



PA-A2 ATM CES Port Adapter Installation and Configuration

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PA-A2-4E1XC-OC3SM(=), PA-A2-4E1XC-E3ATM(=)

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PA-A2 ATM CES Port Adapter Installation and Configuration

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Preface: PA-A2 ATM CES Port Adapter Installation and Configuration

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, page vii
- Organization, page viii
- Related Documentation, page viii
- Obtaining Documentation, page ix
- Obtaining Technical Assistance, page x

Objectives

This document describes how to install and configure the dual-wide ATM circuit emulation services (CES) port adapter, hereafter referred to as the PA-A2 ATM CES, which is used in the following platforms:

- Cisco 7200 series routers, including the 2-slot Cisco 7202, 4-slot Cisco 7204 and Cisco 7204VXR, and the 6-slot Cisco 7206 and Cisco 7206VXR
- 6-slot Cisco uBR7246

For complete descriptions of interface subcommands and the configuration options that support ATM CES port adapter functionality, refer to publications listed in the “Related Documentation” section on page viii.

Organization

This document contains the following chapters:

Section	Title	Description
Chapter 1	Overview: <XXXXXX Module>	Describes the module and its LED displays, cables, and receptacles.
Chapter 2	Preparing to Install the <XXXXXX Module>	Describes safety considerations, tools required, and procedures you should perform before the actual installation.
Chapter 3	Removing and Installing the <XXXXXX Module>	Describes the procedures for installing and removing module.
Chapter 4	Configuring the PA-A2 ATM CES Port Adapter	Provides instructions for configuring the module.

Related Documentation

The documentation listed below is available online, on the Documentation CD-ROM, or as printed documents.

Your router, switch, or gateway 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.
 - 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: <http://www.cisco.com/cgi-bin/Support/CompNav/Index.pl>. You must be a registered user on Cisco.com to access this tool.



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

- Cisco 7200 series routers:
 - For port adapter hardware and memory configuration guidelines, refer to the *Cisco 7200 Series Port Adapter Hardware Configuration Guidelines*.
 - For hardware installation and maintenance information (including the Cisco 7206 or Cisco 7206VXR as a router shelf in a Cisco AS5800 Universal Access Server), refer to the installation and configuration guide that shipped with your Cisco 7200 series router.
 - For information on network processing engines or network services engines, refer to the *Network Processing Engine and Network Services Engine Installation and Configuration* publication.

- For information on the router boot images, refer to the Cisco 7200 Series Routers Boot Images Information publication.
- Cisco 7200 VXR routers:
- For hardware installation and maintenance information, refer to the *Cisco 7200 VXR Installation and Configuration Guide* or the *Cisco 7200 VXR Quick Start Guide*.
- Cisco uBR7200 series routers:
- For installation and maintenance information, refer to the *Cisco uBR7200 Series Hardware Installation Guide*.
- For international agency compliance, safety, and statutory information for WAN interfaces:
 - *Regulatory Compliance and Safety Information for the Cisco 7200 Series Routers*
 - “Regulatory Compliance and Safety Information” appendix in the *Cisco uBR7200 Series Universal Broadband Router Hardware Installation Guide*
 - *Site Preparation and Safety Guide*
- To view Cisco documentation or obtain general information about the documentation, refer to the following sections:
 - Obtaining Documentation, page ix
 - Obtaining Technical Assistance, page x
 - Customer service at 800 553-6387 or 408 526-7208. Customer service hours are 5:00 a.m. to 6:00 p.m. Pacific time, Monday through Friday (excluding Cisco-observed holidays). You can also send e-mail to cs-rep@cisco.com.

Obtaining Documentation

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World Wide Web

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

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Translated documentation is available at the following URL:

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

Documentation CD-ROM

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

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Obtaining Technical Assistance

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

- Priority level 4 (P4)—You need information or assistance concerning Cisco product capabilities, product installation, or basic product configuration.
- Priority level 3 (P3)—Your network performance is degraded. Network functionality is noticeably impaired, but most business operations continue.
- Priority level 2 (P2)—Your production network is severely degraded, affecting significant aspects of business operations. No workaround is available.
- Priority level 1 (P1)—Your production network is down, and a critical impact to business operations will occur if service is not restored quickly. No workaround is available.

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

Cisco TAC Web Site

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

<http://www.cisco.com/tac>

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

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

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

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

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

Cisco TAC Escalation Center

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

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

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



Overview: PA-A2 ATM CES Port Adapter

This chapter describes the PA-A2 ATM CES port adapter and contains the following sections:

- Circuit Emulation Services Overview, page 1-1
- PA-A2 ATM CES Port Adapter Overview, page 1-15
- LEDs, page 1-17
- PA-A2 ATM CES Cables, Connectors, and Pinouts, page 1-18
- ATM Management Information Base Specifications, page 1-20
- Fibre-Optic Transmission Specifications, page 1-20
- Setting ATM CES Port Adapter Jumpers, page 1-23
- PA-A2 ATM CES Port Adapter Slot Locations on the Supported Platforms, page 1-24
- Identifying Interface Addresses, page 1-27

Circuit Emulation Services Overview

Voice and video services—circuit emulation services (CES)—allow you to interconnect existing T1/E1 interfaces and other types of constant bit rate (CBR) equipment. CBR services include such features as PBX interconnect, consolidated voice and data traffic, and video conferencing.

With circuit emulation, data received from an external device at the edge of an ATM network is converted to ATM cells, sent through the network, reassembled into a bit stream, and passed out of the ATM network to its destination. T1/E1 circuit emulation does not interpret the contents of the data stream. All the bits flowing into the input edge port of the ATM network are reproduced at one corresponding output edge port.

An emulated circuit is carried across the ATM network on a PVC, which is configured through the network management system.

The ATM CES port adapter offers two types of services, that are covered in the following sections:

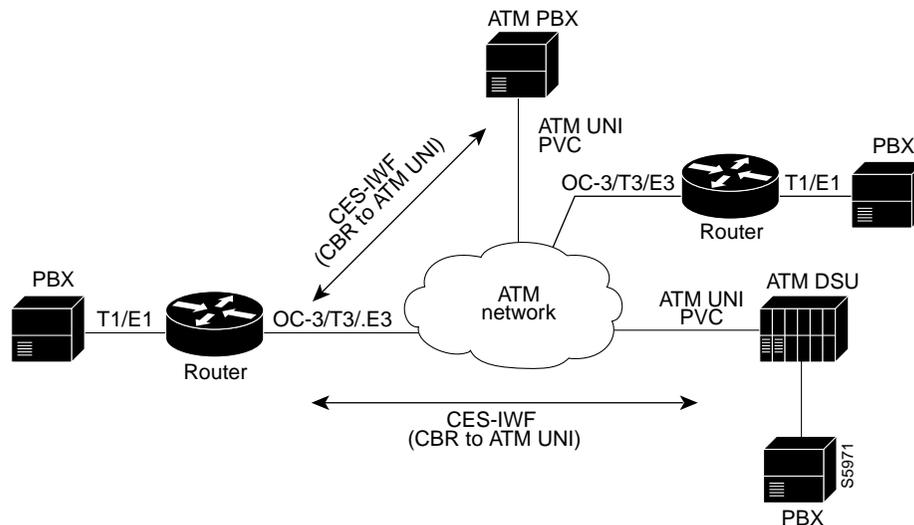
- Circuit Emulation Services Internetworking Function, page 1-2
- Network Timing Services for CES Operations, page 1-8

Circuit Emulation Services Internetworking Function

CES-IWF is a service based on ATM Forum standards that allows communications between CBR and ATM UNI interfaces, that is, between non-ATM telephony devices (such as classic PBXs or TDMs) and ATM devices (such as Cisco 7200 series routers). Thus, a Cisco 7200 series router equipped with an ATM CES port adapter offers a migration path from classic T1/E1 CBR data communications services to emulated CES T1/E1 unstructured (clear channel) services or structured (N x 64) services in an ATM network. A Cisco uBR7200 series equipped with an ATM CES port adapter offers an ATM WAN connection between the broadband cable network and the Internet.

Figure 1-1 is a simplified representation of CES-IWF functions in an ATM network.

Figure 1-1 Typical CES-IWF Operations in an ATM Network



The circuit emulation services offered by the ATM CES port adapter are discussed in the following sections:

- T1/E1 Unstructured (Clear Channel) CES Services, page 1-2
- T1/E1 Structured (N x 64) CES Services, page 1-4
- Channel-Associated Signaling (for Structured CES Services Only), page 1-6

T1/E1 Unstructured (Clear Channel) CES Services

Unstructured CES services in an ATM network emulate point-to-point connections over T1/E1 leased lines. This service maps the entire bandwidth necessary for a T1/E1 leased line connection across the ATM network, allowing users to interconnect PBXs, TDMs, and video conferencing equipment. Unstructured CES operations do not decode or alter the CBR data in any way.

The ATM CES port adapter supports DSX-1 physical interfaces, providing T1/E1 unstructured (clear channel) CBR data transmission services to Cisco 7200 series and Cisco uBR7200 series users at a rate of 1.544 Mbps for T1 and 2.048 Mbps for E1.

The use of an ATM CES port adapter for unstructured CES services simulates a point-to-point T1/E1 leased line across your ATM network.

Figure 1-2 is a generalized representation of how T1/E1 unstructured CES services are set up in conjunction with a Cisco 7200 series router equipped with an ATM CES port adapter.

Figure 1-2 T1/E1 Unstructured CES Services Across Leased Lines

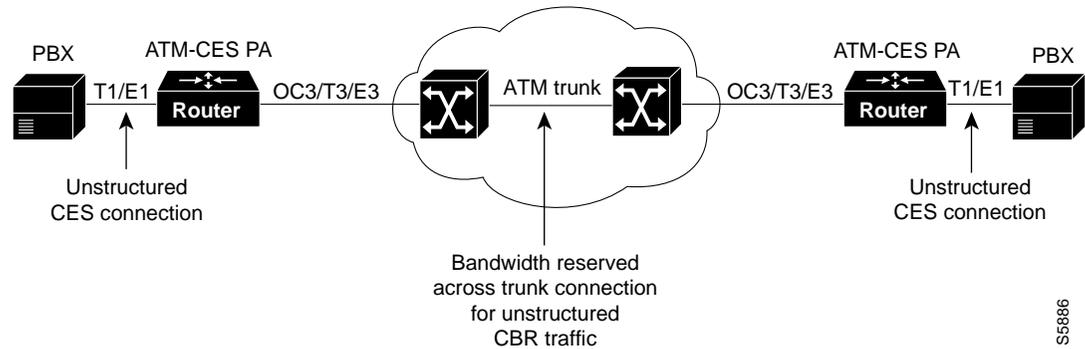
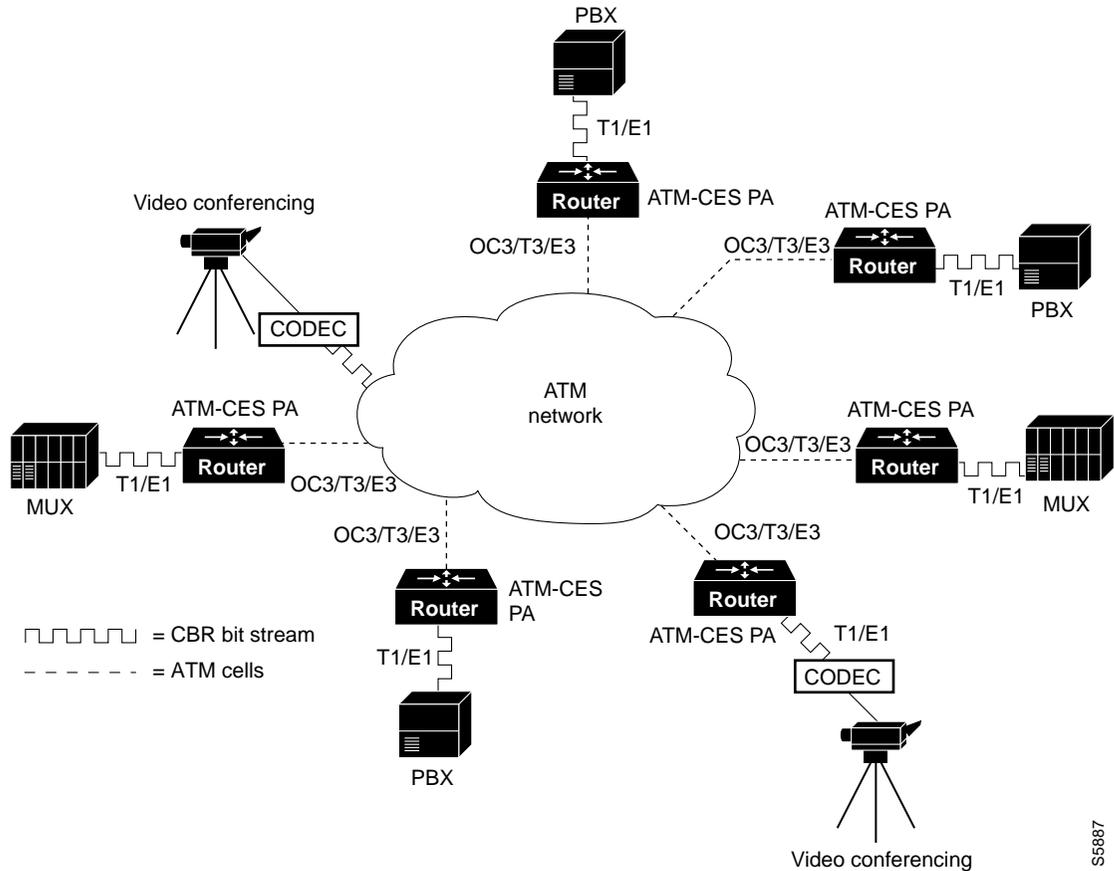


Figure 1-3 is a general example of unstructured CES applications in an ATM network. In unstructured CES services, user CBR data received from an edge device at one side of the network is segmented into ATM cells and propagated through the ATM network. After traversing the network, the ATM cells are reassembled into a CBR bit stream that matches the original user data. This CBR data is then passed out of the network to the edge device at the destination endpoint.

Figure 1-3 T1/E1 CES Applications in ATM Network



T1/E1 Structured (N x 64) CES Services

The T1/E1 structured (N x 64) CES services enable a CES module to function like a classic digital access and crossconnect system (DACS) switch.

The ATM CES port adapter supports DSX-1 physical interfaces, providing T1/E1 channelized data transmission services at a rate of 1.544 Mbps for T1 and 2.048 Mbps for E1.

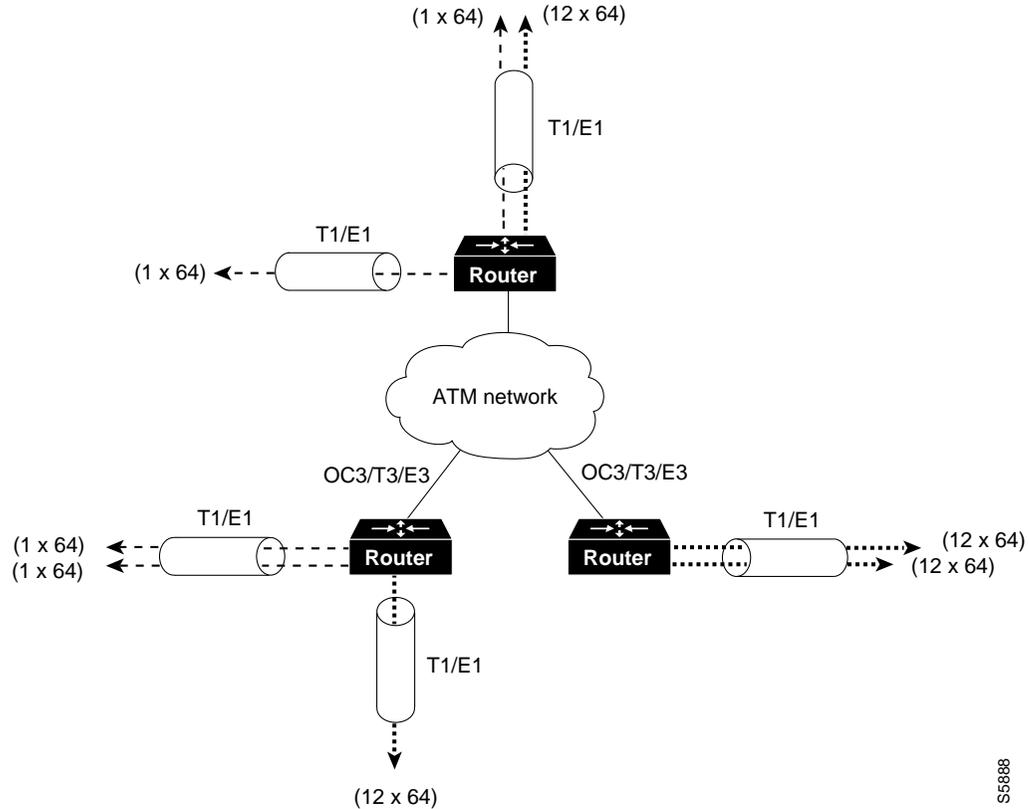
Using an ATM CES port adapter, you can map a single DS0 channel or multiple DS0 channels across an ATM network. Each T1 port has up to 24 time slots, and each E1 port has up to 31 time slots for allocation to structured CES circuits. Each time slot can transmit CBR data at a rate of 64 kbps, or at 56 kbps, if you choose to use optional channel associated signaling (CAS). The “Channel-Associated Signaling (for Structured CES Services Only)” section on page 1-6, describes the CAS mechanism.

Figure 1-4 illustrates the digital crossconnect and channelized mapping functions offered by a Cisco 7200 series router or a Cisco uBR7200 series equipped with an ATM CES port adapter. Single or multiple DS0 time slots can be mapped across the ATM network. Each time slot (or DS0 channel) represents a single N x 64 circuit that can transmit CBR data at a rate of 64 kbps.

Multiple N x 64 circuits can be connected to a single port, if separate time slots are used.

With T1/E1 structured CES services, network designers can simplify networks by eliminating TDM devices, using ATM CES port adapters instead as a means of allocating T1/E1 bandwidth to PBXs and teleconferencing equipment.

