

Loading and Maintaining System Images and Microcode

This chapter describes how to load and maintain system images and microcode. System images contain the system software. Microcode images contain microcode to be downloaded to various hardware devices.

To benefit most from the instructions and organization of this chapter, your router must contain a minimal configuration that allows you to interact with the system software. You can create a basic configuration file using the **setup** command facility. See the user guide for your hardware platform for more information on using **setup** at first-time startup. See the “Using Setup for Configuration Changes” chapter in this publication for information on using **setup** after first-time startup.

For a complete description of the system image and microcode commands mentioned in this chapter, refer to the “System Image and Microcode Commands” chapter in the *Configuration Fundamentals Command Reference*. To locate documentation of other commands that appear in this chapter, use the command reference master index or search online.

Note One or more of the commands that previously appeared in this chapter have been replaced by new commands. Table 52 maps the old commands to their replacements. The old commands continue to perform their normal functions in the current release, but support for these commands will cease in a future release.

Table 52 Mapping Old Commands to New Commands

Old Command	New Command
copy erase flash	erase flash: (Class B Flash file systems only) format (Class A and C Flash file systems only)
copy verify	verify
copy verify flash	verify flash:
verify flash	
copy verify bootflash	verify bootflash:
verify bootflash	

System Images and Microcode Task List

You can perform the tasks involving images described in the following sections:

- Display System Image Information
- Understand Images
- Copy Operation General Output Conventions
- Copy Images from Flash Memory to a Network Server
- Copy Images from Flash Memory to a Network Server
- Copy Images from a Network Server to Flash Memory
- Copy Images between Local Flash Memory Devices
- Specify the Startup System Image in the Configuration File
- Recovering a System Image Using Xmodem or Ymodem
- Load and Display Microcode Images

Note These tasks assume you have a minimal configuration that you want to modify.

Display System Image Information

Use the following commands in EXEC mode to display information about system software:

Step	Command	Purpose
1	show bootvar	List the contents of the BOOT environment variable, the name of the configuration file pointed to by the CONFIG_FILE environment variable, and the contents of the BOOTLDR environment variable.
2	show flash-filesystem: [partition number] [all chips detailed err summary] (Class B Flash file systems) show flash-filesystem: [all chips fileys] (Class A Flash file systems) show flash-filesystem: (Class C Flash file systems)	List information about Flash memory.
3	show microcode	Display microcode information.
4	show version	List the system software release version, configuration register setting, and other information.

Refer to the *Configuration Fundamentals Command Reference* for examples of these commands.

Understand Images

System images contain the Cisco IOS software. Your router already has an image on it when you receive it. However, you may want to load a different image onto the router at some point. For example, you may wish to upgrade your software to the latest release or use the same version of the software for all the routers in a network.

Types of Images

The following are two main types of images your router may use:

- System image—The complete Cisco IOS software. This image is loaded when your router boots and is used most of the time.

On most platforms, the image is located in Flash memory. On platforms with multiple Flash memory file systems (Flash, Bootflash, slot 0, or slot 1), the image can be located in any existing Flash file system. Use the **show file systems** command to determine which file systems your router supports. Refer to your hardware documentation for information about where these images are located by default.

- Boot image—A subset of the Cisco IOS software. This image is used to perform network booting or to load Cisco IOS images onto the router. This image is also used if the router cannot find a valid system image. Depending on your platform, this image may be called xboot image, rxboot image, bootstrap image, or boot loader/helper image.

On some platforms, the boot image is contained in ROM. In others, the boot image can be stored in Flash memory. On these platforms, you can specify which image should be used as the boot image using the **boot bootldr** command.

Refer to your hardware documentation for information about the boot image used on your router.

Image Naming Conventions

You can identify the platform, features, and image location by the name of the image. The naming convention for images that are stored on a UNIX system is as follows:

platform-features-type

The *platform* variable indicates which platforms can use this image. Examples of *platform* variables are *rsp* (Cisco 7000 series with RSP7000 and Cisco 7500 series), *c1600* (Cisco 1600 series), and *c1005* (Cisco 1005).

The *feature* variable identifies the feature sets supported by the image.

The *type* field can contain the following characters:

- *f*—The image runs from Flash memory.
- *m*—The image runs from RAM.
- *r*—The image runs from ROM.
- *l*—The image is relocatable.
- *z*—The image is zip compressed.
- *x*—The image is mzip compressed.

Copy Operation General Output Conventions

During a copy operation, you may get the following characters:

- A pound sign (#) generally means that a Flash memory device is being cleared and initialized. (Different platforms use different ways of indicating that Flash is being cleared.)
- An exclamation point (!) means that ten packets have been transferred successfully.
- A series of “V” characters means that a checksum verification of the file is occurring after the file is written to Flash memory.

- An “O” means an out-of-order packet.
- A period (.) means a timeout.

The last line in the output indicates whether or not the copy was successful.

To interrupt a copy operation, press **Ctrl-^** or **Ctrl-Shift-6**. The operation terminates, but any partial file copied remains until Flash memory is erased.

Refer to the *Internetwork Troubleshooting Guide* publication for procedures on how to resolve Flash memory problems.

Copy Images from Flash Memory to a Network Server

You can copy system images from Flash memory to an FTP, rcp, or TFTP server. You can use this server copy of the system image as a backup copy, or you can use it to verify that the copy in Flash is the same as the original file on disk. The following sections describe these tasks:

- Copy an Image from Flash Memory to a TFTP Server
- Copy an Image from Flash Memory to an rcp Server
- Copy an Image from Flash Memory to an FTP Server

The protocol you use depends on which type of server you are using. The FTP and rcp transport mechanisms provide faster performance and more reliable delivery of data than TFTP. These improvements are possible because the FTP and rcp transport mechanisms are built on and use the Transmission Control Protocol/Internet Protocol (TCP/IP) stack, which is connection-oriented.

To stop the copy process, press **Ctrl-^** or **Ctrl-Shift-6**.

In the output, an exclamation point (!) indicates that the copy process is taking place. Each exclamation point (!) indicates that ten packets have been transferred successfully.

Refer to the *Internetwork Troubleshooting Guide* publication for procedures on how to resolve Flash memory problems.

Copy an Image from Flash Memory to a TFTP Server

You can copy a system image to a TFTP network server. In some implementations of TFTP, you must first create a “dummy” file on the TFTP server and give it read, write, and execute permissions before copying a file over it. Refer to your TFTP documentation for more information.

