CHAPTER 5

Maintaining the Router

This chapter provides maintenance procedures for the router, its processor modules, and its replaceable spare parts. Your router is configured to your order and ready for installation and startup when it leaves the factory. In the future, as your communication requirements change, you might want or need to upgrade your system, add components, or change the initial hardware configuration.

This chapter describes the procedures for installing, replacing, and reconfiguring interface processors, and for adding and replacing internal system components and replaceable spares. Software and microcode component upgrades require specific part numbers and other frequently updated information; therefore, only basic replacement guidelines are included in this publication.

Note Detailed, up-to-date instructions (called *configuration notes*) are shipped with the replacement parts, spare parts, FRUs, or upgrade kits.

The replaceable system components fall into two categories: those that support online insertion and removal (OIR) and those that do not (requiring you to turn off the system power before replacement). Because interface processors support OIR, you can remove and replace them while the system is operating; however, you must shut down the system power before removing the RSP2 or accessing the chassis interior.

This chapter contains information on the following:

- RSP2 and interface processor installation and configuration (general instructions for installing, replacing, upgrading, and reconfiguring the processor modules and associated components and, when necessary, instructions for using software configuration commands, and includes information on configuring the high system availability [HSA] feature)
- Chassis component replacement (instructions for replacing the following components):
    - — Blower module
    - — Power supplies
    - — Card cage assembly

Warning Before performing any procedures in this chapter, review the section “Safety Recommendations” in the chapter “Preparing for Installation” to help prevent problems.

Installing and Configuring Processor Modules

All interface processors support OIR, which allows you to install, remove, replace, and rearrange the interface processors without turning off the system power. This feature is not supported for the RSP2 because it is required for system operation. When the system detects that an interface processor has been installed or removed, it automatically runs diagnostic and discovery routines, acknowledges the presence or absence of the interface processor, and resumes system operation without any operator intervention. This section provides installation and removal procedure for all interface processors.

This section also includes instructions for replacing spares on the interface processors and using basic configuration commands that you may need when setting up new interfaces.

An EPROM component on each interface processor contains a default microcode image. New features and enhancements to the system or interfaces are often implemented in microcode upgrades. The Cisco 7513 supports downloadable microcode for most maintenance upgrades, which enables you to download new microcode images remotely and store them in Flash memory. You can then use software commands to instruct the system to load a specific microcode image from Flash memory or to load the default microcode image from Flash memory.

System software upgrades also can contain upgraded microcode images, which will load automatically when the new software image is loaded. Although most upgrades support the downloadable microcode feature and are distributed on floppy disk or Flash memory card, some may require ROM replacement. If replacement is necessary, refer to the section "Microcode Component Replacement" in this chapter. Also, specific up-to-date replacement and configuration instructions will be provided with the replacement component in the upgrade kit.

On the FSIP and MIP interface processors, you can replace a port adapter if one fails, and with software commands you can change specific functions on the individual interfaces.

Online Insertion and Removal—An Overview

The OIR feature allows you to remove and replace interface processors while the system is operating; you do not need to prepare or shut down the system. All interface processors support OIR. The RSP2, which is a required system component and is always installed in RSP slot 6 or 7, should *not* be removed and replaced without first shutting down the system.

Caution All interface processors support OIR; however, *you must shut down the system before removing or installing the RSP2*, which is a required system component. Removing an RSP2 while the system is operating will cause the system to shut down or crash, and might damage or destroy memory files.

Each RSP2 and interface processor contains a bus connector with which it connects to the system backplane. The bus connector is a set of tiered pins, in three lengths. The pins send specific signals to the system as they make contact with the backplane. The system assesses the signals it receives and the order in which it receives them to determine what event is occurring and what task it needs to perform, such as reinitializing new interfaces or shutting down removed ones. For example, when you insert an interface processor, the longest pins make contact with the backplane first, and the shortest pins make contact last. The system recognizes the signals and the sequence in which it receives them. The system expects to receive signals from the individual pins in this logical sequence, and the ejector levers help to ensure that the pins mate in this sequence.

When you remove or insert an interface processor, the backplane pins send signals to notify the system, which then performs as follows:

1. Rapidly scans the backplane for configuration changes and does not reset any interfaces
2. Initializes all newly inserted interface processors, noting any removed interfaces and placing them in the administratively shutdown state
3. Brings all previously configured interfaces on the interface processor back to the state they were in when they were removed

   Any newly inserted interfaces are put in the administratively shutdown state, as if they were present (but unconfigured) at boot time. If a similar interface processor type has been reinserted into a slot, then its ports are configured and brought online up to the port count of the original interface processor.

OIR 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. When you insert a new interface processor, the system runs a diagnostic test on the new interfaces and compares them to the existing configuration. If this initial diagnostic test fails, the system remains off line while it performs a second set of diagnostic tests to determine whether or not the interface processor is faulty and if normal system operation is possible.

If the second diagnostic test passes, which indicates that the system is operating normally and the new interface processor is faulty, the system resumes normal operation but leaves the new interfaces disabled. If the second diagnostic test fails, the system crashes, which usually indicates that the new interface processor has created a problem on the bus and should be removed.

The system brings online only interfaces that match the current configuration and were previously configured as up; all other interfaces require that you configure them with the **configure** command. On interface processors with multiple interfaces, only the interfaces that have already been configured are brought on line.

For example, if you replace a single-PCA CIP with a dual-PCA CIP, only the previously configured interface is brought on line automatically; the new interface remains in the administratively shutdown state until you configure it and bring it on line.

The function of the ejector levers (see the section"Online Insertion and Removal—An Overview" in this chapter) 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 FSIP 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 may 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.

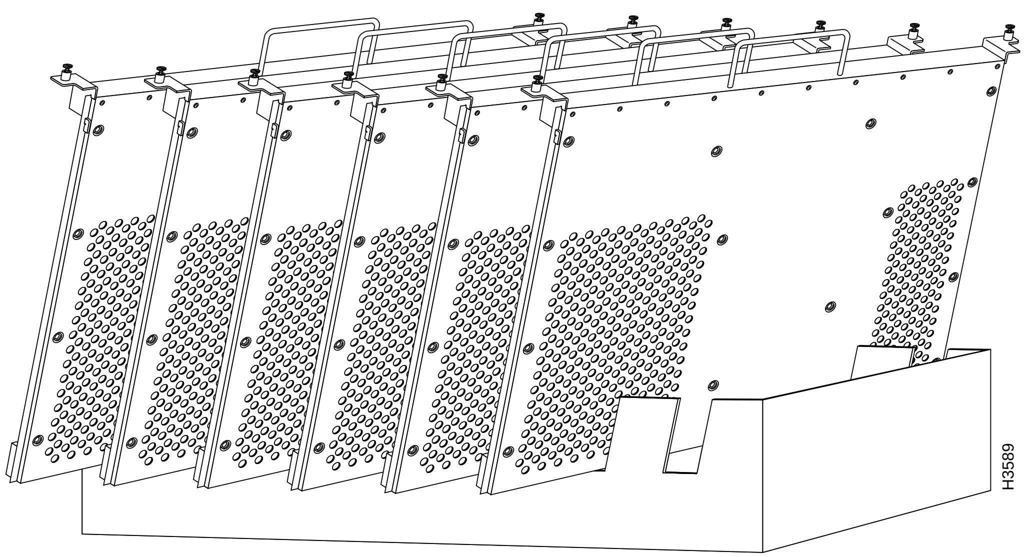
- Using the handle to insert or remove an interface processor, or failing to push the ejector levers to the full 90-degree position, can leave some (not all) of the connector pins mated to the backplane, a state which will hang the system. Using the ejector levers and making sure that they are pushed 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 RSP2 or interface processor that is only partially connected to the backplane can hang the bus. Detailed steps for correctly performing OIR are included in the following procedures for installing and removing interface processors.

Caution The RSP2 is a required system component; removing it without first shutting down the system will cause an abrupt system shutdown and can damage or destroy memory files. To remove or replace the RSP2, first shut down all system power, then follow the same removal and insertion procedures (following) that you would for OIR to ensure that the processor module is properly seated.

Note Place removed processor modules in the collapsible, black-cardboard board racks that were provided with your packing material, as shown in Figure 5-1.

Figure 5-1 Board Rack with Processor Modules



Tools Required

You will need a number 1 Phillips or 3/16-inch flat-blade screwdriver to remove any blank interface processor carriers (fillers) and to tighten the captive installation screws that secure the interface processor in its slot. (Most interface processor carriers use slotted screws, but some were manufactured with Phillips screws.) Whenever you handle interface processors, use a wrist strap or other grounding device to prevent ESD damage. (See the section “Preventing Electrostatic Discharge Damage” in the chapter “Preparing for Installation.”)

Removing Interface Processors

Following are detailed steps for removing interface processors and successfully performing OIR. Refer to Figure 5-2, which shows the functional details of the ejector levers, which you must use properly when inserting or removing interface processors.

To remove an interface processor, follow these steps:

Step 1 Attach an ESD-preventive strap between you and an unpainted surface on the chassis.

Note The procedure to remove the RSP2 is identical to that for an interface processor, except that you must turn off chassis power before removing the RSP2. Because the RSP2 is a required chassis component, it does not support OIR.

Step 2 If you will not immediately reinstall the interface processor you are removing, or if there is not enough slack in the network interface cables to remove the interface processor without straining the cables, disconnect any cables attached to the interface ports.

Step 3 You must pull processor modules straight out of the slot. Ensure that there are no obstructions that will prevent you from doing so, such as a power strip on a rack post, network connection devices attached to adjacent interface processors, or extensive cabling in front of the processor slots.

Step 4 Use a screwdriver to loosen the captive installation screws at the both ends of the interface processor. (See Figure 5-2a.)

Step 5 Place your thumbs on the ejector levers on both ends of the interface processor (see Figure 5-2c) and simultaneously pull them both outward to release the interface processor from the backplane connector.

Step 6 Grasp the interface processor handle with one hand and place your other hand under the carrier to support it. Pull the interface processor straight out of the slot keeping it at a 90-degree orientation to the backplane. (See Figure 5-3.)

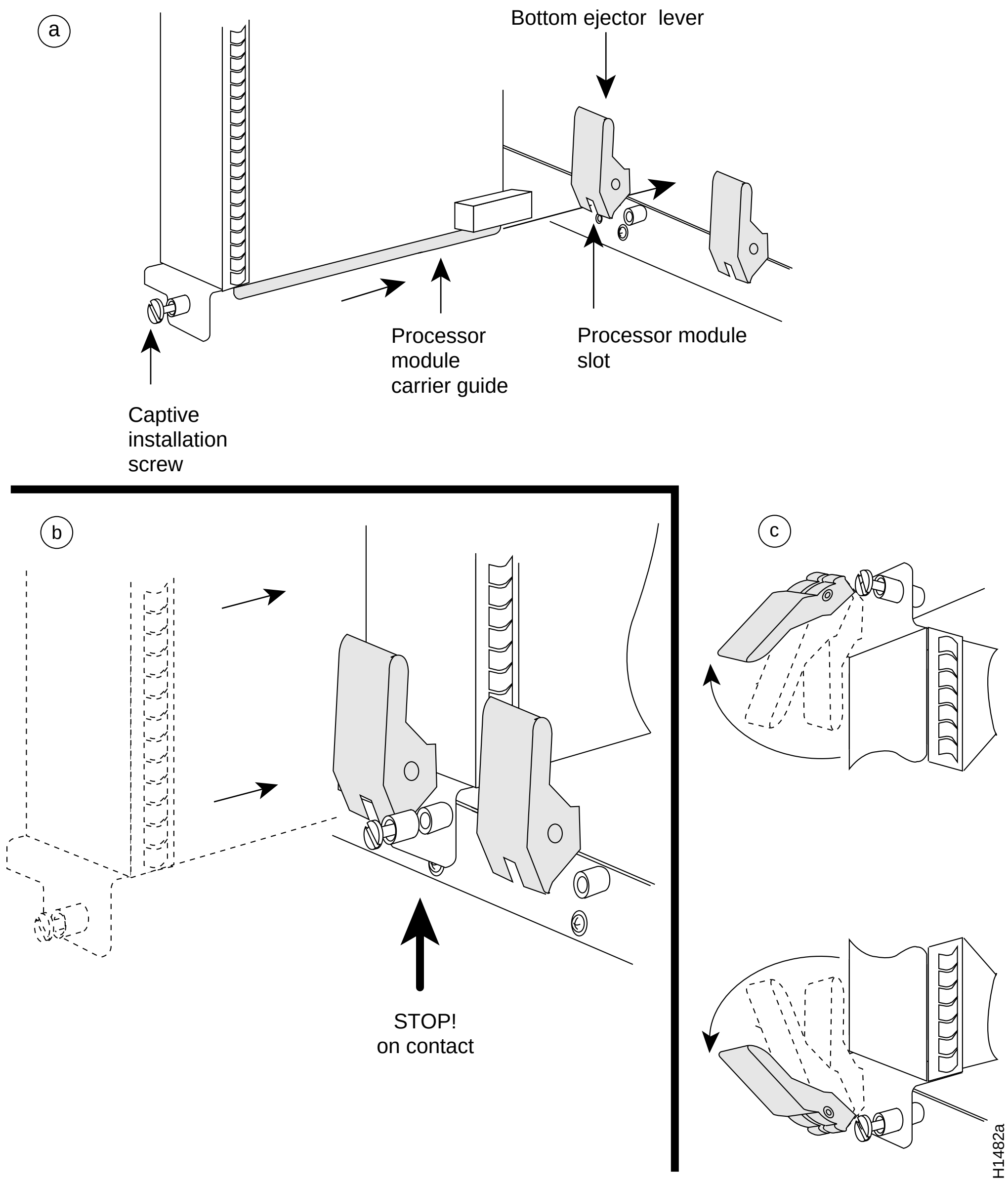
Step 7 Place the removed interface processor on an antistatic mat or immediately install it in another slot.

Step 8 If the slot is to remain empty, install a blank interface processor filler (MAS-7KBLANK) or a blank RSP filler (MAS-RSPBLANK) to keep dust out of the chassis, to maintain proper air flow through the interface processor compartment, and to maintain the EMI integrity of the system.

Caution Always install blank interface processor fillers in empty interface processor slots to maintain the proper flow of cooling air through the chassis.

Note Interface processor fillers do not fit into the RSP slots, which require RSP fillers (MAS-RSPBLANK=). One RSP filler is shipped with each single-RSP2 system.

Figure 5-2 Ejector Levers and Captive Installation Screws

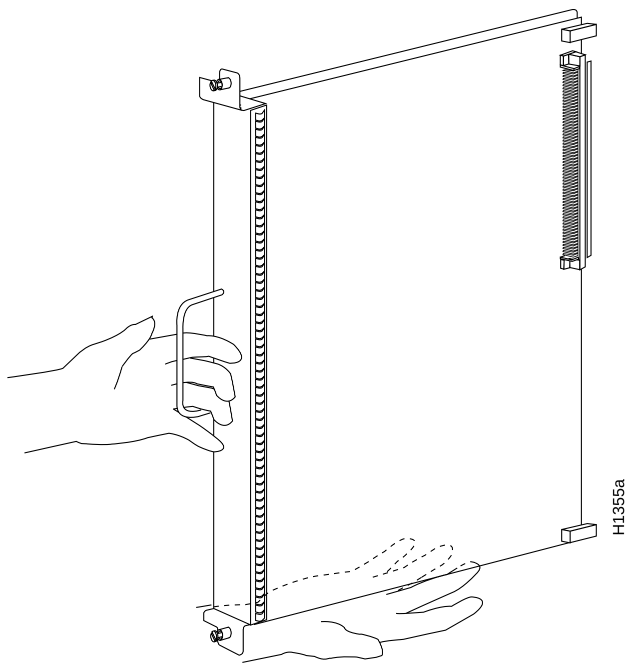


Installing Interface Processors

You can install an interface processor in any of the 11 interface processor slots, numbered 0 through 5 and 8 through 12, from left to right, viewing the chassis from the interface processor end. (See Figure 1-6.) Slots 6 and 7 can contain *only* an RSP2. Following are installation steps for the interface processors, which support OIR and can be removed and installed while the system is operating.

Caution To prevent system and network problems, you must turn off the chassis power before removing or installing an RSP2. After the chassis power has been turned off, the installation procedure is the same as the following steps for interface processors.

Figure 5-3 Handling an Interface Processor during Installation



Caution Handle interface processors by the handles and carrier edges only to prevent ESD damage.

Step 1 Choose a slot for the new interface processor and ensure that there is enough clearance to accommodate any interface equipment that you will connect directly to the interface processor ports. (For example, 10BASE-T Ethernet transceivers that connect directly to EIP ports may be wider than the interface processor and can obstruct connections on adjacent interface processors.)

Step 2 Interface processors are secured with two captive installation screws. Use a number 1 Phillips or a 1/4-inch flat-blade screwdriver to loosen the two captive installation screws and remove the interface processor filler (or the existing interface processor) from the slot to be filled.

Step 3 Hold the interface processor handle with one hand, and place your other hand under the carrier to support it. (See Figure 5-3.) Avoid touching the board.

Step 4 Place the back of the interface processor in the slot and align the carrier guides along the sides of the interface processor with the grooves in the top and bottom of the slot. (See Figure 5-2a.)

Step 5 While keeping the interface processor at a 90-degree orientation to the backplane, carefully slide the interface processor into the slot until the interface processor faceplate makes contact with the ejector levers. (See Figure 5-2b.)

Step 6 Using your thumbs, simultaneously push both ejector levers inward until they push the interface processor completely into the slot. The ejector levers should be in approximately the same orientation as the interface processor faceplate. (See Figure 5-2c.)

Step 7 Use a screwdriver to tighten both of the captive installation screws.

Step 8 Attach network interface cables or other devices to the interface ports.

Step 9 Check the status of the interfaces as follows:

- If this installation is a replacement interface processor, use the **show interfaces** or **show controllers** [*type*] command to verify that the system has acknowledged the new interfaces and brought them up.
- If the interfaces are new, use the **configure** command or the **setup** command facility to configure the new interface(s). This does not have to be done immediately, but the interfaces will not be available until you configure them.

Note 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.

Sample Screen Display for OIR

When you remove and replace interface processors, the system provides status messages across the console screen. The messages are only informational. In the following sample display, the events logged by the system show that an EIP was removed from slot 0; the system reinitialized the remaining interface processors, and marked the EIP that was removed from slot 0 as *down*. When the EIP was reinserted, the system marked the interfaces as *up* again.

```
Router#

%OIR-6-REMCARD: Card removed from slot 0, interfaces disabled
%LINK-5-CHANGED: Interface Ethernet0/1, changed state to administratively down
%LINK-5-CHANGED: Interface Ethernet0/5, changed state to administratively down

Router#

%OIR-6-INSCARD: Card inserted in slot 0, interfaces administratively shut down
%LINK-5-CHANGED: Interface Ethernet0/1, changed state to up
%LINK-5-CHANGED: Interface Ethernet0/5, changed state to up
```

Microcode Component Replacement

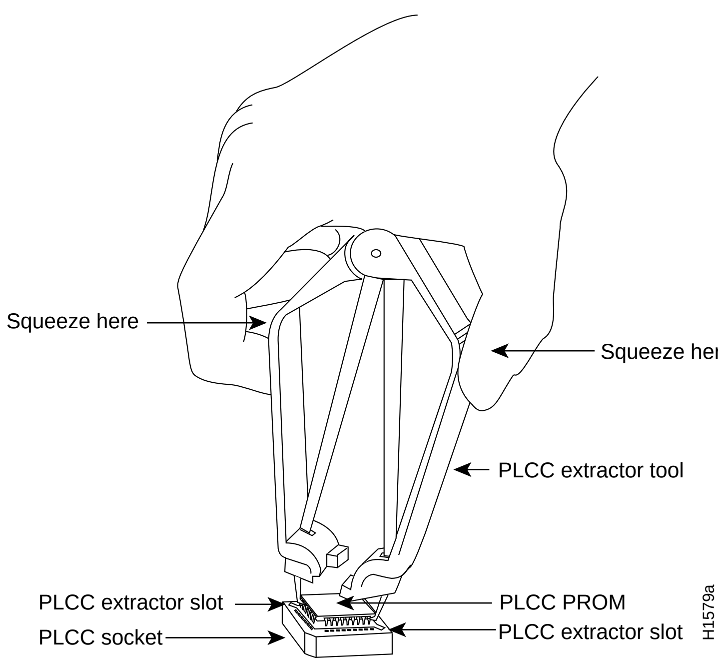
Each interface processor contains default microcode (firmware), which is an image of board-specific software instructions on a single EPROM on each board. Microcode operates with the system software and controls features and functions that are unique to an interface processor type. New features and enhancements to the system or interfaces are often implemented in microcode upgrades.

Although each processor type contains the latest available microcode version (in ROM) when it leaves the factory, updated microcode images are periodically distributed with system software images to enable new features, improve performance, or fix bugs in earlier versions. The latest available microcode version for each interface processor type is bundled with each new system software maintenance upgrade; the bundled images are distributed as a single image on floppy disk or a Flash memory card.

Although most upgrades support the downloadable microcode feature, some images may require EPROM replacement. If necessary, use the following instructions to replace an interface processor EPROM in case Flash memory is damaged or otherwise not available, or to change the default microcode on a board for any other reason. The replacement procedures are the same for each board with the exception of the FSIP, which uses a PLCC-type package for the microcode.

You must use a PLCC extractor to remove the FSIP microcode component. (See Figure 5-4.) You cannot use a small flat-blade screwdriver to pry it out of the socket as with the older type of ICs. A PLCC IC does not have legs or pins that plug into the socket; instead, the contacts are on the sides of the IC and along the inner sides of the socket. When the IC is seated in the socket, the top of the IC is flush with the top of the socket. Forcing a small screwdriver or other tool between the IC and the sides of the socket to pry out the IC will damage the component or the socket or both, and you will have to replace them.

Figure 5-4 Removing a Microcode Component from a PLCC-Type Package



Tools Required

You need the following tools to replace the microcode component:

- Chip extractor or puller (you need a PLCC-type extractor to remove the FSIP component)
- Antistatic mat or foam pad
- ESD-preventive strap (a disposable wriststrap is included in microcode upgrade kits)

Replacing a Microcode EPROM

Following are the steps for replacing a microcode EPROM on any interface processor. Refer to the illustrations of the individual interface processors in the section "Interface Processors" in the chapter "Product Overview" for socket locations.

Caution Handle interface processors by the handles and carrier edges only, and always use a grounding strap to prevent ESD damage.

Step 1 If you are replacing the component on an interface processor, check the state of each interface before removing the interface processor, and note any that are shut down.

Step 2 Follow the steps in to remove the interface processor from the chassis. If you perform the replacement close enough to the chassis to avoid straining the interface cables attached to the interface processor (if any), leave the cables connected. Otherwise, label the cables before disconnecting them to avoid crossing them later.

Step 3 Place the removed interface processor on an antistatic mat or foam.

Step 4 Locate the microcode component; refer to the appropriate interface processor illustrations in the chapter "Product Overview" for socket locations. Following are the socket designators for each interface processor:

- AIP: U111
- CIP: U37 (contains the microcode boot image; the entire microcode image is contained in the software/microcode bundle)
- EIP: U101
- FEIP: U37
- FIP: U23
- FSIP: U81
- HIP: U133
- MIP: U41
- TRIP: U41

Step 5 Note the orientation of the notch on the existing microcode component so that you can install the new component with the same orientation.

Step 6 Use a chip or PLCC-type extractor to remove the microcode component from the socket. Place the removed component on antistatic foam or into an antistatic bag.

Step 7 Insert the new microcode component in the socket with the notched end in the same orientation as the previous component.

Step 8 To replace the interface processor, follow the steps in the section "Installing Interface Processors" in this chapter.

Step 9 Verify that the enabled LED on the interface processor goes on and remains on. If it does not, immediately use the ejector levers to eject the interface processor and reinstall it in the slot.

Step 10 Connect any network interface cables that were removed.

Step 11 If the system power is OFF, turn it back ON.

Verifying the Microcode Version

The system automatically reloads the microcode when you insert an interface processor online or restart the system. The system default is to load the EPROM-based microcode for all processor types. However, because microcode upgrades are usually distributed as files to be stored and loaded from Flash memory, the system may be configured to bypass the EPROM-based microcode for a particular processor type, and load an image from a Flash memory file instead. (This can be true for any or all processor types.) To determine whether the interface processor you just upgraded is loading the new EPROM-based microcode or an image from Flash memory, issue the **show controllers cyBus** command. The first line of the status display for each interface processor displays the currently loaded and running microcode version for that particular processor type.

The following example shows that the EIP in slot 0 is running EIP Microcode Version 10.0:

```
Router# show cont cybus

(display text omitted)
 EIP 0, hardware version 5.1, microcode version 10.0
  Interface 0 - Ethernet0/0, station addr 0000.0c02.d0ec (bia 0000.0c02.d0cc)
(display text omitted)
```

If the microcode version in the display is different from the ROM version you just installed, use the **microcode** *card-type* **rom** configuration command to change the configuration so the system loads the ROM microcode for that processor type. Verify that the new microcode version is loading from ROM and, if necessary, correct the configuration with the following steps:

Step 1 Verify that the system boots correctly. If the enabled LED on the RSP2 or interface processor does not go on, repeat the steps in the preceding section "Replacing a Microcode EPROM."

- Ensure that the ROM is installed with the notch at the correct end and that none of the pins are bent.
- If a pin is bent, remove the ROM, straighten the pin, and try the installation again.