Figure 1-4 Digital Access and Crossconnect (DACs) Functions of CES Modules



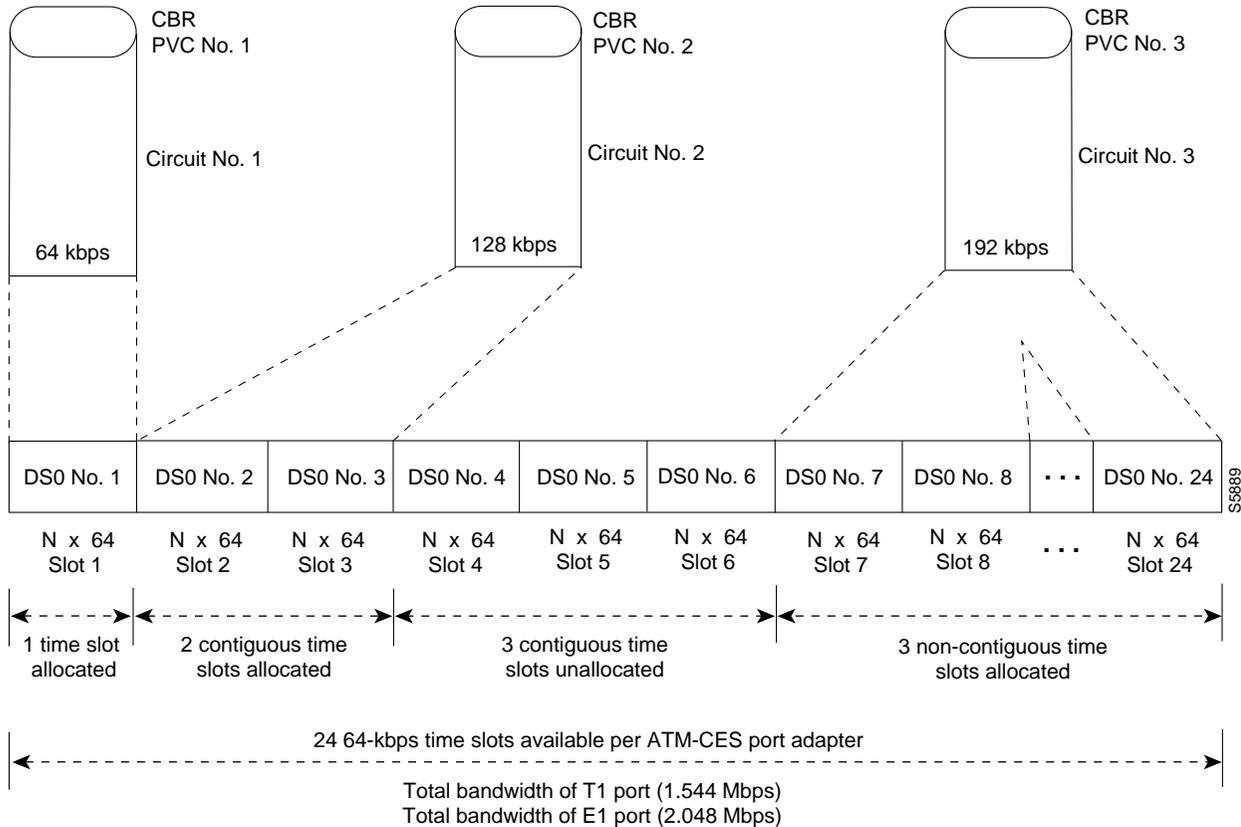
As Figure 1-4 demonstrates, structured services in an ATM CES port adapter allow T1/E1-formatted CBR data to be provisioned into individual DS0 channels (PVCs) or groups of DS0 channels.

Data from these channels can be sent to multiple individual output ports on a CES module, where the data can be combined with CBR data from other DS0 channels or groups of DS0 channels to form an outgoing T1/E1 bit stream. Thus, you can combine structured CBR data with great flexibility for transport across an ATM network.

Figure 1-5 gives one example of how 24 available N x 64 time slots for T1 (31 time slots for E1 not shown) in an ATM CES port adapter can be combined to accomplish structured CBR data transport in an ATM network. The DS0 channels can be grouped as either contiguous or noncontiguous time slots.

The ingress (source) DS0 channels can be mapped into different DS0 channels on egress from the ATM network at the destination node.

Figure 1-5 Time Slots for Structured Services in PA-A2 ATM CES Port Adapters



For CES structured services, each DS0 time slot represents a data bandwidth of 64 kbps for CBR data transport. If optional channel associated signaling (CAS) is being used, however, a data bandwidth of 56 kbps per DS0 time slot is available for CBR data transport.

Figure 1-5 shows one end of three PVCs that have been provisioned for structured CBR data transport. Think of these DS0 channels as the source ends of the PVCs. The destination ends of the PVCs each require the allocation of an identical number of DS0 time slots.

However, the actual DS0 numbers assigned at the destination node can differ from those assigned at the source node. In other words, the DS0 numbers at each end of the PVC need not correspond one for one. Only the actual numbers of time slots provisioned at each end of the PVC must agree.

For example, the circuit identified as PVC No. 3 in Figure 1-5 requires a similar bundling of three time slots at the destination end of the PVC (representing a data bandwidth of 192 kbps) in order for the circuit to operate properly.

Channel-Associated Signaling (for Structured CES Services Only)

Because the ATM CES port adapter emulates constant bit rate services over ATM networks, it must be capable of providing support for handling channel-associated signaling (CAS) information introduced into structured CES circuits by PBXs and time-division multiplexing (TDM) devices. An optional CAS feature for the ATM CES port adapter meets this requirement.

With respect to the CAS information carried in a CBR bit stream, an ATM CES port adapter can be configured to operate as follows:

- Without the optional CAS feature enabled (the default state).

In this case, the ATM CES port adapter does not sense the CAS information (carried as so-called “ABCD” bits in the CBR bit stream) and provides no support for CAS functions.

- With the optional CAS feature enabled, but without the optional (Cisco-proprietary) “on-hook detection” feature enabled.

In this case, in addition to packaging incoming CBR data into ATM AAL1 cells in the usual manner for transport through the network, the ATM CES port adapter in the ingress node senses the ABCD bit patterns in the incoming data, incorporates these patterns in the ATM cell stream, and propagates the cells to the next node in the network. The ATM cells are transported across the network from link to link until the egress node is reached.

At the egress node, the ATM CES port adapter strips off the ABCD bit patterns carried by the ATM cells, reassembles the CAS ABCD bits and the user’s CBR data into the original form, and passes the frames out of the ATM network in the proper DS0 time slot.

All these processes occur transparently without user intervention.

- With both the optional CAS and on-hook detection features enabled.

In this case, the CAS and on-hook detection features work together to enable an ingress node in an ATM network to monitor on-hook and off-hook conditions for a specified 1 x 64 structured CES circuit. As implied by the notation “1 x 64,” the on-hook detection (or bandwidth-release) feature is supported only in a structured CES circuit that involves a single DS0 time slot at each end of the connection.

The DS0 time slot configured for the structured CES circuit at the ingress node (time slot 2) can be different from the DS0 time slot configured at the egress node (time slot 4). Only one such time slot can be configured at each end of the circuit when the on-hook detection feature is used.

When you invoke this feature, the ingress ATM CES port adapter monitors the ABCD bits in the incoming CBR bit stream to detect on-hook and off-hook conditions in the circuit. In an “off-hook” condition, all the bandwidth provisioned for the specified CES circuit is used for transporting ATM AAL1 cells across the network from the ingress node to the egress node.

In an on-hook condition, the network periodically sends dummy ATM cells from the ingress node to the egress node to maintain the connection. However, these dummy cells consume only a fraction of the circuit’s reserved bandwidth, leaving the remainder of the bandwidth available for use by other network traffic. This bandwidth-release feature enables the network to make more efficient use of its resources.

When the CAS feature is enabled for a CES circuit, the bandwidth of the DS0 channel is limited to 56 kbps for user data, because CAS functions consume 8 kbps of channel bandwidth for transporting the ABCD signaling bits. These signaling bits are passed transparently from the ingress node to the egress node as part of the ATM AAL1 cell stream.

In summary, when the optional CAS and on-hook detection features are enabled, the following conditions apply:

- The permanent virtual connection (PVC) provisioned for the CES circuit always exists.
- The bandwidth for the CES circuit is always reserved.
- During an on-hook state, most of the bandwidth reserved for the CES circuit is not in use. (Dummy cells are sent from the ingress node to the egress node to maintain the connection.) Therefore, this bandwidth becomes available for use by other network traffic, such as available bit rate (ABR) traffic.
- During an off-hook state, all the bandwidth reserved for the CES circuit is dedicated to that circuit.

See Chapter 4, “Configuring the PA-A2 ATM CES Port Adapter,” for more information on the procedures for enabling the CAS feature and configuring structured CES services.

Network Timing Services for CES Operations

Circuit emulation services internetworking functions (CES-IWF) and constant bit rate (CBR) traffic relate to a quality of service (QoS) classification defined by the ATM Forum for Class A (AAL1) traffic in ATM networks. In general, Class A traffic pertains to voice and video transmissions.

In an ATM networking environment, CBR refers to a particular class of traffic that is generated by edge (source) devices and propagated into ATM networks for transmission to other edge (destination) devices in the network.

The ATM CES port adapter is designed specifically to handle CBR traffic in an ATM networking environment. To provide requisite timing functions in support of CES operations, you can specify any one of three clocking modes covered in the following sections:

- Network Clock Synchronization, page 1-8
- Designating a PRS Source Port in a Cisco 7200 Series Router or Cisco uBR7200 series, page 1-8
- Network Clock Distribution in a Cisco 7200 Series Router or a Cisco uBR7200 series, page 1-9

However, to support synchronous clocking or SRTS clocking in your ATM networking environment, your network must incorporate the following facilities:

- **A primary reference source (PRS)**—Throughout this document, the term *PRS* refers to a precision reference timing signal that must be made available, wherever required, to synchronize the flow of CBR data from its source to its destination.
- **Network clock synchronization services**—This refers to a network clock synchronization and distribution service that provides a PRS to those user and network devices that require a precision reference timing signal for synchronizing the flow of CBR traffic.

Network Clock Synchronization

Any constant bit rate (CBR) edge device that communicates with another CBR edge device across an ATM network must be driven by a clocking signal of identical frequency. This “synchronized” signal controls the rate of CBR data insertion into the network, and also the rate of extraction of CBR data from the network. If the clock frequency is not synchronized at both the ingress and egress nodes of the circuit, the data queues and buffers in the network will either overflow or underflow, resulting in line errors.

Distributing a clocking signal within the network ensures that each CBR device has access to a common reference clocking signal, called Primary Reference Source (PRS), for synchronizing CBR data transport.

Designating a PRS Source Port in a Cisco 7200 Series Router or Cisco uBR7200 series

Any port adapter in a Cisco 7200 series router or a Cisco uBR7200 series that can receive and distribute a network timing signal can propagate that signal to any other port adapter in the chassis that has similar capabilities.

By issuing the **network-clock-select** command with appropriate parameters, you can define a particular port in a Cisco 7200 series router or a Cisco uBR7200 series to serve as the source of a PRS for the entire chassis or for other devices in the networking environment. This command enables you to designate a particular port in a Cisco 7200 series router or a Cisco uBR7200 series to serve as a “master clock”

source in distributing a single clocking signal throughout the chassis or to other network devices. This clocking signal can be distributed wherever needed in the network to globally synchronize the flow of CBR data. The use of this command is described in Chapter 4, “Configuring the PA-A2 ATM CES Port Adapter.”

Network Clock Distribution in a Cisco 7200 Series Router or a Cisco uBR7200 series

When equipped with an ATM CES port adapter and appropriate software, any Cisco 7200 series router or a Cisco uBR7200 series can serve as a means for receiving and distributing a PRS to other devices in the network.

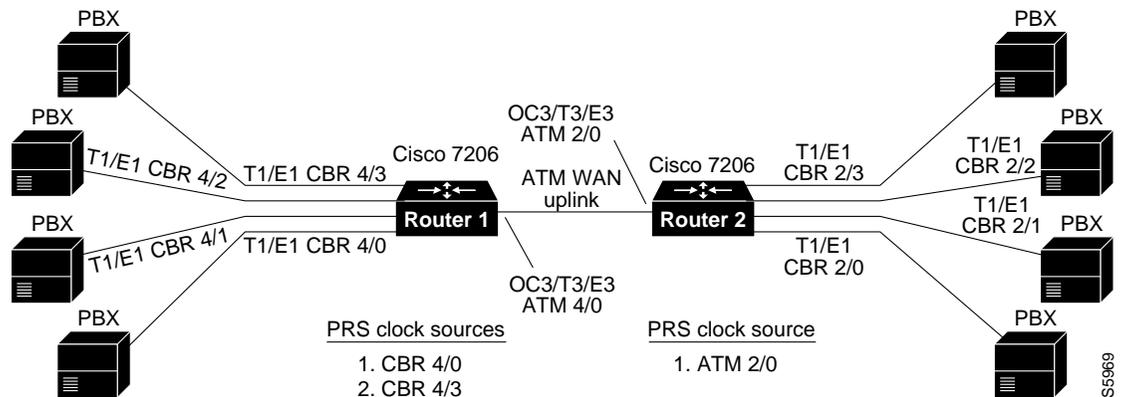
A Cisco 7200 series router or a Cisco uBR7200 series can make use of a PRS that originates from any one of several sources in the networking environment.

Figure 1-6 shows three possible sources of a PRS when two Cisco 7206 routers are connected back-to-back. However, you should not interpret that to mean that only three such clocking signals can be made available for use in the ATM network. In fact, more than three clocking signals may be present in the Cisco 7200 series router or Cisco uBR7200 series operating environment.

The important concepts that you should take from Figure 1-6 include the following:

- Up to four clocking signals can be defined per Cisco 7200 series router or a Cisco uBR7200 series in the network.
- The PRS that is used in Cisco 7200 series routers or a Cisco uBR7200 series *must be traceable to a single clock source*. (In Figure 1-6, Router No. 2’s PRS is traceable to Router No. 1’s PRS.)

Figure 1-6 Cisco 7206 Routers Connected Back-to-Back



Each PRS depicted in Figure 1-6 is externally generated—that is, the timing signal originates from a source outside the router. Also shown is an OC-3 trunk line that can propagate a PRS between adjacent router/network devices.

If the Router No. 1 priority 1 PRS fails (CBR 4/0), the network clock synchronization service automatically recovers network timing by using the Router No. 1 priority 2 PRS (CBR 4/3).

Assume, for example, that the T1/E1 line (CBR 4/0) at Router No. 1 in Figure 1-6 is currently supplying PRS to the network. If this PRS fails, the T1/E1 line (CBR 4/3) at the same router is used as PRS.

Router No. 2 has ATM 2/0 as its PRS. If the ATM 2/0 port fails, there is no configured alternate clock source for PRS. The default clock source is the local oscillator. But, in this case, this is not a problem because the traffic from the T1/E1 CBR ports is also disrupted. In the Cisco 7200 series router or the Cisco uBR7200 series, all T1/E1 traffic goes only on the ATM WAN uplink. When ATM 3/0 goes up, the PRS is automatically recovered.

If the Router No. 1 priority 1 PRS is restored to service, the network clock synchronization service automatically reverts to this PRS for timing purposes, regardless of which lower priority PRS may be active at the time.

Figure 1-7 illustrates Cisco 7206 routers connected to an ATM network. This figure shows how a PRS can be derived from the ATM network and provided to an edge node and propagated through the network to synchronize the flow of CBR data between the communicating ATM end nodes.

In Figure 1-7, when the PRS clock source is taken from the ATM network, all the transmit nodes at the edge of the network on T1/E1 trunk lines on the ATM CES port adapter in Routers 1, 2, and 3 are synchronized.

Figure 1-7 Cisco 7206 Routers Connected to ATM Network

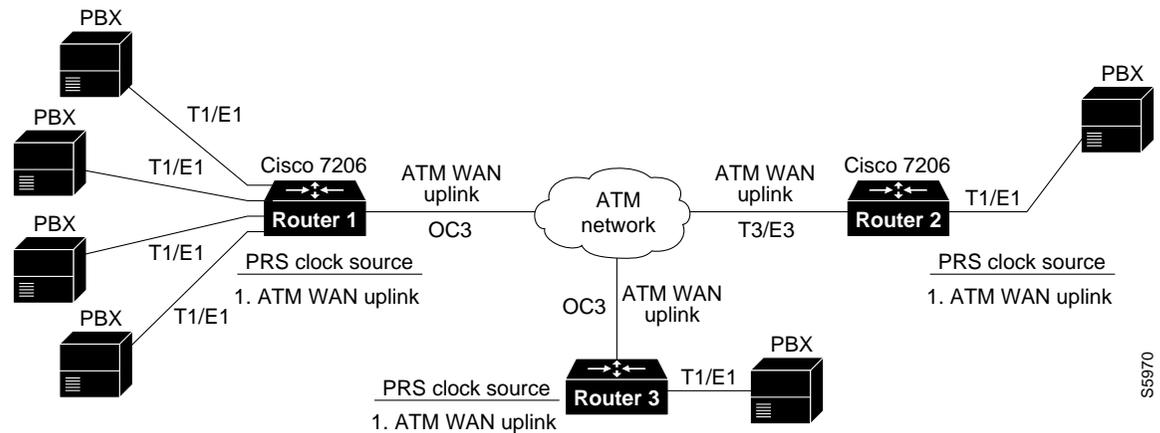
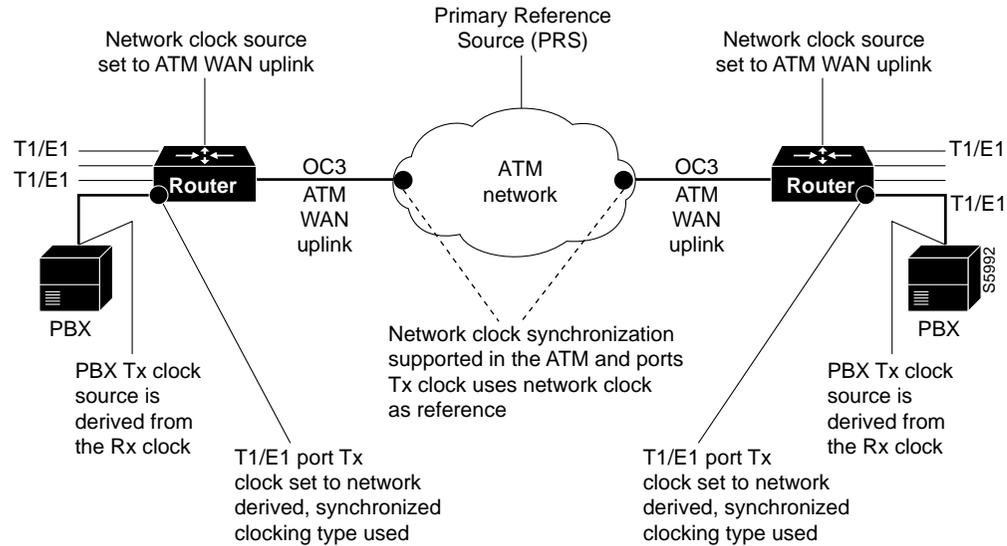


Figure 1-8 illustrates a typical configuration of a network clock source. In this figure, the PBX T1/E1 transmit clocks, ATM CES T1/E1 transmit clocks, ATM CES OC-3/T3/E3 ATM WAN uplinks, and ATM network OC-3/T3/E3 ATM port transmit clocks are all derived from and referenced to a single clock source, the PRS. This limits the jitter and wander in the emulated circuits.

