



## CISCO NETWORKING ACADEMY PROGRAM



# CCNA 2:

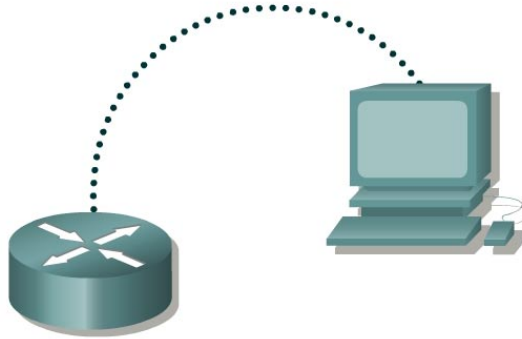
## Routers and Routing Basics v3.1.1




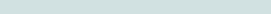
### Student Lab Manual

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## Lab 1.2.5 Connecting Console Interfaces



Straight-through cable	
Serial cable	
Console (Rollover)	
Crossover cable	

### Objective

- Connect a PC to a router using a console or rollover cable.

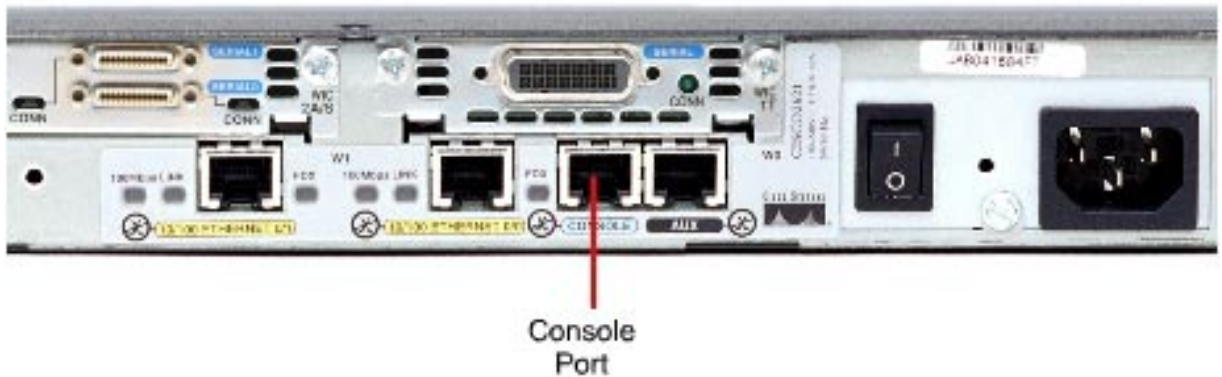
### Background/Preparation

A console cable is necessary to establish a console session in order to allow checking or changing the configuration of the router. The following resources will be required:

- Workstation with a serial interface
- Cisco Router
- Console or rollover cable for connecting the workstation to the router

## Step 1 Identify connectors and components

- a. Examine the router and locate the RJ-45 connector labeled Console.



## Step 2 Identify the computer serial interface (COM 1 or 2)

- a. Examine the computer and locate a 9-pin or 25-pin male connector labeled serial. It may or may not be identified.



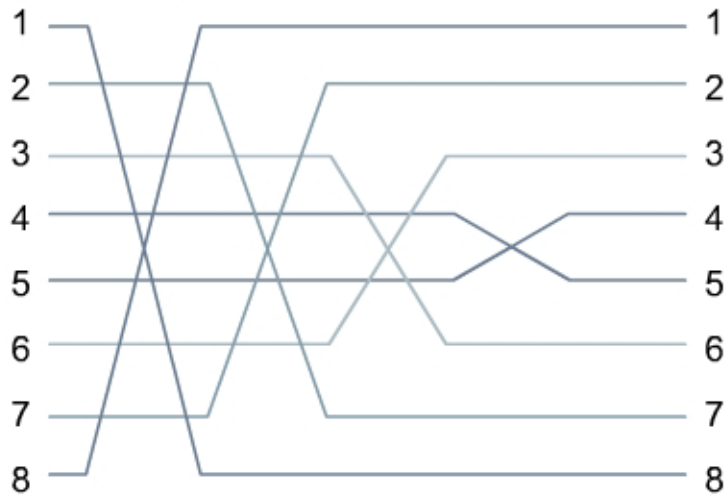
## Step 3 Locate the adapter for the console cable

- a. Locate the RJ-45 to DB-9 or RJ-45 to DB-25 adapter depending on the available PC serial port. An RJ-45 to DB-9 adapter is shown below.



#### Step 4 Locate or build a rollover cable

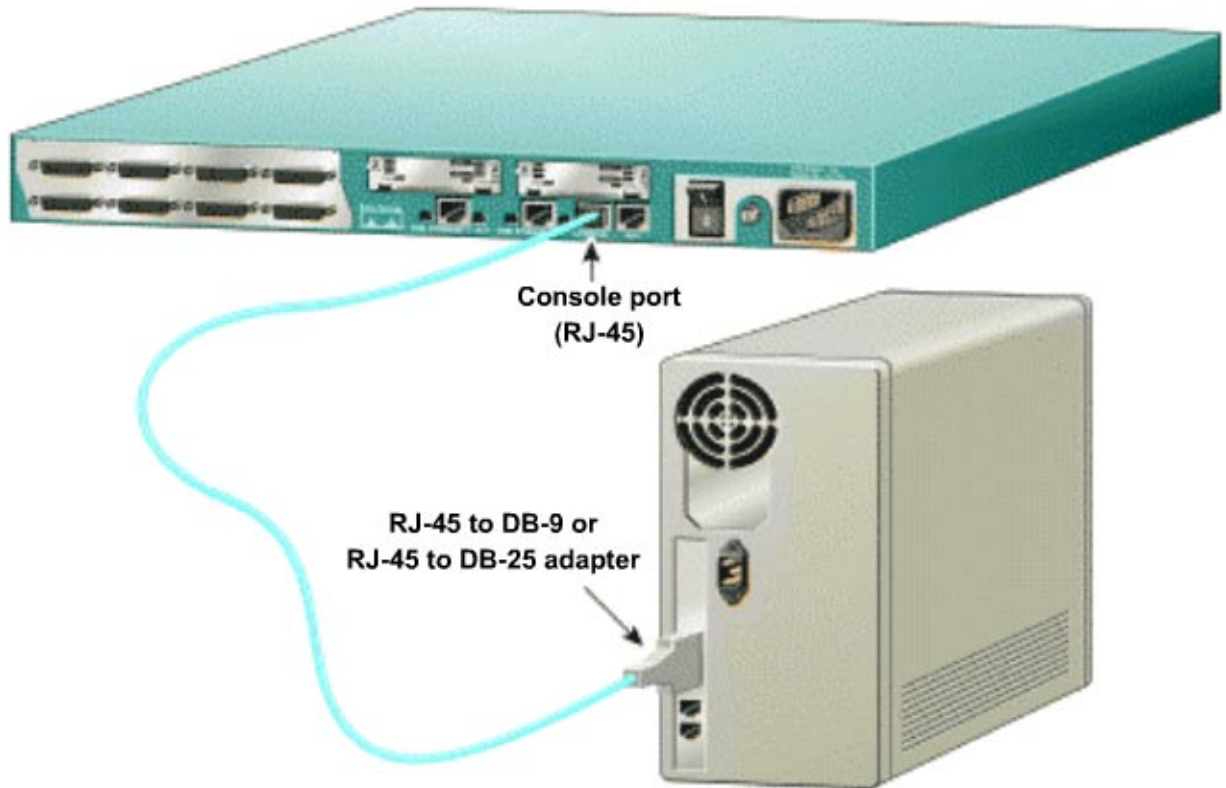
- a. Use a console or rollover cable of adequate length to connect the router to one of the workstations. Make a rollover cable if necessary.



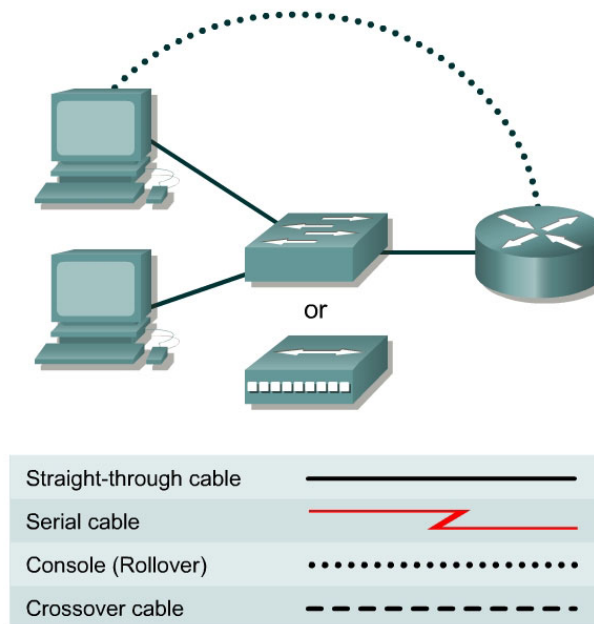


## Step 5 Connect cabling components

- a. Connect the console or rollover cable to the router console port, an RJ-45 connector. Next, connect the other end of the console or rollover cable to the RJ-45 to DB-9 or RJ-45 to DB-25 adapter depending on the available PC serial port. Finally attach the adapter to a PC serial port, either DB-9 or DB-25, depending on the computer.



## Lab 1.2.6 Connecting Router LAN Interfaces



### Objective

- Identify the Ethernet or Fast Ethernet interfaces on the router.
- Identify and locate the proper cables to connect the router and PC to a hub or switch.
- Use the cables to connect the router and PC to the hub or switch.

### Background/Preparation

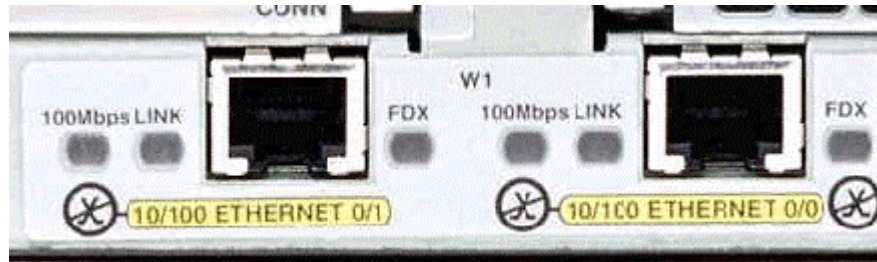
This lab focuses on the ability to connect the physical cabling between Ethernet LAN devices such as hubs and switches and the appropriate Ethernet interface on a router. The computer(s) and router should be preconfigured with the correct IP network settings. Start this lab with the computer(s), router and hub or switch all turned off and unplugged. The following resources will be required:

- At least one workstation with an Ethernet 10/100 NIC installed
- One Ethernet switch or hub
- One router with an RJ-45 Ethernet or Fast Ethernet interface, or an AUI interface
- 10BASE-T AUI, DB-15 to RJ-45 transceiver, for a 2500 series router with an AUI Ethernet interface

- Several straight-through Ethernet cables to choose from for connecting the workstation and router to the hub or switch

### Step 1 Identify the Ethernet or FastEthernet interfaces on the router

- Examine the router.
- What is the model number of the router? \_\_\_\_\_
- Locate one or more RJ-45 connectors on the router labeled 10/100 Ethernet on the 2500 series or 10/100 Fast Ethernet on the 2600 series. This identifier may vary depending on the type of router used. A 2500 series router will have an AUI DB-15 Ethernet port labeled AUI 0. These will require a 10BaseT transceiver to connect to the RJ-45 cable.



- Identify the Ethernet ports shown that could be used for connecting the routers. Record the information below. Record the AUI port numbers if the router is a Cisco 2500 series router.

Router	Port	Port

### Step 2 Identify the proper cables and connect router

- The connection between the router and the hub will be accomplished using a Category 5 straight-through patch cable. Locate a patch cable that is long enough to reach from the router to the hub. Be sure to examine the cable ends carefully and select only straight-through cables.
- Use a cable to connect the Ethernet interface that uses the 0 (zero) designation on the router to a port on the hub or switch. Also, use the 10BaseT AUI transceiver for the 2500 series.

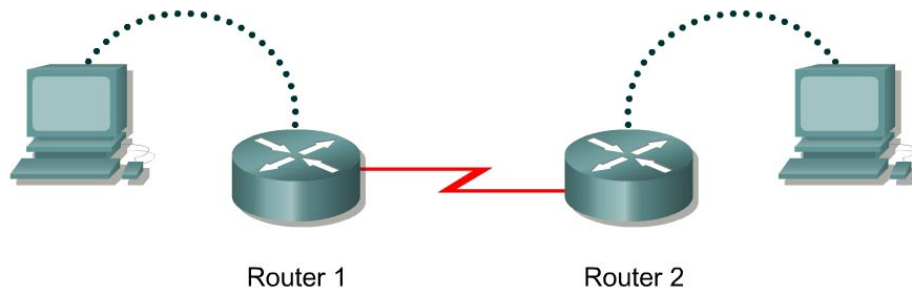
### Step 3 Locate the RJ-45 to DB-9 adapter


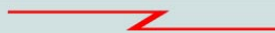


- The computer(s) will also connect to the hub using a straight through patch cable. Run Category 5 patch cables from each PC to where the switch or hub is located. Connect one end of these cables to the RJ-45 connector on the computer NIC and connect the other end to a port on the hub or switch. Be sure to examine the cable ends carefully and select only straight through cables.

### Step 4 Locate or build a rollover cable

- Plug in and turn on the routers, computers, and hub or switch.
- To verify the router connections, insure that the link light on the router interface and the hub/switch interface are both lit.
- To verify the computer connections, insure that the link light on the NIC and the hub interface are both lit.

## Lab 1.2.7 Connecting WAN Interfaces



Straight-through cable	
Serial cable	
Console (Rollover)	
Crossover cable	

### Objective

- Identify the serial interfaces on the router.
- Identify and locate the proper cables to interconnect the routers.
- Use the cables to connect the router.

### Background/Preparation

This lab connects two routers together using directly attached cables to simulate a WAN link. This allows the routers to be configured and tested as though they were geographically separated. This simulated WAN link takes the place of the service providers network and can be thought of as a CSU/DSU eliminator. The first steps involve finding out what kind of connections are on the router and what kind of cables are needed.

### Step 1 Identify the serial interfaces on the router

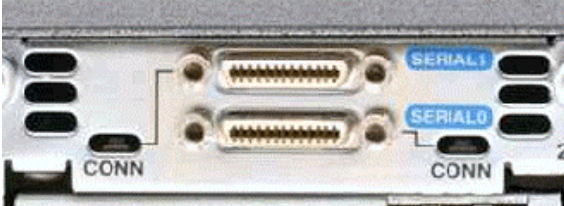

- Examine the router.
- What is the model number of the router? \_\_\_\_\_
- What is the model number of the second router? \_\_\_\_\_

- d. How many serial ports are there on each router that could be used for connecting the routers?  
Record the information below.

Router Name	Serial Port	Serial Port	Serial Port
Router 1			
Router 2			

## Step 2 Identify and locate the proper cables



- a. Inspect the serial cables available in the lab. Depending on what type of router and/or serial card used, the router may have different connectors. The two most common types are the DB-60 and the smart serial connectors. Using the table below indicate which type of interfaces the routers have.

Router	Smart Serial	DB-60
		
1	<input type="checkbox"/>	<input type="checkbox"/>
2	<input type="checkbox"/>	<input type="checkbox"/>

- b. Since this lab will not be connected to a live leased line, one of the routers will need to provide the clocking for the circuit. This is normally provided to each of the routers by the service provider. To provide this clocking signal in the lab, one of the routers will need a DCE cable instead of the DTE cable used on the other router.

In this lab, the connection between routers uses one DCE cable and one DTE cable. The DCE-DTE connection between routers is referred to as a null serial cable. This lab will use one V.35 DCE cable and one V.35 DTE cable to simulate the WAN connection.

The V.35 DCE connector is usually a female V.35 (34-pin) connector. The DTE cable has a male V.35 connector. The cables are also labeled as DCE or DTE on the router end of the cable. Using the chart below, identify the V.35 cable that will be used, on each router, by placing a check mark in the appropriate box.

Router	DTE	DCE
		
Router 1	<input type="checkbox"/>	<input type="checkbox"/>
Router 2	<input type="checkbox"/>	<input type="checkbox"/>

- c. After having indicated the cables required to interconnect the router locate them in the equipment inventory.


### Step 3 Cable the routers

- a. The DTE and DCE V.35 cables must now be joined together. Holding one of the V.35 ends in each hand examine the pins and sockets as well as the threaded connectors. Note that there is only one proper way for the cables to fit together. Align the pins on the male cable with the sockets on the female cable and gently couple them. Very little effort should be required to accomplish this. When they are joined, turn the thumbscrews clockwise and secure the connectors.
- b. Before making the connection to one of the routers, examine the connector on the router and the cable. Note that the connectors are tapered to help prevent improper connection. Holding the connector in one hand, orient the cable and router connectors so that the tapers match. Now push the cable connector partially into the router connector. It probably will not go on all the way as the threaded connectors need to be tightened in order for the cable to be inserted completely. While holding the cable in one hand and gently pushing the cable toward the router, turn one of the thumb screws clockwise, 3 or 4 rounds to start the screws. Now turn the other thumbscrew clockwise, 3 or 4 rounds to get it started. At this point the cable should be attached enough enabling the use of both hands to advance each thumbscrew at the same rate until the cable is fully inserted. Do not over-tighten these connectors.



## Lab 2.2.1 Router Configuration Using Setup



Straight-through cable	—————
Serial cable	—————  —————
Console (Rollover)	.....
Crossover cable	- - - - -

### Objective

- Use the System Configuration dialog (setup).
- Establish some basic router configurations.

### Background/Preparation

A new router will not find its configuration file when started and should automatically enter the setup dialog. If the router has already been configured the **setup** command may be used at the command line while in privileged mode. The setup dialog prompts for basic setup options, such as which protocols will be used and the IP address and subnet mask for each interface the router has. The setup dialog provides default values for most of the configurable options. The user can either accept these or enter their own. If setup does not provide a prompted entry for specific interface information, it will have to be entered manually at a later time. (With this lab, the setup utility will be run but the configuration will not be saved.)

This lab assumes that the HyperTerminal console session to the router has already been established by the instructor. The following resources will be required:

- PC with HyperTerminal configured
- Console or rollover cable and DB-9 to RJ-45 adapter
- Router

### Step 1 Start the router and begin setup mode

#### Option 1

If the router was just started and the configuration file was missing, setup mode will be entered automatically with no passwords required. This is what would happen with a new router.

### Option 2

If the router was previously configured and it is desired to see and change existing settings, it will be necessary to login and provide a password of **cisco**. Type **enable** at the command prompt to enter privileged mode and enter the password **class**. Enter **setup** at the router prompt to start the system configuration dialog.

### Option 3

If the router was previously configured, it is possible to simulate a new router by removing the configuration file from NVRAM using the **erase startup-config** command in privileged mode. Use the **reload** command to restart the router and enter setup mode.

**Note:** The order of the messages displayed during Setup may vary depending on the Cisco IOS software release and feature set on the router. Therefore the following prompts may not exactly reflect the messages on the screen.

## Step 2 Continue with the setup dialog

- The router prompts, "Continue with configuration dialog?" Enter **yes** to continue with the setup dialog.
- The router prompts afterwards, "Would you like to enter basic management setup?" Enter **no** to continue.
- What is the importance of words in the square brackets? \_\_\_\_\_

## Step 3 Show the current interface summary

- The router asks, "First, would you like to see the current interface summary?" or "Would you like to enter basic management setup?" Press the **Enter** key or type **yes** to accept the default answers.
- Fill in the following table with the information displayed.

Interface	IP-Address	OK	Method	Status	Protocol

## Step 4 Configure global parameters

- Configure the router using the default settings for any questions the router asks if it has already been configured. The router may be named at this time if it has not been already. Make sure that **cisco** is entered as the enable secret password. Next, the basic management setup prompt will appear. This allows parameters such as router name, privileged level passwords, and virtual terminal password to be entered. Answer the prompts as follows: Router name = **Central**, enable secret password = **cisco**, enable password = **class**, virtual password = **cisco**.
- Next will be the prompt to enter various parameters including SNMP settings, and routed and routing protocol settings. Answer **no** to these prompts, except for the "Configure IP?" prompt.

## Step 5 Configure interface parameters

- From this point on, the prompts vary depending on the available router interfaces. Complete the setup steps as appropriate.

## Step 6 Configuration command script

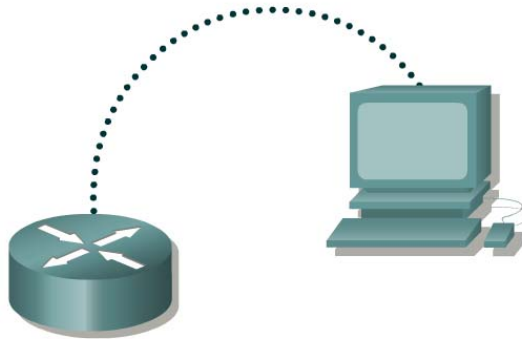
- a. The router displays the configuration command script that was created and then asks if this configuration is to be saved.
- b. When asked whether or not to use the configuration, answer **no**.
- c. If the answer was **yes**, when asked whether or not to use the configuration, where would this information be saved?

---

**Note:** Remember that setup does not provide for entry of key information such as clock rate for DCE interfaces. These must be entered later.

Upon completion of the previous steps, logoff by typing **exit**. Turn the router off.

## Lab 2.2.4 Establishing a Console Session with HyperTerminal



Straight-through cable	—————
Serial cable	————— ⚡
Console (Rollover)	.....
Crossover cable	- - - - -

### Objective

- Connect a router and workstation using a console cable.
- Configure HyperTerminal to establish a console session with the router.

### Background/Preparation

HyperTerminal is a simple Windows-based terminal emulation program that can be used to connect to the console port on the router. A PC with HyperTerminal provides a keyboard and monitor for the router. Connecting to the console port with a rollover cable and using HyperTerminal is the most basic way to access a router for checking or changing its configuration.

Set up a network similar to the one in the diagram. Any router that meets the interface requirements may be used. Possible routers include 800, 1600, 1700, 2500, 2600 routers, or a combination. The following resources will be required:

- Workstation with a serial interface and HyperTerminal
- Cisco Router
- Console (rollover) cable for connecting the workstation to the router

### Step 1 Basic router configuration

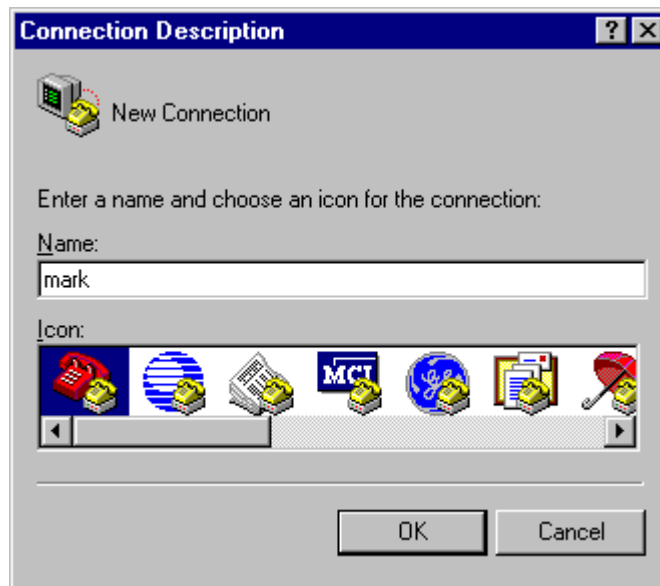
- Connect a rollover cable to the console port on the router and the other end to the PC with a DB-9 or DB-25 adapter to the COM 1 port. This should be completed prior to powering on any devices.

## Step 2 Start HyperTerminal program

- a. Turn on the computer and router.
- b. From the Windows taskbar, locate the HyperTerminal program:  
**Start > Programs > Accessories > Communications > Hyper Terminal**

## Step 3 Name the HyperTerminal session

- a. At the “Connection Description” popup, enter a name in the connection *Name:* field and select **OK**.



## Step 4 Specify the computers connecting interface

- a. At the “Connect To” popup, use the drop down arrow in the *Connect using:* field to select **COM1** and select **OK**.

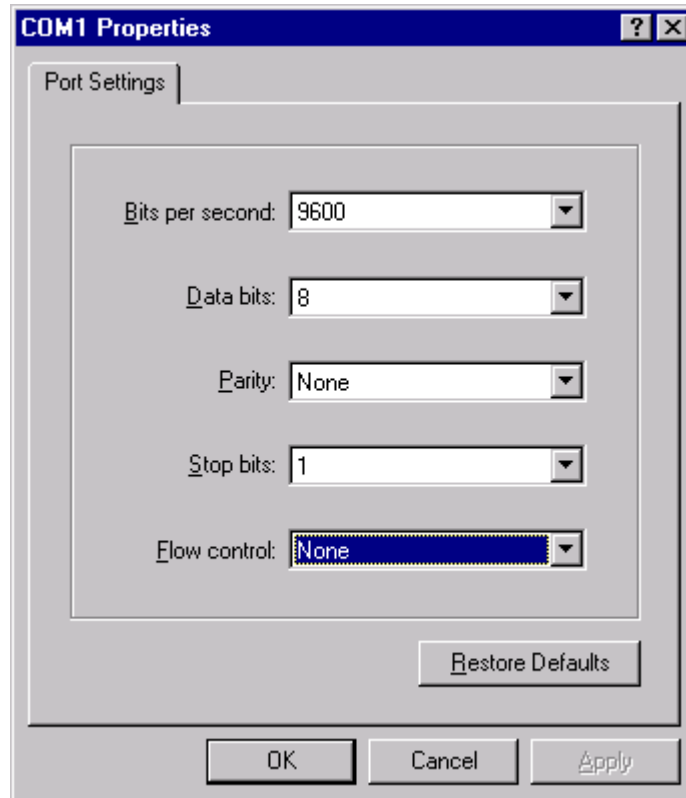


### Step 5 Specify the interface connection properties

- a. At the “COM1 Properties” popup, use the drop down arrows to select:

Bits per second: **9600**  
Data bits: **8**  
Parity: **None**  
Stop bits: **1**  
Flow control: **None**

Then select **OK**.

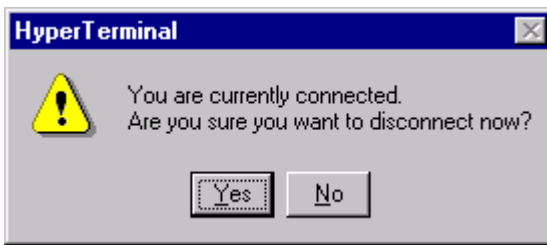


- b. When the HyperTerminal session window comes up, turn on the router. If the router is already on, press the **Enter** key. There should be a response from the router.  
  
If there is, then the connection has been successfully completed. If there is no connection, troubleshoot as necessary. For example, verify that the router has power. Check the connection to the COM 1 port on the PC and the console port on the router. If there is still no connection, ask the instructor for assistance.
- c. Record in the engineering journal the correct procedure for establishing a console session with the router.

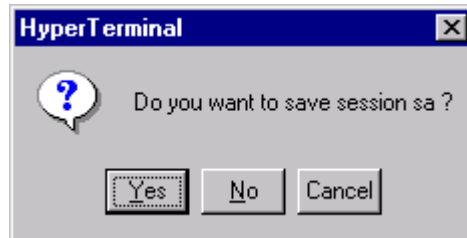
### Step 6 Closing the session

- a. To end the console session from a HyperTerminal session, select:  
**File > Exit**
- b. When the HyperTerminal disconnect warning popup appears, select **Yes**.



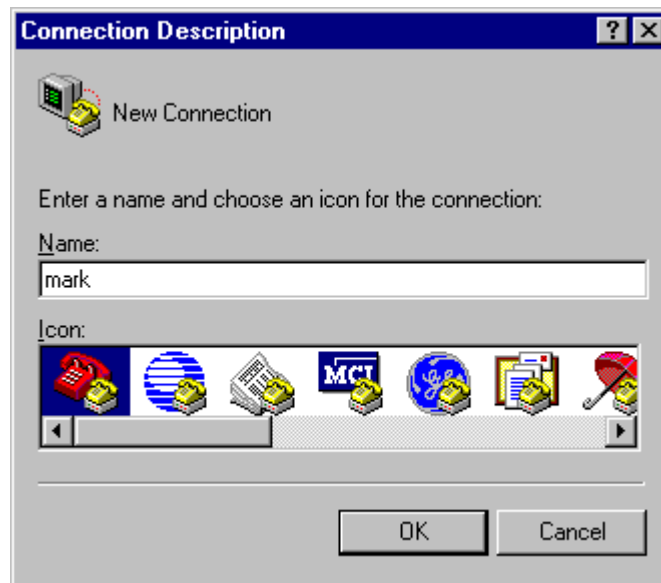


- c. The computer will then ask if the session is to be saved. Select **Yes**.



### Step 7 Reopen the HyperTerminal connection, as shown in Step 2

- a. At the "Connection Description" popup, select **Cancel**.



- b. To open the saved console session from HyperTerminal, select:

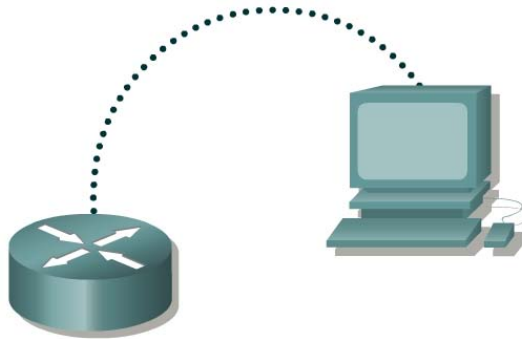
#### **File > Open**


The saved session will now appear and by double-clicking on the name, the connection will open without reconfiguring it each time.

### Step 8 Terminating the HyperTerminal session

- Close HyperTerminal.
- Shut down the router.

## Lab 2.2.9 Command Line Fundamentals



Straight-through cable	—————
Serial cable	—————  —————
Console (Rollover)	.....
Crossover cable	- - - - -

### Objective

- Log into a router and go to the user and privileged modes.
- Use several basic router commands to determine how the router is configured.
- Use the router HELP facility.
- Use command history and editing features.
- Logout of the router.

### Background/Preparation

HyperTerminal is a simple Windows-based terminal emulation program that can be used to connect to the routers console port. A PC with HyperTerminal provides a keyboard and monitor for the router. Connecting to the console port with a rollover cable and using HyperTerminal is the most basic way to access a router for checking or changing its configuration.

Set up a network similar to the one in the diagram. 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 a 1721 series router. Other routers may produce slightly different output.

The following resources will be required:

- Workstation with a serial interface and HyperTerminal
- Cisco Router
- Rollover, or console, cable for connecting the workstation to the router

The following steps are intended to be executed on each router unless specifically instructed otherwise.

### Step 1 Start HyperTerminal

- a. Start a HyperTerminal session as performed in the Establishing a HyperTerminal session lab.

### Step 2 Log into the router

- a. Log into the router. If prompted to enter the initial setup mode, answer **no**. If prompted for a password, enter **cisco**.
- b. If the prompt shows "Router" this is the default. Something other than that may appear if this router has been named. What prompt did the router display? \_\_\_\_\_
- c. What does the prompt symbol following a router name mean? \_\_\_\_\_

### Step 3 Use the HELP feature

- a. Enter the **help** command by typing the **?** at the user EXEC router prompt.

Router>?

List eight available commands from the router response.


### Step 4 Enter privileged EXEC mode

- a. Enter enable mode by using the **enable** command. If a password is asked for, enter **class** when prompted.

Router>**enable** [Enter]

- b. Was **enable** one of the commands available from Step 3? \_\_\_\_\_
- c. What changed in the router prompt display and what does it mean?  
\_\_\_\_\_

### Step 5 Use the help feature

- a. Enter the help mode by typing a question mark (?) at the router privileged EXEC prompt.

Router#?

- b. List ten (10) available commands from the router response.



### Step 6 List the **show** commands

- List all show commands by entering **show ?** at the router privileged EXEC prompt.

Router#**show ?**

- Is **running-config** one of the available commands from this mode?

### Step 7 Examine the running configuration

- Display the running router configuration by using the command **show running-config** at the privileged EXEC router prompt.

Router#**show running-config**

- List six key pieces of information shown with this command:


### Step 8 Examine the configuration in more detail

- Continue looking at the configuration.
- When the word "more" appears, press the space bar. By pressing the space bar the router will display the next page of information.
- What happened when the space bar was pressed ?

### Step 9 Use the command history feature

- Use the command **history** to see and reuse the previously entered commands. Press the up arrow or **Ctrl-p** to see the last entered command. Press it again to go to the command before that. Press the down arrow or **Ctrl-n** to go back through the list. This function lets the command history be viewed.
- What appeared at the router prompt when the up arrow was pressed?

### Step 10 Logoff and turn the router off

- Close HyperTerminal.
- Shut down the router.



### Lab 3.1.2 Command Modes and Router Identification



Straight-through cable	—————
Serial cable	————— ⚡
Console (Rollover)	.....
Crossover cable	- - - - -

#### Objective

- Identify basic router modes of user EXEC and privileged EXEC.
- Use commands to enter specific modes.
- Become familiar with the router prompt for each mode.
- Assign a name to the router.

#### Background/Preparation

Any router that meets the interface requirements may be used. Possible routers include 800, 1600, 1700, 2500, 2600 routers, or a combination. Refer to the chart at the end of the lab to correctly identify the interface identifiers to be used based on the equipment in the lab. The configuration output used in this lab is produced from 1721 series routers. Any other router used may produce slightly different output. The following steps are intended to be executed on each router unless specifically instructed otherwise.

Start a HyperTerminal session as performed in the Establishing a HyperTerminal session lab.

**Note:** Go to the erase and reload instructions at the end of this lab. Perform those steps before continuing with this lab.

#### Step 1 Login to the router in user EXEC mode

- a. Connect to the router and login.
- b. What prompt did the router display?

- c. What does this prompt mean?
- 

## Step 2 Login to the router in privileged EXEC mode

- a. Enter **enable** at the user mode prompt.  
Router>**enable**
- b. If prompted for a password, enter the password class.
- c. What prompt did the router display?
- 

- d. What does this prompt mean?
- 

## Step 3 Enter global configuration mode

- a. Enter **configure terminal** at the privilege mode prompt.  
Router#**configure terminal**
- b. What prompt did the router display? \_\_\_\_\_
- c. What does this prompt mean?
- 

## Step 4 Enter router configuration mode

- a. Enter **router rip** at the global configuration mode.  
Router(config)#**router rip**
- b. What prompt did the router display? \_\_\_\_\_
- c. What does this prompt mean?
- 

## Step 5 Exit from router mode and go into interface configuration mode

- a. Enter **exit** at the prompt to return to global configuration mode.  
Router(config-router)#**exit**
- b. Enter **interface serial 0** at the global configuration mode prompt.  
**Note:** See chart for the interface identifier.  
Router(config)#**interface serial 0**
- c. What prompt did the router display? \_\_\_\_\_
- d. What does this prompt mean?
- 

- e. Enter **exit** at the prompt to return to global configuration mode.  
Router(config-if)#**exit**



### Step 6 Assign a name to the router

- a. Router(config) #**hostname GAD**
- b. What prompt did the router display? \_\_\_\_\_
- c. What does this prompt mean?

\_\_\_\_\_

- d. What change has occurred in the prompt?

\_\_\_\_\_

### Step 7 Exit the router

- a. Enter **exit** at the prompt to close out of the router.  
GAD(config) #**exit**
- b. From the privileged EXEC mode, type exit to logoff. Turn the router off.

## Erasing and reloading the router

Enter into the privileged EXEC mode by typing **enable**.

If prompted for a password, enter **class**. If “class” does not work, ask the instructor for assistance.

```
Router>enable
```

At the privileged EXEC mode, enter the command **erase startup-config**.

```
Router#erase startup-config
```

The responding line 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
```

Now at the privileged EXEC mode, enter the command **reload**.

```
Router#reload
```

The responding line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Proceed with reload? [confirm]
```

Press **Enter** to confirm.

In the first line of the response will be:

```
Reload requested by console.
```

After the router has reloaded the line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

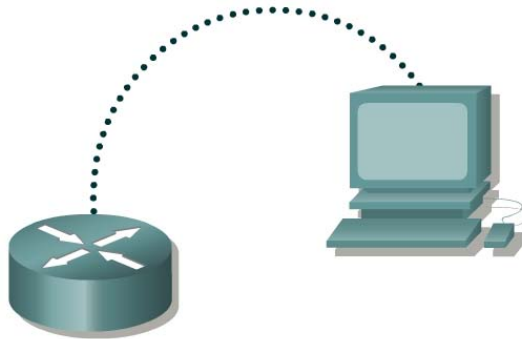
```
Press RETURN to get started!
```

Press **Enter**.

The router is ready for the assigned lab to be performed.

Router Interface Summary					
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2	Interface #5
800 (806)	Ethernet 0 (E0)	Ethernet 1 (E1)			
1600	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
1700	FastEthernet 0 (FA0)	FastEthernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)	
2500	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
2600	FastEthernet 0/0 (FA0/0)	FastEthernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)	
In order to find out exactly how the router is configured, look at the interfaces. This will identify the type of router as well as how many interfaces the router has. There is no way to effectively list all of the combinations of configurations for each router class. What is provided are the identifiers for the possible combinations of interfaces in the device. This interface chart does not include any other type of interface even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in IOS command to represent the interface.					

## Lab 3.1.3 Configuring Router Passwords



Straight-through cable	—————
Serial cable	————— —————
Console (Rollover)	.....
Crossover cable	- - - - -

### Objective

- Configure a password for console login to user EXEC mode.
- Configure a password for virtual terminal (Telnet) sessions.
- Configure a secret password for privileged EXEC mode.

### Background/Preparation

Any router that meets the interface requirements may be used. Possible routers include 800, 1600, 1700, 2500, 2600 routers, or a combination. Refer to the chart at the end of the lab to correctly identify the interface identifiers to be used based on the equipment in the lab. The configuration output used in this lab is produced from 1721 series routers. Any other router used may produce slightly different output. The following steps are intended to be executed on each router unless specifically instructed otherwise.

Start a HyperTerminal session as performed in the Establishing a HyperTerminal session lab.

**Note:** Go to the erase and reload instructions at the end of this lab. Perform those steps on all routers in this lab assignment before continuing.

### Step 1 Login to the router in user EXEC mode

- Connect to the router and login.
- What prompt did the router display?

- c. What does this prompt mean?
- 

## Step 2 Login to the router in privileged EXEC mode

- a. Enter **enable** at the user EXEC mode prompt.

```
Router>enable
```

- b. What prompt did the router display?
- 

- c. What does this prompt mean?
- 

## Step 3 Enter global configuration mode

- a. Enter **configure terminal** at the privilege EXEC mode prompt.

```
Router#configure terminal
```

- b. What prompt did the router display? \_\_\_\_\_

- c. What does this prompt mean?
- 

## Step 4 Enter a hostname of GAD for this router

- a. Enter **hostname GAD** at the prompt.

```
Router(config)#hostname GAD
```

- b. What prompt did the router display?
- 

- c. What does this prompt mean?
- 

## Step 5 Configure and exit

Configure the console password on the router and exit from line console:

```
GAD(config)#line console 0  
GAD(config-line)#password cisco  
GAD(config-line)#login  
GAD(config-line)#exit  
GAD(config)#
```

## Step 6 Configure and exit

Configure the password on the virtual terminal lines and exit line mode:

```
GAD(config)#line vty 0 4  
GAD(config-line)#password cisco  
GAD(config-line)#login  
GAD(config-line)#exit  
GAD(config)#
```

## Step 7 Configure the enable password

Configure the **enable password** on the router and exit from global configuration mode:

```
GAD(config)#enable password cisco
GAD(config)#exit
```

## Step 8 Return to the user EXEC mode

Return to the user EXEC mode by entering the **disable** command:

```
GAD#disable
```

## Step 9 Enter the privileged EXEC mode again

This time a prompt for a password will show. Enter **cisco** but the characters will not be seen on the line.

```
GAD>enable
Password:cisco
```

## Step 10 Return to the configuration mode

Return to the configuration mode by entering **configure terminal**:

```
GAD#configure terminal
```

## Step 11 Configure the enable secret password

Configure the enable secret password and exit from global configuration mode:

```
GAD(config)#enable secret class
GAD(config)#exit
```

**Note:** Remember the enable secret password is encrypted from the configuration view. Also do not type **enable secret password class**, or the secret password will be password, not class.

## Step 12 Return to the user EXEC mode

Return to the user EXEC mode by entering the command **disable**:

```
GAD#disable
GAD>
```

## Step 13 Enter the privileged EXEC mode again

A prompt for a password will show. Enter **cisco**. The characters will not be seen on the line. If it fails, continue until the bad secrets message is displayed:

```
GAD>enable
Password:cisco
```



```
Password:cisco
Password:cisco
% Bad secrets
```

### Step 14 Enter the privileged EXEC mode again

A prompt for a password will show. Enter **class**. The characters will not be displayed on the line:

```
GAD>enable
Password: class
GAD#
```

**Note:** The enable secret password takes precedence over the enable password. So once an enable secret password is entered the enable password no longer is accepted.

### Step 15 Show the routers running configuration

```
GAD#show running-config
```

- a. Is there an encrypted password? \_\_\_\_\_
- b. Are there any other passwords? \_\_\_\_\_
- c. Are any of the other passwords encrypted? \_\_\_\_\_

Upon completion of the previous steps, logoff by typing **exit**. Turn the router off.

## Erasing and reloading the router

Enter into the privileged EXEC mode by typing **enable**.

If prompted for a password, enter **class**. If “class” does not work, ask the instructor for assistance.

```
Router>enable
```

At the privileged EXEC mode, enter the command **erase startup-config**.

```
Router#erase startup-config
```

The responding line 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
```

Now at the privileged EXEC mode, enter the command **reload**.

```
Router#reload
```

The responding line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Proceed with reload? [confirm]
```

Press **Enter** to confirm.

In the first line of the response will be:

```
Reload requested by console.
```

After the router has reloaded the line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

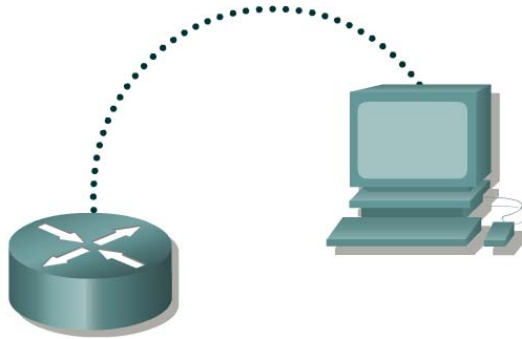
```
Press RETURN to get started!
```

Press **Enter**.

The router is ready for the assigned lab to be performed.

Router Interface Summary					
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2	Interface #5
800 (806)	Ethernet 0 (E0)	Ethernet 1 (E1)			
1600	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
1700	FastEthernet 0 (FA0)	FastEthernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)	
2500	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
2600	FastEthernet 0/0 (FA0/0)	FastEthernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)	
In order to find out exactly how the router is configured, look at the interfaces. This will identify the type of router as well as how many interfaces the router has. There is no way to effectively list all of the combinations of configurations for each router class. What is provided are the identifiers for the possible combinations of interfaces in the device. This interface chart does not include any other type of interface even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in IOS command to represent the interface.					

## Lab 3.1.4 Using Router `show` Commands



Straight-through cable	—————
Serial cable	————— $\color{red}\text{Z}$
Console (Rollover)	.....
Crossover cable	- - - - -

### Objective

- Become familiar with the basic router `show` commands.
- Retrieve the current running configuration from RAM using `show running-config`.
- View the backup configuration file in NVRAM using `show startup-config`.
- View the IOS file information using `show flash` and `show version`.
- View the current status of the router interfaces using `show interface`.
- View the status of any configured Layer 3 protocol using `show protocols`.

### Background/Preparation

This lab helps the student become familiar with the router `show` commands. The `show` commands are the most important information-gathering commands available for the router.

- `show running-config` (or `show run`) is probably the single most valuable command to help determine the current status of a router, because it displays the active configuration file running in RAM.
- `show startup-config` (or `show start`) displays the backup configuration file that is stored in non-volatile RAM (NVRAM). This is the file that will be used to configure the router when it is first started or rebooted with the `reload` command. All the detailed router interface settings are contained in this file.
- `show flash` is used to view the available flash memory and the amount used. Flash is where the Cisco Internetwork Operating System (IOS) file or image is stored.

- **show arp** displays the routers address resolution table.
- **show interfaces** displays statistics for all interfaces configured on the router.
- **show protocols** displays global and interface-specific status of configured Layer 3 protocols, such as IP and IPX.

Any router that meets the interface requirements may be used. Possible routers include 800, 1600, 1700, 2500, 2600 routers, or a combination. Refer to the chart at the end of the lab to correctly identify the interface identifiers to be used based on the equipment in the lab. The configuration output used in this lab is produced from 1721 series routers. Any other router used may produce slightly different output. The following steps are intended to be executed on each router unless specifically instructed otherwise.

Start a HyperTerminal session as performed in the Establishing a HyperTerminal session lab.

### Step 1 Log on to the router

- Connect to the router and log on. If prompted, enter the password **cisco**.

### Step 2 Enter the help command

- Enter the **help** command by typing **?** at the router prompt. The router responds with all commands available in user mode.
- What did the router reply with? \_\_\_\_\_
- Are all router commands available at the current prompt? \_\_\_\_\_
- Is **show** one of the options available? \_\_\_\_\_

### Step 3 Display help for the show command

- Enter the **show ?** command. The router responds with the **show** subcommands available in user mode.
- List three user mode **show** subcommands.

show Subcommand	Description

### Step 4 Display IOS version and other important information with the show version command

- Enter the **show version** command. The router will return information about the IOS that is running in RAM.
- What is the IOS version? \_\_\_\_\_
- What is the name of the system image (IOS) file? \_\_\_\_\_
- Where was the router IOS image booted from? \_\_\_\_\_
- What type of processor (CPU) and how much RAM does this router have?  
\_\_\_\_\_
- How many Ethernet interfaces does this router have? \_\_\_\_\_ How many serial interfaces?  
\_\_\_\_\_

- g. The router backup configuration file is stored in non-volatile random access memory (NVRAM). How much NVRAM does this router have? \_\_\_\_\_
- h. The router operating system (IOS) is stored in Flash memory. How much Flash memory does this router have? \_\_\_\_\_
- i. What is the configuration register set to? \_\_\_\_\_

### Step 5 Display the time and date for the router

- a. Enter the **show clock** command. What information is displayed? \_\_\_\_\_

### Step 6 Display a cached list of host names and addresses

- a. Enter the **show hosts** command. What information is displayed with **show hosts**?  
\_\_\_\_\_

### Step 7 Display users who are connected to the router

- a. Enter the **show users** command. What information is displayed with **show users**?  
\_\_\_\_\_

### Step 8 Show the command buffer

- a. Enter the **show history** command. What information is displayed with **show history**?  
\_\_\_\_\_

### Step 9 Enter privileged EXEC mode

- a. From user EXEC mode, enter privileged EXEC mode using the **enable** command.
- b. Enter the enable password **class**.
- c. What command did you use to enter privileged EXEC mode? \_\_\_\_\_
- d. How do you know if you are in privileged EXEC mode? \_\_\_\_\_

### Step 10 Enter the help command

- a. Enter the **show ?** command at the router prompt. What did the router reply with?  
\_\_\_\_\_
- b. How is this output different from the one you got in user EXEC mode in Step 3?  
\_\_\_\_\_

### Step 11 Show the router ARP table

- a. Enter the **show arp** command at the router prompt. What is the ARP table?  
\_\_\_\_\_

### Step 12 Show information about the Flash memory device

- a. Enter **show flash** at the router prompt.
- b. How much Flash memory is available and used? \_\_\_\_\_
- c. What is the file that is stored in Flash memory? \_\_\_\_\_
- d. What is the size in bytes of the Flash memory? \_\_\_\_\_

### Step 13 Show information about the active configuration file

- a. Enter **show running-config** (or **show run**) at the router prompt. What important information is displayed with **show run**?

---

---

---

---

### Step 14 Show information about the backup configuration file

- a. Enter **show startup-config** (or **show start**) at the router prompt. What important information is displayed with **show start**, and where is this information kept?