Step 2 Check the state of the interfaces with the LEDs and verify that the interfaces return to the same state they were in before you removed the interface processor (some may have been shut down).

Step 3 Enter the **show controller cybus** command to display the status of the RSP2 and all interface processors.

Step 4 If the display indicates that the new EPROM-based microcode image is the currently running microcode version, your installation is complete. If a different (older) version is displayed, the microcode is still loading from a Flash memory file. Proceed with the following steps to configure the EPROM-based microcode to load.

Step 5 Enable the privileged level of the EXEC command interpreter (which usually requires a password) and enter the configuration mode from the terminal:

```
Router> enable
Password:

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

Step 6 Enter the command **microcode** *card-type* **rom** to negate the instruction to load from Flash memory, then issue the **microcode reload** command to reload the microcode with the new instructions. The following example shows the command used to load EIP microcode from ROM:

```
Router(config)# microcode eip rom
Router(config)# microcode reload
```

Step 7 Press **Ctrl-Z** (^Z) to return to the system prompt, and save (write) the new configuration to memory with the **copy running-config startup-config** command.

```
Router(config)# ^Z
Router# copy running-config startup-config
[OK]
Router#
```

Step 8 Enter the **show controller cybus** command again. The first line of the display for the interface processor (and for all interface processors of the same type) should show the new ROM microcode version.

The replacement procedure is complete. If the enabled indicator does not go on after a second installation attempt, or if any of the interfaces fail to return to their previous state, refer to the troubleshooting procedures in the chapter “Troubleshooting the Installation.”

Configuring the RSP2

This section describes the following maintenance aspects of the RSP2:

- Installing and removing a Flash memory card
- Making changes to the software configuration register
- Replacing DRAM SIMMs

Installing and Removing a Flash Memory Card

It might become necessary for you to replace or install a Flash memory card in your RSP2. The RSP2 has two PCMCIA slots: Slot 0 (bottom) and Slot 1 (top). (See Figure 5-5 on the following page.) The following procedure is generic and can be used for a Flash memory card in either slot position.

Note Insert the Flash memory card with the Flash label in the direction of the arrow, which is adjacent to the PCMCIA slots. This arrow points to the right as shown in Figure 5-5. The Flash memory card is keyed. If it is inserted incorrectly, the appropriate ejector button (shown in Figure 5-5b) will not pop out.

Following is the procedure for installing and removing a Flash memory card:

Step 1 Connect an ESD-preventive strap between you and an unpainted chassis surface.

Step 2 Face the front panel of the RSP2 (which should appear as shown in Figure 5-5a), and hold the Flash memory card with the connector end of the card toward the slot and the Flash label to the right (in the direction of the arrow shown in Figure 5-5).

Step 3 Insert the card into the appropriate slot until the card completely seats in the connector at the back of the slot and the eject button pops out toward you. (See Figure 5-5b.) *Do not attempt to force the card past this point.*

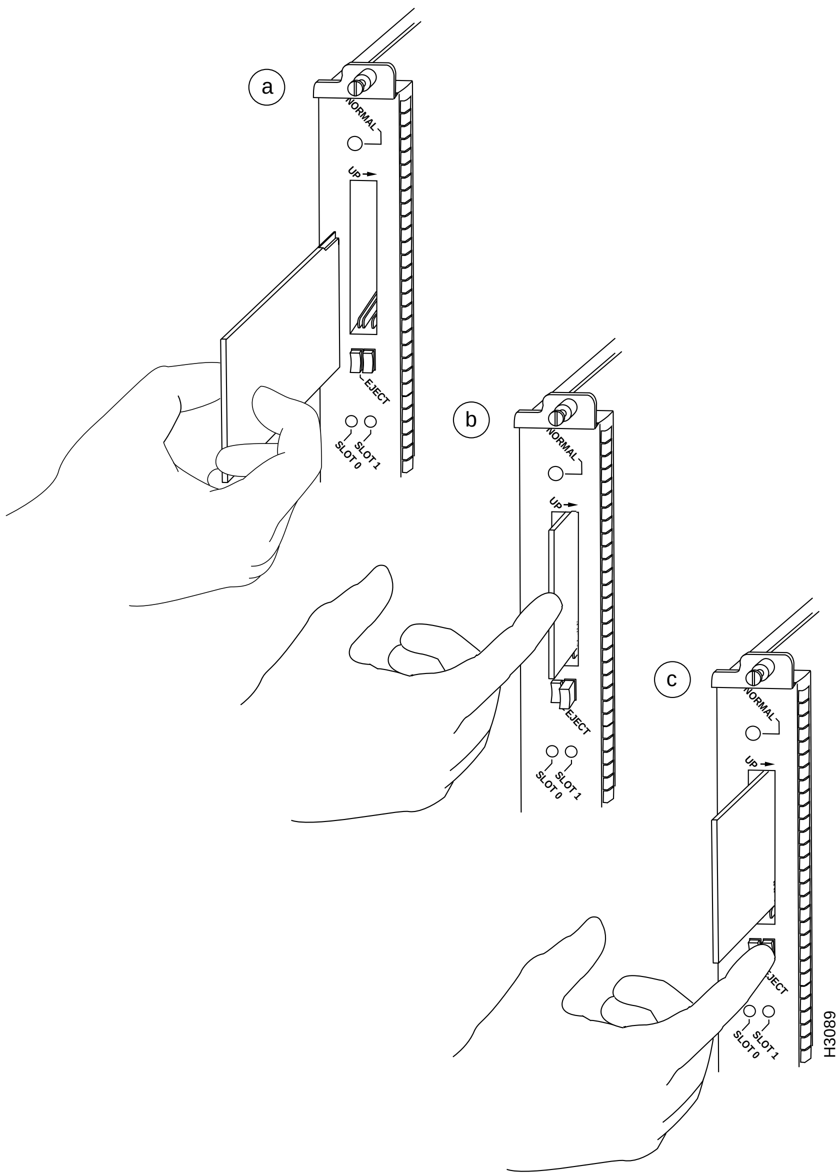
Note The Flash memory card does not insert all the way inside the RSP2; a portion of the card will remain outside of the slot.

Step 4 To eject a card, press the appropriate ejector button. (See Figure 5-5c.)

Step 5 Remove the card from the slot and place it in an antistatic bag to protect it.

Note Use only Intel Series 2+ Flash memory cards.

Figure 5-5 Installing and Removing a Flash Memory Card



Making Changes to the Software Configuration Register

This section describes the software (virtual) configuration register that is used with the RSP2.

Following is the information included in this section:

- Software configuration register settings
- Explanation of boot field
- Changing configuration register settings
- Software configuration register bit meanings
- Default boot filenames
- Software configuration register settings for broadcast address destination
- System console terminal baud-rate settings
- Enabling booting from Flash memory
- Copying to Flash memory

Note Software configuration register setting changes take effect *only* after the system is restarted.

Software Configuration Register Settings

Settings for the 16-bit software configuration register are written into the NVRAM. Following are some reasons for changing the software configuration register settings:

- Select a boot source and default boot filename.
- Enable or disable the Break function.
- Control broadcast addresses.
- Set the console terminal baud rate.
- Load operating software from Flash memory.
- Enable booting from a Trivial File Transfer Protocol (TFTP) server.
- Recover a lost password.
- Manually boot the system using the **b** command at the bootstrap program prompt.
- Force the router to boot automatically from the system bootstrap software (boot image) or from its default system image in onboard Flash memory, and read any **boot system** commands that are stored in the configuration file in NVRAM.

  If the router finds no **boot system** commands, it uses the configuration register value to form a filename for a default system image that it attempts to boot from a network server. (See Table 5-3.)

Table 5-1 lists the meaning of each of the software configuration memory bits, and Table 5-2 defines the boot field.

Caution To avoid confusion and possibly halting the router, remember that valid configuration register settings might be combinations of settings and not just the individual settings listed in Table 5-1. For example, the factory default value of 0x0101 is a combination of settings.

Table 5-1 Software Configuration Register Bit Meanings

Bit Number[1]	Hexadecimal	Meaning
00 to 03	0x0000 to 0x000F	Boot field (see Table 5-2)
06	0x0040	Causes system software to ignore NVRAM contents
07	0x0080	OEM bit enabled[2]
08	0x0100	Break disabled
09	0x0200	Use secondary bootstrap
10	0x0400	Internet Protocol (IP) broadcast with all zeros
11 to 12	0x0800 to 0x1000	Console line speed (default is 9600 baud)
13	0x2000	Boot default Flash software if network boot fails
14	0x4000	IP broadcasts do not have network numbers
15	0x8000	Enable diagnostic messages and ignore NVRAM contents

1. The factory default value for the configuration register is 0x0101. This value is a combination of the following: bit 8 = 0x0100 and bits 00 through 03 = 0x0001 (see Table 5-2).
2. OEM = original equipment manufacturer.

Table 5-2 Explanation of Boot Field (Software Configuration Register Bits 00 to 03)

Boot Field	Meaning
00	Stays at the system bootstrap prompt
01	Boots the first system image in onboard Flash memory
02 to 0F	Specifies a default netboot filename Enables boot system commands that override the default netboot filename

Changing Settings

To change the configuration register while running the system software, follow these steps:

Step 1 Enter the **enable** command and your password to enter privileged level, as follows:

```
Router> enable
Password:
Router#
```

Step 2 At the privileged-level system prompt (router #), enter the command **configure terminal.** You will be prompted as shown in the following example:

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

Step 3 To set the contents of the configuration register, enter the **config-register** *value* configuration command where *value* is a hexadecimal number preceded by 0x (see Table 5-1), as in the following:

```
Router(config)# config-register 0xvalue
```

Step 4 Exit the configuration mode by entering **Ctrl-Z**. The new value settings will be saved to memory; however, the new settings do not take effect until the system software is reloaded by rebooting the router.

Step 5 To display the configuration register value currently in effect and the value that will be used at the next reload, enter the **show version** EXEC command. The value will be displayed on the last line of the screen display, as in the example following:

```
Configuration register is 0x141 (will be 0x101 at next reload)
```

Step 6 Reboot the router. The new value takes effect. Configuration register changes take effect only when the server restarts, such as when you switch the power off and on or when you issue a **reload** command from the console.

Bit Meanings

The lowest four bits of the software configuration register (bits 3, 2, 1, and 0) form the *boot field.* (See Table 5-2.) The boot field specifies a number in binary form. If you set the boot field value to 0, you must boot the operating system manually by entering the **b** command at the bootstrap prompt as follows:

```
rommon1> b [tftp] flash filename
```

Definitions of the various **b** command options follow:

- **b—**Boots the default system software image from onboard Flash memory
- **b flash**—Boots the first file in onboard Flash memory
- **b slot0:** *filename*—Boots the file *filename* from the Flash memory card in PCMCIA Slot 0
- **b slot1:** *filename*—Boots the file *filename* from the Flash memory card in PCMCIA Slot 1
- **b** *filename [host]*—Boots from server *host* using TFTP
- **b flash:** *[filename]*—Boots the file *filename* from onboard Flash memory

For more information about the **b** [**tftp**] **flash** *filename* command, refer to the set of router products configuration publications.

If you set the boot field value to *0x2* through *0xF*, and there is a valid system boot command stored in the configuration file, then the router boots the system software as directed by that value. If you set the boot field to any other bit pattern, the router uses the resulting number to form a default boot filename for netbooting. (See Table 5-3.)

In the following example, the software configuration register is set to boot the router from onboard Flash memory and to ignore Break at the next reboot of the router:

```
Router# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)# config-register 0x102
Router(config)# boot system flash [filename]
Router(config)# ^z
Router#
```

The server creates a default boot filename as part of the automatic configuration processes. To form the boot filename, the server starts with the name cisco and adds the octal equivalent of the boot field number, a hyphen, and the processor-type name. Table 5-3 lists the default boot filenames or actions for the processor.

Note A **boot system** configuration command in the router configuration in NVRAM overrides the default netboot filename.

Table 5-3 Default Boot Filenames

Action/File Name	Bit 3	Bit 2	Bit 1	Bit 0
Bootstrap mode	0	0	0	0
Default software	0	0	0	1
cisco2-RSP	0	0	1	0
cisco3-RSP	0	0	1	1
cisco4-RSP	0	1	0	0
cisco5-RSP	0	1	0	1
cisco6-RSP	0	1	1	0
cisco7-RSP	0	1	1	1
cisco10-RSP	1	0	0	0
cisco11-RSP	1	0	0	1
cisco12-RSP	1	0	1	0
cisco13-RSP	1	0	1	1
cisco14-RSP	1	1	0	0
cisco15-RSP	1	1	0	1
cisco16-RSP	1	1	1	0
cisco17-RSP	1	1	1	1

Bit 8 controls the console Break key. Setting bit 8 (the factory default) causes the processor to ignore the console Break key. Clearing bit 8 causes the processor to interpret the Break key as a command to force the system into the bootstrap monitor, thereby halting normal operation. A break can be sent in the first 60 seconds while the system reboots, regardless of the configuration settings.

Bit 9 controls the secondary bootstrap program function. Setting bit 9 causes the system to use the secondary bootstrap; clearing bit 9 causes the system to ignore the secondary bootstrap. The secondary bootstrap program is used for system debugging and diagnostics.

Bit 10 controls the host portion of the IP broadcast address. Setting bit 10 causes the processor to use all zeros; clearing bit 10 (the factory default) causes the processor to use all ones. Bit 10 interacts with bit 14, which controls the network and subnet portions of the broadcast address. Table 5-4 shows the combined effect of bits 10 and 14.

Table 5-4 Configuration Register Settings for Broadcast Address Destination

Bit 14	Bit 10	Address (<net> <host>)
Off	Off	<ones> <ones>
Off	On	<zeros> <zeros>
On	On	<net> <zeros>
On	Off	<net> <ones>

Bits 11 and 12 in the configuration register determine the baud rate of the console terminal. Table 5-5 shows the bit settings for the four available baud rates. (The factory-set default baud rate is 9600.)

Table 5-5 System Console Terminal Baud Rate Settings

Baud	Bit 12	Bit 11
9600	0	0
4800	0	1
1200	1	0
2400	1	1

Bit 13 determines the server response to a bootload failure. Setting bit 13 causes the server to load operating software from Flash memory after five unsuccessful attempts to load a boot file from the network. Clearing bit 13 causes the server to continue attempting to load a boot file from the network indefinitely. By factory default, bit 13 is cleared to 0.

Enabling Booting from Flash Memory

To enable booting from Flash memory, set configuration register bits 3, 2, 1, and 0 to a value between 2 and 15 in conjunction with the **boot system flash** *[filename]* configuration command.

To enter configuration mode while in the system software image and to specify a Flash memory filename from which to boot, enter the **configure terminal** command at the enable prompt, as follows:

```
Router# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)# boot system flash [filename]
```

To disable Break and enable the **boot system flash** command, enter the **config-register** command with the value shown in the following example:

```
Router(config)# config-reg 0x2102
Router(config)# ^Z
Router#
```

Copying to Flash Memory

Copying a new image to Flash memory might be required whenever a new image or maintenance release becomes available. You *cannot* copy a new image into Flash memory while the system is running from Flash memory.

Use the command **copy tftp:***filename* [**bootflash** | **slot0** | **slot1**]:*filename* for the copy procedure, where **tftp:***filename* is the source of the file and [**bootflash** | **slot0** | **slot1**]:*filename* is the destination in onboard Flash memory or on either of the Flash memory cards.

An example of the **copy tftp:***filename* command follows:

```
Router# copy tftp:myfile1 slot0:myfile1
20575008 bytes available on device slot0, proceed? [confirm]
Address or name of remote host [1.1.1.1]?
Loading new.image from 1.1.1.1 (via Ethernet1/0): !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!![OK - 7799951/15599616 bytes]
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
Router#
```

Note In the preceding example, the exclamation points (!!!) appear as the file is downloaded and the "C" characters signify calculation of the checksum, which is a verification that the file has been correctly downloaded to the Flash memory card.

Following are additional commands related to the Flash memory on the RSP2 and on PCMCIA cards. (The following example assumes you are currently in PCMCIA slot 0.) You can determine which PCMCIA slot you are accessing using the **pwd** command as follows:

```
Router# pwd
slot0
```

You can move between Flash memory media using the **cd** [**bootflash** | **slot0** | **slot1**] command as follows:

```
Router# cd slot0
slot0
Router# cd slot1
Router# pwd
slot1
```

You can list the directory of any Flash memory media using the **dir** [**bootflash** | **slot0** | **slot1**] command as follows:

```
Router# dir
-#- -length- -----date/time------ name
1   4601977  May 19 1994 09:42:19 myfile1
6   679      May 19 1994 05:43:56 todays–config
7   1        May 19 1994 09:54:53 fun1
```

You can delete a file from any Flash memory media using the **delete** command as follows:

```
Router# delete slot0:fun1
Router# dir
-#- -length- -----date/time------ name
1   4601977  May 19 1994 09:42:19 myfile1
6   679      May 19 1994 05:43:56 todays–config
```

Files that are deleted are simply marked as deleted, but still occupy space in Flash memory. The **squeeze** command removes them permanently, and pushes all other undeleted files together to eliminate spaces between them.

Following is the syntax of the **squeeze** command:

```
Router# squeeze slot0:
All deleted files will be removed, proceed? [confirm]
Squeeze operation may take a while, proceed? [confirm]
ebESZ
```

To prevent loss of data due to sudden power loss, the "squeezed" data is temporarily saved to another location of Flash memory, which is specially used by the system.

In the preceding command display output, the character "e" means this special location has been erased (which must be performed before any write operation). The character "b" means that the data that is about to be written to this special location has been temporarily copied. The character "E" signifies that the sector which was temporarily occupied by the data has been erased. The character "S" signifies that the data was written to its permanent location in Flash memory.

The **squeeze** command operation keeps a log of which of these functions has been performed so that on sudden power failure, it can come back to the right place and continue with the process. The character "Z" means this log was erased after the successful **squeeze** command operation.

The configuration register setting 0x2101 tells the system to boot the default image (the first image) from onboard Flash memory, but does *not* reset the Break disable or check for a default netboot filename. The configuration register setting 0x2102 tells the system to boot from Flash memory if netboot fails, disable Break, and check for a default netboot filename. For more information on the **copy tftp:***filename* [**bootflash** | **slot0** | **slot1**]:*filename* command, and other related commands, refer to the *Router Products Command Reference* publication.

Recovering a Lost Password

An overview of recovering a lost password follows:

- Enter the **show version** command to note the existing software configuration register value.
- Break to the bootstrap program prompt.
- Change the configuration register to ignore NVRAM.

Note A key to recovering a lost password is to set the configuration register so that the contents of NVRAM are ignored (0x0040), allowing you to see your password.

- Enter privileged level in the system EXEC.
- Enter the **show startup-configuration** command to display the enable password.
- Change the configuration register value back to its original setting.

To recover a lost password, follow these procedures.

Step 1 Attach an ASCII terminal to the router console port, which is located on the rear panel.

Step 2 Configure the terminal to operate at 9600 baud, 8 data bits, no parity, 2 stop bits (or to whatever settings the router is set).

Step 3 Enter the **show version** command to display the existing configuration register value. Note this value for later use in Step 13.

Step 4 If Break is disabled, power cycle the router. (To power cycle, turn off the router, wait five seconds, and then turn it on again.) If Break is enabled on the router, press the Break key or send a break (^[) and then proceed to Step 5.

Step 5 Within 60 seconds of turning on the router, press the Break key. This action causes the terminal to display the bootstrap program prompt:

```
rommon 1 >
```

Step 6 Set the configuration register to ignore the configuration file information as follows:

```
rommon 1 > confreg

       Configuration Summary
enabled are:
console baud: 9600
boot: image specified by the boot system command
      or default to : cisco2-RSP

do you wish to change the configuration? y/n [n]: y
enable “diagnostic mode”? y/n [n]:
enable “use net in IP bcast address”? y/n [n]:
enable “load rom after netbootfails”? y/n [n]:
enable “use all zero broadcast”? y/n [n]:
enable “break/abort has effect?” y/n [n]:
enable “ignore system config info?” [n]: y
change console baud rate? y/n [n]:
change boot characteristics? y/n [n]

       Configuration Summary
enabled are:
console baud: 9600
boot: image specified by the boot system command
      or default to : cisco2-RSP

do you wish to change the configuration? y/n [n]

You must reset or power cycle for the new config to take effect
```

Step 7 Initialize the router by entering the **i** command as follows:

```
rommon 1 > i
```

The router will power cycle, the configuration register will be set to ignore the configuration file, and the router will boot the boot system image and prompt you with the system configuration dialog as follows:

```
    --- System Configuration Dialog ---
```

Step 8 Enter **no** in response to the system configuration dialog prompts until the following system message is displayed:

```
Press RETURN to get started!
```

Step 9 Press **Return**. After some interface information, the prompt appears as follows:

```
Router >
```

Step 10 Enter the **enable** command to enter the enabled mode. The prompt changes to the following:

```
Router #
```

Step 11 Enter the **show configuration** EXEC command to display the enable password in the configuration file.

Step 12 Enter the **configure terminal** command at the EXEC prompt. You are prompted as follows:

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

Step 13 Using the **config-register** 0x<*value*> command, change the configuration register value back to its original value (noted from Step 3) or change it to a value of 0x0101 (factory default).

Step 14 Exit the configuration mode by entering **Ctrl-Z**.

Step 15 Reboot the router and enable it using the recovered password.

Replacing SIMMs

The system DRAM resides on up to four single in-line memory modules (SIMMs) on the RSP2. The default DRAM configuration is 16 MB. This section provides the steps for increasing the amount of DRAM by replacing the SIMMs with SIMMs that you obtain from an approved vendor.

Note You must use SIMMs that you obtain from an approved vendor; otherwise, Cisco Systems cannot ensure proper operation. To ensure that you obtain the latest available product and vendor information, contact one of the sources listed in the section "Obtaining Technical Assistance" in the preface "About This Manual."

Although the SIMM specifications are defined in the manufacturers' part numbers, the SIMMs must meet the following requirements:

- DRAM SIMMs must be obtained from an approved vendor.
- Minimum speed is 60 nanoseconds (ns).
- Maximum height is one inch.

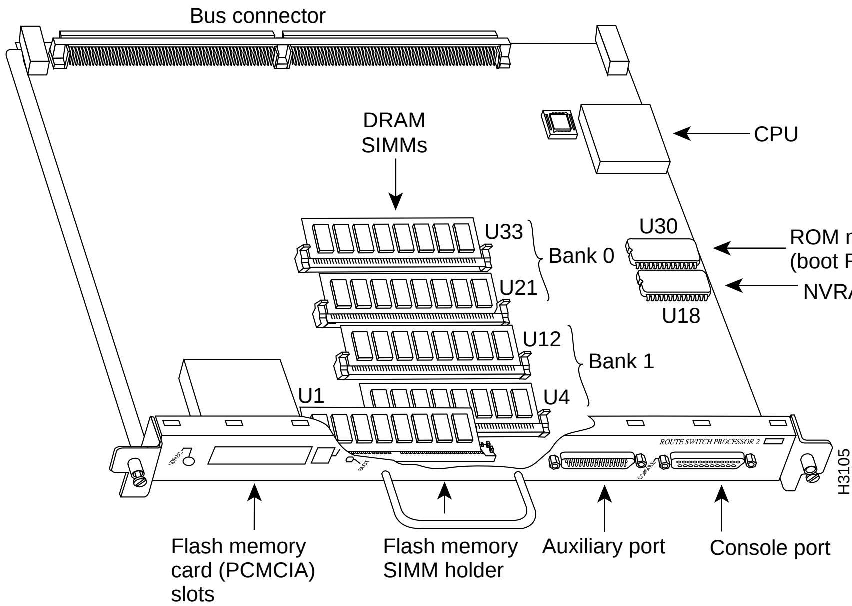
Parts and Tools Required

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

- Medium flat-blade and number 1 Phillips screwdriver to loosen the captive installation screws on the chassis cover and RSP2
- 60-ns, one-inch high SIMMs from an approved vendor
- ESD-preventive wrist strap and antistatic mat or pad for the removed RSP2

The DRAM SIMM sockets are U33 and U21 for Bank 0, and U12 and U4 for Bank 1. The default DRAM configuration is 16 MB (two 8-MB SIMMs in Bank 0). (See Figure 5-6.)

Figure 5-6 RSP2 DRAM SIMMs



Note The total number of memory devices per SIMM differs for each manufacturer. The SIMMs in the following illustrations are generic representations of the actual DRAM SIMMs for your RSP2. To be assured that you are using the correct SIMMs, refer to the specific part or product numbers indicated in the approved vendor list (AVL) on CIO and by your DRAM upgrade requirements.

Before proceeding, ensure that you have met the following prerequisites:

- You have the proper tools and ESD-prevention equipment available.
- You have two or four SIMMs of an approved type and speed that you obtained from an approved vendor.

To upgrade DRAM, you install SIMMs in one or both DRAM SIMM banks. Table 5-6 lists the various configurations of DRAM SIMMs that are available to you. This information is also available on CIO. Note which banks are used given the combinations of available SIMM sizes and the maximum DRAM you require. The onboard, default Flash memory is 8 MB.

Table 5-6 DRAM SIMM Configurations

DRAM Bank 0	Quantity	DRAM Bank 1	Quantity	Total DRAM	Product Names
U33 and U21	2, 8-MB SIMMs	U12 and U4	–	16 MB	MEM-RSP-16M=
U33 and U21	2, 16-MB SIMMs	U12 and U4	–	32 MB	MEM-RSP-32M=
U33 and U21	2, 32-MB SIMMs	U12 and U4	–	64 MB	MEM-RSP-64M=
U33 and U21	2, 32-MB SIMMs	U12 and U4	2, 32-MB SIMMs	128 MB	MEM-RSP-128M=

Caution To prevent DRAM errors, each DRAM bank *must* contain no less than two SIMMs of the same type. Also, you must install either two SIMMs in Bank 0 or four SIMMs in both banks. You should *not* install two SIMMs and Bank 1 with no SIMMs in Bank 0; Bank 0 must always contain two SIMMs

Removing SIMMs

Place removed SIMMs on an antistatic mat and store them in an antistatic bag. You can use the SIMMs that you remove in compatible equipment. To prevent ESD damage, handle SIMMs by the card edges only.

Follow these steps to remove the existing SIMMs:

Step 1 Turn OFF the system power. To channel ESD voltages to ground, ground the chassis.

Step 2 Attach an ESD-preventive wrist strap between you and an unpainted chassis surface.

Step 3 Disconnect the console and auxiliary cables from the RSP2.

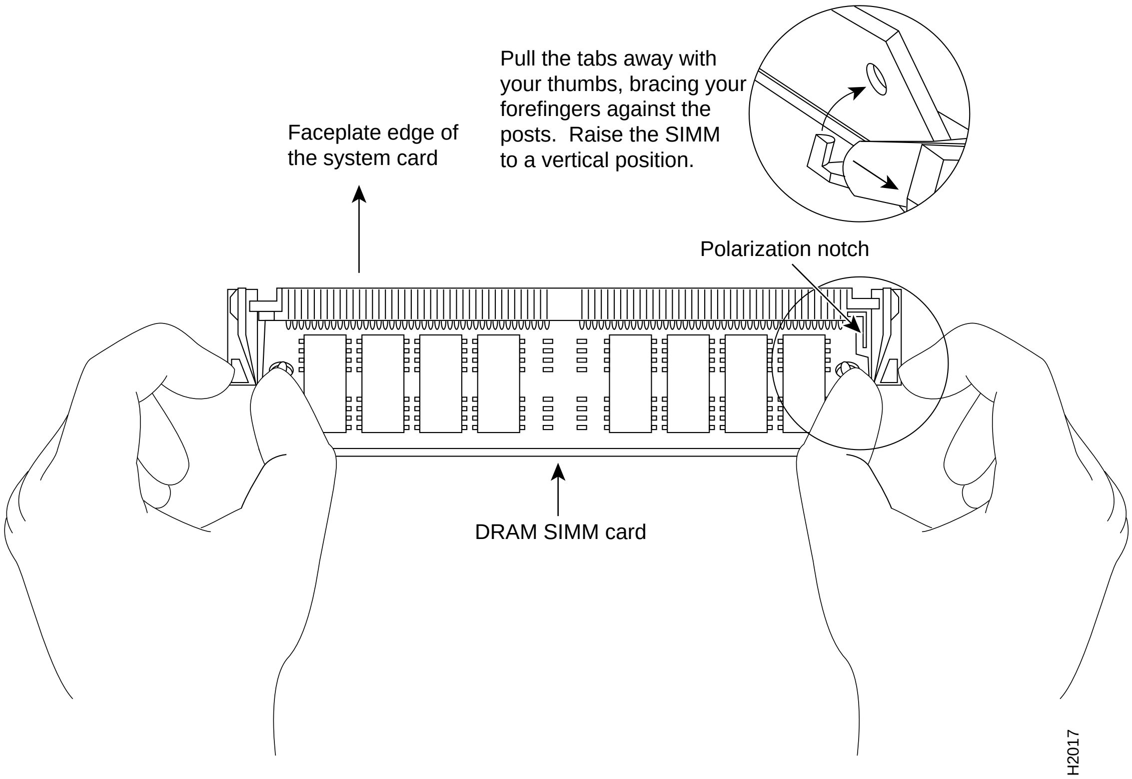
Step 4 Referring to Figure 5-2 in the section "Removing Interface Processors," loosen the captive installation screws on the RSP2 and remove it from the chassis.

Step 5 Place the RSP2 on an antistatic mat or pad, and ensure that you are wearing an antistatic device, such as a wrist strap. Position the RSP2 so that the handle is away from you, and the edge connector is toward you; this is the opposite of the position shown in Figure 5-6.

Step 6 Locate SIMMs. The DRAM SIMMs occupy U21 and U33 in Bank 0, and U12 and U4 in Bank 1. (See Figure 5-6.)

Step 7 Release the spring clips from the SIMM that you want to remove and release the SIMM from the socket. (See Figure 5-7.)

Figure 5-7 Releasing the SIMM Spring Clips



Step 8 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 9 Place the SIMM in an antistatic bag to protect it from ESD damage.

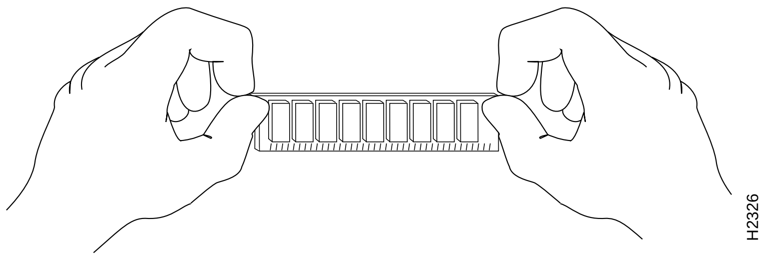
Step 10 Repeat Steps 7 through 9 for the remaining SIMMs, as required for your upgrade.

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

Installing 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 5-8.)

Figure 5-8 Handling a SIMM



Caution Handle SIMMs by the card edges only. SIMMs are sensitive components that can be shorted by mishandling.

Follow these steps to install the new SIMMs:

Step 1 With the RSP2 in the same orientation as the preceding procedure (with the handle away from you and the edge connector toward you), install the first SIMM in the socket farthest from you. Then install the last SIMM in the socket closest to you.

Step 2 Remove a new SIMM from the antistatic bag.

Caution To prevent DRAM errors, each DRAM bank *must* contain no less than two SIMMs of the same type. Also, you must install either two SIMMs in Bank 0 or four SIMMs in both banks. You should *not* install two SIMMs in Bank 1 with no SIMMs in Bank 0; Bank 0 must always contain two SIMMs.

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 middle finger, with your forefinger against the far edge, opposite the connector edge. (See Figure 5-8.)

Step 5 Tilt the SIMM to approximately the same angle as the socket and insert the entire 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 RSP2 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 all SIMMs are installed, check all 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.

To replace the RSP2 in the chassis, proceed to the section “Installing Interface Processors” in this chapter and then restart the system for an installation check.

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

- Ensure that all SIMMs are installed correctly. If necessary, shut down the system and remove the RSP2. Check the SIMMs by looking straight down on them and then at eye level. The SIMMs should all be aligned at the same angle and the same height when properly installed. If a SIMM appears to stick out, or rest in the socket at a different angle from the others, remove the SIMM and reinsert it. Then replace the RSP2 and reboot the system for another installation check.
- Each DRAM SIMM bank 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.

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.

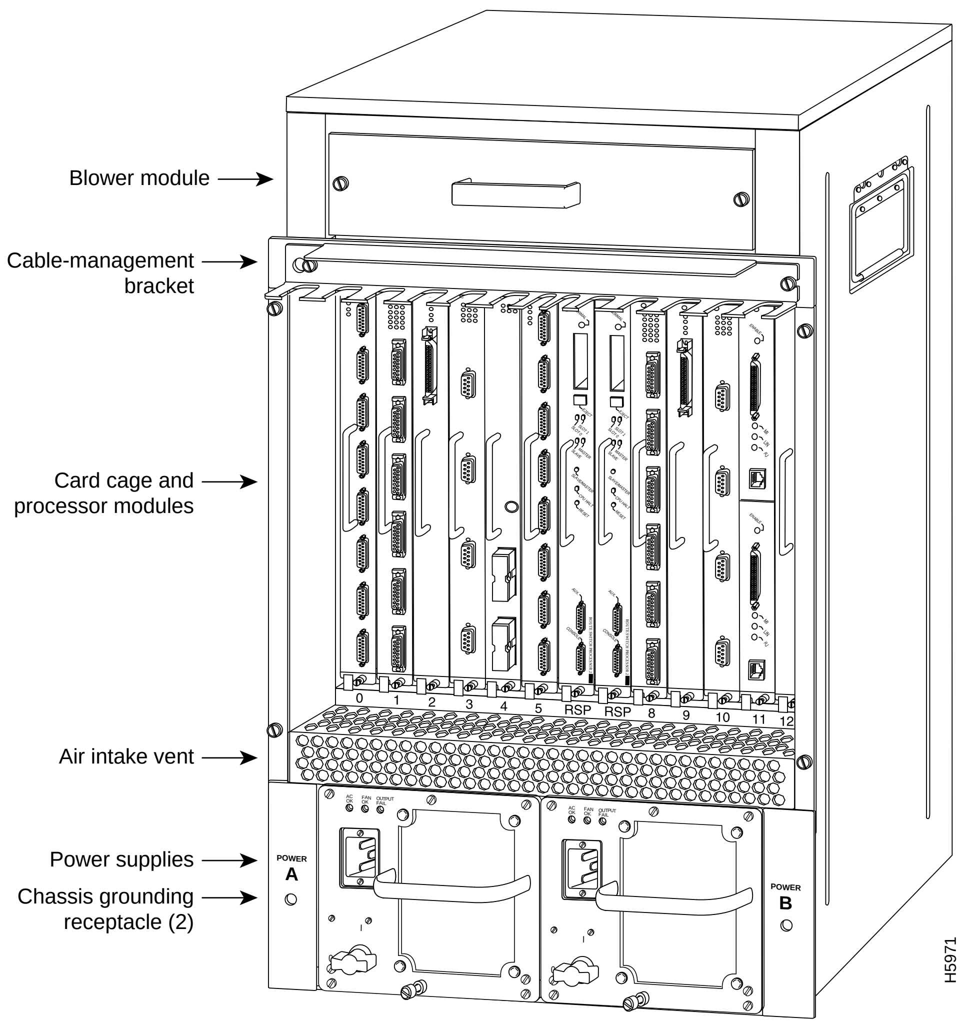
Note The time required for the system to initialize varies with different router configurations. Routers with 128 MB of DRAM will take longer to boot than those with 16 MB of DRAM.

Configuring the High System Availability (HSA) Feature

The RSP2 supports high system availability (HSA), which is a new feature in Cisco internetwork Operating System (Cisco IOS) Release 11.1(2) or later (or a Cisco-approved beta version of Release 11.1[2]), which allows two RSP2s to be used simultaneously in a Cisco 7513 router.

One RSP2 operates as system *master* and the other RSP2 operates as the system *slave*, which takes over if the master RSP2 fails. Figure 5-9 shows a Cisco 7513 with two RSP2s installed.

Figure 5-9 Cisco 7513 with Two RSP2s



The HSA feature requires that the boot read-only memory (ROM) device be updated to Version 11.1(2) or later. New RSP2s are shipping with this new boot ROM version; however, to check the boot ROM (*System Bootstrap*) version currently running on your RSP2, use the **show version** command and check the boot ROM's version number as follows:

```
Router# sh version
(display text omitted)
System Bootstrap, Version 11.1(2)
```

Caution To ensure that the slave RSP2 will operate properly with the full system configuration, should the master RSP2 ever fail, the slave RSP2 should have the same DRAM configuration as the master RSP2. In addition, removing the system master RSP2, while the system is operating, will cause the system to crash; however, the system *will* reload with the slave RSP2 as the new system master. To prevent any system problems, *do not* remove the system master RSP2 while the system is operating.

Using the Y-Cables for Console and Auxiliary Connections

For systems with two RSP2s installed (one as master and one as slave in RSP slots 6 and 7, using the HSA feature), you can simultaneously connect to both console or auxiliary ports using a special Y-cable. RSP2 defaults as the system masters if only one is installed. Figure 5-10 shows the console Y-cable and Figure 5-11 shows the auxiliary Y-cable.

Figure 5-10 Console Y-Cable

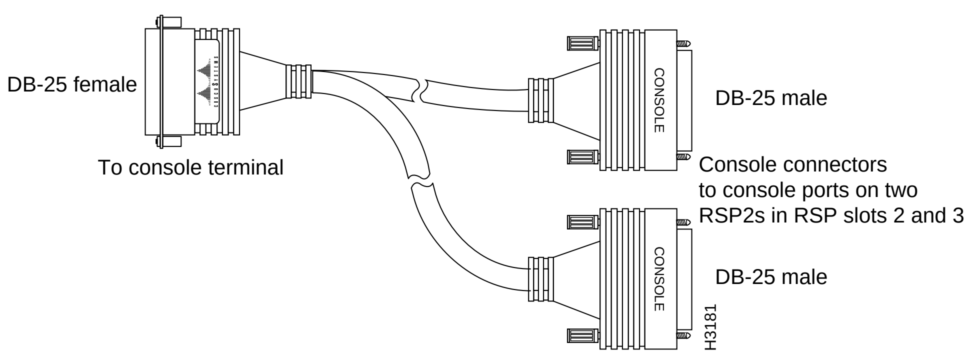
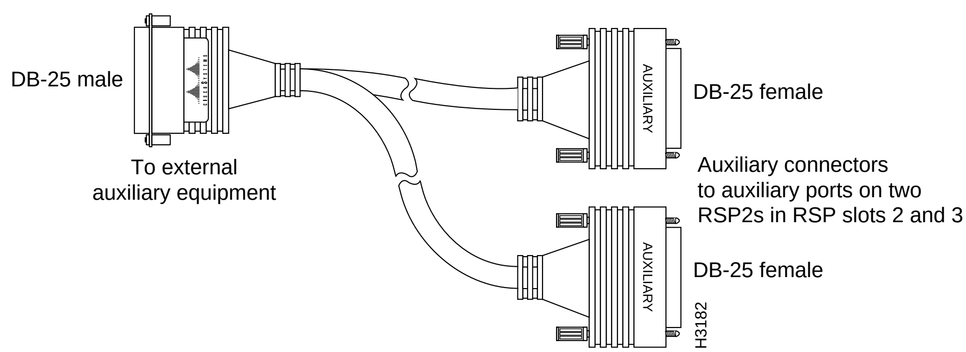


Figure 5-11 Auxiliary Y-Cable



Configuring HSA Operation

High system availability (HSA) (available with Cisco IOS Release 11.1[2] or later) refers to how quickly your router returns to an operational status after a failure occurs. You can install two RSP2 cards in a single router to improve system availability. For more complete HSA configuration information, refer to the *Configuration Fundamentals Configuration Guide* and the *Configuration Fundamentals Command Reference* publications, which are available on UniverCD or as printed copies.

Two RSP2 cards in a router provide the most basic level of increased system availability through a “cold restart” feature. A “cold restart” means that when one RSP2 card fails, the other RSP2 card reboots the router. In this way, your router is never in a failed state for very long, thereby increasing system availability.

When one RSP2 card takes over operation from another, system operation is interrupted. Such a change is similar to issuing the **reload** command. The following events occur when one RSP2 card fails and the other takes over:

- The router stops passing traffic.
- Route information is lost.
- All connections are lost.
- The backup or “slave” RSP2 card becomes the active or “master” RSP2 card that reboots and runs the router. Thus, the slave has its own image and configuration file to be a complete router that can act as a single processor.

Note HSA does not impact performance in terms of packets per second or overall bandwidth. Additionally, HSA does not provide fault-tolerance or redundancy.

Master and Slave Operation

A router configured for HSA operation has one RSP2 card that is the master and one that is the slave. The master RSP2 card functions as if it were a single processor, controlling all functions of the router. The slave RSP2 card does nothing but actively monitor the master for failure. A system crash can cause the master RSP2 to fail or go into a nonfunctional state. When the slave RSP2 detects a nonfunctional master, the slave resets itself and takes part in *master-slave arbitration*. Master-slave arbitration is a ROM monitor process that determines which RSP2 card is the master and which is the slave upon startup (or reboot).

If a system crash causes the master RSP2 to fail, the slave RSP2 becomes the new master RSP2 and uses its own system image and configuration file to reboot the router. The failed RSP2 card (now the slave) remains inactive until you perform diagnostics, correct the problem, and then issue the **slave reload** command.

Caution To ensure that the slave RSP2 will operate properly with the full system configuration should the master RSP2 ever fail, the slave RSP2 should have the same DRAM configuration as the master RSP2.

With HSA operation, the following items are important to note:

- An RSP2 card that acts as the slave runs a different software version than it does when it acts as the master. The slave mode software is a subset of the master mode software.
- The two RSP2 cards do not have to run the same master software image and configuration file. When the slave reboots the system and becomes the new master, it uses its own system image and configuration file to reboot the router.
- When enabled, automatic synchronization mode automatically ensures that the master and slave RSP2 card have the same configuration file.
- Both hardware and software failures can cause the master RSP2 to enter a nonfunctional state; but, the system does not indicate the type of failure.
- The console is always connected to master. Thus, your view of the environment is always from the master's perspective.
- You must *not* remove the system master RSP2 while the system is operating; however, the system slave RSP2 can be removed while the system is operating.

Caution Removing the system master RSP2 while the system is operating will cause the system to crash; however, the system *will* reload with the slave RSP2 as the new system master. To prevent any system problems, *do not* remove the system master RSP2 while the system is operating.

Implementation Methods

There are two common ways to use HSA as follows:

- Simple hardware backup

  Use this method to protect against an RSP2 card failure. With this method, you configure both RSP2 cards with the same software image and configuration information. Also, you configure the router to automatically synchronize configuration information on both cards when changes occur.

- Software error protection

  Use this method to protect against critical Cisco IOS software errors in a particular release. With this method, you configure the RSP2 cards with different software images, but with the same configuration information.

You can also use HSA for advanced implementations. For example, you can configure the RSP2 cards with the following:

- Similar software versions, but different configuration files
- Different software images *and* different configuration files
- Widely varied configuration files (for example, various features or interfaces can be turned off/on per card)

Note While other, more complex uses are possible, the configuration information in this guide describes tasks for only the two common methods—simple hardware backup and software error protection.

HSA System Requirements

To configure HSA operation, you must have a Cisco 7513 containing two RSP2 processor cards and Cisco IOS Release 11.1(2) or later (or a Cisco-approved beta version of Release 11.1[2]). The slave RSP2 should have the same DRAM configuration as the master RSP2

Configure HSA Operation Task List

When configuring HSA operation, complete the tasks in the following sections. The first is required. Depending on the outcome of the first, the second or third is also required. The fourth is optional.

- Determining the HSA Implementation Method to Use
- Configuring HSA for Simple Hardware Backup
- Configuring HSA for Software Error Protection
- Setting Environment Variables on the Master and Slave RSP2

Determining the HSA Implementation Method to Use

Before you can configure HSA operation, you must first decide how you want to use HSA in your internetwork. Do you want to use HSA for simple hardware backup or for software error protection? If you are using new or experimental Cisco IOS software, consider using the software error protection method; otherwise, use the simple hardware backup method.

Once you have decided which method to use, proceed to either the "Configuring HSA for Simple Hardware Backup" section or the "Configuring HSA for Software Error Protection" section.

Configuring HSA for Simple Hardware Backup

With the simple hardware backup method, you configure both RSP2 cards with the same software image and configuration information. To configure HSA for simple hardware backup, perform the tasks in the following sections. The first is optional.

- Specifying the Default Slave RSP2
- Ensuring That Both RSP2 Cards Contain the Same Images
- Ensuring That Both RSP2 Cards Contain the Same Configuration File

Specifying the Default Slave RSP2

Because your view of the environment is always from the master RSP2's perspective, you define a default slave RSP2. The router uses the default slave information when booting:

- If a system boot is due to powering up the router or using the **reload** command, then the specified default slave will be the slave RSP2.
- If a system boot is due to a system crash or hardware failure, then the system ignores the default slave designation and makes the crashed or faulty RSP2 the slave RSP2.

To define the default slave RSP2, perform the following task, beginning in global configuration mode:

Tasks		Command
Step 1	Enter the configuration mode from the terminal.	**configure terminal**
Step 2	Define the default slave RSP2.	**slave default-slot** *processor-slot-number*
Step 3	Exit configuration mode.	**Ctrl-Z**
Step 4	Save this information to your startup configuration.	**copy running-config startup-config**

Upon the next system reboot, the above changes take effect (if both RSP2 cards are operational). Thus, the specified default slave becomes the slave RSP2 card. The other RSP2 card takes over mastership of the system and controls all functions of the router.

If you do not specifically define the default slave RSP2, the RSP2 card located in the higher number processor slot is the default slave. On the Cisco 7513, processor slot 7 contains the default slave RSP2.

The following example sets the default slave RSP2 to processor slot 7 on a Cisco 7513:

```
Router# configure terminal
Router (config)# slave default-slot 7
Ctrl-Z
Router# copy running-config startup-config
```

Ensuring That Both RSP2 Cards Contain the Same Images

To ensure that both RSP2 cards have the same system image, perform the following tasks in EXEC mode:

Tasks		Command
Step 1	Display the contents of the BOOT environment variable to learn the current booting parameters for the master and slave RSP2.	**show boot**
Step 2	Verify the location and version of the master RSP2 software image.	**dir** [**/all** | **/deleted**] [**/long**] {**bootflash** | **slot0** | **slot1**} [*filename*]
Step 3	Determine if the slave RSP2 contains the same software image in the same location.	**dir** [**/all** | **/deleted**] [**/long**] {**slavebootflash** | **slaveslot0** | **slaveslot1**} [*filename*]
Step 4	If the slave RSP2 does not contain the same system image in the same location, copy the master's system image to the appropriate slave location.	**copy** *file_id* {**slavebootflash** | **slaveslot0** | **slaveslot1**} Note that you might also have to use the **delete** and/or **squeeze** command in conjunction with the **copy** command to accomplish this step.

The following example ensures that both RSP2 cards have the same system image. Note that because no environment variables are set, the default environment variables are in effect for both the master and slave RSP2.

```
Router# show boot
BOOT variable =
CONFIG_FILE variable =
Current CONFIG_FILE variable =
BOOTLDR variable does not exist
Configuration register is 0x0

Slave auto-sync config mode is on

current slave is in slot 7
BOOT variable =
CONFIG_FILE variable =
BOOTLDR variable does not exist

Configuration register is 0x0

Router# dir slot0:
-#- -length- -----date/time------ name
1    3482498  May 4  1993 21:38:04 rsp-k-mz11.2

7993896 bytes available (1496 bytes used)

Router# dir slaveslot0:
-#- -length- -----date/time------ name
1    3482498  May 4  1993 21:38:04 rsp-k-mz11.1

7993896 bytes available (1496 bytes used)

Router# delete slaveslot0:rsp-k-mz11.1
Router# copy slot0:rsp-k-mz11.2 slaveslot0:rsp-k-mz11.2
```

To ensure that both RSP2 cards have the same microcode images, perform the following tasks beginning in privileged EXEC mode:

Tasks		Command
Step 1	Determine the microcode images used on the interface processors. If all interface processors are running from the bundled system microcode, no further action is required.	**show controller cbus**
Step 2	If any interface processors are running from the flash file system, verify the location and version of the master RSP2's supplementary microcode.	**dir** [**/all** | **/deleted**] [**/long**] {**bootflash** | **slot0** | **slot1**} [*filename*]
Step 3	Determine if the slave RSP2 contains the same microcode image in the same location.	**dir** [**/all** | **/deleted**] [**/long**] {**slavebootflash** | **slaveslot0** | **slaveslot1**} [*filename*]
Step 4	If the slave RSP2 does not contain the same microcode image in the same location, copy the master's microcode image to the appropriate slave location.	**copy** *file_id* {**slavebootflash** | **slaveslot0** | **slaveslot1**} Note that you might also have to use the **delete** and/or **squeeze** command in conjunction with the **copy** command to accomplish this step.

The following example ensures that both RSP2 cards have the same microcode image. Notice that slots 0, 1, 4, 9, and 10 load microcode from the bundled software, as noted by the *statement software loaded from system*. Slot 11, the FSIP processor, does not use the microcode bundled with the system. Instead, it loads the microcode from *slot0:pond/bath/rsp_fsip20-1* . Thus, you must ensure that the slave RSP2 has a copy of the same FSIP microcode in the same location.

