impulse noise or clipping, both of which affect chunks of data rather than random bits, you can compensate by turning on or increasing interleaving and error correction. (However, note that this approach adds delay.) Use the **dmt interleaving-delay** command for interleaving. Use the **dmt encoding-trellis** command or the **dmt check-bytes** command for error correction. If you use **dmt check-bytes** and if the codeword size is not set to auto, you might need to use the **dmt codeword-size** command to adjust the codeword setting. **4.** If errors or retraining occur while the line is ringing, use the **dmt interleaving-delay** command to turn on interleaving. **5.** In interface configuration mode, reset the port by executing the **shutdown** command followed by the **no shutdown** command.

Symptom	Steps to Take (continued)
	6. Connect the customer to a different port on the Cisco 6160. If the modems train, replace the line card with the faulty port.
	7. Troubleshoot the CPE device and the loop as described above under the symptom "You suspect a problem with the CPE or the subscriber loop." section on page 5-10.
	8. Replace the line card.
Card cannot be fully inserted into its slot.	**1.** Remove the card and reinsert it, pushing firmly on both the top and the bottom of the faceplate. (The card might jam in the slot if you apply pressure to the top only.) If the chassis is full, you might need to push sideways to insert the card.
	2. Inspect connectors on both the card and the backplane, looking for obstructions, bent pins, or other damage. If you find damage to a line card connector, replace the line card. If you find damage to a backplane connector, contact the Cisco TAC.
Card experiences problems in one slot but operates normally in another.	There might be a fault in your backplane. Contact the Cisco TAC.

5.5.2 NI-2 Card Problems

Use the following table to diagnose and troubleshoot any problems with the NI-2 cards.

Note If you need to remove or replace an NI-2 card, see Chapter 6, "Upgrading and Maintaining the Cisco 6160 System" for instructions.

Symptom	Steps to Take
POWER LED is off.	**1.** Check the STATUS LEDs on the line cards and the INPUT OK LED on each PEM. If all LEDs are off, or if the red OUT FAIL LED on either PEM is on, troubleshoot the PEMs—see the "PEM Problems" section on page 5-15.
	2. If the line card STATUS LEDs and the PEM INPUT OK LEDs are lit, remove the NI-2 card from its slot and check for bent or broken pins on both the card and the backplane. If you find damaged pins on the card, replace it. If you find damaged pins on the backplane, contact the Cisco TAC.
STATUS LED is off, indicating that the NI-2 failed to boot or failed its power-on self test.	Press the **Reset** button on the NI-2. If the problem persists, replace the card.
CRITICAL LED, MAJOR LED, or MINOR LED is on.	See the "System-Wide Problems" section on page 5-3.
A trunk or subtending port fails to come up.	See the "System-Wide Problems" section on page 5-3.
NI-2 cannot be fully inserted into its slot.	Inspect connectors on both the card and the backplane, looking for obstructions, bent pins, or other damage. If you find damage to a line card connector, replace the line card. If you find damage to a backplane connector, contact the Cisco TAC.

5.5.3 NI-2 Redundancy Problems

Table 5-2 provides information about symptoms and corrective actions related to NI-2 card cold redundancy problems.

Note If you need to remove or replace an NI-2 card, see Chapter 6, "Upgrading and Maintaining the Cisco 6160 System" for instructions.

Table 5-2   Troubleshooting NI-2 Card Cold Redundancy Problems

Symptom	Steps to Take
Both NI-2 cards go active.	Ensure that both NI-2 cards are Revision AO or later.
DS3 traffic interrupted.	1. Ensure that both NI-2 cards are Revision AO or later. 2. Ensure that the correct boot image is installed on the NI-2 cards. Refer to the *Upgrading DSLAMs for NI-2 Card and APS Link Redundancy* document for instructions.
Line card communication is interrupted.	1. Ensure that both NI-2 cards are Revision AO or later. 2. Ensure that the correct boot image is installed on the NI-2 cards. Refer to the *Upgrading DSLAMs for NI-2 Card and APS Link Redundancy* document for instructions.
Transient environmental alarms occur.	Ensure that the correct boot image is installed on the NI-2 cards. Refer to the *Upgrading DSLAMs for NI-2 Card and APS Link Redundancy* document for instructions.
TFTP boot fails.	The NI-2 card is not configured to boot from Flash. Refer to the *Upgrading DSLAMs for NI-2 Card and APS Link Redundancy* document for instructions.
Line cards reboot or reset upon switchover.	The software versions on the primary and secondary NI-2 cards might be mismatched. Use the Cisco IOS command **show version** to determine the IOS release currently installed on each of the NI-2 cards. Refer to the *Upgrading DSLAMs for NI-2 Card and APS Link Redundancy* document for more information on upgrading software images.
Redundant NI2 will not become active	Be sure that you have enabled the command **no auto-sync bootflash** in the redundancy configuration mode if you are using OC3 NI2's with different product numbers (for example, an NI2-155SM-155SM or NI2-155MM-155MM with an NI2-155SM-155SM2 or NI2-155MM-155MM2). Different types of NI2's require different bootflash image types to operate properly.

5.5.4 I/O Card Problems

Use the following table to diagnose and troubleshoot any problems with the I/O cards.

Note If you need to remove or replace the I/O card, see Chapter 6, "Upgrading and Maintaining the Cisco 6160 System" for instructions.

Symptom	Steps to Take
A trunk port fails to come up.	See the "System-Wide Problems" section on page 5-3.
A subtending port fails to come up.	See the "System-Wide Problems" section on page 5-3.
An alarm relay or BITS circuit fails.	1. Check the connection at the wire wrap connector on the I/O card. Refer to the pin assignments of the wire wrap connector. 2. If the problem involves the circuit breaker trip alarm, check the connection at the small green terminal block behind each PEM. 3. Check the connection at the other end of the circuit. 4. For a BITS problem, troubleshoot the T1 line at the other end of the circuit. 5. Replace the I/O card (except in the case of a circuit breaker alarm problem; the I/O card does not provide the circuit breaker trip alarm).
This message appears on the console or in the system log file: `00:00:28:%C6100-4-COOKIE: Corrupt or missing MAC address cookie using random base 007e.eb7d.e700`	1. Make sure the software release running on your system is compatible with the hardware. The Cisco 6160 requires Cisco IOS Release 12.1(1)DA or greater. 2. Enter the command **show hardware chassis**. In the resulting display, look for data from the I/O card EEPROM. If the system can read the contents of the EEPROM, the I/O card is likely to be healthy. 3. If the I/O card is missing, install it. 4. If the I/O card is present, reseat it. First, turn off system power. Use a screwdriver to unfasten the screws that secure the I/O card cover, and pull the card off the connectors. Push it firmly back into place and tighten the screws. 5. If the problem persists, replace the I/O card.

5.5.5 PEM Problems

Use the following table to diagnose and troubleshoot any problems with the PEM.

Note If you need to remove or replace a PEM, see Chapter 6, "Upgrading and Maintaining the Cisco 6160 System" for instructions.

Symptom	Steps to Take
INPUT OK LED on PEM fails to go on.	1. Make sure the circuit breaker on the PEM is turned to the ON (1) position. 2. Make sure the PEM is properly seated in the chassis and screwed in place. 3. Make sure the power leads are properly connected to power connectors on the PEM. (If the connections are loose or their polarity is reversed on the DC PEM, the chassis does not receive power.) 4. Check the power cable for breaks, cracked insulation, loose lugs, and signs of wear. Replace the power cable if it is not in good condition. 5. Check the power source. 6. Turn the circuit breaker on the PEM to the OFF (0) position, and move it to the other PEM slot. If the PEM still fails, replace it.
OUT FAIL LED on PEM goes on.	1. Make sure the PEM is fully inserted into its slot and firmly screwed in place. 2. Replace the PEM. 3. If the problem persists, there might be a fault in your backplane. Contact the Cisco TAC.
Circuit breaker on PEM trips.	A tripped circuit breaker indicates a serious overcurrent situation. The probable cause is a faulty backplane, a faulty power connector on the backplane, or a faulty PEM. Contact the Cisco TAC for assistance.
PEM has problems in one slot but operates normally in the other.	There might be a fault in your backplane. Contact the Cisco TAC.

5.5.6 Blower Tray and Air Filter Problems

Use the following table to diagnose and troubleshoot any problems with the blower tray and air filter.

Note If you need to remove or replace the blower tray or air filter as part of the troubleshooting steps below, see Chapter 6, "Upgrading and Maintaining the Cisco 6160 System" for instructions.

Symptom	Steps to Take
Blowers do not run.	1. Make sure the blower trays are fully inserted into the chassis and screwed in place. 2. Replace the blower tray.
Blowers run, but the system overheats.	1. Make sure that the air intake vents at the bottom front of the chassis and the exhaust vents on the top of the chassis are free of blockages, as explained in the "Ventilation" section on page 2-11. 2. Make sure that the ambient temperature and other environmental factors affecting the system are within the ranges specified in the "Environmental Requirements" section on page 2-10. 3. Make sure that all cards, blank faceplates, and covers are in place. The cooling system cannot operate effectively unless the chassis is fully enclosed. 4. Check the LED on the blower tray. If the LEDs show a problem, replace the indicated blower tray. 5. Check the air filter at the bottom of the blower tray, and if necessary clean or replace it. See the "Cleaning or Replacing the Air Filter" section on page 6-37 for instructions on cleaning or replacing the air filter. 6. Reduce the ambient temperature.
Air filter is damaged, dirty, or clogged.	See Chapter 6, "Upgrading and Maintaining the Cisco 6160 System," for instructions on cleaning or replacing air filters.

5.6 Alarms

Table 5-3 through 5-12 describe alarms for the Cisco 6160. In each table, the text in the Alarm column is the text that appears in the description field of the alarm message. Alarm messages appear on the console screen as the alarms occur; to see a list of current alarms, enter **show facility-alarm status**.

Refer to the problem tables in this chapter for more detailed troubleshooting instructions.

Table 5-3   Chassis Alarm

Alarm	Severity	Description
Chassis temperature too high	Major	A temperature too high for safe operation of the chassis has been detected. (Temperature is measured on the NI-2 card.)

Table 5-4   Card Slot Alarms

Alarm	Severity	Description
Provisioned slot is empty	Major	The line card in this slot does not match the type configured for this slot.
Line card not equal to provisioning	Minor	This slot is configured for a line card, but no line card is present.
Invalid line card for this slot	Minor	The line card detected in this slot cannot operate in this slot or is incompatible with the system configuration.
Line card was detected	Info	A line card is present in the slot and its software was successfully loaded. This alarm appears for all line cards when they are operating normally.
Flexi ATU-C line card not provisioned	Info	You must use the **slot** command to configure a 4xflexi as either CAP or DMT.

The source of the DS3 alarms in Table 5-5 is one of the following interfaces: ATM0/1 (the trunk), ATM0/2 (subtending interface), or ATM0/2 (subtending interface).

Table 5-5   DS3 Network Interface Alarms

Alarm	Severity	Description
Loss of Cell Delineation	Critical	The DS3 line is experiencing a loss of cell delineation.
RAI Received	Critical	The DS3 line is receiving a remote alarm indication.
Yellow Alarm Received	Critical	The DS3 line is receiving a yellow alarm, indicating that another device has detected a failure that might be in this device.
AIS Received	Critical	The DS3 line is receiving an alarm indication signal.
OOF Received	Critical	The DS3 line has detected an out of frame condition.
LOS Detected	Critical	The DS3 line has detected loss of signal at the framer.
PLCP LOF Detected	Critical	The DS3 line has detected a physical layer convergence procedure loss of frame error.

The source of the OC-3c alarms in Table 5-6 is one of the following interfaces: ATM0/1 (the trunk) or ATM0/2 (the subtending interface).

Table 5-6   OC-3c Network Interface Alarms

Alarm	Severity	Description
Loss of Cell Delineation	Critical	Loss of cell delineation on a SONET line.
Path RDI Received	Critical	Path remote defect indication was received on a SONET line. This is equivalent to path FERF[1].
Path AIS Received	Critical	Path alarm indication signal was received on a SONET line.
Loss of Pointer	Critical	Loss of pointer condition on a SONET line.
Line RDI	Critical	Line remote defect indication received on a SONET line. This is equivalent to line FERF.

Table 5-6   OC-3c Network Interface Alarms (continued)

Alarm	Severity	Description
Line AIS Received	Critical	Line alarm indication signal received on a SONET line.
Loss of Frame	Critical	LOF condition on a SONET line.
Loss of Signal	Critical	LOS detected on the SONET line.
Signal Label Mismatch	Minor	Incorrect payload type signal label mismatch on a SONET line.

1. FERF = far end receive failure

The source of the T1/E1 network interface alarms in Table 5-7 is one of the following interfaces: ATM0/2 through ATM0/9.

Table 5-7   T1/E1 Network Interface Alarms

Alarm	Severity	Description
LOS Detected	Critical	The T1/E1 line has detected loss of signal at the framer.
AIS Received	Critical	The T1/E1 line is receiving an alarm indication signal.
RAI Received	Critical	The T1/E1 line is receiving a remote alarm indication.
LOF Detected (red alarm)	Critical	The T1/E1 line has detected a loss of frame error.
LCD	Critical	The T1/E1 line is experiencing a loss of cell delineation.

The source of the IMA link alarms in Table 5-8 is one of the following interfaces: ATM0/ima0 through ATM0/ima3.

Table 5-8   IMA Link Network Interface Alarms

Alarm	Severity	Description
LOS Detected	Critical	The IMA link has detected loss of signal at the framer.
LOF Detected	Critical	The IMA link has detected a physical layer convergence procedure loss of frame error.
AIS Received	Critical	The IMA link is receiving an alarm indication signal.
RAI Received	Critical	The IMA link is receiving a remote alarm indication.
LCD	Critical	The IMA link is experiencing a loss of cell delineation.
LIF[1]	Critical	The IMA link is experiencing an LIF defect at the near end.
LODS[2]	Critical	The link differential delay between the link and the other links in the group is over the tolerable value for the link differential delay.
Rx Failed	Critical	A persistent detection of a defect at the receiver. The criteria for entering the condition are implementation specific.
Tx Link Misconnected	Critical	The Tx link is not connected to the same far end IMA unit as the other Tx links in the group. The detection is implementation specific.

Table 5-8   IMA Link Network Interface Alarms (continued)

Alarm	Severity	Description
Rx Link Misconnected	Critical	The Rx link is not connected to the same far end IMA unit as the other Rx links in the group. The detection is implementation specific.
Remote Defect Indication-IMA	Critical	One of the available remote defect indicators (including IMA link specific defect) is in the link-related "Link Information" field.
Rx Fault	Critical	Implementation specific Rx fault declared at the near end.
Tx Fault	Critical	Implementation specific Tx fault declared at the near end.
Tx Link Unusable—FE[3]	Critical	The far end is reporting that Tx is unusable.
Rx Link Unusable—FE	Critical	The far end is reporting that Rx is unusable.

1. LIF = loss of IMA frame

2. LODS = link out of delay sync

3. FE = far end

Table 5-9   Redundancy Alarms

Alarm	Severity	Description
Active/Standby NI2 type mismatch	Major	The NI-2 cards installed in slot 10 and slot 11 are different types; for example, one is an OC-3c/OC-3c NI-2 card and the other is an OC-3c/2DS3 NI-2 card.
Standby NI2 missing	Major	The secondary NI-2 card slot has been provisioned for a standby NI-2 card, but the card is not installed in the chassis.
Redundancy process failed	Major	An internal redundancy software process has failed and redundancy may not be available.
Peer APS mode mismatch	Minor	The OC-3 trunk is connected to a device not configured for nonrevertive, unidirectional APS.
Both units ACTIVE	Info	Both the primary and the secondary NI-2 cards have come up in an active state.

Table 5-10   IOS Controller Alarms

Alarm	Severity	Description
Loss of active clock sync	Major	Loss of timing reference. The configured clock source is not available, so the system is using its internal clock.
BITS clock failure	Major	BITS clock failure (LOS or AIS). The configured clock source is not available, so the system is using its internal clock.

Table 5-11   Power Alarms

Alarm	Severity	Description
Fan voltage out of range	Major	The voltage going to the blowers from one or both PEMs is outside the acceptable range.
Power supply fault	Major	One or both PEMs are reporting a fault caused by high temperature, output failure, or input failure.
Temperature exceeds limit	Major	The PEM temperature is beyond the acceptable range.

Table 5-12   Blower Tray Alarms

Alarm	Severity	Description
Blower tray not detected or missing	Major	The blower tray has been removed from the chassis or is missing.
Multiple fan failures	Major	More than one fan in the blower tray has failed. When fans fail, the remaining fans run at full speed until the fault is corrected.
Single fan failure	Minor	One fan in the blower tray has failed. When a fan fails, the remaining fans run at full speed until the fault is corrected.

CHAPTER

6

Upgrading and Maintaining the Cisco 6160 System

This chapter describes upgrade and maintenance procedures for the Cisco 6160 system. The chapter includes the following sections:

- Backing Up Software, page 6-1
- Removing and Installing Hardware, page 6-2
- Air Filter Maintenance, page 6-36

6.1 Backing Up Software

We recommend that you maintain, on a TFTP server, current copies of three files for each Cisco 6160 system.

- The Cisco IOS software image
- The bootflash file
- The configuration file (running-config)

If you keep copies of these files on a TFTP server, you can easily recover from a fault in an NI-2 card. You can simply replace the NI-2 card, then download the software image, bootflash and configuration file from the TFTP server. Remember to update your backup files whenever you change your configuration or upgrade your Cisco IOS software.

Note For more information about copying Cisco IOS software images and examples of the procedure, refer to the *Configuration Guide for Cisco DSLAMs with NI-2*.

To copy the Cisco IOS software image, the bootflash, and configuration file to a TFTP server, complete the following steps in privileged EXEC mode:

Step 1 Enter the **dir** command to display the names of the files:

```
6160# dir
```

Step 2 Enter a **copy** command to copy the IOS software file to the node TFTP server:

```
6160# copy flash:<image-name> tftp
```

Step 3   Enter a **copy** command to copy the bootflash file to the node TFTP server:

```
6160# copy bootflash:<image-name> tftp
```

Step 4   Enter a second copy command to copy the configuration file to the node TFTP server:

```
6160# copy running-config tftp
```

6.2 Removing and Installing Hardware

This section provides removal and installation procedures for the following field-replaceable unit (FRU) hardware components:

- xTU-C Line Card, page 6-3
- Blank Faceplate, page 6-5
- DS3+T1/E1 IMA NI-2 Card, page 6-6
- DS3/2DS3 NI-2 Card, page 6-9
- OC-3c/2DS3 NI-2 Card, page 6-11
- OC-3c/OC-3c NI-2 Card, page 6-13
- DS3/2DS3+8xT1 IMA I/O Card, page 6-16
- DS3/2DS3 I/O Card, page 6-23
- PEM, page 6-30
- Blower Tray, page 6-33

Note   See the "General Maintenance Guidelines" section on page 2-9 for installation and replacement practices for the Cisco 6160 system hardware components.

Caution   Proper ESD protection is required whenever you handle Cisco equipment. Installation and maintenance personnel should be properly grounded by means of grounding straps to eliminate the risk of ESD damage to the equipment. Equipment is subject to ESD damage whenever it is removed from the chassis.

6.2.1 *x*TU-C Line Card

The following sections describe how to remove and install an *x*TU-C line card in the Cisco 6160 chassis.

6.2.1.1 Removing an *x*TU-C Line Card

Complete the following steps to remove an *x*TU-C line card from the chassis:

⚠️
Caution   When a line card is removed from the chassis, service is interrupted for the subscribers served by that line card.

Step 1   Connect a grounding strap to the ESD grounding jack on the chassis. See the "Preventing Electrostatic Discharge Damage" section on page 2-8 for the ESD grounding jack location on the Cisco 6160.

Step 2   Use a flat-head screwdriver to move the locking tab from the locked to the unlocked position. Be sure to turn the locking tab so that it does not overlap the ejector lever as shown in Figure 6-1.

Figure 6-1   Positioning the Locking Tab for Line Card Removal and Installation

Locked position   Unlocked position   27035
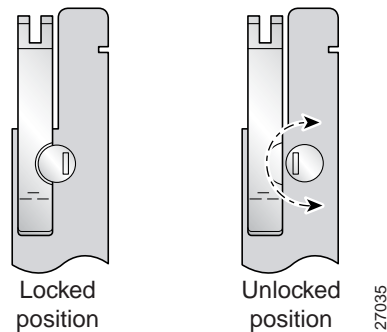
Step 3   Lift the ejector lever to disconnect the line card from the backplane.

Step 4   Carefully slide the line card out of the slot.

Either replace the line card that you remove, or insert a blank faceplate in the empty slot. For line card installation instructions, see the "Installing an xTU-C Line Card" section on page 6-4. For blank faceplate installation instructions, see the "Installing a Blank Faceplate" section on page 6-5.

✎
Note   Blank faceplates should occupy any empty line card slots in the chassis.

⚠️
Warning   **Blank faceplates and cover panels serve three important functions: they prevent exposure to hazardous voltages and currents inside the chassis; they contain electromagnetic interference (EMI) that might disrupt other equipment; and they direct the flow of cooling air through the chassis. Do not operate the system unless all cards, faceplates, front covers, and rear covers are in place.**

6.2.1.2 Installing an *x*TU-C Line Card

Complete the following steps to install an *x*TU-C line card in the chassis:

Note All cards must be fully seated in the chassis. Push on the faceplate of each card to be sure that the card is fully seated.

Step 1 Connect a grounding strap to the ESD grounding jack on the chassis. See the "Preventing Electrostatic Discharge Damage" section on page 2-8 for the ESD grounding jack location on the Cisco 6160.

Step 2 Hold the line card vertically, with the faceplate toward you and the connectors facing the chassis slot.

Step 3 Align the line card edges with the guides at the top and bottom of the slot in the chassis.

Step 4 Lift the ejector lever and gently apply pressure to the faceplate while pushing the line card into the slot.

Figure 6-2 shows the line card installation for a Cisco 6160 chassis.

Figure 6-2   xTU-C Line Card Installation
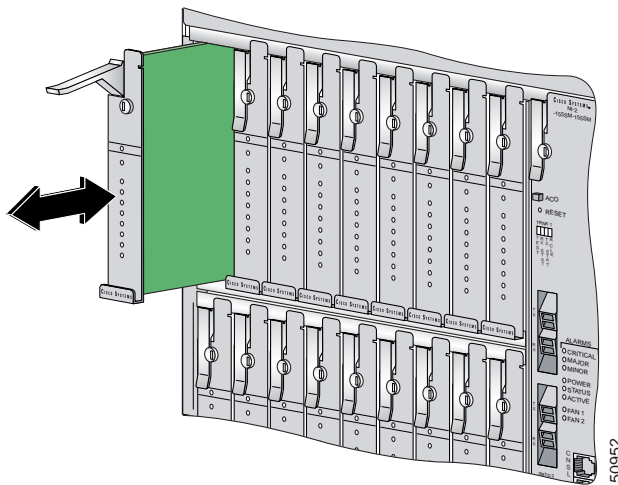
Step 5 Push on the faceplate of the line card to fully seat the line card.

Step 6 Press down on the ejector lever to secure the line card and connect it to the backplane.

Step 7 Use a flat-head screwdriver to turn the locking tab so that it overlaps the ejector lever to prevent inadvertent dislodging. Figure 6-1 shows how to position the locking tab.

Step 8 Verify that the STATUS LED is solid green after the brief self-test. If the STATUS LED is not green after the self-test, see Chapter 5, "Troubleshooting" for troubleshooting procedures.

Note If you are installing the line card for the first time, refer to the provisioning procedures in the appropriate software guide for your chassis.

6.2.2 Blank Faceplate

The following sections describe how to remove and install a blank faceplate in the Cisco 6160 chassis.

