CISCO SYSTEMS

®

Text Part Number: OL-3523-01

Channelized T3 Dual-Wide Port Adapter Installation and Configuration

Product Number: PA-CT3/4T1(=)

This configuration note describes the installation and configuration of the channelized T3 dual-wide port adapter (PA-CT3/4T1), which can be used in Cisco 7200 series routers.

This configuration note also contains basic configuration steps and examples. For complete descriptions of additional interface subcommands and configuration options available for your router, refer to the appropriate configuration publications listed in the section "If You Need More Information" on page 1 . (Also refer to the section "Software and Hardware Requirements" on page 9 .)

Document Contents

Sections in this document include the following:

- If You Need More Information, page 1

- Product Description, page 3

- PA-CT3/4T1 Port Adapter Installation Prerequisites, page 8

  This section contains important information about specific software and hardware requirements for the PA-CT3/4T1 port adapter.

- Installing or Removing a Port Adapter in a Cisco 7200 Series Router, page 14

- Configuring the T3 and T1 Interfaces, page 23

If You Need More Information

The Cisco IOS software running your router contains extensive features and functionality. The effective use of many PA-CT3/4T1 port adapter features is easier if you have more information at hand. For additional information on configuring the Cisco 7200 series routers and the PA-CT3/4T1 port adapter, the following documentation resources are available:

- Cisco documentation and additional literature are available in a CD-ROM package, which ships with your product. The Documentation CD-ROM, a member of the Cisco Connection Family, is updated monthly. Therefore, it might be more up to date than printed documentation. To order additional copies of the Documentation CD-ROM, contact your local sales representative or call customer service. The CD-ROM package is available as a single package or through an annual subscription. You can also access Cisco documentation on the World Wide Web at http://www.cisco.com, http://www-china.cisco.com, or http://www-europe.cisco.com.

- Refer to the following modular configuration and modular command reference publications, as appropriate for your configuration:

  — *Configuration Fundamentals Configuration Guide*

  — *Configuration Fundamentals Command Reference*

  — *Security Configuration Guide*

  — *Security Command Reference*

  — *Wide-Area Networking Configuration Guide*

  — *Wide-Area Networking Command Reference*

  — *Network Protocols Configuration Guide, Part 1*

  — *Network Protocols Command Reference, Part 1*

  — *Network Protocols Configuration Guide, Part 2*

  — *Network Protocols Command Reference, Part 2*

  — *Network Protocols Configuration Guide, Part 3*

  — *Network Protocols Command Reference, Part 3*

  — *Configuration Builder Getting Started Guide*

  — *Troubleshooting Internetworking Systems*

  — *Debug Command Reference*

  — *System Error Messages*

  — *Cisco IOS Software Command Summary*

  — *Cisco Management Information Base (MIB) User Quick Reference*

- For hardware installation, configuration, and maintenance information on the Cisco 7200 series router, refer to the following publications:

  — *Cisco 7206 Installation and Configuration Guid*e

  — *Cisco 7200 Series Port Adapter Hardware Configuration Guidelines*

- For international agency compliance, safety, and statutory information for wide-area network (WAN) interfaces for the Cisco 7200 series routers, refer to the document *Regulatory Compliance and Safety Information for the Cisco 7200 Series Routers* (Part Number 78-3419-xx; Customer Order Number Doc-7200-RCSI=).

- For port adapter hardware and memory configuration guidelines for the Cisco 7200 series routers, refer to the document *Cisco 7200 Series Port Adapter Hardware Configuration Guidelines* (Part Number 78-3471-xx; Customer Order Number Doc-7200PA-HCG=).

- To obtain general information about documentation, refer to the section "Obtaining Documentation" on page 42 , or call 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, or you can refer to the *Cisco Information Packet* that shipped with your router.

- For specific Cisco IOS software release information, refer to the Cisco IOS software release note for the Cisco IOS software release you are running. (For the Cisco IOS releases that support the PA-CT3/4T1 port adapter, refer to the section "Software and Hardware Requirements" on page 9 .)

Product Description

The CT3 channelized port adapter (PA-CT3/4T1) is a dual-wide module that provides four T1 connections via DB-15 connectors and one DS3 connection via BNC connectors. (See Figure 1.) Each DS3 interface can provide up to 28 T1 channels (a single T3 group). Each channel is presented to the system as a serial interface that can be configured individually.

Figure 1   PA-CT3/4T1 Port Adapter, Front-Panel View
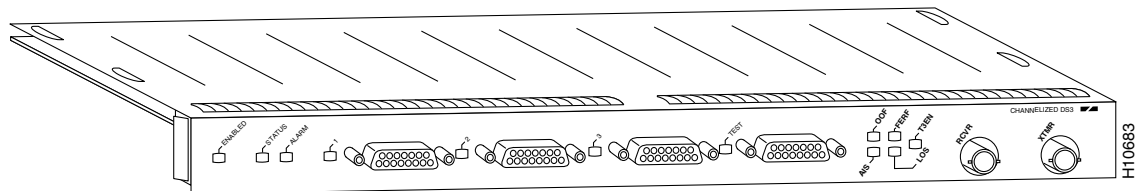
The PA-CT3/4T1 port adapter has the following features and physical characteristics:

- Transmits and receives data bidirectionally at the T1 rate of 1.536 Mbps. The individual T1 connections use 100-ohm twisted-pair serial cables to external channel service units (CSUs) or to a MultiChannel Interface Processor (MIP). External T1 channels do not provide CSU functionality and must connect to an external CSU.

- Supports RFC 1406 and RFC 1407 (CISCO-RFC-1407-CAPABILITY.my). For information on accessing Cisco MIB files, refer to the *Cisco MIB User Quick Reference.* For RFC 1406, Cisco supports all tables except the "Frac" table. For RFC 1407, Cisco supports all tables except the "FarEnd" tables.

- For wide-area networking, the PA-CT3/4T1 port adapter can function as a concentrator for a remote site.

- The T3 connection, provided by way of two female BNC connections for transmit (TX) and receive (RX), has an impedance of 75 ohms.

- Packet memory for the PA-CT3/4T1 port adapter is 1 megabyte (MB) of static random-access memory (SRAM) with the 150-MHz network processor and 4 MB with the 200-MHz network processor.

- PA-CT3/4T1 port adapter microcode is loaded into and operates from dynamic random-access memory (DRAM).

- DRAM configuration is up to 128 MB with either the 150-MHz or 200-MHz network processor.

T3 Overview

T3 traditionally involves multiplexing 28 T1 lines on to a single higher-speed line (T3 line). Each of the 28 T1 lines in the T3 are asynchronous to one other. A T1 line accommodates 24 64-kilobit-per-second (Kbps) DS0 channels. While the DS0s are byte multiplexed to each T1, the T1 lines are bit multiplexed to the T3 in a framing format called *M23* or *C-BIT parity.*

M13 multiplexing is done in two steps. First, four T1 lines are bit multiplexed together to form a DS2 line using M12 multiplexing. These seven DS2 lines are then bit multiplexed together to form the DS3/T3 using M23 multiplexing.

M13 multiplexing uses bit stuffing to bring each asynchronous DS1/DS2 up to a common data rate for transmission. C-BIT Parity multiplexing forces the seven DS2s to be synchronous to each other at a rate that causes 100-percent pulse stuffing in the M23 frame. This allows the "stuff" indicator bits in the M23 frame to be used as a maintenance link between the end points.

CT3 Channelized Dual-Wide Port Adapter Overview

The CT3 channelized dual-wide port adapter (PA-CT3/4T1) functions very much like an M13 multiplexer with each T1 line terminating with or originating into or from an HDLC controller on the port adapter. The PA-CT3/4T1 port adapter offers 28 individual T1 channels (bundled in the T3) for serial transmission of data. Each of the T1 channels uses a portion of the T1 bandwidth (fractional T1) or the entire T1 bandwidth for data transmission. Usable bandwidths for each T1 are n x 56 Kbps or n x 64 Kbps, where *n* is a number from 1 to 24. The unused portion of the T1 bandwidth, when not running at full T1 speeds, cannot be used and is filled with idle channel data.

Note   The n x 56-Kbps bandwidths are only available on DS1s 21 through 28. T1 channels on the PA-CT3/4T1 port adapter are numbered 1–28, rather than the more traditional zero-based scheme (0–27) used with other Cisco products. This is to ensure consistency with Telco numbering schemes for T1 channels within channelized T3 equipment.

The T3 section of the PA-CT3/4T1 port adapter supports the maintenance data link channel (C-BIT parity) as well as payload and network loopbacks. The T1 section of the PA-CT3/4T1 port adapter supports facilities data link (FDL) in extended super frame (ESF) framing, as well as network and payload loopbacks. Bit error rate testing (BERT) is supported on each of the T1 links. The BERT testing is *only* done over a framed T1 signal. The M13 multiplexer performs M12 multiplexing on 4 four T1 signals. (There are seven M12 multiplexers available on board.) The seven M12 multiplexers pass their data to the M23 multiplexer, which takes the seven tributaries and formats them into a DS3 stream. This transmit stream is passed on to the T3 line interface unit (LIU) for transmission out of the BNC connector into a 75-ohm coaxial line.

The first three T1 channels of the channelized T3 can be broken out, under software control, to the three DB-15 connectors on the front of the PA-CT3/4T1 port adapter for further demultiplexing via a MultiChannel Interface Processor (MIP). This allows three (the first three) of the 28 T1 streams in the channelized T3 to be a channelized T1 stream.

The broken-out T1(s) are sent to a T1 LIU, which transmits the T1(s) at the DSX-1 level. (DSX-1 refers to the cross connection point for DS-1 signals.) When operating in this mode, these ports are *not* CSU ports. They do *not* detect loop codes, provide ones-density requirements, or respond to any FDL messages. The receiving end (MIP) must provide the CSU functionality. Under software control, each external T1 port can be disabled or enabled.

The PA-CT3/4T1 port adapter does *not* support the aggregation of multiple T1s (called *inverse muxing* or *bonding*) for higher bandwidth data rates. The PA-CT3/4T1 port adapter supports Cisco HDLC, Frame Relay, PPP, and SMDS Data Exchange Interface (DXI) encapsulations over each T1 link. For SMDS only, DXI is sent on the T1 line so it needs to connect to an SMDS switch that has direct DXI input.

There is a special DB-15 connector on the PA-CT3/4T1 port adapter, labeled *TEST*. This test connector allows you to break out any T1 of the T3 stream, under software control. This functionality allows you to break out any of the 28 T1s within the T3 stream for testing (for example, 24-hour BERT testing as is commonly done by telephone companies before a line is brought into service), or for further channelization via a MIP card.

Location of PA-CT3/4T1 Port Adapter in a Cisco 7200 Series Router

Figure 2 shows a Cisco 7206 router with port adapters installed. In the Cisco 7206 router, port adapter slot 1 is in the lower left position, and port adapter slot 2 is in the lower right position. (The CT3 channelized port adapter can be installed in any horizontal pair of these slots; use the odd-numbered slot number associated with the left-side slots.)
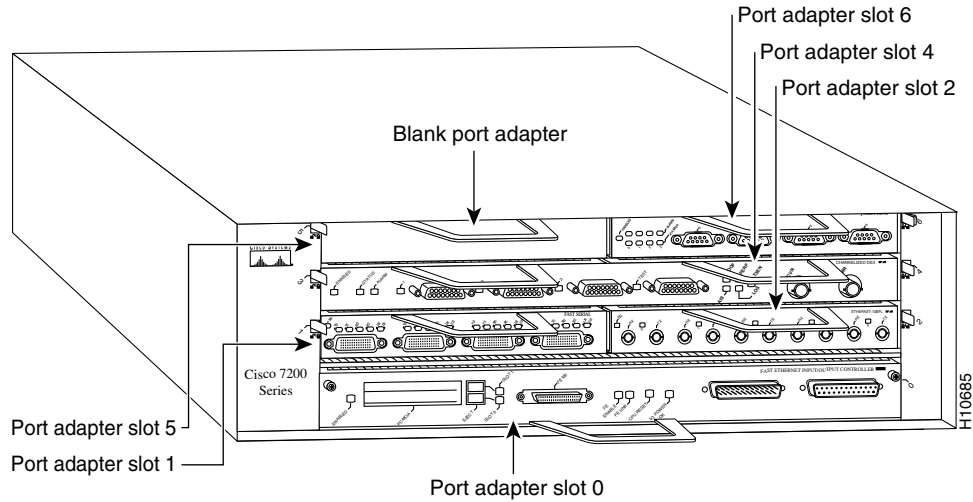
Note The PA-CT3/4T1 port adapter is a high-speed port adapter. No more than two PA-CT3/4T1 port adapters can be installed in a Cisco 7200 series router. Any other configuration is not supported.

