CISCO SYSTEMS

Cisco 1-Port OC-12 ATM Line Card Installation and Configuration Guide

Platform: Cisco 7304 router

CONTENTS

CHAPTER **2**   **Preparing for Installation**   2-1

CHAPTER **3**   **Removing and Installing the OC-12 ATM Line Card**   3-1

CHAPTER **4**   **Configuring the 1-Port OC-12 ATM Line Card**   4-1

Preface

This preface describes the objectives and organization of this document and explains how to find additional information on related products and services. This chapter contains the following sections:

- Revision History, page vii
- Objectives, page vii
- Organization, page viii
- Related Documentation, page viii
- Obtaining Documentation, page ix
- Documentation Feedback, page x
- Cisco Product Security Overview, page x
- Obtaining Technical Assistance, page xi
- Obtaining Additional Publications and Information, page xii

Revision History

Date	Revision	Reason
2/28/2005	OL-6876-01	First release of this document.

Objectives

This document describes how to install and configure the single-port OC-12 ATM line card, hereafter referred to as the OC-12 ATM line card, which is used in the Cisco 7304 router.

Organization

This document contains the following chapters:

:

Section	Title	Description
Chapter 1	Overview: 1-Port OC-12 ATM Line Card	Describes the OC-12 ATM line card.
Chapter 2	Preparing for Installation	Describes safety considerations, tools required, and procedures you should perform before the actual installation.
Chapter 3	Removing and Installing the OC-12 ATM Line Card	Provides instructions for removing and installing the OC-12 ATM line card.
Chapter 4	Configuring the 1-Port OC-12 ATM Line Card	Provides instructions for the configuration information for the OC-12 ATM line card.

Related Documentation

Your router and the Cisco IOS software running on it contain extensive features and functionality, which are documented in the following resources:

- Cisco IOS software:

    For configuration information and support, refer to the modular configuration and modular command reference publications in the Cisco IOS software configuration documentation set that corresponds to the software release installed on your Cisco hardware.

    Note You can access Cisco IOS software configuration and hardware installation and maintenance documentation on the World Wide Web at http://www.cisco.com. Translated documentation is available at the following URL: http://www.cisco.com/public/countries_languages.shtm.

- Cisco 7304 router:

    For hardware installation and configuration information, refer to the *Cisco 7304 Router Installation and Configuration Guide* at the following URL:

    http://www.cisco.com/univercd/cc/td/doc/product/core/cis7300/install/index.htm

    For international agency compliance, safety, and statutory information for WAN interfaces:

    Regulatory Compliance and Safety Information for the Cisco 7304 Internet Router at the following URL

    http://www.cisco.com/univercd/cc/td/doc/product/core/cis7300/12952r.htm

Obtaining Documentation

Cisco documentation and additional literature are available on Cisco.com. Cisco also provides several ways to obtain technical assistance and other technical resources. These sections explain how to obtain technical information from Cisco Systems.

Cisco.com

You can access the most current Cisco documentation at this URL:

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

You can access the Cisco website at this URL:

http://www.cisco.com

You can access international Cisco websites at this URL:

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

Documentation DVD

Cisco documentation and additional literature are available in a Documentation DVD package, which may have shipped with your product. The Documentation DVD is updated regularly and may be more current than printed documentation. The Documentation DVD package is available as a single unit.

Registered Cisco.com users (Cisco direct customers) can order a Cisco Documentation DVD (product number DOC-DOCDVD=) from the Ordering tool or Cisco Marketplace.

Cisco Ordering tool:

http://www.cisco.com/en/US/partner/ordering/

Cisco Marketplace:

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

Ordering Documentation

You can find instructions for ordering documentation at this URL:

http://www.cisco.com/univercd/cc/td/doc/es_inpck/pdi.htm

You can order Cisco documentation in these ways:

- Registered Cisco.com users (Cisco direct customers) can order Cisco product documentation from the Ordering tool:

    http://www.cisco.com/en/US/partner/ordering/

- Nonregistered Cisco.com users can order documentation through a local account representative by calling Cisco Systems Corporate Headquarters (California, USA) at 408 526-7208 or, elsewhere in North America, by calling 1 800 553-NETS (6387).

Documentation Feedback

You can send comments about technical documentation to bug-doc@cisco.com.

You can submit comments by using the response card (if present) behind the front cover of your document or by writing to the following address:

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

We appreciate your comments.

Cisco Product Security Overview

Cisco provides a free online Security Vulnerability Policy portal at this URL:

http://www.cisco.com/en/US/products/products_security_vulnerability_policy.html

From this site, you can perform these tasks:

- Report security vulnerabilities in Cisco products.

- Obtain assistance with security incidents that involve Cisco products.

- Register to receive security information from Cisco.

A current list of security advisories and notices for Cisco products is available at this URL:

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

If you prefer to see advisories and notices as they are updated in real time, you can access a Product Security Incident Response Team Really Simple Syndication (PSIRT RSS) feed from this URL:

http://www.cisco.com/en/US/products/products_psirt_rss_feed.html

Reporting Security Problems in Cisco Products

Cisco is committed to delivering secure products. We test our products internally before we release them, and we strive to correct all vulnerabilities quickly. If you think that you might have identified a vulnerability in a Cisco product, contact PSIRT:

- Emergencies — security-alert@cisco.com

- Nonemergencies — psirt@cisco.com

Tip We encourage you to use Pretty Good Privacy (PGP) or a compatible product to encrypt any sensitive information that you send to Cisco. PSIRT can work from encrypted information that is compatible with PGP versions 2.x through 8.x.

Never use a revoked or an expired encryption key. The correct public key to use in your correspondence with PSIRT is the one that has the most recent creation date in this public key server list:

http://pgp.mit.edu:11371/pks/lookup?search=psirt%40cisco.com&op=index&exact=on

In an emergency, you can also reach PSIRT by telephone:

- 1 877 228-7302
- 1 408 525-6532

Obtaining Technical Assistance

For all customers, partners, resellers, and distributors who hold valid Cisco service contracts, Cisco Technical Support provides 24-hour-a-day, award-winning technical assistance. The Cisco Technical Support Website on Cisco.com features extensive online support resources. In addition, Cisco Technical Assistance Center (TAC) engineers provide telephone support. If you do not hold a valid Cisco service contract, contact your reseller.

Cisco Technical Support Website

The Cisco Technical Support Website provides online documents and tools for troubleshooting and resolving technical issues with Cisco products and technologies. The website is available 24 hours a day, 365 days a year, at this URL:

http://www.cisco.com/techsupport

Access to all tools on the Cisco Technical Support Website requires a Cisco.com user ID and password. If you have a valid service contract but do not have a user ID or password, you can register at this URL:

http://tools.cisco.com/RPF/register/register.do

Note Use the Cisco Product Identification (CPI) tool to locate your product serial number before submitting a web or phone request for service. You can access the CPI tool from the Cisco Technical Support Website by clicking the **Tools & Resources** link under Documentation & Tools. Choose **Cisco Product Identification Tool** from the Alphabetical Index drop-down list, or click the **Cisco Product Identification Tool** link under Alerts & RMAs. The CPI tool offers three search options: by product ID or model name; by tree view; or for certain products, by copying and pasting **show** command output. Search results show an illustration of your product with the serial number label location highlighted. Locate the serial number label on your product and record the information before placing a service call.

Submitting a Service Request

Using the online TAC Service Request Tool is the fastest way to open S3 and S4 service requests. (S3 and S4 service requests are those in which your network is minimally impaired or for which you require product information.) After you describe your situation, the TAC Service Request Tool provides recommended solutions. If your issue is not resolved using the recommended resources, your service request is assigned to a Cisco TAC engineer. The TAC Service Request Tool is located at this URL:

http://www.cisco.com/techsupport/servicerequest

For S1 or S2 service requests or if you do not have Internet access, contact the Cisco TAC by telephone. (S1 or S2 service requests are those in which your production network is down or severely degraded.) Cisco TAC engineers are assigned immediately to S1 and S2 service requests to help keep your business operations running smoothly.

To open a service request by telephone, use one of the following numbers:

Asia-Pacific: +61 2 8446 7411 (Australia: 1 800 805 227)
EMEA: +32 2 704 55 55
USA: 1 800 553-2447

For a complete list of Cisco TAC contacts, go to this URL:

http://www.cisco.com/techsupport/contacts

Definitions of Service Request Severity

To ensure that all service requests are reported in a standard format, Cisco has established severity definitions.

Severity 1 (S1)—Your network is "down," or there is a critical impact to your business operations. You and Cisco will commit all necessary resources around the clock to resolve the situation.

Severity 2 (S2)—Operation of an existing network is severely degraded, or significant aspects of your business operation are negatively affected by inadequate performance of Cisco products. You and Cisco will commit full-time resources during normal business hours to resolve the situation.

Severity 3 (S3)—Operational performance of your network is impaired, but most business operations remain functional. You and Cisco will commit resources during normal business hours to restore service to satisfactory levels.

Severity 4 (S4)—You require information or assistance with Cisco product capabilities, installation, or configuration. There is little or no effect on your business operations.

Obtaining Additional Publications and Information

Information about Cisco products, technologies, and network solutions is available from various online and printed sources.

- Cisco Marketplace provides a variety of Cisco books, reference guides, and logo merchandise. Visit Cisco Marketplace, the company store, at this URL:

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

- *Cisco Press* publishes a wide range of general networking, training and certification titles. Both new and experienced users will benefit from these publications. For current Cisco Press titles and other information, go to Cisco Press at this URL:

    http://www.ciscopress.com

- *Packet* magazine is the Cisco Systems technical user magazine for maximizing Internet and networking investments. Each quarter, Packet delivers coverage of the latest industry trends, technology breakthroughs, and Cisco products and solutions, as well as network deployment and troubleshooting tips, configuration examples, customer case studies, certification and training information, and links to scores of in-depth online resources. You can access Packet magazine at this URL:

    http://www.cisco.com/packet

- *iQ Magazine* is the quarterly publication from Cisco Systems designed to help growing companies learn how they can use technology to increase revenue, streamline their business, and expand services. The publication identifies the challenges facing these companies and the technologies to help solve them, using real-world case studies and business strategies to help readers make sound technology investment decisions. You can access iQ Magazine at this URL:

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

- *Internet Protocol Journal* is a quarterly journal published by Cisco Systems for engineering professionals involved in designing, developing, and operating public and private internets and intranets. You can access the Internet Protocol Journal at this URL:

  http://www.cisco.com/ipj

- World-class networking training is available from Cisco. You can view current offerings at this URL:

  http://www.cisco.com/en/US/learning/index.html

Overview: 1-Port OC-12 ATM Line Card

This chapter describes the OC-12 ATM line cards and contains the following sections:

Line Card Overview

The 1-port OC-12 ATM line card is a half-slot single-port line card used witht he Cisco 7304 router. The OC-12 ATM line card provides an ATM over SONET interface at OC-12c speeds (622.08 Mbps) . The OC-12 receives and transmits ATM cells on the physical interface while transmitting and receiving packets from the 4 Gigabits serial links via the backplane.

Figure 1-1   Cisco 1-Port OC-12 ATM Faceplate
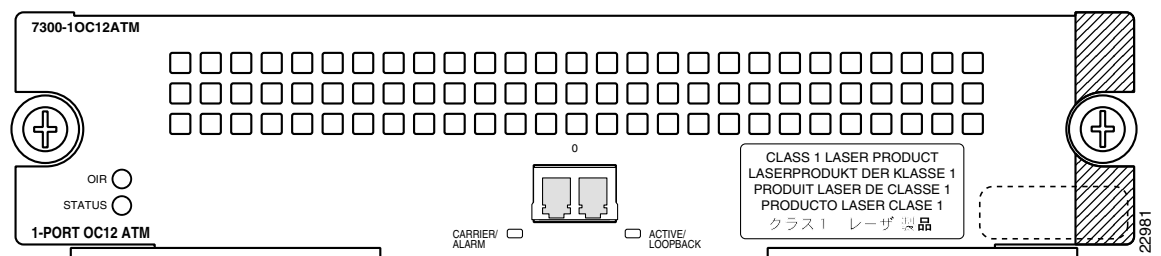
Asynchronous Transfer Mode Overview

Asynchronous Transfer Mode (ATM) uses cell-switching and multiplexing technology that combines the benefits of circuit switching (constant transmission delay and guaranteed capacity) with those of packet switching (flexibility and efficiency for intermittent traffic).

ATM is a connection-oriented environment. All traffic to or from an ATM network is prefaced with a virtual path identifier (VPI) and virtual channel identifier (VCI). A VPI/VCI pair is considered a single virtual circuit (VC). Each VC is a private connection to another node on the ATM network. It is treated as a point-to-point mechanism to another router or host and is capable of supporting bidirectional traffic.

Each ATM node is required to establish a separate connection to every other node in the ATM network with which it must communicate. All such connections are established using a permanent virtual circuit (PVC) or a switched virtual circuit (SVC) with an ATM signaling mechanism. This signaling is based on the ATM Forum User-Network Interface (UNI) Specification V3.0.

Each VC is considered a complete and separate link to a destination node. Users can encapsulate data across the connection as they see fit. The ATM network disregards the contents of the data. The only requirement is that data be sent to the OC-12 ATM card in the specific ATM adaptation layer (AAL) format.

An AAL defines the conversion of user information into cells. The AAL segments upper-layer information into cells at the transmitter and reassembles them at the receiver. ATM adaptation layer 5 (AAL5), one of four AALs recommended by the International Telecommunication Union Telecommunication Standardization Sector, supports data communications.

An ATM connection transfers raw bits of information to a destination router or host. The ATM router takes the common part convergence sublayer (CPCS) frame, carves it up into 53-byte cells, and sends these cells to the destination router or host for reassembly. 48 bytes of each cell are used for the CPCS data; the remaining 5 bytes are used for cell routing. The 5-byte cell header contains the destination VPI/VCI, payload type, cell loss priority (CLP), and header error control.

Unlike a LAN, which is connectionless, ATM requires certain features to provide a LAN environment to the users. One such feature is broadcast capability. Protocols wanting to broadcast packets to all stations in a subnet must be allowed to do so with a single call to Layer 2. In order to support broadcasting, the router allows you to specify a particular VC as a broadcast VC. When the protocol passes a packet with a broadcast address to the ATM driver, the packet is duplicated and sent to each VC marked as a broadcast VC. This method is known as pseudo broadcasting.

Encapsulation Method Support

The following encapsulation methods are supported by the OC-12 ATM line card:

- Multiprotocol Encapsulation over ATM AAL5 (RFC 1483)
- Classical IP and ARP over ATM (RFC 1577)
- PPP over ATM (RFC 2364)

SONET/SDH Overview

Synchronous Optical NETwork (SONET) is an American National Standards Institute (ANSI) standard (T1.1051988) for optical digital transmission at hierarchical rates from 51.840 Mbps (STS-1c) to 622.080 Mbps (STS-12c) and greater. SDH is the international standard for optical digital transmission at hierarchical rates from 155.520 Mbps (STM-1) to 2.488 Gbps (STM-16c) and greater.

SONET is an octet-synchronous multiplex scheme that defines a family of standard rates and formats. The available information bandwidth is 600.768 Mbps, which is the STS-3c/STM-4 Synchronous Payload Envelope (SPE), the payload portion of the SONET frame into which the octet-oriented user data is mapped. (Octet boundaries are aligned with the SPE octet boundaries.)

The International Telecommunication Union Telecommunication Standardization Sector (ITU-T) defines a series of SDH transmission rates beginning at 155.520 Mbps as follows:

SONET[1]	SDH Equivalent
STS-3c	STM-1
STS-12c[2]	STM-4c
STS-48c	STM-16c

1. ANSI-defined SONET specifications.

2. Currently supported by the OC-12 ATM line card.

Despite the name, SONET is not limited to optical links. Electrical specifications have been defined for CATV 75-ohm coaxial cable. Transmission rates are integer multiples of 51.840 Mbps, which can be used to carry T3/E3 bit-synchronous signals.

The following transmission multiples are currently specified and commonly used:

- STS-3c—155.520 Mbps

- STS-12c—622.080 Mbps (the OC-12 ATM line card conforms to STS-12c/STM-4c)

- STS-48c—2.488 Gbps

Features

The OC-12 ATM line card has the following features:

- Field-replaceable SFP optics modules with single- mode shor- reach, intermediate-reach, long-reach, and multimode options

- Dedicated I^2C master port allowing the route processor (RP) to identify the type of the optical transceiver

- OC-12 line rate (622.080 Mbps) SONET/SDH physical layer ports

- Insertion and extraction of SONET overhead bits

- Scrambles and de scrambles cell payload

- Clock and data recovery

- Supports all 16 VCI and 8 VPI bits

- Supports maximum transmission unit (MTU) of up to 9180 octets

- Works in both US and Europe

- Supports 2047 total connections

- 4094 simultaneous AAL5 frame reassemblies and segmentations for average packet size of 200 bytes

- Supports AAL5 data transport, F4 operation, administration, and maintenance (OAM) cells for loopback

- Supports per-VC and per-VP traffic shaping

- Supports per-VC queuing

- Unspecified bit rate (UBR) support

- Non-real-time variable bit rate (nrt-VBR)

- Online insertion and removal (OIR) on Cisco 7304 routers

The OC-12 ATM line card supports the following protocols, services, and ATM-specific software:

- User-Network Interface (UNI) signaling

- Integrated Local Management Interface (ILMI)

- RFC-1483 and RFC-2684 Multiprotocol Encapsulation over ATM AAL5

- RFC-1577 Classical IP and ARP over ATM

- RFC-1626 Maximum Transmission Unit (MTU) up to 9180 octets

- RFC-2364 PPP over ATM

Interface Specifications

The physical layer interface for the OC-12 ATM line card is Optical Carrier-3 (OC-12c, the specification for SONET STS-12c and SDH STM-4c transmission rates). The OC-12 ATM line card provides a single 622.080-Mbps packet OC-12 network interface for the Cisco 7304 router.

