Objective

- Log into a router and go to the user and privileged modes and get familiar with these modes.
- Get familiar with basic IOS commands.
- Use the router HELP facility.
- Assign a name to the router.
- Set and manage passwords.
- Use several basic router commands to determine how the router is configured.

Note: Please read and thoroughly understand the ‘Theory’ section before proceeding to the lab exercises.

Theory

Most Cisco routers run on an operating system referred to as IOS. Cisco IOS (originally Internetwork Operating System) is the software used on the vast majority of Cisco Systems routers and all current Cisco network switches. IOS is a package of routing, switching, internetworking and telecommunications functions tightly integrated with a multitasking operating system. The first IOS was written by William Yeager. In all versions of Cisco IOS, packet routing and forwarding (switching) are distinct functions. Routing and other protocols run as Cisco IOS processes and contribute to the Routing Information Base (RIB). This is processed to generate the final IP forwarding table (FIB -- Forwarding Information Base), which is used by the forwarding function of the router.

Cisco IOS has a characteristic command line interface (CLI), whose style has been widely copied by other networking products. The IOS CLI provides a fixed set of multiple-word commands -- the set available is determined by the "mode" and the privilege level of the current user. "Global configuration mode" provides commands to change the system's configuration, and "interface configuration mode" provides commands to change the configuration of a specific interface. A typical command may be "show interface fa0/48" or "no ip cef traffic-statistics". All commands are assigned a privilege level, from 0 to 15, and can only be accessed by users with the necessary privilege. Through the CLI, the commands available to each privilege level can be defined.

Background and Preparation

Cisco IOS is a text based command line interface that allows you to type in the various commands and set device parameters. This lab exercise will be focusing on using the IOS to help shorten your learning curve.

This lab exercise contains two sections A and B. In section A there are three exercises. Exercise 1 gets you familiar with basic IOS commands, the router HELP facility and also
identifies basic router modes of operation. Exercise 2 and 3 deal with setting hostnames and passwords respectively.

In Section B, the focus is on router line configuration. In particular, it introduces you to basic LAN and WAN interface configuration commands.

Any router that meets the interface requirements may be used. Possible routers include 800, 1600, 1700, 2500, 2600 routers, or a combination. The configuration output used in this lab is produced from 1721 series routers. Any other router used may produce slightly different output.

**Note:** You must thoroughly know this material before proceeding to attempt exercises in subsequent weeks. Please do not hesitate to seek lab assistant’s help.

**Equipment required for each group**

If your class has 10 or less students you may work in pairs, otherwise work in groups of three.

- Two additional straight through network cables per group.
- Two serial cables per group (for console connections).
- One DTE/smart serial cable and one DCE/smart serial cable per group.
- Two Cisco switches per group.
- Two Cisco routers per group.

**Procedure**

**Section A: Get familiar with Cisco IOS modes and Basic IOS commands**

Configure a simple network as shown below.

![Diagram of network setup](image)

**Procedure**

Start a HyperTerminal session.

**Reset the routers: Erasing and reloading the router**

**Note:** You must perform these steps on all routers in this lab exercise before continuing. Since many of the labs require a clean router configuration, it is always advised to run this procedure through before performing the relevant exercise.

**Step 1:** Enter into the global configuration mode (privileged EXEC mode) by typing the following:

```
Router>enable
```

**Step 2:** At the privileged EXEC mode, enter the following command:

```
Router#erase startup-config
```
The responding prompt will be:

**Erasing the nvram filesystem will remove all files! Continue? [confirm]**

Press **Enter** to confirm

The response should be:

**Erase of nvram: complete**

**Step 3:** Now at the privileged EXEC mode, enter the following command:

```
Router#reload
```

The responding prompt line will be:

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

Press **Enter** to confirm

The Corresponding line prompt will be:

**Proceed with reload? [confirm]**

Press **Enter** to confirm.

In the first line of the response will be:

**Reload requested by the console.**

After the router has reloaded, the line prompt will be:

**Would you like to enter the initial configuration dialog? [yes/no]: n**

*If you are asked...*

Would you like to terminate autoinstall? [yes]: **y**

The responding line prompt will be:

Press **Return** to get started!

Press **Enter**.

