

## CHAPTER 3: ROUTER MANAGEMNT

In this chapter, you will learn how to manage Cisco routers on an internetwork. The Internetwork Operating System (IOS) and configuration files reside in different locations in a Cisco device, and it is important to understand where these files are located and how they work. You will learn about the main components of a router, the router boot sequence, and the configuration register, including how to use the configuration register for password recovery. Then you will learn how to manage routers by performing the following tasks:

- Backing up and restoring the Cisco IOS
- Backing up and restoring the Cisco configuration
- Gathering information about neighbor devices through CDP and Telnet
- Resolving hostnames
- Using the ping and trace commands to test network connectivity

### The Internal Components of a Cisco Router

In order to configure and troubleshoot a Cisco internetwork, you need to know the major components of Cisco routers and understand what these components do. Table 7.1 describes the major Cisco router components.

**TABLE 7.1** Cisco Router Components

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.
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.
RAM (random access memory)	Used to hold packet buffers, routing tables, and also the software and data structures that allow the router to function. Running-config is stored in RAM, and the IOS can also be run from RAM in some routers.
ROM (read-only memory)	Used to start and maintain the router.
Flash memory	Used on the router to hold the Cisco IOS. Flash memory is not erased when the router is reloaded. It is an EEPROM 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.
Configuration register	Used to control how the router boots up. This value can be seen with the show version command and typically is 0x2102, which tells the router to load the IOS from flash memory.

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## The Router Boot Sequence

When a router boots up, it performs a series of steps, called the boot sequence, to test the hardware and load the necessary software. The boot sequence consists of the following steps:

The router performs a POST. The POST tests the hardware to verify that all components of the device are operational and present. For example, the POST checks for the different interfaces on the router. The POST is stored in and run from ROM.

The bootstrap looks for and loads the Cisco IOS software. The boot-strap is a program in

ROM that is used to execute programs. The bootstrap program is responsible for finding where each IOS program is located and then loading the file. By default, the IOS software is loaded from flash memory in all Cisco routers.

The IOS software looks for a valid configuration file stored in NVRAM. This file is called startup-config and is only there if an administrator copies the running-config file into NVRAM.

If a startup-config file is in NVRAM, the router will load and run this file. The router is now operational. If a startup-config file is not in NVRAM, the router will start the setup mode configuration upon bootup.

### Managing Configuration Registers

All Cisco routers have a 16-bit software register, which is written into NVRAM. By default, the configuration register is set to load the Cisco IOS from flash memory and to look for and load the startup-config file from NVRAM.

### Understanding the Configuration Register Bits

The 16 bits of the configuration register are read 15–0, from left to right. The default configuration setting on Cisco routers is 0x2102. This means that bits 13, 8, and 1 are on, as shown in Table 7.2. Notice that each set of four bits is read in binary with a value of 1, 2, 4, and 8, from right to left.

**TABLE 7.2** The Configuration Register Bit Numbers

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



Add the prefix 0x to the configuration register address. The 0x means that the digits that follow are in hexadecimal.

Table 7.3 lists the software configuration bit meanings. Notice that bit 6 can be used to ignore the NVRAM contents. This bit is used for password recovery, as described in the “Recovering Passwords” section later in this chapter.

**TABLE 7.3** Software Configuration Meanings

Bit	Hex	Description
0–3	0x0000–0x000F	Boot field (see Table 7.4).
6	0x0040	Ignore NVRAM contents.
7	0x0080	OEM bit enabled.
8	0x0100	Break disabled.
10	0x0400	IP broadcast with all zeros.
11–12	0x0800–0x1000	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 NVM contents.

The boot field, which consists of bits 0–3 in the configuration register, controls the router boot sequence. Table 7.4 describes the boot field bits.

**TABLE 7.4** 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 an IOS image stored in ROM, set the configuration register to 2101. The router will show the router(boot)> prompt.

02–F	Specifies a default boot Filename	Any value from 2102 through 210F tells the router to use the boot commands specified in NVRAM.
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Remember that in hex, the scheme is 0–9 and A–F (A=10, B=11, C=12, D=13, E=14, and F=15). This means that a 210F setting for the configuration register is actually 210(15), or 1111 in binary.

