Route Switch Processor (RSP4/4+) Installation and Configuration Guide

Product Numbers: RSP4+=, RSP4=, CISCO 7505/4=, CISCO 7507/4=, CISCO 7513/4=, CISCO 7507/4x2=, CISCO 7513/4x2=, CISCO 7576=, MEM-RSP4-32M=, MEM-RSP4-64M=, MEM-RSP4-128M=, MEM-RSP4-128M-4PK=, MEM-RSP4-256MB=, MEM-RSP4-256-4PK=, MEM-RSP4-FLC16M=, MEM-RSP4-FLC20M=, MEM-RSP4-FLC32M=

Customer Order Number: DOC-782662=

This document discusses the Route Switch Processor (RSP4/4+), an optional system processor available for the Cisco 7505, Cisco 7507, Cisco 7507-MX, Cisco 7513, Cisco 7513-MX, and Cisco 7576 routers. The RSP4+ significantly increases the performance for most protocols and services over the RSP2 and the RSP4.

The RSP4/4+ supports the high system availability (HSA) feature, which allows two RSP4/4+s (or an RSP2 and an RSP4/4+) to be used in a Cisco 7507, Cisco 7505-MX, Cisco 7513, or Cisco 7513-MX router. The redundancy increases system availability during planned and unplanned network outages. See the "Configuring High System Availability" section on page 28 for more information on HSA.

The RSP4/4+ also supports high availability (HA), a series of features that operates similarly to HSA, but which further minimizes system downtime. (HSA is the system default.) For more information on HA, see the "Enabling High Availability Features" section on page 44.

With HA or HSA enabled, the RSP4/4+ supports online insertion and removal (OIR).

Document Contents

This document contains the following sections:

Corporate Headquarters:
Cisco Systems, Inc., 170 West Tasman Drive, San Jose, CA 95134-1706 USA

Related Documentation

All of the documentation mentioned below is available online, on the Documentation CD-ROM, or as printed documents. For a complete list of documentation, refer to the *Cisco 7500 Series Router Documentation* flyer (part number 7812955=) that shipped with your RSP, or online at http://www.cisco.com/univercd/cc/td/doc/product/core/cis7505/12955fly.htm.

Your router and the Cisco IOS software running on it contain extensive features and functionality, which are documented in the following resources:

- Cisco IOS software:

  For configuration information and support, refer to the Cisco IOS software configuration documentation set that corresponds to the software release installed on your Cisco Systems hardware.

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

- Cisco 7500 series routers:

  For hardware installation and maintenance information, refer to the Quick Start Guide for your router, or refer to the *Cisco 7500 Installation and Configuration Guide* online at http://www.cisco.com/univercd/cc/td/doc/product/core/cis7505/cicg7500/index.htm.

- For international agency compliance, safety, and statutory information for WAN interfaces:
  - *Site Preparation and Safety Guide* at http://www.cisco.com/univercd/cc/td/doc/product/lan/cat5000/hardware/safety/index.htm
  - *Regulatory Compliance and Safety Information for the Cisco 7500 Series Routers* at http://www.cisco.com/univercd/cc/td/doc/product/core/cis7505/4194pc75.htm

- Flash Memory Card:

  For Flash memory card information with the RSP4/4+, refer to *Flash Memory Card Installation Instructions* (part number 78-2083-*xx*, where *xx* represents the latest document version).

- To view Cisco documentation or obtain general information about the documentation, refer to the following sources:
  - World Wide Web, page 91
  - Documentation CD-ROM, page 91

Product Description

This section discusses the following topics:

The RSP4/4+ supports the VIP2, the VIP4 in the Cisco 7000 series routers, and the VIP2, VIP4, and the VIP6-80 in the Cisco 7505, Cisco 7507, Cisco 7507-MX, Cisco 7513, Cisco 7513-MX, and Cisco 7576 routers. (See Figure 2 and Figure 1.) The RSP4 is not available as an upgrade to the RSP1 or RSP2.The RSP4+ is not available as an upgrade to the RSP1, RSP2, or RSP4.

Storing the IOS software images in Flash memory enables you to download and boot from upgraded Cisco IOS software images remotely or from software images resident in the RSP4/4+ Flash memory, without having to remove and replace read-only memory (ROM) devices.

Note For specific Cisco IOS software release compatibility, refer to the "System Software" section on page 9, and to the Software Advisor at http://www.cisco.com/cgi-bin/Support/CompNav/Index.pl.

The RSP4/4+ also contains:

- Most of the additional memory components used by the system, including 16-MB onboard Flash memory and up to two Flash memory cards (16-MB, 20-, or 32-MB Flash memory card, with 16-MB being the shipping default).
- Air-temperature sensors for environmental monitoring. (All of the logic for the environmental monitoring functions is contained on the router interface card.)

In addition to running the system software from Dynamic Random-Access Memory (DRAM), the RSP4/4+ contains and executes the following management functions that control the system:

- Sending and receiving routing protocol updates.
- Managing tables and caches.
- Monitoring interface and environmental status.
- Providing Simple Network Management Protocol (SNMP) management and the interface between the console and Telnet.

The high-speed switching section of the RSP4/4+ communicates with and controls the interface processors on the high-speed CyBus. This switching section of the RSP4/4+ decides the destination of a packet and switches it based on that decision.

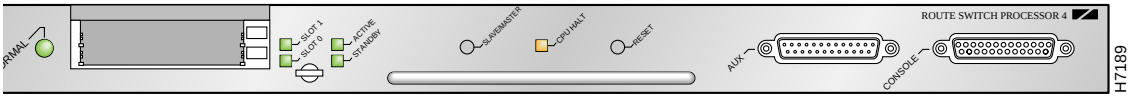
Note When configuring the router for HSA or HA, you can use the RSP4 and RSP4+ in the same router, but the RSP4+ should be configured as the active RSP.

The RSP4/4+ installs in the following slots on your Cisco 7000 or Cisco 7500 series router:

- RP slot in the Cisco 7000 router
- Slot 4 in the Cisco 7505 router
- Slots 2 and 3 in the Cisco 7507 and Cisco 7507-MX routers
- Slots 6 and 7 in the Cisco 7513 router and Cisco 7513-MX routers
- Slots 6 and 7 in the Cisco 7576 router

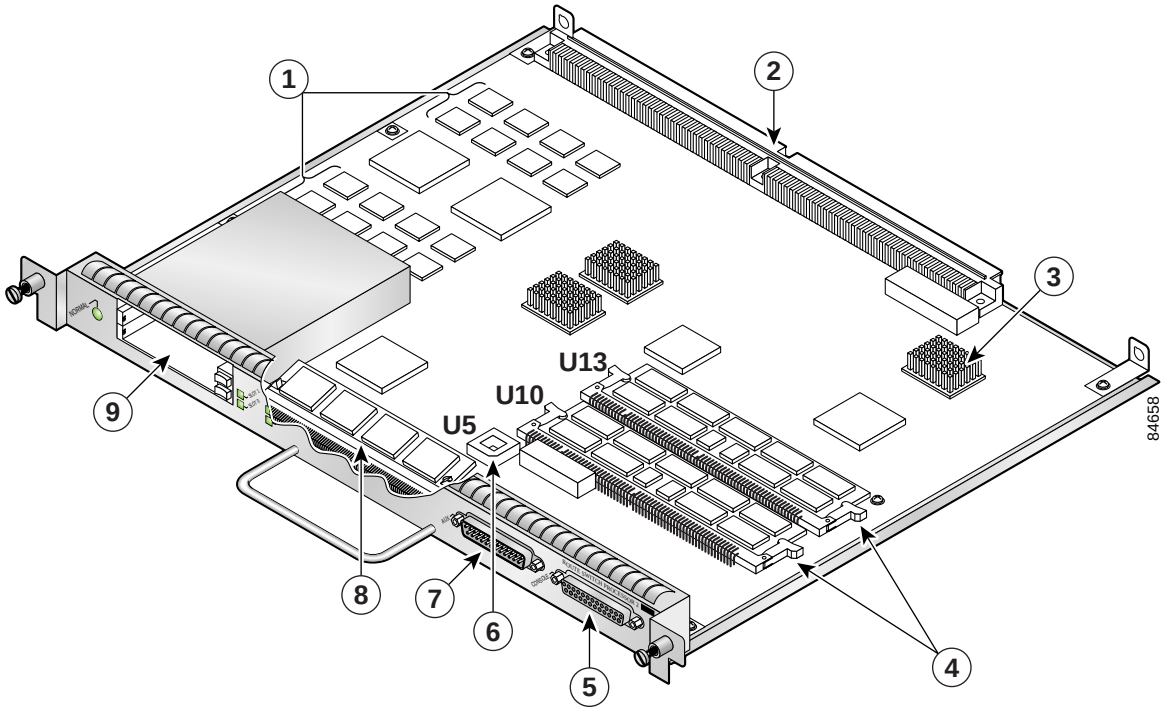
The RSP4+ is an enhanced version of the RSP4 with larger default program memory (64 MB versus 32 MB), Error Correction Code (ECC) memory protection, and compatibility with Cisco IOS software releases that support the current RSP4.

Figure 1 RSP4/4+



Note The Standby/Active button manually transitions the RSP from active to standby status, and from standby to active status when the router is configured for HSA or HA. The Reset button reboots the system.

Figure 2 RSP4/4+ Components



1	MEMD SRAM	**6**	Flash EPROM (ROMmon) U5
2	Bus connectors	**7**	Auxiliary port
3	CPU	**8**	Flash memory SIMM holder
4	DRAM DIMMs (bank 0: bottom) U10 DRAM DIMMs (bank 1: top) U13	**9**	PC Card slot 0: bottom PC Card slot 1: top (For Flash memory cards)
5	Console port		

Note A bank of hardware (Media Access Control [MAC]–layer) addresses for the interface ports is contained in a Non-Volatile Random-Access Memory (NVRAM) device on the router backplane.

CPU

The CPU used in the RSP4/4+ is an IDT R5000 Reduced Instruction Set Computing (RISC) processor, which runs at an external bus clock speed of 100 MHz and an internal clock speed of 200 MHz.

Memory Components

Table 1 shows the memory components on the RSP4/4+.

Table 1 RSP4/4+ Memory Components

Type	Size	Quantity	Description	Location (See Figure 2)
DRAM	32-MB[1] to 256-MB DIMMs	1 or 2	32-, 64-, 128-, or 256-MB DIMMs (based on DRAM required) for main Cisco IOS image functions	U10, or U10 and U13
SRAM[2]	2 MB (fixed)	–	SRAM for packet buffering functions (MEMD)	–
	512 KB (fixed)	–	SRAM for secondary CPU cache memory functions	–
NVRAM	128 KB	1	Non-volatile SRAM for the system configuration file[3]	–
Flash memory	16-MB SIMM[4]	1	Contains the Cisco IOS images on the RSP4/4+	U1
	16-[5], 20-, or 32-MB	Up to 2	Contains the Cisco IOS images on up to two Flash memory cards[6]	Slot 0 and slot 1
Flash boot ROM	256 KB	1	Flash EPROM for the ROM monitor program image	U5

1. 32 MB of DRAM is the default DRAM configuration for the RSP4; 64 MB of DRAM is the default DRAM configuration for the RSP4+.
2. Synchronous Random-Access Memory (SRAM) is not user-configurable or field-upgradable.
3. A system configuration file is contained in NVRAM, which allows the Cisco IOS software to control several system variables.
4. The current RSP4+ ships with a 16-MB SIMM as the default.
5. A 16-MB Flash memory card is the default shipping configuration for the RSP4/4+ products.
6. Type I, Type II, and Type III PC Cards can be used in PC Card slot 1, and Type I and Type II PC Cards can be used in slot 0.

DRAM

DRAM stores routing tables, protocols, and network accounting applications and runs the Cisco IOS software. The standard (default) RSP4 configuration is 32 MB of DRAM, and the standard (default) RSP4+ configuration is 64 megabytes (MB) of DRAM. Both the RSP4 and RSP4+ have up to 256 MB of DRAM available through DIMM upgrades. DRAM is contained in up to two DIMM sockets: U10 (also called bank 0) and U13 (also called bank 1). When upgrading DRAM, you must use only compatible DIMMs. (Also see the "Compatibility Requirements" section on page 14.)

Caution To prevent memory problems, DRAM DIMMS must be 3.3-volt (V) devices. Do not attempt to install higher-voltage devices (such as those designed for the RSP2) in the RSP4/4+ DIMM sockets.

For RSP4/4+ DRAM upgrade procedures, refer to the "Replacing and Upgrading DRAM DIMMs" section on page 78.

SRAM

SRAM provides packet buffering and CPU cache memory functions. The standard RSP4/4+ configuration is 2 MB of SRAM for packet buffering, and 512 kilobytes (KB) of secondary CPU cache memory.

Note SRAM is fixed and is *not* field-upgradable.

NVRAM

The system configuration, software configuration register settings, and environmental monitoring logs are contained in the 128-KB NVRAM, which is backed up with built-in lithium batteries that retain the contents for a minimum of 5 years. When replacing an RSP4/4+, be sure to back up your configuration to a remote server so you can retrieve it later.

Caution Before you replace an RSP4/4+ in a system with one RSP4/4+, back up the running configuration to a TFTP file server or to Flash memory so you can retrieve it later. If the configuration is not saved, the entire configuration will be lost—inside the NVRAM on the removed RSP4/4+—and you will have to reenter the entire configuration manually. For instructions on how to save the configuration file, see the "Saving and Retrieving a Configuration File" section on page 73. This procedure is not necessary if you are temporarily removing an RSP4/4+; lithium batteries retain the configuration in memory until you replace the RSP4/4+ in the system.

Flash Memory

The Flash memory card for the RSP4/4+ is a 16-, 20-, or 32-MB Flash memory card, which conforms to the PC Card format (formally the Personal Computer Memory Card International Association (PCMCIA) format).

Both the onboard 8-MB Flash memory and the 16-, 20-, or 32-MB Flash memory cards allow you to remotely load and store multiple Cisco IOS software and microcode images. (The 16-MB Flash memory card is the default Flash memory card that ships with the RSP4/4+.) You can download a new image over the network or from a local server and then add the new image to Flash memory or replace the existing files. You can then boot routers either manually or automatically from any of the images stored in Flash memory. Flash memory also functions as a TFTP server to allow other servers to boot remotely from stored images or to copy them into their own Flash memory.

Caution To prevent system problems, use Flash memory cards in the RSP4/4+ that were formatted on an RP, RSP1, RSP2, RSP7000, or RSP4/4+ running Cisco IOS Release 11.1(8)CA1 or a later release of 11.1 CA1. You cannot use Flash memory cards on the RSP4/4+ (as storage or boot devices) that were formatted on an RP, RSP1, RSP2, or RSP7000 using a Cisco IOS boot image earlier than Cisco IOS Release 11.1(8)CA1.

Table 2 lists the Flash memory card options, with the product numbers.

Table 2 Flash Memory Options

Memory Size	Product Number
16-MB[1]	MEM-RSP4-FLC16M=
20-MB	MEM-RSP4-FLC20M=
32-MB	MEM-RSP4-FLC32M=

1. A 16-MB Flash memory card is the default shipping configuration for the RSP4/4+ products.

LEDs

Figure 2 describes the operation of the LEDs found on the RSP4/4+.

Table 3 RSP4/4+ LEDs

LED Label	Color	State	Indication
Normal[1]	Green	On	RSP is on and receiving +5V.
CPU halt[1]	Green	Off	RSP is operating normally.
	Yellow	On	Processor hardware failure has been detected.
Master	Green	On	RSP is an active RSP.
Slave	Green	On	RSP is a standby RSP (HSA/HA configuration required).
Slot 0	Green	On	PC Card in this slot is being accessed.
Slot 1	Green	On	PC Card in this slot is being accessed.

1. The RSP4/4+ controls these LEDs and turns them on in parallel to indicate that the system is operational.

PC Card Slots

The RSP4/4+ has two PC Card slots available. Either slot can support a Flash memory card. Type I and Type II PC Cards can be used in PC Card slot 0 and slot 1. Type III PC Cards can be used in slot 1. Not all Flash memory cards that are commercially available are supported.

Note Other Flash memory card limitations might apply. For additional Flash memory information, refer to the Flash memory configuration notes listed in the "Related Documentation" section on page 2.

Serial Ports

Two asynchronous serial ports on the RSP4/4+, labeled *Console* and *Auxiliary*, allow you to connect external terminal devices to monitor and manage the system. The console port is an Electronics Industries Association/Telecommunications Industry Association (EIA/TIA)-232 receptacle (female) that provides a data circuit-terminating equipment (DCE) interface for connecting a console terminal.

Note EIA/TIA-232 was known as recommended standard RS-232 before its acceptance as a standard by the Electronic Industries Association (EIA) and Telecommunications Industry Association (TIA).

The auxiliary port is an EIA/TIA-232 plug (male) that provides a data terminal equipment (DTE) interface; the auxiliary port supports flow control and is often used to connect a modem, a channel service unit (CSU), or other optional equipment for Telnet management.

Specifications

Table 4 lists the physical specifications for the RSP4/4+.

Table 4 RSP Specifications

Description	Specifications
Physical Dimensions	The RSP4/4+ occupies one RSP slot and can only be operated in a Cisco 7500 series or RSP7000-equipped Cisco 7000 series router
Shipping weight	5 lb (2.25 kg)
Operating temperature	32 to 104˚F (0 to 40˚C)
Relative humidity	10 to 90 percent, noncondensing
Storage temperature	–4 to 149˚F (–20 to 65˚C)

System Software

The Cisco 7507, Cisco 7507-MX, Cisco 7513, and Cisco 7513-MX routers support downloadable system software and microcode for most Cisco IOS and microcode upgrades. This enables you to remotely download, store, and boot from a new image. For information on upgrading software and microcode in Cisco 7500 series routers, see the Cisco IOS Configuration Fundamentals Configuration Guides for the mainline software release that you are running. The Cisco IOS Configuration Fundamentals Configuration Guides are not platform-specific; however, the information in these books also pertains to the Cisco 7500 series.

Note For the Cisco IOS releases that are supported on the RSP4/4+, refer to the "System Software" section on page 9, and to the Software Advisor at http://www.cisco.com/cgi-bin/Support/CompNav/Index.pl.

The publication *Upgrading Software and Microcode in Cisco 7000 Series and Cisco 7500 Series Routers* (Document Number DOC-781144) provides instructions for upgrading over the network or from floppy disks. Flash memory contains the default system software image and bundled microcode images. The Flash memory card is supported on the RSP4/4+. Flash Disks are not supported on the RSP4/4+.

At system startup, an internal system utility scans for compatibility problems between the installed interface processor types and the bundled microcode images. The utility then decompresses the images into running dynamic random-access memory (DRAM). The bundled microcode images then function the same as the EPROM images.

The Cisco IOS software images reside in Flash memory, which is located either on the RSP4/4+, in the form of a single in-line memory module (SIMM), or on Flash memory cards that insert in the two PC Card slots (slot 0 and slot 1) on the front of the RSP4/4+. (See Figure 2.) Storing the Cisco IOS images in Flash memory enables you to download and boot from upgraded Cisco IOS images remotely or from software images resident in the RSP4/4+ Flash memory.

Although no monitoring of voltage or temperature is done by the RSP4/4+, a comparator device ensures that voltage is within the normal operating ranges, and three temperature sensors on the RSP4/4+ send temperature information to the chassis interface (CI) card. The CI card reports all voltage and temperature readings, and these readings are available through standard software commands for environmental monitoring. The RSP4/4+ uses a software-controlled configuration register, so you do not have to remove the RSP4/4+ to configure jumpers. There are no user-configurable jumpers on the RSP4/4+.

Comparing the RSP4 and RSP4+

The RSP4+ is an enhanced version of the RSP4 with larger default program memory (64 MB for RSP4+; 32 MB for RSP4). The RSP4+ includes Error Correction Code (ECC) memory protection; the RSP4 does not. Both versions are compatible with Cisco IOS software releases.

To determine if you have an RSP4 or an RSP4+, perform one of the following procedures:

- Observe the label on the card
- Use the **show diag** command and observe the part number (73-1689-*xx* for the RSP4, or 73-5512-*xx* for the RSP4+)
- Use the **show version** command to see the installed processor

Note You can upgrade the memory on your RSP4/4+, however, you cannot upgrade the RSP4 to an RSP4+. The RSP4+ has a different system controller (for CPU memory), an application-specific integrated circuit (ASIC) that provides the ECC functionality.

The following example shows sample output from the **show diag** command with an RSP4 installed in slot 2:

```
Router#show diag 2
Slot 2:
        EEPROM format version 1
        Route/Switch Processor 4, HW rev 1.03, board revision C0
        Serial number: 13959511  Part number: 73-1689-05
        Test history: 0x00        RMA number: 00-00-00
        Flags: cisco 7000 board; 7500 compatible

        EEPROM contents (hex):
          0x20: 01 1A 01 03 00 D5 01 57 49 06 99 05 00 00 00 00
          0x30: 60 00 00 02 00 00 00 00 00 00 00 00 00 00 00 00
```

The following example shows output from the **show version** command with an RSP4+ installed:

```
Router#show version
Cisco Internetwork Operating System Software
IOS (tm) RSP Software (RSP-JK2SV-M), Version 12.1(18), RELEASE SOFTWARE (fc1)
Copyright (c) 1986-2002 by cisco Systems, Inc.
Compiled Mon 02-Dec-02 18:05 by kellythw
Image text-base: 0x60010958, data-base: 0x615EE000

ROM: System Bootstrap, Version 12.0(10r)S1, RELEASE SOFTWARE (fc1)

Router uptime is 1 week, 1 day, 3 hours, 49 minutes
System returned to ROM by reload at 11:25:51 UTC Wed Feb 26 2003
System image file is "slot0:rsp-jk2sv-mz.121-18.bin"

cisco RSP4+ (R5000) processor with 131072K/2072K bytes of memory.
R5000 CPU at 200Mhz, Implementation 35, Rev 2.1, 512KB L2 Cache
Last reset from power-on
G.703/E1 software, Version 1.0.
G.703/JT2 software, Version 1.0.
X.25 software, Version 3.0.0.
SuperLAT software (copyright 1990 by Meridian Technology Corp).
Bridging software.
TN3270 Emulation software.
Chassis Interface.
1 FIP controller (1 FDDI).
1 VIP2 controller (2 HSSI).
```

```
2 HSSI network interface(s)
1 FDDI network interface(s)
123K bytes of non-volatile configuration memory.

20480K bytes of Flash PCMCIA card at slot 0 (Sector size 128K).
8192K bytes of Flash internal SIMM (Sector size 256K).

Configuration register is 0x2102
```

Installation Prerequisites

Before beginning the installation procedures, review the following sections to ensure awareness of the appropriate regulatory and safety requirements, and that your RSP4/4+ hardware functions properly with compatible components.