To copy a system image to a TFTP network server, use the following commands in EXEC mode:

Step	Command	Purpose
1	show flash-filesystem:	(Optional) Learn the exact spelling of the system image filename in Flash memory.
2	copy flash-url tftp:[[/location]/directory]/filename]	Copy the system image from Flash memory to a TFTP server.
3		Reply to any router prompts for additional information or confirmation. The prompting will depend on how much information you provide in the copy command and the current setting of the file prompt command.

Copy from Flash Memory to a TFTP Server Example

The following example uses the **show flash:** command to learn the name of the system image file and the **copy flash: tftp:** command to copy the system image to a TFTP server.

```
RouterB# show flash:

System flash directory:
File Length Name/status
  1 4137888 c3640-c2is-mz.Feb24
[4137952 bytes used, 12639264 available, 16777216 total]
16384K bytes of processor board System flash (Read/Write)\

Router# copy flash: tftp:
IP address of remote host [255.255.255.255]? 172.16.13.110
filename to write on tftp host? c3640-c2is-mz.Feb24
writing c3640-c2is-mz.Feb24 !!!!!..
successful tftp write.
```

Copy from Partitioned Flash Memory to a TFTP Server Example

In this example, the file your-ios is copied from partition 1 of the Flash memory PC card in slot 0 to the TFTP server at 172.23.1.129. The file will be saved with the name your-ios in the dirt/sysadmin directory relative to the directory of the remote username.

```
Router# copy slot0:1:your-ios tftp://172.23.1.129/dirt/sysadmin/your-ios
Verifying checksum for 'your-ios' (file # 1)... OK
Copy 'your-ios' from Flash to server
  as 'dirt/sysadmin/ios-2'? [yes/no] yes
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
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!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
Upload to server done
Flash device copy took 00:00:23 [hh:mm:ss]
```

Copy an Image from Flash Memory to an rcp Server

You can copy a system image from Flash memory to an rcp network server.

If you copy the configuration file to a personal computer used as a file server, the computer must support rsh.

Understand the rcp Username

The rcp protocol requires a client to send a remote username on each rcp request to a server. When you copy an image from the router to a server using rcp, the Cisco IOS software sends the first valid username in the following list:

- 1 The remote username specified in the **copy** command, if one is specified.
- 2 The username set by the **ip rcmd remote-username** command, if the command is configured.
- 3 The remote username associated with the current TTY (terminal) process. For example, if the user is connected to the router through Telnet and was authenticated through the **username** command, the router software sends the Telnet username as the remote username.
- 4 The router host name.

For the rcp copy request to execute successfully, an account must be defined on the network server for the remote username. If the server has a directory structure, the configuration file or image is written or copied relative to the directory associated with the remote username on the server. The path for all files and images to be copied begins at the remote user's home directory. For example, if the system image resides in the home directory of a user on the server, specify that user's name as the remote username.

If you are writing to the server, the rcp server must be properly configured to accept the rcp write request from the user on the router. For UNIX systems, you must add an entry to the .rhosts file for the remote user on the rcp server. For example, suppose the router contains the following configuration lines:

```
hostname Rtr1
ip rcmd remote-username User0
```

If the router's IP address translates to Router1.domain.com, then the .rhosts file for User0 on the rcp server should contain the following line:

```
Router1.domain.com Rtr1
```

Refer to the documentation for your rcp server for more details.

Copy from Flash Memory to an rcp Server Tasks

To copy the system image from Flash memory to a network server, use the following commands:

Step	Command	Purpose
1	show flash-filesystem:	Learn the exact spelling of the system image filename in Flash memory.
2	configure terminal	(Optional) Enter configuration mode from the terminal. This step is required only if you want to change the default remote username (see Step 3).
3	ip rcmd remote-username <i>username</i>	(Optional) Configure the remote username.
4	end	(Optional) Exit configuration mode. This step is required only if you want to change the default remote username (see Step 3).
5	copy flash-url rcp:[[[/[<i>username</i>@]<i>location</i>]/<i>directory</i>]/<i>filename</i>]	Copy the system image from Flash memory to a network server using rcp.
6		Reply to any router prompts for additional information or confirmation. The prompting will depend on how much information you provide in the copy command and the current setting of the file prompt command.

Copy from Flash to RCP Server Example

The following example copies the system image c5200-ds-1 to the network server at 172.16.1.111 using rcp and a username of netadmin:

```
Router# copy flash:c5200-ds-1 rcp:netadmin1@172.16.1.111/c5200-ds-1
Verifying checksum for 'c5200-ds-1' (file # 1)...[OK]
Writing c5200-ds-1 -
```


Copy from Flash Memory to an FTP Server Tasks

To copy a system image to an FTP network server, use the following commands in EXEC mode:

Step	Command	Purpose
1	configure terminal	(Optional) Enter configuration mode from the terminal. This step is required only if you override the default remote username or password (see Steps 2 and 3).
2	ip ftp username <i>username</i>	(Optional) Change the default remote username.
3	ip ftp password <i>password</i>	(Optional) Change the default password.
4	end	(Optional) Exit configuration mode. This step is required only if you override the default remote username or password (see Steps 2 and 3).
5	show flash-filesystem:	(Optional) If you do not already know it, learn the exact spelling of the system image filename in Flash memory.
6	copy flash-filesystem:filename ftp:[[[/[username [:password]@]location]directory] /filename]	Copy the image to the FTP server.
7		Reply to any router prompts for additional information or confirmation. The prompting will depend on how much information you provide in the copy command and the current setting of the file prompt command.

