CISCO SYSTEMS

2-Port OC3 ATM Line Card Installation and Configuration

Product Numbers: 7300-2OC3ATM-MM, 7300-2OC3ATM-SMI,
7300-2OC3ATM-SML

Platform Supported: Cisco 7304

February 3, 2004

Preface

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

Objectives

This document describes how to install and configure the 2-port OC3 ATM line cards (7300-2OC3ATM-MM[=], 7300-2OC3ATM-SMI[=], and 7300-2OC3ATM-SML[=]), hereafter referred to as the OC3 ATM line cards, which are used in the Cisco 7304 router.

Organization

This document contains the following chapters:

Section	Title	Description
Chapter 1	Overview	Describes the OC3 ATM line cards and their LED displays, cables, and receptacles.
Chapter 2	Preparing for Installation	Describes safety considerations, tools required, and procedures you should perform before the actual installation.
Chapter 3	Removing and Installing Line Cards	Describes the procedures for installing and removing the OC3 ATM line cards in the supported platform.
Chapter 4	Configuring the OC3 ATM Line Card	Provides instructions for configuring the OC3 ATM line cards on the supported platform.

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.shtml.

- Cisco 7304 router:

  - For hardware installation and maintenance information, refer to the *Cisco 7304 Router Installation and Configuration Guide*.

  - Cisco 7304 Router Quick Start Guide

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

  - *Regulatory Compliance and Safety Information for Cisco 7304 Routers*

  - *Site Preparation and Safety Guide*

  - *Cisco Information Packet* that shipped with your router.

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 on the World Wide Web at this URL:

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

You can access the Cisco website at this URL:

http://www.cisco.com

International Cisco websites can be accessed from this URL:

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

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Cisco TAC Website

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

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Accessing all the tools on the Cisco TAC website requires a Cisco.com user ID and password. If you have a valid service contract but do not have a login ID or password, register at this URL:

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

Opening a TAC Case

Using the online TAC Case Open Tool is the fastest way to open P3 and P4 cases. (P3 and P4 cases are those in which your network is minimally impaired or for which you require product information.) After you describe your situation, the TAC Case Open Tool automatically recommends resources for an immediate solution. If your issue is not resolved using the recommended resources, your case will be assigned to a Cisco TAC engineer. The online TAC Case Open Tool is located at this URL:

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

For P1 or P2 cases (P1 and P2 cases are those in which your production network is down or severely degraded) or if you do not have Internet access, contact Cisco TAC by telephone. Cisco TAC engineers are assigned immediately to P1 and P2 cases to help keep your business operations running smoothly.

To open a case 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 listing of Cisco TAC contacts, go to this URL:

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

TAC Case Priority Definitions

To ensure that all cases are reported in a standard format, Cisco has established case priority definitions.

Priority 1 (P1)—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.

Priority 2 (P2)—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.

Priority 3 (P3)—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.

Priority 4 (P4)—You require information or assistance with Cisco product capabilities, installation, or configuration. There is little or no effect on your business operations.

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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. Go to this URL to visit the company store:

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• The Cisco *Product Catalog* describes the networking products offered by Cisco Systems, as well as ordering and customer support services. Access the Cisco Product Catalog at this URL:

    http://cisco.com/univercd/cc/td/doc/pcat/

- *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 online at this URL:

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- *Packet* magazine is the Cisco quarterly publication that provides the latest networking trends, technology breakthroughs, and Cisco products and solutions to help industry professionals get the most from their networking investment. Included are networking deployment and troubleshooting tips, configuration examples, customer case studies, tutorials and training, certification information, and links to numerous in-depth online resources. You can access Packet magazine at this URL:

  http://www.cisco.com/packet

- *iQ Magazine* is the Cisco bimonthly publication that delivers the latest information about Internet business strategies for executives. 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

- Training—Cisco offers world-class networking training. Current offerings in network training are listed at this URL:

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

C H A P T E R 1

Overview

This chapter describes the OC3 ATM line cards and contains the following sections:

Line Card Overview

The OC3 ATM line card provides the Cisco 7304 router with two OC-3 (155.52-Mbps) ATM interfaces on a single card. You must use the appropriate optical fiber cables to connect the OC3 ATM line card with an external OC-3 network. (See the "Fiber-Optic Transmission Specifications" section on page 1-5 and the "Cables and Connectors" section on page 1-11 for more information on optical fiber cables.)

Three models of the OC3 ATM line card are available:

- 7300-2OC3ATM-MM—Multimode (See Figure 1-1.)

- 7300-2OC3ATM-SMI—Single-mode, intermediate reach (See Figure 1-2.)

- 7300-2OC3ATM-SML—Single-mode, long reach (See Figure 1-3.)

Figure 1-1   7300-2OC3ATM-MM—Faceplate View
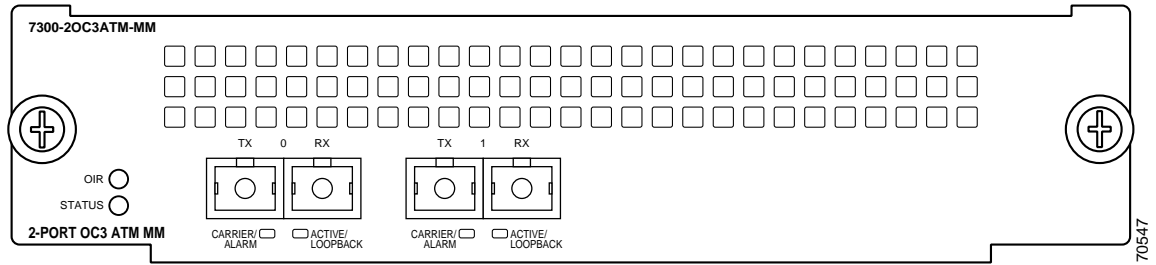
Figure 1-2   7300-2OC3ATM-SMI—Faceplate View
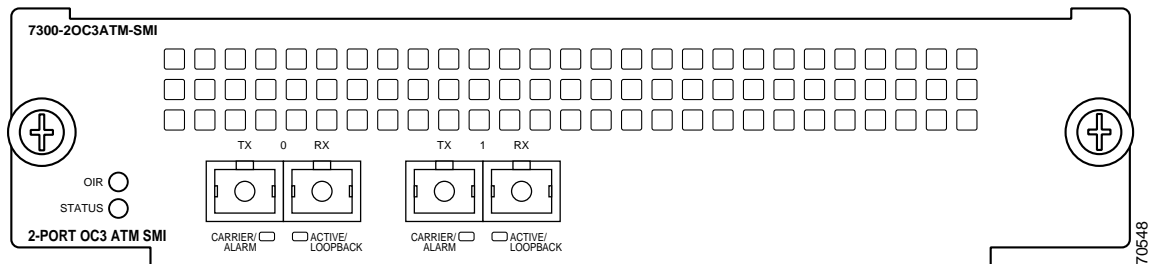
Figure 1-3   7300-2OC3ATM-SML—Faceplate View
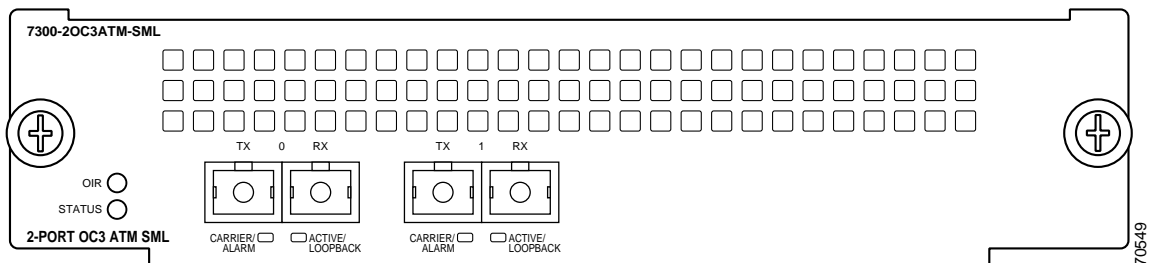
SONET/SDH Overview

SONET is an American National Standards Institute (ANSI) standard (T1.1051988) for optical digital transmission at hierarchical rates from 51.840 Mbps (STS-1) to 622.080 Mbps (STS-12) 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-16) and greater.