⚠

Warning   **Blank faceplates and cover panels serve three important functions: they prevent exposure to hazardous voltages and currents inside the chassis; they contain electromagnetic interference (EMI) that might disrupt other equipment; and they direct the flow of cooling air through the chassis. Do not operate the system unless all cards, faceplates, front covers, and rear covers are in place.**

6.2.2.1 Removing a Blank Faceplate

Complete the following steps to remove a blank faceplate from the chassis:

Step 1   Connect a grounding strap to the ESD grounding jack on the chassis. See the "Preventing Electrostatic Discharge Damage" section on page 2-8 for the ESD grounding jack location on the Cisco 6160.

Step 2   Lift the ejector lever to disconnect the blank faceplate from the backplane.

Step 3   Carefully slide the blank faceplate out of the slot.

Either replace the blank faceplate that you remove, or insert an *x*TU-C line card. For blank faceplate installation instructions, see the "Installing a Blank Faceplate" section on page 6-5. For line card installation instructions, see the "Installing an xTU-C Line Card" section on page 6-4.

✎

Note   Blank faceplates should occupy any empty line card slots in the chassis.

6.2.2.2 Installing a Blank Faceplate

Blank faceplates should occupy any empty line card slots in Cisco 6160 chassis. Blank faceplate installation is similar to line card installation.

Complete the following steps to install a blank faceplate from the chassis:

Step 1   Vertically align the blank faceplate edges with the guides at the top and bottom of the slot.

Step 2   Lift up on the ejector lever and gently apply pressure to the bottom of the faceplate while pushing the blank faceplate into the slot.

Step 3   Push on the faceplate to fully seat the blank faceplate.

Step 4   Press down on the ejector lever to secure the faceplate.

6.2.3 DS3+T1/E1 IMA NI-2 Card

The following sections describe how to remove and install a DS3+T1/E1 IMA NI-2 card.

6.2.3.1 Removing a DS3+T1/E1 IMA NI-2 Card

Complete the following steps to remove a DS3+T1/E1 IMA NI-2 card from the chassis. Accomplish each step completely before moving on to the next step.

⚠
Caution   Service is interrupted to the entire system when the NI-2 card is removed unless a secondary NI-2 card is installed in the chassis. If a secondary NI-2 card is not installed, ensure that a service interruption is acceptable before proceeding.

Fif a secondary NI-2 card is installed in the chassis, removing the active NI-2 card causes a switchover to the standby NI-2 card, which interrupts data traffic for approximately 60 seconds.

Removing a standby NI-2 card does not interrupt service to the system.

Step 1   Connect a grounding strap to the ESD grounding jack on the chassis. See the "Preventing Electrostatic Discharge Damage" section on page 2-8 for the ESD grounding jack location on the Cisco 6160.

Step 2   Disconnect the cable connected to the RJ-45 auxiliary port (AUX) on the NI-2 card, as necessary.

Step 3   Disconnect the cable connected to the system console port (CNSL) on the NI-2 card, as necessary.

Step 4   Disconnect the cable connected to the RJ-45 10BaseT receptacle (ENET) on the NI-2 card, as necessary.

Step 5   Use a flat-head screwdriver to move the locking tabs on the faceplate from the locked to the unlocked position. Be sure to turn the locking tabs so that they do not overlap the NI-2 card ejector levers, as shown in Figure 6-3.

Figure 6-3   Positioning the Locking Tab for NI-2 Card Removal and Installation
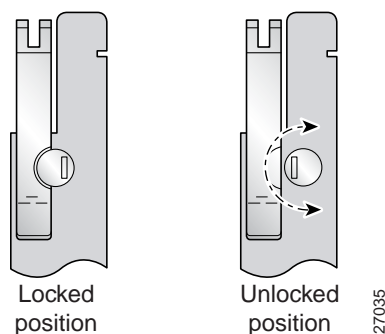
Locked position   Unlocked position   27035

Step 6   Lift up on the ejector levers. This action disconnects the card from the backplane.

Step 7   Carefully slide the card out of the slot.

See the "Installing a DS3+T1/E1 IMA NI-2 Card" section on page 6-7 for NI-2 card installation procedures.

6.2.3.2 Installing a DS3+T1/E1 IMA NI-2 Card

Complete the following steps to install a DS3+T1/E1 IMA NI-2 card in the chassis. Accomplish each step completely before moving on to the next step.

✎ **Note** All cards must be fully seated in the chassis. Push on the faceplate of each card to be sure that the card is fully seated.

Step 1 Connect a grounding strap to the ESD grounding jack on the chassis. See the "Preventing Electrostatic Discharge Damage" section on page 2-8 for the ESD grounding jack location on the Cisco 6160.

Step 2 Inspect the NI-2 card. Verify that the daughterboard is fully seated on the main board.

Step 3 Verify that the NI-2 card slot in the chassis has no bent pins.

Step 4 Hold the NI-2 card with the faceplate toward you and the connectors facing the chassis slot.

Step 5 Align the card edges with the slot guides in the chassis.

Step 6 Lift up on the ejector levers and gently apply pressure to the faceplate while pushing the card into the slot.

Figure 6-4 shows how to install an NI-2 card in a Cisco 6160 chassis.

Figure 6-4   NI-2 Card Installation in the Cisco 6160
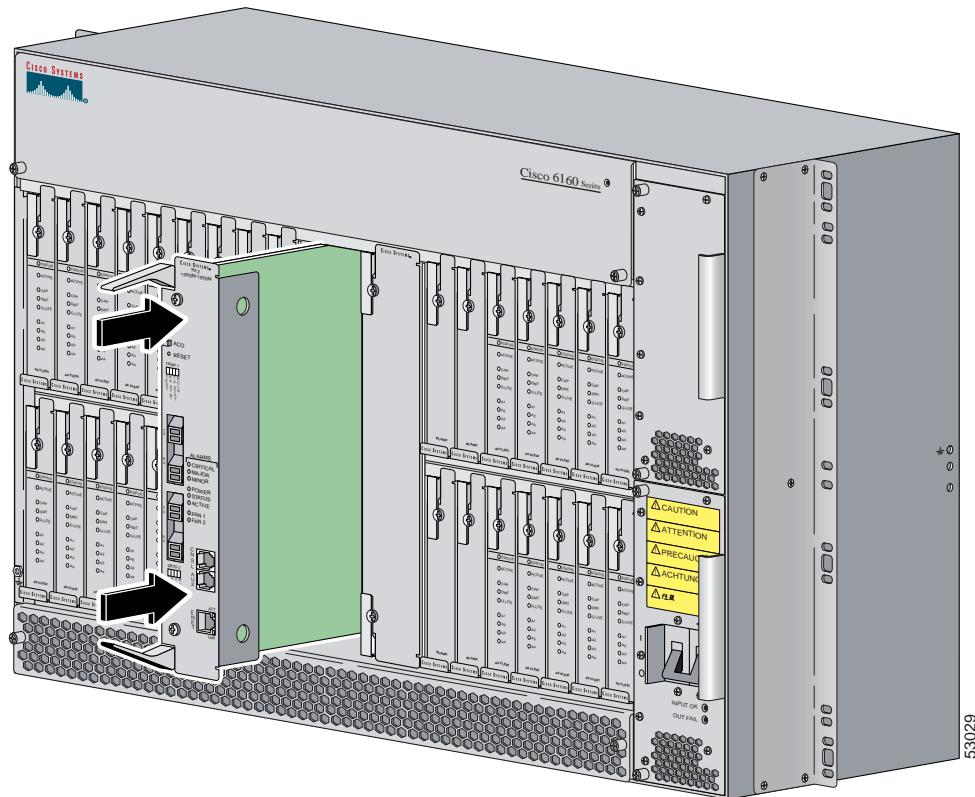
Step 7 Push on the faceplate of the card to fully seat the card.

Step 8 Press down on the ejector levers to secure the card and connect it to the backplane.

Step 9 Use a flat-head screwdriver to turn the locking tabs on the faceplate so that they overlap the NI-2 card ejector levers to prevent inadvertent dislodging. Figure 6-3 on page 6-6 shows how to position the locking tabs.

Step 10 Verify that the STATUS, ACTIVE, and POWER LEDs on the NI-2 card are solid green after the self-test is complete. This self-test procedure takes several minutes. If the LEDs are not green after the self-test, see Chapter 5, "Troubleshooting" for troubleshooting procedures.

> **Note** If you are installing the card for the first time, refer to the provisioning procedures in the *Configuration Guide for Cisco DSLAMs with NI-2*.

Step 11 Perform a software update if the STATUS LED on the NI-2 card is blinking.

Refer to the *Configuration Guide for Cisco DSLAMs with NI-2* for software upgrade procedures.

Step 12 Connect the Ethernet to the management network.

   a. Connect an Ethernet cable to the RJ-45 10BaseT receptacle (ENET) on the DS3+T1/E1 IMA NI-2 card faceplate.

   b. Connect the other end of the Ethernet cable to the management network (for example, a LAN).

Step 13 Connect a VT100-compatible terminal to the system console port (CNSL) on the NI-2 card faceplate. Connect the terminal to a power source and set it up using the values shown in Table 6-1.

Table 6-1   Terminal Settings

Baud rate	9600 (transmit and receive)
Character size	8 bits
Parity	None
Stop bits	1
Flow control	None

Step 14 Connect a terminal, a modem, or another serial device to the RJ-45 auxiliary port (AUX) on the NI-2 card faceplate. This step is optional.

6.2.4 DS3/2DS3 NI-2 Card

The following sections describe how to remove and install a DS3/2DS3 NI-2 card.

6.2.4.1 Removing a DS3/2DS3 NI-2 Card

Complete the following steps to remove a DS3/2DS3 NI-2 card from the chassis. Accomplish each step completely before moving on to the next step.

⚠
Caution   Service is interrupted to the entire system when the NI-2 card is removed unless a secondary NI-2 card is installed in the chassis. If a secondary NI-2 card is not installed, ensure that a service interruption is acceptable before proceeding.

Fif a secondary NI-2 card is installed in the chassis, removing the active NI-2 card causes a switchover to the standby NI-2 card, which interrupts data traffic for approximately 60 seconds.

Removing a standby NI-2 card does not interrupt service to the system.

Step 1   Connect a grounding strap to the ESD grounding jack on the chassis. See the "Preventing Electrostatic Discharge Damage" section on page 2-8 for the ESD grounding jack location on the Cisco 6160.

Step 2   Disconnect the cable connected to the RJ-45 auxiliary port (AUX) on the NI-2 card, as necessary.

Step 3   Disconnect the cable connected to the system console port (CNSL) on the NI-2 card, as necessary.

Step 4   Disconnect the cable connected to the RJ-45 10BaseT receptacle (ENET) on the NI-2 card, as necessary.

Step 5   Use a flat-head screwdriver to move the locking tabs on the faceplate from the locked to the unlocked position. Be sure to turn the locking tabs so that they do not overlap the ejector levers on the NI-2 card, as shown in Figure 6-3.

Step 6   Lift up on the ejector levers. This action disconnects the card from the backplane.

Step 7   Carefully slide the card out of the slot.

See the "Installing a DS3/2DS3 NI-2 Card" section on page 6-9 for NI-2 card installation procedures.

6.2.4.2 Installing a DS3/2DS3 NI-2 Card

Complete the following steps to install a DS3/2DS3 NI-2 card in the chassis. Accomplish each step completely before moving on to the next step.

✎
Note   All cards must be fully seated in the chassis. Push on the faceplate of each card to be sure that the card is fully seated.

Step 1   Connect a grounding strap to the ESD grounding jack on the chassis. See the "Preventing Electrostatic Discharge Damage" section on page 2-8 for the ESD grounding jack location on the Cisco 6160.

Step 2   Inspect the NI-2 card. Verify that the daughterboard is fully seated on the main board.

Step 3   Verify that the NI-2 card slot in the chassis has no bent pins.

Step 4   Hold the NI-2 card with the module faceplate toward you and the connectors facing the chassis slot.

Step 5   Vertically align the card edges with the guides at the top and bottom of slot 10 or slot 11 in the chassis.

Figure 6-4 shows how to install an NI-2 card in a Cisco 6160 chassis.

Step 6   Lift up on the ejector levers and gently apply pressure to the bottom of the faceplate while pushing the card into the slot.

Step 7   Push on the faceplate of each card to fully seat the card.

Step 8   Press down on the ejector levers to secure the card and connect it to the backplane.

Step 9   Use a flat-head screwdriver to turn the locking tabs on the faceplate so that they overlap the NI-2 card ejector levers to prevent inadvertent dislodging, as shown in Figure 6-3 on page 6-6.

> **Note**   The network connection to the ATM switch and the subtending connections for the DS3/2DS3 NI-2 card are made from the I/O card. For more information on these connection procedures, see Chapter 3, "Installing a Cisco 6160 with a POTS Splitter Configuration," and Chapter 4, "Installing a Cisco 6160 Without a POTS Splitter Configuration."

Step 10   Verify that the STATUS, ACTIVE, and POWER LEDs on the NI-2 card are solid green after the self-test is complete. This self-test procedure takes several minutes. If the LEDs are not green after the self-test, see Chapter 5, "Troubleshooting" for troubleshooting procedures.

> **Note**   If you are installing the card for the first time, refer to the provisioning procedures in the *Configuration Guide for Cisco DSLAMs with NI-2*.

Step 11   Perform a software update if the STATUS LED on the NI-2 card is blinking.

Refer to the *Configuration Guide for Cisco DSLAMs with NI-2* for software upgrade procedures.

Step 12   Connect the Ethernet to the management network.

   a.   Connect an Ethernet cable to the RJ-45 10BaseT receptacle (ENET) on the NI-2 card faceplate.

   b.   Connect the other end of the Ethernet cable to the management network (for example, a LAN).

Step 13   Connect a VT100-compatible terminal to the system console port (CNSL) on the NI-2 card faceplate. Connect the terminal to a power source and set it up using the values that are shown in Table 6-1.

Step 14   Connect a terminal, a modem, or another serial device to the RJ-45 auxiliary port (AUX) on the NI-2 card faceplate. This step is optional.

6.2.5 OC-3c/2DS3 NI-2 Card

The following sections describe how to remove and install an OC-3c/2DS3 NI-2 card.

6.2.5.1 Removing an OC-3c/2DS3 NI-2 Card

Complete the following steps to remove an OC-3c/2DS3 NI-2 card from the chassis. Accomplish each step completely before moving on to the next step.

⚠
Caution   Service is interrupted to the entire system when the NI-2 card is removed unless a secondary NI-2 card is installed in the chassis. If a secondary NI-2 card is not installed, ensure that a service interruption is acceptable before proceeding.

Lf a secondary NI-2 card is installed in the chassis, removing the active NI-2 card causes a switchover to the standby NI-2 card, which interrupts data traffic for approximately 60 seconds.

Removing a standby NI-2 card does not interrupt service to the system.

Step 1   Connect a grounding strap to the ESD grounding jack on the chassis. See the "Preventing Electrostatic Discharge Damage" section on page 2-8 for the ESD grounding jack location on the Cisco 6160.

Step 2   Disconnect the cable connected to the RJ-45 auxiliary port (AUX) on the NI-2 card, as necessary.

Step 3   Disconnect the cable connected to the system console port (CNSL) on the NI-2 card, as necessary.

Step 4   Disconnect the cable connected to the RJ-45 10BaseT receptacle (ENET) on the NI-2 card, as necessary.

Step 5   Disconnect the ATM switch receive cable from the TRNK 1 TX optical interface connector on the NI-2 card.

Step 6   Disconnect the ATM switch transmit cable from the TRNK 1 RX optical interface connector on the NI-2 card.

Step 7   Use a flat-head screwdriver to move the locking tabs on the faceplate from the locked to the unlocked position. Be sure to turn the locking tabs so that they do not overlap the NI-2 card ejector levers, as shown in Figure 6-3.

Step 8   Lift up on the ejector levers. This action disconnects the card from the backplane.

Step 9   Carefully slide the card out of the slot.

See the "Installing an OC-3c/2DS3 NI-2 Card" section on page 6-12 for NI-2 card installation procedures.

6.2.5.2 Installing an OC-3c/2DS3 NI-2 Card

Complete the following steps to install an OC-3c/2DS3 NI-2 card in the chassis. Accomplish each step completely before moving on to the next step.

> ✎
> **Note**   All cards must be fully seated in the chassis. Push on the faceplate of each card to be sure that the card is fully seated.

Step 1   Connect a grounding strap to the ESD grounding jack on the chassis. See the "Preventing Electrostatic Discharge Damage" section on page 2-8 for the ESD grounding jack location on the Cisco 6160.

Step 2   Inspect the NI-2 card. Verify that the daughterboard is fully seated on the main board.

Step 3   Verify that the NI-2 card slot in the chassis has no bent pins.

Step 4   Hold the NI-2 card with the faceplate toward you and the connectors facing the chassis slot.

Step 5   Vertically align the card edges with the guides at the top and bottom of slot 10 or slot 11 in the chassis.

Figure 6-4 on page 6-7 shows how to install an NI-2 card in a Cisco 6160 chassis.

Step 6   Lift up on the ejector levers and gently apply pressure to the bottom of the faceplate while pushing the card into the slot.

Step 7   Push on the faceplate of each card to fully seat the card.

Step 8   Press down on the ejector levers to secure the card and connect it to the backplane.

Step 9   Use a flat-head screwdriver to turn the locking tabs on the faceplate so that they overlap the NI-2 card ejector levers to prevent inadvertent dislodging, as shown in Figure 6-3 on page 6-6.

Step 10   Verify that the STATUS, ACTIVE, and POWER LEDs on the NI-2 card are solid green after the self-test is complete. This self-test procedure takes several minutes. If the LEDs are not green after the self-test, see Chapter 5, "Troubleshooting" for troubleshooting procedures.

> ✎
> **Note**   If you are installing the card for the first time, refer to the provisioning procedures in the *Configuration Guide for Cisco DSLAMs with NI-2*.

Step 11   Perform a software update if the STATUS LED on the NI-2 card is blinking.

Refer to the *Configuration Guide for Cisco DSLAMs with NI-2* for software upgrade procedures.

Step 12   Attach the receive cable from the ATM switch to the TRNK 1 TX optical interface connector on the OC-3c/2DS3 NI-2 card. See Figure 1-16 for the OC-3c network trunk interface connection location.

The TRNK 1 TX connector is the one closest to the top of the faceplate. The TRNK 1 RX connector is closer to the bottom of the faceplate. The connector IDs are silkscreened inside the faceplate inset.

Step 13   Attach the transmit cable from the ATM switch to the TRNK 1 RX optical interface connector on the OC-3c/2DS3 NI-2 card. See Figure 1-16 for the OC-3c network trunk interface connection location.

> ✎
> **Note**   The subtending connections for the OC-3c/2DS3 NI-2 card are made from the I/O card. For more information on these connection procedures, see Chapter 3, "Installing a Cisco 6160 with a POTS Splitter Configuration," and Chapter 4, "Installing a Cisco 6160 Without a POTS Splitter Configuration."

Step 14   Connect the Ethernet to the management network.

   a.   Connect an Ethernet cable to the RJ-45 10BaseT receptacle (ENET) on the NI-2 card faceplate.

   b.   Connect the other end of the cable to the management network (for example, a LAN).

Step 15   Connect a VT100-compatible terminal to the system console port (CNSL) on the NI-2 card faceplate. Connect the terminal to a power source and set it up using the values that are shown in Table 6-1.

Step 16   Connect a terminal, a modem, or another serial device to the RJ-45 auxiliary port (AUX) on the NI-2 card faceplate. This step is optional.

6.2.6 OC-3c/OC-3c NI-2 Card

The following sections describe how to remove and install an OC-3c/OC-3c NI-2 card.

6.2.6.1 Removing an OC-3c/OC-3c NI-2 Card

Complete the following steps to remove an OC-3c/OC-3c NI-2 card from the chassis. Accomplish each step completely before moving on to the next step.

⚠

Caution   Service is interrupted to the entire system when the NI-2 card is removed unless a secondary NI-2 card is installed in the chassis. If a secondary NI-2 card is not installed, ensure that a service interruption is acceptable before proceeding.

Service is interrupted to the entire system when the NI-2 card is removed unless a secondary NI-2 card is installed in the chassis. If a secondary NI-2 card is not installed, ensure that a service interruption is acceptable before proceeding.

If a secondary NI-2 card is installed in the chassis, removing the active NI-2 card causes a switchover to the standby NI-2 card, which interrupts data traffic for approximately 60 seconds.

Removing a standby NI-2 card does not interrupt service to the system.

Step 1   Connect a grounding strap to the ESD grounding jack on the chassis. See the "Preventing Electrostatic Discharge Damage" section on page 2-8 for the ESD grounding jack location on the Cisco 6160.

Step 2   Disconnect the cable connected to the RJ-45 auxiliary port (AUX) on the NI-2 card, as necessary.

Step 3   Disconnect the cable connected to the system console port (CNSL) on the NI-2 card, as necessary.

Step 4   Disconnect the cable connected to the RJ-45 10BaseT receptacle (ENET) on the NI-2 card, as necessary.

Step 5   Disconnect the ATM switch receive cable from the TRNK 1 TX optical interface connector on the NI-2 card.

Step 6   Disconnect the ATM switch transmit cable from the TRNK 1 RX optical interface connector on the NI-2 card.

Step 7   Disconnect the SBTD 2 RX optical interface connector on the NI-2 card, as necessary.

Step 8   Disconnect the SBTD 2 TX optical interface connector on the NI-2 card, as necessary.

Step 9   Use a flat-head screwdriver to move the locking tabs on the faceplate from the locked to the unlocked position. Be sure to turn the locking tabs so that they do not overlap the NI-2 card ejector levers, as shown in Figure 6-3.

Step 10   Lift up on the ejector levers. This action disconnects the card from the backplane.

Step 11   Carefully slide the card out of the slot.

See the "Installing an OC-3c/OC-3c NI-2 Card" section on page 6-14 for NI-2 card installation procedures.

6.2.6.2 Installing an OC-3c/OC-3c NI-2 Card

Complete the following steps to install an OC-3c/OC-3c NI-2 card in the chassis. Accomplish each step completely before moving on to the next step.

✎
Note   All cards must be fully seated in the chassis. Push on the faceplate of each card to be sure that the card is fully seated.

Step 1   Connect a grounding strap to the ESD grounding jack on the chassis. See the "Preventing Electrostatic Discharge Damage" section on page 2-8 for the ESD grounding jack location on the Cisco 6160.

Step 2   Inspect the NI-2 card. Verify that the daughterboard is fully seated on the main board.

Step 3   Verify that the NI-2 card slot in the chassis has no bent pins.

Step 4   Hold the NI-2 card with the faceplate toward you and the connectors facing the chassis slot.

Step 5   Align the card edges with the slot guides in the chassis.

Figure 6-4 on page 6-7 shows how to install an NI-2 card in a Cisco 6160 chassis.

Step 6   Lift up on the ejector levers and gently apply pressure to the bottom of the faceplate while pushing the card into the slot.

Step 7   Push on the faceplate of each card to fully seat the card.

Step 8   Press down on the ejector levers to secure the card and connect it to the backplane.

Step 9   Use a flat-head screwdriver to turn the locking tabs on the faceplate so that they overlap the NI-2 card ejector levers to prevent inadvertent dislodging, as shown in Figure 6-3.

Step 10   Verify that the STATUS, ACTIVE, and POWER LEDs on the NI-2 card are solid green after the self-test is complete. This self-test procedure takes several minutes. If the STATUS LEDs are not green after the self-test, see Chapter 5, "Troubleshooting" for troubleshooting procedures.

Step 11   Perform a software update if the STATUS LED on the NI-2 card is blinking.

✎
Note   Refer to the *Configuration Guide for Cisco DSLAMs with NI-2* for software upgrade procedures.

Step 12   Attach the receive cable from the ATM switch to the TRNK 1 TX optical interface connector on the OC-3c/2DS3 NI-2 card. See Figure 1-17 for the OC-3c network trunk interface connection location.

The TRNK 1 TX connector is the one closest to the top of the faceplate. The TRNK 1 RX connector is closer to the bottom of the faceplate. The connector IDs are silkscreened inside the faceplate inset.