---

### Step 15 Display statistics for all interfaces configured on the router

- a. Enter **show interfaces** at the router prompt.
- b. Find the following information for interface FastEthernet 0: (Refer to the chart at the end of the lab to correctly identify the interface based on equipment)

1. What is MTU? \_\_\_\_\_
2. What is rely? \_\_\_\_\_
3. What is load? \_\_\_\_\_

- c. Find the following information for interface Serial 0

1. What is the IP address and subnet mask? \_\_\_\_\_
2. What data link layer encapsulation is being used? \_\_\_\_\_

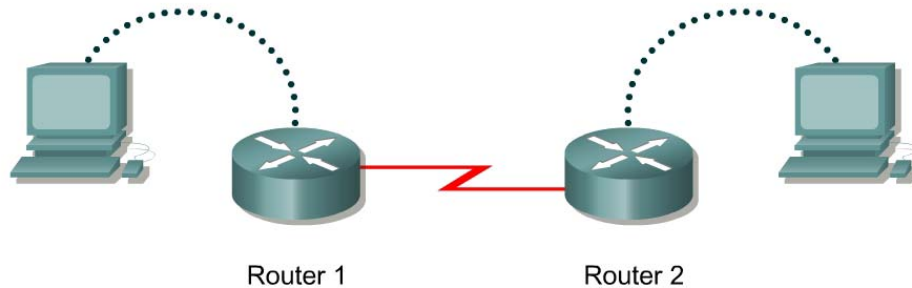
### Step 16 Display the protocols configured on the router

- a. Enter **show protocols** at the router prompt. What important information is displayed?

---

Upon completion of the previous steps, logoff by typing **exit**. Turn the router off.

## Lab 3.1.5 Configuring a Serial Interface



Router Designation	Router Name	Interface type	Serial 0 Address	Subnet mask	Enable secret password	Enable/VTY/Console passwords
Router 1	GAD	DCE	192.168.15.1	255.255.255.0	class	cisco
Router 2	BHM	DTE	192.168.15.2	255.255.255.0	class	cisco

Straight-through cable	—————
Serial cable	————— Z
Console (Rollover)	.....
Crossover cable	- - - - -

### Objective

- Configure a serial interface on each of two routers so they can communicate.

### Background/Preparation

Any router that meets the interface requirements may be used. Possible routers include 800, 1600, 1700, 2500, 2600 routers, or a combination. Refer to the chart at the end of the lab to correctly identify the interface identifiers to be used based on the equipment in the lab. The configuration output used in this lab is produced from 1721 series routers. Any other router used may produce slightly different output. The following steps are intended to be executed on each router unless specifically instructed otherwise.

Start a HyperTerminal session as performed in the Establishing a HyperTerminal session lab.

**Note:** Go to the erase and reload instructions at the end of this lab. Perform those steps on all routers in this lab assignment before continuing.

### Step 1 Basic Router Configuration

- Configure the router. Connect the routers as shown in the diagram. This lab requires a null serial cable and two rollover or console cables.



## Step 2 Configure the name and passwords for Router 1

- On Router 1, enter the global configuration mode and configure the hostname as shown in the chart.
- Configure the console, virtual terminal and enable passwords. If there are any problems, refer to the Lab 3.1.3 Configuring Router Passwords.

## Step 3 Configure serial interface Serial 0

From global configuration mode, configure serial interface Serial 0 on Router GAD. Refer to Interface Summary.

```
GAD(config)#interface serial 0
GAD(config-if)#ip address 192.168.15.1 255.255.255.0
GAD(config-if)#clock rate 56000
GAD(config-if)#no shutdown
GAD(config-if)#exit
GAD(config)#exit
```

**Note:** Once the interface configuration mode is entered, note the IP address of the interface. Enter the subnet mask. Enter the clock rate only on the DCE side of the device. The command **no shutdown** turns on the interface. Shutdown is when the interface is off.

## Step 4 Save the running configuration

Save the running configuration to the startup configuration at the privileged EXEC mode:

```
GAD#copy running-config startup-config
```

**Note:** Save the running configuration for the next time that the router is restarted. The router can be restarted either by a software **reload** command or a power shutdown. The running configuration will be lost if the running configuration is not saved. The router uses the startup configuration when the router is started.

## Step 5 Display information about Serial interface 0 on GAD

- Enter the command **show interface serial 0** on GAD. Refer to interface chart.

```
GAD#show interface serial 0
```

This will show the details of interface serial 0.

- List at least three details discovered by issuing this command.
  - Serial 0 is \_\_\_\_\_. Line protocol is \_\_\_\_\_.
  - Internet address is \_\_\_\_\_.
  - Encapsulation \_\_\_\_\_.
  - To what OSI layer is the "Encapsulation" referring? \_\_\_\_\_.
  - If the Serial interface was configured, why did the **show interface serial 0** say that the interface is down?
-

## Step 6 Configure the name and passwords for Router 2

- On the Birmingham router, enter the global configuration mode. Configure hostname, console, virtual terminal and enable passwords as shown in the previous chart.

## Step 7 Configure serial interface Serial 0

From the global configuration mode, configure serial interface Serial 0 on Router BHM. Refer to interface chart.

```
BHM(config)#interface serial 0
BHM(config-if)#ip address 192.168.15.2 255.255.255.0
BHM(config-if)#no shutdown
BHM(config-if)#exit
BHM(config)#exit
```

## Step 8 Save the running configuration

Save the running configuration to the startup configuration at the privileged EXEC mode:

```
BHM#copy running-config startup-config
```

## Step 9 Display information about Serial interface 0 on BHM

- Enter the command **show interface serial 0** on BHM. Refer to interface chart.

```
BHM#show interface serial 0
```

This will show the details of interface serial 0.

- List at least three details discovered by issuing this command.
  - Serial 0 is \_\_\_\_\_, line protocol is \_\_\_\_\_.
  - Internet address is \_\_\_\_\_.
  - Encapsulation \_\_\_\_\_
  - What is the difference in the Line and Protocol status recorded on GAD earlier? Why?
- 

## Step 10 Verify that the serial connection is functioning

- ping** the serial interface of the other router.

```
BHM#ping 192.168.15.1
```

```
GAD#ping 192.168.15.2
```

- From GAD, ping the BHM router serial interface. Does the ping work? \_\_\_\_\_
- From BHM, ping the GAD router serial interface. Does the ping work? \_\_\_\_\_
- If the answer is no for either question, troubleshoot the router configurations to find the error. Then ping the interfaces again until the answer to both questions is yes.

Upon completion of the previous steps, logoff by typing **exit**. Turn the router off. Remove and store the cables and adapter.

## Erasing and reloading the router

Enter into the privileged EXEC mode by typing **enable**.

If prompted for a password, enter **class**. If “class” does not work, ask the instructor for assistance.

```
Router>enable
```

At the privileged EXEC mode, enter the command **erase startup-config**.

```
Router#erase startup-config
```

The responding line 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
```

Now at the privileged EXEC mode, enter the command **reload**.

```
Router#reload
```

The responding line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Proceed with reload? [confirm]
```

Press **Enter** to confirm.

In the first line of the response will be:

```
Reload requested by console.
```

After the router has reloaded the line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Press RETURN to get started!
```

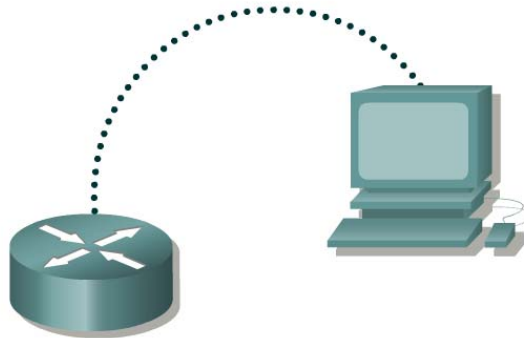
Press **Enter**.

The router is ready for the assigned lab to be performed.

Router Interface Summary					
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2	Interface #5
800 (806)	Ethernet 0 (E0)	Ethernet 1 (E1)			
1600	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
1700	FastEthernet 0 (FA0)	FastEthernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)	
2500	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
2600	FastEthernet 0/0 (FA0/0)	FastEthernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)	
In order to find out exactly how the router is configured, look at the interfaces. This will identify the type of router as well as how many interfaces the router has. There is no way to effectively list all of the combinations of configurations for each router class. What is provided are the identifiers for the possible combinations of interfaces in the device. This interface chart does not include any other type of interface even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in IOS command to represent the interface.					



## Lab 3.1.6 Making Configuration Changes



Router Name	Router Type	Serial 0 Address	Subnet mask	Enable Secret password	Enable/VTY/Console passwords
GAD		192.168.14.1	255.255.255.0	class	cisco

Straight-through cable	—————
Serial cable	————— <del>      </del>
Console (Rollover)	.....
Crossover cable	- - - - -

### Objective

- Configure some basic router settings.
- Bring interfaces up and down.
- Make changes to the router configuration.

### Background/Preparation

Any router that meets the interface requirements may be used. Possible routers include 800, 1600, 1700, 2500, 2600 routers, or a combination. Refer to the chart at the end of the lab to correctly identify the interface identifiers to be used based on the equipment in the lab. The configuration output used in this lab is produced from 1721 series routers. Any other router used may produce slightly different output. The following steps are intended to be executed on each router unless specifically instructed otherwise.

Start a HyperTerminal session as performed in the Establishing a HyperTerminal session lab.

**Note:** Go to the erase and reload instructions at the end of this lab. Perform those steps on all routers in this lab assignment before continuing.

## Step 1 Basic router configuration

- a. Connect the router as shown in the diagram. This lab requires a console (rollover) and a serial cable.

## Step 2 Configure hostname and passwords

- a. On the GAD router, enter the global configuration mode. Configure the hostname as shown in the chart. Configure the console, virtual terminal and enable passwords.

## Step 3 Configure interface Serial 0

- a. From the global configuration mode, configure serial interface 0 on Router GAD. Refer to interface chart.

```
GAD(config)#interface Serial 0
GAD(config-if)#ip address 192.168.14.1 255.255.255.0
GAD(config-if)#no shutdown
GAD(config-if)#description Connection to the host
GAD(config-if)#exit
GAD(config)#exit
```

## Step 4 Save the configuration

- a. Save the running configuration to the startup configuration at the privileged EXEC mode.

```
GAD#copy running-config startup-config
```

**Note:** Save the running configuration for the next time that the router is restarted. The router can be restarted either by a software **reload** command or a power shutdown. The running configuration will be lost if the running configuration is not saved. The router uses the startup configuration when the router is started.

## Step 5 Verify the configuration

- a. Issue the **show running-config** command from the privileged EXEC mode
- b. If the configuration is not correct, reenter any incorrect commands.

## Step 6 Modify the configuration

- a. Based on the new table, reconfigure the GAD router. Change the router hostname. Change the enable/VTY/console passwords. Remove the secret password and interface description. To remove an old command, go to the proper command mode and retype the command exactly as it was entered with the word **no** in front of it. For example:

```
GAD(config-if)#description Connection to the host
```

```
GAD(config-if)#no description Connection to the host
```

**Note:** Before making changes to the interface IP address and subnet mask bring the interface down as shown in Step 7.

Router Name	Serial 0 Address	Subnet mask	Enable Secret password	Enable/VTY/Console passwords
GAD	172.16.0.1	255.255.0.0		Cisco1

- b. To change information, go to the proper command mode and retype the command with the new information.

### Step 7 Bring down Serial interface 0

- a. Bring the interface down for maintenance by entering:

```
GAD(config)#interface Serial 0
GAD(config-if)#shutdown
GAD(config-if)#exit
GAD(config)#exit
GAD#
```

- b. Issue the **show interface Serial 0** and note the interface status.  
c. Issue the **show running-config** command and note the status of interface Serial 0:
- 

### Step 8 Bring up Serial interface 0

- a. To make the interface operational, enable the interface by entering:

```
GAD(config)#interface Serial 0
GAD(config-if)#no shutdown
GAD(config-if)#exit
GAD (config)#exit
```

- b. Issue the **show interface Serial 0** and note the interface status.  
c. Serial 0 is \_\_\_\_\_. Line protocol is \_\_\_\_\_.

### Step 9 Verify the configuration

- a. Issue a **show running-config** command from the privileged EXEC mode to see if the modifications were properly made. If the configuration is not correct, reenter any incorrect commands and verify again.

Upon completion of the previous steps, logoff by typing **exit**. Turn the router off.

## Erasing and reloading the router

Enter into the privileged EXEC mode by typing **enable**.

If prompted for a password, enter **class**. If “class” does not work, ask the instructor for assistance.

```
Router>enable
```

At the privileged EXEC mode, enter the command **erase startup-config**.

```
Router#erase startup-config
```

The responding line 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
```

Now at the privileged EXEC mode, enter the command **reload**.

```
Router#reload
```

The responding line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Proceed with reload? [confirm]
```

Press **Enter** to confirm.

In the first line of the response will be:

```
Reload requested by console.
```

After the router has reloaded the line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Press RETURN to get started!
```

Press **Enter**.

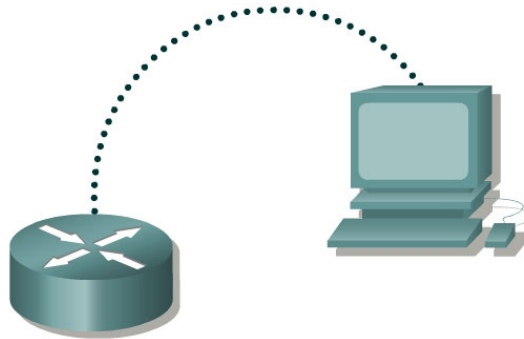
The router is ready for the assigned lab to be performed.



Router Interface Summary					
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2	Interface #5
800 (806)	Ethernet 0 (E0)	Ethernet 1 (E1)			
1600	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
1700	FastEthernet 0 (FA0)	FastEthernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)	
2500	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
2600	FastEthernet 0/0 (FA0/0)	FastEthernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)	
In order to find out exactly how the router is configured, look at the interfaces. This will identify the type of router as well as how many interfaces the router has. There is no way to effectively list all of the combinations of configurations for each router class. What is provided are the identifiers for the possible combinations of interfaces in the device. This interface chart does not include any other type of interface even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in IOS command to represent the interface.					



## Lab 3.1.7 Configuring an Ethernet Interface



Router Designation	Router Name	Router Type	FA0/0 Address	Subnet mask	Enable Secret password	Enable/VTY/ Console passwords
Router 1	GAD		192.168.14.1	255.255.255.0	class	cisco

Straight-through cable	—————
Serial cable	————— 
Console (Rollover)	.....
Crossover cable	- - - - -

### Objective

- Configure an Ethernet interface on the router with an IP address and a subnet mask.

### Background/Preparation

In this lab, students configure an Ethernet interface on the router with an IP address and a subnet mask.

Any router that meets the interface requirements may be used. Possible routers include 800, 1600, 1700, 2500, 2600 routers, or a combination. Refer to the chart at the end of the lab to correctly identify the interface identifiers to be used based on the equipment in the lab. The configuration output used in this lab is produced from 1721 series routers. Any other router used may produce slightly different output. The following steps are intended to be executed on each router unless specifically instructed otherwise.

Start a HyperTerminal session as performed in the Establishing a HyperTerminal session lab.

**Note:** Go to the erase and reload instructions at the end of this lab. Perform those steps on all routers in this lab assignment before continuing.

### Step 1 Configure the hostname and passwords on the GAD router

- a. On the router, enter the global configuration mode and configure the hostname as shown in the chart. Then configure the console, virtual terminal and enable passwords.

## Step 2 Configure the FastEthernet 0 interface

**Note:** The designation for the first Ethernet interface on the router will vary. It may be ethernet 0, fastethernet 0 or fastethernet 0/0 depending on the type of router.

```
GAD(config)#interface fastEthernet 0
GAD(config-if)#ip address 192.168.14.1 255.255.255.0
GAD(config-if)#no shutdown
GAD(config-if)#exit
GAD (config)#exit
```

## Step 3 Save the configuration

- Save the running configuration to the startup configuration at the privileged EXEC mode:

```
GAD#copy running-config startup-config
```

## Step 4 Display the FastEthernet 0 configuration information

```
GAD#show interface fastethernet 0
```

**Note:** This will show the details of the Ethernet interface.

- List at least three details discovered by issuing this command.
- FastEthernet0 is \_\_\_\_\_. Line protocol is \_\_\_\_\_.
- Internet address is \_\_\_\_\_.
- Encapsulation \_\_\_\_\_
- To what OSI layer is the "Encapsulation" referring? \_\_\_\_\_

Upon completion of the previous steps, logoff by typing **exit**. Turn the router off.

## Erasing and reloading the router

Enter into the privileged EXEC mode by typing **enable**.

If prompted for a password, enter **class**. If “class” does not work, ask the instructor for assistance.

```
Router>enable
```

At the privileged EXEC mode, enter the command **erase startup-config**.

```
Router#erase startup-config
```

The responding line 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
```

Now at the privileged EXEC mode, enter the command **reload**.

```
Router#reload
```

The responding line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Proceed with reload? [confirm]
```

Press **Enter** to confirm.

In the first line of the response will be:

```
Reload requested by console.
```

After the router has reloaded the line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Press RETURN to get started!
```

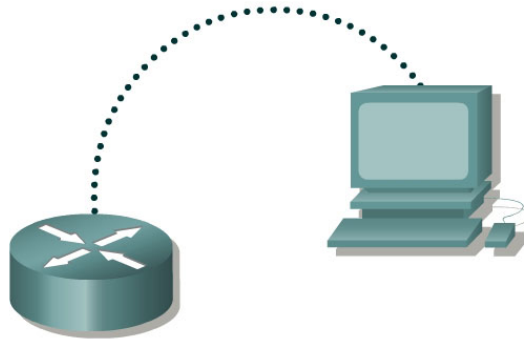
Press **Enter**.

The router is ready for the assigned lab to be performed.

Router Interface Summary					
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2	Interface #5
800 (806)	Ethernet 0 (E0)	Ethernet 1 (E1)			
1600	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
1700	FastEthernet 0 (FA0)	FastEthernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)	
2500	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
2600	FastEthernet 0/0 (FA0/0)	FastEthernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)	
In order to find out exactly how the router is configured, look at the interfaces. This will identify the type of router as well as how many interfaces the router has. There is no way to effectively list all of the combinations of configurations for each router class. What is provided are the identifiers for the possible combinations of interfaces in the device. This interface chart does not include any other type of interface even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in IOS command to represent the interface.					



### Lab 3.2.3 Configuring Interface Descriptions



Router Designation	Router Name	Fast Ethernet 0 Address	Serial 0 Address	Subnet mask for both interfaces	Enable Secret password	Enable/VTY/ Console passwords
Router 1	GAD	192.168.14.1	192.168.15.1	255.255.255.0	class	cisco

Straight-through cable	—————
Serial cable	————— <del>      </del>
Console (Rollover)	.....
Crossover cable	- - - - -

### Objective

- Choose a description for an interface and use interface configuration mode to enter that description.
- Set up a network similar to the one in the previous diagram.

### Background/Preparation

Any router that meets the interface requirements may be used. Possible routers include 800, 1600, 1700, 2500, 2600 routers, or a combination. Refer to the chart at the end of the lab to correctly identify the interface identifiers to be used based on the equipment in the lab. The configuration output used in this lab is produced from 1721 series routers. Any other router used may produce slightly different output. The following steps are intended to be executed on each router unless specifically instructed otherwise.

Start a HyperTerminal session as performed in the Establishing a HyperTerminal session lab.

**Note:** Go to the erase and reload instructions at the end of this lab. Perform those steps on all routers in this lab assignment before continuing.

### Step 1 Configure the hostname and passwords on the router

- a. On the router, enter the global configuration mode. Configure the hostname as shown in the chart. Then configure the console, virtual terminal and enable passwords. If there are any difficulties, refer to the Configuring router passwords lab.

- b. What is the router command to view the current running configuration?
- 
- c. What command mode must be used to enter the command listed in the last question?
- 
- d. Enter the command from the previous question to verify the configuration that was just entered. If the configuration is not correct, fix the errors. Verify it again until correct.

## Step 2 Enter Global Configuration mode

- a. Enter **configure terminal** at the router prompt. Notice the change in the router prompt. What did the router prompt change to?
- 

## Step 3 Enter Interface Configuration mode

- a. Enter **interface serial 0** at the global configuration prompt. Refer to interface chart. What does the router prompt look like in interface configuration mode?
- 

## Step 4 Display help for the description command

- a. Enter **description ?** at the router prompt. What is the maximum number of characters in an interface description?
- 

## Step 5 Choose a description for the interface

- a. An interface description includes the purpose and location of the interface, other devices or locations connected to the interface, and circuit identifiers. Descriptions help the support personnel better understand the scope of problems related to an interface. Descriptions also allow for a faster resolution of problems.
- b. Given the following circuit information, choose a description for the serial 0 interface for GAD. Use the following form to document the choice.

Link	Carrier	Circuit ID	Speed
GAD to BHM -	BellSouth	10DHDG551170	1.544Mbps/sec

## Step 6 Enter a description for interface serial 0

- a. From the interface configuration mode for serial 0, enter the description text. The text is the description from the previous step. Then enter **Ctrl-z** or type **end** to return to the privileged EXEC mode.

**Note:** this would be the same as typing **exit** to leave the interface configuration mode and **exit** again to leave Global Configuration mode. This is a keyboard shortcut.

## Step 7 Examine the active configuration file

- a. From the privileged EXEC mode, enter the command that will show the running configuration. The privileged EXEC mode is also called enable mode. The router will display information on how it is currently configured.
- b. What command was entered? \_\_\_\_\_
-

- c. What is the description for interface serial 0?
- 

### Step 8 Confirm interface description is correct

- a. From the enable mode, enter the **show interfaces serial 0** command. The router displays information about the interface. Examine this output to confirm that the description entered is the correct description.

Upon completion of the previous steps, logoff by typing **exit**. Turn the router off.



## Erasing and reloading the router

Enter into the privileged EXEC mode by typing **enable**.

If prompted for a password, enter **class**. If “class” does not work, ask the instructor for assistance.

```
Router>enable
```

At the privileged EXEC mode, enter the command **erase startup-config**.

```
Router#erase startup-config
```

The responding line 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
```

Now at the privileged EXEC mode, enter the command **reload**.

```
Router#reload
```

The responding line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Proceed with reload? [confirm]
```

Press **Enter** to confirm.

In the first line of the response will be:

```
Reload requested by console.
```

After the router has reloaded the line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Press RETURN to get started!
```

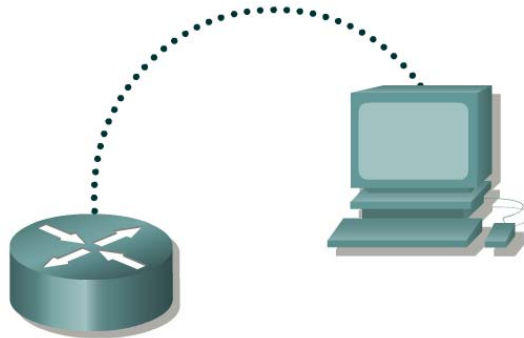
Press **Enter**.

The router is ready for the assigned lab to be performed.

Router Interface Summary					
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2	Interface #5
800 (806)	Ethernet 0 (E0)	Ethernet 1 (E1)			
1600	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
1700	FastEthernet 0 (FA0)	FastEthernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)	
2500	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
2600	FastEthernet 0/0 (FA0/0)	FastEthernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)	
In order to find out exactly how the router is configured, look at the interfaces. This will identify the type of router as well as how many interfaces the router has. There is no way to effectively list all of the combinations of configurations for each router class. What is provided are the identifiers for the possible combinations of interfaces in the device. This interface chart does not include any other type of interface even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in IOS command to represent the interface.					



## Lab 3.2.5 Configuring Message-of-the-Day (MOTD)



Router Name	FA0/0 Address	S0/0 Address	Subnet mask	Enable Secret password	Enable/VTY/Console passwords
GAD	172.16.0.1	172.17.0.1	255.255.0.0	class	cisco

Straight-through cable	—————
Serial cable	————— <del>      </del>
Console (Rollover)	.....
Straight-through cable	- - - - -

### Objective

- Demonstrate the commands to enter a message-of-the-day (MOTD) on the router. This procedure allows all users to view the message upon entering the router.
- Set up a network similar to the one in the previous diagram.

### Background/Preparation

In this lab a message-of-the-day banner will be configured.

Any router that meets the interface requirements may be used. Possible routers include 800, 1600, 1700, 2500, 2600 routers, or a combination. Refer to the chart at the end of the lab to correctly identify the interface identifiers to be used based on the equipment in the lab. The configuration output used in this lab is produced from 1721 series routers. Any other router used may produce slightly different output. The following steps are intended to be executed on each router unless specifically instructed otherwise.

Start a HyperTerminal session as performed in the Establishing a HyperTerminal session lab.

**Note:** Go to the erase and reload instructions at the end of this lab. Perform those steps on all routers in this lab assignment before continuing.

### Step 1 Configure basic router information

- On the router, enter the global configuration mode. Configure the hostname as shown in the chart. Then configure the console, virtual terminal and enable passwords. If there are any difficulties, refer to the Configuring Router Passwords lab.
- Enter the **show running-config** command to verify the configuration that was just entered.
- Save the configuration information from the privileged EXEC mode.

```
GAD#copy running-config startup-config
```

### Step 2 Enter Global Configuration mode

- Enter **configure terminal** at the router prompt. Notice the change in the router prompt.

### Step 3 Display help for the **banner motd** command

- Enter **banner motd ?** at the router prompt.
  - What is the character called that is used to indicate the beginning and end of the banner?
- 

### Step 4 Choose the text for the MOTD

- The login banner should be a warning not to attempt login unless authorized. In the following space, enter an appropriate warning banner. The message can contain any printable character, other than the delimiting character, as well as spaces and carriage returns.
- 

### Step 5 Enter the desired banner message

- From the global configuration mode enter **banner motd # message #**. The “#” signs are used as delimiters and the “message” is the banner message chosen in the previous step.

### Step 6 Test the MOTD display

- Exit the console session. Reenter the router to display the message-of-the-day. This is done by pressing the **Enter** key. This will display the message entered into the configuration.

### Step 7 Verify the MOTD by looking at the router configuration

- Enter the **show running-config** command.
  - How does the banner MOTD show in the configuration listing?
- 

- Save the configuration information from the privileged EXEC mode.

Upon completion of the previous steps, logoff by typing **exit**. Turn the router off.

## Erasing and reloading the router

Enter into the privileged EXEC mode by typing **enable**.

If prompted for a password, enter **class**. If “class” does not work, ask the instructor for assistance.

```
Router>enable
```

At the privileged EXEC mode, enter the command **erase startup-config**.

```
Router#erase startup-config
```

The responding line 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
```

Now at the privileged EXEC mode, enter the command **reload**.

```
Router#reload
```

The responding line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Proceed with reload? [confirm]
```

Press **Enter** to confirm.

In the first line of the response will be:

```
Reload requested by console.
```

After the router has reloaded the line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

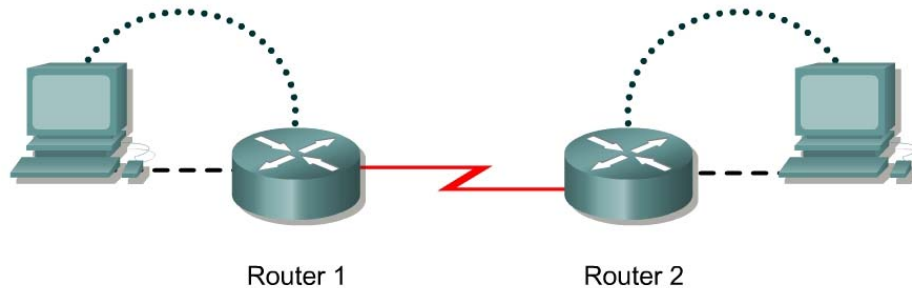
```
Press RETURN to get started!
```

Press **Enter**.

The router is ready for the assigned lab to be performed.

Router Interface Summary					
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2	Interface #5
800 (806)	Ethernet 0 (E0)	Ethernet 1 (E1)			
1600	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
1700	FastEthernet 0 (FA0)	FastEthernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)	
2500	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
2600	FastEthernet 0/0 (FA0/0)	FastEthernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)	
In order to find out exactly how the router is configured, look at the interfaces. This will identify the type of router as well as how many interfaces the router has. There is no way to effectively list all of the combinations of configurations for each router class. What is provided are the identifiers for the possible combinations of interfaces in the device. This interface chart does not include any other type of interface even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in IOS command to represent the interface.					

## Lab 3.2.7 Configuring Host Tables



Router Designation	Router Name	Fast Ethernet 0 Address	Interface type	Serial 0 Address	Subnet mask for both interfaces	Enable secret password	Enable/VTY/ Console passwords
Router 1	GAD	172.16.0.1	DCE	172.17.0.1	255.255.0.0	class	cisco
Router 2	BHM	172.18.0.1	DTE	172.17.0.2	255.255.0.0	class	cisco

Straight-through cable	—————
Serial cable	————— ⚡
Console (Rollover)	.....
Crossover cable	- - - - -

### Objective

- Create IP host tables that allow a router to use names to identify all of the attached interfaces on that router. These names can be used in place of an IP addresses in commands that use IP addresses to identify a location.
- Set up a network similar to the one in the above diagram.

### Background/Preparation

IP host tables allow a router to use names to identify all of the attached interfaces on that router. These names can be used in place of an IP address in commands that use IP addresses to identify a location such as ping or Telnet.

Any router that meets the interface requirements may be used. Possible routers include 800, 1600, 1700, 2500, 2600 routers, or a combination. Refer to the chart at the end of the lab to correctly identify the interface identifiers to be used based on the equipment in the lab. The configuration output used in this lab is produced from 1721 series routers. Any other router used may produce slightly different output. The following steps are intended to be executed on each router unless specifically instructed otherwise.

Start a HyperTerminal session as performed in the Establishing a HyperTerminal session lab.

**Note:** Go to the erase and reload instructions at the end of this lab. Perform those steps on all routers in this lab assignment before continuing.

## Step 1 Configure the hostname and passwords on the GAD router

- a. On the router, enter the global configuration mode. Configure the hostname as shown in the chart. Then configure the console, virtual terminal and enable passwords. If there are any difficulties, refer to the Configuring Router Passwords lab.

## Step 2 Configure the interfaces and routing protocol on the GAD router

- a. Go to the proper command mode and enter the following text:

```
GAD(config)#interface fastethernet 0
GAD(config-if)#ip address 172.16.0.1 255.255.0.0
GAD(config-if)#no shutdown
GAD(config-if)#exit
GAD(config)#interface serial 0
GAD(config-if)#ip address 172.17.0.1 255.255.0.0
GAD(config-if)#clock rate 56000
GAD(config-if)#no shutdown
GAD(config-if)#exit
GAD(config)#router rip
GAD(config-router)#network 172.16.0.0
GAD(config-router)#network 172.17.0.0
GAD(config-router)#exit
GAD(config)#exit
```

## Step 3 Save the GAD router configuration

```
GAD#copy running-config startup-config
```

## Step 4 Configure the hostname and passwords on the BHM router

- a. On the BHM router, enter the global configuration mode. Configure the hostname as shown in the chart. Then configure the console, virtual terminal and enable passwords. If there are any difficulties, refer to the Configuring Router Passwords lab.

## Step 5 Configure the interfaces and routing protocol on the BHM router

- a. Go to the proper command mode and enter the following:

```
BHM(config)#interface fastethernet 0
BHM(config-if)#ip address 172.18.0.1 255.255.0.0
BHM(config-if)#no shutdown
BHM(config-if)#exit
BHM(config)#interface serial 0
BHM(config-if)#ip address 172.17.0.2 255.255.0.0
BHM(config-if)#no shutdown
BHM(config-if)#exit
BHM(config)#router rip
BHM(config-router)#network 172.17.0.0
BHM(config-router)#network 172.18.0.0
BHM(config-router)#exit
BHM(config)#exit
```



## Step 6 Save the BHM router configuration

```
BHM#copy running-config startup-config
```

## Step 7 Verify that the internetwork is functioning

Verify that the internetwork is functioning. Ping the FastEthernet interface of the other router.

- a. From GAD, ping the BHM router FastEthernet interface. Does the ping work?

- 
- b. From BHM, ping the GAD router FastEthernet interface. Does the ping work?

- 
- c. If the answer is no for either question troubleshoot the router configurations to find the error. Then do the pings again until the answer to both questions is yes.

## Step 8 Configure the IP host table for the network

- a. Create a name for each router in the network lab. Enter that name along with the IP addresses of the routers interfaces. This is a local name and can be anything that is comfortable. Although the name does not have to match the configured hostname of the router, that would be the normal procedure.

Router Name	IP Address Ethernet 0	IP Address Interface Serial 0

- b. From the global configuration mode, enter the command `ip host` followed by the name of each router in the network, as well as all of the IP addresses of the interfaces on each of the routers.

For example to name the GAD router accessible from BHM by the name "G", enter:

```
BHM(conf)#ip host G 172.16.0.1 172.17.0.1
```

- c. What commands did you enter on GAD?

- 
- d. What commands did you enter on BHM?
- 

## Step 9 Exit configuration mode and test

- a. Go to the enable, or privileged EXEC mode.
- b. Examine the host table entries, using the `show hosts` command on each router.
- c. Are the host entries that were configured in the previous steps visible?

GAD \_\_\_\_\_ BHM \_\_\_\_\_

- d. If there are no IP host entries go back and repeat Step 8.

- e. Now ping the other router by host name. From the enable prompt type **ping** *host*. The “host” is the ip host name that was configured in the previous steps. For example for a host name of “G”, enter:

```
BHM#ping G
```

- f. Was the ping successful? \_\_\_\_\_
- g. If the ping was not successful, check the accuracy of the IP host table entries.
- h. From the enable prompt, enter the host name. Press **Enter**. For example for a host name of “G”, enter:

```
BHM#G
```

- i. What happened? \_\_\_\_\_

Upon completion of the previous steps, logoff by typing **exit**. Turn the router off.

## Erasing and reloading the router

Enter into the privileged EXEC mode by typing **enable**.

If prompted for a password, enter **class**. If “class” does not work, ask the instructor for assistance.

```
Router>enable
```

At the privileged EXEC mode, enter the command **erase startup-config**.

```
Router#erase startup-config
```

The responding line 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
```

Now at the privileged EXEC mode, enter the command **reload**.

```
Router#reload
```

The responding line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Proceed with reload? [confirm]
```

Press **Enter** to confirm.

In the first line of the response will be:

```
Reload requested by console.
```

After the router has reloaded the line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

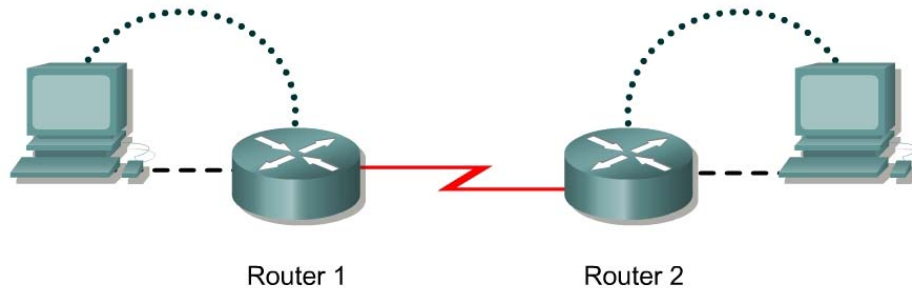
```
Press RETURN to get started!
```

Press **Enter**.


The router is ready for the assigned lab to be performed.

Router Interface Summary					
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2	Interface #5
800 (806)	Ethernet 0 (E0)	Ethernet 1 (E1)			
1600	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
1700	FastEthernet 0 (FA0)	FastEthernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)	
2500	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
2600	FastEthernet 0/0 (FA0/0)	FastEthernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)	
In order to find out exactly how the router is configured, look at the interfaces. This will identify the type of router as well as how many interfaces the router has. There is no way to effectively list all of the combinations of configurations for each router class. What is provided are the identifiers for the possible combinations of interfaces in the device. This interface chart does not include any other type of interface even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in IOS command to represent the interface.					

## Lab 3.2.9 Backing up Configuration Files



Router Designation	Router Name	Fast Ethernet 0 Address	Interface type	Serial 0 Address	Subnet mask for both interfaces	Enable secret password	Enable/VTY/ Console passwords
Router 1	GAD	172.16.0.1	DCE	172.17.0.1	255.255.0.0	class	cisco
Router 2	BHM	172.18.0.1	DTE	172.17.0.2	255.255.0.0	class	cisco

Straight-through cable	—————
Serial cable	—————  —————
Console (Rollover)	.....
Crossover cable	- - - - -

### Objective

- Demonstrate the capture of the running configuration of a router to an ASCII text file with HyperTerminal.
- Edit or modify the configuration with a text editor such as Notepad.
- Use the edited text file to configure another router using HyperTerminal.
- Cable a network similar to the one in the previous diagram.

### Background/Preparation

The HyperTerminal capture option can be very useful not only for configuration files but for capturing command output and for documentation. It is a simple way to save whatever is displayed on the screen of the PC acting as a console to the router.

Any router that meets the interface requirements may be used. Possible routers include 800, 1600, 1700, 2500, 2600 routers, or a combination. Refer to the chart at the end of the lab to correctly identify the interface identifiers to be used based on the equipment in the lab. The configuration output used in this lab is produced from 1721 series routers. Any other router used may produce slightly different output. The following steps are intended to be executed on each router unless specifically instructed otherwise.

Start a HyperTerminal session as performed in the Establishing a HyperTerminal session lab.

**Note:** Go to the erase and reload instructions at the end of this lab. Perform those steps on all routers in this lab assignment before continuing.

### Step 1 Configure the hostname and passwords on the GAD router

- a. On the GAD router, enter the global configuration mode. Configure the hostname as shown in the chart. Configure the console, virtual terminal and enable passwords.

### Step 2 Configure the interfaces and routing protocol on the GAD router

- a. Go to the proper command mode and enter the following:

```
GAD(config)#interface fastethernet 0
GAD(config-if)#ip address 172.16.0.1 255.255.0.0
GAD(config-if)#no shutdown
GAD(config-if)#exit
GAD(config)#interface serial 0
GAD(config-if)#ip address 172.17.0.1 255.255.0.0
GAD(config-if)#clock rate 56000
GAD(config-if)#no shutdown
GAD(config-if)#exit
GAD(config)#router rip
GAD(config-router)#network 172.16.0.0
GAD(config-router)#network 172.17.0.0
GAD(config-router)#exit
GAD(config)#exit
```

### Step 3 Save the GAD router configuration

```
GAD#copy running-config startup-config
Destination filename [startup-config]? [Enter]
```

### Step 4 Configure the hostname and passwords on the BHM router

- a. On the BHM router, enter the global configuration mode. Configure the hostname as shown in the chart. Configure the console, virtual terminal and enable passwords.

### Step 5 Configure the interfaces and routing protocol on the BHM router

- a. Go to the proper command mode and enter the following:

```
BHM(config)#interface fastethernet 0
BHM(config-if)#ip address 172.18.0.1 255.255.0.0
BHM(config-if)#no shutdown
BHM(config-if)#exit
BHM(config)#interface serial 0
BHM(config-if)#ip address 172.17.0.2 255.255.0.0
BHM(config-if)#no shutdown
BHM(config-if)#exit
BHM(config)#router rip
BHM(config-router)#network 172.17.0.0
BHM(config-router)#network 172.18.0.0
BHM(config-router)#exit
BHM(config)#exit
```

## Step 6 Save the BHM router configuration

```
BHM#copy running-config startup-config
```

```
Destination filename [startup-config]? [Enter]
```

## Step 7 Verify that the internetwork is functioning

Ping the FastEthernet interface of the other router.

- From GAD, can the BHM router FastEthernet interface be reached? \_\_\_\_\_
- From BHM, can the GAD router FastEthernet interface be reached? \_\_\_\_\_
- If the answer is no for either question, troubleshoot the router configurations to find the error. Then do the pings again until the answer to both questions is yes.

## Step 8 Start capturing the configuration file

- Start the process of copying the router configuration to a text file.

Use HyperTerminal to capture all text displayed on its screen to a text file.

- In HyperTerminal click on **Transfer**.
  - Capture Text**
  - Specify the name of the router for the filename and use **.txt** for the extension. Browse to find a location to store the text file on the computer. This file will be edited and used in later steps of this lab.
  - Click on **Start** button to start capturing text.
- Write down the name and location of this file:  
  

---
  - Enter the **show running-config** command. Press the space bar when the **"- More -"** prompt appears. The **show running-config** command is used to display the active configuration file for the router that is stored in RAM.

## Step 9 Stop capturing the configuration file

- To discontinue capturing the output of the router configuration to a text file:  
On the HyperTerminal menu bar select **Transfer > Capture text > Stop**.

## Step 10 Clean up captured configuration file

- The captured text file will have information not required for configuring a router. For example, the **"- More -"** prompts are not required for configuring a router. To put this in a form to be "pasted" back in the router, remove any unnecessary information from the captured configuration.
- To add comments into the configuration to explain its various parts, use the exclamation mark **!**. The router will ignore any comment in a router configuration that starts with an exclamation mark. Therefore, write any kind of comment that helps to understand the configuration.
- Start Notepad. From the Windows Desktop select:
  - Start**
  - Run**
  - Type **Notepad**
  - Press the **Enter** key
- In Notepad click on:
  - File**

- **Open**
  - Find the file made and select it.
  - Click **Open**.
- e. Delete the lines that contain:
- Show running-config
  - Building configuration
  - Current configuration:
  - - More -
  - Lines that appear after the word "End"
- f. At the end of each of the interface sections add:
- no shutdown

**Example:**

```
interface Serial 0
ip address 199.6.13.1 255.255.255.0
no shutdown
```

- g. The last line to edit is the:
- ```
enable secret 5 $1$prts$Rbf8hxlss.ZrufvI7rMVy/
```
- change this to:
- ```
enable secret class
```

This password must be entered in clear text or the encryption algorithm will re-encrypt the current password. Then entry from the user prompt will be impossible.

- h. Save the clean version of the configuration by clicking on **File > Save** and exit Notepad.

## Step 11 Test the backup configuration

- a. Any form of backup that has not been tested could be a liability in a failure situation. This includes backup configurations. The backup configuration must be tested. The test should be scheduled during low network usage periods as the router will have to be taken off line. All users that may be affected should be notified well in advance to ensure that the down time will not be an inconvenience.
- b. Before testing the backup configuration, erase the startup configuration. From the HyperTerminal session, enter the command **erase startup-config** at the enable router prompt. This deletes the configuration file from NVRAM.

Confirm that startup configuration has been deleted. Enter **show startup-config** at the router prompt.

- c. What does the router show after this command is entered?

## Step 12 Restart the router to remove the running configuration

- a. Enter reload at the privileged EXEC mode prompt to reboot the router.
- If prompted that the configuration has been modified. Save? type **N** and press **Enter**.
  - When asked to proceed with the reload, enter **Y** and press the **Enter** key.
  - When the router restarts, note that the router displays the message:

```
"Notice: NVRAM invalid, possibly due to write erase."
```

- When prompted to enter the initial configuration dialog, type **N** and press **Enter**.
- When prompted to terminate autoinstall type **Y** and press **Enter**.



- Press **Enter** again.
  - b. What does the prompt look like?
- 

### Step 13 Reconfigure the router from the saved text file

Use the **send file** command in HyperTerminal to restore the new configuration. The edited version of the router configuration file from the previous step will be copied into the area of memory known as the clipboard.

- a. Change to privileged EXEC mode.
- b. Why was a password not required?
- c. Enter global config mode:
  - Enter the command **configure terminal**.
  - Click on Transfer > Send Text File.
  - Select the file.
  - Each line in the text file will be entered.
  - Observe for any errors.
- d. What is the most obvious indication that the router has been restored? Press **Ctrl-Z** to exit global configuration mode.
- e. Save new configuration file as the startup configuration in NVRAM. Use the command **copy running-config startup-config** to save the newly created router configuration.
  - Verify that the running configuration is correct by using the **show running-config** command.

### Step 14 Verify that the internetwork is functioning again

Ping the FastEthernet interface of the other router.

- a. Use the **reload** command to restart the router. Verify that the new configuration has been saved to NVRAM by restarting the router.

When prompted to confirm, press **Y**. This will restart the router.

Once the router restarts, press the **Enter** key again.

- b. From GAD, can the BHM FastEthernet interface be pinged? \_\_\_\_\_
- c. From BHM, can the GAD FastEthernet interface be pinged? \_\_\_\_\_
- d. If the answer is no for either question, troubleshoot the router configurations to find the error. Then perform the pings again until the answer to both questions is yes.

Upon completion of the previous steps, logoff by typing **exit**. Turn the router off.

## Erasing and reloading the router

Enter into the privileged EXEC mode by typing **enable**.

If prompted for a password, enter **class**. If “class” does not work, ask the instructor for assistance.

```
Router>enable
```

At the privileged EXEC mode, enter the command **erase startup-config**.

```
Router#erase startup-config
```

The responding line 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
```

Now at the privileged EXEC mode, enter the command **reload**.

```
Router#reload
```

The responding line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Proceed with reload? [confirm]
```

Press **Enter** to confirm.

In the first line of the response will be:

```
Reload requested by console.
```

After the router has reloaded the line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

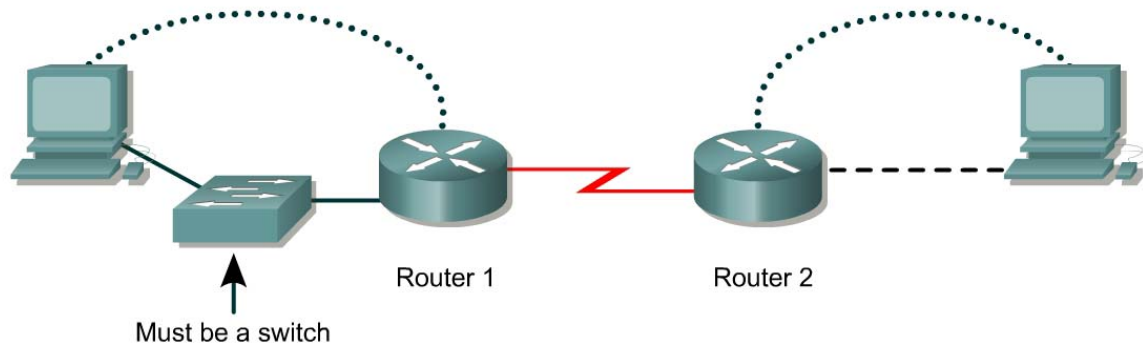
```
Press RETURN to get started!
```

Press **Enter**.

The router is ready for the assigned lab to be performed.

Router Interface Summary					
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2	Interface #5
800 (806)	Ethernet 0 (E0)	Ethernet 1 (E1)			
1600	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
1700	FastEthernet 0 (FA0)	FastEthernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)	
2500	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
2600	FastEthernet 0/0 (FA0/0)	FastEthernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)	
In order to find out exactly how the router is configured, look at the interfaces. This will identify the type of router as well as how many interfaces the router has. There is no way to effectively list all of the combinations of configurations for each router class. What is provided are the identifiers for the possible combinations of interfaces in the device. This interface chart does not include any other type of interface even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in IOS command to represent the interface.					

## Lab 4.1.4 Creating a Network Map using CDP



Router Designation	Router Name	Interface type	Serial 0 Clock	Serial 0 Address	Ethernet 0 Address	Subnet mask (all interfaces)
Router 1	GAD	DCE	56000	192.168.15.1	192.168.14.1	255.255.255.0
Router 2	BHM	DTE	Not set	192.168.15.2	192.168.16.1	255.255.255.0

Straight-through cable	—————
Serial cable	————— —————
Console (Rollover)	.....
Crossover cable	- - - - -

## Objective

- Use Cisco Discovery Protocol (CDP) commands to get information about neighboring network devices.

## Background/Preparation

CDP discovers and shows information about directly connected Cisco devices, including routers and switches.

Cable a network similar to the one in the diagram. Any router that meets the interface requirements may be used. Possible routers include 800, 1600, 1700, 2500, 2600 routers, or a combination. Refer to the chart at the end of the lab to correctly identify the interface identifiers to be used based on the equipment in the lab. The configuration output used in this lab is produced from 1721 series routers. Any other router used may produce slightly different output. The following steps are intended to be executed on each router unless specifically instructed otherwise.

Start a HyperTerminal session as performed in the Establishing a HyperTerminal session lab.

**Note:** Go to the erase and reload instructions at the end of this lab. Perform those steps on all routers in this lab assignment before continuing.