SONET is an octet-synchronous multiplex scheme that defines a family of standard rates and formats. The available information bandwidth is 149.760 Mbps, which is the STS-3c/STM-1 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[2]	STM-1
STS-12c	STM-4c
STS-48c	STM-16c

1. ANSI-defined SONET specifications.
2. Currently supported by the OC3 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 OC3 ATM line card conforms to STS-12c)
- STS-48c—2.488 Gbps

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 OC3 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.

■ Features

Unlike a LAN, which is connection less, 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 *pseudobroadcasting*.

Features

The OC3 ATM line card has the following features:

- Short-reach (7300-2OC3ATM-MM), intermediate-reach (7300-2OC3ATM-SMI), and long-reach (7300-2OC3ATM-SML) optical interface with single-mode optical fiber

> **Note**   For information on the type of cables to use with the OC3 ATM line card, see the "Fiber-Optic Transmission Specifications" section on page 1-5, and the "Cables and Connectors" section on page 1-11.

- Two duplex OC-3 line rate 155.520 Mbps SONET/SDH physical layer ports
- Insertion/extraction of SONET overhead bits
- Compliant with Bellcore-GR-253 jitter requirements
- Scrambles/descrambles 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
- Support of 2,048 total connections per OC-3 ATM port
- 4096 simultaneous AAL5 frame reassemblies and segmentations for average packet size of 200 bytes
- Supports AAL5 data transport, F4 and F5 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 OC3 ATM line card supports the following protocols, services, and ATM-specific software:

- User-Network Interface (UNI) signaling
- Integrated Local Management Interface (ILMI)
- RFC-1483 Multiprotocol Encapsulation over ATM AAL5
- RFC-1577 Classical IP and ARP over ATM
- RFC-1626 Maximum Transmission Unit (MTU) up to 9180 octets

Interface Specifications

The physical layer interface for the OC3 ATM line card is Optical Carrier-3 (OC-3c, the specification for SONET STS-3c and SDH STM-1 transmission rates). The OC3 ATM line card provides a single 155.520-Mbps Packet OC-3 network interface for all supported platforms.

Each OC3 ATM line card has one pair of SC-type fiber receptacles to allow connection to single-mode optical fiber. (For more information on the optical fiber cables you should use with this line card, see the "Fiber-Optic Transmission Specifications" section on page 1-5 and the "Cables and Connectors" section on page 1-11.)

Packet data is transported using Point-to-Point Protocol (PPP) and is mapped into the STS-3c/STM-1 frame. (RFC-1619)

The management of the OC3 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, page 1-5
- Power Budget, page 1-6
- Approximating the OC3 ATM Line Card Power Margin, page 1-7
- Multimode Power Budget Example with Sufficient Power for Transmission, page 1-8
- Multimode Power Budget Example of Dispersion Limit, page 1-8
- Single-Mode Transmission, page 1-8
- SONET Single-Mode Power Budget Example, page 1-9

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-3 optical parameters.

Table 1-1   OC-3 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 dBm min. to 0 dBm max. 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 min. to –8 dBm max. at 1280–1335 nm[4]	–8 dBm	–31 dBm	0 to 12 dB	Up to 9 mi. (15 km)
Multimode[6] short reach	–20 dBm min. to –14 dBm max. at 1280–1335 nm[4]	–8 dBm	–30 dBm	0 to 7 dB	Up to 1.2 mi. (2 km)

1. This table gives nominal OC-3 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 Short-Reach OC-3 Specification SR-OC-3.

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 Equipments 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 OC3 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 dBm – (–30 dBm)

PB = 10 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   OC3 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.

Multimode Power Budget Example of Dispersion Limit

Following is an example with the same parameters as the previous example, but with a multimode link distance of 4 km:

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

PB = 10 dB – 4 dB – 2 dB – 1.5 dB – 0.5 dB – 1 dB

PB = 1 dB

The value of 1 dB indicates that this link would have sufficient power for transmission. But due to the dispersion limit on the link (4 km x 155.52 MHz > 500 MHz/km), this link would not work with multimode fiber. In this case, single-mode fiber would be the better choice.

Single-Mode Transmission

The single-mode 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 OC3 ATM line card faceplate has two LEDs that indicate line card status and two LEDs per port that indicate interface status. (See Figure 1-4.)

Figure 1-4   LEDs on the OC3 ATM Line Card
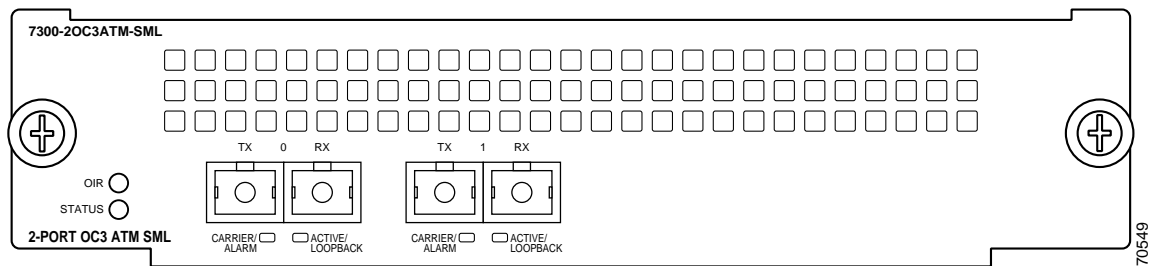
After system initialization, the STATUS LED goes on to indicate that power is received and that the OC3 ATM line card is enabled for operation.

The following conditions must all be met before the OC3 ATM line card is enabled:

- The OC3 ATM line card is correctly connected and receiving power.
- The system bus recognizes the OC3 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   OC3 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
NEWPTR	new pointer
PSE	Positive Stuff Event
NSE	Negative Stuff Event
PLM-P	STS Path Payload Label Mismatch
UNEQ-P	STS Path Unequipped

Cables and Connectors

Use single-mode (for short-, intermediate- or long-reach configurations) optical fiber cable to connect your router to a network or to connect two OC3 ATM line card-equipped routers back to back. For SONET/SDH single-mode optical fiber connections, use two simplex SC-type cables (see Figure 1-5), or one duplex SC-type cable (see Figure 1-6).

Figure 1-5   Simplex SC-Type Cable and Connector
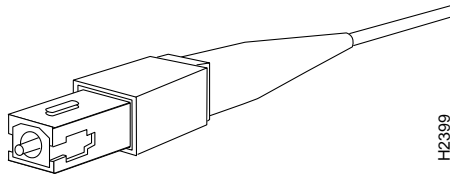
Figure 1-6   Duplex SC-Type Cable and Connector
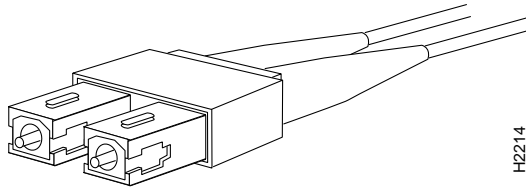
Note   For maximum cable lengths between stations, see Table 1-1 on page 1-6. Single-mode optical fiber cables for the OC3 ATM line card are not available from Cisco Systems; they are available from commercial cable vendors.