The OC-12 ATM line card uses small form-factor pluggable (SFP) modules with LC-type fiber connectors. The SFP is an input/output (I/O) device used to connect the OC-12 to the network. (For more information on the optical fiber cables, see "Cables and Connectors".)

Packet data is transported using Point-to-Point Protocol (PPP) and is mapped into the STS-12c/STM-4c frame (RFC-1619).

The management of the OC-12 ATM line card interface is compliant with RFC 1595.

Fiber-Optic Transmission Specifications

This section describes the SONET specifications for fiber-optic transmissions, defines the power budget, and helps you approximate the power margin for multimode and single-mode transmissions. This section includes the following subsections:

SONET Distance Limitations

The SONET specification for fiber-optic transmission defines two types of fiber: single mode and multimode. Modes can be thought of as bundles of light rays entering the fiber at a particular angle. Single-mode fiber allows only one mode of light to propagate through the fiber, whereas multimode fiber allows multiple modes of light to propagate through the fiber. Because multiple modes of light propagating through the fiber travel different distances depending on the entry angles, causing them to arrive at the destination at different times (a phenomenon called *modal dispersion*), single-mode fiber is capable of higher bandwidth and greater cable run distances than multimode fiber.

The typical maximum distances for single-mode and multimode transmissions, as defined by SONET, are in Table 1-1.

Note If the distance between two connected stations is greater than the maximum distances listed, significant signal loss can result, making transmission unreliable.

Table 1-1 lists the OC-12 ATM line card optical parameters.

Table 1-1   OC-12 Optical Parameters

Transceiver Type[1]	Transmit Power	Maximum Power to Receiver[2]	Receiver Sensitivity	Loss Budgets	Nominal Distance Between Stations
Single-mode[3] long reach	–5 dB to 0 dBm at 1280–1335 nm[4]	–10 dBm	–34 dBm	10 to 28 dB	Up to 25 mi. (40 km)
Single-mode[5] intermediate reach	–15 dBm to –8 dBm at 1280–1335 nm[4]	–8 dBm	–31 dBm	0 to 12 dB	Up to 9 mi. (15 km)
Multimode[6] short reach	62.5 um fiber (–20 to –14 dBm) 50 um fiber (–24 to –14 dBm) at 1270–1380 nm[4]	–14 dBm	–26 dBm	62.5 um fiber 0 to 6dB 50 um fiber 0 to 2 dB	Up to 500 meters

1. This table gives nominal OC-12 optical parameters.

2. This value represents the maximum power to which any receiver can be exposed.

3. Complies with Bellcore GR-253-CORE Long Reach Specification (LR-1).

4. Nominal wavelength is 1310 nm.

5. Complies with Bellcore GR-253-CORE Intermediate Reach Specification (IR-1).

6. Complies with Complies with ATM Forum Technical committee 622.08 Physical Layer Specification af-phy-0046.000.

To calculate link losses and dispersion losses for your application, refer to the following specifications and documents:

- EIA/TIA-IVa *Dispersion Unshifted Single-Mode Fiber*
- EIA/TIA-IVb *Dispersion Shifted Single-Mode Fiber*
- GR-20-CORE *Generic Requirements for Optical Fiber and Fiber-Optic Cable*
- ITU-T Recommendation G.957 *Optical Interfaces for Equipment and Systems Relating to the Synchronous Digital Hierarchy*

Power Budget

To design an efficient optical data link, evaluate the power budget. The power budget is the amount of light available to overcome attenuation in the optical link and to exceed the minimum power that the receiver requires to operate within its specifications. Proper operation of an optical data link depends on modulated light reaching the receiver with enough power to be correctly demodulated.

Attenuation, caused by the passive media components (cables, cable splices, and connectors), is common to both multimode and single-mode transmission.

The following variables reduce the power of the signal (light) transmitted to the receiver in multimode transmission:

- Chromatic dispersion (spreading of the signal in time because of the different speeds of light wavelengths)

- Modal dispersion (spreading of the signal in time because of the different propagation modes in the fiber)

Attenuation is significantly lower for optical fiber than for other media. For multimode transmission, chromatic dispersion and modal dispersion reduce the available power of the system by the combined dispersion penalty. The power lost over the data link is the sum of the component, dispersion, and modal losses.

Table 1-2 lists the factors of attenuation and dispersion for typical optical fiber cable.

Table 1-2   Typical Fiber-Optic Link Attenuation and Dispersion Limits

Limits	Single Mode	Multimode
Attenuation	0.5 dB/km	1.0 dB/km
Dispersion	No limit	500 MHz/km[1]

1. The product of bandwidth and distance must be less than 500 MHz/km.

Approximating the OC-12 ATM Line Card Power Margin

The LED used for a multimode transmission light source creates multiple propagation paths of light, each with a different path length and time requirement to cross the optical fiber, causing signal dispersion (smear). Higher-order mode loss (HOL) results from light from the LED entering the fiber and being radiated into the fiber cladding. A worst-case estimate of power margin (PM) for multimode transmissions assumes minimum transmitter power (PT), maximum link loss (LL), and minimum receiver sensitivity (PR). The worst-case analysis provides a margin of error; not all of the parts of an actual system will operate at the worst-case levels.

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

$$PB = PT - PR$$

$$PB = -20 \text{ dBm} - (-30 \text{ dBm})$$

$$PB = 10 \text{ dBm}$$

The power margin (PM) calculation is derived from the power budget minus the link loss, as follows:

$$PM = PB - LL$$

If the power margin is positive, as a rule, the link will work.

Table 1-3 lists the factors that contribute to link loss and the estimate of the link loss value attributable to those factors.

Table 1-3   Link Loss Factors and Values

Link Loss Factor	Estimate of Link Loss Value
Higher-order mode losses	0.5 dB
Clock recovery module	1 dB
Modal and chromatic dispersion	Dependent on fiber and wavelength used
Connector	0.5 dB
Splice	0.5 dB
Fiber attenuation	1 dB/km

After you calculate the power budget minus the data link loss, the result should be greater than zero. Circuits with results that are less than zero may have insufficient power to operate the receiver.

The SONET specification requires that the signal must meet the worst-case parameters listed in Table 1-4.

Table 1-4   OC-12 ATM Line Card SONET Signal Requirements

	Single Mode (SML)	Single Mode (SMI)	Multimode
PT	–5 dBm	–15 dBm	–20 dBm
PR	–34 dBm	–31 dBm	–30 dBm
PB	29 dBm	16 dBm	10 dB

Multimode Power Budget Example with Sufficient Power for Transmission

The following is a sample multimode power budget calculated based on the following variables:

- Length of multimode link = 3 kilometers (km)
- Four connectors
- Three splices
- High-order mode loss (HOL)
- Clock recovery module (CRM)

Estimate the power budget as follows:

PB = 10 dB – 3 km (1.0 dB/km) – 4 (0.5 dB) – 3 (0.5 dB) – 0.5 dB (HOL) – 1 dB (CRM)

PB = 10 dB – 3 dB – 2 dB – 1.5 dB – 0.5 dB – 1 dB

PB = 2 dB

The positive value of 2 dB indicates that this link would have sufficient power for transmission.

Single-mode Transmission

The singlemode signal source is an injection laser diode. Single-mode transmission is useful for longer distances because there is a single transmission path within the fiber, and smear does not occur. In addition, chromatic dispersion is also reduced because laser light is essentially monochromatic.

The receiver for single-mode intermediate reach (SMI) cannot be overloaded by the SMI transmitter and does not require a minimum fiber cable length or loss. The maximum receive power for single-mode long reach (SML) is –10 dBm, and the maximum transmit power is 0 dBm. The SML receiver can, therefore, be overloaded when short lengths of fiber are used. Overloading the receiver will not damage the receiver but can cause unreliable operation. To prevent overloading an SML receiver connected with short fiber links, insert a minimum 10-dB attenuator on the link between any single-mode long-reach transmitter and the receiver.

SONET Single-Mode Power Budget Example

The following example of a single-mode power budget assumes two buildings, 8 kilometers apart, connected through a patch panel in an intervening building with a total of 12 connectors.

- Length of single-mode link = 8 km
- 12 connectors

Estimate the power budget as follows:

PM = PB – LL

PM = 16 dB – 8 km (0.5 dB/km) – 12 (0.5 dB)

PM = 16 dB – 4 dB – 6 dB

PM = 6 dB

The value of 6 dB indicates that this link would have sufficient power for transmission and does not exceed the maximum receiver input power.

Using Statistics to Estimate Link Loss and Power Budget

Statistical models more accurately determine the power budget than standard worst-case methods. Determining the link loss with statistical methods requires accurate knowledge of variations in the data link components. Statistical power budget analysis is beyond the scope of this document. For further information, refer to ITU-T standards and your equipment specifications.

The following publications contain information on determining attenuation and power budget:

- T1E1.2/92-020R2 ANSI, the Draft American National Standard for Telecommunications entitled *Broadband ISDN Customer Installation Interfaces: Physical Layer Specification*.
- *Power Margin Analysis, AT&T Technical Note,* TN89-004LWP, May 1989.

LEDs

The OC-12 ATM line card faceplate has one LED that indicates line card status and one LED that indicates interface status. (See Figure 1-2.)

Figure 1-2   LEDs on the OC-12 ATM Line Card
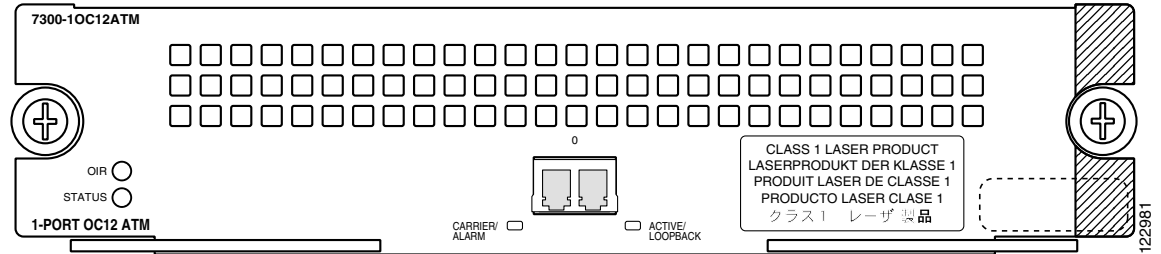
After system initialization, the STATUS LED goes on to indicate that power is received and that the OC-12 ATM line card is enabled for operation.

The following conditions must all be met before the OC-12 ATM line card is enabled:

- The OC-12 ATM line card is correctly connected and receiving power.
- The system bus recognizes the OC-12 ATM line card.
- A valid version of microcode is loaded and running.

If any one of these conditions is not met, or if the initialization fails, the STATUS LED does not go on.

Table 1-5 lists LED colors and indications.

Table 1-5   OC-12 ATM Line Card LEDs

LED Label	Color	State	Function
STATUS	Green/Yellow	Green	Indicates line card is online.
		Yellow	Indicates line card bootstrapping is in progress.
		Off	Indicates line card is offline and deactivated.
OIR	Green	On	Line card is ready to be removed in CLI-controlled OIR.
		Off	Line card is online.
CARRIER/ALARM	Green/Yellow	Green	Indicates that a valid SONET signal has been detected with no alarm conditions.
		Yellow	Indicates that an alarm condition is present. See Table 1-6 for alarm definitions.
		Off	No valid SONET signal has been detected.
ACTIVE/ LOOPBACK	Green/Yellow	Green	Indicates that the port has been configured and is enabled.
		Yellow	Indicates that the port is in diagnostic loopback mode.
		Off	Indicates that the port has not been configured.

Alarms

A yellow CARRIER/ALARM LED indicates the presence of an alarm condition. Table 1-6 lists the alarm conditions that might be present. Use the **show controllers** command to show the specific alarm condition.

Table 1-6   Alarm Definitions

Alarm	Definition
Section	
LOF	Loss of Frame
LOS	Loss of Signal
BIP(B1)	Bit Interleaved Parity N
Line	
AIS	Alarm Indication Signal
RDI	Remote Defect Indication
BIP(B2)	Bit Interleaved Parity N
Path	
AIS	Alarm Indication Signal
RDI	Remote Defect Indication
BIP(B3)	Bit Interleaved Parity N
LOP	Loss of Pointer

Small Form-Factor Pluggable Modules

The OC-12 ATM line card uses a single optical small form-factor pluggable (SFP) module to connect to the network. The five types of SFP modules are listed in Table 1-7.

Figure 1-3   SFP Module
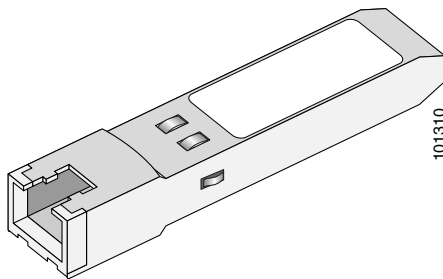
Table 1-7   SFP Modules Used with the OC-12 ATM Line Card

Product ID	Type	Distance	Mbps
SFP-OC12-SR	Single-mode short range	1310 nm	622
SFP-OC12-IR1	Single-mode intermediate range	1310 nm	622

Table 1-7   SFP Modules Used with the OC-12 ATM Line Card (continued)

Product ID	Type	Distance	Mbps
SFP-OC12-LR1	Single-mode long range (LR-1)	1310 nm	622
SFP-OC12-LR2	Single-mode long range (LR-2)	1550 nm	622
SFP-OC12-MM	Multimode	1310 nm	622

Table 1-8   SFP Module Transmit Power, Receive Power, and Power Budget

SFP Module	Transmit Power		Receive Sensitivity	
	Minimum	Maximum	Minimum	Maximum
SFP-OC12-SR	–5 dBm	–8 dBm	N/A	–23 dBm
SFP-OC12-IR1	–15 dBm	–8 dBm	–8 dBm	–28 dBm
SFP-OC12-LR1	–5 dBm	0 dBm	–10 dBm	–34 dBm
SFP-OC12-LR2	–5 dBm	–14 dBm	–8 dBm	–23 dBm
SFP-OC12-MM	–20 dBm	–14 dBm	–8 dBm	–23 dBm

Table 1-9   SFP Module Specifications

Specification	Description
Dimensions (H x W x D)	0.03 in x 0.53 in x 2.22 in (8.5 mm x 13.4mm x 56.5 mm)
Connectors	Multimode fiber-optic: LC-type connector Single-mode fiber-optic: LC-type connector
Wavelength (average)	SFP-OC12-SR—1310 nm SFP-OC12-IR1—1310 nm SFP-OC12-LR1—1310 nm SFP-OC12-LR2—1550 nm SFP-OC12-MM—1310 nm
Cabling distance (maximum)	SFP-OC12-SR—1.2 miles (2 km) SFP-OC12-IR1—9 miles (15 km) SFP-OC12-LR1—25 miles (40 km) SFP-OC12-LR2—50 miles (80 km) SFP-OC12-MM—1.2 miles (2 km)
Operating temperature range	32 to 122 degrees F (0 to 50 degrees C)
Storage temperature range	–40 to 185 degrees F (–40 to 85 degrees C)

Cables and Connectors

The SFP modules used with the OC-12 ATM line card support LC-type connections.

Figure 1-4   Duplex Cable with LC-Type Connectors
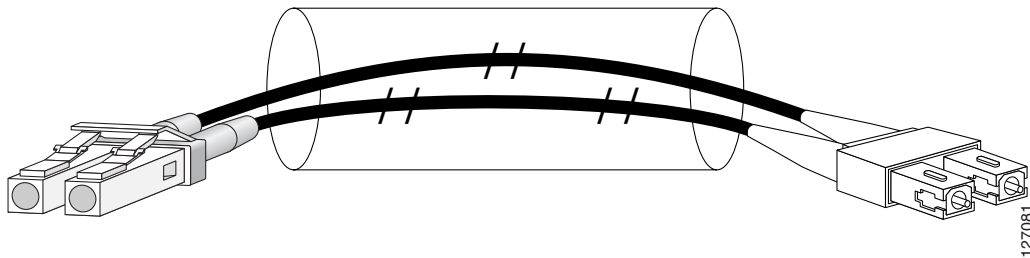
Note   For maximum cable lengths between stations, see Table 1-1. Single-mode optical fiber cables for the OC-12 ATM line card are not available from Cisco Systems; they are available from commercial cable vendors.