Step 13   Attach the transmit cable from the ATM switch to the TRNK 1 RX optical interface connector on the OC-3c/2DS3 NI-2 card. See Figure 1-17 for the OC-3c network trunk interface connection location.

> ✎
> **Note**   To cable the chassis for OC-3c subtending, see the appropriate installation chapter in this guide.

Step 14   Reconnect the SBTD 2 optical interface connectors (RX and TX) on the NI-2 card, as necessary.

> ✎
> **Note**   To cable the chassis for OC-3c subtending, see Chapter 3, "Installing a Cisco 6160 with a POTS Splitter Configuration," or Chapter 4, "Installing a Cisco 6160 Without a POTS Splitter Configuration."

Step 15   Connect the Ethernet to the management network.

   a.   Connect an Ethernet cable to the RJ-45 10BaseT receptacle (ENET) on the OC-3c/OC-3c NI-2 card faceplate.

   b.   Connect the other end of the cable to the management network (for example, a LAN).

Step 16   Connect a VT100-compatible terminal to the system console port (CNSL) on the NI-2 card faceplate. Connect the terminal to a power source and set it up using the values that are shown in Table 6-1.

Step 17   Connect a terminal, a modem, or another serial device to the RJ-45 auxiliary port (AUX) on the NI-2 card faceplate. This step is optional.

6.2.7 DS3/2DS3+8xT1 IMA I/O Card

The following sections describe how to remove or install a DS3/2DS3+8xT1 IMA I/O card.

⚠

Caution   Static voltages as low as 30 volts can cause latent damage to circuitry on the I/O card. Observe all standard antistatic procedures (for example, wear a ground strap).

6.2.7.1 Removing a DS3/2DS3+8xT1 IMA I/O Card

Complete the following steps to remove the DS3/2DS3+8xT1 IMA I/O card from the chassis backplane:

⚠

Caution   To prevent the system from powering up, do not install the fuses at this time. If the fuses are already installed in the fuse and alarm panel, remove them. You can replace the fuses after the system is installed and connected.

The fuse and alarm panel is not provided by Cisco.

🔍

Tip   Cisco recommends that you label each cable and wire at both ends to identify its destination.

Step 1   Connect a grounding strap to the ESD grounding jack on the chassis. See the "Preventing Electrostatic Discharge Damage" section on page 2-8 for the ESD grounding jack location on the Cisco 6160.

Step 2   Power off the Cisco 6160.

a.   Type the following command to save the configuration changes to NVRAM:

```
DSLAM# copy running-config startup-config
```

b.   Set the circuit breakers on both power entry modules (PEMs) to the OFF (0) position.

Step 3   Mark and disconnect all DS3 coaxial cables from the six BNC connectors (DS3 Port 1 through Port 3) on the I/O card, as necessary. Each port has a TX and an RX connection.

See Figure 1-19 for the DS3 BNC connector locations.

Step 4   Mark and disconnect all T1 wires from the eight RJ-48C receptacles (T1 Port 1 through Port 8) on the I/O card, as necessary.

See Figure 1-19 for the T1 receptacle locations.

Step 5   Mark and disconnect all wires from the I/O card wire-wrap pins.

See Figure 1-19 for the wire-wrap pin locations.

Step 6   Use a Phillips-head screwdriver to remove the ten screws from the I/O card EMI cover, as shown in Figure 6-5.

Figure 6-5   DS3/2DS3+8xT1 IMA I/O Card EMI Cover Removal
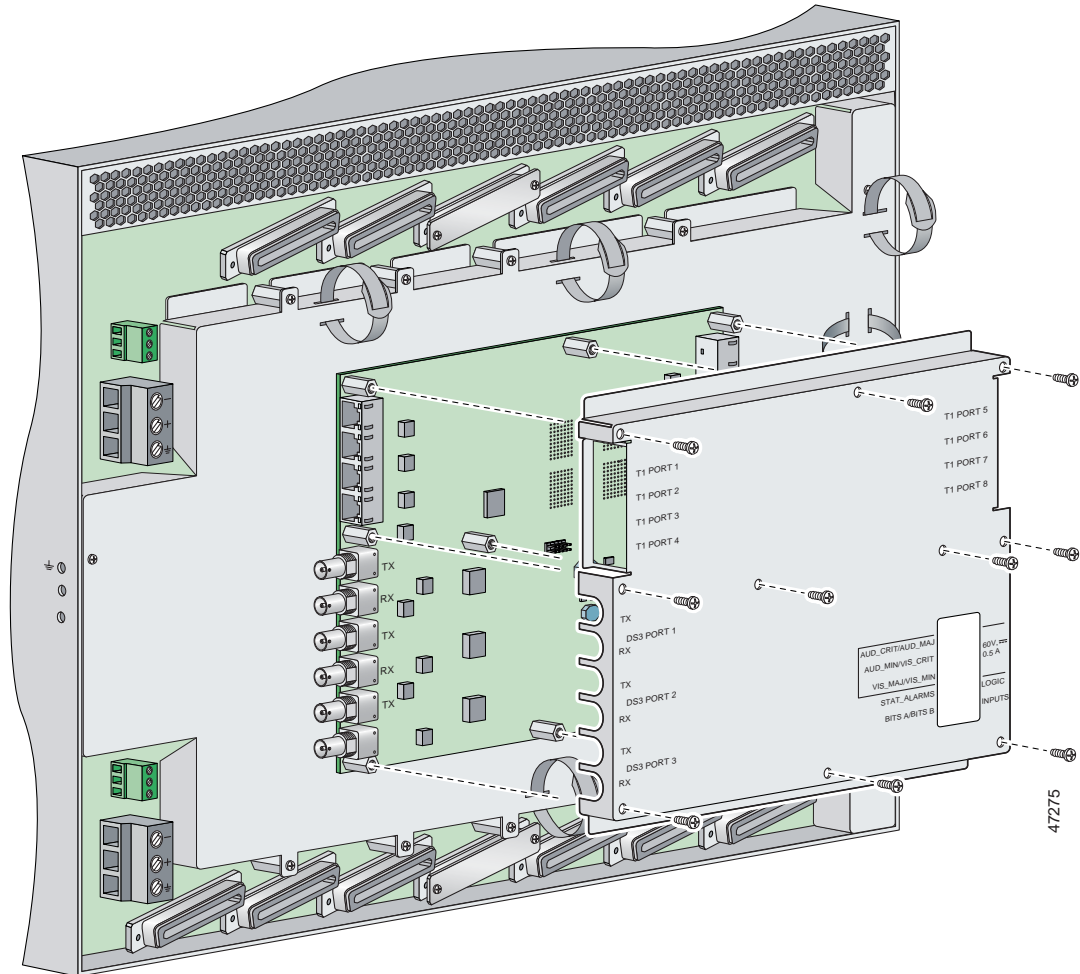
Step 7   Carefully lift the EMI cover off of the I/O card.

Step 8   Use a 1/4 inch socket driver or wrench to remove the ten standoff screws and washers that attach the I/O card to the chassis, as shown in Figure 6-6.

Figure 6-6   DS3/2DS3+8xT1 IMA I/O Card Removal
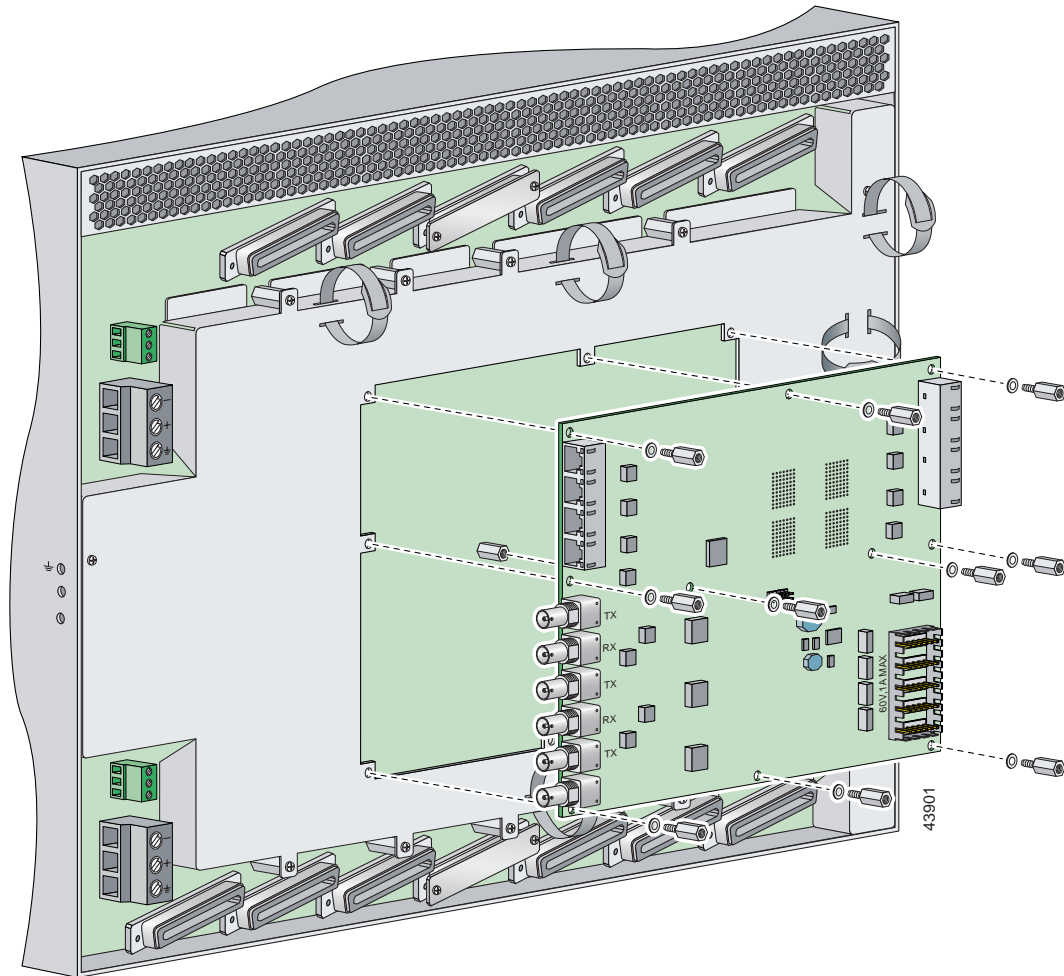
Step 9   Grasp the sides, or top and bottom, of the I/O card, and carefully pull the I/O card away from the P3 and P9 connectors on the Cisco 6160 backplane.

Step 10   Place the I/O card in an antistatic bag or in a box lined with antistatic material.

Step 11   Store the removed screws, standoff screws, washers, and EMI cover in a safe place for reinstallation.

See the "Installing a DS3/2DS3+8xT1 IMA I/O Card" section on page 6-19 for I/O card installation procedures.

6.2.7.2 Installing a DS3/2DS3+8xT1 IMA I/O Card

Complete the following steps to install the DS3/2DS3+8xT1 IMA I/O card from the chassis backplane:

⚠
Caution   To prevent the system from powering up, do not install the fuses at this time. If the fuses are already installed in the fuse and alarm panel, remove them. You can replace the fuses after the system is installed and connected.

The fuse and alarm panel is not provided by Cisco.

Step 1   Connect a grounding strap to the ESD grounding jack on the chassis. See the "Preventing Electrostatic Discharge Damage" section on page 2-8 for the ESD grounding jack location on the Cisco 6160.

Step 2   Verify that your configuration is saved to NVRAM.

Step 3   Verify that the circuit breakers on both PEMs are turned to the OFF (0) position.

Step 4   Use a 1/4 inch socket driver or wrench to tighten the two standoff screws. One standoff screw is located to the left of the P9 connector and the other is located to the right of the P3 connector.

⚠
Caution   Be careful not to damage backplane circuitry when you tighten the standoff screws on the backplane.

Step 5   Hold the I/O card vertically with its component side (primary side) facing you and align the I/O card over the two standoff screws.

Step 6 Carefully press J15 and J16 receptacles on the I/O card onto the P3 and P9 connectors on the chassis backplane until the I/O card is in place and against the two standoff screws, as shown in Figure 6-7.

Figure 6-7   DS3/2DS3+8xT1 IMA I/O Card Placement on P3 and P9 Connectors
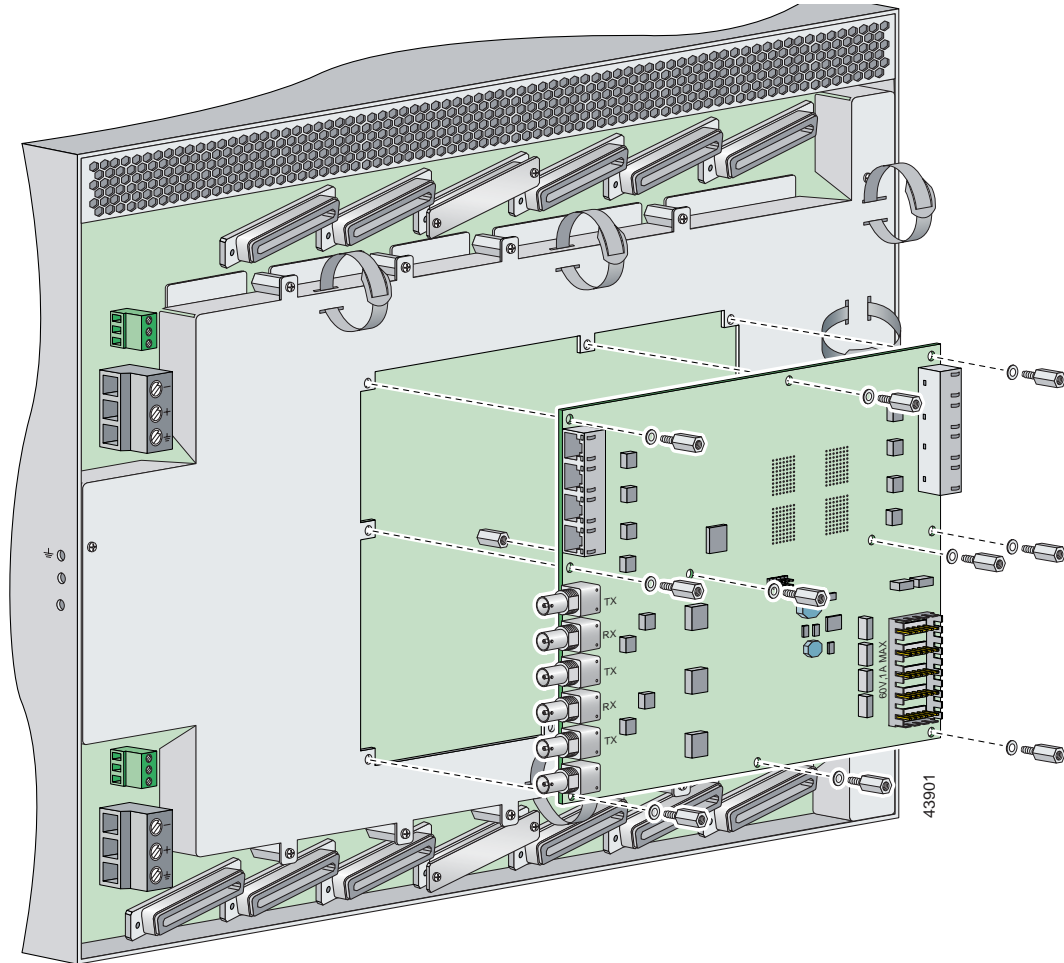
Step 7 Ensure that all of the mounting holes on the I/O card line up with the standoff screw holes on the backplane.

Step 8 Fasten the I/O card to the Cisco 6160 backplane by inserting the ten standoff screws and washers into the ten standoff screw holds in the I/O card, as shown in Figure 6-7.

Step 9 Use a 1/4 inch socket driver or wrench to tighten the ten standoff screws as necessary.

⚠

Caution Do not exceed a torque control of 4 foot-pounds. Doing so can damage the I/O card.

Step 10 Align the ten mounting holes on the EMI cover with the ten standoff screws installed on the I/O card.

Step 11   Use a Phillips-head screwdriver and ten screws to attach the EMI cover to the I/O card, as shown in Figure 6-8.

⚠️

Caution   Do not exceed a torque control of 4 foot-pounds.

Figure 6-8   DS3/2DS3+8xT1 IMA I/O Card EMI Cover Installation
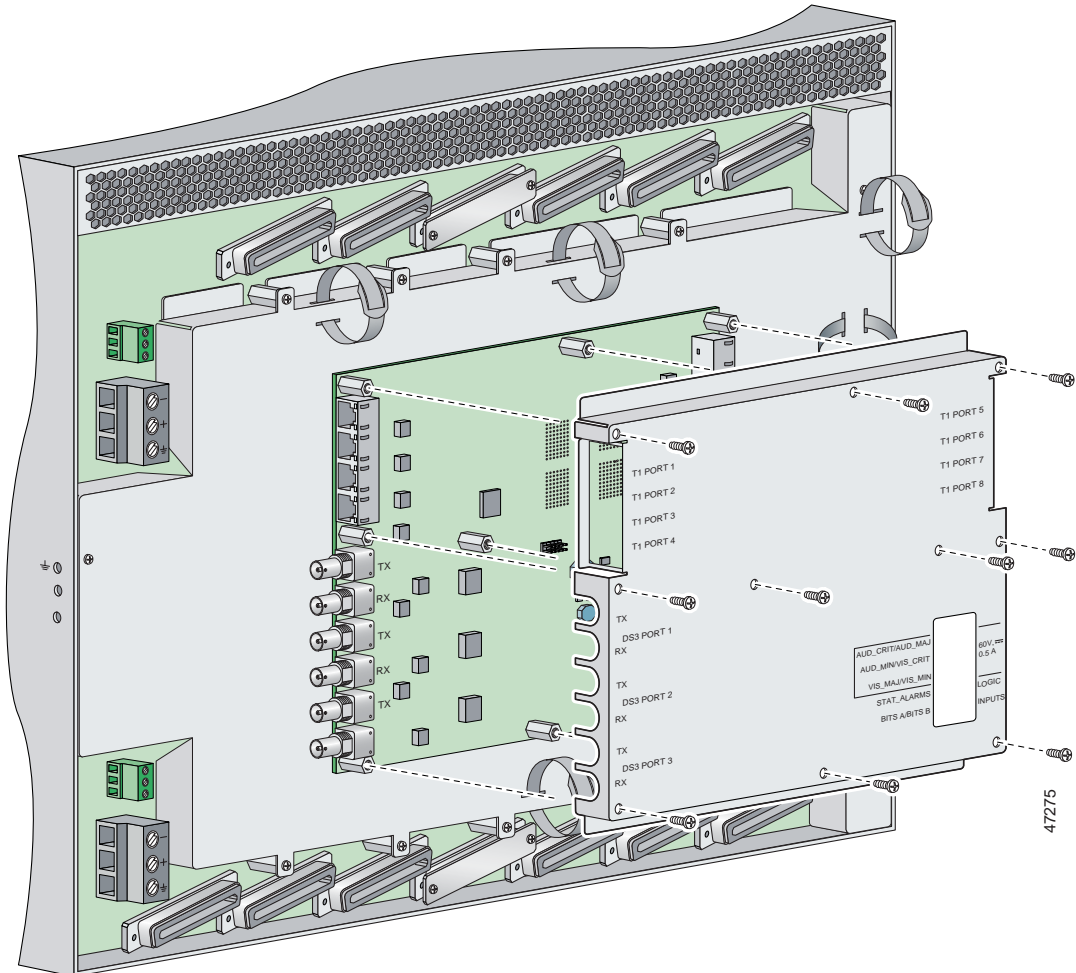
Step 12   If you disconnected the wire from the wire-wrap pins in the "Removing a DS3/2DS3+8xT1 IMA I/O Card" section on page 6-16, reconnect them.

Step 13   If you disconnected the T1 wires from the RJ-48C receptacles in the "Removing a DS3/2DS3+8xT1 IMA I/O Card" section on page 6-16, reconnect them.

Step 14   If you disconnected the DS3 coaxial cables from the BNC connectors in the "Removing a DS3/2DS3+8xT1 IMA I/O Card" section on page 6-16, reconnect them.

Step 15   Set the circuit breakers on each PEM to the ON (1) position.

✎

Note   The OUT FAIL LED might blink briefly.

Step 16   Verify that the INPUT OK LED is green.

> ✎
>
> **Note**   If the INPUT OK LED is not green or if other issues arise, see Chapter 5, "Troubleshooting" for troubleshooting procedures.

Step 17   Reboot the system to reassociate the system MAC address.

Step 18   Confirm that the Cisco IOS software recognizes the new I/O card.

    a.   Type the following command:

```
DSLAM# show hardware
```

    b.   Scroll through the data and locate the I/O card information.

    The information displayed on the screen will be similar to the following output:

> ✎
>
> **Note**   The command output below is an example display. Slots 1 through 9 and 12 through 34 are available for line cards and slot 11 is for a secondary NI-2 card.

```
Chassis Type: C6160
I/O Card: 6160-DS3+8T1-IO
Slot 1 : EMPTY Slot 19: EMPTY
Slot 2 : EMPTY Slot 20: EMPTY
Slot 3 : EMPTY Slot 21: EMPTY
Slot 4 : EMPTY Slot 22: EMPTY
Slot 5 : EMPTY Slot 23: EMPTY
Slot 6 : EMPTY Slot 24: EMPTY
Slot 7 : EMPTY Slot 25: EMPTY
Slot 8 : EMPTY Slot 26: EMPTY
Slot 9 : EMPTY Slot 27: EMPTY
Slot 10:NI-2-155MM-155MM
Slot 11:EMPTY
Slot 12: EMPTY Slot 28: EMPTY
Slot 13: EMPTY Slot 29: EMPTY
Slot 14: EMPTY Slot 30: EMPTY
Slot 15: EMPTY Slot 31: EMPTY
Slot 16: EMPTY Slot 32: EMPTY
Slot 17: EMPTY Slot 33: EMPTY
Slot 18: EMPTY Slot 34: EMPTY
Fan Module 1: Present 2: Present
Power Supply Module 1: 6160-PEM-DC
Power Supply Module 2: EMPTY
```

> ✎
>
> **Note**   If the information displays as "Unreadable" or "Unknown", the I/O card was not installed properly or a problem exists with the I/O card. Install the I/O card again by following the procedures in this section. If the I/O card is still not recognized by the system, see Chapter 5, "Troubleshooting" for troubleshooting procedures.

6.2.8 DS3/2DS3 I/O Card

The following sections describe how to remove or install a DS3/2DS3 I/O card.

⚠️

Caution   Static voltages as low as 30 volts can cause latent damage to circuitry on the I/O card. Observe all standard antistatic procedures (for example, wear a ground strap).

6.2.8.1 Removing a DS3/2DS3 I/O Card

Complete the following steps to remove the DS3/2DS3 I/O card from the chassis backplane:

⚠️

Caution   To prevent the system from powering up, do not install the fuses at this time. If the fuses are already installed in the fuse and alarm panel, remove them. You can replace the fuses after the system is installed and connected.

The fuse and alarm panel is not provided by Cisco.

🔎

Tip   Cisco recommends that you label each cable and wire at both ends to identify its destination.

Step 1   Connect a grounding strap to the ESD grounding jack on the chassis. See the "Preventing Electrostatic Discharge Damage" section on page 2-8 for the ESD grounding jack location on the Cisco 6160.

Step 2   Power off the Cisco 6160.

    a.   Type the following command to save the configuration changes to NVRAM:

```
DSLAM# copy running-config startup-config
```

    b.   Set the circuit breakers on both power entry modules (PEMs) to the OFF (0) position.

Step 3   Mark and disconnect all DS3 coaxial cables from the six BNC connectors (DS3 Port 1 through Port 3) on the I/O card, as necessary. Each port has a TX and an RX connection.

See Figure 1-23 for the DS3 BNC connector locations.

Step 4   Mark and disconnect all wires from the I/O card wire-wrap pins.

See Figure 1-23 for the wire-wrap pin locations.

Step 5   Use a Phillips-head screwdriver to remove the ten screws from the I/O card EMI cover, as shown in Figure 6-9.