Attach one pair of simplex fiber cables between the line card and the device to which the line card is connected. Observe the receive (RX) and transmit (TX) cable relationship shown in Figure 1-7.

Note   For important laser safety information, see the "Laser Safety" section on page 2-9.

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   The optical fiber connectors must be free of dust, oil, or other contaminants. Carefully clean the optical fiber connectors using an alcohol wipe or other suitable cleanser.

Figure 1-7   Transmit (TX) and Receive (RX) Ports on the OC3 ATM Line Card
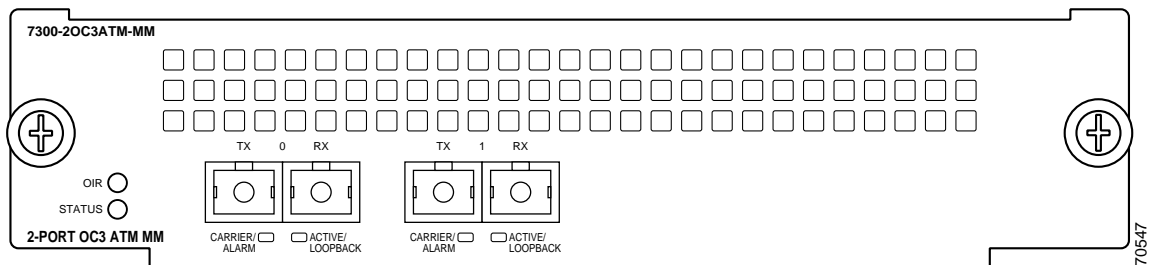
Encapsulation Method Support

The following encapsulation methods are supported by the OC3 ATM line card:

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

Slot Locations on the Cisco 7304 Router

The following section describes the slot locations in the Cisco 7304 router. This section includes the following subsection:

- Cisco 7304 Router Slot Numbering, page 1-13

Cisco 7304 Router Slot Numbering

The OC3 ATM line card can be installed in slots 2 through 5 in Cisco 7304 routers. Figure 1-8 shows a Cisco 7304 with an OC3 ATM line card installed in slot 4.

Figure 1-8   Slots in the Cisco 7304 Router
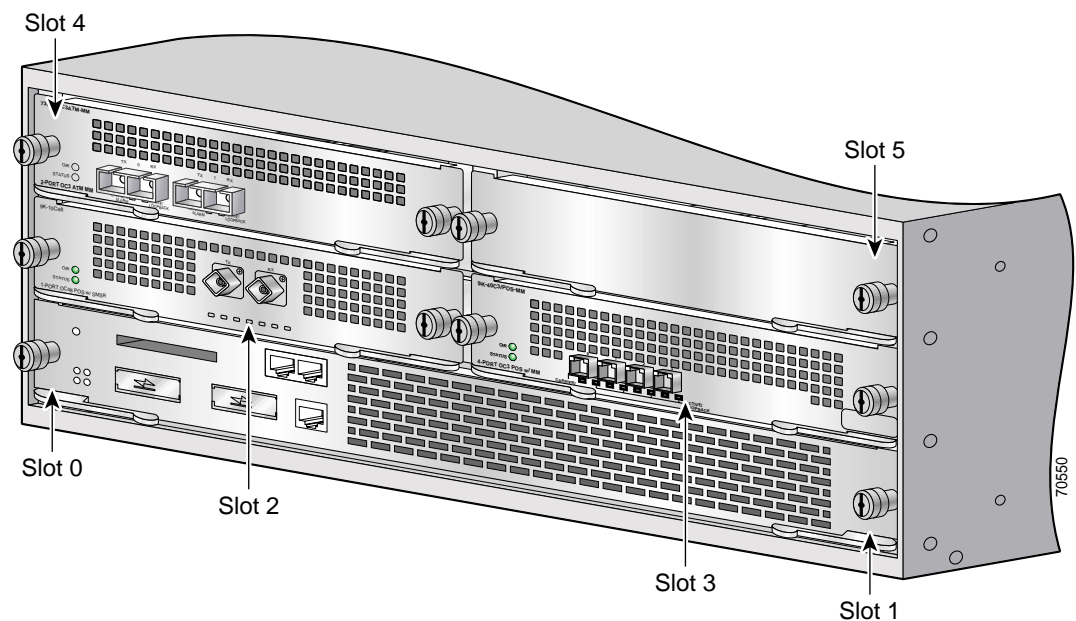
> **Note**   Slot 0 and slot 1 are for the network services engine (NSE) only.

Identifying Interface Addresses

This section describes how to identify the interface address for the OC3 ATM line card in a Cisco 7304 router. Interface addresses specify the actual physical location of each interface on a router.

The interfaces on the OC3 ATM line card installed in a Cisco 7304 router maintain the same interface address regardless of whether other line cards are installed or removed. However, when you move a line card to a different slot, the first number in the interface address changes to reflect the new slot number.

Table 1-7 explains how to identify interface addresses.

Table 1-7   Identifying Interface Addresses

Platform	Interface Address Format	Numbers	Syntax
Cisco 7304 router	Slot-number/interface-port-number	Slot—0 through 5 [1]	2/0

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

Cisco 7304 Router Interface Addresses

This section describes how to identify the interface addresses used for the OC3 ATM line card in a Cisco 7304 router. The interface address is composed of a two-part number in the format *slot-number/interface-port-number*. See Table 1-7 for the interface address format.

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.

Note   The NSE-100 is the only card supported in slot 0.

The interface address of the interface on an OC3 ATM line card in slot 2 is 2/0 (slot 2 and interface 0). If the OC3 ATM line card was in slot 4, this same interface would be numbered 4/0 (slot 4 and interface 0).

Preparing for Installation

This chapter provides the general equipment, safety, and site preparation requirements for installing the OC3 ATM line card. This chapter contains the following sections:

- Required Tools and Equipment, page 2-1
- Software and Hardware Requirements, page 2-1
- Checking Hardware and Software Compatibility, 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 a line card. If you need additional equipment, contact a service representative for ordering information.

- OC3 ATM line card (For information about the specific OC3 ATM line card models, see the "Line Card Overview" section on page 1-1.)
- SC-type single-mode optical fiber cables to connect the interfaces with the network (Single-mode optical fiber cables for the OC3 ATM line cards are not available from Cisco Systems but are available from commercial cable vendors. For information about optical fiber cables, see the "Fiber-Optic Transmission Specifications" section on page 1-5 and the "Cables and Connectors" section on page 1-11.)
- Number 1 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 and antistatic container

Software and Hardware Requirements

The table below lists the minimum Cisco IOS software release required to use the OC3 ATM line card in the Cisco 7304 router.

2-Port OC3 ATM Line Card Installation and Configuration

Table 2-1   OC3 ATM Line Card Software Requirements

Platform	Recommended Minimum Cisco IOS Release
Cisco 7304 Router[1]	Cisco IOS Release 12.1(10)EX1 or a later release of Cisco IOS Release 12.1 EX1

1.   The OC3 ATM line card requires a Network Services Engine 100 (NSE-100) to operate.

For all systems in which you install the OC3 ATM line card, use the **show version** command to display the current configuration of the router, including the system software version that is currently loaded and running. Use the **show diag** *slot* command to view specific information about the hardware installed in your system.

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 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 **Technical Support Help—Cisco TAC**: **Tool Index**: **Software Advisor**. You can also access the tool by pointing your browser directly to http://www.cisco.com/cgi-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, might harm you. A warning symbol precedes each warning.