Also, the PA-CT3/4T1 port adapter can be used only on a Cisco 7200 series router that has a 150-MHz or 200-MHz network processor.

**Figure 2   Port Adapter Slots in the Cisco 7206 Router**

PA-CT3/4T1 Port Adapter Cables

For T1, two standard serial cables, null-modem and straight-through, are available from Cisco Systems and other vendors for use with the PA-CT3/4T1 port adapter. The PA-CT3/4T1 port adapter T1 interface cables are used to connect your router to external CSUs or a MIP card. The PA-CT3/4T1 port adapter T1 interface cables have two male 15-pin DB connectors at each end to connect the PA-CT3/4T1 port adapter's T1 interfaces.

Figure 3 shows the PA-CT3/4T1 port adapter interface cable, connectors, and pinouts. Table 1 lists the signal pinout for the straight-through cable. Table 2 lists the signal pinout for the null-modem cable.

Figure 3   PA-CT3/4T1 Port Adapter T1 Interface Cable and Connectors
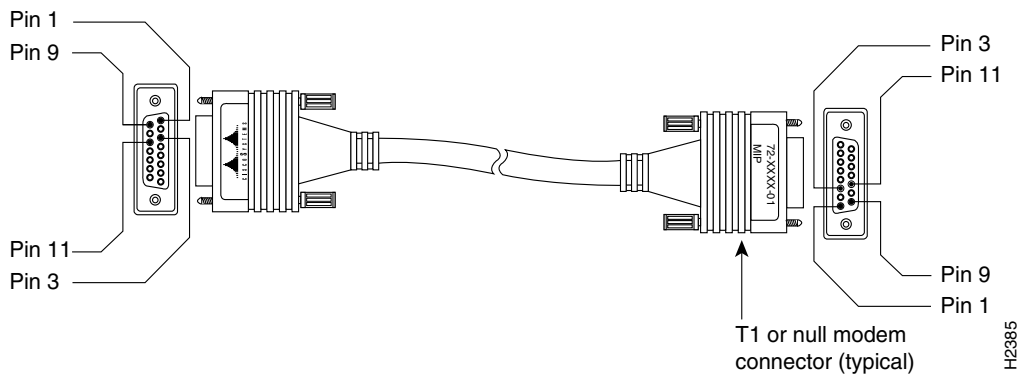
Table 1   T1 Straight-Through Cable Signals

DB-15 Connector		DB-15 Connector	
Pin	**Signal[1]**	**Pin**	**Signal**
1	Tx tip	1	Tx tip
3	Rx tip	3	Rx tip
9	Tx ring	9	Tx ring
11	Rx ring	11	Rx ring
Case	Ground/shield	Case	Ground/shield

1. Tx = transmit. Rx = receive.

Table 2   T1 Null-Modem Cable Signals

DB-15 Connector		DB-15 Connector	
Pin	**Signal[1]**	**Pin**	**Signal**
1	Tx tip	3	Rx tip
3	Rx tip	1	Tx tip
9	Tx ring	11	Rx ring
11	Rx ring	9	Tx ring
Case	Ground/shield	Case	Ground/shield

1. Tx = transmit. Rx = receive.

Compliance and Electrical Interface Specifications for T3 and T1

The T3 line interface unit (LIU) is designed to meet the following specifications:

- ANSI T1.102 - 1987

- BELLCORE TR-TSY-000499

The T3 LIU is compliant for the above specifications for input jitter tolerance, pulse shape/amplitude (DSX3), line termination, and jitter. The LIU has a flat transfer function so jitter introduced by the LIU is insignificant.

The PA-CT3/4T1 port adapter's T3 port is designed to receive and transmit at the DSX-3 level while driving and receiving from a 75-ohm coaxial cable (ATT 728A type coax). It connects directly to any equipment with DSX-3 level BNC connectors. The T3 front end is designed to meet the following specifications:

- Line rate: 44.736 Mbps (± 20 ppm)

- Line code: B3ZS (bipolar with three-zero substitution)

- Impedance: 75 ohms

- Pulse shape: ANSI T1.102, pulse amplitude is between 0.36 and 0.85 volts (V) peak.

- Input signal: DSX-3 (9.7 db to -11.8 db)

- Output signal: DSX-3, able to drive 450 feet (135 meters) of 75-ohm coaxial cable (728A or equivalent) and meet pulse shape template at the line side.

The T1 LIU is designed to meet the following specifications. (See also Table 3.)

- ANSI 62411

- BELLCORE TR499

The T1 LIU is designed to meet the preceding specifications for input jitter tolerance, pulse shape/amplitude (DSX1), line termination, and jitter. The LIU has a relatively flat transfer function so jitter introduced by the LIU is minimal.

The PA-CT3/4T1 port adapter T1 ports are designed to receive and transmit at the DSX-1 level while driving and receiving from a 100-ohm twisted-pair cable. It connects directly to any equipment with DSX-1 level input/output. The T1 front end is designed to meet the following specifications:

- Line rate: 1.544 Mbps (± 32ppm)

- Line code: AMI/B8ZS (bipolar with eight-zero substitution) on only the four external ports

- Impedance: 100 ohms

- Pulse shape: ANSI T1.102, pulse amplitude is between 2.4 and 3.6V peak.

- Input signal: DSX-3 (3 db to –13.6 db)

- Output signal: DSX-1 able to drive 655 feet (199.6 meters) of 75-ohm twisted-pair cable and to meet DSX-1 pulse shape template at the line side.

Table 3   T1 Channel Data Rates

T1 Channel No.	Data Rates
1–20	n x 64 Kbps up to full T1 (1.536 Mbps)
21–28	n x 56 Kbps up to full T1 (1.344 Mbps) or n x 64 Kbps up to full T1 (1.536 Mbps)

PA-CT3/4T1 Port Adapter Installation Prerequisites

Before you begin the installation, review the guidelines in this section to assure proper system operation, avoid injuring yourself, or damaging the equipment.

This section provides software requirements, a list of parts and tools you will need to perform the port adapter installation, and safety and ESD-prevention guidelines to help you avoid injury and damage to the equipment during installation. This section also includes information on the systems in which port adapters can be installed and overview information on interface specifications.

Note The PA-CT3/4T1 port adapter is a high-speed port adapter. No more than two PA-CT3/4T1 port adapters can be installed in a Cisco 7200 series router. Any other configuration is not supported.

The following sections present general information and information about port adapter installation requirements:

- Software and Hardware Requirements, page 9

- List of Parts and Tools, page 9

- Safety Guidelines, page 10

Software and Hardware Requirements

The PA-CT3/4T1 port adapter is compatible with any Cisco 7200 series router that is operating with Cisco IOS Release 11.1.16(CA) or later.

The PA-CT3/4T1 port adapter and Cisco 7200 series router's network processor memory configurations include the following:

- NPE-150 (150-MHz network processor)—1 MB of SRAM and up to 128 MB of DRAM

- NPE-200 (200-MHz network processor)—4 MB of SRAM and up to 128 MB of DRAM

Note For specific software features and commands available for the PA-CT3/4T1 port adapter and the Cisco IOS release in which they are supported, refer to the Cisco IOS release note specific to your Cisco IOS release.

Note For port adapter hardware and memory configuration guidelines for Cisco 7200 series routers, refer to the document *Cisco 7200 Series Port Adapter Hardware Configuration Guidelines*.

To determine if your Cisco 7200 series router is compatible with the PA-CT3/4T1 port adapter, use the **show version** command to display the current hardware configuration of the router, including the system software version that is currently loaded and running.

In the following example, the running system software is Release 11.1.16(CA).

```
Router> show version
Cisco Internetwork Operating System Software
IOS (tm) 7200 Software (C7200-P-M), Version 11.1.16(CA)
Synced to mainline version: 11.1(12.1)
Copyright (c) 1986-1997 by cisco Systems, Inc.
Compiled Mon 30-Jun-97 08:45
```

You can check the version of the default ROM image by removing the board and checking the ROM labels, or by configuring the interface or system software to boot from ROM, restarting the system, and using these same commands to check the running version.

If the displays indicate that the running system software is earlier than Cisco IOS Release 11.1.16(CA) or later, check the contents of Flash memory to determine if the required images are available on your system. The **show flash** command displays a list of all files stored in Flash memory.

The **show microcode** command displays a list of all the microcode images currently bundled with the Cisco IOS software. If these displays indicate that the required system software and microcode are *not* available, contact a service representative for upgrade information. For information on additional **show** commands, refer to "Command Descriptions and Examples" on page 32 .

List of Parts and Tools

You need the following parts and tools to install a PA-CT3/4T1 port adapter. If you need additional equipment, ask your service representative for ordering information.

- Channelized T3 port adapter—PA-CT3/4T1(=)

- T1 CSU to connect the PA-CT3/4T1 port adapter with the external network

- T1 interface cables to connect the PA-CT3/4T1 port adapter and CSU:

  — Null-modem cable—CAB-7KCT1NULL(=) or equivalent

  — Straight-through cable—CAB-7KCT1DB15(=) or equivalent

- ESD-preventive equipment or the disposable grounding wrist strap included with the PA-CT3/4T1 port adapter

Safety Guidelines

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

Safety Warnings

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

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

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

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

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

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

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

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

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

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

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

Electrical Equipment

Follow these basic guidelines when working with any electrical equipment:

- Before beginning any procedure 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, and 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

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

- Never install telephone wiring during a lightning storm.

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

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

- Use caution when installing or modifying telephone lines.

Preventing Electrostatic Discharge Damage

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

Use these guidelines to prevent ESD damage:

- Always use an ESD wrist or ankle strap and ensure that it makes good skin contact.

- Connect the equipment end of the strap to an unfinished chassis surface.

- When installing a component, use any available ejector levers or captive installation screws to properly seat the bus connectors in the backplane or midplane. These devices prevent accidental removal, provide proper grounding for the system, and help to ensure that bus connectors are properly seated.

- When removing a component, use any available ejector levers or captive installation screws to release the bus connectors from the backplane or midplane.

- Handle carriers by available handles or edges only; avoid touching the printed circuit boards or connectors.

- Place a removed component board-side-up on an antistatic surface or in a static shielding container. If you plan to return the component to the factory, immediately place it in a static shielding container.

- Avoid contact between the printed circuit boards and clothing. The wrist strap protects components from ESD voltages on the body only; 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.

Guidelines for Port Adapter Removal and Installation

This section describes mechanical functions of system components, emphasizes the importance of following correct procedures to avoid unnecessary board failures, and is for background only; specific procedures follow in the section "Installing or Removing a Port Adapter in a Cisco 7200 Series Router" on page 14 .

You can remove and replace port adapters while the system is operating; you do not need to notify the software or reset the system power. This functionality enables you to add, remove, or replace port adapters with the system online, which provides a method that is seamless to end users on the network, maintains all routing information, and ensures session preservation.

After a port adapter is reinstalled, the system brings on line only interfaces that match the current configuration and were previously configured as up; all others require that you configure them with the **configure** command. .