Figure 1-8 Typical Configuration of Network Clock Source



Clocking Modes for CES Operations

For CES operations, three clocking modes can be used in conjunction with any ATM CES port adapter. These clocking modes are described in the following sections in the recommended order of consideration and use:

- Synchronous Clocking Mode, page 1-11
- Synchronous Residual Time Stamp Clocking Mode, page 1-12
- Adaptive Clocking Mode, page 1-12
- Summary of Clocking Modes, page 1-13

Synchronous Clocking Mode

Synchronous clocking mode requires a PRS and network clock synchronization services. When equipped with an ATM CES port adapter and appropriate software, any Cisco 7200 series router or Cisco uBR7200 series can serve as a means for synchronizing the flow of user CBR traffic through the network.

Synchronous clocking can be used for unstructured service (clear channel) and is the only clocking mode for structured (N x 64 kbps) CES services. It is the recommended option for three reasons:

- First, this clocking mode is the only one that supports full CES functionality. SRTS and adaptive clocking do not support structured CES services.
- Second, synchronous clocking exhibits superior stability, reliability, and wander/jitter characteristics.
- Third, synchronous clocking is typically used in public telephone systems, making a precision reference signal readily and widely available for the synchronizing of CBR data transport.

For these reasons, synchronous clocking is the default clocking mode for all CES services.

Synchronous Residual Time Stamp Clocking Mode

Synchronous residual time stamp (SRTS) clocking requires a PRS and network clock synchronization services. SRTS, which can be used only for unstructured services, carries asynchronous DS1 circuits. In this case, the input service clock frequency must be recovered at the output CES-IWF. SRTS is one of the clocking modes that can be used for recovering this clock frequency.

The SRTS clocking mode, which requires a network-wide reference clock, measures the service clock input frequency against a network-wide synchronization signal that must be present in the CES-IWF, and sends different signals, called residual time stamps, in the AAL1 header to the reassembly IWF. At the output IWF, the differences can be combined with the network-wide synchronization signal, to re-create the input service clock. The network-wide reference clock is described in the “Network Clock Distribution in a Cisco 7200 Series Router or a Cisco uBR7200 series” section on page 1-9.

Adaptive Clocking Mode

Adaptive clocking mode requires neither a PRS nor network clock synchronization services for effective handling of CBR traffic. However, as is the case with SRTS clocking, adaptive clocking can be used only for unstructured (clear channel) CES services.



Note

Although this clocking mode is the simplest and easiest to implement in an ATM network, it exhibits the poorest wander and jitter performance of all the available clocking modes. Therefore, Cisco does not recommend its use, except in instances where a PRS and network clock synchronization services are not available.

The term *adaptive clocking* is used because the rate at which CBR data is propagated through an ATM network is driven by the rate at which such data is introduced into the network by the user's edge equipment.

For example, adaptive clocking in an ATM CES port adapter derives timing for data transport by calculating the “average” rate at which data arrives and conveying that data to the output port of the module at an equivalent rate. For this reason, the actual rate of CBR data flow through the network may vary when adaptive clocking is used, depending on how rapidly CBR data is being introduced into the network.

CBR data transport through the network occurs in a “pseudo synchronous” manner that ensures the integrity of the data.

Rather than using a clocking signal to convey CBR traffic through an ATM network, adaptive clocking obtains appropriate timing for data transport by calculating an average data rate for the CBR traffic.

For example, if CBR data is arriving at an ATM CES port adapter at a rate of so many bits per second, then that rate is used, in effect, to govern the flow of CBR data through the network. Meanwhile, however, the ATM CES port adapter automatically calculates the average data rate by means of microcode (firmware) built into the board. This calculation occurs while user data traverses the network.

When the ATM CES port adapter senses that its segmentation and reassembly (SAR) buffer is filling up, it increases the rate of the transmit (TX) clock for its output port, thereby “draining” the buffer.

Similarly, the ATM CES port adapter slows down the transmit clock of its output port if it senses that the buffer is being “drained” faster than CBR data is being received. In this manner, adaptive clocking attempts to minimize wide variations in SAR buffer loading while providing an effective means of propagating CBR traffic through the network.

Implementing adaptive clocking is simple and straightforward, because it does not require network clock synchronization services, a PRS, or the advance planning typically associated with the development of a logical network timing map. However, adaptive clocking does not support structured CES services, and it exhibits relatively high wander characteristics.

Summary of Clocking Modes

Table 1-1 summarizes the characteristics of the three clocking modes available for handling CBR traffic in an ATM networking environment. Although the wander and jitter characteristics of these clocking modes differ, each mode preserves the integrity of the user's CBR data, ensuring its error-free transport from source to destination.

Table 1-1 *Clocking Modes for CBR Traffic*

Clocking Mode	Advantages	Limitations
Synchronous	Supports both unstructured (clear channel) and structured CBR traffic. Exhibits superior wander and jitter characteristics.	Requires network clock synchronization services. Ties the CES interface to the network clock synchronization services clocking signal (PRS).
SRTS (synchronous residual time stamp)	Conveys externally generated user clocking signal through ATM network, providing independent clocking signal for each CES circuit.	Requires network clock synchronization services. Supports only unstructured (clear channel) CBR traffic. Exhibits moderate wander characteristics.
Adaptive	Does not require network clock synchronization services.	Supports only unstructured (clear channel) CBR traffic. Exhibits poorest wander characteristics.

Other Network Factors Relevant to CES Operations

The following factors affect the functioning of CES circuits:

- The intended source and destination nodes for CES circuits.
- The clocking mode that best suits your particular network topology and timing requirements for the handling of CBR data.

Although synchronous clocking is the recommended (default) clocking mode for CES operations, this fact does not preclude other clocking modes from consideration.

- The cell delay variation (CDV) characteristics of the network, measured in microseconds.
- Each end-to-end CES circuit exhibits delay characteristics, based on the following factors:
 - The delay characteristics of the individual devices participating in the CES circuit. Each network device contributes some increment of delay, reflecting that device's unique electrical characteristics.

- The number of intermediate hops through which the CBR data must pass in traversing the network from source to destination. The network designer/administrator calculates a CDV value for each hop in the data path in order to establish a maximum allowable CDV value for the network at large.
- The type and speed of the trunk lines interconnecting the ATM networks.
- The volume of traffic being handled by the trunk lines at any given time, that is, the degree to which the network may be experiencing congestion conditions.

Network designers and administrators calculate a maximum allowable CDV value for the network in order to establish network cell delay tolerance limits. Thus, to some degree, the network's maximum allowable CDV value is a measure of the network's expected performance.

When a CDV threshold for the network is established, appropriate buffer sizing can be derived for the network devices involved in any given CES circuit. This helps to ensure that the network will operate as expected.

In the case of an ATM CES port adapter, for example, the maximum allowable CDV value for the network is used to determine an appropriate size (depth) for the segmentation and reassembly (SAR) buffer built into the board. This sizing of the SAR buffer prevents buffer overflow or underflow conditions. An overflow condition can cause a loss of frames, and an underflow condition can cause frames to be repeated.

The actual CDV value for a circuit varies according to the particular data path used for the circuit. Consequently, the depth of the SAR buffer may increase or decrease in proportion to the CDV value for the CES circuit being set up.

You can issue the **show ces circuit interface** command in an unstructured (clear channel) circuit to measure the current CDV value. See Chapter 4, "Configuring the PA-A2 ATM CES Port Adapter," for more information on verifying a configured hard PVC.

For an unstructured hard PVC, the CDV value for the circuit (including all hops) should not exceed a maximum allowable CDV value. The procedure for setting up a hard PVC is described in Chapter 4, "Configuring the PA-A2 ATM CES Port Adapter."

For an unstructured hard PVC, the network automatically determines the best data path through the network and handles the routing of CBR traffic. The network accomplishes this dynamically by means of the ATM connection admission control (CAC) mechanism. The CAC determines the best path through the network by executing a routing algorithm that consults local routing tables in network devices.

If the requested data path is equal to or less than the maximum allowable CDV value established by the network administrator, the connection request is granted. If the requested CES circuit exceeds the maximum allowable CDV value, the connection request is denied. These connection admission control processes occur "on the fly" as network connection requests are initiated.

For example, when a user requests a connection from source node A at one edge of the network to destination node B at the opposite edge of the network, the CAC mechanism takes into account the CDV value for each hop in the requested connection to determine a suitable path through the network that does not exceed the network's maximum allowable CDV value.

PA-A2 ATM CES Port Adapter Overview

The ATM CES port adapter is a dual-wide module. It has four T1 (1.544 Mbps) or four E1 (2.048 Mbps) 120-ohm constant bit rate (CBR) ports that can support both structured (N x 64 kbps) and unstructured ATM Forum-compliant circuit emulation services (CES), and a single port of an OC-3 (155 Mbps) single-mode intermediate reach or a T3 (45 Mbps) or E3 (34 Mbps) standards-based ATM interface. (See Figure 1-9 and Figure 1-10 for examples of each version.)

The ATM CES port adapter can be used only on a Cisco 7200 series router or a Cisco uBR7200 series that has a 150-MHz network processing engine (NPE-150).

The target application of the ATM CES port adapter is access to a broadband public or private ATM network where multiservice consolidation of voice, video, and data traffic over a single ATM link is a requirement.

Table 1-2 lists the different types of ATM CES port adapters and their associated part numbers.

Table 1-2 PA-A2 ATM CES Port Adapter Types and Part Numbers

ATM-CES Type	Part Number
4 T1 CBR ports and 1 OC-3 ATM SM ¹ port	PA-A2-4T1C-OC3SM(=)
4 T1 CBR ports and 1 T3 ATM port	PA-A2-4T1C-T3ATM(=)
4 E1 120-ohm CBR ports and 1 OC-3 ATM SM port	PA-A2 4E1XC-OC3SM(=)
4 E1 120-ohm CBR ports and 1 E3 ATM port	PA-A2-4E1XC-E3ATM(=)

1. SM = single mode

Figure 1-9 PA-A2 ATM CES Port Adapter—PA-A2-4T1C-OC3SM(=) or PA-A2 4E1XC-OC3SM(=)

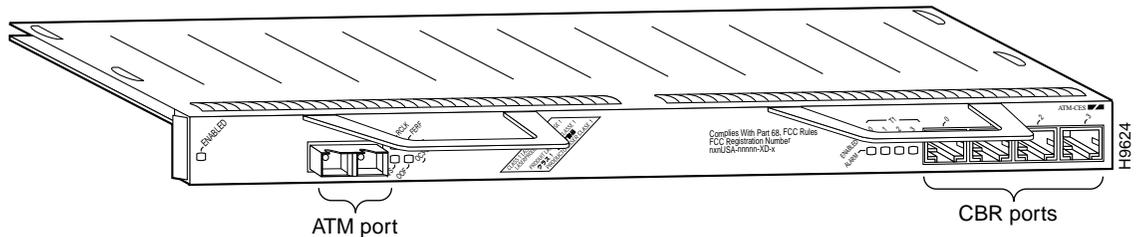
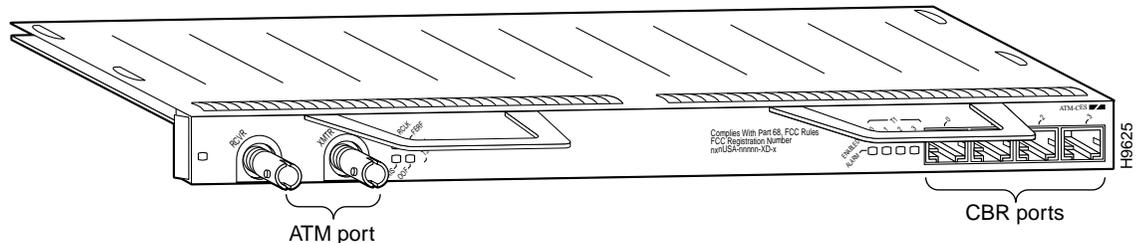


Figure 1-10 PA-A2 ATM CES Port Adapter—PA-A2-4T1C-T3ATM(=) or PA-A2 4E1XC-E3ATM(=)



You can install a PA-A2 ATM CES port adapter in any available, horizontally aligned, port of port adapter slots in a Cisco 7200 series router or a Cisco uBR7246.

In previous versions of PPP over ATM, you configure permanent virtual circuits (PVCs) for PPP over ATM on point-to-point subinterfaces. In the current Cisco IOS releases (see the “Minimum Software and Hardware Requirements” section on page 2-1), each PPP over ATM connection no longer requires two Internet Data Blocks (IDBs), one for virtual access interfaces, and one for ATM subinterfaces. Instead, you can configure multiple PVCs for PPP over ATM on multipoint subinterfaces.

The new version of PPP over ATM also complies with the Internet Engineering Task Force (IETF) draft on multiplexed encapsulation. The previous version of PPP over ATM supported Cisco's Frame Forwarding data encapsulation (aal5ciscopp). In the current Cisco IOS software releases (see the “Minimum Software and Hardware Requirements” section on page 2-1), PPP over ATM is enhanced to support virtual circuit (VC) multiplexed PPP payloads as specified by the PPP over AAL5 Internet Draft (12/23/97). Therefore, the name for this new PPP over ATM feature is more accurately IETF PPP over ATM.


Note

The IETF PPP over ATM feature does not currently support LLC encapsulated PPP over ATM Adaption Layer 5 (AAL5).

Features

The PA-A2 ATM CES port adapter has the following features:

- Cross-connect Circuit Emulation Services (CES)—Structured and unstructured
- Four-port T1 or E1 (120-ohm) constant bit rate (CBR) for CES
- Network timing distribution
- On/off hook Channel Associated Signaling (CAS)
- Segmentation and reassembly (SAR) of up to 512 buffers simultaneously, where each buffer represents a transmit channel
- Up to 2046 virtual circuits (VCs) and 124 CBR VCs
- ATM adaptation layer (AAL) 5
- Single-port SONET/SDH OC-3 single-mode intermediate reach ATM uplink
- Single-port DS3 ATM WAN uplink over T3/E3
- Traffic shaping (per VP and VC)
- ABR, CBR, VBR, and UBR Quality of Service (QoS)
- Operation, Administration, and Maintenance (OAM) cells
- Online insertion and removal (OIR)

In addition, the ATM CES port adapters now support the following additional features:

- New VC configuration
- VC integrity management
- PVC discovery
- Multiprotocol inverse ARP
- PPP over ATM

LEDs

The PA-A2 ATM CES port adapter has 13 LEDs that indicate the status of the port adapter, the status of the uplink ports, and the status of the CBR ports. (See Figure 1-11 and Figure 1-12.)

Figure 1-11 LEDs on the PA-A2 ATM CES Port Adapter—OC-3 Single Mode

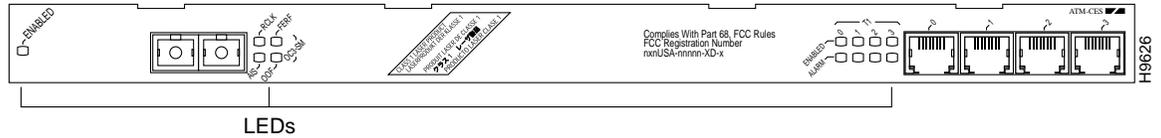
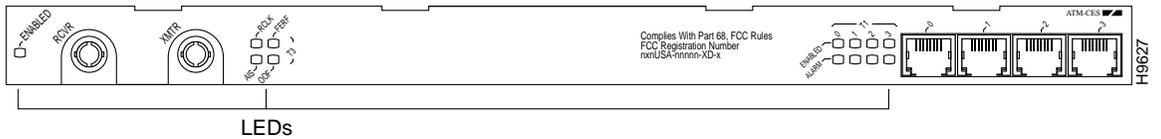


Figure 1-12 LEDs on the PA-A2 ATM CES Port Adapter—T3/E3



After system initialization, the enabled LED goes on to indicate that the PA-A2 ATM CES port adapter has been enabled for operation.

The following conditions must be met before the PA-A2 ATM CES port adapter is enabled:

- The PA-A2 ATM CES port adapter is correctly connected and is receiving power.
- A valid system software image for the PA-A2 ATM CES port adapter has been downloaded successfully.
- The system recognizes the installed PA-A2 ATM CES port adapter.

If any of the above conditions are not met, or if the initialization fails for other reasons, the enabled LED does not go on.

Table 1-3 describes the LED that indicates port adapter status.

Table 1-3 Port Adapter Status LEDs

LED Label	Color	State	Description
ENABLED	Green	On	PA-A2 ATM CES port adapter is enabled for operation.

Table 1-4 describes the LEDs that indicated uplink port status.

Table 1-4 Uplink Port Status LEDs

LED Label	Color	State	Description
RCLK	Green	On	Indicates that a receive clock was detected.
FERF	Yellow	On	Indicates that Framers detected Far End Receive Failure.

Table 1-4 Uplink Port Status LEDs

OOF	Yellow	On	Indicates that Frammer detected Out of Frame.
AIS	Yellow	On	Indicates that Frammer detected Alarm Indication Signal.

Table 1-5 describes the LEDs that indicated CBR port status. There are four Enabled and four Alarm LEDs, one for each port.