```
Router# show controller cbus
MEMD at 40000000, 2097152 bytes (unused 416, recarves 3, lost 0)
  RawQ 48000100, ReturnQ 48000108, EventQ 48000110
  BufhdrQ 48000128 (2948 items), LovltrQ 48000140 (5 items, 1632 bytes)
  IpcbufQ 48000148 (16 items, 4096 bytes)
  3571 buffer headers (48002000 - 4800FF20)
  pool0: 28 buffers, 256 bytes, queue 48000130
  pool1: 237 buffers, 1536 bytes, queue 48000138
  pool2: 333 buffers, 4544 bytes, queue 48000150
  pool3: 4 buffers, 4576 bytes, queue 48000158
  slot0: EIP, hw 1.5, sw 20.00, ccb 5800FF30, cmdq 48000080, vps 4096
    software loaded from system
    Ethernet0/0, addr 0000.0ca3.cc00 (bia 0000.0ca3.cc00)
      gfreeq 48000138, lfreeq 48000160 (1536 bytes), throttled 0
      rxlo 4, rxhi 42, rxcurr 0, maxrxcurr 2
      txq 48000168, txacc 48000082 (value 27), txlimit 27
                        .........

  slot1: FIP, hw 2.9, sw 20.02, ccb 5800FF40, cmdq 48000088, vps 4096
    software loaded from system
    Fddi1/0, addr 0000.0ca3.cc20 (bia 0000.0ca3.cc20)
      gfreeq 48000150, lfreeq 480001C0 (4544 bytes), throttled 0
      rxlo 4, rxhi 165, rxcurr 0, maxrxcurr 0
      txq 480001C8, txacc 480000B2 (value 0), txlimit 95
  slot4: AIP, hw 1.3, sw 20.02, ccb 5800FF70, cmdq 480000A0, vps 8192
    software loaded from system
    ATM4/0, applique is SONET (155Mbps)
      gfreeq 48000150, lfreeq 480001D0 (4544 bytes), throttled 0
      rxlo 4, rxhi 165, rxcurr 0, maxrxcurr 0
      txq 480001D8, txacc 480000BA (value 0), txlimit 95
  slot9: MIP, hw 1.0, sw 20.02, ccb 5800FFC0, cmdq 480000C8, vps 8192
    software loaded from system
    T1 9/0, applique is Channelized T1
      gfreeq 48000138, lfreeq 480001E0 (1536 bytes), throttled 0
      rxlo 4, rxhi 42, rxcurr 0, maxrxcurr 0
      txq 480001E8, txacc 480000C2 (value 27), txlimit 27
                     .......

  slot10: TRIP, hw 1.1, sw 20.00, ccb 5800FFD0, cmdq 480000D0, vps 4096
    software loaded from system
    TokenRing10/0, addr 0000.0ca3.cd40 (bia 0000.0ca3.cd40)
      gfreeq 48000150, lfreeq 48000200 (4544 bytes), throttled 0
      rxlo 4, rxhi 165, rxcurr 1, maxrxcurr 1
      txq 48000208, txacc 480000D2 (value 95), txlimit 95
                    .........

  slot11: FSIP, hw 1.1, sw 20.01, ccb 5800FFE0, cmdq 480000D8, vps 8192
    software loaded from flash slot0:pond/bath/rsp_fsip20-1
    Serial11/0, applique is Universal (cable unattached)
      gfreeq 48000138, lfreeq 48000240 (1536 bytes), throttled 0
      rxlo 4, rxhi 42, rxcurr 0, maxrxcurr 0
      txq 48000248, txacc 480000F2 (value 5), txlimit 27
                   ...........
```

```
Router# dir slot0:pond/bath/rsp_fsip20-1
-#- -length- -----date/time------ name
3   10242    Jan 01 1995 03:46:31 pond/bath/rsp_fsip20-1

Router# dir slaveslot0:pond/bath/rsp_fsip20-1
No such file

4079832 bytes available (3915560 bytes used)

Router# copy slot0:pond/bath/rsp_fsip20-1 slaveslot0:
4079704 bytes available on device slaveslot0, proceed? [confirm]

Router# dir slaveslot0:pond/bath/rsp_fsip20-1
-#- -length- -----date/time------ name
3   10242    Mar 01 1993 02:35:04 pond/bath/rsp_fsip20-1

4069460 bytes available (3925932 bytes used)
Router#
```

Ensuring That Both RSP2 Cards Contain the Same Configuration File

With the simple hardware backup and software error protection implementation methods, you always want your master and slave configuration files to match. To ensure that they match, turn on automatic synchronization. In automatic synchronization mode, the master copies its startup configuration to the slave's startup configuration when you issue a **copy** command that specifies the master's startup configuration (**startup-config**) as the target.

Automatic synchronization mode is on by default; however, to turn it on manually, perform the following tasks, beginning in global configuration mode:

Tasks		Command
Step 1	Enter the configuration mode from the terminal.	**configure terminal**
Step 2	Turn on automatic synchronization mode.	**slave auto-sync config**
Step 3	Exit configuration mode.	**Ctrl-Z**
Step 4	Save this information to your startup configuration and copy the configuration to the slave's startup configuration.	**copy running-config startup-config**

The following example turns on automatic configuration file synchronization:

```
Router# configure terminal
Router (config)# slave auto-sync config
Ctrl-z
Router# copy running-config startup-config
```

Configuring HSA for Software Error Protection

With the software error protection method, you configure the RSP2 cards with different software images, but with the same configuration information. To configure HSA for software error protection, perform the tasks in the following sections. The first is optional.

- Specifying the Default Slave RSP2 (in the previous section "Configuring HSA for Simple Hardware Backup.")
- Ensuring That Both RSP2 Cards Contain the Same Configuration File (in the previous section "Configuring HSA for Simple Hardware Backup.")
- Specifying Different Startup Images for the Master and Slave RSP2 (which follows)

Specifying Different Startup Images for the Master and Slave RSP2

When the factory sends you a new Cisco 7513 with two RSP2s, you receive the same system image on both RSP2 cards. For the software error protection method, you need two different software images on the RSP2 cards. Thus, you copy a desired image to the master RSP2 card and modify the boot system commands to reflect booting two different system images. Each RSP2 card uses its own image to boot the router when it becomes the master.

To specify different startup images for the master and slave RSP2, perform the following tasks, beginning in EXEC mode:

Tasks		Command
Step 1	Verify the location and version of the master RSP2 software image.	**dir** [**/all** | **/deleted**] [**/long**] {**bootflash** | **slot0** | **slot1**} [*filename*]
Step 2	Determine if the slave RSP2 contains the same software image in the same location.	**dir** [**/all** | **/deleted**] [**/long**] {**slavebootflash** | **slaveslot0** | **slaveslot1**} [*filename*]
Step 3	Copy a different system image to the master RSP2.	**copy** *file_id* {**bootflash** | **slot0** | **slot1**} **copy flash** {**bootflash** | **slot0** | **slot1**} **copy rcp** {**bootflash** | **slot0** | **slot1**} **copy tftp** {**bootflash** | **slot0** | **slot1**}
Step 4	Enter configuration mode from the terminal.	**configure terminal**
Step 5	From global configuration mode, configure the master RSP2 to boot the new image from the appropriate location.	**boot system flash bootflash:**[*filename*] **boot system flash slot0:**[*filename*] **boot system flash slot1:**[*filename*]
Step 6	Also, add a **boot system** command that specifies the slave's boot image and location. This is the boot image that the slave uses when it becomes the master RSP2 and boots the system. Note that because the slave will boot this image when the slave is actually the new master RSP2, the command syntax does not use a "**slave**" prefix.	**boot system flash bootflash:**[*filename*] **boot system flash slot0:**[*filename*] **boot system flash slot1:**[*filename*]
Step 7	Configure the master RSP2 to boot from a network server.	**boot system** [**rcp** | **tftp**] *filename* [*ip-address*]
Step 8	Set the configuration register to enable loading of the system image from a network server or Flash.	**config-register** *value* [1]
Step 9	Exit configuration mode.	**Ctrl-Z**
Step 10	Save the configuration file to the master's startup configuration. Because automatic synchronization is turned on, this step saves the **boot system** commands to the master and slave startup configuration.	**copy running-config startup-config**
Step 11	Reset the router with the new configuration information.	**reload**

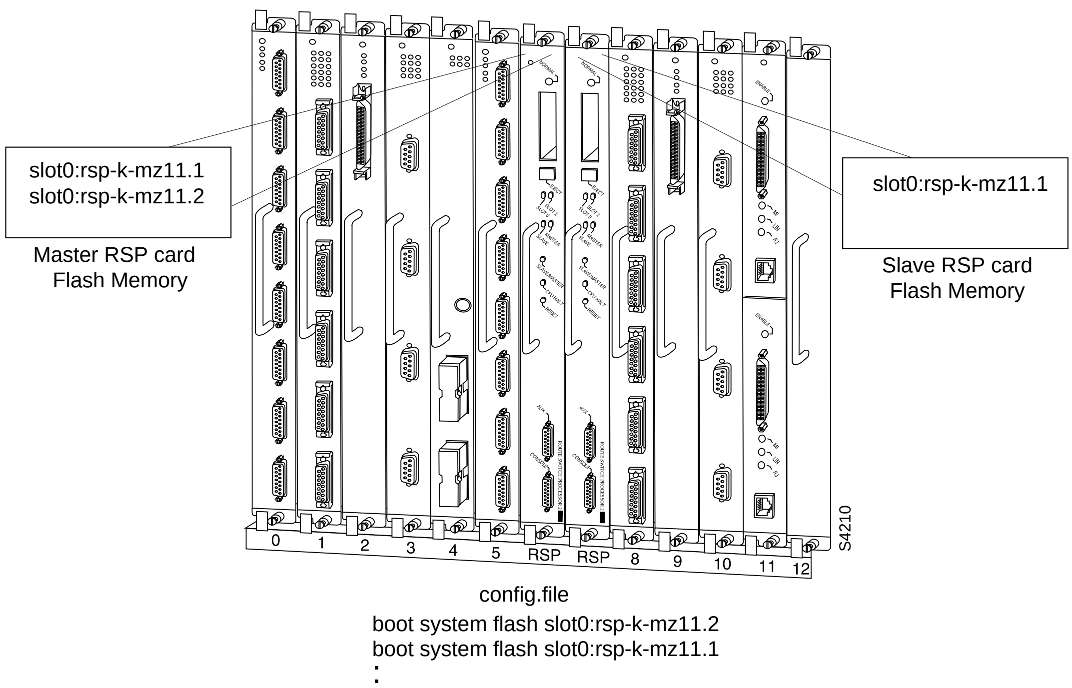
1. Refer to the "Software Configuration Register Settings" section for more information on systems that can use this command to modify the software configuration register.

In the following example scenario, assume the following:

- The master RSP2 is in processor slot 6 and the slave RSP2 is in processor slot 7 of a Cisco 7513.
- The system has the same image, *rsp-k-mz11.1*, in PCMCIA slot 0 of both the master and slave RSP2 card.
- You want to upgrade to Cisco IOS Release 11.2, but you want to guard against software failures. So, you must configure HSA operation for software error protection.

Figure 5-12 illustrates the software error protection configuration for this example scenario. The configuration commands for this configuration follow the figure.

Figure 5-12 Software Error Protection: Upgrading to a New Software Version



Because you always view the environment from the master RSP2's perspective, in the following command you view the master's slot 0 to verify the location and version of the master's software image:

```
Router# dir slot0:
-#- -length- -----date/time------ name
1    3482496  May 4  1993 21:38:04 rsp-k-mz11.1

7993896 bytes available (1496 bytes used)
```

Now view the slave's software image location and version:

```
Router# dir slaveslot0:
-#- -length- -----date/time------ name
1    3482496  May 4  1993 21:38:04 rsp-k-mz11.1

7993896 bytes available (1496 bytes used)
```

Because you want to run the Release 11.2 system image on one RSP2 card and the Release 11.1 system image on the other RSP2 card, copy the Release 11.2 system image to the master's slot 0:

```
Router# copy tftp slot0:rsp-k-mz11.2
```

Enter global configuration mode and configure the system to boot first from a Release 11.2 system image and then from a Release 11.1 system image.

```
Router# configure terminal
Router (config)# boot system flash slot0:rsp-k-mz11.1.2
Router (config)# boot system flash slot0:rsp-k-mz11.1
```

With this configuration, when the slot 6 RSP2 card is master, it looks first in its PCMCIA slot 0 for the system image file *rsp-k-mz11.2* to boot. Finding this file, the router boots from that system image. When the slot 7 RSP2 card is master, it also looks first in its slot 0 for the system image file *rsp-k-mz11.2* to boot. Because that image does not exist in that location, the slot 7 RSP2 card looks for the system image file *rsp-k-mz11.1* in slot 0 to boot. Finding this file in its PCMCIA slot 0, the router boots from that system image. In this way, each RSP2 card can reboot the system using its own system image when it becomes the master RSP2 card.

Configure the system further with a fault-tolerant booting strategy:

```
Router (config)# boot system tftp rsp-k-mz11.1 192.37.1.25
```

Set the configuration register to enable loading of the system image from a network server or from Flash and save the changes to the master and slave startup configuration file:

```
Router (config)# config-register 0x010F
Ctrl-Z
Router# copy running-config startup-config
```

Reload the system so that the master RSP2 uses the new Release 11.2 system image:

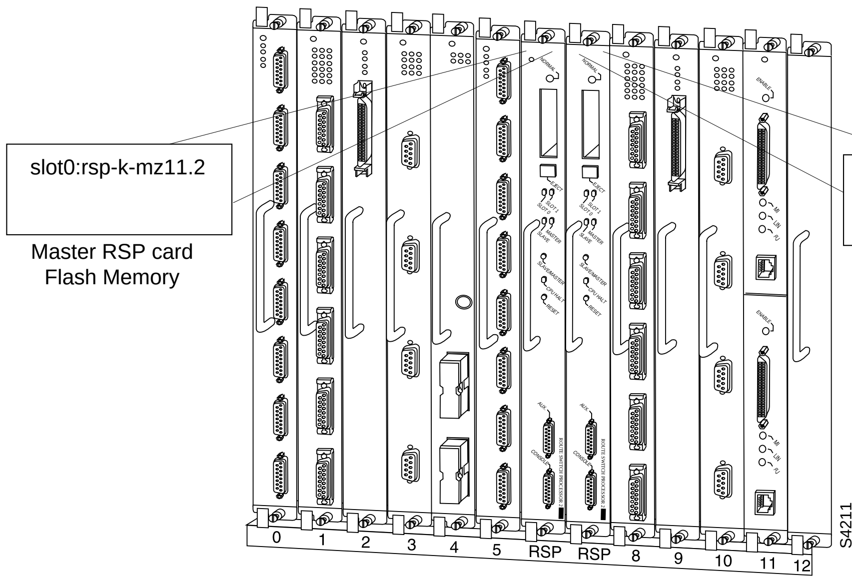
```
Router# reload
```

In the following example scenario, assume the following:

- The master RSP2 is in processor slot 6, and the slave RSP2 is in processor slot 7 of a Cisco 7513.
- The system has the same image, *rsp-k-mz11.2*, in PCMCIA slot 0 of both the master and slave RSP2 card.
- You want to use to Cisco IOS Release 11.1 as backup to guard against software failures. So, you configure HSA operation for software error protection.

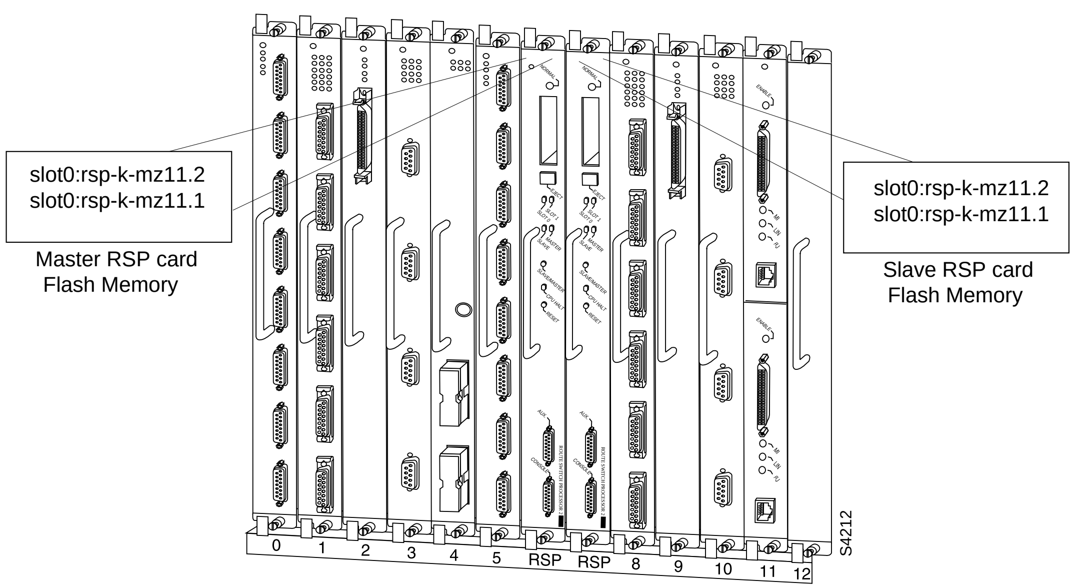
In this scenario, you begin with the configuration shown in Figure 5-13.

Figure 5-13 Software Error Protection: Backing Up with an Older Software Version, Part I



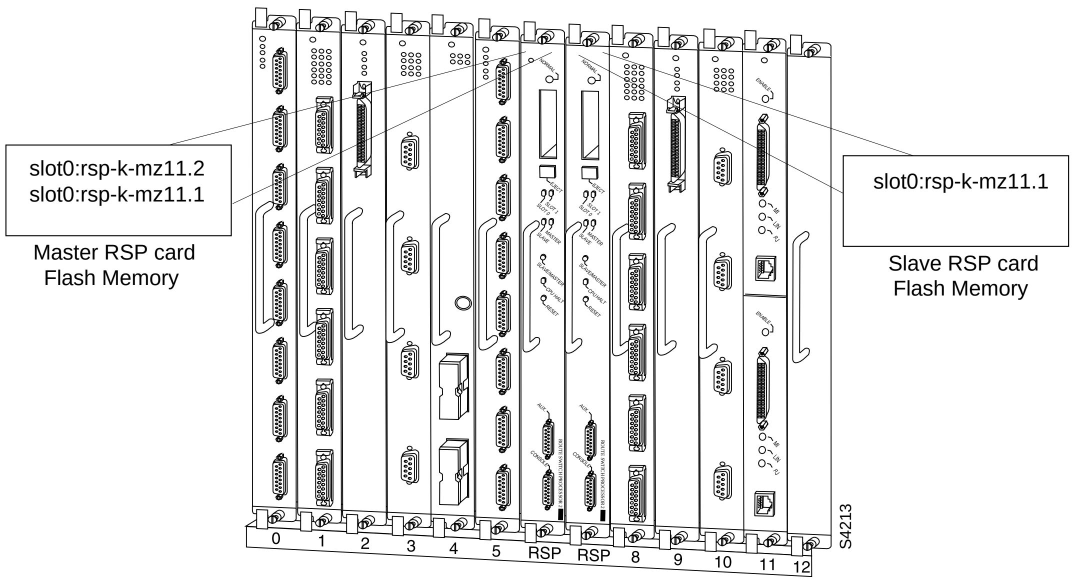
Next, you copy the *rsp-k-mz11.1* image to the master and slave RSP2 card, as shown in Figure 5-14.

Figure 5-14 Software Error Protection: Backing Up with an Older Software Version, Part II



Last, delete the *rsp-k-mz11.2* image from the slave RSP2 card as shown in Figure 5-15.

Figure 5-15 Software Error Protection: Backing Up with an Older Software Version, Part III



The following commands configure software error protection for this example scenario.

View the master and slave slot 0 to verify the location and version of their software images:

```
Router# dir slot0:
-#- -length- -----date/time------ name
1    3482498  May 4  1993 21:38:04 rsp-k-mz11.2

7993896 bytes available (1496 bytes used)

Router# dir slaveslot0:
-#- -length- -----date/time------ name
1    3482498  May 4  1993 21:38:04 rsp-k-mz11.2

7993896 bytes available (1496 bytes used)
```

Copy the Release 11.1 system image to the master and slave slot 0:

```
Router# copy tftp slot0:rsp-k-mz11.1
Router# copy tftp slaveslot0:rsp-k-mz11.1
```

Delete the *rsp-k-mz11.2* image from the slave RSP2 card:

```
Router# delete slaveslot0:rsp-k-mz11.2
```

Configure the system to boot first from a Release 11.2 system image and then from a Release 11.1 system image.

```
Router# configure terminal
Router (config)# boot system flash slot0:rsp-k-mz11.2
Router (config)# boot system flash slot0:rsp-k-mz11.1
```

Configure the system further with a fault-tolerant booting strategy:

```
Router(config)# boot system tftp rsp-k-mz11.1 192.37.1.25
```

Set the configuration register to enable loading of the system image from a network server or from Flash and save the changes to the master and slave startup configuration file:

```
Router(config)# config-register 0x010F
Ctrl-Z
Router# copy running-config startup-config
```

Note You do not need to reload the router in this example, because the router is currently running the Release 11.2 image.

Setting Environment Variables on the Master and Slave RSP2

You can optionally set environment variables on both RSP2 cards in a Cisco 7513.

Note When configuring HSA operation, Cisco recommends that you use the default environment variables. If you do change the variables, Cisco recommends setting the same device for equivalent environment variables on each RSP2 card. For example, if you set one RSP2 card's CONFIG_FILE environment variable device to NVRAM, then set the other RSP2 card's CONFIG_FILE environment variable device to NVRAM also.

You set environment variables on the master RSP2 just as you would if it were the only RSP2 card in the system. You can set the same environment variables on the slave RSP2 card, manually or automatically.

The following sections describe these two methods:

- Manually Setting Environment Variables on the Slave RSP2
- Automatically Setting Environment Variables on the Slave RSP2

For more complete configuration information on how to set environment variables, refer to the *Configuration Fundamentals Configuration Guide* and the *Configuration Fundamentals Command Reference* publications, which are available on UniverCD or as printed copies.

Manually Setting Environment Variables on the Slave RSP2

Once you set the master's environment variables, you can manually set the same environment variables on the slave RSP2 card using the **slave sync config** command.

To manually set environment variables on the slave RSP2, perform the following steps beginning in global configuration mode:

Tasks		Command
Step 1	Set the master's environment variables. For more complete HSA configuration information, refer to the *Configuration Fundamentals Configuration Guide* and the *Configuration Fundamentals Command Reference* publications, which are available on UniverCD or as printed copies.	**boot system** **boot bootldr** **boot config**
Step 2	Save the settings to the startup configuration. This also puts the information under that RSP2 card's ROM monitor control.	**copy running-config startup-config**
Step 3	Save the same environment variables to the slave RSP2 by manually synchronizing their configuration files.	**slave sync config**
Step 4	Verify the environment variable settings.	**show boot**

Automatically Setting Environment Variables on the Slave RSP2

With automatic synchronization turned on, the system automatically saves the same environment variables to the slave's startup configuration when you set the master's environment variables and save them.

Note Automatic synchronization mode is on by default.

To set environment variables on the slave RSP2 when automatic synchronization is on, perform the following steps beginning in global configuration mode:

Tasks		Command
Step 1	Set the master's environment variables. For more complete HSA configuration information, refer to the *Configuration Fundamentals Configuration Guide* and the *Configuration Fundamentals Command Reference* publications, which are available on UniverCD or as printed copies.	**boot system** **boot bootldr** **boot config**
Step 2	Save the settings to the startup configuration. This also puts the information under that RSP2 card's ROM monitor control.	**copy running-config startup-config**
Step 3	Verify the environment variable settings.	**show boot**

Monitoring and Maintaining HSA Operation

To monitor and maintain HSA operation, you can override the slave image that is bundled with the master image. To do so, perform the following task in global configuration mode:

Tasks	Command
Specify which image the slave runs.	**slave image** {**system** | *device***:***filename*}

You can manually synchronize configuration files and ROM monitor environment variables on the master and slave RSP2 card. To do so, perform the following task in privileged EXEC mode:

Tasks	Command
Manually synchronize master and slave configuration files.	**slave sync config**

Caution When you install a second RSP2 card for the first time, you *must* immediately configure it using the **slave sync config** command. This ensures that the new slave is configured consistently with the master. Failure to do so may result in an unconfigured slave RSP2 card taking over mastership of the router when the master fails, rendering the network inoperable.

The **slave sync config** command is also a useful tool for more advanced implementation methods not discussed in this document. Refer to the *Configuration Fundamentals Configuration Guide* and the *Configuration Fundamentals Command Reference* publications, which are available on UniverCD or as printed copies.

Verifying HSA Operation

Following are the steps required to verify HSA operation:

Step 1 With HSA configured, verify that the console terminal displays the system banner and startup screen as the system restarts. The master console display should look similar to the following (note the RSP2 slots indicated):

```
System Bootstrap, Version 11.1(2), RELEASED SOFTWARE
Copyright (c) 1986-1996 by cisco Systems, Inc.
SLOT 6 RSP2 is system master
SLOT 7 RSP2 is system slave
RSP2 processor with 16384 Kbytes of main memory

[additional displayed text omitted from this example]

Cisco Internetwork Operating System Software
IOS (tm) GS Software (RSP-K-M), Version 11.1(2) [biff 51096]
Copyright (c) 1986-1996 by cisco Systems, Inc.
Compiled Mon 22-Jan-96 21:15 by biff
Image text-base: 0x600108A0, data-base: 0x607B8000

cisco RSP2 (R4600) processor with 16384K bytes of memory.
R4600 processor, Implementation 32, Revision 2.0

[additional displayed text omitted from this example]

8192K bytes of Flash PCMCIA card at slot 0 (Sector size 128K).
8192K bytes of Flash internal SIMM (Sector size 256K).
Slave in slot 7 is halted.

[additional displayed text omitted from this example]
```

Step 2 After the system boots the software and initializes the interface processors (approximately 30 seconds for systems with 16 MB of DRAM, and approximately 2 minutes for systems with 64 MB of DRAM), verify that the RSP2 LEDs are in the following states:

- RSP2 normal LED is on (for each RSP2 installed)
- CPU halt LED is off (for each RSP2 installed)
- Master RSP2’s master LED is on
- Slave RSP2’s slave LED is on

Step 3 Verify that all the enabled LEDs (on the interface processors) are on.

Step 4 Use the **show version** command to verify that the slave RSP2 is recognized by the system. Following is a sample:

```
Router> show version
Cisco Internetwork Operating System Software
IOS (tm) GS Software (RSP-K-M), Version 11.1(2) [biff 51096]
Copyright (c) 1986-1996 by cisco Systems, Inc.
Compiled Mon 22-Jan-96 21:15 by biff
Image text-base: 0x600108A0, data-base: 0x607B8000

[additional displayed text omitted from this example]

Slave in slot 7 is running Cisco Internetwork Operating System Software

(Note that this could also be “slot 6” depending on which RSP2 is configured as the
slave or the recent crash history of your router.)