To see translations of the warnings used in this document, refer to *Regulatory Compliance and Safety Information for the Cisco uBR7200 Series Universal Broadband Router* at the following URL:

http://www.cisco.com/univercd/cc/td/doc/product/cable/cab_rout/ub72rcsi.htm

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。

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 사고를 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. Line cards 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 line card levers and locking thumbscrews to properly seat the bus connectors in the backplane. 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 line card levers and locking thumbscrews to release the bus connectors from the backplane.

- 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

The single-mode aperture port contains a Class 1 laser warning label, as shown in Figure 2-1.

Figure 2-1   Class 1 Laser Warning Label on OC3 ATM Line Card
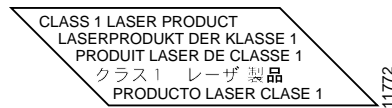
```
CLASS 1 LASER PRODUCT
LASERPRODUKT DER KLASSE 1
PRODUIT LASER DE CLASSE 1
クラス１　レーザ製品
PRODUCTO LASER CLASE 1
```
11772

⚡ **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

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

FCC Class A Compliance

Class A Notice for FCC

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

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.

✎ **Note**   The OC3 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.

C H A P T E R 3

Removing and Installing Line Cards

This chapter describes how to remove the OC3 ATM line card from its supported platform, how to install a new or replacement line card, and how to connect cables.

This chapter contains the following sections:

Installation Overview

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

Note When a slot is not in use, a blank line card must fill the empty slot to allow the router to conform to electromagnetic interference (EMI) emissions requirements and to allow proper airflow across the line cards. If you plan to install a new line card in a slot that is not in use, you must first remove the blank line card.

Handling Line Cards

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
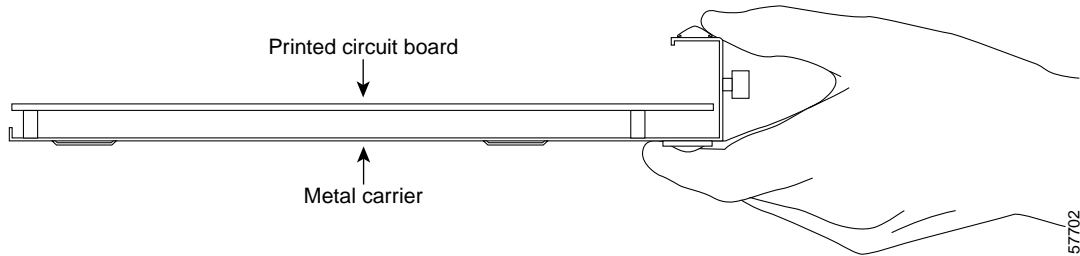
Online Insertion and Removal
Online Insertion and Removal

The Cisco 7304 router supports online insertion and removal (OIR) of line cards; therefore, you do not have to power down the router when removing and replacing an OC3 ATM line card on a Cisco 7304 router. The Cisco 7304 router also supports *CLI-controlled OIR* (see the "CLI-Controlled OIR" section on page 4-29), 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 Chapter 2, "Preparing for Installation," 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.

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.

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 the cutaway in the following illustration. If the line card does not slide freely into the backplane, loosen the locking thumbscrews on the neighboring line cards.

Warning   **During this procedure, wear grounding wrist straps to avoid ESD damage to the card. Do not directly touch the midplane with your hand or any metal tool, or you could shock yourself.** Statement 181

Line Card Removal and Installation

In this section, the illustration that follows gives step-by-step instructions on how to remove and install line cards in the following supported platform:

- Cisco 7304—Removing and Installing a Line Card, page 3-4

Cisco 7304—Removing and Installing a Line Card

1. To remove the line card, loosen the locking thumbscrews on both sides of the line card.
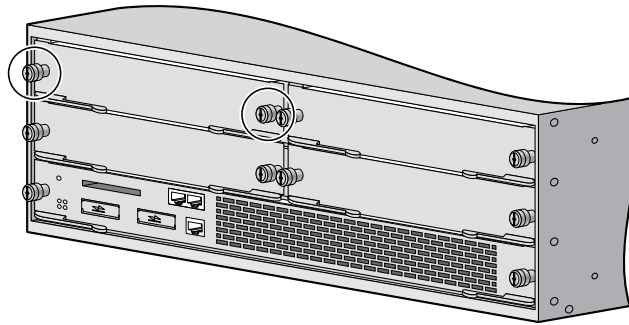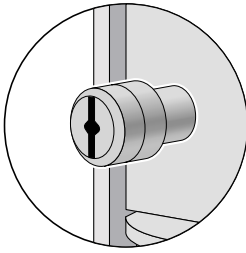
2. Pull out the line card levers and carefully slide the line card halfway out of the slot. If you are removing a blank line card, pull the blank line card completely out of the chassis slot.
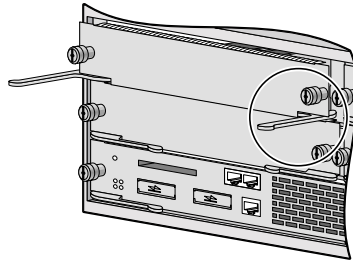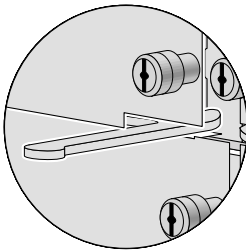
3. With the line card halfway out of the slot, disconnect all cables from the line card. After disconnecting the cables, pull the line card out of the chassis slot.

4. To insert the line card, carefully align the edges of the carrier or printed circuit board between the upper and the lower edges of the chassis slot.
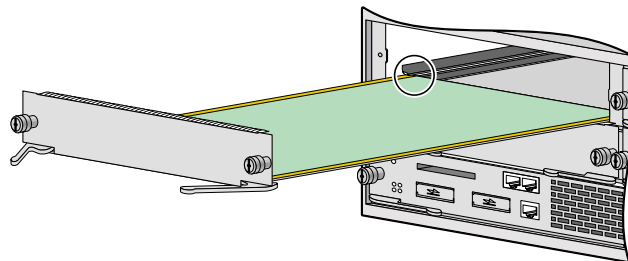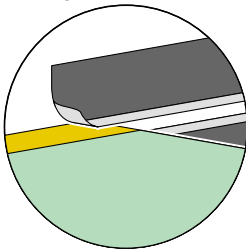
5. Carefully slide the new line card halfway into the line card slot and connect all required cables.

6. With the cables connected, carefully slide the line card into the slot until the line card makes contact with the backplane.

NOTE: The line card levers must be positioned at a 45-degree angle before the line card makes contact with the backplane.

7. Push the line card levers in until the line card is fully seated in the router backplane.

NOTE: When the chassis is fully populated, seating a new line card may be difficult. In order to properly seat the line card and avoid physical damage, loosen the thumbscrews on the neighboring line cards.

⚠ **CAUTION**: Use of excessive force to seat the line card may damage the router or line card.

8. Tighten the locking thumbscrews on both sides of the line card.

Proceed to the "Connecting OC3 ATM Line Card Interface Cables" section on page 3-5.

Connecting OC3 ATM Line Card Interface Cables

To continue your OC3 ATM line card installation, you must connect the interface cables.

Note   Optical fiber cables are not available from Cisco Systems; they are available from outside commercial cable vendors. (For more information on the cables you should use with this line card, see the "Fiber-Optic Transmission Specifications" section on page 1-5 and the "Cables and Connectors" section on page 1-11.)

To connect cables to the OC3 ATM line card, attach one duplex or two simplex optical fiber cables between the OC3 interface port on your OC3 ATM line card and your network.