Warning   **Invisible laser radiation may be emitted from disconnected fibers or connectors. Do not stare into beams or view directly with optical instruments.** Statement 1051

Warning   **Class 1 laser product.** Statement 1008

Note   For more important laser safety information, see "Laser Safety".

Note   The optical fiber connectors must be free of dust, oil, or other contaminants. See *Inspection and Cleaning Procedures for Fiber-Optic Connection*s at the following URL:

http://www.cisco.com/warp/public/127/cleanfiber2.html

Line Card Slot Numbering

In a Cisco 7304 router, slots are numbered beginning with slot 0 (a dual-width slot reserved for the NSE-100) on the bottom, and continuing from the lower left to the upper right through slot 5. The OC-12 ATM line card can be installed in slots 2 through 5. Figure 1-5 shows a Cisco 7304 with an OC-12 ATM line card installed in slot 4.

Figure 1-5   Slots in the Cisco 7304 Router
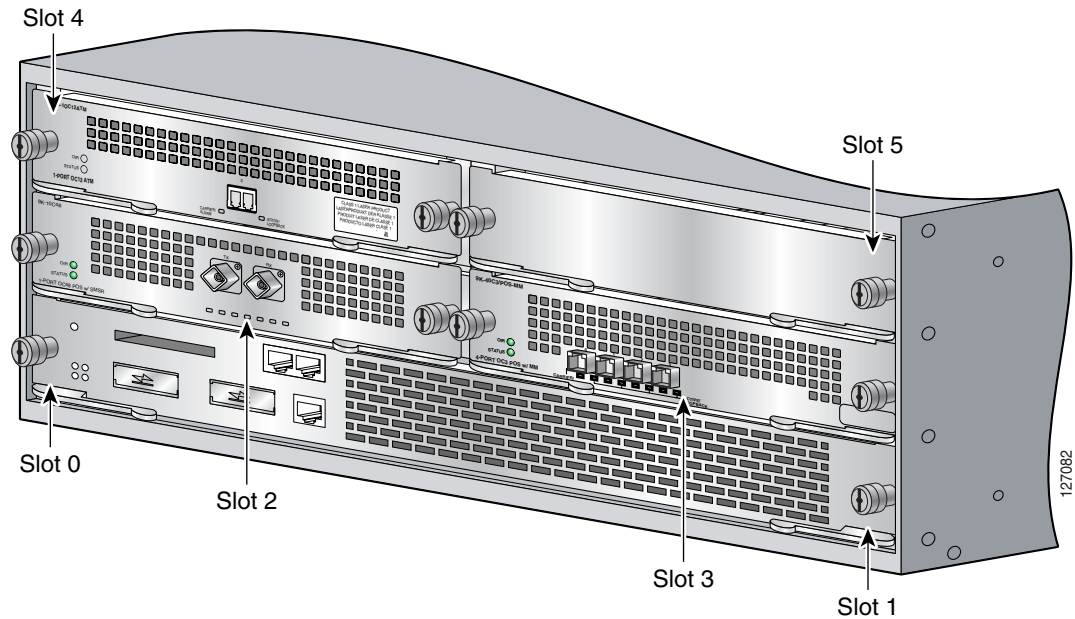
Note   Slot 0 and slot 1 are for the network services engine (NSE) only.

Line Card Interface Address

Interface addresses specify the actual physical location of each interface on a router. The address is composed of a two-part number in the format *slot-number/interface-port-number*. See Table 1-10.

The OC-12 maintains the same interface address regardless of whether other cards are installed or removed from the router. However, if you move the OC-12 to a different slot in the router, the first number in the interface address changes to reflect the new slot number.

Table 1-10   Identifying Interface Addresses

Platform	Interface Address Format	Numbers	Syntax
Cisco 7304 router	Slot-number/interface-port-number	Slot—0 through 5[1] Interface port number—0	**4 / 0**

1. Slot 0 and slot 1 are reserved for the network services engine (NSE).

The interface address of the interface for the OC-12 in slot 4 is 4/0 (slot 4 and interface 0). If the OC-12 was in slot 2, this same interface would be numbered 2/0 (slot 2 and interface 0).

Preparing for Installation

This chapter describes the general equipment, safety, and site preparation requirements for installing the OC-12 ATM line card. This chapter contains the following sections:

- Required Tools and Equipment, page 2-1
- Software and Hardware Requirements, page 2-2
- Safety Guidelines, page 2-2
- FCC Class A Compliance, page 2-9

Required Tools and Equipment

You need the following tools and parts to install aa OC-12 line card. If you need additional equipment, contact a service representative for ordering information.

- 7300-1OC12ATM, 7300-1OC12ATM=
- SFP modules:
    - SFP-OC12-SR
    - SFP-OC12-IR1
    - SFP-OC12-LR1
    - SFP-OC12-LR2
    - SFP-OC12-MM
- One LC-type duplex, multimode, or single-mode optical fiber cable to connect the SFP module interface with the network

> **Note** Single-mode and multimode optical fiber cables are not available from Cisco Systems but are available from commercial cable vendors. For information about optical fiber cables, see the "Cables and Connectors" section on page 1-12.

- Number 1 Phillips screwdriver
- Number 2 Phillips screwdriver
- Your own electrostatic discharge (ESD)-prevention equipment or the disposable grounding wrist strap included with all upgrade kits, field-replaceable units (FRUs), and spares
- Antistatic mat

Cisco 1-Port OC-12 ATM Line Card Installation and Configuration

Software and Hardware Requirements

The minimum Cisco IOS software release required to use the OC-12 ATM line card in the Cisco 7304 router is Cisco IOS Release 12.2(25)S3.

Checking Hardware and Software Compatibility

To check the minimum software requirements of Cisco IOS software with the hardware installed on your router, Cisco maintains the Software Advisor tool on Cisco.com. This tool does not verify whether modules within a system are compatible, but it does provide the minimum Cisco IOS requirements for individual hardware modules or components.

Note Access to this tool is limited to users with Cisco.com login accounts.

To access Software Advisor, click **Login** at Cisco.com and go to **Products & Solutions: Related Tools: Software Advisor**. You can also access the tool at the following URL:

http://www.cisco.com/pcgi-bin/Support/CompNav/Index.pl

Choose a product family or enter a specific product number to search for the minimum supported software release needed for your hardware.

Safety Guidelines

This section provides safety guidelines that you should follow when working with any equipment that connects to electrical power or telephone wiring.

Safety Warnings

Safety warnings appear throughout this publication in procedures that, if performed incorrectly, may harm you. A warning symbol precedes each warning statement.

Warning Definition

Warning **IMPORTANT SAFETY INSTRUCTIONS**

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. Use the statement number provided at the end of each warning to locate its translation in the translated safety warnings that accompanied this device. Statement 1071

SAVE THESE INSTRUCTIONS

Waarschuwing   **BELANGRIJKE VEILIGHEIDSINSTRUCTIES**

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 de standaard praktijken om ongelukken te voorkomen. Gebruik het nummer van de verklaring onderaan de waarschuwing als u een vertaling van de waarschuwing die bij het apparaat wordt geleverd, wilt raadplegen.

BEWAAR DEZE INSTRUCTIES

Varoitus   **TÄRKEITÄ TURVALLISUUSOHJEITA**

Tämä varoitusmerkki merkitsee vaaraa. Tilanne voi aiheuttaa ruumiillisia vammoja. Ennen kuin käsittelet laitteistoa, huomioi sähköpiirien käsittelemiseen liittyvät riskit ja tutustu onnettomuuksien yleisiin ehkäisytapoihin. Turvallisuusvaroitusten käännökset löytyvät laitteen mukana toimitettujen käännettyjen turvallisuusvaroitusten joukosta varoitusten lopussa näkyvien lausuntonumeroiden avulla.

SÄILYTÄ NÄMÄ OHJEET

Attention   **IMPORTANTES INFORMATIONS DE SÉCURITÉ**

Ce symbole d'avertissement indique un danger. Vous vous trouvez dans une situation pouvant entraîner des blessures ou des dommages corporels. Avant de travailler sur un équipement, soyez conscient des dangers liés aux circuits électriques et familiarisez-vous avec les procédures couramment utilisées pour éviter les accidents. Pour prendre connaissance des traductions des avertissements figurant dans les consignes de sécurité traduites qui accompagnent cet appareil, référez-vous au numéro de l'instruction situé à la fin de chaque avertissement.

CONSERVEZ CES INFORMATIONS

Warnung   **WICHTIGE SICHERHEITSHINWEISE**

Dieses Warnsymbol bedeutet Gefahr. Sie befinden sich in einer Situation, die zu Verletzungen führen kann. Machen Sie sich vor der Arbeit mit Geräten mit den Gefahren elektrischer Schaltungen und den üblichen Verfahren zur Vorbeugung vor Unfällen vertraut. Suchen Sie mit der am Ende jeder Warnung angegebenen Anweisungsnummer nach der jeweiligen Übersetzung in den übersetzten Sicherheitshinweisen, die zusammen mit diesem Gerät ausgeliefert wurden.

BEWAHREN SIE DIESE HINWEISE GUT AUF.

Avvertenza   **IMPORTANTI ISTRUZIONI SULLA SICUREZZA**

Questo simbolo di avvertenza indica un pericolo. La situazione potrebbe causare infortuni alle persone. Prima di intervenire su qualsiasi apparecchiatura, occorre essere al corrente dei pericoli relativi ai circuiti elettrici e conoscere le procedure standard per la prevenzione di incidenti. Utilizzare il numero di istruzione presente alla fine di ciascuna avvertenza per individuare le traduzioni delle avvertenze riportate in questo documento.

CONSERVARE QUESTE ISTRUZIONI

Advarsel   **VIKTIGE SIKKERHETSINSTRUKSJONER**

Dette advarselssymbolet betyr fare. Du er i en situasjon som kan føre til skade på person. Før du begynner å arbeide med noe av utstyret, må du være oppmerksom på farene forbundet med elektriske kretser, og kjenne til standardprosedyrer for å forhindre ulykker. Bruk nummeret i slutten av hver advarsel for å finne oversettelsen i de oversatte sikkerhetsadvarslene som fulgte med denne enheten.

TA VARE PÅ DISSE INSTRUKSJONENE

Aviso   **INSTRUÇÕES IMPORTANTES DE SEGURANÇA**

Este símbolo de aviso significa perigo. Você está em uma situação que poderá ser causadora de lesões corporais. Antes de iniciar a utilização de qualquer equipamento, tenha conhecimento dos perigos envolvidos no manuseio de circuitos elétricos e familiarize-se com as práticas habituais de prevenção de acidentes. Utilize o número da instrução fornecido ao final de cada aviso para localizar sua tradução nos avisos de segurança traduzidos que acompanham este dispositivo.

GUARDE ESTAS INSTRUÇÕES

¡Advertencia!   **INSTRUCCIONES IMPORTANTES DE SEGURIDAD**

Este símbolo de aviso indica peligro. Existe riesgo para su integridad física. Antes de manipular cualquier equipo, considere los riesgos de la corriente eléctrica y familiarícese con los procedimientos estándar de prevención de accidentes. Al final de cada advertencia encontrará el número que le ayudará a encontrar el texto traducido en el apartado de traducciones que acompaña a este dispositivo.

GUARDE ESTAS INSTRUCCIONES

Varning!   **VIKTIGA SÄKERHETSANVISNINGAR**

Denna varningssignal 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 vanliga förfaranden för att förebygga olyckor. Använd det nummer som finns i slutet av varje varning för att hitta dess översättning i de översatta säkerhetsvarningar som medföljer denna anordning.

SPARA DESSA ANVISNINGAR

Figyelem   FONTOS BIZTONSÁGI ELOÍRÁSOK

Ez a figyelmezeto jel veszélyre utal. Sérülésveszélyt rejto helyzetben van. Mielott bármely berendezésen munkát végezte, legyen figyelemmel az elektromos áramkörök okozta kockázatokra, és ismerkedjen meg a szokásos balesetvédelmi eljárásokkal. A kiadványban szereplo figyelmeztetések fordítása a készülékhez mellékelt biztonsági figyelmeztetések között található; a fordítás az egyes figyelmeztetések végén látható szám alapján keresheto meg.

ORIZZE MEG EZEKET AZ UTASÍTÁSOKAT!

Предупреждение   ВАЖНЫЕ ИНСТРУКЦИИ ПО СОБЛЮДЕНИЮ ТЕХНИКИ БЕЗОПАСНОСТИ

Этот символ предупреждения обозначает опасность. То есть имеет место ситуация, в
которой следует опасаться телесных повреждений. Перед эксплуатацией оборудования
выясните, каким опасностям может подвергаться пользователь при использовании
электрических цепей, и ознакомьтесь с правилами техники безопасности для
предотвращения возможных несчастных случаев. Воспользуйтесь номером заявления,
приведенным в конце каждого предупреждения, чтобы найти его переведенный вариант
в переводе предупреждений по безопасности, прилагаемом к данному устройству.

СОХРАНИТЕ ЭТИ ИНСТРУКЦИИ

警告   重要的安全性说明

此警告符号代表危险。您正处于可能受到严重伤害的工作环境中。在您使用设备开始工作之前，必须充分意
识到触电的危险，并熟练掌握防止事故发生的标准工作程序。请根据每项警告结尾提供的声明号码来找到此
设备的安全性警告说明的翻译文本。

请保存这些安全性说明

警告   安全上の重要な注意事項

「危険」の意味です。人身事故を予防するための注意事項が記述されています。装置の取り扱い作業を
行うときは、電気回路の危険性に注意し、一般的な事故防止策に留意してください。警告の各国語版は、
各注意事項の番号を基に、装置に付属の「Translated Safety Warnings」を参照してください。

これらの注意事項を保管しておいてください。

주의   중요 안전 지침

이 경고 기호는 위험을 나타냅니다. 작업자가 신체 부상을 일으킬 수 있는 위험한 환경에 있습니다.
장비에 작업을 수행하기 전에 전기 회로와 관련된 위험을 숙지하고 표준 작업 관례를 숙지하여 사고
를 방지하십시오. 각 경고의 마지막 부분에 있는 경고문 번호를 참조하여 이 장치와 함께 제공되는
번역된 안전 경고문에서 해당 번역문을 찾으십시오.

이 지시 사항을 보관하십시오.

Aviso   INSTRUÇÕES IMPORTANTES DE SEGURANÇA

Este símbolo de aviso significa perigo. Você se encontra em uma situação em que há risco de lesões
corporais. Antes de trabalhar com qualquer equipamento, esteja ciente dos riscos que envolvem os
circuitos elétricos e familiarize-se com as práticas padrão de prevenção de acidentes. Use o
número da declaração fornecido ao final de cada aviso para localizar sua tradução nos avisos de
segurança traduzidos que acompanham o dispositivo.

GUARDE ESTAS INSTRUÇÕES

Advarsel **VIGTIGE SIKKERHEDSANVISNINGER**

Dette advarselssymbol betyder fare. Du befinder dig i en situation med risiko for legemesbeskadigelse. Før du begynder arbejde på udstyr, skal du være opmærksom på de involverede risici, der er ved elektriske kredsløb, og du skal sætte dig ind i standardprocedurer til undgåelse af ulykker. Brug erklæringsnummeret efter hver advarsel for at finde oversættelsen i de oversatte advarsler, der fulgte med denne enhed.

GEM DISSE ANVISNINGER

تحذير إرشادات الأمان الهامة

يوضح رمز التحذير هذا وجود خطر. وهذا يعني أنك متواجد في مكان قد ينتج عنه التعرض لإصابات. قبل بدء العمل،
احذر مخاطر التعرض للصدمات الكهربائية وكن على علم بالإجراءات القياسية للحيلولة دون وقوع أي حوادث. استخدم
رقم البيان الموجود في أخر كل تحذير لتحديد مكان ترجمته داخل تحذيرات الأمان المترجمة التي تأتي مع الجهاز.
قم بحفظ هذه الإرشادات

Upozorenje **VAŽNE SIGURNOSNE NAPOMENE**

Ovaj simbol upozorenja predstavlja opasnost. Nalazite se u situaciji koja može prouzročiti tjelesne ozljede. Prije rada s bilo kojim uređajem, morate razumjeti opasnosti vezane uz električne sklopove, te biti upoznati sa standardnim načinima izbjegavanja nesreća. U prevedenim sigurnosnim upozorenjima, priloženima uz uređaj, možete prema broju koji se nalazi uz pojedino upozorenje pronaći i njegov prijevod.

SAČUVAJTE OVE UPUTE

Upozornění **DŮLEŽITÉ BEZPEČNOSTNÍ POKYNY**

Tento upozorňující symbol označuje nebezpečí. Jste v situaci, která by mohla způsobit nebezpečí úrazu. Před prací na jakémkoliv vybavení si uvědomte nebezpečí související s elektrickými obvody a seznamte se se standardními opatřeními pro předcházení úrazům. Podle čísla na konci každého upozornění vyhledejte jeho překlad v přeložených bezpečnostních upozorněních, která jsou přiložena k zařízení.