Figure 6-9   DS3/2DS3 I/O Card EMI Cover Removal
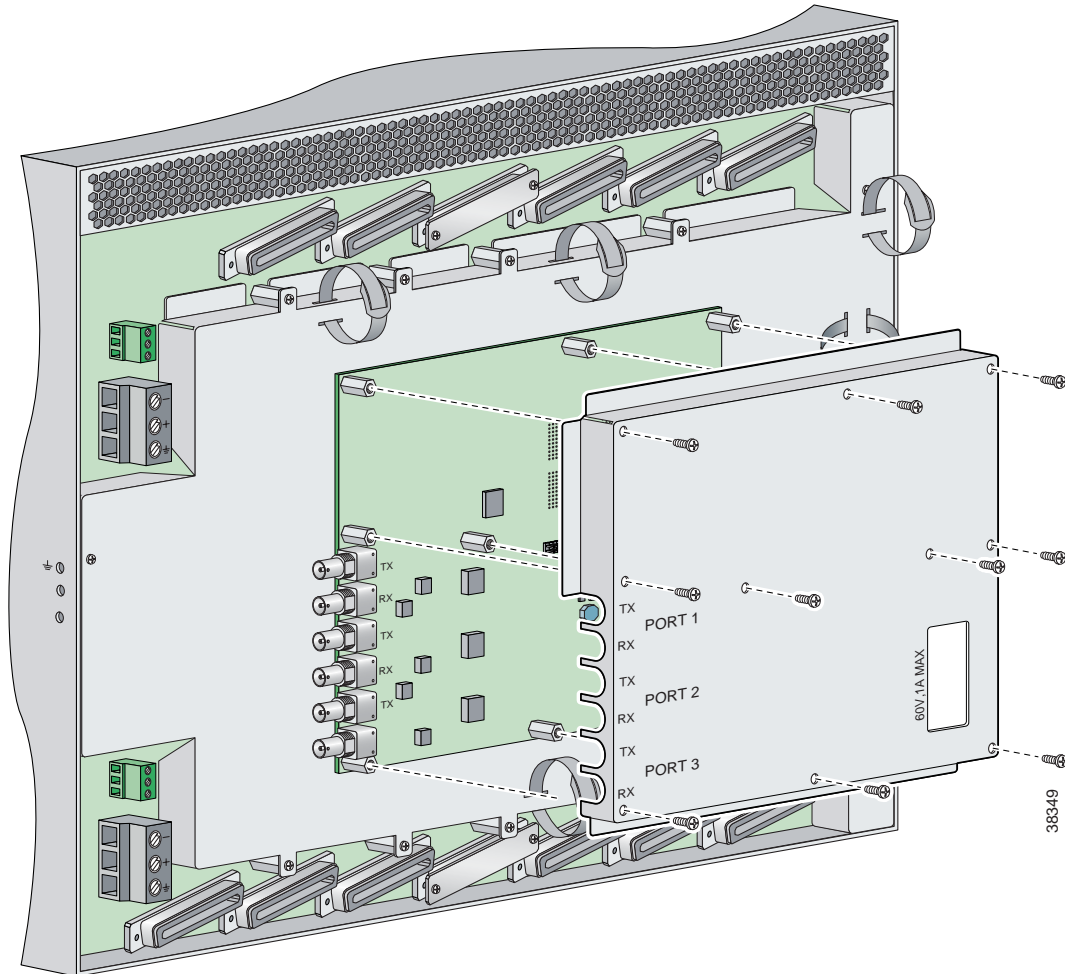
Step 6   Carefully lift the EMI cover off of the I/O card.

Step 7   Use a 1/4 inch socket driver or wrench to remove the ten standoff screws and washers that attach the I/O card to the chassis, as shown in Figure 6-10.

Figure 6-10   DS3/2DS3 I/O Card Removal
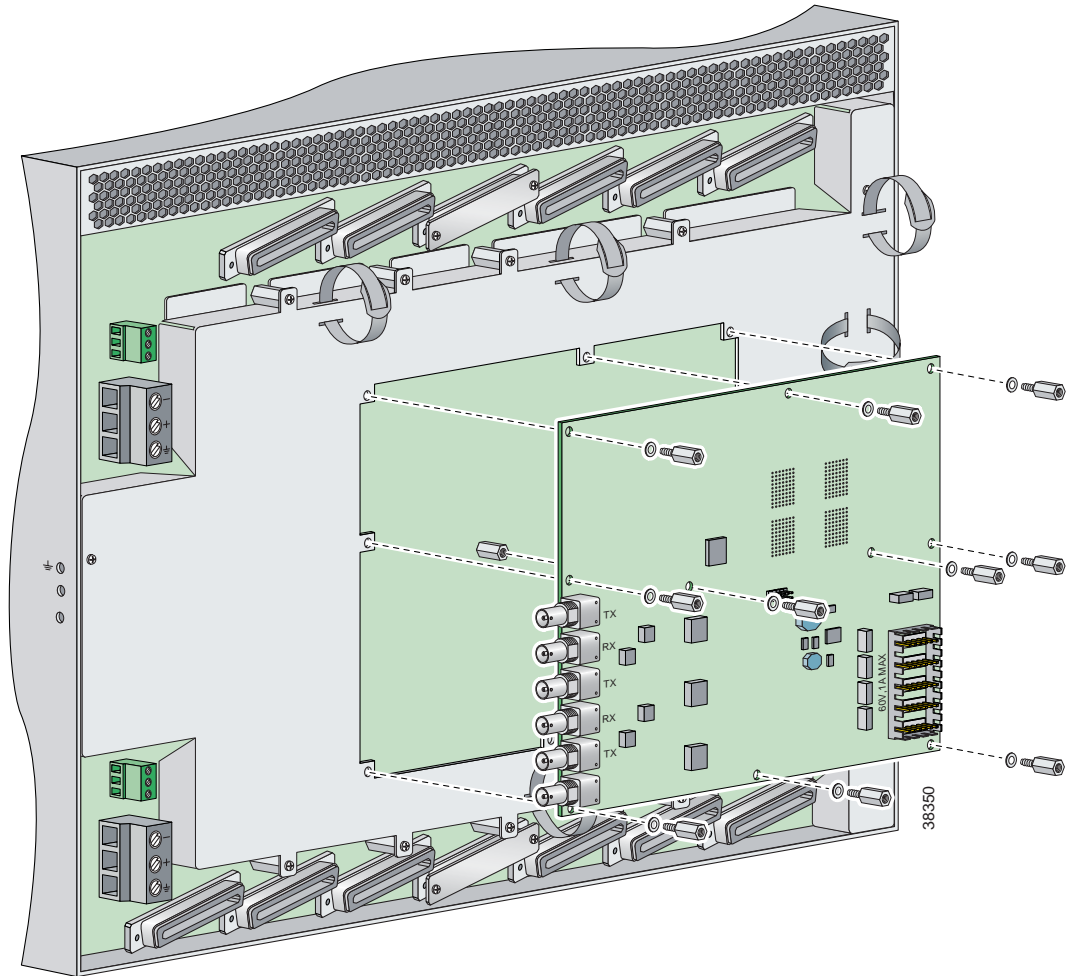
Step 8   Grasp the sides, or top and bottom, of the I/O card, and carefully pull the I/O card away from the P3 and P9 connectors on the Cisco 6160 backplane.

Step 9   Place the I/O card in an antistatic bag or in a box lined with antistatic material.

Step 10   Store the removed screws, standoff screws, washers, and EMI cover in a safe place for reinstallation.

See the "Installing a DS3/2DS3 I/O Card" section on page 6-26 for I/O card installation procedures.

6.2.8.2 Installing a DS3/2DS3 I/O Card

Complete the following steps to install the DS3/2DS3 I/O card from the chassis backplane:

⚠
Caution   To prevent the system from powering up, do not install the fuses at this time. If the fuses are already installed in the fuse and alarm panel, remove them. You can replace the fuses after the system is installed and connected.

The fuse and alarm panel is not provided by Cisco.

Step 1   Connect a grounding strap to the ESD grounding jack on the chassis. See the "Preventing Electrostatic Discharge Damage" section on page 2-8 for the ESD grounding jack location on the Cisco 6160.

Step 2   Verify that your configuration is saved to NVRAM.

Step 3   Verify that the circuit breakers on both PEMs are turned to the OFF (0) position.

Step 4   Use a 1/4 inch socket driver or wrench to tighten the two standoff screws. One standoff screw is located to the left of the P9 connector and the other is located to the right of the P3 connector.

⚠
Caution   Be careful not to damage backplane circuitry when you tighten the standoff screws on the backplane.

Step 5   Hold the I/O card vertically with its component side (primary side) facing you and align the I/O card over the two standoff screws.

Step 6   Carefully press J15 and J16 receptacles on the I/O card onto the P3 and P9 connectors on the chassis backplane until the I/O card is in place and against the two standoff screws, as shown in Figure 6-11.

Figure 6-11   DS3/2DS3 I/O Card Placement on P3 and P9 Connectors
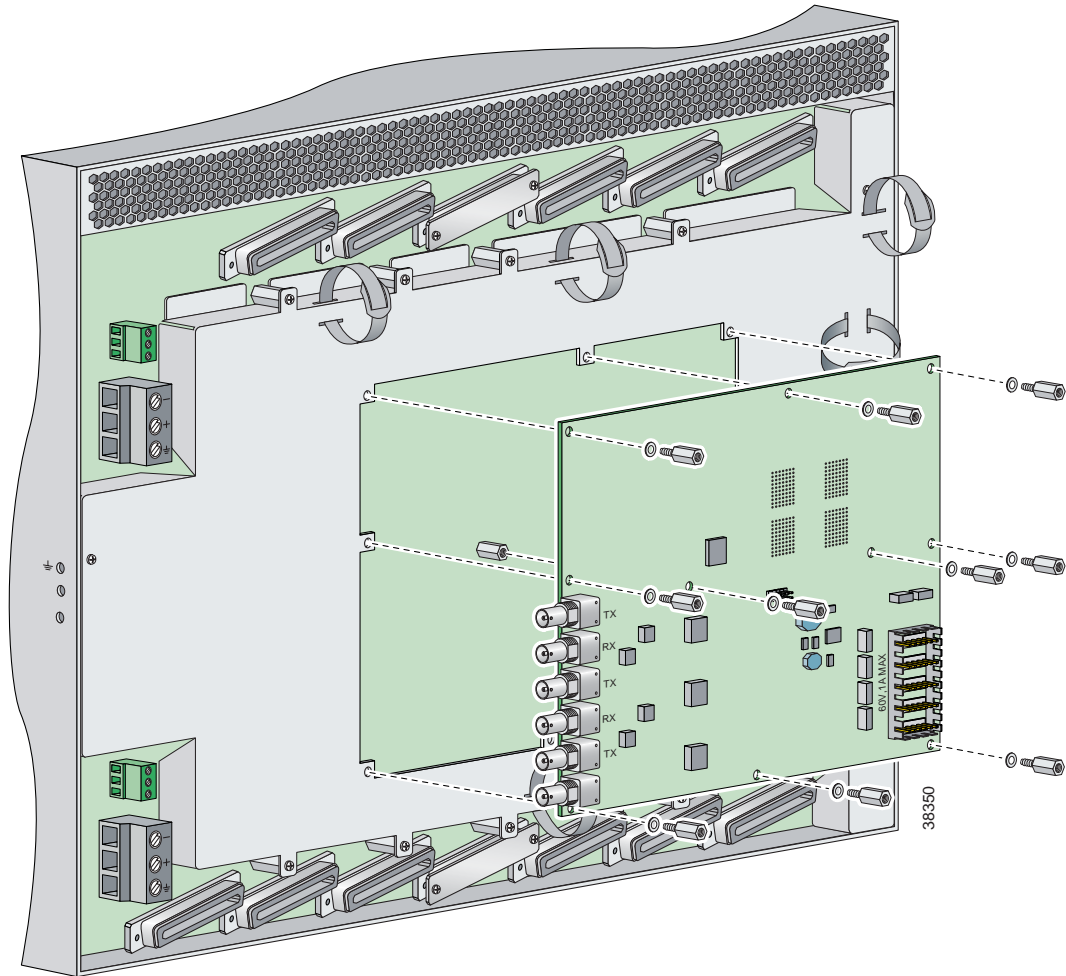
Step 7   Ensure that all of the mounting holes on the I/O card line up with the standoff screw holes on the backplane.

Step 8   Fasten the I/O card to the Cisco 6160 backplane by inserting the ten standoff screws and washers into the ten standoff screw holds in the I/O card, as shown in Figure 6-11.

Step 9   Use a 1/4 inch socket driver or wrench to tighten the ten standoff screws as necessary.

⚠
Caution   Do not exceed a torque control of 4 foot-pounds. Doing so can damage the I/O card.

Step 10   Align the ten mounting holes on the EMI cover with the ten standoff screws installed on the I/O card.

Step 11   Use a Phillips-head screwdriver and ten screws to attach the EMI cover to the I/O card, as shown in Figure 6-12.

⚠️

Caution   Do not exceed a torque control of 4 foot-pounds.

Figure 6-12   DS3/2DS3 I/O Card EMI Cover Installation
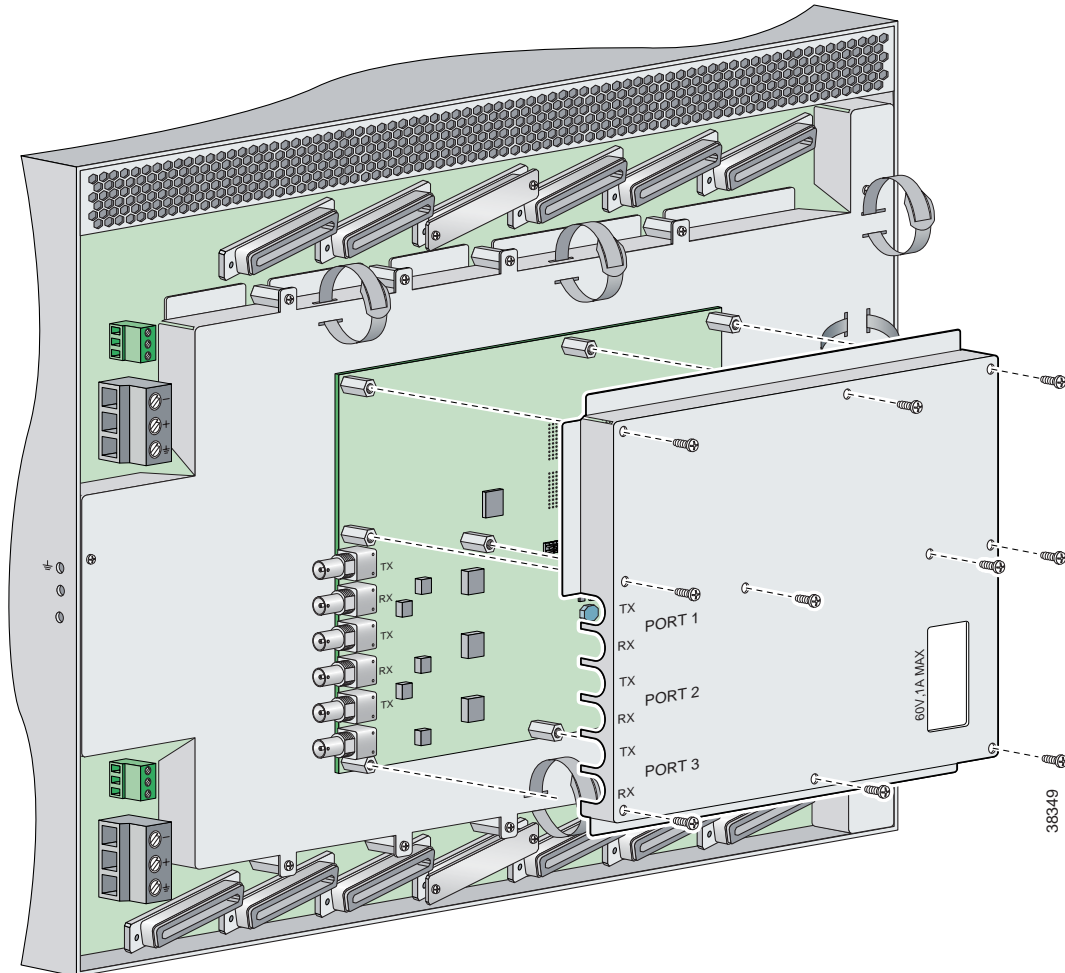
Step 12   If you disconnected the wire from the wire-wrap pins in the "Removing a DS3/2DS3+8xT1 IMA I/O Card" section on page 6-16, reconnect them.

Step 13   If you disconnected the DS3 coaxial cables from the BNC connectors in the "Removing a DS3/2DS3+8xT1 IMA I/O Card" section on page 6-16, reconnect them.

Step 14   Set the circuit breakers on each PEM to the ON (1) position.

✎

Note   The OUT FAIL LED might blink briefly.

Step 15 Verify that the INPUT OK LED is green.

> ✎
>
> **Note** If the INPUT OK LED is not green or if other issues arise, see Chapter 5, "Troubleshooting" for troubleshooting procedures.

Step 16 Reboot the system to reassociate the system MAC address.

Step 17 Confirm that the Cisco IOS software recognizes the new I/O card.

a. Type the following command:

```
DSLAM# show hardware
```

b. Scroll through the data and locate the I/O card information.

The information displayed on the screen will be similar to the following output:

> ✎
>
> **Note** The command output below is an example display. Slots 1 through 9 and 12 through 34 are available for line cards and slot 11 is for a secondary NI-2 card.

```
I/O Card EEPROM:
    Hardware Revision : 1.0
    Part Number : 800-06477-01
    Board Revision : 05
    Deviation Number : 0-0
    Fab Version : 02
    PCB Serial Number : SAD0407009H
    RMA Test History : 00
    RMA Number : 0-0-0-0
    RMA History : 00
    Chassis MAC Address : 0030.96fe.9700
    MAC Address block size : 1024
    CLEI Code : UNASSIGNED
    Asset Identifier :
    EEPROM format version 4
    EEPROM contents (hex):
    0x00: 04 FF 40 01 CB 41 01 00 C0 46 03 20 00 19 4D 01
    0x10: 42 30 35 80 00 00 00 00 02 02 C1 8B 53 41 44 30
    0x20: 34 30 37 30 30 39 48 03 00 81 00 00 00 00 04 00
    0x30: C3 06 00 30 96 FE 97 00 43 04 00 C6 8A 55 4E 41
    0x40: 53 53 49 47 4E 45 44 CC 20 00 00 00 00 00 00 00
    0x50: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
    0x60: 00 00 00 00 00 00 00 00 00 FF FF FF FF FF FF FF
    0x70: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
    0x80: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
    0x90: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
    0xA0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
    0xB0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
    0xC0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
    0xD0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
    0xE0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
    0xF0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
```

> **Note**   If the information displays as "Unreadable" or "Unknown", the I/O card was not installed properly or a problem exists with the I/O card. Install the I/O card again by following the procedures in this section. If the I/O card is still not recognized by the system, see Chapter 5, "Troubleshooting" for troubleshooting procedures.

6.2.9 PEM

The following sections describe how to remove or install a power entry module (PEM).

> **Note**   All modules must be fully seated in the chassis. Push on the faceplate of each module to be sure that the card is fully seated.

6.2.9.1 Removing a PEM

Complete the following steps to remove a PEM from the chassis:

> **Caution**   If you remove a PEM from the Cisco 6160 chassis in which a secondary PEM is installed and providing power, the chassis continues to operate. If you remove the only operating PEM from the chassis, power down the system before you begin.

Step 1   Connect a grounding strap to the ESD grounding jack on the chassis. See the "Preventing Electrostatic Discharge Damage" section on page 2-8 for the ESD grounding jack location on the Cisco 6160.

Step 2   Power down the Cisco 6160, as necessary.

    a. Type the following command to save the configuration changes to NVRAM:

```
DSLAM# copy running-config startup-config
```

    b. Set the circuit breaker on the operating PEM to the OFF (0) position.

Step 3   Use a Phillips-head screwdriver to loosen the two captive screws on the front of the PEM.

Step 4   Grasp the handle on the right side of the PEM and pull the PEM from the slot.

Step 5   Place the PEM in an antistatic bag or in a box lined with antistatic material.

See the "Installing a PEM" section on page 6-31 for PEM installation procedures.

6.2.9.2 Installing a PEM

Complete the following steps to install a PEM in the chassis:

✎

Note   Connect each Cisco 6160 PEM to a separate fuse. Do not power the components in the rack by chaining them together. See the appropriate installation chapter for power and ground procedures.

Step 1   Connect a grounding strap to the ESD grounding jack on the chassis. See the "Preventing Electrostatic Discharge Damage" section on page 2-8 for the ESD grounding jack location on the Cisco 6160.

Step 2   Verify that your configuration is saved to NVRAM.

Step 3   Verify that the circuit breaker on the PEM is turned to the OFF (0) position, as necessary.

Step 4   Verify that the power and ground wires are connected to the power terminal block located on the backplane, directly behind the PEM that you are installing. See the appropriate installation chapter for procedures to connect power and ground to the power terminal block.

Step 5   Grasp the handle on the right side of the PEM to slide it into the appropriate slot. Verify that the connector on the back of the PEM mates with the backplane connector and guide pins.

Figure 6-13 shows the installation of the PEM in a Cisco 6160 chassis.

Figure 6-13   PEM Installation
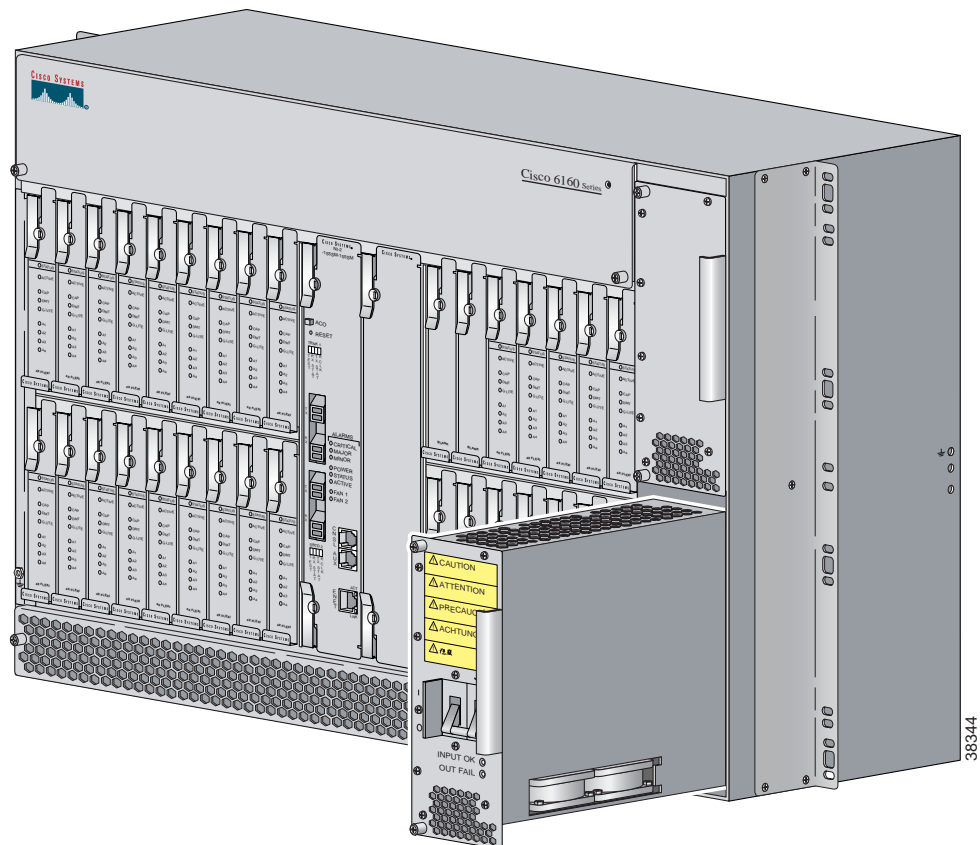
Step 6   Use a Phillips-head screwdriver to tighten the two captive screws to secure the PEM in place.