Ensure that you observe the proper relationship of receive (RX) cable to RX SC-type receptacle and transmit (TX) cable to TX SC-type receptacle on the OC3 ATM line card.

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

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

C H A P T E R 4

Configuring the OC3 ATM Line Card

To continue your OC3 ATM line card installation, you must configure the OC-3 interface. This chapter contains the following sections:

Using the EXEC Command Interpreter

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

Tip 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 OC3 ATM line card is installed correctly (the STATUS LED goes on), 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 OC3 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 OC3 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 OC3 ATM line card, refer to the appropriate configuration publications listed in the "Related Documentation" section on page viii.

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 for an explanation of the privileged level of the EXEC.)

This section contains the following subsections:

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 on the supported platform:

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 subcommands, 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** subcommand, 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   Syntax 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 OC3 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 the new interface is in the correct state (shut down) using the **show interfaces** command (followed by the interface type and interface address) to display the specific interface. Table 4-2 provides examples.

Table 4-2   Examples of the show interfaces atm Command

Platform	Command	Example

Cisco 7304 routers	**show interfaces atm**, followed by *slot/port* (slot-number/ interface-port-number)	The example is for interface 0 on an OC3 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   Enable the interface by doing the following:

a.   Repeat Step 3 to enable 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 subcommands, 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** subcommand, followed by the interface address of the interface you plan to configure. Table 4-3 gives an example.

Table 4-3   Examples of the interface atm Subcommand

Platform	Command	Example

Cisco 7304 routers	**interface atm**, followed by *slot/port* (slot-number/ interface-port-number)	The example is for the interface of an OC3 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** subcommand, as in the following example:

```
Router(config-if)# ip address 10.0.0.0 255.255.255.0
```

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

Step 5   Enable 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 subcommands 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.

Tip   If you are going to disconnect an ATM interface cable, use the **shutdown** command first. After reattaching cable and configuring the interface, use the **no shutdown** command.

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 Connection, page 4-9
- CLI-Controlled OIR, page 4-29

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 OC3 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 2**
show c7300	Displays types of line cards with status information for each installed line card	Router# **show c7300**
show interfaces atm *interface-port-number*	Displays status information about a specific ATM interface in a Cisco 7304 router	Router# **show interfaces atm 3/1**
show protocols	Displays protocols configured for the entire system and for specific interfaces	Router# **show protocols**
show running-config	Displays the running configuration file	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 4-8

Choose the subsection appropriate for your system. Proceed to the "Using the ping Command to Verify Network Connection" section on page 4-9 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.

Cisco 7304 Router

Following is an example of the **show version** command from a Cisco 7304 router with the OC3 ATM line card:

```
Router# show version
Cisco Internetwork Operating System Software
IOS (tm) 7300 Software (C7300-IS-M), Version 12.1(20020129:220814) [ra-ws2 103]
Copyright (c) 1986-2002 by cisco Systems, Inc.
Compiled Mon 04-Feb-02 11:19 by ra
Image text-base: 0x40008970, data-base: 0x414E0000

ROM: System Bootstrap, Version 12.1(20011026:021245) [hih-rommon_1_1 101], DEVELOPMENT
SOFTWARE
Currently running ROMMON from ROM 1
BOOTLDR: 7300 Software (C7300-BOOT-M), Version 12.1(1.23.158), CISCO DEVELOPMENT TEST
VERSION

c7300router uptime is 2 minutes
System returned to ROM by power-on
System image file is "tftp://223.255.254.254/muck/ra/c7300-is-mz"

cisco 7300 (NSE100) processor (revision B) with 114688K/16384K bytes of memory.
Processor board ID SCA053200L0
R7000 CPU at 350Mhz, Implementation 39, Rev 3.2, 256KB L2, 1024KB L3 Cache
4 slot midplane, Version 65.48

Last reset from power-on
Bridging software.
X.25 software, Version 3.0.0.
PXF processor tmc0 running 'system:pxf/ucode1' v1.6 is active
PXF processor tmc1 running 'system:pxf/ucode1' v1.6 is active
1 FastEthernet/IEEE 802.3 interface(s)
2 Gigabit Ethernet/IEEE 802.3 interface(s)
4 ATM network interface(s)
509K bytes of non-volatile configuration memory.

16064K bytes of ATA compact flash in bootdisk (Sector size 512 bytes).
31360K bytes of ATA compact flash in disk0 (Sector size 512 bytes).
Configuration register is 0x100
```

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.

Cisco 7304 Router

Following is an example of the **show diag** *slot* command for an OC3 ATM line card in slot 2 of a Cisco 7304 router:

```
Router# show diag 2
Slot 2:
        OC3 ATM Multimode Line Card, 2 ports
        Line Card state: Active
        Insertion time: 00:03:21 ago
        Bandwidth points: 32
        EEPROM contents at hardware discovery:
        Hardware Revision      : 2.0
        Unknown Field (type 0046): 00 00
        PCB Serial Number      : CAB0549LNKQ
        Part Number            : 73-6828-02
        Board Revision         : A0
        Fab Version            : 02
        RMA Test History       : 00
        RMA Number             : 0-0-0-0
        RMA History            : 00
        Deviation Number       : 0-0
        Product Number         : 7300-2OC3ATM-MM
        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 03 74 41 02 00 46 00 00 C1 8B 43 41 42
          0x10: 30 35 34 39 4C 4E 4B 51 82 49 1A AC 02 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 32 4F 43 33 41 54 4D 2D 4D
          0x40: 4D 20 20 20 20 20 87 44 00 00 00 C4 08 00 00 00
          0x50: 00 00 00 00 00 00 C5 08 00 00 00 00 00 00 00 C8
          0x60: 09 00 00 00 00 00 00 00 00 C7 7C F6 44 3F 30
          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 C8 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
        FPGA information:
          Current FPGA version     : 0.3
          IOS bundled FPGA version : 0.10
```

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.

Cisco 7304 Router

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        3d02h ago
2,3       NSE100             Standby       3d02h ago
4         2OC3-ATM           Active        3d02h ago


The FPGA versions for the cards listed above are current

System is compliant with hardware configuration guidelines.

Network IO Interrupt Throttling:
 throttle count=0, timer count=0
 active=0, configured=1
 netint usec=3999, 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 subcommands 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.