USCHOVEJTE TYTO POKYNY

Προειδοποίηση ΣΗΜΑΝΤΙΚΕΣ ΟΔΗΓΙΕΣ ΑΣΦΑΛΕΙΑΣ

Αυτό το προειδοποιητικό σύμβολο σημαίνει κίνδυνο. Βρίσκεστε σε κατάσταση που μπορεί να προκαλέσει τραυματισμό. Πριν εργαστείτε σε οποιοδήποτε εξοπλισμό, να έχετε υπόψη σας τους κινδύνους που σχετίζονται με τα ηλεκτρικά κυκλώματα και να έχετε εξοικειωθεί με τις συνήθεις πρακτικές για την αποφυγή ατυχημάτων. Χρησιμοποιήστε τον αριθμό δήλωσης που παρέχεται στο τέλος κάθε προειδοποίησης, για να εντοπίσετε τη μετάφρασή της στις μεταφρασμένες προειδοποιήσεις ασφαλείας που συνοδεύουν τη συσκευή.

ΦΥΛΑΞΤΕ ΑΥΤΕΣ ΤΙΣ ΟΔΗΓΙΕΣ

אזהרה

הוראות בטיחות חשובות

סימן אזהרה זה מסמל סכנה. אתה נמצא במצב העלול לגרום לפציעה. לפני שתעבוד עם ציוד
כלשהו, עליך להיות מודע לסכנות הכרוכות במעגלים חשמליים ולהכיר את הנהלים המקובלים
למניעת תאונות. השתמש במספר ההוראה המסופק בסופה של כל אזהרה כד לאתר את התרגום
באזהרות הבטיחות המתורגמות שמצורפות להתקן.

שמור הוראות אלה

Opomena

постои кај електричните кола и треба да ги познавате стандардните постапки за спречување на
несреќни случаи. Искористете го бројот на изјавата што се наоѓа на крајот на секое
предупредување за да го најдете неговиот период во преведените безбедносни
предупредувања што се испорачани со уредот.
ЧУВАЈТЕ ГИ ОВИЕ НАПАТСТВИЈА

Ostrzeżenie

WAŻNE INSTRUKCJE DOTYCZĄCE BEZPIECZEŃSTWA

**Ten symbol ostrzeżenia oznacza niebezpieczeństwo. Zachodzi sytuacja, która może
powodować obrażenia ciała. Przed przystąpieniem do prac przy urządzeniach należy
zapoznać się z zagrożeniami związanymi z układami elektrycznymi oraz ze standardowymi
środkami zapobiegania wypadkom. Na końcu każdego ostrzeżenia podano numer, na
podstawie którego można odszukać tłumaczenie tego ostrzeżenia w dołączonym do
urządzenia dokumencie z tłumaczeniami ostrzeżeń.**

NINIEJSZE INSTRUKCJE NALEŻY ZACHOWAĆ

Upozornenie

DÔLEŽITÉ BEZPEČNOSTNÉ POKYNY

**Tento varovný symbol označuje nebezpečenstvo. Nachádzate sa v
situácii s nebezpečenstvom úrazu. Pred prácou na akomkoľvek vybavení
si uvedomte nebezpečenstvo súvisiace s elektrickými obvodmi a
oboznámte sa so štandardnými opatreniami na predchádzanie úrazom.
Podľa čísla na konci každého upozornenia vyhľadajte jeho preklad v
preložených bezpečnostných upozorneniach, ktoré sú priložené k
zariadeniu.**

USCHOVAJTE SI TENTO NÁVOD

Electrical Equipment Guidelines

Follow these basic guidelines when working with any electrical equipment:

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

Telephone Wiring Guidelines

Use the following guidelines when working with any equipment that is connected to telephone wiring or to other network cabling:

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

Preventing Electrostatic Discharge Damage

Electrostatic discharge (ESD) damage, which can occur when electronic cards or components are improperly handled, results in complete or intermittent failures. Port adapters and processor modules consist of printed circuit boards that are fixed in metal carriers. Electromagnetic interference (EMI) shielding and connectors are integral components of the carrier. Although the metal carrier helps to protect the board from ESD, use a preventive antistatic strap during handling.

Following are guidelines for preventing ESD damage:

- Always use an ESD wrist or ankle strap and ensure that it makes good skin contact.
- Connect the equipment end of the strap to an unfinished chassis surface.
- When installing a component, use any 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 to ensure that bus connectors are properly seated.
- When removing a component, use any available ejector levers or captive installation screws to release the bus connectors from the backplane or midplane.
- Handle carriers by available handles or edges only; avoid touching the printed circuit boards or connectors.

- 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 only protects components from ESD voltages on the body; ESD voltages on clothing can still cause damage.

- Never attempt to remove the printed circuit board from the metal carrier.

⚠

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

Laser Safety

Figure 2-1 shows the Class 1 laser warning label.

Figure 2-1   Class 1 Laser Product Warning Label on the OC-12 ATM Line Card

```
CLASS 1 LASER PRODUCT
LASERPRODUKT DER KLASSE 1
PRODUIT LASER DE CLASSE 1
PRODUCTO LASER CLASE 1
クラス1　レーザ製品                    127089
```

⚠
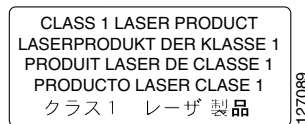
Warning   **Class 1 laser product.** Statement 1008

⚠

Warning   **Because invisible laser radiation may be emitted from the aperture of the port when no fiber cable is connected, avoid exposure to laser radiation and do not stare into open apertures.** Statement 1051

FCC Class A Compliance

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

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

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

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

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

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

Caution The OC-12 ATM line card has been designed to meet these requirements. Modifications to this product that are not authorized by Cisco Systems, Inc. could void the various approvals and negate your authority to operate the product.

Removing and Installing the OC-12 ATM Line Card

This chapter describes how to remove the OC-12 ATM line card from its supported platform, how to install a new or replacement line card, and how to install SFP modules.

This chapter contains the following sections:

- Handling Line Cards, page 3-1
- Online Insertion and Removal, page 3-2
- Warnings and Cautions, page 3-2
- Line Card Removal and Installation, page 3-3
- SFP Module Removal and Installation, page 3-5
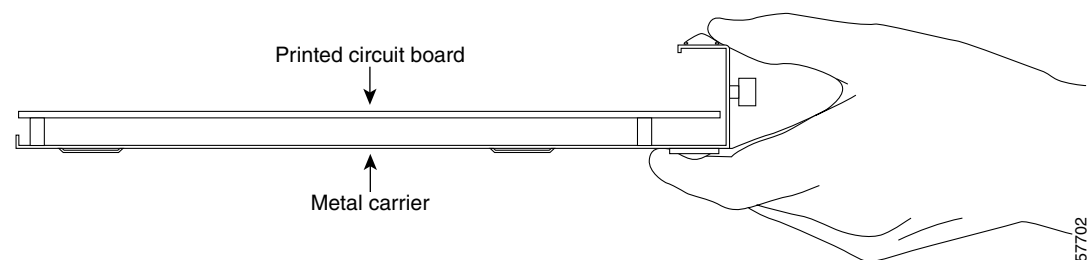
Handling Line Cards

Each line card circuit board is mounted to a metal carrier and is sensitive to electrostatic discharge (ESD) damage.

⚠️

Caution   Always handle the line card by the carrier edges and handle; never touch the line card components or connector pins. (See Figure 3-1.)

Figure 3-1   *Handling a Line Card*

Printed circuit board

Metal carrier

Online Insertion and Removal

The Cisco 7304 router supports online insertion and removal (OIR) of line cards; you do not have to power down the router when removing and replacing an OC-12 ATM on a Cisco 7304 router. The Cisco 7304 router also supports CLI-controlled OIR (see the "CLI-Controlled OIR" section on page 4-32), which allows for the completion of data traffic before the active interfaces are shut down.

Note As you disengage the line card from the router, online insertion and removal (OIR) administratively shuts down all active interfaces in the line card.

Note Before you begin installation, read the "Preparing for Installation" section on page 2-1 for a list of parts and tools required for installation.

Warnings and Cautions

Observe the following warnings and cautions when installing or removing line cards.

Warning **Class 1 laser product.** Statement 1008

Warning **Only trained and qualified personnel should be allowed to install, replace, or service this equipment.** Statement 1030

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.** Statement 1029

Warning **Hazardous voltage or energy is present on the backplane when the system is operating. Use caution when servicing.** Statement 1034

Caution To prevent jamming the carrier between the upper and the lower edges of the slot, and to ensure that the connector at the rear of the line card mates with the connection at the rear of the slot, make certain that the carrier is positioned correctly, as shown in cutaway D in Figure 3-2. If the line card does not slide freely into the backplane, loosen the locking thumbscrews on the neighboring line cards

Caution When removing or installing the OC-12 ATM line card, wear a grounding wrist strap to avoid ESD damage to the card. Some routers have an ESD connector for attaching the wrist strap.

Line Card Removal and Installation

This section describes how to remove and install the OC-12 ATM in the Cisco 7304 router.

Removing the Line Card

To remove the line card, refer to Figure 3-2 and do the following:

Step 1   Make sure you are properly grounded.

Step 2   Remove any cables from the card.

Step 3   Loosen the locking thumbscrews (see A in Figure 3-2) on both sides of the line card. Use a Phillips head screwdriver if necessary.

Step 4   Open the line card levers (see B in Figure 3-2) completely (at a 45-degree angle).

Step 5   Carefully slide the card out of the slot (see C in Figure 3-2) and place it on an antistatic surface.

Installing the Line Card

To install the line card, refer to Figure 3-2 and do the following:

Step 1   Make sure you are properly grounded.

Step 2   Carefully align the line card with the slot guides on the chassis (see D in Figure 3-2).

Note   The line card levers must be positioned at a 45-degree angle before the line card makes contact with the backplane (see B in Figure 3-2).

Step 3   Make sure that the line card levers are open (see B in Figure 3-2) and then slide the card into the chassis until it makes contact with the backplane.

Step 4   Close the line card levers.

Note   If a line card lever or other retaining mechanism does not move to the locked position, the line card is not completely seated in the backplane. Carefully pull the line card halfway out of the slot, reinsert it, and move the line card lever to the locked position.

Step 5   Tighten the locking thumbscrews (A) on both sides of the line card.

Note   When a chassis is fully populated, seating a new line card may be difficult. To avoid damage when seating a new line card, loosen the locking thumbscrews of the neighboring cards. Do not use excessive force to seat the line card.

Figure 3-2   Line Card Removal and Installation
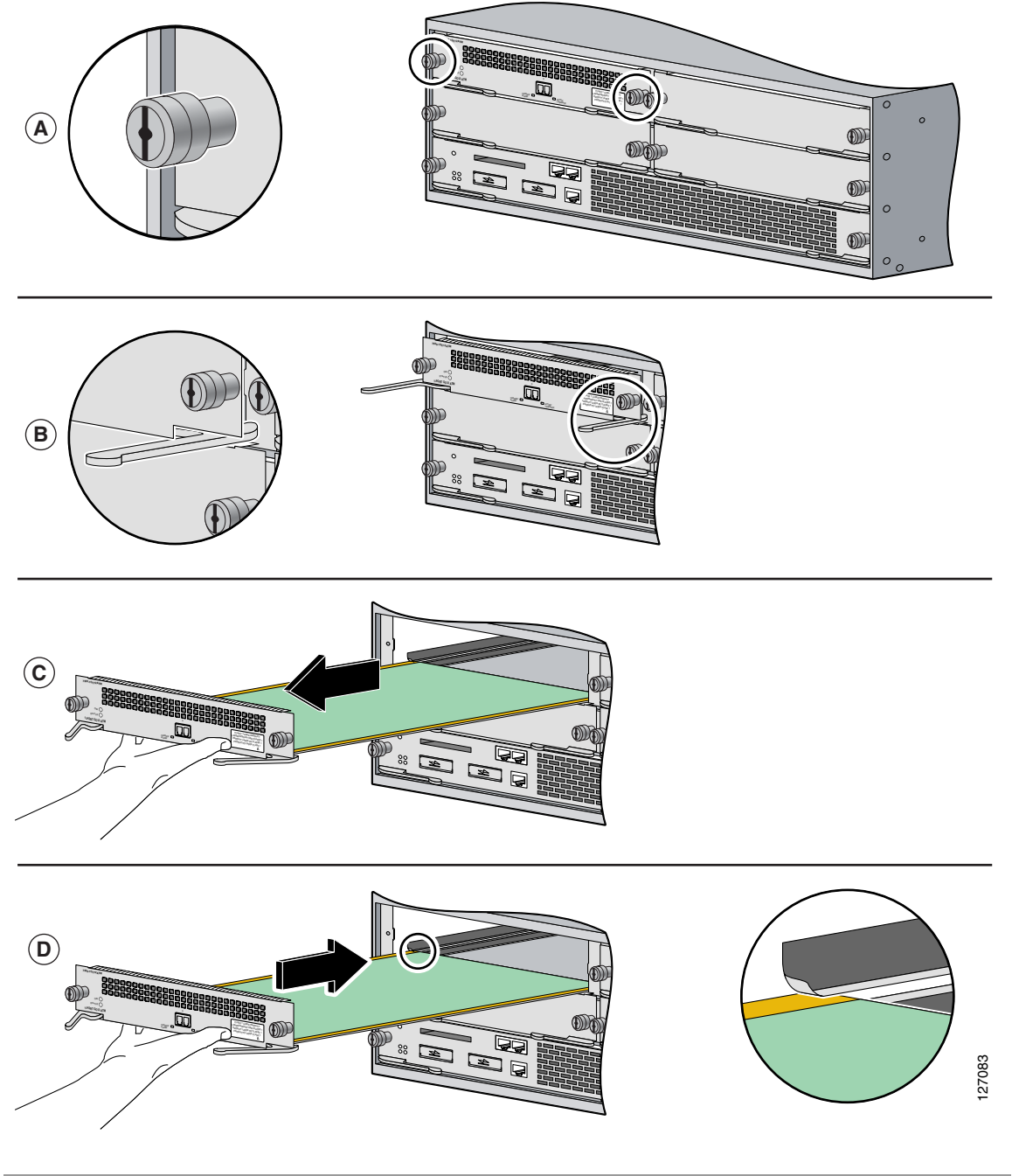
SFP Module Removal and Installation

The OC-12 ATM line card only accepts the SFP modules listed as supported in this document. An SFP module check is run each time an SFP module is inserted into the OC-12 ATM line card and only SFP modules that pass this check are usable by the OC-12 ATM line card.

✎
Note   The SFP modules used with the OC-12 ATM line card have LC-type connectors

The SFP modules support online insertion and removal (OIR). However, if the line card is already installed in the router and the system is operational, we recommend that you administratively shut down the SFP module port before installing a new SFP module.

Available Cisco SFP modules include the following:

- SFP-OC12-SR—Single-mode short range
- SFP-OC12-IR1—Single-mode intermediate range
- SFP-OC12-LR1—Singlemode long range (LR-1)
- SFP-OC12-LR2—Single-mode long range (LR-2)
- SFP-OC12-MM—Multimode

Handling the SFP Module

Before handling the SFP module, observe the following guidelines:

- SFP modules are static-sensitive. To prevent electrostatic discharge (ESD) damage, follow your normal board- and component-handling procedures.
- SFP modules are dust-sensitive. When storing an SFP module or when a fiber-optics cable is not plugged into the connector, always keep plugs in the SFP optical bores.

✎
Note   The most common source of contaminants in the optical bores is debris picked up on the ferrules of the optical connectors. Use a swab or lint-free absorbent wipes to clean the ferrules of the optical connector.

Removing the SFP Module

The following procedure describes removing the SFP module from a vertically or horizontally oriented card slot.

⚠
Warning   **Ultimate disposal of this product should be handled according to all national laws and regulations.** Statement 1040

⚠
Caution   You can remove and install SFP modules with power on to the system; however, we strongly recommend that you do not remove or install an SFP module with optical fiber cables attached.

To remove the SFP module, perform the following steps:

Step 1 Make sure you are properly grounded.

Step 2 Disconnect the network fiber cable from the SFP module connector.

Step 3 Remove the SFP module from the slot.

    a. Using your thumb and forefinger, grip the colored latching band on the front of the SFP module.

    b. Gently push the latching band back toward the SFP slot. You may hear a click or feel the SFP module disengage from the holding latch.

> **Note** Not all SFP modules have the same kind of latching mechanism.

    c. While still holding the latching band, pull the SFP module towards you and out of the slot.

Step 4 Set the SFP module aside on an antistatic surface.

Installing the SFP Module

Use the following procedure to install the SFP module:

Step 1 Make sure you are properly grounded.

Step 2 Verify that you have the correct SFP module for your installation. Check the part number and distance information on the SFP module label.

Step 3 Align the SFP module with the slot so that the label is facing away from the handle.

Step 4 Holding the SFP module at the latching band (with your thumb and forefinger), insert the SFP module into the slot on the line card.

Step 5 Push the SFP module back into the slot until the latch engages. When fully inserted, only the band around the front of the SFP module is visible.