Copy from Flash Memory to an FTP Server Example

The following example uses the **show flash:** command to learn the name of the system image file and the **copy flash: tftp:** command to copy the system image (c3640-2is-mz) to a TFTP server. The router uses the default username and password.

```
Router# show flash:

System flash directory:
File Length Name/status
  1 4137888 c3640-c2is-mz
[4137952 bytes used, 12639264 available, 16777216 total]
16384K bytes of processor board System flash (Read/Write)\

Router# copy flash: tftp:
IP address of remote host [255.255.255.255]? 172.16.13.110
filename to write on tftp host? c3600-c2is-mz
writing c3640-c2is-mz !!!!!...
successful ftp write.
```

Copy from Slot1 to an FTP Server Example

The following example uses the **show slot1:** command to display the name of the system image file in the second PCMCIA slot and the copies the file (test) to an FTP server.

```
Router# show slot1:

-#- ED --type-- --crc--- -seek-- nlen -length- -----date/time----- name
1  .. 1          46A11866 2036C   4    746      May 16 1995 16:24:37 test

Router# copy slot1:test ftp://thisuser:thatpass@172.16.13.110/test
writing test!!!!...
successful ftp write.
```

Copy from Partitioned Flash to an FTP Server Example

In this example, the file `your-ios` is copied from partition 1 of the Flash memory PC card in slot 0 to the TFTP server at 172.23.1.129. The file will be saved with the name `your-ios` in the `dirt/sysadmin` directory relative to the directory of the remote username.

```
Router#show slot0: partition 1

PCMCIA Slot0 flash directory, partition 1:
File Length Name/status
  1 1711088 your-ios
[1711152 bytes used, 2483152 available, 4194304 total]

Router# copy slot0:1:your-ios ftp://myuser:mypass@172.23.1.129/dirt/sysadmin/your-ios

Verifying checksum for 'your-ios' (file # 1)... OK
Copy 'your-ios' from Flash to server
  as 'dirt/sysadmin/ios-2'? [yes/no] yes
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
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!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
Upload to server done
Flash device copy took 00:00:23 [hh:mm:ss]
```

Copy Images from a Network Server to Flash Memory

You can copy system images or boot image from a TFTP, rcp, or FTP server to a Flash memory file system to upgrade or change the Cisco IOS software or boot image on your router.

The protocol you use depends on which type of server you are using. The FTP and rcp transport mechanisms provide faster performance and more reliable delivery of data than TFTP. These improvements are possible because the FTP and rcp transport mechanisms are built on and use the Transmission Control Protocol/Internet Protocol (TCP/IP) stack, which is connection-oriented.

The following sections describe the copying tasks. The first two tasks and the last task are required. If you have a run-from-Flash system, the third section is required. Perform one of the remaining tasks, depending on which file transfer protocol you use.

- Understand Flash Memory Space Considerations
- Output for Image Downloading Process
- Copy to Flash Memory Tasks for Run-from-Flash Systems
- Copy an Image from a TFTP Server to a Flash Memory File System
- Copy an Image from an rcp Server to a Flash Memory File System
- Copy an Image from an FTP Server to a Flash Memory File System
- Verify the Image in Flash Memory

Note When you are upgrading or changing to a different Cisco IOS release, refer to the appropriate release notes for information on system requirements and limitations.

Restrictions on File Naming

Filenames in Flash memory can be up to 63 characters long; they are not case-sensitive and are always converted to lowercase.

Note The destination filename must be an alphanumeric expression. For example, the filename 1 is invalid.

The filename can be in either lowercase or uppercase; the system ignores case. If more than one file of the same name is copied to Flash, regardless of case, the last file copied becomes the valid file.

Understand Flash Memory Space Considerations

Be sure there is enough space available before copying a file to Flash memory. Use the **show flash-filesystem:** command, and compare the size of the file you want to copy to the amount of Flash memory available. If the space available is less than the amount needed, the **copy** command is partially executed, but the entire file is not copied into Flash memory. The failure message “buffer overflow - xxx/xxx” appears, where xxx/xxx is the number of bytes read from the source file and the number of bytes available on the destination device.



Caution Do not reboot the router if there is no valid image in Flash memory.

Note For the Cisco 3600 series, if you do not have access to a network server and need to download a system image, you can copy an image from a local or remote computer (such as a PC, UNIX workstation, or Macintosh) using the Xmodem or Ymodem protocols. See the section “Recovering a System Image Using Xmodem or Ymodem” later in this chapter.

On Cisco 2500, Cisco 3000, and Cisco 4000 systems, if the file being downloaded to Flash memory is an uncompressed system image, the **copy** command automatically determines the size of the file being downloaded and validates it with the space available in Flash memory.

On Class B Flash file systems, the router gives you the option of erasing the existing contents of Flash memory before writing to it. If there is no free Flash memory available, or if no files have ever been written to Flash memory, the erase routine is required before new files can be copied. If there is enough free Flash memory, the router gives you the option of erasing the existing Flash memory before writing to it. The system will inform you of these conditions and prompt you for a response.

Note If you enter **n** after the “Erase flash before writing?” prompt, the copy process continues. If you enter **y** and confirm the erasure, the erase routine begins. Be sure to have ample Flash memory space before entering **n** at the erasure prompt.

If you attempt to copy a file into Flash memory that is already there, a prompt informs you that a file with the same name already exists. This file is “deleted” when you copy the new file into Flash.

- On Class A and B Flash file systems, the first copy of the file still resides within Flash memory, but it is rendered unusable in favor of the newest version and is listed with the “deleted” tag when you use the **show flash-filesystem:** command. If you terminate the copy process, the newer file is marked “deleted” because the entire file was not copied and is not valid. In this case, the original file in Flash memory is valid and available to the system.
- On Class C Flash file systems, the first copy of the file is erased.

You can copy normal or compressed images to Flash memory. You can produce a compressed system image on any UNIX platform using the **compress** command. Refer to your UNIX platform's documentation for the exact usage of the **compress** command.

On some platforms, the Flash security jumper must be installed in order to write to Flash memory. In addition, some platforms have a write protect switch which must be set to *unprotected* in order to write to Flash memory.

Output for Image Downloading Process

The output and dialogue may vary depending on the platform.

Output for Partitioned Flash Memory

One of the following prompts displayed after the command indicates how the file can be downloaded:

- None—The file cannot be copied.
- RXBOOT-Manual—You must manually reload to the rxboot image in ROM to copy the image.
- RXBOOT-FLH—The copy is done automatically via the Flash load helper software in boot ROMs.
- Direct—The copy can be done directly.

If the file can be downloaded into more than one partition, you are prompted for the partition number. To obtain help, enter any of the following at the partition number prompt:

- ?—Display the directory listings of all partitions.
- ?1—Display the directory of the first partition.
- ?2—Display the directory of the second partition.
- q—Quit the copy command.

