CISCO SYSTEMS

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Channelized T3 Interface Processor (CT3IP) Installation and Configuration

Product Numbers: CT3IP-20= and CT3IP-40(=)

Introduction

This configuration note contains instructions for installing the Channelized T3 Interface Processor (CT3IP) in the Cisco 7000 series routers and the Cisco 7500 series routers. For the CT3IP to operate properly in the Cisco 7000 series routers, the 7000 Series Route Switch Processor (RSP7000) and 7000 Series Chassis Interface (RSP7000CI) *must* be installed.

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 2. (Also refer to the section "Software and Hardware Prerequisites" on page 8.)

Contents

Sections in this document include the following:

If You Need More Information

The Cisco IOS software running your router contains extensive features and functionality. For information on Cisco IOS software and for general installation and maintenance information for your router, use the following resources:

- Cisco Documentation CD-ROM package

  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 as an annual subscription.

- For Cisco IOS software configuration information and support, refer to the modular configuration and modular command reference publications in the Cisco IOS software configuration documentation set that corresponds to the software installed on your Cisco hardware. You can also refer to the Cisco IOS software release notes for the version of software you are using on your hardware.

- For hardware installation and maintenance information on the Cisco 7500 series routers, refer to the *Cisco 7500 Series Installation and Configuration Guide* that shipped with your Cisco 7500 series router.

- For hardware installation and maintenance information on the Cisco 7000 series routers, refer to the *Cisco 7000 Hardware Installation and Maintenance* manual and the *Cisco 7000 User Guide,* or to the *Cisco 7010 Hardware Installation and Maintenance* manual and the *Cisco 7010 User Guide*, which shipped with your Cisco 7000 or Cisco 7010 router, respectively.

Note   You can access Cisco IOS software documentation and hardware installation and maintenance documentation on the World Wide Web at http://www.cisco.com, http://www-china.cisco.com, http://www-europe.cisco.com.

If you are reading Cisco documentation on the World Wide Web, you can submit comments electronically. Click **Feedback** on the toolbar, and then select **Documentation**. After you complete the form, click **Submit** to send it to Cisco. We appreciate your comments.

- To view Cisco documentation or obtain general information about documentation, refer to the following sources:

  — Documentation CD-ROM.

  — Cisco Connection Online (CCO). (Refer to the section "Cisco Connection Online," on page 51.)

  — 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 company holidays). You can also send e-mail to cs-rep@cisco.com.

What Is the CT3IP?

The CT3IP, shown in Figure 1 and Figure 2, is a fixed-configuration interface processor based on the second-generation Versatile Interface Processor (VIP2).

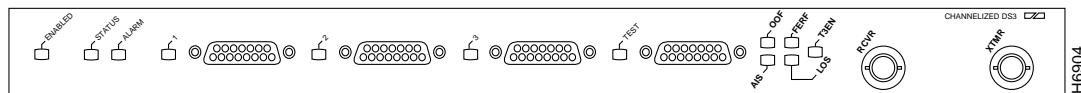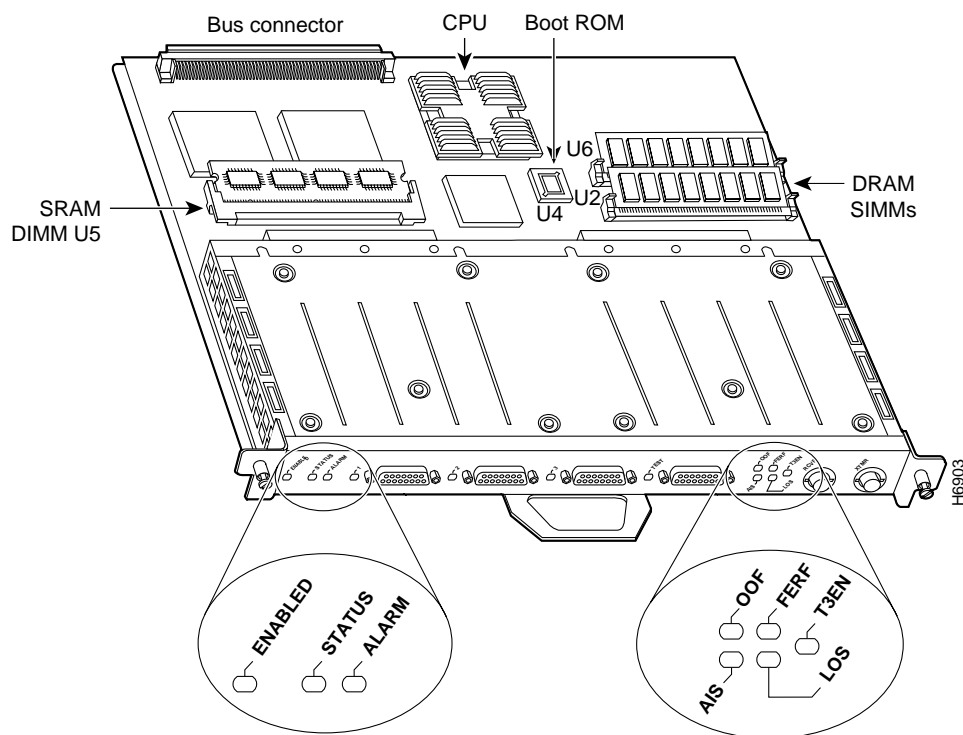**Figure 1   CT3IP, Front-Panel View**

Figure 2   CT3IP, Top View

The CT3IP has the following features and physical characteristics:

- 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 (using a DB-15 connector) that can be configured individually.

- 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.

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- For wide-area networking, the CT3IP 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 CT3IP is 1 to 2 megabytes (MB) of static random-access memory (SRAM) provided on one dual-inline memory module (DIMM). (See Figure 2.)

- CT3IP microcode is loaded into and operates from dynamic random-access memory (DRAM).

- DRAM configuration is 16 to 32 MB, and is provided on two single-inline memory modules (SIMMs). (See Figure 2.)

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.

CT3IP Overview

The CT3IP 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 CT3IP 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 CT3IP 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 CT3IP supports the maintenance data link channel (C-BIT parity) as well as payload and network loopbacks. The T1 section of the CT3IP supports Facility 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 CT3IP 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 CT3IP does *not* support the aggregation of multiple T1s (called *inverse muxing* or *bonding*) for higher bandwidth data rates. CT3IP 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 CT3IP, 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.

CT3IP Microcode

The CT3IP microcode is a software image that provides card-specific software instructions. Cisco 7000 series and Cisco 7500 series routers support downloadable microcode, which enables you to upgrade microcode versions by downloading new microcode images, storing them in Flash memory, and instructing the system to load an image from Flash memory.

You can store multiple images for an interface type and instruct the system to load any one of them with a configuration command. All interfaces of the same type (all CT3IPs, and so on) will load the same microcode image from a single image stored in Flash memory. The Flash-based boot read-only memory (ROM) device on the CT3IP contains a microcode boot image that instructs the system to load the full microcode image as described by the configuration.

Although multiple microcode versions for a specific interface type can be stored concurrently in Flash memory, only one image can load at startup. The **show controller cbus** command displays the currently loaded and running microcode version for each interface processor. The **show microcode** command displays the microcode images bundled with the Cisco IOS software.

An example follows:

```
Router# sh microcode
Microcode bundled in system

Card      Microcode    Target Hardware      Description
Type      Version      Version
----      ---------    ---------------      -----------

(additional display text omitted)

VIP2      21.40            2.x            VIP2 version 21.40

(additional display text omitted from this example)
```

In the preceding example, the CT3IP's microcode is listed as *VIP2* because the CT3 port adapter is attached to a VIP2 motherboard and uses its microcode image. For a complete description of microcode and downloading procedures, refer to the section "Upgrading Microcode" on page 41. The example does not necessarily show an actual version of CT3IP microcode.

CT3IP Cables

For T1, two standard serial cables, null-modem and straight-through, are available from Cisco Systems for use with the CT3IP. The CT3IP T1 interface cables are used to connect your router to external CSUs or a MIP card. The CT3IP T1 interface cables have two male 15-pin DB connectors at each end to connect the CT3IP's T1 interfaces.

Figure 3 shows the CT3IP 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.