Figure 3-3   *Inserting an SFP Module*
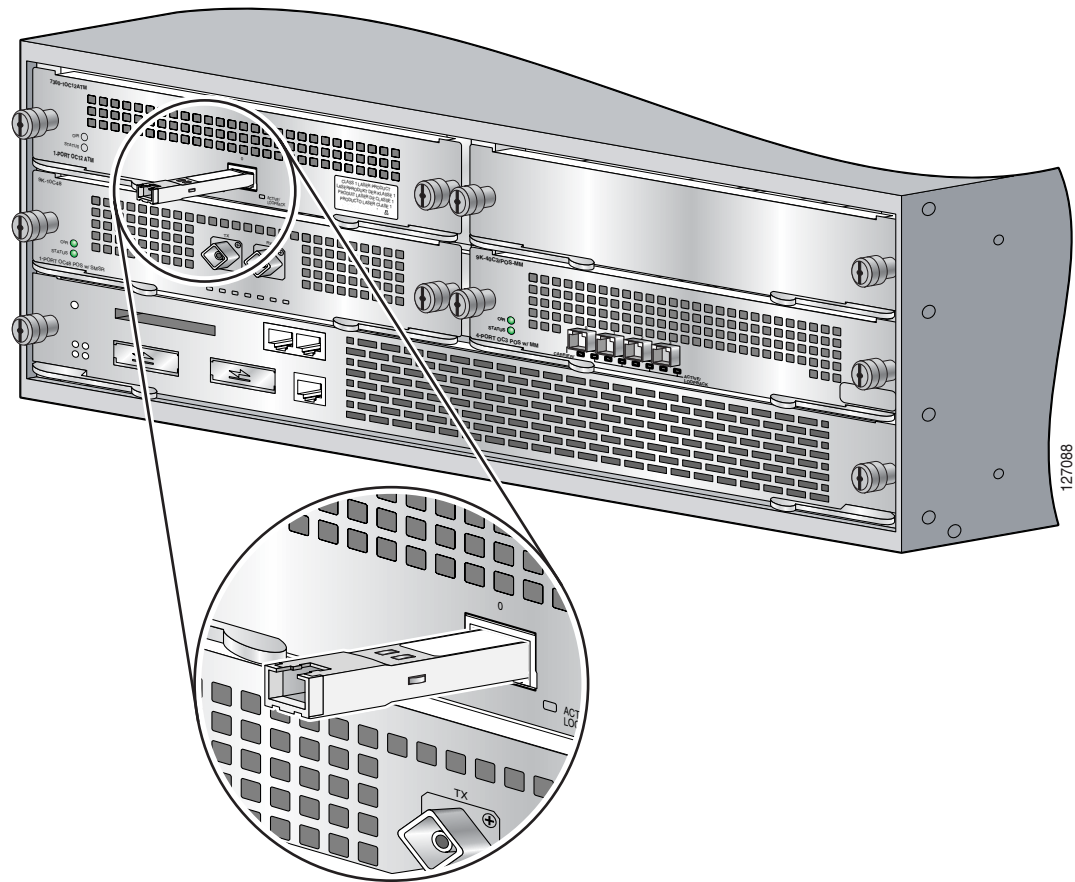
Cabling the SFP Module

To continue your OC-12 ATM line card installation, you must connect the interface cables.

Step 1   Remove the plug from the SFP module bore plug and save the plug for future use.

Step 2   Attach the network interface fiber-optics cable to the SFP module and then attach the optical fiber cable your network.

Note   Optical fiber cables are not available from Cisco Systems; they are available from outside commercial cable vendors.

Warning   **Invisible laser radiation may be emitted from disconnected fibers or connectors. Do not stare into beams or view directly with optical instruments.** Statement 1051

Cisco 1-Port OC-12 ATM Line Card Installation and Configuration

Configuring the 1-Port OC-12 ATM Line Card

To continue your OC-12 ATM line card installation, you must configure the OC-12 ATM interface. This chapter contains the following sections:

- Using the EXEC Command Interpreter, page 4-1
- Configuring the Interfaces, page 4-2
- Checking the Configuration, page 4-5
- Performing an Advanced Configuration, page 4-11
- Customizing the 1-Port OC-12 ATM Line Card, page 4-19
- Checking the Advanced Configuration, page 4-20
- Traffic Management, page 4-21
- Testing and Troubleshooting the 1-Port OC-12 ATM Line Card, page 4-21
- ATM Configuration Examples, page 4-27
- Upgrading Your Bootdisk Image, page 4-31
- CLI-Controlled OIR, page 4-32

Using the EXEC Command Interpreter

You modify the configuration of your router through the software command interpreter called the EXEC (also called enable mode). You must enter the privileged level of the EXEC command interpreter with the **enable** command before you can use the configure command to **configure** a new interface or change the existing configuration of an interface. The system prompts you for a password if one has been set.

The system prompt for the privileged level ends with a pound sign (#) instead of an angle bracket (>).

At the console terminal, use the following procedure to enter the privileged level:

Step 1 At the user-level EXEC prompt, enter the **enable** command. The EXEC prompts you for a privileged-level password as follows:

```
Router> enable

Password:
```

Step 2 Enter the password (the password is case sensitive). For security purposes, the password is not displayed.

When you enter the correct password, the system displays the privileged-level system prompt (#):

```
Router#
```

Configuring the Interfaces

After you verify that the new OC-12 ATM line card is installed correctly (the STATUS LED turns green), use the privileged-level **configure** command to configure the new interface. Have the following information available:

- Protocols you plan to route on the new interface
- IP addresses, if you plan to configure the interface for IP routing
- Bridging protocols you plan to use

If you installed a new OC-12 ATM line card or if you want to change the configuration of an existing interface, you must enter configuration mode to configure the new interface. If you replaced an OC-12 ATM line card that was previously configured, the system recognizes the new interface and brings it up in its existing configuration.

For a summary of the configuration options available and instructions for configuring the interface on an OC-12 ATM line card, refer to the appropriate configuration publications listed in the Related Documentation, page -viii section.

You execute configuration commands from the privileged level of the EXEC command interpreter, which usually requires password access. Contact your system administrator, if necessary, to obtain password access. (See the "Using the EXEC Command Interpreter" section on page 4-1 section for an explanation of the privileged level of the EXEC.)

This section contains the following subsections:

- Shutting Down an Interface, page 4-2
- Performing a Basic Configuration, page 4-4

Shutting Down an Interface

Before you replace an interface cable, replace line cards, or remove an interface that you will not replace, use the **shutdown** command to shut down (disable) the interfaces. When you shut down an interface, it is designated administratively down in the **show** command displays.

Follow these steps to shut down an interface:

Step 1 Enter the privileged level of the EXEC command interpreter (also called enable mode). (See the "Using the EXEC Command Interpreter" section on page 4-1 for instructions.)

Step 2 At the privileged-level prompt, enter configuration mode and specify that the console terminal is the source of the configuration commands, as follows:

```
Router# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#
```

Step 3 Shut down the interface by entering the **interface atm** command (followed by the interface address of the interface), and then enter the **shutdown** command. Table 4-1 shows the command syntax.

When you have finished, press **Ctrl-Z**—hold down the **Control** key while you press **Z**—or enter **end** or **exit** to exit configuration mode and return to the EXEC command interpreter.

Table 4-1   Example of the shutdown Command

Platform	Command	Example
Cisco 7304 router	**interface atm** followed by *slot/port* (slot-number/interface-port-number)	The example is for interface 0 on an OC-12 ATM line card in slot 4. `Router(config-if)# interface atm 4/0` `Router(config-if)# shutdown` `Ctrl-Z` `Router#`

Step 4   Write the new configuration to NVRAM as follows:

```
Router# copy running-config startup-config
[OK]
Router#
```

The system displays an OK message when the configuration has been stored in NVRAM.

Step 5   Verify that new interface is now in the correct state (shut down) using the **show interfaces atm** command to display the specific interface.

Table 4-2   Example of the show interfaces atm Command

Platform	Command	Example
Cisco 7304 router	**show interfaces atm** followed by *slot/port* (slot-number/interface-port-number)	The example is for interface 0 on an OC-12 ATM line card in slot 4. `Router# show interfaces atm 4/0` `ATM 4/0 is administratively down, line protocol is down` `[Additional display text omitted from this example]`

Step 6   Reenable the interface by doing the following:

  a.   Repeat Step 3 to reenable an interface. Substitute the **no shutdown** command for the **shutdown** command.

  b.   Repeat Step 4 to write the new configuration to memory. Use the **copy running-config startup-config** command.

  c.   Repeat Step 5 to verify that the interface is in the correct state. Use the **show interfaces atm** command followed by the interface address of the interface.

For complete descriptions of software configuration commands, refer to the publications listed in the "Related Documentation" section on page viii.

Performing a Basic Configuration

The following steps describe a basic interface configuration. Press the **Return** key after each step unless otherwise noted. At any time, you can exit the privileged level and return to the user level by entering **disable** at the prompt as follows:

```
Router# disable
Router>
```

Follow these steps to perform a basic configuration:

Step 1   At the privileged-level prompt, enter configuration mode and specify that the console terminal will be the source of the configuration commands, as follows:

```
Router# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#
```

Step 2   Specify the first interface to configure by entering the **interface atm** command, followed by the interface address of the interface you plan to configure. Table 4-3 shows an example.

Table 4-3   Example of the interface atm Command

Platform	Command	Example

Cisco 7304 routers	**interface atm**, followed by *slot/port* (slot-number/interface-port-number)	The example is for the interface 0 for the OC-12 ATM line card in slot 4.
		
		`Router(config)# interface atm 4/0`
		`Router(config-if)#`

Step 3   Assign an IP address and subnet mask to the interface (if IP routing is enabled on the system) by using the **ip address** command, as in the following example:

```
Router(config-if)# ip address 10.0.0.1 255.0.0.0
```

Step 4   Add any additional configuration commands required to enable routing protocols and set the interface characteristics.

Step 5   Reenable the interfaces using the **no shutdown** command. (See the "Shutting Down an Interface" section on page 4-2.)

Step 6   After including all of the configuration commands to complete your configuration, press **Ctrl-Z** or enter **end** or **exit** to exit the configuration mode and return to the EXEC command interpreter prompt.

Step 7   Write the new configuration to NVRAM as follows:

```
Router# copy running-config startup-config
[OK]
Router#
```

The system displays an OK message when the configuration has been stored in NVRAM.

> ✎
>
> **Note**   If you are going to disconnect or reconfigure the ATM interface cable, use the **shutdown** command before doing so. After reattaching the ATM interface cable, use the **no shutdown** command to bring up the ATM interface.

Checking the Configuration

After configuring the interface, use the **show** commands to display the status of the new interface and use the **ping** and **loopback** commands to check connectivity. This section includes the following subsections:

- Using show Commands to Verify the New Interface Status, page 4-5
- Using the ping Command to Verify Network Connectivity, page 4-10
- Using loopback Commands, page 4-10

Using show Commands to Verify the New Interface Status

Table 4-4 demonstrates how you can use the **show** commands to verify that new interfaces are configured and operating correctly and that the OC-12 ATM line card appears in them correctly. Sample displays of the output of selected **show** commands appear in the sections that follow. For complete command descriptions and examples, refer to the publications listed in the "Related Documentation" section on page viii.

Table 4-4   Using show Commands

Command	Function	Example
show version or **show hardware**	Displays system hardware configuration, the number of each interface type installed, Cisco IOS software version, names and sources of configuration files, and boot images	Router# **show version**
show controllers	Displays all the current interface processors and their interfaces	Router# **show controllers**
show diag *slot*	Displays types of line cards installed in your system and information about a specific chassis slot	Router# **show diag 4**
show c7300	Displays types of line cards with status information for each installed line card	Router# **show c7300**
show interfaces atm *interface-port-number/slot*	Displays status information about a specific ATM interface in a Cisco 7304 router	Router# **show interfaces atm 4/0**
show protocols	Displays protocols configured for the entire system and for specific interfaces	Router# **show protocols**

Table 4-4   *Using show Commands (continued)*

Command	Function	Example
show running-config	Displays the running configuration files	Router# **show running-config**
show startup-config	Displays the configuration stored in NVRAM	Router# **show startup-config**

If an interface is shut down and you configured it as up, or if the displays indicate that the hardware is not functioning properly, ensure that the interface is properly connected and terminated. If you still have problems bringing up the interface, contact a service representative for assistance.

This section includes the following subsections:

- Using the show version or show hardware Commands, page 4-6
- Using the show diag Command, page 4-7
- Using the show c7300 Command, page 4-8
- Using the show interfaces Command, page 4-9
- Using the ping Command to Verify Network Connectivity, page 4-10
- Using loopback Commands, page 4-10

Proceed to the"Using the ping Command to Verify Network Connectivity" section on page 4-10 when you have finished using the **show** commands.

Using the show version or show hardware Commands

Display the configuration of the system hardware, the number of each interface type installed, the Cisco IOS software version, the names and sources of configuration files, and the boot images, by using the **show version** (or **show hardware**) command.

Note   The outputs that appear in this document may not match the output you receive when running these commands. The outputs in this document are examples only.

Following is an example of the **show version** command from a Cisco 7304 router with the OC-12 ATM line card:

```
Router# show version

Cisco IOS Software, 7300 Software (C7300-JS-M), Version 12.2(25S2.041109.),
Copyright (c) 1986-2004 by Cisco Systems, Inc.
Compiled Tue 09-Nov-04 04:31 by

ROM: System Bootstrap, Version 12.1(12r)EX1, RELEASE SOFTWARE (fc1)
Currently running ROMMON from ROM 1
WS_REG_0 uptime is 1 hour, 5 minutes
Uptime for this control processor is 1 hour, 5 minutes
System returned to ROM by bus error at PC 0x41941398, address 0x20 at 20:10:58 UTC Thu Nov
11 2004
System image file is "disk0:c7300-js-mz.2004-11-09.x"

cisco 7300 (NSE100) processor (revision B) with 458752K/65536K bytes of memory.
Processor board ID SCA070200CS
R7000 CPU at 350Mhz, Implementation 39, Rev 3.2, 256KB L2, 1024KB L3 Cache
4 slot midplane, Version 67.49
```

```
Last reset from software reset or reload
PXF processor tmc0 'system:pxf/ucode1' is running ( v4.1 ).
PXF processor tmc1 'system:pxf/ucode1' is running ( v4.1 ).
1 FastEthernet interface
4 Gigabit Ethernet interfaces
2 ATM interfaces
509K bytes of non-volatile configuration memory.
31168K bytes of ATA compact flash in bootdisk (Sector size 512 bytes).
62976K bytes of ATA compact flash in disk0 (Sector size 512 bytes).
Standby route processor in slot 2 is down.
Configuration register is 0x2002
Router#
```

Using the show diag Command

Display the types of line cards installed in your system (and specific information about each) using the **show diag** *slot* command, where *slot* is the line card slot in a Cisco 7304.

✎
Note   The outputs that appear in this document may not match the output you receive when running these commands. The outputs in this document are examples only.

Following is an example of the **show diag** *slot* command for an OC-12 ATM line card in slot 4 of a Cisco 7304 router:

```
Router# show diag 4
Slot 4:
        OC12 ATM with SFP Line Card, 1 port
        Line Card state: Active
        Insertion time: 00:15:14 ago
        Bandwidth points: 620000
        EEPROM contents at hardware discovery:
        Controller Type         : 1223
        Hardware Revision       : 3.1
        Boot Timeout            : 0 msecs
        PCB Serial Number       : CSJ08407407
        PCB Part Number         : 73-6828-04
        Board Revision          : A0
        Fab Version             : 02
        RMA Test History        : 00
        RMA Number              : 0-0-0-0
        RMA History             : 00
        Deviation Number        : 0-0
        Product Identifier (PID) : 7300-1OC12ATM
        Top Assy. Part Number   : 68-0000-00
        Manufacturing Test Data : 00 00 00 00 00 00 00 00
        Field Diagnostics Data  : 00 00 00 00 00 00 00 00
        Calibration Data        : Minimum: 0 dBmV, Maximum: 0 dBmV
              Calibration values :
        EEPROM format version 4
        EEPROM contents (hex):
          0x00: 04 FF 40 04 C7 41 03 01 46 00 00 C1 8B 43 53 4A
          0x10: 30 38 34 30 37 34 30 37 82 49 1A AC 04 42 41 30
          0x20: 02 02 03 00 81 00 00 00 00 04 00 80 00 00 00 00
          0x30: CB 94 37 33 30 30 2D 31 4F 43 31 32 41 54 4D 20
          0x40: 20 20 20 20 20 20 87 44 00 00 00 C4 08 00 00 00
          0x50: 00 00 00 00 00 C5 08 00 00 00 00 00 00 00 00 C8
          0x60: 09 00 00 00 00 00 00 00 00 00 C7 7C F6 49 44 35
```

```
                    0x70: 00 00 00 00 00 00 00 00 00 00 00 00 07 08 64 32
                    0x80: 28 37 26 09 C4 64 32 28 32 DD 0C E4 64 32 28 43
                    0x90: 24 2E E0 AA 82 64 F4 24 00 00 00 00 00 00 00 00
                    0xA0: 00 00 00 00 00 00 F4 B9 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
                    0x100: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
                    0x110: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
                    0x120: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
                    0x130: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
                    0x140: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
                    0x150: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
                    0x160: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
                    0x170: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
                    0x180: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
                    0x190: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
                    0x1A0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
                    0x1B0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
                    0x1C0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
                    0x1D0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
                    0x1E0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
                    0x1F0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
                  FPGA information:
                    Current FPGA version     : 00.19
                    IOS bundled FPGA version : 00.19
                  CPLD version     : 00.06
          Router#
```

Using the show c7300 Command

Display the types of line cards installed in your system, their status, and insertion time by using the **show c7300** command.