Copy to Flash Memory Tasks for Run-from-Flash Systems

You cannot run the system from Flash memory and copy to it at the same time. Therefore, for systems that run from Flash, do *one* of the following before copying to Flash:

- Partition Flash memory or use Flash load helper to allow the system to run from Flash memory while you copy to it.
- Reload the system to use a system image from boot ROMs.

Refer to “Compare Types of Memory” section in the “Maintaining Router Memory” chapter of the *Configuration Fundamentals Configuration Guide* for more information on run-from-Flash systems.

Refer to the appropriate hardware installation and maintenance publication for information about the jumper settings required for your configuration.

Understand the rcp Username

The rcp protocol requires a client to send a remote username on each rcp request to a server. When you copy an image from the router to a server using rcp, the Cisco IOS software sends the first valid username in the following list:

- 1 The remote username specified in the **copy** command, if one is specified.
- 2 The username set by the **ip rcmd remote-username** command, if the command is configured.
- 3 The remote username associated with the current TTY (terminal) process. For example, if the user is connected to the router through Telnet and was authenticated through the **username** command, the router software sends the Telnet username as the remote username.
- 4 The router host name.

For the rcp copy request to execute successfully, an account must be defined on the network server for the remote username. If the server has a directory structure, the configuration file or image is written or copied relative to the directory associated with the remote username on the server. The path for all files and images to be copied begins at the remote user's home directory. For example, if the system image resides in the home directory of a user on the server, specify that user's name as the remote username.

Copy from an rcp Server to Flash Memory Tasks

To copy an image from an rcp server to Flash memory, use the following commands, beginning in privileged EXEC mode:

Step	Command	Purpose
1	See the instructions in the section "Copy Images from Flash Memory to a Network Server."	Make a backup copy of the current system or bootstrap software image.
2	configure terminal	(Optional) Enter configuration mode from the terminal. This step is required only if you override the default remote username (see Step 3).
3	ip rcmd remote-username <i>username</i>	(Optional) Specify the remote username.
4	end	(Optional) Exit configuration mode. This step is required only if you override the default remote username (see Step 3).
5	copy rcp: [[[/ <i>username@</i>] <i>location</i>]/ <i>directory</i>] <i>/filename</i>] <i>flash-filesystem:</i> [<i>filename</i>]	Copy the image from an rcp server to a Flash memory file system.
6		Reply to any router prompts for additional information or confirmation. The prompting will depend on how much information you provide in the copy command and the current setting of the file prompt command.

Copy from an rcp Server to Flash Example

The following example copies a system image named mysysim1 from the netadmin1 directory on the remote server named SERVER1.CISCO.COM with an IP address of 172.16.101.101 to Flash memory. To ensure that enough Flash memory is available to accommodate the system image to be copied, the Cisco IOS software allows you to erase the contents of Flash memory first.

```
Router1# configure terminal
Router1(config)# ip rcmd remote-username netadmin1
Router1(config)# end
Router# copy rcp: flash:

System flash directory:
File name/status
  1 mysysim1
[2076072 bytes used, 21080 bytes available]

Address or name of remote host[UNKNOWN]? 172.16.101.101
Name of file to copy? mysysim1
Copy mysysim1 from SERVER1.CISCO.COM?[confirm]

Checking for file 'mysysim1' on SERVER1.CISCO.COM...[OK]

Erase Flash device before writing?[confirm]
Are you sure?[confirm]
Erasing device...ezeeze...erased.

Connected to 172.16.101.101

Loading 2076007 byte file mysysim1:!!!!...
[OK]

Verifying checksum... (0x87FD)...[OK]
```



```

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
[OK - 4823492/9646080 bytes]

4823492 bytes copied in 264.312 secs (18270 bytes/sec)

```

Verify the Image in Flash Memory

Before booting from Flash memory, verify that the checksum of the image in Flash memory matches the checksum listed in the README file that was distributed with the system software image by using the **verify** command. The checksum of the image in Flash memory is displayed at the bottom of the screen when you issue the **copy** command to copy an image. The README file was copied to the network server automatically when you installed the system software image on the server.



Caution If the checksum value does not match the value in the README file, do not reboot the router. Instead, issue the **copy** command and compare the checksums again. If the checksum is repeatedly wrong, copy the original system software image back into Flash memory *before* you reboot the router from Flash memory. If you have a corrupted image in Flash memory and try to boot from Flash, the router will start the system image contained in ROM (assuming that booting from a network server is not configured). If ROM does not contain a fully functional system image, the router will not function and must be reconfigured through a direct console port connection.

The Flash memory content listing does not include the checksum of individual files. To recompute and verify the image checksum after an image is copied into Flash memory or a Flash memory device, use the following EXEC mode command:

Command	Purpose
<code>verify flash-filesystem:[partition-number:][filename]</code>	Recompute and verify the image checksum after the image is copied into Flash memory.

If you do not provide the filename in the command, the router prompts you. By default, it prompts for the last (most recent) file in Flash. Press **Return** to recompute the default file checksum, or enter the filename of a different file at the prompt. Note that the checksum for microcode images is always 0x0000.

The following example verifies the image `c7200-js-mz` in slot0:

```

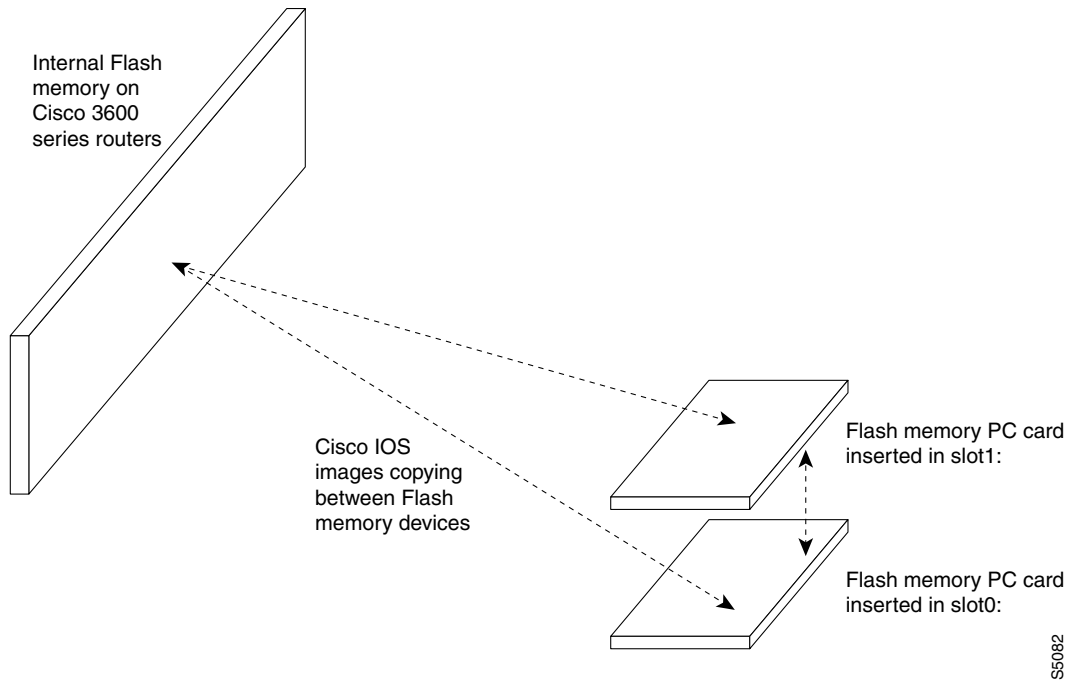
Router# verify slot0:c7200-js-mz
Verified slot0:c7200-js-mz