Step 7   Power on the PEM by setting the circuit breaker to the ON (1) position, as necessary.

Note   The OUT FAIL LED might blink briefly.

Step 8   Verify that the INPUT OK LED is green.

Note   If the INPUT OK LED is not green or if other issues arise, see Chapter 5, "Troubleshooting" for troubleshooting procedures.

Step 9   Confirm that the Cisco IOS software recognizes the new PEM.

a. Type the following command:

```
DSLAM# show hardware chassis
```

b. Scroll through the data and locate the PEM information.

The information displayed on the screen will be similar to the following output:

```
Slot 2 Power Module EEPROM:
Hardware Revision : 1.0
Part Number : 34-1259-01
Deviation Number : 0-0
RMA Test History : 00
RMA Number : 0-0-0-0
RMA History : 00
Chassis Serial Number : 000000PP830
Power Supply Type : DC
CLEI Code : ABCDEFGHIJ
Asset Identifier :
EEPROM format version 4
EEPROM contents (hex):
0x00: 04 FF 41 01 00 82 22 04 EB 01 80 00 00 00 00 03
0x10: 00 81 00 00 00 00 04 00 C2 8B 30 30 30 30 30 30
0x20: 50 50 38 33 30 0B 01 C6 8A 41 42 43 44 45 46 47
0x30: 48 49 4A CC 20 00 00 00 00 00 00 00 00 00 00 00
0x40: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0x50: 00 00 00 00 00 FF FF FF FF FF FF FF FF FF FF FF
0x60: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
0x70: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
0x80: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
0x90: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
0xA0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
0xB0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
0xC0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
0xD0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
0xE0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
0xF0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
```

Note   If the information displays as "Unreadable" or "Unknown", the PEM was not installed properly or a problem exists with the PEM. Install the PEM again by following the procedures in this section. If the PEM is still not recognized by the system, see Chapter 5, "Troubleshooting" for troubleshooting procedures.

Step 10   View PEM operating information.

    a. Type the following command:

```
DSLAM# show environment all
```

    b. Scroll through the data and locate the PEM information.

        If the PEM is operating properly, the information displayed on the screen will be similar to the following output:

```
                Slot 1     Slot 2
Power Modules:
Present:        Yes        Yes
Faults:         No         No
Internal Temp:  21C/69 F   22C/71 F
External Temp 1: 20C/68 F  23C/73 F
External Temp 2: 20C/68 F  20C/68 F
Temp Alarms:    No         No
```

Note   If a problem exists with the PEM operating information, see Chapter 5, "Troubleshooting" for troubleshooting procedures.

6.2.10 Blower Tray

The following sections describe how to remove or install the Cisco 6160 blower tray.

Caution   Proper ESD protection is required whenever you handle Cisco equipment. Installation and maintenance personnel should be properly grounded by means of grounding straps to eliminate the risk of ESD damage to the equipment. Equipment is subject to ESD damage whenever it is removed from the chassis.

6.2.10.1 Removing a Blower Tray

Complete the following steps to remove the blower tray from the chassis:

Warning   **Before you remove the blower tray from its slot, make sure you grasp it firmly to prevent it from slipping to the floor. This unit is heavier than it appears.**

Step 1   Connect a grounding strap to the ESD grounding jack on the chassis. See the "Preventing Electrostatic Discharge Damage" section on page 2-8 for the ESD grounding jack location on the Cisco 6160.

Step 2   Use a Phillips-head screwdriver to loosen the two captive screws on the blower tray faceplate.

Step 3   Grasp the two captive screws, and slowly slide the blower tray out until it catches. (Do not pull the unit completely out. It is supported only by the captive screws.)

Step 4   Locate and press the safety catch (see Figure 6-14) on the right side of the blower tray.

Step 5   While pressing the safety catch, firmly grasp the sides of the blower tray and slowly remove the blower tray from its slot.

See the "Installing a Blower Tray" section on page 6-34 for blower tray installation procedures.

6.2.10.2 Installing a Blower Tray

Complete the following steps to install the blower tray in the chassis:

Step 1   Connect a grounding strap to the ESD grounding jack on the chassis. See the "Preventing Electrostatic Discharge Damage" section on page 2-8 for the ESD grounding jack location on the Cisco 6160.

Step 2   Slide the blower tray into the blower tray slot of the Cisco 6160.

Figure 6-14 shows the installation of the blower tray in the Cisco 6160 chassis.

Figure 6-14   Blower Tray Installation in the Cisco 6160 Chassis
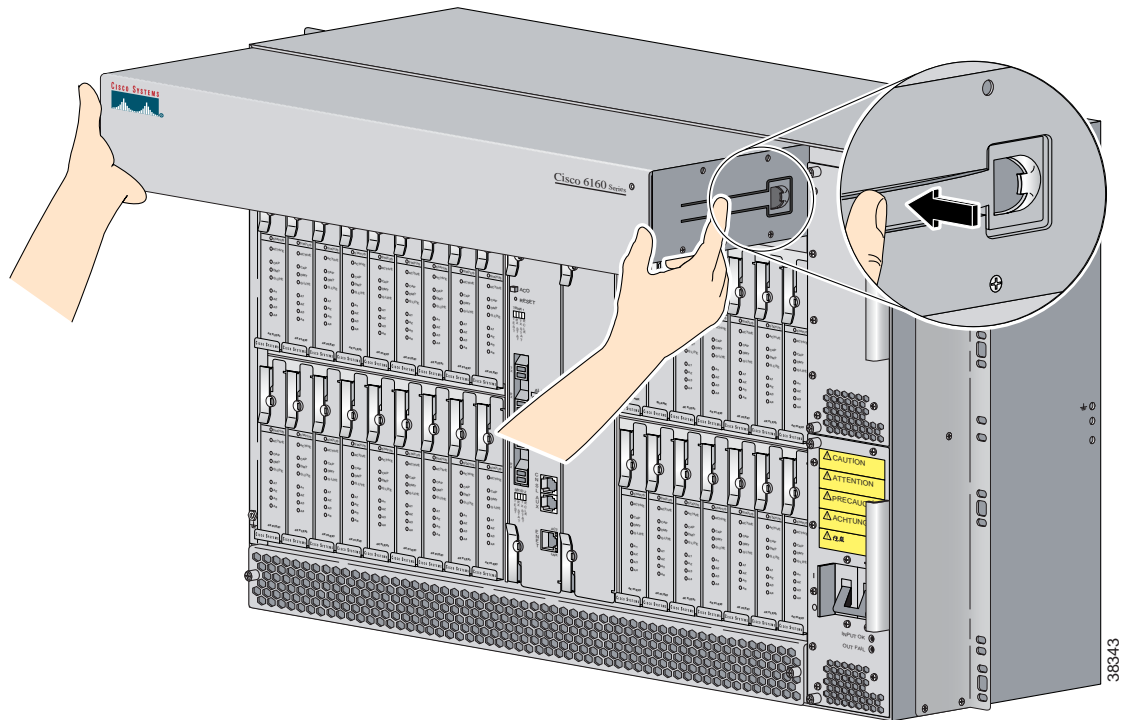
Step 3   Press the blower tray into its slot. Ensure that the blower tray connector mates with the connector on the backplane.

Step 4   Use a Phillips-head screwdriver to tighten the two captive screws on the blower tray faceplate.

Step 5   Verify that the INPUT OK LED is green. At startup, the LED may blink red momentarily before it changes to green. This is normal at startup.

✎

Note   If the INPUT OK LED is not green or if other issues arise, see Chapter 5, "Troubleshooting" for troubleshooting procedures.

Step 6   Confirm that the Cisco IOS software recognizes the new blower tray.

a.   Type the following command:

```
DSLAM# show hardware chassis
```

b.   Scroll through the data and locate the blower tray information.

The information displayed on the screen will be similar to the following output:

```
Blower Module EEPROM:
    Hardware Revision : 1.0
    Part Number : 74-1529-01
    Deviation Number : 0-0
    PCB Serial Number : 00000000151
    RMA Test History : 00
    RMA Number : 0-0-0-0
    RMA History : 00
    CLEI Code : ABCDEFGHIJ
    Asset Identifier :
    EEPROM format version 4
    EEPROM contents (hex):
    0x00: 04 FF 41 01 00 82 4A 05 F9 01 80 00 00 00 00 C1
    0x10: 8B 30 30 30 30 30 30 30 30 31 35 31 03 00 81 00
    0x20: 00 00 00 04 00 C6 8A 41 42 43 44 45 46 47 48 49
    0x30: 4A CC 20 00 00 00 00 00 00 00 00 00 00 00 00 00
    0x40: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
    0x50: 00 00 00 FF FF FF FF FF FF FF FF FF FF FF FF FF
    0x60: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
    0x70: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
    0x80: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
    0x90: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
    0xA0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
    0xB0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
    0xC0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
    0xD0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
    0xE0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
    0xF0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
```

✎

Note   If the information displays as "Unreadable" or "Unknown", the blower tray was not installed properly or a problem exists with the blower tray. Install the blower tray again by following the procedures in this section. If the blower tray is still not recognized by the system, see Chapter 5, "Troubleshooting" for troubleshooting procedures.

Step 7   View blower tray operating information.

a.   Type the following command:

```
DSLAM# show environment all
```

b.   Scroll through the data and locate the blower tray information.

If the blower tray is operating properly, the information displayed on the screen will be similar to the following output:

```
Fans:
    Present: Yes
    Speed: Normal
    Fan Number 0: OK
    Fan Number 1: OK
    Fan Number 2: OK
    Fan Number 3: OK
    Temperature: 21C/69 F
```

Note   If a problem exists with the blower tray operating information, see Chapter 5, "Troubleshooting" for troubleshooting procedures.

6.3 Air Filter Maintenance

You must periodically clean or replace the air filter in the Cisco 6160 chassis.

Once a month (or more often in dusty environments), examine the air filter and clean or replace it if it is dirty. Keep a log recording the date that the filter was cleaned or replaced.

Note   You can clean or replace the air filter while the Cisco 6160 remains powered up and fully operational.

The remainder of this section explains how to remove, clean, and replace the filter.

6.3.1 Required Tools and Equipment

To clean the air filter, you need one of the following:

- Vacuum cleaner (preferred)
- Clean water
- Mild detergent, if the filter is very dirty
- Phillips-head screwdriver

A new air filter (product number 6160-AF-01= for a 5-pack) is the only part you need if you decide that the old filter needs replacing.

6.3.2 Removing an Air Filter

Complete the following steps to remove an air filter from the Cisco 6160 chassis:

Step 1   Use a Phillips-head screwdriver to unscrew the two captive screws located on the perforated metal bezel that covers the air filter. (See Figure 6-15.)

Step 2   Remove the metal bezel.

Step 3   Remove the filter from the chassis.

Figure 6-15   Removing the Bezel and Air Filter
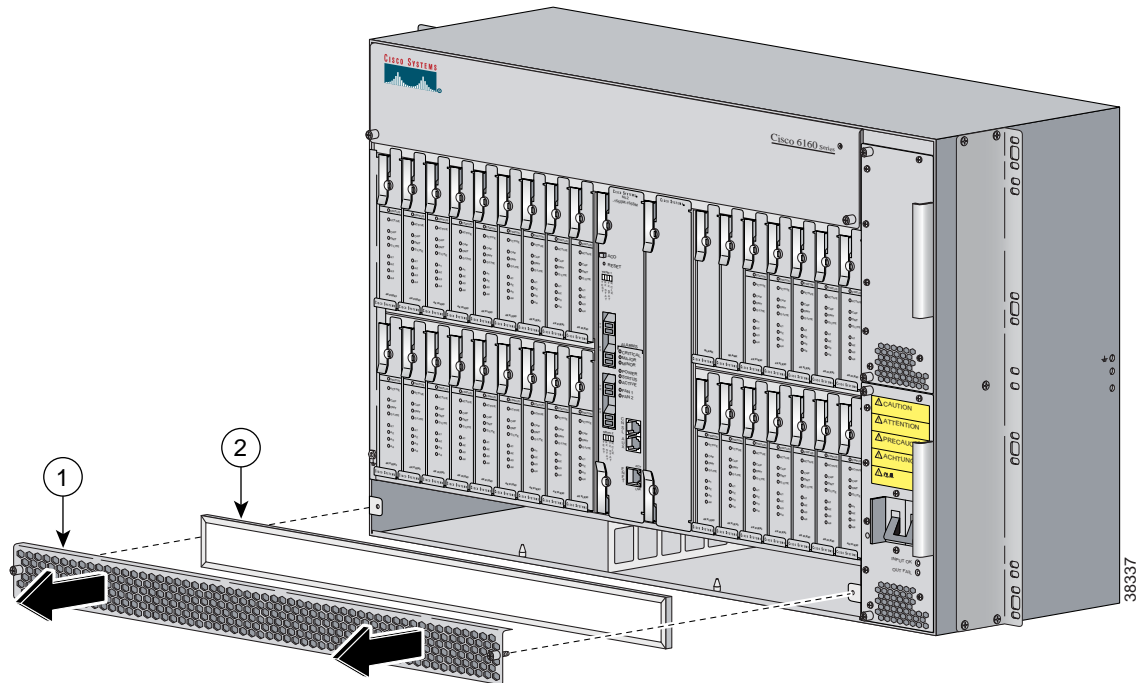
1	Protective bezel	**2**	Air filter

6.3.3 Cleaning or Replacing the Air Filter

This section describes how to clean or replace a Cisco 6160 air filter.

Step 1   Use one of the following methods to clean the air filter:

- Vacuum the filter until it is clean and free of dust. This method is preferred because you need not dry the filter afterwards.

- Wash the filter by holding it under a stream of plain water. Supporting the filter with your fingers, hold the filter under the water with the metal grill facing up and let the water flow down through the filter. (This orientation causes the water to flow through the filter in the direction opposite from the usual air flow, so you dislodge rather than embed matter trapped in the filter.) Allow the filter to dry thoroughly before reinstalling it.

- If the filter is extremely dirty, immerse the filter in a solution of hot water and mild detergent. Rinse the filter thoroughly in clear water and allow it to dry completely before reinstalling it.

Step 2   To replace the clean filter or to install a new one, hold the filter so that the side with the metal grill is facing the chassis.

Step 3   Insert the filter into its slot at the bottom of the chassis.

Step 4   Replace the bezel that covers the air filter and use a screwdriver to tighten the captive screws to secure the bezel.

A P P E N D I X   **A**

Technical Specifications

This appendix provides the technical specifications for the Cisco 6160 system. The appendix contains the following sections:

- Hardware Specifications, page A-1
- Software Specifications, page A-14

A.1 Hardware Specifications

This section details the specifications for the following hardware components:

- Cisco 6160 system
- Octal-port ITU-C line card (8xIDSL)
- Octal-port G.SHDSL SHTU-C line card (8xG.SHDSL)
- Octal-port DMT ATU-C line card (8xDMT)
- Quad-port STU-C line card (4xSDSL)
- Quad-port flexi ATU-C line card (4xflexi)
- DS3+T1/E1 IMA NI-2 card
- DS3/2DS3 NI-2 card
- OC-3c/2DS3 NI-2 card
- OC-3c/OC-3c NI-2 card
- DS2/2DS3+8xT1 IMA I/O card
- DS3/2DS3 I/O card
- Power entry module (PEM)
- Blower tray

A.1.1 Cisco 6160 System

Table A-1 lists the hardware specifications for the Cisco 6160 system.

Table A-1   Cisco 6160 System Hardware Specifications

Specification		Description
Cisco 6160 chassis dimensions		11 RUs[1]—18.35 in. x 21.35[2] in. x 11.8 in. (46.6 cm x 54.2 cm x 30.0 cm)
Cisco 6160 chassis weight		Empty—Approximately 40 lb (18.2 kg)
		Loaded—Approximately 95 lb (43.2 kg)
Acoustic noise		60 dB at normal fan speed
Network interface		• OC-3c (single- or multimode fiber) WAN uplink or subtend
		• DS3 WAN uplink or subtend
		• T1 WAN uplink or subtend
		• T1 IMA group WAN uplink or subtend
ADSL Interface		CAP—Up to 7.168 Mbps downstream/1.088 Mbps upstream
		DMT—Up to 8.032 Mbps downstream/864 kbps upstream
		G.lite—Up to 1.536 Mbps downstream/512 kbps upstream
SDSL Interface		2B1Q up to 1168 kbps upstream and downstream
SHDSL Interface		TC-PAM up to 2312 kbps upstream and downstream
IDSL Interface		2B1Q
Craft interface		Console terminal connection on the NI-2 card
Management access		• RJ-45 interface for craft alarm discovery
		• RJ-45 Ethernet
		• ATM in-band management
External alarm contacts		Single dry contact alarm input (NO)
Power requirements		Dual inputs, –48VDC each
		Note See Chapter 2, "Preparing for Installation," for detailed power requirements.
CO operating requirements	Temperature	41 to 104ºF (5 to 40ºC)—Operating 23 to 122ºF (–5 to 50ºC)—Short-term operating
	Altitude	–197 to 13,124 feet (–60 to 4,000 meters)
	Humidity	5 to 90% (noncondensing)
Subtending		NI-2 card
		DS3/2DS3+8xT1 IMA I/O card
		DS3/2DS3 I/O card

1. RU = rack unit. An RU is equal to 1.75 inches (4.45 cm).

2. Mounting brackets not included in width

A.1.2 8xIDSL Specifications

Table A-2 lists the specifications for the 8xIDSL.

Table A-2   8xIDSL Specifications

Specification	Description
Standards supported	• Frame Relay FRF.8 • Frame Relay FRF.9 (compatible) • RFC 1661/1662 (PPP over HDLC) • RFC 1973 (PPP over Frame Relay) • ANSI T1.601-1992 • ETSI ETR 080 (1966) • ITU G.961
External interfaces	8 (no connectors on card)
Data rates (per port)	Downstream: Up to 144 kbps Upstream: Up to 144 kbps
Line encoding	2B1Q
Internal hardware	• 50 MHz Motorola MPC860 microprocessor • Siemens PEF 24911/24902 (DFE/AFE) • 32 MB SDRAM • 2 MB Flash
Dimensions	Height: 6.07 in. (15.42 cm) Depth: 8.50 in. (21.59 cm) Width: 0.88 in. (2.24 cm)
Weight	0.8 lb (0.36 kg)
Power consumption	5.5W
Minimum software and network management requirement	Cisco IOS—Release 12.1(2)DA CDM[1]— Release 3.2 (optional)

1. CDM = Cisco DSL Manager

A.1.3 8xG.SHDSL Specifications

Table A-3 lists the specifications for the 8xG.SHDSL.

Table A-3   8xG.SHDSL Specifications

Specification	Description
Standards supported	• TC-PAM without optis • ITU G.991.2 • ITU G.994.1 • ETSI SDSL, TM6(00)10 • ETSI SDSL DRAFT (TS 101 524)
Power consumption	11.3W at 136 kbps 15.0W at 1.554 Mbps 16.5W at 2.312 Mbps
Maximum data rates (per port)	2.312 Mbps
Maximum data rate (per card)	Minimum software—Cisco IOS 12.1(7)DA2 • 18.5 Mbps downstream • 5.0 Mbps for odd ports upstream • 5.0 Mbps for even ports upstream Minimum software—Cisco IOS 12.2(7)DA • 18.5 Mbps downstream • 18.5 Mbps upstream
External interfaces	8 (no connectors on card)
Internal hardware	MPC850 3.3V power 40-Mhz CPU
Dimensions	Height: 6.07 in. (15.42 cm) Depth: 8.50 in. (21.59 cm) Width: 0.88 in. (2.24 cm)
Weight	0.70 lb (0.32 kg)
Minimum software and network management requirement	Cisco IOS—Release 12.1(7)DA2 CDM—Release 3.3(3) (optional)
Minimum software and network management requirement for RADSL[1]	Cisco IOS—Release 12.2(7)DA CDM—Release 3.4 (optional)

1. RADSL = rate adaptive digital subscriber line

A.1.4 8xDMT Specifications

Table A-4 lists the specifications for the 8xDMT.

Table A-4   8xDMT Specifications

Specification	Description
Standards supported	• ANSI T1.413, Category 1 only • ANSI T1.413, Annex F (Reduced NEXT)\\ • Universal Test & Operations PHY for ATM, Level 2; A standard for transport of ATM cells over a 16-bit parallel data bus. Refer to the ATM Forum document af-phy-0039.000. • ITU G.992.1, Annex A (G.dmt) • ITU G.992.2. (G.lite) • ITU G.994.1. (G.hs)
External interfaces	8 (no connectors on card)
Data rates (per port)	Upstream: Up to 1024 kbps Downstream: Up to 8.064 Mbps
Internal hardware	• 40 MHz Motorola MPC850 microprocessor • 8 MB SDRAM • 1 Mb boot flash • 1 kb serial EEPROM
Dimensions	Height: 6.07 in. (15.42 cm) Depth: 8.50 in. (21.59 cm) Width: 0.88 in. (2.24 cm)
Weight	0.875 lb (0.4 kg)
Power consumption	24W
Minimum software and network management requirement	Cisco IOS—Release 12.1(6)DA CDM—Release 3.3(2) (optional)

A.1.5 4xSDSL Specifications

Table A-5 lists the specifications for the 4xSDSL.

Table A-5   4xSDSL Specifications

Specification	Description
Standards supported	ITU G.991.1
External interfaces	4 (no connectors on card)
Maximum data rates (per port) Downstream Upstream	 1168 kbps 1168 kbps
Line encoding	2B1Q
Internal hardware	• AMD 186-based 3.3V 18-MHz CPU • 128 KB SRAM • 512K Flash
Dimensions	Height: 6.07 in. (15.42 cm) Depth: 8.50 in. (21.59 cm) Width: 0.88 in. (2.24 cm)
Weight	0.875 lb (0.4 kg)
Power consumption	9W
Minimum software and network management requirement	Cisco IOS—Release 12.1(1)DA CDM—Release 3.0 (optional)

A.1.6 4xflexi Specifications

Table A-6 lists the specifications for the 4xflexi.

Table A-6   4xflexi Specifications

Specification	Description
External interfaces	4 (no connectors on card)
Internal hardware	• AMD 186-based 3.3V 18-MHz CPU • 128KB SRAM • 512K Flash
Dimensions	Height: 6.07 in. (15.42 cm) Depth: 8.50 in. (21.59 cm) Width: 0.88 in. (2.24 cm)
Weight	0.875 lb (0.4 kg)

Table A-6   4xflexi Specifications (continued)

Specification	Description		
Minimum software and network management requirement	Cisco IOS—Release 12.1(1)DA CDM—Release 3.0 (optional)		
	DMT Mode	**CAP Mode**	**G.lite Mode**
Standards supported	• ITU G.dmt (G.992.1) ANSI T1.413	• RADSL	• ITU G.lite (G.992.2)
Power consumption	17.5W	13.5W	13W
Maximum data rates (per port)			
Downstream	8.032 Mbps	7.168 Mbps	1.536 Mbps
Upstream	864 kbps	1.088 Mbps	512 kbps

A.1.7 DS3+T1/E1 IMA NI-2 Card Specifications

Table A-7 lists the physical and electrical specifications of the DS3+T1/E1 IMA NI-2 card.