Table 1-5 CBR Port Status LEDs

Enabled LED State	Alarm LED State	Decription
Off	Off	Indicates that the port is administratively down.
Off	On (yellow)	Indicates that the port is in loop mode.
On (green)	Off	Indicates that the port is enabled (normal state).
On (green)	Blinking (yellow)	Indicates an integrtng state, an idle state, a yellow or a blue alarm.
On (green)	On (yellow)	Indicates a red alarm condition.

PA-A2 ATM CES Cables, Connectors, and Pinouts

Cables on the ATM CES port adapter fall into two categories described in the following sections:

- ATM Port Cables, page 1-18
- CBR Port Cables, page 1-19

ATM CES port adapter interfaces are full-duplex. You must use the appropriate ATM interface cable and CBR cable to connect the ATM CES port adapter with an external ATM network. The ATM CES port adapters, shown in Figure 1-9 and Figure 1-10, provides an interface to ATM switching fabrics for transmitting and receiving data at rates of up to 155 Mbps bidirectionally for OC-3, 44.736 Mbps bidirectionally for DS3 over T3, and 34 Mbps bidirectionally for E3.

ATM Port Cables

Two types of cables are available for use with the ATM CES port adapter's OC-3 and T3/E3 ATM ports:

- An OC-3 single-mode ATM interface cable, which is used to connect a router to an external DSU (an ATM network)
- A T3/E3 75-ohm coaxial interface cable, which is used to connect a router to an external DSU (an ATM network)

Both ATM cables conform to the EIA/TIA-612 and EIA/TIA-613 specifications. The ATM port on the ATM CES port adapter is a DTE device.

For OC-3 single-mode, the ATM CES port adapter connects to the SONET/SDH 155-Mbps single-mode optical fiber physical layer, either STS-3C or STM-1. The connection is made by means of single-mode OC-3 ATM cables with SC connectors (see Figure 1-13). The SONET single-mode SC connector is shipped with removable dust covers on each SC connector. Keep covers on any connectors that are not being used.

For SONET/STC-3C single-mode connections, use one duplex SC connector (see Figure 1-13) or two single SC connectors (see Figure 1-14).

Figure 1-13 Duplex SC Connector

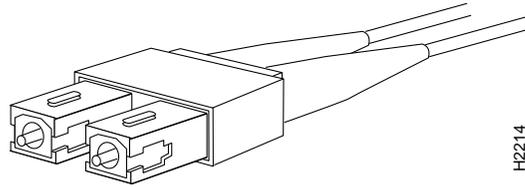
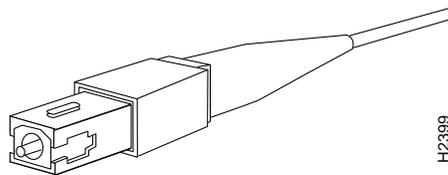
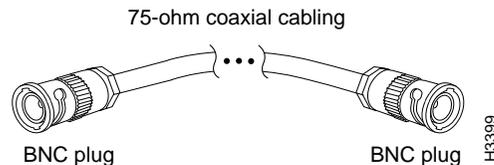


Figure 1-14 Simplex SC Connector



For T3/E3 connections, use a 75-ohm coaxial interface cable (see Figure 1-15). The T3/E3 75-ohm coaxial cable is available from Cisco in five different lengths: 10, 25, 50, 75, and 100 feet. They are *not* available from outside commercial vendors. The typical maximum distance between stations for T3 transmissions is 450 feet (135 meters) and for E3 transmissions is 1300 feet (390 meters).

Figure 1-15 T3/E3 75-Ohm Coaxial Cable and Connector



Note

For connections in Australia, interconnecting cables shall comply with TS 016, clause 5.5.5.2: “The maximum interconnecting cable insertion loss shall not exceed 12 dB measured at 17,184 kHz. This attenuation should take into account any losses incurred by the presence of a digital distribution frame between equipment.”

The T3/E3 line interface performs physical layer translation from the ATM CES port adapter to the T3/E3 line interface in accordance with ATM Forum UNI specification Version 3.1, ACCUNET T45 service specifications, and ANSI T1E1.107.

CBR Port Cables

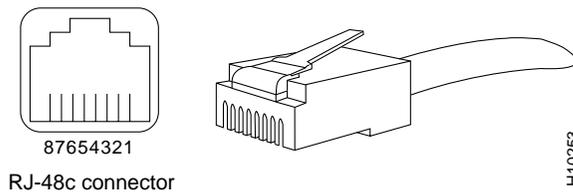
The four CBR interface receptacles on the ATM CES port adapter are RJ-48C for T1 and E1 (120 ohm). Each connection supports T1 or E1 (120-ohm) interfaces that meet T1E1.403 and ACCUNET TR62411 standards. The RJ-48C connection does not require an external transceiver. The CBR ports are T1

interfaces that use UTP, 100-ohm twisted pair cables and E1 interfaces that use UTP, 120-ohm twisted pair cables (see Figure 1-16). The typical maximum distance between stations for T1 and E1 transmissions is 1000 feet (300 meters).

**Note**

For RJ-48C T1 and E1 (120-ohm) connections in the U.S. and Canada, you can use UTP cables to meet FCC Part 15 Class A EMI requirements. For RJ-48C T1 and E1 (120-ohm) connections in Japan and other countries, you can use STP cables to meet VCCI Class II EMI requirements.

Figure 1-16 CBR 120-Ohm RJ-48C Interface Cable and Connector



ATM Management Information Base Specifications

The ATM UNI specification defines the required management information base (MIB) functionality for ATM interfaces. MIB attributes are readable and writable across the Interim Local Management Interface (ILMI) through use of the Simple Network Management Protocol (SNMP). The ILMI uses SNMP, without UDP, and Internet Protocol (IP) addressing along with the ATM MIB.

The ATM CES port adapter supports RFC 1213, RFC 1406, RFC 1407, and SONET MIB RFC 1595 interface MIBs. Refer to the ATM UNI specification for additional details on the MIBs.

Fibre-Optic Transmission Specifications

The following sections describe the SONET specifications for fiber-optic transmissions, define the power budget, and help you approximate the power margin for single-mode transmissions:

- Maximum Transmission Distances for SONET, page 1-20
- Power Budget, page 1-21

Maximum Transmission Distances for SONET

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, while 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, they arrive at the destination at different times (a phenomenon called modal dispersion). The typical maximum distance between stations, as defined by SONET, for single-mode transmissions is up to 9 miles (15 kilometers). The ATM CES port adapter uses single-mode fiber, which is capable of higher bandwidth and greater cable run distances than multimode fiber.

Use the power budget calculations in the following section to determine actual distances. If the distance between two connected stations is greater than this maximum distance, significant signal loss can result, making transmission unreliable.

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 single-mode transmission.

The following variables reduce the power of the signal (light) transmitted to the receiver in single-mode 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 fiber-optic transmission, chromatic and modal dispersion reduce the available power of the system by the combined dispersion penalty (measured in decibels). The power lost over the data link is the sum of the component, dispersion, and modal losses. However, at OC-3 speeds on single-mode fiber, dispersion and modal losses are minimal.

The following sections offer more detail on power budgeting:

- Approximating the ATM CES Port Adapter Power Margin, page 1-21
- Using Statistics to Estimate the Power Budget, page 1-23
- For Further Reference, page 1-23

Approximating the ATM CES Port Adapter Power Margin

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 maximum overload specification on the single-mode receiver is -8 dBm. The single-mode receiver can be overloaded when you are using short lengths of fiber, because the transmitter can transmit up to -8 dB, but no damage to the receiver will result from an overload.



Note

If you are connecting to a non-Cisco single-mode SONET receiver or transmitter, insert a 5- to 10-dB attenuator on the link to prevent overloading the receiver that connects short fiber links.

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 single-mode 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 following equation lists the calculation of the power budget:

$$PB = PT - PR$$

The SONET specification requires that the signal meet the worst case parameters listed in Table 1-6.

Table 1-6 PA-A2 ATM CES Port Adapter SONET Signal Requirements

Value	Single-Mode Signal
PT	-15 dBm
PR	-31 dBm
PB	-16 dBm

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

Length of single-mode link = 8 km

12 connectors

The power margin is equal to the PB value minus the link loss:

$$PM = PB - LL$$

$$PM = 16 \text{ dB} - 8 \text{ km} (0.5 \text{ dB/km}) - 12 (0.5 \text{ dB})$$

$$PM = 16 \text{ dB} - 4 \text{ dB} - 6 \text{ dB}$$

$$PM = 6 \text{ dB}$$

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

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

Table 1-7 lists the factors that contribute to link loss and the estimate of the link loss value attributable to each factor.

Table 1-7 Typical 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 fibre and wavelength used
Connector	0.5 dB
Splice	0.5 dB
Fibre attenuation	1 dB/km

The power margin (calculated above) should be greater than zero. Circuits whose results are less than zero may have insufficient power to operate the receiver.

Using Statistics to Estimate the Power Budget

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

For Further Reference

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*

Setting ATM CES Port Adapter Jumpers

Depending on the circumstances, you might need to change the configuration of the ATM CES port adapter's receive interface from ungrounded to grounded. (The ATM CES port adapter is configured in manufacturing for ungrounded at the receive interface.) The following steps explain how to set the configuration for grounded or ungrounded:

-
- Step 1** Attach an ESD-preventive wrist strap to yourself and to an unfinished chassis surface.
 - Step 2** Remove the PA-A2 ATM CES port adapter from the chassis. To do so, follow the steps in the "Port Adapter Removal and Installation" section on page 3-6.
 - Step 3** With the PA-A2 ATM CES port adapter on an antistatic mat, use a number 1 Phillips screwdriver to remove the three screws that secure the plastic shield to the ATM CES port adapter's printed circuit board. (See Figure 1-17.) Save the screws.
 - Step 4** Set the jumper on the PA-A2 ATM CES port adapter to grounded (covered pins) or ungrounded (uncovered pins). This jumper is at location E1 on the port adapter's circuit board. See Figure 1-18.



Note The PA-A2 ATM CES port adapter is configured in manufacturing for ungrounded (uncovered pins) at the receive interface.

- Step 5** Replace the plastic shield over the PA-A2 ATM CES port adapter's jumper and secure the shield to the port adapter's printed circuit board using a number 1 Phillips screwdriver and the three screws that you saved.
 - Step 6** Replace the PA-A2 ATM CES port adapter in the chassis. To do so, follow the instructions in the "Port Adapter Removal and Installation" section on page 3-6.
-

Figure 1-17 Removing the Plastic Shield

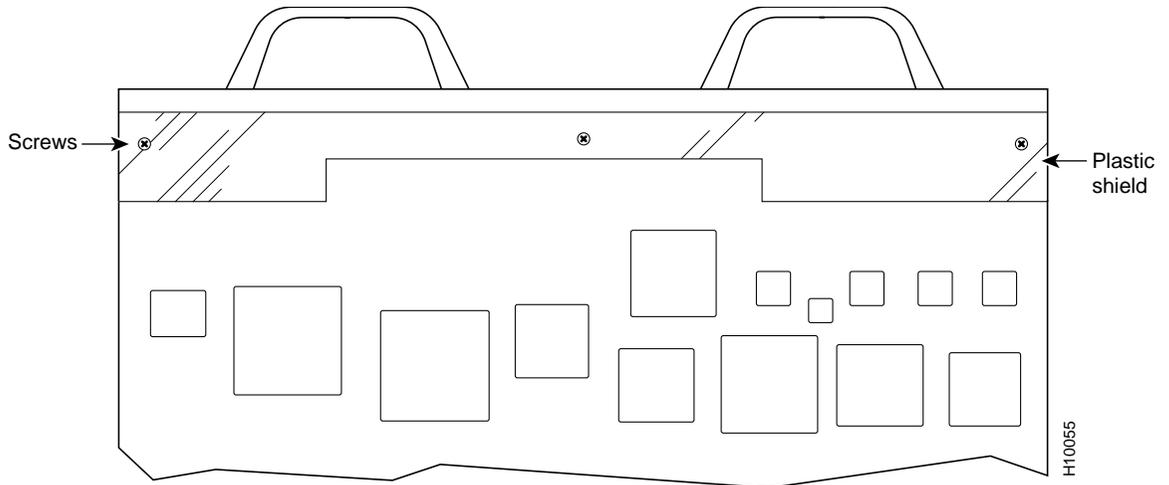
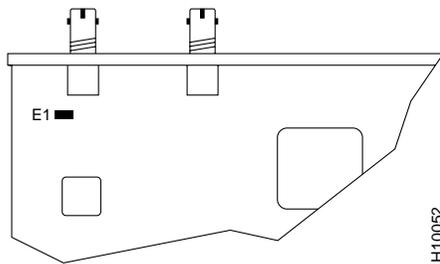


Figure 1-18 Location of Jumper on PA-A2-4E1XC-E3ATM



PA-A2 ATM CES Port Adapter Slot Locations on the Supported Platforms

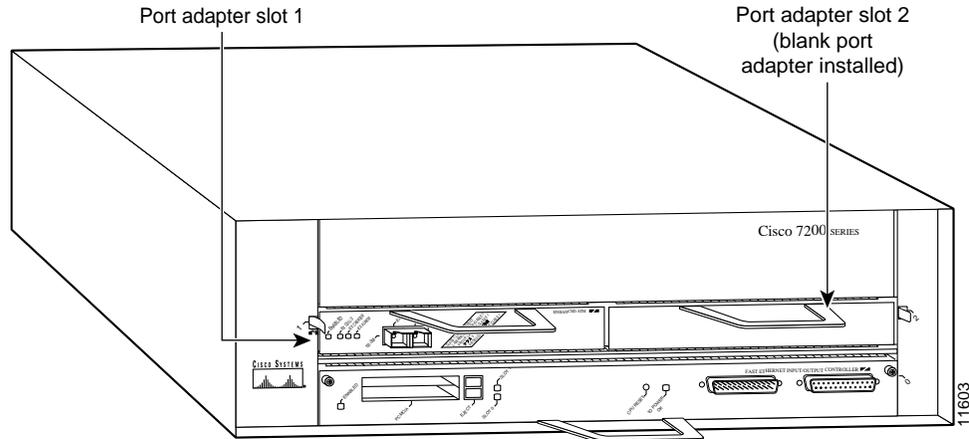
This section discusses the module slot locations on the supported platforms. The illustrations that follow summarize slot location conventions on each platform:

- Cisco 7200 Series Routers and Cisco uBR7200 Series Routers Slot Numbering, page 1-25

Cisco 7200 Series Routers and Cisco uBR7200 Series Routers Slot Numbering

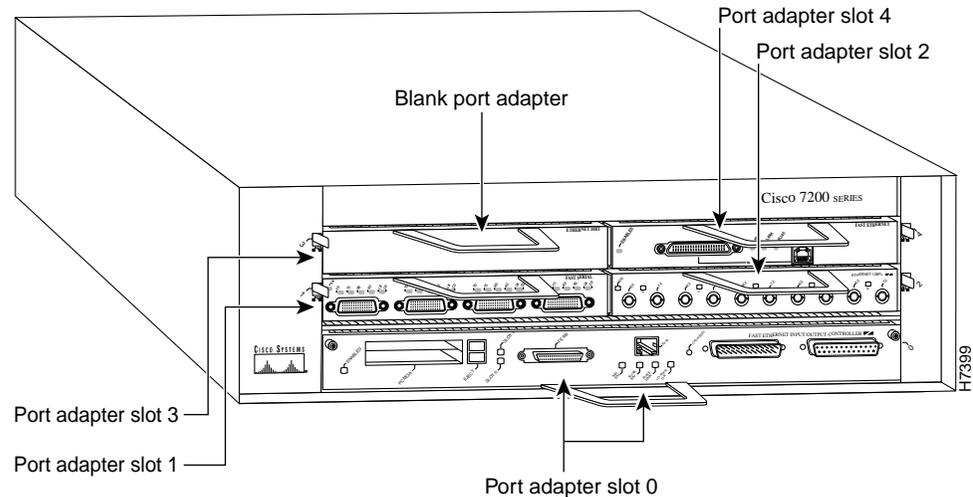
Slots in the Cisco 7202 router are numbered from left to right, slot 1 and slot 2. (See Figure 1-19.)

Figure 1-19 Module Slots in the Cisco 7202



Slots in the Cisco 7204 router are numbered from left to right, beginning with slot 1 and continuing through slot 4. Slot 0 is the Fast Ethernet port on the I/O controller. (See Figure 1-20.)

Figure 1-20 Module Slots in the Cisco 7204



Slots in the Cisco 7206 are numbered from 1 through 6; slot 0 is reserved for the optional Fast Ethernet port on the I/O controller—if present. (See Figure 1-21.)