IOS (tm) GS Software (RSP-DW-M), Version 11.1(2) [biff 51096]
Copyright (c) 1986-1996 by cisco Systems, Inc.
Compiled Mon 22-Jan-96 20:59 by biff

Configuration register is 0xF

Router>
```

When you have verified all the conditions in Steps 1 through 4, the installation is complete.

Troubleshooting a Failed RSP2

When a new master RSP2 takes over mastership of the router, it automatically reboots the failed RSP2 as the slave RSP2. You can access the state of the failed RSP2 in the form of a stack trace from the master console using the **show stacks** command.

You can also manually reload a failed RSP2 from the master console. To do so, perform the following task from global configuration mode:

Tasks	Command
Reload the inactive slave RSP card.	**slave reload**

You can also display information about both the master and slave RSP2s. To do so, perform any of the following tasks from EXEC mode:

Tasks	Command
Display the environment variable settings and configuration register settings for both the master and slave RSP cards.	**show boot**
Show a list of flash devices currently supported on the router.	**show flash devices**
Display the software version running on the master and slave RSP card.	**show version**
Display the stack trace and version information of the master and slave RSP cards.	**show stacks** [1]

1. This command is documented in the "System Management Commands" chapter of the *Configuration Fundamentals Command Reference* publication.

Configuring the AIP

Configuration of the AIP is a two-step process: you will configure the AIP, then you will configure the ATM switch. To configure your ATM switch, refer to the appropriate user document. To configure ATM, complete the following tasks. The first two tasks are required, and then you must configure at least one PVC or SVC. The VC options you configure must match in three places: on the router, on the ATM switch, and at the remote end of the PVC or SVC connection.

- Enable the AIP and configure the rate queue.
- Change the AIP default values (optional).
- Configure PVCs.
- Configure SVCs.
- Monitor and maintain the ATM interface (optional).

Note AIP debug information is beyond the scope of this publication. For debug information, refer to the configuration note *Asynchronous Transfer Mode Interface Processor (AIP) Installation and Configuration*, which is available on UniverCD or can be ordered separately (Document Number 78-1214-xx, where xx represents the latest version of this document). For complete information on AIP-related software commands, refer to the software documentation appropriate for your IOS software release.

Initial AIP Configuration

On power up, a new AIP is shut down. To enable the AIP, you must enter the **no shutdown** command in the configuration mode. (See the section "Using the Configure Command" which follows.) If you installed a new AIP or want to change the configuration of an existing interface, you must enter the configuration mode. When the AIP is enabled (taken out of shutdown) with no additional arguments, the default interface configuration file parameters are as listed in Table 5-7.

Table 5-7 AIP Configuration Default Values

Parameter	Configuration Command	Default Value
MTU	**mtu** *bytes*	4470 bytes
Exception queue buffers	**atm exception-queue**	32
ATM virtual path filter	**atm vp-filter hexvalue**	0x7B (hexadecimal)
Receive buffers	**atm rxbuff**	256
Transmit buffers	**atm txbuff**	256
Maximum number of VCs	**atm maxvc**	2048
AAL encapsulation	**atm aal aal5**	AAL5
ATM raw cell queue size	**atm rawq-size**	32
ATM VCs per VP	**atm vc-per-vp**	1024
E3 interface framing	**atm framing g751**	G.804

After you verify that the new AIP is installed correctly (the enabled LED goes on), you can use the **configure** command to configure the new ATM interface. Be prepared with the information you will need, such as the interface IP address, maximum transmission unit (MTU) size, ATM Adaptation Layer (AAL) mode, and desired rate queues.

Using the Configure Command

Following are instructions for a basic configuration: enabling an interface and specifying IP routing. You might also need to enter other configuration subcommands, depending on the requirements for your system configuration and the protocols you plan to route on the interface. For complete descriptions of configuration subcommands and the configuration options available for ATM, refer to the *Router Products Configuration Guide* and *Router Products Command Reference* publication.

The router identifies an interface number by its interface processor slot number (slots 0 through 5 and 8 through 12) and port number (port numbers 0 to 7, depending on the interface processor type) in the format *slot/port*. Because each AIP contains a single ATM interface, the port number is always 0. For example, the slot/port address of an ATM interface on an AIP installed in interface processor slot 1 would be *1/0*.

The following steps describe a basic configuration. Before using 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 is set. Press the Return key after each configuration step unless otherwise noted.

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

```
Router# configure terminal
```

Step 2 At the prompt, specify the new ATM interface to configure by entering the **interface atm** command, followed by the *type* (**ATM**) *and slot/port* (interface processor slot number/port number). The example that follows is for an AIP in interface processor slot 1:

```
Router(config)# interface atm 1/0
```

Step 3 If IP routing is enabled on the system, you can assign an IP address and subnet mask to the interface with the **ip address** configuration subcommand, as in the following example:

```
Router(config)# ip address 1.1.1.1 255.255.255.0
```

Step 4 Change the shutdown state to up and enable the ATM interface as follows:

```
Router(config-if)# no shutdown
```

The **no shutdown** command passes an **enable** command to the AIP, which then begins segmentation and reassembly (SAR) operations. It also causes the AIP to configure itself based on the previous configuration commands sent.

Step 5 Add any additional configuration subcommands required to enable routing protocols and adjust the interface characteristics.

Step 6 When you have included all of the configuration subcommands to complete the configuration, enter **^Z** (hold down the Control key while you press Z) to exit the configuration mode.

Step 7 Write the new configuration to memory as follows:

```
Router# copy running-config startup-config
```

The system will display an OK message when the configuration has been stored.

Step 8 For an explanation of **show** commands that allow you to check the interface configuration, see the section “Checking the Configuration” in this chapter.

Configuring the Rate Queue

A rate queue defines the maximum speed at which an individual virtual circuit (VC) transmits data to a remote ATM host.

There are no default rate queues. Every VC *must* be associated with one rate queue. The AIP supports up to eight different *peak* rates. The peak rate is the maximum rate, in kilobits per second, at which a VC can transmit. After attachment to this rate queue, the VC is assumed to have its peak rate set to that of the rate queue.

You can configure each rate queue independently to a portion of the overall bandwidth available on the ATM link. The combined bandwidths of all rate queues should not exceed the total bandwidth available for the AIP physical-layer interface. The total bandwidth depends on the PLIM. (See the section “ATM Connection Equipment” in the chapter “Preparing for Installation.”)

The rate queues are broken into a high (0 through 3) and low (4 through 7) bank. When the rate queues are configured, the AIP will service the high-priority banks until they are empty and then service the low-priority banks.

VCs get the entire bandwidth of the associated rate queue. If oversubscription occurs, the other rate queues in bank A will miss the service opportunities. In the worst case, a 10-Mbps rate queue will take 100 Mbps if there are 10 VCs attached to it and all of them have packets to send at the same time.

Note For E3, rate queues >34 are disallowed. For DS3, rate queues >45 are disallowed.

To configure rate queue 1 at 10 Mbps, use the **atm rate-queue** *queuenumber rate* command in interface configuration mode as follows:

```
Router(config-if)# atm rate-queue 1 10
```

where the queue number is in the range of 0 to 7 and the *rate* (in Mbps) in the range of 1 to 155. The **no** form of the command removes the rate queue.

You must create a rate queue before you can create PVCs or SVCs. If all rate queues are unconfigured, a warning message will appear, as follows:

```
%WARNING:(ATM4/0): All rate queues are disabled
```

`If the combined queue rates exceed the AIP physical layer interface bandwidth maximum, a warning message will appear, as follows:`

```
%WARNING(ATM4/0): Total rate queue allocation nMbps exceeds maximum of nMbps
```

Changing AIP Default Values

The AIP default values may be changed to match your network environment. Perform the tasks in the following sections if you need to customize the AIP:

- Selecting an AIP Interface
- Setting the MTU Size
- Configuring SONET Framing
- Configuring an ATM Interface for Local Loopback
- Setting the Reassembly Buffers
- Setting Framing on the E3 Interface
- Setting the Transmit Buffers
- Setting the Source of the Transmit Clock

Selecting an AIP Interface

The AIP interface is referred to as **atm** in the RP configuration commands. An interface is created for each AIP found in the system at reset time. To select a specific AIP interface, use the **interface atm** command, as follows:

```
interface atm n / i
```

where **n** is the slot number and **i** is the interface number.

Setting the MTU Size

To set the MTU size, use the following command:

```
mtu bytes
no mtu
```

where *bytes* is in the range of 64 through 9188 bytes and the default is 4470 bytes. (4470 bytes exactly matches FDDI and HSSI interfaces for autonomous switching.) The **no** form of the command restores the default.

Configuring SONET Framing

In STM-1 mode, the AIP sends *idle* cells for cell-rate decoupling. In STS-3C mode, the AIP sends *unassigned* cells for cell-rate decoupling. The default SONET setting is STS-3C. To configure for STM-1, use the following command:

```
atm sonet stm-1
```

To change back to STS-3C, use the **no atm sonet stm-1** command.

Configuring an ATM Interface for Local Loopback

To configure an ATM interface for local loopback (useful for checking that the AIP is working), use the following command:

```
loopback plim
no loopback plim
```

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

Setting the Reassembly Buffers

The **atm rxbuff** command sets the maximum number of reassemblies that the AIP can perform simultaneously. The AIP allows up to 512 simultaneous reassemblies; the default is 256. The **no** form of the command restores the default.

Setting Framing on the E3 Interface

The E3 interface supports G.804 and G.751 framing. The default is G.804. To set the framing to G.751, use the following command:

```
atm framing g751
no atm framing g751
```

The **no atm framing g751** command resets the E3 interface to the default G.804 framing.

Setting the Transmit Buffers

To set the number of transmit buffers for simultaneous fragmentation, use the following command:

```
atm txbuff n
no atm txbuff
```

where *n* is in the range 0 to 512. The default is 256.

Setting the Source of the Transmit Clock

By default, the AIP uses the recovered receive clock to provide transmit clocking. To specify that the AIP generates the transmit clock internally for SONET, E3, and DS3 PLIM operation, use the following command:

```
atm clock internal
```

Virtual Circuits

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

- Quality of service (QOS)
- AAL mode (AAL3/4 or AAL5)
- Encapsulation type (LLC/SNAP, MUX, NLPID, and QSAAL)
- Peak and average transmission rates

Each VC supports the following router functions:

- Multiprotocol (AppleTalk, CLNS, DECnet, IP, IPX, VINES, XNS)
- Fast switching of IP, IPX, VINES, CLNS, and AppleTalk packets
- Autonomous switching of IP packets
- Pseudobroadcast support for multicast packets

By default, fast switching is enabled on all AIP interfaces. These switching features can be turned off with interface configuration commands. Autonomous switching must be explicitly enabled for each interface.

Permanent Virtual Circuit (PVC) Configuration

All PVCs, configured into the router, remain active until the circuit is removed from the configuration. The PVCs also require a permanent connection to the ATM switch.

All virtual circuit characteristics apply to PVCs. When a PVC is configured, all the configuration options are passed on to the AIP. These PVCs are writable into the nonvolatile RAM (NVRAM) as part of the RP configuration and are used when the RP image is reloaded.

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

To configure a PVC, you must perform the following tasks:

- Create a PVC.
- Map a Protocol Address to a PVC.

PVC Configuration Commands

When you create a PVC, you create a virtual circuit descriptor (VCD*)* and attach it to the VPI and VCI. A VCD is an AIP-specific mechanism that identifies to the AIP which VPI/VCI to use for a particular packet. The AIP requires this feature to manage the packets, for transmission. The number chosen for the VCD is independent of the VPI/VCI used.

When you create a PVC, you also specify the AAL and encapsulation. A rate queue is used that matches the *peak* and *average* rate selections, which are specified in kilobits per second. Omitting a *peak* and *average* value causes the PVC to be connected to the highest bandwidth rate queue available. In that case, the *peak* and *average* values are equal.

To create a PVC on the AIP interface, use the **atm pvc** command. To remove a PVC, use the **no** form of this command.

```
atm pvc vcd vpi vci aal-encap [peak] [average] [cell-quota]
no atm pvc vcd
```

For example:

```
Router(config)# interface atm 2/0
Router(config-if)# atm pvc 2048 255 128 aal5snap 10 10 2046
```

vcd—A per-AIP unique index value describing this VC in the range of 1 to MAXVC.

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

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

encapsulation—The encapsulation type to use on this VC from the following:

aal5mux—Specifies the MUX-type for this VC. A protocol type must be specified.
aal5snap—LLC/SNAP precedes the protocol datagram.
aal5nlpid—NLPID precedes the protocol datagram.
aal34smds—SMDS framing precedes the protocol datagram.
qsaal—A signaling type VC.

protocol-type-for-mux—A protocol type compatible with the MUX is required from the following protocols: **ip**, **decnet**, **novell, vines**, **xns**.

peak-rate—(Optional) The maximum rate, in Kbps, at which this VC can transmit.

average-rate—(Optional) The average rate, in Kbps, at which this VC will transmit.

cell quota—(Optional) The **cell-quota** is an integer value, in the range 1 through 2047, describing the maximum number of credits that a VC can accumulate. The AIP makes use of this in multiples of 32 cells. Every cell transfer consumes one cell credit. One cell transfer credit is issued to a VC in the average rate speed.

The **atm pvc** command creates *PVC n* and attaches the PVC to *VPI* and *VCI*. The AAL used is specified by *aal* and encapsulation by *encap*. A rate queue is used that matches the *peak* and average (*avg*) rate selection. The *peak* and *avg* rate selection values are specified in Kbps. Not specifying a *peak* and *avg* value causes the PVC to default to the highest bandwidth rate queue available.

Note For E3, rate queues >34 are disallowed. For DS3, rate queues >45 are disallowed.

The defaults for *peak-rate* and *average-rate* is that peak = average, and the PVC is automatically connected to the highest bandwidth rate queue available. A *VCD* is an AIP specific mechanism that identifies to the AIP which VPI/VCI to use for a particular packet. The AIP requires this feature to manage the packets for transmission.

VP Filter

The vp filter (vp_filter) configures the hex value used in the vp filter register in the reassembly operation. When a cell is received, the right half (most-significant byte) of the filter is exclusively NORed with the incoming VPI. The result is then ORed with the left half (least-significant byte) of the filter (the mask). If the result is all ones, then reassembly is done using the VCI/MID table. Otherwise, reassembly is done using the VPI/VCI table. The vp filter mechanism allows a way of specifying which VPI (or range of VPIs) will be used for AAL3/4 processing, all other VPIs mapping to AAL5 processing. In the case where only AAL5 processing is desired, the vp filter should be set to the default VPI of 0x7B (hexadecimal). AAL5 processing will be performed on the first 127 VPIs in that case. Currently you can only configure one VPI for all the AAL3/4 packets.

Examples follow:

```
atm vp-filter 1
```

All incoming cells with VPI = 1 will be reassembled via AAL3/4 processing. AAL3/4 is supported with IOS Release 10.2 and later.

```
atm vp-filter 0
```

All incoming cells with VPI = 0 will be reassembled via AAL3/4 processing. All other cells will be reassembled via AAL5 processing.

Mapping a Protocol Address to a PVC

A mapping scheme identifies the ATM address of remote hosts/routers. This address can be specified either as a VCD for a PVC or an NSAP address for SVC operation.

Enter mapping commands as groups; multiple map entries can exist in one map list. First create a map list, then associate the list with an interface. Enter the **map-list name** command; then enter the protocol, protocol address, and other variables, as follows:

```
map-list name
protocol protocol address atm-vc vcd | atm-nsap nsap [broadcast]
```

The **broadcast** keyword specifies that this map entry receives the corresponding protocol broadcast requests to the interface (for example, any network routing protocol updates). If you do not specify **broadcast**, the ATM software is prevented from sending routing protocol updates to the remote hosts.

After you create the map list, specify the ATM interface to which it applies with the interface command, as follows:

```
interface atm slot/port
```

Associate the map list to an interface with the following command:

```
map-group name
```

You can create multiple map lists, but only one map list can be associated with an interface. Different map lists can be associated with different interfaces. The following is an example of mapping a list to an interface:

```
interface atm4/0
ip address 1.1.1.1 255.255.255.0
map-group atm
atm rate-queue 1 100
atm pvc 1 0 8 aal5snap
atm pvc 2 0 9 aal5mux decnet
decnet cost 1
!
map-list atm
ip 1.1.1.1 atm-vc 1 broadcast
decnet 10.2 atm-vc 2 broadcast
```

Checking the Configuration

After configuring the new interface, use the **show** commands to display the status of the new interface or all interfaces.

ATM Show Commands

ATM **show** commands are available to display the current state of the ATM network and the connected VCs.

To show current VCs and traffic information, use the following command:

```
show atm vc [vcd]
```

Specifying a VCD will display specific information about that VCD.

To show current information about an ATM interface, use the following command:

```
show atm int interface
```

The **show atm int interface** command will display ATM-specific information about an interface.

To show current ATM traffic, use the following command:

```
show atm traffic
```

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

To show the current ATM mapping, use the following command:

```
show atm map
```

The **show atm map** command displays the active list of ATM static maps to remote hosts on an ATM network.

Other Commands That Display AIP Information

Following are descriptions and examples of the **show** commands that display AIP information.

- The **show controllers cbus** command displays the internal status of the interface processor, including the interface processor slot location, the card hardware version, and the currently running microcode version. The **show controllers cbus** command 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 an AIP installed in interface processor slot 4, the running AIP microcode is Version 170.46, the PLIM type is 4B/5B, and the available bandwidth is 100 Mbps:

```
Router# show cont cbus

 AIP 4, hardware version 1.0, microcode version 10.1
  Microcode loaded from system
  Interface 32 - ATM4/0, PLIM is 4B5B(100Mbps)
    15 buffer RX queue threshold, 36 buffer TX queue limit, buffer size 4496
    ift 0007, rql 12, tq 0000 0620, tql 36
    Transmitter delay is 0 microseconds
```

- The **show atm vc** command displays the following types of statistics for all PVCs:

```
Router# show atm vc
Intfc.   VCD   VPI   VCI   Input   Output  AAL/Encaps    Peak  Avg.  Burst
ATM4/0.1 1     1     1     305     0       AAL3/4-SMDS   0     0     0
ATM4/0   2     2     2     951     0       AAL5-SNAP     0     0     0
ATM4/0   3     3     3     0       0       AAL5-SNAP     0     0     0
ATM4/0   4     4     4     162     0       AAL5-MUX      0     0     0
ATM4/0   6     6     6     2722    0       AAL5-SNAP     0     0     0
ATM4/0   7     7     7     733     0       AAL5-SNAP     0     0     0
```

- Use the **show atm vc** *n* command, where *n* is the VCD, to display statistics for a given PVC, as follows:

```
Router# show atm vc 4
ATM4/0: VCD: 4, VPI: 4, VCI: 4, etype:0xBAD, AAL5 - MUX, Flags: 0x34
PeakRate: 0, Average Rate: 0, Burst: 0 *32cells, Vcmode: 0xE200
InPkts: 164, OutPkts: 0, InFast: 0, OutFast: 0, Broadcasts: 0
```

- The following is sample output from the **show atm vc** command when a VCD is specified, AAL3/4 is enabled, an ATM SMDS subinterface has been defined, and a range of message identifier numbers (MIDs) has been assigned to the PVC:

```
Router# show atm vc 1

ATM4/0.1: VCD: 1, VPI: 0, VCI: 1, etype:0x1, AAL3/4 - SMDS, Flags: 0x35
PeakRate: 0, Average Rate: 0, Burst: 0 *32cells, VCmode: 0xE200
MID start: 1, MID end: 16
InPkts: 0, OutPkts: 0, InFast: 0, Broadcasts: 0
```

- Use the **show interfaces** command without arguments to display statistics for all interfaces in the system. Use the **show interfaces atm** *slot/port* command to display statistics for the ATM interface you specify by its slot/port address as follows:

```
Router# show atm int atm 4/0
ATM interface ATM4/0:
AAL enabled:  AAL5, Maximum VCs: 1024, Current VCs: 6
Tx buffers 256, Rx buffers 256, Exception Queue: 32, Raw Queue: 32
VP Filter: 0x7B, VCIs per VPI: 1024
PLIM Type:4B5B - 100Mbps, No Framing, TX clocking: LINE
4897 input, 2900 output, 0 IN fast, 0 OUT fast
Rate-Queue 1 set to 100Mbps, reg=0x4EA
Config. is ACTIVE
```

- Use the **show atm map** command to display the PVC map, as follows:

```
Router# show atm map
Map list atm:
vines 3004B310:0001 maps to VC 4, broadcast
ip 1.1.1.1 maps to VC 1, broadcast
clns 47.0004.0001.0000.0c00.6e26.00 maps to VC 6, broadcast
appletalk 10.1 maps to VC 7, broadcast
decnet 10.1 maps to VC 2, broadcast
```

- Use the **show atm traffic** command to display the interface traffic, as follows:

```
Router# show atm traffic
4915 Input packets
0 Output packets
2913 Broadcast packets
0 Packets for non-existent VC
0 Packets with CRC errors
0 OAM cells received
0 Cells lost
```

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

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

```
Router> show version
GS Software (RSP-K), Version 10.3(571)
Copyright (c) 1986-1995 by cisco Systems, Inc.
Compiled Wed 10-May-95 14:44

System Bootstrap, Version 4.6(1)

Current date and time is Fri 5-12-1995 2:18:52
Boot date and time is Fri 5-12-1993 11:42:38
Router uptime is 2 hours, 36 minutes
System restarted by power-on
Running default software
Network configuration file is "Router", booted via tftp from 1.1.1.1
RSP2 (Risc 4600) processor with 16384K bytes of memory.
X.25 software.
Bridging software.
1 Route Switch Processor.
1 TRIP controller (4 Token Ring).
4 Token Ring/IEEE 802.5 interface.
1 AIP controller (1(ATM)
1 ATM network interface
8192K bytes of flash memory on embedded flash (in RSP2).
Configuration register is 0x0
   (display text omitted)
```

- The **show protocols** command displays the global (system-wide) and interface-specific status of any configured Level 3 protocol.
- The **write terminal** command displays the currently running AIP configuration in RAM, as follows:

```
Router# write term

interface atm2/0
ip address 1.1.1.1 255.255.255.0
atm rate-queue 1 100
atm rate-queue 2 5
atm pvc 1 1 1 aal5mux ip
atm pvc 3 3 3 aal5snap
atm pvc 4 4 5 aal5snap 4000 3000
appletalk address 10.1
appletalk zone atm
```

Configuring the FSIP

The FSIP supports EIA/TIA-232, EIA/TIA-449, V.35, and X.21 electrical interfaces in both DTE and DCE mode, and EIA-530 interfaces in DTE mode. The port adapter cable connected to each port determines the electrical interface type and mode of the port. To change the electrical interface type or mode of a port, you replace the port adapter cable and use software commands to reconfigure the port for the new interface. At system startup or restart the FSIP polls the interfaces and determines the electrical interface type of each port (according to the type of port adapter cable attached). However, it does not necessarily repoll an interface when you change the adapter cable on line.

To ensure that the system recognizes the new interface type, you must shut down and reenable the interface after changing the cable. When setting up a new DCE interface or changing the mode of an interface from DTE to DCE, or when setting up a loopback test, you must also set the clock rate on the interface. If necessary, you can also use software commands to invert the clock to compensate for phase shifts caused by circuit delays or variances in cable lengths.

The default configuration for serial ports is DCE mode, NRZ format, and 16-bit CRC error detection. All serial interfaces support nonreturn to zero inverted (NRZI) format and 32-bit error detection, both of which are enabled with a software command.

This section contains brief descriptions and examples of software commands that you may need when installing or changing the configuration of serial interface ports. For complete command descriptions and instructions, refer to the related software documentation.

Configuring Timing (Clock) Signals

To use an FSIP port as a DCE interface, you must connect a DCE port adapter cable and set the clock speed with the **clockrate** command. You must also set the clock rate to perform a loopback test. This section describes how use software commands to set the clock rate on a DCE port and, if necessary, how to invert the clock to correct a phase shift between the data and clock signals.

Setting the Clock Rate

All DCE interfaces require a noninverted internal transmit clock signal, which is generated by the FSIP. The default operation on an FSIP DCE interface is for the DCE device (FSIP) to generate its own clock signal (TxC) and send it to the remote DTE. The remote DTE device returns the clock signal to the DCE (FSIP port). When using DCE interfaces, you must connect a DCE-mode adapter cable to the port and specify the rate of the internal clock with the **clockrate** configuration command followed by the bits-per-second value.

In the following example, the first serial interface on an FSIP in interface processor slot 2 (2/0) is defined as having a clock rate of 2 Mbps.