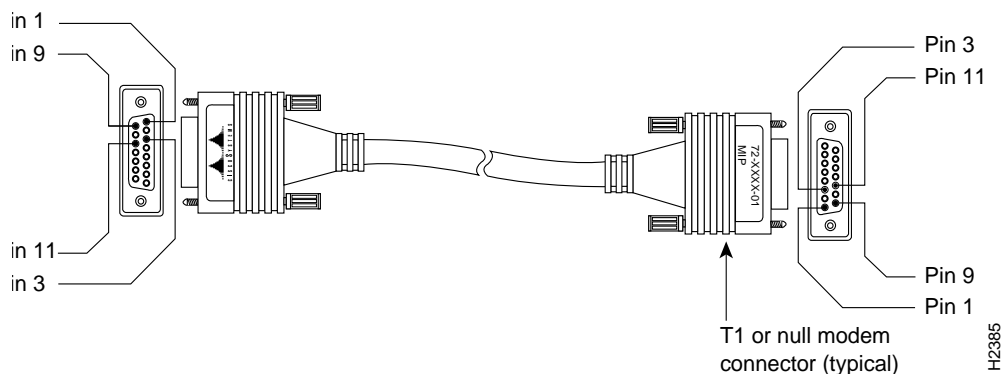**Figure 3   CT3IP T1 Interface Cable and Connectors**

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.

CT3IP Agency 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 CT3IP T3 port is designed to receive and transmit at the DSX-3 level while driving and56 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 (9.7db to -11.8db)

- 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 CT3IP 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 (3db 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)

CT3IP 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.

Software and Hardware Prerequisites

The CT3IP is compatible with any Cisco 7000 series or Cisco 7500 series router that is operating with Cisco IOS Release 11.1(8)CA or later; however, certain command and feature functionality is only available with Cisco IOS Release 11.1(9)CA1 or later, or Cisco IOS Release 11.2(7)P or later.

Note For specific software features and commands available for the CT3IP and the Cisco IOS release in which they are supported, refer to the Cisco IOS release note specific to your Cisco IOS release.

For the CT3IP to operate properly in the Cisco 7000 series routers, the 7000 Series Route Switch Processor (RSP7000) and 7000 Series Chassis Interface (RSP7000CI) *must* be installed. The CT3IP will not operate properly in Cisco 7000 series routers with the Route Processor (RP) and Switch Processor (SP) (or Silicon Switch Processor [SSP]) installed.

The **show version** command displays the current hardware configuration of the router, including the system software version that is currently loaded and running. The **show controller cbus** command lists all electrical interfaces and includes the currently loaded and running microcode version for each.

If the displays indicate that the running system software is earlier than Cisco IOS Release 11.1(8)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. (Refer to the section "Upgrading Microcode," on page 41, for more information. For information on additional **show** commands, refer to the section "Command Descriptions and Examples" on page 28.)

Safety Guidelines

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

Electrical Equipment Guidelines

Follow these basic guidelines when working with any electrical equipment:

- Before beginning any procedures requiring access to the chassis interior, locate the emergency power-off switch for the room in which you are working.

- Disconnect all power and external cables before moving a chassis.

- Do not work alone if potentially hazardous conditions exist.

- Never assume that power is disconnected from a circuit; always check.

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

- Carefully examine your work area for possible hazards such as moist floors, ungrounded power extension cables, and missing safety grounds.

Telephone Wiring Guidelines

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

- Never install telephone wiring during a lightning storm.

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

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

- Use caution when installing or modifying telephone lines.

Preventing Electrostatic Discharge Damage

Electrostatic discharge (ESD) damage, which can occur when electronic cards or components are improperly handled, results in complete or intermittent failures. The CT3IP comprises a printed circuit board that is fixed in a metal carrier. Electromagnetic interference (EMI) shielding, connectors, and a handle are integral components of the carrier. Although the metal carrier helps to protect the board from ESD, use a preventive antistatic strap whenever handling the CT3IP. Handle the carriers by the handles and the carrier edges only; never touch the boards or connector pins.

Following are guidelines for preventing ESD damage:

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

- Connect the equipment end of the strap to a captive installation screw on an installed power supply.

- When installing a CT3IP, use the ejector levers to properly seat the bus connectors in the backplane, then tighten both captive installation screws. (See Figure 4.) These screws prevent accidental removal, provide proper grounding for the system, and help ensure that the bus connectors are seated in the backplane.

- When removing a CT3IP, use the ejectors to release the bus connectors from the backplane. Use the handle to pull the CT3IP out slowly while keeping your other hand underneath the carrier to guide it straight out of the slot.

- Handle carriers by the handles and carrier edges only; avoid touching the board or connectors.

- Place a removed CT3IP board-side-up on an antistatic surface or in a static shielding bag. If you plan to return the component to the factory, immediately place it in a static shielding bag.

- Avoid contact between the CT3IP and clothing. The wrist strap only protects the board from ESD voltages on the body; ESD voltages on clothing can still cause damage.

- Never attempt to remove the CT3IP printed circuit board from the metal interface processor carrier.

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

Parts and Tools

You need the following tools and parts to install the CT3IP. If you need additional equipment, contact your service representative for ordering information.

- CT3IP-20= or CT3IP-40(=)

- Number 1 Phillips or 3/26-inch flatblade screwdriver for captive installation screws on the CT3IP

- T1 CSU to connect the CT3IP with the external network

- T1 interface cables to connect the CT3IP 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 CT3IP

Guidelines for Interface Processor 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 "CT3IP Installation Procedures" on page 14.

You can remove and replace interface processors 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 interface processors 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 an interface processor 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 interface processor at a time. Allow at least 15 seconds for the system to complete the preceding tasks before removing or inserting another interface processor. Disrupting the sequence before the system completes its verification can cause the system to interpret hardware failures.

All interface processors have ejector levers that allow you to firmly seat an interface processor in the interface processor 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 interface processor 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 interface processor 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 interface processor, 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 interface processor 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 interface processor in the backplane, you might need to pull the interface processor 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 an interface processor, 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 an interface processor to ensure that the board connector pins disconnect from the backplane in the logical sequence expected by the system. Any processor module that is only partially connected to the backplane can hang the bus. Detailed steps for correctly installing and removing the interface processor follow.

The processor modules slide into slots in the rear of the chassis and connect directly to the backplane. The backplane slots are keyed so that the processor modules can be installed only in the slots designated for them.
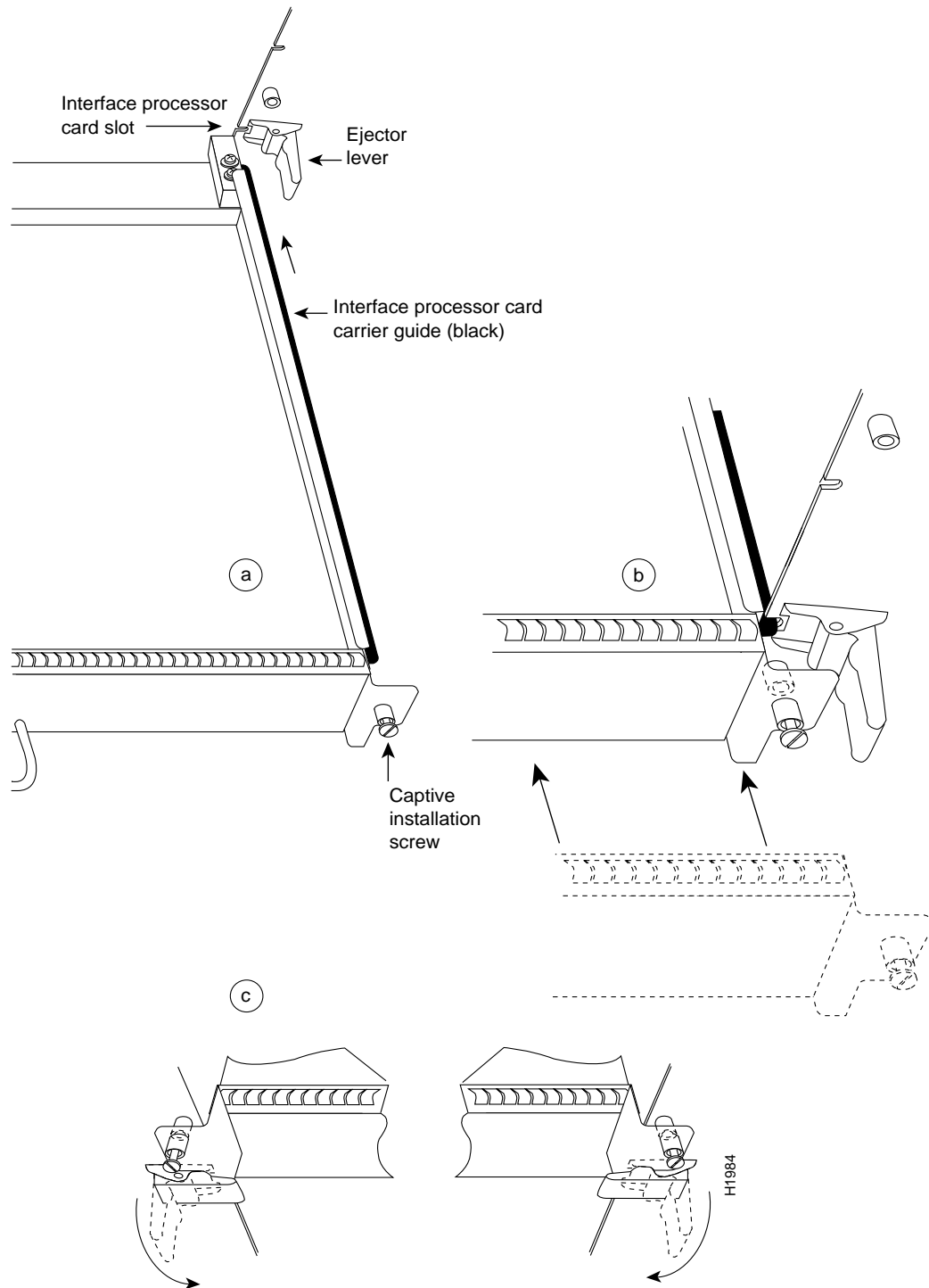
Figure 4 shows the ejector levers and captive installation screws on a typical interface processor. To remove an interface processor, loosen the captive screws and pull the ejector levers to the sides; then pull the module out using the handle. To insert an interface processor, reverse the process, making sure to firmly seat the interface processor in its connectors on the backplane. For detailed directions, follow the procedures in the section "CT3IP Installation Procedures" on page 14.