### Step 1 Log on to Router 1 (GAD)

- a. Why is it necessary to log on to Router 1 in order to see all of the devices (routers and switches) in the network shown above?
- 

### Step 2 Configure the routers

- a. Configure the routers according to the information in the table above in order for CDP to be able to collect information about them. Refer to prior labs on configuring serial and Ethernet interfaces and making changes to configurations if you need help.
  - b. What is the clock rate to be set to and which interface is it set on?
- 

- c. Why is it necessary to use the **no shutdown** command on all interfaces?
- 

### Step 3 Gather information about the router interfaces

- a. Enter **show interface** command at either the user EXEC or the privileged EXEC router prompt.
  - b. How many interfaces are present? \_\_\_\_\_
  - c. What type are they? \_\_\_\_\_
- 

### Step 4 Display the CDP updates received on the local router

- a. Enter **show cdp neighbors** command at the router prompt.
- b. Fill in the following table:

Device and Port ID	Local Interface	Hold Time	Capability	Platform

Upon completion of the previous steps, logoff by typing **exit**. Turn the router off.

## Erasing and reloading the router

Enter into the privileged EXEC mode by typing **enable**.

If prompted for a password, enter **class**. If “class” does not work, ask the instructor for assistance.

```
Router>enable
```

At the privileged EXEC mode, enter the command **erase startup-config**.

```
Router#erase startup-config
```

The responding line 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
```

Now at the privileged EXEC mode, enter the command **reload**.

```
Router(config)#reload
```

The responding line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Proceed with reload? [confirm]
```

Press **Enter** to confirm.

In the first line of the response will be:

```
Reload requested by console.
```

After the router has reloaded the line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

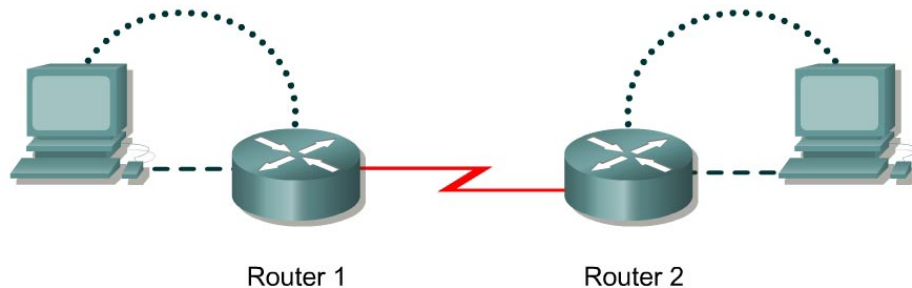
```
Press RETURN to get started!
```

Press **Enter**.

The router is ready for the assigned lab to be performed.

Router Interface Summary					
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2	Interface #5
800 (806)	Ethernet 0 (E0)	Ethernet 1 (E1)			
1600	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
1700	FastEthernet 0 (FA0)	FastEthernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)	
2500	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
2600	FastEthernet 0/0 (FA0/0)	FastEthernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)	
In order to find out exactly how the router is configured, look at the interfaces. This will identify the type of router as well as how many interfaces the router has. There is no way to effectively list all of the combinations of configurations for each router class. What is provided are the identifiers for the possible combinations of interfaces in the device. This interface chart does not include any other type of interface even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in IOS command to represent the interface.					

## Lab 4.1.6 Using CDP Commands



Router Designation	Router Name	Interface type	Serial 0 Clock	Serial 0 Address	Ethernet 0 Address	Subnet mask (all interfaces)
Router 1	GAD	DCE	56000	192.168.15.1	192.168.14.1	255.255.255.0
Router 2	BHM	DTE	Not set	192.168.15.2	192.168.16.1	255.255.255.0

Straight-through cable	—————
Serial cable	————— <del>      </del>
Console (Rollover)	.....
Crossover cable	- - - - -

### Objective

- Use CDP commands to obtain information about neighboring networks and devices.
- Display information on how CDP is configured for its advertisement and discovery frame transmission.
- Display CDP updates received on the local router.

### Background/Preparation

CDP discovers and shows information about directly connected Cisco devices, including routers and switches. CDP is a Cisco proprietary protocol that runs at the data link layer of the OSI model. The data link layer is Layer 2 of the OSI model. This allows devices that may be running different network Layer 3 protocols, such as IP or IPX, to learn about each other. CDP begins automatically upon a device system startup. CDP may be enabled globally using the `cdp run` command. It may be enabled on any interface as required using the `cdp enable` command. CDP is enabled on all interfaces by default. Using the command `show cdp interface` gathers the information that CDP uses for its advertisement and discovery frame transmission. Use `show cdp neighbors` and `show cdp neighbors detail` to display the CDP updates received on the local router.

Cable a network similar to the one in the diagram. Any router that meets the interface requirements may be used. Possible routers include 800, 1600, 1700, 2500, 2600 routers, or a combination. Refer to the chart at the end of the lab to correctly identify the interface identifiers to be used based on the equipment in the lab. The configuration output used in this lab is produced from 1721 series routers.



Any other router used may produce slightly different output. The following steps are intended to be executed on each router unless specifically instructed otherwise.

Start a HyperTerminal session as performed in the Establishing a HyperTerminal session lab.

**Note:** Go to the erase and reload instructions at the end of this lab. Perform those steps on all routers in this lab assignment before continuing.

### Step 1 Log on to Router 1 (GAD)

### Step 2 Configure the routers

- Configure the routers according to the information in the table above in order for CDP to be able to collect information about them. Refer to prior labs on configuring serial and Ethernet interfaces and making changes to configurations if you need help.

**Note:** Do not use the `no shutdown` command on either of the router interfaces at this time.

- What is the clock rate to be set to and which interface is it set on?
- 

### Step 3 Gather information about the router interfaces

- Enter `show interface` command at either the user EXEC or the privileged EXEC router prompt.

Document the following information about the router:

- What is the name of the router? \_\_\_\_\_
- List operational status of each interface.

Interface	Interface Up or Down? (Carrier Detect Signal)	Line Protocol Up/Down? (Keep Alives Being received)

### Step 4 Enable the interfaces on Router 1 (GAD)

```
Router(config)#interface serial 0
Router(config-if)#no shutdown
Router(config-if)#exit
Router(config)#interface FastEthernet 0
Router(config-if)#no shutdown
Router(config-if)#exit
Router(config)#exit
```

### Step 5 Gather information about the router interfaces

- Enter `show interface` command at either the user EXEC or the privileged EXEC router prompt.
- Document the following information about the router:
- What is the name of the router? \_\_\_\_\_

- d. List operational status of each interface:

Interface	Interface Up or Down? (Carrier Detect Signal)	Line Protocol Up/Down? (Keep Alives Being received)

### Step 6 Display the values of the CDP timers, the interface status, and encapsulation used

- Enter `show cdp interface` command at the router prompt.
- How often is the router sending CDP packets? \_\_\_\_\_
- What is the holdtime value? \_\_\_\_\_
- Global CDP settings can be seen using the `show cdp` command by itself.
- What information is not shown in the `show cdp` command?  
\_\_\_\_\_

### Step 7 Display the CDP updates received on the local router

- Enter `show cdp neighbors` command at the router prompt.
- Fill in the following table:

Device and Port ID	Local Interface	Hold Time	Capability	Platform

### Step 8 Enable serial 0 interface on Router 2 (BHM)

- Enter the `no shutdown` command on the serial 0 interface of Router 2. Return to Router 1 and enter the `show cdp neighbors` command at the router prompt. Notice how the router now appears in the `cdp neighbor` command display.

### Step 9 Display details about CDP updates received on the local router

- Enter `show cdp neighbors detail` from the router prompt.
- Fill in the following table:

Information Gathered	Device 1	Device 2
Neighbor device name		
Neighbor device type		
IP address of interface attached to your router		
Port ID of your router that the neighbor is on		
Port ID of neighbor router that your router is on		
IOS version of neighbor router		

### Step 10 Observe CDP packets being sent and received on the router

- a. Enter the `debug cdp packets` command from the privileged EXEC mode.
  - b. What is the output? (Wait for at least two minutes)
- 
- c. After observing the output enter the `undebug all` command to stop debugging activity.

### Step 11 Observe CDP packet traffic

- a. Enter the following commands at the privileged EXEC mode prompt and record the results.
  - b. `show cdp traffic`
- 
- c. `clear cdp counters`
- 
- d. `show cdp traffic`
-

## Erasing and reloading the router

Enter into the privileged EXEC mode by typing **enable**.

If prompted for a password, enter **class**. If “class” does not work, ask the instructor for assistance.

```
Router>enable
```

At the privileged EXEC mode, enter the command **erase startup-config**.

```
Router#erase startup-config
```

The responding line 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
```

Now at the privileged EXEC mode, enter the command **reload**.

```
Router(config)#reload
```

The responding line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Proceed with reload? [confirm]
```

Press **Enter** to confirm.

In the first line of the response will be:

```
Reload requested by console.
```

After the router has reloaded the line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

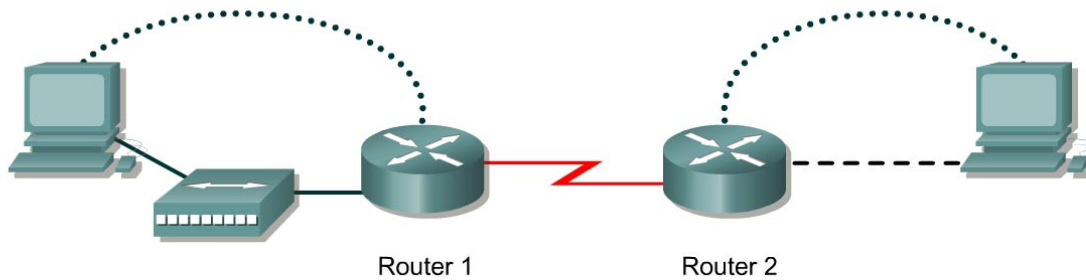
```
Press RETURN to get started!
```

Press **Enter**.

The router is ready for the assigned lab to be performed.

Router Interface Summary					
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2	Interface #5
800 (806)	Ethernet 0 (E0)	Ethernet 1 (E1)			
1600	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
1700	FastEthernet 0 (FA0)	FastEthernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)	
2500	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
2600	FastEthernet 0/0 (FA0/0)	FastEthernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)	
In order to find out exactly how the router is configured, look at the interfaces. This will identify the type of router as well as how many interfaces the router has. There is no way to effectively list all of the combinations of configurations for each router class. What is provided are the identifiers for the possible combinations of interfaces in the device. This interface chart does not include any other type of interface even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in IOS command to represent the interface.					

## Lab 4.2.2 Establishing and Verifying a Telnet Connection



Router ID	Router Name	Ethernet 0 Address	Interface type	Serial 0 Address	Subnet mask	Routing protocol	Enable secret password	Enable, VTY and console password
Router 1	GAD	192.168.14.1	DCE	192.168.15.1	255.255.255.0	RIP	class	cisco
Router 2	BHM	192.168.16.1	DTE	192.168.15.2	255.255.255.0	RIP	class	cisco

Straight-through cable	—————
Serial cable	————— —————
Console (Rollover)	.....
Crossover cable	- - - - -

### Objective

- Establish a Telnet connection to a remote router.
- Verify that the application layer between source and destination is working properly.
- Retrieve information about remote routers using `show` commands.
- Retrieve CDP information from routers not directly connected.

### Background/Preparation

This lab focuses on the Telnet (remote terminal) utility to access routers remotely. Telnet is used to connect from a local router to another remote router in order to simulate being at the console on the remote router. The local router acts as a Telnet client and the remote router acts as a Telnet server. Telnet is a good testing or troubleshooting tool since it is an application layer utility. A successful Telnet demonstrates that the entire TCP/IP protocol stack on both the client and server are functioning properly. Telnet from the workstation as a client into any router with IP connectivity on the network. In addition, Telnet into an Ethernet switch if an IP address has been assigned.

Cable a network similar to the one in the diagram. Any router that meets the interface requirements may be used. Possible routers include 800, 1600, 1700, 2500, 2600 routers, or a combination. Refer to the chart at the end of the lab to correctly identify the interface identifiers to be used based on the equipment in the lab. The configuration output used in this lab is produced from 1721 series routers.

Any other router used may produce slightly different output. The following steps are intended to be executed on each router unless specifically instructed otherwise.

Start a HyperTerminal session as performed in the Establishing a HyperTerminal session lab.

**Note:** Go to the erase and reload instructions at the end of this lab. Perform those steps on all routers in this lab assignment before continuing.

### Step 1 Configure the routers

- If there are any difficulties configuring hostname or passwords, refer to the Configuring Router Passwords lab. If there are any difficulties configuring interfaces or the routing protocol, refer to the Configuring Host Tables lab.
- Verify the configurations of the routers by performing a `show running-config` on each router. If not correct, fix any configuration errors, and verify.

### Step 2 Login to Router 1 and verify the connection to Router 2

- Login to the GAD router in user mode.
- Verify the connection between the two routers. Ping the serial 0 interface of the BHM router. If the ping is not successful, return to Step 1 and troubleshoot the configuration.

### Step 3 Use help with the `telnet` command

- Enter `telnet ?` at either the user EXEC or the privileged EXEC router prompt.
  - What did the router reply with?
- 

### Step 4 Telnet to a remote router

- Enter `telnet router-name` if IP host tables were configured. Otherwise, enter `telnet ip address` at the router prompt to connect to a remote router.
- What prompt did the router display? \_\_\_\_\_

### Step 5 Look at the interfaces on the remote router

- Enter `show interface` at the router prompt.
- List the interfaces, their IP address and subnet masks:

Interface	IP Address	Subnet mask

### Step 6 Display the protocols on the remote router

- Enter `show ip protocols` at the router prompt.
- Fill in the following table with the information that was generated by the remote access router.

Interface	Are the updates being sent?	When is the next update due?

### Step 7 Enter privileged EXEC mode

- a. Enter **enable** at the command prompt. Enter the password **class**.
  - b. What prompt did the router display? What mode is this?
- 

### Step 8 Look at the running configuration

- a. Enter **show running-config** at the remote router prompt.
  - b. What file is being viewed on the remote router? Where is this file stored?
- 

### Step 9 Look at the saved configuration

- a. Enter **show startup-config** at the router prompt.
  - b. What file is being viewed on the remote router? Where is this file stored?
- 

- c. What information is seen concerning the line VTY connections?
- 

### Step 10 Look at the neighbor configuration

- a. Enter **show cdp neighbors** command at the router prompt.
  - b. List all device IDs that are connected to the remote router with a Telnet session.
- 

Upon completion of the previous steps, logoff by typing **exit**. Turn the router off.



## Erasing and reloading the router

Enter into the privileged EXEC mode by typing **enable**.

If prompted for a password, enter **class**. If “class” does not work, ask the instructor for assistance.

```
Router>enable
```

At the privileged EXEC mode, enter the command **erase startup-config**.

```
Router#erase startup-config
```

The responding line 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
```

Now at the privileged EXEC mode, enter the command **reload**.

```
Router(config)#reload
```

The responding line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Proceed with reload? [confirm]
```

Press **Enter** to confirm.

In the first line of the response will be:

```
Reload requested by console.
```

After the router has reloaded the line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

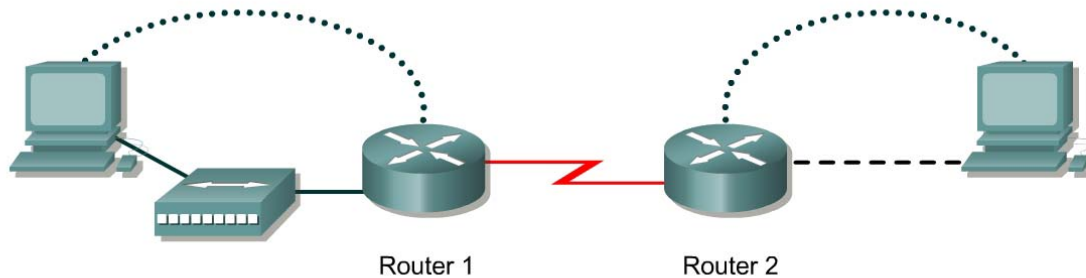
```
Press RETURN to get started!
```

Press **Enter**.

The router is ready for the assigned lab to be performed.

Router Interface Summary					
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2	Interface #5
800 (806)	Ethernet 0 (E0)	Ethernet 1 (E1)			
1600	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
1700	FastEthernet 0 (FA0)	FastEthernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)	
2500	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
2600	FastEthernet 0/0 (FA0/0)	FastEthernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)	
In order to find out exactly how the router is configured, look at the interfaces. This will identify the type of router as well as how many interfaces the router has. There is no way to effectively list all of the combinations of configurations for each router class. What is provided are the identifiers for the possible combinations of interfaces in the device. This interface chart does not include any other type of interface even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in IOS command to represent the interface.					

## Lab 4.2.3 Suspending and Disconnecting Telnet Sessions



Router ID	Router Name	Fast Ethernet 0 Address	Interface type	Serial 0 Address	Subnet mask	Routing protocol	Enable secret password	Enable, VTY and console password
Router 1	GAD	192.168.14.1	DCE	192.168.15.1	255.255.255.0	RIP	class	cisco
Router 2	BHM	192.168.16.1	DTE	192.168.15.2	255.255.255.0	RIP	class	cisco

Straight-through cable	—————
Serial cable	————— Z —————
Console (Rollover)	.....
Crossover cable	- - - - -

### Objective

- Establish a Telnet session with a remote router.
- Suspend and reestablish a Telnet session.
- Display active Telnet sessions.
- Disconnect a Telnet session.

### Background/Preparation

This lab focuses on the ability to Telnet to a router, suspend that session, return to the local router console, and then reestablish the previous connection.

Cable a network similar to the one in the diagram. Any router that meets the interface requirements may be used. Possible routers include 800, 1600, 1700, 2500, 2600 routers, or a combination. Refer to the chart at the end of the lab to correctly identify the interface identifiers to be used based on the equipment in the lab. The configuration output used in this lab is produced from 1721 series routers. Any other router used may produce slightly different output. The following steps are intended to be executed on each router unless specifically instructed otherwise.

Start a HyperTerminal session as performed in the Establishing a HyperTerminal session lab.

**Note:** Go to the erase and reload instructions at the end of this lab. Perform those steps on all routers in this lab assignment before continuing.

### Step 1 Configure the routers

- a. If there are any difficulties configuring hostname or passwords, refer to the Configuring Router Passwords lab. If there are any difficulties configuring interfaces or the routing protocol, refer to the Configuring Host Tables lab.

### Step 2 Login to Router 1 and verify the connection to Router 2

- a. Login to the GAD router.
- b. Verify the connection between the two routers. Ping the serial 0 interface of the BHM router. If the ping is not successful, return to Step 1 and troubleshoot the configuration.

### Step 3 Telnet to a remote router

- a. Enter `telnet BHM` if IP host tables were configured. Otherwise, enter the *IP address* at the router prompt to connect to a remote router.  
Enter the password **cisco** to enter the router.
- b. What prompt did the router display? \_\_\_\_\_

### Step 4 Look at the interfaces on the remote router

- a. Enter `show interface` at the router prompt.
- b. Are both the serial 0 and the FastEthernet 0 interfaces up? \_\_\_\_\_

### Step 5 Suspend the current Telnet session

- a. Enter **Ctrl+Shift+6** followed by the **x** key.  
This only suspends the session and returns to the previous router. It does not disconnect from this router.
- b. What prompt did the router display? \_\_\_\_\_

### Step 6 Resume a Telnet session

- a. Press the **Enter** key at the router prompt. The router will respond with:  
[Resuming connection 1 to 192.168.15.2 ... ]
- b. Press the **Enter** key.  
This will resume the Telnet session that was previously suspended in Step 4.
- c. What prompt did the router display? \_\_\_\_\_

### Step 7 Close a Telnet session

- a. Enter the command `exit` while in a Telnet session.  
This will terminate the Telnet session.
- b. What prompt did the router display? \_\_\_\_\_  
**Note:** To disconnect from a suspended Telnet session, type **disconnect** and press **Enter**.

Upon completion of the previous steps, logoff by typing **exit**. Turn the router off.

## Erasing and reloading the router

Enter into the privileged EXEC mode by typing **enable**.

If prompted for a password, enter **class**. If “class” does not work, ask the instructor for assistance.

```
Router>enable
```

At the privileged EXEC mode, enter the command **erase startup-config**.

```
Router#erase startup-config
```

The responding line 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
```

Now at the privileged EXEC mode, enter the command **reload**.

```
Router(config)#reload
```

The responding line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Proceed with reload? [confirm]
```

Press **Enter** to confirm.

In the first line of the response will be:

```
Reload requested by console.
```

After the router has reloaded the line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

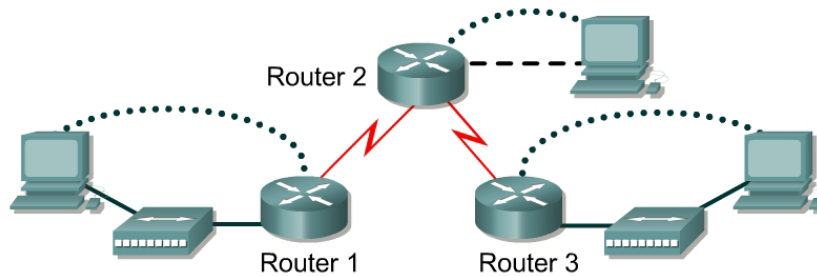
```
Press RETURN to get started!
```

Press **Enter**.

The router is ready for the assigned lab to be performed.


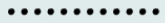


Router Interface Summary					
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2	Interface #5
800 (806)	Ethernet 0 (E0)	Ethernet 1 (E1)			
1600	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
1700	FastEthernet 0 (FA0)	FastEthernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)	
2500	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
2600	FastEthernet 0/0 (FA0/0)	FastEthernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)	
In order to find out exactly how the router is configured, look at the interfaces. This will identify the type of router as well as how many interfaces the router has. There is no way to effectively list all of the combinations of configurations for each router class. What is provided are the identifiers for the possible combinations of interfaces in the device. This interface chart does not include any other type of interface even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in IOS command to represent the interface.					

## Lab 4.2.4 Advanced Telnet Operations



Router designation	Router Name	Enable secret password	Enable/VTY/ and Console passwords	Routing protocol	RIP network statements		
Router 1	GAD	class	cisco	RIP	192.168.14.0	192.168.15.0	
Router 2	BHM	class	cisco	RIP	192.168.15.0	192.168.13.0	192.168.16.0
Router 3	PHX	class	cisco	RIP	192.168.13.0	192.168.17.0	

Router designation	IP host name	Fast Ethernet 0 address	Interface type Serial 0	Serial 0 address	Interface type Serial 1	Serial 1 address	Subnet mask all addresses
Router 1	GAD	192.168.14.1	DCE	192.168.15.1	NA	No address	255.255.255.0
Router 2	BHM	192.168.16.1	DTE	192.168.15.2	DCE	192.168.13.1	255.255.255.0
Router 3	PHX	192.168.17.1	NA	No address	DTE	192.168.13.2	255.255.255.0

Straight-through cable		Console (Rollover)	
Serial cable		Crossover cable	

### Objective

- Use the `telnet` command to remotely access other routers.
- Verify that the application layer between the source and the destination is working properly.
- Suspend a Telnet session.
- Engage in multiple Telnet sessions.
- Return to the suspended session.
- Disconnect from the Telnet session.

### Background/Preparation

It is often desirable to have Telnet sessions to multiple routers simultaneously in order to check and compare configuration information. This lab focuses on the ability to Telnet to multiple routers, suspend those sessions, and switch between the active sessions. A list of active connections can also be displayed in the process.

Cable a network similar to the one in the diagram. Any router that meets the interface requirements may be used. Possible routers include 800, 1600, 1700, 2500, 2600 routers, or a combination. Refer to the chart at the end of the lab to correctly identify the interface identifiers to be used based on the

equipment in the lab. The configuration output used in this lab is produced from 1721 series routers. Any other router used may produce slightly different output. The following steps are intended to be executed on each router unless specifically instructed otherwise.

Start a HyperTerminal session as performed in the Establishing a HyperTerminal session lab.

**Note:** Go to the erase and reload instructions at the end of this lab. Perform those steps on all routers in this lab assignment before continuing.

### Step 1 Configure the GAD, BHM and PHX routers using the tables

- Configure the three routers as indicated in the Copying, Editing, and Pasting Configurations lab.
- If there are any difficulties configuring hostname or passwords, refer to the Configuring Router Passwords lab.  
  
If there are any difficulties configuring interfaces or the routing protocol, refer to the Configuring Host Tables lab.
- Verify the routers configurations by performing a **show running-config** on each router. If not correct, fix any configuration errors and verify.

### Step 2 Login to Router 1 and verify the connection to Routers 2 and 3

- Login to the GAD router.
- Verify the connection between the two routers. Ping the serial 0 interface of the BHM router. If the ping is not successful, return to Step 1 and troubleshoot the configuration.

### Step 3 Telnet to a remote router

- Enter **telnet BHM** if IP host tables were configured. Otherwise, enter *ip address* at the router prompt to connect to the BHM router.  
  
Enter the password **cisco** to enter the router.
- What prompt did the router display? \_\_\_\_\_

### Step 4 Look at the interfaces on the remote router

- Enter **show interface** at the router prompt.
- Are both the serial 0 and the FastEthernet 0 interfaces up? \_\_\_\_\_

### Step 5 Suspend the current Telnet session

- Enter **Ctrl-Shift-6** followed by the **x** key.  
  
This only suspends the session and returns to the previous router. It does not disconnect from this router.
- What prompt did the router display? \_\_\_\_\_

### Step 6 Establish another Telnet session

- Enter **telnet router-name** if IP host tables were configured. Otherwise, enter **telnet ip address** at the router prompt to connect to the PHX router.  
  
Enter the password **cisco** to enter the router.
- What prompt did the router display? \_\_\_\_\_

### Step 7 Suspend the current Telnet session

- Enter **Ctrl-Shift-6** followed by the **x** key.



This only suspends the session and returns to the previous router. It does not disconnect from this router.

b. What prompt did the router display? \_\_\_\_\_

### Step 8 Use the `show session` command to see the connections

a. Enter `show sessions` at the command prompt.

This will reveal that 2 sessions are in use.

### Step 9 Resume the previously suspended Telnet session

a. Type `resume` and the number of the session that is to be resumed followed by the **Enter** key at the router prompt. The router will respond with:

```
[Resuming connection 1 to 192.168.X.X ... ]
```

b. Press the **Enter** key.

This will resume a Telnet session that was previously suspended.

c. What prompt did the router display? \_\_\_\_\_

### Step 10 Use the `show session` command to see the connections

a. Enter `show sessions` at the command prompt.

b. How many sessions are shown? \_\_\_\_\_

c. There were two the last time. What is the difference? \_\_\_\_\_

### Step 11 Close a Telnet session

a. Enter the command `exit` while in a Telnet session.

This will terminate the Telnet session.

b. What prompt did the router display? \_\_\_\_\_

**Note:** Do not do this now. To disconnect from a suspended Telnet session, type `disconnect` and press **Enter**.

### Step 12 Use the `show session` command to see the connections

a. Enter `show sessions` at the command prompt.

b. How many sessions are shown? \_\_\_\_\_

c. There were two on this router the last time. What is the difference?

\_\_\_\_\_

### Step 13 Resume the previously suspended Telnet session

a. Press the **Enter** key. The router will respond with:

```
[Resuming connection 1 to 192.168.X.X ... ]
```

Press the **Enter** key.

This will resume a Telnet session that was previously suspended.

b. What prompt did the router display? \_\_\_\_\_

### Step 14 Close a Telnet session

Enter the command **exit** while in a Telnet session.

This will terminate the Telnet session.

### Step 15 Problems with linked Telnet sessions on multiple routers

- a. When working with Telnet, one of the most common problems is remembering the focus of the session. Focus means the device that is the focus of the commands that are being issued. Many times people Telnet to a router and then Telnet from that router to another and so on. Without host names, or if the routers have similar hostnames, confusion can happen. For example:
- b. Telnet to the PHX router.

From the configuration prompt type **no hostname**.

### Step 16 Telnet to the BHM router

- a. Telnet to the BHM router.

From the configuration prompt type **no hostname**.

### Step 17 Telnet back to the PHX router

- a. Telnet back to the PHX router.
- b. By looking at the prompt, it is not evident whether the Telnet worked or not.

### Step 18 Telnet to the GAD router

- a. Telnet to the GAD router.

From the configuration prompt type **no hostname**.

### Step 19 Telnet to the BHM router

- a. Telnet to the BHM router.
- b. Type **show sessions**.
- c. How many sessions are there running? \_\_\_\_\_
- d. Why are there that many? \_\_\_\_\_
- e. Now type **exit** three times.
- f. What router are you on? \_\_\_\_\_
- g. How many Telnet sessions are still open? \_\_\_\_\_

### Step 20 Exiting from all sessions

- a. Keep typing **exit** until the following prompt appears:  
Router con0 is now available  
Press RETURN to get started.
- b. Scroll back up the HyperTerminal listing.
- c. How many session closed messages were displayed? \_\_\_\_\_
- d. Is that the number listed in the how many Telnet sessions are still open question? \_\_\_\_\_

Upon completion of the previous steps, logoff by typing **exit**. Turn the router off.

## Erasing and reloading the router

Enter into the privileged EXEC mode by typing **enable**.

If prompted for a password, enter **class**. If “class” does not work, ask the instructor for assistance.

```
Router>enable
```

At the privileged EXEC mode, enter the command **erase startup-config**.

```
Router#erase startup-config
```

The responding line 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
```

Now at the privileged EXEC mode, enter the command **reload**.

```
Router(config)#reload
```

The responding line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Proceed with reload? [confirm]
```

Press **Enter** to confirm.

In the first line of the response will be:

```
Reload requested by console.
```

After the router has reloaded the line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

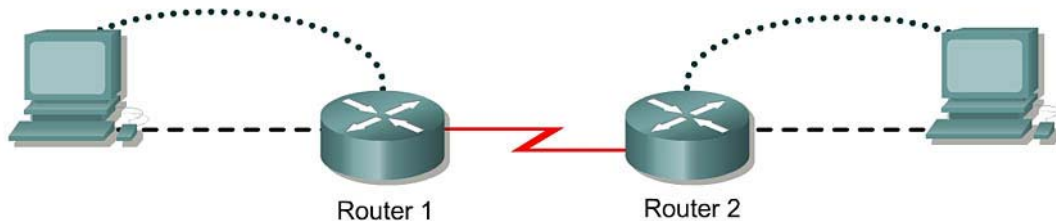
```
Press RETURN to get started!
```

Press **Enter**.

The router is ready for the assigned lab to be performed.

Router Interface Summary					
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2	Interface #5
800 (806)	Ethernet 0 (E0)	Ethernet 1 (E1)			
1600	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
1700	FastEthernet 0 (FA0)	FastEthernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)	
2500	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
2600	FastEthernet 0/0 (FA0/0)	FastEthernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)	
In order to find out exactly how the router is configured, look at the interfaces. This will identify the type of router as well as how many interfaces the router has. There is no way to effectively list all of the combinations of configurations for each router class. What is provided are the identifiers for the possible combinations of interfaces in the device. This interface chart does not include any other type of interface even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in IOS command to represent the interface.					

## Lab 4.2.5a Connectivity Tests – Ping



Router designation	Router Name	Enable secret password	Enable, VTY and console password	Routing protocol	RIP network statements	
Router 1	GAD	class	cisco	RIP	192.168.14.0	192.168.15.0
Router 2	BHM	class	cisco	RIP	192.168.15.0	192.168.16.0

Router designation	IP host name	Fast Ethernet 0 address	Interface type Serial 0	Serial 0 address	Interface type Serial 1	Serial 1 address	Subnet mask all addresses
Router 1	GAD	192.168.14.1	DCE	192.168.15.1	NA	No address	255.255.255.0
Router 2	BHM	192.168.16.1	DTE	192.168.15.2	NA	No address	255.255.255.0

Straight-through cable	
Serial cable	
Console (Rollover)	
Crossover cable	

### Objective

- Use the **ping** command to send ICMP datagrams to target host.
- Verify that the network layer between source and destination is working properly.
- Retrieve information to evaluate the path-to-host reliability.
- Determine delays over the path and whether the host can be reached or is functioning.
- Use the extended **ping** command to increase number of packets.

### Background/Preparation

The **ping** command is a good tool for troubleshooting Layers 1 through 3 of the OSI model and diagnosing basic network connectivity. Using **ping** sends an ICMP packet to the specified device (workstation, server, router or switch) and then waits for a reply. The IP address or host name can be pinged. In order to ping the host name of a router, there must be a static host lookup table in the router or a DNS server for name resolution to IP addresses.

Cable a network similar to the one in the diagram. Any router that meets the interface requirements may be used. Possible routers include 800, 1600, 1700, 2500, 2600 routers, or a combination. Refer to the chart at the end of the lab to correctly identify the interface identifiers to be used based on the equipment in the lab. The configuration output used in this lab is produced from 1721 series routers.

Any other router used may produce slightly different output. The following steps are intended to be executed on each router unless specifically instructed otherwise.

Start a HyperTerminal session as performed in the Establishing a HyperTerminal session lab.

**Note:** Go to the erase and reload instructions at the end of this lab. Perform those steps on all routers in this lab assignment before continuing.

### Step 1 Configure the GAD and BHM routers

- If there are any difficulties configuring hostname or passwords, refer to the Configuring Router Passwords lab. If there are any difficulties configuring interfaces or the routing protocol, refer to the Configuring Host Tables lab.
- This lab requires that IP hostnames are configured.
- Verify the routers configurations by performing a **show running-config** on each router. If not correct, fix any configuration errors and verify.

### Step 2 Login to Router 1 and verify the connection to Router 2

- Login to the GAD router.
- Verify the connection between the two routers. Ping the Serial 0 interface of the BHM router. If the ping is not successful, return to Step 1 and troubleshoot the configuration.

### Step 3 Display information about host to Layer 3 address mappings

- Enter **show host** at the router prompt.

The router will display information about host to Layer 3 (IP) address mappings, how this information was acquired, and the age of the entry.

- List host names and the IP addresses listed for each one.

Host name	IP Address

### Step 4 Use the ping command

- Enter **ping xxx.xxx.xxx.xxx** where xxx.xxx.xxx.xxx is the previous listed IP address.
- Repeat with all IP addresses listed.
- The router sends an Internet Control Message Protocol (ICMP) packet to verify the hardware connection and network layer address. The PC is acting as the console to the router, pinging from one router to another router.
- Did the IP addresses ping? \_\_\_\_\_
- List four important pieces of information received back from issuing the **ping** command.

---

---

---

---

### Step 5 Examine the results of the `ping` command

- a. Look at the example of the `ping` command generated by a router.

```
lab-b#ping 192.168.3.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echoes to 210.93.105.1, timeout is 2 seconds:
.!!!!
Success rate is 80 percent (4/5), round-trip min/avg/max = 68/68/168 ms
```

What does the exclamation point (!) indicate? \_\_\_\_\_

b. What does the period (.) indicate? \_\_\_\_\_

c. What does the `ping` command test for? \_\_\_\_\_

### Step 6 Configure the workstations

- a. The configuration for the host connected to the GAD Router is:

IP Address	192.168.14.2
IP subnet mask	255.255.255.0
Default gateway	192.168.14.1

- b. The configuration for the host connected to the BHM Router is:

IP Address	192.168.16.2
IP subnet mask	255.255.255.0
Default gateway	192.168.16.1

### Step 7 Ping from the workstation

- a. From Windows go to **Start > Programs > Accessories > Command Prompt**. This will open a Command Prompt window.
- b. To test that the TCP/IP stack and default gateway on the workstation are configured and working properly, use the MS DOS window to ping the routers by issuing the following command:

```
C:\> ping 192.168.14.1
```

The ping should respond with successful results. If not, check the configurations on the host and directly connected router.

### Step 8 Test Layer 3 connectivity

- a. Using the command prompt enter `ping` and the IP address of all routers interfaces.

This will test Layer 3 connectivity between the workstation and the routers.

- b. Is the output from the workstation `ping` command the same as the output from the `ping` command from a router?

---

### Step 9 From the Host, telnet to the directly connected router

- a. Telnet to the connected router. Type `telnet` and the default gateway IP address of the router.

```
C:\>telnet 192.168.14.1
```

- b. The password prompt will appear, enter `cisco`.

### Step 10 Perform an extended ping

- a. Enter into the privileged EXEC mode. Type `enable` and then the password `class`.

Type **ping** and press **Enter**. Fill out the rest of the prompts as shown following:

```
Protocol [ip]:
Target IP address: 192.168.16.1
Repeat count [5]: 50
Datagram size [100]:
Timeout in seconds [2]:
Extended commands [n]:
Sweep range of sizes [n]:
Type escape sequence to abort.
Sending 50, 100-byte ICMP Echos to 192.168.16.1, timeout is 2 seconds:
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
Success rate is 100 percent (50/50), round-trip min/avg/max = 32/32/40
ms
GAD#
```

- b. Notice how fast the ping response is. What was the average response time? \_\_\_\_\_

### Step 11 Perform another extended ping

- a. Type **ping** and press **Enter**. Fill out the rest of the prompts as shown following.

During the ping, remove the crossover cable from the BHM FastEthernet port after 10 pings have responded.

```
Protocol [ip]:
Target IP address: 192.168.16.1
Repeat count [5]: 50
Datagram size [100]: 1500
Timeout in seconds [2]:
Extended commands [n]:
Sweep range of sizes [n]:
Type escape sequence to abort.
Sending 50, 1500-byte ICMP Echos to 192.168.16.1, timeout is 2 seconds:
!!!!!!!!!!!!!!U.U.....!!!!!!!!!!!!!!!!!!!!!!!!!!!!
Success rate is 72 percent (36/50), round-trip min/avg/max =
432/434/464 ms
GAD#
```

- b. What does the output from this extended ping say? \_\_\_\_\_
- c. Try doing this with a standard ping, can the cable be removed before the ping is over?  
\_\_\_\_\_
- d. What was the result of increasing the datagram size in the extended ping? \_\_\_\_\_

### Step 12 Perform an extended ping from the host

- a. Exit the Telnet session and return to the host MS-DOS prompt. Type **ping** and press **Enter**.
- b. Does the extended ping work the same way on the router as on the host? \_\_\_\_\_

At the MS-dos prompt type:

```
C:\>ping 192.168.16.1 -n 25
```

There should be 25 responses from the command.

- c. Experiment with other combinations of the extended ping commands on both the router and the host.

Upon completion of the previous steps, logoff by typing **exit**. Turn the router off.



## Erasing and reloading the router

Enter into the privileged EXEC mode by typing **enable**.

If prompted for a password, enter **class**. If “class” does not work, ask the instructor for assistance.

```
Router>enable
```

At the privileged EXEC mode, enter the command **erase startup-config**.

```
Router#erase startup-config
```

The responding line 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
```

Now at the privileged EXEC mode, enter the command **reload**.

```
Router(config)#reload
```

The responding line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Proceed with reload? [confirm]
```

Press **Enter** to confirm.

In the first line of the response will be:

```
Reload requested by console.
```

After the router has reloaded the line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

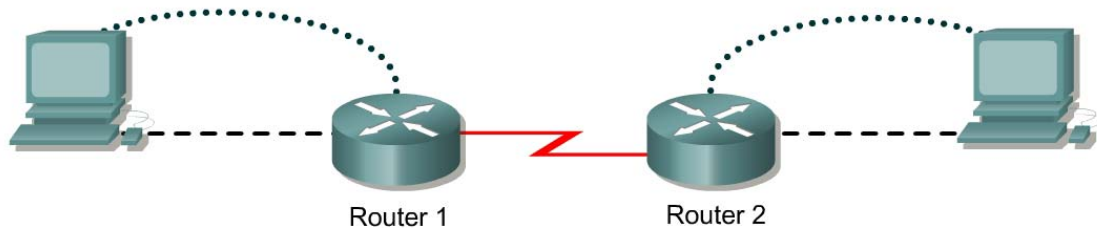
```
Press RETURN to get started!
```

Press **Enter**.

The router is ready for the assigned lab to be performed.

Router Interface Summary					
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2	Interface #5
800 (806)	Ethernet 0 (E0)	Ethernet 1 (E1)			
1600	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
1700	FastEthernet 0 (FA0)	FastEthernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)	
2500	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
2600	FastEthernet 0/0 (FA0/0)	FastEthernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)	
In order to find out exactly how the router is configured, look at the interfaces. This will identify the type of router as well as how many interfaces the router has. There is no way to effectively list all of the combinations of configurations for each router class. What is provided are the identifiers for the possible combinations of interfaces in the device. This interface chart does not include any other type of interface even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in IOS command to represent the interface.					

## Lab 4.2.5b Connectivity Tests – Traceroute



Router designation	Router Name	Enable secret password	Enable, VTY and console password	Routing protocol	RIP network statements	
Router 1	GAD	class	Cisco	RIP	192.168.14.0	192.168.15.0
Router 2	BHM	class	Cisco	RIP	192.168.15.0	192.168.16.0

Router designation	IP host name	Fast Ethernet 0 address	Interface type Serial 0	Serial 0 address	Interface type Serial 1	Serial 1 address	Subnet mask all addresses
Router 1	GAD	192.168.14.1	DCE	192.168.15.1	NA	No address	255.255.255.0
Router 2	BHM	192.168.16.1	DTE	192.168.15.2	NA	No address	255.255.255.0

Straight-through cable	—————
Serial cable	————— ⚡
Console (Rollover)	.....
Crossover cable	- - - - -

### Objective

- Use the **traceroute** Cisco IOS command from source router to destination router.
- Use the **tracert** MS-DOS command from source workstation to destination router. Verify that the network layer between source, destination, and each router along the way is working properly.
- Retrieve information to evaluate the end-to-end path reliability.
- Determine delays at each point over the path and whether the host can be reached.

### Background/Preparation

The **traceroute** command, abbreviated as **trace**, is an excellent utility for troubleshooting the path that a packet takes through an internetwork of routers. It can help to isolate problem links and routers along the way. The **traceroute** command uses ICMP packets and the error message generated by routers when the packet exceeds its Time-To-Live (TTL). The Windows version of this command is **tracert**.

Cable a network similar to the one in the diagram. Any router that meets the interface requirements may be used. Possible routers include 800, 1600, 1700, 2500, 2600 routers, or a combination. Refer to the chart at the end of the lab to correctly identify the interface identifiers to be used based on the

equipment in the lab. The configuration output used in this lab is produced from 1721 series routers. Any other router used may produce slightly different output. The following steps are intended to be executed on each router unless specifically instructed otherwise.

Start a HyperTerminal session as performed in the Establishing a HyperTerminal session lab.

**Note:** Go to the erase and reload instructions at the end of this lab. Perform those steps on all routers in this lab assignment before continuing.

### Step 1 Configure the routers

- a. If there are any difficulties configuring hostname or passwords, refer to the Configuring Router Passwords lab. If there are any difficulties configuring interfaces or the routing protocol, refer to the Configuring Host Tables lab.
- b. This lab requires that IP hostnames are configured.
- c. Verify the routers configurations by performing a **show running-config** on each router. If not correct, fix any configuration errors and verify.

### Step 2 Configure the workstations

- a. The configuration for the host connected to the GAD Router is:

IP Address	192.168.14.2
IP subnet mask	255.255.255.0
Default gateway	192.168.14.1

- b. The configuration for the host connected to the BHM Router is:

IP Address	192.168.16.2
IP subnet mask	255.255.255.0
Default gateway	192.168.16.1

### Step 3 Ping from the workstation

- a. From a Windows host, click on **Start > Programs > Accessories > Command Prompt**. This will open a Command Prompt window.
- b. To test that the TCP/IP stack and default gateway on the workstation are configured and working properly, use the MS-DOS window to ping the routers by issuing the following command:  

```
C:\>ping 192.168.14.1
```
- c. The **ping** should respond with successful results. If not, check the configurations on the host and directly connected router.

### Step 4 Test Layer 3 connectivity

- a. Using the command prompt enter **ping** and the IP address of all routers interfaces.  
This will test Layer 3 connectivity between the workstation and the routers.
- b. Is the output from the workstation **ping** command the same as the output from the **ping** command from a router?

---

### Step 5 Login to the router in user mode

- a. Login to the GAD user EXEC prompt.

### Step 6 Discover the trace options

- a. Type **traceroute** at the router prompt and press Enter.
- b. What did the router respond with? \_\_\_\_\_

### Step 7 Use the help function with trace

- Enter **trace ?** at the router prompt.
- What did the router respond with? \_\_\_\_\_

### Step 8 Continue discovering of the trace options

- Enter into the privileged EXEC mode and type **traceroute ?**.
- What did the router respond with? \_\_\_\_\_
- Was there anything different between the two trace outputs? \_\_\_\_\_
- There should have been an added option of <cr>. This allows an extended traceroute at the privileged EXEC mode. This is unavailable at the user EXEC mode.

### Step 9 Use the traceroute command

- Enter **traceroute ip xxx.xxx.xxx.xxx** where xxx.xxx.xxx.xxx is the IP address of the target destination.

**Note:** Use one of the end routers and trace IP to the other end host. The router will respond with:

```
GAD#traceroute 192.168.16.2
Type escape sequence to abort.
Tracing the route to 192.168.16.2
 1 BHM (192.168.15.2) 16 msec 16 msec 16 msec
 2 192.168.16.2 16 msec 16 msec 12 msec
GAD#
```

- If the output is not successful, check the router and host configurations.

### Step 10 Continue using traceroute

Login to the other routers and repeat the **traceroute** command.

### Step 11 Use the trace command from a workstation

- From the console workstation, click on **Start > Programs > Accessories > Command Prompt**. An MS-DOS Command Prompt window will open.  
Enter **tracert** and the same IP address used in Step 9.
- The first hop is the default gateway or the near side router interface on the LAN that the workstation is connected to. List the host names and IP addresses of the routers that the ICMP packet was routed through as well as any other entries displayed in the table below.

Host Name	IP Address

- There is one more entry in the output of the **tracert** command when the trace is from the computer command prompt to the target host.  
Why?  
\_\_\_\_\_

## Step 12 Trace to Cisco and other common Web sites

- a. From a Window host that has Internet access, click on **Start > Programs > Accessories > Command Prompt**. An MS-DOS Command Prompt window will open.

```
C:\>tracert www.cisco.com
```

```
C:\>tracert www.yahoo.com
```

```
C:\>tracert www.aol.com
```

- b. This procedure will show the IP address and the route of the destination.
- c. What is the IP address of www.cisco.com? \_\_\_\_\_
- d. How many hops did it take to get to www.cisco.com? \_\_\_\_\_

If a packet passes through a router it is considered one hop and the TTL of the packet is decremented by one.

## Step 13 Look at the ip route traces to Cisco, Yahoo, and AOL

- a. Where are the differences in the traces?
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- b. Why are they always the same in the beginning? \_\_\_\_\_

Upon completion of the previous steps, logoff by typing **exit**. Turn the router off.

## Erasing and reloading the router

Enter into the privileged EXEC mode by typing **enable**.

If prompted for a password, enter **class**. If “class” does not work, ask the instructor for assistance.

```
Router>enable
```

At the privileged EXEC mode, enter the command **erase startup-config**.

```
Router#erase startup-config
```

The responding line 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
```

Now at the privileged EXEC mode, enter the command **reload**.

```
Router(config)#reload
```

The responding line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Proceed with reload? [confirm]
```

Press **Enter** to confirm.