Cisco 7304 Router

Following is an example of the **show interfaces atm** command used with a Cisco 7304 router. In this example, the OC3 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-3 ATM
  Internet address is 40.1.1.40/24
  MTU 4470 bytes, sub MTU 4470, BW 149760 Kbit, DLY 80 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ATM, loopback not set
  Keepalive not supported
  Encapsulation(s): AAL5
  2048 maximum active VCs, 10 current VCCs
  VC idle disconnect time: 300 seconds
  0 carrier transitions
  Last input 00:00:41, output 00:00:41, 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: fifo
  Output queue :0/40 (size/max)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     38 packets input, 4256 bytes, 0 no buffer
     Received 0 broadcasts, 0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     38 packets output, 4104 bytes, 0 underruns
     0 output errors, 0 collisions, 0 interface resets
     0 output buffer failures, 0 output buffers swapped out
```

Using the ping Command to Verify Network Connection

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 timeout 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-3c interface and a remote device. The **loop** subcommand 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 Internal 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 router interface without actually being transmitted. Internal loopback is useful for checking that the OC3 POS line card is working. To configure an interface for internal loopback, enter the **loop internal** command:

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

To disable internal loopback, enter the **no loop internal** 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 section describes the advanced configuration tasks you perform to change default values on your OC3 ATM line card:

- Configuring the OC3 ATM Line Card for OC-3, page 4-11

The following sections include steps for configuring and customizing various ATM features of your OC3 ATM line card:

- Configuring VCs, page 4-11
- Configuring PVCs, page 4-12
- Configuring SVCs, page 4-14
- Configuring Classical IP and ARP over ATM, page 4-18

Configuring the OC3 ATM Line Card for OC-3

To configure the OC3 ATM line card for OC-3, perform the following tasks in interface configuration mode:

	Command	Purpose
Step 1	Router# **interface atm** *slot/port*	Specify an ATM interface to configure. To use these commands, you need to be in interface configuration mode. (For the appropriate interface address to use for your system, see Table 4-3 on page 4-4.)
Step 2	Router(config-if)# **atm clock internal**	Select 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-1**	Specify SONET framing: STM-1 (optional). Use the **no** form of this command to return to the default, STS-3c framing.

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
- Pseudobroadcast support for multicast packets

By default, fast switching is enabled on all OC3 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.

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 OC3 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

To create a PVC on the OC3 ATM line card interface, enter the following command in interface configuration mode:

pvc [name] vpi/vci [ilmi | qsaal | smds]

The command values are as follows:

- *vcd*—The virtual circuit descriptor unique number.

  When you create any PVC, you create a virtual circuit descriptor (VCD) and attach it to the virtual path identifier (VPI) and virtual channel identifier (VCI). A VCD is an OC3 ATM line card-specific mechanism that identifies to the OC3 ATM line card the VPI-VCI pair to be used for a particular packet. The OC3 ATM line card requires this feature in order to manage the packets for transmission. The number chosen for the VCD is independent of the VPI-VCI pair used.

- *vpi*—The ATM network VPI to use for this VC in the range of 0 through 255.

- *vci*—The ATM network VCI to use for this VC in the range of 0 through 65,535.

- *ilmi*—Interim Local Management Interface (ILMI) use so that the router can receive SNMP traps and new network prefixes. The recommended vpi and vci values for the ILMI PVC are 0 and 16, respectively.

- *qsaal*—Used to configure an ATM main interface that uses SVC.

- *smds*—Switched Multimegabit Data Service (smds), high-speed packet-switched, datagram-based WAN networking technology.

- *aal-encap*—(Optional) 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's 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).

- *burst*—(Optional) The burst cell size is an integer value, in the range 1 through 64,000. This value is the maximum number of ATM cells that the virtual circuit can transmit to the network at the peak rate of the PVC.

- **oam** *seconds*—(Optional) Specifies how often to generate an OAM F5 loopback cell from this virtual circuit. The default value is 10 seconds.

- **inarp** *minutes*—(Optional) Specifies how often inverse Address Resolution Protocol (ARP) datagrams will be sent on this virtual circuit. The default value is 15 minutes.

The **pvc** command creates *PVC n* and attaches the PVC to *VPI* and *VCI*. When you create any PVC, you also specify the ATM adaptation layer (AAL) and encapsulation. The AAL used is specified by *aal* and encapsulation by *encap*.

The *peak* and *average* rate selection values are specified in kilobits per second. Omitting *peak* and *average* values causes the PVC and those values to default to the line rate, with the *peak* and *average* values being equal.

You can configure the PVC for communication with ILMI, which enables the router to receive Simple Network Management Protocol (SNMP) traps and new network prefixes. Refer to the *Wide-Area Networking Configuration Guide* for details.

You can also configure the PVC to send OAM F5 loopback cells, which verify connectivity on the virtual circuit. The remote end must respond by echoing back such cells.

The following example creates a PVC on interface 0 in a Cisco 7304 router with a line card in slot 2 with VPI 0 and VCI 6. The PVC uses AAL AAL5-MUX with IP.

```
Router(config)# interface ATM2/0.1 point-to-point
Router(config-subif)# ip address 10.1.1.1 255.255.255.252
Router(config-subif)# pvc 0/6
Router(config-if-atm-vc)# encapsulation aal5mux ip
```

See examples of PVC configurations in the .

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`
	`Enter configuration commands, one per`
	`line. End with CNTL/Z.`
	`Router(config)#`
		To enter these commands, you need to be in configuration mode.

Step 2	`Router(config)# int atm4/1.1` `point-to-point`	Create a map list by naming it, and enter map-list configuration mode.
Step 3	`Router(config-subif)#pvc 1/100`	Associate a protocol and an address to a specific virtual circuit.
Step 4	`Router(config-if-atm-vc)#protocol ip` `10.1.1.2 broadcast`	Associate a protocol and address it to a different virtual circuit.

Step 5	`Router(config-if-atm-vc)#^Z`
	
	`Router#`
		Specify an ATM interface.

A map list can contain multiple map entries, as Step 3 and Step 4 in the preceding table illustrate. 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, pseudobroadcasting is enabled. To eliminate pseudobroadcasting and set up point-to-multipoint signaling on virtual circuits configured for broadcasting, refer to the *Wide-Area Networking Configuration Guide*.

When the map list is complete, you associate it with an ATM interface by using the *name* argument. (See Step 7.)

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 on page 4-24.

For further information on configuring the OC3 ATM line card for PVCs, refer to *Wide-Area Networking Configuration Guide*.

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.

Figure 4-1   Basic ATM Environment
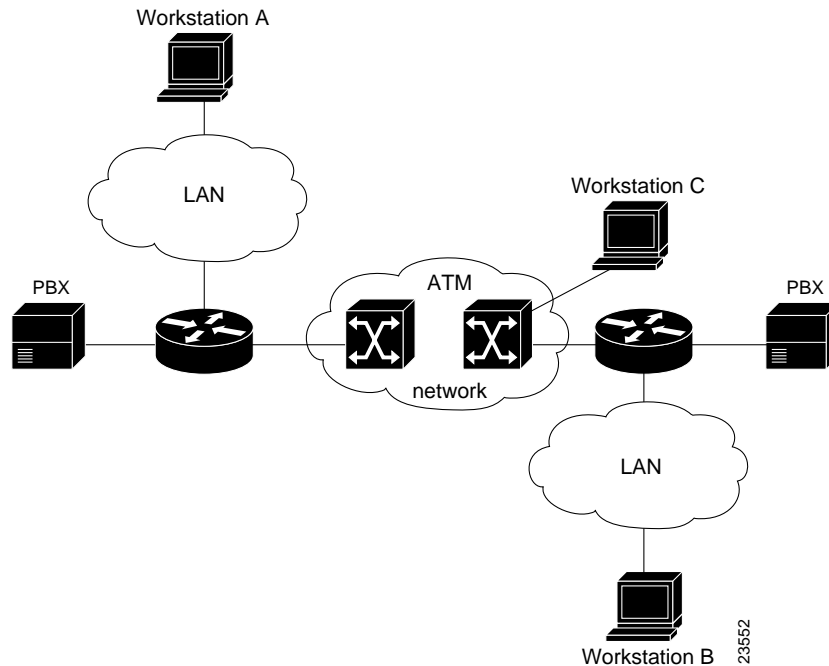
To use SVCs, complete the required tasks in the following sections:

- Configuring the PVC That Performs SVC Call Setup, page 4-15
- Configuring the Network Service Access Point Address, page 4-16

For further information on configuring the OC3 ATM line card for SVCs, see the *Wide-Area Networking Configuration Guide*.

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 4-2   One or More SVCs Require a Signaling PVC
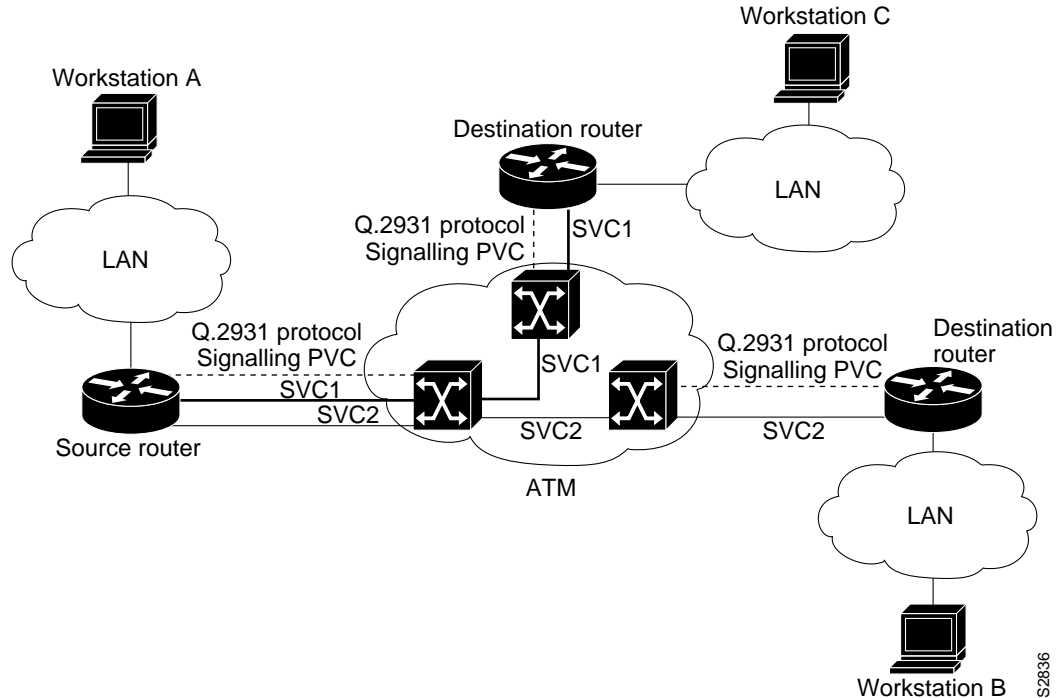
To configure the signaling PVC for all SVC connections, enter the following command in interface configuration mode:

pvc [name] *vpi/vci* **qsaal**

✎

Note   This signaling PVC can be set up on a major interface only, not on the subinterfaces.

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 4-27 for a sample ATM signaling configuration.

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:

•   Configure the complete NSAP address manually

•   Configure the ESI and Selector fields

To configure the ESI and Selector fields, you must also configure a PVC to communicate with the switch through 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:

nsap-address *nsap-address*

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.

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)# `**`pvc`** *`vcd`* **`0 16 ilmi`**	Configure an ILMI PVC on an ATM main interface for communicating with the switch by using ILMI. (For the appropriate interface address to use for your system, see Table 4-3 on page 4-4.)
Step 2	**exit** .	Return to interface configuration mode.
Step 3	`Router(config-if)# `**`atm esi-address`** *`esi.selector`*	Enter the ESI and selector fields of the NSAP address.

In the **atm esi-address** command, the *esi* 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 2 0 16 ilmi
Router(config-if)# atm esi-address 345678901234.12
```