⚠ Caution   Always use the ejector levers to remove or install the CT3IP. 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.

The captive installation screws on the ends (see Figure 4) of each faceplate, when tightened, provide EMI shielding and also help ensure proper seating in the backplane. After using the ejector levers to install a CT3IP, tighten the captive installation screws to prevent the CT3IP from becoming partially dislodged from the backplane. These screws must be tightened to meet EMI specifications.

Figure 4 **Ejector Levers and Captive Installation Screws (Horizontal Orientation Shown)**

Interface processor card slot

Ejector lever

Interface processor card carrier guide (black)

a

b

Captive installation screw

c

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CT3IP Installation Procedures

The following sections describe the procedures for removing or installing the CT3IP. The OIR feature allows you to install and remove the CT3IP without turning off system power. Refer to the section "Guidelines for Interface Processor Removal and Installation," on page 11, for a complete description of OIR.

⚠️ **Caution** To avoid erroneous failure messages, remove or insert only one interface processor at a time. Also, after inserting or removing an interface processor, allow at least 15 seconds before removing or inserting another interface processor so that the system can reinitialize and note the current configuration of all interfaces. For the initial release of the CT3IP, OIR for the CT3IP functions as described; however, if you install or remove other interface processors in a Cisco 7000 series or Cisco 7500 series router with a CT3IP installed, you might have to reset the chassis after OIR of that interface processor. To prevent system problems, we recommend you follow the OIR procedures.

Removing a CT3IP

You need not shut down the interface or the system power when removing a CT3IP or other interface processor.

Note   In Cisco 7507 or Cisco 7513 systems, online insertion and removal of any interface processor in either CyBus might cause the slave RSP2 to reboot with a bus error or a processor memory parity error. The master RSP will recover from this event and issue a "cBus Complex Restart" message. Cisco 7507 and Cisco 7513 systems that are configured with an RSP4 as the system slave are not affected and will not experience this problem.

If you have a Cisco 7507 or a Cisco 7513 with an RSP2 configured as the system slave, we strongly recommend that you use the following procedure to remove and replace an interface processor:

Step 1   Remove the slave RSP2.

Step 2   Wait 15 seconds.

Step 3   Remove and replace the interface processor using the procedures in this publication.

Step 4   Wait 15 seconds.

Step 5   Reinsert the slave RSP2.

If you are replacing a failed CT3IP, remove the existing board first, then replace the new CT3IP in the same slot. If you are replacing a currently installed interface processor with a CT3IP, remove the existing board first, then install the new CT3IP in the same slot.

Figure 5 shows proper handling of an interface processor during installation.

Figure 5   Handling Interface Processors during Installation (Horizontal Orientation Shown)

Captive installation screws

H4714
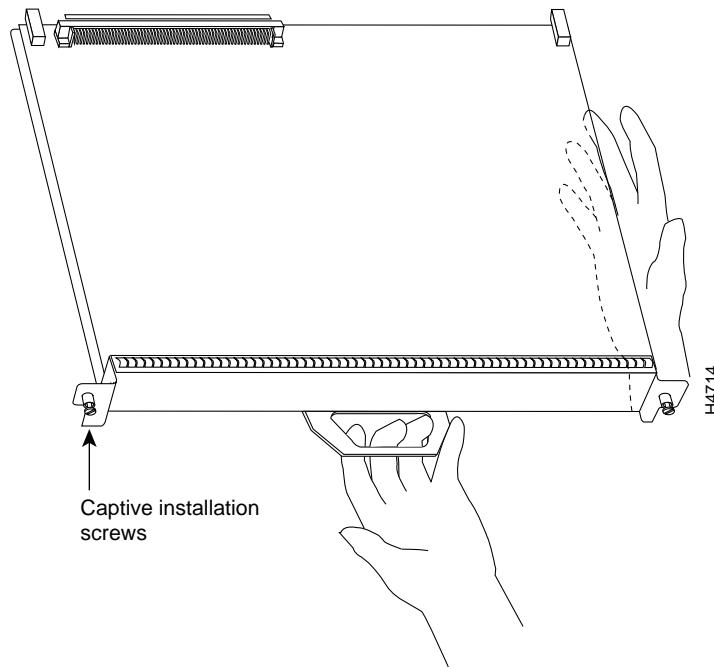
To remove the CT3IP, follow these steps:

Step 1   Disconnect the CT3IP interface cables from the CT3IP ports.

Step 2   Loosen the captive installation screws at the top and bottom of the CT3IP. (See Figure 4a.)

> ⚠ **Caution**   Always use the ejector levers to remove or install the CT3IP. Failure to do so can cause erroneous system error messages, indicating a board failure.

Step 3   Place your thumbs on the upper and lower ejector levers and simultaneously push the top ejector lever up and the bottom ejector lever down (in the opposite direction from that shown in Figure 4c) to release the CT3IP from the backplane connector.

Step 4   Grasp the CT3IP handle with one hand and place your other hand under the carrier to guide the CT3IP out of the slot. (See Figure 4.) Avoid touching the board or any connector pins.

Step 5   Carefully pull the CT3IP straight out of the slot, keeping one hand under the carrier to guide it. (See Figure 4.) Keep the CT3IP parallel to the backplane.

Step 6   Place the removed CT3IP on an antistatic mat or foam pad, or place it in an antistatic bag if you will return it to the factory.

Step 7   If the interface processor slot is to remain empty, install an interface processor filler (MAS-7000BLANK=) to keep dust out of the chassis and to maintain proper airflow through the interface processor compartment.

Installing a CT3IP

The CT3IP slides into any available interface processor slot and connects directly to the backplane. The backplane slots are keyed so that the CT3IP can be installed only in an interface processor slot. Interface processor fillers, which are blank interface processor carriers, occupy empty slots to maintain consistent air flow through the interface processor compartment. If you are installing a new CT3IP, you will have to first remove the interface processor filler from the available interface processor slot. Figure 4 shows the functional details of inserting an interface processor and using the ejector levers. Figure 5 shows proper handling of an interface processor during installation.

Note   There are no restrictions on slot locations or interface processor sequence; you can install the CT3IP in any available interface processor slot.

Caution   Remove or insert only one interface processor at a time. Allow at least 15 seconds for the system to complete the preceding tasks before removing or inserting another interface processor. Disrupting the sequence before the system completes its verification can cause the system to interpret hardware failures.

Follow these steps to install the CT3IP:

Step 1   Ensure that a console terminal is connected to the RP (or RSP) *Console* port and that the console is turned on.

Step 2   Choose an available interface processor slot for the CT3IP and ensure that the CT3IP interface cable is of a sufficient length to connect the CT3IP with the CSU.

Step 3   Interface processors and interface processor fillers are secured with two captive installation screws. (See Figure 4a.) Use a flat-blade screwdriver to loosen the captive installation screws and remove the interface processor filler (or the existing CT3IP) from the slot. If you remove the CT3IP, immediately place it into an antistatic bag to prevent damage from electrostatic discharge.

Step 4   Hold the CT3IP handle with one hand, and place your other hand under the carrier to support the CT3IP (see Figure 4) and guide it into the slot. Avoid touching the card or any connector pins.