Table A-7   DS3+T1/E1 IMA NI-2 Card Specifications

Specification	Description
Internal hardware	• 150 MHz RC64475 CPU • Galileo GT64120 system controller • 1M x 32 boot flash • 4M x 32 Flash • 512 KB boot EPROM
Dimensions	Height: 12.38 in. (31.45 cm) Depth: 8.50 in. (21.59 cm) Width: 1.80 in. (4.57 cm)
Weight	3.0 lb (1.36 kg)
External interfaces[1]	One DS3 (44.736 Mbps) coaxial port Eight T1(1.544 Mbps)/E1 (2.048 Mbps) RJ-48 ports
Connector types[2]	DS3—BNC E1/T1—RJ-48
Impedance	DS3—75 ohms (nominal) T1—100 ohms (nominal) E1—120 ohms (nominal)

Table A-7   DS3+T1/E1 IMA NI-2 Card Specifications (continued)

Specification	Description
Line encoding	DS3—B3ZS T1—AMI or B8ZS E1—AMI or HDB3
Framing	DS3—C-bit parity, optionally PLCP with M23, otherwise ADM[3] T1—SF or ESF E1—PCM30 or CRC4
Transmission distance	DS3—Short haul: <225 feet (68.58 meters), long haul: 225 to 450 feet (68.58 to 137.16 meters) T1/E1—Short haul: 0 to 655 feet (0 to 199.64 meters), long haul: >655 feet (199.64 meters) no span power
Power consumption	32.5W
Minimum software and network management requirement	Cisco IOS • Non-redundant NI-2 card configurations—Release 12.1(6)DA • Redundant NI-2 card configurations—Release 12.1(7)DA CDM—Release 3.3(2) (optional)

1. All external interfaces for the DS3+T1/E1 IMA NI-2 card are located on the I/O card.

2. All trunk and subtend connectors for the DS3+T1/E1 IMA NI-2 card are located on the I/O card.

3. ADM = add/drop multiplexer.

A.1.8 DS3/2DS3 NI-2 Card Specifications

Table A-8 lists the specifications of the DS3/2DS3 NI-2 card.

Table A-8   DS3/2DS3 NI-2 Card Specifications

Specification	Description
Internal hardware	• 150 MHz RC64475 CPU • Galileo GT64120 system controller • 1M x 32 boot flash • 4M x 32 Flash • 512 KB boot EPROM
Dimensions	Height: 12.38 in. (31.45 cm) Depth: 8.50 in. (21.59 cm) Width: 1.80 in. (4.57 cm)
Weight	3.0 lb (1.36 kg)
Layer 2 protocol	ATM
External interfaces[1]	Three DS3/E3 coaxial ports
Connector type[2]	BNC
Impedance	75 ohms (nominal)
Line encoding	B3ZS
Framing	C-bit parity, optionally PLCP with M23, otherwise ADM
Transmission distance	DS3—Short haul: <225 feet (68.58 meters), long haul: 225 to 450 feet (68.58 to 137.16 meters)
Power consumption	33.5W
Minimum software and network management requirement	Cisco IOS • Non-redundant NI-2 card configurations—Release 12.1(1)DA • Redundant NI-2 card configurations—Release 12.1(7)DA CDM—Release 3.0/3.2 (optional)

1. All external interfaces for the DS3/2DS3 NI-2 card are located on the I/O card.

2. All trunk and subtend connectors for the DS3/2DS3 NI-2 card are located on the I/O card.

A.1.9 OC-3c/2DS3 NI-2 Card Specifications

Table A-9 lists the specifications of the OC-3c/2DS3 NI-2 card.

Table A-9   OC-3c/2DS3 NI-2 Card Specifications

Specification	Description	
Internal hardware	• 150 MHz RC64475 CPU • Galileo GT64120 system controller • 1M x 32 boot flash • 4M x 32 Flash • 512 KB boot EPROM	
Dimensions	Height: 12.38 in. (31.45 cm) Depth: 8.50 in. (21.59 cm) Width: 1.80 in. (4.57 cm)	
Weight	3.0 lb (1.36 kg)	
Power consumption	33.5W	
Layer 2 protocol	ATM	
Minimum software and network management requirement	Cisco IOS • Non-redundant NI-2 card configurations—Release 12.1(1)DA • Redundant NI-2 card configurations—Release 12.1(7)DA CDM—Release 3.0/3.2 (optional)	
DS3 Ports (Subtending)	(DS3 port specifications are the same for single-mode and multimode cards.)	
External interfaces[1]	Two DS3 (44.736 Mbps) coaxial ports	
Connector type[2]	BNC	
Impedance	75 ohms (nominal)	
Line encoding	B3ZS	
Framing	C-bit parity, optionally PLCP with M23, otherwise ADM	
OC-3c Port (Trunk)	**Single-Mode Card**	**Multimode Card**
External interface	One OC-3c/STM-1 (155 Mbps) single-mode port	One OC-3c/STM-1 (155 Mbps) multimode port
Connector type	SC-PC	SC-PC
Fiber type	Intermediate reach single mode	Multimode
Average transmitted power	–15 to –8 dBm	–20 to –14 dBm
Average received power	–8 dBm	–11 dBm
Transmission distance	Up to 12 miles (19.3 km)	Up to 1.2 miles (1.93 km)
Wavelength	1310 nm	1300 nm

1. The DS3 subtending interfaces for the OC-3c/2DS3 NI-2 card are located on the I/O card.

2. The BNC subtend connectors for the OC-3c/2DS3 NI-2 card are located on the I/O card.

A.1.10 OC-3c/OC-3c NI-2 Card Specifications

Table A-10 lists the specifications of the single-mode and multimode versions of the OC-3c/OC-3c NI-2 card.

Table A-10   OC-3c/OC-3c NI-2 Card Specifications

Specification	Description	
Internal hardware	• 150 MHz RC64475 CPU • Galileo GT64120 system controller • 1M x 32 boot flash[1] (4 MB) • 4M x 32 Flash (16 MB) • 512 KB boot EPROM	
Dimensions	Height: 12.38 in. (31.45 cm) Depth: 8.50 in. (21.59 cm) Width: 1.80 in. (4.57 cm)	
Weight	3.0 lb (1.36 kg)	
Layer 2 protocol	ATM	
Power consumption	33.5W	
Minimum software and network management requirement	Cisco IOS • Non-redundant NI-2 card configurations—Release 12.1(1)DA • Redundant NI-2 card configurations—Release 12.1(7)DA CDM—Release 3.0/3.2 (optional)	
	Single-Mode Card	**Multimode Card**
External interfaces	Two OC-3c/STM-1 (155 Mbps) single-mode ports	Two OC-3c/STM-1 (155 Mbps) multimode ports
Connector type	SC-PC	SC-PC
Fiber type	Intermediate reach single mode	Multimode
Average transmitted power	–15 to –8 dBm	–20 to –14 dBm
Average received power	–8 dBm	–11 dBm
Transmission distance	Up to 12 miles (19.3 km)	Up to 1.2 miles (1.93 km)
Wavelength	1310 nm	1300 nm

1. The version of the OC-3c/OC-3c NI-2 card with enhanced upstream bandwidth features (NI2-155SM-155SM2 and NI2-155MM-155MM2) has a 2M x 32 bootflash (8 MB).

A.1.11 DS3/2DS3+8xT1 IMA I/O Card Specifications

Table A-11 lists the specifications of the DS3/2DS3+8xT1 IMA I/O card.

Table A-11   DS3/2DS3+8xT1 IMA I/O Card Specifications

Specification	Description
Standards supported	ANSI T1.102
Power consumption	6W
External interfaces	• Three DS3 • Eight T1 • Alarm relay • BITS clock
Internal hardware	N/A
Dimensions	Height: 9.0 in. (22.86 cm) Depth: 0.69 in. (1.75 cm) Width: 10.72 in. (27.22 cm)
Weight	1.2 lb (0.544 kg)
Minimum software and network management requirement	Cisco IOS—Release 12.1(6)DA CDM—Release 3.3(2) (optional)

A.1.12 DS3/2DS3 I/O Card Specifications

Table A-12 lists the specifications of the DS3/2DS3 I/O card.

Table A-12   DS3/2DS3 I/O Card Specifications

Specification	Description
Standards supported	ANSI T1.102
Power consumption	6W
External interfaces	• Three DS3 • Alarm relay • BITS clock
Internal hardware	N/A
Dimensions	Height: 9.0 in. (22.86 cm) Depth: 0.69 in. (1.75 cm) Width: 10.72 in. (27.22 cm)
Weight	1.2 lb (0.544 kg)
Minimum software and network management requirement	Cisco IOS—Release 12.1(1)DA CDM—Release 3.0/3.2 (optional)

A.1.13 PEM Specifications

Table A-13 lists the specifications of the PEM.

Table A-13   PEM Specifications

Specification	Description
Dimensions	Height: 8.82 in. (22.4 cm)
	Depth: 9.27 in. (23.55 cm)
	Width: 2.45 in. (6.223 cm)
Weight	6 lb (2.72 kg)
Power consumption	60W
Minimum software and network management requirements	Cisco IOS—Release 12.0(5)DA
	CDM—Release 3.2 (optional)

A.1.14 Blower Tray Specifications

Table A-14 lists the specifications of the blower tray.

Table A-14   Blower Tray Specifications

Specification	Description
Dimensions	Height: 3.375 in. (8.48 cm)
	Depth: 8.125 in. (20.64 cm)
	Width:18.50 in. (47.0 cm)
Weight	10.5 lb (4.76 kg)
Power consumption	37 to 120W
Minimum software and network management requirement	Cisco IOS—Release 12.0(5)DA
	CDM—Release 3.2 (optional)

A.2 Software Specifications

Table A-15 lists Cisco 6160 system software specifications.

Table A-15   Software Specifications

Specification	Description
Management protocols	Software support for SNMP to Cisco EMF[1]
Management applications	• Cisco IOS • CDM
Management interfaces	In band—ATM VC Out of band—10BaseT Ethernet, console, auxiliary

1. EMF = Element Management Framework

Cable and Port Mapping Specifications

This appendix provides a port mapping table for the Cisco 6160 subscriber connections and a cable standard telco color chart. Cisco used a standard telco color chart when designing the cables for the Cisco 6160 system connections.

Warning **Only trained and qualified personnel should be allowed to install, replace, or service this equipment.**

B.1 Port Mapping Table

Table B-1 maps the Cisco 6160 ports for subscriber connections.

Table B-1   Port Mapping for the Cisco 6160 Subscriber Connectors

Slot/Line	Champ Pins		Cisco 6160 Connector	Slot/Line	Champ Pins		Cisco 6160 Connector
	Tip	Ring			Tip	Ring	
1/1	26	1	JC1 Slots 1 through 3	4/1	26	1	J2 Slots 4 through 6
1/2	27	2		4/2	27	2	
1/3	28	3		4/3	28	3	
1/4	29	4		4/4	29	4	
1/5*	30	5		4/5*	30	5	
1/6*	31	6		4/6*	31	6	
1/7*	32	7		4/7*	32	7	
1/8*	33	8		4/8*	33	8	
2/1	34	9		5/1	34	9	
2/2	35	10		5/2	35	10	
2/3	36	11		5/3	36	11	
2/4	37	12		5/4	37	12	
2/5*	38	13		5/5*	38	13	
2/6*	39	14		5/6*	39	14	
2/7*	40	15		5/7*	40	15	
2/8*	41	16		5/8*	41	16	
3/1	42	17		6/1	42	17	
3/2	43	18		6/2	43	18	
3/3	44	19		6/3	44	19	
3/4	45	20		6/4	45	20	
3/5*	46	21		6/5*	46	21	
3/6*	47	22		6/6*	47	22	
3/7*	48	23		6/7*	48	23	
3/8*	49	24		6/8*	49	24	

Table B-1   Port Mapping for the Cisco 6160 Subscriber Connectors (continued)

Slot/Line	Champ Pins		Cisco 6160 Connector	Slot/Line	Champ Pins		Cisco 6160 Connector
	Tip	Ring			Tip	Ring	
7/1	26	1	JC3 Slots 7 through 9	12/1	26	1	JC4 Slots 12 through 14
7/2	27	2		12/2	27	2	
7/3	28	3		12/3	28	3	
7/4	29	4		12/4	29	4	
7/5*	30	5		12/5*	30	5	
7/6*	31	6		12/6*	31	6	
7/7*	32	7		12/7*	32	7	
7/8*	33	8		12/8*	33	8	
8/1	34	9		13/1	34	9	
8/2	35	10		13/2	35	10	
8/3	36	11		13/3	36	11	
8/4	37	12		13/4	37	12	
8/5*	38	13		13/5*	38	13	
8/6*	39	14		13/6*	39	14	
8/7*	40	15		13/7*	40	15	
8/8*	41	16		13/8*	41	16	
9/1	42	17		14/1	42	17	
9/2	43	18		14/2	43	18	
9/3	44	19		14/3	44	19	
9/4	45	20		14/4	45	20	
9/5*	46	21		14/5*	46	21	
9/6*	47	22		14/6*	47	22	
9/7*	48	23		14/7*	48	23	
9/8*	49	24		14/8*	49	24	

Table B-1   Port Mapping for the Cisco 6160 Subscriber Connectors (continued)

Slot/Line	Champ Pins		Cisco 6160 Connector	Slot/Line	Champ Pins		Cisco 6160 Connector
	Tip	Ring			Tip	Ring	
15/1	26	1	JC5 Slots 15 through 17	34/1	26	1	JC6 Slots 18 and 34
15/2	27	2		34/2	27	2	
15/3	28	3		34/3	28	3	
15/4	29	4		34/4	29	4	
15/5*	30	5		34/5*	30	5	
15/6*	31	6		34/6*	31	6	
15/7*	32	7		34/7*	32	7	
15/8*	33	8		34/8*	33	8	
16/1	34	9		18/1	34	9	
16/2	35	10		18/2	35	10	
16/3	36	11		18/3	36	11	
16/4	37	12		18/4	37	12	
16/5*	38	13		18/5*	38	13	
16/6*	39	14		18/6*	39	14	
16/7*	40	15		18/7*	40	15	
16/8*	41	16		18/8*	41	16	
17/1	42	17					
17/2	43	18					
17/3	44	19					
17/4	45	20					
17/5*	46	21					
17/6*	47	22					
17/7*	48	23					
17/8*	49	24					

Table B-1   Port Mapping for the Cisco 6160 Subscriber Connectors (continued)

Slot/Line	Champ Pins		Cisco 6160 Connector	Slot/Line	Champ Pins		Cisco 6160 Connector
	Tip	Ring			Tip	Ring	
19/1	26	1	JC7 Slots 19 through 21	22/1	26	1	JC8 Slots 22 through 24
19/2	27	2		22/2	27	2	
19/3	28	3		22/3	28	3	
19/4	29	4		22/4	29	4	
19/5*	30	5		22/5*	30	5	
19/6*	31	6		22/6*	31	6	
19/7*	32	7		22/7*	32	7	
19/8*	33	8		22/8*	33	8	
20/1	34	9		23/1	34	9	
20/2	35	10		23/2	35	10	
20/3	36	11		23/3	36	11	
20/4	37	12		23/4	37	12	
20/5*	38	13		23/5*	38	13	
20/6*	39	14		23/6*	39	14	
20/7*	40	15		23/7*	40	15	
20/8*	41	16		23/8*	41	16	
21/1	42	17		24/1	42	17	
21/2	43	18		24/2	43	18	
21/3	44	19		24/3	44	19	
21/4	45	20		24/4	45	20	
21/5*	46	21		24/5*	46	21	
21/6*	47	22		24/6*	47	22	
21/7*	48	23		24/7*	48	23	
21/8*	49	24		24/8*	49	24	

Table B-1   Port Mapping for the Cisco 6160 Subscriber Connectors (continued)

Slot/Line	Champ Pins		Cisco 6160 Connector	Slot/Line	Champ Pins		Cisco 6160 Connector
	Tip	Ring			Tip	Ring	
25/1	26	1	JC9 Slots 25 through 27	28/1	26	1	JC10 Slots 28 through 30
25/2	27	2		28/2	27	2	
25/3	28	3		28/3	28	3	
25/4	29	4		28/4	29	4	
25/5*	30	5		28/5*	30	5	
25/6*	31	6		28/6*	31	6	
25/7*	32	7		28/7*	32	7	
25/8*	33	8		28/8*	33	8	
26/1	34	9		29/1	34	9	
26/2	35	10		29/2	35	10	
26/3	36	11		29/3	36	11	
26/4	37	12		29/4	37	12	
26/5*	38	13		29/5*	38	13	
26/6*	39	14		29/6*	39	14	
26/7*	40	15		29/7*	40	15	
26/8*	41	16		29/8*	41	16	
27/1	42	17		30/1	42	17	
27/2	43	18		30/2	43	18	
27/3	44	19		30/3	44	19	
27/4	45	20		30/4	45	20	
27/5*	46	21		30/5*	46	21	
27/6*	47	22		30/6*	47	22	
27/7*	48	23		30/7*	48	23	
27/8*	49	24		30/8*	49	24	

Table B-1   Port Mapping for the Cisco 6160 Subscriber Connectors (continued)

Slot/Line	Champ Pins		Cisco 6160 Connector	Slot/Line	Champ Pins		Cisco 6160 Connector
	Tip	Ring			Tip	Ring	
31/1	26	1	JC11 Slots 31 through 33				
31/2	27	2					
31/3	28	3					
31/4	29	4					
31/5*	30	5					
31/6*	31	6					
31/7*	32	7					
31/8*	33	8					
32/1	34	9					
32/2	35	10					
32/3	36	11					
32/4	37	12					
32/5*	38	13					
32/6*	39	14					
32/7*	40	15					
32/8*	41	16					
33/1	42	17					
33/2	43	18					
33/3	44	19					
33/4	45	20					
33/5*	46	21					
33/6*	47	22					
33/7*	48	23					
33/8*	49	24					

B.2 Standard Telco Color Chart

In designing the cables for the Cisco 6160 connections, Cisco used a standard telco color chart. Table B-2 lists the colors that are used for the Cisco 6160 cables.

Table B-2   Standard Telco Color Chart

Wire Color	P1	Wire Color	P2		Wire Color	P1	Wire Color	P2
Wht/blu	1	Wht/blu	1		Grn/blk	38	Grn/blk	38
Blu/wht	26	Blu/wht	26		Blk/brn	14	Blk/brn	14
Wht/org	2	Wht/org	2		Brn/blk	39	Brn/blk	39
Org/wht	27	Org/wht	27		Blk/gry	15	Blk/gry	15
Wht/grn	3	Wht/grn	3		Gry/blk	40	Gry/blk	40
Grn/wht	28	Grn/wht	28		Yel/blu	16	Yel/blu	16
Wht/brn	4	Wht/brn	4		Blu/yel	41	Blu/yel	41
Brn/wht	29	Brn/wht	29		Yel/org	17	Yel/org	17
Wht/gry	5	Wht/gry	5		Org/yel	42	Org/yel	42
Gry/wht	30	Gry/wht	30		Yel/grn	18	Yel/grn	18
Red/blu	6	Red/blu	6		Grn/yel	43	Grn/yel	43
Blu/red	31	Blu/red	31		Yel/brn	19	Yel/brn	19
Red/org	7	Red/org	7		Brn/yel	44	Brn/yel	44
Org/red	32	Org/red	32		Yel/gry	20	Yel/gry	20
Red/grn	8	Red/grn	8		Gry/yel	45	Gry/yel	45
Grn/red	33	Grn/red	33		Vio/blu	21	Vio/blu	21
Red/brn	9	Red/brn	9		Blu/vio	46	Blu/vio	46
Brn/red	34	Brn/red	34		Vio/org	22	Vio/org	22
Red/gry	10	Red/gry	10		Org/vio	47	Org/vio	47
Gry/red	35	Gry/red	35		Vio/grn	23	Vio/grn	23
Blk/blu	11	Blk/blu	11		Grn/vio	48	Grn/vio	48
Blu/blk	36	Blu/blk	36		Vio/brn	24	Vio/brn	24
Blk/org	12	Blk/org	12		Brn/vio	49	Brn/vio	49
Org/blk	37	Org/blk	37		Vio/gry	25	Vio/gry	25
Blk/grn	13	Blk/grn	13		Gry/vio	50	Gry/vio	50

Connector and Pinout Specifications

This appendix provides information about connectors and pinouts for configuration of the Cisco 6160 system.

C.1 *x*DSL Connectors

The backplane of the Cisco 6160 chassis contains eleven Champ connectors which connect to the *x*TU-C twisted-pair subscriber data interface. This connection can be made by either of the following:

- Through a POTS splitter for voice and data applications (Cisco 6160 with a POTS splitter configuration)

- Directly to the main distribution frame (MDF) for *x*DSL data only applications (Cisco 6160 without a POTS splitter configuration)

Figure C-1 shows connector pin locations for the *x*DSL Champ connectors. Pin locations are the same for all Champ connectors.

Figure C-1   xDSL Connector Pin Locations
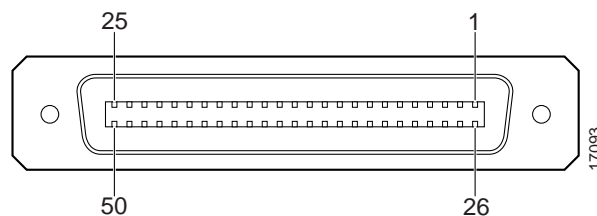
C.2 Cisco 6160 Terminal Block Connectors

Use the terminal block connector to wire the Cisco 6160 to the power source on the fuse and alarm panel. The terminal block connector can also be used to ground the chassis. For more information on power connections and grounding procedures, see the appropriate installation chapter.

Figure C-2 shows the Cisco 6160 system power terminal block.

Figure C-2   Cisco 6160 Terminal Block Connector for Power and Grounding

Correct terminal
position (open)

Incorrect terminal
position (closed)
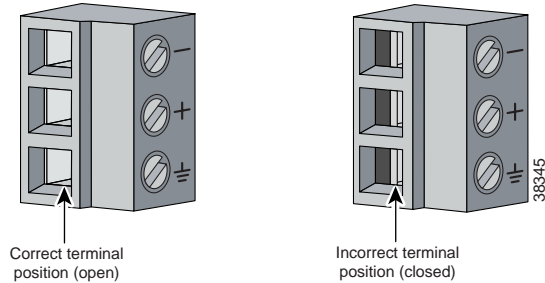
C.3 DS3/2DS3+8xT1 IMA I/O Card Wire-Wrap Pin Mapping

Figure C-3 shows a close-up of the wire-wrap pins.

Figure C-3   DS3/2DS3+8xT1 IMA I/O Card Wire-Wrap Pins Close-Up
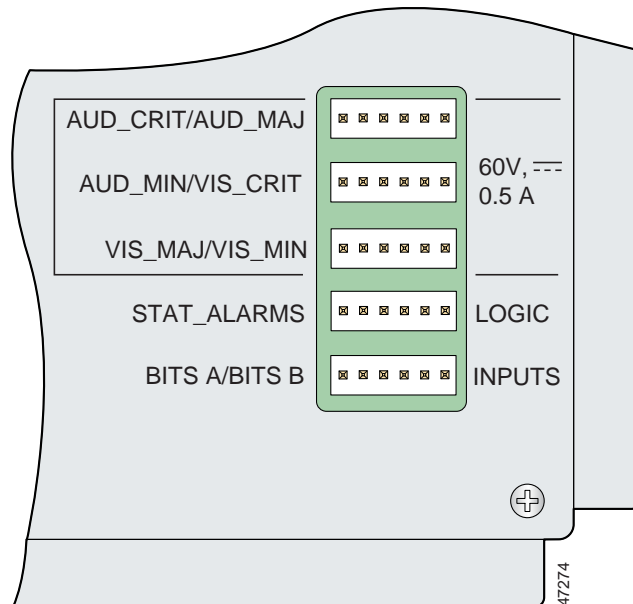
Table C-1 maps the wire-wrap pins to the alarms supported by the NI-2 card through the Cisco 6160 backplane.