- Safety Guidelines, page 11
- Compatibility Requirements, page 14
- List of Parts and Tools, page 17

Note If you are replacing an existing RSP4/4+, back up your current configuration file to a remote server before you remove the RSP4/4+ to avoid having to reenter all your current configuration information manually. To back up the file, you need access to a remote TFTP server. See the "Saving and Retrieving a Configuration File" section on page 73 for instructions for uploading the file to a TFTP server or saving it to Flash memory, and then retrieving it after the new RSP4/4+ is installed.

Safety Guidelines

Following are safety guidelines that you should follow when working with any equipment that connects to electrical power or telephone wiring.

Warning **Only trained and qualified personnel should be allowed to install or replace this equipment.**

Safety Warnings

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

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

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

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

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

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

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

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

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

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

Electrical Equipment Guidelines

Use the following basic guidelines when working with any electrical equipment:

- Before beginning any procedures requiring access to the chassis interior, locate the emergency power-off switch for the room in which you are working.
- Disconnect all power and external cables before moving a chassis.
- Do not work alone when potentially hazardous conditions exist.
- Never assume that power has been disconnected from a circuit; always check.
- Do not perform any action that creates a potential hazard to people or makes the equipment unsafe.
- Carefully examine your work area for possible hazards such as moist floors, ungrounded power extension cables, and missing safety grounds.

Telephone Wiring Guidelines

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

- Never install telephone wiring during a lightning storm.
- Never install telephone jacks in wet locations unless the jack is specifically designed for wet locations.

- Never touch uninsulated telephone wires or terminals unless the telephone line has been disconnected at the network interface.
- Use caution when installing or modifying telephone lines.

Preventing Electrostatic Discharge Damage

Electrostatic discharge (ESD) damage, which can occur when electronic cards or components are improperly handled, can result in complete or intermittent failures. Each processor module contains a printed circuit card that is fixed in a metal carrier.

Electromagnetic interference (EMI) shielding, connectors, and a handle are integral components of the carrier. Although the metal carrier helps to protect the board from ESD, use an ESD-preventive wrist or ankle strap whenever you handle any electronic system component.

Following are guidelines for preventing ESD damage:

- Always use an ESD-preventive wrist or ankle strap and ensure that it makes good skin contact.
- When you work at the interface processor end of the router, connect the equipment end of the strap to the captive installation screw on an installed interface processor, or to the chassis grounding receptacle that is located next to each power supply.
- When you install a processor module, use the ejector levers to properly seat the bus connectors in the backplane, then tighten both captive installation screws. These screws prevent accidental removal, provide proper grounding for the system, and help to ensure that the bus connectors are seated in the backplane.
- Handle processor modules by the carrier handles and carrier edges only; never touch the board or any connector pins.
- When you remove a processor module, place it card side up on an antistatic surface or in a static shielding bag. Immediately place the module in a static shielding bag if you need to return it to the factory.
- Avoid contact between electronic equipment and clothing. Antistatic straps only protect the equipment from ESD voltages on the body; ESD voltages on clothing can still cause damage.

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

Compatibility Requirements

This section describes compatibility requirements for the RSP4/4+.

Chassis Requirements

Following are chassis slot and DRAM requirements for ensuring RSP4/4+ compatibility.

- You have no restrictions on installing an RSP4/4+ in a Cisco 7505 provided that you install the RSP4/4+ in slot 4. (The Cisco 7505 does not support the HSA or HA features.)
- You have no restrictions on installing an RSP4/4+ in a Cisco 7507 or Cisco 7507-MX provided that you install the RSP4/4+ in slot 2, slot 3, or both. With the HSA and HA features enabled, you can use both RSP slots.

- You have no restrictions on installing an RSP4/4+ in a Cisco 7513 or Cisco 7513-MX provided that you install the RSP4/4+ in slot 6, slot 7, or both. With the HSA and HA features enabled, you can use both RSP slots.
- You have no restrictions on installing RSP4/4+s in a Cisco 7576 provided that you install the RSP4/4+s in slot 6 (for Router A) and slot 7 (for Router B). (The Cisco 7576 does not support the HSA or HA features.)
- It is assumed that if you install two RSP4/4+s (or an RSP2 and an RSP4/4+) in the Cisco 7507, Cisco 7507-MX, Cisco 7513, or Cisco 7513-MX, you plan to enable and configure the HSA or HA features.

Memory Requirements

Flash memory cards and DRAM DIMMs must meet the following requirements:

- Flash memory cards and DRAM DIMMs must be obtained from Cisco Systems. Flash memory cards are available in 16-, 20-, or 32-MB, with 16 MB being the shipping default. See the "PC Card Slots" section on page 8 for additional information on supported Flash memory cards.
- Maximum DRAM speed is 60 nanoseconds (ns), maximum DIMM height is 1 inch (2.54 centimeters), and maximum DRAM DIMM voltage is 3.3 volts (V).
- The minimum required DRAM configuration for the RSP4 is 32MB, and for the RSP4+, the minimum is 64MB.
- You cannot use a Flash memory card that was formatted on another RSP-based system, such as the RSP7000, RSP1, RSP2, or RSP4, which is running a boot or Cisco IOS software image earlier than:
  - 12.0(5)T or a later release of Cisco IOS Release 12.0 T
  - 12.0(9)S or a later release of Cisco IOS Release 12.0 S
  - 12.1(0) or a later release of Cisco IOS Release 12.1
  - 12.1(2)E or a later release of Cisco IOS Release 12.1 E
- You *must* first reformat the Flash memory card, formatted on one of these other RSP-based systems, *before* you can use it as a boot or storage source with the RSP4/4+. Refer to *Flash Memory Card Installation Instructions* (part number DOC-782083=) for instructions on reformatting a Flash memory card.

Table 5 shows the systems which require reformatting before the Flash memory card can be used.

Table 5 Flash Memory Card Compatibility

Formatted On	Installed In	Reformatting Required?
RSP1	RSP1 or RSP2	No[1]
RSP1	RSP4 or RSP8	Yes
RSP1	RP	Yes
RSP2	RSP1 or RSP2	No[1]
RSP2	RSP4 or RSP8	Yes
RSP2	RP	Yes
RSP7000	RSP1 or RSP2	No
RSP7000	RSP4 or RSP8	Yes

Table 5 Flash Memory Card Compatibility (continued)

Formatted On	Installed In	Reformatting Required?
RSP7000	RP	Yes
RP	RSP1, RSP2, RSP4, RSP8, and RSP7000	Yes

1. Cisco IOS Release 10.3(572) and higher (for example Cisco IOS Release 10.3[6]) make the RSP1and RSP2 formats compatible. In Cisco IOS Release 10.3(5) and lower, RSP1 and RSP2 formats are not compatible and require you to reformat the card before it can be used.

Software Prerequisites

The minimum supported Cisco IOS release compatible with the RSP4/4+ is Cisco IOS Release 11.1(22)CC or a later release of Cisco IOS release 11.1 CC. For the latest compatible software releases, refer to the Software Advisor at http://www.cisco.com/cgi-bin/Support/CompNav/Index.pl.

Use the **show version** and **show hardware** commands to display the router's current hardware and software configurations. The **show microcode** command lists the bundled microcode (and target hardware) version for each processor type. The **show controller cbus** command shows the microcode version you are running. The **show diagbus** command shows the RSP4/4+ board's hardware version (Version 1.0 at initial release) and revision (Revision A0 at initial release).

For additional descriptions of **show** commands, refer to the *Configuration Fundamentals Configuration Guide* and *Configuration Fundamentals Command Reference* publications, which are available online, on the Documentation CD-ROM, or as printed documents.

Note If the required system software and microcode are not available in your system, contact a customer service representative for upgrade information. (To obtain assistance, see the "Obtaining Technical Assistance" section on page 92.)

Hardware Prerequisites

Your router configuration, protocols, and features might require more than the 32 MB of DRAM (default) shipped with the RSP4 and 64 MB (default) shipped with the RSP4+. To upgrade DRAM, see the "Replacing and Upgrading DRAM DIMMs" section on page 78.

To ensure proper operation of a system configured for HSA or HA, note the guidelines below:

- With HSA and HA, the RSP4/4+ can interoperate with another RSP4/4+, or with an RSP2.
- To ensure that the standby RSP4/4+ operates properly, the active and the standby RSP4/4+ should have the same DRAM configuration and boot ROM version.
- Removing the active RSP4/4+ while the system is operating might cause the system to crash; however, the system reloads with the standby RSP4/4+ as the new active RSP4/4+. To prevent any system problems, *do not* remove the active RSP4/4+ while the system is operating.

Microcode Requirements

Microcode is a set of processor-specific software instructions that enables and manages the features and functions of a specific processor type. At system startup or reload, the system loads the microcode for each processor type present in the system. The latest available microcode image for each processor type is bundled and distributed with the system software image.

Note Overriding the bundle can result in incompatibility between the various interface processors in the system. We recommend that you use *only* the microcode image that is bundled.

List of Parts and Tools

You need some or all of the following parts and tools to install, remove, and replace an RSP4/4+ or to upgrade DRAM. If you need additional equipment, contact a customer service representative for ordering information.

- An RSP4/4+ or related product listed in the "Product Description" section on page 3.
- DRAM DIMMs that are described in the "Replacing and Upgrading DRAM DIMMs" section on page 78. (Also see the "Compatibility Requirements" section on page 14.)

Caution To prevent memory problems, DRAM DIMMs must be 3.3-volt (V) devices. Do not attempt to install higher-voltage devices (such as those designed for the RSP2) in the RSP4/4+ DIMM sockets.

- Number 1 Phillips screwdriver and a number 2 Phillips or 3/16-inch flat-blade screwdriver for the captive installation screws that secure the RSP4/4+ in its slot.
- ESD-prevention equipment or the disposable ESD-preventive wrist strap included with all spares and upgrade kits.
- Antistatic mat, foam pad, or bag for the removed RSP4/4+ (place the removed RSP4/4+ in an antistatic bag if you plan to return it to the factory, or on an antistatic mat or foam if you are replacing components and will reinstall the RSP4/4+).

Installing the RSP4/4+

Before you begin, be sure that your system meets the minimum software, hardware, and microcode requirements described in the "Compatibility Requirements" section on page 14.

This section includes the following procedures for installing or replacing an RSP4/4+:

After the new RSP4/4+ is secure, follow the procedures in the "Troubleshooting the Installation" section on page 67 to verify that it is installed and functioning properly.

Removing the RSP4/4+

Caution Removing the only installed RSP4/4+ from a system while the system is operating will cause the system to crash. Consider this *before* removing an RSP4/4+ while the system is operating. To ensure that the standby RSP4/4+ operates properly with the full system configuration should the active RSP4/4+ ever fail, the standby RSP4/4+ must have the same DRAM and Flash memory capacity as the active RSP4/4+. See the "Memory Components" section on page 6 for RSP4/4+ memory component requirements.

Note The carriers on processor modules have EMI fences for EMI shielding; therefore, they fit very tightly in the chassis slots. To ensure that you can properly remove or install an RSP4/4+ in RSP slot 7, we recommend that you proceed as follows: first remove an interface processor installed in slot 8, remove or install the RSP4/4+ in RSP slot 7 (and fasten its captive installation screws as appropriate), and then reinstall the interface processor in slot 8.

When you remove or install the RSP4/4+, be sure to use the ejector levers, which help to ensure that the RSP4/4+ is fully inserted in the backplane or fully dislodged from it. An RSP4/4+ that is only partially connected to the backplane can halt the system unless a second RSP4/4+ is installed.

Figure 3 shows the ejector lever mechanism. When you simultaneously push the ejector levers inward (toward the carrier handle), the levers push the RSP4/4+ into the slot and ensure that the board connectors are fully seated in the backplane.

To remove the RSP4/4+, complete the following steps:

Step 1 (Optional) If you are replacing the RSP4/4+ in a system with one RSP4/4+, copy the currently running configuration file to a TFTP server so you can retrieve it later. (See the "Saving and Retrieving a Configuration File" section on page 73.)

Step 2 Attach an antistatic strap to yourself and then connect the equipment end of the strap to a captive installation screw on an installed interface processor, or to any unfinished chassis surface.

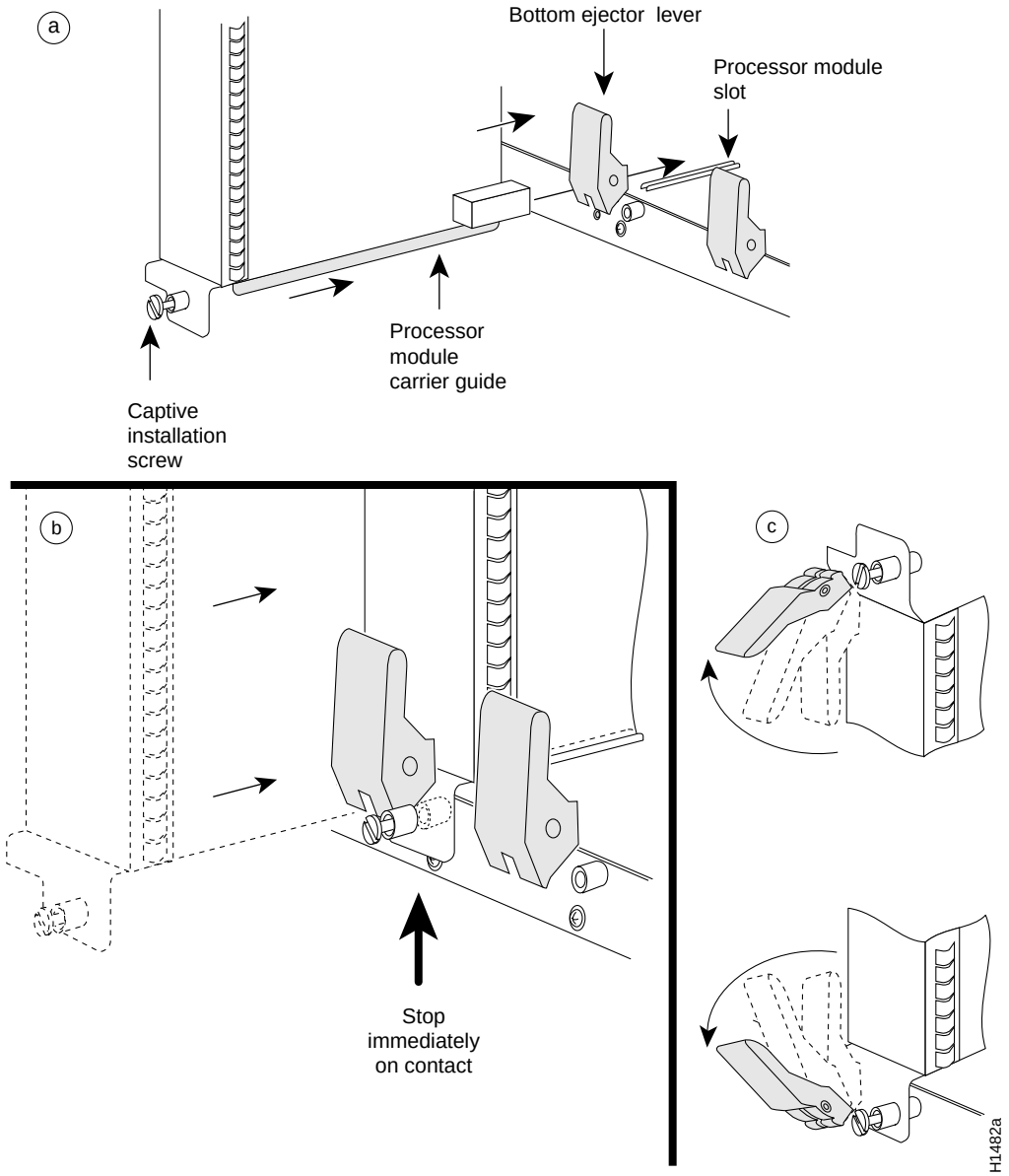
Step 3 If you are replacing the RSP4/4+, disconnect any devices that are attached to the console or auxiliary ports. If you are removing the RSP4/4+ for maintenance and will reinstall the same one, you can leave the devices attached provided that doing so will not strain the cables.

Step 4 Use a screwdriver to loosen the two captive installation screws. (See Figure 3.)

Step 5 Place your thumbs on the ends of each of the ejector levers and simultaneously pull them both outward, away from the carrier handle (as shown in the illustration at the bottom of Figure 3c) to release the carrier from the slot and to dislodge the RSP4/4+ from the backplane.

Step 6 Grasp the handle of the RSP4/4+ with one hand and pull the RSP4/4+ straight out of the slot, keeping your other hand under the carrier to guide it. (See Figure 4.) Keep the carrier parallel to the backplane. Avoid touching the board or any connector pins.

Figure 3 Ejector Levers and Captive Installation Screw



Step 7 Place the removed RSP4/4+ on an antistatic mat or foam. If you plan to return the RSP4/4+ to the factory, immediately place it in an antistatic bag to prevent ESD damage.

Step 8 Attach the equipment end of the ESD-preventive strap to the RSP4/4+ before performing any maintenance on the RSP4/4+ that might create an ESD hazard.

This completes the removal procedure. If you removed the RSP4/4+ to replace DIMMs, proceed to the "Replacing and Upgrading DRAM DIMMs" section on page 78. If you are replacing the RSP4/4+, proceed to the next section to install the new RSP4/4+.

Replacing the RSP4/4+

Caution Removing the only installed RSP4/4+ from a system while the system is operating will cause the system to crash. Consider this *before* removing an RSP4/4+ while the system is operating. To ensure that the standby RSP4/4+ operates properly with the full system configuration should the active RSP4/4+ ever fail, the standby RSP4/4+ must have the same DRAM and Flash memory capacity as the active RSP4/4+. See the "Memory Components" section on page 6 for RSP4/4+ memory component requirements.

Note The carriers on processor modules have EMI fences for EMI shielding; therefore, they fit very tightly in the chassis slots. To ensure that you can properly remove or install an RSP4/4+ in RSP slot 7, we recommend that you proceed as follows: first remove an interface processor installed in slot 8, remove or install the RSP4/4+ in RSP slot 7 (and fasten its captive installation screws as appropriate), and then reinstall the interface processor in slot 8.

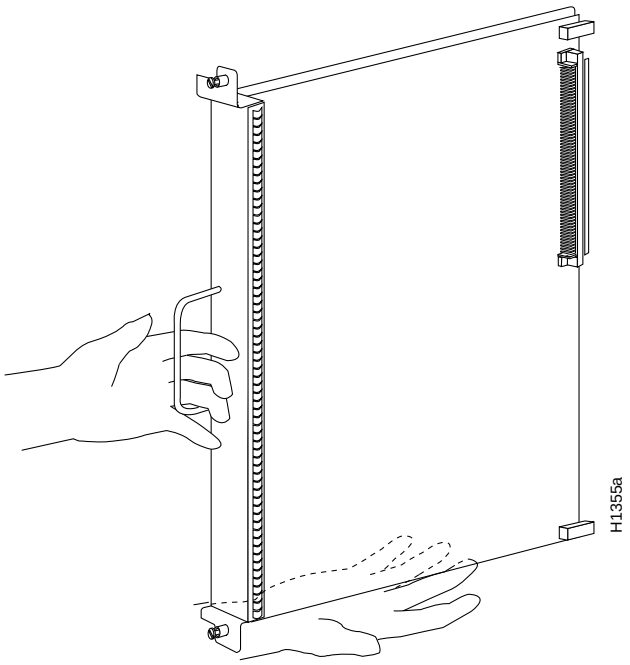
The RSP4/4+ is keyed for installation only in an RSP slot. By default, the active RSP is the one that occupies the first RSP slot in the router: slot 2 in the Cisco 7507 and Cisco 7507-MX, and slot 6 in the Cisco 7513 and Cisco 7513-MX.

To install an RSP4/4+, complete the following steps:

Step 1 Grasp the RSP4/4+ handle with one hand and place your other hand under the carrier to support and guide it into the slot. (See Figure 4.) Avoid touching the board or any connectors.

Step 2 Place the back of the RSP4/4+ in the appropriate RSP slot and align the notches along the edge of the carrier with the grooves in the slot. (See Figure 3a.)

Figure 4 Handling the RSP4/4+ During Removal and Installation



Caution To prevent damage to the backplane, you must install the RSP4/4+ in one of the two RSP slots on the router. The slots are keyed for correct installation. Forcing the RSP4/4+ into a different slot can damage the backplane and the RSP4/4+.

Step 3 While keeping the RSP4/4+ parallel to the backplane, carefully slide the carrier into the slot until the RSP4/4+ faceplate makes contact with the ejector levers, and then *stop*. (See Figure 3b.)

Step 4 Using the thumb and forefinger of each hand to pinch each ejector lever, simultaneously push both ejector levers inward (toward the handle) until they are parallel to the faceplate. (See Figure 3c.)

Step 5 Use a screwdriver to tighten the captive installation screws on the ends of the RSP4/4+. (See Figure 3a.)

Step 6 Use a screwdriver to tighten the two captive installation screws on the RSP4/4+ faceplate to prevent the RSP4/4+ from becoming partially dislodged from the backplane and to ensure proper EMI shielding. (These screws must be tightened to meet EMI specifications.)

Step 7 If you disconnected the console terminal to remove the RSP4/4+, or if you are installing a new RSP4/4+, connect the console terminal to the console port. (See the "Connecting a Console Terminal" section on page 22.)

Step 8 Ensure that a console terminal is connected (see the "Connecting a Console Terminal" section on page 22) and that it is turned on.

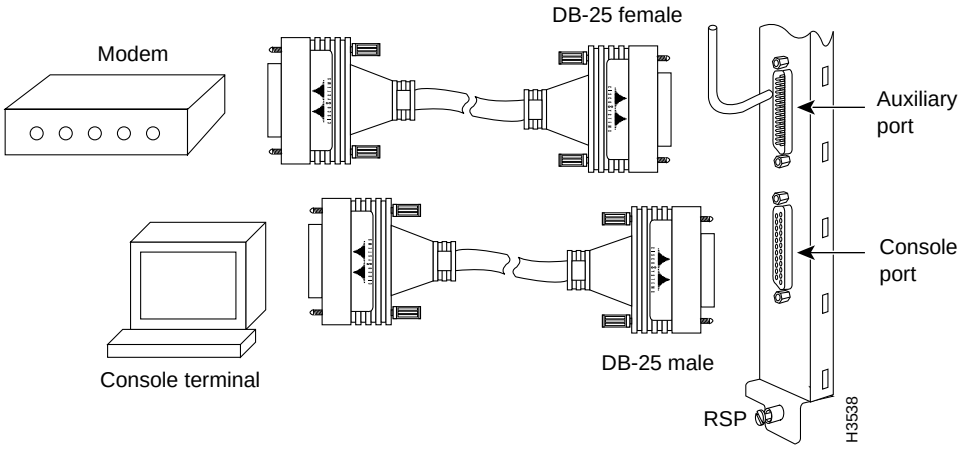
Step 9 Turn the system power back on, and proceed to the "Restarting the System" section on page 23 to check the installation.