Caution   The system can indicate a hardware failure if you do not follow proper procedures. Remove or insert only one port adapter at a time. Allow at least 15 seconds for the system to complete the preceding tasks before removing or inserting another port adapter. Disrupting the sequence before the system completes its verification can cause the system to interpret hardware failures.

All port adapters have ejector levers that allow you to firmly seat a port adapter in the port adapter slot. The function of the ejector levers is to align and seat the card connectors in the backplane. Failure to use the ejector levers and insert the port adapter properly can disrupt the order in which the pins make contact with the backplane.

Follow the installation and removal instructions carefully, and review the following examples of *incorrect* insertion practices and results:

- Using the handle to force the port adapter all the way into the slot can pop the ejector levers out of their springs. If you then try to use the ejector levers to seat the port adapter, the first layer of pins (which are already mated to the backplane) can disconnect and then remate with the backplane, which the system interprets as a board failure.

- Using the handle to force or slam the port adapter all the way into the slot can also damage the pins on the board connectors if they are not aligned properly with the backplane.

- When using the handle (rather than the ejector levers) to seat the port adapter in the backplane, you might need to pull the port adapter back out and push it in again to align it properly.

- Even if the connector pins are not damaged, the pins mating with and disconnecting from the backplane will cause the system to interpret a board failure. Using the ejector levers ensures that the board connector mates with the backplane in one continuous movement.

- Using the handle to insert or remove a port adapter, or failing to push the ejector levers to the full parallel position, can leave some (not all) of the connector pins mated to the backplane, a state which will hang the system. Using the ejector levers and making sure that they are pushed fully into position ensures that all three layers of pins are mated with (or free from) the backplane.

It is also important to use the ejector levers when removing a port adapter to ensure that the board connector pins disconnect from the backplane in the logical sequence expected by the system. Any port adapter that is only partially connected to the backplane can hang the bus. Detailed steps for correctly installing and removing the port adapter follow.

For detailed directions about removal and installation, follow the procedures in the section "Installing or Removing a Port Adapter in a Cisco 7200 Series Router" on page 14 ..

⚠ **Caution** Always use the ejector levers to remove or install the PA-CT3/4T1 port adapter. The ejectors help ensure that backplane connectors on the card are fully seated in, or fully ejected from, the backplane. Failure to use the ejector levers could result in a partial backplane connection, which can hang the system.

Installing or Removing a Port Adapter in a Cisco 7200 Series Router

The PA-CT3/4T1 port adapter can be installed in any available, horizontally aligned pair of port adapter slots in a Cisco 7200 series router. Figure 4 shows a PA-CT3/4T1 port adapter installed in port adapter slot 3 and slot 4 of a Cisco 7206 router.

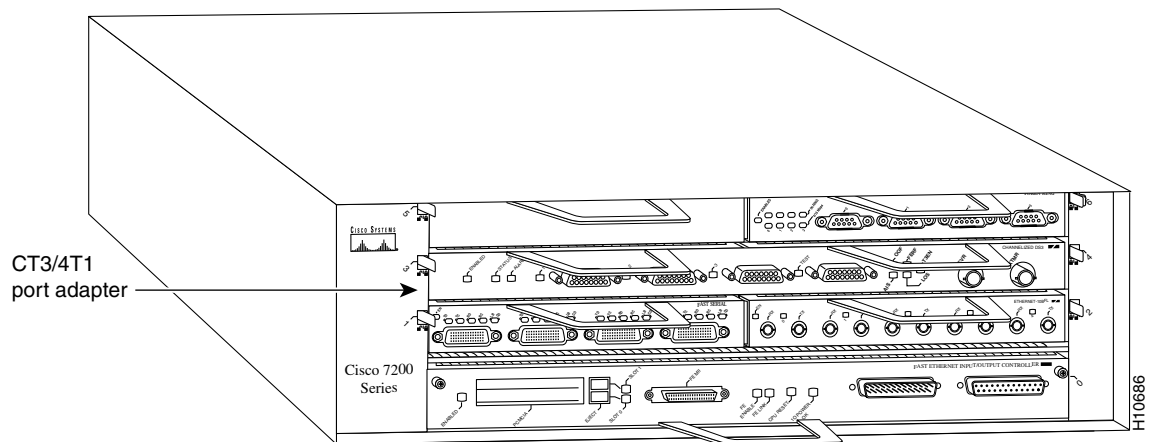**Note** The slot number used shall be that of the odd-numbered left-side slots in the Cisco 7200 series router.

Note You can install up to two PA-CT3/4T1 port adapters in a Cisco 7200 series router. No other configuration is supported.

Figure 4   **Cisco 7206 Router with a PA-CT3/4T1 Port Adapter in Port Adapter Slot 4**

- An ESD-preventative wrist strap

If you plan to remove a PA-CT3/4T1 port adapter or some other dual-wide port adapter from a Cisco 7200 series router and replace it with a PA-CT3/4T1 port adapter, use the instructions in these two sections:

1 Removing a Port Adapter, page 15

2 Installing a Dual-Wide Port Adapter, page 19

If, however, you are replacing two single-width port adapters (or port adapter blanks) in a Cisco 7200 series router with a new PA-CT3/4T1 port adapter, you first need to remove the port adapter slot divider before you can install the PA-CT3/4T1 port adapter. To do so, use the instructions in these sections:

1 Removing a Port Adapter, page 15

2 Removing and Replacing a Port Adapter Slot Divider, page 17

Note Installing a Dual-Wide Port Adapter, page 19The Cisco 7200 series routers support online insertion and removal (OIR); therefore, you do not have to power down the Cisco 7200 series router when you are removing and replacing a PA-CT3/4T1 port adapter.

When a port adapter slot is not in use, a blank port adapter must fill the empty slot. This allows the router to conform to EMI emissions requirements and helps provide proper air flow across the port adapters. If you plan to install a new port adapter in a slot that is not in use, you must first remove a blank port adapter.

Removing a Port Adapter

The PA-CT3/4T1 port adapter requires two adjacent port adapter slots in a Cisco 7200 series router.

Here is the procedure for removing a port adapter from a Cisco 7200 series router:

Step 1 Attach an ESD-preventive wrist strap to yourself and to an unfinished chassis surface.

Step 2 Move the port adapter lever for the desired port adapter slot to the unlocked position. (See Figure 5.)

Note If you plan to remove only one port adapter, unlock only its port adapter lever. If you plan to remove two adjacent port adapters, in preparation for installing a dual-wide port adapter, unlock both port adapter levers as shown in Figure 5.

Figure 5   **Placing the Port Adapter Lever in the Unlocked Position (Cisco 7206 Shown)**

Port adapter
handle

Port adapter
lever (unlocked
position)
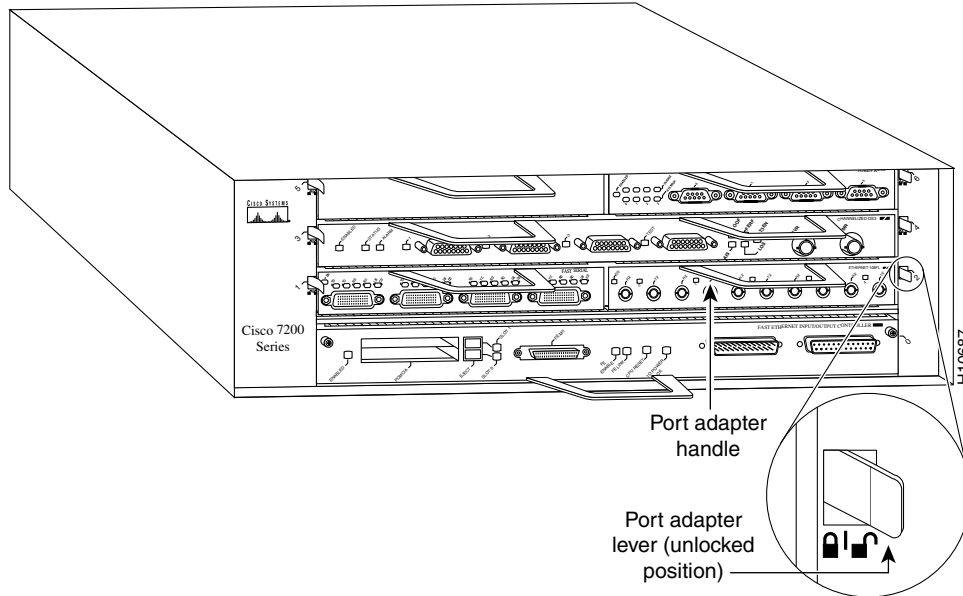
Step 3   Grasp the two handles on the port adapter and pull the port adapter from the midplane, about halfway out of its slot. If you are removing a blank port adapter, pull the blank port adapter out of the chassis slot.

Note   As you disengage the port adapter from the router midplane, the OIR feature administratively shuts down all active interfaces on the port adapter.

Step 4   With the port adapter halfway out of the slot, disconnect all cables from the port adapter.

Step 5   After disconnecting the cables, pull the port adapter from its chassis slot..

Caution   Always handle the port adapter by the carrier edges and handles; never touch the port adapter's components or connector pins. (See Figure 6.)

Figure 6   **Handling a Port Adapter**

Metal carrier

Printed circuit board
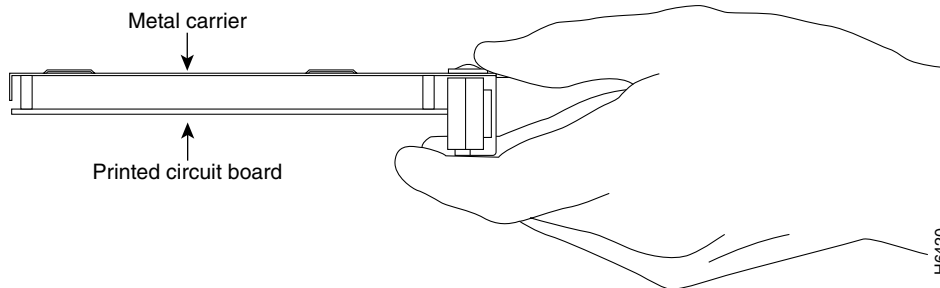
Step 6   Place the port adapter on an antistatic surface with its components facing upward, or in a static shielding bag. If you are returning the port adapter to Cisco, immediately place it in a static shielding bag.

Note If you plan to remove two adjacent port adapters in preparation for installing a dual-wide port adapter, repeat Steps 2 through 6; otherwise, this completes the procedure for removing port adapters from a Cisco 7200 series router.

If you plan to replace two single-width port adapters with a new PA-CT3/4T1 port adapter, you need to first remove the port adapter slot divider before you can install the PA-CT3/4T1 port adapter; therefore, proceed to the section "Removing and Replacing a Port Adapter Slot Divider" on page 17 .

# Removing and Replacing a Port Adapter Slot Divider

The following sections explain how to remove and replace a port adapter slot divider in a Cisco 7200 series router. If you are replacing a PA-CT3/4T1 port adapter, this slot divider is already removed and you can proceed to the section "Installing a Dual-Wide Port Adapter" on page 19 .

Removing a Port Adapter Slot Divider

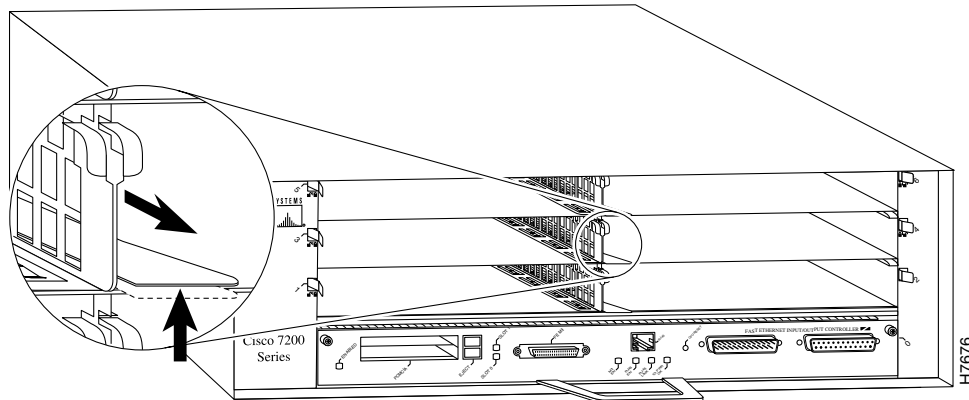Following is the procedure for removing a port adapter slot divider from a Cisco 7200 series router:

Step 1   Remove the port adapters from the slots on both sides of the port adapter slot divider. Refer to the previous section "Removing a Port Adapter" on page 15 when removing a port adapter from a Cisco 7200 series router.