**Now the router is ready for the assigned lab exercise to be performed.**
**Exercise 1: IOS modes, Help, basic commands**
By pressing enter, you should see a prompt ending with ‘ >’. This indicates that you are in user mode. The user mode is used for viewing the user configuration.

**Step 1: Enter into the privileged mode.**

Router>enable or en

Privileged Exec Mode is simply the administration mode for the router. This mode by itself allows you to view router settings that are considered private.
Privileged mode has a few sub modes as well such as global configuration mode, interface configuration mode, and routing configuration mode, which are described below.

**Step 2: Exit the privileged mode.**

Router>#disable

This changes the prompt to “Router>”

**Step 3: Enter into the global configuration mode.**
To enter into the global configuration mode, give the following commands:

Router>enable
Router#configure terminal or conf t

This mode allows you to make changes to the router settings that are currently in memory.
The configuration that is currently in memory is referred to as the running configuration.

**Cisco Modes**

<table>
<thead>
<tr>
<th>User Exec Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Privileged Mode (en)</td>
</tr>
<tr>
<td>Global Configuration (conf t)</td>
</tr>
<tr>
<td>Interface (int ...)</td>
</tr>
</tbody>
</table>

**Step 4: Exit the global configuration mode.**
Exit the global configuration mode by using the command:

Router(config)#exit or press “ctrl+z”

This changes the prompt to “Router#” indicating you are in privileged mode.

**Step 5: Exit the privileged mode.**
Router#exit

This changes the prompt to “Router>” indicating you are back in user mode.

**Step 6: System Help Commands.**
Type ‘?’ in user mode. Press enter at “—more—“ prompt.

List eight available commands from the router response:

In any mode of IOS (see below) you can query for help. Just by entering a ‘?’ by itself, a list of available commands will be displayed corresponding to the mode you are currently in.
This displays the list of available commands in the current mode. At the ‘—more—‘ prompt, repeatedly press enter to scroll by line.
**Note:** You can type ‘?’ in any mode to view list of available commands.

**Step 7: Enter into privileged mode and type ‘?’**. Press spacebar at ‘—more—‘ prompt.
List 10 commands from the router response:

**Step 8: List all the show commands by entering ‘show ?’** At the router privileged mode.

Router#show ?

**Observation:**
Is running config one of the available commands from this mode?
Ans.

**Step 9: Examine the running configuration.**
Display the running router configuration by using the command show running-config at the privileged mode prompt.

Router#show running-config
List six key pieces of information shown with this command:

**Note: Running-Config vs. Startup-Config**

The router keeps two different sets of configurations. When you first turn it on the router loads the startup configuration into memory. Now that it is loaded it is now called the running configuration, the startup configuration is the original copy.

When you make a change, it happens on the fly and is applied to the running configuration. Suppose you totally screw up and cannot even telnet to the router anymore, just unplug it and plug it back in and it will boot up off the startup configuration again.

This is a good feature in this case, but what if you made a bunch of changes, forgot to update the startup configuration and then the power goes out? You guessed it, all your work is lost. So keep in mind what you are doing and keep track of when you want to save.

Saving the running configuration is easily done with the command (Do not type these commands):

```
copy running-config startup-config
```
```
copy run start
```

And of course if you ever screw anything up but still have access to the router, you can always copy the startup configuration to the running configuration. And you do not even have to reboot.

**Step 10: Use ‘?’ to view the options to a command.**

The ‘?’ is a powerful help utility. You can type any command followed by ‘?’ to view supported command options. Give the command:

```
Router#configure ?
```

You can use this option to view available options for all supported commands. Note that there is a space the command and question mark.

**Step 11: Exit the privileged exec mode.**

```
Router#exit
```

**Step 12: Type in the following commands:**
Router>show version or sh version
Router>show clock or sh clock
Router>show users or sh users

Show version: Displays the IOS version number and its internal name. The IOS internal name tells you about its capabilities and options.
Show users: Displays users who are connected to the Cisco router
Show clock: Displays the clock settings

Step 13: Press up arrow to recall an old command and press down arrow to recall a new command.

Exercise 2: Setting Hostname
In this exercise you will set the hostname for the router. This changes the router prompt. The default hostname is router.