Caution   To prevent ESD damage, handle interface processors by the handles and carrier edges only.

Step 5   Place the back of the CT3IP in the slot and align the notch on the bottom of the carrier with the groove in the slot. (See Figure 4a.)

Step 6   While keeping the CT3IP parallel to the backplane, carefully slide the CT3IP into the slot until the back of the faceplate makes contact with the ejector levers, then *stop*. (See Figure 4b.)

Caution   Always use the ejector levers when installing or removing processor modules. A module that is partially seated in the backplane will cause the system to hang and subsequently crash.

Step 7 Using the thumb and forefinger of each hand to pinch each ejector lever, simultaneously push the top ejector lever down and the bottom ejector lever up until both are parallel to the faceplate. (See Figure 4c.)

Step 8 Tighten the captive screws on the top and bottom of the interface processor faceplate to prevent the interface processor from becoming partially dislodged from the backplane and ensure proper EMI shielding. (These screws must be tightened to meet EMI specifications.)

> ⚠️ **Caution** Always tighten the captive installation screws on interface processors. These screws prevent accidental removal and provide proper grounding for the system.

This completes the CT3IP installation. Proceed to the following section to attach interface cables to the CT3IP.

Attaching Network Interface Cables to the CT3IP

Attach the CT3IP network interface cables between the CT3IP interface ports and the CSU. This includes up to four T1 cables and two DS1 BNC cables. (See Figure 6.) Proceed to the following section to check the cable connections.
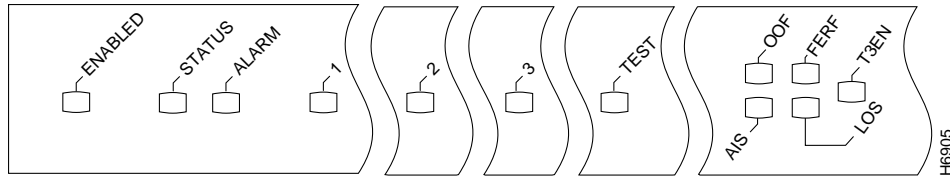
Figure 6   Connecting Interface Cables to the CT3IP (Horizontal Orientation Shown)

To appropriate transmitter connection

To appropriate receiver connection

To CSU
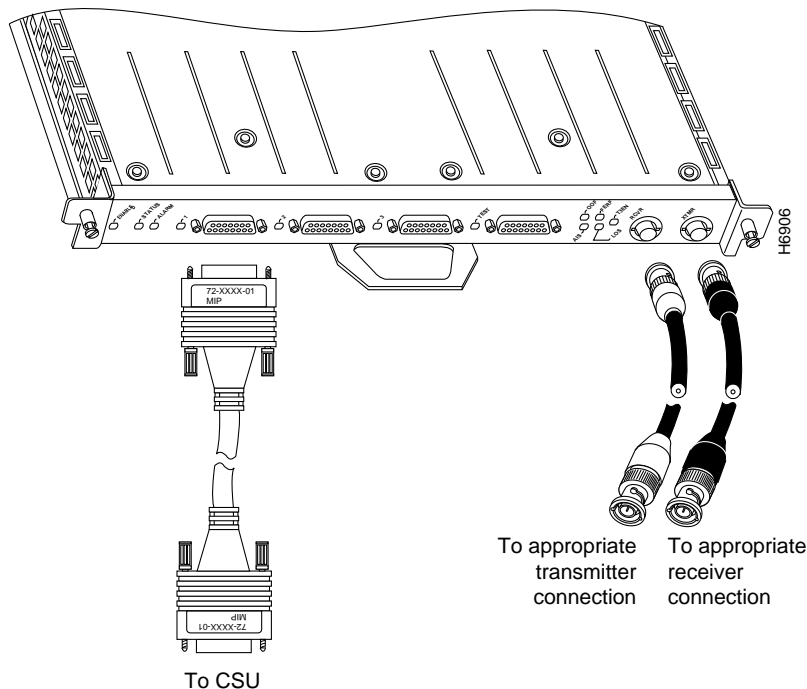
Using LEDs to Check CT3IP Initialization

The CT3IP has several status LEDs on its faceplate. (See Figure 7.)

Figure 7   CT3IP LEDs (Horizontal Orientation Shown)

Following are the functions of the CT3IP 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 37.

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 37.

Observe the LED states and the console displays as the router initializes. When the system has reinitialized all interfaces, the enabled LED on the CT3IP 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 CT3IP is enabled for operation.

The following conditions must be met before the CT3IP is enabled:

- The CT3IP is correctly connected to the backplane and receiving power.

- The system bus recognizes the CT3IP.

- A valid version of CT3IP microcode is loaded and running.

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

Verify that the CT3IP 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 CT3IP. The system should recognize the CT3IP's interfaces but leave them configured as *down*.

Step 2   When the reinitialization is complete, verify that the enabled LED on the CT3IP 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 CT3IP fails to go on, suspect the that the CT3IP board connector is not fully seated in the backplane. Loosen the captive installation screws, then firmly push the top ejector down while pushing the bottom ejector up until both are parallel to the CT3IP faceplate. Tighten the captive installation screws. After the system reinitializes the interfaces, the enabled LED on the CT3IP 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 CT3IP and try installing it in another available interface processor slot.

- If the enabled LED goes on when the CT3IP is installed in the new slot, suspect a failed backplane port in the original interface processor slot.

- If the enabled LED still fails to go on, but other LEDs on the CT3IP go on to indicate activity, proceed to Step 5 to resume the installation checkout and suspect that the enabled LED on the CT3IP has failed.

- If no LEDs on the CT3IP go on, suspect that the CT3IP 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** or **show controllers cbus** command to verify the status of the CT3IP's interfaces. (If the interfaces are not configured, you must use the procedures in the section "Configuring the CT3IP," 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 CT3IP

If you installed a new CT3IP or if you want to change the configuration of an existing controller, you must enter the Configuration mode. If you replaced the CT3IP that was previously configured, the system will recognize the new CT3IP and bring it up in the existing configuration.

After you verify that the new CT3IP is installed correctly, use the privileged-level **configure** command to configure the new CT3IP 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 CT3IP controller, refer to the appropriate configuration publications, which are listed in the section "If You Need More Information," on page 2.

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 CT3IP controller.

Interface Port Numbering for T1 and T3

The interface numbering scheme for the CT3IP's T1 interfaces is in the form of *slot/port-adapter/port:t1 channel*: where *slot* refers to the chassis slot in which the CT3IP is installed, *port-adapter* is always 0 (because the CT3IP has only one dual-width port adapter); *port* refers to the physical port on the CT3IP and is always 0; and *t1 channel* is a number between 1 and 28. (Refer to the section "Configuring the CT3IP," on page 20, for more specific interface configuration information.)

Note T1 channels on the CT3IP 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 CT3IP interface port numbering and sample displays:

- For T1 channel 5 on a CT3IP in chassis slot 2: 2/0/0:5

- For the T3 port on a CT3IP in chassis slot 4: 4/0/0

The following sample display shows the events logged by the system as the CT3IP was removed from slot 3; the system then reinitialized the remaining interface processors and marked as *down* the CT3IP when it is installed in slot 4. When the CT3IP was reinserted, the system marked the interfaces as *down* again because the CT3IP interfaces were not shut down before the CT3IP was removed.

```
Router#

%OIR-6-REMCARD: Card removed from slot 3, interfaces disabled
%LINK-5-CHANGED: Interfaces T3 3/0/0, changed to administratively down
```

When a new CT3IP is inserted, or when a CT3IP whose interfaces are shut down is moved to a new slot, the system recognizes the CT3IP 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 CT3IP to a new slot and its interfaces were *not* shut down, the system recognizes them as not shut down when the CT3IP is installed in the new slot.

The following example display shows the events logged by the system as a new CT3IP is inserted in slot 4:

```
Router#
%OIR-6-INSCARD: Card inserted in slot 4, interfaces administratively shut down
%LINK-5-CHANGED: Interfaces T3 4/0/0, 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 **t1** or **t3**, and *slot/port* (interface processor slot number/interface port number). The example that follows is for the CT3IP in interface processor slot 3 for T3 channel 0:

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

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 CT3IP 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
```

Note To shut down the T3 controller, use the **shutdown** command at the controller prompt. This command sends a DS3 Idle signal toward the network. You can bring the T3 controller back up with the **no shutdown** controller command.

Configuring MDL Messages

Maintenance Data Link (MDL) messages (which are defined in the ANSI T1.107a-1990 specification) can be configured on the CT3IP.

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 22.