Note The outputs that appear in this document may not match the output you receive when running these commands. The outputs in this document are examples only.

Following is an example of the **show c7300** command for a Cisco 7304 router:

```
Router# show c7300

Slot      Card Type          Status         Insertion time
----      ---------          ------         --------------
0,1       NSE100 (Active)    Up             01:06:35 ago
2,3       NSE100 (Standby)   Down           01:06:33 ago
4         1OC12-ATM          Active         01:06:30 ago
5         1OC12-ATM          Active         01:06:29 ago

FPGA information:
                          Hardware         FPGA version
Slot Card Type            Version      Bundled    Flash     Current
---- ---------            --------     -------    -------   -------
  0  NSE100 (MB)          02.01        01.07      01.07     01.07
  0  NSE100 (DB)          02.01        01.07      01.07     01.07
  4  1OC12-ATM            02.01        00.19      00.19     00.19
  5  1OC12-ATM            02.01        00.19      00.19     00.19
```

```
* - Card needs an FPGA update
# - Card needs to be reloaded for the new FPGA to take effect

System is compliant with hardware configuration guidelines.

Network IO Interrupt Throttling:
 throttle count=0, timer count=0
 active=0, configured=1
 netint usec=4000, netint mask usec=200

Router#
```

Using the show interfaces Command

The **show interfaces** command displays status information (including the physical slot and interface address) for the interfaces you specify. The example that follows specifies ATM interfaces.

For complete descriptions of interface commands and the configuration options available for Cisco 7304 interfaces, refer to the publications listed in the "Related Documentation" section on page -viii.

Note The outputs that appear in this document may not match the output you receive when running these commands. The outputs in this document are examples only.

Following is an example of the **show interfaces atm** command used with a Cisco 7304 router. In this example, the OC-12 ATM line card is installed in slot 4 of a Cisco 7304 router:

```
Router# show interfaces atm 4/0

ATM4/0 is up, line protocol is up
  Hardware is OC-12 ATM, address is 000b.5f2d.2e80 (bia 000b.5f2d.2e80)
  MTU 4470 bytes, sub MTU 4470, BW 599040 Kbit, DLY 80 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ATM, loopback not set
  Encapsulation(s): AAL5
  2047 maximum active VCs, 2040 current VCCs
  VC idle disconnect time: 300 seconds
  0 carrier transitions
  Last input never, output 00:30:42, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: None
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     0 packets input, 0 bytes, 0 no buffer
     Received 0 broadcasts (0 IP multicast)
     0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     2040 packets output, 57120 bytes, 0 underruns
     0 output errors, 0 collisions, 1 interface resets
     0 output buffer failures, 0 output buffers swapped out
Router#
```

Using the ping Command to Verify Network Connectivity

Using the **ping** command, you can verify that an interface port is functioning properly. This section provides a brief description of this command. Refer to the publications listed in the "Related Documentation" section on page viii for detailed command descriptions and examples.

The **ping** command sends echo request packets out to a remote device at an IP address that you specify. After sending an echo request, the system waits a specified time for the remote device to reply. Each echo reply is displayed as an exclamation point (!) on the console terminal; each request that is not returned before the specified time out is displayed as a period (.). A series of exclamation points (!!!!!) indicates a good connection; a series of periods (.....) or the messages [timed out] or [failed] indicate a bad connection.

Following is an example of a successful **ping** command to a remote server with the address 10.0.0.10:

```
Router# ping 10.0.0.10 <Return>

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echoes to 10.0.0.10, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/15/64 ms
Router#
```

If the connection fails, verify that you have the correct IP address for the destination and that the device is active (powered on), and repeat the **ping** command.

Using loopback Commands

The loopback test allows you to troubleshoot, detect, and isolate equipment malfunctions by testing the connection between the OC-12 ATM interface and a remote device. The **loop** command places an interface in internal loopback (also called *local loopback*) or line loopback mode, which enables test packets that are generated from the **ping** command to loop through a remote device or a cable. If the packets complete the loop, the connection is good. If not, you can isolate a fault to the remote device or the cable in the path of the loopback test.

Configuring an Interface for Diagnostic Loopback

The default loopback setting is for no loopback. With internal (or local) loopback, packets from the router are looped back in the framer. Outgoing data gets looped back to the receiver without actually being transmitted. Internal loopback is useful for checking that the OC-12 ATM line card is working. To configure an interface for internal loopback, enter the **loop diagnostic** command:

```
Router(config)# interface atm 4/0
Router(config-if)# loop diagnostic
```

To disable internal loopback, enter the **no loop diagnostic** command.

Configuring an Interface for Line Loopback

The default loopback setting is for no loopback. With line loopback, the receive (RX) fiber is logically connected to the transmit (TX) optical fiber cable so that packets from the remote router are looped back to it. Incoming data gets looped around and retransmitted without actually being received.

To configure an interface for line loopback, enter the **loop line** command:

```
Router(config)# interface atm 3/0
Router(config-if)# loop line
```

To disable line loopback, enter the **no loop line** command.

Performing an Advanced Configuration

The following sections include steps for configuring and customizing various ATM features of your OC-12 ATM line card:

- Configuring the OC-12 ATM Line Card for OC-12c (STM-4c) Framing, page 4-11
- About Configuring VCs, page 4-12
- About Configuring PVCs, page 4-12
- Configuring SVCs, page 4-15
- Configuring Classical IP and ARP over ATM, page 4-19

Configuring the OC-12 ATM Line Card for OC-12c (STM-4c) Framing

To configure the OC-12 ATM line card for OC-12c (STM-4c) framing, perform the following tasks in interface configuration mode:

	Command	Purpose
Step 1	Router# **interface atm** *slot/port*	Specifies an ATM interface to configure. To use these commands, you need to be in interface configuration mode. (See Table 4-3 on page 4-4 for examples.)
Step 2	Router(config-if)# **atm clock internal**	Select s the transmit clock source. This can be internal or derived from the receive clock through use of the **no** form of the command. By default, the receive clock source is used for the transmit clock.
Step 3	Router(config-if)# **atm sonet stm-4c**	Specifies SONET framing: STM-4c (optional). Use the **no** form of this command to return to the default, STS-12c framing.
Step 4	Router(config-if)# **exit**	Exits configuration mode.

About Configuring VCs

Virtual circuits (VCs) are point-to-point connections between remote hosts and routers. A VC is established for each ATM end node with which the router communicates. The characteristics of the VC are established when the VC is created and include the following:

- Quality of service (QoS)
- ATM adaptation layer 5 (AAL5)
- Encapsulation type (logical link control [LLC], Subnetwork Address Protocol [SNAP], multiplexer [MUX], Network Level Protocol ID [NLPID], Integrated Local Management Interface [ILMI], Switched Multimegabit Data Service [SMDS], and ITU-T Q.2931 Signaling ATM Adaptation Layer [QSAAL])

When you assign a class of service to a VC for QoS management, the following default priority levels apply:

- Operation, Administration, and Maintenance (OAM) and signaling (highest level)
- Non-real-time variable bit rate (nrt-VBR)
- Unspecified bit rate (UBR), ILMI (lowest level)

Each VC supports the following router functions:

- Multiprotocol (AppleTalk, CLNS, DECnet, IP, IPX, VINES, XNS)
- Fast switching of IP packets
- Optimum, Flow, and Cisco Express Forwarding (CEF) switching of IP packets
- Pseudo broadcast support for multicast packets

By default, fast switching is enabled on all OC-12 ATM line card interfaces. These switching features can be turned off with interface configuration commands. Optimum, Flow, or CEF switching must be explicitly enabled for each interface.

About Configuring PVCs

To use a permanent virtual circuit (PVC), you must configure the PVC in both the router and the ATM switch. PVCs remain active until the circuit is removed from either configuration.

When a PVC is configured, all of the configuration options are passed on to the OC-12 ATM line card. You can write these PVCs into nonvolatile RAM (NVRAM); they are used when the system image is reloaded.

Some ATM switches might have point-to-multipoint PVCs that do the equivalent of broadcasting. If a point-to-multipoint PVC exists, it can be used as the sole broadcast PVC for all multicast requests.

To configure a PVC, perform the two required tasks in the following sections:

- Creating a PVC, page 4-13
- Mapping a Protocol Address to a PVC, page 4-13

Creating a PVC

You can create the PVC on either the main interface or the subinterface.

For example, to create a **PVC** on the subinterface, you can use this syntax:

	Command	Purpose
Step 1	Router# **configure terminal**	Enters configuration mode
Step 2	Router (config)# **interface atm 1/0.100 point-to-point**	Create a sub interface
Step 3	Router (config-subif)# **ip address 10.1.1.1 255.0.0.0**	Creates link to ip address
Step 4	Router (config)# **pvc 1/300**	Creates PVC (vpi+1, pvc=300)
Step 5	Router (config)# **encapsulation aal5snap**	Creates AAL5SNAP encapsulation
Step 6	Router (config)# **control Z**	Exits configuration mode

Optional Commands for ATM Adaptation Layer and Encapsulation

The following list of optional commands are used to configure the ATM adaptation layer (AAL) and encapsulation types:

- **aal5snap**: AAL5 + LLC/SNAP encapsulation. AAL5 Logical Link Control/Subnetwork Access Protocol (LLC/SNAP) encapsulation supports Inverse ARP and incorporates the LLC/SNAP that precedes the protocol datagram. This allows the multiple protocols to transverse the same PVC.

  > **Note**   aal5snap is the default encapsulation and the most widely used because it allows multiple protocols to be carried over one PVC.

- **aal5mux**: AAL5 + MUX encapsulation. AAL5 MUX encapsulation supports only a single protocol (IP or IPX) per PVC.

- **aal5ciscoppp**: For Cisco proprietary PPP over ATM, aal5ciscoppp supports only Cisco routers with ATM or asymmetric digital subscriber line (ADSL) interfaces. Use this type of encapsulation when PPP authentication is desired.

- **aal5nlpid:** AAL5 Network Layer Protocol Identification (NLPID) encapsulation allows ATM interfaces to interoperate with High-Speed Serial Interfaces (HSSIs) that are using an ATM data service unit (ADSU) and running ATM-Data Exchange Interface (DXI).

See examples of PVC configurations in the "ATM Configuration Examples" section on page 4-27.

Mapping a Protocol Address to a PVC

This section describes the procedure for mapping a protocol address to a PVC, which is a required task if you are configuring a PVC. The ATM interface supports a static mapping scheme that identifies the ATM addresses of remote hosts or routers. An address is specified as a virtual circuit descriptor (VCD) for a PVC (or network service access point [NSAP] address for SVC operation).

You enter mapping commands as groups. You first create a map list and then associate it with an interface. Begin the following steps in global configuration mode:

	Command	Purpose
Step 1	Router# **configure terminal**	Enters configuration mode
Step 2	Router(config)# **int atm 4/1.1 point-to-point**	Creates a subinterface.
Step 3	Router(config-subif)# **pvc 1/100**	Creates a PVC (vpi+1, pvic=100)
Step 4	Router(config-if-atm-vc)# **encapsulation aal5mux ip**	Create IP AAL5MUX encapsulation
Step 5	Router(config-if-atm-vc)# **protocol ip 10.1.1.2 broadcast**	Maps the IP protocol with broadcast option
Step 6	Router(config-if-atm-vc)# **cntl Z** Router#	Exits configuration mode

A map list can contain multiple map entries. The **broadcast** keyword specifies that this map entry is to be used when the corresponding protocol sends broadcast packets to the interface (for example, any network routing protocol updates). If you do not specify **broadcast**, the ATM software is prevented from sending routing protocol updates to the remote hosts.

If you do specify **broadcast** but do *not* set up point-to-multipoint signaling, pseudo broadcasting is enabled. To eliminate pseudo broadcasting and set up point-to-multipoint signaling on virtual circuits configured for broadcasting, refer to the *Cisco IOS Wide-Area Networking Configuration Guide, Release 12.3* at the following URL:

http://www.cisco.com/univercd/cc/td/doc/product/software/ios123/123cgcr/wan_vcg.htm

For more information, see:

- *Cisco IOS Configuration Fundamentals and Network Management Configuration Guide, Release 12.3* at the following URL:

    http://www.cisco.com/univercd/cc/td/doc/product/software/ios123/123cgcr/cfun_vcg.htm

- *Cisco IOS Configuration Fundamentals and Network Management Command Reference, Release 12.3* at the following URL:

    http://www.cisco.com/univercd/cc/td/doc/product/software/ios123/123cgcr/fun_r/index.htm

You can create multiple map lists and associate them with one ATM interface only. You must create different map lists to associate with different interfaces. See the "ATM Configuration Examples" section.

For further information on configuring the OC-12 ATM line card for PVCs, refer to the *Wide-Area Networking Configuration Guide* at the following URL:

http://www.cisco.com/univercd/cc/td/doc/product/software/ios123/123cgcr/wan_vcg.htm

For more information about mapping and routing protocols, refer to the following information at the listed URLs:

- *Multiple Routed Protocols Over ATM PVCs Using VC Multiplexing*

    http://www.cisco.com/warp/public/121/routed_rfc1483.html

- *Multiple Routed Protocols over ATM PVCs Using LLC Encapsulation*

    http://www.cisco.com/warp/public/121/routed_LLC.html

Configuring SVCs

ATM switched virtual circuit (SVC) service operates much like X.25 SVC service, although ATM allows much higher throughput. Virtual circuits are created and released dynamically, providing user bandwidth on demand. This service requires a signaling protocol between the router and the switch.

The ATM signaling software provides a method of dynamically establishing, maintaining, and clearing ATM connections at the User-Network Interface (UNI). The ATM signaling software conforms to the ATM Forum UNI 3.0 specification.

In UNI mode, the user is the router, and the network is an ATM switch. This is an important distinction. The Cisco router does not perform ATM-level call routing. Instead, the ATM switch does the ATM call routing, and the router routes packets through the resulting circuit. The router is viewed as the user and the LAN interconnection device at the end of the circuit, and the ATM switch is viewed as the network.

Figure 4-1 illustrates the router position in a basic ATM environment. The router is used primarily to interconnect LANs through an ATM network. Workstation C in Figure 4-1 is connected directly to the destination ATM switch. You can connect not only routers to ATM switches, but also any computer with an ATM interface that conforms to the ATM Forum UNI specification.

For more information about configuring SVCs, refer to *Configuring ATM SVCs With Static Map Statements* at the following URL:

http://www.cisco.com/warp/public/121/atm_svc.html

To use SVCs, complete the required tasks in the following sections:

- To configure the signaling PVC for all SVC connections, use the following command in interface configuration mode:, page 4-16
- Configuring the Network Service Access Point Address, page 4-17

For further information on configuring the OC-12 ATM line card for SVCs, see the *Cisco IOS Wide-Area Networking Configuration Guide, Release 12.3* at the following URL:

http://www.cisco.com/univercd/cc/td/doc/product/software/ios123/123cgcr/wan_vcg.htm

Configuring the PVC That Performs SVC Call Setup

Unlike X.25 service, which uses in-band signaling (connection establishment done on the same circuit as data transfer), ATM uses out-of-band signaling. One dedicated PVC exists between the router and the ATM switch, over which all SVC call establishment and call termination requests flow. After the call is established, data transfer occurs over the SVC, from router to router. The signaling that accomplishes the call setup and teardown is called *Layer 3 signaling* or the *Q.2931 protocol*.

For out-of-band signaling, a signaling PVC must be configured before any SVCs can be set up. In Figure 4-2, a signaling PVC from the source router to the ATM switch is used to set up two SVCs. This is a fully meshed network; workstations A, B, and C can all communicate with one another.

Figure 4-1   *Basic ATM Environment*
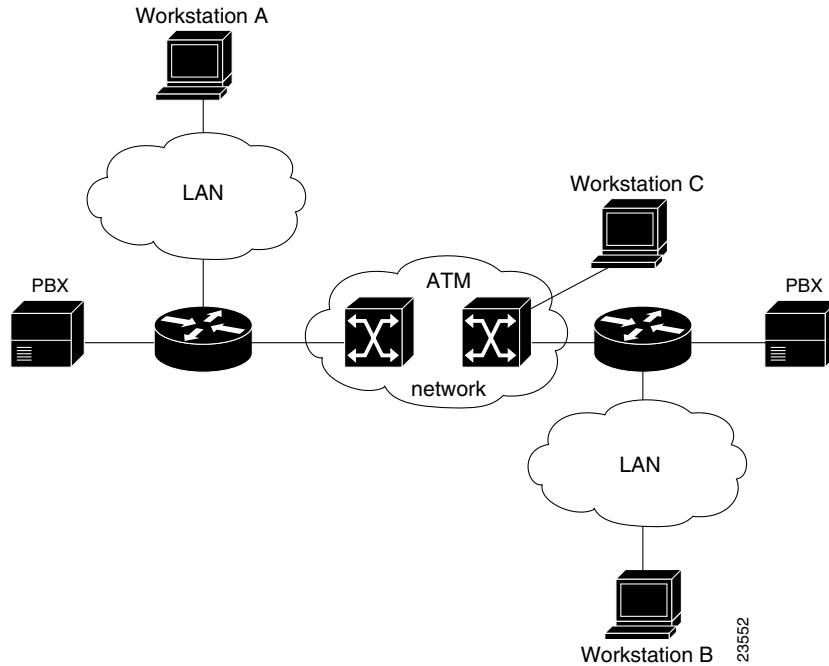
To configure the signaling PVC for all SVC connections, use the following command in interface configuration mode:

Command	Purpose
pvc [name] *vpi/vci* **qsaal**	Configures the signaling PVC for an ATM main interface that uses SVCs.