Step 2   With one hand, raise the slot divider lever to unlock the slot divider from the chassis. (See Figure 7.)

Figure 7   Lifting the Slot Divider Lever (Cisco 7206 Shown)
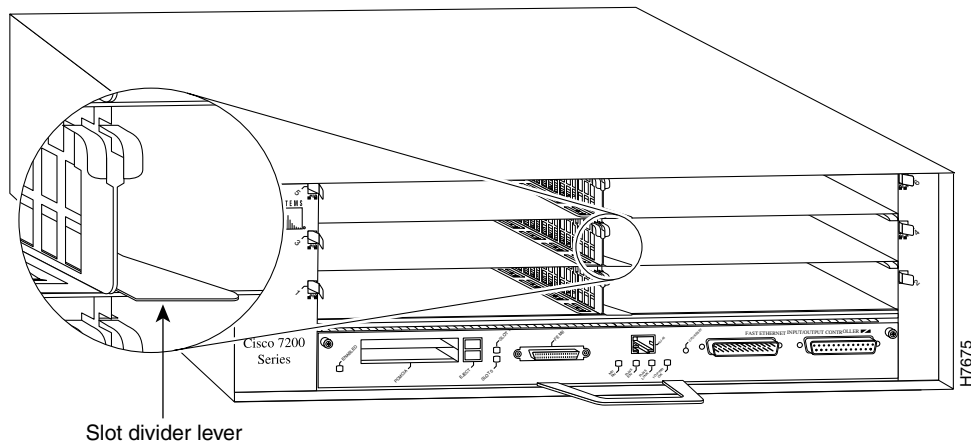
Slot divider lever

Step 3   With the slot divider lever still raised, use your other hand to pull the slot divider from the chassis. (See Figure 8.)

Figure 8   Pulling the Slot Divider from the Chassis (Cisco 7206 Shown)

Step 4   Store the slot divider for use at a later date.

This completes the procedure for removing a port adapter slot divider from a Cisco 7200 series router. Proceed to the section "Installing a Dual-Wide Port Adapter" on page 19 .

Replacing a Port Adapter Slot Divider

Following is the procedure for installing a port adapter slot divider in a Cisco 7200 series router.


Note   You might need to replace the port adapter slot divider at some future time; if so, use the following procedure.

Step 1   Position the slot divider so that the slot divider lever faces you and is at the bottom.

Step 2   Align the left and right edges of the slot divider between the guides in the port adapter slot. (See Figure 9.)

Figure 9   Aligning the Slot Divider Between the Slot Guides (Cisco 7206 Shown)
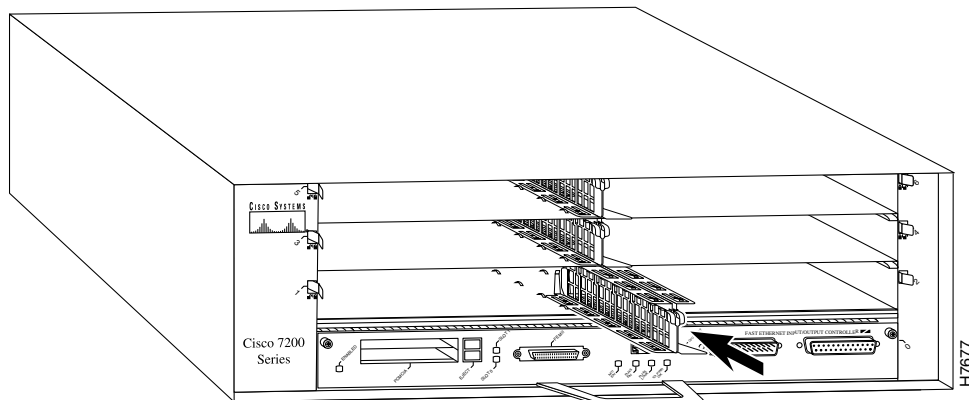
Step 3   With the left and right edges of the slot divider aligned in the slot guides, slide the slot divider all the way into the slot until you feel the slot divider lock into place (listen for a click).

This completes the procedure for installing a port adapter slot divider in a Cisco 7200 series router.

Installing a Dual-Wide Port Adapter

Following is the procedure for installing a new dual-wide port adapter in a Cisco 7200 series router:

Step 1 Attach an ESD-preventive wrist strap to yourself and to an unfinished chassis surface.

> **Note** Because the PA-CT3/4T1 port adapter is a dual-wide port adapter, you must remove the separator between the two horizontally aligned slots on the Cisco 7200 series router. Refer to the section "Removing and Replacing a Port Adapter Slot Divider" on page 17 .

Step 2 Use both hands to grasp the port adapter by its metal carrier edges with the adapter components facing downward. (See Figure 6.)

Step 3 Align the left and right edges of the port adapter metal carrier between the guides in the port adapter slot. (See Figure 10.)

Figure 10   **Aligning the Port Adapter Metal Carrier Between the Slot Guides (Cisco 7206 Shown)**
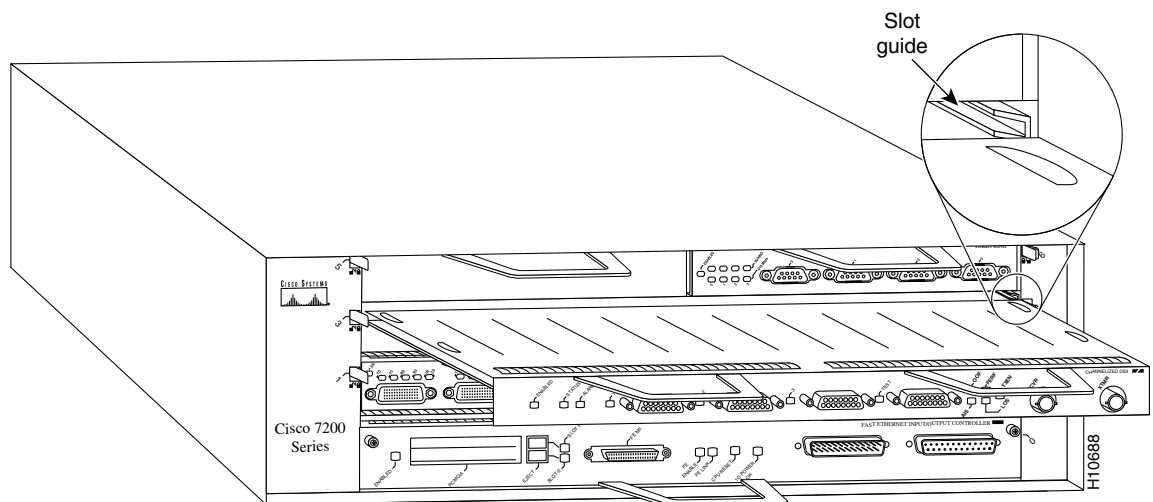
Step 4 With the metal carrier edges aligned in the slot guides, gently slide the port adapter halfway into the slot..

> **Caution** Do not slide the port adapter all the way into the slot until you have connected all cables. Doing so disrupts normal operation of the router.

Step 5 With the port adapter halfway into the slot, connect all required cables to the port adapter.

Step 6 After connecting all required port adapter cables, carefully slide the port adapter all the way into the slot until you feel the port adapter's connectors mate with the midplane.

Step 7 After feeling the connectors mate, move the port adapter lever to the locked position. Figure 11 shows the port adapter lever in the locked position.

> **Note** If the port adapter lever does not move to the locked position, the port adapter is not properly seated in the midplane. Carefully pull the port adapter halfway out of the slot, reinsert it, and move the port adapter lever to the locked position.

Figure 11   **Port Adapter Lever in the Locked Position (Cisco 7206 Shown)**
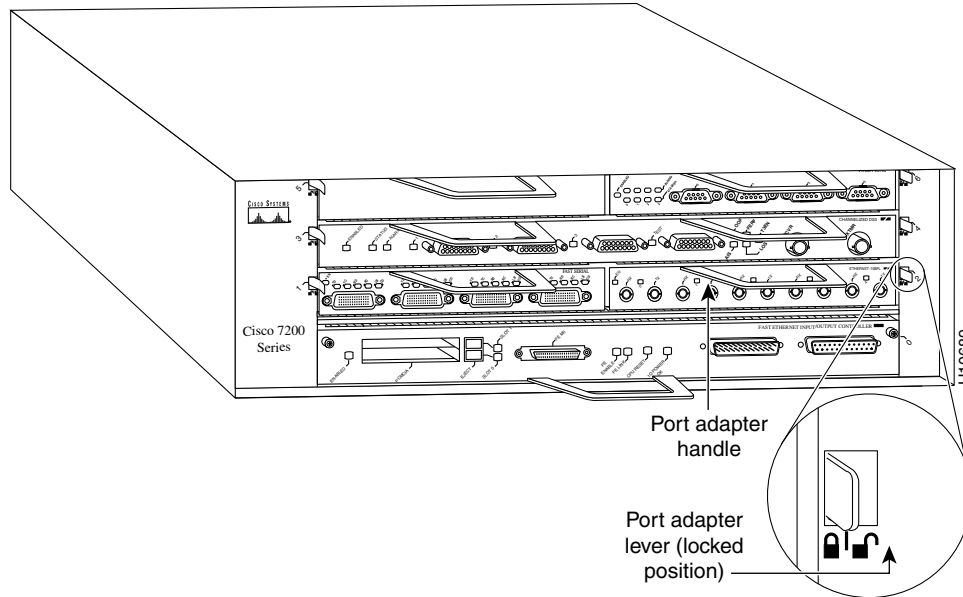
This completes the procedure for installing a new port adapter in a Cisco 7200 series router.

Attaching Network Interface Cables to the PA-CT3/4T1 Port Adapter

Attach the PA-CT3/4T1 port adapter network interface cables between the port adapter interface ports and the CSU. This includes up to four T1 cables and two DS1 BNC cables. (See Figure 12.) Proceed to the following section to check the cable connections.

Figure 12   Connecting Interface Cables to the CT3 Channelized Port Adapter

To appropriate
transmitter
connection

To appropriate
receiver
connection

To CSU
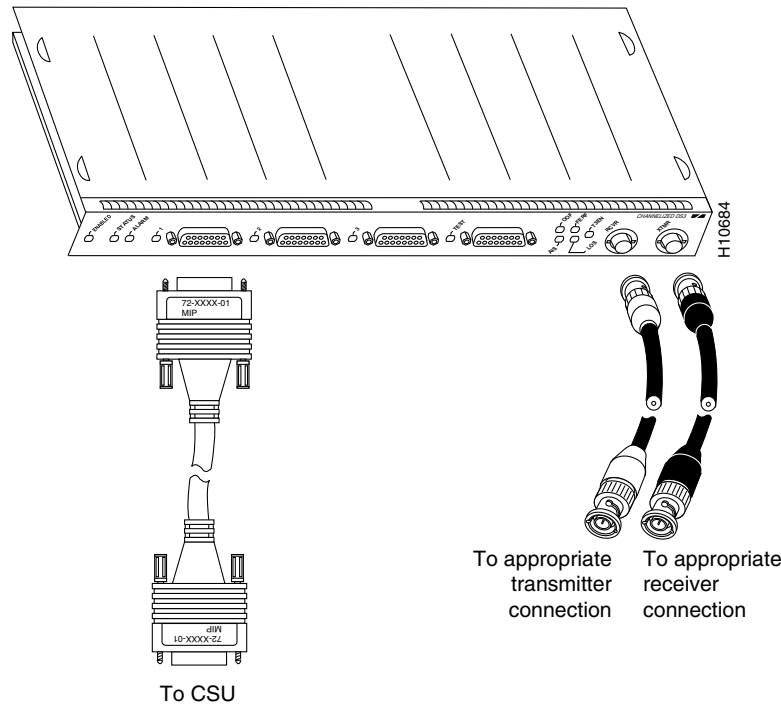
Using LEDs to Check PA-CT3/4T1 Port Adapter Initialization

The PA-CT3/4T1 port adapter has several status LEDs on its faceplate. (See Figure 13.)

