

## FILE SYSTEMS

URIs in Cisco's IOS look like "flash:/directory/filename" when they're referred to by commands. For example

```
R5# more flash:/BHS_CICD_Lab31_post.txt
```

*Display the contents of the file, pausing after each screenful. The "/" isn't truly necessary.*

You can see the list of possible file system prefixes and the available space on each file system thusly:

```
R5# show file systems
```

```
File Systems:
```

	Size(b)	Free(b)	Type	Flags	Prefixes
	-	-	opaque	rw	archive:
	-	-	opaque	rw	system:
	-	-	opaque	rw	tmpsys:
	-	-	opaque	rw	null:
	-	-	network	rw	tftp:
*	255963136	188637184	disk	rw	flash:#
	245752	238532	nvr	rw	nvr
	-	-	opaque	wo	syslog:
	-	-	opaque	rw	xmodem:
	-	-	opaque	rw	ymodem:
	-	-	network	rw	rcp:
	-	-	network	rw	pram:
	-	-	network	rw	http:
	-	-	network	rw	ftp:
	-	-	network	rw	scp:
	-	-	opaque	ro	tar:
	-	-	network	rw	https:
	-	-	opaque	ro	cns:

And the contents of any one file system:

```
R5# dir flash:
```

```
Directory of flash:/
```

```

  1  -rw-   65869056  Nov 19 2015 23:39:40 +00:00  c2800nm-advipservicesk9-
      mz.151-4.M4.bin
  2  -rw-    2037    Nov 20 2015 00:05:24 +00:00  BHS_CICD_Lab31_post.txt
  3  drw-     0    Nov 20 2015 01:02:36 +00:00  CME 8.6.0 GUI
 22  drw-     0    Dec  2 2015 07:47:26 +00:00  its

```

```
255963136 bytes total (188637184 bytes free)
```

```
R5# show flash:
```

```

-#-  --length--  -----date/time-----  path
  1    65869056  Nov 19 2015 23:39:40 +00:00  c2800nm-advipservicesk9-mz.151-4.M4.bin
  2      2037    Nov 20 2015 00:05:24 +00:00  BHS_CICD_Lab31_post.txt
  3         0    Nov 20 2015 01:02:36 +00:00  CME 8.6.0 GUI
  4      4118    Nov 20 2015 01:02:38 +00:00  CME 8.6.0 GUI/admin_user.html
  5     677820    Nov 20 2015 01:02:40 +00:00  CME 8.6.0 GUI/admin_user.js
  6      1029    Nov 20 2015 01:02:42 +00:00  CME 8.6.0 GUI/CiscoLogo.gif

```

*Rest Omitted*

File number 1 in the listings above happens to be the IOS operating system, itself. The "show" command displays the contents of subdirectories, the "dir" command doesn't.

Shorthand—Flash: refers to whichever flash file system is the default, usually flash0:. Several files have a shorthand form that eliminates the name of the file system where they're really stored:

SHORTHAND	REAL LOCATION
running-config	system:running-config
startup-config	nvram:startup-config

## U P G R A D I N G I O S

IOS files are downloaded from Cisco's website and require a service contract. Check the MD5 hash of the file after download to make sure it's not corrupted. The website tells you what the correct hash is when you hover over the filename. Your PC can probably generate a hash of the file, or you can wait until it's on the router:

```
R5# verify /md5 flash:c2800nm-advipservicesk9-mz.151-4.M4.bin
```

The old (and slow) way to copy an operating system onto a router is across the network, using a local TFTP server. The router will quiz you about the source address and the name of the file to copy, then fill your screen with exclamation points (!) to show its achingly slow progress while you go to lunch.

```
R5# copy tftp flash
```

```
Address or name of remote host []? 10.10.0.2
```

```
Source filename []? c2800nm-advipservicesk9-mz.151-5.M4.bin
```

```
Destination filename [c2800nm-advipservicesk9-mz.151-5.M4.bin]?
```

*Just hit return to accept the default. If you type "Y" you'll end up with a file named "Y"*

```
Accessing tftp://10.10.0.2/c2800nm-advipservicesk9-mz.151-5.M4.bin...
```

Because Cisco devices load the operating system into RAM and run it there, the file it came from can be replaced while the device is running. If there's not enough room in flash for the old and new operating systems, just erase the old and copy the new file into place. Once you reboot, you'll be running the new version... or googling how to copy an operating system onto a router that won't even boot. Luckily flash has gotten bigger faster than IOS files, so you can fit old and new, choosing which to boot from with a "boot system" command (next page) allowing the old to run if the new one bombs.

