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Sybex CCENT
Chapter 8: Cisco IOS

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Chapter 8 Objectives

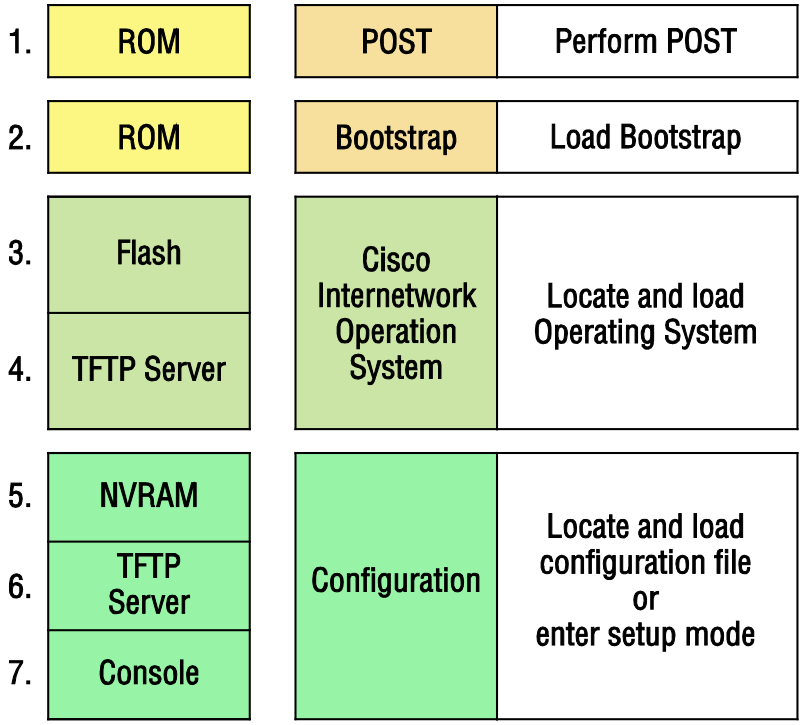
- The ICND1 Topics Covered in this chapter include:
- **5.0 Infrastructure Management**
- 5.2 Configure and verify device management.
- 5.2.c Licensing
- 5.5 Perform device maintenance.
- 5.5.a Cisco IOS upgrades and recovery (SCP, FTP, TFTP, and MD5 verify)
- 5.5.b Password recovery and configuration register
- 5.5.c File system management

The Internal Components of a Cisco Router

Component	Description
Bootstrap	Stored in the microcode of the ROM, the bootstrap is used to bring a router up during initialization. It will boot the router and then load the IOS.
POST (power-on self-test)	Stored in the microcode of the ROM, the POST is used to check the basic functionality of the router hardware and determines which interfaces are present.
ROM monitor	Stored in the microcode of the ROM, the ROM monitor is used for manufacturing, testing, and troubleshooting. In older routers it could load what was called a mini-IOS.
Mini-IOS	Called the RXBOOT or bootloader by Cisco, the mini-IOS is a small IOS in ROM that can be used to bring up an interface and load a Cisco IOS into flash memory. The mini-IOS can also perform a few other maintenance operations, but not much.
RAM (random access memory)	Used to hold packet buffers, ARP cache, routing tables, and also the software and data structures that allow the router to function. Running-config is stored in RAM, and most routers expand the IOS from flash into RAM upon boot.
ROM (read-only memory)	Used to start and maintain the router. Holds the POST and the bootstrap program as well as the mini-IOS.
Flash memory	Stores the Cisco IOS by default. Flash memory is not erased when the router is reloaded. It is EEPROM (electronically erasable programmable read-only memory) created by Intel.
NVRAM (nonvolatile RAM)	Used to hold the router and switch configuration. NVRAM is not erased when the router or switch is reloaded. Does not store an IOS. The configuration register is stored in NVRAM.
Configuration register	Used to control how the router boots up. This value can be found as the last line of the show version command output, and by default is set to 0x2102, which tells the router to load the IOS from flash memory as well as to load the configuration from NVRAM.

Router bootup process

- **Major phases to the router bootup process**
  - Test router hardware
    - Power-on self-test (POST)
    - Execute bootstrap loader
  - Locate and load Cisco IOS software
    - Locate IOS
    - Load IOS
  - Locate and load startup configuration file or enter setup mode
    - Bootstrap program looks for configuration file



The configuration register bit numbers

The default configuration setting on Cisco routers is 0x2102. This means that bits 13, 8, and 1 are on, as shown in the table. Notice that each set of 4 bits (called a nibble) is read in binary with a value of 8, 4, 2, 1.