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 3/0/0
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 0 for full T1 bandwidth, as follows:

```
Router(config-controll)# t1 0 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-control)# 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 0 linecode ami
Router(config-controller)# int s2/0/0:0
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 0 linecode ami** command does not modify local line driver settings. Rather, it advises the CT3IP what line code the remote T1 is using. The CT3IP 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.

Examples follow:

Set internal clock source for T1 6 as follows:

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

Set network clock source for T1 1 as follows:

```
Router(config-control)# 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 CT3IP

The following controller configuration commands are valid only to the first three T1 channels (T1 0 through 2) 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 31 of the section "Command Descriptions and Examples.")

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

```
Router(config-controll)# t1 external 1 lincecode 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 CT3IP

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 31 of the section "Command Descriptions and Examples.")

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 CT3IP Configuration

Following are additional commands required to complete the CT3IP 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-adapter/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 3:

  ```
  Router# show controller t3 3/0/0
  ```

- Display the information for T1 channel 5, for the T3 in slot 3:

  ```
  Router# show controller t3 3/0/0:5
  ```

- Display less verbose information for a T3 in slot 3:

  ```
  Router# show controller t3 3/0/0 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 interface processor type installed), the software version, the names and sources of configuration files, and the boot images.

  Following is an example from a Cisco 7505 router:

  ```
  Router# show version
  Copyright (c) 1986-1996 by cisco Systems, Inc.
  Compiled Tue 09-Jul-96 09:58 by biff
  Image text-base: 0x600108A0, data-base: 0x606C6000

  ROM: System Bootstrap, Version 5.3.2(3.2) [kmac 3.2], RELEASED SOFTWARE
  ROM: GS Software (RSP-P-M), Version 11.1(9)CA1, RELEASED SOFTWARE

  Router uptime is 19 hours, 15 minutes
  System restarted by reload
  System image file is "rsp-pv-mz", booted via tftp from 1.1.1.254

  cisco RSP1 (R4600) processor with 16384K bytes of memory.
  R4600 processor, Implementation 32, Revision 2.0
  Last reset from power-on
  G.703/E1 software, Version 1.0.
  X.25 software, Version 2.0, NET2, BFE and GOSIP compliant.
  Chassis Interface.
  1 VIP2 controller.
  1 Channelized T3 port.
  125K bytes of non-volatile configuration memory.

  8192K bytes of Flash PCMCIA card at slot 0 (Sector size 128K).
  8192K bytes of Flash internal SIMM (Sector size 256K).
  Configuration register is 0x0
  ```

- The **show controllers cbus** command displays the internal status of each interface processor, including the interface processor slot location, the card hardware version, and the currently running microcode version. It also lists each interface (port) on each interface processor including the logical interface number, interface type, physical (slot/port) address, and hardware (station address) of each interface. The following example shows the CT3IP installed in interface processor slot 3:`

```
Router# show cont cbus
slot3: VIP2, hw 2.4, sw 21.40, ccb 5800FF40, cmdq 48000090, vps 8192
    software loaded from system
    IOS (tm) VIP Software (SVIP-DW-M), Version 11.1(9)CA1 [biff 120]
    ROM Monitor version 17.0
    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
    T3 2/0/0, applique is Channelized T3
      gfreeq 48000138, lfreeq 48000168 (1536 bytes), throttled 0
      rxlo 4, rxhi 258, rxcurr 4, maxrxcurr 130
Router#
```

Note In the example above, the CT3IP in chassis slot 3 is displayed as *VIP2*.

- The **show controller** *type slot/port-adapter/port* command displays the status of the default T1 and T3 (which is specified in RFC 1406). The command **show controller t1** *slot/port-adapter/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 3/0/0
T3 3/0/0 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
           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-adapter/port* **brief** command displays less verbose information about a T3 and all configured T1s. An example follows:

```
Router# show controller t3 2/0/0 brief
T3 2/0/0 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-adapter/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 2/0/0:1 brief
T3 2/0/0 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

Serial3/0/0:0 is up, line protocol is up
  Internet address is 30.30.30.2/24
Serial3/0/0:1 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 3/0/0
 cablelength 224
 t1 0 timeslots 1-24
 t1 1 timeslots 1-24
 t1 2 timeslots 1-24
!
interface Serial3/0/0:0
 ip address 30.30.30.2 255.255.255.0
 no ip route-cache optimum
 no keepalive
 no fair-queue
!
interface Serial3/0/0:1
 ip address 1.1.1.2 255.255.255.0
 no ip route-cache optimum
 no keepalive
 no fair-queue
!
interface Serial3/0/0:2
 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)
```

- The **show interfaces** *type slot/port-adapter/port:t1 channel* command displays information about a T1 interface you specify. Following is an example:

```
Router# sh int serial 3/0/0:0
Serial3/0/0:0 is up, line protocol is up
  Hardware is cxBus T3
  Internet address is 30.30.30.2/24
  MTU 1500 bytes, BW 1536 Kbit, DLY 20000 usec, rely 255/255, load 1/255
  Encapsulation HDLC, loopback not set, keepalive not set
  Last input 10:05:52, output 10:05:52, output hang never
  Last clearing of "show interface" counters 17:53:35
  Queueing strategy: fifo
  Output queue 0/40, 0 drops; input queue 0/75, 26 drops
  5 minute input rate 1426000 bits/sec, 1700 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     102606572 packets input, 2285893928 bytes, 1 no buffer
     Received 0 broadcasts, 0 runts, 0 giants
     298 input errors, 0 CRC, 0 frame, 298 overrun, 0 ignored, 0 abort
     5 packets output, 530 bytes, 0 underruns
     0 output errors, 0 collisions, 0 interface resets
     0 output buffer failures, 0 output buffers swapped out
     0 carrier transitions no alarm present
  Timeslot(s) Used:1-24, Transmitter delay is 0 flags, transmit queue length 7
  non-inverted data
```

Using Show Commands to Verify the CT3IP Status

The following procedure summarizes how to use the **show** commands to verify that a new CT3IP interface is configured correctly:

Step 1 Use the **show version** command to display the system hardware configuration. Ensure that the list includes the new CT3IP network interface.

Step 2 Display all of the current CxBus interface processors and their interfaces with the **show controllers cbus** command. Verify that the new CT3IP appears in the correct slot.

Step 3 Display the T1 alarm condition with the **show controllers T3** command.

Step 4 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 5 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 6 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. If you still have problems bringing the interface up, contact a customer service representative for assistance.

This completes the configuration procedure for the new CT3IP interface.

Testing and Troubleshooting the CT3IP Using loopback Commands, LED Indications, and a BERT

Following are suggested guidelines for troubleshooting the CT3IP using the **loopback** command, LED indications, a bit error rate test (BERT), FDL performance reports, and for displaying remote performance reports.

Using loopback Commands

Should you have difficulty with the CT3IP configuration or installation, you can troubleshoot the CT3IP using the **loopback** interface configuration command. Specify loopback for a T1 channel where the T1 channel is 1–28. Specify the loopback format using the following command format:

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

Use the **no** form of this command to remove the loopback.

Note   To shut down the T3 controller, use the **shutdown** command at the controller prompt. This command sends a DS3 Idle signal toward the network. You can bring the T3 controller back up with the **no shutdown** controller command.

Explanations of specific loopback modes follow:

local	(Optional) Loops the router output data back toward the router at the T1 framer and sends an AIS signal out toward the network.
network {**line**	**payload**}	(Optional) Loops the data back toward the network before the T1 framer and automatically sets a local loopback at the HDLC controllers (line) or loops the payload data back toward the network at the T1 framer and automatically sets a local loopback at the HDLC controllers (payload).
remote line fdl {**ansi**	**bellcore**}	(Optional) Sends a repeating, 16-bit ESF data link code word (00010010 11111111) to the remote end requesting that it enter into a network line loopback. Specify the **ansi** keyword to enable the remote line Facility Data Link (FDL) ANSI bit loopback on the T1 channel, per the ANSI T1.403 Specification. Specify the **bellcore** keyword to enable the remote SmartJack loopback on the T1 channel, per the TR-TSY-000312 Specification.
remote line inband	(Optional) Sends a repeating, 5-bit inband pattern (00001) to the remote end requesting that it enter into a network line loopback.
remote payload [**fdl**] [**ansi**]	(Optional) Sends a repeating, 16-bit ESF data link code word (00010100 11111111) to the remote end requesting that it enter into a network payload loopback. Enables the remote payload Facility Data Link (FDL) ANSI bit loopback on the T1 channel.
	You can optionally specify **fdl** and **ansi**, but it is not necessary.