Figure 13   PA-CT3/4T1 Port Adapter LEDs, Horizontal Orientation
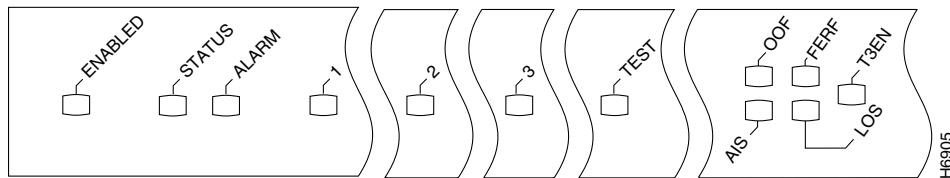
Following are the functions of the PA-CT3/4T1 port adapter LEDs:

- Status—This green CPU status LED is set by the support processor after it is booted and indicates that the current status of the support processor is booted and operational. Only when downloaded microcode is successfully operating will this LED be on continuously.

- Alarm—This yellow LED indicates that a T3 or T1 alarm condition is currently active.

For additional functions of the status and alarm LEDS, refer to the section "Using Status and Alarm LED Indications" on page 38 .

The individual 1, 2, 3, and test LEDS next to each T1 port indicate the following: This green LED will go on when the respective port is enabled. When the port is not enabled, the LED is off.

The remaining five LEDs, between the TEST and T3 ports, indicate the following:

- OOF—This yellow out-of-frame LED goes on when there is an out-of-frame condition.

- FERF —This yellow far-end-receive-failure LED goes on when the receive DS3 stream indicates the presence of a far-end-receive failure.

- AIS—This yellow alarm-indication-signal LED goes on when the receive DS3 stream indicates the presence of AIS.

- LOS—This yellow loss-of-signal LED pulses or stays on when 175 successive zeros are detected on the DS3 input stream. Indicates a loss of signal, a loss of frame, or unavailability due to excessive errors.

- T3EN—This green LED is on when the T3 is enabled via software and means that the internal relay is on, thereby connecting the T3 to the BNC connector.

Note For additional functions of the status and alarm LEDS, refer to the section "Using Status and Alarm LED Indications" on page 38 .

Observe the LED states and the console displays as the router initializes. When the system has reinitialized all interfaces, the enabled LED on the PA-CT3/4T1 port adapter should go on.

The console screen will also display a message as the system discovers each interface during its reinitialization. After system initialization, the enabled LED goes on to indicate that the PA-CT3/4T1 port adapter is enabled for operation.

The following conditions must be met before the PA-CT3/4T1 port adapter is enabled:

- The PA-CT3/4T1 port adapter is correctly connected to the backplane and receiving power.

- The system bus recognizes the PA-CT3/4T1 port adapter.

- A valid version of PA-CT3/4T1 port adapter microcode is loaded and running.

If any of these conditions is not met, the enabled LED does not go on.

Verify that the PA-CT3/4T1 port adapter is connected correctly as follows:

Step 1 While the system reinitializes each interface, observe the console display messages and verify that the system discovers the PA-CT3/4T1 port adapter. The system should recognize the PA-CT3/4T1 port adapter's interfaces but leave them configured as *down*.

Step 2 When the reinitialization is complete, verify that the enabled LED on the PA-CT3/4T1 port adapter is on and remains on. If the LED does stay on, proceed to Step 5. If the enabled LED does not stay on, proceed to the next step.

Step 3 If the enabled LED on the PA-CT3/4T1 port adapter fails to go on, suspect the that the PA-CT3/4T1 port adapter board connector is not fully seated in the backplane. After the system reinitializes the interfaces, the enabled LED on the PA-CT3/4T1 port adapter should go on. If the enabled LED goes on, proceed to Step 5. If the enabled LED does not go on, proceed to the next step.

Step 4 If the enabled LED still fails to go on, remove the PA-CT3/4T1 port adapter and try installing it in another available port adapter slot.

- If the enabled LED goes on when the PA-CT3/4T1 port adapter is installed in the new slot, suspect a failed backplane port in the original port adapter slot.

- If the enabled LED still fails to go on, but other LEDs on the PA-CT3/4T1 port adapter go on to indicate activity, proceed to Step 5 to resume the installation checkout and suspect that the enabled LED on the PA-CT3/4T1 port adapter has failed.

- If no LEDs on the PA-CT3/4T1 port adapter go on, suspect that the PA-CT3/4T1 port adapter is faulty.

- If the enabled LED still does not go on, do not proceed with the installation. Contact a service representative to report the faulty equipment and obtain further instructions.

Step 5 Use the **show interfaces** command to verify the status of the PA-CT3/4T1 port adapter's interfaces. (If the interfaces are not configured, you must use the procedures in the section "Configuring the T3 and T1 Interfaces" on page 23 , which are not available until you configure them.)

If an error message displays on the console terminal, refer to the appropriate reference publication for error message definitions. If you experience other problems that you are unable to solve, contact a service representative for assistance.

Configuring the T3 and T1 Interfaces

If you installed a new PA-CT3/4T1 port adapter or if you want to change the configuration of an existing controller, you must enter the Configuration mode. If you replaced the PA-CT3/4T1 port adapter that was previously configured, the system will recognize the new PA-CT3/4T1 port adapter and bring it up in the existing configuration.

After you verify that the new PA-CT3/4T1 port adapter is installed correctly, use the privileged-level **configure** command to configure the new PA-CT3/4T1 port adapter controller. Be prepared with the information you will need, such as the following:

- T3 information: for example clock source and framing type

- T1 information: for example clock source, line code, and framing type

- Channel information and timeslot mapping

- Protocols and encapsulations you plan to use on the new interfaces

- Internet protocol (IP) addresses if you plan to configure the interfaces for IP routing

- Whether the new interface will use bridging

For a complete summary of the configuration options available and more detailed instructions for configuring the PA-CT3/4T1 port adapter controller, refer to the appropriate configuration publications, which are listed in the section "If You Need More Information" on page 1 .

Using the EXEC Command Interpreter

Before you can use the **configure** command, you must enter the privileged level of the EXEC command interpreter with the **enable** command. The system will prompt 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, enter the privileged level as follows:

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.

Step 3 When you enter the correct password, the system displays the privileged-mode system prompt (#) as follows:

```
Router#
```

Note To save your configuration changes to NVRAM, use the **copy running-config startup-config** command at the privileged-mode system prompt.

Proceed to the following section to configure the PA-CT3/4T1 port adapter controller.

Interface Port Numbering for T1 and T3

The interface numbering scheme for the PA-CT3/4T1 port adapter's T1 interfaces is in the form of *slot/port:t1 channel* where *slot* refers to the chassis slot in which the PA-CT3/4T1 port adapter is installed; *port* refers to the physical port on the PA-CT3/4T1 port adapter and is always 0; and *t1 channel* is a number between 1 and 28. (Refer to the section "Configuring the T3 and T1 Interfaces" on page 23 , for more specific interface configuration information.)

Note T1 channels on the PA-CT3/4T1 port adapter are numbered 1–28, rather than the more traditional zero-based scheme (0–27) used with other Cisco products. This is to ensure consistency with Telco numbering schemes for T1 channels within channelized T3 equipment.

Designate and turn on an external T1 port (one of the three DB-15 connectors labeled *1* through *3*) using the **t1 external** *channel* command, where *t1 channel* is a number between 1 and 3.

Designate and turn on the T1 test port (the DB-15 connector labeled *TEST*) using the **t1 test** *channel* command, where *t1 channel* is a number between 1 and 28.

Port Numbering Examples and Sample Displays

Following are examples of PA-CT3/4T1 port adapter interface port numbering and sample displays:

- For T1 channel 5 on a PA-CT3/4T1 port adapter in chassis slot 3: 3/0:3

- For the T3 port on a PA-CT3/4T1 port adapter in chassis slot 5: 5/0:3

The following sample display shows the events logged by the system as the PA-CT3/4T1 port adapter was removed from slot 3; the system then reinitialized the remaining port adapters and marked as *down* the PA-CT3/4T1 port adapter when it is installed in slot 5. When the PA-CT3/4T1 port adapter was reinserted, the system marked the interfaces as *down* again because the PA-CT3/4T1 port adapter interfaces were not shut down before the PA-CT3/4T1 port adapter was removed.

```
Router#

%OIR-6-REMCARD: Card removed from slot 3, interfaces disabled
%LINK-5-CHANGED: Interfaces T1 3/0, changed to administratively down
```

When a new PA-CT3/4T1 port adapter is inserted, or when a PA-CT3/4T1 port adapter whose interfaces are shut down is moved to a new slot, the system recognizes the PA-CT3/4T1 port adapter controller, but leaves its interfaces in a *shutdown* state until you configure them and change the state to *up* with the **configure** command. If you move a PA-CT3/4T1 port adapter to a new slot and its interfaces were *not* shut down, the system recognizes them as not shut down when the PA-CT3/4T1 port adapter is installed in the new slot.

The following example display shows the events logged by the system as a new PA-CT3/4T1 port adapter is inserted in slot 5:

```
Router#
%OIR-6-INSCARD: Card inserted in slot 5, interfaces administratively shut down
%LINK-5-CHANGED: Interfaces T3 5/0, changed to administratively down
Router#
```

Configuration Guidelines and Configuration Command Examples

The following steps describe basic configuration guidelines and configuration command examples for the T3 and then T1 interfaces. Press the **Return** key after each step.

Configuring the T3 Interface

Following are the steps to configure the T3 interface:

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

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

Step 2 Specify the controller to configure by entering the subcommand **controller**, followed by **t3**, and *slot/port* (port adapter slot number/interface port number). The example that follows is for the PA-CT3/4T1 port adapter in port adapter slot 3for T3 channel 0:

```
Router(config)# cont t3 3/0
```

Step 3 At the prompt, specify the framing type using the **framing** [**c-bit** | **m23** | **auto-detect**] command: set c-bit framing format, as follows:

```
Router(config-controll)# framing c-bit
```

At the prompt, request the PA-CT3/4T1 port adapter to detect the framing type it is to receive from the far end, as follows:

```
Router(config-controll)# framing auto-detect
```

Step 4 Specify the cable length using the **cablelength** *feet* command, where feet is expressed as a numeral from 0 to 450, with the default value of 224 feet. Issue the **cablelength** command as follows:

```
Router(config-controller)# cablelength 200
```

Note For the **cablelength** *feet* command, user-specified T3 cable lengths are structured into ranges as follows: 0–224 and 225-450. If a cable length value is entered, which falls into one of these ranges, the range within which that value applies will be used.

In the preceding example, a cable length of 200 is specified. If it is changed to 220, then the 0–224 range applies in each case. Further, if a cable length of 300 is specified, then is changed to 400, the 225-450 range applies in each case; therefore, these changes have no effect. Only moving from one range to another has an effect. The actual number you enter is stored in the configuration file.

Step 5 Specify the clock source for the controller using the **clock source** [**internal** | **line**] command, which determines which end of the circuit provides the clocking.

```
Router(config-controll)# clock source line
```

If the PA-CT3/4T1 port adapter is not connected to an external clock source, you must use the **internal** option.

Note To shut down the T3 interface, use the **shutdown** command at the controller prompt.