In the first line of the response will be:

```
Reload requested by console.
```

After the router has reloaded the line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Press RETURN to get started!
```

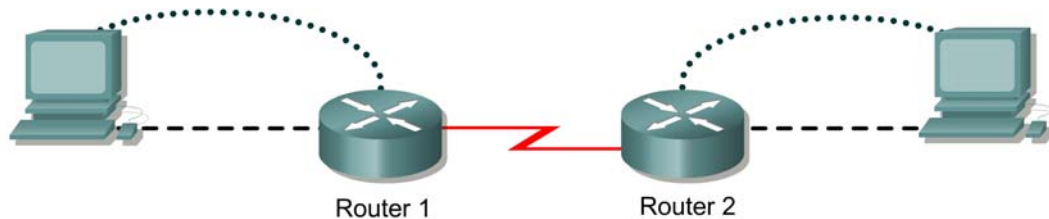
Press **Enter**.

The router is ready for the assigned lab to be performed.

Router Interface Summary					
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2	Interface #5
800 (806)	Ethernet 0 (E0)	Ethernet 1 (E1)			
1600	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
1700	FastEthernet 0 (FA0)	FastEthernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)	
2500	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
2600	FastEthernet 0/0 (FA0/0)	FastEthernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)	
In order to find out exactly how the router is configured, look at the interfaces. This will identify the type of router as well as how many interfaces the router has. There is no way to effectively list all of the combinations of configurations for each router class. What is provided are the identifiers for the possible combinations of interfaces in the device. This interface chart does not include any other type of interface even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in IOS command to represent the interface.					



## Lab 4.2.6 Troubleshooting IP Address Issues



Router designation	Router Name	Enable secret password	Enable, VTY and console password	Routing protocol	RIP network statements	
Router 1	GAD	class	cisco	RIP	192.168.14.0	192.168.15.0
Router 2	BHM	class	cisco	RIP	192.168.15.0	192.168.16.0

Router designation	IP host name	Fast Ethernet 0 address	Interface type Serial 0	Serial 0 address	Interface type Serial 1	Serial 1 address	Subnet mask all addresses
Router 1	GAD	192.168.14.1	DCE	192.168.16.1	NA	No address	255.255.255.0
Router 2	BHM	192.168.16.1	DTE	192.168.15.2	NA	No address	255.255.255.0

Straight-through cable	—————
Serial cable	————— 
Console (Rollover)	.....
Crossover cable	- - - - -

### Objective

- Configure two routers and two workstations in a small WAN.
- Troubleshoot problems introduced by incorrect configurations.

### Background/Preparation

Cable a network similar to the one in the diagram. Any router that meets the interface requirements may be used. Possible routers include 800, 1600, 1700, 2500, 2600 routers, or a combination. Refer to the chart at the end of the lab to correctly identify the interface identifiers to be used based on the equipment in the lab. The configuration output used in this lab is produced from 1721 series routers. Any other router used may produce slightly different output. The following steps are intended to be executed on each router unless specifically instructed otherwise.

Start a HyperTerminal session as performed in the Establishing a HyperTerminal session lab.

**Note:** Work in teams of two. Team member 1 should configure the GAD router according to the table above and its attached workstation according to the instructions below. Team member 2 should configure the BHM router and its workstation. Both configurations have errors and will result in IP related communications problems. Team member 1 will then troubleshoot problems with the BHM router and workstations and Team member 2 will troubleshoot problems with the GAD router and workstations.

**Note:** Go to the erase and reload instructions at the end of this lab. Perform those steps on all routers in this lab assignment before continuing.

### Step 1 Configure the routers

- a. If there are any difficulties configuring hostname or passwords, refer to the Configuring Router Passwords lab. If there are any difficulties configuring interfaces or the routing protocol, refer to the Configuring Host Tables lab. This lab requires that the IP host tables are configured.
- b. Verify the routers configurations by performing a **show running-config** on each router. If not correct, fix any configuration errors and verify.

### Step 2 Configure the workstations

- a. The configuration for the host connected to the GAD Router is:

IP Address	192.168.14.2
IP subnet mask	255.255.255.0
Default gateway	192.168.14.2

- b. The configuration for the host connected to the BHM Router is:

IP Address	192.168.16.2
IP subnet mask	255.255.255.0
Default gateway	192.168.16.1

### Step 3 Ping from the workstation

- a. From a Windows host, click on **Start > Programs > Accessories > Command Prompt**. This will open a Command Prompt window.
- b. Test that the TCP/IP stack and default gateway on the workstation are configured and work properly. Use the MS-DOS window to ping the routers. Issue the following command:

```
C:\>ping 192.168.14.1
```

The **ping** should respond with unsuccessful results. Check configurations on the host and routers.

- c. There are two problems that were introduced into the configurations. Correct the configurations and ping all interfaces on the hosts and routers.

What were the problems?

---

---

Upon completion of the previous steps, logoff by typing **exit**. Turn the router off.

## Erasing and reloading the router

Enter into the privileged EXEC mode by typing **enable**.

If prompted for a password, enter **class**. If “class” does not work, ask the instructor for assistance.

```
Router>enable
```

At the privileged EXEC mode, enter the command **erase startup-config**

```
Router#erase startup-config
```

The responding line 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
```

Now at the privileged EXEC mode, enter the command **reload**.

```
Router(config)#reload
```

The responding line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Proceed with reload? [confirm]
```

Press **Enter** to confirm.

In the first line of the response will be:

```
Reload requested by console.
```

After the router has reloaded the line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Press RETURN to get started!
```

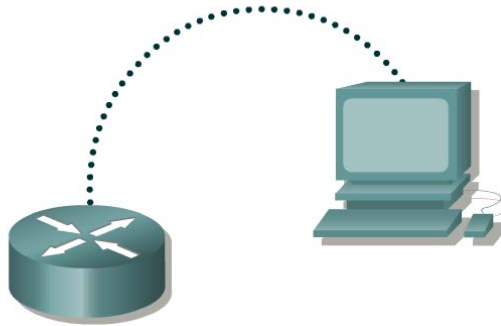
Press **Enter**.

The router is ready for the assigned lab to be performed.

Router Interface Summary					
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2	Interface #5
800 (806)	Ethernet 0 (E0)	Ethernet 1 (E1)			
1600	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
1700	FastEthernet 0 (FA0)	FastEthernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)	
2500	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
2600	FastEthernet 0/0 (FA0/0)	FastEthernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)	
In order to find out exactly how the router is configured, look at the interfaces. This will identify the type of router as well as how many interfaces the router has. There is no way to effectively list all of the combinations of configurations for each router class. What is provided are the identifiers for the possible combinations of interfaces in the device. This interface chart does not include any other type of interface even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in IOS command to represent the interface.					



### Lab 5.1.3 Using the `boot system` Command



Router designation	Router name	Enable secret password	Enable/VTY/ and Console passwords
Router 1	GAD	class	cisco

Straight-through cable	—————
Serial cable	————— ⚡
Console (Rollover)	.....
Crossover cable	- - - - -

### Objective

- Display information about the Cisco IOS Image (software) that is currently running.
- Determine where the IOS is booting from.
- Check the amount of RAM, Flash and NVRAM memory the router has.
- Check the IOS image and Flash for space used and available.
- Document the parts of the IOS image file name.
- Check and document the configuration register settings related to boot method.
- Document a fallback boot sequence.

### Background/Preparation

Setup a network as displayed in the figure. Any router that meets the interface requirements may be used. Possible routers include 800, 1600, 1700, 2500, 2600 routers, or a combination. Refer to the chart at the end of the lab to correctly identify the interface identifiers to be used based on the equipment in the lab. The configuration output used in this lab is produced from 1721 series routers. Any other router used may produce slightly different output. Start a HyperTerminal session as performed in the Establishing a HyperTerminal session lab.

**Note:** Go to the erase and reload instructions at the end of this lab. Perform those steps on the router in this lab assignment before continuing.

### Step 1 Login to the router

- Connect to the router and login.

### Step 2 Enter privileged EXEC mode

- Enter **enable** at the command prompt.

### Step 3 Save the existing running-config to the startup-config

- At the privileged EXEC command prompt enter:

```
Router#copy running-config startup-config  
Destination filename [startup-config]? Enter
```

This will save the current blank configuration.

### Step 4 Configure the router and view the running configuration file

- Configure the router with the information in the table on page 1.
  - Enter **show running-config** at the router prompt. The router will display information on the running configuration file stored in RAM.
  - Does the configuration display the changes entered?
- 

### Step 5 Show information about the backup configuration file

- Enter **show startup-config** at the router prompt. The router will display information on the backup configuration file stored in NVRAM.
  - Does the configuration display the changes entered?
- 
- If not, why? \_\_\_\_\_
  - What command would make the running-config file and startup-config file identical?
- 
- Why is the startup-config file so important? \_\_\_\_\_
  - Is there any indication of the configuration register setting? \_\_\_\_\_

### Step 6 Display IOS version and other important information

- Enter **show version** command at the router prompt.  
The router will return information about the IOS that is running in RAM.
  - What is the IOS version and revision level? \_\_\_\_\_
  - What is the name of the system image (IOS) file? \_\_\_\_\_
  - Where was the router IOS image booted from? \_\_\_\_\_
  - What type of processor and how much RAM does this router have?
- 
- What kind of router (platform type) is this? \_\_\_\_\_
  - The router backup configuration file is stored in Non-Volatile Random Access Memory (NVRAM). How much NVRAM does this router have?
-

- h. The router operating system (IOS) is stored in Flash memory. How much flash memory does this router have?
- 

- i. What is the configuration register set to? What boot type does this setting specify?
- 

### Step 7 Create the statements to perform the following functions

- a. Assuming that the **config-register** is set to 0x2102, write the global configuration commands specifying that the IOS image should be loaded from:

ROM Monitor: \_\_\_\_\_

Flash (without checking for **boot system** commands): \_\_\_\_\_

Flash (checks for **boot system** commands first):

\_\_\_\_\_

ROM IOS:

\_\_\_\_\_

**Note:** ROM IOS is the default on older platforms.

### Step 8 Show information about the Flash memory device

- a. Enter **show flash** at the router prompt.

The router will respond with information about the flash memory and what IOS image file(s) are stored there.

- b. Document the following information:

How much flash memory is available and used? \_\_\_\_\_

What is the file that is stored in flash memory? \_\_\_\_\_

What is the size in bytes of the flash memory? \_\_\_\_\_

### Step 9 Specify a fallback boot sequence

- a. Write the **boot system** command to specify that the IOS image should load from:

Flash: \_\_\_\_\_

A TFTP server: \_\_\_\_\_

ROM: \_\_\_\_\_

Will this be a full IOS image? \_\_\_\_\_

- b. To ensure that these commands are available for the router to use the next time it is restarted, which task would need to be completed before reloading or power cycling the router?
- \_\_\_\_\_

Upon completion of the previous steps, logoff by typing **exit**. Turn the router off.

## Erasing and reloading the router

Enter into the privileged EXEC mode by typing **enable**.

```
Router>enable
```

If prompted for a password, enter **class**. If “class” does not work, ask the instructor for assistance.

At the privileged EXEC mode, enter the command **erase startup-config**.

```
Router#erase startup-config
```

The responding line 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
```

Now at the privileged EXEC mode, enter the command **reload**.

```
Router#reload
```

The responding line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Proceed with reload? [confirm]
```

Press **Enter** to confirm.

In the first line of the response will be:

```
Reload requested by console.
```

After the router has reloaded the line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Press RETURN to get started!
```

Press **Enter**.

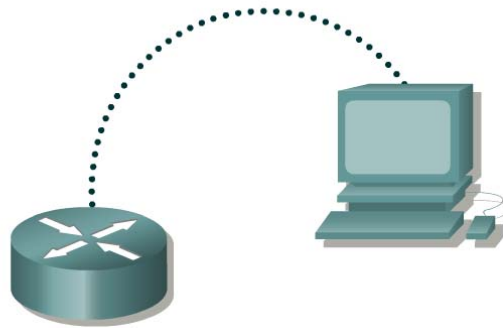
The router is ready for the assigned lab to be performed.



Router Interface Summary					
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2	Interface #5
800 (806)	Ethernet 0 (E0)	Ethernet 1 (E1)			
1600	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
1700	FastEthernet 0 (FA0)	FastEthernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)	
2500	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
2600	FastEthernet 0/0 (FA0/0)	FastEthernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)	
In order to find out exactly how the router is configured, look at the interfaces. This will identify the type of router as well as how many interfaces the router has. There is no way to effectively list all of the combinations of configurations for each router class. What is provided are the identifiers for the possible combinations of interfaces in the device. This interface chart does not include any other type of interface even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in IOS command to represent the interface.					



### Lab 5.1.5 Troubleshooting Configuration Register Boot Problems



Router designation	Router name	Enable secret password	Enable/VTY/ and Console passwords
Router 1	GAD	class	cisco

Straight-through cable	—————
Serial cable	————— <del>      </del>
Console (Rollover)	.....
Crossover cable	- - - - -

#### Objective

- Check and document the configuration register settings related to boot method.
- Configure the router to boot using the configuration file in NVRAM and reload the router.

#### Background/Preparation

Setup a network as displayed in the figure. Any router that meets the interface requirements may be used. Possible routers include 800, 1600, 1700, 2500, 2600 routers, or a combination. Refer to the chart at the end of the lab to correctly identify the interface identifiers to be used based on the equipment in the lab. The configuration output used in this lab is produced from 1721 series routers. Any other router used may produce slightly different output. Start a HyperTerminal session as performed in the Establishing a HyperTerminal session lab.

**Note:** Go to the erase and reload instructions at the end of this lab. Perform those steps on the router in this lab assignment before continuing.

#### Step 1 Login to the router

- a. Connect to the router and login.

## Step 2 Configure the router name and configuration register setting

- a. Enter the following commands:

```
Router>enable  
Router#configure terminal  
Router(config)#hostname GAD  
GAD(config)#config-register 0x2142  
GAD(config)#exit
```

## Step 3 Save the existing running-config to the startup-config

- a. At the privileged EXEC command prompt enter:

```
GAD#copy running-config startup-config  
Destination filename [startup-config]? Enter
```

## Step 4 Restart the router

- a. At the privileged EXEC command prompt enter:

```
GAD#reload  
Proceed with reload? [confirm] Enter
```

After the reload the router will respond with:

```
--- System Configuration Dialog ---  
  
Would you like to enter the initial configuration dialog? [yes/no]:n  
  
Type n and press Enter.
```

## Step 5 View the running configuration file

- a. Enter **show running-config** at the privileged EXEC mode prompt. The router will display information on the running configuration file stored in RAM.
  - b. Have the configuration commands from Step 2 loaded into RAM?
- 

## Step 6 Reload the saved configuration

- a. At the privileged EXEC command prompt enter:

```
Router#copy startup-config running-config  
Destination filename [running-config]? Enter
```

- b. Notice that the router name that was configured in Step 2 (GAD), is now displayed. Why did the Startup config file not load when we reloaded the router?

## Step 7 Display IOS version and other important information

- a. Enter the **show version** command at the router prompt.

The router will display information about the IOS that is running in RAM.

- b. Notice that at the end of the output shows a configuration register setting of 0x2142 that we configured in Step 2. This is the problem. The setting configures the router to ignore the Startup configuration file on bootup. The setting will be useful to boot up in the password recovery mode.

## Step 8 Change the config-register to boot from NVRAM, save, and reload the router

- a. Enter global configuration mode and enter the following commands:

```
GAD>enable
GAD#configure terminal
GAD(config)#config-register 0x2102
GAD(config)#exit
GAD#copy running-config startup-config
Destination filename [startup-config]? Enter
GAD#reload
Proceed with reload? [confirm] Enter
```

## Step 9 Verify the configuration register setting

- a. Once the router has rebooted, it should look to NVRAM for bootup configuration. Verify this by issuing the command, **show version**.

```
GAD#show version
```

The results will be shown. You should be able to see the config-register 0x2102.

Upon completion of the previous steps, logoff by typing **exit**. Turn the router off.

## Erasing and reloading the router

Enter into the privileged EXEC mode by typing **enable**.

```
Router>enable
```

If prompted for a password, enter **class**. If “class” does not work, ask the instructor for assistance.

At the privileged EXEC mode, enter the command **erase startup-config**.

```
Router#erase startup-config
```

The responding line 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
```

Now at the privileged EXEC mode, enter the command **reload**.

```
Router#reload
```

The responding line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Proceed with reload? [confirm]
```

Press **Enter** to confirm.

In the first line of the response will be:

```
Reload requested by console.
```

After the router has reloaded the line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

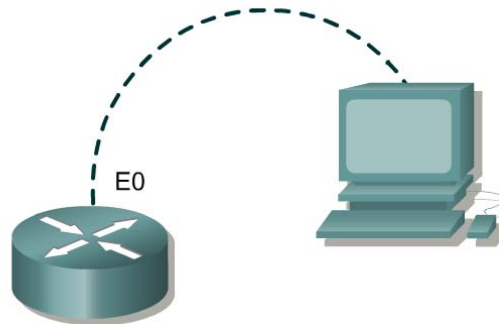
```
Press RETURN to get started!
```

Press **Enter**.

The router is ready for the assigned lab to be performed.

Router Interface Summary					
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2	Interface #5
800 (806)	Ethernet 0 (E0)	Ethernet 1 (E1)			
1600	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
1700	FastEthernet 0 (FA0)	FastEthernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)	
2500	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
2600	FastEthernet 0/0 (FA0/0)	FastEthernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)	
In order to find out exactly how the router is configured, look at the interfaces. This will identify the type of router as well as how many interfaces the router has. There is no way to effectively list all of the combinations of configurations for each router class. What is provided are the identifiers for the possible combinations of interfaces in the device. This interface chart does not include any other type of interface even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in IOS command to represent the interface.					

## Lab 5.2.3 Managing Configuration Files with TFTP



Router designation	Router name	Enable secret password	Enable/VTY/ and Console passwords	Fast Ethernet 0 address	Subnet mask all addresses
Router 1	GAD	class	cisco	192.168.14.1	255.255.255.0

Straight-through cable	—————
Serial cable	————— <del>      </del>
Console (Rollover)	.....
Crossover cable	- - - - -

### Objective

- Backup a copy of a router configuration file.
- Reload the backup configuration file from a TFTP server into RAM on a router.
- Save the new running-config to NVRAM.

### Background/Preparation

For documentation and recovery purposes it is important to keep backup copies of router configuration files. These can be stored in a central location such as a TFTP server for reference and retrieval if necessary.

Setup a network as displayed in the figure. Any router that meets the interface requirements may be used. Possible routers include 800, 1600, 1700, 2500, 2600 routers, or a combination. Refer to the chart at the end of the lab to correctly identify the interface identifiers to be used based on the equipment in the lab. The configuration output used in this lab is produced from 1721 series routers. Any other router used may produce slightly different output.

Start a HyperTerminal session as performed in the Establishing a HyperTerminal session lab.

**Note:** Go to the erase and reload instructions at the end of this lab. Perform those steps on all routers in this lab assignment before continuing.

### Step 1 Configure the GAD router

- a. Using the table at the beginning of the lab, configure the router hostname and Ethernet interface.  
If there are any difficulties configuring hostname, refer to the Configuring Router Passwords lab.  
If there are any difficulties configuring the interface, refer to the Configuring Host Tables lab.
- b. Verify the routers configurations by performing a **show running-config** on each router. If not correct, fix any configuration errors and verify.
- c. Issue the command **copy running-config startup-config** to save the changes.

## Step 2 Configure the workstation

- a. A workstation with TFTP server software must be available for this lab. There are a number of good freeware and shareware TFTP servers available by searching the Internet for "tftp server". This Lab uses the Cisco TFTP server. Verify that the software is available. If not, ask the instructor for assistance.

Configure the TFTP Host as follows:

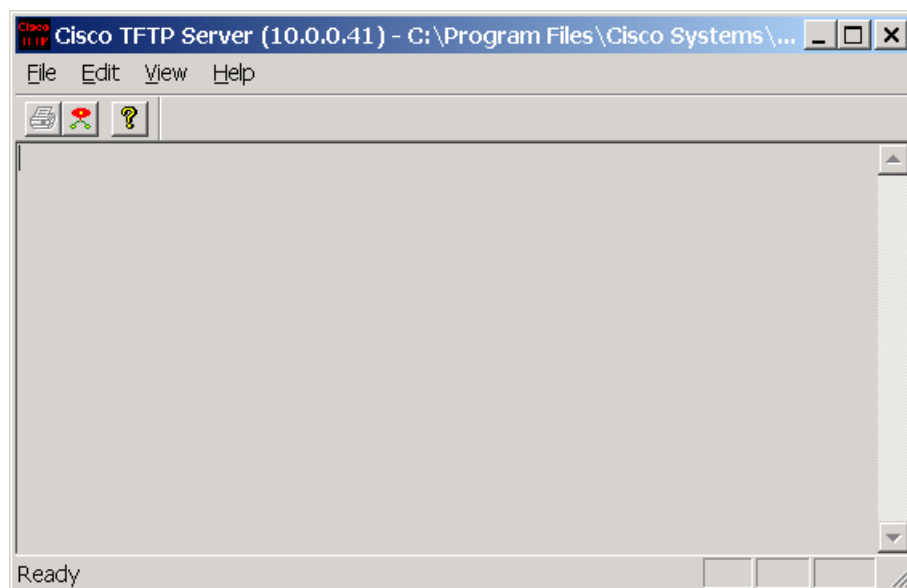
IP Address	192.168.14.2
IP subnet mask	255.255.255.0
Default gateway	192.168.14.1

Confirm that the host has accepted the new IP settings with the **winipcfg** command (Windows 9x) or the **ipconfig** command (Windows NT/2000/XP).

- b. Verify the router configuration by performing a **show running-config**. If not correct, fix any configuration errors and verify.

## Step 3 Start and configure the Cisco TFTP server

Start the TFTP server. If the computer is properly connected, there is no configuration of the Cisco TFTP server needed.



## Step 4 Verify connectivity

**ping** the TFTP server from the GAD router.

If the ping fails, review host and router configurations to resolve the problem.



## Step 5 Copy the startup-config to TFTP server

- Before copying the files, verify that the TFTP server is running.
- Record the IP address of the TFTP server. \_\_\_\_\_
- From the privileged EXEC prompt, issue the **copy startup-config tftp** command. Follow the prompts:

```
GAD#copy startup-config tftp
Address or name of remote host []? 192.168.14.2
Destination filename [gad-config]? startup-config
!!
667 bytes copied in 0.036 secs (18528 bytes/sec)
```

## Step 6 Verify the transfer to the TFTP server

Check the TFTP server log file. Click **View > Log File**. The output should be similar to the following:

```
Mon Sep 16 14:10:08 2003: Receiving 'startup-config' file from
192.168.14.1 in binary mode
Mon Sep 16 14:11:14 2003: Successful.
```

## Step 7 Copy the startup-config from the TFTP server

- Now that the startup-config is backed up, test this image by restoring the file to the router.  
Assume that the configuration on the GAD router has become corrupt and copy the backup startup-config file from the tftp server to the running-config of the router. To simulate this, change the hostname of the router from GAD to "Router".
- What is the IP address of the TFTP server? \_\_\_\_\_
- Complete the following to copy the startup-config file from the TFTP server to the router.

```
Router#copy tftp running-config
Address or name of remote host []? 192.168.14.2
Source filename []? startup-config
Destination filename [running-config]? [Enter]
Accessing tftp://192.168.14.2/startup-config...
Loading startup-config from 192.168.14.2 (via FastEthernet0): !
[OK - 667 bytes]

667 bytes copied in 9.584 secs (70 bytes/sec)

GAD#
```

## Step 8 Save the new running-config

Save the new running-config to NVRAM using the following command:

```
GAD#copy running-config startup-config
Destination filename [startup-config]? [Enter]
Building configuration...
[OK]
```

## Step 9 Test the restored file

Issue the **show startup-config** command to verify the entire configuration.

Upon completion of the previous steps, logoff by typing **exit**. Turn the router off.

## Erasing and reloading the router

Enter into the privileged EXEC mode by typing **enable**.

```
Router>enable
```

If prompted for a password, enter **class**. If “class” does not work, ask the instructor for assistance.

At the privileged EXEC mode, enter the command **erase startup-config**.

```
Router#erase startup-config
```

The responding line 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
```

Now at the privileged EXEC mode, enter the command **reload**.

```
Router#reload
```

The responding line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Proceed with reload? [confirm]
```

Press **Enter** to confirm.

In the first line of the response will be:

```
Reload requested by console.
```

After the router has reloaded the line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Press RETURN to get started!
```

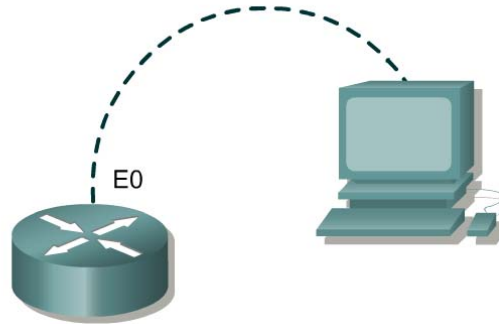
Press **Enter**.

The router is ready for the assigned lab to be performed.

Router Interface Summary					
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2	Interface #5
800 (806)	Ethernet 0 (E0)	Ethernet 1 (E1)			
1600	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
1700	FastEthernet 0 (FA0)	FastEthernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)	
2500	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
2600	FastEthernet 0/0 (FA0/0)	FastEthernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)	
In order to find out exactly how the router is configured, look at the interfaces. This will identify the type of router as well as how many interfaces the router has. There is no way to effectively list all of the combinations of configurations for each router class. What is provided are the identifiers for the possible combinations of interfaces in the device. This interface chart does not include any other type of interface even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in IOS command to represent the interface.					



## Lab 5.2.5 Managing IOS Images with TFTP



Router designation	Router name	Fast Ethernet 0 address	Subnet mask all addresses
Router 1	GAD	192.168.14.1	255.255.255.0

Straight-through cable	—————
Serial cable	————— <del>      </del>
Console (Rollover)	.....
Crossover cable	- - - - -

### Objective

- Backup a copy of a router IOS from flash to a TFTP server.
- Reload the backup IOS software image from a TFTP server into flash on a router.

### Background/Preparation

For recovery purposes it is important to keep backup copies of router IOS images. These can be stored in a central location such as a TFTP server and retrieved if necessary.

Setup a network as displayed in the figure. Any router that meets the interface requirements may be used. Possible routers include 800, 1600, 1700, 2500, 2600 routers, or a combination. Refer to the chart at the end of the lab to correctly identify the interface identifiers to be used based on the equipment in the lab. The configuration output used in this lab is produced from 1721 series routers. Any other router used may produce slightly different output.

Start a HyperTerminal session as performed in the Establishing a HyperTerminal session lab.

### Step 1 Configure the GAD router

- Using the table at the beginning of the lab, configure the router hostname and Ethernet interface. If there are any difficulties configuring hostname, refer to the Configuring Router Passwords lab. If there are any difficulties configuring the interface, refer to the Configuring Host Tables lab.
- Verify the router configuration by performing a **show running-config**. Correct any configuration errors and verify.

## Step 2 Configure the workstation

A workstation with the TFTP server software must be available for this lab. There are a number of good freeware and shareware TFTP servers available by searching the Internet for "TFTP server". This Lab uses the Cisco TFTP server. Verify that the software is available. If not, ask your instructor for assistance.

Configure the TFTP Host as follows:

IP Address	192.168.14.2
IP subnet mask	255.255.255.0
Default gateway	192.168.14.1

Confirm that the host has accepted the new IP settings with the **winiipcfg** command (Windows 9x) or the **ipconfig** command (Windows NT/2000/XP).

## Step 3 Collect information to document the router

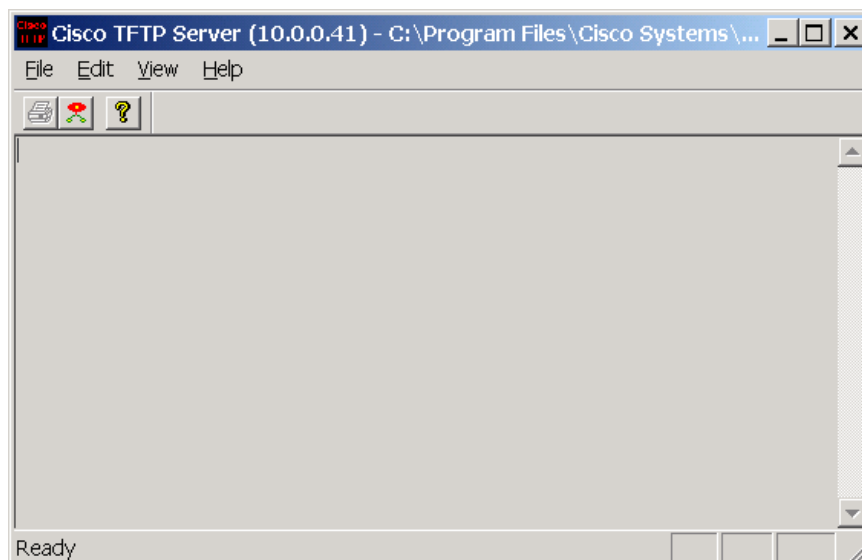
- Issue the **show version** command.
- What is the current value of the config-register? \_\_\_\_ 0x \_\_\_\_
- How much flash memory does this router have? \_\_\_\_\_
- Is there at least 4mb (4096K) of flash? \_\_\_\_\_
- What is the version number of boot ROM? \_\_\_\_\_
- Is the boot ROM version 5.2 or later? \_\_\_\_\_

## Step 4 Collect more information to document the router

- Issue the **show flash** command.
- Is there a file already stored in flash? \_\_\_\_\_
- If so, what is the exact name of that file? \_\_\_\_\_
- How much of flash is available or unused? \_\_\_\_\_

## Step 5 Start and configure the Cisco TFTP Server

Start the TFTP server.



## Step 6 Verify connectivity

Ping the TFTP server from the Gadsden router.

If the ping fails, review host and router configurations to resolve the problem.

## Step 7 Copy IOS to TFTP server

a. Before copying the files, verify that the TFTP server is running.

b. What is the IP address of the TFTP server? \_\_\_\_\_

c. From the console session, enter **show flash**.

d. What is the name and length of the Cisco IOS image stored in flash?

\_\_\_\_\_

e. What attributes can be identified from codes in the Cisco IOS filename?

## Step 8 Copy the IOS image to the TFTP server

a. From the console session in the privileged EXEC mode, enter the **copy flash tftp** command. At the prompt enter the IP address of the TFTP server. Filenames will vary based on IOS and platform. The filename for your system was reported in Step 4:

```
GAD#copy flash tftp
Source filename []? flash:c1700-y-mz.122-11.T.bin
Address or name of remote host []? 192.168.14.2
Destination filename [c1700-y-mz.122-11.T.bin]? y
```

After entering this command and answering the process requests, the student should see the following output on the console. The process may take a few minutes depending on the size of the image. Do not interrupt this process.

```
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
4284648 bytes copied in 34.012 secs (125975 bytes/sec)
```

## Step 9 Verify the transfer to the TFTP server

a. Check the TFTP server log file by clicking **View > Log File**. The output should resemble the following output:

```
Mon Sep 16 14:10:08 2003: Receiving 'c1700-y-mz.122-11.T.bin' in binary
mode
Mon Sep 16 14:11:14 2003: Successful.
```

b. Verify the flash image size in the TFTP server directory. To locate it, click on **View > Options**. This will show the TFTP server root directory. It should be similar to the following, unless the default directories were changed:

```
C:\Program Files\Cisco Systems\Cisco TFTP Server
```

c. Locate this directory using Windows Explorer or My Computer. Look at the detail listing of the file. The file length in the **show flash** command should be the same file size as the file stored on the TFTP server. If the file sizes are not identical, check with the instructor.

## Step 10 Copy the IOS image from the TFTP server

- Now that the IOS is backed up, the image must be tested and the IOS restored to the router. Ping the TFTP server IP address. When prompted for "Destination filename" use the file name from Step 7.
- Record the IP address of the TFTP server. \_\_\_\_\_
- Copy from the privileged EXEC prompt.

```
GAD#copy tftp flash
Address or name of remote host []?192.168.14.2
Source filename []?c1700-y-mz.122-11.T.bin
Destination filename [c1700-y-mz.122-11.T.bin]? [Enter]
%Warning:There is a file already existing with this name
Do you want to over write? [confirm]
Accessing tftp://192.168.14.2/c1700-y-mz.122-11.T.bin...
Erase flash: before copying? [confirm] [Enter]
Erasing the flash filesystem will remove all files! Continue?
[confirm] [Enter]
Erasing device...
eeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeee
eeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeee
...erased
Erase of flash: complete
Loading c1700-y-mz.122-11.T.bin from 192.168.14.2 (via
FastEthernet0):!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
[OK - 4284648 bytes]

Verifying checksum... OK (0x9C8A)
4284648 bytes copied in 26.584 secs (555739 bytes/sec)
```

- The router may prompt to erase flash. Will the image fit in available flash? \_\_\_\_\_
- If the flash is erased, what happened on the router console screen as it was doing so?  
\_\_\_\_\_
- What is the size of the file being loaded? \_\_\_\_\_
- What happened on the router console screen as the file was being downloaded?  
\_\_\_\_\_
- Was the verification successful? \_\_\_\_\_
- Was the whole operation successful? \_\_\_\_\_

## Step 11 Test the restored IOS image

- Verify that the router Image is correct. Cycle the router power and observe the startup process to confirm that there were no flash errors. If there are none, then the router IOS should have started correctly.
- Further verify IOS image in flash by issuing the **show version** command which will show output similar to:

System image file is "flash:c1700-y-mz.122-11.T.bin"

Upon completion of the previous steps, logoff by typing **exit**. Turn the router off.



## Erasing and reloading the router

Enter into the privileged EXEC mode by typing **enable**.

```
Router>enable
```

If prompted for a password, enter **class**. If “class” does not work, ask the instructor for assistance.

At the privileged EXEC mode, enter the command **erase startup-config**.

```
Router#erase startup-config
```

The responding line 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
```

Now at the privileged EXEC mode, enter the command **reload**.

```
Router#reload
```

The responding line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Proceed with reload? [confirm]
```

Press **Enter** to confirm.

In the first line of the response will be:

```
Reload requested by console.
```

After the router has reloaded the line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Press RETURN to get started!
```

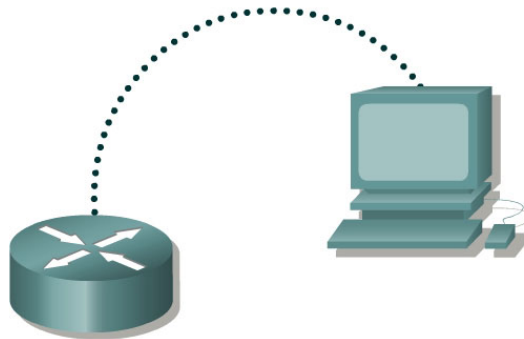
Press **Enter**.

The router is ready for the assigned lab to be performed.

Router Interface Summary					
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2	Interface #5
800 (806)	Ethernet 0 (E0)	Ethernet 1 (E1)			
1600	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
1700	FastEthernet 0 (FA0)	FastEthernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)	
2500	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
2600	FastEthernet 0/0 (FA0/0)	FastEthernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)	
In order to find out exactly how the router is configured, look at the interfaces. This will identify the type of router as well as how many interfaces the router has. There is no way to effectively list all of the combinations of configurations for each router class. What is provided are the identifiers for the possible combinations of interfaces in the device. This interface chart does not include any other type of interface even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in IOS command to represent the interface.					



## Lab 5.2.6a Password Recovery Procedures



Router designation	Router name	Enable secret password	Enable/VTY/ and Console passwords
Router 1	GAD	class	cisco

Straight-through cable	—————
Serial cable	————— <del>      </del>
Console (Rollover)	.....
Crossover cable	- - - - -

### Objective

- Gain access to a router with an unknown privileged mode (enable) password.

### Background/Preparation

This lab demonstrates gaining access to a router with an unknown privileged mode (enable) password. One point to be made here is that anyone with this procedure and access to a console port on a router can change the password and take control of the router. That is why it is of critical importance that routers also have physical security to prevent unauthorized access.

Setup a network as displayed in the figure. Any router that meets the interface requirements may be used. Possible routers include 800, 1600, 1700, 2500, 2600 routers, or a combination. Refer to the chart at the end of the lab to correctly identify the interface identifiers to be used based on the equipment in the lab. The configuration output used in this lab is produced from 1721 series routers. Any other router used may produce slightly different output.

Start a HyperTerminal session as performed in the Establishing a HyperTerminal session lab.

**Note:** Configure the hostname and passwords on the router. Have an instructor, lab assistant, or other student change the enable secret password. Perform **copy running-config startup-config** and reload the router.

**Note:** The version of HyperTerminal provided with Windows 95, 98, NT and 2000 was developed for Microsoft by Hilgraeve. Some versions may not issue a "break" sequence as required for the Cisco router password recovery technique. If this is the case, upgrade to

HyperTerminal Private Edition (PE) available free of charge for personal and educational use.  
The program may be downloaded at <http://www.hilgraeve.com>.

### Step 1 Attempt login to the router

- Make the necessary console connections and establish a HyperTerminal session with the router. Attempt to logon to the router using the enable password **cisco**. The output should look like the following:

```
Router>enable
Password:
Password:
Password:
% Bad secrets

Router>
```

### Step 2 Document the current config-register setting

- At the user EXEC prompt type **show version**.
- Record the value displayed for configuration register \_\_\_\_\_. For example 0x2102.

### Step 3 Enter the ROM Monitor mode

- Turn the router off, wait a few seconds and turn it back on. When the router starts displaying "System Bootstrap, Version ..." on the HyperTerminal screen, press the **Ctrl** key and the **Break** key together. The router will boot in ROM monitor mode. Depending on the router hardware, one of several prompts such as: "**rommon 1 >**" or simply ">" may show.

### Step 4 Examine the ROM Monitor mode help

- Type **?** at the prompt. The output should be similar to this:

```
rommon 1 >?
alias                set and display aliases command
boot                 boot up an external process
break                set/show/clear the breakpoint
config               configuration register utility
context              display the context of a loaded image
dev                  list the device table
dir                  list files in file system
dis                  display instruction stream
help                 monitor builtin command help
history              monitor command history
meminfo              main memory information
repeat               repeat a monitor command
reset                system reset
set                  display the monitor variables
sysret               print out info from last system return
tftpdnld              tftp image download
xmodem                x/ymodem image download
```

### Step 5 Change the configuration register setting to boot without loading configuration file

- From the ROM Monitor mode, type **confreg 0x2142** to change the config-register.

```
rommon 2 >confreg 0x2142
```

## Step 6 Restart Router

- a. From the ROM Monitor mode, type **reset** or power cycle the router.  
`rommon 2 >reset`
- b. Due to the new configuration register setting, the router will not load the configuration file. The system prompts:  
"Would you like to enter the initial configuration dialog? [yes]:"  
Enter **no** and press **Enter**.

## Step 7 Enter Privileged EXEC mode and change password

- a. Now at the user mode prompt Router>, type **enable** and press **Enter** to go to the privileged mode without a password.
- b. Use the command **copy startup-config running-config** to restore the existing configuration. Since the user is already in privileged EXEC no password is needed.
- c. Type **configure terminal** to enter the global configuration mode.
- d. In the global configuration mode type **enable secret class** to change the secret password.
- e. While still in the global configuration mode, type **config-register xxxxxxxx**. xxxxxxxx is the original configuration register value recorded in Step 2. Press **Enter**.
- f. Use the **Ctrl z** combination to return to the privileged EXEC mode.
- g. Use the **copy running-config startup-config** command to save the new configuration.
- h. Before restarting the router, verify the new configuration setting. From the privileged EXEC prompt, enter the **show version** command and press **Enter**.
- i. Verify that the last line of the output reads:  
Configuration register is 0x2142 (will be 0x2102 at next reload).
- j. Use the **reload** command to restart the router.

## Step 8 Verify new password and configuration

- a. When the router reloads the enable password should be **class**.

Upon completion of the previous steps, logoff by typing **exit**. Turn the router off.

## Erasing and reloading the router

Enter into the privileged EXEC mode by typing **enable**.

```
Router>enable
```

If prompted for a password, enter **class**. If “class” does not work, ask the instructor for assistance.

At the privileged EXEC mode, enter the command **erase startup-config**.

```
Router#erase startup-config
```

The responding line 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
```

Now at the privileged EXEC mode, enter the command **reload**.

```
Router#reload
```

The responding line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Proceed with reload? [confirm]
```

Press **Enter** to confirm.

In the first line of the response will be:

```
Reload requested by console.
```

After the router has reloaded the line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Press RETURN to get started!
```

Press **Enter**.

The router is ready for the assigned lab to be performed.

Router Interface Summary					
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2	Interface #5
800 (806)	Ethernet 0 (E0)	Ethernet 1 (E1)			
1600	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
1700	FastEthernet 0 (FA0)	FastEthernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)	
2500	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
2600	FastEthernet 0/0 (FA0/0)	FastEthernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)	
In order to find out exactly how the router is configured, look at the interfaces. This will identify the type of router as well as how many interfaces the router has. There is no way to effectively list all of the combinations of configurations for each router class. What is provided are the identifiers for the possible combinations of interfaces in the device. This interface chart does not include any other type of interface even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in IOS command to represent the interface.					

## Lab 5.2.6b Managing IOS Images with ROMmon and Xmodem



Straight-through cable	—————
Serial cable	————— ⚡
Console (Rollover)	.....
Crossover cable	- - - - -

### Objective

- Recover a Cisco router stuck in ROM monitor (ROMmon) mode.
- Learn how to avoid having to use Xmodem to restore an IOS file.

### Background/Preparation

This is a process that is needed only as an emergency when a user has deleted or erased the IOS and there is no possibility of being able to download a new version of the IOS from a TFTP server.

If the procedure cannot be avoided, this lab explains how to use the **xmodem** command at the console to download Cisco IOS® Software using the ROM monitor (ROMmon). Xmodem can be used on a group of routers (listed below) and is used in disaster recovery situations where the router has no valid Cisco IOS software to boot from and hence, only boots up in ROMmon. This procedure can also be used where there are no Trivial File Transfer Protocol (TFTP) servers or network connections, and a direct PC connection (or through a modem connection) to the router console is the only viable option. Because this procedure relies on the console speed of the router and the serial port of the PC, it can take a long time to download an image. Depending on the size of the IOS image and the console baud rate, the download can take 20 minutes or more. This process is valid for the Cisco 827, 1600, 1700, 2600, 3600, and 3700 Series Routers.

Setup a network as displayed in the figure. Refer to the chart at the end of the lab to correctly identify the interface identifiers to be used based on the equipment in the lab. The configuration output used in this lab is produced from 1721 series routers. Any other router used may produce slightly different output.

Start a HyperTerminal session as performed in the Establishing a HyperTerminal session lab.

**Note:** Erase and reload the router to prevent problems that may be caused by residual configurations. Instructions are available at the end of this lab.



Note: To complete this lab, a copy of the recommended Cisco IOS software image (for example, **c1700-y-mz.122-11.T.bin**) must be available on your PC.

### Step 1 Enter the ROM Monitor mode

To simulate Power, cycle the router and Ctrl - Break into ROM monitor mode. Depending on the router hardware, one of several prompts such as "rommon 1 >" or simply ">" may display.

### Step 2 Finding a Valid Image in Flash

From the ROM Monitor prompt, issue the **dir flash:** command for each available device. Look for a valid Cisco IOS® Software image:

```
rommon 3 >dir flash:
      File size             Checksum   File name
  3307884 bytes (0x804b4c) 0x6ba0   cl700-ny-mz.121-6.bin
rommon 4 >
```

### Step 3 Recover from Listed Images if there are any

Boot from any image that is listed in Step 1. If the image is valid, it will bring back normal operation mode:

```
rommon 5 >boot flash:cl700-ny-mz.121-6.bin
program load complete, entry point: 0x80008000, size: 0x804a30
Self decompressing the image : #####
#####...
```

### Step 4 Record information using show version

- a. If none of the files are valid, download a new one using one of the following procedures. The first step is to have recorded the **show version** information at the initial setup. This will provide the needed information about the IOS image name.

```
Cisco Internetwork Operating System Software
IOS (tm) C1700 Software (C1700-Y-M), Version 12.2(11)T, RELEASE
SOFTWARE (fcl)
TAC Support: http://www.cisco.com/tac
Copyright (c) 1986-2002 by cisco Systems, Inc.
Compiled Wed 31-Jul-02 09:08 by ccai
Image text-base: 0x80008124, data-base: 0x807E332C
```

```
ROM: System Bootstrap, Version 12.2(7r)X1, RELEASE SOFTWARE (fcl)
```

```
Router uptime is 15 minutes
System returned to ROM by reload
System image file is "flash:cl700-y-mz.122-11.T.bin"
```

```
cisco 1721 (MPC860P) processor (revision 0x100) with 29492K/3276K bytes
of memory.
Processor board ID FOC06380F0T (479701011), with hardware revision 0000
MPC860P processor: part number 5, mask 2
Bridging software.
X.25 software, Version 3.0.0.
1 FastEthernet/IEEE 802.3 interface(s)
2 Serial(sync/async) network interface(s)
32K bytes of non-volatile configuration memory.
16384K bytes of processor board System flash (Read/Write)
--More--
Configuration register is 0x2102
```

- b. The Highlighted lines should be recorded in case this procedure needs to be performed.

## Step 5 Configure boot register to enter ROMmon mode

If not already done, configure Windows HyperTerminal for 8-N-1 at 9600 bps. Connect the PC serial port to the console port of the router. Once connected, get into the ROMmon prompt (rommon 1>). Typically, if the router Cisco IOS software image and bootflash image are both corrupt, the router only comes up in ROMmon mode. If the former is not true and it is necessary to get into the ROMmon prompt, change the configuration register. Typically, change 0x2102 as given by **show version** to 0x0 as follows:

```
Router>enable
Router#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#config-register 0x0
Router(config)#exit
Router#
*Mar 1 00:29:21.023: %SYS-5-CONFIG_I: Configured from console by
console
Router#reload
System configuration has been modified. Save? [yes/no]: n
Proceed with reload? [confirm][Enter]

*Mar 1 00:30:32.235: %SYS-5-RELOAD: Reload requested by console.
System Bootstrap, Version 12.2(7r)XM1, RELEASE SOFTWARE (fc1)
TAC Support: http://www.cisco.com/tac
Copyright (c) 2001 by cisco Systems, Inc.
C1700 platform with 32768 Kbytes of main memory

rommon 1 >
```

## Step 6 View available commands from the rommon prompt

- a. Enter the following at the ROM monitor prompt:

```
rommon 1 >?
alias          set and display aliases command
boot           boot up an external process
break         set/show/clear the breakpoint
confreg        configuration register utility
context        display the context of a loaded image
dev            list the device table
dir            list files in file system
dis           display instruction stream
help          monitor builtin command help
history        monitor command history
meminfo        main memory information
repeat         repeat a monitor command
reset          system reset
set            display the monitor variables
sync           write monitor environment to NVRAM
sysret         print out info from last system return
tftpdnld       tftp image download
unalias        unset an alias
unset          unset a monitor variable
xmodem         x/ymodem image download
```

- b. This lab will use the **confreg** to reset the console speed. Use **xmodem** to transfer the file.

## Step 7 Reset terminal speed for faster download

By specifying a data-rate of 115200 bps for example, the download rate can be increased reducing download time. These are the steps to reset the speed on the router.

```
rommon 2 >confreg
Configuration Summary
(Virtual Configuration Register: 0x1820)
enabled are:
break/abort has effect
console baud: 9600
boot: the ROM Monitor
do you wish to change the configuration? y/n [n]: y
enable "diagnostic mode"? y/n [n]: [Enter]
enable "use net in IP bcast address"? y/n [n]: [Enter]
enable "load rom after netboot fails"? y/n [n]: [Enter]
enable "use all zero broadcast"? y/n [n]: [Enter]
disable "break/abort has effect"? y/n [n]: y
enable "ignore system config info"? y/n [n]: [Enter]
change console baud rate? y/n [n]: y
enter rate: 0 = 9600, 1 = 4800, 2 = 1200, 3 = 2400
4 = 19200, 5 = 38400, 6 = 57600, 7 = 115200 [0]: 7
change the boot characteristics? y/n [n]: [Enter]

Configuration Summary
(Virtual Configuration Register: 0x1920)
enabled are:
console baud: 115200

boot: the ROM Monitor
do you wish to change the configuration? y/n [n]: n
You must reset or power cycle for new config to take effect

rommon 3 >reset
```

**Note:** The HyperTerminal setting must be changed to reflect the new console speed of 115200, instead of 9600 baud. Otherwise a garbled output is displayed.

```
System Bootstrap, Version 12.2(7r)XM1, RELEASE SOFTWARE (fc1)
TAC Support: http://www.cisco.com/tac
Copyright (c) 2001 by cisco Systems, Inc.
C1700 platform with 32768 Kbytes of main memory
```

## Step 8 Use the **xmodem** command to request file from host

Before issuing the **xmodem** command, ensure that the new Cisco IOS software image is installed on the PC. From the ROMmon prompt, issue the **xmodem** command.