![pencil icon]

Note   This signaling PVC can be set up only on an ATM main interface, not on ATM subinterfaces.

Also see *Configuring ATM* at the following URL:

http://www.cisco.com/univercd/cc/td/doc/product/software/ios121/121cgcr/wan_c/wcdatm.htm

The VPI and VCI values must be configured consistently with the local switch. The standard value of VPI is 0; the standard value of VCI is 5.

See the "Example of SVCs in a Fully Meshed Network" section on page 4-29 for a sample ATM signaling configuration.

Figure 4-2   *One or More SVCs Require a Signaling PVC*
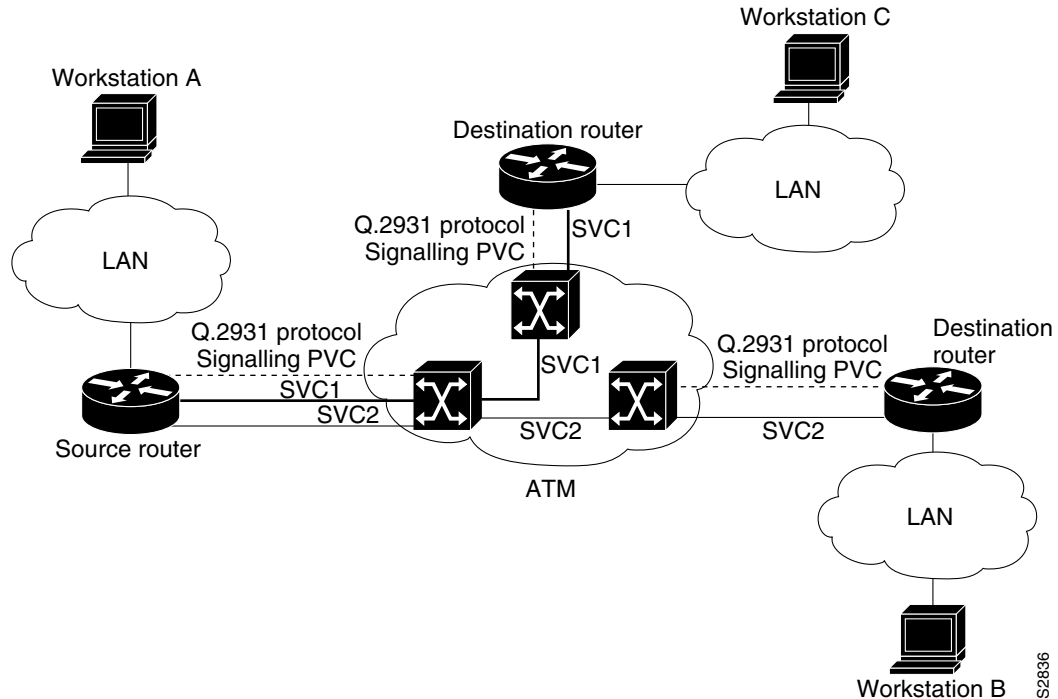
Configuring the Network Service Access Point Address

Every ATM interface involved with signaling must be configured with a network service access point (NSAP) address. The NSAP address is the ATM address of the interface and must be unique across the network.

You can do one of the following to configure an NSAP address:

- Configuring the Complete NSAP Address Manually
- Configuring the ESI and Selector Fields

  To configure the end system identifier (ESI) and Selector fields, you must also configure a PVC to communicate with the switch through Interim Local Management Interface (ILMI). The switch then provides the Prefix field of the NSAP address.

Configuring the Complete NSAP Address Manually

When you configure the ATM NSAP address manually, you must enter the entire address in hexadecimal format; that is, each digit entered represents a hexadecimal digit. To represent the complete NSAP address, you must enter 40 hexadecimal digits in the following format:

XX.XXXX.XX.XXXXXX.XXXX.XXXX.XXXX.XXXX.XXXX.XXXX.XX

Note   All ATM NSAP addresses must be entered in the dotted hexadecimal format shown, which conforms to the UNI specification.

Because the interface has no default NSAP address, you must configure the NSAP address for SVCs. To set the ATM interface source NSAP address, enter the following command in interface configuration mode:

Command	Purpose
nsap-address *nsap-address*	Configures the NSAP address for SVCs

The following is an example of an NSAP address assigned to ATM interface 4/0 on a Cisco 7304 router:

```
Router (config-if)# interface atm 4/0
Router (config-if)# atm nsap-address AB.CDEF.01.234567.890A.BCDE.F012.3456.7890.1234.12
```

You can display the ATM address for the interface by executing the **show interfaces atm** command.

For more information, see *Static and Dynamic Mapping* at the following URL:

http://www.cisco.com/warp/public/121/atm_svc.html

Configuring the ESI and Selector Fields

You can configure the router to get the NSAP address prefix from the switch; however, the switch must be capable of delivering the NSAP address prefix to the router through ILMI, and the router must be configured with a PVC for communication with the switch through ILMI.

To configure the router to get the NSAP prefix from the switch and use locally entered values for the remaining fields of the address, complete the following tasks in interface configuration mode:

	Command	Purpose
Step 1	Router(config-if)# **interface atm 4/0**	Selects the interface
Step 2	Router(config-if)# **pvc** *FCC* **0/16 ilmi**	Configures an ILMI PVC on an ATM main interface for communicating with the switch by using ILMI. (See Table 4-3 on page 4-4 for an example.)
Step 3	Router(config-if)# **atm Asia-address** *esi.selector*	Enters the end station ID (ESI) and selector fields of the NSAP address. End station ID field value in hexadecimal; 6 bytes long. Selector field value in hexadecimal; 1 byte long
Step 4	Router (config-if)# **exit**	Returns to interface configuration mode

In the **atm Asia-address** command, the *Asia* argument is 6 hexadecimal bytes long (12 digits), and the *selector* argument is 1 hexadecimal byte long (2 digits).

In the following example on a Cisco 7304 router, the ESI and Selector field values are assigned, and the ILMI PVC is set up:

```
Router(config-if)# interface atm 4/0
Router(config-if)# pvc FCC 0/16 ilmi
Router(config-if)# atm Asia-address 345678901234.12
Router(config-if)# exit
```

Note The ESI address is local and is required to create and register a 20-byte NSAP address with the ATM switch.

Configuring Classical IP and ARP over ATM

Cisco implements both the ATM Address Resolution Protocol (ARP) server and ATM ARP client functions described in RFC 1577. RFC 1577 models an ATM network as a logical IP subnetwork on a LAN.

The tasks required to configure classical IP and ARP over ATM depend on whether there are SVCs or PVCs in the environment. For further information, refer to the *Cisco IOS Wide-Area Networking Configuration Guide, Release 12.3* at the following URL:

http://www.cisco.com/univercd/cc/td/doc/product/software/ios123/123cgcr/wan_vcg.htm

Customizing the 1-Port OC-12 ATM Line Card

You can customize the OC-12 ATM line card. The features you can customize have default values that will probably suit your environment and not need to be changed. However, you might need to enter configuration commands, depending on the requirements for your system configuration and the protocols you plan to route on the interface. Perform the tasks in the following sections if you need to customize the OC-12 ATM line card:

- Setting the MTU Size, page 4-19
- Configuring an ATM Interface for Local Loopback, page 4-19
- Configuring an ATM Interface for External Loopback, page 4-20

Note   For the commands that follow, you must be in interface configuration mode. To enter interface configuration mode, use the **interface atm** command, followed by the interface address of the ATM interface you plan to configure. (For information on the **interface atm** command and the interface address to use, see Table 4-3 on page 4-4.)

Setting the MTU Size

Each ATM interface has a default maximum packet size or maximum transmission unit (MTU) size. On the OC-12 ATM line card, this number defaults to 4470 bytes, the range being 64 through 9216 bytes. To set the maximum MTU size, enter the following command in interface configuration mode:

Router(config-if)# mtu *bytes*

Configuring an ATM Interface for Local Loopback

To configure an ATM interface for local loopback (useful for checking that the OC-12 ATM line card is working by looping the transmit data back to the receive data), use the following command:

```
Router(config-if)# loopback diagnostic
```

The **no** form of the command turns off local loopback.

Configuring an ATM Interface for External Loopback

To configure an ATM interface for external loopback (useful for checking that the OC-12 ATM line card is working by looping the receive data back to the transmit data), use the following command:

```
Router(config-if)# loopback line
```

The **no** form of each command turns off external loopback.

For more information, see *Understanding Loopback Modes on Cisco Routers* at the following URL:

http://www.cisco.com/warp/public/121/atmloopback.html

Checking the Advanced Configuration

After configuring the new interface, you can display its status. You can also display the current state of the ATM network and connected virtual circuits. To show current virtual circuits and traffic information, enter the following commands in EXEC mode.

	Command	Purpose
Step 1	Router# **show atm interface atm** *slot-number*/interface port number	Displays ATM-specific information about an ATM interface.
Step 2	Router# **show atm map**	Displays the configured list of ATM static maps to remote hosts on an ATM network.
Step 3	Router# **show atm traffic**	Displays information about global traffic to and from all ATM networks connected to the router. Display a list of counters of all ATM traffic on this router.
Step 4	Router# **show atm** *vc [vcd]*	Displays ATM virtual circuit information about all PVCs and SVCs (or a specific virtual circuit).
Step 5	Router# **show sscop**[1]	Displays details for the ATM interface.
Step 6	Router# **show atm arp-server**	Displays ATM ARP server table.
Step 7	Router# **show atm ilmi-status**	Displays ATM ILMI information.

1. SSCOP = Service-Specific Connection-Oriented Protocol.

Traffic Management

The OC-12 ATM line card supports the traffic-shaping parameters defined in Table 4-5 on page 4-21. This ensures that generated traffic conforms to the *ATM Forum Traffic Management Specification Version 4.0.*

Table 4-5   Traffic-Shaping Parameters and Ranges

Traffic Parameter	Range	Default
Peak rate OC-12	38 kbps to 599040 kbps	If the peak rate is not defined, each new VC is set to the maximum physical layer rate.
Sustained Cell Rate (SCR) Average rate	38 kbps <SCR < 299520 for vbr-nrt	Average = peak rate
Maximum burst size	1 to 65,535	Equal to the OC-12 ATM line card MTU size. (User-configurable on ATM interface only.)

- *ATM Forum Traffic Management Specification Version 4.0*

  ftp://ftp.atmforum.com/pub/approved-specs/af-tm-0056.000.pdf

- *Understanding the VBR-nrt Service Category and Traffic Shaping for ATM VCs*

  http://www.cisco.com/warp/public/121/atm_vbrshape.shtml

Note The OC-12 ATM line card supports universal broadband router (UBR) and nrt-VBR traffic only.

Testing and Troubleshooting the 1-Port OC-12 ATM Line Card

The following sections provide suggested guidelines for troubleshooting the OC-12 ATM line card. Use the **ping** command to verify network connectivity, the **debug** commands to help solve network problems, and the **show** commands to display the current state of the network.

The following topics are covered in this section:

- "1-Port OC-12 ATM Line Card Statistics" section on page 4-21
- "Using the debug atm Commands" section on page 4-23
- "Commands That Display ATM Information" section on page 4-24
- "More Troubleshooting Information" section on page 4-27

1-Port OC-12 ATM Line Card Statistics

The OC-12 ATM line card maintains a count of certain errors, and tracks the ATM controller facility performance. In addition to keeping a count of these errors, the OC-12 ATM line card also takes snapshots of the last VCI/VPI that caused the error. Each OC-12 ATM line card error counter is made up of 16 bits. Errors counted include the following:

- CRC errors
- Giants received

- No buffers available

- Framing errors

- Application layer or physical layer errors

- Packet time-out errors on receive

You can use the following ATM commands to gather statistical information about the OC-12 ATM line card.

To display line card-specific error statistics, use the **show interfaces atm** command.

```
Router# show interface atm
```

Note   For examples of the **show interfaces atm** command for the supported platform, see the "Using the show interfaces Command" section on page 4-9.

To display the ATM framing information and ATM facility performance statistics, use the **show controllers atm** command.

```
Router# show controllers atm 4/0
```

The following is an example of the **show controllers atm** command from a Cisco 7304 router:

```
Router# show controllers atm 4/0
Interface ATM4/0 is administratively down
Hardware is OC-12 ATM, bandwidth OC12 (622000Kbps)
SFP is SFP_OC12_MM, Framer is PMC PM5357 S/UNI-SATURN (622-SATURN).
SAR device is MXT4400 TSP
  PortMakerI AAL5 SAR firmware version for MXT4400 Reassembly SAR:
    major 0x1, minor 0x6, patch 0x03, code level 0x00
  PortMakerI AAL5 SAR firmware version for MXT4400 Segmemtation SAR:
    major 0x1, minor 0x6, patch 0x03, code level 0x00
  hwidb=0x45BEF610, ds=0x45BF0A40, ds_vp=0x45C49A00, ds_vc=0x45BF18C0
  slot=4, slotunit=0, fci_type=0x04C7, ticks=405
  atm_db_flags=0x00048300
Current VCC count: current=0, peak=100
Framer Information:
  Framing mode: SONET OC12 STM-4. Clock source: line. Loopback mode: none.
  Facility alarm: None
  S1 byte: in synchronization
  Phy stats:
        sbip        lbip        lfebe        pbip        pfebe        hcse
  --------------------------------------------------------------------------
          86         294         282        65670       70241           0
  sbip:  Section BIP8
  lbip:  Line BIP8/96
  lfebe: Line FEBE
  pbip:  Path BIP8
  pfebe: Path FEBE
  hcse:  Rx Cell HCS Error
  RXCP received cells: 89110445, TXCP transmitted cells: 602953649
PATH TRACE BUFFER : STABLE
  Remote hostname :
  Remote interface:
  Remote IP addr  :

Reassembler Counters:
  RXBytes:              3920822400
  RXCellsUnopenedChannel: 849
  RXPacketsCRC32Error:   0
  RXPacketsLECIDMatch:   0
```

```
                         RXCellsCRC10Error:      0
                         RXPacketsNoBuffers:     0
                         RXPacketsTrailerLen:    0
                         RXPacketsAbort:         0
                         RXPacketsMPSError:      0
                         RXPacketsDeEncapError:  0
                         RXPacketsReasmTO:       0
                  Segmenter Counters:
                         TXBytes:                3920829148
                         TXPacketsMPSError:      0
                  Line Card FPGA Counters:
                         RXPackets: 14851600        RXBytes: 3920822400        RxMTUPacketDrop: 0
                         TXPackets: 14851841        TXBytes: 3920829148        TXDataPacketDrop: 0
                  Router#
```

Using the debug atm Commands

Use the following **debug atm** commands help to solve ATM network problems.

Table 4-6   *Using debug Commands*

Command	Function	Example
debug atm packet	Displays the contents of the SNAP/NLPID/SMDS header followed by the first 40 bytes of a packet in hexadecimal format.	Router# **debug atm packet**
debug atm error	Displays information from all detected ATM errors. This includes such errors as encapsulation failures and errors during ATM configuration.	Router# **debug atm errors**
debug atm events	Displays event changes to the OC-12 ATM line card; reset, VC configurations, and OC-12 ATM line card configurations are displayed.	Router# **debug atm events**
debug atm oam	Displays the contents of OAM cells as they arrive from the network	Router# **debug atm oam**

After using a **debug** command, turn off debugging with the **no debug** command.

Commands That Display ATM Information

The following commands display information about the OC-12 ATM line card.

