APPENDIX B

Virtual Configuration Register

This appendix describes the router virtual configuration register, the factory default settings, and the procedures for changing those settings.

Following is the information included in this appendix:

- Changing configuration register settings
- Virtual configuration register bit meanings
- Default boot filenames
- Enabling booting from Flash memory
- Copying to Flash memory

The router has a 16-bit virtual configuration register, which is written into the nonvolatile random-access memory (NVRAM). Following are some reasons for changing the virtual configuration register settings:

- Setting and displaying the configuration register value
- Forcing the system into the bootstrap program
- Selecting a boot source and default boot filename
- Enabling or disabling the Break function
- Controlling broadcast addresses
- Setting the console terminal baud rate
- Loading operating software from ROM
- Enabling booting from a Trivial File Transfer Protocol (TFTP) server

Table B-1 lists the meaning of each of the virtual configuration memory bits and Table B-2 defines the boot field names.

Caution To avoid confusion and possibly hanging the router, remember that valid configuration register settings might be combinations of settings and not just the individual settings listed in Table B-1. For example, the factory default value of 0x2102 is a combination of settings.

Table B-1 Virtual Configuration Register Bit Meanings

Bit No.[1]	Hexadecimal	Meaning
00 to 03	0x0000 to 0x000F	Boot field (see Table B-2)
06	0x0040	Causes system software to ignore NVRAM contents
07	0x0080	OEM bit enabled
08	0x0100	Break disabled
10	0x0400	IP broadcast with all zeros
11 to 12	0x0800 to 0x1000	Console line speed
13	0x2000	Boot default ROM software if network boot fails
14	0x4000	IP broadcasts do not have net numbers
15	0x8000	Enable diagnostic messages and ignore NVRAM contents

1. The factory default value for the configuration register is 0x2102. This value is a combination of the following: bit 13 = 0x2000, bit 8 = 0x0100, and bits 00 through 03 (see Table B-2) = 0x0002.

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

Boot Field	Meaning
0x0	Stays at the system bootstrap prompt
0x1	Boots system image in system ROM
0x2 to 0xF	Specifies a default netboot filename Enables boot system commands that override default netboot filename

Changing Configuration Register Settings

Some common reasons to modify the value of the virtual configuration register follow:

- Recovering a lost password
- Changing the console baud rate
- Enabling or disabling Break
- Allowing you to manually boot the operating system using the **b** command at the bootstrap program (ROM monitor) prompt
- Forcing the router to boot automatically from the system bootstrap software (boot ROM image) or from its system image in Flash memory, and read any **boot system** commands that are stored in the configuration file in NVRAM.

Note If the router finds no **boot system** commands, it uses the configuration register value to form a filename from which to netboot a default system image stored on a network server. (See Table B-3.)

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

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

```
router> enable
Password:
router#
```

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

```
router# configure terminal
Enter configuration commands, one per line.
Edit with DELETE, CTRL/W, and CTRL/U; end with CTRL/Z
```

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

```
config-register 0xvalue
```

(The virtual configuration register is stored in nonvolatile memory.)

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

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

```
Configuration register is 0x142 (will be 0x102 at next reload)
```

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

Virtual Configuration Register Bit Meanings

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

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

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

- **b**—Boots the default system software from ROM
- **b flash**—Boots the first file in Flash memory
- **b** *filename* [*host*]—Netboots using TFTP
- **b flash** [*filename*]—Boots the file (*filename*) from Flash memory

For more information about the **b** [**tftp**] **flash** *filename* command, refer to the router products configuration publication. The configuration publication is available on UniverCD or a printed copy can be ordered separately.

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

Table B-3 Default Boot Filenames

Action/Filename	Bit 3	Bit 2	Bit 1	Bit 0
bootstrap mode	0	0	0	0
ROM software	0	0	0	1
cisco2-igs	0	0	1	0
cisco3-igs	0	0	1	1
cisco4-igs	0	1	0	0
cisco5-igs	0	1	0	1
cisco6-igs	0	1	1	0
cisco7-igs	0	1	1	1
cisco10-igs	1	0	0	0
cisco11-igs	1	0	0	1
cisco12-igs	1	0	1	0
cisco13-igs	1	0	1	1
cisco14-igs	1	1	0	0
cisco15-igs	1	1	0	1
cisco16-igs	1	1	1	0
cisco17-igs	1	1	1	1

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

```
router# configure terminal
Enter configuration commands, one per line.
Edit with DELETE, CTRL/W, and CTRL/U; end with CTRL/Z
config-register 0x102
boot system flash [filename]
^Z
router#
```

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

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

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

Bit 10 controls the host portion of the Internet 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 B-4 shows the combined effect of bits 10 and 14.