```

Copy Images between Local Flash Memory Devices

On routers with multiple Flash memory file systems, you can copy images from one Flash memory file system, such as internal Flash memory or a Flash memory card in a PCMCIA slot, to another Flash memory file system, as shown in Figure 351. One reason to copy the image to a different flash device is to make a backup copy of it.

Figure 351 Copying Images between Flash Memory File Systems



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To copy an image between Flash memory file systems, use these commands in EXEC mode:

Step	Command	Purpose
1	show <i>flash-filesystem:</i>	Display the layout and contents of Flash memory.
2	copy <i>source-url destination-url</i>	Copy an image between Flash memory devices.
3	verify <i>flash-filesystem:filename</i>	Verify the checksum of the image you copied.

Note The source device and the destination device cannot be the same. For example, the command **copy slot1: slot1:** is invalid.

- From ROM—In case of both Flash memory corruption and network failure, specifying a system image to be loaded from ROM provides a final backup boot method. System images stored in ROM may not always be as current as those stored in Flash memory or on network servers.

Note Some platforms, such as the Cisco 7000 family, cannot boot from ROM.

You can enter the different types of boot commands in any order in the startup configuration file or in the BOOT environment variable. If you enter multiple boot commands, the Cisco IOS software tries them in the order they are entered.

Note Booting from ROM is faster than booting from Flash memory. However, booting from Flash memory is faster and more reliable than booting from a network server.

Load the System Image from Flash Memory

Use the following sections to configure your router to boot from Flash memory. Flash memory can reduce the effects of network failure by reducing dependency on files that can only be accessed over the network.

Flash Memory Configuration Process

To configure the router to load a system image in Flash memory, perform the following steps:

Step	Task
1	(Optional) Copy a system image or boot image to Flash memory using TFTP, rcp, and FTP. See the “Copy Images from a Network Server to Flash Memory” section for more information on performing this step.
2	Configure the system to automatically boot from the desired file and location in Flash memory or bootflash memory. See the “Configure the Router to Automatically Boot from an Image in Flash Memory” section.
3	(Optional) Depending on the current configuration register setting, you may need to change the configuration register value. See the “Configure the Router to Automatically Boot from an Image in Flash Memory” section for more information on modifying the configuration register.
4	(Optional) For some platforms, to change the location of the boot image, set the BOOTLDR environment variable.
5	Save your configurations.
6	Power-cycle and reboot your system to ensure that all is working as expected.

Configure the Router to Automatically Boot from an Image in Flash Memory

To configure a router to automatically boot from an image in Flash memory, use the following commands beginning in EXEC mode:

Step	Command	Purpose
1	configure terminal	Enter configuration mode from the terminal.

Step	Command	Purpose
2	boot system flash [<i>flash-filesystem:</i>] [<i>partition-number:</i>] <i>filename</i>	Enter the filename of an image stored in Flash memory.
3	config-register <i>value</i>	Set the configuration register to enable loading of the system image specified in the configuration file.
4	end	Exit configuration mode.
5	copy system:running-config nvram:startup-config	Save the configuration file to your startup configuration.
6	more nvram:startup-config	(Optional) Verify the contents of the startup configuration.
7	reload	Power-cycle and reboot the system to ensure that all works as expected.

For routers which are partitioned, if you do not specify a partition, the router boots from the first partition. If you do not specify a filename, the router boots from the first valid image found in the partition.

If you enter more than one image filename, the router tries them in the order entered.

To remove a filename from the configuration file, enter the **no boot system flash** command and specify the file location.

Note The **no boot system** configuration command disables all **boot system** configuration commands regardless of argument. Specifying the **flash** keyword or the *filename* argument with the **no boot system** command disables only the commands specified by these arguments.

You cannot explicitly specify a remote username when you issue the **boot** command. Instead, the host name of the router is used. If the remote server has a directory structure, as do UNIX systems, and you boot the router from a network server using rcp, the Cisco IOS software searches for the system image on the server relative to the directory of the remote username.

You can also boot from a compressed image on a network server. One reason to use a compressed image is to ensure that there is enough memory available for storage. On routers that do not contain a run-from-ROM image in EPROM, when the router boots software from a network server, the image being booted and the running image both must fit into memory. If the running image is large, there might not be room in memory for the image being booted from the network server.

If there is not enough room in memory to boot a regular image from a network server, you can produce a compressed software image on any UNIX platform using the **compress** command. Refer to your UNIX platform's documentation for the exact usage of the **compress** command.

To specify the loading of a system image from a network server, use the following commands beginning in EXEC mode:

Step	Command	Purpose
1	configure terminal	Enter configuration mode from the terminal.
2	boot system [rcp tftp] filename [ip-address] or boot system mop filename [mac-address] <i>[interface]</i>	Specify the system image file to be booted from a network server using rcp, TFTP, or MOP.
3	config-register value	Set the configuration register to enable loading of the image specified in the configuration file.
4	end	Exit configuration mode.
5	copy system:running-config nvram:startup-config	Save the configuration file to your startup configuration.