Figure 1-21 Module Slots in the Cisco 7206

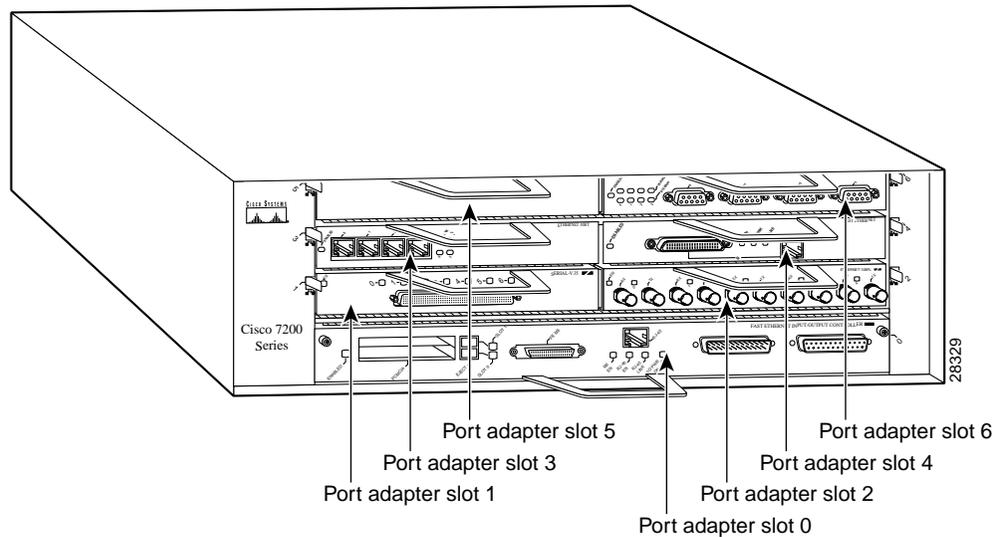
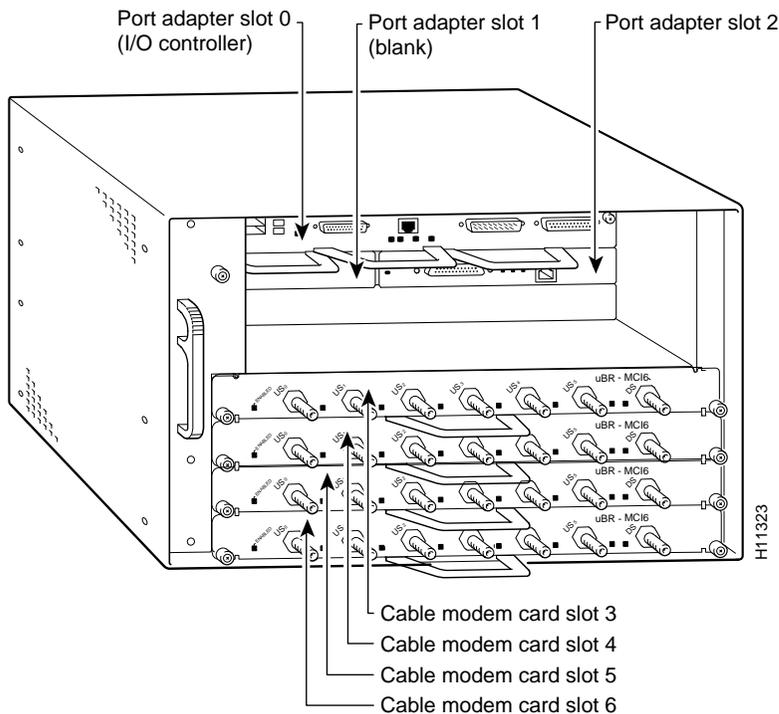


Figure 1-22 shows the slot numbering of modules installed on a Cisco uBR7246 router. The slots are numbered slot 1 and slot 2 for the Cisco uBR7246 and slot 1 for the Cisco uBR7223. (Slot 0 is always reserved for the Fast Ethernet port on the I/O controller—if present.)

Figure 1-22 Module Slots in the Cisco uBR7246



Identifying Interface Addresses

This section describes how to identify the interface addresses for modules in supported platforms. Interface addresses specify the actual physical location of each interface on a router or switch.

Interfaces on the module installed in a router maintain the same address regardless of whether other modules are installed or removed. However, when you move a module to a different slot, the first number in the interface address changes to reflect the new module slot number.



Note

Interface ports are numbered from left to right starting with 0.

The following subsections describe the interface address formats for specific platforms:

- Interface Addresses of Cisco 7200 Series Routers and Cisco uBR7200 Series Routers, page 1-27

Interface Addresses of Cisco 7200 Series Routers and Cisco uBR7200 Series Routers

The interface address for a module installed in Cisco 7200 series routers or uBR7200 series routers is composed of a two-part number in the format *slot/port-number*.

In Cisco 7200 series routers, slots are numbered from the lower left to the upper right, beginning with slot 1 and continuing through slot 2 for the Cisco 7202, slot 4 for the Cisco 7204, and slot 6 for the Cisco 7206. (Slot 0 is reserved for the optional Fast Ethernet port on the I/O controller—if present.)

The interface addresses of a 4-port module installed in slot 1 would be 1/0 through 1/4 (slot 1 and interface port 0 through port 4). If the 4-port module was installed in slot 4, these same interfaces would be numbered 4/0 through 4/4 (slot 4 and interface port 0 through port 4).

In Cisco uBR7200 series routers, slots are numbered slot 1 and slot 2 for the Cisco uBR7246. (Slot 0 is always reserved for the Fast Ethernet port on the I/O controller—if present.) The individual interfaces always begin with 0. The number of additional interfaces depends on the number of interface ports on a module.

The interface addresses of a module installed in slot 2 would be 2/0 and 2/1 (slot 2 and interface ports 0 and 1). If a module is installed in slot 1, these same interface addresses would be 1/0 and 1/1 (slot 1 and interface ports 0 and 1).



Preparing to Install the PA-A2 ATM CES Port Adapter

This chapter describes the general equipment, safety, and site preparation requirements for installing modules. This chapter contains the following sections:

- Required Tools and Equipment, page 2-1
- Minimum Software and Hardware Requirements, page 2-1
- Checking Hardware and Software Compatibility, page 2-2
- Safety Guidelines, page 2-2
- Laser/LED Safety, page 2-5
- FCC Class A Compliance, page 2-6
- BABT Compliance, page 2-7
- CE Compliance, page 2-7

Required Tools and Equipment

You need the following tools and parts to install modules. If you need additional equipment, contact a service representative for ordering information.

- PA-A2 ATM CES port adapter to be installed
- Specific cables for your module
- Number 1 Phillips and a 3/16-inch flat-blade screwdriver
- Number 2 Phillips screwdriver
- Your own electrostatic discharge (ESD)-prevention equipment or the disposable grounding wrist strap included with all upgrade kits, field-replaceable units (FRUs), and spares
- Antistatic mat
- Antistatic container

Minimum Software and Hardware Requirements

Table 2-1 lists the minimum Cisco IOS software release required to use the PA-A2 ATM CES port adapter in supported router platforms.

Table 2-1 PA-A2 ATM CES Port Adapter Software Requirements

Router Platform	Recommended Minimum Cisco IOS Release
Cisco 7200 series routers	
<ul style="list-style-type: none"> Cisco 7204VXR and Cisco 7206VXR 	Cisco IOS Release 12.0(2)XE2 or a later release of Cisco IOS Release 12.0 XE Cisco IOS Release 12.0(3)T or a later release of Cisco IOS Release 12.0T
<ul style="list-style-type: none"> Cisco 7202, Cisco 7204, and Cisco 7206 	Cisco IOS Release 11.1(14)CA or a later release of Cisco IOS Release 11.1 CC Cisco IOS Release 11.3(4)AA or a later release of Cisco IOS Release 11.3 AA
Cisco uBR7200 series routers	
Cisco uBR7246	Cisco IOS Release 12.0(3)T or a later release of Cisco IOS Release 12.0 T

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 statement.



Warning

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

Waarschuwing

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

Varoitus

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

Attention

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

Warnung

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

Avvertenza

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

Advarsel

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

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

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

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

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 when potentially hazardous conditions exist.
- Never assume that power has been disconnected from a circuit; always check.
- Do not perform any action that creates a potential hazard to people or makes the equipment unsafe; carefully examine your work area for possible hazards such as moist floors, ungrounded power extension cables, and missing safety grounds.

Telephone Wiring Guidelines

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

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

Preventing Electrostatic Discharge Damage

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

Following are guidelines for preventing ESD damage:

- Always use an ESD wrist or ankle strap and ensure that it makes good skin contact.
- Connect the equipment end of the strap to an unfinished chassis surface.
- When installing a component, use any available ejector levers or captive installation screws to properly seat the bus connectors in the backplane or midplane. These devices prevent accidental removal, provide proper grounding for the system, and help to ensure that bus connectors are properly seated.
- When removing a component, use any available ejector levers or captive installation screws to release the bus connectors from the backplane or midplane.
- Handle carriers by available handles or edges only; avoid touching the printed circuit boards or connectors.
- Place a removed board component-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/LED Safety

The single-mode transmitter in the module uses a small laser to transmit the light signal to the network ring. Keep the transmit port covered whenever a cable is not connected to it. Although multimode transceivers typically use LEDs for transmission, it is good practice to keep open ports covered and avoid staring into open ports or apertures. The single-mode aperture port contains a laser warning label, as shown in Figure 2-1.

Figure 2-1 Laser Warning Labels for Single-Mode Port





Warning

Invisible laser radiation may be emitted from the aperture ports of the single-mode products when no fiber cable is connected. *Avoid exposure and do not stare into open apertures.*



Warning

Class 1 laser product.

The multimode aperture contains a Class 1 LED warning label, as shown in Figure 2-2.

Figure 2-2 Class 1 LED Warning Label for Multimode Port



Warning

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



Warning

Class 1 LED product.

FCC Class A Compliance

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

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

- Turn the television or radio antenna until the interference stops.
- Move the equipment to one side or the other of the television or radio.
- Move the equipment farther away from the television or radio.
- Plug the equipment into an outlet that is on a different circuit from the television or radio. (That is, make certain the equipment and the television or radio are on circuits controlled by different circuit breakers or fuses.)



Warning

This product 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.

BABT Compliance

The BABT607116 marking on the module signifies that it meets United Kingdom directive 607116 and has been designed to BABT standards. The BABT label is located on the top of the module; Figure 2-3 shows the BABT label for the module.

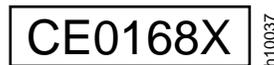
Figure 2-3 BABT Label



CE Compliance

The CE0168 marking on the ATM CES port adapter signifies that the port adapter's 120-ohm E1 ports meet United Kingdom directive 0168 and has been designed to CE standards, which complies with the CTR12 and TBR13 specifications. The CE label is located on the top of the ATM CES port adapter; Figure 2-4 shows the CE label for the 120-ohm E1 ports of the ATM CES port adapter.

Figure 2-4 CE Label for PA-A2 ATM CES Port Adapter 120-Ohm Ports



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



Removing and Installing the PA-A2 ATM CES Port Adatper

This chapter describes how to remove PA-A2 ATM CES port adapters from supported platforms and also how to install new or replacement modules. This chapter contains the following sections:

- Handling Port Adapters, page 3-1
- Online Insertion and Removal, page 3-2
- Warnings and Cautions, page 3-3
- Port Adapter Slot Divider, page 3-3
- Port Adapter Removal and Installation, page 3-6

Each PA-A2 ATM CES port adapter circuit board is mounted to a metal carrier and is sensitive to electrostatic discharge (ESD) damage. Before you begin installation, read Chapter 2, “Preparing to Install the <XXXXXX Module>,” for a list of parts and tools required for installation.



Note

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



Caution

When powering off the router, wait a minimum of 30 seconds before powering it on again.

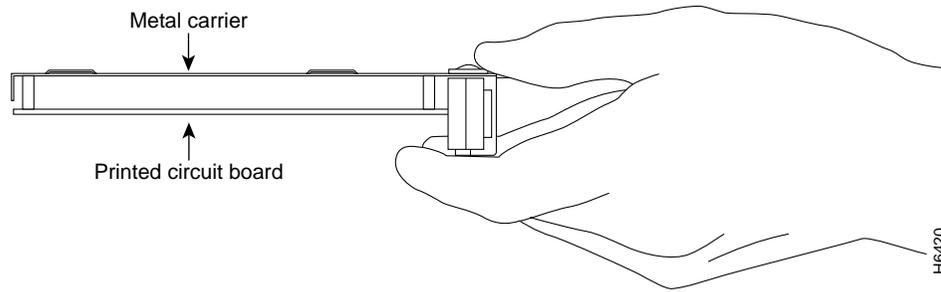
Handling Port Adapters



Warning

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

Figure 3-1 Handling a Port Adapter



Online Insertion and Removal

The Cisco 7200 series routers, Cisco 7200 VXR router, and Cisco uBR7246 router support the OIR of all module types. Therefore, you do not have to power down routers when removing and replacing modules in these chassis.

It is wise to gracefully shut down the system before removing a port adapter that has active traffic moving through it. Removing a module while traffic is flowing through the ports can cause system disruption. Once the module is inserted, the ports can be brought back up.



Note

As you disengage the module from the router or switch, online insertion and removal (OIR) administratively shuts down all active interfaces in the module.

OIR allows you to install and replace modules while the router is operating; you do not need to notify the software or shut down the system power, although you should not run traffic through the module you are removing while it is being removed. OIR is a method that is seamless to end users on the network, maintains all routing information, and preserves sessions.

The following is a functional description of OIR for background information only; for specific procedures for installing and replacing a module in a supported platform, refer to the “Port Adapter Removal and Installation” section on page 3-6.

Each module has a bus connector that connects it to the router. The connector has a set of tiered pins in three lengths that send specific signals to the system as they make contact with the module. The system assesses the signals it receives and the order in which it receives them to determine if a module is being removed from or introduced to the system. From these signals, the system determines whether to reinitialize a new interface or to shut down a disconnected interface.

Specifically, when you insert a module, the longest pins make contact with the module first, and the shortest pins make contact last. The system recognizes the signals and the sequence in which it receives them.

When you remove or insert a module, the pins send signals to notify the system of changes. The router then performs the following procedure:

1. Rapidly scans the system for configuration changes.
2. Initializes newly inserted port adapters or administratively shuts down any vacant interfaces.
3. Brings all previously configured interfaces on the module back to their previously installed state. Any newly inserted interface is put in the administratively shutdown state, as if it was present (but not configured) at boot time. If a similar module type is reinserted into a slot, its ports are configured and brought online up to the port count of the originally installed module of that type.

Warnings and Cautions

Observe the following warnings and cautions when installing or removing modules:

- Do not slide a module all the way into the slot until you have connected all required cables. Trying to do so disrupts normal operation of the router or switch.
- If a module lever or other retaining mechanism does not move to the locked position, the module is not completely seated in the midplane. Carefully pull the module halfway out of the slot, reinsert it, and move the module lever or other mechanism to the locked position.
- To prevent jamming the carrier between the upper and the lower edges of the module slot, and to ensure that the edge connector at the rear of the module mates with the connection at the rear of the module slot, make certain that the carrier is positioned correctly, as shown in the cutaway in the following illustrations.



Warning

When performing the following procedures, wear a grounding wrist strap to avoid ESD damage to the card. Some platforms have an ESD connector for attaching the wrist strap. Do not directly touch the midplane or backplane with your hand or any metal tool, or you could shock yourself.

Port Adapter Slot Divider

If you are replacing two single-width modules with a dual-width module, you first need to remove the slot divider. The following sections describe how to remove the slot divider:

- Cisco 7200 Series Routers—Removing the Slot Divider, page 3-4
- Cisco uBR7200 Series Routers—Removing the Slot Divider, page 3-5

Cisco 7200 Series Routers—Removing the Slot Divider

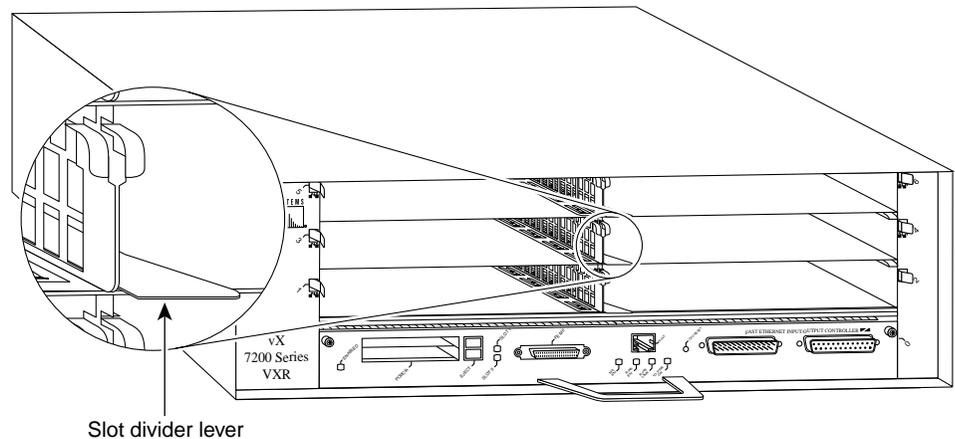
To install a dual-width module in Cisco 7200 series routers or in Cisco 7200 VXR routers that have two single-width modules installed, first remove the slot divider. Follow this procedure:

Step 1

Remove installed single-width port adapters from the slots on both sides of the port adapter slot divider.

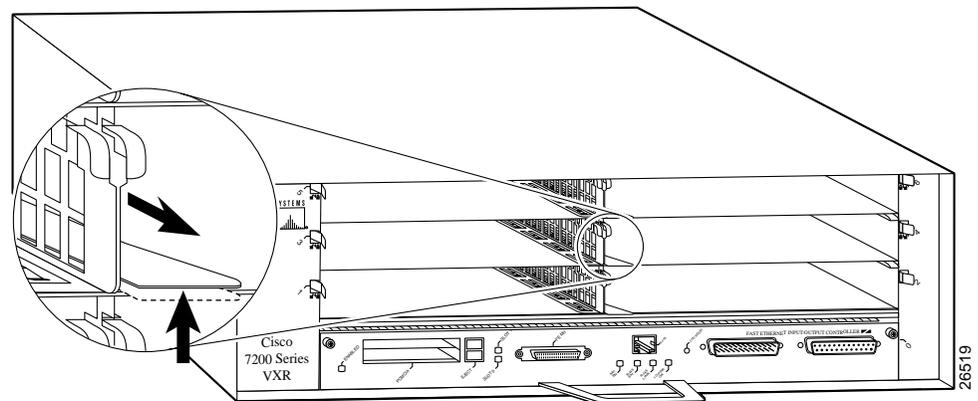
Step 2

With one hand, raise the slot divider lever to unlock the slot divider from the chassis.



Step 3

With the slot divider lever still raised, use your other hand to pull the slot divider from the chassis.



Step 4

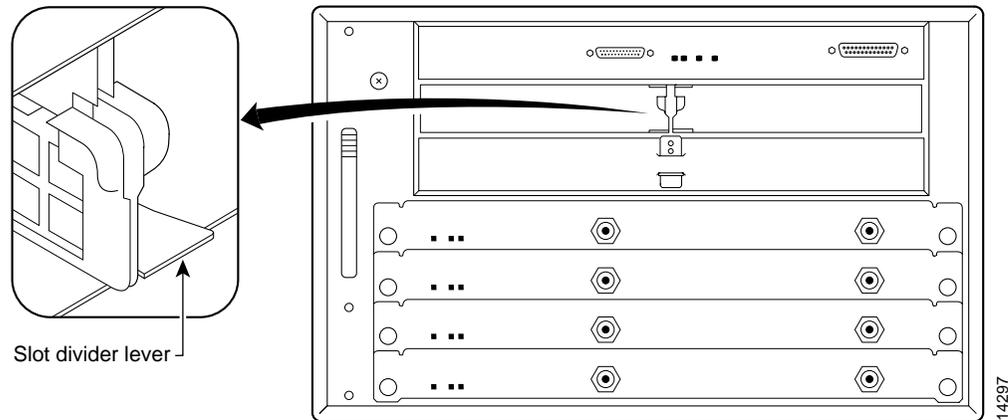
Store the slot divider in a location where you can retrieve it for use later.