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 *Wide-Area Networking Configuration Guide*.

Customizing the OC3 ATM Line Card

You can customize the OC3 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 OC3 ATM line card:

- Setting the MTU Size, page 4-18
- Configuring an ATM Interface for Local Loopback, page 4-18
- Configuring an ATM Interface for External Loopback, page 4-19

Note For the commands that follow, you need to be in interface configuration mode. To enter interface configuration mode, use the **interface atm sub**command, followed by the interface address of the ATM interface you plan to configure. (For information on the **interface atm** subcommand 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 OC3 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 OC3 ATM line card is working by looping the transmit data back to the receive data), use the following command:

```
Router(config-if)# loopback diagnostic
Router(config-if)# no 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 OC3 ATM line card is working by looping the receive data back to the transmit data), use the following command:

```
Router(config-if)# loopback line
Router(config-if)# no loopback line
```

To configure an ATM interface for external loopback at the cell level, use the following command:

```
Router(config-if)# loopback cell
Router(config-if)# no loopback cell
```

To configure an ATM interface for external loopback at the payload level, use the following command:

```
Router(config-if)# loopback payload
Router(config-if)# no loopback payload
```

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

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. (For information about EXEC mode, see the "Using the EXEC Command Interpreter" section on page 4-1.)

	Command	Purpose
Step 1	Router# **show atm interface atm** *slot-number*/0	Display ATM-specific information about an ATM interface.
Step 2	Router# **show atm map**	Display the configured list of ATM static maps to remote hosts on an ATM network.
Step 3	Router# **show atm traffic**	Display 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*]**	Display ATM virtual circuit information about all PVCs and SVCs (or a specific virtual circuit).
Step 5	Router# **show sscop**[1]	Display details for the ATM interface.
Step 6	Router# **show atm arp-server**	Display ATM ARP server table.
Step 7	Router# **show atm ilmi-status**	Display ATM ILMI information.

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

Traffic Management

The OC3 ATM line card supports the traffic-shaping parameters defined in Table 4-5. 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-3c	38 kbps to 77.5 Mbps and 155 Mbps	If the peak rate is not defined, each new VC is set to the maximum physical layer rate.
Average Rate	38 kbps < average ≤ peak rate	Average = peak rate.
Maximum Burst Size	1 to 64,000	Equal to the OC3 ATM line card MTU size. (User-configurable on ATM interface only.)

Note   The OC3 ATM line card supports UBR and nrt-VBR traffic only.

Testing and Troubleshooting the OC3 ATM Line Card

The following sections provide suggested guidelines for troubleshooting the OC3 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.

OC3 ATM Line Card Statistics

The OC3 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 OC3 ATM line card also takes snapshots of the last VCI/VPI that caused the error. Each OC3 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 timeout errors on receive

The OC3 ATM line card provides line card-specific error statistics through the **show interfaces atm** command.

Note   For examples of the **show interfaces atm** command for the supported platform, see the "Using the show interfaces Command" section on page 4-8.

The **show controllers atm** command displays the ATM framing information and ATM facility performance statistics.

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 up
Hardware is OC-3 ATM, bandwidth OC3 (155000Kbps)
Framer is PMC PM5351 S/UNI-TETRA (155-TETRA). SAR device is MXT4400 TSP
  PortMakerI AAL5 SAR firmware version for MXT4400 Reassembly SAR:
    major 0x1, minor 0x5, patch 0x0E, code level 0x0C
  PortMakerI AAL5 SAR firmware version for MXT4400 Segmemtation SAR:
    major 0x1, minor 0x5, patch 0x0E, code level 0x0C
  hwidb = 0x43553890, ds = 0x435F0CE0, ds_vp = 0x435553E0, ds_vc = 0x4369E200
  slot 4, slotunit 0, fci_type 0x0374, ticks 1000
  atm_db_flags = 0x00048308
Current VCC count: current=10, peak=10
Framer Information:
  Framing mode: SONET OC3 STS-3C. Clock source: line. Loopback mode: none.
  RXCP received cells: 2064, TXCP transmitted cells: 353253850
  Facility alarm:
  Phy stats:
        sbip     lbip     lfebe     pbip     pfebe     hcse
      ----------------------------------------------------------------
          9       12        l9        1        1         0
    sbip:  Section BIP8
    lbip:  Line BIP8/24
    lfebe: Line FEBE
    pbip:  Path BIP8
    pfebe: Path FEBE
    hcse:  Rx Cell HCS Error
Reassembler Counters:
  RXBytes:               75924
  RXCellsUnopenedChannel: 0
  RXPacketsCRC32Error:    0
  RXPacketsLECIDMatch:    0
  RXCellsCRC10Error:      0
  RXPacketsNoBuffers:     0
  RXPacketsTrailerLen:    0
  RXPacketsAbort:         0
  RXPacketsMPSError:      0
  RXPacketsDeEncapError:  0
Segmenter Counters:
  TXBytes:               75924
  TXPacketsMPSError:      0
Line Card FPGA Counters:
  RXPackets: 688                  RXBytes: 75924
  TXPackets: 688                  TXBytes: 75924
```

Using the Debug ATM Commands

The following **debug** commands help to solve ATM network problems.