## Checking the Current Configuration Register Value

You can see the current value of the configuration register by using the show version command (sh version or show ver for short), as in the following example:

Router#**sh version**

Cisco Internetwork Operating System Software

IOS (tm) C2600 Software (C2600-I-M), Version 12.0(3)T3, RELEASE SOFTWARE (fc1)

[output cut]

Configuration register is 0x2102

The last information given from this command is the value of the configuration register. In this example, the value is 0x2102, which is the default setting. Notice the show version command provides the IOS version. In the example above, it shows the IOS version as 12 0(3)T3.

## Changing the Configuration Register

You can change the configuration register value to modify how the router boots and runs, as follows:

Force the system into the ROM monitor mode  
Select a boot source and default boot filename  
Enable or disable the Break function

Control broadcast addresses

Set the console terminal baud rate

Load operating software from ROM

Enable booting from a TFTP (Trivial File Transfer Protocol) server



Before you change the configuration register, make sure you know the current configuration register value. Use the `show version` command to get this information.

You can change the configuration register by using the `config-register` command. For example, the following commands tell the router to boot from ROM monitor mode and then show the current configuration register value:

```
Router(config)#config-register 0x0101
```

```
Router(config)#^Z Router#sh ver [cut]
```

Configuration register is 0x2102 (will be 0x0101 at next reload)

Notice that the `show version` command shows the current configuration register value, as well as what it will be when the router reboots. Any change to the configuration register will not take effect until the router is reloaded.

## Recovering Passwords

If you are locked out of a router because you forgot the password, you can change the configuration register to help you recover. As noted earlier, bit 6 in the configuration register is used to tell the router whether to use the contents of NVRAM to load a router configuration.

The default configuration register value for bit 6 is 0x2102, which means that bit 6 is off. With the default setting, the router will look for and load a router configuration stored in NVRAM (`startup-config`). To recover a password, you need to turn on bit 6, which will tell the router to ignore the NVRAM contents. The configuration register value to turn on bit 6 is 0x2142.

Here are the main steps to password recovery:

Boot the router and interrupt the boot sequence by performing a break.

Change the configuration register to turn on bit 6 (with the value 0x2142).

Reload the router.

Enter privileged mode.

Copy the startup-config file to running-config.

Change the password.

Reset the configuration register to the default value.

Reload the router.

These steps are discussed in more detail in the following sections, showing the commands to restore access to 2600 and 2500 series routers.

### **Interrupting the Router Boot Sequence**

Your first step is to boot the router and perform a break. Typically, you perform a break by pressing the Ctrl+Break key combination when using HyperTerminal.

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Windows NT's default HyperTerminal program will not perform the break.

You must upgrade the HyperTerminal program or use Windows 95/98.

You should see something like this:

System Bootstrap, Version 11.3(2)XA4, RELEASE SOFTWARE (fc1)

Copyright (c) 1999 by cisco Systems, Inc. TAC:Home:SW:IOS:Specials for info

PC = 0xffff0a530, Vector = 0x500, SP = 0x680127b0 C2600 platform with 32768 Kbytes of main memory PC = 0xffff0a530, Vector = 0x500, SP = 0x80004374

monitor: command "boot" aborted due to user interrupt rommon 1 >

Notice the line "boot" aborted due to user interrupt. At this point, you will be at the rommon 1> prompt on some routers.

## Changing the Configuration Register

As explained earlier, you can change the configuration register by using the config-register command. To turn on bit 6, use the configuration register value 0x2142.

### Cisco 2600 Series Commands

To change the bit value on a Cisco 2600 series router, simply enter the command at the rommon 1> prompt:

```
rommon 1 > confreg 0x2142
```