Cisco uBR7200 Series Routers—Removing the Slot Divider

If you are installing a dual-width module in a Cisco uBR7200 router that has two single-width modules installed, you must first remove the slot divider that is located between the two slots. Follow this procedure:

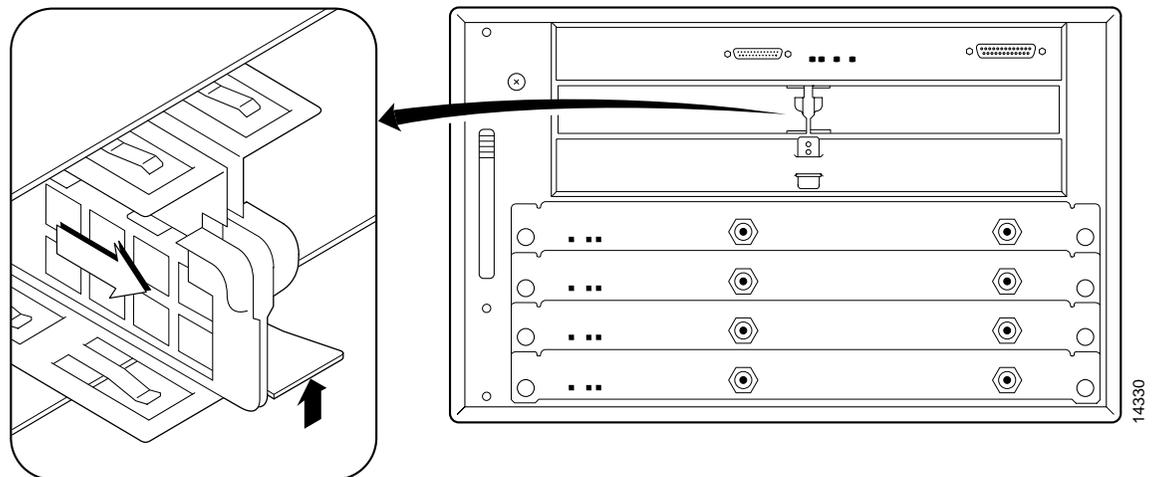
- Step 1** Remove installed single-width port adapters from the slots on both sides of the port adapter slot divider.
- Step 2** With one hand, raise the slot divider lever to unlock the slot divider from the chassis. (See Figure 3-2.)

Figure 3-2 Slot Divider Lever—Cisco uBR7246 Shown



- Step 3** With the slot divider lever still raised, use your other hand to pull the slot divider from the chassis. (See Figure 3-3.)

Figure 3-3 Removing the Slot Divider from the Chassis—Cisco uBR7246 Shown



- Step 4** Store the slot divider in a location where you can retrieve it for use later.

Port Adapter Removal and Installation

In this section, the illustrations that follow give step-by-step instructions on how to remove and install modules. Although the procedures may refer to a particular type of module, the steps are the same for installing and removing all types of modules. This section contains the following illustrations:

- Cisco 7200 Series Routers and Cisco 7200 VXR Routers—Removing and Installing a Module, page 3-7
- Cisco uBR7200 Series Routers—Removing a Module, page 3-8
- Cisco uBR7200 Series Routers—Installing a Module, page 3-9

Cisco 7200 Series Routers and Cisco 7200 VXR Routers—Removing and Installing a Module

Step 1

To remove the port adapter, place the port adapter lever in the unlocked position. (See A.) The port adapter lever remains in the unlocked position.

Step 2

Grasp the handle of the port adapter and pull the port adapter from the router, about halfway out of its slot. If you are removing a blank port adapter, pull the blank port adapter completely out of the chassis slot.

Step 3

With the port adapter halfway out of the slot, disconnect all cables from the port adapter. After disconnecting the cables, pull the port adapter from its chassis slot.

Step 4

To insert the port adapter, carefully align the port adapter carrier between the upper and the lower edges of the port adapter slot. (See B.)

Step 5

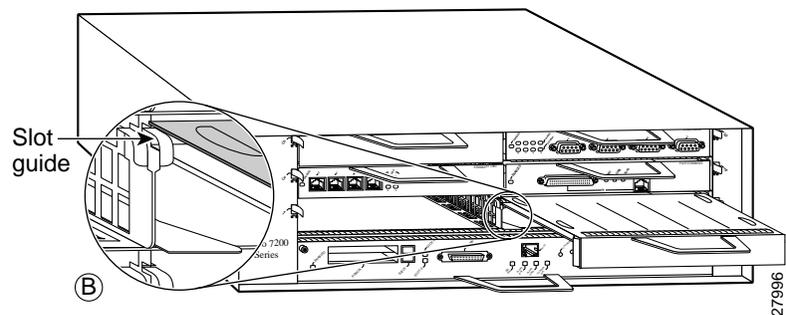
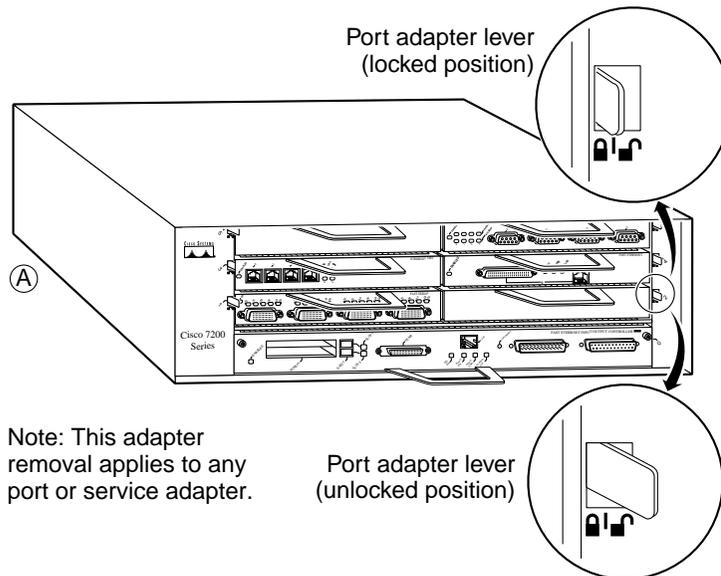
Carefully slide the new port adapter halfway into the port adapter slot. (See B.)

Step 6

With the port adapter halfway into the slot, connect all required cables to the port adapter. After connecting all required cables, carefully slide the port adapter all the way into the slot until the port adapter is seated in the router midplane.

Step 7

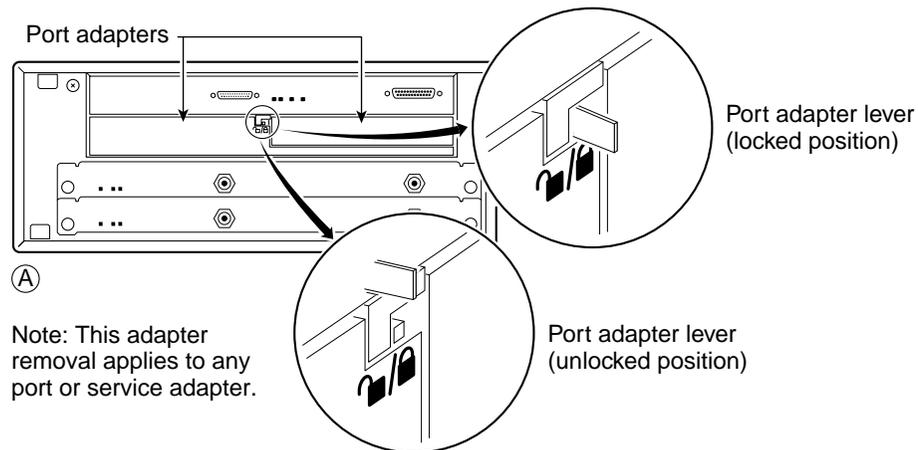
After the port adapter is properly seated, lock the port adapter lever. (See A.)



Cisco uBR7200 Series Routers—Removing a Module

Step 1

To remove the port adapter, unlock the port adapter retaining mechanism. The port adapter lever remains in the unlocked position.

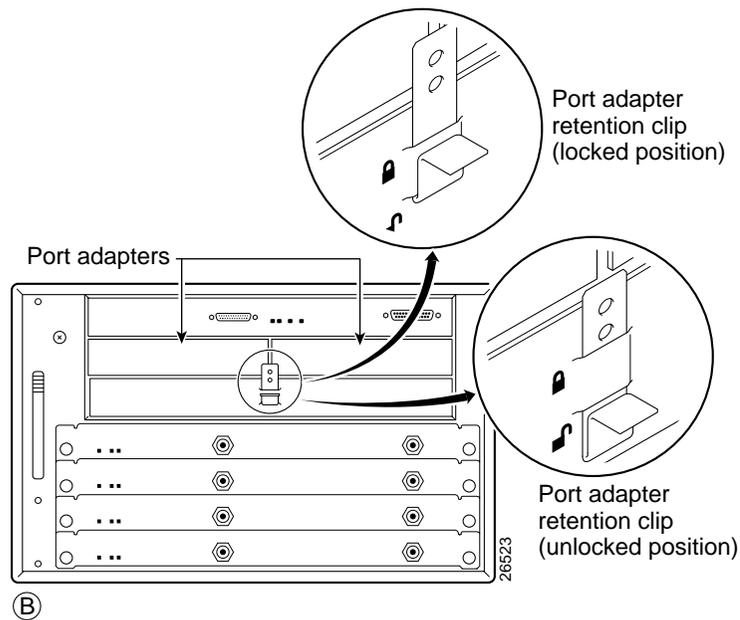


Place the port adapter lever (Cisco uBR7223, see A), or the port adapter retention clip (Cisco uBR7246 and Cisco uBR7246 VXR, see B) in the unlocked position. Either mechanism remains in the unlocked position.

Note: This adapter removal applies to any port or service adapter.

Step 2

Grasp the handle of the port adapter and pull the port adapter from the router, about halfway out of its slot. If you are removing a blank port adapter, pull the blank port adapter completely out of the chassis slot.



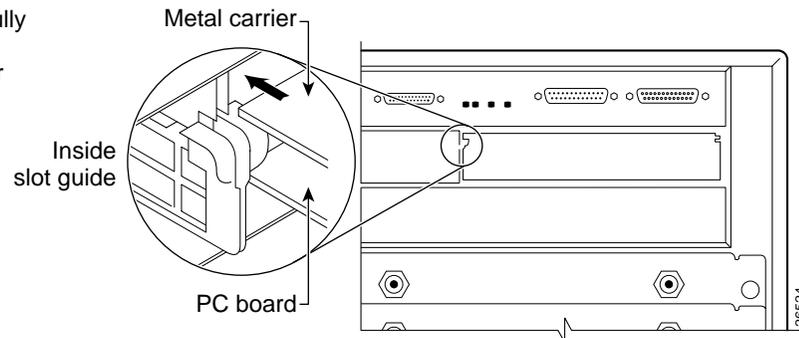
Step 3

With the port adapter halfway out of the slot, disconnect all cables from the port adapter. After disconnecting the cables, pull the port adapter from its chassis slot.

Cisco uBR7200 Series Routers—Installing a Module

Step 1

To insert the port adapter, carefully align the port adapter carrier between the upper and the lower edges of the port adapter slot.



Step 2

Carefully slide the new port adapter halfway into the port adapter slot.

Step 3

With the port adapter halfway into the slot, connect all required cables to the port adapter. After connecting all required cables, carefully slide the port adapter all the way into the slot until the port adapter is seated in the router midplane.

Step 4

After the port adapter is properly seated, lock the port adapter lever or retention clip, depending on your system. (See illustration on preceding page.)



Configuring the PA-A2 ATM CES Port Adapter

To continue your port adapter installation, you must configure the ATM interfaces.

The instructions that follow apply to all supported platforms. Minor differences between the platforms—with Cisco IOS software commands—are noted.

This chapter contains the following sections:

- Using the EXEC Command Interpreter, page 4-1
- PA-A2 ATM CES Configurations, page 4-2
- Customizing the PA-A2 ATM CES Port Adapter, page 4-14
- Checking the Configuration, page 4-15
- Traffic Management, page 4-20
- Troubleshooting the PA-A2 ATM CES Port Adapter Installation and Configuration, page 4-21
- ATM Configuration, page 4-24
- Upgrading Your Boot Flash Image, page 4-25
- Port Adapter Error Messages, page 4-26

Using the EXEC Command Interpreter

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

The system prompt for the privileged level ends with a pound sign (#) instead of an angle bracket (>). At the console terminal, use the following procedure to enter the privileged level:

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

```
Router> enable
```

```
Password:
```

- Step 2** Enter the password (the password is case sensitive). For security purposes, the password is not displayed. When you enter the correct password, the system displays the privileged-level system prompt (#):
- ```
Router#
```
- 

## PA-A2 ATM CES Configurations

After you verify that the new port adapter is installed correctly (the ENABLED LED goes on), use the privileged-level **configure** command to configure the new interfaces. Have the following information available:

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

If you installed a new port adapter or if you want to change the configuration of an existing interface, you must enter configuration mode to configure the new interfaces. If you replaced a port adapter that was previously configured, the system recognizes the new interfaces and brings each of them up in their existing configuration.

For a summary of the configuration options available and instructions for configuring interfaces on a port adapter, refer to the appropriate configuration publications listed in the “Related Documentation” section on page viii.

When an interface is enabled (taken out of shutdown mode) with no additional arguments, the default interface configuration file parameters are functional.

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 configuration subsections for the standard configuration tasks:

- Shutting Down an Interface, page 4-3
- Performing a Basic Interface Configuration, page 4-4
- Configuring the PA-A2 ATM CES Port Adapter for T3, page 4-5
- Configuring the PA-A2 ATM CES Port Adapter for E3, page 4-5
- Configuring the PA-A2 ATM CES Port Adapter for OC-3, page 4-6
- Configuring VCs, page 4-6
- Configuring PVCs, page 4-7
- Configuring SVCs, page 4-9
- Configuring Classical IP and ARP over ATM, page 4-13
- Classes of Service and Transmit Priority on the PA-A2 ATM CES Port Adapter, page 4-13

## Shutting Down an Interface

Before you remove an interface that you will not replace, replace interface cables, or replace port adapters, use the **shutdown** command to shut down (disable) the interfaces to prevent anomalies when you reinstall the new port adapter or reconfigured port adapter. When you shut down an interface, it is designated administratively down in the **show** command displays.

Follow these steps to shut down an interface:

---

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

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

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

**Step 3** Shut down interfaces by entering the **interface** command (followed by the interface type and the interface address of the interface), and then enter the **shutdown** command. See “Using the show interfaces Command” section on page 4-17 for 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.




---

**Note** If you need to shut down additional interfaces, enter the **interface** command (followed by the interface type and the interface address of the interface) for each of the interfaces on your port adapter. Use the **no shutdown** command to enable the interface.

---

**Step 4** Write the new configuration to NVRAM as follows:

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

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

**Step 5** Verify that new interfaces are now in the correct state (shut down) using the **show interfaces** command (followed by the interface type and the interface address of the interface) to display the specific interface. The “Using the show interfaces Command” section on page 4-17 provides examples.

**Step 6** Reenable interfaces by doing the following:

- a. Repeat Step 3 to reenablen 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 interfaces are in the correct state. Use the **show interfaces** command followed by the interface type and 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 Interface Configuration

Following are instructions for a basic configuration, which includes enabling an interface and specifying IP routing. You might also need to enter other configuration subcommands, depending on the requirements for your system configuration and the protocols you plan to route on the interface. For complete descriptions of configuration subcommands and the configuration options available for the interfaces of your port adapter, refer to the appropriate software documentation.

In the following procedure, 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>
```

- 
- Step 1** 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 2** Specify the first interface to configure by entering the **interface** command, followed by the type of interface and the interface address of the interface you plan to configure. (The command for your port adapter will be specific to the technology of your interface.) The “Using the show interfaces Command” section on page 4-17 provides examples.

- 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 10.255.255.255
```

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

- Step 5** Reenable the interfaces using the **no shutdown** command. (See the “Shutting Down an Interface” section on page 4-3.)

- Step 6** After including all of the configuration subcommands to complete your configuration, 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 prompt.

- Step 7** Write the new configuration to NVRAM as follows:

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

---

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



### Note

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

---

## Configuring the PA-A2 ATM CES Port Adapter for T3

To configure the PA-A2 ATM CES port adapter for T3, perform the following tasks in interface configuration mode:

- 
- Step 1** Specify an ATM interface to configure. For the appropriate interface address to use for your system, refer to the “Identifying Interface Addresses” section on page 1-15.
- ```
Router# interface atm slot/port or slot/port-adapter/port
```
- Step 2** Set the line build-out length (0 to 50 feet is **short** and greater than 50 feet is **long**). Use the **no** form of this command to return to the default, which is **short**.
- ```
Router(config-if)# lbo {short | long}
```
- Step 3** 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.
- ```
Router(config-if)# clock internal
```
- Step 4** Enable DS-3 scrambling. Use the **no** form of the command to restore the default value.
- ```
Router (config-if)# DS3-scramble
```
- Step 5** Specify DS-3 framing: **m23plcp**, **cbitplcp**, **m23adm**, or **cbitadm**. Use the **no** form of the command to return to the default, which is **cbitadm**.
- ```
Router(config-if)# framing {m23plcp | cbitplcp | m23adm | cbitadm}
```
-

Configuring the PA-A2 ATM CES Port Adapter for E3

To configure the PA-A2 ATM CES port adapter for E3, perform the following tasks in interface configuration mode:

-
- Step 1** Specify an ATM interface to configure. For the appropriate interface address to use for your system, refer to the “Identifying Interface Addresses” section on page 1-15.
- ```
Router# interface atm slot/port or slot/port-adapter/port
```
- Step 2** Select the transmit clock source. This can be internal or derived from the receive clock through use of the **no** form of this command. By default, the source is used for the transmit clock.
- ```
Router (config-if)# clock internal
```
- Step 3** Enable E3 scrambling. Use the **no** form of the command to restore the default value.
- ```
Router (config-if)# e3-scramble
```
- Step 4** Specify DS-3 framing: **g832adm**, **g751adm**, or **g751plcp**. Use the **no** form of the command to return to the default, which is **g832adm**.
- ```
Router(config-if)# framing {g832adm | g751adm | g751plcp}
```
-

Configuring the PA-A2 ATM CES Port Adapter for OC-3

To configure the PA-A2 ATM CES port adapter for OC-3, perform the following tasks in interface configuration mode:

-
- Step 1** Specify an ATM interface to configure. For the appropriate interface address to use for your system, refer to the “Identifying Interface Addresses” section on page 1-15.
- ```
Router# interface atm slot/port or slot/port-adapter/port
```
- Step 2** Select the transmit clock source. This can be internal or derived from the receive clock through use of the **no** form of this command. By default, the source is used for the transmit clock.
- ```
Router (config-if)# clock internal
```
- Step 3** Specify SONET framing by using the **sonet stm-1** command. Use the **no** form of this command to return to the default, sts-3c framing.
- ```
Router (config-if)# sonet stm-1
```
- 



### Note

In ATM environments, the key difference between SONET and SDH framing modes is the type of cell transmitted when no user or data cells are available. The ATM forum specifies use of idle cells if unassigned cells are not generated. More specifically, in Synchronous Transport Module-X (STM-X) mode, an ATM interface sends idle cells for cell-rate decoupling. In Synchronous Transport Signal-Xc (STS-Xc) mode, the ATM interface sends unassigned cells for cell-rate decoupling.