```
Router# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)# interface serial 2/0
Router(config-if)# clockrate 2000000
Router(config-if)# ^z
Router#
```

Following are acceptable clockrate settings:

1200, 2400, 4800, 9600, 19200, 38400, 56000, 64000, 72000, 125000, 148000, 500000, 800000, 1000000, 1300000, 2000000, and 4000000

Speeds above 64 kbps (64000) are not appropriate for EIA/TIA-232; use EIA/TIA-449 on faster interfaces. And, the faster speeds might not work if your cable is too long. If you change an interface from DCE to DTE, you can use the **no clockrate** command to remove the clock rate although it is not necessary to do so. The port automatically recognizes the DTE cable and ignores the clock rate until a DCE cable is attached to the port again.

The FSIP ports support full duplex operation at DS1 (1.544 Mbps) and E1 (2.048 Mbps) speeds. Each four-port module (see the section “Fast Serial Interface Processor” in the chapter “Product Overview.”) is controlled by a dedicated MC68040 processor and can support up to 4 T1 or 3 E1 interfaces. An eight-port FSIP, which has two modules, can support up to 8 T1 or 6 E1 interfaces.

Because each four-port module shares a processor, you can delegate bandwidth to a single port and leave the other ports idle to optimize speed and bandwidth on a single interface. For example, you can configure each of the four ports on a module to operate at 2 Mbps, *or* configure one port to operate at 8 Mbps and leave the remaining three ports idle. The type of interface, the amount of traffic, and the types of external network devices connected to the ports affect actual rates.

Inverting the Clock Signal

Systems that use long cables may experience high error rates when operating at the higher speeds. Slight variances in cable length, temperature, and network configuration can cause the data and clock signals to shift out of phase. Inverting the clock can often correct this shift. The **invert-transmit-clock** configuration command inverts the TxC clock signal for DCE interfaces. This prevents phase shifting of the data with respect to the clock. To change the clock back to its original phase, use the **no invert-transmit-clock** command.

In the example that follows, the clock is inverted for the first serial port on an FSIP in interface processor slot 2:

```
Router# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)# interface serial 2/0
Router(config-if)# invert-transmit-clock
Router(config-if)# ^z
Router#
```

Configuring NRZI Format

The default for all interface types is for nonreturn to zero (NRZ) format; however, all types also support nonreturn to zero inverted (NRZI). NRZ encoding is most common. NRZI encoding is used primarily with EIA/TIA-232 connections in IBM environments. To enable NRZI encoding on any interface, specify the slot and port address of the interface followed by the command **nrzi-encoding**. In the example that follows, the first serial port on an FSIP in interface processor slot 2 is configured for NRZI encoding:

```
Router# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)# interface serial 2/0
Router(config-if)# nrzi-encoding
Router(config-if)# ^z
Router#
```

To disable NRZI encoding on a port, specify the slot and port address and use the **no nrzi-encoding** command. For a brief overview of NRZ and NRZI, refer to the section “NRZ and NRZI Formats” in the chapter “Preparing for Installation.” For complete command descriptions and instructions, refer to the related software documentation.

Configuring 32-Bit Cyclic Redundancy Check

All interfaces (including the HIP) use a 16-bit cyclic redundancy check (CRC) by default but also support a 32-bit CRC.

Note To determine if your HIP will support a 32-bit CRC, use the **show diag** command. If the resulting display indicates Part Number 81-0050-01, Hardware Version 1.0, you cannot use the CRC-32 feature. If the display indicates Part Number 81-0050-02, Hardware Version 1.1, you can use the CRC-32 feature.

CRC is an error-checking technique that uses a calculated numeric value to detect errors in transmitted data. Because 32-bit CRC transmits longer data streams at faster rates, it provides better ongoing error detection with less retransmits. However, both the sender and the receiver must use the same setting. The default for all serial interfaces is for 16-bit CRC. To enable 32-bit CRC on an interface, specify the slot and port address of the interface followed by the command **crc32**. In the example that follows, the first serial port on an FSIP in interface processor slot 2 is configured for 32-bit CRC:

```
Router# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)# interface serial 2/0
Router(config-if)# crc32
Router(config-if)# ^z
Router#
```

To disable 32-bit mode and return to the default 16-bit setting on a specific interface, specify the slot and port address of the interface and use the **no crc32** command. For a brief overview of CRCs, refer to the section “Cyclic Redundancy Checks” in the chapter “Preparing for Installation.” For complete command descriptions and instructions, refer to the related software documentation.

Configuring 4-Bit Cyclic Redundancy Check

The E1-G.703/G.704 interface supports 4-bit CRC in framed mode only. CRC-4 is not enabled by default. To enable CRC-4 on the E1-G.703/G.704 interface, specify the slot and port address of the interface followed by the **crc4** command. In the example that follows, the top port on an FSIP in interface processor slot 3 is configured for CRC:

```
Router# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)# interface serial 3/0
Router(config-if)# crc4
Router(config-if)# ^z
Router#
```

To disable CRC-4 and return to the default of no CRC error checking, specify the slot and port address and use the **no crc4** command. For complete command descriptions and instructions, refer to the related software documentation.

Replacing Serial Port Adapter Cables

The port adapter cable connected to each FSIP port determines the electrical interface type and mode of the port. The FSIP ports are not configured for either DTE or DCE mode by default. When there is no cable attached to a port, the software identifies the port as *Universal, Cable Unattached* rather than either a DTE or DCE interface. When a cable is attached, the port recognizes the mode and automatically uses the clock signal from the appropriate source (external for DTE or internal for DCE).

Although you do not have to configure a clock *source* for the ports, you do have to define the clock *speed* the first time you configure a port as a DCE interface. Because the ports automatically use the appropriate clock source for the type (mode) of cable it detects, you can configure a clock rate for a DCE interface and later replace the DCE cable with a DTE cable; the FSIP will ignore the internal clock rate unless it detects that a DCE cable is attached. This configuration allows you to perform a loopback test on a serial port without a port adapter cable attached.

Following is an example of the **show controllers cybus** command that shows an interface port (2/0) that has an EIA/TIA-232 DTE cable attached, and a second port (2/1) that does not have a cable attached:

```
Router# show controller cybus

 FSIP 2, hardware version 3, microcode version 10.0
  Interface 16 - Serial2/0, electrical interface is RS-232 DTE
    31 buffer RX queue threshold, 101 buffer TX queue limit, buffer size 1520
    Transmitter delay is 0 microseconds
  Interface 17 - Serial2/1, electrical interface is Universal (cable unattached)
    31 buffer RX queue threshold, 101 buffer TX queue limit, buffer size 1520
```

To change the electrical interface type or mode of a port on line, replace the serial adapter cable and use software commands to restart the interface and, if necessary, reconfigure the port for the new interface. At system startup or restart, the FSIP polls the interfaces and determines the electrical interface type of each port (according to the type of port adapter cable attached). However, it does not necessarily repoll an interface when you change the adapter cable on line. To ensure that the system recognizes the new interface type, shut down and reenable the interface after changing the cable.

Perform the following steps to change the mode or interface type of a port by replacing the adapter cable. If you are replacing a cable with one of the same interface type and mode, these steps are not necessary. (Simply replace the cable without interrupting operation.)

Step 1 Locate and remove the adapter cable to be replaced.

Step 2 Connect the new cable between the FSIP port and the network connection. Tighten the thumbscrews at both ends of the cable to secure it in the ports.

Step 3 At the privileged level of the EXEC, specify the port address, shut down the interface, and write the configuration to NVRAM. Add additional configuration commands, if any, before you exit from the configuration mode (before you press **Ctrl-Z**).

```
Router> ena
Password:
Router# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)# int serial 2/5
Router(config-int)# shutdown
Router(config-int)# ^z
Router#

Router# copy running-config startup-config
```

Step 4 Enter the configuration mode again and bring the port back up.

```
Router# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#
Router(config-int)# int serial 2/5
Router(config-int)# no shutdown
Router(config-int)# ^z
Router#
```

These steps will prompt the system to poll the interface and recognize the new interface immediately. When configuring a port for a DCE interface for the first time, or when setting up a loopback test, you must set the clock rate for the port. When you connect a DCE cable to a port, the interface will remain down, the clock LEDs will remain off, and the interface will not function until you set a clock rate (regardless of the DCE mode default).

If you are changing the mode of the interface from DCE to DTE, you do not need to change the clock rate for the port. After you replace the DCE cable with a DTE cable and the system recognizes the interface as a DTE, it will use the external clock signal from the remote DCE device and ignore the internal clock signal that the DCE interface normally uses. Therefore, once you configure the clock rate on a port for either a DCE interface or loopback, you can leave the clock rate configured and still use that port as a DTE interface.

Removing and Replacing Serial Port Adapters

Serial port adapters provide the high-density ports for FSIP serial interfaces. Each port adapter provides two ports, and each port supports any one of the available interface types: EIA/TIA-232, EIA/TIA-449, V.35, X.21, and EIA-530. (See the section “Fast Serial Interface Processor” in the chapter “Product Overview” for a discussion of the universal serial port adapters.) The adapter cable connected to the port determines the electrical interface type and mode (DTE or DCE) of the interface. Each FSIP is shipped from the factory with four or eight port adapters installed. FSIP port adapters are spare parts; if you have spares on hand and have a failure, you can replace interfaces without having to return the FSIP to the factory. You cannot, however, add ports to an FSIP by installing additional port adapters.

The four-port FSIP supports only one four-port module. To change the electrical interface type or mode of a port, you need only replace the adapter cable and reset the interface. When setting up the DCE port, you must also set the clock rate. Although DCE is the default mode, you do not need to specify the mode when configuring DTE interfaces. When the port recognizes the DTE interface cable, it automatically uses the clock signal from the remote DCE device.

Caution Remove and install port adapters only when it is necessary to replace interfaces. Do not attempt to isolate faults or to troubleshoot FSIPs or serial interfaces by swapping port adapters. The surface-mount circuitry on the port adapters will not tolerate excessive handling.

All serial interface types support NRZI format and 32-bit CRC, both of which you set with software commands. (Refer to the section “Configuring the FSIP” earlier in this chapter.) For complete command descriptions and instructions, refer to the related software documentation.

Tools Required

You need the following tools to complete this procedure:

- Number 1 Phillips or 3/16-inch flat-blade screwdriver
- 3/16-inch nut driver
- Wrist strap or other grounding device to prevent ESD damage

Removing the FSIP

Two or four port adapters are installed on each FSIP at the factory (each port adapter provides two ports), so in order to install a new port adapter (or to replace an existing one), you need to remove an existing port adapter. Each four-port module on an FSIP is driven by a CPU; four-port FSIPs contain one processor, and eight-port FSIPs contain two processors. You cannot add additional ports to a four-port FSIP to upgrade it to eight ports.

Follow these steps to remove and replace the FSIP:

Step 1 Disconnect all network interface cables attached to the FSIP ports.

Step 2 Put on a grounding strap and attach the equipment end to one of the captive installation screws on the rear of the chassis.

Step 3 Use a screwdriver to loosen the two captive installation screws on the FSIP.

Step 4 Place your thumbs on the upper and lower ejector levers and simultaneously push the top lever up and the bottom lever down to release the FSIP from the backplane connector.

Step 5 Grasp the FSIP handle with one hand and place your other hand under the carrier to support and guide the FSIP out of the slot. Avoid touching the board.

Step 6 Carefully pull the FSIP straight out of the slot, keeping your other hand under the carrier to guide it. (See Figure 5-3.) Keep the FSIP at a 90-degree orientation to the backplane.

Step 7 Place the removed FSIP on an antistatic mat or antistatic foam and proceed to the following section "Removing FSIP Port Adapters."

Removing FSIP Port Adapters

Port adapters are installed on each FSIP at the factory. You must remove an existing port adapter in order to replace or install a new one. Each port adapter is anchored to the FSIP with two double-row vertical board-to-board (BTB) connectors and two Phillips-head screws that extend down into the standoffs. (See Figure 5-16.) The port adapter is also anchored to the carrier faceplate with four jackscrews with lock washers (two per port).

Caution The surface-mounted components on the port adapters are extremely susceptible to ESD damage. Keep each port adapter in a separate antistatic bag until you are ready to install it. Always wear a ground strap and handle boards as little as possible. When you must handle the board, limit contact to the board edges only, avoiding contact between the board and clothing.

To remove a port adapter from the FSIP, perform the following steps:

Step 1 Ensure that the FSIP is resting on an antistatic mat or on antistatic foam. You should still be wearing an ESD-prevention ground strap.

Step 2 Position the FSIP so that it is in the same orientation as shown in Figure 5-16.

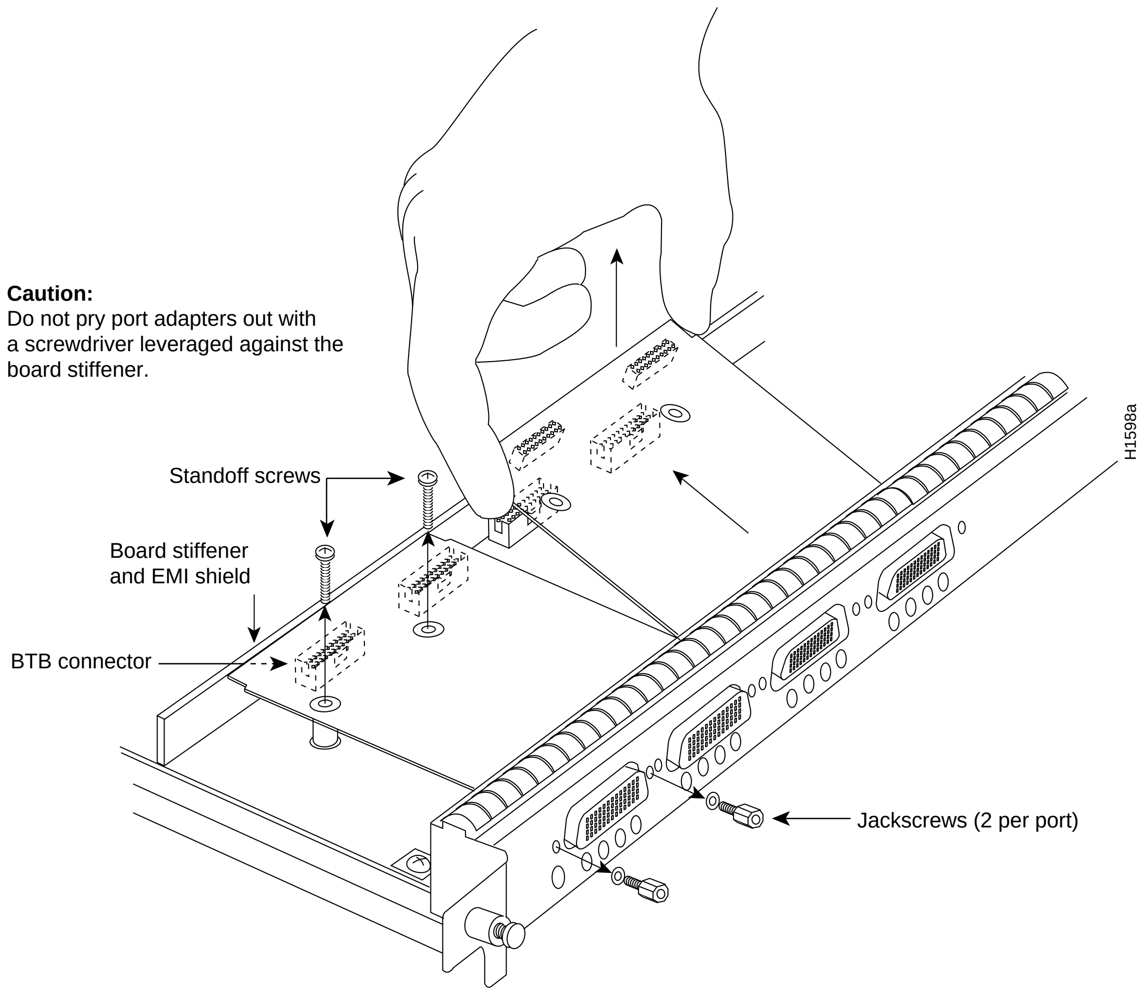
Step 3 Locate the port adapter to be replaced. Use a 3/16-inch nut driver to loosen the four jackscrews. (One jackscrew is located on each side of each serial connector port.)

Step 4 Remove the jackscrews and washers and put them aside. You may need them to install the new port adapter.

Step 5 Use a Phillips screwdriver to loosen and remove the two standoff screws. (See Figure 5-16.) You will need the standoff screws to install the new port adapter.

Step 6 While avoiding contact with any traces or components on the board, insert your thumb and forefinger into the finger holes on the sides of the port adapter and gently lift the port adapter upward to dislodge the BTB connectors. If the port adapter resists, rock it very slightly from side to side until it pulls free of the FSIP connector.

Figure 5-16 Removing FSIP Port Adapters



Caution Do not use a screwdriver or other tool to pry the port adapter up or out of the BTB connectors apart. In particular, do not use the board stiffener for leverage, or you will damage the FSIP board.

Step 7 When the port adapter BTB connector is completely disconnected from the BTB connector on the FSIP, tilt the back of the port adapter up at about a 70-degree angle from vertical and slowly pull it upward and outward (up and out using the orientation shown in Figure 5-16), away from the faceplate. The serial port connectors will pull out of the cutouts in the faceplate.

Step 8 Immediately place the removed port adapter into an antistatic bag.

Step 9 Proceed to the following section to install a new port adapter.

Caution Do not reinstall the FSIP in the chassis unless all port adapters are in place. The empty port will allow cooling air to escape freely through the cutouts in the faceplate, which could misdirect the airflow inside the chassis and allow components on other boards to overheat.

Installing FSIP Port Adapters

The FSIP should already be out of the chassis and have an empty space available for the new port adapter. If it is not, refer to the two preceding sections to remove the FSIP from the chassis and remove a port adapter from the FSIP. Refer to Figure 5-17 while performing the following steps.

Step 1 Ensure that the FSIP is resting on an antistatic mat or on antistatic foam and position it with the same orientation as that shown in Figure 5-17. You should still be wearing an ESD-prevention ground strap.

Step 2 Carefully remove the new port adapter from its antistatic bag. Handle the port adapter by the board edges only.

Step 3 If jackscrews are installed on the sides of the connectors, remove them and the four lock washers by turning them counterclockwise. If necessary, use a 3/16-inch nut driver to loosen them. Put the screws and washers aside.

Step 4 While still handling the board edges only, position the port adapter so that it is in the orientation shown in Figure 5-17: at about a 70-degree angle from vertical, component side down, standoffs on the underside, and the external interface port connectors facing the inside of the carrier faceplate.

Step 5 As shown in Figure 5-17, *partially* insert the port connectors through the back of the cutouts in the carrier faceplate. Do not force the connectors through the cutouts until the standoffs and BTB connectors are aligned.

Step 6 With the port connectors partially inserted into the faceplate cutouts, slowly lower the back (opposite) side of the port adapter and continue to ease the port connectors through the cutouts until the BTB connectors on the FSIP and port adapter meet, and the standoffs on the underside of the port adapter are aligned with the standoff holes in the FSIP. Shift the port adapter until the port connectors are fully inserted through the cutouts, and the standoffs are aligned with the standoff holes.

Caution Before seating the port adapter onto the FSIP, ensure that the port adapter is aligned properly with the BTB connectors and the standoffs. Forcing a misaligned port adapter into place can damage the port adapter or the FSIP and cause immediate or intermittent failures.

Step 7 Place your fingers along the back edge of the port adapter board and press down firmly until the BTB connectors mate. If the connectors resist, do not force them. Shift the port adapter around until the connectors mate properly.

Step 8 Insert the two long Phillips-head screws through the two standoffs and finger-tighten them. These screws extend through the standoffs and the FSIP board and thread into the metal carrier.

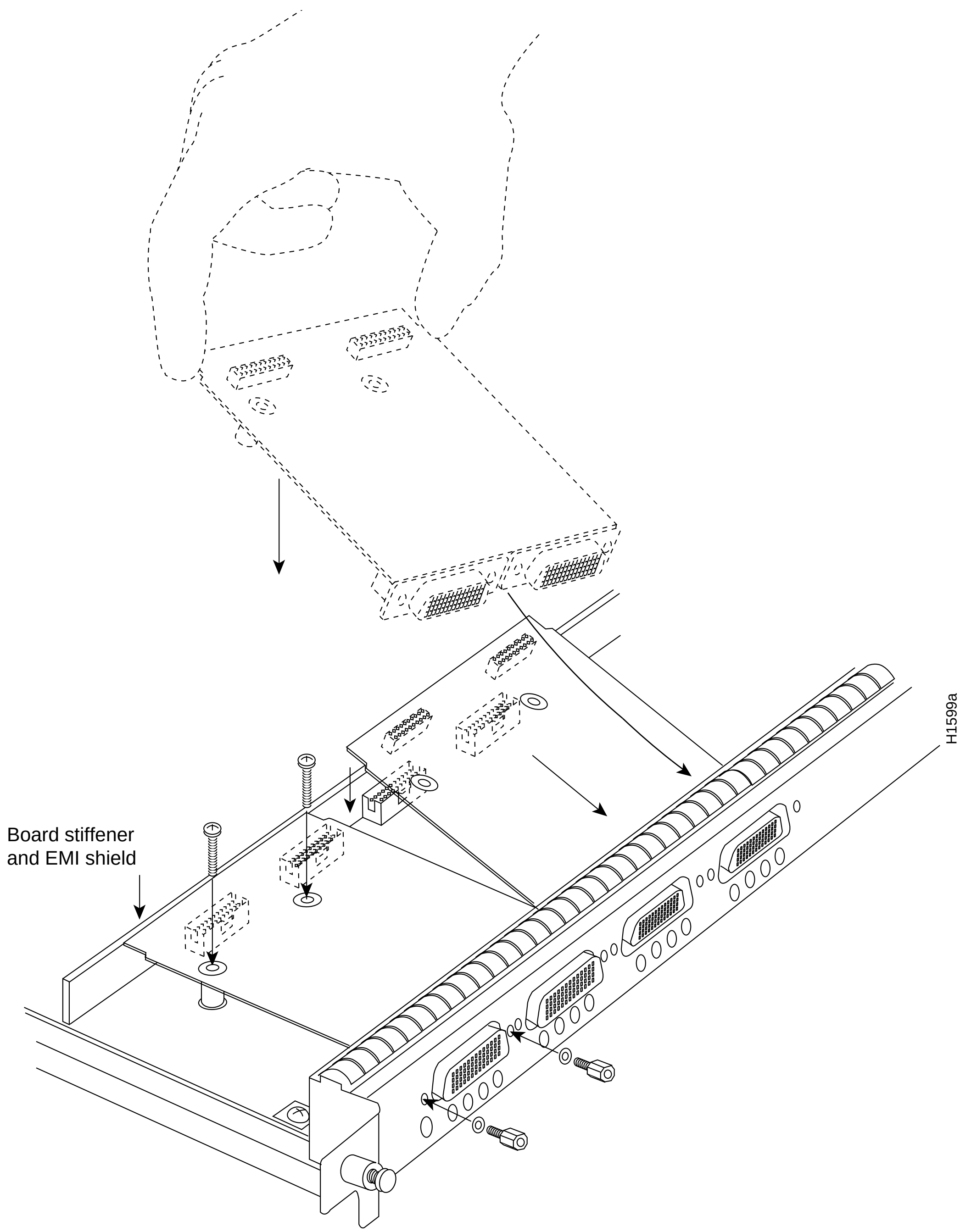
Step 9 Install a lockwasher on each of the four jackscrews.

Step 10 On the front of the carrier faceplate, insert the four jackscrews through the front of the faceplate and into the holes on either side of both port connectors.

Step 11 When all screws and connectors are aligned properly, use a Phillips screwdriver to tighten the standoff screws and a 3/16-inch nut driver to tighten the four jackscrews. Do not overtighten any of the screws.

Step 12 Proceed to the next section to reinstall the FSIP in the chassis.

Figure 5-17 Installing FSIP Port Adapters



Replacing the FSIP in the Chassis

There should now be four or eight port adapters installed on the FSIP. If there are not, do not install the FSIP until you install all port adapters or until you install a blank interface processor filler in the FSIP slot.

Caution Do not reinstall the FSIP unless all port adapters are installed. The empty port will allow cooling air to escape freely through the cutouts in the faceplate, which could misdirect the airflow inside the chassis and allow components on other boards to overheat. To prevent ESD damage, handle interface processors by the handles and carrier edges only.

Step 1 Grasp the FSIP handle with one hand and place your other hand under the carrier to support the FSIP and guide it into the slot. (See Figure 5-3.) Avoid touching the board.

Step 2 Place the back of the FSIP in the slot and align the notch on the bottom of the carrier with the groove in the slot. (See Figure 5-2.)

Step 3 While keeping the FSIP at a 90-degree orientation to the backplane, carefully slide the carrier into the slot until the FSIP faceplate makes contact with the ejector levers. (See Figure 5-2.)

Step 4 Using the thumb and forefinger of each hand, simultaneously push the top lever down and the bottom lever up (as shown in Figure 5-2) to fully seat the FSIP in the backplane connector.

Step 5 Use a number 1 Phillips or a 3/16-inch flat-blade screwdriver to tighten the captive installation screws on the top and bottom of the FSIP.

Step 6 Reconnect the network interface cables or other connection equipment to the FSIP interface ports.

Step 7 When you insert the new FSIP, the console terminal will display several lines of status information about the OIR as it reinitializes the interfaces. Change the state of the interfaces to up and verify that the configuration matches that of the interfaces you replaced.

Step 8 Use the **configure** command or the **setup** command facility to configure the new interfaces. You do not have to do this immediately, but the interfaces will not be available until you configure them and bring them up.

Step 9 After you configure the interfaces, use the **show controller serial** or the **show interfaces** command to display the status of the new interfaces.

This completes the port adapter replacement procedure. For complete command descriptions and instructions, refer to the related software documentation.

Configuring the MIP

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

After you verify that the new MIP is installed correctly (the enabled LED is on), use the privileged-level **configure** command to configure the new MIP controller. Be prepared with the information you will need, such as the following:

- T1 and/or E1 information, for example clock source (for T1), line code, and framing type
- Channel-group information and timeslot mapping
- Protocols and encapsulations you plan to use on the new interfaces
- Internet protocol (IP) addresses if you will configure the interfaces for IP routing
- Whether the new interface will use bridging

Refer to the *Router Products Configuration Guide* and *Router Products Command Reference* publications for a summary of the configuration options available and instructions for configuring the MIP controller.

Configuring Jumper J6 on the E1 Port Adapter

By default, channelized E1 port adapters are set with capacitive coupling between the receive (Rx) shield and chassis ground. This provides direct current (DC) isolation between the chassis and external devices, as stated in the G.703 specification. Jumper J6 controls this function. To make changes, remove the E1 port adapter from the mother board, place one of the spare jumpers on J6 pins one and two *or* pins two and three (refer to Table 5-8), and replace the port adapter on the mother board. Pin 1 of J6 is designated with a square. (See Figure 5-18.)

Figure 5-18 Location of Jumper J6 on the E1 Port Adapter—Partial View

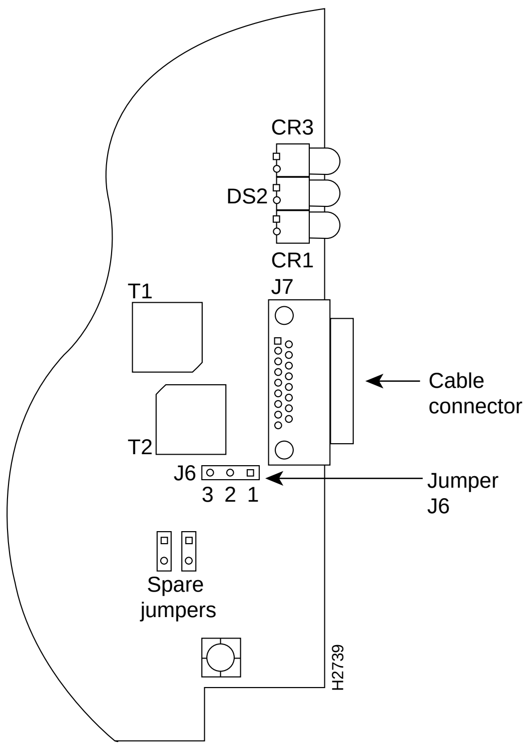


Table 5-8 Jumper Settings and Functions

Jumper	Pins and Impedance	Function
J6	1 and 2 for 120 ohm 2 and 3 for 75 ohm	Controls capacitive coupling for either 120-ohm or 75-ohm operation; an installed jumper directly connects the Rx shield to chassis ground.

Warning To prevent problems with the E1 interface and to reduce the potential for injury, jumper J6 should be installed by trained service personnel *only*. For either impedance option, a jumper installed at J6 bypasses the AC-decoupling capacitor to ground, thereby coupling the interface directly to AC. This is a setting that could pose a risk of severe injury. By default and for safety, J6 has no jumper installed.

After you set jumper J6, proceed to the section "Removing and Replacing MIP Port Adapters" to replace the MIP port adapter.

Using the Configure Commands

Following are instructions for a configuration that enables a controller and specifies IP routing. You might also need to enter other configuration subcommands, depending on the requirements for your system configuration and the protocols you plan to route on the interface. The channel-groups must be mapped before the MIP controller can be configured.

For complete descriptions of configuration subcommands and the configuration options available, refer to the *Router Products Configuration Guide* and *Router Products Command Reference* publication.

Before you 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#
```

Step 4 Proceed to the following section to configure the MIP controller.