Step 1: Enter the privileged mode and then the global configuration mode.

Router>enable or en
Router#configure terminal or conf t

Step 2: Change the hostname to semsim.

Router(config)#hostname semsim

You can keep a hostname of your preference. This changes the prompt to the new hostname e.g. “semsim (Config)”. The text in our instructions assumes the default hostname Router.

Step 3: Exit the global configuration mode.

Router(config)#exit

This changes the prompt to “semsim#”.

Step 4: View the running-config to ensure the new hostname is set.
Type the following command:

Semsim#show running-config or sh run

You should see the hostname specified in running-config.

Exercise 3: Managing Passwords
In this lab you will enable, view, encrypt and disable the password to the privileged mode of the router. Access to the privileged mode permits modification of the router configuration, it is important to have an access constraint to this mode.
Step 1: Enter the global configuration mode.

Semsim>enable or en
Semsim#configure terminal or conf t

Step 2: Password protect the privileged mode.
Type the following command:

Semsim(config)#enable password mypwd

Step 3: Exit the global configuration mode.

Semsim(config)#exit or press Ctrl + z

Step 4: View the running-config.
Type the following command:

Semsim# show running-config or sh run

Observation:
Is the password encrypted?.. You should see the unencrypted password specified in the running-config.

Step 5: Enter global configuration mode.

Semsim#conf t

Step 6: Protect the privileged mode with encrypted password.
Type the following command:

Semsim(config)#enable secret myEncryptedPwd

Step 7: Exit the global configuration mode.

Semsim(config)#exit

Step 8: View the running-config. Is the password encrypted?

Semsim#show running-config or sh run

You should see encrypted password specified in the running-config.

Step 9: Exit the privileged mode.

To exit the privileged mode type the command:

Semsim#disable
Step 10: Enter the privileged mode. Which password do you enter?
Type:

Semsim>enable or en

You will be prompted to enter the password. Enter the enable secret password as it takes precedence when both unencrypted and encrypted passwords are set.

Step 11: Enter global configuration mode.

Semsim#conf t

Step 12: Disable enable secret password.
Type the following command:

Semsim(Config)#no enable secret

Step 13: Disable enable password.
Type the following command:

Semsim(config)#no enable password

Step 14: Exit the global configuration mode.

Semsim(config)#exit

Step 15: Exit the privileged mode

Semsim#disable

This changes the prompt to ‘Semsim>’

Step 16: Enter the privileged mode. Do you still need to specify a password?
Use the command:

Semsim>enable or en

This changes the prompt to “Semsim#” indicating that you have entered the privileged mode. You were not prompted for password since you disabled them.

Step 17: Reboot the router.
Use the following command:

Semsim#reload
You will be prepared for reboot. Press y or Y:
Proceed with reload? [confirm] Y
Section B: Router Line Configuration

To bring up an Ethernet/Serial interface, all that is necessary is to assign it an IP address, associate a netmask with that address, and turn up the interface. There is also a need to enable the routing protocol for packet forwarding. In this exercise we will learn how to configure Router Ethernet and serial interfaces and learn to enable Routing Information Protocol (RIP) for packet forwarding.

Configure the network as shown below. Before configuring routers, reset them using the instructions below.

- **Note:** Do not enter the `no shutdown` command for the serial interface of router 2--leave that interface down at the start of the exercise. This means that the network will not be properly connected.
- Name the two routers with different names (Router1 and Router2)
- Use the network 192.168.1.0 (i.e. 192.168.1.x) for the local network side of router 1.
- Use the network 192.168.2.0 for the local network side of router 2.
- Use the network 192.168.3.0 for the serial connection between the two routers.

**Procedure**

Start a HyperTerminal session.

**Reset the routers: Erasing and reloading the router**

Note: You must perform these steps on all routers in this lab exercise before continuing. Note: Please refer to the meaning and structure of the command syntax provided at the end of the exercise.
Step 1: Enter into the global configuration mode (privileged EXEC mode) by typing the following:

Router> enable

Step 2: At the privileged EXEC mode, enter the following command:

Router# erase startup-config

The responding prompt will be:

Erasing the nvram filesystem will remove all files! Continue? [confirm]

Press Enter to confirm

The response should be:

Erase of nvram: complete

Step 3: Now at the privileged EXEC mode, enter the following command:

Router# reload

The responding prompt line will be:

System configuration has been modified. Save? [yes/no]: n
Proceed with reload? [confirm]

Press Enter to confirm

The corresponding line prompt will be:

Proceed with reload? [confirm]

Press Enter to confirm.