In addition to TFTP, you can also use other sources, including a thumb drive (my favorite), or FTP.

```
R5# copy usbflash0:c2800nm-advipservicesk9-mz.151-5.M4.bin flash
```

```
R5# copy ftp://ben@192.168.1.3/c2800nm-advipservicesk9-mz.151-5.M4.bin flash
```

You can even copy via an encrypted SSH connection using SCP, though that one's a bit backward.

You'll actually set the router up as an SCP server, then copy from the PC as a client. Any Unix-based computer (Linux, Mac, etc.) should be able to copy files across the network using SCP from the command line. Windows will require a program like WinSCP.

```
R5(config)# username betty privilege 15 password rubble
```

*User accounts with a privilege level of 15 log in already "enabled" to privileged exec mode*

*Note: Mr. Odom has a typo in the middle of page 829 where he uses "privilege-level" instead of*

*"privilege" It's possible that newer versions of IOS will allow that, but older ones won't.*

```
R5(config)# ip scp server enable
```

### Boot Steps

- POST (Power-On Self Test)
- Copy bootstrap program from ROM to RAM and run it
- Bootstrap chooses IOS file (flash / network), loads it to RAM, and runs it
- IOS finds startup-config (NVRAM, Network, Console) and copies it to RAM as running-config

### Alternative Operating Systems

- ROMMON—Rom Monitor
- RxBoot / Boot Helper—Only in older systems, ignored here. A version of IOS in ROM

Configuration Register—Consulted before IOS loaded or startup-config read. 16-bits (4 hex digits). Controls console speed (baud), which OS to load, and whether to use the startup-config. Default is 0x2102—the 0x means the number is hexadecimal, sort of like \$ would mean dollars.

Boot Field—last hex digit of configuration register

- 0—(e.g. 0x2100) ROMMON
- 1—First IOS found in flash, based on the “file number” shown in left column of flash listing
- 2-F—(e.g. 0x2102) Try each “boot system” command in the startup-config file until one works; failover to the first IOS found in flash. (The last is factory default and most common.)

Startup Config Field—next to last digit

- 0—(e.g. 0x2102) Load the startup config normally
- 4—(e.g. 0x2142) Boot normally, but ignore the startup config; Router will boot as if the startup-config had been erased, prompting "Would you like to enter the initial configuration dialog? [yes/no]:"

Failover—If normal boot fails, router broadcasts for a tftp server and guesses at an IOS file name. eventual failover is to ROMMON, which can copy a file from tftp to flash.

Which IOS to run—each new command is added to the end of the list of OS's to try.

```
# boot system flash filename
# boot system flash:filename
# boot system tftp filename 10.0.0.1
```

## SHOW VERSION

The show version command can give you a great deal of information about your router or switch, including which ios file it booted from. Information includes:

- IOS Version running—Line 2
- How long it's been running—Line 10
- Why it rebooted—Line 11 (reload)
- Which IOS file it's running—Line 13
- How much memory it has—Line 19—The second number is set aside for buffers. Add both numbers together to get the total RAM. This is important to see if your device will support a specific version of IOS.
- Available hardware and interfaces—Lines 21-23
- Available NVRAM for storing startup-config files and Flash for storing the ios—Lines 25 -26
- The current setting of the configuration register—Line 36—This may tell you what the configuration register was during boot and what you've changed it to for the next boot. Normally, it'll just say something boring like "Configuration register is 0x2102."

```
1 Router# show version
2 Cisco IOS Software, 2800 Software (C2800NM-ADVIPSERVICESK9-M), Version 15.1(4)M4,
3 RELEASE SOFTWARE (fc1)
4 Technical Support: http://www.cisco.com/techsupport
5 Copyright (c) 1986-2012 by Cisco Systems, Inc.
6 Compiled Tue 20-Mar-12 18:13 by prod_rel_team
7
8 ROM: System Bootstrap, Version 12.4(13r)T, RELEASE SOFTWARE (fc1)
9
10 Router uptime is 9 minutes
11 System returned to ROM by reload at 07:33:47 UTC Wed Jan 4 2006
12 System restarted at 11:59:46 UTC Mon Jan 2 2006
13 System image file is "flash:c2800nm-advipservicesk9-mz.151-4.M4.bin"
14 Last reload type: Normal Reload
15
16 This product contains cryptographic features and is subject to United...
17 [lots omitted]
18
19 Cisco 2821 (revision 1.0) with 509952K/14336K bytes of memory.
20 Processor board ID FTX1146A4GE
21 2 Gigabit Ethernet interfaces
22 2 Serial(sync/async) interfaces
23 1 Virtual Private Network (VPN) Module
24 DRAM configuration is 64 bits wide with parity enabled.
25 239K bytes of non-volatile configuration memory.
26 250368K bytes of ATA CompactFlash (Read/Write)
27
28 License Info:
29
30 License UDI:
31 -----
32 Device# PID SN
33 -----
34 *0 CISCO2821 FTX1146A4GE
35
36 Configuration register is 0x2142 (will be 0x2102 at next reload)
```