Connecting a Console Terminal

The system console port on the RSP4/4+ is a DB-25 receptacle DCE port for connecting a data terminal, which you need to configure in order to communicate with your system. The console port is located on the RSP4/4+ just below the auxiliary port, as shown in Figure 5, and is labeled *Console*.

Before connecting the console port, check the documentation for your terminal to determine the baud rate of the terminal you are using. The baud rate of the terminal must match the default baud rate (9600 baud). Set up the terminal as follows: 9600 baud, 8 data bits, no parity, and 2 stop bits (9600,8N2). Use the console cable provided to connect the terminal to the console port on the RSP4/4+, and then follow the steps in the "Restarting the System" section on page 23.

Figure 5 Console and Auxiliary Port Connections



Note The console and auxiliary ports are asynchronous serial ports; any devices connected to these ports must be capable of asynchronous transmission. (Asynchronous is the most common type of serial device; for example, most modems are asynchronous devices.)

Connecting to the Auxiliary Port

The auxiliary port on the RSP4/4+ is a DB-25 plug DTE port for connecting a modem or other DCE device (such as a channel service unit [CSU], data service unit [DSU], or other router) to the router. The port is located next to the console port on the RSP4/4+ and is labeled *AUX*. An example of a modem connection is shown in Figure 5.

Using the Y-Cables for Console and Auxiliary Connections

For systems with two RSPs installed and the HSA or the HA feature enabled, you can connect to either the console or the auxiliary ports simultaneously on both RSPs using a special, optional Y-cable.If only one RSP2 is installed, it is the system active by default.

Note The Y-cables are *not required*; two individual console cables and two individual auxiliary cables can be used instead.

Figure 6 shows the console Y-cable and Figure 7 shows the auxiliary Y-cable.

Figure 6 Console Y-Cable (Part Number CAB-RSP4CON=)

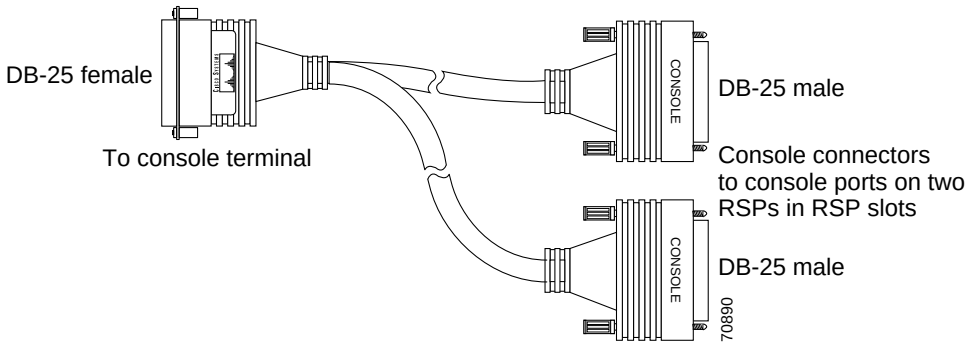
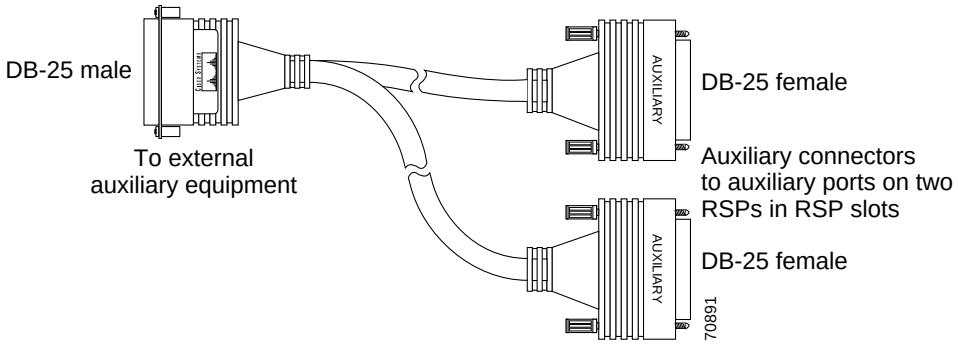


Figure 7 Auxiliary Y-Cable (Part Number CAB-RSP4AUX=)



Restarting the System

When you turn the system power back on, verify that the system boots and resumes normal operation. If you are restarting the system after upgrading the DRAM, expect that it will take the system longer to complete the memory initialization portion of the boot sequence with more DRAM. (See the "Verifying System Startup Sequence" section on page 68.)

Follow these steps to verify that the RSP4/4+ is installed and functioning properly:

Step 1 Check the RSP4/4+ connections to make sure they are secure:

- The RSP4/4+ is inserted all the way into its slot, and both captive installation screws are tightened.
- The console terminal is turned on and is connected to the console port.

Step 2 Observe the RSP4/4+ LEDs. While the system initializes, the CPU halt LED on the RSP4/4+ stays on. It goes off when the boot process is complete. As the RSP4/4+ initializes each interface processor, the status LEDs on each interface processor go on and off in irregular sequence.

Step 3 For a Cisco 7507, Cisco 7507-MX, Cisco 7513, or Cisco 7513-MX with HSA or HA configured, verify that the console terminal displays the system banner and startup screen as the system restarts.

- The active console display should look similar to the following for a Cisco 7513 and Cisco 7513-MX (note the RSP slots indicated):

```
System Bootstrap, Version 12.0(20011126:200409) [mssunil-RSP4_BENGAL_120S 251], DEVEL
OPMENT SOFTWARE
Copyright (c) 1994-2001 by cisco Systems, Inc.

SLOT 6 RSP is system master
RSP4 platform with 262144 Kbytes of main memory

rommon 1 > b

Self decompressing the image :############################################################
################################################################################################
################################################################################ [OK]

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(c) (1) (ii) of the Rights in Technical Data and Computer
Software clause at DFARS sec. 252.227-7013.

           cisco Systems, Inc.
           170 West Tasman Drive
           San Jose, California 95134-1706

Cisco Internetwork Operating System Software
IOS (tm) RSP Software (RSP-PV-M), Experimental Version 12.1(20020307:194032) [mssunil-
121E_LATEST 127]
Copyright (c) 1986-2002 by cisco Systems, Inc.
Compiled Fri 26-Apr-02 16:52 by mssunil
Image text-base:0x60010958, data-base:0x611A4000

cisco RSP4 (R7000A) processor with 262144K/8216K bytes of memory.
R7000 CPU at 400Mhz, Implementation 39, Rev 3.3, 256KB L2, 2048KB L3 Cache
Last reset from power-on
G.703/E1 software, Version 1.0.
G.703/JT2 software, Version 1.0.
X.25 software, Version 3.0.0.
Chassis Interface.
1 EIP controller (4 Ethernet).
4 Ethernet/IEEE 802.3 interface(s)
2043K bytes of non-volatile configuration memory.

16384K bytes of Flash internal SIMM (Sector size 256K).
No slave installed in slot 7.
```

```
Press RETURN to get started!

00:00:05:%CI-6-BPLANE:CI type 7 differs from NVRAM type 2
00:00:06:%SYS-5-CONFIG_I:Configured from memory by console
00:00:08:%LINK-5-CHANGED:Interface Ethernet8/0, changed state to administratively down
00:00:08:%LINK-5-CHANGED:Interface Ethernet8/1, changed state to administratively down
00:00:08:%LINK-5-CHANGED:Interface Ethernet8/2, changed state to administratively down
00:00:08:%LINK-5-CHANGED:Interface Ethernet8/3, changed state to administratively down
00:00:08:%SYS-5-RESTART:System restarted --
Cisco Internetwork Operating System Software
IOS (tm) RSP Software (RSP-PV-M), Experimental Version 12.1(20020307:194032)
[mssunil-121E_LATEST 127]
Copyright (c) 1986-2002 by cisco Systems, Inc.
Compiled Fri 26-Apr-02 16:52 by mssunil
00:00:08:%SNMP-5-COLDSTART:SNMP agent on host Router is undergoing a cold start
00:00:10:%LINEPROTO-5-UPDOWN:Line protocol on Interface Ethernet8/0, changed state to
down
00:00:10:%LINEPROTO-5-UPDOWN:Line protocol on Interface Ethernet8/1, changed state to
down
00:00:10:%LINEPROTO-5-UPDOWN:Line protocol on Interface Ethernet8/2, changed state to
down
00:00:10:%LINEPROTO-5-UPDOWN:Line protocol on Interface Ethernet8/3, changed state to
down
00:00:10:%SYS-6-BOOTTIME:Time taken to reboot after reload = -210 seconds
Router>
```

- The active console display should look similar to the following for a Cisco 7507 and Cisco 7507-MX (note the RSP slots indicated):

```
System Bootstrap, Version 11.1, RELEASED SOFTWARE
Copyright (c) 1986-1999 by cisco Systems, Inc.
SLOT 2 RSP4 is system master
SLOT 3 RSP4 is system slave
RSP4 processor with 128 Mbytes of main memory

[additional displayed text omitted from this example]

Slave in slot 3 is halted.
```

Step 4 With a single RSP4/4+ (non-HSA or non-HA), verify that the console terminal displays the system banner and startup screen as the system restarts. The display should look similar to the following:

```
System Bootstrap, Version 11.1, RELEASED SOFTWARE
Copyright (c) 1986-1999 by cisco Systems, Inc.
SLOT 6 RSP4 is system master
RSP4 processor with 128 Mbytes of main memory

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

Step 5 After the system boots the software and initializes the interface processors, verify that the RSP4/4+ LEDs are in the following states:

- RSP4/4+ normal LED is on (for each RSP4/4+ installed).
- CPU halt LED is off (for each RSP4/4+ installed).
- Active RSP4/4+ active LED is on.
- Standby RSP4/4+ standby LED is on (if HSA is configured).

Note Boot time is approximately 1 minute for systems with one RSP4/4+ and approximately 1.5 minutes for systems with two RSP4/4+s. These times vary with system configuration and with the source location of the image being booted.

Step 6 Verify that all the enabled LEDs (on the interface processors) are on.

Step 7 In systems with a second RSP4/4+ installed (and HSA or HA configured), use the **show version** command to verify that the standby RSP4/4+ is recognized by the system. Following is a sample from a Cisco 7513:

```
Router> show version

Cisco Internetwork Operating System Software
IOS (tm) RSP Software (RSP-JSV-M), Version 11.1 [biff 51096]
Copyright (c) 1986-1999 by cisco Systems, Inc.
Compiled Mon 22-Sep-99 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 RSP is configured as the standby or the recent crash history of your router.)

When you have verified all the conditions in Step 2 through Step 6 (or Step 7 if you have a second RSP4/4+ installed and want to use the HSA or HA features), the installation is complete. If you replaced the RSP4/4+ and saved your configuration file to a remote server before doing so, see the "Retrieving the Configuration File" section on page 76. If you replaced the RSP4/4+ and did not save the configuration, use the **configure** command or the setup facility to reenter the configuration information.

An error condition exists if no LEDs go on at power up or after initialization, or if the boot error or CPU halt LEDs go on and remain on. If this happens, proceed to the "Troubleshooting the Installation" section on page 67 to try to isolate the problem. For more complete configuration information, refer to the *Configuration Fundamentals Configuration Guide* and the *Configuration Fundamentals Command Reference* publications, which are available online, on the Documentation CD-ROM, or as printed documents.

If you have a second RSP4/4+ installed, you must configure the HSA (or HA, if you prefer) features for your Cisco 7507, Cisco 7507-MX, Cisco 7513, or Cisco 7513-MX router. Read the following caution, and then proceed to either the "Configuring High System Availability" section on page 28, or the "Enabling High Availability Features" section on page 44.

Caution When you install a second RSP4/4+ card for the first time and plan to enable the HSA or HA features, you *must* immediately configure it correctly. See the "Configuring High System Availability" section on page 28, or the "Enabling High Availability Features" section on page 44. This ensures that the new standby is configured consistently with the active. Failure to do so might result in an unconfigured standby RSP4/4+ card taking over control of the router when the active fails, rendering the network inoperable.

This completes the procedure for restarting the system.

Configuring the Router for a Single RSP4/4+

If you have a single RSP4/4+, you can configure your system according to the Cisco IOS release appropriate for your router. See the Cisco IOS software configuration documentation set that corresponds to the software release installed on your Cisco hardware at http://www.cisco.com/univercd/cc/td/doc/product/software/index.htm.

If you have more than one RSP4/4+ (or an RSP4/4+ and an RSP2), and you are using a Cisco 7507 or a Cisco 7507-MX router or a Cisco 7513 or a Cisco 7513-MX router, you must configure your router for either high system availability (HSA), the default (see the "Configuring High System Availability" section on page 28), or high availability (HA) (see the "Enabling High Availability Features" section on page 44).

Using the EXEC Command Interpreter

Before you configure your system using the EXEC-level commands, you must enter the privileged level of the EXEC command interpreter using the **enable** command. The system prompts you for a password if one has been set. The system prompt for the privileged level ends with a pound sign (#) instead of an angle bracket (>).

At the console terminal, enter the privileged EXEC level as follows:

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

```
Router> enable

Password:
```

Step 2 Type 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-level system prompt (#) as follows:

```
Router#
```

The pound sign (#) at the system prompt indicates the privileged level of the EXEC command interpreter, from which you can execute EXEC-level commands.

This completes the procedure for using the EXEC command interpreter.

For configuration information and support, refer to the Cisco IOS software configuration documentation set that corresponds to the software release installed on your Cisco hardware.

Note You can access Cisco IOS software configuration information at http://www.cisco.com. Refer to the Software Advisor at http://www.cisco.com/cgi-bin/Support/CompNav/Index.pl for additional information.

For troubleshooting information, refer to the "Troubleshooting the Installation" section on page 67.

Configuring High System Availability

This section describes high system availability (HSA), a feature that enables a router to continue processing and forwarding packets after a planned or unplanned outage.

It includes the following topics:

HSA is the system default when two RSP4/4+ cards (one designated as the “active” and the other as the “standby”) are installed in a router and the active RSP4/4+ card fails. The standby RSP4/4+ card takes over in this situation, known as a “cold standby.” The router restarts without manual intervention (for example, without inserting a new RSP) by rebooting with the standby RSP. The standby has its own image and configuration file and acts as a single processor.

Caution To ensure proper functioning of the standby RSP4/4+ in the event of an active RSP4/4+ failure, the standby RSP4/4+ should have the same boot image, the same ROM monitor, and the same DRAM configuration as the active RSP4/4+.

Note An RSP4/4+ can interoperate with another RSP4/4+ or with an RSP2. It cannot interoperate with an RSP1, RSP8, or an RSP16. In the following text, you can substitute references to two RSP4/4+s with an RSP4/4+ and an RSP2.

When two new RSP4/4+s (or an RSP4/4+ and an RSP2) are installed at the same time, the RSP that occupies the first even RSP slot on the router is the active (normally the RSP4/4+, if the RSP2 was used in conjunction with the RSP4/4+), and the RSP that occupies the odd RSP slot is the standby. If a crash has occurred, the RSP in the odd slot becomes the active and the RSP in the even slot becomes the standby.

HSA is supported on the following routers: Cisco 7507, Cisco 7507-MX, Cisco 7513, and Cisco 7513-MX. HSA is not supported on the Cisco 7505 or the Cisco 7576 routers.

The cold standby procedure, from initial failure to first packet transmission, currently takes approximately eight to ten minutes.

For more complete HSA configuration information, refer to the *Cisco IOS Configuration Fundamentals Configuration Guide* and the *Cisco IOS Configuration Fundamentals Command Reference* publications, which are available online, on the Cisco Documentation CD-ROM, or as printed copies.

HSA Active and Standby Operation

During HSA operation, the active RSP4/4+ card functions as if it were a single processor, controlling all functions of the router. The standby RSP4/4+ card does nothing but actively monitor the active RSP4/4+ for failure.

When the standby RSP4/4+ detects a nonfunctional active RSP4/4+, the standby resets itself and takes part in *active-standby arbitration*. Active-standby arbitration is a ROM monitor process that determines which RSP4/4+ card is the active and which is the standby upon startup (or reboot).

If a system crash causes the active RSP4/4+ to fail, the standby RSP4/4+ becomes the new active RSP4/4+ and uses its own system image and configuration file to reboot the router. The failed RSP4/4+ card (now the standby) remains inactive until you perform diagnostics, correct the problem, and then issue the **standby reload** command.

With HSA operation, use the following guidelines:

- The standby RSP4/4+ should have the same boot image, the same ROM monitor, and the same DRAM configuration as the active RSP4/4+. (See the "Hardware Prerequisites" section on page 16.)
- The two RSP4/4+ cards are not required to run the same active software image and configuration file. The standby-mode software is a subset of the active-mode software.
- When enabled, automatic synchronization mode automatically ensures that the active and the standby RSP4/4+ cards have the same configuration file. (See the "Ensuring that Both RSPs Contain the Same Configuration Files" section on page 31.)
- The console always connects to the active RSP4/4+, so your view is always from the active RSP's perspective.
- You must *not* remove the system active RSP4/4+ while the system is operating; however, the system standby RSP4/4+ can be removed while the system is operating.

Caution Removing the active RSP4/4+ while the system is operating might cause the system to crash; however, the system reloads with the standby RSP4/4+ as the new active. To prevent any system problems, *do not* remove the active RSP4/4+ while the system is operating.

HSA Implementation Methods

Common HSA uses follow:

- Hardware backup—Protects against an RSP4/4+ card failure. You configure both RSP4/4+ cards with the same software image and configuration, and you configure the router to automatically synchronize configuration information on both cards when changes occur.
- Software error protection—Protects against critical Cisco IOS software errors in a particular release. You configure the RSP4/4+ 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 RSP4/4+ 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 or on per card)

Note Other, more complex uses of HSA are also possible, but are not addressed in this document. For more information, contact your Cisco service representative.

HSA System Requirements

To configure HSA operation with the RSP4/4+, you must have:

- A Cisco 7507, Cisco 7507-MX, Cisco 7513, or Cisco 7513-MX containing one RSP active processor card, one RSP standby processor card, and the proper Cisco IOS release (refer to the Software Advisor at http://www.cisco.com/cgi-bin/Support/CompNav/Index.pl for additional information).
- A standby RSP with the same (or higher) DRAM and Flash memory capacity as the active RSP. See the "Memory Requirements" section on page 15 for RSP4/4+ memory component requirements.
- A standby RSP with the same boot image, the same ROM monitor, and the same DRAM configuration as the active RSP. (See the "Hardware Prerequisites" section on page 16.)

Caution The HSA feature works with two RSP4/4+ cards, or with one RSP4/4+ and one RSP2. The RSP4/4+ cannot be used in combination with any other RSP cards when utilizing the HSA feature.

HSA Configuration Task List

Before you configure HSA, decide how you intend to use HSA, as described in the "HSA Implementation Methods" section on page 29. Do you want it 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, complete the tasks in the following sections. The first two and last two tasks are required for both implementations. The third and fourth tasks relate to simple hardware backup only. The fifth task relates to software error protection only.

- Specifying the Default Standby RSP Card, page 31 (both implementations)
- Ensuring that Both RSPs Contain the Same Configuration Files, page 31 (both implementations)
- Ensuring that Both RSPs Contain the Same System Image, page 32 (simple hardware backup only)
- Ensuring that Both RSPs Contain the Same Microcode Image, page 33 (simple hardware backup only)
- Specifying Different Startup Images for the Active and the Standby RSPs, page 35 (software error protection only)
- Setting Environment Variables on the Active and the Standby RSPs, page 41 (both implementations)

Note The following HSA configuration examples refer to a Cisco 7513. If you have a Cisco 7507, the primary difference is that the active and the standby RSPs are located in slots 2 and 3, respectively.

Specifying the Default Standby RSP Card

Your view of the environment is always from the active RSP8 perspective, and you must define a default standby RSP4/4+. The router uses the default standby information when booting.

- If a system boot is due to powering up the router or using the **reload** command, then the specified default standby is the standby RSP4/4+.
- If a system boot is due to a system crash or hardware failure, then the system ignores the default standby designation and makes the crashed or faulty RSP4/4+ the standby RSP4/4+.

To define the default standby RSP4/4+, use the following commands beginning in privileged EXEC configuration mode:

	Command	Purpose
Step 1	Router# **configure terminal**	Enters global configuration mode.
Step 2	Router(config)# **slave default-slot** *processor-slot-number*	Defines the default standby RSP4/4+.
Step 3	Router(config)# **end**	Exits global configuration mode and returns you to privileged EXEC configuration mode.
Step 4	Router# **copy system: running-config nvram:startup-config**	Saves this information to your startup configuration.

Upon the next system reboot, the above changes take effect (if both RSP4/4+ cards are operational). Thus, the specified default standby becomes the standby RSP4/4+ card. The other RSP4/4+ card takes control of the system and controls all functions of the router.

If you do not specifically define the default standby RSP4/4+, the RSP4/4+ card located in the higher odd-numbered processor slot is the default standby. On the Cisco 7507 and Cisco 7507-MX, processor slot 3 contains the default standby RSP. On the Cisco 7513 and Cisco 7513-MX, processor slot 7 contains the default standby RSP.

The following example sets the default standby RSP4/4+ to processor slot 2 on a Cisco 7507 or Cisco 7507-MX:

```
Router# configure terminal
Router(config)# slave default-slot 2
Router(config)# end
Router# copy system: running-config nvram:startup-config
```

Ensuring that Both RSPs Contain the Same Configuration Files

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

Automatic synchronization mode is on by default; however, to turn it on manually, use the following commands beginning in privileged EXEC configuration mode:

	Command	Purpose
Step 1	Router# **configure terminal**	Enters global configuration mode.
Step 2	Router(config)# **slave auto-sync config**	Enables automatic synchronization mode.
Step 3	Router(config)# **end**	Exits global configuration mode and returns you to privileged EXEC configuration mode.
Step 4	Router# **copy system: running-config nvram:startup-config**	Saves this information to your startup configuration and copies the configuration to the standby's startup configuration.

The following example turns on automatic configuration file synchronization:

```
Router# configure terminal
Router(config)# slave auto-sync config
Router(config)# end
Router# copy system: running-config nvram:startup-config
```

Ensuring that Both RSPs Contain the Same System Image

For simple hardware backup, ensure that both RSPs have the same system image.