Configuring MDL Messages

Maintenance Data Link (MDL) messages (which are defined in the ANSI T1.107a-1990 specification) can be configured on the PA-CT3/4T1 port adapter.

Note MDL messages are only supported when the DS3 framing is set for C-BIT parity; refer to Step 3 in the section "Configuring the T3 Interface" on page 25 .

To configure MDL messages, use the following controller configuration commands:

mdl {**transmit** {**path** | **idle-signal** | **test-signal**} | **string** {**eic** | **lic** | **fic** | **unit** | **pfi** | **port** | **generator**} *string*}

no mdl {**transmit** {**path** | **idle-signal** | **test-signal**} | **string** {**eic** | **lic** | **fic** | **unit** | **pfi** | **port** | **generator**} *string*}

where the command arguments are defined as follows:

- **eic**—equipment identification code (up to 10 characters)

- **lic**—location identification code (up to 11 characters)

- **fic**—frame identification code (up to 10 characters)

- **unit**—unit identification code (up to 6 characters)

- **pfi**—facility identification code to send in the MDL path message (up to 38 characters)

- **port**—the equipment port, which initiates the idle signal, to send in the MDL idle signal message (up to 38 characters)
- **generator**—generator number to send in the MDL test signal message (up to 38 characters)

Use the **no** form of this command to remove message. The default is that no MDL message is configured.

Examples of MDL Message Configuration

Following are examples of configuring MDL messages; enter controller Configuration mode first, as follows:

```
Router# conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)# cont t3 5/0
Router(config-controll)#
```

- Enter the equipment identification code, as follows:

```
Router(config-controll)# mdl string eic router A
```

- Enter the location identification code, as follows:

```
Router(config-controll)# mdl string lic test network
```

- Enter the frame identification code, as follows:

```
Router(config-controll)# mdl string fic buidling b
```

- Enter the unit identification code, as follows:

```
Router(config-controll)# mdl string unit abc
```

- Enter the facility identification code, to send in the MDL path message, as follows:

```
Router(config-controll)# mdl string pfi string
```

- Enter the port number to send in the MDL idle signal message, as follows:

```
Router(config-controll)# mdl string port string
```

- Enter the generator number to send in the MDL test signal message, as follows:

```
Router(config-controll)# mdl string generator string
```

- Enable the MDL path message transmission, as follows:

```
Router(config-controll)# mdl transmit path
```

- Enable the MDL idle signal message transmission, as follows:

```
Router(config-controll)# mdl transmit idle-signal
```

- Enable the MDL test signal message transmission, as follows:

```
Router(config-controll)# mdl transmit test-signal
```

Configuring the Logical T1 Interfaces

Following are the guidelines for configuring the logical T1 interfaces using controller configuration commands. Examples follow:

Step 1 Specify the channel and timeslots to be mapped using the **t1** *t1 channel* **timeslots** *range* [**speed** {**56** | **64**}] command.

Where T1 channels are 1–28, range supports contiguous timeslots as well as arbitrary timeslots, and a speed of 56 Kbps is only valid for T1 21–28 (default is 64 Kbps).

Examples follow:

Configure T1 1for full T1 bandwidth, as follows:

```
Router(config-controll)# t1 1 timeslots 1-24 speed 64
```

Configure the T1 20 to use timeslots 1 through 5 and timeslots 20 through 23 as follows:

```
Router(config-controll)# t1 20 timeslots 1-5,20-23
```

Configure the T1 21 for 24 x 56 Kbps as follows:

```
Router(config-controll)# t1 21 timeslot 1-24 speed 56
```

Step 2 Specify the T1 framing format using the **t1** *t1 channel* **framing** [**esf** | **sf**] command. The default is the extended super frame (ESF) framing format, and T1 channel is 1–28.

Examples follow:

Set super frame (SF) framing format for T1 6 as follows:

```
Router(config-controll)# t1 6 framing sf
```

Note You can use the [**no**] **t1** *t1 channel* **yellow** [**detection** | **generation**] command (where T1 channel is 1–28) to turn the detection or generation of a yellow alarm on and off. When you select SF framing, you should consider using the **no** *t1 channel* **yellow detection** command to turn off yellow alarm detection because the yellow alarm can be incorrectly detected with SF framing.

Set ESF framing format for T1 18 as follows:

```
Router(config-controll)# t1 18 framing esf
```

Step 3 Specify remote T1 line code using the **t1** *t1 channel* **linecode** [ami | b8zs] command. The default is b8zs, and the T1 channel is 1–28.

An example follows:

```
Router(config-controller)# t1 1 linecode ami
Router(config-controller)# int s3/0:0
Router(config-if)# invert data
```

Note The default for the logical T1 interfaces is noninverted data; however, if the *ami* argument is selected with the **linecode** command, inverted data is required (using the **invert data** interface subcommand) because the T1 channel is bundled into the T3 signal, so there are no local T1 line drivers and receivers associated with it. Therefore, the **t1 1 linecode ami** command does not modify local line driver settings. Rather, it advises the PA-CT3/4T1 port adapter what line code the remote T1 is using. The PA-CT3/4T1 port adapter uses this information solely for the purpose of determining whether or not to enable the pulse density enforcer for that T1 channel.

When the argument *b8zs* is selected, the pulse density enforcer will be disabled. When the *ami* argument is selected, the pulse density enforcer will be enabled. To avoid having the pulse density enforcer corrupt data, the T1 interface should be configured for inverted data, as described above, when the *ami* argument is selected.

Step 4   Specify the T1 clock source using the **t1** *t1 channel* **clock source** [**internal** | **line**] command, where the T1 channel is 1–28, and the default is network (line) clocking.

> **Note** If the PA-CT3/4T1 port adapter is not connected to an external clock source, you must use the **internal** option.

Examples follow:

Set internal clock source for T1 6 as follows:

```
Router(config-controll)# t1 6 clock source internal
```

Set network clock source for T1 1 as follows:

```
Router(config-controll)# t1 1 clock source line
```

To remove a T1 channel, use the **no t1** *t1 channel* **timeslots 1-24** command, where the T1 channel is 1–28. For example, remove the channel for T1 20 as follows:

```
Router(config-controll)# no t1 20 timeslots 1-24
```

Note After a T1 channel is configured, it appears to the Cisco IOS software as a serial interface; therefore, all the configuration commands for a serial interface are available. However, not all commands are applicable to the T1 interface. All the encapsulation formats, such as PPP, HDLC, SMDS, and Frame Relay are applicable to the configured T1. Encapsulation can be set via the serial interface configuration commands. All the switchings that are applicable to a serial interface, including the optimum switch, are also applicable to the configured T1 channel.

Configuring the External T1 Ports on a PA-CT3/4T1 Port Adapter

The following controller configuration commands are valid only to the first three T1 channels (T1 1 through 3) when they are broken out to the external T1 port. Configure a T1 Interface as an external port using the **t1 external** *t1 channel* [**linecode** {**b8zs** | **ami**}] [**cablelength** *feet*] command, where external T1 channels are 1–3, and the cable length range is 0–655 feet. The default values are as follows: line code is B8ZS; cable length is 133 feet.

(Use the **show controller t3** command to check the status of the external ports; refer to the example of this command on page 34 of the section "Command Descriptions and Examples" on page 32 .)

For example, configure T1 1 to be an external port as follows:

```
Router(config-controll)# t1 external 1 linecode ami cablelength 300
```

To remove a T1 interface from an external port, use the **no t1 external** *t1 channel* command, where external T1 channels are 1–3.

For example, remove T1 1 from external port 1 as follows:

```
Router(config-controll)# no t1 external 1
```

Note If a T1 channel that was previously configured as a serial interface is broken out to the external T1 port, that interface and its associated configuration remain intact while the channel is broken out to the external T1 port. The serial interface is not usable during the time the T1 channel is broken out to the external T1 port; however, the configuration remains to facilitate the return of the T1 channel to a serial interface with the **no t1 external** command.

Configuring the T1 Test Port on a PA-CT3/4T1 Port Adapter

The following controller configuration commands are valid only to the T1 test port. Configure the T1 test port using the **t1 test** *t1 test channel* [**linecode** {**b8zs** | **ami**}] [**cablelength** *feet*] command, where the T1 test channels are 1–28, and the cable length range is 0–655 feet. The default values are as follows: line code is B8ZS; cable length is 133 feet.

(Use the **show controller t3** command to check the status of the test port; refer to the example of this command on page 34 of the section "Command Descriptions and Examples" on page 32 .)

For example, bring T1 20 to the test port as follows:

```
Router(config-controll)# t1 test 20 lincecode ami cablelength 300
```

Note For both the **t1 external** *t1 channel* [**linecode** {**b8zs** | **ami**}] [**cablelength** *feet*] and **t1 test** *t1 test channel* [**linecode** {**b8zs** | **ami**}] [**cablelength** *feet*] commands, user-specified T1 cable lengths are structured into ranges as follows: 0–133, 134–266, 267–399, 400–533, and 534–655. If a cable length value is entered, which falls into one of these ranges, the range within which that value applies will be used.

In the preceding example, a cable length of 300 is specified. If it is changed to 350, then the 267–399 range applies in each case. Further, if a cable length of 550 is specified, then is changed to 600, the 534–655 range applies in each case; therefore, in each example, these changes have no effect. Only moving from one range to another has an effect. The actual number you enter is stored in the configuration file.

To remove a T1 port from the test port, use the **no t1 test** *t1 test channel* command, where T1 test channels are 1–28.

For example, remove T1 20 from the test port as follows:

```
Router(config-controll)# no t1 test 20
```

Note If a T1 channel that was previously configured as a serial interface is broken out to the T1 test port, that interface and its associated configuration remain intact while the channel is broken out to the T1 test port. The serial interface is not usable during the time the T1 channel is broken out to the T1 test port; however, the configuration remains to facilitate the return of the T1 channel to a serial interface with the **no t1 test** command.

Additional Commands for PA-CT3/4T1 Port Adapter Configuration

Following are additional commands required to complete the PA-CT3/4T1 port adapter configuration:

Step 1 Assign an IP address and subnet mask to the interface with the **ip address** configuration subcommand as in the following example:

```
Router(config-if)# ip address 1.1.15.1 255.255.255.0
Router(config-if)#
```

Step 2 Add any additional interface subcommands required to enable routing protocols and adjust the interface characteristics.

Step 3 After including all of the interface subcommands to complete the configuration, press **Ctrl-Z** (hold down the **Control** key while you press **Z**) to exit the configuration mode.

Step 4 Write the new configuration to memory as follows:

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

The system displays an OK message when the configuration is stored.

Step 5 Exit the privileged level and return to the user level by entering **disable** at the prompt as follows:

```
Router# disable
Router>
```

Proceed to the following section to check the interface configuration with **show** commands.

Checking the Configuration

After configuring the new interface, use the **show** commands to display the status of the new interface or all interfaces. Using the **show controller T3** *slot/port***:***t1 channel* command, display T3 or T1 channel information as follows, where the T1 channel is 1–28:

- Display the information for the T3 in slot 5:

  ```
  Router# show controller t3 5/0
  ```

- Display the information for T1 channel 5, for the T3 in slot 5:

  ```
  Router# show controller t3 5/0:5
  ```

- Display far-end ANSI performance monitor information when enabled on the T1 channel with the **t1 fdl ansi** controller command:

```
Router# show controller t3 5/0 remote performance
```

- Display less verbose information for a T3 in slot 5:

```
Router# show controller t3 5/0 brief
```

Command Descriptions and Examples

Following are descriptions and examples of the **show** commands. Descriptions are limited to fields that are relevant for verifying the configuration.

- The **show version** command displays the configuration of the system hardware (the channel of each port adapter type installed), the software version, the names and sources of configuration files, and the boot images.

