

Introduction

I'm the author of [Boson's CCIE Written Practice Exam #3](#), and [NLI's Study Guide for the CCIE R&S Written Exam](#) (ISBN: 1-931881-00-6). I also occasionally teach a three-day test preparation seminar for the CCIE Written (350-001).

I developed this document to help people who are preparing for the CCIE track to better understand the router boot process. If you have any questions, issues, concerns or of course, compliments; you can reach me through e-mail at Dennis@Laganiere.net. I hope this proves to be useful in your preparation.

Configuration Register

Early Cisco routers had a set of hardware switches that controlled certain aspects of the routers performance, such as the boot sequence. This was phased out some time ago, but there is now a software equivalent, the sixteen-bit Software Configuration Register which is written into nonvolatile memory.

Common reasons for modifying the register include:

- Recovering a lost password.
- Changing the router boot configuration to allow Flash or ROM boot.
- Loading an image into Flash memory.
- Enabling or disabling the console break key.

Here are some of the common Configuration Register values:

- 0x2102 – The most common value, which establishes booting to flash and NVRAM.
- 0x2142 – The value used most commonly to recover passwords.
- 0x2100 – Boots using the bootstrap found in ROM.

Software Configuration Bit Meanings

	BR 15	BR 14	BR 13	BR 12	BR 11	BR 10	BR 9	BR 8	BR 7	BR 6	BR 5	BR 4	BR 3	BR 2	BR 1	BR 0
0x2102 =	0	0	1	0	0	0	0	1	0	0	0	0	0	0	1	0
	Enable diagnostic messages and ignore NVM contents	IP Broadcasts do not have net numbers	Boot default ROM software if network boot fails	Console line speed	Console line speed	IP broadcast with all zeros	Not significant	Break disabled	OEM bit enabled	Ignore NVM contents	Not significant	Fast boot	Boot field	Boot field	Boot field	Boot field

* Please note that a **boot system** global command in the router's NVRAM configuration will override the default net-boot filename.

Bunch of Bits (some of the more interesting Configuration Register Bits and what they do)

Bits 0,1,2 and 3 are known collectively as the **boot field**, and determine where the router will load its IOS image from.

- If the boot field value is 0x0, you will need to boot the operating system manually by entering the “b” command at the bootstrap prompt.
- If the boot field value is 0x1 (the factory default), the router will boot using the default ROM software.
- If the boot field has any other value, the router uses the resulting number to form a default boot filename for network booting, which is created as part of the automatic configuration process. To form the boot filename, the server starts with the word “cisco” attaches the octal equivalent of the boot field number, then a dash, and finally the processor-type name. The table below lists the default boot filenames for boot field values between 0x2 and 0xf on an IGS router.

Default Boot Filenames

<i>Bit 3</i>	<i>Bit 2</i>	<i>Bit 1</i>	<i>Bit 0</i>	<i>Hex Value</i>	<i>Net-boot Filename</i>
0	0	1	0	0x2	cisco2-igs
0	0	1	1	0x3	cisco3-igs
0	1	0	0	0x4	cisco4-igs
0	1	0	1	0x5	cisco5-igs
0	1	1	0	0x6	cisco6-igs
0	1	1	1	0x7	cisco7-igs
1	0	0	0	0x8	cisco10-igs
1	0	0	1	0x9	cisco11-igs
1	0	1	0	0xa	cisco12-igs
1	0	1	1	0xb	cisco13-igs
1	1	0	0	0xc	cisco14-igs
1	1	0	1	0xd	cisco15-igs
1	1	1	0	0xe	cisco16-igs
1	1	1	1	0xf	cisco17-igs

It's important to remember that the boot sequence, barring the involvement of "boot system" commands in the configuration, is Flash, Network, ROM.

Bit 4 enables "Fast Boot", which is only supported on dual RSP chassis. This allows the "slave" RSP to reload without going through an IOS load sequence, just reload the config file and go. The documentation says it will accomplish a fast boot in approximately 30 sec.

Bit 6 determines whether the router should load its startup config from NVRAM (1) or not (0). This is the key bit used for recovering a lost password. If it is turned on, the startup configuration (usually in NVRAM) is ignored. This will allow you to log in without using a password and display the startup configuration passwords.

Bit 7 allows Cisco boot messages to be suppressed when IOS is licensed to another manufacturer.

Bit 8 controls the console Break key. Setting bit 8 on (the factory default) causes the processor to ignore the console Break key. Clearing bit 8 causes the processor to interpret the break as a command, which forces the system into the bootstrap monitor, halting normal operation. Remember that a break can be issued anytime during the first 60 seconds of booting to go to ROM mode, regardless of the configuration settings.

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. Bits 10 and 14 interact to control the network and subnet portions of the broadcast address. This table shows how these settings are configured.

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

Bits 11 and 12 determine the baud rate of the console port. The default setting is 9600 (00). The most common reason for changing the speed is to increase the speed at which you can transfer a new IOS version through the console port connection. Here are the possible combinations of these two bits, and the speeds they represent:

<i>Bit 12</i>	<i>Bit 11</i>	<i>Baud Rate</i>
0	0	9600
0	1	4800
1	0	1200
1	1	2400

Bit 13 determines the routers response to a boot load failure. If the bit is turned on (1), it causes the server to load IOS from ROM after five unsuccessful attempts to load a boot file from the network. If the bit is set to “0” (factory default), the router will continue trying to load a boot file from the network indefinitely. The important thing to remember is that if the bit is (0) and no IOS is found, the router will hang. If the bit is (1), and no IOS is found, the router will boot from ROM.