To ensure that both RSPs have the same system image, use the following commands beginning in privileged EXEC configuration mode:

	Command	Purpose
Step 1	Router# **show bootvar**	Displays the contents of the BOOT environment variable to learn the current booting parameters for the active and the standby RSP.
Step 2	Router# **dir** {**bootflash:** | **slot0:** | **slot1:**} or Router# **show** {**bootflash:** | **slot0:** | **slot1:**}	Verifies the location and version of the active RSP software image.
Step 3	Router# **dir** {**slavebootflash:** | **slaveslot0:** | **slaveslot1:**} or Router# **show** {**slavebootflash:** | **slaveslot0:** | **slaveslot1:**}	Determines if the standby RSP contains the same software image in the same location.
Step 4	Router#**copy**{**bootflash:**[*filename*]|**slot0:**[*filename*]| **slot1:**[*filename*]}{**slavebootflash:**[*filename*] | **slaveslot0:**[*filename*] | **slaveslot1:**[*filename*]} **Note** You might also have to use the **delete** and/or **squeeze** command in conjunction with the **copy** command to accomplish this step.	If the standby RSP does not contain the same system image in the same location, copies the active's system image to the appropriate standby location. **Note** Deleted space is not reusable until after you perform the **squeeze** command.

The following example ensures that both RSPs have the same system image. Note that because no environment variables are set, the default environment variables are in effect for both the active and the standby RSP.

```
Router# show bootvar
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# show slot0:
1   .. image        143B4C13  ACB820   21 11188128 Jan 28 2000 01:02:37
rsp-pv-mz.120-22.3.S1

Router# show slavebootflash:
-#- ED ----type---- --crc--- -seek-- nlen -length- -----date/time------ name
1   .. image        FEC9823F  AF0424   18 11203868 Jan 24 2000 23:26:33
rsp-pv-mz.120-23.S

Router# delete slaveslot0:rsp-pv-mz.120-23.S
Router# copy slot0:rsp-pv-mz.120-22.3.S1 slaveslot0:rsp-pv-mz.120-22.3.S1
```

Ensuring that Both RSPs Contain the Same Microcode Image

To ensure that both RSPs have the same microcode images, use the following commands beginning in privileged EXEC configuration mode:

	Command	Purpose
Step 1	Router# **show controller cbus**	Determines the microcode images used on the interface processors. If all interface processors are running from the bundled system microcode, no further action is required.
Step 2	Router# **dir** {**bootflash: | slot0: | slot1:**}	If any interface processors are running from the Flash memory file system, verifies the location and version of the active RSP supplementary microcode.
Step 3	Router# **dir** {**slavebootflash:** | **slaveslot0:** | **slaveslot1:**}	Determines whether the standby RSP contains the same microcode image in the same location.
Step 4	Router# **copy** {**bootflash**:[*filename*] | **slot0**:[*filename*] | **slot1**:[*filename*]} {**slavebootslot**:[*filename*] | **slaveslot0**:[*filename*] | **slaveslot1**:[*filename*]} **Note** You might also have to use the **delete** and/or **squeeze** command in conjunction with the **copy** command to accomplish this step.	Copies the active's system image to the appropriate standby location. Use this command if the standby RSP does not contain the same system image in the same location. **Note** Deleted space is not reusable until after you perform the **squeeze** command.

The following example ensures that both RSPs 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*." The Channel Interface Processor (CIP2) in slot 11 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 standby RSP has a copy of the same CIP2 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
                    .......

  slot     10: 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: CIP2, 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 1999 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 1999 02:35:04 pond/bath/rsp_fsip20-1

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

Specifying Different Startup Images for the Active and the Standby RSPs

For software error protection, the RSPs should have different system images.

When the factory sends you a new router with two RSP4/4+s, you receive the same system image on both RSPs. To configure the HSA feature for software error protection, you need two separate software images on the RSPs. You copy a desired image to the active RSP and modify the **boot system** commands to reflect booting two separate system images. Each RSP uses its own image to boot the router when it becomes the active.

To specify different startup images for the active and the standby RSPs, use the following commands beginning in privileged EXEC configuration mode:

	Command	Purpose
Step 1	Router# **dir** {**bootflash:** | **slot0:** | **slot1:**} or Router# **show** {**bootflash:** | **slot0:** | **slot1:**}	Verifies the location and version of the active RSP software image.
Step 2	Router# **dir** {**slavebootflash:** | **slaveslot0:** | **slaveslot1:**} or Router# **show** {**slavebootflash:** | **slaveslot0:** | **slaveslot1:**}	Determines whether the standby RSP contains the same software image in the same location.
Step 3	Router# **copy** *source* {**bootflash:** | **slot0:** | **slot1:**}	Copies a different system image to the active RSP.
Step 4	Router# **configure terminal**	Enters global configuration mode.
Step 5	Router(config)# **boot system flash bootflash:**[*filename*] or Router(config)# **boot system flash slot0:**[*filename*] or Router(config)# **boot system flash slot1:**[*filename*]	From global configuration mode, configures the active RSP to boot the new image from the appropriate location. **Note** In this procedure, the image that you specify in this command only resides on the first, or active, RSP.

	Command	Purpose
Step 6	Router(config)# **boot system flash bootflash:**[*filename*] or Router(config)# **boot system flash slot0:**[*filename*] or Router(config)# **boot system flash slot1:**[*filename*]	Configures a second **boot system** command that specifies the boot image and location on the standby RSP. **Note** This is the boot image that the standby uses when it boots the system as the active RSP, assuming that the image file that you specified in the first **boot system** command does not exist on the second RSP. Therefore, when the standby RSP cannot locate the image in the first **boot system** command, it uses the image specified in this second command.
Step 7	Router(config)# **boot system** {**rcp** | **tftp** | **ftp**} *filename* [*ip-address*]	(Optional) Configures the active RSP to boot from a network server.
Step 8	Router(config)# **config-register** *value* [1]	Sets the configuration register to enable loading of the system image from a network server or Flash memory.
Step 9	Router(config)# **end**	Exits global configuration mode and returns you to privileged EXEC configuration mode.
Step 10	Router# **copy system: running-config nvram:startup-config**	Saves the configuration file to the active RSP startup configuration. Because automatic synchronization is turned on, this step saves the **boot system** commands to the active and the standby startup configuration.
Step 11	Router# **reload**	Resets the router with the new configuration information.

1. See the "Software Configuration Register Settings" section on page 86 for more information on systems that can use this command to modify the software configuration register.

Upgrading to a New Software Version Example

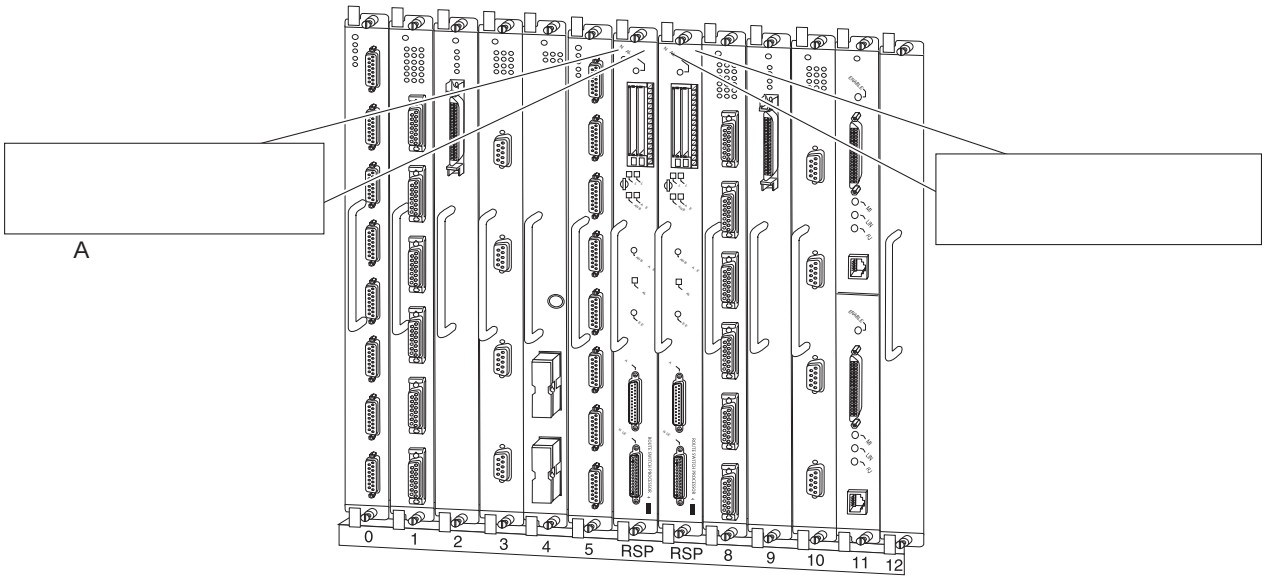
Note The following examples show systems with two RSP4/4+s.

The following example describes an upgrade scenario under the following conditions:

- The active RSP4/4+ is in processor slot 6, and the standby RSP4/4+ is in processor slot 7 of a Cisco 7513 or Cisco 7513-MX.
- Both the active and the standby RSPs currently use the same Cisco IOS Enterprise image, *rsp-pv-mz.120-23.S*, in PC Card slot 0.
- We want to upgrade one RSP to run Cisco IOS Release 12.0(22.3)S1, and allow the other RSP to run Cisco IOS Release 12.0(23)S. To guard against software failures, we will configure HSA operation for software error protection.

Figure 8 illustrates the software error protection configuration for this sample scenario. The configuration commands for this configuration follow the figure.

Figure 8 Software Error Protection—Upgrading to a New Software Version



Step 1 To verify the location and version of the software image on the active RSP's PC Card in slot 0, use the following command:

```
Router# show slot0:
-#- ED ----type---- --crc--- -seek-- nlen -length- -----date/time------ name
1   .. image        FEC9823F  AF0424   18 11203868 Jan 24 2000 23:26:33 rsp-pv-mz.120-23.S
```

Step 2 Now view the standby software image location and version:

```
Router# show bootflash:
-#- ED ----type---- --crc--- -seek-- nlen -length- -----date/time------ name
1   .. image        FEC9823F  AF0424   18 11203868 Jan 24 2000 23:26:33 rsp-pv-mz.120-23.S
```

Step 3 To upgrade to the Cisco IOS Release 12.0(22.3)S1 system image on the active RSP, copy the Cisco IOS Release 12.0(22.3)S1 system image from a TFTP server to slot 0 on the active RSP:

```
Router# copy tftp slot0:rsp-pv-mz.120-22.3.S1
```

Step 4 Enter global configuration mode and configure the system to boot first from a Cisco IOS Release 12.0(22.3)S1 system image and then from a Cisco IOS Release 12.0(23)S system image.

```
Router# configure terminal
Router(config)# boot system flash slot0:rsp-pv-mz.120-22.3.S1
Router(config)# boot system flash slot0:rsp-pv-mz.120-23.S
```

With this configuration, when the slot 6 RSP is active, it looks first in its PC Card slot 0 for the system image file *rsp-pv-mz.120-22.3.S1* to boot. Finding this file, the router boots from that system image. When the slot 7 RSP is active, it also looks first in its slot 0 for the system image file *rsp-pv-mz.120-22.3.S1* to boot. Because that image does not exist in that location, the slot 7 RSP looks for the system image file *rsp-pv-mz.120-23.S* in slot 0 to boot. Finding this file in its PC Card slot 0, the router boots from that system image. In this way, each RSP can reboot the system using its own system image when it becomes the active RSP.

Step 5 Configure the system further with a fault-tolerant booting strategy:

```
Router(config)# boot system tftp rsp-pv-mz.120-23.S 10.1.1.25
```

Step 6 Set the configuration register to enable loading of the system image from a network server or from Flash memory and save the changes to the active and the standby startup configuration file:

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

Step 7 Reload the system so that the active RSP4/4+ uses the new Cisco IOS Release 12.0(22.3)S1 system image:

```
Router# reload
```

This completes the sample procedure for upgrading to a new software version.

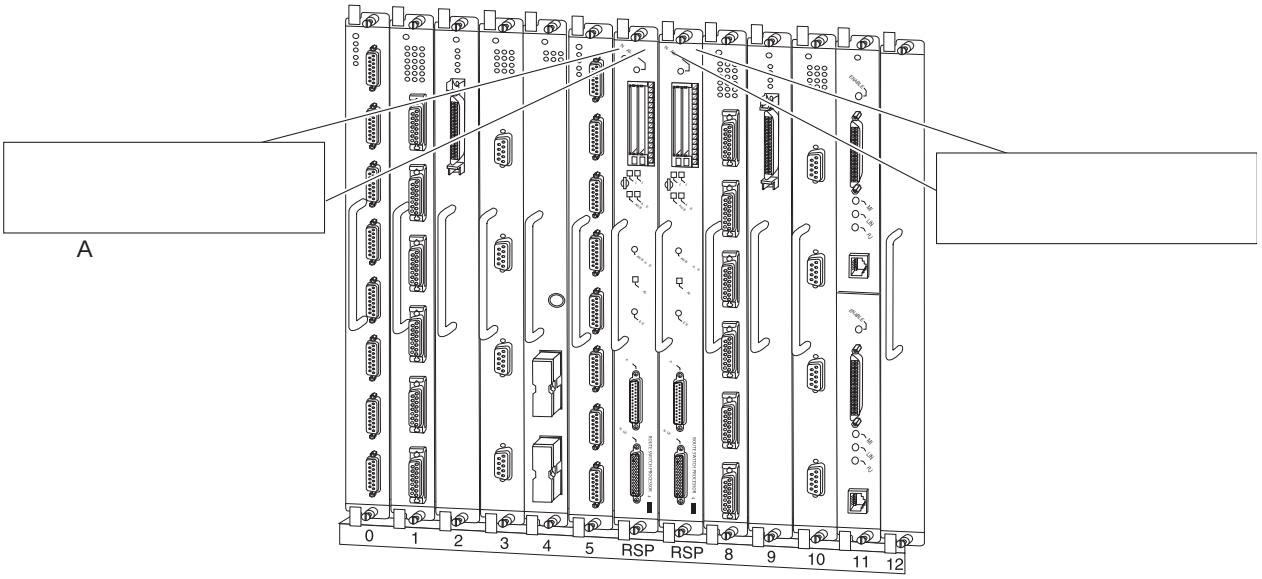
Backing Up with an Older Software Version Example

The following example describes a backup scenario under the following conditions:

- The active RSP is in processor slot 6, and the standby RSP is in processor slot 7 of a Cisco 7513 or Cisco 7513-MX.
- Both the active and the standby RSPs currently use the same image, *rsp-pv-mz.120-22.3.S1*, in PC Card slot 0.
- We want to use Cisco IOS Release 12.0(23)S as a backup to guard against software failures, and we will configure HSA operation for software error protection.

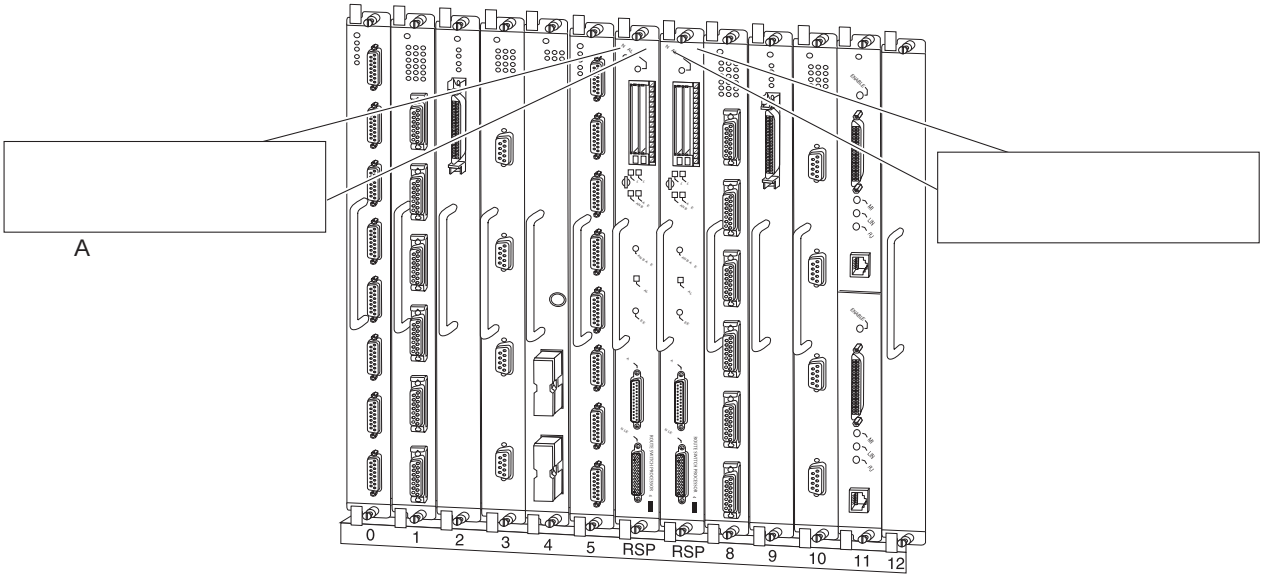
In this scenario, we begin with the configuration shown in Figure 9.

Figure 9 Software Error Protection—Backing Up with an Older Software Version, Part I



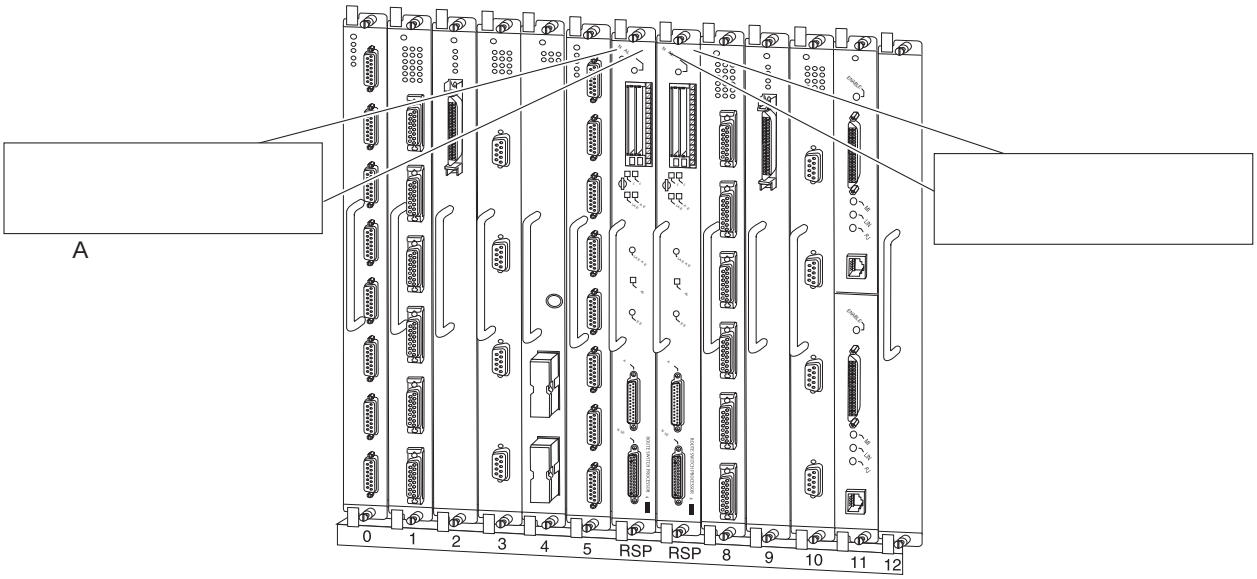
Next, we copy the *rsp-pv-mz.120-23.S* image to the active and the standby RSPs, as shown in Figure 10.

Figure 10 Software Error Protection—Backing Up with an Older Software Version, Part II



Last, we delete the *rsp-pv-mz.120-22.3.S1* image from the standby RSP4/4+ card, as shown in Figure 11:

Figure 11 Software Error Protection—Backing Up with an Older Software Version, Part III



Complete the following steps to configure software error protection for this sample scenario:

Step 1 To verify the location and version of the RSP software images, use the following commands to view slot 0 on the active and standby RSPs:

```
Router# show slot0:
-#- ED ----type---- --crc--- -seek-- nlen -length- -----date/time------ name
1   .. image        143B4C13  ACB820   21 11188128 Jan 28 2000 01:02:37
rsp-pv-mz.120-22.3.S1

Router# show bootflash:
-#- ED ----type---- --crc--- -seek-- nlen -length- -----date/time------ name
1   .. image        143B4C13  ACB820   21 11188128 Jan 28 2000 01:02:37
rsp-pv-mz.120-22.3.S1
```

Step 2 Copy the Cisco IOS Release 12.0(23)S system image from a TFTP server to PC Card slot 0 on the active and standby RSPs:

```
Router# copy tftp slot0:rsp-pv-mz.120-23.S
Router# copy tftp slaveslotk0:rsp-pv-mz.120-23.S
```

Step 3 Delete the *rsp-pv-mz.120-22.3.S1* image from the standby RSP:

```
Router# delete slaveslot0:rsp-pv-mz.120-22.3.S1
```

Step 4 Configure the system to boot first from a Cisco IOS Release 12.0(22.3)S1 system image and then from a Cisco IOS Release 12.0(23)S system image:

```
Router# configure terminal
Router(config)# boot system flash slot0:rsp-pv-mz.120-22.3.S1
Router(config)# boot system flash slot0:rsp-pv-mz.120-23.S
```

Step 5 Configure the system further with a fault-tolerant booting strategy:

```
Router(config)# boot system tftp rsp-pv-mz.120-23.S 10.1.1.25
```

Step 6 Set the configuration register to enable loading of the system image from a network server or from Flash memory and save the changes to the active and the standby startup configuration file:

```
Router(config)# config-register 0x010F
Router (config)# Crtl-Z
Router# copy system: running-config startup-config
```

Note You do not need to reload the router in this example, because the router is currently running the Cisco IOS Release 12.0(22.3)S1 image.

This completes the sample procedure for backing up with an older software version.

Setting Environment Variables on the Active and the Standby RSPs

You can optionally set environment variables on both RSP4/4+ cards in a Cisco 7507, Cisco 7507-MX, Cisco 7513, or Cisco 7513-MX.

Note When you configure the HSA operation, we recommend that you use the default environment variables. If you do change the variables, we recommend that you set the same device for equivalent environment variables on each RSP4/4+ card. For example, if you set one RSP4/4+ card CONFIG_FILE environment variable to NVRAM, then set the other RSP4/4+ card CONFIG_FILE environment variable to NVRAM also.

You set environment variables on the active RSP4/4+ just as you would if it were the only RSP4/4+ card in the system. You can set the same environment variables on the standby RSP4/4+ card manually or automatically.

The following sections describe these two methods:

- Manually Setting Environment Variables on the Standby RSP4/4+, page 41
- Automatically Setting Environment Variables on the Standby RSP4/4+, page 42

For more complete configuration information on how to set environment variables, refer to the *Cisco IOS Configuration Fundamentals Configuration Guide* and the *Cisco IOS Configuration Fundamentals Command Reference* publications, which are available online on Cisco.com, on the Documentation CD-ROM, or as printed documents.

Manually Setting Environment Variables on the Standby RSP4/4+

Once you set the active RSP4/4+ environment variables, you can manually set the same environment variables on the standby RSP4/4+ card using the **slave sync config** command.