Following is an example from a Cisco 7206 router:

```
Router# show version
Cisco Internetwork Operating System Software
IOS (tm) 7200 Software (C7200-P-M), Version 11.1.16(CA) [jkui 165]
Synced to mainline version: 11.1(12.1)
Copyright (c) 1986-1997 by cisco Systems, Inc.
Compiled Mon 30-Jun-97 08:45 by jkui
Image text-base: 0x600088D0, data-base: 0x604D2000

ROM: System Bootstrap, Version 11.1(5) [mkamson 5], RELEASE SOFTWARE (fc1)
ROM: 7200 Software (C7200-BOOT-M), Version 11.1.16(CA) [lali 189]

ct3-sw1 uptime is 2 hours, 34 minutes
System restarted by reload
System image file is "jkui/c7200-p-mz", booted via tftp from 171.69.209.28

cisco 7206 (NPE150) processor with 26624K/6144K bytes of memory.
R4700 processor, Implementation 33, Revision 1.0 (512KB Level 2 Cache)
Last reset from power-on
X.25 software, Version 2.0, NET2, BFE and GOSIP compliant.
4 Ethernet/IEEE 802.3 interfaces.
2 Serial network interfaces.
1 FDDI network interface.
125K bytes of non-volatile configuration memory.
1024K bytes of packet SRAM memory.

4096K bytes of Flash internal SIMM (Sector size 256K).
Configuration register is 0x0
```

- The **show controller** *type slot/port* command displays the status of the default T1 and T3 (which is specified in RFC 1406). The command **show controller t1** *slot/port* command displays the verbose information for a particular T1 including the T3 alarms and all 28 T1 alarms. (The port adapter and port arguments must always be 0.)

```
Router# show cont t3 5/0
T3 5/0 is up.
  Applique type is Channelized T3
  No alarms detected.
  Framing is C-BIT Parity, Line Code is B3ZS, Clock Source is Line.
  Data in current interval (120 seconds elapsed):
     1 Line Code Violations, 2 P-bit Coding Violation
     3 C-bit Coding Violation
     4 P-bit Err Secs, 5 P-bit Severely Err Secs
     6 Severely Err Framing Secs, 7 Unavailable Secs
     8 Line Errored Secs, 9 C-bit Errored Secs, 10 C-bit Severely Errored Secs
  Data in Interval 1:
     10 Line Code Violations, 12 P-bit Coding Violation
     0 C-bit Coding Violation
     14 P-bit Err Secs, 15 P-bit Severely Err Secs
     16 Severely Err Framing Secs, 17 Unavailable Secs
     18 Line Errored Secs, 19 C-bit Errored Secs, 20 C-bit Severely Errored Secs
  Data in Interval 2:
     10 Line Code Violations, 12 P-bit Coding Violation
     0 C-bit Coding Violation
     14 P-bit Err Secs, 15 P-bit Severely Err Secs
     16 Severely Err Framing Secs, 17 Unavailable Secs
     18 Line Errored Secs, 19 C-bit Errored Secs, 20 C-bit Severely Errored Secs
  Data in Interval 3:
     10 Line Code Violations, 12 P-bit Coding Violation
     0 C-bit Coding Violation
     14 P-bit Err Secs, 15 P-bit Severely Err Secs
     16 Severely Err Framing Secs, 17 Unavailable Secs
     18 Line Errored Secs, 19 C-bit Errored Secs, 20 C-bit Severely Errored Secs
  T1 0, speed: 1536 kbs
  timeslots: 1-24
  No alarms detected.
  Framing is ESF, LineCode is AMI, Clock Source is Line.
  Data in current interval (180 seconds elapsed):
     2 Line Code Violations, 1 Path Code Violations
     7 Slip Secs, 5 Fr Loss Secs, 8 Line Err Secs, 10 Degraded Mins
     3 Errored Secs, 9 Bursty Err Secs, 4 Severely Err Secs, 6 Unavail Secs
  Data in Interval 1:
     12 Line Code Violations, 11 Path Code Violations
     17 Slip Secs, 15 Fr Loss Secs, 18 Line Err Secs, 20 Degraded Mins
     13 Errored Secs, 19 Bursty Err Secs, 14 Severely Err Secs, 16 Unavail Secs
  Data in Interval 2:
     12 Line Code Violations, 11 Path Code Violations
     17 Slip Secs, 15 Fr Loss Secs, 18 Line Err Secs, 20 Degraded Mins
     13 Errored Secs, 19 Bursty Err Secs, 14 Severely Err Secs, 16 Unavail Secs
  Data in Interval 3:
     12 Line Code Violations, 11 Path Code Violations
     17 Slip Secs, 15 Fr Loss Secs, 18 Line Err Secs, 20 Degraded Mins
     13 Errored Secs, 19 Bursty Err Secs, 14 Severely Err Secs, 16 Unavail Secs
  T1 1, speed: 1536 kbs
  timeslots: 1-24
  No alarms detected.
  Framing is ESF, LineCode is AMI, Clock Source is Line.
  Data in current interval (250 seconds elapsed):
     2 Line Code Violations, 1 Path Code Violations
     7 Slip Secs, 5 Fr Loss Secs, 8 Line Err Secs, 10 Degraded Mins
     3 Errored Secs, 9 Bursty Err Secs, 4 Severely Err Secs, 6 Unavail Secs
  Data in Interval 1:
     12 Line Code Violations, 11 Path Code Violations
```

Channelized T3 Dual-Wide Port Adapter Installation and Configuration **33**

```
       17 Slip Secs, 15 Fr Loss Secs, 18 Line Err Secs, 20 Degraded Mins
       13 Errored Secs, 19 Bursty Err Secs, 14 Severely Err Secs, 16 Unavail Secs
  Data in Interval 2:
       12 Line Code Violations, 11 Path Code Violations
       17 Slip Secs, 15 Fr Loss Secs, 18 Line Err Secs, 20 Degraded Mins
       13 Errored Secs, 19 Bursty Err Secs, 14 Severely Err Secs, 16 Unavail Secs
  Data in Interval 3:
       12 Line Code Violations, 11 Path Code Violations
       17 Slip Secs, 15 Fr Loss Secs, 18 Line Err Secs, 20 Degraded Mins
       13 Errored Secs, 19 Bursty Err Secs, 14 Severely Err Secs, 16 Unavail Secs
Router#
```

- The **show controller t3** command (entered with no additional arguments) displays the status of the four T1 ports (external 1, external 2, external 3, and the test port, respectively), as follows:

```
Router# show cont t3

(additional displayed text omitted from this example)

  Ext1: LOS, Ext2: LOS, Ext3: LOS, Test: OK
```

The information in the preceding example is displayed even if the external or test ports are not configured, which allows you to determine the health of the external equipment and cabling before configuring the external or test ports.

Following are explanations of the individual fields in this line:

— LOS: loss of signal indicates that the port is not receiving a valid signal, and is the expected state if nothing is connected to the port.

— AIS: alarm indication signal indicates that the port is receiving an all-ones signal.

— OK: this indicates that a valid signal is being received and that this signal is *not* an all-ones signal. (This condition is opposite that indicated by AIS.)

- The **show controller** *type slot/port* **brief** command displays less verbose information about a T3 and all configured T1s.

An example follows:

```
Router# show controller t3 3/0 brief
T3 3/0 is up.
  CT3 H/W Version : 4, CT3 ROM Version : 0.116, CT3 F/W Version : 0.7.0
  Mxt H/W version : 2, Mxt ucode ver : 1.24
  Applique type is Channelized T3
  No alarms detected.
  FEAC code received : No code is being received
  Framing is C-BIT Parity, Line Code is B3ZS, Clock Source is Internal.

  T1 0 is up, speed: 1536 kbs, non-inverted data
  timeslots: 1-24
  No alarms detected.
  Framing is ESF, LineCode is B8ZS, Clock Source is Internal.

  T1 1 is up, speed: 1536 kbs, non-inverted data
  timeslots: 1-24
  No alarms detected.
  Framing is ESF, LineCode is B8ZS, Clock Source is Internal.

  T1 2 is up, speed: 1536 kbs, non-inverted data
  timeslots: 1-24
  No alarms detected.
  Framing is ESF, LineCode is B8ZS, Clock Source is Internal.
```

- Another permutation of the preceding **show controller** *type slot/port* command shows the T3 and an individual T1 that you specify by adding *:t1 channel (t1 channel* is 1–28).

  An example follows:

  ```
  Router# sh cont t3 3/0:1 brief
  T3 3/0 is up.
    CT3 H/W Version : 4, CT3 ROM Version : 0.116, CT3 F/W Version : 0.7.0
    Mxt H/W version : 2, Mxt ucode ver : 1.24
    Applique type is Channelized T3
    No alarms detected.
    FEAC code received : No code is being received
    Framing is C-BIT Parity, Line Code is B3ZS, Clock Source is Internal.

    T1 1 is up, speed: 1536 kbs, non-inverted data
    timeslots: 1-24
    No alarms detected.
    Framing is ESF, LineCode is B8ZS, Clock Source is Internal.
  ```

- The **show protocols** command displays the global (system-wide) and interface-specific status of any configured Level 3 protocol.

  ```
  Router# show protocols

  Serial3/0:0 is up, line protocol is up
    Internet address is 30.30.30.2/24
  Serial3/0:1 is up, line protocol is up
    Internet address is 1.1.1.2/24
  ```

- The **show startup-config** command displays the contents of the system configuration file stored in NVRAM. This file should reflect all new configuration changes you made and wrote to memory with the **copy running-config startup-config** command. (The **show running-config** command displays the contents of a configuration file before it is written to NVRAM.)

  ```
  Router# show startup-config

  controller T3 3/0
   cablelength 224
   t1 0 timeslots 1-24
   t1 1 timeslots 1-24
   t1 2 timeslots 1-24
  !
  interface Serial 3/0:0
   ip address 30.30.30.2 255.255.255.0
   no ip route-cache optimum
   no keepalive
   no fair-queue
  !
  interface Serial 3/0:1
   ip address 1.1.1.2 255.255.255.0
   no ip route-cache optimum
   no keepalive
   no fair-queue
  !
  interface Serial 3/0:2
   ip address 2.2.2.2 255.255.255.0
   no ip route-cache optimum
   no keepalive
   no fair-queue
  !
  (additional display text omitted from this example)
  ```

Using Show Commands to Verify the PA-CT3/4T1 Port Adapter Status

The following procedure summarizes how to use the **show** commands to verify that a new PA-CT3/4T1 port adapter interface is configured correctly:

Step 1   Use the **show version** command to display the system hardware configuration. Ensure that the list includes the new PA-CT3/4T1 port adapter network interface.

Step 2   Display the T1 alarm condition with the **show controllers T3** command.

Step 3   Specify the new interface with the **show interfaces** command and verify that the first line of the display specifies the serial interface with the correct slot, port adapter, and port. Also verify that the interface and line protocol are in the correct state: up or down.

Step 4   Display the protocols configured for the entire system and specific interfaces with the command **show protocols**. If necessary, return to the configuration mode to add or remove protocol routing on the system or specific interfaces.

Step 5   Display the entire system configuration file with the **show running-config** and **show startup-config** commands. Verify that the configuration is accurate for the system and each interface.

If the interface is down and you configured it as up, or if the displays indicate that the hardware is not functioning properly, ensure that the network interface is properly connected and terminated.

This completes the configuration procedure for the new PA-CT3/4T1 port adapter interface.

Testing and Troubleshooting the PA-CT3/4T1 Port Adapter

Following are suggested guidelines for troubleshooting the PA-CT3/4T1 port adapter using the loopback command, LED indications, a bit error test (BERT), FDL performance reports, and for displaying remote performance reports.

Using loopback Commands

Should you have difficulty with the PA-CT3/4T1 port adapter configuration or installation, you can troubleshoot the PA-CT3/4T1 port adapter using the **loopback** command. Specify loopback for a T1 channel using the *t1 channel* **loopback** command, where the T1 channel is 1–28. There are three main loopback modes as follows: local, network (both line and payload), and remote (line and payload). Specify the loopback format using the **loopback** [**local** | **network** | **remote**] command.