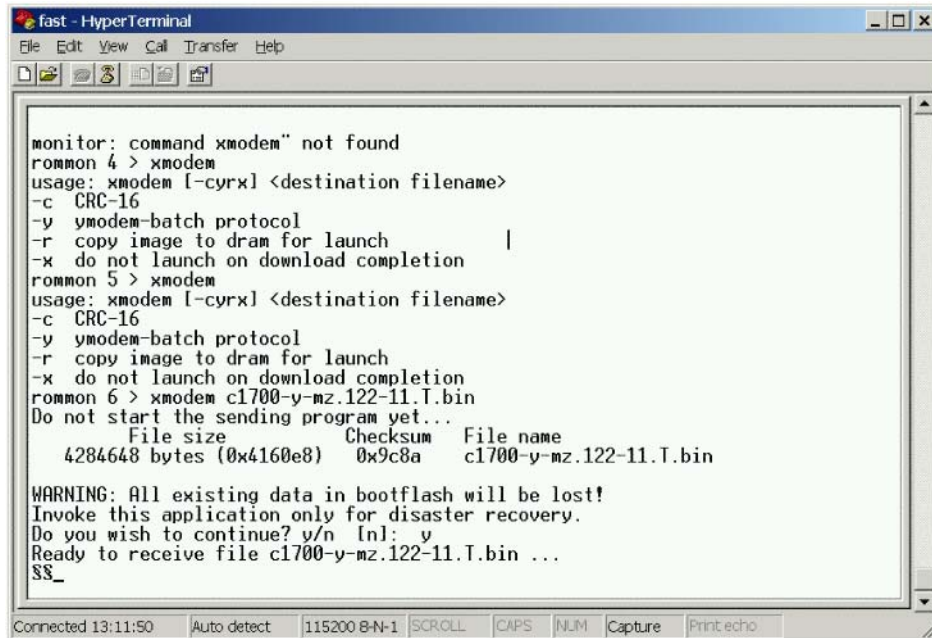
```
rommon 2 >xmodem
usage: xmodem [-cyrx] <destination filename>
-c CRC-16
-y ymodem-batch protocol
-r copy image to dram for launch
-x do not launch on download completion

rommon 3 >xmodem c1700-y-mz.122-11.T.bin
Do not start the sending program yet...
File size      Checksum      File name
4284648 bytes (0x4160e8)  0x9c8a  c1700-y-mz.122-11.T.bin
WARNING: All existing data in bootflash will be lost!
```

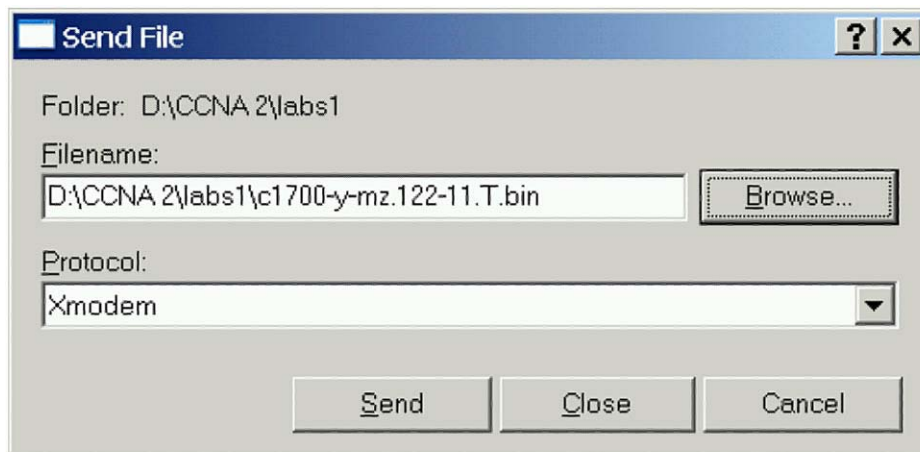
```
Invoke this application only for disaster recovery.
Do you wish to continue? y/n [n]: n
Ready to receive file c1700-y-mz.122-11.T.bin ...
```

## Step 9 Send the file from the HyperTerminal program

- From the HyperTerminal program send the IOS file using the steps as follows:



- Select **Transfer > Send File**. Specify the location of the IOS file on the host hard drive.



- c. Next click on **Send** to initiate file transfer to the router.

The dialog box titled "Xmodem file send for fast" displays the following fields and values:

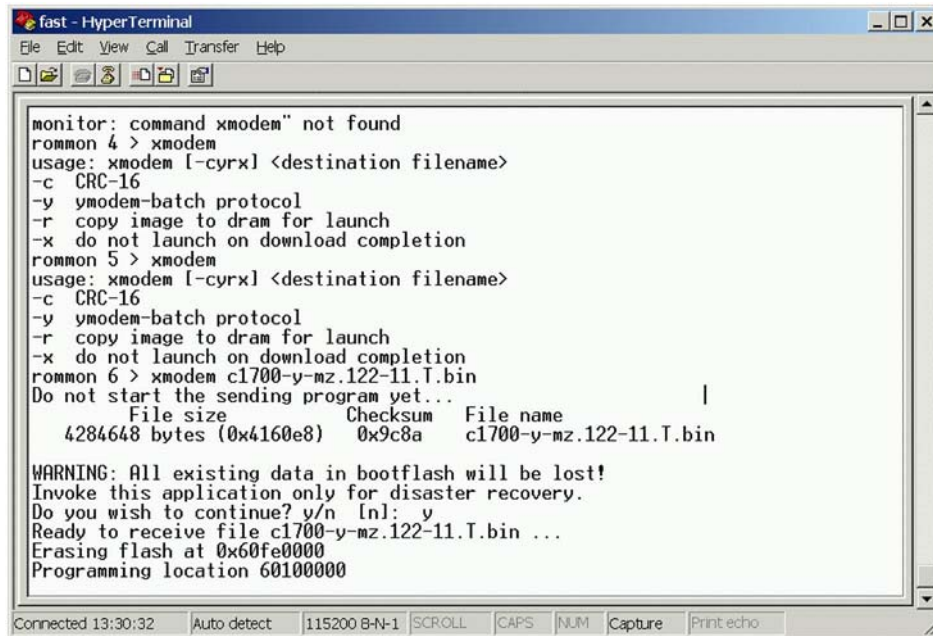
- Sending:** D:\CCNA 2\labs1\c1700-y-mz.122-11.T.bin
- Packet:** 180
- Error checking:** Checksum
- Retries:** 0
- Total retries:** 0
- Last error:** (empty)
- File:** (empty)
- Progress:** 20K of 4185K
- Elapsed:** 00:00:05
- Remaining:** 00:18:09
- Throughput:** 3916 cps
- Buttons:** Cancel, cps/bps

- d. As the transfer progresses it will look like this:

The dialog box titled "Xmodem file send for fast" displays the following fields and values after some progress:

- Sending:** D:\CCNA 2\labs1\c1700-y-mz.122-11.T.bin
- Packet:** 7327
- Error checking:** Checksum
- Retries:** 0
- Total retries:** 2
- Last error:** Got retry request
- File:** (displayed as a progress bar with 7 filled blocks)
- Progress:** 915K of 4185K
- Elapsed:** 00:03:47
- Remaining:** 00:13:31
- Throughput:** 4125 cps
- Buttons:** Cancel, cps/bps

- e. When finished it looks like this:



```
fast - HyperTerminal
File Edit View Call Transfer Help

monitor: command xmodem" not found
rommon 4 > xmodem
usage: xmodem [-cyrx] <destination filename>
-c CRC-16
-y ymodem-batch protocol
-r copy image to dram for launch
-x do not launch on download completion
rommon 5 > xmodem
usage: xmodem [-cyrx] <destination filename>
-c CRC-16
-y ymodem-batch protocol
-r copy image to dram for launch
-x do not launch on download completion
rommon 6 > xmodem c1700-y-mz.122-11.T.bin
Do not start the sending program yet...
File size      Checksum      File name
4284648 bytes (0x4160e8)  0x9c8a    c1700-y-mz.122-11.T.bin

WARNING: All existing data in bootflash will be lost!
Invoke this application only for disaster recovery.
Do you wish to continue? y/n [n]: y
Ready to receive file c1700-y-mz.122-11.T.bin ...
Erasing flash at 0x60fe0000
Programming location 60100000

Connected 13:30:32  Auto detect  115200 8-N-1  SCROLL  CAPS  NUM  Capture  Print echo
```

- f. When the process is completed the router will reload.

## Step 10 Reset the boot register and the console speed

- a. From the configuration prompt, set the boot register back to 0x2102 or the original setting before the IOS transfer. This is done using the **config-register** command at the global configuration prompt.

```
Router(config)#config-register 0x2102
Router(config)#exit
Router#show flash
```

```
System flash directory:
File  Length  Name/status
1    4284648  c1700-y-mz.122-11.T.bin
[4285452 bytes used, 12491764 available, 16777216 total]
16384K bytes of processor board System flash (Read/Write)
```

Reset the console speed in HyperTerminal, to 9600.

```
Router(config)#line con 0
Router(config-line)#speed 9600
Router(config-line)#^Z
```

- b. HyperTerminal will stop responding. Reconnect to the router with HyperTerminal using 9600 Baud, 8-N-1.
- c. Save the configuration to NVRAM on the router.

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

## Step 11 Review the new settings

Reload the router and review the new settings using the **show version** command.

Router#**show version**

Cisco Internetwork Operating System Software  
IOS (tm) C1700 Software (C1700-Y-M), Version 12.2(11)T, RELEASE  
SOFTWARE (fcl)

TAC Support: <http://www.cisco.com/tac>

Copyright (c) 1986-2002 by cisco Systems, Inc.

Compiled Wed 31-Jul-02 09:08 by ccai

Image text-base: 0x80008124, data-base: 0x807E332C

ROM: System Bootstrap, Version 12.2(7r)XM1, RELEASE SOFTWARE (fcl)

Router uptime is 12 minutes

System returned to ROM by power-on

System image file is "flash:c1700-y-mz.122-11.T.bin"

cisco 1721 (MPC860P) processor (revision 0x100) with 29492K/3276K bytes  
of memory

Processor board ID FOC06380F95 (3103823619), with hardware revision 0000

MPC860P processor: part number 5, mask 2

Bridging software.

X.25 software, Version 3.0.0.

1 FastEthernet/IEEE 802.3 interface(s)

2 Serial(sync/async) network interface(s)

32K bytes of non-volatile configuration memory.

16384K bytes of processor board System flash (Read/Write)

--More--

Configuration register is 0x2102

## Erasing and reloading the router

Enter into the privileged EXEC mode by typing **enable**.

```
Router>enable
```

If prompted for a password, enter **class**. If “class” does not work, ask the instructor for assistance.

At the privileged EXEC mode, enter the command **erase startup-config**.

```
Router#erase startup-config
```

The responding line 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
```

Now at the privileged EXEC mode, enter the command **reload**.

```
Router#reload
```

The responding line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Proceed with reload? [confirm]
```

Press **Enter** to confirm.

In the first line of the response will be:

```
Reload requested by console.
```

After the router has reloaded the line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Press RETURN to get started!
```

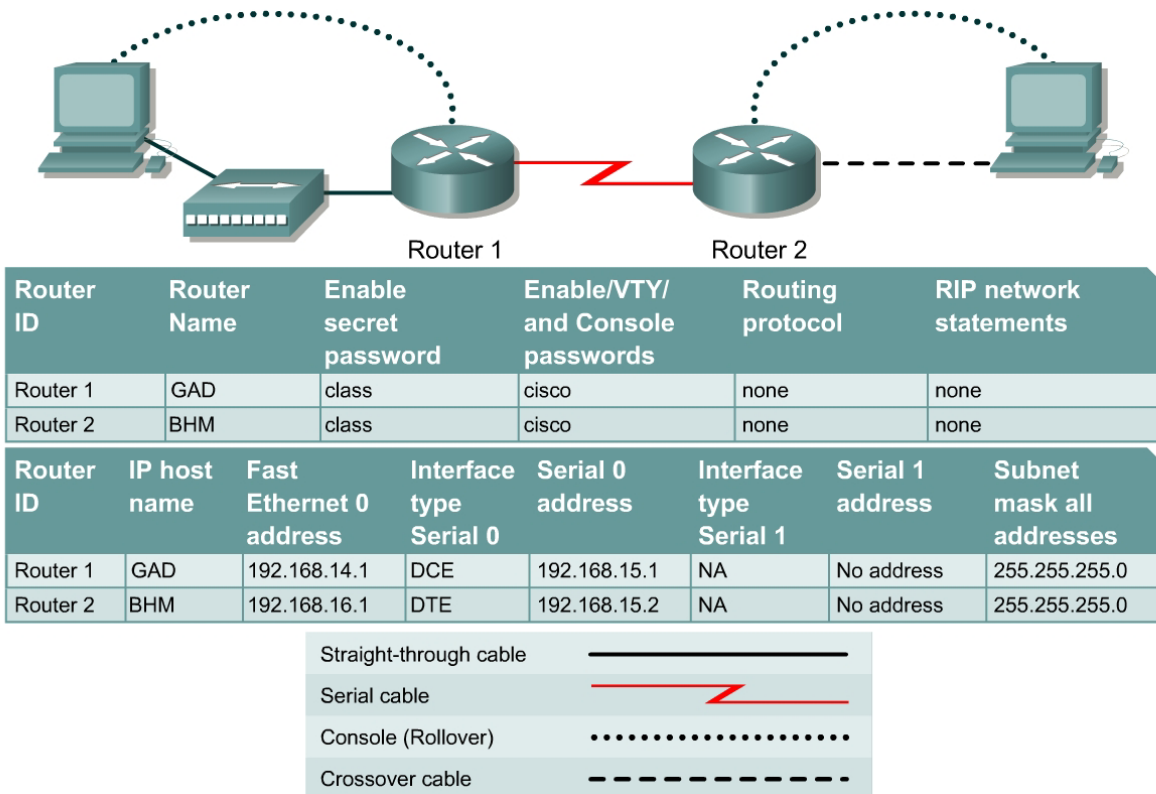
Press **Enter**.

The router is ready for the assigned lab to be performed.



Router Interface Summary					
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2	Interface #5
800 (806)	Ethernet 0 (E0)	Ethernet 1 (E1)			
1600	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
1700	FastEthernet 0 (FA0)	FastEthernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)	
2500	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
2600	FastEthernet 0/0 (FA0/0)	FastEthernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)	
In order to find out exactly how the router is configured, look at the interfaces. This will identify the type of router as well as how many interfaces the router has. There is no way to effectively list all of the combinations of configurations for each router class. What is provided are the identifiers for the possible combinations of interfaces in the device. This interface chart does not include any other type of interface even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in IOS command to represent the interface.					

## Lab 6.1.6 Configuring Static Routes



### Objective

- Configure static routes between routers to allow data transfer between routers without the use of dynamic routing protocols.

### Background/Preparation

Setup a network similar to the one in the diagram. Any router that meets the interface requirements may be used. Possible routers include 800, 1600, 1700, 2500, 2600 routers, or a combination. Refer to the chart at the end of the lab to correctly identify the interface identifiers to be used based on the equipment in the lab. The configuration output used in this lab is produced from 1721 series routers. Any other router used may produce slightly different output. The following steps are intended to be executed on each router unless specifically instructed otherwise.

Start a HyperTerminal session as performed in the Establishing a HyperTerminal session lab.

**Note:** Go to the erase and reload instructions at the end of this lab. Perform those steps on all routers in this lab assignment before continuing.

### Step 1 Configure both routers

- Enter the global configuration mode and configure the hostname as shown in the chart. Then configure the console, virtual terminal, and enable passwords. If there are any difficulties, refer to

the Configuring router passwords lab. Configure interfaces and IP host tables. If there are any difficulties, refer to the Configuring Host Tables lab. Do not configure a routing protocol.

## Step 2 Configure the workstations

Configure the workstations with the proper IP address, subnet mask, and default gateway.

- a. The configuration for the host connected to the GAD Router is:

IP Address 192.168.14.2

IP subnet mask 255.255.255.0

Default gateway 192.168.14.1

- b. The configuration for the host connected to the BHM Router is:

IP Address 192.168.16.2

IP subnet mask 255.255.255.0

Default gateway 192.168.16.1

- c. Check connectivity between the workstations using **ping**. From the workstation attached to the GAD router, ping the workstation attached to the BHM router.

```
C:\>ping 192.168.16.2
```

```
Pinging 192.168.16.2 with 32 bytes of data:
```

```
Request timed out.
```

```
Request timed out.
```

```
Request timed out.
```

```
Request timed out.
```

```
Ping statistics for 192.168.16.2:
```

```
Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

```
Approximate round trip times in milli-seconds:
```

```
Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

- d. Was the **ping** successful? \_\_\_\_\_
- e. Why did the **ping** fail? \_\_\_\_\_

## Step 3 Check interface status

- a. Check the interfaces on both routers with the command **show ip interface brief**.
- b. Are all the necessary interfaces up? \_\_\_\_\_

## Step 4 Check the routing table entries

- a. Using the command **show ip route**, view the IP routing table for GAD.

```
GAD>show ip route
```

```
output eliminated
```

```
Gateway of last resort is not set
```

```
C    192.168.14.0/24 is directly connected, FastEthernet0
```

```
C    192.168.15.0/24 is directly connected, Serial0
```

- b. Use the command **show ip route**, view the IP routing table for BHM.

```
BHM>show ip route
```

Output eliminated.

```
Gateway of last resort is not set
```

```
C    192.168.15.0/24 is directly connected, Serial0
```

```
C    192.168.16.0/24 is directly connected, FastEthernet0
```

- c. Are all of the routes needed in the routing tables? \_\_\_\_\_
- d. "Based on the output from the show ip route command on the GAD and BHM routers, can a host on network 192.168.16.0 connect to a host on network 192.168.14.0?" \_\_\_\_\_

If a route is not in the routers to which the host is connected, the host cannot reach the destination host.

### Step 5 Adding static routes

- a. How can this situation be changed so that the hosts can ping each other?

Add static routes to each router or run a routing protocol.

- b. In global configuration mode, add a static route on Router1 to network 192.168.16.0 and on Router2 to network 192.168.14.0.

```
GAD(config)#ip route 192.168.16.0 255.255.255.0 192.168.15.2
```

```
BHM(config)#ip route 192.168.14.0 255.255.255.0 192.168.15.1
```

- c. Why is a static route needed on both routers? \_\_\_\_\_

### Step 6 Verify the new routes

- a. Use the command **show ip route**, view the IP routing table for GAD.

```
GAD>show ip route
```

output eliminated

```
Gateway of last resort is not set
```

```
C    192.168.14.0/24 is directly connected, FastEthernet0
```

```
C    192.168.15.0/24 is directly connected, Serial0
```

```
S    192.168.16.0/24 [1/0] via 192.168.15.2
```

- b. Using the command **show ip route**, view the IP routing table for BHM.

```
BHM>show ip route
```

Output eliminated.

```
Gateway of last resort is not set
```

```
S    192.168.14.0/24 [1/0] via 192.168.15.1
```

```
C    192.168.15.0/24 is directly connected, Serial0
```

```
C    192.168.16.0/24 is directly connected, FastEthernet0
```

- c. Are all of the routes needed in the routing tables? \_\_\_\_\_
- d. Can a host on subnet 192.168.16.0 see a host on network 192.168.14.0? \_\_\_\_\_

### Step 7 ping host to host again

- a. Check connectivity between the workstations using **ping**. From the workstation attached to the GAD router, ping the workstation attached to the BHM router.

```
C:\>ping 192.168.16.2
Pinging 192.168.16.2 with 32 bytes of data:
Reply from 192.168.16.2: bytes=32 time=20ms TTL=254
Reply from 192.168.16.2: bytes=32 time=20ms TTL=254
Reply from 192.168.16.2: bytes=32 time=20ms TTL=254
Reply from 192.168.16.2: bytes=32 time=20ms TTL=254
Ping statistics for 192.168.16.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 20ms, Maximum = 20ms, Average = 20ms
```

- b. If the **ping** was not successful, check routing table to make sure static routes are entered correctly.

Upon completion of the previous steps, logoff by typing **exit**. Turn the router off.

## Erasing and reloading the router

Enter into the privileged EXEC mode by typing **enable**.

If prompted for a password, enter **class**. If “class” does not work, ask the instructor for assistance.

```
Router>enable
```

At the privileged EXEC mode, enter the command **erase startup-config**.

```
Router#erase startup-config
```

The responding line 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
```

Now at the privileged EXEC mode, enter the command **reload**.

```
Router#reload
```

The responding line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Proceed with reload? [confirm]
```

Press **Enter** to confirm.

In the first line of the response will be:

```
Reload requested by console.
```

After the router has reloaded the line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

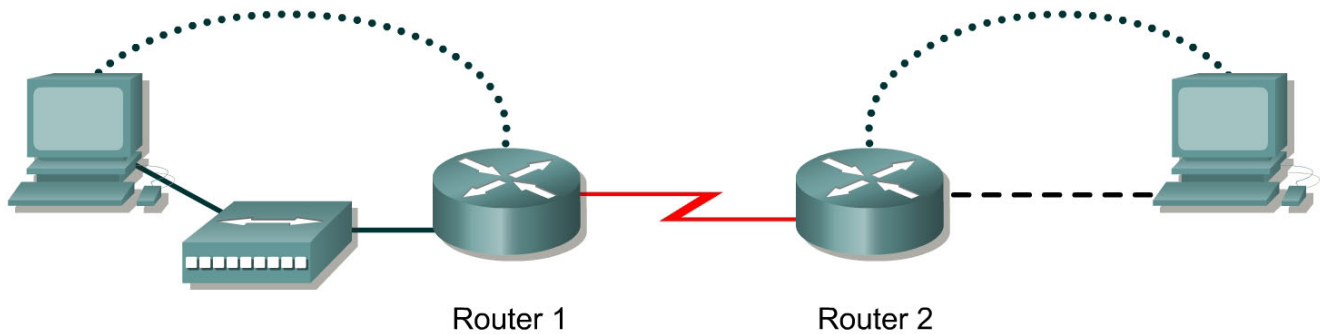
```
Press RETURN to get started!
```

Press **Enter**.

The router is ready for the assigned lab to be performed.

Router Interface Summary					
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2	Interface #5
800 (806)	Ethernet 0 (E0)	Ethernet 1 (E1)			
1600	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
1700	FastEthernet 0 (FA0)	FastEthernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)	
2500	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
2600	FastEthernet 0/0 (FA0/0)	FastEthernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)	
In order to find out exactly how the router is configured, look at the interfaces. This will identify the type of router as well as how many interfaces the router has. There is no way to effectively list all of the combinations of configurations for each router class. What is provided are the identifiers for the possible combinations of interfaces in the device. This interface chart does not include any other type of interface even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in IOS command to represent the interface.					

## Lab 7.2.2 Configuring RIP



Router Designation	Router Name	Fast Ethernet 0 Address	Interface type	Serial 0 Address	Subnet mask for both interfaces	Enable secret password	Enable, VTY and console password
Router 1	GAD	172.16.0.1	DCE	172.17.0.1	255.255.0.0	class	cisco
Router 2	BHM	172.18.0.1	DTE	172.17.0.2	255.255.0.0	class	cisco

Straight-through cable	—————
Serial cable	————— —————
Console (Rollover)	.....
Crossover cable	- - - - -

### Objective

- Setup an IP addressing scheme using class B networks.
- Configure the RIP dynamic routing protocol on routers.

### Background/Preparation

Setup a network similar to the one in the diagram. Any router that meets the interface requirements displayed in the above diagram, such as 800, 1600, 1700, 2500, 2600 routers, or a combination, may be used. Please refer to the chart at the end of the lab to correctly identify the interface identifiers to be used based on the equipment in the lab. The configuration output used in this lab is produced from 1721 series routers. Any other router used may produce a slightly different output. The following steps are intended to be executed on each router unless specifically instructed otherwise.

Start a HyperTerminal session as performed in the Establishing a HyperTerminal session lab.

**Note:** Go to the erase and reload instructions at the end of this lab. Perform those steps on all routers in this lab assignment before continuing.



## Step 1 Configure the routers

- a. From the global configuration mode, configure the hostname as shown in the chart. Then configure the console, virtual terminal, and enable passwords. If there is a problem doing this, refer to the configuring router passwords lab. Next, configure the interfaces according to the chart. Refer to the Configuring Host Tables lab for assistance.

## Step 2 Check the routing table entries

- a. Using the command **show ip route**, view the IP routing table for GAD.

```
GAD>show ip route
```

```
output eliminated
```

```
Gateway of last resort is not set
```

```
C    172.16.0.0/16 is directly connected, FastEthernet0
```

```
C    172.17.0.0/16 is directly connected, Serial0
```

- b. Using the command **show ip route**, view the IP routing table for BHM.

```
BHM>show ip route
```

```
output eliminated
```

```
Gateway of last resort is not set
```

```
C    172.17.0.0/24 is directly connected, Serial0
```

```
C    172.18.0.0/24 is directly connected, FastEthernet0
```

## Step 3 Configure the routing protocol on the GAD router

- a. From the global configuration mode, enter the following:

```
GAD(config)#router rip
GAD(config-router)#network 172.16.0.0
GAD(config-router)#network 172.17.0.0
GAD(config-router)#exit
GAD(config)#exit
```

## Step 4 Save the GAD router configuration

```
GAD#copy running-config startup-config
```

## Step 5 Configure the routing protocol on the BHM router

- a. From the global configuration mode, enter the following:

```
BHM(config)#router rip
BHM(config-router)#network 172.17.0.0
BHM(config-router)#network 172.18.0.0
BHM(config-router)#exit
BHM(config)#exit
```

### Step 6 Save the BHM router configuration

```
BHM#copy running-config startup-config
```

### Step 7 Configure the hosts with the proper IP address, subnet mask and default gateway

### Step 8 Verify that the internetwork is functioning by pinging the FastEthernet interface of the other router

- a. From the host attached to GAD, is it possible to ping the BHM router FastEthernet interface?  
\_\_\_\_\_
- b. From the host attached to BHM, is it possible to ping the GAD router FastEthernet interface?  
\_\_\_\_\_
- c. If the answer is no for either question, troubleshoot the router configurations to find the error. Then do the pings again until the answer to both questions is yes.

### Step 9 Show the routing tables for each router

- a. From the enable or privileged EXEC mode, examine the routing table entries using the **show ip route** command on each router.
- b. What are the entries in the GAD routing table?

---

- c. What are the entries in the BHM routing table?

---

Upon completion of the previous steps, log off by typing **exit** and turn the router off.

## Erasing and reloading the router

Enter into the privileged EXEC mode by typing **enable**.

If prompted for a password, enter **class**. If “class” does not work, ask the instructor for assistance.

```
Router>enable
```

At the privileged EXEC mode, enter the command **erase startup-config**.

```
Router#erase startup-config
```

The responding line 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
```

Now at the privileged EXEC mode, enter the command **reload**.

```
Router(config)#reload
```

The responding line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Proceed with reload? [confirm]
```

Press **Enter** to confirm.

In the first line of the response will be:

```
Reload requested by console.
```

After the router has reloaded the line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Press RETURN to get started!
```

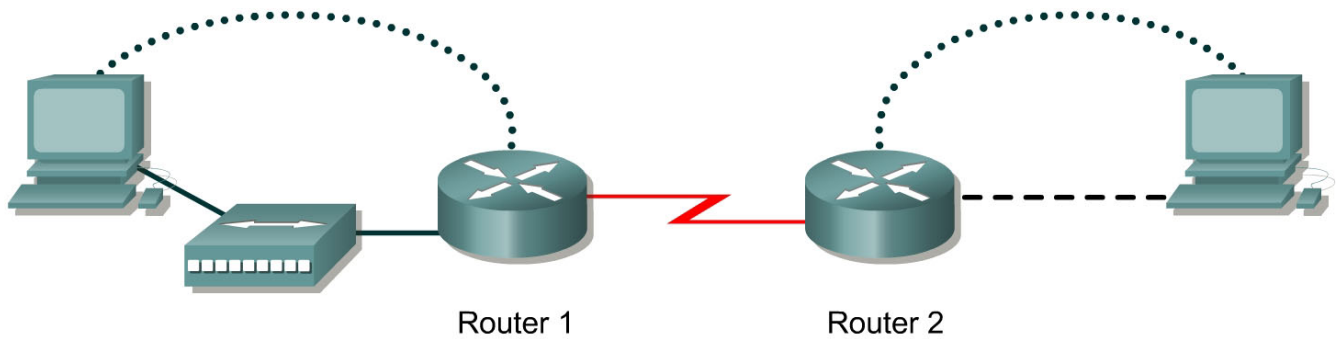
Press **Enter**.

The router is ready for the assigned lab to be performed.

Router Interface Summary					
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2	Interface #5
800 (806)	Ethernet 0 (E0)	Ethernet 1 (E1)			
1600	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
1700	FastEthernet 0 (FA0)	FastEthernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)	
2500	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
2600	FastEthernet 0/0 (FA0/0)	FastEthernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)	
In order to find out exactly how the router is configured, look at the interfaces. This will identify the type of router as well as how many interfaces the router has. There is no way to effectively list all of the combinations of configurations for each router class. What is provided are the identifiers for the possible combinations of interfaces in the device. This interface chart does not include any other type of interface even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in IOS command to represent the interface.					



## Lab 7.2.6 Troubleshooting RIP



Router Designation	Router Name	Fast Ethernet 0 Address	Interface type	Serial 0 Address	Subnet mask for both interfaces	Enable secret password	Enable, VTY and console password
Router 1	GAD	172.16.0.1	DCE	172.17.0.1	255.255.0.0	class	cisco
Router 2	BHM	172.18.0.1	DTE	172.17.0.2	255.255.0.0	class	cisco

Straight-through cable	—————
Serial cable	————— <del>      </del>
Console (Rollover)	.....
Crossover cable	- - - - -

### Objective

- Set up an IP addressing scheme using class B networks.
- Configure RIP on routers.
- Observe routing activity using the `debug ip rip` command.
- Examine routes using the `show ip route` command.

### Background/Preparation

Cable a network similar to the one in the diagram. Any router that meets the interface requirements displayed in the above diagram, such as 800, 1600, 1700, 2500, 2600 routers, or a combination, may be used. Please refer to the chart at the end of the lab to correctly identify the interface identifiers to be used based on the equipment in the lab. The configuration output used in this lab is produced from 1721 series routers. Any other router used may produce a slightly different output.

The following steps are intended to be executed on each router unless specifically instructed otherwise.

Start a HyperTerminal session as performed in the Establishing a HyperTerminal session lab.

**Note:** Go to the erase and reload instructions at the end of this lab. Perform those steps on all routers in this lab assignment before continuing.

### Step 1 Configure the routers

- a. On the routers, enter the global configuration mode and configure the hostname as shown in the chart. Then configure the console, virtual terminal and enable passwords. If there is a problem doing this, refer to the Configuring Router Passwords lab. Next configure the interfaces according to the chart. If there is a problem doing this, refer to the Configuring Host Tables lab. Finally configure the RIP routing. This is covered in the Configuring RIP lab if help is needed. Do not forget to save the configurations to the startup configuration file.

### Step 2 Configure the hosts with the proper IP address, subnet mask and default gateway

### Step 3 Make sure that routing updates are being sent

- a. Type the command `debug ip rip` and the privileged EXEC mode prompt. Wait for at least 45 seconds.
- b. Was there any output from the debug command? \_\_\_\_\_
- c. What did the output show ? \_\_\_\_\_
- d. To turn off specific debug commands type the **no** option, for example `no debug ip rip events`. To turn off all debug commands type `undebug all`.

### Step 4 Show the routing tables for each router

- a. From the enable or privileged EXEC mode, examine the routing table entries, using `show ip route` command on each router.
- b. What are the entries in the GAD routing table?

\_\_\_\_\_

- c. What are the entries in the BHM routing table?

\_\_\_\_\_

### Step 5 Show the RIP routing table entries for each router

- a. Enter `show ip route rip`
- b. List the routes listed in the routing table? \_\_\_\_\_
- c. What is the administrative distance? \_\_\_\_\_

### Step 6 Verify that the internetwork is functioning by pinging the FastEthernet interface of the other router

- a. From the host attached to GAD, is it possible to ping the BHM router FastEthernet interface?

\_\_\_\_\_

- b. From the host attached to BHM, is it possible to ping the GAD router FastEthernet interface?

\_\_\_\_\_

- c. If the answer is no for either question, troubleshoot the router configurations using **show ip route** to find the error. Also check the workstation IP settings. Then do the pings again until the answer to both questions is yes.

Upon completion of the previous steps, log off by typing **exit** and turn the router off.

## Erasing and reloading the router

Enter into the privileged EXEC mode by typing **enable**.

If prompted for a password, enter **class**. If “class” does not work, ask the instructor for assistance.

```
Router>enable
```

At the privileged EXEC mode, enter the command **erase startup-config**.

```
Router#erase startup-config
```

The responding line 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
```

Now at the privileged EXEC mode, enter the command **reload**.

```
Router#reload
```

The responding line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Proceed with reload? [confirm]
```

Press **Enter** to confirm.

In the first line of the response will be:

```
Reload requested by console.
```

After the router has reloaded the line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Press RETURN to get started!
```

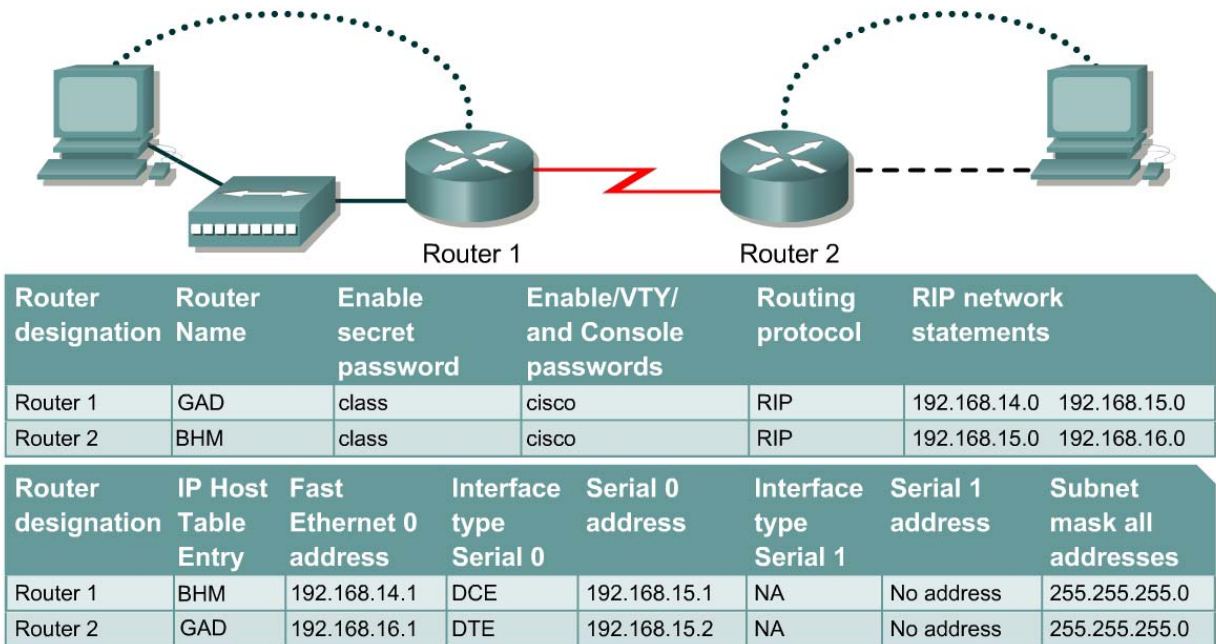
Press **Enter**.

The router is ready for the assigned lab to be performed.



Router Interface Summary					
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2	Interface #5
800 (806)	Ethernet 0 (E0)	Ethernet 1 (E1)			
1600	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
1700	FastEthernet 0 (FA0)	FastEthernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)	
2500	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
2600	FastEthernet 0/0 (FA0/0)	FastEthernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)	
In order to find out exactly how the router is configured, look at the interfaces. This will identify the type of router as well as how many interfaces the router has. There is no way to effectively list all of the combinations of configurations for each router class. What is provided are the identifiers for the possible combinations of interfaces in the device. This interface chart does not include any other type of interface even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in IOS command to represent the interface.					

## Lab 7.2.7 Preventing Routing Updates Through an Interface



Note: The IP Host Table Entry column contents indicate the name(s) of the other router(s) in the IP host table.



### Objective

- Prevent routing updates through an interface to regulate advertised routes.
- Use the **Passive-interface** command and add a default route.

### Background/Preparation

This lab will focus on preventing routing updates through an interface to regulate advertised routes and observing the results. To make this work, it is necessary to use the **Passive-interface** command and add a default route.

Cable a network similar to the one in the diagram. Any router that meets the interface requirements displayed in the above diagram, such as 800, 1600, 1700, 2500, 2600 routers, or a combination, may be used. Please refer to the chart at the end of the lab to correctly identify the interface identifiers to be used based on the equipment in the lab. The configuration output used in this lab is produced from 1721 series routers. Any other router used may produce a slightly different output. The following steps are intended to be executed on each router unless specifically instructed otherwise.

Start a HyperTerminal session as performed in the Establishing a HyperTerminal session lab.

**Note:** Go to the erase and reload instructions at the end of this lab. Perform those steps on all routers in this lab assignment before continuing.

### Step 1 Configure the hostname and passwords on the routers

- a. On the routers, enter the global configuration mode and configure the hostname as shown in the chart. Then configure the console, virtual terminal and enable passwords. When having a problem doing this, refer to the Configuring router passwords lab. Next configure the interfaces and routing according to the chart. If there is a problem doing this, refer to the Configuring Host Tables lab and the Configuring RIP lab. Make sure to copy the **running-config** to the **startup-config** on each router.

### Step 2 Configure the hosts with the proper IP address, subnet mask and default gateway

- a. Test the configuration by pinging all interfaces from each host. If the pinging is not successful, troubleshoot the configuration.

### Step 3 Check Basic Routing Configuration

- a. Enter **show ip protocol** command on each router.
- b. In the configuration, is "Routing protocol is RIP" displayed?  
\_\_\_\_\_.
- c. Enter the command **show ip route** on both routers. List how the route is connected (directly, RIP), the IP address and via what network or interface.

#### GAD

Route connected	IP address	Through Network / Interface

#### BHM

Route connected	IP address	Through Network / Interface

### Step 4 Observe RIP routing updates

- a. From the GAD router, use the **debug ip rip** command to verify that the router is sending updates out the interface to the BHM router. Look for a section in the output that looks something like the following:

```
GAD#debug ip rip
RIP protocol debugging is on
GAD#
*Mar 1 03:12:17.555: RIP: sending v1 update to 255.255.255.255 via
FastEthernet 0 (192.168.14.1)
*Mar 1 03:12:17.555: RIP: build update entries
*Mar 1 03:12:17.555:   network 192.168.15.0 metric 1
*Mar 1 03:12:17.555:   network 192.168.16.0 metric 2
*Mar 1 03:12:17.555: RIP: sending v1 update to 255.255.255.255 via
Serial0 (192.168.15.1)
*Mar 1 03:12:17.555: RIP: build update entries
*Mar 1 03:12:17.555:   network 192.168.14.0 metric 1
```

```
*Mar 1 03:12:22.671: RIP: received v1 update from 192.168.15.2 on
Serial0
*Mar 1 03:12:22.671:    192.168.16.0 in 1 hops
```

- b. Other **debug** commands that function with RIP are the following:

```
debug ip rip events
debug ip rip trigger
debug ip rip database
```

- c. To turn off specific **debug** commands type the **no** option, such as **no debug ip rip events**. To turn off all **debug** commands type **undebug all**.

### Step 5 Stop routing updates from GAD to BHM

- On the console session for the GAD router, enter global configuration mode and then enter router configuration mode by entering the command **router rip**. Enter the command **passive-interface serial 0**. Refer to the chart at the end of the sheet for the model or router. This will prevent the GAD router from advertising its routes to the BHM router.
- To confirm this, use the **debug ip rip events** command on the GAD router. Verify from the output that the router is not sending updates out the interface to the BHM router.
- Disable the debug output with the **no debug all** command.
- Also from the BHM router, issue the **show ip route** to verify that the route to the GAD LAN has been removed.
- Attempt to ping from the computers in GAD to the computers in BHM.
- What is the response? \_\_\_\_\_
- Confirm that the BHM router is still sending update to GAD. To do this, use the **debug ip rip events** command on the BHM router. Verify from the output that the router is sending updates out the interface to the GAD router.
- How many routes are being sent? \_\_\_\_\_
- Disable the debug output with the **no debug all** command.

### Step 6 Add Default Route to BHM

- Since BHM is not getting routing updates, it does not have a route to the outside world. It needs to be provided with a default route. A default route is the route that data is sent out if the routing table does not have a specific route to use.
- From the global configuration mode of BHM, enter:

```
BHM(config)#ip route 0.0.0.0 0.0.0.0 192.168.15.1
```

- Verify the default route is in the BHM routing table by issuing the **show ip route** command. There should be an output similar to the following:

```
BHM#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
```

i - IS-IS, L1 - IS-IS level-1, \* - candidate default  
U - per-user static route, o - ODR

Gateway of last resort is 192.168.15.1 to network 0.0.0.0

```
C 192.168.15.0/24 is directly connected, Serial0
C 192.168.16.0/24 is directly connected, Ethernet0
S* 0.0.0.0/0 [1/0] via 192.168.15.1
BHM#
```

- d. Be sure to be able to ping from the computers in GAD to the computers in BHM. If not check routing tables and interfaces.

Upon completion of the previous steps, log off by typing **exit** and turn the router off.

## Erasing and reloading the router

Enter into the privileged EXEC mode by typing **enable**.

If prompted for a password, enter **class**. If “class” does not work, ask the instructor for assistance.

```
Router>enable
```

At the privileged EXEC mode, enter the command **erase startup-config**.

```
Router#erase startup-config
```

The responding line 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
```

Now at the privileged EXEC mode, enter the command **reload**.

```
Router#reload
```

The responding line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Proceed with reload? [confirm]
```

Press **Enter** to confirm.

In the first line of the response will be:

```
Reload requested by console.
```

After the router has reloaded the line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

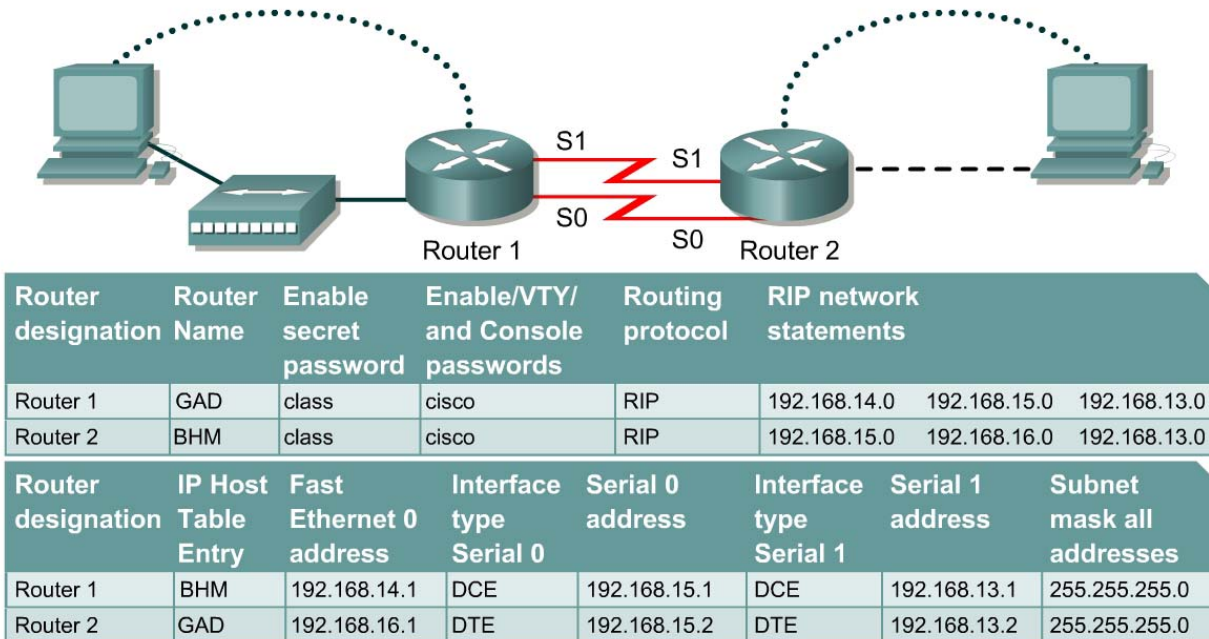
```
Press RETURN to get started!
```

Press **Enter**.

The router is ready for the assigned lab to be performed.

Router Interface Summary					
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2	Interface #5
800 (806)	Ethernet 0 (E0)	Ethernet 1 (E1)			
1600	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
1700	FastEthernet 0 (FA0)	FastEthernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)	
2500	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
2600	FastEthernet 0/0 (FA0/0)	FastEthernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)	
In order to find out exactly how the router is configured, look at the interfaces. This will identify the type of router as well as how many interfaces the router has. There is no way to effectively list all of the combinations of configurations for each router class. What is provided are the identifiers for the possible combinations of interfaces in the device. This interface chart does not include any other type of interface even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in IOS command to represent the interface.					

## Lab 7.2.9 Load Balancing Across Multiple Paths



Note: The IP Host Table Entry column contents indicate the name(s) of the other router(s) in the IP host table.

Straight-through cable		Console (Rollover)	
Serial cable		Crossover cable	

### Objective

- Configure Load balance across multiple paths.
- Observe the load balancing process.

### Background/Preparation

Cable a network similar to the one in the diagram. Any router that meets the interface requirements displayed in the above diagram, such as 800, 1600, 1700, 2500, and 2600 routers, or a combination, may be used. Please refer to the chart at the end of the lab to correctly identify the interface identifiers to be used based on the equipment in the lab. The configuration output used in this lab is produced from 1721 series routers. Any other router used may produce a slightly different output. The following steps are intended to be executed on each router unless specifically instructed otherwise.

Start a HyperTerminal session as performed in the Establishing a HyperTerminal session lab.

**Note:** Go to the erase and reload instructions at the end of this lab. Perform those steps on all routers in this lab assignment before continuing.



## Step 1 Configure the hostname and passwords on the routers

- On the routers, enter the global configuration mode and configure the hostname as shown in the chart. Then configure the console, virtual terminal, and enable passwords. If there are problems doing this, refer to the Configuring Router Passwords lab. Next configure the interfaces and routing according to the chart. If there are problems doing this, refer to the Configuring Host Tables lab and the Configuring RIP lab. Make sure to copy the **running-config** to the **startup-config** on each router so the configuration will not be lost if the router is power-cycled.

## Step 2 Configure the hosts with the proper IP address, subnet mask and default gateway

- Test the configuration by pinging all interfaces from each host. If the pinging is not successful troubleshoot the configuration.

## Step 3 Check Basic Routing Configuration

- Enter **show ip protocol** command on each router.
- In the configuration, is "Routing protocol is RIP" displayed?  
\_\_\_\_\_
- Enter the command **show ip route** on both routers. List how the route is connected (directly, RIP), the IP address and via through what network. There should be four routes in each table.

### GAD

Route connected	IP address	Through Network / Interface

### BHM

Route connected	IP address	Through Network / Interface

- Circle the evidence of load balancing in the above output.

## Step 4 Make sure that the router load balance is on a per-packet basis

- Configure the router to load balance on a per-packet basis. Both serial interfaces must use process switching. Process switching forces the router to look in the routing table for the destination network of each routed packet. In contrast, fast-switching, which is the default, stores the initial table lookup in a high-speed cache and uses the information to route packets to the same destination.
- Enable process switching on both serial interfaces:  

```
GAD(config-if) # no ip route-cache  
BHM(config-if) # no ip route-cache
```
- Verify that fast switching is disabled by using the **show ip interface** command.
- Was fast switching disabled? \_\_\_\_\_

### Step 5 Verify per-packet load balancing

- a. Because there are two routes to the destination network, half the packets will be sent along one path, and half will travel over the other. The path selection alternates with each packet received.
- b. Observe this process by using the `debug ip packet` command on the GAD.
- c. Send 30 ping packets across the network from the host attached to BHM router to the host attached to the GAD router. This can be done with the `ping 192.168.16.2 - n 30` command on the host. As the pings are responded to the router generates IP packet information. Stop the debug by using the command `undebug all` on the GAD router.
- d. Examine and record part of the debug output.
- e. What is the evidence of load balancing in the output? \_\_\_\_\_

### Step 6 Verify per-destination load balancing

- a. After verifying per-packet load balancing, configure the router to use per-destination load balancing. Both serial interfaces must use fast switching so that the route-cache can be used after the initial table lookup.
- b. Use the command `GAD(config-if) #ip route-cache`.
- c. Use the `show ip interface` to verify that fast switching is enabled.
- d. Is fast switching enabled? \_\_\_\_\_
- e. The routing table is consulted only once per destination, therefore, packets that are part of a packet train to a specific host will all follow the same path. Only when a second destination forces another table lookup or when the cached entry expires will the alternate path be used.  
  
Use the `debug ip packet` command and `ping` across the network. Note which serial interface the packet was sent out on.
- f. Examine and record part of the debug output. Which serial interface was the packet sent out on?  
  
\_\_\_\_\_

Upon completion of the previous steps, log off by typing `exit` and turn the router off.

## Erasing and reloading the router

Enter into the privileged exec mode by typing **enable**.

If prompted for a password, enter **class**. If “class” does not work, ask the instructor for assistance.