However, automatic synchronization is enabled by default on the RSP. Therefore, unless you have disabled automatic synchronization, or this is the first time you are installing a second RSP, a manual update is not required. For more information about automatic synchronization, see the "Ensuring that Both RSPs Contain the Same Configuration Files" section on page 31.

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

For additional information about using the **slave sync config** command, see the "Monitoring and Maintaining HSA Operation" section on page 43. For more complete HSA configuration information, refer to the *Cisco IOS Configuration Fundamentals Configuration Guide* and the *Cisco IOS Configuration Fundamentals Command Reference* publications.

To manually set environment variables on the standby RSP4/4+, use the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	Router(config)# **boot system**	(Optional) Specifies the system image that the router loads at startup and stores it in the BOOT variable in the current running configuration. **Note** For a complete syntax description and usage guidelines, refer to the *Cisco IOS Configuration Fundamentals Command Reference* publication.
Step 2	Router(config)# **boot bootldr** *file-url*	(Optional) Specifies the Flash file system and file name that ROM uses at startup and stores it in the BOOTLDR variable in the current running configuration
Step 3	Router(config)# **boot config** *file-url*	(Optional) Specifies the location of the configuration file that the router uses at startup and stores it in the CONFIG_FILE environment variable in the current running configuration.
Step 4	Router(config)# **end**	Exits global configuration mode and returns you to privileged EXEC configuration mode.
Step 5	Router# **copy running-config startup-config**	Saves the settings to the startup configuration. This also puts the information under the RSP's ROM monitor control.
Step 6	Router# **slave sync config**	Saves the same environment variables to the standby RSP by manually synchronizing their configuration files.
Step 7	Router# **show bootvar**	Verifies the environment variable settings.

Automatically Setting Environment Variables on the Standby RSP4/4+

With automatic synchronization turned on, when you set the active RSP4/4+ environment variables and save them, the system automatically saves the same environment variables to the standby's startup configuration.

You do not need to use the **slave sync config** command when automatic synchronization is enabled, unless this is the first time you are installing a second RSP. For more information about this use of the **slave sync config** command, see the "Monitoring and Maintaining HSA Operation" section on page 43.

Note Automatic synchronization mode is on by default. Therefore, unless you have disabled automatic synchronization a manual update is not required. For more information about automatic synchronization, see the "Ensuring that Both RSPs Contain the Same Configuration Files" section on page 31.

To set environment variables on the standby RSP4/4+ when automatic synchronization is on, use the following commands on the active RSP beginning in global configuration mode:

	Command	Purpose
Step 1	Router(config)# **boot system**	(Optional) Specifies the system image that the router loads at startup and stores it in the BOOT variable in the current running configuration. **Note** For a complete syntax description and usage guidelines, refer to the *Cisco IOS Configuration Fundamentals Command Reference* publication.
Step 2	Router(config)# **boot bootldr** *file-url*	(Optional) Specifies the Flash file system and file name that ROM uses at startup and stores it in the BOOTLDR variable in the current running configuration
Step 3	Router(config)# **boot config** *file-url*	(Optional) Specifies the location of the configuration file that the router uses at startup and stores it in the CONFIG_FILE environment variable in the current running configuration.
Step 4	Router(config)# **end**	Exits global configuration mode and returns you to privileged EXEC configuration mode.
Step 5	Router# **copy running-config startup-config**	Saves the settings to the startup configuration. This also puts the information under that RSP4/4+ card's ROM monitor control.
Step 6	Router# **show bootvar**	Verifies the environment variable settings.

Monitoring and Maintaining HSA Operation

To monitor and maintain HSA operation, you can override the standby image that is bundled with the active image by using the following command in global configuration mode:

Command	Purpose
Router(config)# **hw-module slot image**	Specifies which image the standby runs.

Note The **slave image system** command, previously used to determine which image the standby runs, is not valid with newer images containing HA features.

You can manually synchronize configuration files and ROM monitor environment variables on the active and the standby RSPs using the following command in privileged EXEC configuration mode:

Command	Purpose
Router# **slave sync config**	Manually synchronizes active and standby configuration files.

Caution When you install a second RSP for the first time, you *must* immediately configure it using the **slave sync config** command. This ensures that the new standby is configured consistently with the active. Failure to do so might result in an unconfigured standby RSP taking control of the router when the active 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 *Cisco IOS Configuration Fundamentals Configuration Guide* and the *Cisco IOS Configuration Fundamentals Command Reference* publications, which are available on the Documentation CD-ROM, online at Cisco.com, or as printed documents.

Enabling High Availability Features

This section discusses the following topics:

High availability (HA), an alternative to the default high system availability (HSA) feature, is a series of features that minimizes system downtime through a "warm standby." Warm standby allows the system to switch over to a standby RSP preloaded with a Cisco IOS image in 30 seconds to 5 minutes, depending on the feature. For more information on high service availability (HSA), the system default program, refer to the "Configuring High System Availability" section on page 28. Like HSA, HA is supported on the Cisco 7507, Cisco 7507-MX, Cisco 7513, and Cisco 7513-MX routers with two RSP4/4+s, or with one RSP4/4+ and one RSP2.

A router configured for HA has two RSPs, an active RSP and a standby RSP. The active RSP controls all functions of the router, and the standby RSP monitors the active for failure.

High Availability Feature Overview

HA features include:

- Single Line Card Reload (SLCR)—Speeds recovery of a failed router by reloading a failed line card without reloading other line cards on the network backplane. SLCR isolates the fault to a single Versatile Interface Processor (VIP2 or VIP4) or Legacy interface processor card, and accelerates recovery time by reloading only the faulty VIP or Legacy interface processor card. Physical lines and routing protocols on the other line cards of the network backplane remain active. The system continues forwarding packets with minimal interruptions.

  SLCR is disabled by default and needs to be manually configured. When SLCR is enabled, and more than two line cards crash simultaneously, all line cards will be reset.

  For more information on how to configure SLCR, refer to the *Cisco 7500 Single Line Card Reload* feature module at http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/120newft/120limit/120s/120s13/slcr.htm.

- Route Processor Redundancy (RPR)—Speeds recovery of a failed router by accelerating switchover to the standby RSP. The standby RSP is preinitialized with the same full Cisco IOS software image as on the active RSP. When the active RSP fails, the standby RSP takes over. The line cards are OIR inserted by the standby RSP during the switchover. Switchover time is reduced to 4 to 5 minutes with RPR.

  RPR is disabled by default, and needs to be manually configured. For more information on RPR, refer to the *Route Processor Redundancy and Fast Software Upgrade on Cisco 7500 Series Routers* feature module available online at http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/120newft/120limit/120st/120st16/st_rpr7x.htm.

- Route Processor Redundancy Plus (RPR+)—Like RPR, RPR+ speeds recovery of a failed router by accelerating switchover to the standby RSP. The RPR+ feature, an enhancement of RPR, prevents a VIP from being reset and reloaded when a switchover occurs between the active and standby RSPs. Switchover time is reduced because VIPs are not reset, microcode does not reload on the VIPs, and the time needed to parse the configuration is eliminated.

  Online removal of the active RSP causes all line cards to reset and reload, which is equivalent to an RPR switchover, and results in a longer switchover time. When it is necessary to remove the active RSP from the system, first issue a switchover command to switch from the active RSP to the standby RSP.

  RPR+ is disabled by default, and needs to be manually configured. RPR+ does not support the Legacy interface processor card. The system will default to RPR if the router includes an Legacy interface processor card. For more information on how to configure RPR+, refer to the *RPR+ on Cisco 7500 Series Routers* feature module, available online at http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/120newft/120limit/120st/120st19/st_rpr2.htm.

- Fast Software Upgrade (FSU)—Accelerates switchover to a new software image. Fast Software Upgrade permits users to upgrade to an interim release or next minor release Cisco IOS image by uploading it to the standby RSP first. After loading the new Cisco IOS image on the standby RSP, the user can issue a command to switch to the standby RSP, and all the line cards will be reloaded, similar to what occurs in RPR. This feature allows users to upgrade Cisco IOS on their Cisco 7500 routers with much less interruption to service than previously experienced.

For more information on FSU, refer to the *Route Processor Redundancy and Fast Software Upgrade on Cisco 7500 Series Routers* feature module available online at http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/120newft/120limit/120st/120st16/st_rpr7x.htm.

- Stateful Switchover (SSO)—Based on RPR+, SSO allows the active RSP to pass the necessary state information of key routing and interface protocols to the standby RSP upon switchover, which reduces the time for the standby RSP to learn and converge routes.

  SSO is disabled by default, and needs to be manually configured. SSO does not support the Legacy interface processor cards. For more information on how to configure SSO, refer to the *Stateful Switchover* feature module available online at http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/120newft/120limit/120s/120s22/sso120s.htm.

- Cisco Nonstop Forwarding (NSF) —Used with SSO, NSF allows routers with redundant RSPs to continue forwarding data to the standby RSP during a switchover. This feature uses the Forwarding Information Base (FIB) that was current at the time of the switchover. Once the routing protocols have converged, the FIB table is updated and stale route entries are deleted. This feature eliminates downtime during the switchover. Note: Cisco NSF always runs together with SSO.

  Cisco NSF is supported by the BGP, OSPF, and IS-IS protocols for routing and by Cisco Express Forwarding (CEF) for forwarding. For more information on how to configure NSF, see the *Cisco Nonstop Forwarding* feature module available online at http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/120newft/120limit/120s/120s22/nsf120s.htm.

Hardware and Software Prerequisites

The HA features are available on the Cisco 7507, Cisco 7507-MX, Cisco 7513, and Cisco 7513-MX routers, loaded with RSP4/4+s (or an RSP4/4+ and an RSP2), provided the RSP4/4+ is running the 12.1(12)E image. The following HA features became available on the following minimum software releases:

- Single Line Card Reload (SLCR)—Cisco IOS Releases 12.0(13)S, 12.1(4)T, and 12.1(5)E
- Route Processor Redundancy (RPR)— Cisco IOS Release 12.0(16)ST
- Route Processor Redundancy Plus (RPR+)— Cisco IOS Release 12.0(19)ST
- Fast Software Upgrade (FSU)—Cisco IOS Release 12.0(16)ST
- Stateful Switchover (SSO) —Cisco IOS Release 12.0(22)S
- Non-Stop Forwarding (NSF)—Cisco IOS Release 12.0(22)S

Note For current hardware and softwarecompatibility information, refer to the Software Advisor tool at http://www.cisco.com/cgi-bin/Support/CompNav/Index.pl.

Installation Procedures

See the following sections for the configuration tasks required to run the RPR/RPR+, SSO with NSF, FSU, and SLCR features.

- Enabling the Router, page 47 (required)
- Copying an Image onto an RSP, page 47 (required)
- Setting the Config-Register Boot Variable, page 49 (optional)
- Configuring RPR and RPR+, page 49 (optional)
- Configuring a Stateful Switchover (SSO), page 52 (optional)
- Configuring Nonstop Forwarding (NSF), page 55 (optional; but SSO required)
- Performing a Fast Software Upgrade, page 63 (optional)
- Configuring SLCR, page 65 (optional)

Enabling the Router

To enter privileged EXEC configuration mode, enable the router using the following steps:

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

```
Router> enable
Password:
```

Step 2 Type the password (the password is case sensitive). For security purposes, the password is not displayed.

When you specify the correct password, the system displays the privileged-level system prompt (#):

```
Router#
```

This completes the procedure for enabling the router.

Copying an Image onto an RSP

You can use TFTP to copy a high availability Cisco IOS image onto the active and standby RSPs.

Note Before you begin to copy a file to Flash memory, be sure that there is enough space available in Flash memory. To verify the amount of Flash memory available, you can use the **show flash:** command. Compare the size of the file you are copying to the amount of available Flash memory shown. If the space available is less than the space required by the file you will copy, the copy process will continue, but the entire file will not be copied into Flash memory.

To copy a Cisco IOS software image from a TFTP server to a Flash memory card on the active RSP, use the following commands beginning in privileged EXEC configuration mode:

	Command	Purpose
Step 1	Router# **copy tftp slot***slot-number***:**	Uses TFTP to copy a high availability Cisco IOS image onto the Flash memory card of the active RSP.[1] • **slot***slot-number*—Specifies the Flash memory card of the active RSP.
	`Address or name of remote host []? ip-address`	The router prompts you for the IP address of the TFTP server. • *ip-address*—Specifies the IP address of the TFTP server that contains the new image.
	`Name of file to copy []? imagename<Return>` `writing filename!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!`	The router prompts you for the name of the image file you are copying to the Flash memory card. • *imagename*—Indicates the name of the image to be loaded onto the Flash memory card.

	`Destination filename? [imagename1] <Return>`
	`Accessing tftp://host ip-address/file 'imagename' on ip-address.. found !`
	`11188128 bytes copied in 2280.664 secs (4906 bytes/sec)`
		The router prompts you to enter the name under which you want the file to appear at the destination.
		• *imagename1*—Indicates the name of the image as it appears at the destination.

Step 2	Router# **copy tftp slaveslot***slot-number***:**	Uses TFTP to copy a high availability Cisco IOS image onto the Flash memory card of the standby RSP. • **slaveslot***slot-number*—Specifies the Flash memory card of the standby RSP.
	`Address or name of remote host []? ip-address`	The router prompts you for the IP address of the TFTP server. • *ip-address*—Specifies the IP address of the TFTP server that contains the new image.

	`Name of file to copy []? imagename<Return>`
	`writing`
	`filename!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!`
		The router prompts you for the name of the image file you are copying to the Flash memory card.
		• *imagename*—Indicates the name of the image to be loaded onto the Flash memory card.

	`Destination filename? [imagename1] <Return>`
	`Accessing file 'imagename' on ip-address.. found !`
	`903500 bytes available for writing without erasure.`
	`Loading imagename from ip-address (via Ethernet1/0):`
	`!`
	`[OK - 3320245/4194176 bytes]`
		The router prompts you to enter the name under which you want the file to appear at the destination.
		• *imagename1*—Indicates the name of the image as it appears at the destination.

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

Setting the Config-Register Boot Variable

Though it is not required, we recommend that you modify the software configuration register boot field so that the system boots the same image that the **hw-module slot** *slot-number* **image** *file-spec* command specifies in the "Configuring RPR and RPR+" section on page 49.

	Command	Purpose
Step 1	Router# **show version**	Obtains the current configuration register setting.
Step 2	Router# **configure terminal**	Enters global configuration mode.
Step 3	Router(config)# **boot system flash slot***slot-number*:[*imagename*]	Specifies the filename of an image stored in Flash memory. • *imagename*—It is recommended that you set the boot variable so that the system boots the same image specified by the **hw-module slot** *slot-number* **image** *file-spec* command. See Step 2 of the "Configuring RPR and RPR+" section on page 49. • *slot-number*—Specifies the active RSP slot where the Flash memory card is located. Valid numbers are slot 2 or slot 3 for a Cisco 7507 router and slot 6 or slot 7 for a Cisco 7513 router.
Step 4	Router(config)# **config-register** *value*	Modifies the existing configuration register setting to reflect the way in which you want to load a system image. *value*—0x0 to 0xFFFFFFFF
Step 5	Router(config)# **end**	Exits global configuration mode and returns you to privileged EXEC configuration mode.
Step 6	Router# **reload**	Resets the router with the new configuration information.

Configuring RPR and RPR+

Note Online removal of the active RSP causes all line cards to reset and reload, which is the equivalent to an RPR switchover, and results in a longer switchover time. When it is necessary to remove the active RSP from the system, first issue a switchover command to switch from the active RSP to the standby RSP.

To configure RPR and RPR+, use the following commands beginning in privileged EXEC configuration mode:

	Command	Purpose
Step 1	Router# **configure terminal**	Enters global configuration mode.
Step 2	Router(config)# **hw-module slot** *slot-number* **image** *file-spec*	Specifies the image to be used by the active RSP at initialization. If a high-availability image is found, the running configuration is updated. • *slot-number*—Specifies the active RSP slot where the Flash memory card is located. Valid numbers are slot 2 or slot 3 for a Cisco 7507 router or slot 6 or slot 7 for a Cisco 7513 router. • *file-spec*—Indicates the flash device and the name of the image on the active RSP. **Note** Step 2 and Step 3 are the same; Step 2 applies to the active RSP and Step 3 applies to the standby RSP.
Step 3	Router(config)# **hw-module slot** *slot-number* **image** *file-spec*	Specifies the image to be used by the standby RSP at initialization. If a high-availability image is found, the running configuration is updated. • *slot-number*—Specifies the standby RSP slot where the Flash memory card is located. Valid numbers are slot 2 or slot 3 for a Cisco 7507 router or slot 6 or slot 7 for a Cisco 7513 router. • *file-spec*—Indicates the Flash device and the name of the image on the standby RSP. **Note** Step 2 and Step 3 are the same; Step 2 applies to the active RSP and Step 3 applies to the standby RSP.
Step 4	Router(config)# **redundancy**	Enters redundancy configuration mode.
Step 5	Router(config-red)# **mode rpr** (Or **mode rpr-plus**)	Sets the redundancy mode to RPR (or RPR+) on both the active and standby RSPs. HSA is the default redundancy mode.
Step 6	Router(config-red)# **exit**	Exits redundancy mode and returns you to global configuration mode.
Step 7	Router(config)# **end**	Exits global configuration mode and returns you to privileged EXEC configuration mode.
Step 8	Router# **hw-module sec-cpu reset**	Resets and reloads the standby RSP with the specified Cisco IOS image and executes the image. **Note** If you do not specify a Cisco IOS image in Step 2, this command loads and executes the bundled default IOS standby image. The system then operates in HSA mode.

Verifying RPR and RPR+

Use the **show redundancy** command to verify that RPR or RPR+ is enabled:

```
Router# show redundancy

Operating mode is sso
redundancy mode sso
hw-module slot 6 image disk0:rsp-pv-mz
hw-module slot 7 image disk0:rsp-pv-mz

Active High Availability version is 3.0
Standby High Availability version is 3.0

Active in slot 6
Standby in slot 7

The system total uptime since last reboot is 2 weeks, 23 hours 41 minutes.
The system has experienced 4 switchovers.
The system has been active (become master) for 21 hours 1 minute.
Reason for last switchover:User forced.
```

RPR and RPR+ Configuration Example

In the following example, the active RSP is in slot 2 and the standby RSP is installed in slot 3 of a Cisco 7507 router.

```
Router# copy tftp slot0:rsp-pv-mz
Router# copy tftp slaveslot0:rsp-pv-mz
Router# configure terminal
Router(config)# hw-module slot 2 image slot0:rsp-pv-mz
Router(config)# hw-module slot 3 image slot0:rsp-pv-mz
Router(config)# redundancy
Router(config-red)# mode rpr (Or mode rpr-plus)
Router(config-red)# exit
Router(config)# end
Router# hw-module sec-cpu reset
Router# show running-config
version 12.0
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
service single-slot-reload-enable
!
hostname Router1
!
boot system rcp://path/to/image/rsp-boot-mz
boot system tftp://path/to/image/rsp-boot-mz
boot bootldr bootflash:rsp-boot-mz
enable password password
!
redundancy
 mode rpr !--indicates Redundancy mode has been configured for RPR
!
hw-module slot 2 image slot0:rsp-pv-mz
hw-module slot 3 image slot0:rsp-pv-mz
ip subnet-zero
ip rcmd remote-username router1
ip cef distributed
ip host iphost 192.168.0.1
mpls traffic-eng auto-bw timers
!
!
```

```
controller T3 6/0/0
 clock source line
!
!
interface Ethernet0/0/0
 ip address 10.0.0.1 255.255.0.0
 no ip directed-broadcast
 ip route-cache distributed
 no keepalive
.
.
.
exec-timeout 0 0
 history size 40
 transport preferred none
 transport input none
line aux 0
line vty 0 4
 login
```

Configuring a Stateful Switchover (SSO)

To configure SSO, use the following commands beginning in privileged EXEC configuration mode:

	Command	Purpose
Step 1	Router# **configure terminal**	Enters global configuration mode.
Step 2	Router(config)# **hw-module slot** *slot-number* **image** *file-spec*	Specifies the image to be used by the active RSP at initialization. If a high-availability image is found, the running configuration is updated. • *slot-number*—Specifies the active RSP slot where the Flash memory card is located. Valid numbers are slot 2 or slot 3 for a Cisco 7507 router or slot 6 or slot 7 for a Cisco 7513 router. • *file-spec*—Indicates the Flash device and the name of the image on the active RSP. **Note** Step 2 and Step 3 are the same; Step 2 applies to the active RSP and Step 3 applies to the standby RSP. **Note** The image indicated by the *file-spec* attribute must be available on the local Flash device. Remote protocols such a TFTP and remote copy are not available.

	Command	Purpose
Step 3	Router(config)# **hw-module slot** slot-number **image** file-spec	Specifies the image to be used by the standby RSP at initialization. If a high-availability image is found, the running configuration is updated. • *slot-number*—Specifies the standby RSP slot where the Flash memory card is located. Valid numbers are slot 2 or slot 3 for a Cisco 7507 router or slot 6 or slot 7 for a Cisco 7513 router. • *file-spec*—Indicates the Flash device and the name of the image on the active RSP. **Note** Step 2 and Step 3 are the same; Step 2 applies to the active RSP and Step 3 applies to the standby RSP. **Note** The image indicated by the *file-spec* attribute must be available on the local Flash device. Remote protocols such a TFTP and remote copy are not available.
Step 4	Router(config)# **redundancy**	Enters redundancy configuration mode.
Step 5	Router(config-red)# **mode sso**	Sets the redundancy configuration mode to SSO on both the active and standby RSP. **Note** After configuring SSO mode, the standby RSP automatically resets.
Step 6	Router(config-red)# **end**	Exits redundancy configuration mode and returns you to privileged EXEC configuration mode.
Step 7	Router(config)# **end**	Exits global configuration mode and returns you to privileged EXEC configuration mode.
Step 8	Router# **copy running-config startup-config**	Saves the configuration changes to the startup configuration file.

Configuring Frame Relay Autosynchronization LMI Sequence Numbers

The autosynchronization procedure is only for devices supporting Frame Relay and is optional. To configure Frame Relay SSO to synchronize LMI sequence numbers between the active and standby RSPs, use the following command in global configuration mode.

Command	Purpose
Router(config)# **frame-relay redundancy auto-sync lmi-sequence-numbers**	Configures automatic synchronization of Frame Relay LMI sequence numbers between the active RSP and the standby RSP.

Verifying SSO

To verify that SSO is configured on the networking device, use the **show redundancy** command. To verify that the device is running in SSO mode, use the show redundancy states command. The **show redundancy states** command specifies whether the unit is running in SSO mode, which is indicated by STANDBY HOT.

Note The output of these commands will vary based on your device configuration and system site requirements.