You must reset or power cycle for new config to take effect

### Cisco 2500 Series Commands

To change the configuration register on a 2500 series router, type o after creating a break sequence on the router. This brings up a menu of configuration register option settings. To change the configuration register, enter the command o/r, followed by the new register value. Here is an example of turning on bit 6 on a 2501 router:

```
System Bootstrap, Version 11.0(10c), SOFTWARE Copyright (c) 1986-1996 by  
cisco Systems
```

```
2500 processor with 14336 Kbytes of main memory Abort at 0x1098FEC (PC)
```

```
>o
```

```
Configuration register = 0x2102 at last boot Bit# Configuration register option  
settings: 15 Diagnostic mode disabled
```

```
14      IP broadcasts do not have network numbers
```

```
13      Boot default ROM software if network boot fails
```

```
12-11   Console speed is 9600 baud
```

```
10      IP broadcasts with ones
```

```
08      Break disabled
```



07 OEM disabled

06 Ignore configuration disabled

03-00 Boot file is cisco2-2500 (or 'boot system' command) >**o/r 0x2142**

## **Reloading the Router and Entering Privileged Mode**

At this point, you need to reset the router, as follows:

From the 2600 series router, type **reset**.

From the 2500 series router, type **I** (for initialize).

The router will reload and ask if you want to use setup mode (because no startup-config is used). Answer No to entering setup mode, press Enter to go into user mode, and then type **enable** to go into privileged mode.

## **Viewing and Changing the Configuration**

Now you are past where you would need to enter the user mode and privileged mode passwords in a router. Copy the startup-config file to the running-config file:

**copy running-config startup-config**

or use the shortcut:

**copy run start**

The configuration is now running in RAM, and you are in privileged mode, which means that you can view and change the configuration. Although you cannot view the enable secret setting for the password, you can change the password, as follows:

**config t**

**enable secret todd**

## **Resetting the Configuration Register and Reloading the Router**

After you are finished changing passwords, set the configuration register back to

the default value with the config-register command:

```
config t  
config-register 0x2102
```

Finally, reload the router.

## **Backing Up and Restoring the Cisco IOS**

Before you upgrade or restore a Cisco IOS, you should copy the exist-ing file to a TFTP host as a backup in case the new image does not work. You can use any TFTP host to perform this function. By default, the flash mem-ory in a router is used to store the Cisco IOS. The following sections describe how to check the amount of flash memory, copy the Cisco IOS from flash memory to a TFTP host, and then copy the IOS from a TFTP host to flash memory.

### **Verifying Flash Memory**

Before you attempt to upgrade the Cisco IOS on your router with a new IOS file, you should verify that your flash memory has enough room to hold the new image. You can verify the amount of flash memory and the file or files being stored in flash memory by using the show flash command (sh flash for short):

```
Router#sh flash
```

System flash directory:

```
File      Length Name/status
```

```
8121000 c2500-js-l.112-18.bin
```

```
[8121064 bytes used, 8656152 available, 16777216 total] 16384K bytes of  
processor board System flash (Read ONLY) Router#
```

Notice that the filename in this example is c2500-js-l.112-18.bin.

The name of the file is platform-specific and is derived as follows:

C 2500 is the platform.

j indicates that the file is an enterprise image.

- S indicates the file contains extended capabilities.
- L indicates that the file can be moved from flash memory if needed and is not compressed.

11.2-18 is the revision number.

.bin indicates that the Cisco IOS is a binary executable file.

The last line in the router output shows that the flash is 16,384KB (or 16MB). So if the new file that you want to use is, say, 10MB in size, you know that there is plenty of room for it. Once you verify that flash mem-ory can hold the IOS you want to copy, you can continue with your backup operation.

## Backing Up the Cisco IOS

To back up the Cisco IOS to a TFTP host, you use the command `copy flash tftp`. This is a straightforward command that requires only the source file-name and the IP address of the TFTP host.

The key to success in this backup routine is to make sure that you have good connectivity to the TFTP host. You can check this by pinging the device from the router console prompt, as in the following example:

```
Router#ping 192.168.0.120
```

Type escape sequence to abort.

```
Sending 5, 100-byte ICMP Echos to 192.168.0.120, timeout is 2 seconds: !!!!!
```

```
Success rate is 100 percent (5/5), round-trip min/avg/max = 4/4/8 ms
```



The Ping (Packet Internet Groper) utility is used to test network connectivity. It is used in some examples in this chapter and discussed in more detail in the “Checking Network Connectivity” section later in this chapter.