Table C-1   DS3/2DS3+8xT1 IMA I/O Card Wire-Wrap Pin Mapping

Pin	AUD[1]_CRIT[2]/ AUD_MAJ[3]	AUD_MIN[4]/ VIS[5]_CRIT	VIS_MAJ/ VIS_MIN	STAT_ ALARMS	BITS A/BITS B
1	AUD_CRITICAL_CO[6]	AUD_MINOR_CO	VIS_MAJOR_CO	DOOR_ALARM	RX[7]_BITS_TIPA (NI-2 slot 11)
2	AUD_CRITICAL_NO[8]	AUD_MINOR_NO	VIS_MAJOR_NO	STATION_3	RX_BITS_RINGA (NI-2 slot 11)
3	AUD_CRITICAL_NC[9]	AUD_MINOR_NC	VIS_MAJOR_NC	STATION_4	RX_BITS_GND[10]/GND
4	AUD_MAJOR_CO	VIS_CRITICAL_CO	VIS_MINOR_CO	STATION_5	RX_BITS_TIPB (NI-2 slot 10)
5	AUD_MAJOR_NO	VIS_CRITICAL_NO	VIS_MINOR_NO	ACO[11]_NO	RX_BITS_RINGB (NI-2 slot 10)
6	AUD_MAJOR_NC	VIS_CRITICAL_NC	VIS_MINOR_NC	STATION_CO/GND	RX_BITS_GND/GND

1. AUD = audible
2. CRIT = critical
3. MAJ = major
4. MIN = minor
5. VIS = visible
6. CO = common
7. RX = receive
8. NO = normally open
9. NC = normally closed
10. GND = ground
11. ACO = alarm cutoff

Note   For additional information about the wire-wrap pins, see the "DS3/2DS3+8xT1 IMA I/O Card Wire-Wrap Pins" section on page 1-46.

The BITS pins on Cisco 6160 DS3/2DS3+8xT1 IMA I/O card are slot specific. BITS_A pins are assigned to slot 11 and BITS_B pins are assigned to slot 10. Each BITS clock input is independent and terminated at 100 ohms.

C.4 DS3/2DS3 I/O Card Wire-Wrap Pin Mapping

Table C-2 maps the wire-wrap pins to the alarms supported by the NI-2 card through the Cisco 6160 backplane.

Table C-2   DS3/2DS3 I/O Card Wire-Wrap Pin Mapping

Pin	P1 AUD CRIT/ AUD MAJ	P2 AUD MIN/ VIS CRIT	P3 VIS MAJ/ VIS MIN	P4 STAT ALARMS	P5 BITS A/ BITS B
1	AUD_CRITICAL_CO	AUD_MINOR_CO	VIS_MAJOR_CO	DOOR_ALARM	RX_BITS_TIPA (NI-2 slot 11)
2	AUD_CRITICAL_NO	AUD_MINOR_NO	VIS_MAJOR_NO	STATION_3	RX_BITS_RINGA (NI-2 slot 11)
3	AUD_CRITICAL_NC	AUD_MINOR_NC	VIS_MAJOR_NC	STATION_4	RX_BITS_GND/GND
4	AUD_MAJOR_CO	VIS_CRITICAL_CO	VIS_MINOR_CO	STATION_5	RX_BITS_TIPB (NI-2 slot 10)
5	AUD_MAJOR_NO	VIS_CRITICAL_NO	VIS_MINOR_NO	ACO_NO	RX_BITS_RINGB (NI-2 slot 10)
6	AUD_MAJOR_NC	VIS_CRITICAL_NC	VIS_MINOR_NC	STATION_CO/GND	RX_BITS_GND/GND

Note   For additional information about the wire-wrap pins, see the "DS3/2DS3 I/O Card Wire-Wrap Pins" section on page 1-51.

The BITS pins on Cisco 6160 DS3/2DS3 I/O card are slot specific. BITS_A pins are assigned to slot 11 and BITS_B pins are assigned to slot 10. Each BITS clock input is independent and terminated at 100 ohms.

C.5 Pinouts for the DS3/2DS3+8xT1 IMA I/O Card RJ-48c Receptacles

The RJ-48c receptacles are used for a T1 or T1 IMA configuration. Table C-3 shows the pin assignments for the receptacles.

Table C-3   Pin Assignments for the RJ-48c Receptacles

Pin	Description
1	Receive ring
2	Receive tip
3	No connection
4	Transmit ring
5	Transmit tip
6	No connection

Table C-3   Pin Assignments for the RJ-48c Receptacles (continued)

Pin	Description
7	No connection
8	No connection

C.6 Console and Auxiliary Ports

The console and auxiliary ports, which are two identical serial EIA/TIA-232 ports, use RJ-45 receptacle connectors on the NI-2 card faceplate. Table C-4 shows the pin assignments, and Figure C-4 shows an RJ-45 receptacle connector.

Table C-4   Pin Assignments for the NI-2 Card Console and Auxiliary Receptacles

Pin Number	Signal
1	RTS
2	DTR
3	TXD
4	GND
5	GND
6	RXD
7	DSR
8	CTS

Figure C-4   NI-2 Card Console and Auxiliary Receptacle

Pin 1

Pin 8

26893

RJ-45 female
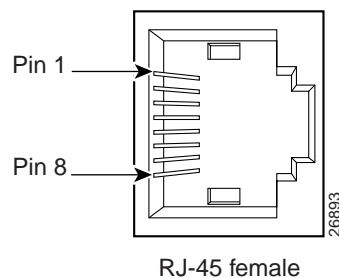
C.7 Ethernet Port

The Ethernet port, a 10BaseT interface with an RJ-45 receptacle connector, is on the NI-2 card faceplate. It is used to connect the Cisco 6160 to the management station, a Sun SPARCstation running Cisco DSL Manager (CDM) software. Table C-5 shows the pin assignments, and Figure C-5 shows an NI-2 card Ethernet connector.

Table C-5   Pin Assignments for the NI-2 Card Management Ethernet Connector

Pin Number	Signal
1	TX+
2	TX–
3	RX+
4	Unused
5	Unused
6	RX–
7	Unused
8	Unused

Figure C-5   NI-2 Card Management Ethernet Connector

RJ-45 female
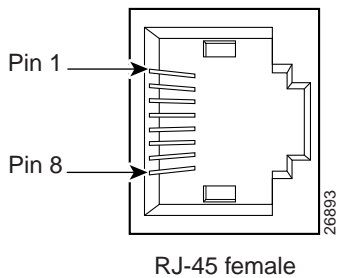
GLOSSARY

Numerics

2B1Q 2 binary 1 quaternary. An encoding scheme that provides a 2 bits per baud, 80k baud per second, 160kbps transfer rate. The most common signaling method on ISDN U interfaces.

4xflexi quad-port flexi ATU-C line card. Supports four ADSL modem connections and CAP, DMT, and G.lite line encoding. For chassis compatibility, refer to the *Cisco DSLAM Compatibility Notes* or the appropriate hardware installation guide.

4xSDSL quad-port STU-C line card. Supports four SDSL modem connections and 2B1Q line encoding. For chassis compatibility, refer to the *Cisco DSLAM Compatibility Notes* or the appropriate hardware installation guide.

8xDMT octal-port DMT ATU-C line card. Supports eight ADSL modem connections and DMT line encoding. For chassis compatibility, refer to the *Cisco DSLAM Compatibility Notes* or the appropriate hardware installation guide.

8xG.SHDSL octal-port SHTU-C line card. Supports eight G.SHDSL modem connections and TC-PAM line encoding. For chassis compatibility, refer to the *Cisco DSLAM Compatibility Notes* or the appropriate hardware installation guide.

8xIDSL octal-port ITU-C line card. Supports eight IDSL modem connections, or four connections when the chassis limits the number of tip and ring connectors. Supports 2B1Q line encoding. For chassis compatibility, refer to the *Cisco DSLAM Compatibility Notes* or the appropriate hardware installation guide.

A

AAL ATM adaptation layer. AAL is an adaptation layer within the data link layer of the OSI model. AAL is divided into a segmentation and reassembly sublayer (SAR) and a convergence sublayer. The SAR divides the application datastream into transmit cells and then reassembles the received cells into a datastream that is compatible with the related application. The convergence sublayer specifies the requirements for the various types of applications that run over ATM. AAL is defined in terms of types, 1 to 5, specified by the type of traffic that it supports. Each type offers an appropriate QoS.

ABR available bit rate. A QoS class defined by the ATM Forum for ATM networks. ABR is used for connections that do not require timing relationships between source and destination. ABR provides no guarantees in terms of cell loss or delay, providing only best-effort service. Traffic sources adjust their transmission rate in response to information they receive describing the status of the network and its capability to successfully deliver data. Compare with *CBR*, *UBR*, and *VBR*.

accounting management	One of five categories of network management defined by ISO for the management of ISO networks. Accounting management subsystems are responsible for collecting network data that relates to resource usage. See also *configuration management*, *fault management*, *performance management*, and *security management*.
address	Data structure or logical convention used to identify a unique entity, such as a particular process or network device.
ADSL	asymmetric digital subscriber line. An *x*DSL technology in which more bandwidth is delivered downstream (from the CO to the customer site) than upstream over a single copper twisted pair. Compare with *IDSL*, *SDSL*, and *SHDSL*. See also *DSL*.
alarm	A notification that a traffic signal has degraded or failed or that equipment is malfunctioning. See also *event* and *trap*.
AM	amplitude modulation. A modulation technique by which information is conveyed through the amplitude of the carrier signal. Compare with *FM* and *PAM*. See also *modulation*.
American National Standards Institute	See *ANSI*.
American Wire Gauge	See *AWG*.
amplitude modulation	See *AM*.
ANSI	American National Standards Institute. An organization that coordinates, develops, and approves international and U.S. standards for, among other things, communications and networking. ANSI is a member of ISO. See also *ISO*.
APS	automatic protection switching. A method that allows transmission equipment to recover automatically from failures, such as a cut cable.
asymmetric digital subscriber line	See *ADSL*.
asynchronous communications	A method of transmitting data in which individual characters are encapsulated in control bits (called start and stop bits) that designate the beginning and end of each character. Asynchronous transmission allows communication without precise clocking.
Asynchronous Transfer Mode	See *ATM*.
ATM	Asynchronous Transfer Mode. The international standard for cell relay in which multiple service types (voice, video, or data, for example) are transmitted in fixed-length (53-byte) cells. ATM offers fast packet technology, and real-time, demand-led switching for efficient use of network resources.
ATM adaptation layer	See *AAL*.
ATU-C	See *xTU-C*.
ATU-R	See *xTU-R*.

authentication	In security, the verification of the identity of a person or a process.
autodiscovery	The process by which a network device automatically searches through a range of network addresses and discovers the known types of devices that are present. Also see *subrack discovery*.
automatic protection switching	See *APS*.
available bit rate	See *ABR*.
AWG	American Wire Gauge. The standard gauge for measurement of thickness of a wire in the United States.

B

backplane	The physical connection between an interface processor or card and the data buses and the power distribution buses inside a DSLAM.
bandwidth	The difference between the highest and lowest frequencies available for network signals. The term also is used to describe the rated throughput capacity of a given network medium or protocol. For a digital channel, this is defined in bits. For an analog channel, it depends on the type and method of modulation used to encode the data.
bandwidth on demand	The ability of a user to dynamically set upstream and downstream line speeds to a particular rate of speed.
BITS	building integrated timing supply. A clock in a CO that supplies DS1 or composite clock timing references to all synchronous network elements in that office.
bits per second	See *bps*.
bootflash	Separate Flash memory device used primarily to store the Cisco IOS boot image, operational Cisco IOS images, and system configuration information.
BOOTP	Bootstrap Protocol. The protocol used by a network node to determine the IP address of its Ethernet interfaces to affect network booting.
Bootstrap Protocol	See *BOOTP*.
bps	bits per second. A standard measurement of digital transmission speeds.
bridge	A device that connects two or more physical networks and forwards packets between them. Bridges can usually be made to filter packets, that is, to forward only certain traffic. See *switch* and *router*.
broadband	In telecommunications, any channel having a bandwidth greater than a voice-grade channel (4 kHz).
broadband remote access server	Device that terminates remote users at the corporate network or Internet users at the internet service provider (ISP) network that provides firewall, authentication, and routing services for remote users.
broadcast	Data packet that are sent to all nodes on a network. Broadcasts are identified by a broadcast address. Compare with *multicast* and *unicast*.

building integrated timing supply	See *BITS*.
bus topology	A linear method of connecting devices so that transmissions from network stations propagate the length of the medium and are received by all other stations. Compare with *daisy-chain topology*, *ring topology*, *star topology*, and *tree topology*.

C

CAP	Carrierless Amplitude and Phase Modulation. A bandwidth efficient transmission technology for implementing DSL. The transmit and receive signals are modulated into two wide-frequency bands using passband modulation techniques. CAP supports ADSL and RADSL line coding.
Carrierless Amplitude and Phase Modulation	See *CAP*.
CBOS	Cisco Broadband Operating System. The operating system that users access to configure and operate the Cisco 600 Series DSL CPE products.
CBR	constant bit rate. A QoS class defined by the ATM Forum for ATM networks. CBR is used for connections that depend on precise clocking to ensure undistorted delivery. Compare with *ABR*, *UBR*, and *VBR*.
CDM	Cisco DSL Manager. An SNMP-based element management system with fault, configuration, and performance reporting capabilities. CDM runs within the Cisco EMF and manages DSLAMs through a GUI.
central office	See *CO*.
chassis	The cage or housing into which cards or modules are installed. See also *DSLAM* and *multiplexer*.
child	See *subtended node chassis*.
Cisco Broadband Operating System	See *CBOS*.
Cisco DSL Manager	See *CDM*.
Cisco Element Management Framework	See *Cisco EMF*.
Cisco EMF	Cisco Element Management Framework. The element management layer of the system. Cisco EMF provides the framework to support carrier-class element managers across Cisco service provider product lines.
Cisco IOS	Cisco system software that provides common functionality, scalability, and security for all products under the CiscoFusion architecture. Cisco IOS is a CLI that allows centralized, integrated, and automated installation and management of internetworks while ensuring support for a wide variety of protocols, media, services, and platforms.

Cisco Service Management	See *CSM*.
CLEI	common language equipment identifier. The standard code used by suppliers to identify equipment parts and system configurations. CLEI is a registered trademark of Bellcore (now Telcordia).
CLI	command line interface. An interface that allows the user to interact with the operating system by entering commands and optional arguments.
client	Node or software program (front-end device) that requests services from a server.
CO	central office. A local telephone company office at all local loops in a given area connect and where the circuit switching of subscriber lines occurs.
command line interface	See *CLI*.
common language equipment identifier	See *CLEI*.
community string	Text string that acts as a password used with SNMP protocol. The password is used to authenticate messages and can be read-only or have read/write privileges; setting it to read-only is private and setting it to read-write is public. A community string is case sensitive.
configuration management	One of five categories of network management defined by ISO for the management of OSI networks. Configuration management subsystems are responsible for detecting and determining the state of a network. See also *accounting management*, *fault management*, *performance management*, and *security management*.
configuration register	In Cisco DSLAMs, a 16-bit, user-configurable value that determines how the DSLAM functions during initialization. The configuration register can be stored in hardware or software. In hardware, the bit position is set using a jumper. In software, the bit position is set by specifying a hexadecimal value using configuration commands.
connectionless network	A type of communications network in which no logical connection (for example, no leased line or dialed-up channel) is required between sending and receiving stations. Compare with *connection-oriented network*.
connection-oriented network	A type of communications network in which data transfer requires the establishment of a virtual circuit. Compare with *connectionless network*.
constant bit rate	See *CBR*.
CPE	customer premises equipment. Terminating equipment, such as terminals, telephones, and modems, supplied by the telephone company. The equipment is installed at customer sites and connected to the telephone company network.
CSM	Cisco Service Management system of OAM&P and management tools for service providers and large enterprise networks.
customer premises equipment	See *CPE*.

D

daemon	A program that is not invoked explicitly but lies dormant waiting for some condition(s) to occur.
daisy-chain topology	A method of connecting devices in a series so that signals are passed through the chain from one device to the next. Unlike a ring topology, the last device in the series is not connected to the first. Compare with *bus topology*, *ring topology*, *star topology*, and *tree topology*.
data circuit-terminating equipment	See *DCE*.
data storage backup	Process of making a copy of the data that resides on a server.
data terminal equipment	See *DTE*.
DCE	Data circuit-terminating equipment (ITU-T expansion). Devices and connections of a communications network that comprise the network end of the user-to-network interface. The DCE provides a physical connection to the network, forwards traffic, and provides a clocking signal used to synchronize data transmissions between DCE and DTE devices. Modems and interface cards are examples of DCE. Compare with *DTE*.
DDTS	Distributed Defect Tracking System. Cisco tracks bugs in a variety of products, including router software, communication server software, and network management software, using a system called DDTS. DDTS is also used for bugs in some hardware and microcode products, and for bugs in some internal tools, including the automated test software and various Software Tools.
destination address	Address of a network device that is receiving data. See also *source address*.
DHCP	Dynamic Host Configuration Protocol. Provides a mechanism to allocate IP addresses dynamically so that addresses can be reused when hosts no longer need them. Defined in RFC 2131.
digital signal level 3	See *DS3*.
digital subscriber line	See *DSL*.
digital subscriber line access multiplexer	See *DSLAM*.
Discrete Multitone	See *DMT*.
Distributed Defect Tracking System	See *DDTS*.
distributed server	Server that supports a specific group of users on the network. Also referred to as local or workgroup server.
DMT	Discrete Multitone. A technology that uses digital signal processors to transmit more than 6 Mbps of video, data, image, and voice signals over existing one pair copper wiring. DMT supports ADSL line coding.

downstream	Data that is coming from the NI-2 card to the subscriber lines. See also *upstream*.
DS3	digital signal level 3. A framing specification used for transmitting digital signals at 44.736 Mbps on a T3 facility. See also *E3*.
DSL	digital subscriber line. Public network technology that delivers high bandwidth over conventional copper wiring at limited distances. There are several types of DSL: ADSL, IDSL, SDSL, and SHDSL, to name a few. All are provisioned via modem pairs, with one modem located at a CO and the other at the customer site. Because most DSL technologies do not use the whole bandwidth of the twisted pair, there is room remaining for a voice channel. See also *ADSL*, *IDSL*, *SDSL*, and *SHDSL*.
DSL Forum	An organization of competing companies that sponsors an Internet Web site (http://www.adsl.com) containing information about the applications, technology, systems, market, trials, and tariffs related to DSL technology.
DSLAM	digital subscriber line access multiplexer. A device that connects many digital subscriber lines to a network by multiplexing the DSL traffic onto one or more network trunk lines. The Cisco DSLAMs include the Cisco 6015, Cisco 6100, Cisco 6130, Cisco 6160, and Cisco 6260. See also *chassis* and *multiplexer*.
DTE	data terminal equipment. Device at the user end of a user-network interface that serves as a data source, destination, or both. DTE connects to a data network through a DCE device (for example, a modem) and typically uses clocking signals generated by the DCE. DTE includes such devices as computers, protocol translators, and multiplexers. Compare with *DCE*.
Dynamic Host Configuration Protocol	See *DHCP*.

E

E1	Wide-area digital transmission scheme used predominantly in Europe that carries data at a rate of 2.048 Mbps. See also *T1*.
E3	Wide-area digital transmission scheme used predominantly in Europe that carries data at a rate of 34.368 Mbps. See also *DS3* and *T3*.
EFCI	explicit forward congestion indication. In ATM, one of the congestion feedback modes allowed by ABR service. EFCI is set by a network element to notify the destination end-system of congestion or impending congestion in the network.
EIA	Electronic Industries Alliance. A standards organization made up of electronics industry organizations. EIA is responsible for the RS-232C and RS-422 standards.
Electronic Industries Alliance	See *EIA*.
electrostatic discharge	See *ESD*.

encapsulation	The wrapping of data in a particular protocol header. For example, Ethernet data is wrapped in a specific Ethernet header before network transit. Also, when bridging a dissimilar network, the entire frame from one network is placed in the header used by the data link layer protocol of the other network.
EPROM	Erasable programmable read-only memory. Nonvolatile memory chips that are programmed after they are manufactured, and, if necessary, can be erased by some means and reprogrammed.
erasable programmable read-only memory	See *EPROM*.
error detection	A process used during file transfer to discover discrepancies between transmitted and received data. Some file transfer programs only detect errors; others detect errors and attempt to fix them (called error correction).
ESD	electrostatic discharge. Discharge of stored static electricity that can damage electronic equipment and impair electrical circuitry, resulting in complete or intermittent failures.
ESF	Extended Superframe. A framing type that is used on T1 circuits that consists of 24 frames of 192 bits each, with the 193rd bit providing timing and other functions.
Ethernet	One of the most common LAN wiring schemes, Ethernet has a transmission rate of 10 Mbps; a newer standard called Fast Ethernet has a rate of 100 Mbps.
ETSI	European Telecommunications Standards Institute. ETSI is a non-profit organization producing voluntary telecommunications standards used throughout Europe, some of which have been adopted by the european community as the technical base for Directives or Regulations.
European Telecommunications Standards Institute	See *ETSI*.
event	Network message indicating operational irregularities in physical elements of a network or a response to the occurrence of a significant task, typically the completion of a request for information. See also *alarm* and *trap*.
explicit forward congestion indication	See *EFCI*.
Extended Superframe	See *ESF*.

F

fault management	One of five categories of network management defined by ISO for management of OSI networks. Fault management attempts to ensure that network faults are detected and controlled. See also *accounting management*, *configuration management*, *performance management*, and *security management*.

FCC	Federal Communications Commission. A U.S. government agency that regulates interstate and foreign communications. The FCC sets rates for communication services, determines standards for equipment, and controls broadcast licensing.
Federal Communications Commission	See *FCC*.
ferrite	Use on coaxial cables to reduce the radiation/EMI susceptibility to high frequency noise.
field replaceable unit	See *FRU*.
File Transfer Protocol	See *FTP*.
firmware	Software instructions set permanently or semi-permanently in ROM.
flash memory	A special type of EPROM that can be used and reprogrammed in blocks instead of one byte at a time.
FM	frequency modulation. Modulation technique in which signals of different frequencies represent different data values. Compare with *AM* and *PAM*. See also *modulation*.
frame	A packet as it is transmitted over a serial line. The term derives from character-oriented protocols that involved the addition of special start-of-frame and end-of-frame characters for packet transmission.
frequency modulation	See *FM*.
FRU	field replaceable unit. Hardware component that can be removed and replaced on-site. Typical FRUs include cards, modules, PEMs, and some chassis components. When FRUs are removed from the chassis, service is interrupted for some or all of the system.
FTP	File Transfer Protocol. The application protocol used to transfer files between network nodes.

G

G.992.1	Also known as *G.dmt*.
G.992.2	The ITU standard for line coding and framing for splitterless, reduced spectrum ADSL. Also known as *G.lite*.
G.994.1	The ITU standard for signaling, identification, and negotiation between broadband systems; an integral part of G.dmt and G.lite. Also known as *G.hs*.
G.997.1	The ITU standard for performance monitoring on DMT access technologies.
G.dmt	Pseudonym for G.992.1.
G.hs	Pseudonym for G.994.1.
G.lite	Pseudonym for G.992.2.

G.SHDSL	See *SHDSL*.
graphical user interface	See *GUI*.
GUI	graphical user interface. A user environment that uses pictorial as well as textual representations of the input and the output of applications and the hierarchical or other data structure in which information is stored.

H

handshake	See *hs*.
HDLC	High-Level Data Link Control. Bit-oriented synchronous data link layer protocol developed by ISO. Derived from Synchronous Data Link Control (SDLC), HDLC specifies a data encapsulation method on synchronous serial links using frame characters and checksums.
header	(1) The protocol control information that is located at the beginning of a protocol data unit. (2) The portion of a message that contains information to guide the message to the correct destination and contains, for example, sender and receiver addresses and routing instructions.
High-Level Data Link Control	See *HDLC*.
host	Computer system on a network. Similar to the term node, except that host usually implies a computer system; node generally applies to any networked system, including access servers and routers. See also *node*.
hot swapping	Feature that permits the addition, replacement, or removal of cards or modules without interrupting the system power, entering console commands, or causing other software or interfaces to shut down. Sometimes called "online insertion and removal" or "power-on servicing." Removal of some cards causes interruption to some or all of the system.
hs	handshake. Sequence of messages that are exchanged between two or more network devices to ensure transmission synchronization.