Step 1 Use the **show redundancy** command to verify that SSO is configured on the device.

```
Router# show redundancy

Operating mode is sso
redundancy mode sso
hw-module slot 6 image disk0:rsp-pv-mz
hw-module slot 7 image disk0:rsp-pv-mz

Active High Availability version is 3.0
Standby High Availability version is 3.0

Active in slot 6
Standby in slot 7

The system total uptime since last reboot is 2 weeks, 23 hours 41 minutes.
The system has experienced 4 switchovers.
The system has been active (become master) for 21 hours 1 minute.
Reason for last switchover:User forced.
```

Step 2 Use the **show redundancy states** command to verify that SSO is operating on the device.

```
Router# show redundancy states
my state = 13 -ACTIVE
peer state = 8  -STANDBY HOT
Mode = Duplex
Unit ID = 7

Redundancy Mode = sso
Maintenance Mode = Disabled
Manual Swact = Enabled
Communications = Up

client count = 12
client_notification_TMR = 30000 milliseconds
RF debug mask = 0x0
```

Step 3 Use the **show redundancy client** command to display the list of applications and protocols that have registered as SSO protocols or applications. Verify the list of supported line protocols.

```
Router# show redundancy client

 clientID = 0      clientSeq = 0        RF_INTERNAL_MSG
 clientID = 25     clientSeq = 130      CHKPT RF
 clientID = 22     clientSeq = 140      Network RF Client
 clientID = 24     clientSeq = 150      CEF RRP RF Client
 clientID = 37     clientSeq = 151      MDFS RRP RF Client
 clientID = 23     clientSeq = 220      FRAME RELAY
 clientID = 49     clientSeq = 225      HDLC
 clientID = 20     clientSeq = 310      IPROUTING NSF RF cli
```

```
clientID = 21     clientSeq = 320      PPP RF
clientID = 34     clientSeq = 330      SNMP RF Client
clientID = 29     clientSeq = 340      ATM
clientID = 35     clientSeq = 350      History RF Client
clientID = 50     clientSeq = 530      SNMP HA RF Client
clientID = 65000  clientSeq = 65000    RF_LAST_CLIENT
```

Configuring Nonstop Forwarding (NSF)

Cisco Nonstop Forwarding (NSF) always runs together with SSO. If you have not already configured SSO, refer to the "Configuring a Stateful Switchover (SSO)" section on page 52. Cisco NSF is supported by the BGP, OSPF, and IS-IS protocols for routing and by Cisco Express Forwarding (CEF) for forwarding. Of the routing protocols, BGP, OSPF, and IS-IS have been enhanced with NSF-capability and awareness, which means that routers running these protocols can detect a switchover and take the necessary actions to continue forwarding network traffic and to recover route information from the peer devices. The IS-IS protocol can be configured to use state information that has been synchronized between the active and the standby RSP to recover route information following a switchover instead of information received from peer devices.

A device is said to be NSF-capable if it has been configured to support NSF; therefore, it would rebuild routing information from NSF-aware or NSF-capable neighbors.

Each protocol depends on CEF to continue forwarding packets during switchover while the routing protocols rebuild the Routing Information Base (RIB) tables. Once the routing protocols have converged, CEF updates the FIB table and removes stale route entries. CEF, in turn, updates the line cards with the new FIB information.

See the following sections for the NSF feature. Each task in the list is identified as either required or optional.

Configuring CEF NSF

The CEF NSF feature operates by default while the networking device is running in SSO mode. No configuration is necessary.

Configuring BGP NSF

Note You must configure BGP graceful restart on all peer devices participating in BGP NSF.

To configure BGP for NSF, use the following commands beginning in privileged EXEC configuration mode, and repeat this procedure on each of the BGP NSF peer devices:

	Command	Purpose
Step 1	Router# **configure terminal**	Enters global configuration mode.
Step 2	Router(config)# **router bgp as-number**	Enables a BGP routing process, and enters router configuration mode.
Step 3	Router(config-router)# **bgp graceful-restart**	Enables the BGP graceful restart capability, starting NSF for BGP. If you enter this command after the BGP session has been established, you must restart the session for the capability to be exchanged with the BGP neighbor. Use this command on the restarting router and all of its peers.

Configuring OSPF NSF

Note All peer devices participating in OSPF NSF must be made OSPF NSF-aware, which happens automatically once you install an NSF software image on the device.

To configure NSF for OSPF, use the following commands beginning in privileged EXEC configuration mode:

	Command	Purpose
Step 1	Router# **configure terminal**	Enters global configuration mode.
Step 2	Router(config)# **router ospf** *processID*	Enables an OSPF routing process, which places the router in router configuration mode.
Step 3	Router(config-router)# **nsf**	Enables NSF operations for OSPF.

Configuring IS-IS NSF

To configure NSF for IS-IS, use the following commands beginning in privileged EXEC configuration mode:

	Command	Purpose
Step 1	Router# **configure terminal**	Enters global configuration mode.
Step 2	Router(config)# **router isis** [*tag*]	Enables an IS-IS routing process, and enters router configuration mode.

	Command	Purpose
Step 3	Router(config-router)# **nsf** [**cisco** | **ietf**]	Enables NSF operation for IS-IS. Use the **ietf** keyword to enable IS-IS in homogeneous network where adjacencies with networking devices supporting IETF draft-based restartability is guaranteed. Use the **cisco** keyword to run IS-IS in heterogeneous networks that might not have adjacencies with NSF-aware networking devices.
Step 4	Router(config-router)# **nsf interval** [*minutes*]	(Optional) Specifies the minimum time between NSF restart attempts. The default time between consecutive NSF restart attempts is 5 minutes.
Step 5	Router(config-router)# **nsf t3** {**manual** [*seconds*] | **adjacency**}	(Optional) Specifies the time IS-IS will wait for the IS-IS database to synchronize before generating overloaded link-state information for itself and flooding that information out to its neighbors. The **t3** keyword applies only if you selected **ietf** operation. Specifying **adjacency** means that the restarting router obtains its wait time from neighboring devices.
Step 6	Router(config-router)# **nsf interface wait** *seconds*	(Optional) Specifies how long an IS-IS NSF restart will wait for all interfaces with IS-IS adjacencies to come up before completing the restart. The default is 10 seconds.

Verifying CEF NSF

To verify that CEF is NSF-capable, use the **show cef state** command:

```
Router# show cef state
CEF Status [RP]
CEF enabled/running
dCEF enabled/running
CEF switching enabled/running
CEF default capabilities:
Always FIB switching: no
Default CEF switching: yes
Default dCEF switching: no
Update HWIDB counters: no
Drop multicast packets: no
Output dCAR supported: no
OK to punt packets: yes
NVGEN CEF state: no
fastsend() used: no
ACL logging at irq: no
Per-packet loadbalancing: no
Allow CEF re-enable: no
MAC accounting on RP: no
Background ADJ updater: no
Force loadinfo structures: no
CEF NSF capable: yes
IPC delayed func on SSO: no
FIB auto repair supported: yes
HW forwarding on this platform: no
HW forwarding in this CEF instance:no
LCs not running at init time:no
IP CEF accounting supported:yes
RP state:
```

```
Expanded LC ipc memory: 0 Kbytes
Linecard reloader type: aggressive (Default)
RRP state:
I am standby RRP: no
RF Peer Presence: yes
RF PeerComm reached: yes
Redundancy mode: sso(7)
CEF NSF: enabled/running
```

Verifying BGP NSF

To verify NSF for BGP, you must check that the graceful restart function is configured on the SSO-enabled networking device and on the neighbor devices. Perform the following steps:

Step 1 Verify that "bgp graceful-restart" appears in the BGP configuration of the SSO-enabled router using the **show running-config** command:

```
Router# show running-config
router bgp 120
bgp graceful-restart
neighbor 10.2.2.2 remote-as 300
```

Step 2 Repeat Step 1 on each of the BGP neighbors.

Step 3 On the SSO device and the neighbor device, verify that the graceful restart function is shown as both advertised and received, and confirm the address families that have the graceful restart capability. If no address families are listed, then BGP NSF also will not occur:

```
Router#show ip bgp neighbors x.x.x.x
BGP neighbor is 192.168.2.2,  remote AS YY, external link
  BGP version 4, remote router ID 192.168.2.2
  BGP state = Established, up for 00:01:18
  Last read 00:00:17, hold time is 180, keepalive interval is 60 seconds
  Neighbor capabilities:
    Route refresh:advertised and received(new)
    Address family IPv4 Unicast:advertised and received
    Address famiiy IPv4 Multicast:advertised and received
    Graceful Restart Capabilty:advertised and received
      Remote Restart timer is 120 seconds
      Address families preserved by peer:
        IPv4 Unicast, IPv4 Multicast
  Received 1539 messages, 0 notifications, 0 in queue
  Sent 1544 messages, 0 notifications, 0 in queue
  Default minimum time between advertisement runs is 30 second
```

Verifying OSPF NSF

To verify NSF for OSPF, you must check that the NSF function is configured on the SSO-enabled networking device. Perform the following steps:

Step 1 Verify that 'nsf' appears in the OSPF configuration of the SSO-enabled device using the **show running-config** command:

```
Router# show running-config
router ospf 120
log-adjacency-changes
nsf
network 192.168.20.0 0.0.0.255 area 0
network 192.168.30.0 0.0.0.255 area 1
network 192.168.40.0 0.0.0.255 area 2
```

Step 2 Use the **show ip ospf** command to verify that NSF is enabled on the device:

```
Router> show ip ospf
Routing Process "ospf 1" with ID 192.168.2.1 and Domain ID 0.0.0.1
Supports only single TOS(TOS0) routes
Supports opaque LSA
SPF schedule delay 5 secs, Hold time between two SPFs 10 secs
Minimum LSA interval 5 secs. Minimum LSA arrival 1 secs
Number of external LSA 0. Checksum Sum 0x0
Number of opaque AS LSA 0. Checksum Sum 0x0
Number of DCbitless external and opaque AS LSA 0
Number of DoNotAge external and opaque AS LSA 0
Number of areas in this router is 1. 1 normal 0 stub 0 nssa
External flood list length 0
Non-Stop Forwarding enabled, last NSF restart 00:02:06 ago (took 44 secs)
Area BACKBONE(0)
Number of interfaces in this area is 1 (0 loopback)
 Area has no authentication
 SPF algorithm executed 3 times
```

Verifying IS-IS NSF

To verify NSF for IS-IS, you must check that the NSF function is configured on the SSO-enabled networking device. Perform the following steps:

Step 1 Verify that “nsf” appears in the IS-IS configuration of the SSO-enabled device by using the **show running-config** command. The display will show either Cisco IS-IS or IETF IS-IS configuration. The following display indicates that the device uses the Cisco implementation of IS-IS NSF:

```
Router# show running-config
router isis
nsf cisco
```

Step 2 If the NSF configuration is set to **cisco**, use the **show isis nsf** command to verify that NSF is enabled on the device. Using the Cisco configuration, the display output will be different on the active and standby RSPs. The following display shows sample output for the Cisco configuration on the active RSP. In this example, note the presence of “NSF restart enabled”:

```
Router# show isis nsf
NSF is ENABLED, mode 'cisco'
RP is ACTIVE, standby ready, bulk sync complete
```

```
NSF interval timer expired (NSF restart enabled)
Checkpointing enabled, no errors
Local state:ACTIVE,  Peer state:STANDBY HOT,  Mode:SSO
```

The following display shows sample output for the Cisco configuration on the standby RSP. In this example, note the presence of “NSF restart enabled”:

```
Router# show isis nsf
NSF enabled, mode 'cisco'
RP is STANDBY, chkpt msg receive count:ADJ 2, LSP 7
NSF interval timer notification received (NSF restart enabled)
Checkpointing enabled, no errors
Local state:STANDBY HOT,  Peer state:ACTIVE,  Mode:SSO
```

Step 3 If the NSF configuration is set to **ietf**, use the **show isis nsf** command to verify that NSF is enabled on the device. The following display shows sample output for the IETF IS-IS configuration on the networking device:

```
Router# show isis nsf
NSF is ENABLED, mode IETF
NSF pdb state:Inactive
NSF L1 active interfaces:0
NSF L1 active LSPs:0
NSF interfaces awaiting L1 CSNP:0
Awaiting L1 LSPs:
NSF L2 active interfaces:0
NSF L2 active LSPs:0
NSF interfaces awaiting L2 CSNP:0
Awaiting L2 LSPs:
Interface:Serial3/0/2
    NSF L1 Restart state:Running
    NSF p2p Restart retransmissions:0
    Maximum L1 NSF Restart retransmissions:3
    L1 NSF ACK requested:FALSE
    L1 NSF CSNP requested:FALSE
    NSF L2 Restart state:Running
    NSF p2p Restart retransmissions:0
    Maximum L2 NSF Restart retransmissions:3
    L2 NSF ACK requested:FALSE
Interface:GigabitEthernet2/0/0
    NSF L1 Restart state:Running
    NSF L1 Restart retransmissions:0
    Maximum L1 NSF Restart retransmissions:3
    L1 NSF ACK requested:FALSE
    L1 NSF CSNP requested:FALSE
    NSF L2 Restart state:Running
    NSF L2 Restart retransmissions:0
    Maximum L2 NSF Restart retransmissions:3
    L2 NSF ACK requested:FALSE
    L2 NSF CSNP requested:FALSE
Interface:Loopback1
    NSF L1 Restart state:Running
    NSF L1 Restart retransmissions:0
    Maximum L1 NSF Restart retransmissions:3
    L1 NSF ACK requested:FALSE
    L1 NSF CSNP requested:FALSE
    NSF L2 Restart state:Running
    NSF L2 Restart retransmissions:0
    Maximum L2 NSF Restart retransmissions:3
    L2 NSF ACK requested:FALSE
    L2 NSF CSNP requested:FALSE
```

Troubleshooting NSF Features

To troubleshoot the NSF feature, use the following commands in privileged EXEC configuration mode, as needed:

Command	Purpose
Router# **clear cef epoch**	Begins a new epoch and increments the epoch number for a CEF table.
Router# **debug isis nsf [detail]**	Displays information about the IS-IS state during a Cisco NSF restart.
Router# **debug ospf nsf [detail]**	Displays debugging messages related to OSPF Cisco NSF commands.
Router# **show cef nsf**	Displays the current NSF state of CEF on both the active and standby RSPs.
Router# **show cef state**	Displays the state of CEF on a networking device.
Router# **show clns neighbors**	Display both end-system (ES) and intermediate system (IS) neighbors.
Router> **show ip bgp**	Displays entries in the BGP routing table.
Router# **show ip bgp neighbor**	Displays information about the TCP and BGP connections to neighbor devices.
Router# **show ip cef**	Displays entries in the FIB that are unresolved, or displays a FIB summary.
Router> **show ip ospf**	Displays general information about OSPF routing processes.
Router> **show ip ospf neighbor [detail]**	Displays OSPF-neighbor information on a per-interface basis.
Router# **show isis database [detail]**	Displays the IS-IS link-state database.
Router# **show isis nsf**	Displays the current state information regarding IS-IS Cisco NSF.

NSF Troubleshooting Tips

For the following troubleshooting situations, try the corresponding recommended action to resolve the problem.

Symptom The system displays FIB errors.

Recommended Action Use the **show cef state** command to verify that distributed CEF switching is enabled on your platform. To enable distributed CEF, use the **ip cef distributed** command in global configuration mode on the active RSP.

Symptom Cannot determine if an OSPF neighbor is NSF-aware.

Recommended Action To verify whether an OSPF neighbor device is NSF-aware and if NSF is operating between them, use the **show ip ospf neighbor detail** command.

Symptom The system loses, or appears to lose, adjacencies with network peers following a stateful switchover.

Recommended Action Use the **show clns neighbors detail** command to find any neighbors that do not have “NSF capable” and make sure that they are running NSF-aware images. Additionally, for ISIS, the standby RSP must be stable for 5 minutes (default) before another restart can be initiated. Use the **nsf interval** command to reset the restart period.

BGP NSF Configuration Example

The following example configures BGP NSF on a networking device:

```
Router# configure terminal
Router(config)# router bgp 590
Router(config-router)# bgp graceful-restart
```

BGP NSF Neighbor Device Configuration Example

The following example configures BGP NSF on a neighbor router. All devices supporting BGP NSF must be NSF-aware, meaning that these devices recognize and advertise graceful restart capability.

```
Router# configure terminal
Router(config)# router bgp 770
Router(config-router)# bgp graceful-restart
```

OSPF NSF Configuration Example

The following example configures OSPF NSF on a networking device:

```
Router# configure terminal
Router(config)# router ospf 400
Router(config-router)# nsf
```

IS-IS NSF Configuration Example

The following example configures Cisco proprietary IS-IS NSF operation on a networking device:

```
Router# configure terminal
Router(config)# router isis
Router(config-router)# nsf cisco
```

The following example configures IS-IS NSF for IETF operation on a networking device:

```
Router# configure terminal
Router(config)# router isis
Router(config-router)# nsf ietf
```

Performing a Fast Software Upgrade

To perform a Fast Software Upgrade (FSU), use the following commands beginning in privileged EXEC configuration mode:

	Command	Purpose
Step 1	Router# **copy tftp slot***slot-number***:**	Uses TFTP to copy a high availability Cisco IOS image onto the Flash memory card of the active RSP.[1] • **slot***slot-number*—Specifies the Flash memory card of the active RSP.
	`Address or name of remote host []? ip-address`	The router prompts you for the IP address of the TFTP server. • *ip-address*—Specifies the IP address of the TFTP server that contains the new image.
	`Name of file to copy []? imagename<Return>` `writing filename!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!`	The router prompts you for the name of the image file you are copying to the Flash memory card. • *imagename*—Indicates the name of the image to be loaded onto the Flash memory card.

	`Destination filename? [imagename1] <Return>`
	`Accessing tftp://host ip-address/file 'imagename' on ip-address.. found !`
	`11188128 bytes copied in 2280.664 secs (4906 bytes/sec)`
		The router prompts you to enter the name under which you want the file to appear at the destination.
		• *imagename1*—Indicates the name of the image as it appears at the destination.
		Note Step 1 and Step 2 are the same. Step 1 applies to the active RSP, and Step 2 applies to the the standby RSP.

Step 2	Router# **copy tftp slot***slot-number***:**
	
	`Address or name of remote host []? ip-address`
	
	`Name of file to copy []? imagename<Return>`
	`writing filename!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!`
	
	`Destination filename? [imagename1] <Return>`
	`Accessing tftp://host ip-address/file 'imagename' on ip-address.. found !`
	`11188128 bytes copied in 2280.664 secs (4906 bytes/sec)`
		Uses TFTP to copy a high availability Cisco IOS image onto the Flash memory card of the standby RSP.
		• **slaveslot***slot-number*—Specifies the Flash memory card of the standby RSP.
		Note Step 1 and Step 2 are the same. Step 1 applies to the active RSP, and Step 2 applies to the the standby RSP.
		The router prompts you for the IP address of the TFTP server.
		• *ip-address*—Specifies the IP address of the TFTP server that contains the new image
		The router prompts you for the name of the image file you are copying to the Flash memory card.
		• *imagename*—Indicates the name of the image to be loaded onto the Flash memory card.
		The router prompts you to enter the name under which you want the file to appear at the destination.
		• *imagename1*—Indicates the name of the image as it appears at the destination.

Step 3	Router# **configure terminal**	Enters global configuration mode.
Step 4	Router(config)# **hw-module slot** *slot-number* **image** *file-spec*	Specifies the image to be used by the active RSP at initialization. If a high-availability image is found, the running configuration is updated. • *slot-number*—Specifies the active RSP slot where the Flash memory card is located. Valid numbers are slot 2 or slot 3 for a Cisco 7507 router or slot 6 or slot 7 for a Cisco 7513 router. • *file-spec*—Indicates the Flash device and the name of the image on the active RSP.
Step 5	Router(config)# **hw-module slot** *slot-number* **image** *file-spec*	Specifies the image to be used by the standby RSP at initialization. If a high-availability image is found, the running configuration is updated. • *slot-number*—Specifies the standby RSP slot where the Flash memory card is located. Valid numbers are slot 2 or slot 3 for a Cisco 7507 router or slot 6 or slot 7 for a Cisco 7513 router. • *file-spec*—Indicates the Flash device and the name of the image of the standby RSP.
Step 6	Router(config)# **slave auto-sync config**	(Optional) Turns on automatic synchronization of configuration files. Use this command to ensure that the active and standby RSPs contain the same configuration files.

Step 7	Router(config)# **end**	Exits global configuration mode and returns you to privileged EXEC configuration mode.
Step 8	Router# **copy running-config startup-config**	Saves the configuration changes to your startup configuration in NVRAM so the router boots with the configuration you have entered.
Step 9	Router# **hw-module sec-cpu reset**	Resets and reloads the standby RSP with the specified Cisco IOS image and executes the image. **Note** If you do not specify a Cisco IOS image in Step 2, this command loads and executes the bundled default IOS standby image. The system then operates in HSA mode.
Step 10	Router# **redundancy force-switchover**	Forces a switchover to the standby RSP.

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

Fast Software Upgrade Example

The following example show a Fast Software Upgrade performed on a Cisco 7507 router with an active RSP in slot 2 and a standby RSP installed in slot 3.

```
Router# copy tftp slot0:rsp-pv-mz
Router# copy tftp slaveslot0:rsp-pv-mz
Router# configure terminal
Router(config)# hw-module slot 2 image slot0:rsp-pv-mz
Router(config)# hw-module slot 3 image slot0:rsp-pv-mz
Router(config)# end
Router# hw-module sec-cpu reset
Router# copy running-config startup-config
Router# redundancy force-switchover
```

Configuring SLCR

The Cisco 7500 SLCR feature is disabled by default. Therefore, the process for disabling this feature is only necessary if the Cisco 7500 SLCR feature has been enabled by the user on the Cisco 7500 series router.

Enabling SLCR

To enable the Cisco 7500 Single Line Card Reload (SLCR) feature, use the **service single-slot-reload-enable** global configuration command on the Cisco 7500 series router.

Command	Purpose
Router(config)# **service single-slot-reload-enable**	Enables single line card reloading for all of the line cards in the Cisco 7500 series router.

Disabling SLCR

To disable the Cisco 7500 Single Line Card Reload feature, use the **no service single-slot-reload-enable** global configuration command on the Cisco 7500 series router.

Command	Purpose
Router(config)# **no service single-slot-reload-enable**	Disables single line card reloading for all of the line cards in the Cisco 7500 series router.

Verifying Cisco 7500 SLCR

Use the **show running-config** command to verify that single line card reloading has been successfully enabled on the Cisco 7500 series router. If the *service single-slot-reload-enable* line appears in the command output, Cisco 7500 SLCR is enabled. If this line does not appear in the command output, Cisco 7500 SLCR is disabled.

SLCR Configuration Example

In the following example, SLCR is enabled for all lines cards in the Cisco 7500 series router:

```
Router(config)# service single-slot-reload-enable
```

In the following example, SLCR is disabled for all line cards in the Cisco 7500 series router:

```
Router(config)# no service single-slot-reload-enable
```

SLCR Troubleshooting Tips

The **debug oir** command is used to debug the online insertion and removal (OIR) feature (which is also known as hot-swapping or power-on servicing). The **debug oir** command is often useful in debugging problems related to OIR, including single line card reloading.