```
Router>enable
```

At the privileged exec mode enter the command **erase startup-config**.

```
Router#erase startup-config
```

The responding line 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
```

Now at the privileged exec mode enter the command **reload**.

```
Router#reload
```

The responding line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Proceed with reload? [confirm]
```

Press **Enter** to confirm.

In the first line of the response will be:

```
Reload requested by console.
```

After the router has reloaded the line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

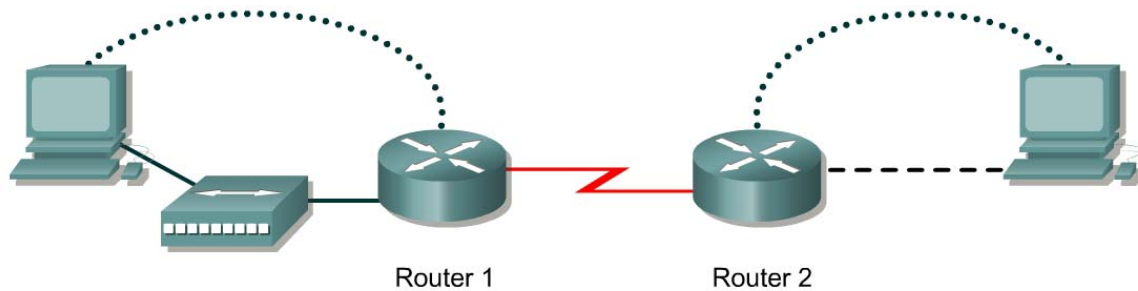
```
Press RETURN to get started!
```

Press **Enter**.

The router is ready for the assigned lab to be performed.

Router Interface Summary					
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2	Interface #5
800 (806)	Ethernet 0 (E0)	Ethernet 1 (E1)			
1600	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
1700	FastEthernet 0 (FA0)	FastEthernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)	
2500	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
2600	FastEthernet 0/0 (FA0/0)	FastEthernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)	
In order to find out exactly how the router is configured, look at the interfaces. This will identify the type of router as well as how many interfaces the router has. There is no way to effectively list all of the combinations of configurations for each router class. What is provided are the identifiers for the possible combinations of interfaces in the device. This interface chart does not include any other type of interface even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in IOS command to represent the interface.					

## Lab 7.3.5 Configuring IGRP



Router Designation	Router Name	Fast Ethernet 0 Address	Interface type	Serial 0 Address	Subnet mask for both interfaces	Enable secret password	Enable, VTY and console password
Router 1	GAD	192.168.20.1	DCE	192.168.22.1	255.255.255.0	class	cisco
Router 2	BHM	192.168.25.1	DTE	192.168.22.2	255.255.255.0	class	cisco

Straight-through cable	—————
Serial cable	————— 
Console (Rollover)	.....
Crossover cable	- - - - -

### Objective

- Setup IP an addressing scheme using class C networks.
- Configure IGRP on routers.

### Background/Preparation

Cable a network similar to the one in the diagram. Any router that meets the interface requirements displayed in the above diagram, such as 800, 1600, 1700, 2500, and 2600 routers, or a combination, may be used. Please refer to the chart at the end of the lab to correctly identify the interface identifiers to be used based on the equipment in the lab. The configuration output used in this lab is produced from 1721 series routers. Any other router used may produce a slightly different output. The following steps are intended to be executed on each router unless specifically instructed otherwise.

Start a HyperTerminal session as performed in the Establishing a HyperTerminal session lab.

**Note:** Go to the erase and reload instructions at the end of this lab. Perform those steps on all routers in this lab assignment before continuing.

### Step 1 Configure the routers

- a. On the routers, enter the global configuration mode and configure the hostname as shown in the chart. Then configure the console, virtual terminal, and enable passwords. If there is a problem doing this, refer to the Configuring Router Passwords lab. Next configure the interfaces according to the chart. If there is a problem doing this, refer to the Configuring Host Tables lab.

### Step 2 Configure the routing protocol on the GAD router

- a. Configure IGRP using AS 101 on GAD. Go to the proper command mode and enter the following:

```
GAD(config)#router igrp 101  
GAD(config-router)#network 192.168.22.0  
GAD(config-router)#network 192.168.20.0
```

### Step 3 Save the GAD router configuration

```
GAD#copy running-config startup-config
```

### Step 4 Configure the routing protocol on the BHM router

- a. Configure IGRP using AS 101 on BHM. Go to the proper command mode and enter the following:

```
BHM(config)#router igrp 101  
BHM(config-router)#network 192.168.25.0  
BHM(config-router)#network 192.168.22.0
```

### Step 5 Save the BHM router configuration

```
BHM#copy running-config startup-config
```

### Step 6 Configure the hosts with the proper IP address, subnet mask and default gateway

### Step 7 Verify that the internetwork is functioning by pinging the FastEthernet interface of the other router

- a. From the host attached to GAD, is it possible to ping the BHM host? \_\_\_\_\_
- b. From the host attached to BHM, is it possible to ping the GAD host? \_\_\_\_\_
- c. If the answer is no for either question, troubleshoot the router configurations to find the error. Then do the pings again until the answer to both questions is yes.

### Step 8 Show the routing tables for each router

- a. From the enable or privileged exec mode do the following:
- b. Examine the routing table entries by using the **show ip route** command on each router.
- c. What are the entries in the GAD routing table?

---

---

- 
- d. What are the entries in the BHM routing table?
- 
- 
- 

### Step 9 Verify the routing protocol

- Type `show ip protocol` on both routers to verify IGRP is running and that it is the only protocol running.
- Is IGRP the only protocol running on GAD? \_\_\_\_\_
- Is IGRP the only Protocol running on BHM? \_\_\_\_\_

### Step 10 Verify IGRP statements in the running configuration of both routers

- Use the `show run | begin igrp` command on both routers.
  - List the IGRP part of the configuration for GAD:
- 
- 
- 

### Step 11 Verify IGRP routing updates

- Type `debug ip igrp events` on the GAD router at the privileged exec mode.
- Are routing updates being displayed? \_\_\_\_\_
- Where are the updates being sent to? \_\_\_\_\_
- Where are the updates being received from? \_\_\_\_\_
- Turn off debugging.

### Step 12 Verify IGRP routing updates

- Type `debug ip igrp transactions` on the GAD router at the privileged exec mode.
  - How are the outputs of these two debug commands `debug ip igrp events` and `debug ip igrp transactions` different?
- 
- 
- 

- Turn off debugging.

### Step 13 Analyze specific routes

- Type `show ip route 192.168.25.0` on the GAD router at the privileged exec mode
- What is the total delay for this route? \_\_\_\_\_
- What is the minimum bandwidth? \_\_\_\_\_

- d. What is the Reliability of this route? \_\_\_\_\_
- e. What is the minimum MTU size for this route? \_\_\_\_\_
- f. f. Type show ip route 192.168.20.1 on the BHM router at the privileged EXEC mode.
- g. What is the total delay for this route? \_\_\_\_\_
- h. What is the minimum bandwidth? \_\_\_\_\_
- i. What is the Reliability of this route? \_\_\_\_\_
- j. What is the minimum MTU size for this route? \_\_\_\_\_

Upon completion of the previous steps, log off by typing **exit** and turn the router off.



## Erasing and reloading the router

Enter into the privileged exec mode by typing **enable**.

If prompted for a password, enter **class**. If “class” does not work, ask the instructor for assistance.

```
Router>enable
```

At the privileged exec mode enter the command **erase startup-config**.

```
Router#erase startup-config
```

The responding line 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
```

Now at the privileged exec mode enter the command **reload**.

```
Router#reload
```

The responding line prompt will be:

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

Type **n** and then **Enter**.

The responding line prompt will be:

```
Proceed with reload? [confirm]
```

Press **Enter** to confirm.

In the first line of the response will be:

```
Reload requested by console.
```

After the router has reloaded the line prompt will be:

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

Type **n** and then **Enter**.

The responding line prompt will be:

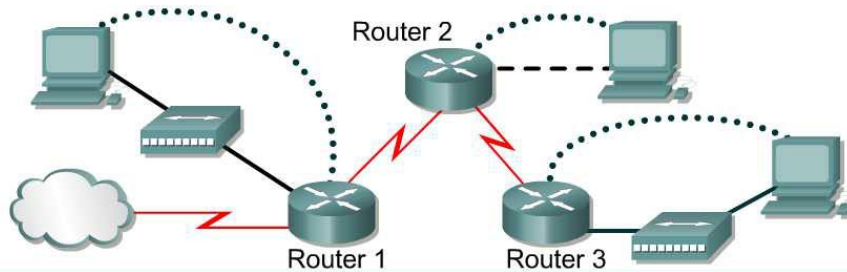
```
Press RETURN to get started!
```

Press **Enter**.

The router is ready for the assigned lab to be performed.

Router Interface Summary					
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2	Interface #5
800 (806)	Ethernet 0 (E0)	Ethernet 1 (E1)			
1600	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
1700	FastEthernet 0 (FA0)	FastEthernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)	
2500	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
2600	FastEthernet 0/0 (FA0/0)	FastEthernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)	
In order to find out exactly how the router is configured, look at the interfaces. This will identify the type of router as well as how many interfaces the router has. There is no way to effectively list all of the combinations of configurations for each router class. What is provided are the identifiers for the possible combinations of interfaces in the device. This interface chart does not include any other type of interface even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in IOS command to represent the interface.					

## Lab 7.3.6 Default Routing with RIP and IGRP



Router designation	Router Name	Enable secret password	Enable/VTY/ and Console passwords	Routing protocol	RIP network statements		
Router 1	Centre	class	cisco	RIP	192.168.2.0	192.168.3.0	
Router 2	Boaz	class	cisco	RIP	192.168.1.0	192.168.2.0	192.168.4.0
Router 3	Mobile	class	cisco	RIP	192.168.1.0	192.168.5.0	

Router designation	IP Host Table Entry	Fast Ethernet 0 address	Interface type Serial 0	Serial 0 address	Interface type Serial 1	Serial 1 address	Subnet mask all addresses
Router 1	Boaz Mobile	192.168.3.1	DTE	192.168.2.2	NA	No address	255.255.255.0
Router 2	Centre Mobile	192.168.4.1	DCE	192.168.1.1	DCE	192.168.2.1	255.255.255.0
Router 3	Boaz Centre	192.168.5.1	DTE	192.168.1.2	NA	No address	255.255.255.0

Note: The IP Host Table Entry column contents indicate the name(s) of the other router(s) in the IP host table.

Straight-through cable		Console (Rollover)	
Serial cable		Crossover cable	

### Objective

- Configure a default route and use RIP to propagate this default information to other routers.
- Migrate the network from RIP to IGRP.
- Configure default routing to work with IGRP

### Background/Preparation

In this lab, a default route will be configured and RIP used to propagate this default information to other routers. When this configuration is working properly, the network will be migrated from RIP to IGRP and default routing will be configured to work with that protocol as well.

Cable a network similar to the one in the diagram. Any router that meets the interface requirements displayed on the above diagram, such as 800, 1600, 1700, 2500, 2600 routers, or a combination, may be used. Please refer to the chart at the end of the lab to correctly identify the interface identifiers to be used based on the equipment in the lab. The configuration output used in this lab is produced from 1721 series routers. Any other router used may produce a slightly different output. The following steps are intended to be executed on each router unless specifically instructed otherwise.

Start a HyperTerminal session as performed in the Establishing a HyperTerminal session lab.

**Note:** Go to the erase and reload instructions at the end of this lab. Perform those steps on all routers in this lab assignment before continuing.

### Step 1 Configure the hostname and passwords on the routers

- a. On the routers, enter the global configuration mode and configure the hostname as shown in the chart. Then configure the console, virtual terminal and enable passwords. If there are problems doing this, refer to the Configuring router passwords lab. Next configure the interfaces and routing according to the chart. If there are problems doing this, refer to the Configuring Host Tables lab and the Configuring RIP lab. Make sure to copy the **running-config** to the **startup-config** on each router so the configuration will not be lost if the router is power recycled.

### Step 2 Configure the hosts with the proper IP address, subnet mask and default gateway

- a. Test the configuration by pinging all interfaces from each host. If the pinging is not successful, troubleshoot the configuration.

### Step 3 Check Basic Routing Configuration

- a. Enter **show ip protocol** command on each router.
- b. In the configuration, is RIP displayed? \_\_\_\_\_

### Step 4 Verify connectivity

- a. To verify connectivity of the network just setup, ping all interfaces from each of the attached hosts. If all interfaces can not be pinged, correct the configuration until all interfaces can be pinged.

### Step 5 Configure Centre as the connection to the Internet Service Provider (ISP)

- a. Configure Centre to simulate the existence of an outside network. The link between the company and its ISP is simulated by configuring a loopback interface with an IP address. Enter the following commands on the Centre router:

```
Centre(config)#interface loopback0
Centre(config-if)#ip address 172.16.1.1 255.255.255.0
```

**Note:** If 172.16.1.1 is pinged from the Centre console, the loopback interface replies.

- b. From the Boaz console, attempt to ping 172.16.1.1. This ping should fail because the 172.16.0.0/16 network is not in the Boaz routing table.
  - c. If no default route exists, what does a router do with a packet destined for a network that is not in its table?
- 

### Step 6 Setup up a default route on the Centre router

- a. A default route must be created on the Centre router pointed at the simulated ISP. Issue the following command on the Centre router in the configuration mode.

```
Centre(config)#ip route 0.0.0.0 0.0.0.0 loopback0
```

- b. This command statically configures the default route. The default route directs traffic destined for networks that are not in the routing table to the ISP WAN link or loopback 0.

- c. In Cisco IOS Software Release 12.0T and later, RIP does not advertise the default route if the route is not learned via RIP. Therefore, depending on the IOS version, RIP may need to be explicitly configured to propagate this 0.0.0.0/0 route. Enter these commands on the Centre router in the proper command mode:

```
Centre(config)#router rip
Centre(config-router)#default-information originate
```

### Step 7 Verify the routing tables

- a. Now check the routing tables of Mobile and Boaz using the `show ip route` command. Verify that they both have received and installed a route to 0.0.0.0/0 in their tables.
- b. On Boaz, what is the metric of this route? \_\_\_\_\_
- c. On Mobile, what is the metric of this route? \_\_\_\_\_
- d. Mobile and Boaz still do not have routes to 172.16.0.0/16 in their tables. From Boaz, `ping 172.16.1.1`. This ping should be successful.
- e. Why does the ping to 172.16.1.1 work, even though there is no route to 172.16.0.0/16 in the Boaz routing table? \_\_\_\_\_
- f. Check to be sure that Mobile can also ping 172.16.1.1. Troubleshoot, if necessary.

### Step 8 Migrate the network from RIP to IGRP

- a. With default routing now working, it is necessary to migrate the network from RIP to IGRP for testing purposes. Issue the following command on all three routers:

```
Mobile(config)#no router rip
```

**Note:** With a normal migration, the IGRP routing protocol would be configured prior to removing the RIP routing protocol. IGRP routes would then replace the RIP routes in the routing table since they have a lower administrative distance and then RIP could then be safely removed.

- b. With RIP removed from each router's configuration, configure IGRP on all three routers using AS 24, as shown:

```
Mobile(config)#router igrp 24
Mobile(config-router)#network 192.168.1.0
Mobile(config-router)#network 192.168.5.0
...
Boaz(config)#router igrp 24
Boaz(config-router)#network 192.168.1.0
Boaz(config-router)#network 192.168.2.0
Boaz(config-router)#network 192.168.4.0
...
Centre(config)#router igrp 24
Centre(config-router)#network 192.168.2.0
Centre(config-router)#network 192.168.3.0
```

- c. Use `ping` and `show ip route` to verify that IGRP is working properly. Do not worry about the 172.16.1.1 loopback address on Centre yet.

## Step 9 Check Centre's routing table for the static default route

- a. Check the Centre routing table. The static default route to 0.0.0.0/0 should still be there. To propagate this route with RIP, the `default-information originate` command was issued. Depending on the IOS version, this might not be necessary. The `default-information originate` command is not available in an IGRP configuration. Therefore, it may be necessary to use a different method to propagate default information in IGRP.

On Centre, issue the following commands:

```
Centre(config)#router igrp 24
Centre(config-router)#network 172.16.0.0
Centre(config-router)#exit
Centre(config)#ip default-network 172.16.0.0
```

- b. These commands configure IGRP to update its neighbor routers about the network 172.16.0.0/16, which includes the simulated ISP link or loopback 0. Not only will IGRP advertise this network, but the `ip default-network` command also will flag this network as a candidate default route. This will be shown by an asterisk in the routing table. When a network is flagged as a default, that flag stays with the route as it passed from neighbor to neighbor by IGRP.
- c. Check the routing tables of Mobile and Boaz. If they do not yet have the 172.16.0.0/16 route with an asterisk, it may be necessary to wait for another IGRP update. This may take up to 90 seconds. Issue the `clear ip route *` command on all three routers in order to force them to immediately send new updates.
- d. When the 172.16.0.0/16 route appears as a candidate default in all three routing tables, proceed to the next step.

## Step 10 Create a second loopback interface on Centre to test the default route

- a. Because the 172.16.0.0/16 network is known explicitly by Mobile and Boaz, it will be necessary to create a second loopback interface on Centre to test the default route. Issue the following commands on Centre:

```
Centre(config)#interface loopback1
Centre(config-if)#ip address 10.0.0.1 255.0.0.0
```

This loopback interface simulates another external network.

- b. Return to Mobile and check its routing table using the `show ip route` command.
- c. Is there a route to the 10.0.0.0/8 network? \_\_\_\_\_  
From Mobile, ping 10.0.0.1. This ping should be successful.
- d. If there is no route to 10.0.0.0/8 and no route to 0.0.0.0/0, why does this ping succeed?

## Erasing and reloading the router

Enter into the privileged exec mode by typing **enable**.

If prompted for a password, enter **class**. If “class” does not work, ask the instructor for assistance.

```
Router>enable
```

At the privileged exec mode, enter the command **erase startup-config**.

```
Router#erase startup-config
```

The responding line 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
```

Now at the privileged exec mode, enter the command **reload**.

```
Router#reload
```

The responding line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Proceed with reload? [confirm]
```

Press **Enter** to confirm.

In the first line of the response will be:

```
Reload requested by console.
```

After the router has reloaded the line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Press RETURN to get started!
```

Press **Enter**.

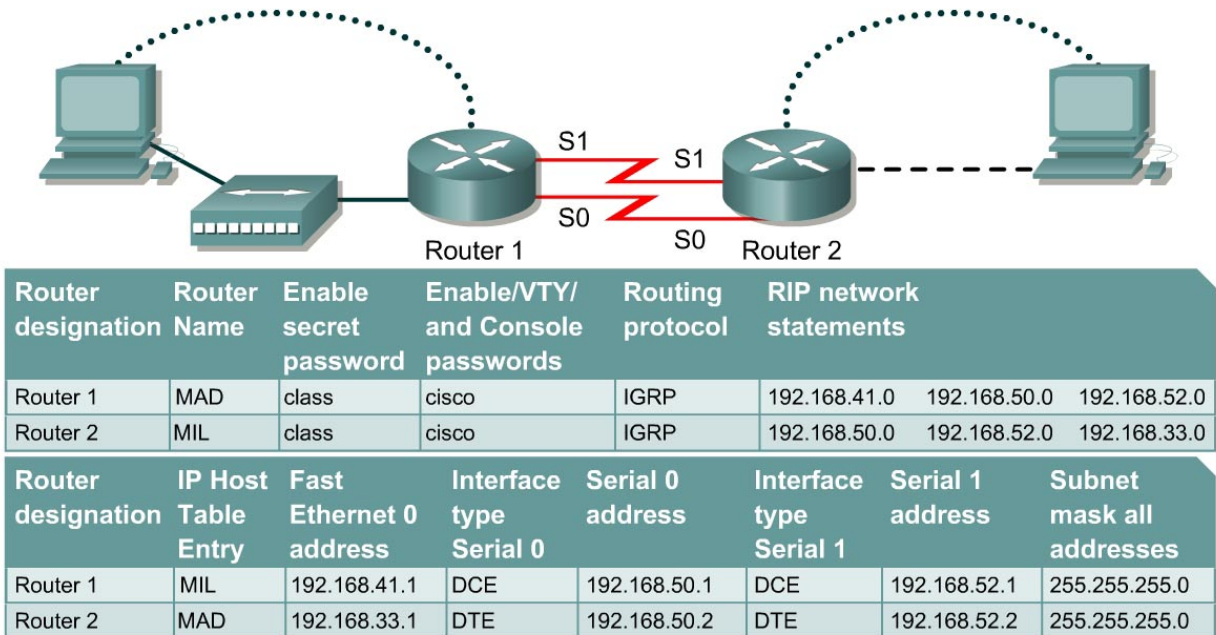
The router is ready for the assigned lab to be performed.

Router Interface Summary					
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2	Interface #5
800 (806)	Ethernet 0 (E0)	Ethernet 1 (E1)			
1600	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
1700	FastEthernet 0 (FA0)	FastEthernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)	
2500	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
2600	FastEthernet 0/0 (FA0/0)	FastEthernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)	
<p>In order to find out exactly how the router is configured, look at the interfaces. This will identify the type of router as well as how many interfaces the router has. There is no way to effectively list all of the combinations of configurations for each router class. What is provided are the identifiers for the possible combinations of interfaces in the device. This interface chart does not include any other type of interface even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in IOS command to represent the interface.</p>					





## Lab 7.3.8 Unequal Cost Load Balancing with IGRP



Note: The IP Host Table Entry column contents indicate the name(s) of the other router(s) in the IP host table.

Straight-through cable		Console (Rollover)	
Serial cable		Crossover cable	

### Objective

- Observe unequal-cost load balancing.
- Tune IGRP networks by using advanced debug commands.

### Background/Preparation

Cable a network similar to the one in the diagram. Any router that meets the interface requirements displayed on the above diagram, such as 800, 1600, 1700, 2500, 2600 routers, or a combination, may be used. Please refer to the chart at the end of the lab to correctly identify the interface identifiers to be used based on the equipment in the lab. The configuration output used in this lab is produced from 1721 series routers. Any other router used may produce a slightly different output. The following steps are intended to be executed on each router unless specifically instructed otherwise.

Start a HyperTerminal session as performed in the Establishing a HyperTerminal session lab.

**Note:** Go to the erase and reload instructions at the end of this lab. Perform those steps on all routers in this lab assignment before continuing.

## Step 1 Configure the hostname and passwords on the routers

- a. On the routers, enter the global configuration mode and configure the hostname as shown in the chart. Then configure the console, virtual terminal and enable passwords. If there are problems doing this, refer to the Configuring router passwords lab. Next configure the interfaces according to the chart. If there are problems doing this, refer to the Configuring Host Tables lab. Finally configure IGRP routing on the routers using the Autonomous System (AS) of 34. If there are problems doing this, refer to the Configuring IGRP lab. Make sure to copy the **running-config** to the **startup-config** on each router.

## Step 2 Configure bandwidth on the MAD router interfaces

- a. In order to make unequal cost load balancing to work, it is necessary need to establish different metrics for the IGRP routes. This is done with the bandwidth command. The serial 0 interface will be set to a bandwidth of 56K and the serial 1 interface will be set to a value of 384K. The route-cache must also be turned off for load balancing. Both serial interfaces must use process switching. Process switching forces the router to look in the routing table for the destination network of each routed packet. In contrast fast-switching, which is the default, stores the initial table lookup in a high-speed cache and uses the info to route packets to the same destination. Enter the following statements on the MAD router:

```
MAD(config)#interface serial 0/0
MAD(config-if)#bandwidth 56
MAD(config-if)#no ip route-cache
MAD(config-if)#interface serial 0/1
MAD(config-if)#bandwidth 384
MAD(config-if)#no ip route-cache
```

- b. Because the IGRP metric includes bandwidth in its calculation, bandwidth must be manually configured on the serial interfaces in order to ensure accuracy. For the purposes of this lab, the alternative paths to network 192.168.41.0 from the MAD router are not of unequal cost until the appropriate bandwidths are set.
- c. Use the **show interface** command output to verify the correct bandwidth settings and the **show ip interface** command to ensure that fast switching is disabled.
- d. Can the bandwidth of Ethernet interfaces be set manually? \_\_\_\_\_

## Step 3 Configure the hosts with the proper IP address, subnet mask and default gateway

- a. Test the configuration by pinging all interfaces from each host. If the pinging is not successful, troubleshoot the configuration.

## Step 4 Use the variance command to configure unequal-cost load balancing

- a. The variance value determines whether IGRP will accept unequal-cost routes. When the **variance** command is used in the IGRP configuration, a router will accept routes less than or equal to the local best metric for the destination multiplied by the variance value. So if the local best metric of an IGRP router for a network is 10476, and the variance is 3, the router will accept unequal-cost routes with any metric up to 31428 or 10,476 x 3. This is as long as the advertising router is closer to the destination. An IGRP router accepts only up to four paths to the same network.

**Note:** An alternate route is added to the route table only if the next-hop router in that path is closer to the destination (has a lower metric value) than the current route.

- b. By default, IGRP variance is set to 1, which means that only routes that are exactly 1 times the local best metric are installed. Therefore, a variance of 1 disables unequal-cost load balancing.
- c. Configure the MAD router to enable unequal-cost load balancing using the following commands:

```
MAD(config)#router igrp 34
MAD(config-router)#variance 10
```

- According to the help feature, what is the maximum variance value? \_\_\_\_\_
- Check the MAD routing table. It should have two routes to network 192.168.33.0 with unequal metrics.
- What is the IGRP metric for the route to 192.168.33.0 through serial 0? \_\_\_\_\_
- What is the IGRP metric for the route to 192.168.33.0 through serial 1? \_\_\_\_\_

## Step 5 Check Basic Routing Configuration

- Enter `show ip protocol` command on each router.
- Enter the command `show ip route` on both routers. List how the route is connected (directly, IGRP), the IP address and via through what network. There should be four routes in each table.

### MAD

Route connected	IP address	Through Network / Interface

### MIL

Route connected	IP address	Through Network / Interface

- Circle the evidence of load balancing in the above output.

## Step 6 Verify per-packet load balancing

- Because there are two routes to the destination network, half the packets will be sent along one path, and half will travel over the other. The path selection alternates with each packet received.
- Observe this process by using the `debug ip packet` command on the MAD router.
- Send 30 ping packets across the network from the host attached to MIL router to the host attached to the MAD router. This can be done with the with the `ping 192.168.41.2 - n 30` command on the host. Stop the debug after the pings by using the command `undebg all`.
- Examine and record part of the debug output.
- What is the evidence of load balancing in the output? \_\_\_\_\_

## Step 7 Verify per-destination load balancing

- a. After verifying per-packet load balancing, configure the router to use per-destination load balancing. Both serial interfaces must use fast switching so that the route-cache can be used after the initial table lookup.
- b. Use the command `ip route-cache` on both serial interfaces of the MAD router.
- c. Use the `show ip interface` to verify that fast switching is enabled.
- d. Is fast switching enabled? \_\_\_\_\_

The routing table is consulted only once per destination. Therefore, packets that are part of a packet train to a specific host will all follow the same path. Only when a second destination forces another table lookup or when the cached entry expires will the alternate path be used.

- e. Use the `debug ip packet` command and `ping` across the network. Note which serial interface the packet was sent out on.
- f. Use the `debug ip packet` command and `ping` across the network. Note which serial interface the packet was sent out on.
- g. Examine and record part of the debug output.
- h. Which serial interface was the packet sent out on? \_\_\_\_\_

Upon completion of the previous steps, log off by typing `exit` and turn the router off.

## Erasing and reloading the router

Enter into the privileged exec mode by typing **enable**.

If prompted for a password, enter **class**. If “class” does not work, ask the instructor for assistance.

```
Router>enable
```

At the privileged exec mode, enter the command **erase startup-config**.

```
Router#erase startup-config
```

The responding line 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
```

Now at the privileged exec mode, enter the command **reload**.

```
Router(config)#reload
```

The responding line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Proceed with reload? [confirm]
```

Press **Enter** to confirm.

In the first line of the response will be:

```
Reload requested by console.
```

After the router has reloaded the line prompt will be:

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

Type **n** and then **Enter**.

The responding line prompt will be:

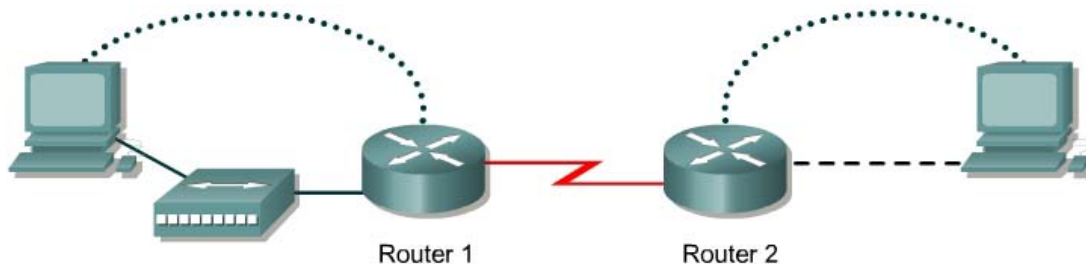
```
Press RETURN to get started!
```

Press **Enter**.


The router is ready for the assigned lab to be performed.

Router Interface Summary					
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2	Interface #5
800 (806)	Ethernet 0 (E0)	Ethernet 1 (E1)			
1600	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
1700	FastEthernet 0 (FA0)	FastEthernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)	
2500	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
2600	FastEthernet 0/0 (FA0/0)	FastEthernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)	
<p>In order to find out exactly how the router is configured, look at the interfaces. This will identify the type of router as well as how many interfaces the router has. There is no way to effectively list all of the combinations of configurations for each router class. What is provided are the identifiers for the possible combinations of interfaces in the device. This interface chart does not include any other type of interface even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in IOS command to represent the interface.</p>					

## Lab 9.1.1 Using `show ip route` to Examine Routing Tables



Router Designation	Router Name	Fast Ethernet 0 Address	Interface type	Serial 0 Address	Subnet mask for both interfaces	Enable secret password	Enable, VTY and console password
Router 1	GAD	172.16.0.1	DCE	172.17.0.1	255.255.0.0	class	cisco
Router 2	BHM	172.18.0.1	DTE	172.17.0.2	255.255.0.0	class	cisco

Straight-through cable	—————
Serial cable	—————  —————
Console (Rollover)	.....
Crossover cable	- - - - -

### Objective

- Setup IP an addressing scheme using class B networks.
- Configure RIP and IGRP on routers.
- Examine the impact on the routing table using multiple routing protocols using the `show ip route` command.

### Background/Preparation

In this lab, a default route will be configured and RIP used to propagate this default information to other routers. When this configuration is working properly, the network will migrate from RIP to IGRP, and default routing will be configured to work with that protocol as well.

Cable a network similar to the one in the diagram. Any router that meets the interface requirements displayed on the above diagram, such as 800, 1600, 1700, 2500, 2600 routers, or a combination may be used. Please refer to the chart at the end of the lab to correctly identify the interface identifiers to be used based on the equipment in the lab. The configuration output used in this lab is produced from 1721 series routers. Any other router used may produce a slightly different output. The following steps are intended to be executed on each router unless specifically instructed otherwise.

Start a HyperTerminal session as performed in the Establishing a HyperTerminal session lab.

**Note:** Go to the erase and reload instructions at the end of this lab. Perform those steps on all routers in this lab assignment before continuing.

### Step 1 Configure the routers

- a. On the routers, enter the global configuration mode and configure the hostname as shown in the chart. Then configure the console, virtual terminal, and enable passwords. If there is a problem doing this, refer to the Configuring Router Passwords lab. Next configure the interfaces according to the chart. If there is a problem doing this, refer to the Configuring Host Tables lab. Finally, configure RIP routing. This is covered in the Configuring RIP lab if help is needed. Do not forget to save the configurations to the startup configuration file.

### Step 2 Configure the hosts with the proper IP address, subnet mask and default gateway

### Step 3 Verify that the internetwork is functioning by pinging the FastEthernet interface of the other router

- a. From the host attached to GAD, is it possible to ping the BHM router FastEthernet interface?  
\_\_\_\_\_
- b. From the host attached to BHM, is it possible to ping the GAD router FastEthernet interface?  
\_\_\_\_\_
- c. If the answer is no for either question, troubleshoot the router configurations to find the error. Then do the pings again until the answer to both questions is yes.

### Step 4 Make sure that routing updates are being sent

- a. Type the command `debug ip rip` at the privileged EXEC mode prompt. Wait for at least 45 seconds.
- b. Was there any output from the debug command? \_\_\_\_\_
- c. What did the output display? \_\_\_\_\_
- d. Stop the debug with `no debug ip rip`.

### Step 5 Show the routing tables for each router

- a. Examine the routing table entries, using command `show ip route` command on each router.
- b. What are the entries in the GAD routing table?  
\_\_\_\_\_
- c. What are the entries in the BHM routing table?  
\_\_\_\_\_

### Step 6 Enable IGRP routing on both routers

- a. Leave RIP enabled but enter router `igrp 25` on both routers at the configuration prompt. Enter the appropriate network statements for each router.

```
GAD(config-router)#network 172.16.0.0
GAD(config-router)#network 172.17.0.0
BHM(config-router)#network 172.18.0.0
BHM(config-router)#network 172.17.0.0
```

- b. On the router where `debug ip rip` was entered, now enter `debug ip igrp events`. Then wait at least two minutes.
- c. What type of routing updates are being sent? \_\_\_\_\_
- d. Why are both protocols sending updates? \_\_\_\_\_



### Step 7 Show the routing tables for each router again

- Examine the routing table entries, using command `show ip route` command on each router.
- What are the entries in the GAD routing table?  
\_\_\_\_\_
- What are the entries in the BHM routing table?  
\_\_\_\_\_
- Why are the RIP routes not in the tables?  
\_\_\_\_\_
- What should be done in order for this network to be more efficient?  
\_\_\_\_\_

### Step 8 Add a second serial cable between routers

- Add a second serial cable between interface S1 on GAD to serial S1 on BHM. GAD is the DCE.
- Configure the GAD router with the additional statements.  
  

```
GAD(config)#interface Serial1
GAD(config-if)#ip address 172.22.0.1 255.255.0.0
GAD(config-if)#clockrate 56000
GAD(config-if)#no shutdown
```
- Configure the BHM router with the additional statements.  
  

```
BHM(config)#interface Serial1
BHM(config-if)#ip address 172.22.0.2 255.255.0.0
BHM(config-if)#no shutdown
```
- On the BHM router remove the IGRP network statement `network 172.18.0.0` so the `router IGRP 25` should only contain the `network 172.17.0.0` statement.

### Step 9 Clear the routing tables on both routers

- Type the command `clear ip route *` at the privileged EXEC prompt on both routers. Wait at least 90 seconds. Then type the command `show ip route` on both routers.
- What types of routes are shown on GAD? \_\_\_\_\_
- What types of routes are shown on BHM? \_\_\_\_\_
- Why is this? \_\_\_\_\_

### Step 10 Use show ip route to see different routes by type

- Enter `show ip route` while connected to the GAD router.
- What networks are displayed?  
\_\_\_\_\_
- What interface is directly connected? \_\_\_\_\_
- Enter `show ip route rip`.
- List the routes listed in the routing table: \_\_\_\_\_

- f. What is the administrative distance? \_\_\_\_\_
- g. Enter **show ip route** while connected to the BHM router.
- h. What networks are displayed? \_\_\_\_\_
- i. What interface is directly connected? \_\_\_\_\_
- j. Enter **show ip route rip**.
- k. List the routes listed in the routing table: \_\_\_\_\_
- l. If you saw none then that is correct, why? \_\_\_\_\_
- m. Enter **show ip route igrp**
- n. List the routes listed in the routing table: \_\_\_\_\_
- o. What is the administrative distance? \_\_\_\_\_

Upon completion of the previous steps, log off by typing **exit** and turn the router off.

## Erasing and reloading the router

Enter into the privileged EXEC mode by typing **enable**.

If prompted for a password, enter **class**. If “class” does not work, ask the instructor for assistance.

```
Router>enable
```

At the privileged EXEC mode, enter the command **erase startup-config**.

```
Router#erase startup-config
```

The responding line 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
```

Now at the privileged EXEC mode, enter the command **reload**.

```
Router(config)#reload
```

The responding line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Proceed with reload? [confirm]
```

Press **Enter** to confirm.

In the first line of the response will be:

```
Reload requested by console.
```

After the router has reloaded the line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

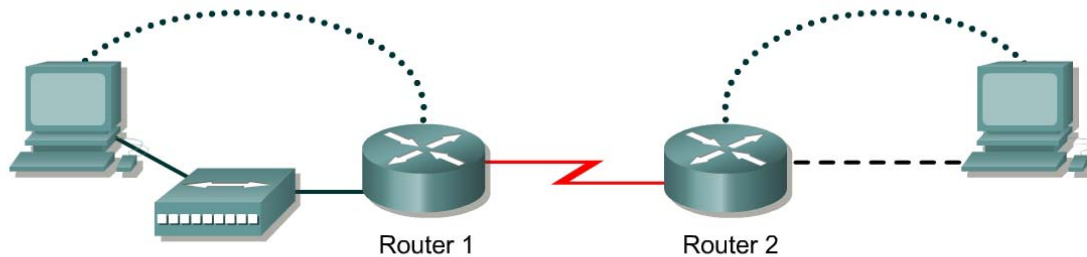
```
Press RETURN to get started!
```

Press **Enter**.


The router is ready for the assigned lab to be performed.

Router Interface Summary					
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2	Interface #5
800 (806)	Ethernet 0 (E0)	Ethernet 1 (E1)			
1600	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
1700	FastEthernet 0 (FA0)	FastEthernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)	
2500	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
2600	FastEthernet 0/0 (FA0/0)	FastEthernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)	
In order to find out exactly how the router is configured, look at the interfaces. This will identify the type of router as well as how many interfaces the router has. There is no way to effectively list all of the combinations of configurations for each router class. What is provided are the identifiers for the possible combinations of interfaces in the device. This interface chart does not include any other type of interface even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in IOS command to represent the interface.					

## Lab 9.1.2 Gateway of Last Resort



Router Designation	Router Name	Fast Ethernet 0 Address	Interface type	Serial 0 Address	Subnet mask for both interfaces	Enable secret password	Enable, VTY and console password
Router 1	GAD	172.16.0.1	DCE	172.17.0.1	255.255.0.0	class	cisco
Router 2	BHM	172.18.0.1	DTE	172.17.0.2	255.255.0.0	class	cisco

Straight-through cable	—————
Serial cable	—————  —————
Console (Rollover)	.....
Crossover cable	- - - - -

### Objective

- Configure RIP routing and add default routes (gateways) to the routers.
- Remove RIP and the default routes.
- Configure IGRP routing and add default routes (gateways) to the routers.

### Background/Preparation

This lab shows the purpose of the gateway of last resort, also known as the default gateway.

Cable a network similar to the one in the diagram. Any router that meets the interface requirements displayed on the above diagram, such as 800, 1600, 1700, 2500, and 2600 routers, or a combination may be used. Please refer to the chart at the end of the lab to correctly identify the interface identifiers to be used based on the equipment in the lab. The configuration output used in this lab is produced from 1721 series routers. Any other router used may produce a slightly different output. The following steps are intended to be executed on each router unless specifically instructed otherwise.

Start a HyperTerminal session as performed in the Establishing a HyperTerminal session lab.

**Note:** Go to the erase and reload instructions at the end of this lab. Perform those steps on all routers in this lab assignment before continuing.

### Step 1 Configure the routers

- a. On the routers, enter the global configuration mode and configure the hostname as shown in the chart. Then configure the console, virtual terminal and enable passwords. If there is a problem doing this, refer to the Configuring Router Passwords lab. Next configure the interfaces according to the chart. If there is a problem doing this, refer to the Configuring Host Tables lab. Finally configure the RIP routing. This is covered in the Configuring RIP lab if help is needed. Do not forget to save the configurations to the startup configuration file.

### Step 2 Configure the hosts with the proper IP address, subnet mask and default gateway

### Step 3 Verify that the internetwork is functioning by pinging the FastEthernet interface of the other router

- a. From the host attached to GAD, is it possible to ping the BHM router FastEthernet interface?  
\_\_\_\_\_
- b. From the host attached to BHM, is it possible to ping the GAD router FastEthernet interface?  
\_\_\_\_\_
- c. If the answer is no for either question, troubleshoot the router configurations to find the error. Then do the pings again until the answer to both questions is yes.

### Step 4 Make sure that routing updates are being sent

- a. Type the command `debug ip rip` and the privileged exec mode prompt. Wait for at least 45 seconds.
- b. Was there any output from the debug command? \_\_\_\_\_
- c. What did the output display? \_\_\_\_\_
- d. Type `undebug all` to turn off debugging.

### Step 5 Show the routing tables for each router

- a. Examine the routing table entries, by using `show ip route` command on each router.
- b. What are the entries in the GAD routing table?  
\_\_\_\_\_
- c. What are the entries in the BHM routing table?  
\_\_\_\_\_

### Step 6 Add the default route to the BHM router

- a. Enter the command `ip route 0.0.0.0 0.0.0.0 172.17.0.1` at the configuration mode prompt.
- b. Type `show ip route` at the privileged exec mode.
- c. What is the Gateway of last resort listed? \_\_\_\_\_
- d. What does the gateway of last resort mean? \_\_\_\_\_

### Step 7 Add the default route to the GAD router

- a. Enter the command `ip route 0.0.0.0 0.0.0.0 172.17.0.2` at the configuration prompt.
- b. Type `show ip route` at the privileged exec mode.

- c. What is the Gateway of last resort listed? \_\_\_\_\_
- d. Are there any other new entries in the routing table? \_\_\_\_\_

### Step 8 Remove RIP routing from both routers

- a. To remove RIP routing type the `no router rip` command at the configuration mode prompt. Then ping the FastEthernet 0 interface on the GAD router from the BHM router.
- b. What were the results of the ping? \_\_\_\_\_
- c. Why was the ping successful? \_\_\_\_\_

### Step 9 Remove the default route from just the GAD router

- a. Remove the gateway of last resort on the GAD router by typing the `no ip route 0.0.0.0 0.0.0.0 172.17.0.2` at the configuration mode prompt on the GAD router.
- b. Type `show ip route` at the privileged exec mode.
- c. What is the Gateway of last resort listed? \_\_\_\_\_
- d. Why is the gateway gone? \_\_\_\_\_
- e. ~~Ping~~ the FastEthernet 0 interface on the GAD router from the BHM router.
- f. What were the results of the ping? \_\_\_\_\_
- g. Why was the ping successful? \_\_\_\_\_
- h. ~~Ping~~ the FastEthernet 0 interface on the BHM router from the GAD router.
- i. What were the results of the pings? \_\_\_\_\_
- j. Why was the ping unsuccessful? \_\_\_\_\_
- k. Remove the gateway of last resort from the BHM router.

### Step 10 Remove RIP routing from the routers and use IGRP instead

- a. Remove the RIP routing by using the `no` form of the RIP routing command. Then set up IGRP routing using 30 as the AS number. Remember to wait for the routes to propagate to the other router.
- b. Check the new routing protocol by typing `show ip route` at the privileged exec mode prompt. There should be two connected and IGRP route in the listing.

### Step 11 Enter a default network entry on the BHM router

- a. Enter the command `ip default-network 172.17.0.0` at the configuration mode prompt
- b. Type the `show ip route` command at the privileged exec mode.
- c. Is there a default route listed? \_\_\_\_\_

Upon completion of the previous steps, log off by typing `exit` and turn the router off.

## Erasing and reloading the router

Enter into the privileged exec mode by typing **enable**.

If prompted for a password, enter **class**. If “class” does not work, ask the instructor for assistance.

```
Router>enable
```

At the privileged exec mode, enter the command **erase startup-config**.

```
Router#erase startup-config
```

The responding line 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
```

Now at the privileged exec mode, enter the command **reload**.

```
Router(config)#reload
```

The responding line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Proceed with reload? [confirm]
```

Press **Enter** to confirm.

In the first line of the response will be:

```
Reload requested by console.
```

After the router has reloaded the line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Press RETURN to get started!
```

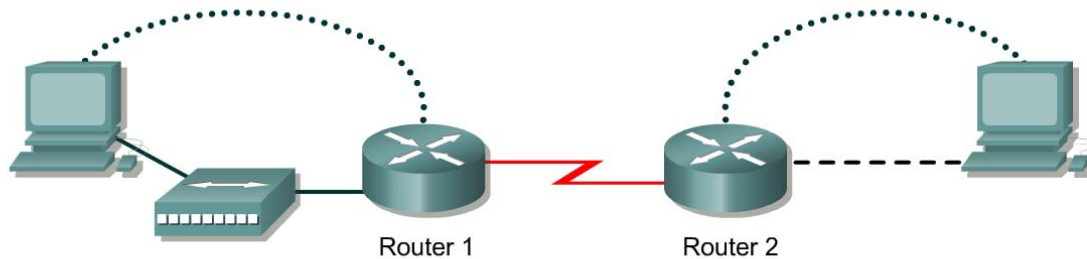
Press **Enter**.

The router is ready for the assigned lab to be performed.



Router Interface Summary					
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2	Interface #5
800 (806)	Ethernet 0 (E0)	Ethernet 1 (E1)			
1600	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
1700	FastEthernet 0 (FA0)	FastEthernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)	
2500	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
2600	FastEthernet 0/0 (FA0/0)	FastEthernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)	
In order to find out exactly how the router is configured, look at the interfaces. This will identify the type of router as well as how many interfaces the router has. There is no way to effectively list all of the combinations of configurations for each router class. What is provided are the identifiers for the possible combinations of interfaces in the device. This interface chart does not include any other type of interface even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in IOS command to represent the interface.					

## Lab 9.1.8 Last Route Update



Router Designation	Router Name	Fast Ethernet 0 Address	Interface type	Serial 0 Address	Subnet mask for both interfaces	Enable secret password	Enable, VTY and console password
Router 1	GAD	172.16.0.1	DCE	172.17.0.1	255.255.0.0	class	cisco
Router 2	BHM	172.18.0.1	DTE	172.17.0.2	255.255.0.0	class	cisco

Straight-through cable	—————
Serial cable	————— <del>      </del>
Console (Rollover)	.....
Crossover cable	- - - - -

### Objective

- Gather information about routing updates and routing protocols.

### Background/Preparation

Cable a network similar to the one in the diagram. Any router that meets the interface requirements displayed on the above diagram, such as, 800, 1600, 1700, 2500, 2600 routers, or a combination, may be used. Please refer to the chart at the end of the lab to correctly identify the interface identifiers to be used based on the equipment in the lab. The configuration output used in this lab is produced from 1721 series routers. Any other router used may produce a slightly different output. The following steps are intended to be executed on each router unless specifically instructed otherwise.

Start a HyperTerminal session as performed in the Establishing a HyperTerminal session lab.

**Note:** Go to the erase and reload instructions at the end of this lab. Perform those steps on all routers in this lab assignment before continuing.

### Step 1 Configure the routers

- On the routers, enter the global configuration mode and configure the hostname as shown in the chart. Then configure the console, virtual terminal, and enable passwords. If there is a problem doing this, refer to the Configuring Router Passwords lab. Next configure the interfaces according to the chart. If there is a problem doing this, refer to the Configuring Host Tables lab.

Finally configure the RIP routing. This is covered in the Configuring RIP lab if help is needed. Do not forget to save the configurations to the startup configuration file.

## Step 2 Configure the hosts with the proper IP address, subnet mask and default gateway

### Step 3 Verify that the internetwork is functioning by pinging the FastEthernet interface of the other router

- From the host attached to GAD, is it possible to ping the BHM router FastEthernet interface?  
\_\_\_\_\_
- From the host attached to BHM, is it possible to ping the GAD router FastEthernet interface?  
\_\_\_\_\_
- If the answer is no for either question, troubleshoot the router configurations to find the error. Then do the pings again until the answer to both questions is yes.