After you ping the TFTP host to make sure that IP is working, you can use the `copy flash tftp` command to copy the IOS to the TFTP host, as shown below. Notice that after you enter the command, the name of the file in flash memory is displayed. This makes it easy for you. You can copy the filename and then paste it when prompted for the source filename.

Router#**copy flash tftp**

System flash directory:

File    Length Name/status

8121000 c2500-js-l.112-18.bin

[8121064 bytes used, 8656152 available, 16777216 total] Address or name of remote host [255.255.255.255]?

**192.168.0.120**

Source file name? **c2500-js-l.112-18.bin**

Destination file name [c2500-js-l.112-18.bin]? **(press enter)**

Verifying checksum for 'c2500-js-l.112-18.bin')file #1)...OK

Copy '/c2500-js-l.112-18' from Flash to server as '/c2500-js-l.112-18'? [yes/no]y

!!

!!!!!!!!!!!!!!!!!!!!!! [output cut] Upload to server done

Flash copy took 00:02:30 [hh:mm:ss] Router#

In this example, the content of flash memory was copied successfully to the TFTP host. The address of the remote host is the IP address of the TFTP host. The source filename is the file in flash memory.



The copy flash tftp command does not prompt you for the location of any file or ask you where to put the file. TFTP is the “grab it and place it” program in this situation. The TFTP host must have a default directory specified, or it won’t work.

## Restoring or Upgrading the Cisco Router IOS

You may need to restore the Cisco IOS to flash memory to replace an original file that has been damaged or to upgrade the IOS. You can download the file from a TFTP host to flash memory by using the copy tftp flash command. This command requires the IP address of the TFTP host and the name of the file you want to download to flash memory.

Before you begin, make sure that the file you want to place in flash memory is in the default TFTP directory on your host. When you issue the command, TFTP will not ask you where the file is. If the file you want to restore is not in the default directory of the TFTP host, this procedure won't work.



Copying the IOS from the TFTP host to flash memory requires a router reboot. So, instead of upgrading or restoring the IOS at 9 A.M. on Monday morning, you should probably wait until lunchtime.

After you enter the `copy tftp flash` command, you will see a message informing you that the router must reboot and run a ROM-based IOS image to perform this operation:

Router#**copy tftp flash**

\*\*\*\*\* NOTICE \*\*\*\*\*

Flash load helper v1.0

This process will accept the copy options and then terminate the current system image to use the ROM based image for the copy.

Routing functionality will not be available during that time.

If you are logged in via telnet, this connection will terminate.

Users with console access can see the results of the copy operation.

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Proceed? [confirm](**press enter**)

After you press Enter to confirm you understand that the router needs to reboot, the following router output is displayed. Once the router has used the TFTP host, it will remember the address and just prompt you to press Enter.

System flash directory:

File	Length	Name/status
------	--------	-------------

8121000 /c2500-js-l.112-18

[8121064 bytes used, 8656152 available, 16777216 total] Address or name of remote host [192.168.0.120]? **(press enter)**

The next prompt is for the name of the file you want to copy to flash memory. As noted earlier, this file *must* be in your TFTP host's default directory.

Source file name? **c2500-js56i-l.120-9.bin**

Destination file name [c2500-js56i-l.120-9.bin]? **(press enter)**

Accessing file 'c2500-js56i-l.120-9.bin' on 192.168.0.120...

Loading c2500-js56i-l.120-9.bin from 192.168.0.120 (via Ethernet0): ! [OK]

After you tell the router the filename and where the file is, it asks you to confirm that you understand the contents of flash memory will be erased.



If you do not have enough room in flash memory to store both copies, or if the flash memory is new and no file has been written to flash memory before, the router will ask to erase the contents of flash memory before writing the new file into flash memory.

You are prompted three times, just to make sure that you really want to proceed with erasing flash memory. If you have not issued a copy run start command, you will be prompted to do so, since the router needs to reboot.

Erase flash device before writing? [confirm] **(press enter)**

Flash contains files. Are you sure you want to erase? [confirm] **(press enter)**

System configuration has been modified. Save? [yes/no]: **y** Building configuration...