Note   To shut down the T3 interface, use the **shutdown** command at the controller prompt.

Examples of specific loopback modes follow:

- Set the first T1 into local loopback as follows:

```
Router# config t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)# interface serial 3/0:1
Router(config-if)# loopback local
```

  In the preceding example, local loopback loops the router output data back toward the router at the T1 framer and sends an AIS signal out toward the network.

- Set the first T1 into network line loopback as follows:

```
Router# config t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)# interface serial 3/0:1
Router(config-if)# loopback network line
```

In the preceding example, network line loopback loops the data back toward the network (before the T1 framer).

- Set the first T1 into network payload loopback as follows:

```
Router# config t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)# interface serial 3/0:1
Router(config-if)# loopback network payload
```

In the preceding example, network payload loopback loops just the payload data back toward the network at the T1 framer.

- The syntax of the **loopback remote** command follows:

```
loopback [remote {line {fdl ansi | inband} | payload fdl ansi}]
```

Set the first T1 into remote line inband loopback, as follows:

```
Router# config t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)# int serial 3/0:1
Router(config-if)# loop remote line inband
```

In the preceding example, remote line inband loopback sends a repeating 5-bit inband pattern (of 00001) to the remote end requesting that it enter into a network line loopback.

Set the first T1 into remote line FDL ANSI bit loopback, as follows:

```
Router# config t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)# int serial 3/0:1
Router(config-if)# loop remote line fdl ansi
```

In the preceding example, remote line FDL ANSI bit loopback sends a repeating 16-bit ESF data link code word (of 00001110 11111111) to the remote end requesting that it enter into a network line loopback.

Set the first T1 into remote payload FDL ANSI bit loopback, as follows:

```
Router# config t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)# int serial 3/0:1
Router(config-if)# loop remote payload fdl ansi
```

In the preceding example, remote payload ANSI bit loopback sends a repeating 16-bit ESF data link code word (of 00010100 11111111) to the remote end requesting that it enter into a network payload loopback.

Using Status and Alarm LED Indications

Following are various system states and functions that are reflected by the front-panel alarm and status LEDs on the PA-CT3/4T1 port adapter during the CPU boot process and microcode download.

1 After the PA-CT3/4T1 port adapter CPU has booted successfully, the alarm and status LEDs goes on.

2 When the PA-CT3/4T1 port adapter microcode download begins, the alarm LED goes off while the status LED flashes on and off.

3 After the PA-CT3/4T1 port adapter microcode is downloaded (and before the PA-CT3/4T1 port adapter microcode image boots) the status LED goes off.

Note After the PA-CT3/4T1 port adapter microcode is booted, the microcode takes over control of the LEDs.

During the system bootup process and microcode download, the following LED error indications might appear:

- Alarm LED on; status LED flashing two times then off (repeatedly)—indicates that memory tests failed

- Alarm LED on; status LED flashing three times then off (repeatedly)—indicates PCI bus interface chip test failed

- Alarm LED on; status LED flashing four times then off (repeatedly)—indicates the microcode download failed

- Alarm LED on; status LED flashing six times then off (repeatedly)—indicates that any exception occurred

In all the preceding error modes, the CPU continually loops and the system does not proceed to the microcode download.

Checking Bit Errors Using a BERT

To check bit errors using a bit error test (BERT), use the following command:

```
[no] t1 t1 channel bert pattern {2^15 | 2^20 | 2^23 | 0s | 1s} interval minutes
```

where *t1 channel* is 1–28, *2^15* is an exponential number that represents a pseudo-random repeating pattern that is 32767 bits long, *2^20* is a pseudo-random repeating pattern that is 1048575 bits long, *2^23* is a pseudo-random repeating pattern that is 8388607 bits long, *0s* is a pattern of all zeroes (00000000...), *1s* is a pattern of all 1s (111111...), and *minutes* are 1–14400, which designate the time the BERT will run. To stop the BERT, use the optional **no** form of the command. Following is an example of this command, where the pseudo-random pattern 2^20 is sent and repeats on the first T1 channel for 60 minutes:

```
Router# t1 1 bert pattern 2^20 interval 60
```

Note that the BERT command is not saved in NVRAM. The test patterns from the PA-CT3/4T1 port adapter are framed test patterns; therefore, they are inserted into the payload of a framed T1 signal.

To display the BERT results, use the following EXEC commands: **sh cont t3** *number* or **sh cont t3** *number* **brief**. Following are examples of displaying BERT results output:

1 Display BERT output results during a test, as follows:

```
Router# sh cont t3 5/0 b
T3 5/0 is up.
  CT3 H/W Version : 4, CT3 ROM Version : 0.116, CT3 F/W Version : 20.2.0
  Mx H/W version : 2, Mx ucode ver : 1.25
  Applique type is Channelized T3
  No alarms detected.
  FEAC code received : No code is being received
  Framing is M23, Line Code is B3ZS, Clock Source is Internal.

  T1 1 is down, speed: 1536 kbs, non-inverted data
  timeslots: 1-24
  FDL per ANSI T1.403 and AT&T 54016 spec.
  Configured for FDL Remotely Line Looped
  No alarms detected.
  Framing is ESF, Line Code is B8ZS, Clock Source is Internal.
  BERT test result (running)
      Test Pattern : All 0's, Status : Sync, Sync Detected : 1
      Interval : 4 minute(s), Time Remain : 4 minute(s)
      Bit Errors(Sync BERT Started) : 0 bits
      Bit Errors(Sync last Sync) : 0 bits , Bits Received : 7 Mbits
```

Note   When the T1 is under BERT, its line state is down. When under BERT (in the running state), the "Total Bit Errors" value is not valid if the "Status" field is "Not Sync."

2 When the test is done, display BERT results output as follows:

```
Router# sh cont t3 5/0 b
T3 5/0 is up.
  CT3 H/W Version : 4, CT3 ROM Version : 0.116, CT3 F/W Version : 20.2.0
  Mx H/W version : 2, Mx ucode ver : 1.25
  Applique type is Channelized T3
  No alarms detected.
  FEAC code received : No code is being received
  Framing is M23, Line Code is B3ZS, Clock Source is Internal.

  T1 1 is up, speed: 1536 kbs, non-inverted data
  timeslots: 1-24
  FDL per ANSI T1.403 and AT&T 54016 spec.
  Configured for FDL Remotely Line Looped
  No alarms detected.
  Framing is ESF, Line Code is B8ZS, Clock Source is Internal.
  BERT test result (done)
      Test Pattern : All 0's, Status : Not Sync, Sync Detected : 1
      Interval : 4 minute(s), Time Remain : 0 minute(s)
      Bit Errors(Sync BERT Started) : 0 bits
      Bit Errors(Sync last Sync) : 0 bits , Bits Received : 368 Mbits
```

Note   The "Status" field is irrelevant when the BERT is done. If the "Sync Detected" counter is 0, the Bit Errors fields have no meaning.

3 When the test is stopped prematurely, display BERT results output as follows:

```
Router# sh cont t3 5/0 b
T3 5/0 is up.
  CT3 H/W Version : 4, CT3 ROM Version : 0.116, CT3 F/W Version : 20.2.0
  Mx H/W version : 2, Mx ucode ver : 1.25
  Applique type is Channelized T3
  No alarms detected.
  FEAC code received : No code is being received
  Framing is M23, Line Code is B3ZS, Clock Source is Internal.

  T1 1 is up, speed: 1536 kbs, non-inverted data
  timeslots: 1-24
  FDL per ANSI T1.403 and AT&T 54016 spec.
  Configured for FDL Remotely Line Looped
  No alarms detected.
  Framing is ESF, Line Code is B8ZS, Clock Source is Internal.
  BERT test result (done)
      Test Pattern : All 0's, Status : Not Sync, Sync Detected : 1
      Interval : 4 minute(s), Time Remain : 2 minute(s) (unable to complete)
      Bit Errors(Sync BERT Started) : 0 bits
      Bit Errors(Sync last Sync) : 0 bits , Bits Received : 368 Mbits
```

Note In the preceding three examples, the "Sync Detected" counter indicates the number of times the pattern sync is detected (from No Sync to Sync), the "Bit Errors(Sync BERT Started)" counter indicates the number of bit errors during BERT, and the "Bit Errors(Sync last Sync)" counter shows the number of bit errors since the last pattern sync is detected.

Enabling Performance Reports

To enable and disable one-second transmissions of performance reports via the FDL (per ANSI T1.403), use the [**no**] **t1** *t1 channel* **fdl ansi** command, where the T1 channel is 1–28.

Note This command can only be used only when the T1 framing is ESF. Use the **no** form of the command to disable remote performance reports.

Displaying Remote Performance Reports

To display remote (far-end) performance data, use the **show controller t3 5/0 remote performance** command, as follows:

```
Router# sh cont t3 5/0 remote performance
T3 5/0 is up.
  CT3 H/W Version : 4, CT3 ROM Version : 0.116, CT3 F/W Version : 20.2.0
  Mx H/W version : 2, Mx ucode ver : 1.25

  T1 1 - Remote Performance Data
  Data in current interval (356 seconds elapsed):
     0 Line Code Violations, 0 Path Code Violations
     0 Slip Secs, 0 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
     0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs
     0 Unavail Secs
  Data in Interval 1:
     1 Slip Secs, 0 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
     2 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs
     0 Unavail Secs
  Data in Interval 2:
     0 Line Code Violations, 0 Path Code Violations
     0 Slip Secs, 0 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
     0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs
     0 Unavail Secs
  Total Data (last 2 15 minute intervals):
     1 Path Code Violations
     1 Slip Secs, 0 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins,
     2 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs
     0 Unavail Secs

  T1 2 - Remote Performance Data
  Data in current interval (425 seconds elapsed):
     0 Line Code Violations, 0 Path Code Violations
     0 Slip Secs, 0 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
     0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs
     0 Unavail Secs
  Data in Interval 1:
     0 Line Code Violations, 0 Path Code Violations
     0 Slip Secs, 0 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
     0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs
     0 Unavail Secs
  Data in Interval 2:
     0 Line Code Violations, 0 Path Code Violations
     0 Slip Secs, 0 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
     0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs
     0 Unavail Secs
  Total Data (last 2 15 minute intervals):
     0 Path Code Violations
     0 Slip Secs, 0 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins,
     0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs
     0 Unavail Secs
```

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.)

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

Obtaining Documentation

These sections explain how to obtain documentation from Cisco Systems.

World Wide Web

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

http://www.cisco.com

Translated documentation is available at this URL:

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

Documentation CD-ROM

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

Ordering Documentation

You can order Cisco documentation in these ways:

- Registered Cisco.com users (Cisco direct customers) can order Cisco product documentation from the Networking Products MarketPlace:

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

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

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

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

Documentation Feedback

You can submit comments electronically on Cisco.com. In the Cisco Documentation home page, click the **Fax** or **Email** option in the "Leave Feedback" section at the bottom of the page.

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

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

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

We appreciate your comments.

Obtaining Technical Assistance

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

Cisco.com

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

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

- Streamline business processes and improve productivity

- Resolve technical issues with online support

- Download and test software packages

- Order Cisco learning materials and merchandise

- Register for online skill assessment, training, and certification programs

If you want to obtain customized information and service, you can self-register on Cisco.com. To access Cisco.com, go to this URL:

http://www.cisco.com

Technical Assistance Center

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

Cisco TAC inquiries 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.

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

Cisco TAC Web Site

You can use the Cisco TAC Web Site 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 this URL:

http://www.cisco.com/tac

All customers, partners, and resellers who have a valid Cisco service 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 this URL to register:

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

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

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

If you have Internet access, we recommend that you open P3 and P4 cases through the Cisco TAC Web Site.

Cisco TAC Escalation Center

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

To obtain a directory of toll-free Cisco TAC telephone numbers for your country, go to this 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). When you call the center, please have available your service agreement number and your product serial number.