I

I/O card or I/O module	input/output card or module.
ICP cell	IMA control protocol cell. IMA control protocol cell used for aligning the cells in multiple links.
IDSL	ISDN digital subscriber line. An *x*DSL technology that uses ISDN technology to deliver data at speeds of 128 Kbps over copper loops as long as 18,000 feet. IDSL is reserved for data communications only. Compare with *ADSL*, *SDSL*, and *SHDSL*. See also *DSL*.
IEEE	Institute of Electrical and Electronics Engineers. A U.S. publishing and standards organization responsible for many LAN standards.

IMA	inverse multiplexing over ATM. A standard protocol defined by the ATM Forum in 1997.
IMA control protocol cell	See *ICP cell*.
IMA group	Physical links grouped to form a higher-bandwidth logical link the rate of which is approximately the sum of the individual link rates.
industrial temperature	See *ITEMP*.
Institute of Electrical and Electronics Engineers	See *IEEE*.
Integrated Services Digital Network	See *ISDN*.
intermixing	Installation of line cards with different modulation types into a single DSLAM. Intermixing rules are determined by spectral frequency overlap considerations, chassis type, and line card modulation type.
International Organization for Standardization	See *ISO*.
International Telecommunication Union Telecommunication Standardization Sector	See *ITU-T*.
inverse multiplexing	Process whereby physical links are grouped to form a higher-bandwidth logical link whose rate is approximately the sum of the individual link rates.
inverse mutliplexing over ATM	See *IMA*.
ISDN	Integrated Services Digital Network. Communication protocol offered by telephone companies that permits telephone networks to carry data, voice, and other source traffic.
ISDN digital subscriber line	See *IDSL*.
ISO	International Organization for Standardization. A voluntary, nontreaty organization founded in 1946 that is responsible for creating international standards in many areas, including computers and communications.
ITEMP	industrial temperature.
ITU-C	See *xTU-C*.

ITU-R   See *xTU-R*.

ITU-T   International Telecommunication Union Telecommunication Standardization Sector. ITU-T is the telecommunication standardization sector of ITU and is responsible for making technical recommendations about telephone and data (including fax) communications systems for service providers and suppliers.

J

jitter   In telecommunications, analog communication line distortion caused by the variation of a signal from its reference timing positions. Jitter can cause data loss, particularly at high speeds.

L

LAN   local-area network. High-speed, low-error data network covering a relatively small geographic area (up to a few thousand meters). LANs connect workstations, peripherals, terminals, and other devices in a single building or other geographically limited area. LAN standards specify cabling and signaling at the physical and data link layers of the OSI model. Ethernet, FDDI, and Token Ring are widely used LAN technologies. Compare with *WAN*.

laser   light amplification by stimulated emission of radiation. Analog transmission device in which a suitable active material is excited by an external stimulus to produce a narrow beam of coherent light that can be modulated into pulses to carry data. Networks based on laser technology are sometimes run over SONET.

LED   light emitting diode. The lights indicate status or activity of electronic equipment.

light emitting diode   See *LED*.

line rate   The speed at which data is transferred over a particular line type, expressed in bps.

link   Network communications channel that consists of a circuit or transmission path and all related equipment between a sender and a receiver. In a transmission network, a link is a point-to-point connection between adjacent nodes.

local-area network   See *LAN*.

logical port   A logical entry to a server machine. Logical ports are mostly invisible to the user, though you may occasionally see a URL with a port number included in it. These ports do not refer to physical locations; they are set up by server administrators for network trafficking.

loopback   A diagnostic test that returns the transmitted signal to the sending device after the signal has passed through a network or across a particular link. The returned signal can then be compared to the transmitted one and the discrepancies between the two can be used to trace the fault. When you are trying to locate a faulty piece of equipment, you can repeat loopbacks, eliminating satisfactory machines, until the problem is found.

M

managed object	In network management, a network device that can be managed by a network management protocol.
Management Information Base	See *MIB*.
maximum rate	Maximum total data throughput allowed on a given virtual circuit. The maximum rate, which cannot exceed the media rate, represents the highest data throughput the virtual circuit will ever deliver, measured in bps or cells per second.
MIB	Management Information Base. A collection of objects that can be accessed through a network management protocol, such as SNMP or Common Management Information Protocol (CMIP).
MMF	multimode fiber. Optical fiber that supports the propagation of multiple frequencies of light. See also *SMF*.
modulation	Process by which the characteristics of electric signals are transformed to represent information. Types of modulation include AM, FM, and PAM. See also *AM*, *FM*, and *PAM*.
multicast	Single packets copied by the network and sent to a specific subset of network addresses. Compare with *broadcast* and *unicast*.
multimode fiber	See *MMF*.
multiplexer	Equipment that enables several data streams to be sent over a single physical line. A device for combining several channels to be carried by one line or fiber. See also *chassis* and *DSLAM*.

N

NAT	Network Address Translation. Mechanism for reducing the need for globally unique IP addresses. NAT allows an organization with addresses that are not globally unique to connect to the Internet by translating those addresses into globally routable address space.
NEBS	Network Equipment Building Systems. An extensive set of performance, quality, environmental and safety requirements developed by Bellcore (now Telcordia).
network	Collection of computers, printers, routers, switches, and other devices that can communicate with each other over some transmission medium.
Network Address Translation	See *NAT*.
network element	A network element is generally a combination hardware and software system that is designed primarily to perform a telecommunications service function.
Network Equipment Building Systems	See *NEBS*.
network management	Generic term used to describe systems or actions that help maintain, characterize, or troubleshoot a network.

network management system	See *NMS*.
network timing reference	See *NTR*.
NI-2 card	A second generation network interface card for Cisco DSLAMs. Board that works with the network software and operating systems to transmit and receive messages on a network.
NMS	network management system. A system responsible for managing at least part of a network. An NMS communicates with agents to help keep track of network statistics and resources.
node	Endpoint of a network connection or a junction common to two or more lines in a network. Nodes can be processors, controllers, or workstations. Nodes can be interconnected by links and serve as control points in the network. Node sometimes is used generically to refer to any entity that can access a network, and frequently is used interchangeably with device. See also *host*.
node system save file	See *NSS file*.
noise margin	Noise margin is the margin between the signal and noise in decibels (dB). The recommended minimum noise margin is typically 6dB. The 6dB noise margin was specified based on empirical research and the resulting algorithms to allow the best performance (line rate and reach) while maintaining the 10-7 bit-error rate. When RADSL is enabled for a DSL DMT application, the modem will train to 1) the specified rate or 2) the highest rate possible given the line conditions while maintaining a 6dB margin.
nonvolatile random-access memory	See *NVRAM*.
NSS file	node system save file. The file that is saved during the Save Configuration procedure or during a software download. This file is required for the Restore Configurations procedure.
NTR	Network timing reference. In DSL, NTR enables the DSLAM to provide clocking for network devices that reside beyond the CPE. The CPE must support NTR to enable this feature.
NVRAM	nonvolatile random-access memory. RAM that retains its contents when a unit is powered off.

O

OAM&P	operations, administration, management, and provisioning. Provides the facilities and the personnel required to manage a network.
OC	Optical Carrier. 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 multimode fiber-optic line at a variety of speeds. The base rate is 51.84 Mbps (OC-1); each signal level thereafter operates at a speed divisible by that number (thus, OC-3 runs at 155.52 Mbps). See also *SONET* and *STS-3c*.
OC-*n*	SONET optical carrier, Level *n* (such as *n* equals 3, 12, 48, 192).

Open System Interconnection	See *OSI*.
operations, administration, management, and provisioning	See *OAM&P*.
Operations Support System	See *OSS*.
octal-port DMT ATU-C line card	See *8xDMT*.
octal-port ITU-C line card	See *8xIDSL*.
octal-port SHTU-C line card	See *8xG.SHDSL*.
Optical Carrier	See *OC*.
optical fiber	See *MMF* and *SMF*.
OSI	Open System Interconnection. An international standardization program created by ISO and ITU-T to develop standards for data networking that facilitate multivendor equipment interoperability. See also *ISO*.
OSS	Operations Support System. Network management system supporting a specific management function, such as alarm surveillance and provisioning, in a carrier network.

P

PAM	pulse amplitude modulation. Modulation scheme where a continuous analog signal is represented with a series of discrete analog samples, which are then recreated as a complete signal. Sampling allows several signals to be combined on a channel that would otherwise carry only one signal. Compare with *AM* and *FM*. See also *modulation*.
parent	See *subtending host chassis*.
PEM	power entry module. A hardware module that distributes power throughout a DSLAM.
performance management	One of five categories of network management defined by ISO for the management of ISO networks. Performance management subsystems are responsible for analyzing and controlling network performance, including network throughput and error rates. See also *accounting management*, *configuration management*, *fault management*, and *security management*.
permanent virtual circuit	See *PVC*.
permanent virtual connection	See *PVC*.

permanent virtual path	See *PVP*.
physical port	A physical connection to a computer through which data flows. An Ethernet port, for example, is the point at which the Ethernet network cabling plugs into a computer.
plain old telephone service	See *POTS*.
Point-to-Point Protocol	See *PPP*.
port	An interface on an internetworking device (such as a DSLAM).
POTS	plain old telephone service. General term referring to the variety of telephone networks and services in place worldwide.
POTS splitter	A device that enables both a DSL data device and a standard analog device to share the same ADSL or IDSL line.
power entry module	See *PEM*.
PPP	Point-to-Point Protocol. The successor to SLIP that provides router-to-router and host-to-network connections over both synchronous and asynchronous circuits. See *SLIP*.
protocol	A formal description of messages to be exchanged and rules to be followed so that two or more systems can exchange information.
pulse amplitude modulation	See *PAM*.
PVC	permanent virtual circuit (or connection). A virtual circuit that is permanently established. PVCs save bandwidth associated with circuit establishment and tear down in situations where certain virtual circuits must exist all the time. Compare with SVC. See also *virtual circuit*.
PVP	permanent virtual path. A virtual path that consists of PVCs. See also *PVC* and *virtual path*.

Q

QoS	quality of service. A measure of performance for a transmission system that reflects its transmission quality and service availability.
quad-port flexi ATU-C line card	See *4xflexi*.
quad-port STU-C line card	See *4xSDSL*.
quality of service	See *QoS*.

R

RADIUS Remote Authentication Dial-In User Service. A client/server security protocol created by Livingston Enterprises. Security information is stored in a central location, known as the RADIUS server.

RADSL rate adaptive digital subscriber line. A transmission technology that supports adaptive transmission rates through the use of intelligent DSL modems, which negotiate the line rate according to line conditions and profile specifications. Once the line rate is negotiated, the rate is locked when the line trains. RADSL supports both asymmetric and symmetric applications on a single twisted pair telephone line. See *ADSL*.

RAM random-access memory. Volatile memory that can be read and written by a microprocessor.

random-access memory See *RAM*.

Rate Adaptive Digital Subscriber Line See *RADSL*.

read-only memory See *ROM*.

redundancy In internetworking, the duplication of devices, services, or connections so that, in the event of failure, the redundant devices, services, or connections can perform the work of those that failed.

remote address The IP address of a remote server.

Remote Authentication Dial-In User Service See *RADIUS*.

remote monitoring See *RMON*.

remote server A network computer that allows a user to log on to the network from a distant location.

Request for Comments See *RFC*.

RFC Request for Comments. The document series, begun in 1969, which describes the Internet suite of protocols and related experiments. Not all RFCs describe Internet standards, but all Internet standards are written up as RFCs.

ring topology A method of connecting devices so that a series of repeaters is connected to one another by unidirectional transmission links to form a single closed loop. Each station on the network connects to the network at a repeater. Compare with *bus topology*, *daisy-chain topology*, *star topology*, and *tree topology*.

RMON remote monitoring. MIB agent specification described in RFC 1271 that defines functions for the remote monitoring of networked devices. The RMON specification provides numerous monitoring, problem detection, and reporting capabilities.

ROM read-only memory. Nonvolatile memory that can be read, but not written, by the microprocessor.

router	A system responsible for making decisions about which of several paths network (or Internet) traffic will follow. The router uses a routing protocol to gain information about the network and algorithms to choose the best route based on several criteria known as "routing metrics." See also *bridge* and *switch*.
routing table	A table that is stored in a router or some other internetworking device that keeps tracks of routes to particular network destinations, and, in some cases, metrics associated with those routes. A routing table is used to select the most appropriate route to forward information.

S

scalability	Capacity of a network to keep pace with changes and growth.
SDSL	symmetrical digital subscriber line. An *x*DSL technology that can delivers 1.168 Mbps downstream and upstream over a single copper twisted pair. The use of a single twisted pair limits the operating range of SDSL to 10,000 feet (3048.8 meters). Compare with *ADSL*, *IDSL*, and *SHDSL*. See also *DSL*.
security management	One of five categories of network management defined by ISO for the management of ISO networks. Security management subsystems are responsible for controlling access to network resources. See also *accounting management*, *configuration management*, *fault management*, and *performance management*.
Serial Line Internet Protocol	See *SLIP*.
server	Node or software program that provides services to clients.
SHDSL	single-pair high-speed digital subscriber line, also known as symmetric high bit rate digital subscriber loop. A version of *x*DSL that includes advanced Trellis line code, a precoding mechanism, spectral shaping, equalization circuits, and forward error correction. SHDSL can deliver 2.312 Mbps of bandwidth downstream and upstream over a single copper twisted pair. Compare with *ADSL*, *IDSL*, and *SDSL*. See also *DSL*.
shielded twisted pair	A pair of insulated wires which are twisted together in a spiral manner. In addition, the pair is wrapped with metallic foil or braid, designed to insulate the pair from electromagnetic interference. Sometimes referred to as STP. See also *twisted pair* and *unshielded twisted pair*.
SHTU-C	See *xTU-C*.
SHTU-R	See *xTU-R*.
signal-to-noise ratio	See *SNR*.
Simple Network Management Protocol	See *SNMP*.
single-mode fiber	See *SMF*.
single-pair high-speed digital subscriber line	See *SHDSL*.

SLIP	Serial Line Internet Protocol. A standard protocols for point-to-point serial connections using a variation of TCP/IP. This protocol is the predecessor of PPP. See *PPP* and *TCP*.
slot	A numbered location within a chassis, which is capable of housing a card or module.
SMF	single-mode fiber. Fiber-optic cabling with a narrow core that allows light to enter only at a single angle. Such cabling has higher bandwidth than multimode fiber, but requires a light source with a narrow spectral width (for example, a laser). See also *MMF*.
SNMP	Simple Network Management Protocol. The network management protocol of choice for TCP/IP-based internets. SNMP provides a means to monitor and control network devices, and to manage configurations, statistics collection, performance, and security.
SNR	signal-to-noise ratio. The usable signal being transmitted divided by the noise or undesired signal. SNR is a measure of transmission quality.
SONET	Synchronous Optical Network. A standard format for transporting a wide range of digital communications services over optical fiber. SONET is characterized by standard line rates, optical interfaces, and signal formats.
source address	Address of a network device that sends data. See also *destination address*.
star topology	A method of connecting devices in which end points on a network are connected to a common central switch by point-to-point links. Compare with *bus topology*, *daisy-chain topology*, *ring topology*, and *tree topology*.
STM-1	Synchronous Transfer Module 1. Synchronous Digital Hierarchy standard for transmission over OC-3c optical fiber at 155.52 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. See also *SONET*.
STU-C	See *xTU-C*.
STU-R	See *xTU-R*.
subinterface	One of a number of virtual interfaces on a single physical interface.
subnet	For routing purposes, IP networks can be divided into logical subnets by means of a subnet mask. Values below those of the mask are valid addresses on the subnet.
subnet address	Portion of an IP address that is specified as the subnetwork by the subnet mask.
subnet mask	The 32-bit address mask used in IP to indicate the bits of an IP address that are being used for the subnet address.
subrack discovery	The process by which a DSLAM node automatically searches through the interfaces and ports within that DSLAM and discovers the components that are present within that DSLAM.
subscriber	A logical entity with attributes identifying the customer that is receiving service on a particular port.
subtended configuration	Services and aggregates the data from one or more chassis into a subtending host chassis requiring only one connection to the outside network. This reduces the number of ATM edge-switch ports necessary to terminate multiple chassis.

subtended node chassis	Downstream chassis in a subtended network configuration. Also known as the *child.*
subtending	See *subtended configuration.*
subtending host chassis	Provides the data network interface for the subtended node chassis and connects to the ATM backbone. Also known as the *parent.*
SVC	switched virtual circuit (or connection). A virtual circuit that is dynamically established on demand and is torn down when transmission is complete. SVCs are used in situations where data transmission is sporadic. Compare with *PVC*. See also *virtual circuit.*
switch	Network device that filters, forwards, and floods frames based on the destination address of each frame. The switch operates at the data link layer of the OSI model. See also *bridge* and *router.*
switched virtual circuit	See *SVC.*
symmetric high bit rate digital subscriber loop	See *SHDSL.*
symmetrical digital subscriber line	See *SDSL.*
synchronous communications	Data is not sent in individual bytes, but as frames of large data blocks.
Synchronous Optical Network	See *SONET.*
Synchronous Transfer Module 1	See *STM-1.*
Synchronous Transport Signal level 3, concatenated	See *STS-3c.*
SYSLOG	SYSLOG allows you to log significant system information to a remote server.

T

T1	A digital carrier that is used to transmit a DS1 formatted digital signal at 1.544 Mbps through the telephone-switching network. See also *E1.*
T1.413	The ANSI standard for line coding and framing for full rate ADSL.
T3	A digital carrier that is used to transmit a DS3 formatted digital signal at 45 Mbps through the telephone-switching network. Compare with *E3*. See also *DS3.*

TC-PAM	trellis coded pulse amplitude modulation. Trellis coding provides forward error correction, while pulse amplitude modulation is a modulation scheme where a continuous analog signal is represented with a series of discrete analog samples.
TCP	Transmission Control Protocol. The major transport protocol in the Internet suite of protocols providing reliable, connection-oriented, full-duplex streams. See *SLIP*.
Telnet	The virtual terminal protocol in the Internet suite of protocols. It allows users of one host to log in to a remote host and use resources as if they were connected to a local system.
TFTP	Trivial File Transfer Protocol. A simple file transfer protocol (a simplified version of FTP) that allows files to be transferred from one computer to another over a network. TFTP does not offer password security.
tip and ring	A pair of wires that provide the electrical connection between a telephone set and the local CO. The more electrically positive side of a POTS telephone line (0 V) is the tip. Its counterpart is the ring, which is the more negative side, 52 v).
topology	Physical arrangement of network nodes and media within a networking structure.
trailer	A block of information that is transmitted at the end of a message to trace error impacts and missing blocks.
training	The handshake procedure that initiates and establishes an end-to-end *x*DSL connection
training mode	The mode, either standard or quick, that a DSLAM port employs when it is training to a CPE. The training mode uses RADSL technology to adjust line speed according to noise conditions on the transmission line.
Transmission Control Protocol	See *TCP*.
trap	Message sent by SNMP agent to an NMS, a console, or a terminal to indicate the occurrence of a significant event, such as a specifically defined condition or a threshold that was reached. See also *alarm* and *event*.
tree topology	A method of connecting devices that is similar to a bus topology, except that tree networks can contain branches with multiple nodes. Transmissions from a station propagate the length of the medium and are received by all other stations. Compare with *bus topology*, *daisy-chain topology*, *ring topology*, and *star topology*.
trellis coded pulse amplitude modulation	See *TC-PAM*.
trellis encoding	A channel coding technique which provides forward error correction capability.
Trivial File Transfer Protocol	See *TFTP*.
twisted pair	Two insulated copper wires twisted together with the twists or lays varied in length to reduce potential signal interference between the pairs.

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U

UBR
unspecified bit rate. A QoS class defined by the ATM Forum for ATM networks. UBR allows any amount of data up to a specified maximum to be sent across the network but there are no guarantees in terms of cell loss rate and delay. Compare with *ABR*, *CBR*, and *VBR*.

UDP
User Datagram Protocol. A connectionless transport protocol that runs on top of the TCP/IP. UDP, like TCP, uses IP for delivery; however, unlike TCP, UDP provides for exchange of datagrams without acknowledgments or guaranteed delivery. This protocol is the best suited for small, independent requests, such as requesting a MIB value from an SNMP agent, in which setting up a connection would take more time than sending the data.

UL
Underwriters Laboratories. A private organization that tests and certifies electrical components and devices against rigorous safety standards. A UL Listing Mark on a product means that representative samples of the product have been tested and evaluated against nationally recognized safety standards with regard to fire, electric shock, and other related safety hazards, and have met the standards.

Underwriters Laboratories
See *UL*.

UNI
User-Network Interface.

UNI signaling
User-Network Interface signaling for ATM communications.

unicast
Message sent to a single network destination. Compare with *broadcast* and *multicast*.

unshielded twisted pair
Four-pair wire medium used in a variety of networks. Sometimes referred to as UTP. See also *shielded twisted pair* and *twisted pair*.

unspecified bit rate
See *UBR*.

upstream
Data that is coming from the subscriber lines to the NI-2 card. See also downstream.

User-Network Interface
See *UNI*.

User Datagram Protocol
See *UDP*.

V

variable bit rate
See *VBR*.

VBR
variable bit rate. A QoS defined by the ATM Forum for ATM networks. VBR is subdivided into a real time (rt) class and non-real time (nrt) class. VBR-rt is used for connections in which there is a fixed timing relationship between samples. VBR-nrt is used for connections in which there is no fixed timing relationship between samples but that still need a guaranteed QoS. Compare with *ABR*, *CBR*, and *UBR*.

VCC
virtual channel connection. A logical circuit, made up of links, that carries data between two endpoints in an ATM network. It is sometimes called a virtual circuit connection. See also *VCI* and *VPI*.

VCI	virtual channel identifier. A 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 to the ATM switch. It is sometimes called virtual circuit identifier. See also *VPI*.
virtual channel connection	See *VCC*.
virtual channel identifier	See *VCI*.
virtual circuit	A logical circuit created to ensure reliable communication between two network devices. A virtual circuit is defined by a VPI/VCI pair and can be either PVC or SVC. In ATM, a virtual circuit is called a virtual channel. See also PVC, SVC, VCI, and VPI.
virtual circuit connection	See *VCC*.
virtual circuit identifier	See *VCI*.
virtual connection	In ATM, a connection between end users that has a defined route and endpoints. See also *PVC* and *SVC*.
virtual path	A logical grouping of virtual circuits that connect two sites. One of two types of ATM circuits identified by a VPI. A virtual path is a bundle of virtual circuits, all of which are switched across a network based on a common VPI. See also *VPI*.
virtual path identifier	See *VPI*.
VPI	virtual path identifier. An 8-bit field in the header of an ATM cell. The VPI, together with the VCI, is used to identify the next destination of a cell as it passes through the network. See also *VCI*.

W

WAN	wide-area network. A data communications network that serves users across a broad geographic area and often uses transmission devices provided by common carriers. Compare with *LAN*.
WAN Interface Card	See *WIC*.
WIC	WAN Interface Card. A WIC card plugs into the card slot of a router and allows DSL use on routers. Each WIC acts as a CPE and can handle the amount of data available depending on the line conditions and the DSL profile assigned to the port.
wide-area network	See *WAN*.

X

xDSL

Generic term used to refer to digital subscriber line equipment and services, including ADSL, IDSL, SDSL, and SHDSL. All are digital technologies that provide high bandwidth over existing copper infrastructure provided by the telephone companies.

xDSL Transmission Unit—central office

See xTU-C.

xDSL Transmission Unit—remote

See xTU-R.

xTU-C

*x*DSL Transmission Unit—central office. A hardware device that supports *x*DSL communication and that is placed in the CO. The *x*TU-C has a matching unit on the subscriber premise in the form of an *x*TU-R. The two units, in combination, support a high data rate over UTP copper cable local loops. Examples of *x*TU-Cs are ATU-C, ITU-C, STU-C, and SHTU-C.

xTU-R

*x*DSL Transmission Unit—remote. A hardware device that supports *x*DSL communication and that is placed in the customer's premise. The *x*TU-R has a matching unit in the carrier's CO in the form of an *x*TU-C. The two units, in combination, support a high data rate over UTP copper cable local loops. Examples of *x*TU-Rs are ATU-R, ITU-R, STU-R, and SHTU-R.

Numerics