Bit 14 controls the network and subnet portions of the broadcast address and allows subnet or directed broadcasts. It should be seen as being related to the function of bit 10.

Bit 15 in a hardware configuration register causes NVRAM configuration files to be ignored. This is not true of virtual configuration registers.

Seeing and Changing Configuration Register Settings

To display the current configuration register value and the value that will be used next time the router is loaded (if the two values are different) use the “**show version**” enable command.

The “**config-register**” global command is used to modify configuration register settings while the operating system is running. Remember that configuration register changes only take effect when the router is rebooted.

Boot Command

You can alter the boot sequence by using the “boot” global configuration command. Here are several possible configurations:

- Boot from a specific Flash image (using the **boot system flash filename** command).
- Boot from a undefined network server by sending broadcast TFTP requests (using the **boot system filename** command).
- Boot from a specific network server by sending a direct TFTP request to a specific IP address (using the **boot system filename address** command).

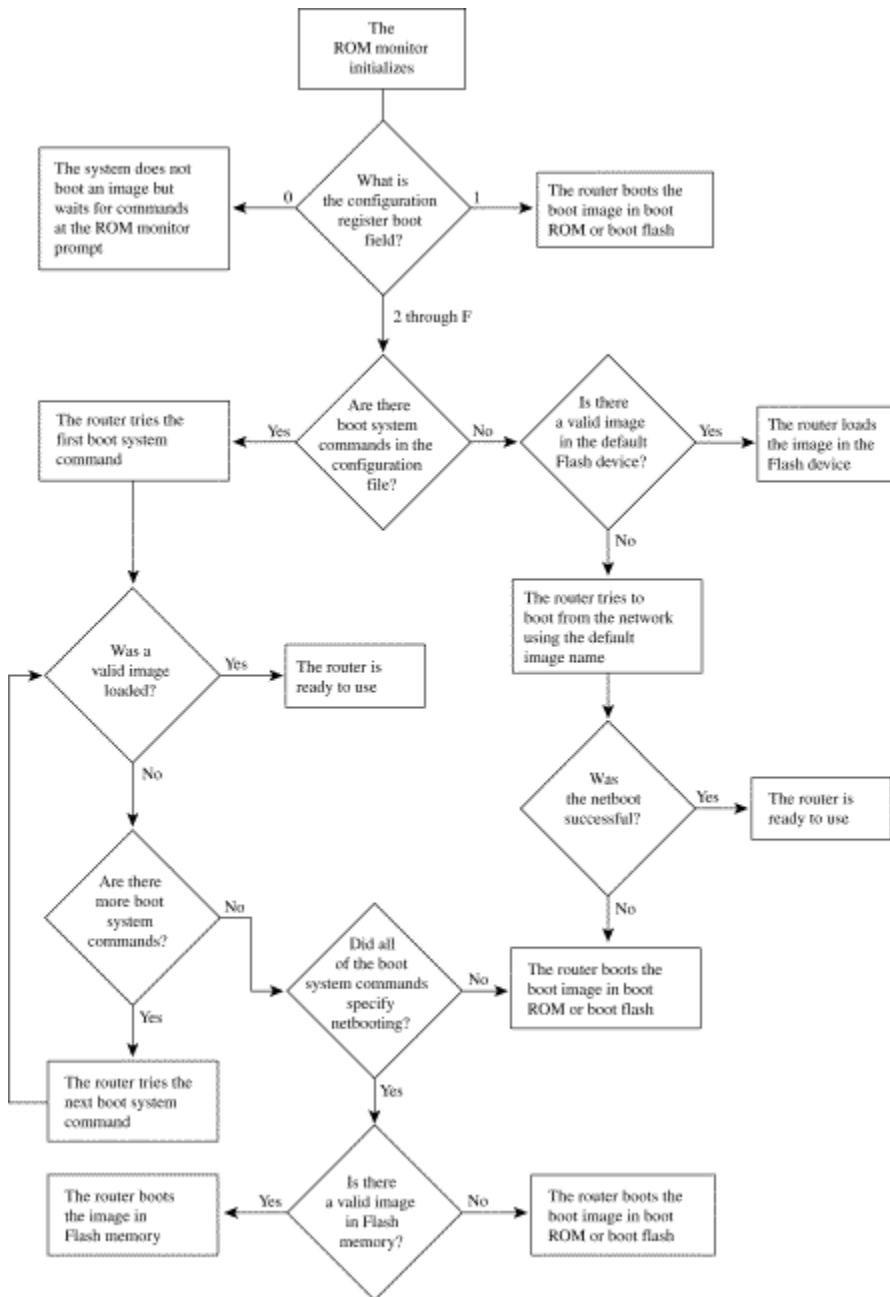
My simplistic description of the boot sequence

The main thing to remember is that with standard configuration register settings (last four bits are between 0x2 and 0xF), and if there are “boot system” commands present in the startup, the boot sequence will not attempt to boot from the network using the default image name. If there aren’t any “boot system” commands, it will attempt a network boot.

- With “boot system” commands in the configuration - Flash, ROM
- Without “boot system” commands in the configuration - Flash, Network, ROM

Diagram

This flowchart from the CCO does an excellent job of detailing the boot process. You'll find the URL to pull up the original at the bottom of this page:



Source:

http://www.cisco.com/univercd/cc/td/doc/product/software/ios122/122cgcr/ffun_c/ffcprt2/fcf010.htm#xtocid3