In the following example, a router uses rcp to boot from the testme5.testster system image file on a network server at IP address 172.16.0.1:

```
Router# configure terminal
Router(config)# boot system rcp testme5.testster 172.16.0.1
Router(config)# config-register 0x010F
Router(config)# end
Router# copy system:running-config nvram:startup-config
```

Load the System Image from ROM

To specify the use of the ROM system image as a backup to other boot instructions in the configuration file, use the following commands beginning in EXEC mode:

Step	Command	Purpose
1	configure terminal	Enter configuration mode from the terminal.
2	boot system rom	Specify use of the ROM system image as a backup image.
3	config-register value	Set the configuration register to enable loading of the system image specified in the configuration file.
4	end	Exit configuration mode.

Step	Command	Purpose
5	copy system:running-config nvram:startup-config	Save the configuration file to your startup configuration.

In the following example, a router is configured to boot from ROM:

```
Router# configure terminal
Router(config)# boot system rom
Router(config)# config-register 0x010F
Router(config)# end
Router# copy system:running-config nvram:startup-config
```

Note The Cisco 7000 family products cannot load from ROM.

Use a Fault-Tolerant Booting Strategy

Occasionally network failures make booting from a network server impossible. To lessen the effects of network failure, consider the following booting strategy. After Flash is installed and configured, you might want to configure the router to boot in the following order:

- 1 Boot an image from Flash.
- 2 Boot an image from a network server.
- 3 Boot from ROM image.

This boot order provides the most fault-tolerant booting strategy. Use the following commands beginning in EXEC mode to allow the router to boot first from Flash, then from a system file from a network server, and finally from ROM:

Step	Command	Purpose
1	configure terminal	Enter configuration mode from the terminal
2	boot system flash <i>[flash-filesystem:][partition-number:] filename</i>	Configure the router to boot from Flash memory.
3	boot system [rcp tftp] filename [ip-address]	Configure the router to boot from a network server.
4	boot system rom	Configure the router to boot from ROM.
5	config-register value	Set the configuration register to enable loading of the system image specified in the configuration file.
6	end	Exit configuration mode.
7	copy system:running-config nvram:startup-config	Save the configuration file to your startup configuration.

In the example, a router is configured to first boot an internal Flash image called *gsxx*. Should that image fail, the router will boot the configuration file *gsxx* from a network server. If that method should fail, then the system will boot from ROM.

```
Router# configure terminal
Router(config)# boot system flash gsxx
Router(config)# boot system gsxx 172.16.101.101
Router(config)# boot system rom
Router(config)# config-register 0x010F
Router(config)# end
Router# copy system:running-config nvram:startup-config
[ok]
```

Using this strategy, a router has three alternative sources from which to boot. These alternative sources help lessen the negative effects of a failure on network or file server.

Recovering a System Image Using Xmodem or Ymodem

If you do not have access to a network server and need to download a system image (to update it, or if all the system images in Flash memory somehow are damaged or erased), you can copy an image from a local or remote computer (such as a PC, UNIX workstation, or Macintosh) using the Xmodem or Ymodem protocols. This functionality primarily serves as a disaster recovery technique and is illustrated in Figure 352.

Note Recovering system images using Xmodem or Ymodem is performed on the Cisco 1600 series and Cisco 3600 series routers only.

Xmodem and Ymodem are common protocols used for transferring files and are included in applications such as Windows 3.1 (TERMINAL.EXE), Windows 95 (HyperTerminal), Windows NT 3.5x (TERMINAL.EXE), Windows NT 4.0 (HyperTerminal), and Linux UNIX freeware (minicom).

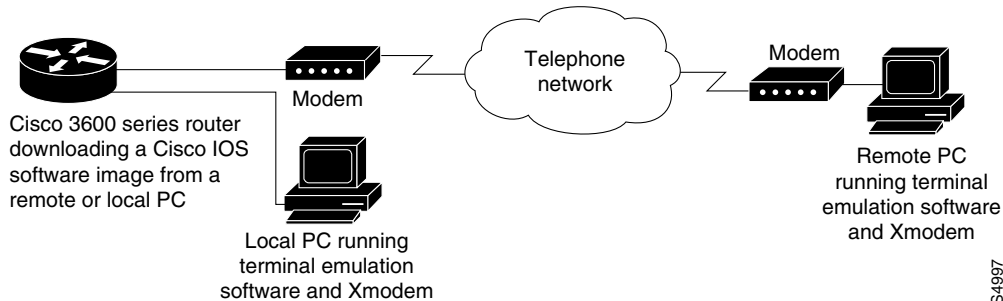
Cisco 3600 series routers do not support XBOOT functionality, a disaster recovery technique for Cisco IOS software, and do not have a separate boot helper (rxboot) image.

Xmodem and Ymodem downloads are slow, so you should use them only when you do not have access to a network server. You can speed up the transfer by setting the transfer port speed to 115200 bps.

On the Cisco 3600 series, you can perform the file transfer using Cisco IOS software or, if all local system images are damaged or erased, the ROM monitor. When you use Cisco IOS software for an Xmodem or Ymodem file transfer, the transfer can occur on either the AUX port or the console port. The AUX port, which supports hardware flow control, is recommended. File transfers from the ROM monitor must use the console port.

On the Cisco 1600 series, you can only perform the file transfer from the ROM monitor over the console port.

Figure 352 Copying a System Image to a Cisco 3600 Series Router with Xmodem /Ymodem



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To copy a Cisco IOS image from a computer or workstation to a router using the Xmodem or Ymodem protocol, use one of the following commands:

Command	Purpose
copy xmodem: <i>flash-filesystem:[partition:][filename]</i> or copy ymodem: <i>flash-filesystem:[partition:][filename]</i>	For the Cisco 3600 only, copy a system image from a computer to Flash memory using Cisco IOS software in EXEC mode.
xmodem [-y] [-c] [-e] [-f] [-r] [-x] [-s <i>data-rate</i>][<i>filename</i>] (Cisco 1600 series only)	Copy a system image from a computer to Flash memory using the ROM monitor.
xmodem [-c -y -r -x] [<i>filename</i>] (Cisco 3600 series only)	
The -c option provides CRC-16 checksumming; -y uses the Ymodem protocol; -e erases the first partition in Flash memory; -f erases all of Flash memory; -r downloads the image to DRAM (the default is Flash memory); and -x prevents the image from executing after download; and -s sets the console port data rate.	