Table B-4 Configuration Register Settings for Broadcast Address Destination

Bit 14	Bit 10	Address (<net> <host>)
off	off	<ones> <ones>
off	on	<zeros> <zeros>
on	on	<net> <zeros>
on	off	<net> <ones>

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

Table B-5 System Console Terminal Baud Rate Settings

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

Bit 13 determines the server response to a bootload failure. Setting bit 13 causes the server to load operating software from ROM 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 set to 1.

Enabling Booting from Flash Memory

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

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

```
router# configure terminal
Enter configuration commands, one per line.
Edit with DELETE, CTRL/W, and CTRL/U; end with CTRL/Z
boot system flash [filename]
```

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

```
router# configure terminal
Enter configuration commands, one per line.
Edit with DELETE, CTRL/W, and CTRL/U; end with CTRL/Z
config-reg 0x2102
^Z
router#
```

Copying to Flash Memory

Copying to Flash memory might be required whenever a new image or maintenance release becomes available. If the boot ROMs for your system support Flash load helper, you can use Flash load helper to download a new image. Otherwise, you must manually download a new image to Flash.

Using Flash Load Helper

Flash load helper is a software option that enables you to upgrade system software on run-from-Flash systems that have a single bank of Flash memory. Or you can use Flash load helper on systems with dual-bank Flash memory that support Flash memory partitioning. Flash load helper is an automated procedure that reloads the ROM-based image, downloads the software to Flash memory, and reboots with the system image in Flash memory. Refer to the chapter "Loading System Images, Microcode Images, and Configuration Files" in the *Router Products Configuration Guide* for detailed instructions about using Flash load helper.

Upgrading Manually

If the boot ROMs on your system do not support Flash load helper, you must perform the Flash upgrade manually. To copy a new image into Flash memory (write to Flash), first reboot from ROM and then copy the new image into Flash memory. You *cannot* copy a new image into Flash memory while the system is running from Flash memory. Use the **copy tftp flash** command for the copy procedure.

Following is the sample output for reloading the router and then copying a file (called *IJ09140Z*) to Flash memory from a TFTP server (called *server1*):

```
router# configure terminal
Enter configuration commands, one per line.
Edit with DELETE, CTRL/W, and CTRL/U; end with CTRL/Z
config-reg 0x2101
^Z
```

The configuration register setting 0x2101 tells the system to boot from ROM, but does *not* reset the break disable or check for a default netboot filename.

```
router# reload
...
router(boot)# copy tftp flash
IP address or name of remote host [255.255.255.255]? server1
Name of tftp filename to copy into flash []? IJ09140Z
copy IJ09140Z from 131.131.101.101 into flash memory? [confirm] <Return>
xxxxxxxx bytes available for writing without erasure.
erase flash before writing? [confirm] <Return>
Clearing and initializing flash memory (please wait)####...
Loading from 101.2.13.110: !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!... [OK - 324572/524212 bytes]
Verifying checksum...
VVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVV...
Flash verification successful. Length = 1204637, checksum = 0x95D9

router(boot)# config term
Enter configuration commands, one per line.
Edit with DELETE, CTRL/W, and CTRL/U; end with CTRL/Z
config-reg 0x2102
^Z
```

The configuration register setting 0x2102 tells the system to boot from ROM if netboot fails, disable break, and check for a default netboot filename.

```
router(boot)# reload
...
```

The system is now ready to be configured to boot from the new image you copied to Flash memory. For more information on the **copy tftp flash** command, and other related commands, refer to the router products configuration publication.

Note Cisco technical documentation is available on UniverCD or a printed copy of individual technical documents can be ordered separately.