RPR, RPR+, SSO, and FSU Troubleshooting Tips

Use the commands in the table below to troubleshoot the RPR, RPR+, SSO, and FSU features on Cisco 7500 series routers:

Command	Purpose
Router# **show diag**	Displays hardware information for the router.
Router# **show redundancy**	Displays the redundancy mode of the RSP. This command also displays information about the number of switchovers, system uptime, RSP uptime, and reasons for any switchovers.
Router# **show version**	Displays image information for each RSP.

Monitoring and Maintaining the Active and Standby RSPs

To display information about the active and the standby RSPs, use any of the following commands beginning in privileged EXEC configuration mode:

Command	Purpose
Router# **show boot var**	Displays the environmental variable settings and configuration register settings for the active and the standby RSPs.
Router# **show flash all**	Shows a list of Flash devices currently supported on the router.
Router# **show version**	Displays the software version running on the active and the standby RSPs.

Troubleshooting the Installation

This section contains procedures to follow if your system does not restart as expected. Review the descriptions that follow so you can anticipate the expected system startup sequence. Then restart the system and try to isolate the problem by observing the LEDs as the system attempts to boot the software and initialize the RSP4/4+s and each interface processor.

This section includes the following topics:

Verifying LEDs

Following are functional descriptions of the LEDs on the power supplies and processor modules, and the behavior you should observe at system startup.

System Power LEDs

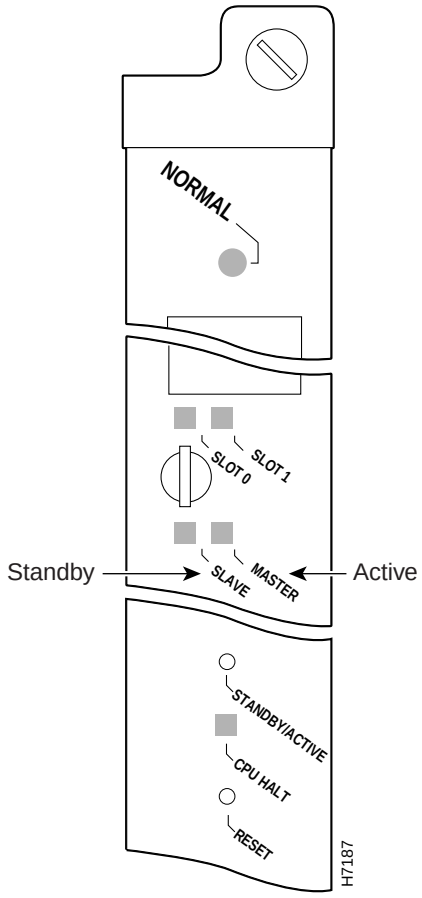
On the router, the AC (or DC) OK LED is located on each power supply. If this LED does not go on and stay on, there is most likely a problem with the input power or one of the internal DC lines.

The AC (or DC) OK LED will not go on or will go off if the power supply reaches an out-of-tolerance temperature or voltage condition. It is unlikely that the power supply will shut down during startup because of an over-temperature condition; however, it can shut down if it detects an over- or undervoltage condition during startup. For descriptions of environmental monitoring functions, refer to the *Cisco 7500 Series Installation and Configuration Guide*, which is available online, on the Documentation CD-ROM, or in print.

RSP4/4+ LEDs

Figure 12 shows the LEDs on the RSP4/4+ faceplate. The LEDs on the RSP4/4+ indicate the system and RSP4/4+ status and which PC Card slot is active. The CPU halt LED, which goes on only if the system detects a processor hardware failure, should remain off. A successful boot is indicated when the normal LED goes on; however, this does not necessarily mean that the system has reached normal operation. During normal operation, the CPU halt LED should be off, and the normal LED should be on, indicating that the RSP4/4+ is receiving +5V. The slot 0 and slot 1 LEDs indicate which PC Card slot is in use, and each LED blinks when the card is accessed by the system. The active and the standby LEDs provide a visual indication of whether the RSP4/4+ is designated as active or standby.

Figure 12 RSP4/4+ LEDs, Active/Standby Switch, and Reset Switch (Vertical Partial Front-Panel View)



Caution The reset switch (see Figure 12) resets the RSP4/4+ and the entire system. To prevent system errors and problems, use it *only* at the direction of your Cisco-certified service representative.

Verifying System Startup Sequence

By checking the state of the LEDs, you can determine when and where the system failed in the startup sequence. Because you turn on the system power with the on/off switches on each power supply, it is easiest to observe the startup behavior from the rear of the router. Use the following descriptions of the

normal startup sequence to isolate the problem, and then use the troubleshooting procedures wherever the system fails to operate as expected. If you are able to isolate the problem to a faulty hardware component, or if you are unable to successfully restart the system, see the "Obtaining Technical Assistance" section on page 92 for instructions on contacting a service representative.

Note The time required for the system to initialize (boot) might vary with different router configurations and the amount of memory that must be initialized. During the system startup sequence, the time required to initialize the memory (not necessarily the entire boot sequence) in a system that contains 256 MB of DRAM might be longer than in a system that contains less DRAM.

During the boot sequence, the system banner display pauses while it initializes the memory. Because your RSP4/4+ has more than 32 MB of DRAM, you might notice an increase in the amount of time required to initialize the memory. The pause in the banner display occurs after the copyright line and before the system displays the list of installed hardware, as shown in the following display:

```
%SYS-5-RELOAD: Reload requested
System Bootstrap, Version 11.1
Copyright (c) 1986-1999 by cisco Systems, Inc.

[System initializes memory at this point in the display]
```

Note The procedures in this section are based on the assumption that your system was operating correctly until you removed (or replaced) the RSP4/4+. If the following sequence uncovers a new problem with the power subsystem or one of the interface processors, refer to the *Cisco 7500 Series Installation and Configuration Guide* for system startup troubleshooting procedures.

Use the following startup sequences and troubleshooting procedures to isolate system problems:

Step 1 When you restart the system, the system power and AC (DC) OK LEDs should go on.

- If the system power LED remains off, the RSP4/4+ is probably not fully inserted and connected to the backplane. Loosen the captive installation screws on the RSP4/4+, and then use the ejector levers to release the RSP4/4+ and reseat it in the backplane. (For a description and illustration of the ejector levers, see the "Removing the RSP4/4+" section on page 18.) Tighten both captive installation screws.

  If the system power LED still fails to go on as expected, a power supply or input power failure could be the problem. Before contacting a service representative, refer to the *Cisco 7500 Series Installation and Configuration Guide* for power subsystem troubleshooting procedures.

- If the system power LED goes on, the power source is good, and the power supply is functional.

When the system power LED indicates normal operation, proceed to the next step.

Step 2 Listen for the system blower and observe the fan OK LED. You should hear the system blower start operating immediately after you turn on the system power. If you determine that the power supply is functioning normally and that an internal fan (or the system blower) is faulty, contact a service representative. If the blower or a power supply fan does not function properly at initial startup, you cannot make any installation adjustments.

Step 3 When you have verified that the power supply is functioning properly, observe the LEDs on the RSP4/4+. The CPU halt LED always turns on during initial power-up of an RSP4/4+ and remains on for approximately one-half second, then turns off. If it remains on during the startup sequence, the system has encountered a processor hardware error.

- Use the **show version** command to check the current configuration register settings.
- If the CPU halt LED remains on during a second startup attempt, suspect a processor hardware error and contact a service representative.

Step 4 During the boot process, the LEDs on most of the interfaces light in irregular sequence; this does not indicate either correct system startup or failure.

Step 5 When the system boot is complete, the RSP4/4+ begins to initialize the interface processors. During this initialization, the LEDs on each interface processor behave differently (most flash on and off). The enabled LED on each interface processor goes on when initialization has been completed.

- If the enabled LEDs on the interface processors go on, the system has booted successfully and is now functional.
- If the RSP4/4+ LEDs previously indicated a successful system boot, but none of the enabled LEDs on the interface processors go on, suspect that one of the interface processors has shifted out of its backplane connector and halted the system. Use the ejector levers to release the interface processor and reseat it in the backplane. (For an illustration of the ejector levers, see Figure 3 on page 19.) Tighten both captive installation screws.
- If the enabled LED on a single interface processor remains off, suspect that the interface processor has shifted out of its slot. Use the ejector levers to release the interface processor and reseat it in the backplane. (For an illustration of the ejector levers, see Figure 3 on page 19.) Tighten both captive installation screws. After the system reinitializes the interfaces, the enabled LED on the interface processor should go on.
- If an enabled LED still fails to go on after you perform these steps, suspect that the specific interface processor has failed.

Step 6 When the system boot is complete and all interface processors have been initialized, the active RSP4/4+'s console screen displays a script and a system banner similar to the following:

```
System Bootstrap, Version 11.1, RELEASED SOFTWARE
Copyright (c) 1986-1999 by cisco Systems, Inc.
SLOT 6 RSP4 is system master (SLOT 2 for a Cisco 7507)
SLOT 7 RSP4 is system slave (SLOT 3 for a Cisco 7507, if installed)
RSP4 processor with 128 Mbytes of main memory

ROM: System Bootstrap, Version 11.1 [biff 2], RELEASE SOFTWARE (fc1)
ROM: GS Bootstrap Software (RSP-BOOT-M), Version 10.3(7), RELEASE SOFTWARE

Warning: monitor nvram area is corrupt... using default values
SLOT 6 RSP4 is system master
SLOT 7 RSP4 is system slave
RSP4 processor with 128 Mbytes of main memory

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

- If all the previous conditions are met and this banner is displayed, the system startup was successful and your installation is complete.
- If an error message is displayed on the terminal, refer to the appropriate software publication for error message definitions.
- If the console screen is blank, check the terminal to ensure that it is turned on and that the console cable is correctly connected between the terminal and the console port on the RSP4/4+.
- Check the terminal settings to ensure that the terminal is set for 9600 baud, 8 data bits, no parity, and 2 stop bits.
- If the terminal is set correctly and still fails to operate, suspect that the terminal is faulty. Connect a different terminal and restart the system.

If the system still fails to start up or operate properly, or if you isolate the cause of the problem to a failed component, contact a service representative for further assistance.

This completes the procedure for verifying system startup.

Troubleshooting a Router That is Failing to Boot

The Cisco 7500 series routers require that the first file on bootflash be a boot image. If it is not, the bootstrap software attempts to boot whatever file is first. While attempting to boot a non-image file, the system either crashes or hangs. The symptom for the RSP4/4+ might be a series of C's (CCCCC) displayed on the console. To troubleshoot, install a Flash memory card with a bootable first image in slot 0 of the RSP4/4+ to allow the router to boot the Cisco IOS image. Verify the system boot settings using the **show bootvar** command.

Note If the configuration register is set incorrectly, this could lead to a boot failure. Refer to the "Software Configuration Register Settings" section on page 86 for instructions on setting your configuration register. Setting the config-register to 0x0 sets the boot variable to boot to ROMMON.

If your router continues to experiences this problem, open a case with TAC. See the "Technical Assistance Center" section on page 92 for more information.

Troubleshooting a Failed RSP4/4+

This section describes actions that you can take to correct or obtain information when an RSP fails. It includes the following topics:

Troubleshooting RSP Boot Errors During OIR of an Interface Processor

Note In Cisco 7507/7507-MX or Cisco 7513/7513-MX routers with the high system availability (HSA) feature active, online insertion and removal of any interface processor in either CyBus might cause the slave RSP2 to reboot with a bus error or a processor memory parity error. The master RSP recovers from this event and issues a "cBus Complex Restart" message. Systems that are configured with an RSP4 or an RSP8 as the system slave are not affected and do not experience this problem. For more information, refer to Field Notice: Cisco 7507 and Cisco 7513: RSP2 HSA OIR.

If you have a Cisco 7507 or a Cisco 7513 with an RSP4/4+ configured as the system standby, we strongly recommend that you use the following procedure to remove and replace an interface processor:

Step 1 Remove the standby RSP.

Step 2 Wait 15 seconds.

Step 3 Remove and replace the interface processor, using the procedures in the configuration note that shipped with your interface processor or in the *Cisco 7500 Series Installation and Configuration Guide*.

Step 4 Wait 15 seconds.

Step 5 Reinsert the standby RSP.

This completes the procedure to remove and replace an interface processor.

Reloading a Failed RSP

When a new active RSP takes over ownership of the router, it automatically reboots the failed RSP as the standby RSP. You can also manually reload the failed RSP.

To manually reload a failed RSP from the active console, use the following command in privileged EXEC configuration mode:

Command	Purpose
Router# **hw-module sec-cpu reset**	Reloads the inactive standby RSP card.

Displaying a Stack Trace of an RSP

To access the state of the failed RSP in the form of a stack trace from the active console, use the following command in privileged EXEC configuration mode:

Command	Purpose
Router# **show stacks**[1]	Displays the stack trace and version information of the active and the standby RSP cards.

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

Displaying Other Information About the RSPs

For information about other commands that you can use to display information about the RSPs, see the "Monitoring and Maintaining the Active and Standby RSPs" section on page 67.

Maintenance Information

This section includes the following RSP4/4+ maintenance procedures:

Saving and Retrieving a Configuration File

This section describes the procedures for saving and retrieving a system configuration file using a TFTP server.

Configuration information resides in two places when the router is operating: the startup default (permanent) configuration in NVRAM, and the running (temporary) memory in RAM. The default startup configuration always remains available; NVRAM retains the information even when the power is shut down. The current information is lost if the system power is shut down. The current configuration contains all nondefault configuration information that you added with the **configure** command, the setup facility, or editing of the configuration file.

The **configure** command adds the current configuration to the default configuration in NVRAM so that it is also saved when power is shut down. Whenever you make changes to the system configuration, use the **copy running-config startup-config** command to ensure that the new configuration is saved.

If you replace the RSP in a system with only one RSP4/4+, you also replace the entire configuration, which resides in NVRAM on the RSP. If you copy the configuration file to a remote server before removing the RSP, you can retrieve it later and write it into NVRAM on the new RSP4/4+. You can also use the **copy running-config slot0:config-file** command to save the configuration file to Flash memory, and then use the **copy slot0:config-file nvram:startup-config** command to restore it.

If you do not copy the configuration file, you must use the **configure** command or the setup facility to reenter the configuration information after you install the new RSP4/4+. For complete descriptions of these two commands, and instructions for using them, refer to the appropriate Cisco IOS software documentation.

If you are temporarily removing an RSP4/4+, it is not necessary to copy the configuration file to a remote server; the lithium batteries retain the configuration file in memory until you replace the RSP4/4+ in the system. This procedure requires privileged-level access to the EXEC command interpreter, which usually requires a password. See the "Using the EXEC Command Interpreter" section on page 27 and contact your system administrator to obtain access, if necessary.

For configuration information and support, refer to the Cisco IOS software configuration documentation set that corresponds to the software release installed on your Cisco hardware.

Using the ping Command to Ensure Connectivity

Before you attempt to copy or retrieve a file from a remote host, ensure that the connection is good between the router and the remote server by using the packet internet groper (ping) program. The ping program sends a series of echo request packets to the remote device and waits for a reply. If the connection is good, the remote device echoes them back to the local device.

The console terminal displays the results of each message sent: an exclamation point (!) indicates that the local device received an echo, and a period (.) indicates that the server timed out while awaiting the reply. If the connection between the two devices is good, the system displays a series of exclamation points (! ! !) or [ok]. If the connection fails, the system displays a series of periods (. . .) or [timed out] or [failed].

To verify the connection between the router and a remote host, use the **ping** command followed by the name or IP address of the remote server; then press **Return**. Although the **ping** command supports configurable options, the defaults, including IP as the protocol, are enabled when you enter a host name or address on the same line as the **ping** command. For a description of the configurable options, refer to the appropriate software documentation.

The following example shows a successful ping operation:

```
Router# ping 10.1.1.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.1.1.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 12/12/12 ms
```

The following example shows the results of a failed ping operation:

```
Sending 5, 100-byte ICMP Echos to 10.1.1.1, timeout is 2 seconds:
.....
Success rate is 0 percent (0/5)
Router#
```

If the connection fails, check the physical connection to the remote file server and verify that you are using the correct address or name, and then ping the server again. If you are unable to establish a good connection, contact your network administrator or see the "Obtaining Technical Assistance" section on page 92 for instructions on contacting technical assistance.

Copying the Configuration File

Before you copy (save) the running configuration to a TFTP file server, ensure the following:

- You have a connection to the router either with a console terminal connected to the RSP4/4+ console port or remotely through a Telnet session.
- The router is connected to a network supporting a file server (remote host).
- The remote host supports the TFTP application.
- You have the interface processor address or name of the remote host available.

To store information on a remote host, use the **copy startup-config tftp** privileged EXEC command. The command prompts you for the destination host address and a filename, and then displays the instructions for confirmation. When you confirm the instructions, the router sends a copy of the currently running configuration to the remote host. The system default is to store the configuration in a file called by the name of the router with *-confg* appended. You can either accept the default filename by pressing **Return** at the prompt, or enter a different name before pressing **Return**.

To copy the currently running configuration to a remote host, perform the following steps:

Step 1 The system prompt should display a pound sign (#) to indicate the privileged level of the EXEC command interpreter. If it does not, follow the steps in the "Using the EXEC Command Interpreter" section on page 27 to enable the privileged level.

Step 2 Use the **ping** command to check the connection between the router and the remote host. (See the preceding section, "Using the ping Command to Ensure Connectivity.")

Step 3 Use the **show running-config** command to display the currently running configuration on the terminal and ensure that the configuration information is complete and correct.

Step 4 If it is not, use the **configure** command to add or modify the existing configuration. (Refer to the appropriate software documentation for descriptions of the configuration options available for the system and individual interfaces, and for specific configuration instructions.)

Note Before you can save (copy) a file to a TFTP server, a file must first exist on the TFTP server. Use the appropriate server commands to create this file and ensure that the filename matches the filename you will copy from the router. Also, ensure that the appropriate server permissions are set so the router can copy to this file.

Step 5 Create a file on the TFTP server.

Step 6 Use the **copy startup-config tftp** command. The EXEC command interpreter prompts you for the name or interface processor address of the remote host that is to receive the configuration file. (The prompt might include the name or address of a default file server.)

```
Router# copy startup-config tftp
Remote host []?
```

Step 7 Type the name or interface processor address of the remote host. In the following example, the name of the remote server is *servername*:

```
Router# copy startup-config tftp
Remote host []? servername
Translating "servername"...domain server (10.1.1.1) [OK]
```

Step 8 The EXEC command interpreter prompts you for the name of the file that will contain the configuration. By default, the system appends *-confg* to the router name to create the new filename. Press **Return** to accept the default filename, or type a different name for the file before pressing **Return**. In the following example, the default is accepted:

```
Name of configuration file to write [Router-confg]?
Write file Router-confg on host 10.1.1.1? [confirm]
Writing Router-confg .....
```

Step 9 Before the router executes the copy process, it displays the instructions you entered for confirmation. If the instructions are not correct, type **n** (no) and then press **Return** to end the process. To accept the instructions, press **Return**, or press **y** and then press **Return**, and the system begins the copy process. In the following example, the default is accepted:

```
Write file Router-confg on host 10.1.1.1? [confirm]
Writing Router-confg: !!!! [ok]
```

While the router copies the configuration to the remote host, it displays a series of exclamation points (! ! !) or periods (. . .). The !!!! and [ok] indicate that the operation is successful. A series of periods (...) and [timed out] or [failed] indicates a failure, which would probably be due to a network fault or the lack of a writable, readable file on the remote file server.

Step 10 If the display indicates that the process was successful (with the series of exclamation points [! ! !] and [ok]), the copy process is complete. The configuration is safely stored in the temporary file on the remote file server.

If the display indicates that the process failed (with the series of periods [. . .] as shown in the following example), then your configuration was not saved:

```
Writing Router-confg .....
```

Repeat the preceding steps, or select a different remote file server and repeat the preceding steps.

Step 11 To further ensure that the configuration file was copied correctly, use the **show startup-config** command and look at the first line for the configuration file's size. Compare it with the file you copied to the TFTP server. Following is an example. (Take special note of the line preceded by >>.)

```
Router# show startup-config
>> Using 1186 out of 126968 bytes
!
version 11.1
hostname Router
Router#
```

After you upload the configuration file, you are prepared to replace the RSP. For more information see the "Removing the RSP4/4+" section on page 18. If you are unable to copy the configuration to a remote host successfully, contact your network administrator or see the "Obtaining Technical Assistance" section on page 92 for instructions on contacting Cisco Systems for technical support.

This completes the procedure for copying the configuration file.

Retrieving the Configuration File

This section describes how to retrieve the saved configuration and copy it to NVRAM. Enter privileged EXEC configuration mode and specify that you will configure the router from the network. The system prompts you for a host name and address, the name of the configuration file stored on the host, and confirmation to reboot using the remote file.

You can access the router through a console terminal attached to the RSP4/4+ console port, or you can Telnet to the router from a remote terminal.

To retrieve the currently running configuration from a remote host, perform the following steps:

Step 1 On the console terminal, the system prompt should display a pound sign (#) to indicate the privileged level of the EXEC command interpreter. If it does not, follow the steps in the "Using the EXEC Command Interpreter" section on page 27 to enable the privileged level.

Note Until you retrieve the previous configuration, the router runs from the default configuration in NVRAM. Therefore, any passwords that were configured on the previous system are not valid until you retrieve the configuration.

Step 2 Configure an interface port on the router for a connection to a remote host (TFTP server).

Step 3 Use the **ping** command to verify the connection between the router and the remote host. (See the "Using the ping Command to Ensure Connectivity" section on page 73.)

Step 4 At the system prompt, use the **copy tftp startup-config** command and press **Return** to enter the configuration mode and specify that you will configure the system from a network device (instead of from the console terminal, which is the default).

```
Router# copy tftp startup-config
```

Step 5 The system prompts you for the IP address of the host. Type the IP address or name of the remote host (the remote TFTP server to which you originally saved the configuration file).

```
Address of remote host [255.255.255.255]? 10.1.1.1
```

Step 6 The system prompts you to select a host or network configuration file. The default is host; press **Return** to accept the default.

```
Name of configuration file [Router-confg]? Router-confg
```

Step 7 The system prompts you for the name of the configuration file. The default is to use the name of the router with the suffix *-confg* (*router-confg* in the following example). If you specified a different filename when you copied the configuration, type the filename; otherwise, press **Return** to accept the default.