---

## Configuring VCs

A virtual circuit (VC) is a point-to-point connection 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:

- Class of service category:
  - Constant bit rate (CBR)
  - Variable bit rate non-real-time (VBR-nrt)
  - Variable bit rate real-time (VBR-rt)
  - Available bit rate (ABR)
  - Unspecified bit rate (UBR)
- ATM adaptation layer 5 (AAL5)
- Encapsulation type:
  - Logical link control Subnetwork Address Protocol (AAL5SNAP)
  - Multiplexer (AAL5MUX)
  - Network Layer Protocol ID (AAL5NLPID)
  - Integrated Local Management Interface (ILMI)
  - Switched Multimegabit Data Service (SMDS)
  - ITU/Q.2931 Signaling ATM Adaptation Layer (QSAAL)

- Cisco AUTO PPP over AAL5 (aal5autopp)
- Cisco PPP over AAL5 (aal5ciscopp)

**Note**

See the ATM virtual circuit configuration commands in the example output of the “Classes of Service and Transmit Priority on the PA-A2 ATM CES Port Adapter” section on page 4-13.

Each VC supports the following router functions:

- Multiprotocol
- Fast switching of IP packets
- Flow, and Cisco Express Forwarding (CEF) switching of IP packets
- Pseudobroadcast support for multicast packets

By default, CEF switching is enabled on all PA-A2 ATM CES interfaces. These switching features can be turned off with interface configuration commands. Flow must be explicitly enabled for each interface.

## Configuring PVCs

To use a permanent virtual circuit (PVC), 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 PA-A2 ATM CES port adapter. 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.

Like Frame Relay, ATM supports two types of interface: point-to-point and multipoint. The one you choose determines whether you need to use the configuration commands that ensure IP to ATM mappings.

To configure a PVC, refer to the following sections:

- Configuring a PVC on a Point-to-Point Subinterface, page 4-7
- Configuring a PVC on a Multipoint Subinterface, page 4-8

## Configuring a PVC on a Point-to-Point Subinterface

With point-to-point subinterfaces, each pair of routers has its own subnet. If you put the PVC on a point-to-point subinterface, the router assumes that there is only one point-to-point PVC configured on the subinterface. Therefore, any IP packets with a destination IP address in the same subnet are forwarded on this VC.

To configure a point-to-point PVC, perform the following tasks from configuration mode:

- Step 1** Enter interface configuration mode and specify an ATM interface using the **interface atm** command. Specify the creation of a point-to-point interface by using the **point** command.

```
Router(config)# interface atm5/0.200 point
```

**Step 2** You can list the VPI and VCI values using the **pvc ?** command.

```
Router(config-if)#pvc ?
<0-255> Enter VPI/VCI value(slash required)
<1-65535> Enter VCI value
WORD Optional handle to refer to this connection
```

**Step 3** Create the PVC. Notice the output telling you that circuit has been configured on a specific interface.

```
Router(config-if)#pvc x/32
Configuring vc 1/1 on interface ATM5/0.200

Router(config-if-atm-vc)#
```



**Note** Static map statements are not required for point-to-point subinterfaces.

## Configuring a PVC on a Multipoint Subinterface

Multipoint networks generally have three or more routers in the same subnet. If you put the PVC in a point-to-multipoint subinterface or in the main interface (which is multipoint by default), you need to either configure a static mapping or enable inverse Address Resolution Protocol (InARP) for dynamic mapping.

The following output example shows a PVC 2/200 on ATM interface 1/1/0.200. It uses the global default AAL5SNAP encapsulation. The local interface IP address is 2.2.2.1, and the remote interface IP address is 2.2.2.2.

```
Router# show interfaces atm 1/1/0.200
interface ATM1/1/0.200 multipoint
ip address 2.2.2.1 255.255.255.0
no ip directed-broadcast
pvc 2/200
protocol ip 2.2.2.2 broadcast
```

InARP is enabled on multipoint links by default. The following example, creates a multipoint subinterface. By using the **show atm map** command, you can see that InARP builds a dynamic mapping between the Layer 3 IP address and the Layer 2 VPI/VCI:

```
Router#show atm map
Map list ATM1/1/0.100_ATM_INARP : DYNAMIC
ip 1.1.1.2 maps to VC 19, VPI 2, VCI 100, ATM1/1/0.100
Map list ATM1/1/0.200_ATM_INARP : DYNAMIC
ip 2.2.2.2 maps to VC 20, VPI 2, VCI 200, ATM1/1/0.200
```

You can check the mapping using the **show atm map** command. In the following example, you can see the mapping of Layer 3 to Layer 2 addresses is dynamic. Such mapping is dynamic using inverse ARP as illustrated in the previous **show atm map** command example.

```
Router#show atm map
Map list ATM1/1/0.100_ATM_INARP : DYNAMIC
ip 1.1.1.2 maps to VC 19, VPI 2, VCI 100, ATM1/1/0.100
Map list ATM1/1/0.200pvc20 : PERMANENT
ip 2.2.2.2 maps to VC 20, VPI 2, VCI 200, ATM1/1/0.200, broadcast
```

You can use the **inarp** command to change the frequency of transmitting a new ATM InARP packet in order to reconfirm the mapping:

```
Router(config-subif)#pvc 2/200
Router(config-if-atm-vc)#inarp ?
```

```

 <1-60> InARP Frequency in minutes
 <cr>
Router(config-if-atm-vc)#inarp 5
Router(config-if-atm-vc)#end

```

Use the **show atm vc** command to confirm your configured value:

```

Router#show atm vc
 5d10h: ATMARP:Sending first PVC INARP
 5d10h: ATMARP(ATM1/1/0.200)O: INARP_REQ to VCD#20 2/200 for link 7(IP)
 5d10h: ATMARP(ATM1/1/0.200)I: INARP Reply VCD#20 2/200 from 2.2.2.2
ATM1/1/0.200: VCD: 20, VPI: 2, VCI: 200
UBR, PeakRate: 44209
AAL5-LLC/SNAP, etype:0x0, Flags: 0xC20, VCmode: 0x0
OAM frequency: 0 second(s)
InARP frequency: 5 minutes(s)
Transmit priority 4
InPkts: 10, OutPkts: 11, InBytes: 680, OutBytes: 708
InPRoc: 10, OutPRoc: 5, Broadcasts: 0
InFast: 0, OutFast: 0, InAS: 0, OutAS: 6
InPktDrops: 0, OutPktDrops: 0
CrcErrors: 0, SarTimeOuts: 0, OverSizedSDUs: 0
OAM cells received: 0
OAM cells sent: 0
Status: UP

```

## Configuring SVCs

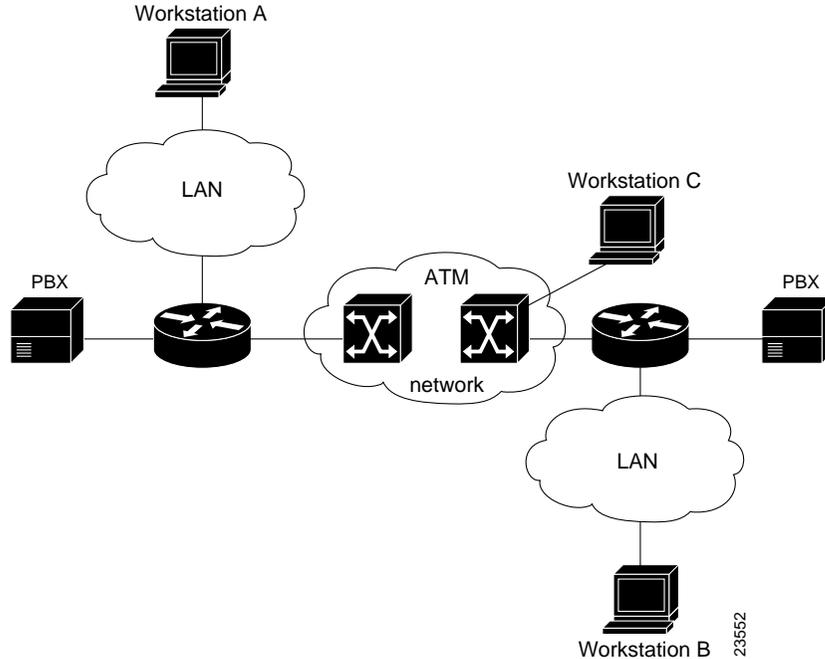
ATM switched virtual circuits (SVCs) are created and released dynamically, providing user bandwidth on demand. This service requires a signaling protocol between the router and the switch.

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 4.0 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 network device 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 4-10
- Configuring the Network Service Access Point Address, page 4-11

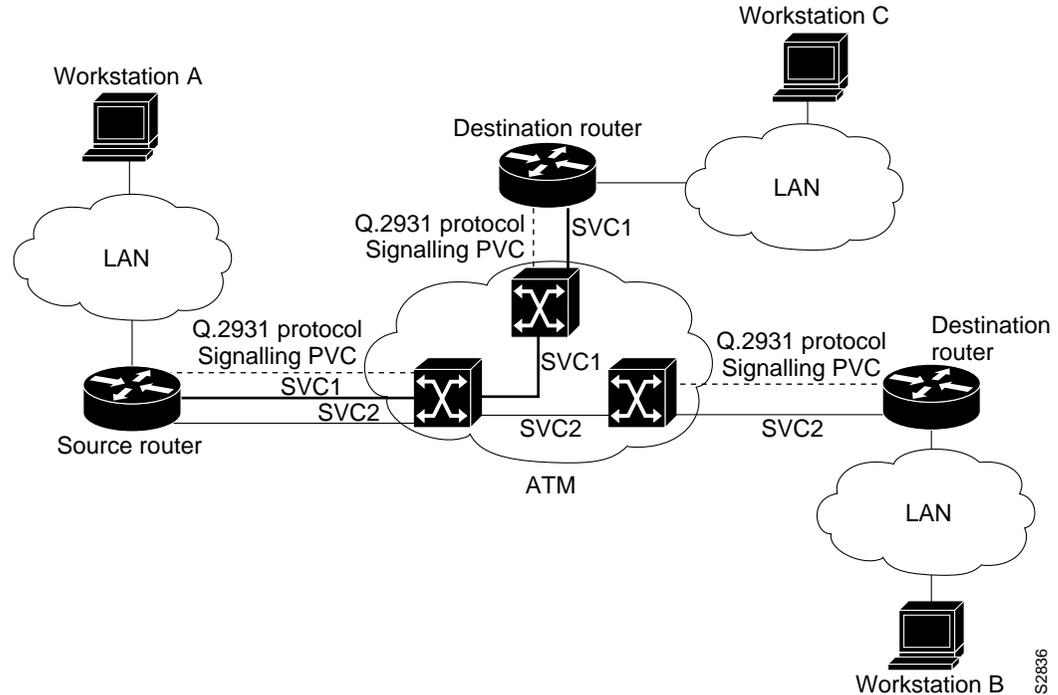
For further information on configuring the PA-A2 ATM CES port adapter for SVCs, see the *Wide-Area Networking Configuration Guide*.

## Configuring the PVC That Performs SVC Call Setup

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 vcd 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, and the range of VPI values is 0 through 255. The standard value of VCI is 5, the range of VCI values is 0 through 65535.



**Note**

VCI values 0 through 31 are reserved and do not carry data traffic.

## 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.

To configure an NSAP address, complete the tasks in the following sections:

- Configuring the Complete NSAP Address Manually, page 4-12
- Configuring the ESI and Selector Fields, page 4-12

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

```
Router(config-if)# pvc 0/16 ilmi
```

The switch then provides the Prefix field of the NSAP address.

## Configuring the Complete NSAP Address Manually

When you configure the 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.XX
```



### Note

All 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 7200 series, Cisco uBR7200 series, or Cisco 7100 series router:

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

**Step 1** Specify an ATM interface to configure.

```
Router(config)# interface atm slot/port or slot/port-adapter/port
```

**Step 2** Enter the ESI and Selector fields of the NSAP address.

```
Router(config-if)# esi-address esi.selector
```

In the **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 7200 series router, the ESI and Selector field values are assigned, and the ILMI PVC is set up:

```
Router(config)# interface atm 4/0
Router(config-if)# 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 present in the environment. For further information, refer to the *Wide-Area Networking Configuration Guide*.

## Classes of Service and Transmit Priority on the PA-A2 ATM CES Port Adapter

The transmit priority determines which queued cell is chosen to be transmitted out an interface during a cell time slot and ensures that real-time ATM service classes, which typically offer more robust QoS and traffic guarantees, have a higher likelihood of access to the next cell time slot. Table 4-1 lists the ATM service classes and their default transmit priorities on the PA-A2 ATM CES port adapter.



### Note

Refer to the Feature Module documentation and Technical Tips on Cisco.com for detailed information about classes of service, configuration features, and the Cisco IOS releases that support specific features.

**Table 4-1 ATM Classes of Service and Default Transmit Priorities on the PA-A2 ATM CES Port Adapter**

| Service Category                             | Transmit Priority |
|----------------------------------------------|-------------------|
| CBR, OAM cells and signaling                 | 0                 |
| AAL5 or AAL2 VoATM VC (any service category) | 1                 |
| rt-VBR                                       | 2                 |
| nrt-VBR                                      | 3                 |
| ABR                                          | 4                 |
| UBR                                          | 5                 |

You can use the transmit priority command in VC configuration mode to change the priority value. The following example shows a customized prioritization scheme with the transmit priority value of a VC changed from four to two.



### Caution

Transmit priority 0 is reserved for control traffic like OAM and signaling.

- Step 1** First, view the characteristics of the existing configuration using the **show atm vc {vcd#}** command. Note how the router has assigned a default transmit priority value of 5 to the UBR PVC:

```
Router# show atm vc 2
ATM5/0: VCD: 2, VPI: 1, VCI: 100
UBR, PeakRate: 10000
AAL5-LLC/SNAP, etype:0x0, Flags: 0x20, VCmode: 0x0
OAM frequency: 0 second(s)
PA TxRingLimit: 0 paritcles
PA Rx Limit: 0 particles
InARP frequency: 15 minute(s)
Transmit priority 5
InPkts: 0, OutPkts: 0, InBytes: 0, OutBytes: 0
InProc: 0, OutProc: 0, Broadcasts: 0
InPktsDrops: 0, OutPktDrops: 0
CrcErrors: 0, SarTimeOuts: 0. OverSizedSDUs: 0
OAM cells received: 0
OAM cells sent:0
Status: ACTIVE
```

- Step 2** Next, customize the transmit priority value from VC configuration mode.

```
Router(config)# interface atm 5/0
Router(config-if)# pvc x/100
Router(config-if-atm-vc)# transmit-priority 2
```

- Step 3** The final action is to confirm your settings. Note how the router indicates the changed transmit priority level. It is now at level 2.

```
Router# show atm vc 2
VC 2 doesn't exist on interface ATM2/0
ATM5/0: VCD: 2, VPI: 1, VCI: 100
UBR, PeakRate: 10000
AAL5-LLC/SNAP, etype:0x0, Flags: 0x20, VCmode: 0x0
OAM frequency: 0 second(s)
PA TxRingLimit: 0 paritcles
PA Rx Limit: 0 particles
InARP frequency: 15 minute(s)
Transmit priority 2
InPkts: 0, OutPkts: 0, InBytes: 0, OutBytes: 0
InProc: 0, OutProc: 0, Broadcasts: 0
InPktsDrops: 0, OutPktDrops: 0
CrcErrors: 0, SarTimeOuts: 0. OverSizedSDUs: 0
OAM cells received: 0
OAM cells sent:0
Status: ACTIVE
```

## Customizing the PA-A2 ATM CES Port Adapter

You can customize the PA-A2 ATM CES port adapter. 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 PA-A2 ATM CES port adapter:

- Setting the MTU Size, page 4-15
- Configuring an ATM Interface for Local Loopback, page 4-15

- Configuring an ATM Interface for External Loopback, page 4-15

**Note**

For the commands that follow, you need to be in interface configuration mode. To enter interface configuration mode, use the **interface atm** command, followed by the interface address of the ATM interface you plan to configure.

## Setting the MTU Size

Each ATM interface has a default maximum packet size or maximum transmission unit (MTU) size. On the PA-A2 ATM CES port adapter, this number defaults to 4470 bytes, the range being 64 through 9188 bytes. To set the maximum MTU size, enter the following command in interface configuration mode:

```
Router(config-if)# mtu bytes
```

**Note**

This command is documented in the *Configuration Fundamentals Command Reference*.