### Step 4 Make sure that routing updates are being sent

- Type the command `debug ip rip` at the privileged EXEC mode prompt. Wait for at least 45 seconds.
- Was there any output from the debug command? \_\_\_\_\_
- Type `undebug all` to turn off debugging.

### Step 5 Show the routing tables for each router

- Examine the routing table entries, using command `show ip route` command on each router.

### Step 6 Check the routing table for a specific route (IOS version must be at least 12.x)

- From BHM privileged EXEC mode prompt enter `show ip route 172.16.0.0`.
- When was the last update? \_\_\_\_\_
- When did BHM receive the last RIP update? \_\_\_\_\_  
Wait five seconds and enter `show ip route 172.16.0.0` a second time.
- What has changed from first time? \_\_\_\_\_  
Wait five seconds and enter `show ip route 172.16.0.0` a third time.
- What has changed from second time? \_\_\_\_\_
- What is the default update time for RIP? \_\_\_\_\_

### Step 7. Check the ip rip database on the BHM router

- Type `show ip rip database` from the privileged EXEC mode prompt.
- When was the last update? \_\_\_\_\_  
Wait five second and enter `show ip rip database`.
- What has changed from the first time? \_\_\_\_\_  
Wait five seconds and enter `show ip rip database`.
- What has changed from the second time? \_\_\_\_\_

## Step 8 Configure IGRP using AS number 101 on all routers. Leave RIP on all routers

### Step 9 From BHM enter show ip route

- a. List the routes shown in the routing table.

\_\_\_\_\_

- b. When did BHM receive the last IGRP update? \_\_\_\_\_

Wait five seconds and enter **show ip route**.

- c. What has changed from the first time? \_\_\_\_\_

Wait five seconds and enter **show ip route**.

- d. What has changed from the second time? \_\_\_\_\_

- e. What is the default update time for IGRP? \_\_\_\_\_

### Step 10 Check the routing protocol on router BHM

- a. From the BHM privileged EXEC mode, enter **show ip protocols**.

- b. What protocols are listed? \_\_\_\_\_

- c. The next update is due in how many seconds for each protocol? \_\_\_\_\_

Upon completion of the previous steps, log off by typing **exit** and turn the router off.

## Erasing and reloading the router

Enter into the privileged EXEC mode by typing **enable**.

If prompted for a password, enter **class**. If “class” does not work, ask the instructor for assistance.

```
Router>enable
```

At the privileged EXEC mode, enter the command **erase startup-config**.

```
Router#erase startup-config
```

The responding line 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
```

Now at the privileged EXEC mode, enter the command **reload**.

```
Router(config)#reload
```

The responding line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Proceed with reload? [confirm]
```

Press **Enter** to confirm.

In the first line of the response will be:

```
Reload requested by console.
```

After the router has reloaded the line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

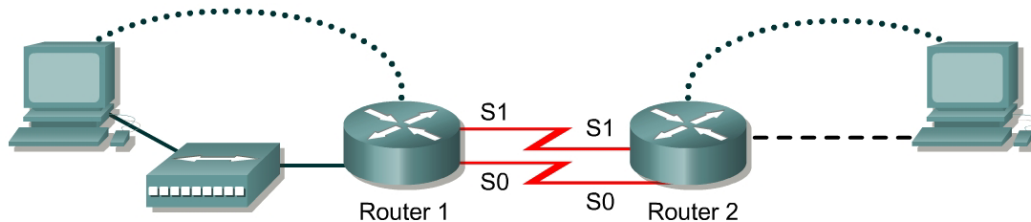
```
Press RETURN to get started!
```

Press **Enter**.

The router is ready for the assigned lab to be performed.

Router Interface Summary					
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2	Interface #5
800 (806)	Ethernet 0 (E0)	Ethernet 1 (E1)			
1600	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
1700	FastEthernet 0 (FA0)	FastEthernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)	
2500	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
2600	FastEthernet 0/0 (FA0/0)	FastEthernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)	
In order to find out exactly how the router is configured, look at the interfaces. This will identify the type of router as well as how many interfaces the router has. There is no way to effectively list all of the combinations of configurations for each router class. What is provided are the identifiers for the possible combinations of interfaces in the device. This interface chart does not include any other type of interface even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in IOS command to represent the interface.					

## Lab 9.2.6 Troubleshooting Using ping and telnet



Router designation	Router Name	Enable secret password	Enable/VTY/ and Console passwords	Routing protocol	RIP network statements	
Router 1	GAD	class	cisco	RIP	192.168.14.0	192.168.15.0
Router 2	BHM	class	cisco	RIP	192.168.16.0	192.168.13.0

Router designation	IP Host Table Entry	Fast Ethernet 0 address	Interface type Serial 0	Serial 0 address	Interface type Serial 1	Serial 1 address	Subnet mask all addresses
Router 1	BHM	192.168.14.1	DCE	192.168.15.1	DCE	192.168.15.2	255.255.255.0
Router 2	GAD	192.168.16.1	DTE	192.168.13.1	DTE	192.168.13.2	255.255.255.0

Note: The IP Host Table Entry column contents indicate the name(s) of the other router(s) in the IP host table.

Straight-through cable		Console (Rollover)	
Serial cable		Crossover cable	

### Objective

- Use knowledge of OSI Layers 1, 2 and 3 to diagnose network configuration errors.
- Use ping and telnet utilities in testing.

### Background/Preparation

Cable a network similar to the one in the diagram. Any router that meets the interface requirements displayed on the above diagram, such as 800, 1600, 1700, 2500, 2600 routers, or a combination, may be used. Please refer to the chart at the end of the lab to correctly identify the interface identifiers to be used based on the equipment in the lab. The configuration output used in this lab is produced from 1721 series routers. Any other router used may produce a slightly different output. The following steps are intended to be executed on each router unless specifically instructed otherwise.

Start a HyperTerminal session as performed in the Establishing a HyperTerminal session lab.

**Note:** Work in teams of 2. Team member 1 should cable and configure the routers and workstations according to the chart. This will introduce some errors. Team member 2 should test the configuration using physical inspection, ping and Telnet.

**Note:** Go to the erase and reload instructions at the end of this lab. Perform those steps on all routers in this lab assignment before continuing.

### Step 1 Configure the routers

- a. On the routers, enter the global configuration mode and configure the hostname as shown in the chart. Then configure the console, virtual terminal, and enable passwords. If there are problems doing this, refer to the Configuring Router Passwords lab. Next configure the interfaces and routing according to the chart. If there are problems doing this, refer to the Configuring Host Tables lab and the Configuring RIP lab. Make sure to copy the **running-config** to the **startup-config** on each router, so the configuration will not be lost if the router is power recycled.

### Step 2 Configure the hosts with the proper IP address, subnet mask and default gateway

- a. Test the configuration by pinging all interfaces from each host. If the pinging is not successful go on to Step 3.
- b. Advise the instructor that the configuration is operational. The instructor will introduce fault(s) in the configuration to diagnose and repair.

### Step 3 Check the connections

- a. Review the physical connections on the standard lab setup.
- b. Check all physical devices, cables, and connections.

### Step 4 Troubleshoot

- a. Troubleshoot induced network problems.
- b. Use the commands **ping** and **telnet** to discover problems.

### Step 5 List the findings

- a. Write down the problems as they are encountered.
- b. Write down what was done to correct the problems.
- c. Have the instructor verify that all problems were corrected.

Problem #	Problem Discovered	Solution	Instructor Verification
1			
2			
3			
4			
5			

### Step 6 Perform the lab again with Team members 1 and 2 switching roles

Upon completion of the previous steps, log off by typing **exit** and turn the router off.



## Erasing and reloading the router

Enter into the privileged EXEC mode by typing **enable**.

If prompted for a password, enter **class**. If “class” does not work, ask the instructor for assistance.

```
Router>enable
```

At the privileged EXEC mode, enter the command **erase startup-config**.

```
Router#erase startup-config
```

The responding line 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
```

Now at the privileged EXEC mode, enter the command **reload**.

```
Router(config)#reload
```

The responding line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Proceed with reload? [confirm]
```

Press **Enter** to confirm.

In the first line of the response will be:

```
Reload requested by console.
```

After the router has reloaded the line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Press RETURN to get started!
```

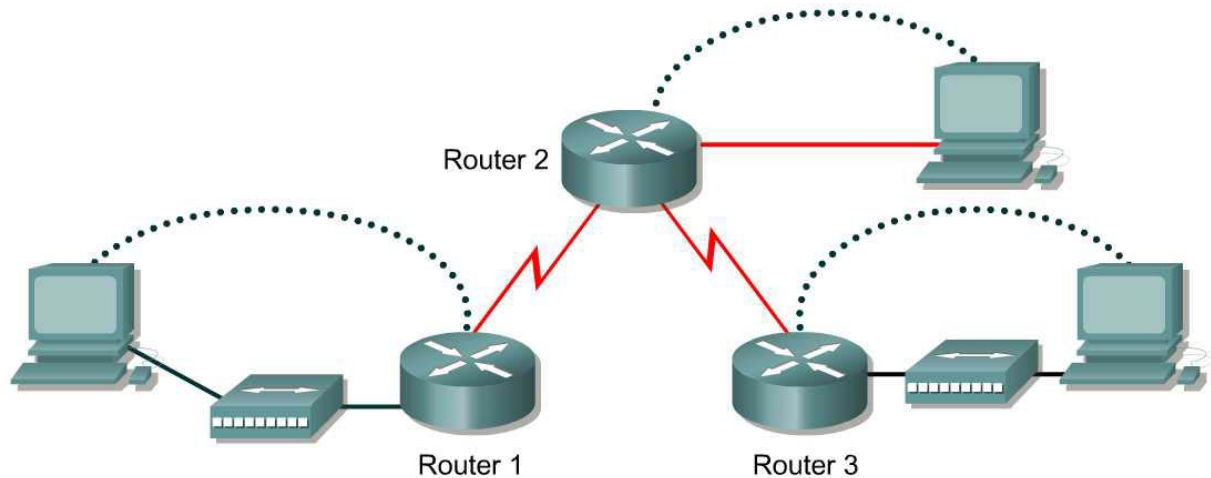
Press **Enter**.


The router is ready for the assigned lab to be performed.

Router Interface Summary					
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2	Interface #5
800 (806)	Ethernet 0 (E0)	Ethernet 1 (E1)			
1600	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
1700	FastEthernet 0 (FA0)	FastEthernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)	
2500	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
2600	FastEthernet 0/0 (FA0/0)	FastEthernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)	
In order to find out exactly how the router is configured, look at the interfaces. This will identify the type of router as well as how many interfaces the router has. There is no way to effectively list all of the combinations of configurations for each router class. What is provided are the identifiers for the possible combinations of interfaces in the device. This interface chart does not include any other type of interface even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in IOS command to represent the interface.					



## Lab 9.3.4 Troubleshooting Using traceroute



Straight-through cable	—————
Serial cable	———  —————
Console (Rollover)	.....
Crossover cable	- - - - -

Router Designation	Router Name	Enable secret password	Enable, VTY and console password	Routing protocol	RIP network statements
Router 1	GAD	class	cisco	RIP	192.168.14.0 192.168.15.0
Router 2	BHM	class	cisco	RIP	192.168.15.0 192.168.13.0 192.168.16.0
Router 3	PHX	class	cisco	RIP	192.168.13.0 192.168.17.0

Router Designation	Fast Ethernet 0 Address	Interface type Serial 0	Serial 0 Address	Interface type Serial 1	Serial 1 Address	Subnet mask all addresses	IP host table entries
Router 1	192.168.14.1	DCE	192.168.15.1	NA	No address	255.255.255.0	BHM, PHX
Router 2	192.168.16.1	DTE	192.168.15.2	DCE	192.168.13.1	255.255.255.0	GAD, PHX
Router 3	192.168.17.1	NA	No address	DTE	192.168.13.2	255.255.255.0	GAD, BHM

## Objective

Use the **traceroute** Cisco IOS command from source router to destination router. Use the **tracert** MS-DOS command from source workstation to destination router. Verify that the network-layer between source, destination and each router along the way is working properly. Retrieve information to evaluate the end-to-end path reliability.

Cable the network in the diagram. Any router that meets the interface requirements displayed on the above diagram such as 800, 1600, 1700, 2500, 2600 routers, or a combination, may be used. Please refer to the chart at the end of the lab to correctly identify the interface identifiers to be used based on the equipment in the lab. The configuration output used in this lab is produced from 1721 series routers. Any other router used may produce slightly different output. The following steps are intended to be executed on each router unless specifically instructed otherwise.

Start a HyperTerminal session as performed in the Establishing a HyperTerminal session lab.

Erase and reload all routers in this lab assignment before continuing. If there are problems in accomplishing this, go to lab 4.2.6 and use those erase and reload instructions.

### Step 1 Configure the GAD, PHX, and BHM routers

- On the routers, enter the global configuration mode and configure the hostname as shown in the chart. Then configure the console, virtual terminal and enable passwords. If there are problems doing this, refer to the Configuring router passwords lab. Next configure the interfaces and routing according to the chart. If there are problems doing this, refer to the Configuring Host Tables lab and the Configuring RIP lab. Make sure to copy the **running-config** to the **startup-config** on each router so the configuration will not be lost if the router is power recycled.
- This lab requires that IP hostnames are configured.
- Verify the routers configurations by performing a **show running-config** on each router. If not correct, fix any configuration errors and verify.

### Step 2 Configure the workstations with appropriate IP address subnet mask and default gateway

#### Step 3 Ping from the workstations

- From a Windows host click on **Start > Programs > Accessories > MS-DOS**. This will open a Command Prompt window. (If this not the correct location see the instructor for the proper location on this computer.)
- To test that the TCP/IP stack and default gateway on the workstation are configured and working properly, use the MS DOS window to ping the routers by issuing the following commands:

```
C:\>ping 192.168.14.1
```

The ping should respond with successful results. If not, check the configurations on the host and directly connected router.

#### Step 4 Test Layer 3 connectivity

Using the command prompt enter **ping** and the IP address of all routers interfaces.

This will test Layer 3 connectivity between the workstation and the routers.

- Is the output from the workstation **ping** command the same as the output from the **ping** command from a router?

### Step 5 Login to the router in user mode

- a. Login to the GAD router, stay at the user EXEC prompt.

### Step 6 Discover the trace options.

- a. Enter **traceroute** at the router prompt.
- b. What did the router respond with? \_\_\_\_\_

### Step 7 Use the **traceroute** command

- a. Enter **traceroute ip xxx.xxx.xxx.xxx** where xxx.xxx.xxx.xxx is the IP address of the target destination.

**Note:** Use one of the end routers and **trace IP** to the other end host. The router will respond with:

```
GAD#traceroute ip 192.168.16.2
Type escape sequence to abort.
Tracing the route to 192.168.16.2

 1 BHM (192.168.15.2) 16 msec 16 msec 16 msec
 2 192.168.16.2 16 msec 16 msec 12 msec
GAD#
```

If the output is not successful, check the router and host configurations.

### Step 8 Continue using **traceroute**

Repeat Step 5 with all other routers on the network.

### Step 9 Use the **tracert** command from a workstation

- a. From the console workstation click on **Start > Programs > Command Prompt**. An MS-DOS Command Prompt window will open up.
- b. Enter **tracert** and the same IP address used in Step 5.
- c. The first hop is the default gateway or the near side router interface on the LAN that the workstation is connected to. List the host name and IP address of the router that the ICMP packet was routed through.

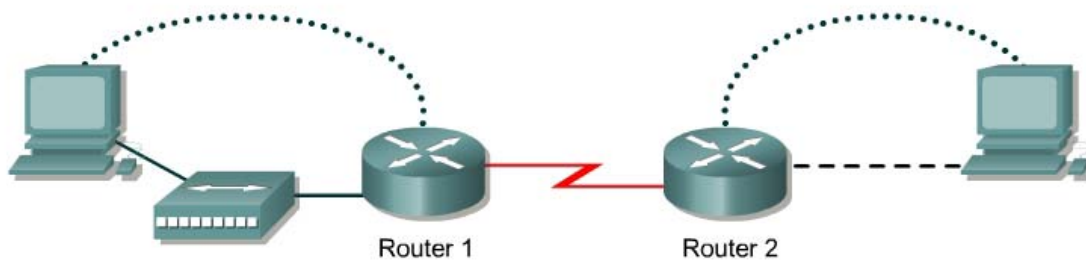
Host Name	IP Address

- d. There is one more entry in the output of the **tracert** command when the trace is from the computer command prompt to the target host.


Why? \_\_\_\_\_

Upon completion of the previous steps logoff by typing **exit** and turn the router off.

## Lab 9.3.5 Troubleshooting Routing Issues with show ip route and show ip protocols



Router Designation	Router Name	Fast Ethernet 0 Address	Interface type	Serial 0 Address	Subnet mask for both interfaces	Enable secret password	Enable, VTY and console password
Router 1	GAD	192.168.1.1	DCE	192.168.2.1	255.255.255.0	class	cisco
Router 2	BHM	192.168.3.1	DTE	192.168.2.2	255.255.255.0	class	cisco

Straight-through cable	—————
Serial cable	—————  —————
Console (Rollover)	.....
Crossover cable	- - - - -

### Objective

- Use the `show ip route` and `show ip protocol` commands to diagnose a routing configuration problem.

### Background/Preparation

Cable a network similar to the one in the diagram. Any router that meets the interface requirements displayed on the above diagram, such as 800, 1600, 1700, 2500, 2600 routers, or a combination, may be used. Please refer to the chart at the end of the lab to correctly identify the interface identifiers to be used based on the equipment in the lab. The configuration output used in this lab is produced from 1721 series routers. Any other router used may produce a slightly different output. The following steps are intended to be executed on each router unless specifically instructed otherwise.

Start a HyperTerminal session as performed in the Establishing a HyperTerminal session lab.

**Note:** Go to the erase and reload instructions at the end of this lab. Perform those steps on all routers in this lab assignment before continuing.

### Step 1 Configure the hostname, passwords and interfaces on the GAD router

- a. On the GAD router, enter the global configuration mode and configure the hostname as shown in the chart. Then configure the console, virtual terminal and enable passwords. If there is a problem doing this, refer to the Configuring Router Passwords lab. Configure interfaces as shown in the table.

### Step 2 Configure the routing protocol on the GAD router

- a. Go to the proper command mode and enter the following:

```
GAD(config)#router rip
GAD(config-router)#network 192.168.1.0
GAD(config-router)#network 192.168.2.0
GAD(config-router)#exit
GAD(config)#exit
```

### Step 3 Save the GAD router configuration

```
GAD#copy running-config startup-config
Destination filename [startup-config]? [Enter]
```

### Step 4 Configure the hostname and passwords on the BHM router

- a. On the BHM router, enter the global configuration mode and configure the hostname as shown in the chart. Then configure the console, virtual terminal and enable passwords. Finally, configure the interfaces on each router.

### Step 5 Configure the routing protocol on the BHM router

- a. Go to the proper command mode and enter the following:

```
BHM(config)#router rip
BHM(config-router)#network 192.168.2.0
BHM(config-router)#network 192.168.1.0
BHM(config-router)#exit
BHM(config)#exit
```

### Step 6 Save the BHM router configuration

```
BHM#copy running-config startup-config
Destination filename [startup-config]? [Enter]
```

### Step 7 Verify that the internetwork is functioning by pinging the FastEthernet interface of the other router

- a. From GAD, is it possible to ping the BHM router FastEthernet interface? \_\_\_\_\_
- b. From BHM, is it possible to ping the GAD router FastEthernet interface? \_\_\_\_\_

### Step 8 Examine the routing table

- a. After an unsuccessful ping, check the routing table with the **show ip route** command. From the GAD router, type the following:

```
GAD#show ip route
```

- b. Is there a route to the BHM Ethernet LAN? \_\_\_\_\_

### Step 9 Examine the routing protocol status

- a. After examining the routing tables, it is discovered that there is no route to the BHM Ethernet LAN. So use the **show ip protocols** command to view the routing protocol status. From the BHM router, type the following:

```
BHM#show ip protocols
```

- b. What networks is RIP routing? \_\_\_\_\_
- c. Are these the correct networks? \_\_\_\_\_

### Step 10 Change the configuration to route correct networks

- a. After examining the **show ip protocols** command results, it is noticed that the network on the Ethernet LAN is not being routed. After examining it further, it is found that there is a network that does not belong has been configured to be advertised. It is decided this is a typo, and it is necessary to correct it. Enter the router RIP configuration mode and make the appropriate changes. From the BHM router, type the following:

```
BHM#configure terminal
BHM(config)#router rip
BHM(config-router)#no network 192.168.1.0
BHM(config-router)#network 192.168.3.0
BHM(config-router)#^Z
```

### Step 11 Confirm RIP is routing the correct networks

- a. Now confirm the new statement corrected the RIP configuration problem. So again type the **show ip protocols** command to observe what networks are being routed.
- b. From the BHM router, type the following:

```
BHM#show ip protocols
```

- c. What networks is RIP routing? \_\_\_\_\_
- d. Are these the correct networks? \_\_\_\_\_

### Step 12 Verify the routing table

- a. Now having confirmed that the configuration problem is corrected, verify that the proper routes are now in the routing table. So again issue the **show ip route** command to verify that the router now has the proper route.
- b. From the GAD router, type the following:

```
GAD#show ip route
```

- c. Is there a route to the BHM LAN? \_\_\_\_\_



### Step 13 Verify connectivity between GAD router and host in BHM

- a. Use the **ping** command to verify connectivity from GAD router to a host in BHM.
- b. From the GAD router, type the following:

```
GAD#ping host-ip
```

For example for host with IP Address, type the following:

```
GAD#ping 192.168.3.2
```

- c. Was the ping successful? \_\_\_\_\_

Upon completion of the previous steps, log off by typing **exit** and turn the router off.

## Erasing and reloading the router

Enter into the privileged exec mode by typing **enable**.

If prompted for a password, enter **class**. If “class” does not work, ask the instructor for assistance.

```
Router>enable
```

At the privileged exec mode, enter the command **erase startup-config**.

```
Router#erase startup-config
```

The responding line 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
```

Now at the privileged exec mode, enter the command **reload**.

```
Router(config)#reload
```

The responding line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Proceed with reload? [confirm]
```

Press **Enter** to confirm.

In the first line of the response will be:

```
Reload requested by console.
```

After the router has reloaded the line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

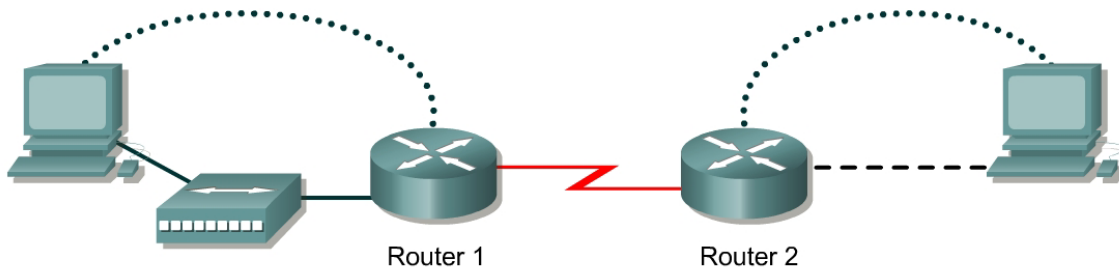
```
Press RETURN to get started!
```

Press **Enter**.

The router is ready for the assigned lab to be performed.

Router Interface Summary					
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2	Interface #5
800 (806)	Ethernet 0 (E0)	Ethernet 1 (E1)			
1600	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
1700	FastEthernet 0 (FA0)	FastEthernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)	
2500	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
2600	FastEthernet 0/0 (FA0/0)	FastEthernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)	
In order to find out exactly how the router is configured, look at the interfaces. This will identify the type of router as well as how many interfaces the router has. There is no way to effectively list all of the combinations of configurations for each router class. What is provided are the identifiers for the possible combinations of interfaces in the device. This interface chart does not include any other type of interface even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in IOS command to represent the interface.					

## Lab 9.3.7 Troubleshooting Routing Issues with debug



Router Designation	Router Name	Fast Ethernet 0 Address	Interface type	Serial 0 Address	Subnet mask for both interfaces	Enable secret password	Enable, VTY and console password
Router 1	GAD	192.168.1.1	DCE	192.168.2.1	255.255.255.0	class	cisco
Router 2	BHM	192.168.3.1	DTE	192.168.2.2	255.255.255.0	class	cisco

Straight-through cable	—————
Serial cable	————— ⚡
Console (Rollover)	.....
Crossover cable	- - - - -

### Objective

- Utilize a systematic OSI troubleshooting process to diagnose routing problems.
- Use various show commands to gather information.
- Use **debug** commands and logging.

### Background/Preparation

Cable a network similar to the one in the diagram. Any router that meets the interface requirements displayed on the above diagram, such as 800, 1600, 1700, 2500, 2600 routers, or a combination, may be used. Please refer to the chart at the end of the lab to correctly identify the interface identifiers to be used based on the equipment in the lab. The configuration output used in this lab is produced from 1721 series routers. Any other router used may produce a slightly different output. The following steps are intended to be executed on each router unless specifically instructed otherwise.

Start a HyperTerminal session as performed in the Establishing a HyperTerminal session lab.

**Note:** Go to the erase and reload instructions at the end of this lab. Perform those steps on all routers in this lab assignment before continuing.

## Step 1 Configure the hostname, passwords and interfaces on the GAD router

- a. On the GAD router, enter the global configuration mode and configure the hostname as shown in the chart. Then configure the console, virtual terminal, and enable passwords. If there is a problem doing this, refer to the Configuring Router Passwords lab. Configure interfaces as shown in the table.

## Step 2 Configure the routing protocol on the GAD router

- a. Go to the proper command mode and enter the following:

```
GAD(config)#router rip
GAD(config-router)#network 192.168.1.0
GAD(config-router)#network 192.168.2.0
GAD(config-router)#version 2
GAD(config-router)#exit
GAD(config)#exit
```

## Step 3 Save the GAD router configuration

```
GAD#copy running-config startup-config
Destination filename [startup-config]? [Enter]
```

## Step 4 Configure the hostname, passwords and interfaces on the BHM router

- a. On the BHM router, enter the global configuration mode and configure the hostname as shown in the chart. Then configure the console, virtual terminal and enable passwords. Configure interfaces as shown in the table.

## Step 5 Configure the routing protocol on the BHM router

- a. Go to the proper command mode and enter the following:

```
BHM(config)#router rip
BHM(config-router)#network 192.168.2.0
BHM(config-router)#network 192.168.1.0
BHM(config-router)#version 1
BHM(config-router)#exit
BHM(config)#exit
```

## Step 6 Save the BHM router configuration

```
BHM#copy running-config startup-config
Destination filename [startup-config]? [Enter]
```

## Step 7 Gather Facts by asking and listening

- a. After asking around, it was found that a network associate on the night shift changed some of the routing parameters on the routers for a circuit between the GAD office and the BHM office. Unfortunately, proper procedure was not followed and no documentation was created on these changes.

### Step 8 Gather facts (test basic functionality)

Verify that the internetwork is not functioning by pinging the LAN interfaces.

- From GAD, is it possible to ping the BHM router FastEthernet interface? \_\_\_\_\_
- From BHM, is it possible to ping the GAD router FastEthernet interface? \_\_\_\_\_

### Step 9 Gather Facts by starting testing to isolate the problem

- This confirmed that there is no reachability between GAD and BHM. Even though it is suspected that there is a routing issue, the temptation to go right to testing routing is resisted. Instead good scientific troubleshooting method is followed.
- First start at the Physical layer, and confirm the WAN link circuit is up. From the GAD router, issue the **show interfaces serial 0** command to confirm that the line and protocol is up.
- Are they both up? \_\_\_\_\_
- Now that it is known that the line and protocol are both up, test the Data Link layer. From the GAD router, issue the **show CDP neighbors** command to confirm that the BHM router is a neighbor to the GAD router serial 0 interface.
- Is BHM shown as a neighbor on interface serial 0? \_\_\_\_\_

### Step 10 Examine the routing table

- It looks like the data link layer is good. Time to move up and examine the network layer. Check the GAD routing table to see if there is a route to the BHM LAN. To do this, issue the **show ip route command** on the GAD router.
- Is the route there? \_\_\_\_\_
- Are there any RIP routes? \_\_\_\_\_

### Step 11 Examine the routing protocol status

- After examining the routing tables, it is discovered that there is no route to the BHM Ethernet LAN. So use the **show ip protocols** command to view the routing protocol status. From the GAD router, type the following:

```
GAD#show ip protocols
```

- What networks is RIP routing? \_\_\_\_\_
- Are these the correct networks? \_\_\_\_\_

### Step 12 Gather Facts to identify the exact problem

- Now that a routing issue has been confirmed, the exact source of the routing problem needs to be discovered so it can be corrected. To observe the routing exchange between the routers will use the **debug ip rip** command.
- From a GAD console, type the **debug ip packet** command and watch the output for a minute or two.
- Record a sample of output from GAD or BHM

\_\_\_\_\_  
\_\_\_\_\_

- Are there routing updates being passed? \_\_\_\_\_
- What is happening to the routing updates from BHM? \_\_\_\_\_

- f. Type **undebug a11** to stop the output.

### Step 13 Consider the possibilities

- a. From the information discovered through the troubleshooting process, what are the possible problems?
- 

### Step 14 Create an action plan

- a. How can the problem be corrected?
- 

### Step 15 Implement the action plan

- a. Try the solution that was proposed in the previous step.

### Step 16 Observe the results

- a. Now it is necessary to confirm that the solution has solved the problem. This is done by reversing the tests that have been previously performed.
- b. Observe the routing exchange between the routers using the **debug ip rip** command and watch the output for a minute or two.
- c. Type **undebug a11** to stop the output.
- d. Check the GAD routing table to see if there is a route to BHM using the **show ip route**.
- e. Are there any RIP routes? \_\_\_\_\_
- f. Is the route to BHM there? \_\_\_\_\_
- g. Just to confirm everything is the working from the GAD router try to ping the LAN interface of the BHM router. Was it successful? \_\_\_\_\_
- h. If this does not correct the problem, then repeat the process.
- i. If the tests were successful, document the changes and back up the configuration.

Upon completion of the previous steps, log off by typing **exit** and turn the router off.

## Erasing and reloading the router

Enter into the privileged EXEC mode by typing **enable**.

If prompted for a password, enter **class**. If “class” does not work, ask the instructor for assistance.

```
Router>enable
```

At the privileged EXEC mode, enter the command **erase startup-config**.

```
Router#erase startup-config
```

The responding line 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
```

Now at the privileged EXEC mode, enter the command **reload**.

```
Router(config)#reload
```

The responding line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Proceed with reload? [confirm]
```

Press **Enter** to confirm.

In the first line of the response will be:

```
Reload requested by console.
```

After the router has reloaded the line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Press RETURN to get started!
```

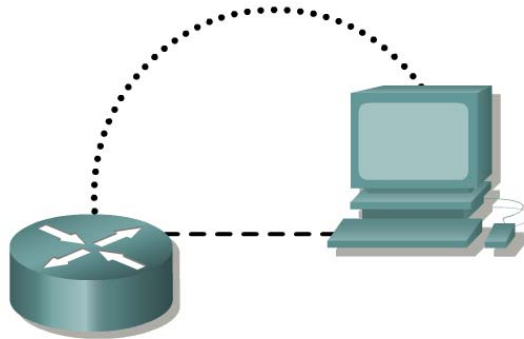
Press **Enter**.

The router is ready for the assigned lab to be performed.



Router Interface Summary					
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2	Interface #5
800 (806)	Ethernet 0 (E0)	Ethernet 1 (E1)			
1600	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
1700	FastEthernet 0 (FA0)	FastEthernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)	
2500	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
2600	FastEthernet 0/0 (FA0/0)	FastEthernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)	
In order to find out exactly how the router is configured, look at the interfaces. This will identify the type of router as well as how many interfaces the router has. There is no way to effectively list all of the combinations of configurations for each router class. What is provided are the identifiers for the possible combinations of interfaces in the device. This interface chart does not include any other type of interface even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in IOS command to represent the interface.					

## Lab 10.1.6 Multiple Active Host Sessions



Router designation	Router name	FA0/0 Address	Subnet mask	Enable secret password	Enable/VTY/ and Console passwords
Router 1	GAD	192.168.14.1	255.255.255.0	class	cisco

Straight-through cable	—————
Serial cable	—————  —————
Console (Rollover)	.....
Crossover cable	- - - - -

### Objective

- Enable HTTP services on a router.
- Observe multiple HTTP and Telnet sessions on a single host using **netstat**.

### Background/Preparation

Cable a network similar to the one in the diagram. Any router that meets the interface requirements displayed on the above diagram, such as 800, 1600, 1700, 2500, 2600 routers, or a combination, may be used. Please refer to the chart at the end of the lab to correctly identify the interface identifiers to be used based on the equipment in the lab. The configuration output used in this lab is produced from 1721 series routers. Any other router used may produce a slightly different output. The following steps are intended to be executed on each router unless specifically instructed otherwise.

Start a HyperTerminal session as performed in the Establishing a HyperTerminal session lab.

**Note:** Go to the erase and reload instructions at the end of this lab. Perform those steps on all routers in this lab assignment before continuing.

### Step 1 Configure the hostname, passwords and interfaces on the GAD router

- a. On the GAD router, enter the global configuration mode and configure the hostname as shown in the chart. Then configure the console, virtual terminal, and enable passwords. Configure the Ethernet interface.

### Step 2 Save the configuration information from the privileged EXEC command mode

```
GAD#copy running-config startup-config
```

### Step 3 Configure the host with the proper IP address, subnet mask, and default gateway

### Step 4 Allow HTTP access to the router

- a. Allow HTTP access by issuing the `ip http server` command in global configuration mode.

### Step 5 Use the workstation browser to access the router

- a. Open a browser on Host 1 and type `http://ip-address of Router GAD`. Then there will be a prompt a username and the enable password of the router. The username can be left blank; only the password is required.

### Step 6 Telnet to the Ethernet interface on the router from the host

### Step 7 Start a second Telnet session to the router

### Step 8 Check the sessions on the host

- a. Enter the `netstat` command from the Command / DOS prompt.
- b. How many sessions are running on the host? \_\_\_\_\_
- c. Explain why the Web browser is not listed as an active session.  
\_\_\_\_\_

Upon completion of the previous steps, logoff and turn the router off.

## Erasing and reloading the router

Enter into the privileged EXEC mode by typing **enable**.

```
Router>enable
```

If prompted for a password, enter **class**. If “class” does not work, ask the instructor for assistance.

```
Router>enable
```

At the privileged EXEC mode, enter the command **erase startup-config**.

```
Router#erase startup-config
```

The responding line 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
```

Now at the privileged EXEC mode, enter the command **reload**.

```
Router#reload
```

The responding line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Proceed with reload? [confirm]
```

Press **Enter** to confirm.

In the first line of the response will be:

```
Reload requested by console.
```

After the router has reloaded the line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

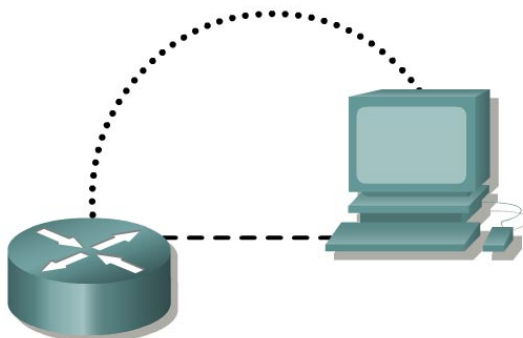
```
Press RETURN to get started!
```

Press **Enter**.

The router is ready for the assigned lab to be performed.

Router Interface Summary					
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2	Interface #5
800 (806)	Ethernet 0 (E0)	Ethernet 1 (E1)			
1600	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
1700	FastEthernet 0 (FA0)	FastEthernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)	
2500	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
2600	FastEthernet 0/0 (FA0/0)	FastEthernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)	
In order to find out exactly how the router is configured, look at the interfaces. This will identify the type of router as well as how many interfaces the router has. There is no way to effectively list all of the combinations of configurations for each router class. What is provided are the identifiers for the possible combinations of interfaces in the device. This interface chart does not include any other type of interface even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in IOS command to represent the interface.					

## Lab 10.2.5 Well-Known Port Numbers and Multiple Sessions



Router designation	Router name	FA0/0 Address	Subnet mask	Enable secret password	Enable/VTY/ and Console passwords
Router 1	GAD	192.168.14.1	255.255.255.0	class	cisco

Straight-through cable	—————
Serial cable	————— <del>      </del>
Console (Rollover)	.....
Crossover cable	- - - - -

### Objective

- Enable HTTP services on a router.
- Show multiple HTTP and Telnet sessions on a single host.
- Observe well-known TCP port numbers on the host and router.

### Background/Preparation

Cable a network similar to one of the diagram. Any router that meets the interface requirements displayed on the above diagram, such as 800, 1600, 1700, 2500, 2600 routers, may be used. Please refer to the chart at the end of the lab to correctly identify the interface identifiers to be used based on the equipment in the lab. The configuration output used in this lab is produced from 1721 series routers. Any other router used may produce a slightly different output. The following steps are intended to be executed on each router unless specifically instructed otherwise.

Start a HyperTerminal session as performed in the Establishing a HyperTerminal session lab.

**Note:** Go to the erase and reload instructions at the end of this lab. Perform those steps on all routers in this lab assignment before continuing.

### Step 1 Configure the hostname, passwords and interface on the GAD router

- a. On the GAD router, enter the global configuration mode and configure the hostname as shown in the chart. Then configure the console, virtual terminal, and enable passwords. Configure the Ethernet interface.

### Step 2 Save the configuration information from the privileged EXEC command mode

```
GAD#copy running-config startup-config
```

### Step 3 Configure the host with the proper IP address, subnet mask and default gateway

### Step 4 Allow HTTP access to the router

- a. Allow HTTP access by issuing the `ip http server` command in global configuration mode.

### Step 5 Use the workstation browser to access the router

- a. Open a browser on Host 1 and type `http://ip-address of Router GAD`. Then there will be a prompt for a username and the enable password of the router. The username can be left blank; only the password is required.

### Step 6 Telnet to the Ethernet interface on the router from the host

### Step 7 Start a second Telnet session to router

### Step 8 Start a third Telnet session to router by opening another command prompt

### Step 9 Start a fourth Telnet session to router by opening another command prompt

### Step 10 Check the number of sessions on the host

- a. Open another command prompt on the host and type `netstat /?` at the DOS prompt.
- b. What options are available for the `netstat` command?

---

c. Now type `netstat -n`.

d. How many open sessions are there? \_\_\_\_\_

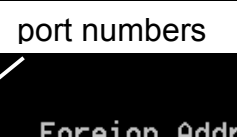
e. What are the open sessions? \_\_\_\_\_

f. What are the port numbers? \_\_\_\_\_

```
C:\>netstat -n
```

#### Active Connections

Proto	Local Address	Foreign Address	State
TCP	192.168.14.2:2099	192.168.14.1:23	TIME_WAIT
TCP	192.168.14.2:2100	192.168.14.1:23	TIME_WAIT
TCP	192.168.14.2:2101	192.168.14.1:23	TIME_WAIT
TCP	192.168.14.2:2109	192.168.14.1:23	ESTABLISHED
TCP	192.168.14.2:2110	192.168.14.1:23	ESTABLISHED
TCP	192.168.14.2:2112	192.168.14.1:23	ESTABLISHED
TCP	192.168.14.2:2115	192.168.14.1:23	ESTABLISHED



### Step 11 Check the number of sessions on the Router

- At the privileged EXEC mode type `show tcp`.
- How many open sessions are there? \_\_\_\_\_
- What are the open sessions? \_\_\_\_\_
- What are the port numbers on the sessions? \_\_\_\_\_
- Why can all the sessions use port 23 (under Foreign Address)?  
\_\_\_\_\_
- List some of the Local Address port numbers (number after the colon following the IP address).  
\_\_\_\_\_
- Why are all of the Local Address port numbers different?  
\_\_\_\_\_

Upon completion of the previous steps, logoff and turn the router off.



## Erasing and reloading the router

Enter into the privileged EXEC mode by typing **enable**.

```
Router>enable
```

If prompted for a password, enter **class**. If “class” does not work, ask the instructor for assistance.

At the privileged EXEC mode, enter the command **erase startup-config**.

```
Router#erase startup-config
```

The responding line 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
```

Now at the privileged EXEC mode, enter the command **reload**.

```
Router(config)#reload
```

The responding line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Proceed with reload? [confirm]
```

Press **Enter** to confirm.

In the first line of the response will be:

```
Reload requested by console.
```

After the router has reloaded the line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Press RETURN to get started!
```

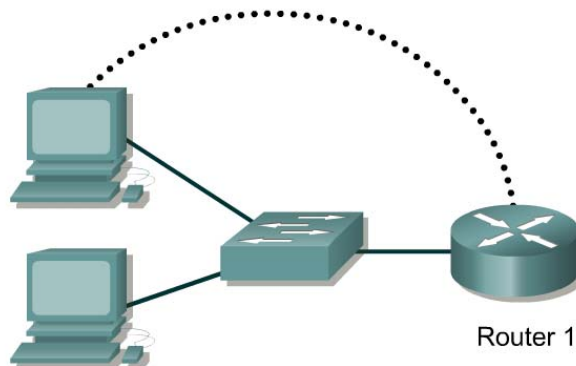
Press **Enter**.

The router is ready for the assigned lab to be performed.

Router Interface Summary					
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2	Interface #5
800 (806)	Ethernet 0 (E0)	Ethernet 1 (E1)			
1600	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
1700	FastEthernet 0 (FA0)	FastEthernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)	
2500	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
2600	FastEthernet 0/0 (FA0/0)	FastEthernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)	
In order to find out exactly how the router is configured, look at the interfaces. This will identify the type of router as well as how many interfaces the router has. There is no way to effectively list all of the combinations of configurations for each router class. What is provided are the identifiers for the possible combinations of interfaces in the device. This interface chart does not include any other type of interface even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in IOS command to represent the interface.					



## Lab 11.2.1a Configuring Standard Access Lists



Router Designation	Router Name	FA0/0 Address	Subnet mask	Enable Secret password	Enable/VTY/ Console passwords
Router 1	GAD	192.168.14.1	255.255.255.0	class	cisco

Straight-through cable	—————
Serial cable	————— <del>      </del>
Console (Rollover)	.....
Crossover cable	- - - - -

### Objective

- Configure, and apply a standard ACL to permit or deny specific traffic.
- Test the ACL to determine if the desired results were achieved.

### Background/Preparation

Cable a network similar to the one in the diagram. Any router that meets the interface requirements displayed on the above diagram, such as 800, 1600, 1700, 2500, 2600 routers, or a combination, may be used. Please refer to the chart at the end of the lab to correctly identify the interface identifiers to be used based on the equipment in the lab. The configuration output used in this lab is produced from 1721 series routers. Any other router used may produce a slightly different output. The following steps are intended to be executed on each router unless specifically instructed otherwise.

Start a HyperTerminal session as performed in the Establishing a HyperTerminal session lab.

**Note:** Go to the erase and reload instructions at the end of this lab. Perform those steps on the router in this lab assignment before continuing.

## Step 1 Configure the hostname and passwords on the Gadsden router

- a. On the Gadsden router, enter the global configuration mode and configure the hostname as shown in the chart. Then configure the console, virtual terminal and enable passwords. Configure the FastEthernet interface on the router according to the chart.

## Step 2 Configure the hosts on the Ethernet segment

- a. Host 1  
IP address            192.168.14.2  
Subnet mask        255.255.255.0  
Default gateway    192.168.14.1
- b. Host 2  
IP address            192.168.14.3  
Subnet mask        255.255.255.0  
Default gateway    192.168.14.1

## Step 3 Save the configuration information from the privileged EXEC command mode

GAD#**copy running-config startup-config**

## Step 4 Confirm connectivity by pinging the default gateway from both hosts

- a. If the pings are not successful, correct the configuration and repeat until they are successful.

## Step 5 Prevent access to the Ethernet interface from the hosts

- a. Create an access list that will prevent access to FastEthernet 0 from the 192.168.14.0 network.
- b. At the router configuration prompt type the following command:

```
GAD(config)#access-list 1 deny 192.168.14.0 0.0.0.255  
GAD(config)#access-list 1 permit any
```

- c. Why is the second statement needed? \_\_\_\_\_

## Step 6 Ping the router from the hosts

- a. Were these pings successful? \_\_\_\_\_
- b. Why or why not? \_\_\_\_\_

## Step 7 Apply the Access list to the interface

- a. At the FastEthernet 0 interface mode prompt type the following:

```
GAD(config-if)#ip access-group 1 in
```

## Step 8 Ping the router from the hosts

- a. Were these pings successful? \_\_\_\_\_
- b. Why or why not? \_\_\_\_\_

## Step 9 Create a new access list

- a. Now create an access list that will not allow the even numbered hosts to ping but permit the odd numbered hosts to ping.

- b. What will that access list look like? Finish this command with an appropriate comparison IP address (aaa.aaa.aaa.aaa) and wildcard mask (www.www.www.www):

```
access-list 2 permit aaa.aaa.aaa.aaa www.www.www.www
```

- c. Why was it not necessary to have the `permit any` statement at the end this time?
- 

### Step 10 Apply access list to the proper router interface

- a. First remove the old access list application by typing `no ip access-group 1 in` at the interface configuration mode.
- b. Apply the new access list by typing `ip access-group 2 in`

### Step 11 Ping the router from each hosts

- a. Was the ping from host 1 successful? \_\_\_\_\_
- b. Why or why not? \_\_\_\_\_
- c. Was the ping from host 2 successful? \_\_\_\_\_
- d. Why or why not? \_\_\_\_\_

Upon completion of the previous steps, logoff by typing `exit`. Turn the router off.

## Erasing and reloading the router

Enter into the privileged EXEC mode by typing **enable**.

```
Router>enable
```

If prompted for a password, enter **class**. If **class** does not work, ask the instructor for assistance.

At the privileged EXEC mode, enter the command **erase startup-config**.

```
Router#erase startup-config
```

The responding line 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
```

Now at the privileged EXEC mode, enter the command **reload**.

```
Router#reload
```

The responding line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Proceed with reload? [confirm]
```

Press **Enter** to confirm.

In the first line of the response will be:

```
Reload requested by console.
```

After the router has reloaded the line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

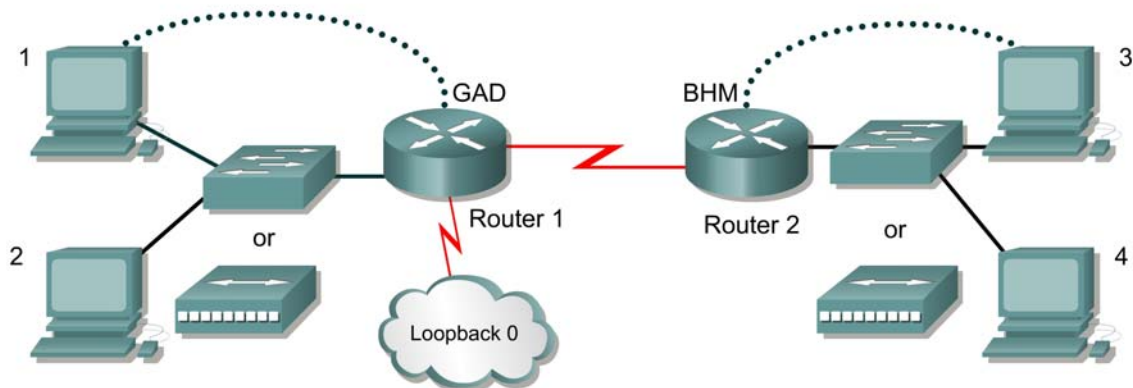
```
Press RETURN to get started!
```

Press **Enter**.

The router is ready for the assigned lab to be performed.

Router Interface Summary					
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2	Interface #5
800 (806)	Ethernet 0 (E0)	Ethernet 1 (E1)			
1600	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
1700	FastEthernet 0 (FA0)	FastEthernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)	
2500	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
2600	FastEthernet 0/0 (FA0/0)	FastEthernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)	
In order to find out exactly how the router is configured, look at the interfaces. This will identify the type of router as well as how many interfaces the router has. There is no way to effectively list all of the combinations of configurations for each router class. What is provided are the identifiers for the possible combinations of interfaces in the device. This interface chart does not include any other type of interface even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in IOS command to represent the interface.					

## Lab 11.2.1b Standard ACLs



Straight-through cable	—————
Serial cable	————— ⚡
Console (Rollover)	.....
Crossover cable	-----

Router Name	FA0/0 Address	Interface Type S0/0	S0/0 Address	LO0 Address	Routing	Enable password	VTY password
GAD	192.168.1.1 /24	DCE	192.168.2.1 /24	172.16.1.1 /24	RIP	cisco	class
BHM	192.168.3.1 /24	DTE	192.168.2.2 /24	--	RIP	cisco	class

Host	IP Address	Subnet Mask	Gateway
1	192.168.1.2	255.255.255.0	192.168.1.1
2	192.168.1.3	255.255.255.0	192.168.1.1
3	192.168.3.2	255.255.255.0	192.168.3.1
4	192.168.3.3	255.255.255.0	192.168.3.1

### Objective

Plan, configure, and apply a standard ACL to permit or deny specific traffic and test the ACL to determine if the desired results were achieved.

### Scenario

The company home office in Gadsden (GAD) provides services to branch offices such as the Birmingham (BHM) office. These offices have some minor security and performance concerns. A Standard ACL needs to be implemented as a simple and effective tool to control traffic



## Infrastructure

Host #3 represents the kiosk station that needs to have its access limited to the local network.

Host #4 represents another host in the BHM office and the Loopback 0 interface on the GAD router represents the Internet.

### Step 1 Basic Router Interconnection

- a. Interconnect the routers as shown in the diagram.

### Step 2 Basic Configuration

- a. The router may contain configurations from a previous use. For this reason, erase the startup configuration and reload the router to remove any residual configurations. Refer to the table on the first page and setup the router and host configurations. Verify reachability by pinging all systems and routers from each system.
- b. To simulate the Internet, add the following configuration to the GAD router.