The computer from which you transfer the Cisco IOS image must be running terminal emulation software and the Xmodem or Ymodem protocol.

For the Cisco 1600 series, if you include the **-r** option (download to DRAM), your router must have enough DRAM to hold the file being transferred. To run from Flash memory, an image must be positioned as the first file in Flash memory. If you are copying a new image to boot from Flash memory, erase all existing files first.

Xmodem Transfer Example Using the Cisco IOS Software (Cisco 3600 series only)

This example shows a file transfer using Cisco IOS software and the Xmodem protocol. The Ymodem protocol follows a similar procedure, using the **copy ymodem:** command.

To transfer a Cisco IOS image from a computer running terminal emulation software and the Xmodem protocol, follow these steps:

- Step 1** Place a Cisco IOS software image on the remote computer’s hard drive. You can download an image from Cisco Connection Online.

Step 2 To transfer from a remote computer, connect a modem to the AUX port of your Cisco 3600 series router and to the standard telephone network. The AUX port is set by default to a speed of 9600 bps, 2 stop bits, and no parity. The maximum speed is 115200 bps. Configure the router for both incoming and outgoing calls by entering the **modem inout** command.

Connect a modem to the remote computer and to the telephone network. The remote computer dials through the telephone network and connects to the router.

To transfer from a local computer, connect the router's AUX port to a serial port on the computer, using a null-modem cable. The AUX speed configured on the router must match the transfer speed configured on the local computer.

Step 3 At the EXEC prompt in the terminal emulator window of the computer, enter the **copy xmodem: flash:** command:

```
Router# copy xmodem: flash:
          **** WARNING ****
x/ymodem is a slow transfer protocol limited to the current speed
settings of the auxiliary/console ports. The use of the auxiliary
port for this download is strongly recommended.
During the course of the download no exec input/output will be
available.
          -----
```

Press **Enter** to continue.

Step 4 Specify whether to use cyclic redundancy check (CRC) block checksumming, which verifies that your data has been correctly transferred from the computer to the router. If your computer does not support CRC block checksumming, answer **no** at the prompt:

```
Proceed? [confirm]
Use crc block checksumming? [confirm] no
```

Step 5 Determine how many times the software should try to receive a bad block of data before it declares the copy operation a failure. The default is 10 retries. A higher number may be needed for noisy telephone lines. You can configure an unlimited number of retries.

```
Max Retry Count [10]: 7
```

Step 6 Decide whether you want to check that the file is a valid Cisco 3600 series image:

```
Perform image validation checks? [confirm]
Xmodem download using simple checksumming with image validation
Continue? [confirm]
```

After the transfer has begun, and if the image is valid, the software checks to see whether enough Flash memory space exists on the router to accommodate the transfer:

```
System flash directory:
File Length Name/status
 1 1738244 images/c3600-i-mz
[1738308 bytes used, 2455996 available, 4194304 total]
```

Step 7 Enter the destination filename:

```
Destination file name ? new-ios-image
```

Step 8 If you do not want the contents of internal Flash memory erased before the file transfer, enter **no**:

```
Erase flash device before writing? [confirm] no  
  
Copy '' from server  
  as 'new-ios-image' into Flash WITHOUT erase? [yes/no] yes  
Ready to receive file.....
```

Step 9 Start an Xmodem or Ymodem send operation with the terminal emulation software on the computer that is sending the system image to the router. See your emulation software application’s manual for instructions on how to execute a file transfer. Depending on the application you use, the emulation software may display the progress of the file transfer.

Xmodem Transfer Example Using the ROM Monitor

This example shows a file transfer using the ROM monitor and the Xmodem protocol. To transmit with the Ymodem protocol, use the **xmodem -y** command.

For the Cisco 3600, the router must have enough DRAM to hold the file being transferred, even if you are copying to Flash memory. The image is copied to the first file in internal Flash memory. Any existing files in Flash memory are erased. Copying files to Flash partitions or to the second-file position is not supported.



Caution A modem connection from the telephone network to your console port introduces security issues that you should consider before enabling the connection. For example, remote users can dial into your modem and access the router’s configuration settings.

Step 1 Place a Cisco IOS software image on the remote computer’s hard drive. You can download an image from Cisco Connection Online or from the Feature Pack (Cisco 1600 series only).

Step 2 To transfer from a remote computer, connect a modem to the console port of your router and to the standard telephone network. The modem and console port must communicate at the same speed, which can be from 9600 to 115200 bps (Cisco 3600 series) or from 1200 to 115200 bps (Cisco 1600 series), depending on the speed supported by your modem. Use the **confreg** ROM monitor command to configure the console port transmission speed for the router. For the Cisco 1600 series, you can also set the transmission speed with the **-s** option.

Connect a modem to the remote computer and to the telephone network. The remote computer dials through the telephone network and connects to the router.

To transfer from a local computer, connect the router’s console port to a serial port on the computer, using a null-modem cable. The console port speed configured on the router must match the transfer speed configured on the local computer.

Note If you are transferring from a local computer, you may need to configure the terminal emulation program to ignore RTS/DTR signals.

Step 3 You should see a ROM monitor prompt in the terminal emulation window:

```
rommon >
```

Enter the **xmodem** ROM monitor command, along with any desired copy options and, optionally, the filename of the Cisco IOS image. The image loads into Flash memory by default; to download to DRAM instead, use the **-r** option. The image is normally executed on completion of the file transfer; to prevent execution, use the **-x** option. The **-c** option specifies CRC-16 checksumming, which is more sophisticated and thorough than standard checksumming, if it is supported by the computer:

```
rommon > xmodem -c new-ios-image
Do not start the sending program yet...
      File size      Checksum  File name
1738244 bytes (0x1a8604)  0xdd25  george-admin/c3600-i-mz

WARNING: All existing data in flash will be lost!
Invoke this application only for disaster recovery.
Do you wish to continue? y/n [n]: yes
Ready to receive file new-ios-image ...
```

Step 4 Start an Xmodem send operation, which is initiated from the terminal emulation software on the remote computer that is sending the system image to the router. See your emulation software application's manual for instructions on how to execute a Xmodem file transfer.