## Configuring an ATM Interface for Local Loopback

To configure an ATM interface for local loopback (useful for checking that the PA-A2 ATM CES port adapter 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 PA-A2 ATM CES port adapter 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
```

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

## Checking the Configuration

After configuring the new interface, use the **show** commands to display the status of the new interface or all interfaces, 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 4-16
- Using the ping Command to Verify Network Connectivity, page 4-18
- Using loopback Commands, page 4-19

## Using show Commands to Verify the New Interface Status

This section demonstrates how you can use the **show** commands to verify that new interfaces are configured and operating correctly and that the port adapter 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.

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 4-16
- Using the show diag Command, page 4-17
- Using the show interfaces Command, page 4-17

### 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 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 7200 Series Routers—Example Output of the show version Command

Following is an example of the **show version** command from a Cisco 7200 series router:

```
Router# show version

Cisco Internetwork Operating System Software
IOS (tm) 7200 Software (C7200-IS-M), Version 12.2(8)B, RELEASE SOFTWARE (fc1)
TAC Support: http://www.cisco.com/tac
Copyright (c) 1986-2002 by cisco Systems, Inc.
Compiled Fri 02-Aug-02 10:51 by ccai
Image text-base: 0x60008940, data-base: 0x61850000

ROM: System Bootstrap, Version 11.1(13)CA, EARLY DEPLOYMENT RELEASE SOFTWARE (f)
BOOTLDR: 7200 Software (C7200-BOOT-M), Version 11.1(16)CA, EARLY DEPLOYMENT REL

d11-5-7206-15 uptime is 1 week, 31 minutes
System returned to ROM by reload at 14:08:34 UTC Tue Aug 20 2002
System image file is "slot0:c7200-is-mz.122-11.T"

cisco 7206 (NPE200) processor (revision B) with 114688K/16384K bytes of memory.
Processor board ID 15455885
R5000 CPU at 200Mhz, Implementation 35, Rev 2.1, 512KB L2 Cache
6 slot midplane, Version 1.3

Last reset from power-on
Bridging software.
X.25 software, Version 3.0.0.
Primary Rate ISDN software, Version 1.1.
1 FastEthernet/IEEE 802.3 interface(s)
```

```

2 Serial network interface(s)
2 HSSI network interface(s)
11 ATM network interface(s)
4 Channelized T1/PRI port(s)
125K bytes of non-volatile configuration memory.
4096K bytes of packet SRAM memory.

20480K bytes of Flash PCMCIA card at slot 0 (Sector size 128K).
4096K bytes of Flash internal SIMM (Sector size 256K).
Configuration register is 0x2102

```

## Using the show diag Command

Display the types of port adapters installed in your system (and specific information about each) using the **show diag slot** command, where *slot* is the *module slot*.



### Note

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

Following is an example of the **show diag slot** command on a Cisco 7200 series router:

```

Router# show diag 6
Slot 6:
 ATM WAN OC3+ (MM) Port adapter, 1 port
 Port adapter is analyzed
 Port adapter insertion time 00:44:57 ago
 EEPROM contents at hardware discovery:
 Hardware Revision: 1.0
 PCB Serial Number:----H
 Part Number: 73-7981-0
 Board Revision: 1A
 RMA Test History: 00
 RMA Number: 00-00-00
 RMA History: 00
 Unknown Field (type 0088): 00 00 00 01
 Product Number: PA-ATM-DBL-DLX-OC3MM
 Top Assy. Part Number: 800-20782-01
 EEPROM format version 4
 EEPROM contents (hex):
 0x00: 04 FF 40 03 A7 41 01 00 C1 8B 2D 20 2D 20 2D 20
 0x10: 2D 20 2D 20 48 82 49 1F 2D 01 42 31 41 03 00 81
 0x20: 00 00 00 00 04 00 88 00 00 00 01 CB 94 50 41 2D
 0x30: 41 54 4D 2D 44 42 4C 2D 44 4C 58 2D 4F 43 33 4D
 0x40: 4D C0 46 03 20 00 51 2E 01 FF FF FF FF FF FF FF
 0x50: FF FF
 0x60: FF FF
 0x70: FF FF

```

## Using the show interfaces Command

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

For complete descriptions of interface subcommands and the configuration options available for specific 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.

Using the **show interfaces** *type module-slot-number/interface-port-number* command displays the status information about a specific type of interface—in these examples, an ATM interface.

Following is an example of the **show interfaces** command for the Cisco 7200 series routers:

```
Router# show interfaces atm 6/0
ATM6/0 is up, line protocol is up
Hardware is ENHANCED ATM PA Plus
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
Encapsulation(s): AAL5
8191 maximum active VCs, 1 current VCCs
VC idle disconnect time: 300 seconds
8 carrier transitions
Last input 00:37:33, output 00:26:16, output hang never
Last clearing of "show interface" counters never
Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
Queueing strategy: None
5 minute input rate 0 bits/sec, 0 packets/sec
5 minute output rate 0 bits/sec, 0 packets/sec
54033 packets input, 81670740 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
8763526 packets output, 296268354 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 Connectivity

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

The **ping** command sends echo request packets out to a remote device at an IP address that you specify. After sending an echo request, the system waits a specified time for the remote device to reply. Each echo reply is displayed as an exclamation point (!) on the console terminal; each request that is not returned before the specified 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** command places an interface in loopback mode, which enables test packets that are generated from the **ping** command to loop through a remote device. If the packets complete the loop, the connection is good. If not, you can isolate a fault to the remote device in the path of the loopback test.

The loopback diagnostic command on an ATM interface of a Cisco router causes traffic going out of the interface to come back to the router.

If loopback is not set on the ATM interface, traffic will not be looped back. Traffic will go out but will not return. Apply the **loopback diagnostic** command, and then use the **show interface** command to show that loopback is indeed set:

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

Router(config)# interface a1/0
Router(config-if)# loopback diagnostic
Router(config-if)# atm clock internal
Router(config-if)# ^Z

Router# show interface a1/0
ATM1/0 is up, line protocol is up
Hardware is A6 ATM
MTU 4470 bytes, sub MTU 4470, BW 155520 Kbit, DLY 80 usec,
reliability 255/255, txload 1/255, rxload 1/255
Encapsulation ATM, loopback set
Keepalive not supported
Encapsulation(s): AAL5, PVC mode
256 TX buffers, 256 RX buffers,
2048 maximum active VCs, 1024 VCs per VP, 1 current VCCs
VC idle disconnect time: 300 seconds
Last input 00:03:16, output 00:03:16, output hang never
Last clearing of "show interface" counters never
Queueing strategy: fifo
Output queue 0/40, 0 drops; input queue 0/75, 0 drops
5 minute input rate 0 bits/sec, 0 packets/sec
5 minute output rate 0 bits/sec, 0 packets/sec
163861 packets input, 3164940 bytes, 0 no buffer
Received 0 broadcasts, 0 runts, 0 giants, 0 throttles
33 input errors, 33 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
144191 packets output, 2138298 bytes, 0 underruns
0 output errors, 0 collisions, 1 interface resets
0 output buffer failures, 0 output buffers swapped out
```



### Note

To ensure proper clocking, set the router as the clock source by specifying the **atm clock internal** setting in the main interface configuration.

The **loopback line** command on an ATM interface of a Cisco router causes incoming traffic to be sent back to the network.

```
Router# config show interface a2/0
ATM2.0 is up, line protocol is up
Hardware is A6 ATM
MTU 4470 bytes, sub MTU 4470, BW 155520 kbit, DLY 80 usec,
reliability 255/255, txload 1/255, rxload 1/255

Encapsulation ATM, loopback set
Keepalive not supported
Encapsulation(s): AAL5, PVC mode
2048 maximum active VCs, 1024 VCs per VP, 1 current VCCs
```

```

VC idle disconnect time: 300 seconds
Last input 00:02:45, output 00:02:45, output hang never
Last clearing of "show interface" counter never
Queueing strategy: fifo
Output queue 0/40, 0 drops; input queue 0/75, 0 drops
5 minute input rate 0 bits/sec, 0 packets/sec
5 minute output rate 0 bits/sec, 0 packets/sec
94917 packets input, 1638383 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
102898 packets output, 2042785 bytes, 0 underruns
0 output errors, 0 collisions, 5 interface resets
0 output buffer failures, 0 output buffers swapped out

```



Tip

For more information on understanding loopback modes on Cisco routers, refer to the ATM Technical Tips on Cisco.com.

## Traffic Management

The PA-A2 ATM CES port adapter supports the traffic-shaping parameters defined in Table 4-2. This ensures that generated traffic conforms to the ATM Forum Traffic Management Specification Version 4.0. Shaping values are configured using the **vbr-nrt** command in VC configuration mode.

**Table 4-2** Traffic-Shaping Parameters and Ranges

| Traffic Parameter  | Range                                      | Default                                                                                                                                 |
|--------------------|--------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| T3                 | 56 kbps to 45 Mbps                         | If the peak rate is not defined, each new VC is set to the maximum physical layer rate. The VC is assigned to the UBR service category. |
| E3                 | 56 kbps to 34 Mbps                         | If the peak rate is not defined, each new VC is set to the maximum physical layer rate. The VC is assigned to the UBR service category. |
| OC-3c Peak Rate    | 56 kbps to 155 Mbps                        | If the peak rate is not defined, each new VC is set to the maximum physical layer rate. The VC is assigned to the UBR service category. |
| Average Rate       | $0 < \text{average} \leq \text{peak rate}$ | Average = peak rate at the maximum physical layer rate.                                                                                 |
| Maximum Burst Size | 1 to 64,000 cells                          | Equal to the PA-A2 ATM CES port adapter MTU size.                                                                                       |



Note

For more information about traffic management specific to the various class of service categories, refer to the ATM Technical Tips on Cisco.com.

# Troubleshooting the PA-A2 ATM CES Port Adapter Installation and Configuration

The following sections provide suggested guidelines for troubleshooting the PA-A2 ATM CES port adapter. 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.



Tip

For more information about troubleshooting ATM port adapters and understanding the output from the **debug** commands, refer to ATM Technical Tips on Cisco.com.

The following topics are covered within this section:

- PA-A2 ATM CES Port Adapter Statistics, page 4-21
- Using the debug atm Commands, page 4-22
- Displaying ATM Information, page 4-23

## PA-A2 ATM CES Port Adapter Statistics

The PA-A2 ATM CES port adapter maintains a count of certain errors and tracks the ATM controller facility performance. In addition to keeping a count of these errors, the PA-A2 ATM CES port adapter also takes snapshots of the last VCI/VPI that caused the error. Each PA-A2 ATM CES port adapter 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 PA-A2 ATM CES port adapter provides port adapter-specific error statistics through the **show interfaces atm** command.



Note

For examples of the **show interfaces atm** command for all supported platforms, see the “Using the show interfaces Command” section on page 4-17.

The **show controllers atm** command displays the ATM framing information and ATM facility performance statistics. The statistics report section includes up to 96 15-minute interval reports, as well as the current interval level. Only those intervals with non-zero data are displayed.

The following is an example of the **show controllers atm** command from a Cisco 7200 series router:

```
Router# show controllers atm 6/0
Interface ATM6/0 is up
Hardware is ENHANCED ATM PA Plus - OC3 (155000Kbps)
Framer is PMC PM5346 S/UNI-155-LITE, SAR is LSI ATMIZER II
Firmware rev: X101, Framer rev: 0, ATMIZER II rev: 4
 idb=0x62EB7C74, ds=0x62EBF0A0, vc=0x62F41080
 slot 6, unit 1, subunit 0, fci_type 0x03A7, ticks 9790
```

```

5200 rx buffers: size=512, encap=64, trailer=28, magic=4
Curr Stats:
VCC count: current=1, peak=1
AAL2 VCC count: 0
AAL2 TX no buffer count: 0
AAL2 RX no buffer count: 0
SAR crashes: Rx SAR=0, Tx SAR=0
rx_cell_lost=0, rx_no_buffer=0, rx_crc_10=0, rx_no_mem=0
rx_cell_len=0, rx_no_vcd=0, rx_cell_throttle=0, tx_aci_err=0
Rx Free Ring status:
base=0x3F2EE040, size=8192, write=40
Rx Compl Ring status:
base=0x7E6AFF80, size=8192, read=3083
Tx Ring status:
base=0x3F723A00, size=12288, write=255
Tx Compl Ring status:
base=0x0E6BFFC0, size=8192, read=6271
BFD Cache status:
base=0x62F35000, size=12288, read=12286
Rx Cache status:
base=0x62F265C0, size=16, write=11
Tx Shadow status:
base=0x62F28F80, size=12288, read=239, write=255
Control data:
rx_max_spins=9, max_tx_count=50, tx_count=16
rx_threshold=3467, rx_count=11, tx_threshold=9216
tx bfd write indx=0x451, rx_pool_info=0x62F26660
Control data base address:
rx_buf_base = 0x0E3ABEE0 rx_p_base = 0x62ECAD80
rx_pak = 0x62DDE7F8 cmd = 0x62ECA7A0
framer = 0x603F75C0 framer_cb = 0x62ECABA0
framer_base = 0x3F100000 pci_pa_stats = 0x7E1B6840
device_base[0] = 0x3F000000 device_base[1] = 0x3F400000
ssram_base[0] = 0x3F200000 ssram_base[1] = 0x3F600000
sdram_base[0] = 0x3F300000 sdram_base[1] = 0x3F700000
pa_cmd_buf[0] = 0x3F2FFC00 pa_cmd_buf[1] = 0x3F6FFC00
vcd_base[0] = 0x3F200000 vcd_base[1] = 0x3F630000
chip_dump[0] = 0x0E1B6868 chip_dump[1] = 0x0E1B6958
sar_buf_base[0] = 0x3F334000 sar_buf_base[1] = 0x3F730000
bfd_base[0] = 0x3F2BE000 bfd_base[1] = 0x3F600000
acd_base[0] = 0x3F240080 acd_base[1] = 0x3F670240
Framer Information:
Framing mode: SONET OC3 STM-1
No alarm detected

```

**Note**

For more information about CRC errors, using the **show interfaces** command, and using the **show controllers** command, refer to Technical Assistance Center (TAC) documentation on Cisco.com.

## Using the debug atm Commands

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

- Use the **debug atm packet** command to create a dump of all protocol packets. 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
```

- Use the **debug atm errors** command to display errors. 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
```

- Use the **debug atm events** command to display ATM events. The command displays event changes to the PA-A2 ATM CES port adapter; reset, VC configurations, and PA-A2 ATM CES port adapter configurations are displayed.

```
Router# debug atm events
```

- Use the **debug atm oam** command to display information about OAM cells. The command displays the contents of OAM cells as they arrive from the network.

```
Router# debug atm oam
```

Use the **no debug** command to turn off debugging after using a **debug** command.

## Displaying ATM Information

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

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

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

- Use the **show atm interfaces** command to show current information about an ATM interface. The command displays ATM-specific information about an interface.

```
Router# show atm interfaces
```

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

```
Router# show atm traffic
```

- Use the **show atm map** command to show the current ATM mapping. 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/
Interface Name VPI VCI Type Encaps SC Kbps Kbps Cells Status
6/0 1 10 100 PVC SNAP VBR 33920 0 0 UP
6/0.300 4 8 88 PVC SNAP VBR 30000 30000 20000 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 4
ATM6/0.300: VCD:4, VPI:8, VCI:88
VBR-NRT, PeakRate:30000, Average Rate:30000, Burst Cells:20000
AAL5-LLC/SNAP, etype:0x0, Flags:0x20, VCmode:0x0
OAM frequency: 0 second(s)
VC TxRingLimit: 1179 particles
InARP frequency: 15 minute(s)
```

```

Transmit priority: 4
InPkts: 0, OutPkts: 0, InBytes: 0, OutBytes: 0
InPRoc: 0, OutPRoc: 0, Broadcasts: 0
InFast: 0, OutPktDrops: 0/0/0 (holdq/outputq/total)
CrcErrors: 0, SarTimeOuts: 0, OverSizedSDUs: 0, Length Violation: 0, CPIErrors: 0
Out CLP=1 Pkts: 0
OAM cells received: 0
OAM cells sent: 0
Status: UP

```

Use the **show interfaces atm** command to display statistics for the ATM interface you specify by its interface address. Use the **show interfaces atm** command to display the currently running PA-A2 ATM CES port adapter configuration in RAM:

```

Router# show interfaces atm 3/0
interface ATM 3/0
 ip address 10.10.10.2 255.255.255.0
 map-group atm1
 pvc 1 0 1 aal5snap

```

**Note**

For examples of the **show interfaces atm** command for all supported platforms, see the “Using the show interfaces Command” section on page 4-17.

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 4-16.

## ATM Configuration

Cisco IOS Release 11.3 T introduced the ATM VC command mode, which, in turn, introduced several new ATM commands that allow you to configure ATM parameters more easily. The new VC configuration mode uses **protocol ip** and other statements (replace **ip** with **ipx**, **decnet**, and so on) to configure static mappings. The protocol statement takes the place of the **map-list** and **map-group** statements used in versions prior to Cisco IOS Release 11.3 T.

For detailed configuration examples, refer to the router software publications listed in the “Related Documentation” section on page viii.

The following example shows how to create a PVC AAL5SNAP. The interface is at IP address 2.2.2.1, with 2.2.2.2 at the other end of the connection.

**First Router:**

```

interface ATM 3/0
 ip address 10.0.0.1 255.0.0.0
 no keepalive
 map-group atm-in
 atm clock internal
 atm pvc 1 1 5 aal5snap
 !

```

```
map-list atm-in
ip 10.0.0.2 atm-vc 1 broadcast
```

**Second Router:**

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

## 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, 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 following procedure:

- 
- Step 1** Enter configuration mode.
- ```
Router# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#
```
- Step 2** Display and note the exact spelling of the system image filename in Flash memory.
- ```
Router(config)# show flash all
```
- Step 3** Make a backup copy of the current boot image.
- ```
Router(config)# copy flash tftp
```
- Step 4** Copy a boot image to Flash memory.
- ```
Router(config)# copy tftp flash
```
- Step 5** When prompted, enter the IP address or domain name of the server.
- ```
Router(config)# ip-address or name
```
-

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

Port Adapter Error Messages

All of the PA-A2 ATM CES port adapter receive buffers are allocated from static random-access memory (SRAM). As a result, during bootup, if the PA-A2 ATM CES port adapter cannot find enough *contiguous* SRAM for its use, the system stops bringing up the PA-A2 ATM CES port adapter and displays an error message such as the following:

```
%ATMPA-A2-PCIMEMNOTENOUGH: Not Enough PCI memory (0x19874) to support ATM PA on bay 5
```