Examples of using the **loopback** command 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 2/0/0:1
Router(config)# 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 2/0/0:1
Router(config)# 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 2/0/0:1
Router(config)# loopback network payload
```

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

- 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 2/0/0:1
Router(config-if)# loop remote line fdl ansi
```

In the preceding example, a repeating 16-bit ESF data link code word (of 00001110 11111111) is sent to the remote end requesting that it enter into a network line loopback. The **ansi** keyword enables the remote line Facility Data Link (FDL) ANSI bit loopback on the T1 channel, per the ANSI T1.403 Specification

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

```
Router# config t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)# int serial 2/0/0:1
Router(config-if)# loop remote line fdl bellcore
```

In the preceding example, a repeating 16-bit ESF data link code word (of 00010010 11111111) to the remote end requesting that it enter into a network line loopback. The **bellcore** keyword enables the remote SmartJack loopback on the T1 channel, per the TR-TSY-000312 Specification.

- 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 2/0/0:1
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 payload FDL ANSI bit loopback, as follows:

```
Router# config t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)# int serial 2/0/0:1
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.

To better diagnose T1 provisioning problems, you can place the remote CSU or remote SmartJack into loopback. The **loopback remote line fdl** interface configuration command allows you to place either the CSU or the SmartJack into loopback:

- **ansi**—Places the CSU into loopback, per the ANSI T1.403 Specification

- **bellcore**—Places the SmartJack into loopback, per the TR-TSY-000312 Specification

When both are configured, transmission of LOF indication (yellow alarm) takes priority over transmission of some FDL messages.

If the remote loopback appears not to be working, use the **show cont t3** command to determine if the given T1 is currently attempting to transmit a LOF indication (yellow alarm):

```
Router# show controllers t3 2/0/0:2
 T3 2/0/0 is up.
    CT3 H/W Version: 5, CT3 ROM Version: 1.2, CT3 F/W Version: 2.5.9
    Mx H/W version: 2, Mx ucode ver: 1.34

    T1 2 is down, speed: 1536 kbs, non-inverted data
    timeslots: 1-24
    FDL per AT&T 54016 spec.
    Transmitter is sending LOF Indication.
    Receiver is getting AIS.
```

If the transmitter is sending a LOF indication, as in the previous example, stop the transmission of the LOF indication (yellow alarm) with the **no t1 yellow generation** configuration command as shown in the following example:

```
Router(config)# controllers t3 2/0/0
Router(config-controll)# no t1 2 yellow generation
Router(config-controll)# ^D
```

To verify that the transmission of the LOF indication (yellow alarm) has stopped, use the **show cont t3** command:

```
Router# show cont t3 2/0/0:2
 T3 0/0/0 is up.
    CT3 H/W Version: 5, CT3 ROM Version: 1.2, CT3 F/W Version: 2.5.9
    Mx H/W version: 2, Mx ucode ver: 1.34
    T1 2 is down, speed: 1536 kbs, non-inverted data
    timeslots: 1-24
    FDL per AT&T 54016 spec.
    Receiver is getting AIS.
    Framing is ESF, Line Code is B8ZS, Clock Source is Internal.
    Yellow Alarm Generation is disabled
```

Now retry the remote loopback command. When diagnosis is complete, remember to re-enable the LOF indication (yellow alarm). You can also loopback all the T1 channels by using the **loopback (CT3IP)** interface configuration command.

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 CT3IP during the CPU boot process and microcode download.

1 After the CT3IP CPU has booted successfully, the alarm and status LEDs goes on.

2 When the CT3IP microcode download begins, the alarm LED goes off while the status LED flashes on and off.

3 After the CT3IP microcode is downloaded (and before the CT3IP microcode image boots) the status LED goes off.

Note After the CT3IP 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 CT3IP 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 3/0/0 b
T3 3/0/0 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 3/0/0 b
T3 3/0/0 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 3/0/0 b
T3 3/0/0 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 3/0/0 remote performance** command, as follows:

```
Router# sh cont t3 3/0/0 remote performance
T3 3/0/0 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
```

Upgrading Microcode

Cisco 7000 series and Cisco 7500 series routers support downloadable microcode. You can download new microcode versions and store multiple versions in Flash memory, and you can boot from them just as you can with the system software images. System software upgrades might also contain upgraded microcode images, which will load automatically when the new software image is loaded.

You can download microcode to Flash memory by copying the TFTP image of a microcode version to Flash memory. When the microcode image is stored in Flash memory, you can use the **microcode reload** command to manually load the new microcode file, and the **configure** command to instruct the system to load the new image automatically at each system boot.

Caution   Before you copy a file to Flash, be sure there is ample space available in Flash memory. Compare the size of the file you want to copy to the amount of available Flash memory shown. If the space available is less than the space required by the file you wish to copy, the copy process will continue, but the entire file will not be copied into Flash.

To compare the size of the microcode image and the amount of Flash memory available, you must know the size of the new microcode image. The image size is specified in the README file that is included on the floppy disk with the new image, and in the *Upgrading System Software and Microcode in the Cisco 7XXX* publication that is shipped with all microcode upgrades. Note the size of the new image before proceeding to ensure that you have sufficient available Flash memory for the new image.

Follow these steps to copy a microcode version from the TFTP server to Flash memory:

Step 1   To display the total amount of Flash memory present, its location, any files that currently exist in Flash memory and their size, and the amount of Flash memory remaining, use the **show flash** command. Following is an example of the output that is displayed:

```
Router# show flash

4096K bytes of flash memory on embedded flash (in RSP1).

file    offset      length      name

  [4085336/4194304 bytes free]
```

Step 2   Compare the amount of available Flash memory (last line in the preceding example) to the size of the new microcode image on the floppy disk to ensure that there is sufficient space available. If you attempt to copy in a new image, and the size of the new image exceeds the available space in Flash, only part of the new image will be copied, and the following error message will be displayed:

```
buffer overflow - xxxx/xxxx
```

where *xxxx/xxxx* is the number of bytes read in/number of bytes available.

Step 3   After you verify that there is sufficient space available in Flash memory for the new image, enter the following command at the privileged-level prompt:

```
Router# copy tftp flash
```

Step 4   Enter the IP address of the remote host:

```
IP address or name of remote host [255.255.255.255]? 1.1.1.106
```

Step 5   Enter the name of the file you want to copy to Flash (*vip221-40* in the following example):

```
Name of file to copy? vip221-40
```

Step 6   To confirm that you want the file copied into Flash, press **Return**.

```
Copy vip221-40 from 1.1.1.106 into flash memory? [confirm]
```

If the correct file is not shown, enter **no** at the prompt to return to the system prompt and enter the correct file name.

Step 7   If you do not want Flash erased, enter **no** at the next prompt. If you accept the default to erase by pressing **Return** without first typing **no**, the new image will write over the entire contents of Flash memory, and you will lose all other microcode and system software images stored in Flash.

```
Erase flash before writing? [confirm] no
```

While the file is copied to Flash, output similar to the following is displayed:

```
Loading from 1.1.1.106: !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
 [OK - 108966/4194304 bytes]
Verifying via checksum...
Flash verification successful. Length = 53364, checksum = 0x0000
```

Step 8   Use the **show flash** command to verify that the microcode has been copied to Flash. The output should display the file name of the image you copied to Flash (*vip221-40* in the following example):

```
Router# show flash
4096K bytes of flash memory on embedded flash (in RSP1).

file   offset    length     name
 1     0xD0D4    53364      vip221-40
  [4085336/4194304 bytes free]
```

Step 9   To ensure that the new microcode is used when you reboot the system, add the appropriate commands to the configuration file. To modify the configuration file, enter the following command:

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

Step 10   Specify that you are changing the microcode for the CT3IP (*microcode vip2*), and that it will load from Flash memory *(flash)*. Then add the filename of the new microcode image to be loaded from Flash:

```
Router(config)# microcode vip2 flash vip221-40
```

Step 11   To save the configuration file, press **Ctrl-Z**.

Step 12   Copy the new configuration to NVRAM as follows:

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

The **microcode reload** command is automatically added to your running configuration. The new CT3IP microcode image will load automatically the next time the system boots or reinitializes.

Step 13 To load the new microcode immediately, you can instruct the system to load the new microcode by issuing the **microcode reload** configuration command (you must be in Configuration mode to enter this command):

```
Router# configure

Router(config)# microcode reload
```

Immediately after you enter the **microcode reload** command and press **Return**, the system reloads all microcode. Configuration mode remains enabled; after the reload is complete, press **Ctrl-Z** to exit from Configuration mode and return to the system prompt.

Step 14 To verify that the CT3IP is using the correct microcode, issue the **show running-config**, **show startup-config,** or **show controller cbus** commands. The **show controller cbus** display also indicates the currently loaded and running microcode version for each interface processor.