[OK]

Copy 'c2500-js56i-l.120-9.bin' from server

as 'c2500-js56i-l.120-9.bin' into Flash WITH erase? [yes/no] **y**

After you say “yes” to erasing flash memory, the router must reboot to load a small IOS from ROM memory. You cannot delete the flash file if it is in use.

Then the contents of flash memory are erased, and the file from the TFTP host is accessed and copied to flash memory.

%SYS-5-RELOAD: Reload requested

%FLH: c2500-js56i-l.120-9.bin from 192.168.0.120 to flash

System flash directory:

File	Length	Name/status
------	--------	-------------

8121000	/c2500-js-l.112-18
---------	--------------------

[8121064 bytes used, 8656152 available, 16777216 total] Accessing file 'c2500-js56i-l.120-9.bin' on 192.168.0.120...

Loading c2500-js56i-l.120-9.bin .from 192.168.0.120 (via Ethernet0): ! [OK]

Erasing device...

ee

Loading c2500-js56i-l.120-9.bin from 192.168.0.120 (via Ethernet0):

!!

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!! [output cut]

The row of e characters shows the contents of flash memory being erased. Each exclamation point (!) means that one UDP segment has been success-fully transferred.

Once the copy is complete, you should receive this message:

[OK - 10935532/16777216 bytes]

Verifying checksum... OK (0x2E3A) Flash copy took 0:06:14 [hh:mm:ss] %FLH: Re-booting system after download

After the file is loaded into flash memory and a checksum is performed, the router is rebooted to run the new IOS file.



Cisco routers can become a TFTP-server host for a router system image that is run in flash. The global configuration command is `tftp-server system ios-name`.

## Backing Up and Restoring the

### Cisco Configuration

Any changes that you make to the router configuration are stored in the running-config file. If you do not perform a `copy run start` command after you make a change to running-config, that change will be gone if the router reboots or gets powered down. You may want to make another backup of the configuration information as an extra precaution, in case the router or switch completely dies, or for documentation. The following sections describe how to copy the configuration of a router and switch to a TFTP host and how to restore that configuration.

### Backing Up the Cisco Router Configuration

To copy the router's configuration from a router to a TFTP host, you can use either the `copy running-config tftp` or `copy starting-config tftp` command. Either command will back up the router configuration that is currently running in DRAM or that is stored in NVRAM.

### Verifying the Current Configuration

To verify the configuration in DRAM, use the `show running-config` command (`sh run` for short), as follows:

```
Router#sh run
```

```
Building configuration...
```

```
Current configuration:
```

```
!
```

```
version 12.0
```

The current configuration information indicates that the router is now running version 12.0 of the IOS.



## Verifying the Stored Configuration

Next, you should check the configuration stored in NVRAM. To see this, use the show starting-config command (sh start for short), as follows:

```
Router#sh start
```

```
Using 366 out of 32762 bytes
```

```
!
```

```
version 11.2
```

The second line shows how much room your backup configuration is using. In this example, NVRAM is 32KB and only 366 bytes of it are used. Notice that the version of configuration in NVRAM is 11.2 (because I have not copied running-config to startup-config since upgrading the router).

If you are not sure that the files are the same, and the running-config file is what you want to use, then use the copy running-config startup-config to make sure both files are the same, as described in the next section.

## Copying the Current Configuration to NVRAM

By copying running-config to NVRAM as a backup, as shown in the following output, you are assured that your running-config will always be reloaded if the router gets rebooted. In the new IOS version 12.0, you are prompted for the filename you want to use. Also, in this example, since the version of IOS was 11.2 the last time a copy run start was performed, the router will let you know that it is going to replace that file with the new 12.0 version.

```
Router#copy run start
```

```
Destination filename [startup-config]? (press enter)
```

```
Warning: Attempting to overwrite an NVRAM configuration previously written by  
a different version of the system image.
```

```
Overwrite the previous NVRAM configuration?[confirm](press enter)
```

```
Building configuration...
```

[OK]

Now when you run show starting-config, the version shows 12.0:

Router#**sh start**

Using 487 out of 32762 bytes

!

version 12.0

### **Copying the Configuration to a TFTP Host**

Once the file is copied to NVRAM, you can make a second backup to a TFTP host by using the copy running-config tftp command (copy run tftp for short), as follows:

Router#**copy run tftp**

Address or name of remote host []? **192.168.0.120**

Destination filename [router-config]? **todd1-config**

!!