## P A S S W O R D R E C O V E R Y

Really what you're doing in password recovery is bypassing the password while you change it.

- Break out of normal boot and into ROMMON. How to send a break can vary by terminal emulation software. (shift-ctrl-^ , ctrl-b in terminal server) (ctrl-a ctrl-b from “screen” utility on unix) etc. Newer routers can be put into ROMMON by removing flash card, then replacing after boot. Many switches require you to push a button on the front panel during boot.
- In ROMMON, change configuration register to ignore startup-config (0x2142), then reboot

```
rommon 1> confreg 0x2142
rommon 2> reset
```

- In IOS, enable to privileged-exec (no password required) and load the saved startup-config onto the running-config. *Now* an enable password would be required, but you're already in privileged-exec!

```
Router> en
Router# copy startup-config running-config
```

- In privileged config mode, change the password modify, save, set config-register back.

```
R5# config t
R5(config)# enable secret MyNewPassword
R5(config)# end
R5# copy run start
```

- Set the configuration register back so the startup-config won't be ignored next time. Remember that the command is "confreg" in ROMMON, "config-register" in IOS. I keep them straight by thinking of ROMMON as an abbreviated operating system with shorter commands.

```
R5(config)# config-register 0x2102
```

- Check your interfaces to make sure none of them are administratively down if they shouldn't be. By default, interfaces are up when the system is booted with a startup-config file and down when a startup-config file isn't used.

## C O N F I G U R A T I O N F I L E S

Running-config is in RAM, startup-config is in NVRAM. Specific locations:

```
nvrám:startup-config
system:running-config
```

Erasing Startup-Config—First two are antiquated; “erase nvram:” is current preferred.

```
# write erase
# erase startup-config
# erase nvram:
```

Backing up startup-config—Just like we copied the IOS file into flash, the startup-config file can be copied from the nvram: file system to a thumb-drive, a TFTP or FTP server, or to any host running SCP.

Restoring Startup-Config—Copying *to* running-config is a merge, not a replace. To completely flush running-config settings, copy to startup-config instead and reload the device.

Setup Mode—Menu-driven. Can enter by restarting a router without a “startup-config” or

```
# setup
```

## A R C H I V E

### Backups Using Archive

```
R5(config)# archive
R5(config-archive)# path ftp://protolab@10.0.0.2/
R5(config-archive)# time-period 1440
                        Automatically backup every day (1440 minutes)
R5(config)# write-memory
                        Also automatically backup anytime an admin saves changes from running-config to startup
```

Restores Using Archive—"Configure Replace" will completely replace running-config, unlike "copy."

```
R5# archive config

Writing Jan--2-13-27-45.883-1

R5# show archive
The maximum archive configurations allowed is 10.
The next archive file will be named ftp://protolab@10.0.0.2/-<timestamp>-1
Archive #  Name
  1      ftp://protolab@10.0.0.2/-Nov-16-17-03-29.542-0
  2      ftp://protolab@10.0.0.2/-Nov-16-18-03-29.542-0 <- Most Recent

R5# configure replace ftp://protolab@10.0.0.2/-Nov-16-17-03-29.542-0
                        Roll back configuration to that backup.
```