```
Router# show running-config
```

This completes the procedure for downloading microcode to Flash memory.

Replacing and Upgrading CT3IP DRAM and SRAM

The following procedures describe the steps required to replace the DRAM or SRAM if a system problem has indicated their replacement or an upgrade is required.

The current CT3IP products include the following:

- CT3IP-20(=)—1 MB of SRAM and 16 MB of DRAM

- CT3IP-40(=)—2 MB of SRAM and 32 MB of DRAM

The following sections describe upgrading DRAM and SRAM:

- Replacing CT3IP DRAM SIMMs, page 43

- Replacing the CT3IP SRAM DIMM, page 47

Replacing CT3IP DRAM SIMMs

The DRAM on the CT3IP is contained in two SIMMs located in sockets U2 and U6. (See Figure 8.) If a system problem is determined to be caused by a SIMM, a SIMM replacement might be required. Use the following procedures to replace the DRAM SIMMs on your CT3IP.

Note Only DRAM from the Cisco Systems approved vendor list should be used. Only 60-nanosecond (ns) DRAM SIMMs should be used. A Cisco part number appears on each SIMM.

Caution To prevent ESD damage, handle SIMMs by the card edges only. (See Figure 10 on page 46.) Place removed SIMMs on an antistatic mat and store them in an antistatic container.

Removing SIMMs
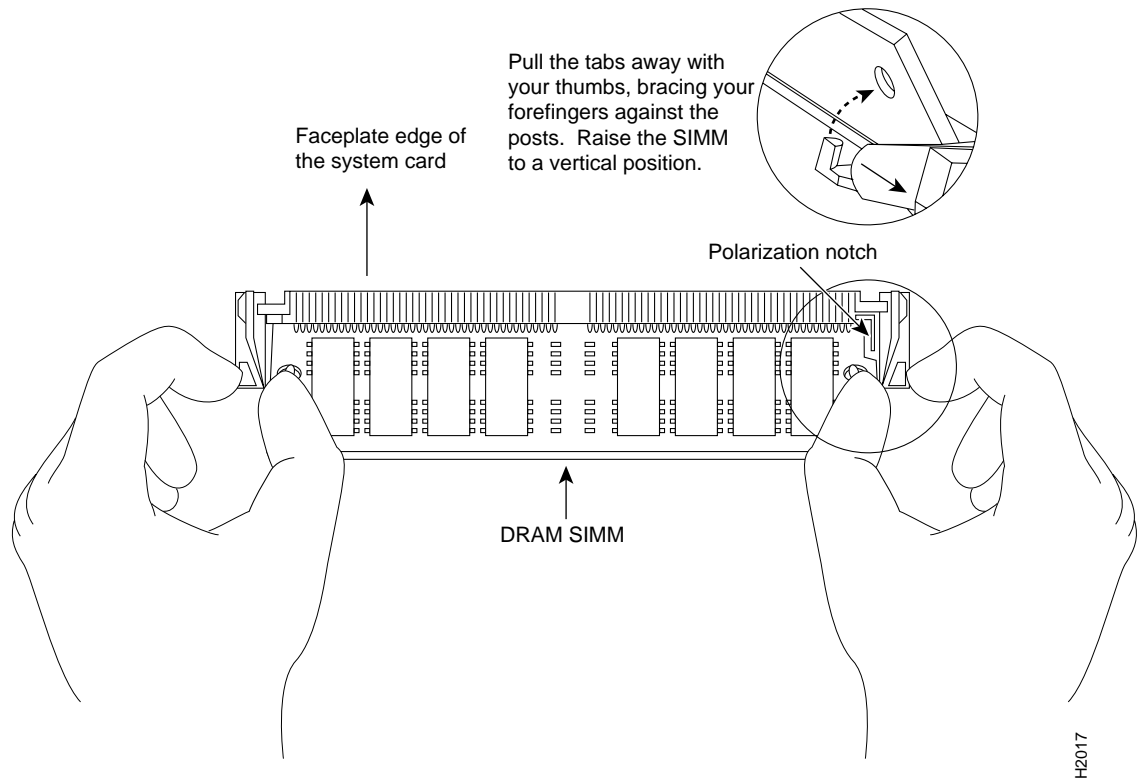
Follow these steps to remove the existing SIMMs:

Step 1   Turn OFF the system power and follow the steps in the section "Removing a CT3IP" on page 14.

Step 2   Place the CT3IP on an antistatic mat or pad and ensure that you are wearing an antistatic device, such as a wrist strap. Position the CT3IP so that the handle is away from you and the bus connector is toward you—opposite of the position shown in Figure 8.

Step 3   Locate the SIMMs. The DRAM SIMMs occupy sockets U2 and U6. (See Figure 8.)

Figure 8   **Location of DRAM SIMMs and SRAM DIMM on CT3IP**
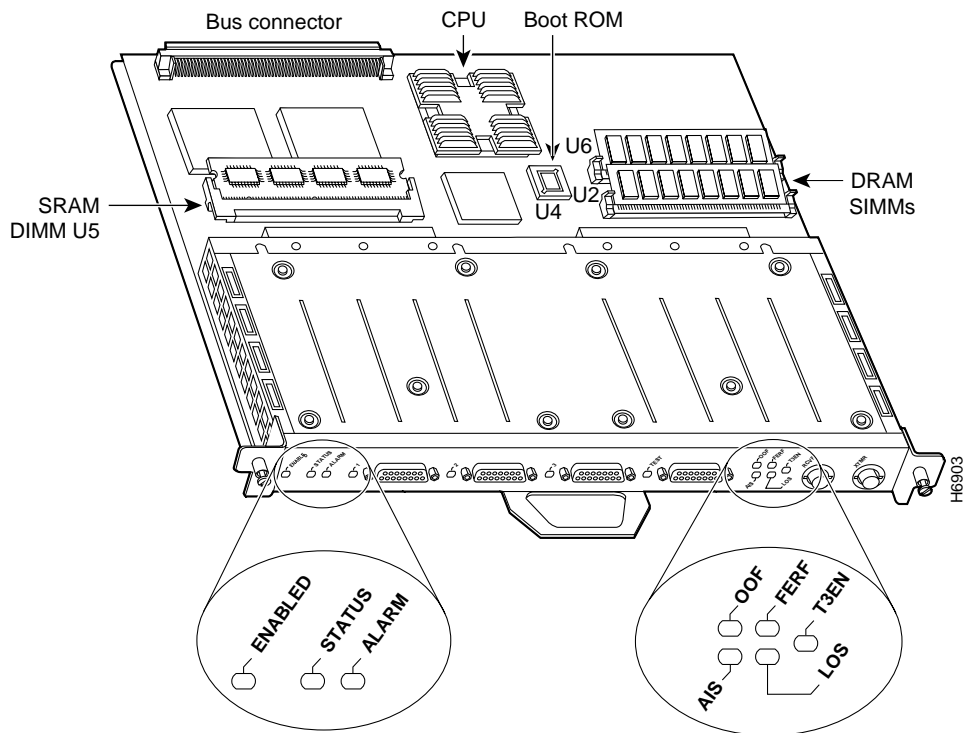
Step 4   Release the spring clips from the SIMM that you want to remove and release the SIMM from the socket. (See Figure 9.)

Figure 9   Releasing SIMM Spring Clips

Pull the tabs away with your thumbs, bracing your forefingers against the posts. Raise the SIMM to a vertical position.

Faceplate edge of the system card

Polarization notch

DRAM SIMM

H2017

Step 5   When both ends of the SIMM are released from the socket, grasp the ends of the SIMM with your thumb and forefinger and pull the SIMM completely out of the socket. Handle the edges of the SIMM only; avoid touching the memory module or pins and the metal traces, or fingers, along the socket edge.

Step 6   Place the SIMM in an antistatic container to protect it from ESD damage.

Step 7   Repeat steps 4 through 6 for the remaining SIMM, as required for this replacement.

This completes the SIMM removal procedure. Proceed to the next section to install the new SIMMs.

Installing New SIMMs

SIMMs are sensitive components that are susceptible to ESD damage. Handle SIMMs by the edges only; avoid touching the memory modules, pins, or traces (the metal *fingers* along the connector edge of the SIMM). (See Figure 10.)

Figure 10   Handling a SIMM
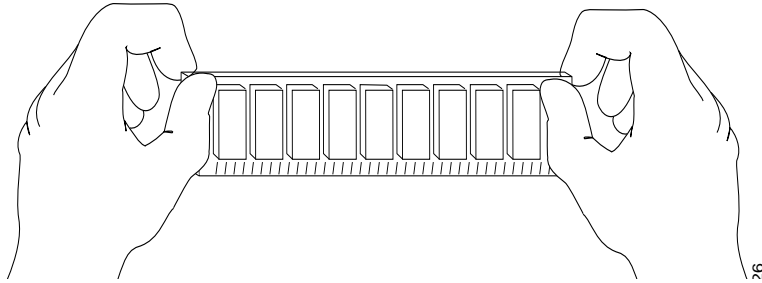
Caution   To prevent ESD damage, handle SIMMs as shown in Figure 10.

Follow these steps to install the new SIMMs:

Step 1   With the CT3IP in the same orientation as the previous procedure (with the handle away from you and the bus connector toward you), you are going to install the first SIMM in the socket farthest from you. Then you will install the last SIMM in the socket closest to you.

Step 2   Remove a new SIMM from the antistatic container.

Step 3   Hold the SIMM component side up, with the connector edge (the metal fingers) closest to you.

Step 4   Hold the sides of the SIMM between your thumb and fore finger, with your forefinger against the far edge, opposite the connector edge. (See Figure 10.)

Step 5   Tilt the SIMM to approximately the same an angle as the socket and insert the connector edge into the socket.

Caution   When inserting SIMMs, use firm but not excessive pressure. If you damage a socket, you will have to return the CT3IP to the factory for repair.

Step 6   Gently push the SIMM into the socket until the spring clips snap over the ends of the SIMM. If necessary, rock the SIMM gently back and forth to seat it properly.

Step 7   Repeat steps 2 through 6 for the remaining SIMMs.

Step 8   When both SIMMs are installed, check all four alignment holes (two on each SIMM) and ensure that the spring retainer is visible. If it is not, the SIMM is not seated properly. If any SIMM appears misaligned, carefully remove it and reseat it in the socket. Push the SIMM firmly back into the socket until the retainer springs snap into place.

This completes the SIMM replacement procedure. Proceed to the section "Replacing the CT3IP SRAM DIMM."

Replacing the CT3IP SRAM DIMM

The SRAM on the CT3IP is contained in a DIMM and located in socket U5. (See Figure 8 on page 44.) If a system problem is determined to be caused by the DIMM, a DIMM replacement might be required. Use the following procedures to replace the SRAM DIMM on your CT3IP.