487 bytes copied in 12.236 secs (40 bytes/sec) Router#

Notice that this took only two exclamation points (!!), which are two UDP acknowledgments. In this example, I named the file todd1-config because I had not set a hostname for the router. If you have a hostname con-figured, the command will automatically use the hostname plus the extension -config as the name of the file.

### **Restoring the Cisco Router Configuration**

If you have changed your router's running-config and want to restore the configuration to the version in startup-config, the easiest way to do this is to use the copy startup-config running-config command (copy start run for short). You can also use the older Cisco command, config mem, to restore a configuration. Of course, this will work only if you first copied running-config into NVRAM before

making any changes.

If you copied the router's configuration to a TFTP host as a second backup, you can restore the configuration using the copy tftp running-config command (copy tftp run for short) or the copy tftp startup-config command (copy tftp start for short), as shown below. Remember that the old command that provides this function is config net.

Router#**copy tftp run**

Address or name of remote host []? **192.168.0.120** Source filename []? **todd1-config**

Destination filename [running-config]? **(press enter)** Accessing tftp://192.168.0.120/todd1-config...

Loading todd1-config from 192.168.0.120 (via Ethernet0):

!!

[OK - 487/4096 bytes]

487 bytes copied in 5.400 secs (97 bytes/sec) Router#

00:38:31: %SYS-5-CONFIG: Configured from tftp:// 192.168.0.120/todd1-config

Router#

The configuration file is an ASCII text file. This means that before you copy the configuration stored on a TFTP host back to a router, you can make changes to the file with any text editor.

## **Erasing the Configuration**

To delete the startup-config file on a Cisco router, use the command erase startup-config, as follows:

Router#**erase startup-config**

Erasing the nvram filesystem will remove all files! Continue? [confirm]**(press enter)**

[OK]

Erase of nvram: complete  
Router#

The preceding command deletes the contents of NVRAM on the router. The next time the router boots, it will run in setup mode.

## UNIT 3

### 1 Marks Questions:

- 1) What is Bootstrap?
- 2) What is POST ?
- 3) What is Rom monitor?
- 4) What is the use of NVRAM?
- 5) What is a Flash Memory?
- 6) Name two configuration Files in Routers.
- 7) Why Flash memory is used in Routers?
- 8) How to check the Flash memory size in a Router?
- 9) FTP is a \_\_\_\_\_
- 10) TFTP is a \_\_\_\_\_
- 11) What is the default value of Configuration Register in CISCO Router?
- 12) Bit no 0-3 in Configuration Register controls \_\_\_\_\_
- 13) Bit no \_\_\_\_ of Configuration Register enables the Startup Configuration file
- 14) Which bit of Configuration Register controls Console Line speed?
- 15) Which command used to change configuration Register Value?

### 7 Marks Questions:

- 1) What are the component of router? Explain any four of them.
- 2) Explain the booting procedure of router?
- 3) What is the configuration register? Give the structure of configuration register in CISCO router?
- 4) What are the different Configuration Files found in Router? Explain.
- 5) What is a Configuration Register? What is its significance? Explain
- 6) How the configuration register value controls the booting operation? Explain
- 7) Give the procedure to recover a password for a Router.
- 8) What is the configuration register? Give the procedure to change its value in a

Router using IOS.

- 9) Demonstrate a password recovery for a given Router using IOS.
- 10) What is Bootstrap? What is the role of a Bootstrap in booting up a Router?
- 11) Why Backing up of CISCO IOS is needed? Explain
- 12) What is meant by Backing up and Restore? Explain
- 13) Give the procedure to backup and restore CISCO IOS in a Router.
- 14) Give the procedure to backup and restore CISCO configurations in a Router
- 15) How to configure the Routers interface with a IP address? Explain
- 16) What are the different passwords available with Router? How to set them?

**10 Marks Questions:**

1. What are the different component of a Router? Explain each of them.
2. In detail, explain the Booting process of a Router.
3. With an example illustrate Routing between two host using single Router
4. With an example illustrate Routing between two host using single multiple Router