Table 4-7   Using show Commands

Command	Function	Example
show atm vc [*vcd*]	Displays current *vc* or *vcd* traffic information the vc or *vdc#* is the unique index value for the the vc or vdc.	Router# **show atm** *vc [vcd]*
show atm interfaces atm	Displays statistics for the ATM interface you specify by its interface address.	Router# **show atm interfaces atm** *slot/port*
show atm traffic	Displays global information about traffic to and from all ATM networks connected to the router.	Router# **show atm traffic**
show atm map	Displays the active list of ATM static maps to remote hosts on an ATM network.	Router# **show atm map**
show sscop atm	Displays SSCOP details for the ATM interface.	Router# **show sscop atm 1/0**
show protocols	Displays the global (system-wide) and interface-specific status of any configured Layer 3 protocol.	Router# **show protocols**
show running-config	Displays the currently running OC-12 ATM line card configuration in RAM.	Router# **show running-config**

Examples

```
Router# show atm vc

VCD /                                 Peak  Avg/Min Burst
Interface  Name       VPI   VCI  Type  Encaps    SC   Kbps    Kbps   Cells  Sts
4/0.1      1           1    100 PVC    NLPID     UBR  599040                 UP
4/0.2      2           1    101 PVC    NLPID     UBR  599040                 UP
4/0.3      3           1    102 PVC    NLPID     UBR  599040                 UP
4/0.4      4           1    103 PVC    NLPID     UBR  599040                 UP
4/0.5      5           1    104 PVC    NLPID     UBR  599040                 UP
4/0.6      6           1    105 PVC    NLPID     UBR  599040                 UP
4/0.7      7           1    106 PVC    NLPID     UBR  599040                 UP
4/0.8      8           1    107 PVC    NLPID     UBR  599040                 UP
4/0.9      9           1    108 PVC    NLPID     UBR  599040                 UP
4/0.10     10          1    109 PVC    NLPID     UBR  599040                 UP
4/0.11     11          1    110 PVC    NLPID     UBR  599040                 UP
4/0.12     12          1    111 PVC    NLPID     UBR  599040                 UP
4/0.13     13          1    112 PVC    NLPID     UBR  599040                 UP
4/0.14     14          1    113 PVC    NLPID     UBR  599040                 UP
4/0.15     15          1    114 PVC    NLPID     UBR  599040                 UP
4/0.16     16          1    115 PVC    NLPID     UBR  599040                 UP
4/0.17     17          1    116 PVC    NLPID     UBR  599040                 UP
4/0.18     18          1    117 PVC    NLPID     UBR  599040                 UP
4/0.19     19          1    118 PVC    NLPID     UBR  599040                 UP
```

```
Router# show atm vcd 13

ATM4/0.13: VCD: 13, VPI: 1, VCI: 112
UBR, PeakRate: 599040
AAL5-NLPID, etype:0x2, Flags: 0xC21, VCmode: 0x0
OAM frequency: 0 second(s)
InARP DISABLED
Transmit priority 4
InPkts: 35926, OutPkts: 371, InBytes: 2371116, OutBytes: 24448
InPRoc: 0, OutPRoc: 1
InFast: 0, OutFast: 0, InAS: 0, OutAS: 0
InPktDrops: 0,  OutPktDrops: 0
InByteDrops: 0, OutByteDrops: 0
CrcErrors: 0, SarTimeOuts: 0, OverSizedSDUs: 0, LengthViolation: 0, CPIErrors: 0
Out CLP=1 Pkts: 0
OAM cells received: 0
OAM cells sent: 0
Status: UP
ATM5/0.2053: VCD: 13, VPI: 1, VCI: 2152
UBR, PeakRate: 599040
AAL5-NLPID, etype:0x2, Flags: 0xC21, VCmode: 0x0
OAM frequency: 0 second(s)
InARP DISABLED
Transmit priority 4
InPkts: 65133, OutPkts: 370, InBytes: 4298778, OutBytes: 24382
InPRoc: 0, OutPRoc: 1
InFast: 0, OutFast: 0, InAS: 0, OutAS: 0
InPktDrops: 0,  OutPktDrops: 0
InByteDrops: 0, OutByteDrops: 0
CrcErrors: 0, SarTimeOuts: 0, OverSizedSDUs: 0, LengthViolation: 0, CPIErrors: 0
Out CLP=1 Pkts: 0
OAM cells received: 0
OAM cells sent: 0
Status: UP
Router#


Router# show atm interface atm 4/0

Interface ATM4/0:
AAL enabled:  AAL5 , Maximum VCs: 2047, Current VCCs: 2040

Maximum Transmit Channels: 0
Max. Datagram Size: 4528
PLIM Type: SONET - 622000Kbps, TX clocking: LINE
Cell-payload scrambling: ON
sts-stream scrambling: ON
0 input, 2040 output, 0 IN fast, 0 OUT fast, 0 out drop
 Avail bw = 622000
Config. is ACTIVE
Router#


Router# show sscop atm 1/0

SSCOP details for interface ATM3/0
   Current State = Idle,   Uni version = 4.0
   Send Sequence Number: Current = 0,   Maximum = 30
   Send Sequence Number Acked = 0
   Rcv Sequence Number: Lower Edge = 0, Upper Edge = 0, Max = 30
   Poll Sequence Number = 0, Poll Ack Sequence Number = 1
   Vt(Pd) = 0   Vt(Sq) = 0
   Timer_IDLE = 10 - Inactive
   Timer_CC = 1 - Inactive
```

Cisco 1-Port OC-12 ATM Line Card Installation and Configuration

```
Timer_POLL = 1000 - Inactive
Timer_KEEPALIVE = 5 - Inactive
Timer_NO-RESPONSE = 45 - Inactive
Current Retry Count = 0, Maximum Retry Count = 10
```

For more information, see *Understanding SSCOP Messages on Router ATM Interfaces* at the following URL:

http://www.cisco.com/warp/public/121/sscop_messages.html

```
Router# show protocols

Global values:
  Internet Protocol routing is enabled
  DECNET routing is enabled
  XNS routing is enabled
  Appletalk routing is enabled
  X.25 routing is enabled
Ethernet 0 is up, line protocol is up
  Internet address is 192.168.1.1, subnet mask is 255.255.255.0
  Decnet cost is 5
  XNS address is 2001.AA00.0400.06CC
  AppleTalk address is 4.129, zone Twilight
Serial 0 is up, line protocol is up
  Internet address is 192.168.7.49, subnet mask is 255.255.255.240
Ethernet 1 is up, line protocol is up
  Internet address is 192.168.2.1, subnet mask is 255.255.255.0
  Decnet cost is 5
  XNS address is 2002.AA00.0400.06CC
  AppleTalk address is 254.132, zone Twilight
Serial 1 is down, line protocol is down
  Internet address is 192.168.7.177, subnet mask is 255.255.255.240
  AppleTalk address is 999.1, zone Magnolia Estates
```

For more information on the parameters or protocols shown in this sample output, see:

- *Cisco IOS Network Protocols Configuration Guide, Part 1*

  http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/12cgcr/np1_c/

- *Network Protocols Configuration Guide, Part 2*

  http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/12cgcr/np2_c/

- *Network Protocols Configuration Guide, Part 3*

  http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/12cgcr/np3_c/

```
Router# show running-config

interface ATM4/0
 no ip address
!
interface ATM4/0.1 point-to-point
 ip address 10.1.1.1 255.255.255.252
 pvc 1/10000
  encapsulation aal5snap
 !
```

More Troubleshooting Information

For more information about troubleshooting, see the following documents:

- *Troubleshooting IP over ATM PVC Connectivity*

  http://www.cisco.com/warp/public/121/ipoveratm.html

- *ATM PVC, SVC, Soft-PVC, and PVP Frequently Asked Questions*

  http://www.cisco.com/warp/public/121/pvcfaq_23520.html

- *Configuring RFC 1577 and RFC 2225 Over SVCs*

  http://www.cisco.com/warp/public/121/1577svc_19150.html

- *CRC Troubleshooting Guide for ATM Interfaces*

  http://www.cisco.com/warp/public/121/crc_tshooting.html

- *Troubleshooting ATM PVCs in a WAN Environment*

  http://www.cisco.com/warp/public/121/newchapter.htm

ATM Configuration Examples

The following sections contain examples of ATM interface configurations. For detailed configuration examples, refer to the router software publications listed in the "Related Documentation" section on page viii.

- Example of PVCs with AAL5 and LLC/SNAP Encapsulation, page 4-27
- Example of PVCs in a Fully Meshed Network, page 4-28
- Example of SVCs in a Fully Meshed Network, page 4-29
- Connecting Two 1-Port OC-12 ATM Line Cards Back to Back, page 4-30

For examples of emulated LAN configurations, refer to the *Wide-Area Networking Configuration Guide*.

Example of PVCs with AAL5 and LLC/SNAP Encapsulation

In the following example, PVC 5 is created on ATM interface 3/0 using LLC/SNAP encapsulation over AAL5. ATM interface 3/0 (IP address 10.0.0.1 255.0.0.0) connects with the ATM interface (IP address 10.0.0.2 255.0.0.0) at the other end of the connection. The static map list named *atm1* declares that the next node is a broadcast point for multicast packets from IP.

```
interface ATM 3/0
ip address 10.0.0.1  255.0.0.0
 map-group atm1
atm pvc 5 0 1 aal5snap
!
no ip classless
!
map-list atm1
ip 10.0.0.2 atm-vc 1 broadcast
```

The following example shows a typical ATM configuration for a PVC:

```
interface ATM 4/0
ip address 10.0.0.1  255.0.0.0
map-group atm
```

```
atm pvc 1 1 1 aal5snap
atm pvc 2 2 2 aal5snap
atm pvc 6 6 6 aal5snap
atm pvc 7 7 7 aal5snap
clns router iso-igrp comet
!
Router iso-igrp comet
net 47.0004.0001.0000.0c00.6666.00
!
Router igrp 109
network 10.255.255.255
!
ip domain-name CISCO.COM
!
map-list atm
ip 10.0.0.2 atm-vc 7 broadcast
clns 47.0004.0001.0000.0c00.6e26.00 atm-vc 6 broadcast
```

Example of PVCs in a Fully Meshed Network

Figure 4-3 shows a fully meshed network. The configurations for Routers A, B, and C follow. In this example, the routers are configured to use PVCs. *Fully meshed* indicates that each network node has either a physical circuit or a virtual circuit connecting it to every other network node. The two map-list statements configured in Router A identify the ATM addresses of Routers B and C. The two map-list statements in Router B identify the ATM addresses of Routers A and C. The two map-list statements in Router C identify the ATM addresses of Routers A and B.

Figure 4-3   Fully Meshed ATM Configuration Example
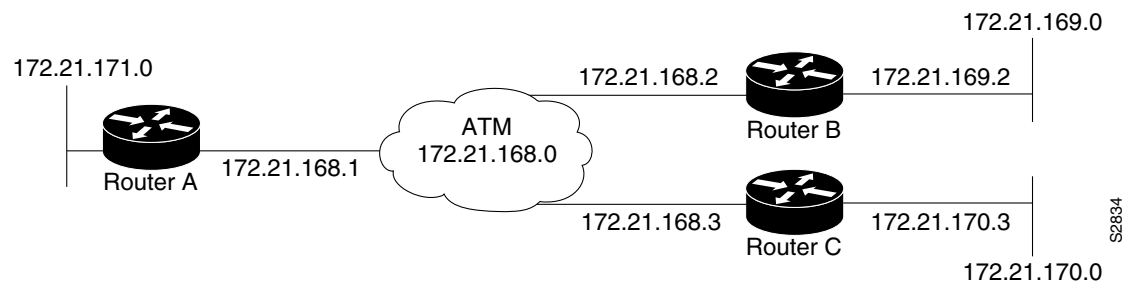
Router A

```
ip routing

interface atm 4/0.1 multipoint
ip address 172.21.168.1 255.255.255.0
pvc 0/10
encapsulation aal2snap
protocol ip 172.21.168.1 broadcast
pvc 0/30
encapsulation aal5snap
protocol ip 172.21.168.3 broadcast
```

Router B

```
ip routing
!
interface atm 2/0.1 multipoint
ip address 172.21.168.2  255.255.255.0
pvc 0/10
encapsulation aal2snap
protocol ip 172.21.168.1 broadcast
pvc 0/30
encapsulation aal5snap
protocol ip 172.21.168.3 broadcast
```

Router C

```
ip routing

interface atm 4/0.1 multipoint
ip address 172.21.168.3 255.255.255.0
pvc 0/20
encapsulation aal5snap
protocol ip 172.21.168.1 broadcast
pvc 0/30
encapsulation aal5snap
protocol ip 172.21.168.2 broadcast
```

Example of SVCs in a Fully Meshed Network

The following example is also a configuration for the fully meshed network shown in Figure 4-3, but one in which SVCs are used. PVC 1 is the signaling PVC.

Router A

```
interface atm 4/0

 ip address 172.16.168.1 255.255.255.0
 atm nsap-address AB.CDEF.01.234567.890A.BCDE.F012.3456.7890.1234.12
 atm maxvc 1024
 pvc 0/5 qsaal
 exit
!
 svc svc-1 nsap BC.CDEF.01.234567.890A.BCDE.F012.3456.7890.1334.13
 protocol ip 172.16.168.2
 exit
!
 svc svc-2 nsap CA.CDEF.01.234567.890A.BCDE.F012.3456.7890.1334.12
 protocol ip 172.16.168.3
 exit
```

Router B

```
interface atm 2/0

 ip address 172.16.168.2 255.255.255.0
 atm nsap-address BC.CDEF.01.234567.890A.BCDE.F012.3456.7890.1334.13
 atm maxvc 1024
 pvc 0/5 qsaal
 exit
!
 svc svc-1 nsap AB.CDEF.01.234567.890A.BCDE.F012.3456.7890.1234.12
 protocol ip 172.16.168.1
 exit
!
 svc svc-2 nsap CA.CDEF.01.234567.890A.BCDE.F012.3456.7890.1334.12
 protocol ip 172.16.168.3
 exit
```

Router C

```
interface atm 4/0

 ip address 172.16.168.3 255.255.255.0
 atm nsap-address CA.CDEF.01.234567.890A.BCDE.F012.3456.7890.1334.12
 atm maxvc 1024
 pvc 0/5 qsaal
 exit
!
 svc nsap AB.CDEF.01.234567.890A.BCDE.F012.3456.7890.1234.12
 protocol ip 172.16.168.1
 exit
!
 svc nsap BC.CDEF.01.234567.890A.BCDE.F012.3456.7890.1334.13
 protocol ip 172.16.168.2
 exit
```

Connecting Two 1-Port OC-12 ATM Line Cards Back to Back

Two routers, each containing an OC-12 ATM line card, can be connected directly with a standard cable, which allows you to verify the operation of the ATM port or to directly link the routers to build a larger node.

To connect two routers, attach the cable between the ATM port on one and the ATM port on the other.

By default, the OC-12 ATM line card "expects" a connected ATM switch to provide transmit clocking. To specify that the OC-12 ATM line card generates the transmit clock internally for SONET physical layer interface module (PLIM) operation, add the **atm clock internal** command to your configuration.

Note   For OC-3c (SONET) interfaces, one of the OC-12 ATM line cards in each router must be configured to supply its internal clock to the line.

The following is an example of configuration file commands for two routers connected through their OC-3c interface:

First Router

```
interface atm 3/0

atm clock internal

interface atm3/0.1 point-to-point
ip address 10.0.0.1 255.0.0.0
pvc 1/5
encapsulation aal5snap
protocol ip 10.0.0.2 broadcast
```

Second Router

```
interface atm 3/0

interface atm3/0.1 point-to-point
ip address 10.0.0.2 255.0.0.0
pvc 1/5
encapsulation aal5snap
protocol ip 10.0.0.1 broadcast
```

Upgrading Your Bootdisk Image

The boot image contains a subset of the Cisco IOS software. This image is used to perform network booting or to load Cisco IOS images onto the router. This image is also used if the system cannot find a valid system image.

When you upgrade your Cisco IOS software to the minimum required software release, we recommend that you also upgrade your bootdisk image. To upgrade your boot image, you can copy the new boot image from a network server to the bootdisk on your router. To copy a boot image from a Trivial File Transfer Protocol (TFTP) server to the bootdisk, complete the tasks shown in the following table:

	Command	Purpose
Step 1	Router# **configure terminal** Enter configuration commands, one per line. End with CNTL/Z. Router(config)#	Specify that the terminal is the source for commands, and enter configuration mode. To enter the commands that follow, you need to be in configuration mode.
Step 2	Router(config)# **dir bootdisk**	(Optional) If you do not already know it, learn the exact spelling of the system image filename in bootdisk memory.
Step 3	Router(config)# **copy bootdisk: tftp**	Make a backup copy of the current bootdisk image.
Step 4	Router(config)# **copy tftp bootdisk**	Copy a boot image to bootdisk memory.
Step 5	Router(config)# *ip-address* or *name*	When prompted, enter the IP address or domain name of the server.

For further information, such as how to set up the TFTP server, refer to the *Configuration Fundamentals Configuration Guide*.

CLI-Controlled OIR

Line cards can be removed from the Cisco 7304 router without disrupting data flow by using the **hw-module slot** *slot* # **stop/start** command in EXEC mode. The **hw-module slot** *slot* # **stop** command will stop traffic, shut down all line card interfaces, and deactivate the line card. The **hw-module slot** *slot* # **start** command resets the line card, puts the line card back online, and turns off the OIR LED.

Note   Upon insertion of a line card, the system will automatically activate the card. The **hw-module slot** *slot* # **start** command is only necessary when reactivating an installed line card that has been deactivated with the **hw-module slot** *slot* # **stop** command.

To remove and install an active line card in slot 2, proceed as follows:

Router# **hw-module slot 4 stop**

When the OIR LED turns green, the line card in slot 2 has been deactivated and can be physically removed and replaced with a new line card (see the "Line Card Removal and Installation" section on page 3-3.)

When the new line card is inserted in slot 4 it is automatically reset, put online, and the OIR LED is turned off.