Note   Only SRAM from the Cisco Systems approved vendor list should be used. Only a 12-ns SRAM DIMM should be used. A Cisco manufacturing part number appears on the DIMM.
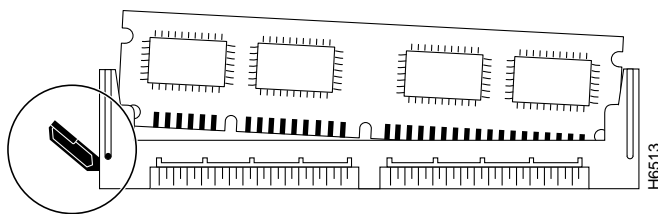
Caution   To prevent ESD damage, handle the DIMM by the edges only. Place a removed DIMM on an antistatic mat and store it in an antistatic container.

Removing the DIMM

Follow these steps to remove the existing DIMM:

Step 1   Turn OFF the system power and follow the steps in the section "Removing a CT3IP" on page 14, if required.

Step 2   Place the CT3IP on an antistatic mat or pad and ensure that you are wearing an antistatic device, such as a wrist strap. Position the CT3IP so that the handle is toward you and the bus connector is facing away from you, approximately as shown in Figure 8.

Step 3   Locate the DIMM. The SRAM DIMM occupies socket U5. (See Figure 8.)

Step 4   Locate the release lever on the DIMM socket (see circle in Figure 11) and release the DIMM from the socket as shown.

Step 5   When one end of the DIMM is released from the socket (see Figure 11), grasp the ends of the DIMM with your thumb and forefinger and pull the DIMM completely out of the socket. Handle the edges of the DIMM only. (See Figure 12.)

Figure 11   Releasing the SRAM DIMM

Step 6   Place the DIMM in an antistatic container to protect it from ESD damage.

This completes the DIMM removal procedure. Proceed to the next section to install the new DIMM.

Installing a New DIMM

The DIMM is a sensitive component that is susceptible to ESD damage. Handle the DIMM by the edges only; avoid touching the memory modules, pins, or traces (the metal *fingers* along the connector edge of the DIMM). (See Figure 12.)

Figure 12   Handling an SRAM DIMM

Key
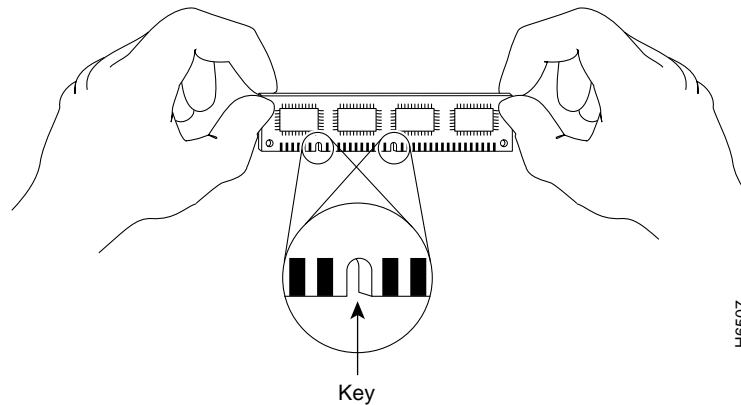
⚠ **Caution** To prevent ESD damage, handle the DIMM as shown in Figure 12.

Follow these steps to install the new DIMM:

Step 1   With the CT3IP in the same orientation as the previous procedure (with the handle toward you and the bus connector away from you), you will install the DIMM in socket U5.

Step 2   Remove the new DIMM from the antistatic container.

Step 3   Hold the DIMM component side up, with the connector edge (the metal fingers) down. (See Figure 12.) Hold the sides of the DIMM between your thumb and fore finger.

Step 4   Tilt the DIMM to approximately the same an angle as the socket and insert the connector edge into the socket. Note the two notches (keys) on the connector edge of the DIMM. (See Figure 12.) These keys are intended to assure correct orientation of the DIMM in the socket.

⚠ **Caution** When inserting the DIMM, use firm but not excessive pressure. If you damage a socket, you will have to return the CT3IP to the factory for repair.

Step 5   Note the orientation of the socket key on the SRAM DIMM and the DIMM socket and gently push the DIMM into the socket until the release lever is flush against the side of the DIMM socket (see Figure 13), and the DIMM's edge connector is fully inserted. If necessary, rock the DIMM gently back and forth to seat it properly.

Figure 13   Installing an SRAM DIMM in the Socket
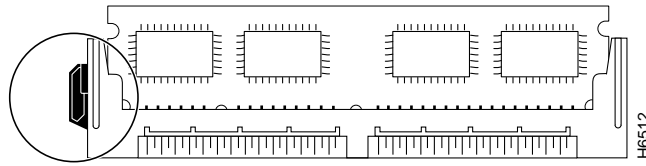
Step 6   When the DIMM is installed, check that the release lever is flush against the side of the DIMM socket. (See Figure 13.) If it is not, the DIMM might not be seated properly. If the DIMM appears misaligned, carefully remove it according to the removal procedure, and reseat it in the socket. Push the DIMM firmly back into the socket until release lever is flush against the side of the DIMM socket.

This completes the DIMM replacement procedure.

Proceed to the section "Installing a CT3IP," on page 16, to replace the CT3IP in the chassis; then restart the system for an installation check. Refer to the section "Checking DRAM and SRAM Replacement."

Checking DRAM and SRAM Replacement

If, after a DRAM or SRAM replacement, the system fails to boot properly, or if the console terminal displays a checksum or memory error, check the following:

- Ensure that all SIMMs (and the DIMM) are installed correctly. If necessary, shut down the system and remove the CT3IP. Check the SIMMs (and the DIMM) by looking straight down on them and then at eye level. The SIMMs (and the DIMM) should be aligned at the same angle and the same height when properly installed. If a SIMM (or DIMM) appears to stick out or rest in the socket at a different angle from the others, remove it and reinsert it. Then replace the CT3IP and reboot the system for another installation check.

- Each DRAM SIMM socket must contain SIMMs of the same size and speed or the system will not operate. SIMMs must be 60 ns or faster. The speed is silkscreened along one edge of the SIMM.

Refer to the section "Using LEDs to Check CT3IP Initialization," on page 18, as required. If after several attempts the system fails to restart properly, contact a service representative for assistance. Before you call, make note of any error messages, unusual LED states, or any other indications that might help solve the problem.

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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.)

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