Step 5 The Cisco IOS image is transferred and executed. If you are transferring from a remote computer, the computer maintains control of your console port even after the new Cisco IOS image is running. To release control to a local terminal, reconfigure the speed of the router's console port to match the speed of the local terminal by entering the **speed bps** configuration command from the remote computer at the router prompt:

```
Router# configure terminal
Router(config)# line 0
Router(config-line)# speed 9600
```

The remote connection is broken, and you can disconnect the modem from the console port and reconnect the terminal line.

Load and Display Microcode Images

On the Cisco 7000 series with RSP7000 and Cisco 7500 series, you can also load and display microcode images, as described in the following sections:

- Understand Microcode Images
- Specify the Location of the Microcode Images
- Reload the Microcode Image
- Display Microcode Image Information

Understand Microcode Images

Microcode images contain microcode which runs on various hardware devices. By default, the system loads the microcode bundled with the system software. However, you can configure the router to use microcode stored in Flash.

Cisco 7000 series with a RSP7000 and Cisco 7500 series each have a writable control store (WCS) which stores microcode. You can load updated microcode onto the WCS from bootflash or a Flash memory card inserted in one of the PCMCIA slots of the RSP card.

You can update microcode without having physical access to the router by using the **copy** command to copy microcode to a Flash file system.

Specify the Location of the Microcode Images

By default, the system loads the microcode bundled with the system software. However, you can configure the router to load different microcode.

Specify the location of the microcode to use, use the following commands beginning in EXEC mode:

Step	Command	Purpose
1	copy tftp: flash: or copy tftp: file-id	(Optional) Copy microcode files into Flash. You only need to if you are loading the microcode from Flash. See the section “Copy Images from a Network Server to Flash Memory” for more information about how to copy images to Flash memory.
2	configure terminal	Enter configuration mode.
3	microcode interface [flash-filesystem:filename [slot] system [slot]]	Configure the router to load microcode into the WCS from Flash memory or the system image. By default, the microcode bundled with the system image is loaded.
4	end	Exit configuration mode.
5	copy system:running-config nvram:startup-config	Retain new configuration information when the system is rebooted.

If an error occurs when you are attempting to download microcode, the system loads the default system microcode image, which is bundled with the system software.

Note Microcode images cannot be compressed.

Reload the Microcode Image

The configuration commands specifying the microcode are implemented following one of three events:

- The system is booted.
- A card is inserted or removed.
- The configuration command **microcode reload** is issued.

After you have entered a microcode configuration command and one of these events has taken place, all cards are reset, loaded with microcode from the appropriate sources, tested, and enabled for operation.

To signal to the system that all microcode configuration commands have been entered and the processor cards should be reloaded, use the following global configuration mode command:

Command	Purpose
microcode reload	Notify the system that all microcode configuration commands have been entered and the processor cards should be reloaded.

Immediately after you enter the **microcode reload** command and press **Return**, the system reloads all microcode. Global configuration mode remains enabled. After the reload is complete, enter the **exit** command to return to the EXEC prompt.

If Flash memory is busy because a card is being removed or inserted, or a **microcode reload** command is executed while Flash is locked, the files will not be available and the onboard ROM microcode will be loaded. Issue another **microcode reload** command when Flash memory is available, and the proper microcode will be loaded. The **show flash** command will show if another user or process has locked Flash memory.

Note The **microcode reload** command should not be used while Flash is in use. For example, do not use this command when a **copy {ftp: | rcp: | tftp:} flash-filesystem** or **show flash-filesystem:** command is active.

The **microcode reload** command is automatically added to your running configuration when you issue a microcode command that changes the system’s default behavior of loading all processors from ROM.

In the following example, all controllers are reset, the specified microcode is loaded, and the CxBus complex is reinitialized according to the microcode configuration commands that have been written to memory:

```
Router# configure terminal
Router(config)# microcode reload
Router(config)# end
```

Display Microcode Image Information

To display microcode information, use the following command in EXEC mode:

Command	Purpose
show microcode	Display microcode information.

Load Cisco IOS Images on the Cisco 12000 GSR

Loading a Cisco IOS image on the GRP on a Cisco 12000 series router is the same as loading images on Cisco 7500 series routers. In addition to the Cisco IOS image that resides on the GRP, each line card on the Cisco 12000 series has a Cisco IOS image. When the router is reloaded, the specified Cisco IOS image is loaded onto the GRP, and that image is automatically downloaded to all the line cards.

For additional information on how to load Cisco IOS images, refer to the “Observing System Startup and Performing a Basic Configuration” chapter in the *Cisco 12012 Gigabit Switch Router Installation and Configuration Guide*.

Normally, you want the same Cisco IOS image on the GRP and all line cards. However, if you want to upgrade a line card with a new version of microcode for testing or to fix a defect, you might need to load a Cisco IOS image that is different from the one on the line card. Additionally, you might need to load a new image on the line card to work around a problem that is affecting only one of the line cards.

On the Cisco 12000 series GSR you load the microcode image as described in the following sections:

- Load Image on a Line Card
- Set the LED Message on a Line Card

Load Image on a Line Card

To load a Cisco IOS image on a line card, first use the **copy tftp** command to download the Cisco IOS image to a slot on one of the PCMCIA Flash cards. After you have downloaded the Cisco IOS image on the Flash card, use the following commands beginning in global configuration mode:

Step	Command	Purpose
1	microcode { oc12-atm oc12-pos oc3-pos-4 } flash <i>file_id slot-number</i>	Specify the type of line card, location of the Cisco IOS image, and the slot of the line card to download the image. If the slot number is omitted, the image is downloaded to all line cards.
2	microcode reload <i>slot-number</i>	Reload the image on the specified line card.
3	exit	Exit configuration mode.
4	execute-on slot <i>slot-number</i> show version or attach <i>slot-number</i> show version exit	Connect to the line card and verify that the new Cisco IOS image is on the line card by checking the version number in the display output.

Set the LED Message on a Line Card

You can specify the message that is displayed on the LED on the front panel of one or more line cards. You can also remove the user-specified message that is displayed on the LED on the front panel of one or more line cards and revert to the normal status message for the line card.

To set or clear the LED message, use one of the following commands in privileged EXEC mode:

Command	Purpose
set card-message { all slot number } [expire <i>seconds</i>] [blink <i>seconds</i>] <i>message</i>	Set the message displayed on the LED on the front panel of one or more line cards.
or clear card-message { all slot number }	Clear the user-specified message that is displayed on the LED on the front panel of one or more line cards and revert to the normal status message for the line card.