```
Name of configuration file [Router-confg]?
```

Step 8 Before the system reloads the new configuration file in NVRAM, it displays the instructions you entered for confirmation. If the instructions are not correct, type **n** (no), and then press **Return** to cancel the process. To accept the instructions, press **Return**, or press **y** and then press **Return**. Output similar to the following appears:

```
Configure using Router-confg from 10.1.1.1? [confirm]
Loading Router-confg from 10.1.1.1: ! ! [OK - 1186/126927 bytes]
Warning: distilled config is not generated
[OK]
%SYS-5-CONFIG_NV: Non-volatile store configured from Router-confg
by console tftp from 10.1.1.1
```

While the router retrieves and reloads the configuration file from the remote host, the console display indicates whether or not the operation is successful. A series of exclamation points (!!!!) and [OK] (as shown in the preceding example) indicates that the operation was successful. A series of periods (...) and [timed out] or [failed] indicate a failure (which would probably be due to a network fault or an incorrect server name, address, or filename). The following is an example of a failed attempt to boot from a remote server:

```
Booting Router-confg ..... [timed out]
```

Step 9 If the display indicates that the process was successful, as shown in Step 8, proceed to Step 10.

If the display indicates that the process failed, verify the name or address of the remote server and the filename, and repeat the preceding steps. If you are unable to retrieve the configuration file, contact your network administrator or see the "Obtaining Technical Assistance" section on page 92 for instructions on contacting technical assistance.

Step 10 To ensure that the configuration file was retrieved correctly, use the **show startup-config** command and look at the first line for the configuration file size. Compare it with the file you retrieved from the TFTP server to confirm that it is correct. Following is an example:

```
Router# show startup-config
Using 1186 out of 126968 bytes
!
version 11.1
hostname Router
!
Router#
```

Step 11 To ensure that the startup configuration file stored in NVRAM is the default running configuration file used by the system, use the **copy running-config startup-config** command as follows:

```
Router# copy running-config startup-config
Router#
%SYS-5-CONFIG_I: Configured from memory by console
Router#
```

This completes the procedure for retrieving the saved configuration file.

Replacing and Upgrading DRAM DIMMs

This section describes how to remove and replace DRAM DIMMs from the RSP4/4+.

The default DRAM configuration is 32 MB for RSP4, residing on U10, and 64 MB for RSP4+, residing on U10 and U13. The DRAM DIMM sockets are U10 (bank 0) and U13 (bank 1). (See Figure 1 and Table 6.)

Caution To prevent system problems, do *not* use DRAM single in-line memory modules (SIMMs) from an RSP2 in the RSP4/4+. The RSP4/4+ requires DRAM dual in-line memory modules (DIMMs).

Note Do not mix memory sizes. If installing two DIMMs, both DIMMs must be the same size. If your router includes redundant RSPs, the RSPs should have the same memory size.

Note The total number of memory devices per DIMM differs for each manufacturer. The DIMMs in Figure 1 are generic representations of the actual DRAM DIMMs for your RSP4/4+.

Table 6 lists the various configurations of DRAM DIMMs that are available, the number of DIMMs for each configuration, and the DRAM banks they occupy. Note which banks are used, given the combinations of available DIMM sizes and the maximum DRAM you require.

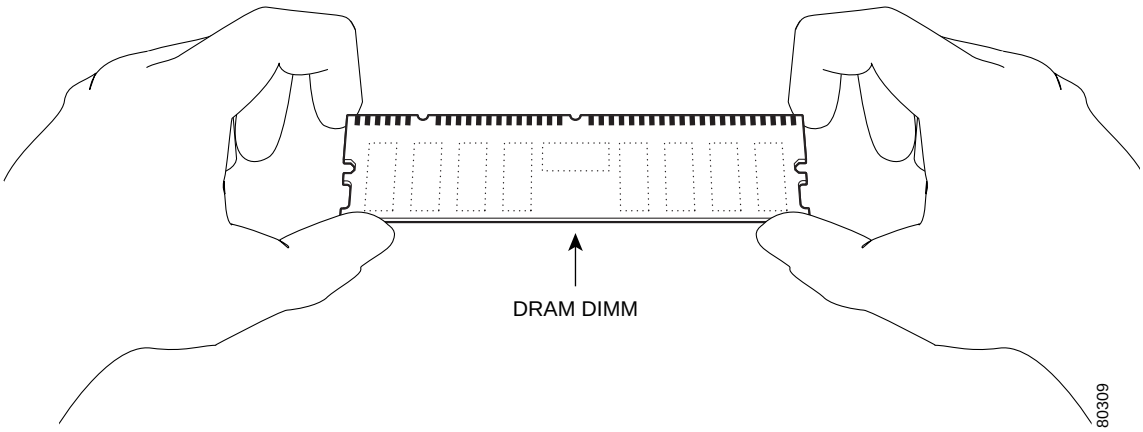
Table 6 RSP4/4+ DRAM DIMM Configurations[1]

Product Numbers	Quantity	DRAM Sockets	Totals
MEM-RSP4-32M(=)[2]	One 32-MB DIMM	U10	32 MB
MEM-RSP4-32M(=)[2]	One 32-MB DIMM	U13	32 MB
MEM-RSP4-64M(=)[3]	Two 32-MB DIMM	U10 and U13	64 MB
MEM-RSP4-128M(=)	One 128-MB DIMM	U10	128 MB
MEM-RSP4-256M(=)	Two 128-MB DIMM	U10 and U13	256 MB

1. Do not mix memory sizes. If installing two DIMMs, both DIMMs must be the same size.
2. The RSP4 default DRAM configuration is 32 MB.
3. The RSP4+ default DRAM configuration is 64MB.

Caution To prevent system and memory problems when you install DRAM, the RSP4/4+ DRAM DIMMS must be 3.3V devices. Do not attempt to install higher-voltage devices in the RSP4/4+ DIMM sockets. Handle the DIMM by the card edges only, and avoid touching the memory module, pins, or traces (the metal *fingers* along the connector edge of the DIMM). (See Figure 13.)

Figure 13 Handling the DIMM



Note Use only DRAM DIMMs from Cisco Systems. A Cisco manufacturing part number appears on each DRAM DIMM.

Removing DIMMs

This section discusses the procedure for removing DIMMs from your RSP4/4+.

Use this procedure to remove the existing DIMMs:

Step 1 Turn off the system power and follow the steps in the "Removing the RSP4/4+" section on page 18.

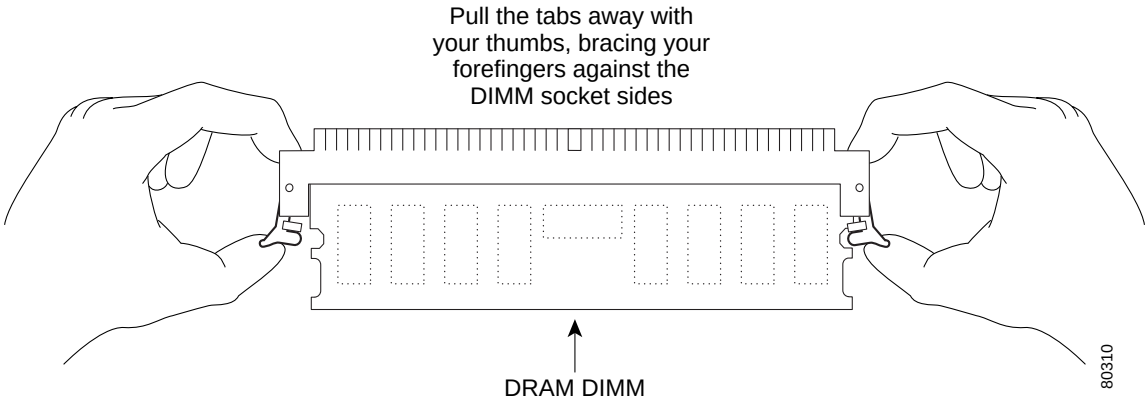
Step 2 Place the RSP4/4+ on an antistatic mat or pad and ensure that you are wearing an antistatic device, such as a wrist strap.

Step 3 Position the RSP4/4+ so that the faceplate is toward you and the bus connectors are away from you—this position is shown in Figure 1.

Step 4 Locate the DRAM DIMMs on the RSP4/4+ and position the RSP4/4+ so that you are facing the DIMM module you want to remove. The DIMMs occupy U10 (bank 0) and U13 (bank 1). (See Figure 1.)

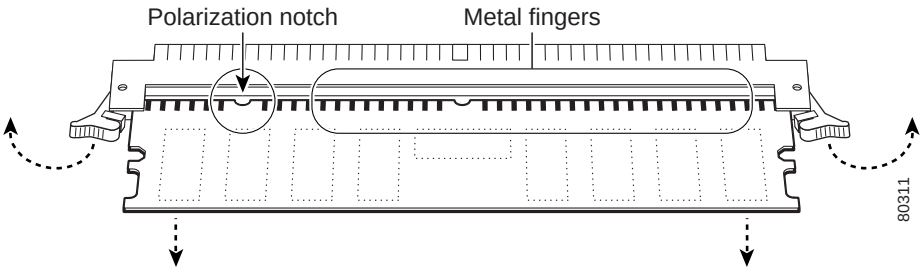
Step 5 Open the DIMM socket release levers on the DIMM to release the DIMM from the socket. (See Figure 14.) The DIMM is under tension in the socket; therefore, the DIMM might be released from the socket with some force.

Figure 14 Using the DIMM Socket Release Lever to Remove a DIMM



Step 6 With the DIMM socket release levers open, grasp the ends of the DIMM between your thumbs and forefingers and pull the DIMM completely out of the socket. (See Figure 15.)

Figure 15 Removing the DIMM



Step 7 Place the removed DIMM on an antistatic mat, and store it in an antistatic container to protect it from ESD damage.

Step 8 Repeat Step 4 through Step 7 for the remaining DIMM, if required for your upgrade.

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

Installing New DIMMs

This section discusses the procedure for installing DIMMs on your RSP4/4+.

Use this procedure to install new DIMMs:

Step 1 Remove the new DIMM from its antistatic container.

Step 2 Hold the DIMM between your thumbs and forefingers. (See Figure 13.)

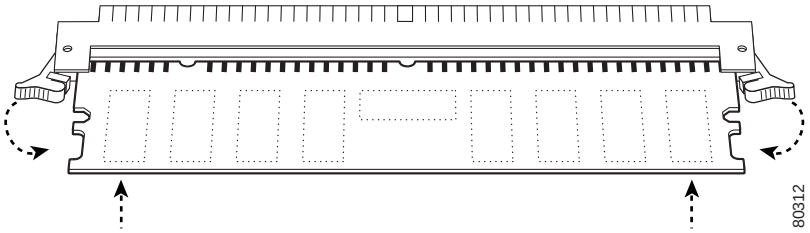
Note The DIMM should be facing component-side down.

Step 3 Insert the connector edge of the DIMM straight into the socket.

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

Step 4 Gently push the DIMM into the socket until the socket release levers close over the ends of the DIMM. (See Figure 16.) If necessary, rock the DIMM gently back and forth to seat it properly.

Figure 16 Inserting the DIMM



Step 5 Check to see if the DIMM is seated properly. If the DIMM appears misaligned, carefully remove it and reseat it in the socket. Push the DIMM firmly back into the socket until first one and then the other socket release lever moves into place.

Step 6 Repeat Step 1 through Step 5 above if you are replacing more than one DIMM.

This completes the procedure for installing DRAM DIMMs. Proceed to the following section to check the installation.

Checking the RSP Memory Upgrade

This section describes how you would verify the memory upgrade.

- Observe the LED states and the console display. As the system reinitializes the interfaces, the enabled LEDs should go on. (Port adapter status LEDs might be on, depending on your connections.) The console screen also displays a message as the system discovers each interface during its reinitialization.
- Use the **show diag** command to verify that the system recognizes the new memory; check the line of the **show diag** command output that begins with *Controller Memory Size*.
- If the system fails to boot properly, if the console terminal displays a checksum or memory error, or if the **show diag** command output indicates an incorrect amount of memory (or no memory), check the following:
  - Ensure that all memory devices are installed correctly. If necessary, shut down the system and remove the RSP4/4+. Check the memory devices by looking straight down on them and then at eye level. The devices should be aligned at the same angle and the same height when properly installed. If a memory device appears to stick out or rest in the socket at a different angle from the others, remove the device and reinsert it; then replace the RSP4/4+ and reboot the system for another installation check.
  - Each DIMM socket must contain a DIMM of the correct size and speed or the system cannot operate. To ensure this, use only memory devices that are included with Cisco Systems memory kits.

If after several attempts the system fails to restart properly, contact TAC (see the "Obtaining Technical Assistance" section on page 92), or 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. The time required for the system to initialize might vary with different router configurations and DRAM configurations. Routers with 256 MB of DRAM might take longer to boot than those with less DRAM.

This completes the RSP4/4+ memory upgrade verification.

Recovering a Lost Password

An overview of the procedure for recovering a lost password follows:

- Use 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.
- Use the **show startup-configuration** command to display the enable password.
- Change the configuration register value back to its original setting.

Note If the enable password is encrypted, the following procedure does not work for password recovery and you must reconfigure the router using the displayed configuration (shown in Step 11), instead of rebooting it.

To recover a lost password, follow these steps:

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

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

Step 5 Within 5 seconds of turning on the router, press **Break**. 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 using the **i** command as follows:

```
rommon 1 > i
```

The router power cycles, the configuration register is set to ignore the configuration file, and the router boots the boot system image and prompts you with the system configuration dialog as follows:

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

Step 8 Type **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 Use the **enable** command to enter the enabled mode. The prompt changes to the following:

```
Router #
```

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

Step 12 At the privileged EXEC prompt, use the **configure terminal** command. 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 in Step 3) or change it to a value of 0x0102 (factory default).

Step 14 Exit global configuration mode using **Ctrl-Z** or by typing **end**.

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

This completes the procedure for recovering a lost password.

Reference Information

The following sections include important reference information:

Console Port Signals

The console port on the RSP4/4+ is an EIA/TIA-232, DCE, DB-25 receptacle. Both Data Set Ready (DSR) and Data Carrier Detect (DCD) are active when the system is running. The Request To Send (RTS) signal tracks the state of the Clear To Send (CTS) input. The console port does not support modem control or hardware flow control. The console port requires a straight-through EIA/TIA-232 cable. Table 7 lists the signals used on this port.

Table 7 Console Port Signals

Pin	Signal	Direction	Description
1	GND	–	Ground
2	TxD	<—	Transmit Data
3	RxD	—>	Receive Data
6	DSR	—>	Data Set Ready (always on)
7	GND	–	Ground
8	DCD	—>	Data Carrier Detect (always on)

Auxiliary Port Signals

The auxiliary port on the RSP4/4+ is an EIA/TIA-232, DTE, DB-25 plug to which you can attach a CSU or DSU or other equipment in order to access the router from the network. The asynchronous auxiliary port supports hardware flow control and modem control. Table 8 lists the signals used on this port.

Table 8 Auxiliary Port Signals

Pin	Signal	Direction	Description
2	TxD	—>	Transmit Data
3	RxD	<—	Receive Data
4	RTS	—>	Request To Send (used for hardware flow control)
5	CTS	<—	Clear To Send (used for hardware flow control)
6	DSR	<—	Data Set Ready
7	Signal Ground	–	Signal Ground

Table 8 Auxiliary Port Signals (continued)

Pin	Signal	Direction	Description
8	CD	<—	Carrier Detect (used for modem control)
20	DTR	—>	Data Terminal Ready (used for modem control only)

Console and Auxiliary Y-Cable Pinouts

The console and auxiliary Y-cables allow you to simultaneously connect the console ports or auxiliary ports on two RSPs (configured as system active and standby in RSP slots 2 and 3 in the Cisco 7507 and Cisco 7507-MX, and RSP slots 6 and 7 in the Cisco 7513 and Cisco 7513-MX) to one console terminal or external auxiliary device (such as a modem).

The two Y-cables (Product Number CAB-RSP4CON=, shown in Figure 6, and Product Number CAB-RSP4AUX=, shown in Figure 7) ship with the router and are available as spare parts. The console Y-cable pinout is listed in Table 9, and the auxiliary Y-cable pinout is listed in Table 10.

Table 9 Console Y-Cable Signals (Product Number CAB-RSP4CON=)

Female DB-25 Pins	Male DB-25 Pins	Signal Description
P1-1	J1-1 and J2-1	Ground
P1-2	J1-2 and J2-2	Receive Data (RxD)
P1-3	J1-3 and J2-3	Transmit Data (TxD)
P1-4	J1-4 and J2-4	Clear To Send (CTS); looped to 5
P1-5	J1-5 and J2-5	Request To Send (RTS); looped to 4
P1-6	J1-6 and J2-6	Data Set Ready (DSR)
P1-7	J1-7 and J2-7	Ground
P1-8	J1-8 and J2-8	Data Carrier Detect (DCD)
P1-13	J1-13 and J2-13	YCBL Detect Ground
P1-19	J1-19 and J2-19	YCBL Detect
P1-20	J1-20 and J2-20	Data Terminal Ready (DTR)

Table 10 Auxiliary Y-Cable Signals (Product Number CAB-RSP4AUX=)

Male DB-25 Pins	Female DB-25 Pins	Signal Description
P1-1	J1-1 and J2-1	Ground
P1-2	J1-2 and J2-2	TxD
P1-3	J1-3 and J2-3	RxD
P1-4	J1-4 and J2-4	RTS
P1-5	J1-5 and J2-5	CTS
P1-7	J1-7 and J2-7	Ground
P1-8	J1-8 and J2-8	DCD
P1-13	J1-13 and J2-13	YCBL Detect

Table 10 Auxiliary Y-Cable Signals (Product Number CAB-RSP4AUX=) (continued)

Male DB-25 Pins	Female DB-25 Pins	Signal Description
P1-19	J1-19 and J2-19	YCBL Detect Ground
P1-20	J1-20 and J2-20	DTR
P1-22	J1-22 and J2-22	Ring

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:

- To select a boot source and default boot filename
- To enable or disable the Break function

Note The Break function (software configuration register bit 8) when enabled allows you to send a Break signal to the router during a system (re)boot. This stops the boot process and places the router into ROM monitor mode. You can activate the Break function by using a dedicated Break key function on the keyboard, or by entering the **Ctrl-[** (left square bracket) key combination.

- To control broadcast addresses
- To set the console terminal baud rate
- To load operating software from the Flash memory card
- To enable booting from a Trivial File Transfer Protocol (TFTP) server
- To recover a lost password
- To allow you to manually boot the system using the **b** command at the bootstrap program prompt
- To force the router to boot automatically from the system bootstrap software (boot image) or from its default system image in onboard Flash memory, and to 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 from which to boot a default system image stored on a network server. (See Table 13.)

Table 11 lists the meaning of each of the software configuration memory bits, and Table 12 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 11. For example, the factory default value of 0x0102 is a combination of settings.

Table 11 Software Configuration Register Bit Meanings

Bit Number[1]	Hexadecimal	Meaning
00 to 0F	0x0000 to 0x000F	Boot field (see Table 12)
06	0x0040	Causes system software to ignore NVRAM contents

Table 11 Software Configuration Register Bit Meanings (continued)

Bit Number[1]	Hexadecimal	Meaning
07	0x0080	OEM[2] bit enabled
08	0x0100	Break disabled
09	0x0200	Use secondary bootstrap
10	0x0400	IP broadcast with all zeros
11 to 12	0x0800 to 0x1000	Console line speed (default is 9600 baud)
13	0x2000	Boot default Flash memory 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 0x0102. This value is a combination of the following: bit 8 = 0x0100 and bits 00 through 03 = 0x0001 (see Table 13).
2. OEM = original equipment manufacturer

Table 12 Explanation of Boot Field (Software Configuration Register Bits 00 to 0F)

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 network boot filename Enables boot system commands that override the default network boot filename

Changing Settings

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

Step 1 To enter privileged EXEC configuration mode, use the **enable** command and your password as shown:

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

Step 2 To enter global configuration mode, use the **configure terminal** command. You are prompted for further commands, 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, use the **config-register 0x***value* configuration command, where *value* is a hexadecimal number preceded by 0x (see Table 12), as shown in the following example:

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

Step 4 Exit global configuration mode using **Ctrl-Z** or by typing **end**. The new configuration register settings are saved to memory; however, the new settings do not take effect until the system software is reloaded when you reboot the router.

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

```
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 system reloads, such as when you issue a **reload** command from the console.

This completes the procedure to change the configuration register while running the system software.

Bit Meanings

The lowest four bits of the software configuration register (bits 3, 2, 1, and 0) form the boot field. (See Table 12.) 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 typing the **b** command at the bootstrap prompt (>), as follows:

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

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

- **b**—Boots the default system software from 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 PC Card slot 0
- **b slot1:** *filename*—Boots the file *filename* from the Flash memory card in PC Card slot 1
- **b** *filename [host]*—Boots from server *host* using TFTP
- **b bootflash:** *[filename]*—Boots the file *filename* from onboard Flash memory

If you set the boot field value to *0x2* through *0xF* and there is a valid **boot system** command stored in the configuration file, then the router boots the system software as directed by that value. If there is no **boot system** command, the router forms a default boot filename for booting from a network server. (See Table 13 for the format of these default filenames.)

In the following example, the software configuration register is set to boot the router from onboard Flash memory and to ignore the Break function 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)# end
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 13 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 13 Default Boot Filenames

Action/Filename	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. Regardless of the setting of the break enable bit, a break causes a return to the ROM monitor during the first few seconds (approximately 5 seconds) of booting.

Bit 9 is unused. 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 14 shows the combined effect of bits 10 and 14.

Table 14 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 15 shows the bit settings for the four available baud rates. (The factory-set default baud rate is 9600.)

Table 15 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 a Boot from Flash Memory

To enable a boot 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** *device***:***filename* configuration command, where *device* is **bootflash:**, **slot0:**, or **slot1:**, and *filename* is the name of the file from which you want to boot the system.

To enter global configuration mode while in the system software image and specify a Flash memory filename from which to boot, use 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 device:filename
```

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

```
Router(config)# config-reg 0x0102
Router(config)# end
Router#
```

Using Flash Memory

The Flash memory (PC Card) slots on the front panel of the RSP4/4+ support PC Card-based Flash memory media for your system. You can use this Flash memory to store and run IOS software images, or as a file server for other routers to access as clients.

Note A complete discussion of PC Card-based Flash memory is beyond the scope of this publication. For detailed information on Flash memory, refer to *Flash Memory Card Installation Instructions* (Part Number: DOC-782083=).

Obtaining Documentation

These sections explain how to obtain documentation from Cisco Systems.

World Wide Web

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

http://www.cisco.com

Translated documentation is available at this URL:

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

Documentation CD-ROM

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

Ordering Documentation

You can order Cisco documentation in these ways:

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

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

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

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

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

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

We appreciate your comments.

Obtaining Technical Assistance

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

Cisco.com

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

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http://www.cisco.com

Technical Assistance Center

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

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

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

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

Cisco TAC Web Site

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

http://www.cisco.com/tac

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

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

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

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

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

Cisco TAC Escalation Center

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

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

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

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

This document is to be used in conjunction with the appropriate Quick Start Guide that shipped with your router and the documents listed in the "Related Documentation" section.