In the first line of the response will be:

Reload requested by the console.

After the router has reloaded, the line prompt will be:

Would you like to enter the initial configuration dialog? [yes/no]: n

If you are asked...
Would you like to terminate autoinstall? [yes]: y

The responding line prompt will be:
Press Return to get started!

Press Enter.

Now the router is ready for the assigned lab exercise to be performed.
Exercise 4: Configuring Router Ethernet and Serial Interfaces.
Configure Router 1

Step 1: Enter into the privileged mode and the global configuration mode.

Router1>enable
Router1#config t

Step 2: Configuring the serial interface of router

Router1(config)#host router1
Router1(config)#interface serial 0/0

This changes the prompt to `Router1(config-if)#`.

This mode is entered by already being in global configuration mode (see the diagram above) and then entering interface mode for serial.

Step 3: Set the IP address and the mask for the serial interface. Type in the following command:

Router1(config-if)#ip address 192.168.3.1 255.255.255.0

Assigning IP address and mask to the serial interface of router 1.

Step 4: Set the clock rate for Serial interface. Type in the following command:

Router1(config-if)#clock rate 56000

This command sets the clock rate for a router with a DCE cable to 56K

Step 5: Enable the serial interface. Type in the following command:

Router1(config-if)#no shutdown

This command enables the interface.

Step 6: Exit the router serial configuration mode. Type in the following command:

Router1(config-if)#exit

Step 7: Enter the router Ethernet interface configuration mode. Type in the following command:

Router1(config)#interface fast 0/0

This mode is entered by already being in global configuration mode (see the diagram above) and then entering interface mode for fast Ethernet.
Step 8: Set the IP address and the mask for the Ethernet interface. Type in the following command:

```bash
Router1(config-if)#ip address 192.168.1.1 255.255.255.0
```

Assigning IP address and mask to the fast Ethernet interface of router 1.

Step 9: Enable the Ethernet interface. Type in the following command:

```bash
Router1(config-if)#no shutdown
```

This command enables the interface.

Step 10: Exit the router Ethernet configuration mode. Type in the following command:

```bash
Router1(config-if)#exit
```

This changes the prompt to ‘Router1(config#)’.

Step 11: Enable Routing Information Protocol (RIP) in the router.

```bash
Router1(config#)router rip
```

This command enables Routing Information Protocol (RIP) on all router interfaces to forward packets.

Step 12: Enable the interfaces for RIP forwarding. Type in the following command:

```bash
Router1(config-if)# network 192.168.1.0
Router1(config-if)# network 192.168.3.0
```

RIP routing for packet forwarding is now enabled on Ethernet and Serial interfaces.

Step 13: Exit the router RIP configuration mode and router configuration mode. Type in the following command:

```bash
Router1(config-if)#exit
Router1(config)#exit
```

Then exit the global configuration mode.

Configure Router 2: Repeat the same steps for Router2.

```bash
Router2>enable
Router2#config t
Router2(config)#host router2
Router2(config)#interface serial 0/0
```
Configure the hosts

- Use a static IP address matching the local area network of the connected router. (e.g. 192.168.1.2 for router 1; 192.168.2.2 for router 2)
- Use the router’s fast Ethernet interface IP address as the gateway address for the PC. (e.g. 192.168.1.1 for router 1; 192.168.2.1 for router 2)
- Use the network mask 255.255.255.0.
- Disable the wireless network.

Connect the network

- Connect the network cables.
- Power-up the switches.
- Reset the switches

Reset the switches

- Wait until the switch has finished booting.
- Press and hold the mode button on the front of the switch until 4 lights in a row come on.
- Release the mode button.
- Press and hold the mode button. After a little while, the four lights should start flashing. Hold the mode button down until the four lights stop flashing.
- Ping the hosts and routers to test connectivity.