Configuration Register			2					1				0			2	
Bit number	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Binary	0	0	1	0	0	0	0	1	0	0	0	0	0	0	1	0

The boot field (configuration register bits 00–03)

Boot Field	Meaning	Use
00	ROM monitor mode	To boot to ROM monitor mode, set the configuration register to 2100. You must manually boot the router with the b command. The router will show the rommon> prompt.
01	Boot image from ROM	To boot the mini-IOS image stored in ROM, set the configuration register to 2101. The router will show the Router(boot)> prompt. The mini-IOS is not available in all routers and is also referred to as RXBOOT. [AU: RXBOOT earlier and in ch7 of the CCENT book.]ok
02–F	Specifies a default boot filename	Any value from 2102 through 210F tells the router to use the boot commands specified in NVRAM.

Boot System Commands

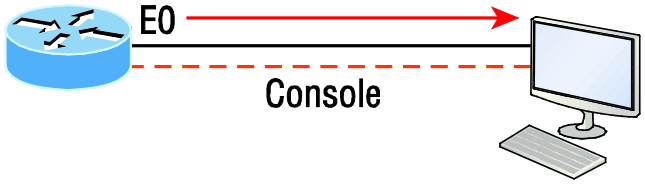
```
Router(config)#boot system ?
  WORD   TFTP filename or URL
  flash  Boot from flash memory
  ftp    Boot from a server via ftp
  mop    Boot from a Decnet MOP server
  rcp    Boot from a server via rcp
  rom    Boot from rom
  tftp   Boot from a tftp server
Router(config)#boot system flash c2800nm-advsecurityk9-
mz.151-4.M6.bin
```

Copying an IOS from a router to a TFTP host

Copy the IOS to a TFTP host.

Router# copy flash tftp

- IP address of the TFTP server
- IOS filename




```
RouterX#copy flash tftp:
Source filename [] ?c2800nm-ipbase-mz.124-5a.bin
Address or name of remote host [] ? 10.1.1.1
Destination filename [c2800nm-ipbase-mz.124-5a.bin] [enter]
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!<output omitted>
12094416 bytes copied in 98.858 secs (122341 bytes/sec)
RouterX#
```

- TFTP server software must be running on the PC.
- The PC must be on the same subnet as the router's E0 interface.
- The `copy flash tftp` command must be supplied the IP address of the PC.

Restoring or upgrading the IOS

```
Router#copy tftp flash
Address or name of remote host []?1.1.1.2
Source filename []?c2800nm-advsecurityk9-mz.151-4.M6.bin
Destination filename [c2800nm-advsecurityk9-mz.151-
4.M6.bin]?[enter]
%Warning: There is a file already existing with this name
Do you want to over write? [confirm][enter]
Accessing tftp://1.1.1.2/ c2800nm-advsecurityk9-mz.151-4.M6.bin...
Loading c2800nm-advsecurityk9-mz.151-4.M6.bin from 1.1.1.2 (via
FastEthernet0/0): !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
[OK - 21710744 bytes]

45395968 bytes copied in 82.880 secs (261954 bytes/sec)
Router#
```

Cisco’s new IOS licensing

Prior to the 15.0 code release, there were eight different software feature sets for each hardware router type.

With the IOS 15.0 code, the packaging is now called a *universal image*, meaning all feature sets are available in one file with all features packed neatly inside.

So instead of the pre-15.0 IOS file packages of one image per feature set, Cisco now just builds one universal image that includes all of them in the file.

To use the features in the IOS software, you must unlock them using the software activation process.

licensing

There are three different technology packages available for purchase that can be installed as additional feature packs on top of the prerequisite IP Base (default), which provides entry-level IOS functionality. These are as follows:

Data: MPLS, ATM, and multiprotocol support

Unified Communications: VoIP and IP telephony

Security: Cisco IOS Firewall, IPS, IPsec, 3DES and VPN

For example, if you need MPLS and IPsec, you'll need the default IP Base, Data, and Security premium packages unlocked on your router.

Show license UDI command

To obtain the license, you'll need the unique device identifier (UDI), which has two components: the product ID (PID) and the serial number of the router.

The `show license UDI` command provides this information in an output as shown:

```
Router#sh license udi
Device#   PID                   SN              UDI
-------------------------------------------------------------------------
*0       CISCO2901/K9          FTX1641Y07J     CISCO2901/K9:FTX1641Y07J
```

Right-To-Use Licenses

Originally called evaluation licenses, Right-To-Use (RTU) licenses are what you need when you want to update your IOS to load a new feature but either don't want to wait to get the license or just want to test if this feature will truly meet your business requirements.

Cisco's license model allows you to install the feature you want without a PAK. The Right-To-Use license works for 60 days before you would need to install your permanent license.

To enable the Right-To-Use license you would use the `license boot module` command.

Show commands

- Show license udu
- Show license
- Show license feature
- Show version

Written Labs and Review Questions

- Read through the Exam Essentials section together in class.
- Open your books and go through all the written labs and the review questions.
- Review the answers in class.