Following are commands used to map the channel-group, with the default variable listed first:

Commands for T1:	Commands for E1:
controller t1 *slot/applique*	**controller e1** *slot/applique*
clock source [*line* | *internal*]	Not required for E1
linecode [*ami* | *b8zs*]	**linecode** [*hdb3* | *ami*]
framing [*sf* | *esf*]	**framing** [*crc4* | *no-crc4*]
loopback [*local* | *remote*]	**loopback**
shutdown	**shutdown**
channel-group *number* **timeslots** *list* [speed {56 | 48 | 64}] For speed, 56 is the default.	**channel-group** *number* **timeslots** *list* [speed {56 | 48 |64}] For speed, 64 is the default.

Number is the channel-group 0 to 23 for T1 and 0 to 29 for E1.

Timeslots *list* is a number between 1 to 24 for T1 and 1 to 31 for E1. It conforms to D3/D4 numbering for T1. Timeslots may be entered individually and separated by commas or as a range that is separated by a hyphen (for example, 1-3, 8, 9-18). For E1 and T1, 0 is illegal.

Speed specifies the DSO speed of the channel-group: T1 default is 56 kbps and E1 default is 64 kbps.

Note Cisco 7513 routers identify channel-groups as serial interfaces by slot number (interface processor slots 0 through 5 and 8 through 12), applique (0 or 1), and channel-group number (0 to 23 for T1 and 0 to 29 for E1) in the format, *slot/port:channel-group*. For example, the address of the MIP installed in interface processor slot 4, with applique 1 and channel-group 5, would be *4/1:5*.

T1 Configuration

The following steps describe a basic T1 configuration. Press the Return key after each configuration step.

Step 1 At the privileged-mode prompt, enter the 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 At the prompt, specify the controller to configure by entering the subcommand **cont**, followed by **t1**, *and slot/applique* (interface processor slot number/applique). The example that follows is for the MIP in interface processor slot 4, applique 1:

```
Router(config)# cont t1 4/1
```

Step 3 At the prompt, specify the clock source for the controller. The **clock source** command will determine which end of the circuit provides the clocking.

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

Note The clock source should only be set to use the internal clocking for testing the network or if the full T1 line is used as the channel-group. Only one end of the T1 line should be set to internal.

Step 4 At the prompt, specify the **framing** type.

```
Router(config-controller)# framing esf
```

Step 5 At the prompt, specify the **linecode** format.

```
Router(config-controller)# linecode b8zs
Router(config-controller)#
%CONTROLLER-3-UPDOWN: Controller T1 4/1, changed state to up
Router(config-controller)#
```

Step 6 At the prompt, specify the **channel-group** modification command, channel-group and timeslots to be mapped. The example shows channel-group 0 and timeslots 1, 3 through 5, and 7 selected for mapping.

```
Router(config-controller)# channel-group 0 timeslots 1,3-5,7
Router(config-controller)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial4/1:0, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial4/1:0, changed state to up
Router(config-controller)#
Router(config-controller)#
```

Step 7 At the prompt, specify the interface, serial, slot, applique, and channel-group to modify.

```
Router(config-controller)# int serial 4/1:0
```

Step 8 At the prompt, 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 1.1.1.1 255.255.255.0
Router(config-if)#
```

Step 9 Add any additional configuration subcommands required to enable routing protocols and adjust the interface characteristics.

Step 10 After including all of the configuration subcommands, to complete the configuration, enter **Ctrl-Z** (hold down the Control key while you press Z) to exit the configuration mode.

Step 11 Write the new configuration to memory as follows:

```
Router# copy running-config startup-config
```

The system will display an OK message when the configuration is stored.

Step 12 Exit the privileged level and return to the user level by entering **disable** at the prompt as follows:

```
Router# disable

Router>
```

Step 13 Proceed to the following section to check the interface configuration with **show** commands.

E1 Configuration

The following steps describe a basic E1 configuration. Press the Return key after each step.

Step 1 At the privileged-mode prompt, enter the 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 At the prompt, specify the controller to configure by entering the subcommand **cont**, followed by **e1**, *and slot/applique* (interface processor slot number/applique). The example that follows is for the MIP in interface processor slot 4, applique 1:

```
Router(config)# cont e1 4/1
```

Step 3 At the prompt, specify the **framing** type.

```
Router(config-controller)# framing crc4
```

Step 4 At the prompt, specify the **linecode** format.

```
Router(config-controller)# linecode hdb3
Router(config-controller)#
%CONTROLLER-3-UPDOWN: Controller E1 4/1, changed state to up
Router(config-controller)#
```

Step 5 At the prompt, specify the **channel-group** modification command, channel-group and timeslots to be mapped. The example shows channel-group 0 and timeslots 1, 3 through 5, and 7 selected for mapping.

```
Router(config-controller)# channel-group 0 timeslots 1,3-5,7
Router(config-controller)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial4/1:0, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial4/1:0, changed state to up
Router(config-controller)#
Router(config-controller)#
```

Step 6 At the prompt, specify the interface, serial, slot, applique, and channel-group to modify.

```
Router(config-controller)# int serial 4/1:0
```

Step 7 At the prompt, 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 1.1.1.1 255.255.255.0
Router(config-if)#
```

Step 8 Add any additional configuration subcommands required to enable routing protocols and adjust the interface characteristics.

Step 9 After including all of the configuration subcommands, to complete the configuration, enter **Ctrl-Z** (hold down the Control key while you press Z) to exit the configuration mode.

Step 10 Write the new configuration to memory as follows:

```
Router# copy running-config startup-config
```

The system will display an OK message when the configuration is stored.

Step 11 Exit the privileged level and return to the user level by entering **disable** at the prompt as follows:

```
Router# disable
Router>
```

Checking the Configuration

After configuring the new interface, use the **show** commands to display the status of the new interface or all interfaces.

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 number of each interface processor type installed), the software version, the names and sources of configuration files, and the boot images.

```
Router> show version

GS Software (RSP-K), Version 10.3(571)
Copyright (c) 1986-1994 by cisco Systems, Inc.
Compiled Wed 10-May-95 15:52

System Bootstrap, Version 4.6(1) [fc2], SOFTWARE

Router uptime is 42 minutes
System restarted by reload
System image file is “myfile-gs7-k”, booted via tftp from 1.1.1.1
```

```
RSP2 (Risc 4600) processor with 16384K bytes of memory. X.25 software, Version 2.0, NET2,
BFE and GOSIP compliant. Bridging software.
1 Route Switch Processor.
1 EIP controller (6 Ethernet).
1 TRIP controller (4 Token Ring).
1 FSIP controller (4 Serial).
1 MIP controller (1 T1). (or 1 E1, and so forth)
6 Ethernet/IEEE 802.3 interfaces.
4 Token Ring/IEEE 802.5 interfaces.
6 Serial network interfaces.
1 FDDI network interface.
128K bytes of non-volatile configuration memory.
8192K bytes of flash memory sized on embedded flash.
Configuration register is 0x100
```

- 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 MIP installed in interface processor slot 1:

```
Router# show controller cbus

FIP 0, hardware version 2.2, microcode version 10.1
 Microcode loaded from system
  Interface 0 - Fddi0/0, address 0000.0c03.648b (bia 0000.0c03.648b)
  15 buffer RX queue threshold, 37 buffer TX queue limit, buffer size 4496
  ift 0006, rql 13, tq 0000 01A0, tql 37

(text omitted from example)

MIP 2, hardware version 1.0, microcode version 10.0
 Microcode loaded from system
 Interface 16 - T1 2/0, electrical interface is Channelized T1
   10 buffer RX queue threshold, 14 buffer TX queue limit, buffer size 1580 ift 0001, rql
   7, tq 0000 05B0, tql 14
   Transmitter delay is 0 microseconds
Router#
```

- The **show controller t1** command displays the status of the default T1 (which is specified in RFC 1406). The **show controller t1** *slot/applique* command displays the verbose information for a particular T1, as follows:

```
Router# show cont t1 3/1
T1 3/1 is up.
  Description: Connected back-to-back to RouterA, nw side
  No alarms detected.
  Framing is ESF, Line Code is B8ZS, Clock Source is Internal.
  Data in current interval (65 seconds elapsed):
     0 Line Code Violations, 4390918 Path Code Violations
     0 Slip Secs, 0 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
     6 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 0 Unavail Secs
  Data in Interval 1:
     0 Line Code Violations, 5373952 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 1 15 minute intervals):
     0 Line Code Violations, 5373952 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
Router#
```

- The **show controller e1** command displays the status of the default E1 (which is specified in RFC 1406). The **show controller e1** *slot/applique* command displays the verbose information for a particular E1, as follows:

```
Router# show cont e1 1/1
E1 1/1 is up.
  Applique type is Channelized E1 - balanced
  No alarms detected.
  Framing is CRC4, Line Code is HDB3.
  Data in current interval (280 seconds elapsed):
     3 Line Code Violations, 1 Path Code Violations
     0 Slip Secs, 0 Fr Loss Secs, 1 Line Err Secs, 0 Degraded Mins
     0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 1 Unavail Secs
  Total Data (last 79 15 minute intervals):
     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
Router#
```

- The **show configuration** 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.

```
Router# show config

Using 1708 out of 130048 bytes
!
version 11.0
!
hostname Router
!
enable password *****
!
clns routing
!
controller T1 4/1 (for E1, E1 4/1, and so forth)
framing esf (for E1, crc4, and so forth)
linecode b8zs (for E1, hdb3, and so forth)
channel-group 0 1,3,5,7
channel-group 1 2,4,6,8-10
!
interface Ethernet 1/0
ip address 1.1.1.1 255.255.255.0
no mop enabled
!
interface Ethernet1/1
no ip address
shutdown
!
interface Ethernet1/2
no ip address
shutdown
!
interface Ethernet1/3

   (display text omitted)
```

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

```
Router> show protocols

Global values:
   Internet Protocol routing is enabled
CLNS routing is enabled (address 41.0000.0000.0000.0001.0000.0000.00) Fddi0/0 is down,
line protocol is down
Internet address is 1.1.1.1, subnet mask is 255.255.255.0
CLNS enabled
Ethernet1/0 is up, line protocol is up
Internet address is 1.1.1.1, subnet mask is 255.255.255.0

(display text omitted)
```

Using Show Commands to Verify the MIP Status

The following procedure describes how to use the **show** commands to verify that the new MIP interface is configured correctly:

Step 1 Use the **show version** command to display the system hardware configuration. Ensure that the list includes the new MIP 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 MIP appears in the correct slot.

Step 3 Display the T1 and/or E1 alarm condition with the **show controller T1** and/or **show controller E1** command.

Step 4 Specify the new interface with the **show interfaces serial** *slot/port:channel-group* command and verify that the first line of the display specifies the serial interface with the correct slot, port and channel-group number. 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 configuration** command. 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 MIP interface.

Removing and Replacing MIP Port Adapters

Port adapters provide the ports for the E1 and T1 interfaces. Each port adapter provides one port. Each MIP is shipped from the factory with one or two port adapters installed. You *cannot* add ports to a MIP by installing an additional port adapter. Port adapters *cannot* be replaced in the field. However, you need to remove an existing E1 port adapter in order to access jumper J6.

Before proceeding, refer to the section “Removing Interface Processors” in this chapter.

Caution To prevent damaging the MIP and port adapters, remove and install port adapters only when it is necessary. Do not attempt to isolate faults or to troubleshoot MIPs or interfaces by swapping port adapters. The surface-mount circuitry on the port adapters will not tolerate excessive handling. *Do not mix T1 and E1 port adapters on the same motherboard.*

Tools Required

You need the following tools to complete this procedure:

- Number 1 Phillips screwdriver
- 3/16-inch nut driver
- An ESD-preventive wrist strap or other grounding device to prevent ESD damage

Removing a MIP Port Adapter

Port adapters are installed on each MIP at the factory. Each port adapter is anchored to the MIP with one plastic double-row vertical board-to-board (BTB) connector and four Phillips screws that extend through standoffs, into the mother board. (See Figure 5-19.) The port adapter is also anchored to the carrier faceplate with two jackscrews and two lock washers.

Caution The surface-mounted components on the port adapters are extremely susceptible to ESD damage. Keep each port adapter in a separate antistatic bag until you are ready to install it. Always wear an ESD-preventive ground strap and handle boards as little as possible. When you must handle the board, limit contact to the board edges only, avoiding contact between the board and clothing.

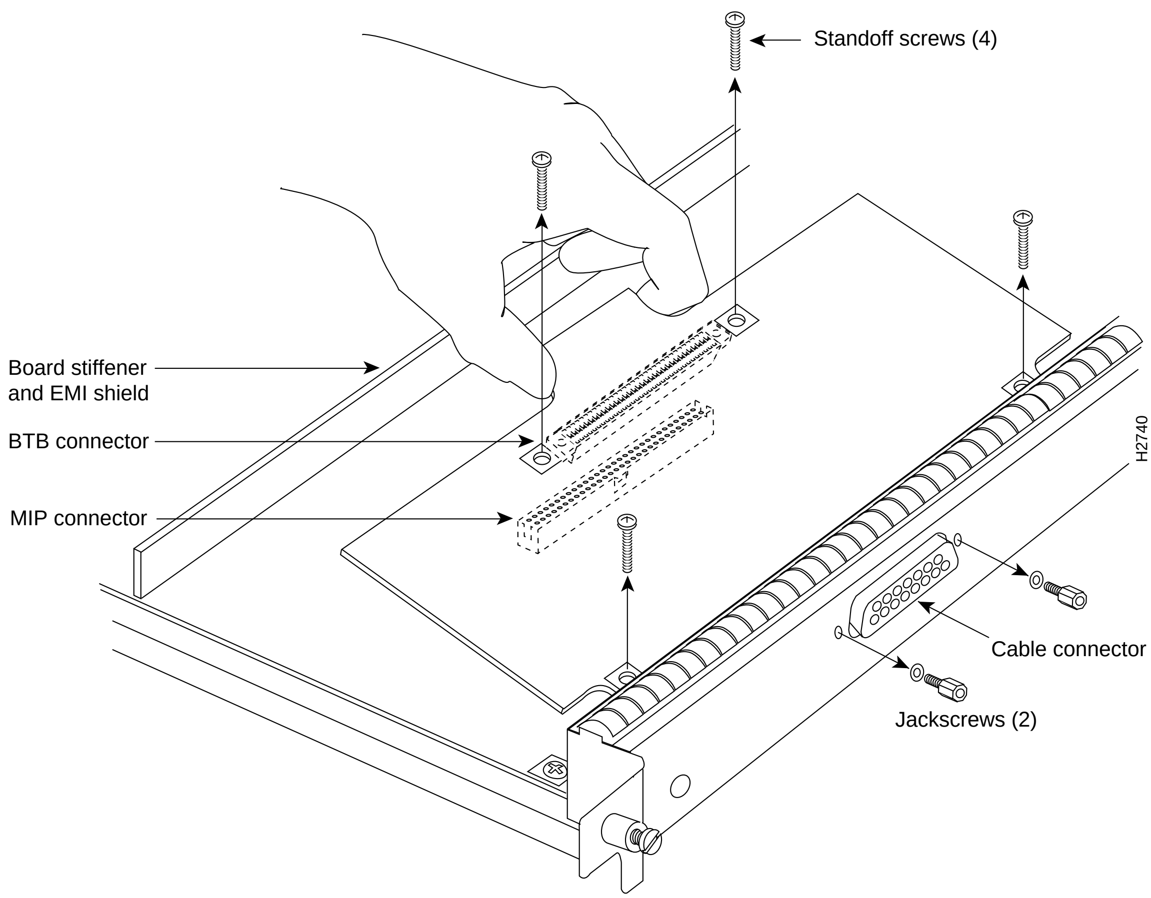
To remove an E1 port adapter from the MIP, refer to Figure 5-19 and perform the following steps:

Step 1 Ensure that the MIP is resting on an antistatic mat or on antistatic foam. You should still be wearing an ESD-preventive strap.

Step 2 Position the MIP so that it is in the same orientation shown in Figure 5-19.

Step 3 Locate the E1 port adapter to be removed and use a 3/16-inch nut driver to loosen the two jackscrews, one on either side of the cable connector. (See Figure 5-19.)

Figure 5-19 Removing a MIP Port Adapter



Step 4 Remove the jackscrews and washers and put them aside.

Step 5 Use a number 1 Phillips screwdriver to loosen and remove the four standoff screws. (See Figure 5-19.) The port adapter is now held in place only by the plastic BTB connector.

Step 6 While avoiding contact with any traces or components on the board, insert your thumb and forefinger under the extension behind the BTB connector and gently lift the adapter upward to dislodge it from the MIP connector. If the port adapter resists, rock it very slightly from side to side until it pulls free of the MIP connector.

Caution To prevent damage to the MIP, do not pry the port adapter out with a screwdriver or any other tool. In particular, do not use the board stiffener for leverage.

Step 7 When the port adapter is completely disconnected from the MIP connector, tilt the back of the port adapter up at about a 70-degree angle from vertical and slowly pull it up and out (using the orientation shown in Figure 5-19) and away from the faceplate. The MIP cable connector will pull out of the cutout in the faceplate.

Step 8 To reconfigure jumpers on the E1 port adapter, refer to the section "Configuring Jumper J6 on the E1 Port Adapter" in this chapter. After you have set the jumpers, proceed to the following section, "Replacing a MIP Port Adapter."

Caution To prevent overheating chassis components, do not reinstall the MIP in the chassis unless all port adapters are in place. The empty port will allow cooling air to escape freely through the cutouts in the faceplate, which could misdirect the airflow inside the chassis and allow components on other boards to overheat.

Replacing a MIP Port Adapter

If necessary, refer to the preceding section to remove an E1 port adapter from the MIP. Refer to Figure 5-20 while you perform the following steps:

Step 1 Ensure that the MIP is resting on an antistatic mat or on antistatic foam and position it with the same orientation as that shown in Figure 5-20. You should still be wearing an ESD-preventive ground strap.

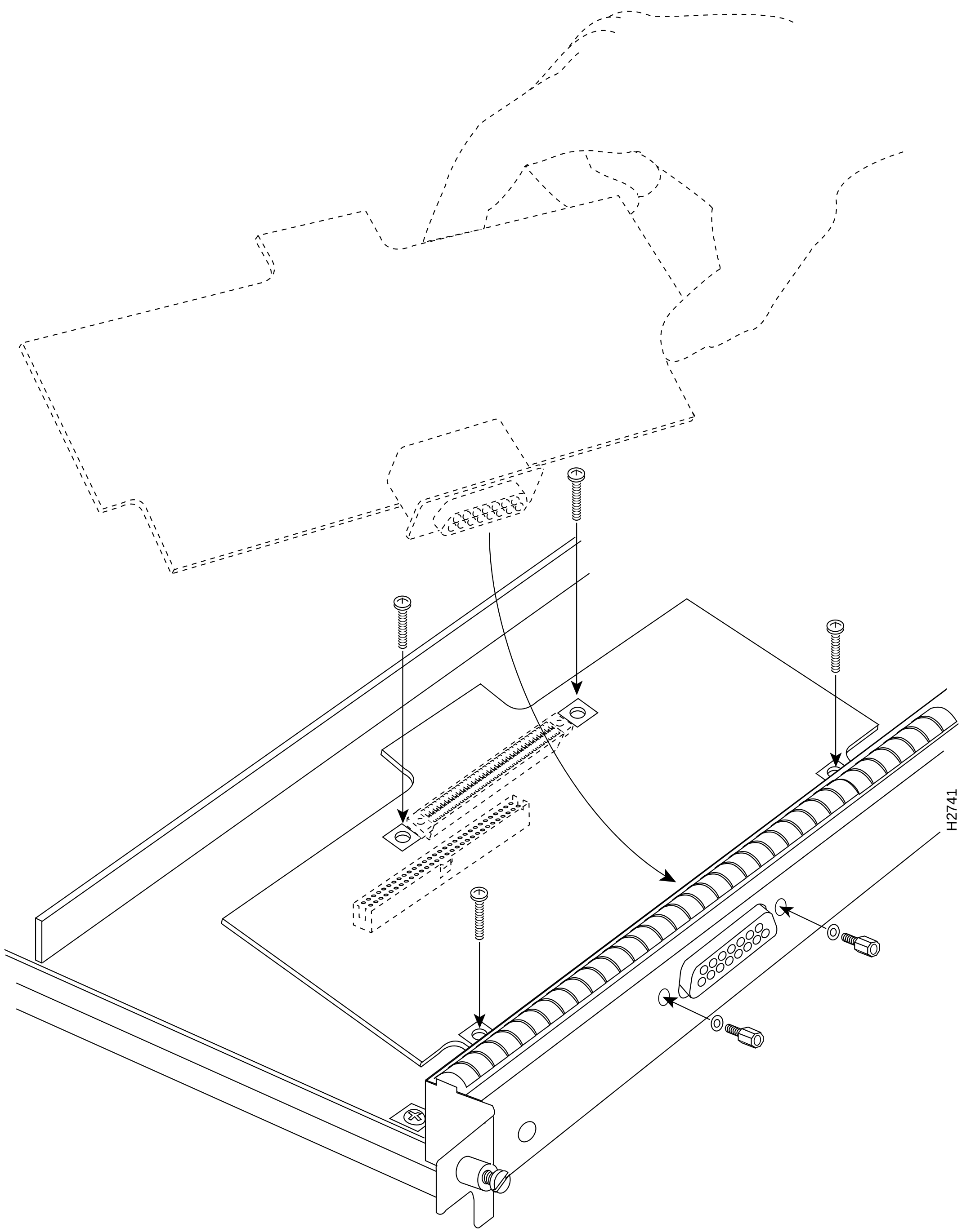
Step 2 Handle the port adapter by the board edges only.

Step 3 Position the port adapter so that it is in the orientation shown in Figure 5-20: at about a 70-degree angle from vertical, component-side down, standoffs on the underside, and the external interface cable connector facing the inside of the carrier faceplate.

Step 4 As shown in Figure 5-20, *partially* insert the cable connector through the back of the cutout in the carrier faceplate. Do not force the cable connector through the cutout until the standoffs and BTB connector are aligned.