- To create a dump of all protocol packets, use the **debug atm packet** command. The command 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
```

- To display errors, use the **debug atm errors** command. The command displays information from all detected ATM errors. This includes such errors as encapsulation failures and errors during ATM configuration.

```
Router# debug atm errors
```

- To display ATM events, use the **debug atm events** command. The command displays event changes to the OC3 ATM line card; reset, VC configurations, and OC3 ATM line card configurations are displayed.

```
Router# debug atm events
```

- To display information about OAM cells, use the **debug atm oam** command. The command 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

You can use ATM **show** commands to display the current state of the ATM network and the connected VCs.

- To show current VCs and traffic information, use the **show atm vc** [*vcd*] command. Specifying a VCD displays specific information about that VCD.

```
Router# show atm vc [vcd]
```

- To show current information about an ATM interface, use the **show atm interfaces** command. The command displays ATM-specific information about an interface.

```
Router# show atm interfaces
```

- To show current ATM traffic, use the **show atm traffic** command. The command displays global information about traffic to and from all ATM networks connected to the router.

```
Router# show atm traffic
```

- To show the current ATM mapping, use the **show atm map** command. The command displays the active list of ATM static maps to remote hosts on an ATM network.

```
Router# show atm map
```

Use the **show atm vc** command to display the following types of statistics for all PVCs:

```
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 10000  PVC    SNAP     UBR  149760                UP
4/0.2     2             1 10001  PVC    SNAP     UBR  149760                UP
4/0.3     3             1 10002  PVC    SNAP     UBR  149760                UP
4/0.4     4             1 10003  PVC    SNAP     UBR  149760                UP
4/0.5     5             1 10004  PVC    SNAP     UBR  149760                UP
```

Use the **show atm vc** *n* command, where *n* is the VCD unique index value, to display statistics for a given PVC:

```
Router# show atm vc 2
ATM4/0.2: VCD: 2, VPI: 1, VCI: 10001
UBR, PeakRate: 149760
AAL5-LLC/SNAP, etype:0x0, Flags: 0xC20, VCmode: 0x0
OAM frequency: 0 second(s)
InARP frequency: 15 minutes(s)
Transmit priority 4
InPkts: 15332898, OutPkts: 15332754, InBytes: 3519887760, OutBytes: 3519877324
InPRoc: 0, OutPRoc: 1
InFast: 46, OutFast: 233, InAS: 0, OutAS: 0
InPktDrops: 0, OutPktDrops: 0/0/0 (holdq/outputq/total)
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
VC 2 doesn't exist on interface ATM4/1
Router#
```

Use the **show interfaces atm** command to display statistics for the ATM interface you specify.

Note For examples of the **show interfaces atm** command for all supported platforms, see the "Using the show interfaces Command" section on page 4-8.

Use the **show atm interface atm** command to display statistics for the ATM interface you specify by its interface address. Following is an example of the **show atm interface atm** command on a Cisco 7304 router:

```
Router#show atm interface atm 4/1.1
Interface ATM4/1:
AAL enabled:  AAL5 , Maximum VCs: 2047, Current VCCs: 0


Maximum Transmit Channels: 0
Max. Datagram Size: 4528
PLIM Type: SONET - 155000Kbps, TX clocking: LINE
Cell-payload scrambling: ON
sts-stream scrambling: ON
0 input, 0 output, 0 IN fast, 0 OUT fast, 0 out drop
 Avail bw = 155000
Config. is ACTIVE
router#
```

Use the **show atm interface atm** command to display statistics for the ATM interface you specify by its interface address. Following is an example of the **show atm interface atm** command on a Cisco 7304 router:

```
Router# show atm interface atm 0/0
ATM interface ATM 0/0:
AAL enabled:  AAL5, Maximum VCs: 2048, Current VCCs: 12
Max. Datagram Size:4528, MIDs/VC: 1024
PLIM Type:DS3 - 45Mbps, Framing is C-bit ADM,
DS3 lbo: short, TX clocking: LINE
Scrambling: OFF
227585 input, 227585 output, 0 IN fast, 0 OUT fast
Config. is ACTIVE
```

Use the **show sscop** command to display SSCOP details for the ATM interface.

Use the **show version** command to display the configuration of the system hardware (the number of each interface processor type installed), the software version, the names and sources of configuration files, and the boot images.

Note   For examples of the **show version** command for all supported platforms, see the "Using the show version or show hardware Commands" section on page 4-6.

Use the **show protocols** command to display the global (system-wide) and interface-specific status of any configured Layer 3 protocol.

Use the **show running-config** command **to** display the currently running OC3 ATM line card configuration in RAM:

```
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
 !
```

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 4-25
- Example of PVCs in a Fully Meshed Network, page 4-25
- Example of SVCs in a Fully Meshed Network, page 4-27
- Connecting Two OC3 ATM Line Cards Back to Back, page 4-28

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
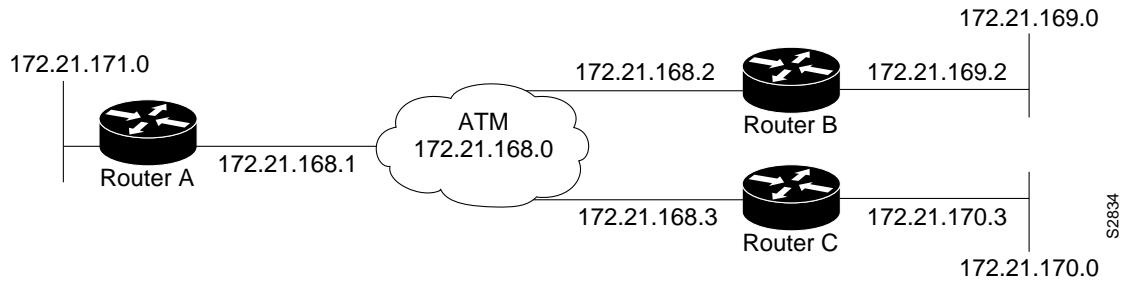
Router A

```
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 OC3 ATM Line Cards Back to Back

Two routers, each containing an OC3 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 OC3 ATM line card "expects" a connected ATM switch to provide transmit clocking. To specify that the OC3 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 OC3 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
```

Upgrading Your Boot Flash 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 (see Table 2-1 on page 2-2), we recommend that you also upgrade your boot image. To upgrade your boot image, you can copy the new boot image from a network server to Flash memory on your router. To copy a boot image from a Trivial File Transfer Protocol (TFTP) server to Flash memory, 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)# show flash all`	(Optional) If you do not already know it, learn the exact spelling of the system image filename in Flash memory.
Step 3	`Router(config)# copy flash tftp`	Make a backup copy of the current boot image.
Step 4	`Router(config)# copy tftp flash`	Copy a boot image to Flash 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 2 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 2 it is automatically reset, put online, and the OIR LED is turned off.