Step 5 With the cable connector partially inserted into the faceplate cutout, slowly lower the back (opposite) side of the port adapter. Continue to ease the cable connector through the cutout until the BTB connector and the MIP and port adapter meet, and the standoffs on the MIP are aligned with the standoff holes in the port adapter. Shift the port adapter until the cable connector is fully inserted through the cutouts and the standoffs are aligned with the standoff holes. (See Figure 5-20.)

Figure 5-20 Installing a MIP Port Adapter



Caution Before seating the port adapter onto the MIP, ensure that the port adapter is aligned properly with the BTB connectors and the standoffs. Forcing a misaligned port adapter into place could damage the port adapter or the MIP and cause immediate or intermittent failures.

Step 6 Place your fingers over the BTB connector and firmly (but gently) press down until the BTB connector mates with the MIP connector. If the connector resists, do not force it. Shift the port adapter around until the connectors mate properly.

Step 7 Insert the four long Phillips screws through the four port adapter holes and finger-tighten them. These screws extend through the standoffs and the MIP board and thread into the metal carrier.

Step 8 Install a lockwasher on each of the two jackscrews.

Step 9 Insert the two jackscrews through the front of the carrier faceplate and into the holes on either side of the cable connector.

Step 10 When all screws and connectors are aligned properly, use a Phillips screwdriver to tighten the four standoff screws and a 3/16-inch nut driver to tighten the two jackscrews. *Do not overtighten any of these screws.*

Step 11 To reinstall the MIP in the chassis, follow the steps in the section "Installing Interface Processors" in this chapter.

Step 12 Reconnect the network interface cables or other connection equipment to the MIP interface ports.

Caution To prevent potential EMI and overheating problems, do not replace the MIP in the chassis unless all port adapters are installed. An empty port violates the EMI integrity of the system and also allows cooling air to escape freely through the cutouts in the carrier faceplate, which could misdirect the airflow inside the chassis and allow components on other boards to overheat.

When you insert the new MIP, the console terminal will display several lines of status information about OIR as it reinitializes the interfaces. Change the state of the interfaces to up and verify that the configuration matches that of the interfaces you replaced.

Use the **configure** command or the **setup** command facility to configure the new interfaces. You do not have to do this immediately, but the interfaces will not be available until you configure them and bring them up.

After you configure the interfaces, use the **show controller cbus**, **show controller T1**, and **show controller E1** commands to display the status of the new interface. For brief descriptions of commands, refer to "Using Show Commands to Verify the MIP Status" earlier in this section.

For complete descriptions of commands and the options available, refer to the *Router Products Configuration Guide* and *Router Products Command Reference* publication.

Removing and Replacing Chassis Components

Spare parts fall into two categories: those that support OIR and those that require you to shut down the system power before replacement. Because interface processors support OIR, you can remove and replace them while the system is operating; however, you must shut down the system power before removing the RSP2.

This section contains replacement procedures for the following spares:

- Blower module (MAS-7513FAN=), the blower, blower control board, and the front-panel LEDs, all on a removable module that draws cooling air through the chassis interior. Replace this unit if the blower, the control board, or a front-panel LED fails.
- Power supply (PWR-7513-DC=), the 1200-watt (W), DC-input power supply.
- Power supply, the 1200W, AC-input power supply. Depending on the type of power cable required, the order number is as follows:
  - PWR-7513-AC=, with U.S. power cable
  - PWR-7513-ACU=, with U.K. power cable
  - PWR-7513-ACA=, with Australian power cable
  - PWR-7513-ACI=, with Italian power cable
  - PWR-7513-ACE=, with European power cable

This document does not include replacement instructions for all chassis spares or packing materials. However, specific replacement instructions, called *configuration notes*, accompany all spares. In addition to the internal spares, the following assemblies are also available as spares:

- Chassis without a power supply (MAS-7513=)
- Chassis with a DC-input power supply (CHAS-7513-DC=)
- Chassis with an AC-input power supply (CHAS-7513-AC=)
- Cable management kit (ACS-7513CBLM=)
- Rack-mount kit (ACS-7000RMK=)
- RSP2 and interface processors (various product numbers); refer to the section "Installing and Configuring Processor Modules" in this chapter for replacement instructions
- Repackaging container and materials (PKG-7513=) for moving or shipping the router safely
- Console Y cable (CAB-RSP2CON=)
- Auxiliary Y cable (CAB-RSP2AUX=)

Warning To prevent personal injury, review the section "Safety Recommendations" in the chapter "Preparing for Installation" before replacing any internal components.

Overview of the Replacement Procedures

All spare parts and FRUs are shipped with detailed, up-to-date instructions (called *configuration notes*) for installation and, if applicable, configuration.

The blower module comprises a blower and a fan control printed circuit board to which the system LEDs are mounted. To remove the blower module, you need only loosen two captive screws that anchor the module to the chassis frame; a receptacle on the end of the module mates with a plug at the back of the module opening. The blower module slides into the chassis (when viewing the chassis from the noninterface processor end).

For the AC-input power supply, an external modular power cable delivers AC source power to the external AC receptacle on the interface processor end of the power supply. For the DC-input power supply, a three-lead, 6-AWG power cable (that you provide) delivers DC source power to the terminal block on the power supply. To remove a power supply, turn off the power switch, disconnect the power cable, loosen the captive screw on the bottom of the power supply faceplate, and pull the power supply from the chassis.

Note The dual arbiter and chassis interface are not available as individual spares, but are considered to be a part of the card cage and backplane assembly, which is a FRU and can only be removed/replaced by a Cisco-certified service provider.

Tools and Materials Required

You need the following tools to replace any one of the internal spares:

- 1/4-inch flat-blade screwdriver to loosen the captive screws on the blower module and power supplies, and a 3/16-inch flat-blade screwdriver to pry off the cover panels
- Number 1 Phillips screwdriver
- Number 2 Phillips screwdriver
- Appropriate length and diameter of conduit through which the DC-input cable will pass into the DC-input power supply terminal block cover. The opening on the terminal block cover is one inch in diameter. Installation of this conduit depends on your site and is beyond the scope of this publication.

Removing and Replacing the Blower Module

The blower provides cooling air to the internal system components. When viewing the chassis from the noninterface processor end, the blower module is located above the card cage. (See Figure 5-21.) Two slotted captive screws hold the blower module in place. The front panel LEDs are located on a printed circuit board inside the blower module. If one of these LEDs fails, the blower module must be replaced. The LED board inside the blower module assembly is not separately replaceable.

Warning Although the system should not be operating when you remove the blower module, it is not necessary to turn OFF system power before removing the blower module. However, with the system power ON and the blower module removed, high current is exposed on the blower module power connector at the backplane; do *not* insert conductive items into the empty blower module opening. After an operating blower module is removed, the blower impeller blades will continue to spin for approximately two minutes; do *not* insert anything into the module’s vent holes while the impeller is spinning.

Caution With chassis power ON and the blower module removed, no cooling air is circulating through the system. Replace the blower module before the system overheats. The system will shut down approximately two minutes after reaching the shutdown temperature threshold.

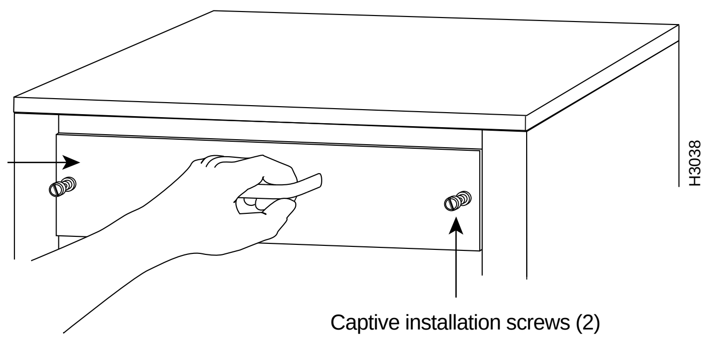
Follow these steps to replace the blower module.

Step 1 Locate the blower module, which is above the card cage on the interface processor end of the chassis. (See Figure 5-21.)

Step 2 Use a flat-blade screwdriver and loosen the captive screws that fasten each end of the blower module. (See Figure 5-21.)

Step 3 Grasp the handle on the front of the module and slowly pull it straight out of the chassis. (See Figure 5-21.)

Figure 5-21 Removing and Replacing the Blower Module



Step 4 Place the removed blower module in an antistatic bag for storage or return to the factory.

Step 5 To replace the blower module, hold the handle with either your right or left hand (as long as you use both hands to handle the module), and, with the intake vents on the blower module facing down and the "Insert This Side Up" label facing up, insert the new blower module into the chassis. Keep the module as straight as possible as you guide it into the chassis.

Step 6 When the blower module is all the way into the chassis opening, tighten the captive installation screws on the front of the blower module.

This completes the blower module removal and replacement procedure.

Removing and Replacing a Power Supply

The power supplies rest on the floor of the chassis under the card cage. On the AC receptacle, located on the faceplate of the AC-input power supply, a cable-retention band wraps around the molded power cable connector to prevent the cable from accidentally being pulled out or from falling out. On the DC-input power supply, you provide two nylon cable ties for cable strain relief. Replace the nylon cable ties after you install the new DC-input power supply. In addition to a large slotted screwdriver, you also need a pair of wire cutters for this procedure.

Note The DC-input cable must be routed through conduit from your power source to the power supply. You provide conduit through which you must route the DC-input power cable. If cables from other equipment are in front of the bay, move them aside and temporarily secure them with cable ties. You must disconnect the conduit from the conduit bracket before you can remove a power supply from the chassis. Router and attach the conduit to make each power supply accessible for replacement and maintenance.

Warning It is only necessary to turn OFF a power supply if you will you remove it; power to the second power supply (if installed) does not need to be turned OFF. When the power is ON, with one of two power supplies removed, high current is exposed on the power connector inside the power supply opening. To avoid injury or damage to the system, do not insert anything conductive into the power supply opening while power is ON to the remaining power supply.

Removing a Power Supply

Follow these steps to remove a power supply:

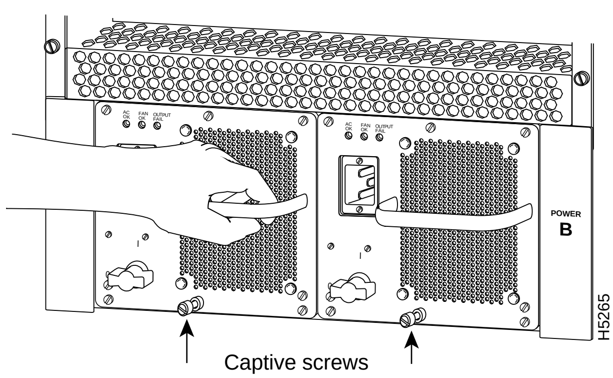
Step 1 If you have two power supplies installed and one power supply has failed, turn OFF (O) the system power switch on the power supply you will remove.

Step 2 AC-input power supply—Using a screwdriver, loosen the cable-retention band and unplug the power cable from the AC receptacle.

DC-input power supply—To disconnect the power cable leads from a DC-input power supply, refer to the section "Connecting Power" in the chapter "Installing the Router." Then, with the power cable leads disconnected, proceed to Step 3, which follows.

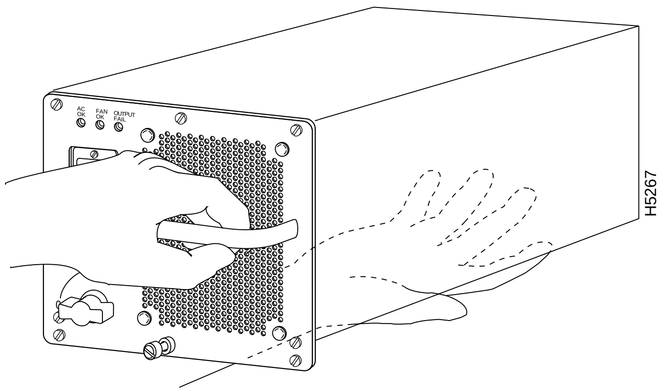
Step 3 Use a flat-blade screwdriver to loosen the captive screw that secures the power supply to the chassis frame. (See Figure 5-22.)

Figure 5-22 Removing a Power Supply—AC-Input Power Supplies Shown



Step 4 Grasp the power supply handle and pull the power supply about halfway out of the bay (approximately eight inches or 20 cm), then with your other hand under the power supply, pull it completely out of the bay. (See Figure 5-23.)

Figure 5-23 Supporting the Power Supply—AC-Input Power Supply Shown

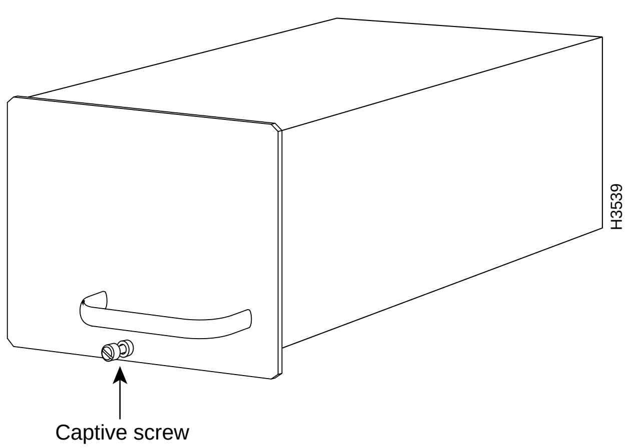


Caution To maintain agency compliance requirements and meet EMI emissions standards in Cisco 7513 chassis with a single power supply, the power supply blank must remain in the power supply bay adjacent to the power supply. (See Figure 5-24.) Do *not* remove this blank from the chassis unless you do so to install a redundant power supply.

Note To prevent system problems, do not mix AC-input and DC-input power supplies.

Warning High current levels on the power supply connections at the rear of the power supply bay are exposed with the power supply or blank removed. Do not insert anything conductive into the open power supply bay, while power is ON.

Figure 5-24 Power Supply Blank



This completes the power supply removal procedure.

Replacing a Power Supply

Follow these steps to replace the power supply:

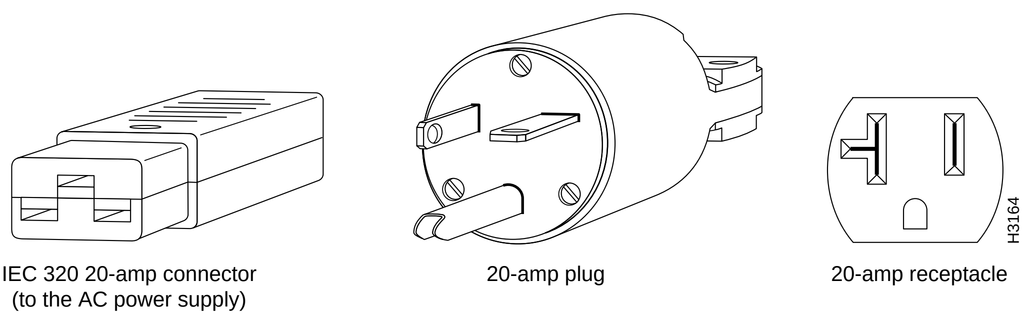
Step 1 To replace a power supply, first make certain the power switch is in the OFF position (O) then hold the supply as shown in Figure 5-23 and slide it into the power supply. Push the supply all the way into the chassis until the sides are flush against the chassis frame.

Step 2 Use a flat-blade screwdriver to tighten the captive screw that secures the power supply to the chassis frame. (See Figure 5-22.)

Step 3 AC-input power supply—Connect the power cable to the AC receptacle and tighten the cable-retention band with a screwdriver. Figure 5-25 shows the cable connector plug and the 20-amp receptacle required to connect the 20-amp cable to your AC source.

DC-input power supply—To connect the power cable leads to a DC-input power supply, refer to the section "Connecting Power" in the chapter "Installing the Router." Then, with the power cable leads connected, proceed to Step 4, which follows.

Figure 5-25 20-Amp AC Power Cable Connector and Plug, and 20-Amp Receptacle

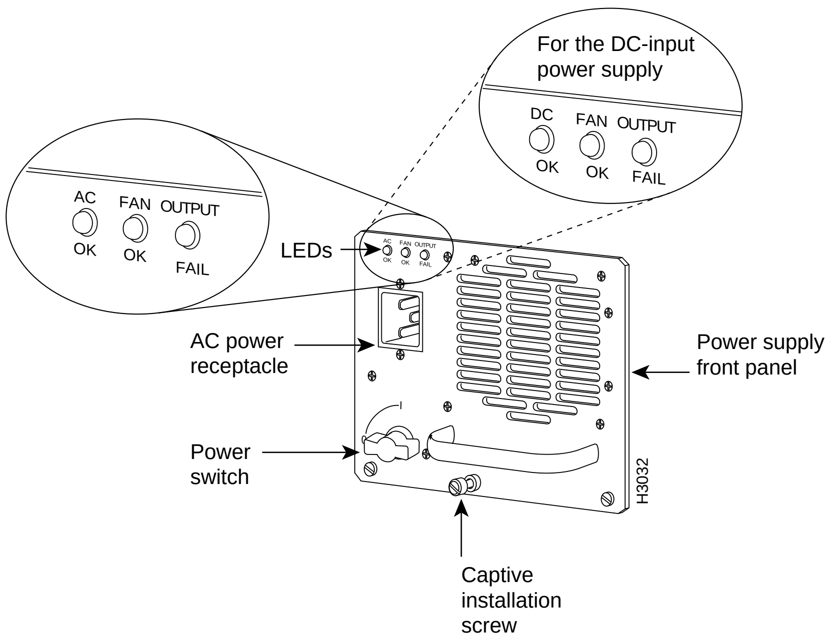


Note Wiring codes prevent this type of power cable from being used with the power strips in equipment racks. AC-input power supplies operating at 120VAC require a minimum of 20-amp service with a 20-amp receptacle at the power source. The power cable supplied with the chassis uses a 20-amp plug.

Step 4 When the AC-input power cable or DC-input power cable leads are reconnected, reconnect the power cable at the power source and turn ON power to the new power supply by rotating the power switch clockwise to the ON position (|).

The AC or DC OK and fan OK LEDs will go ON and stay ON. (See Figure 5-26.) The output fail LED might go ON momentarily, but will go off after a few seconds.

Figure 5-26 Power Supply LEDs



This completes the power supply replacement procedure.

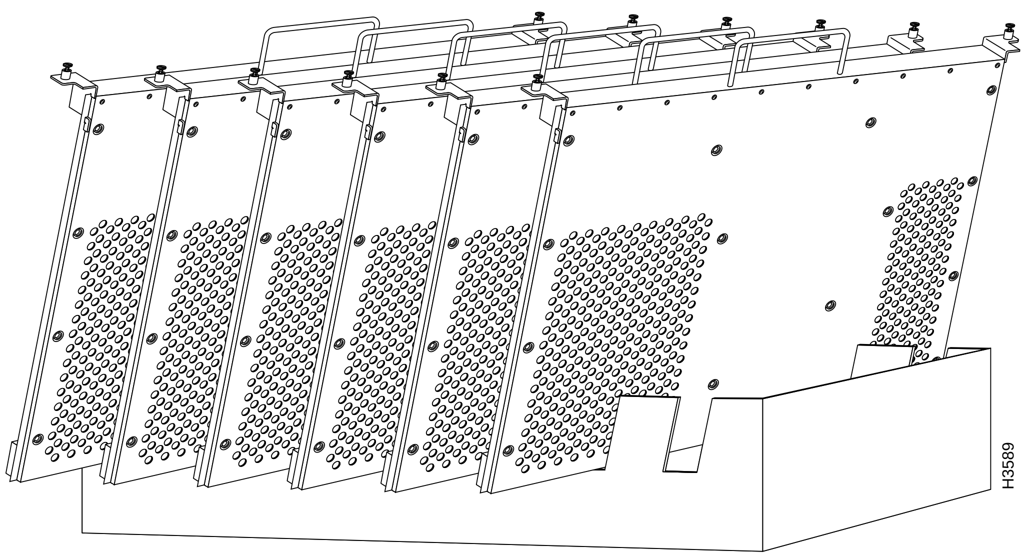
Removing and Replacing the Card Cage and Backplane Assembly

The card cage and backplane comprise one assembly that can be removed to reduce the chassis weight for rack-mounting, moving the chassi from location to another, and so forth. There are no wires, harnesses, or connectors. The assembly slides into and out of the chassis and attaches the chassis frame with four slotted, captive screws. (See Figure 5-28.) For this procedure, you will need one large flat-blade screwdriver, an antistatic bag for each removed processor module, or several antistatic mats or pieces of antistatic foam.

Timesaver Before the card cage and backplane assembly can be removed, all processor modules and both power supplies must be removed. Plan this procedure so that you can minimize its effects.

Place removed processor modules in the collapsible, black-cardboard board racks that were provided with your packing material, as shown in Figure 5-27.

Figure 5-27 Placing Removed Processor Modules in a Board Rack



Following is the procedure to remove the card cage and backplane assembly:

Step 1 Turn the power switch on each power supply to the OFF position (O).

Step 2 Disconnect the power cable from each power supply. (Refer to the section “Connecting Power” in the chapter “Installing the Router.”)

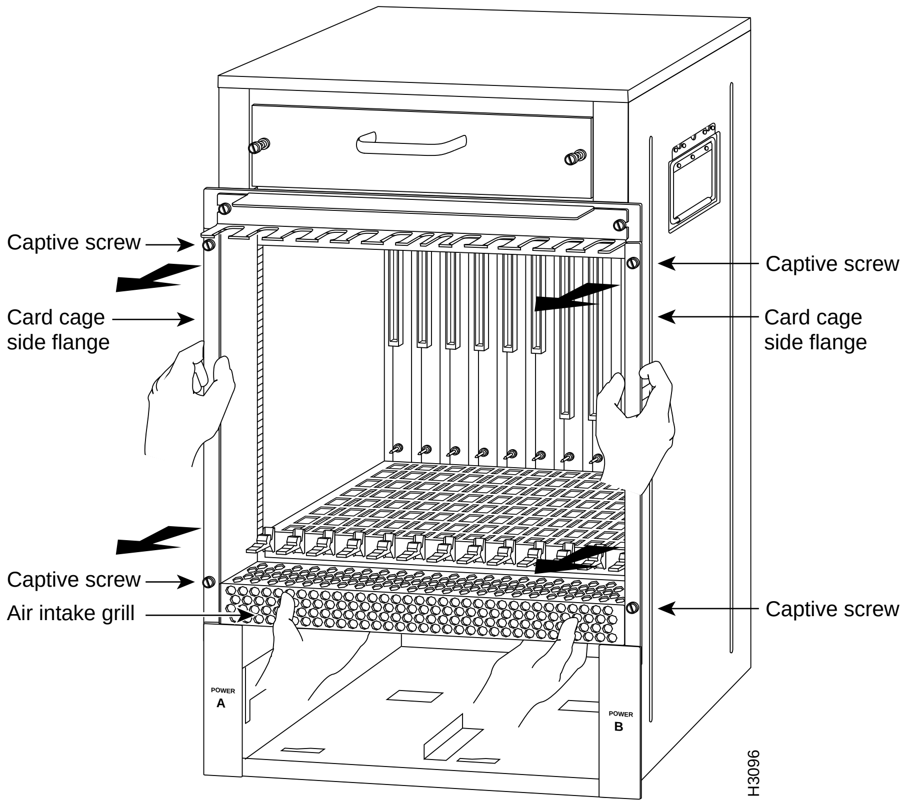
Step 3 Remove each power supply and set it aside. (Refer to the section “Removing and Replacing a Power Supply” in this chapter.)

Step 4 Before removing processor modules in the following step, make a note of your router’s configuration using the Port and Slot Configuration Worksheet in Table 2-18. Also refer to Figure 2-42.

Step 5 Remove all processor modules from the card cage, and carefully place them in the board racks supplied with your original packing material. (See Figure 5-27.) Do *not* stack the processor modules one on top of another.

Step 6 With the processor modules and power supplies removed, loosen the four large captive screws located to the left and right of the card cage opening. (See Figure 5-28.)

Figure 5-28 Removing and Replacing the Card Cage and Backplane Assembly



Caution Unless the chassis is mounted in a rack, or otherwise anchored, the chassis might move toward you as you pull the card cage and backplane assembly. To prevent injury, have a second person hold the chassis in place while you pull the card cage and backplane assembly from the chassis in the following step.

Step 7 With the captive screws loosened, carefully grasp the intake grill with both hands, and then pull the card cage assembly straight out of the chassis until there is enough clearance at the card cage side flanges to pull the entire assembly clear of the chassis sides. (See Figure 5-28.) The assembly is heavier at the backplane and might be awkward to handle.

Step 8 When the card cage and backplane assembly is completely free of the chassis, carefully place it on an antistatic mat or foam.

Caution The electronic components on the rear of the backplane are completely exposed when the card cage and backplane assembly is removed from the chassis. To prevent damaging these components, place the card cage and backplane assembly on an antistatic mat or foam, and place the assembly in the same orientation as when it is mounted in the chassis. (See Figure 5-28.)

Step 9 To replace the card cage and backplane assembly, carefully lift the assembly, place it into the chassis opening, and slide the assembly into the chassis opening until the left and right flanges on the card cage are flush with the chassis flanges.

Step 10 Press the card cage and chassis side flanges together and tighten each captive screw. (See Figure 5-28.) Do not overtighten the captive screws.

Caution The electronic components on the rear of the backplane are completely exposed when the card cage and backplane assembly is removed from the chassis. To prevent damaging these components, carefully slide the assembly into the chassis opening. (See Figure 5-28.)

This completes the procedure for removing and replacing the card cage and backplane assembly.