```
GAD(config)#interface loopback0
GAD(config-if)#address 172.16.1.1 255.255.255.0
GAD(config-if)#exit
GAD(config)#router rip
GAD(config-router)#network 172.16.0.0
GAD(config-if)#^z
```

### Step 3 Establish Access List Requirements

- a. The kiosk station (host 3) needs to have its access limited to the local network. It is determined that a standard access list needs to be created to prevent traffic from this host from reaching any other networks. The access control list should block traffic from this host and not affect other traffic from this network. A standard IP ACL satisfies this requirement as it filters based on the source address to any destination.

What source address of the kiosk? \_\_\_\_\_

### Step 4 Plan the Access List Requirements

- a. As with any project, the most important part of the process is the planning. First, define the information needed to create the ACL. Remember that statements are added sequentially to an ACL. Therefore, the order of the statements needs to be planned carefully.
- b. It has been determined that this ACL will require 2 logical steps. Each of these steps can be accomplished with one statement each. As a planning tool, a text editor like Notepad can be used to organize the logic and then write the list. In the text editor enter the logic by typing:

```
! stop traffic from host 3

! permit all other traffic
```

- c. From this logic the actual ACL will be written. Using the tables below, document the information for each statement.

<b>stop traffic from host 3</b>			
List #	permit or deny	Source address	Wildcard mask

<b>permit all other traffic</b>			
List #	permit or deny	Source address	Wildcard mask

- d. What would be the result of not including a statement to permit all other source addresses?

---

- e. What would be the result of reversing the order of the 2 statements in the list?

---

- f. Why are both statements using the same ACL number?

---

- g. The final step in the planning process is to determine the best location for the access list and the direction the list should be applied. Examine the internetwork diagram and choose the appropriate interface and direction. Document this in the table below:

Router	Interface	Direction

## Step 5 Write and Apply the ACL

- a. Using the previously constructed logic and information of the access list, complete the commands in the text editor. The list syntax should look similar to:

```
! stop traffic from host 3
  access-list # deny address wildcard
! permit all other traffic
  access-list # permit address wildcard
```

- b. Add to this text file the configuration statements to apply the list.

The configuration statements take the form of:

```
interface type #/#
ip access-group # {in, out}
```

- c. Now the text file configuration needs to be applied to the router. Enter the configuration mode on the appropriate router and copy and paste the configuration. Observe the CLI display to ensure no errors were encountered.

## Step 6 Verify the ACL

Now that the ACL is completed, the ACL needs to be confirmed and tested.

- a. The first step is to check the list to see if it was configured properly on the router. To check the ACL logic use the **show access-lists** command. Record the output.

---

---

---

- b. Next, verify that the access list was applied to the proper interface and in the correct direction. To do this examine the interface with the **show ip interface** command. Look at the output from each interface and record the lists applied to the interface.

Interface \_\_\_\_\_

Outgoing access list is \_\_\_\_\_

Inbound access list is \_\_\_\_\_

- c. Finally, test the functionality of the ACL by trying to send packets from the source host and verify that is to be permitted or denied as appropriate. In this case, ping will be used to test this.

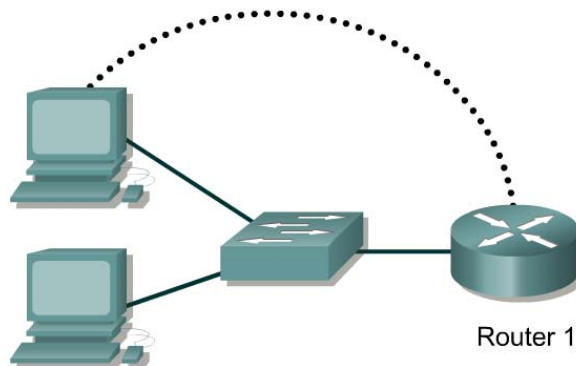
```
[ ] verify that host 3 CAN ping host 4
[ ] verify that host 3 CANNOT ping host 1
[ ] verify that host 3 CANNOT ping host 2
[ ] verify that host 3 CANNOT ping GAD Fa0/0
[ ] verify that host 3 CANNOT ping GAD LO0
[ ] verify that host 4 CAN ping host 1
[ ] verify that host 4 CAN ping host 2
[ ] verify that host 4 CAN ping GAD Fa0/0
[ ] verify that host 4 CAN ping GAD LO0
```

## Step 7 Document the ACL

- a. As a part of all network management, documentation needs to be created. Using the text file created for the configuration, add additional comments. This file should also contain output from the **show access-lists** and the **show ip interface** commands.
- b. The file should be saved with other network documentation. The file naming convention should reflect the function of the file and the date of implementation.  
That should complete the ACL project.
- c. Once finished, erase the start-up configuration on routers, remove and store the cables and adapter. Also logoff and turn the router off.



## Lab 11.2.2a Configuring Extended Access Lists



Router Designation	Router Name	FA0/0 Address	Subnet mask	Enable Secret password	Enable/VTY/ Console passwords
Router 1	GAD	192.168.14.1	255.255.255.0	class	cisco

Straight-through cable	—————
Serial cable	————— <del>      </del>
Console (Rollover)	.....
Crossover cable	- - - - -

### Objective

- Configure, and apply an extended ACL to permit or deny specific traffic.
- Test the ACL to determine if the desired results were achieved.

### Background/Preparation

Cable a network similar to the one in the diagram. Any router that meets the interface requirements displayed on the above diagram, such as 800, 1600, 1700, 2500, 2600 routers, or a combination, may be used. Please refer to the chart at the end of the lab to correctly identify the interface identifiers to be used based on the equipment in the lab. The configuration output used in this lab is produced from 1721 series routers. Any other router used may produce a slightly different output. The following steps are intended to be executed on each router unless specifically instructed otherwise.

Start a HyperTerminal session as performed in the Establishing a HyperTerminal session lab.

**Note:** Go to the erase and reload instructions at the end of this lab. Perform those steps on the router in this lab assignment before continuing.

### Step 1 Configure the hostname and passwords on the GAD router

- a. On the GAD router, enter the global configuration mode and configure the hostname as shown in the chart. Then configure the console, virtual terminal and enable passwords. Configure the FastEthernet interface on the router according to the chart.
- b. Allow HTTP access by issuing the `ip http server` command in global configuration mode.

### Step 2 Configure the hosts on the Ethernet segment

- a. Host 1  
IP address           192.168.14.2  
Subnet mask        255.255.255.0  
Default gateway    192.168.14.1
- b. Host 2  
IP address           192.168.14.3  
Subnet mask        255.255.255.0  
Default gateway    192.168.14.1

### Step 3 Save the configuration information from the privileged EXEC command mode

```
GAD#copy running-config startup-config
```

### Step 4 Confirm connectivity by pinging the default gateway from both hosts

- a. If the pings are not successful, correct the configuration and repeat until they are successful.

### Step 5 Connect to the router using the Web browser

- a. From a host, connect to the router using a Web browser to ensure that the Web server function is active.

### Step 6 Prevent access to HTTP (port 80) from the Ethernet interface hosts

- a. Create an access list that will prevent Web browsing access to FastEthernet 0 from the 192.168.14.0 network.
- b. At the router configuration prompt type the following commands:

```
GAD(config)#access-list 101 deny tcp 192.168.14.0 0.0.0.255 any eq 80  
GAD(config)#access-list 101 permit ip any any
```

- c. Why is the second statement needed? \_\_\_\_\_

### Step 7 Apply the access list to the interface

- a. At the FastEthernet 0 interface mode prompt type:

```
GAD(config-if)#ip access-group 101 in
```

### Step 8 Ping the router from the hosts

- a. Were these pings successful? \_\_\_\_\_
- b. If they were, why? \_\_\_\_\_

### Step 9 Connect to the router using the web browser

- a. Was the browser able to connect? \_\_\_\_\_

### Step 10 Telnet to the router from the hosts

- a. Were you able to Telnet successfully? \_\_\_\_\_
- b. Why or why not? \_\_\_\_\_

Upon completion of the previous steps, logoff by typing **exit**. Turn the router off.

## Erasing and reloading the router

Enter into the privileged EXEC mode by typing **enable**.

```
Router>enable
```

If prompted for a password, enter **class**. If **class** does not work, ask the instructor for assistance.

At the privileged EXEC mode, enter the command **erase startup-config**.

```
Router#erase startup-config
```

The responding line 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
```

Now at the privileged EXEC mode, enter the command **reload**.

```
Router#reload
```

The responding line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Proceed with reload? [confirm]
```

Press **Enter** to confirm.

In the first line of the response will be:

```
Reload requested by console.
```

After the router has reloaded the line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Press RETURN to get started!
```

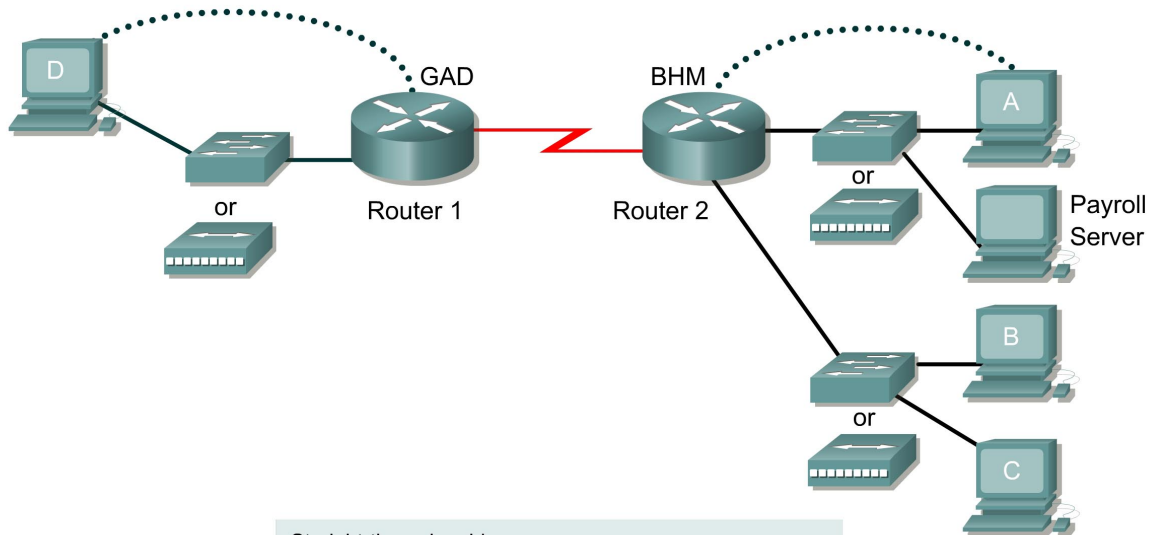
Press **Enter**.

The router is ready for the assigned lab to be performed.

Router Interface Summary					
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2	Interface #5
800 (806)	Ethernet 0 (E0)	Ethernet 1 (E1)			
1600	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
1700	FastEthernet 0 (FA0)	FastEthernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)	
2500	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
2600	FastEthernet 0/0 (FA0/0)	FastEthernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)	
In order to find out exactly how the router is configured, look at the interfaces. This will identify the type of router as well as how many interfaces the router has. There is no way to effectively list all of the combinations of configurations for each router class. What is provided are the identifiers for the possible combinations of interfaces in the device. This interface chart does not include any other type of interface even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in IOS command to represent the interface.					



## Lab 11.2.2b Simple Extended Access Lists



Router Designation	Router Name	Enable secret password	Enable, VTY and console password	Routing protocol	RIP network statements
Router 1	GAD	class	cisco	RIP	172.16.0.0
Router 2	BHM	class	cisco	RIP	192.168.1.0 172.16.0.0

Router Designation	Fast Ethernet 0 Address	Interface type Serial 0	Serial 0 Address	Fast Ethernet 1 Address	IP host table entries
Router 1	172.16.2.1/24	DTE	172.16.1.1/24		BHM
Router 2	192.168.1.17/28	DCE	172.16.1.2/24	192.168.1.33/28	GAD

Host	IP Address	Subnet Mask	Gateway
Payroll Server	192.168.1.18	255.255.255.240	192.168.1.17
A	192.168.1.19	255.255.255.240	192.168.1.17
B	192.168.1.34	255.255.255.240	192.168.1.33
C	192.168.1.35	255.255.255.240	192.168.1.33
D	172.16.2.2	255.255.255.0	172.16.2.1

## Objective

In this lab, configuring extended access lists to filter network to network, host to network, and network to host traffic.

## Scenario

A marketing company has two locations. The main site is in Birmingham (BHM) and the branch site is in Gadsden (GAD). The telecommunication administrator for both sites needs to plan and implement access control lists for security and performance. At the Birmingham site, there are two groups of network users. These groups are an Administrative group and a Production group and each are on separate networks. Both networks are interconnected with a router.

The Gadsden site is a stub network and only has a LAN connected to it.

## Step 1 Basic Router and Host Configurations

- a. Interconnect the routers and hosts as shown in the diagram. Configure all router basics such as hostname, enable password, telnet access, router interfaces. Use the preceding diagram and tables for reference.

**Note:** The BHM router requires two Ethernet interfaces.

- b. The configurations on each router should be as follows:

```
BHM#show running-config
```

```
<Output Omitted>
```

```
hostname BHM
!
enable secret class
!
interface FastEthernet0/0
 ip address 192.168.1.17 255.255.255.240
!
interface Serial0
 ip address 172.16.1.2 255.255.255.0
 clock rate 56000
!
interface FastEthernet0/1
 ip address 192.168.1.33 255.255.255.240
!
router rip
 network 172.16.0.0
 network 192.168.1.0
!
line vty 0 4
 password cisco
 login
!
end
```

```
BHM#
```

```
GAD#show running-config
```

```
<Output Omitted>
```

```
!
hostname GAD
!
enable password class
```

```

!
interface FastEthernet0
 ip address 172.16.2.1 255.255.255.0
!
interface Serial0
 ip address 172.16.1.1 255.255.255.0
!
router rip
 network 172.16.0.0
!
line vty 0 4
 password cisco
 login
!
no scheduler allocate
end

GAD#

```

- c. Configure the hosts with the appropriate information using the information previously defined. Before applying any type of access list, it is important to verify reachability between systems.

Verify reachability by pinging all systems and routers from each system.

- d. All hosts should be able to ping each other and the router interfaces. If pings to some interfaces are not successful, the problem will need to be located and corrected. Always verify the Physical layer connections, as they seem to be the more common source of connectivity problems. Next, verify the router interfaces. Make sure they are not shutdown, improperly configured, and that RIP is correctly configured. Finally, remember that along with valid IP addresses, hosts must also have default gateways specified.
- e. Now that the infrastructure is in place, it is time to begin securing the internetwork.

## Step 2 Prevent the Production Users from Accessing the Gadsden Network

- a. Company policy specifies that only the Administrative group should have access to the Gadsden site. The Production group should be restricted from accessing that network.
- b. Configure an extended access list to allow the Administrative group access to the Gadsden site. The production group should not have access to the Gadsden site.
- c. After careful analysis, it is decided that it would be best to use an extended access list and apply it to the outgoing S0 interface on the BHM router.

**Note:** Remember that when the access list is configured, each statement in the list is processed by the router in the order it was created. It is not possible to reorder an access list, skip statements, edit statements, or delete statements from a numbered access list. For this reason, it may be beneficial to create the access-list in a text editor such as Notepad and then paste the commands to the router, instead of being typed in directly on a router.

- d. Enter the following:

```

BHM#conf terminal
Enter configuration commands, one per line. End with CNTL/Z.
BHM(config)#access-list 100 deny ip 192.168.1.32 0.0.0.15 172.16.2.0
0.0.0.255

```

- e. This statement defines an extended access list called "100". It will deny ip access for any users on the 192.168.1.32 – 192.168.1.47 network if they are trying to access network 172.16.2.0. Although a less specific access list could be defined, this access list could allow the production users to access other sites (if available) through the S0 interface.

- f. Remember that there is an implicit deny all at the end of every access list. We must now make sure to let the administrative group access the Gadsden network. Although we could be more restrictive, we will simply let any other traffic through. Enter the following statement:

```
BHM(config)#access-list 100 permit ip any any
```

- g. Now we need to apply the access list to an interface. We could apply the list to any incoming traffic going to the production network Fa0/1 interface. However, if there were a great deal of traffic between the administrative network and the production network, the router would have to check every packet. There is concern that this would add unwanted overhead to the router. Therefore the access list is applied to the any outgoing traffic going through the BHM router S0 interface.

Enter the following:

```
BHM(config)#interface s0
BHM(config-if)#ip access-group 100 out
```

- h. Verify the syntax of the access-list with the **show running-config** command. The following lists the valid statements that should be in the configuration.

```
interface Serial0
 ip access-group 100 out
```

<Output Omitted>

```
access-list 100 deny ip 192.168.1.32 0.0.0.15 172.16.2.0 0.0.0.255
access-list 100 permit ip any any
```

- i. Another valuable command is the **show access-lists** command. The following is a sample output.

```
BHM#show access-lists
Extended IP access list 100
    deny ip 192.168.1.32 0.0.0.15 172.16.2.0 0.0.0.255
    permit ip any any
```

- j. The **show access-lists** command also displays counters, indicating how many times the list has been used. No counters are listed here since we haven't attempted to verify it yet.

**Note:** Use the **clear access-list counters** command to restart the access list counters

- k. Now test the access list by verifying reachability to the Gadsden network by the administrative and production hosts.

Can the production host (B) ping the Gadsden host (D)? \_\_\_\_\_

Can the production host (C) ping the Gadsden host (D)? \_\_\_\_\_

Can the administrative host (A) ping the Gadsden host (D)? \_\_\_\_\_

Can the production host (B) ping the administration host (A)? \_\_\_\_\_

Can the production host (B) ping the Gadsden router Serial interface? \_\_\_\_\_

- l. The production hosts (B) and (C) should be able to ping the administrative host (A) and Gadsden router Serial interface. However, they should not be able to ping the Gadsden host (D). The router should return a reply message to the host stating "Destination net unreachable".

Issue the **show access-lists** command. How many matches are there? \_\_\_\_\_

**Note:** The **show access-lists** command displays the number of matches per line. Therefore the number of deny matches may seem odd until it is realized that the pings matched the deny statement and the permit statement.

- m. To help understand how the access list is operating, keep periodically issuing the **show access-lists** command.

### Step 3 Allow a Production User Access to the Gadsden Network

- a. A call is received from a user in the production group (B). They are responsible for exchanging certain files between the production network and the Gadsden network. The extended access list needs to be altered to allow them access to the Gadsden network, while denying everyone else on the production network.
- b. Configure an extended access-list to allow that user access to Gadsden.
- c. Unfortunately, it is not possible to reorder an access list, skip statements, edit statements, or delete statements from a numbered access list. With numbered access lists, any attempt to delete a single statement results in the entire list's deletion.
- d. Therefore the initial extended access list needs to be deleted and a new one created. To delete access-list 100, enter the following:

```
BHM#conf t
Enter configuration commands, one per line. End with CNTL/Z.
BHM(config)#no access-list 100
```

Verify that it has been deleted with the **show access-lists** command.

- e. Now create a new extended access list. Always filter from the most specific to the most generic. Therefore the first line of the access list should allow the production host (B) access to the Gadsden network. The remainder of the access-list should be the same as the previous we had entered.
- f. To filter the production host (B) the first line of the access list should be as follows:

```
BHM(config)#access-list 100 permit ip host 192.168.1.34 172.16.2.0
0.0.0.255
```

Therefore, the access list permits the production host (B) access to the Gadsden network.

- g. Now deny all of the remaining production hosts access to the Gadsden network and permit any on else. Refer to the previous step for the next two lines of the configuration.

The **show access-list** command would display output similar to the following:

```
BHM#show access-lists
Extended IP access list 100
    permit ip host 192.168.1.34 172.16.2.0 0.0.0.255
    deny ip 192.168.1.32 0.0.0.15 172.16.2.0 0.0.0.255
    permit ip any any
BHM#
```

- h. Now test the access list by verifying reachability to the Gadsden network by the administrative and production hosts.

Can the production host (B) ping the Gadsden host (D)? \_\_\_\_\_

Can the production host (C) ping the Gadsden host (D)? \_\_\_\_\_

The production host (B) should now be able to ping the Gadsden host (D). However, all other production hosts (C) should not be able to ping the Gadsden host (D). Again, the router should return a reply message to the host stating "Destination net unreachable" for host (C).

#### Step 4 Allow Gadsden Users Access to the Administration Payroll Server

- a. The administration group houses the payroll server. Users from the Gadsden site need FTP and HTTP access the payroll server from time to time to upload and download payroll reports.
- b. Configure an extended access-list to allow users from the Gadsden site FTP, HTTP access to the payroll server only. It is decided to also allow ICMP access for them to ping the server. Gadsden users should not be able to ping any other host on the Administration network.
- c. We do not want unnecessary traffic between the sites therefore it is decided to configure an extended access list on the Gadsden router.
- d. Anticipate that privileged EXEC access to GAD will be required occasionally. That is why Telnet access to it is configured. Otherwise travel would be required to the Gadsden site to configure it.
- e. Telnet to the Gadsden router from the Birmingham router and enter enable mode. Troubleshoot as necessary.

**Note:** A common pitfall when configuring access lists on remote routers is to inadvertently "lock yourself" out. This is not a big problem when the router is physically located local. However, this could be a huge problem if the router is physically located in another geographical location.

- f. For this reason, it is strongly suggest that the `reload in 30` command be issued on the remote router. This would automatically reload the remote router within 30 minutes of issuing the command. Therefore, if the administrator was locked out, it would eventually reload to the previous configuration, allowing access to the router again. Use the `reload cancel` command to deactivate the pending reload.
- g. Configure an extended access list to allow FTP access to the payroll server. The access list statement should be similar to the following:

```
GAD(config)#access-list 110 permit tcp any host 192.168.1.18 eq ftp
```

This line will permit any host from the Gadsden network FTP access to the payroll server at address 192.168.1.18.

What could we have defined instead of using the keyword "any"? \_\_\_\_\_

What could we have defined instead of using the keyword "host"? \_\_\_\_\_

What could we have defined instead of using the keyword "ftp"? \_\_\_\_\_

- h. Now configure the next line of the access list to permit HTTP access to the payroll server. The access list statement should be similar to the following:

```
GAD(config)#access-list 110 permit tcp any host 192.168.1.18 eq www
```

This line will permit any host from the Gadsden network FTP access to the payroll server at address 192.168.1.18.

What else could we have defined instead of using the keyword “www”?

---

- i. Now configure the next line of the access list to permit ICMP access to the payroll server. The access list statement should be similar to the following:

```
GAD(config)#access-list 110 permit icmp any host 192.168.1.18
```

This line will permit any host from the Gadsden network to ping the payroll server at address 192.168.1.18.

- j. Finally, no Gadsden user should be able access any other host on the Administration network. Although it is not required, it is always a good idea to include a deny statement. Adding the statement is a good reminder and makes it easier to “read” the access list. The access list statement should be similar to the following:

```
GAD(config)#access-list 110 deny ip any 192.168.1.16 0.0.0.15
```

- k. Now we need to apply the access list to an interface. To reduce unwanted WAN traffic, it is decided to apply the access list to the any outgoing traffic going through the Gadsden routers S0 interface.

Enter the following:

```
GAD(config)#interface s0
GAD(config-if)#ip access-group 110 out
```

- l. Now test the access list by verifying reachability to the payroll server by a Gadsden host (D).

Can the Gadsden host (D) ping the payroll server? \_\_\_\_\_

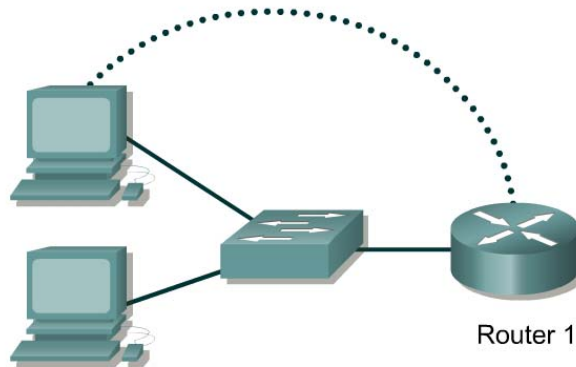
Can the Gadsden host (D) ping the host (A)? \_\_\_\_\_

The Gadsden host should be able to ping the payroll server only. The router should return the “Destination net unreachable” when it tries to ping the administrative host (D).

## Step 5 Document the ACL

- As a part of all network management, documentation needs to be created. Using the text file created for the configuration, add additional comments. This file should also contain output from the `show access-lists` and the `show ip interface` commands.
- The file should be saved with other network documentation. The file naming convention should reflect the function of the file and the date of implementation.
- That should complete this extended ACL lab.
- Once finished, erase the start-up configuration on routers, remove and store the cables and adapter. Also logoff and turn the router off.

## Lab 11.2.3a Configuring a Named Access List



Router Designation	Router Name	FA0/0 Address	Subnet mask	Enable Secret password	Enable/VTY/ Console passwords
Router 1	GAD	192.168.14.1	255.255.255.0	class	cisco

Straight-through cable	—————
Serial cable	————— <del>      </del>
Console (Rollover)	.....
Crossover cable	- - - - -

### Objective

- Create a named ACL to permit or deny specific traffic.
- Test the ACL to determine if the desired results were achieved.

### Background/Preparation

Cable a network similar to the one in the diagram. Any router that meets the interface requirements displayed on the above diagram, such as 800, 1600, 1700, 2500, 2600 routers, or a combination, may be used. Please refer to the chart at the end of the lab to correctly identify the interface identifiers to be used based on the equipment in the lab. The configuration output used in this lab is produced from 1721 series routers. Any other router used may produce a slightly different output. The following steps are intended to be executed on each router unless specifically instructed otherwise.

Start a HyperTerminal session as performed in the Establishing a HyperTerminal session lab.

**Note:** Go to the erase and reload instructions at the end of this lab. Perform those steps on the router in this lab assignment before continuing.

### Step 1 Configure the hostname and passwords on the Gadsden router

- On the Gadsden router, enter the global configuration mode and configure the hostname as shown in the chart. Then configure the console, virtual terminal, and enable passwords. Configure the FastEthernet interface on the router according to the chart.



## Step 2 Configure the hosts on the Ethernet segment

- a. Host 1
  - IP address 192.168.14.2
  - Subnet mask 255.255.255.0
  - Default gateway 192.168.14.1
- b. Host 2
  - IP address 192.168.14.3
  - Subnet mask 255.255.255.0
  - Default gateway 192.168.14.1

## Step 3 Save the configuration information from the privileged EXEC command mode

```
GAD#copy running-config startup-config
```

## Step 4 Confirm connectivity by pinging the default gateway from both hosts

- a. If the pings are not successful, correct the configuration and repeat until they are successful.

## Step 5 Prevent access to the Ethernet interface from the hosts

- a. Create a named access list that will prevent access to FastEthernet 0 from the 192.168.14.0 network.
- b. At the configuration prompt type the following command:

```
GAD(config)#ip access-list standard no_access  
GAD(config-std-nacl)#deny 192.168.14.0 0.0.0.255  
GAD(config-std-nacl)#permit any
```

- c. Why is the third statement needed? \_\_\_\_\_

## Step 6 Ping the router from the hosts

- a. Were these pings successful? \_\_\_\_\_
- b. If they were, why? \_\_\_\_\_

## Step 7 Apply the Access list to the interface

- a. At the FastEthernet interface mode prompt type the following:

```
GAD(config-if)#ip access-group no_access in
```

## Step 8 Ping the router from the hosts

- a. Were these pings successful? \_\_\_\_\_
- b. Why or why not? \_\_\_\_\_

Upon completion of the previous steps, logoff by typing **exit**. Turn the router off.

## Erasing and reloading the router

Enter into the privileged EXEC mode by typing **enable**.

```
Router>enable
```

If prompted for a password, enter **class**. If **class** does not work, ask the instructor for assistance.

At the privileged EXEC mode, enter the command **erase startup-config**.

```
Router#erase startup-config
```

The responding line 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
```

Now at the privileged EXEC mode, enter the command **reload**.

```
Router#reload
```

The responding line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

```
Proceed with reload? [confirm]
```

Press **Enter** to confirm.

In the first line of the response will be:

```
Reload requested by console.
```

After the router has reloaded the line prompt will be:

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

Type **n** and then press **Enter**.

The responding line prompt will be:

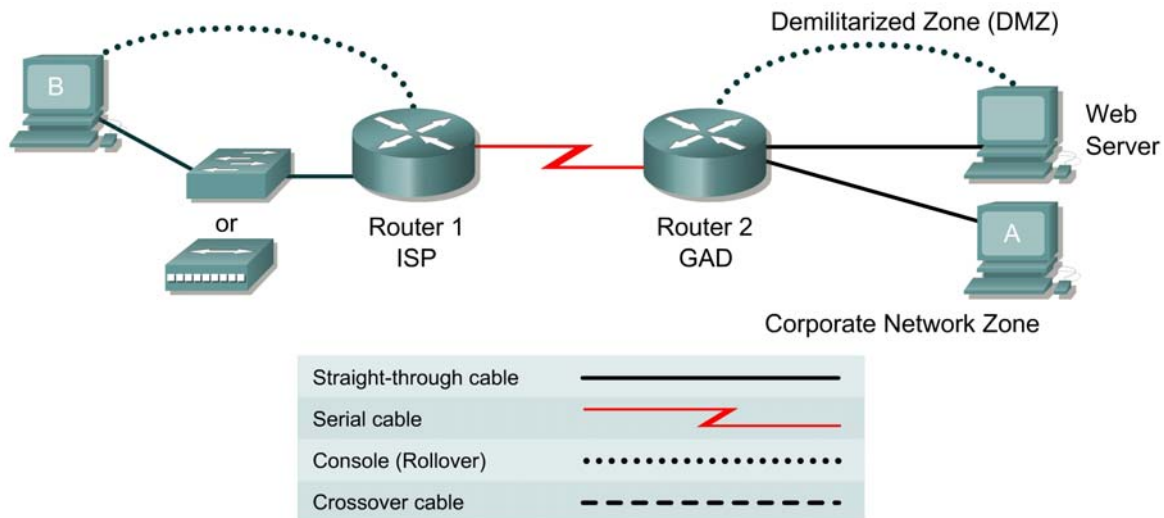
```
Press RETURN to get started!
```

Press **Enter**.

The router is ready for the assigned lab to be performed.

Router Interface Summary					
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2	Interface #5
800 (806)	Ethernet 0 (E0)	Ethernet 1 (E1)			
1600	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
1700	FastEthernet 0 (FA0)	FastEthernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)	
2500	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)	
2600	FastEthernet 0/0 (FA0/0)	FastEthernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)	
In order to find out exactly how the router is configured, look at the interfaces. This will identify the type of router as well as how many interfaces the router has. There is no way to effectively list all of the combinations of configurations for each router class. What is provided are the identifiers for the possible combinations of interfaces in the device. This interface chart does not include any other type of interface even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in IOS command to represent the interface.					

## Lab 11.2.3b Simple DMZ Extended Access Lists



Router Designation	Router Name	Enable secret password	Enable, VTY and console password	Routing protocol	RIP network statements
Router 1	ISP	class	cisco	RIP	172.16.0.0
Router 2	GAD	class	cisco	RIP	10.0.0.0 172.16.0.0

Router Designation	IP host names	Fast Ethernet 0 Address	Interface type Serial 0	Serial 0 Address	Fast Ethernet 1 Address
Router 1	ISP	172.16.2.1/24	DTE	172.16.1.1/24	N/A
Router 2	GAD	10.1.1.1/24	DCE	172.16.1.2/24	10.10.10.1/24

Host	IP Address	Subnet Mask	Gateway
Web Server	10.1.1.10	255.255.255.0	10.1.1.1
A	10.10.10.10	255.255.255.0	10.10.10.1
B	172.16.2.10	255.255.255.0	172.16.2.1

### Objective

In this lab, the use of extended access lists to create a simple DeMilitarized Zone (DMZ) will be learned.

## Scenario

The BMTC is a small manufacturing company located in Gadsden. They have decided that they would like to create an awareness of their products over the Internet. Therefore their immediate requirement is to promote their products to potential customers by providing product overviews, reports, and testimonials. Future requirements could include e-mail, FTP, DNS, and online e-commerce services.

They have contracted you to design and configure a secure infrastructure to support their internal and external network requirements while maintaining fiscal responsibility which means “make it secure but keep costs down”.

After careful analysis, it is proposed to create a two-tier security architecture consisting of a corporate network zone and a DeMilitarized Zone (DMZ). The corporate network zone would house private servers and internal clients. The DMZ would house only one external server that would provide World Wide Web services. Although the one server creates a single point of failure, the service is only informational and not considered mission critical.

They liked the proposal and have signed a contract.

## Step 1 Basic Router and Host Configurations

- a. Interconnect the routers and hosts as shown in the diagram. Configure all router basics such as hostname, router interfaces, and routing protocol. Use the preceding diagram and tables for reference.

The configurations on each router should similar to the following:

```
GAD#show running-config
```

```
<Output Omitted>
```

```
!  
hostname GAD  
!  
interface FastEthernet0  
 ip address 10.1.1.1 255.255.255.0  
!  
interface Serial0  
 ip address 172.16.1.2 255.255.255.0  
!  
interface FastEthernet1  
 ip address 10.10.10.1 255.255.255.0  
!  
router rip  
 network 10.0.0.0  
 network 172.16.0.0  
!  
GAD#
```

```
ISP#show running-config
```

```
<Output Omitted>
```

```
!  
hostname ISP  
!  
interface FastEthernet0  
 ip address 172.16.2.1 255.255.255.0  
!  
interface Serial0  
 ip address 172.16.1.1 255.255.255.0  
!  
router rip
```

```
network 172.16.0.0
!

ISP#
```

- b. Configure the hosts with the correct settings using the information previously defined.
- c. To make the lab more realistic, web server software should be installed on the web server host. Examples include Microsoft IIS or Microsoft Personal Web Server (Windows 98). A third-party software such as TinyWeb Server (<http://www.ritlabs.com/tinyweb/>) can be used. If TinyWeb Server is used, it is recommended that TinyBox (<http://people.freenet.de/ralph.becker/tinybox/>) also be installed, which is a GUI front-end for TinyWeb Server.
- Be sure to create a default index.html page. The web page should include a message such as "Hello World". Save the page as instructed by the Web Server software.
- d. Before applying any type of access list, it is important to verify reachability between systems.
- [ ] Verify reachability by pinging all systems and routers from each system.
- Can Host A ping Host B? \_\_\_\_\_
- Can Host A ping the Web Server? \_\_\_\_\_
- Can Host B ping Host A? \_\_\_\_\_
- Can Host B ping the Web Server? \_\_\_\_\_
- All hosts should be able to ping each other, if not troubleshoot the unsuccessful interfaces. Always verify the physical layer connections, because they are a common source of connectivity problems.
- e. On Host A, open a Web browser such as Windows Explorer or Netscape Navigator and enter the address of the Web Server in the address location.
- [ ] Verify that each Host has Web access to the Web Server.
- Can Host A view the index.html page? \_\_\_\_\_
- Can Host B view the index.html page? \_\_\_\_\_
- Both hosts should be able to view the index.html page in the Web Browser. Troubleshoot as necessary.
- f. Now that the infrastructure is in place, it is time to begin securing the internetwork.

## Step 2 Protect the Corporate Network

- a. The corporate network zone houses private servers and internal clients. No other network should be able to access it.
- b. Configure an extended access list to protect the corporate network. Protecting a corporate network begins by specifying which traffic can exit out the network. Although this may initially sound strange, it becomes clearer when it is known that most hackers are internal employees. The first access list will specify which network can exit out of the network.

Enter the following:

```
GAD#conf terminal
Enter configuration commands, one per line. End with CNTL/Z.
GAD(config)#access-list 101 permit ip 10.10.10.0 0.0.0.255 any
GAD(config)#access-list 101 deny ip any any
```

The first line defines of access list "101" will only let valid corporate users on network 10.10.10.0 into the router. The second line is not really required because of the implicit deny all, but has been added for readability.

- c. Now we need to apply the access list to the corporate network interface.

Enter the following:

```
GAD(config)#interface fa1  
GAD(config-if)#ip access-group 101 in
```

- d. Now it is necessary to test the access lists.

[ ] Verify reachability by pinging all systems and routers from each system.

Can Host A ping the Web Server? \_\_\_\_\_

Can Host A ping Host B? \_\_\_\_\_

Can Host B ping the Web Server? \_\_\_\_\_

Can Host B ping Host A? \_\_\_\_\_

All hosts should be able to ping any location.

- e. Next, configure an outbound extended access list on the corporate network interface. Traffic entering the corporate network will be coming from either the Internet or the DMZ. For this reason which traffic can be allowed into the corporate network must be limited.
- f. The first issue to address is to make sure that only traffic that originated from the corporate network can be allowed back into that network. Enter the following:

```
GAD(config)#access-list 102 permit tcp any any established
```

The keyword **established** in this line only permits TCP traffic that originated from the 10.10.10.0 network.

- g. To make network management and troubleshooting easier, it is also decided to permit ICMP into the network. This will allow the internal hosts to receive ICMP messages (e.g., ping messages).

Enter the following:

```
GAD(config)#access-list 102 permit icmp any any echo-reply  
GAD(config)#access-list 102 permit icmp any any unreachable
```

The first line only allows successful pings back into the corporate network. The second line allows unsuccessful ping messages to be displayed.

- h. At this time no other traffic is desired into the corporate network. Therefore enter the following:

```
GAD(config)#access-list 102 deny ip any any
```

- i. Finally, apply the access-list to the corporate network Fast Ethernet port.

```
GAD(config)#interface fa 1  
GAD(config-if)#ip access-group 102 out
```

- j. Remember that an interface can support one incoming and one outgoing access list. To verify this, issue the `show ip interface fa1` command. The output should confirm that the outgoing access list is 102 and that the inbound access list is 101.
- k. Use the `show access-lists` command to verify the syntax of the access lists. The output should be similar to the following:

```
GAD#show access-lists
Extended IP access list 101
    permit ip 10.10.10.0 0.0.0.255 any
    deny ip any any
Extended IP access list 102
    permit tcp any any established
    permit icmp any any echo-reply
    permit icmp any any unreachable
    deny ip any any
```

Access lists may have to be deleted and re-entered if there is any discrepancy between the preceding output and the configuration.

- l. Now the access list needs to be tested.
  - [ ] Verify reachability by pinging all systems and routers from each system.
  - Can Host A ping the Web Server? \_\_\_\_\_
  - Can Host A ping Host B? \_\_\_\_\_
  - Can Host B ping the Web Server? \_\_\_\_\_
  - Can Host B ping Host A? \_\_\_\_\_
  - Host A should be able to ping all locations. However, no other host should be able to ping Host A.
- m. On Host A, open a Web browser such as Windows Explorer or Netscape Navigator and enter the address of the Web Server in the address location.
  - [ ] Verify that Host A still has Web access to the Web Server.
  - Can Host A view the index.html page? \_\_\_\_\_
- n. Host A should still be able to view the index.html page in the Web Browser. Troubleshoot as necessary.
- o. The internal corporate network is now secure. Next we need to secure the DMZ network.

### Step 3 Protect the DMZ Network

- a. The DMZ network will house only one external server that will provide World Wide Web services. Other services such as E-mail, FTP, and DNS will be implemented at a later time. Although the one server creates a single point of failure, the service is only informational and not considered mission critical.
  - b. Configure an extended access list to protect the DMZ network. Again, as with the corporate network, specify which traffic can exit the network and apply it to the interface.
- Enter the following:

```
GAD#conf terminal
Enter configuration commands, one per line. End with CNTL/Z.
GAD(config)#access-list 111 permit ip 10.1.1.0 0.0.0.255 any
GAD(config)#access-list 111 deny ip any any

GAD(config)#interface fa0
GAD(config-if)#ip access-group 111 in
```

- c. Now test the new access lists.
  - [ ] Verify reachability by pinging all systems and routers from each system.
  - Can Host A ping the Web Server? \_\_\_\_\_



Can Host A ping Host B? \_\_\_\_\_

Can Host B ping the Web Server? \_\_\_\_\_

Can Host B ping Host A? \_\_\_\_\_

Host A should be able to ping all locations. However, external hosts should not be able to ping Host A.

- d. Next, an outbound extended access list is required to specify which traffic can enter the DMZ network. Traffic entering the DMZ network will be coming from either the Internet or the corporate network requesting World Wide Web services.
- e. Configure an outbound extended access-list specifying that World Wide Web requests be allowed into the network. Enter the following:

```
GAD(config)#access-list 112 permit tcp any host 10.1.1.10 eq www
```

This line will allow World Wide Web services destined for the Web server into the DMZ network.

What command would be entered to allow DNS requests into the DMZ?

---

What command would be entered to allow E-mail requests into the DMZ?

---

What command would be entered to allow FTP requests into the DMZ?

---

- f. For management purposes, it would be useful to let corporate users **ping** the Web Server. However, Internet users should not be provided the same privilege. Add a line to the access list to allow only corporate users ICMP access into the DMZ network.

Enter the following:

```
GAD(config)#access-list 112 permit icmp 10.10.10.0 0.0.0.255 host 10.1.1.10
```

This line only allows hosts on the Corporate network to **ping** the Web Server. Although the configuration could be more restrictive with the ICMP options, it is not viewed as being necessary.

- g. Other services could be permitted into the DMZ network in the future. However, at this time, no other traffic is to be permitted into the DMZ network. Therefore enter the following:

```
GAD(config)#access-list 112 deny ip any any
```

- h. Apply the outbound access-list to the DMZ network Fast Ethernet port.

```
GAD(config)#interface fa 0  
GAD(config-if)#ip access-group 112 out
```

- i. To verify the syntax of the access lists, use the **show-access-lists** command. The output should be similar to the following:

```
GAD#show access-lists  
Extended IP access list 101  
    permit ip 10.10.10.0 0.0.0.255 any (70 matches)
```

```

deny ip any any
Extended IP access list 102
  permit tcp any any established (8 matches)
  permit icmp any any echo-reply (12 matches)
  permit icmp any any unreachable
  deny ip any any (4 matches)
Extended IP access list 111
  permit ip 10.1.1.0 0.0.0.255 any (59 matches)
  deny ip any any
Extended IP access list 112
  permit tcp any host 10.1.1.10 eq www (29 matches)
  permit icmp 10.10.10.0 0.0.0.255 host 10.1.1.10 (4 matches)
  deny ip any any (14 matches)

```

The access lists may have to be deleted and re-entered if there is any discrepancy between the preceding output and the configuration.

- j. The access lists now need to be tested.

[ ] Verify reachability by pinging all systems and routers from each system.

Can Host A ping the Web Server? \_\_\_\_\_

Can Host A ping Host B? \_\_\_\_\_

Can Host B ping the Web Server? \_\_\_\_\_

Can Host B ping Host A? \_\_\_\_\_

- k. Only Host A should be able to ping all locations.

Use a Web browser such as Windows Explorer or Netscape Navigator on each host and enter the address of the Web Server in the address location.

[ ] Verify that the hosts still have Web access to the Web Server.

Can Host A view the index.html page? \_\_\_\_\_

Can Host B view the index.html page? \_\_\_\_\_

Both hosts should still be able to view the index.html page in the Web Browser. Troubleshoot as necessary.

- l. The DMZ network is now secure. Next, we need to configure our external interface to deter spoofing and hacking practices.

## Step 4 Deter Spoofing

- Networks are becoming increasingly prone to attacks from outside users. Hackers, crackers, and script kiddies are titles used to describe various individuals who maliciously try to break into networks or render networks incapable of responding to legitimate requests (Denial of Service (DoS) attacks). This has proven to be a troublesome for the Internet community.
- You are well aware of the practices used by some of these hackers. A common method that they employ is to attempt to forge a valid internal source IP addresses. This practice is commonly known as “spoofing”.
- To deter spoofing, it is decided to configure an access list so that Internet hosts cannot easily spoof an internal network addresses. Three common source IP addresses that hackers attempt to forge are valid internal addresses (e.g., 10.10.10.0), loopback addresses (i.e., 127.x.x.x), and multicast addresses (i.e., 224.x.x.x – 239.x.x.x).
- Configure an inbound access list that will make it difficult for outside users to spoof internal addresses and apply it to the Serial 0 interface.

Enter the following:

```
GAD(config)#access-list 121 deny ip 10.10.10.0 0.0.0.255 any
```

```
GAD(config)#access-list 121 deny ip 127.0.0.0 0.255.255.255 any
GAD(config)#access-list 121 deny ip 224.0.0.0 31.255.255.255 any
GAD(config)#access-list 121 permit ip any any

GAD(config)#interface serial 0
GAD(config-if)#ip access-group 121 in
```

The first line will stop outside users from forging a valid source IP address. The second line stops them from using the loopback address range. The third line stops the practice of hackers using the multicast range of addresses (i.e., 224.0.0.0 – 239.255.255.255) to create unnecessary internal traffic.

- e. Verify the syntax of the access lists with the **show-access-lists** command. The output should be similar to the following:

```
GAD#show access-lists
GAD#show access-lists
Extended IP access list 101
    permit ip 10.10.10.0 0.0.0.255 any (168 matches)
    deny ip any any
Extended IP access list 102
    permit tcp any any established (24 matches)
    permit icmp any any echo-reply (28 matches)
    permit icmp any any unreachable
    deny ip any any (12 matches)
Extended IP access list 111
    permit ip 10.1.1.0 0.0.0.255 any (122 matches)
    deny ip any any
Extended IP access list 112
    permit tcp any host 10.1.1.10 eq www (69 matches)
    permit icmp 10.10.10.0 0.0.0.255 host 10.1.1.10 (12 matches)
    deny ip any any (22 matches)
Extended IP access list 121
    deny ip 10.10.10.0 0.0.0.255 any
    deny ip 127.0.0.0 0.255.255.255 any
    deny ip 224.0.0.0 31.255.255.255 any
    permit ip any any (47 matches)
```

The access lists may have to be deleted and re-entered if there is any discrepancy between the preceding output and the configuration.

- f. Finally, test if connectivity still exists.

[ ] Verify reachability by pinging all systems and routers from each system.

Can Host A ping the Web Server? \_\_\_\_\_

Can Host A ping Host B? \_\_\_\_\_

Can Host B ping the Web Server? \_\_\_\_\_

Can Host B ping Host A? \_\_\_\_\_

Only Host A should be able to ping all locations.

- g. Use a Web browser such as Windows Explorer or Netscape Navigator on each host and enter the address of the Web Server in the address location.

[ ] Verify that the hosts still have Web access to the Web Server.

Can Host A view the index.html page? \_\_\_\_\_

Can Host B view the index.html page? \_\_\_\_\_

Both hosts should still be able to view the index.html page in the Web Browser. Troubleshoot as necessary.

- h. The BMTC network is now secure.

**Note:** The preceding lab is a basic solution to providing a secure network. It is by no means intended to be a complete solution.

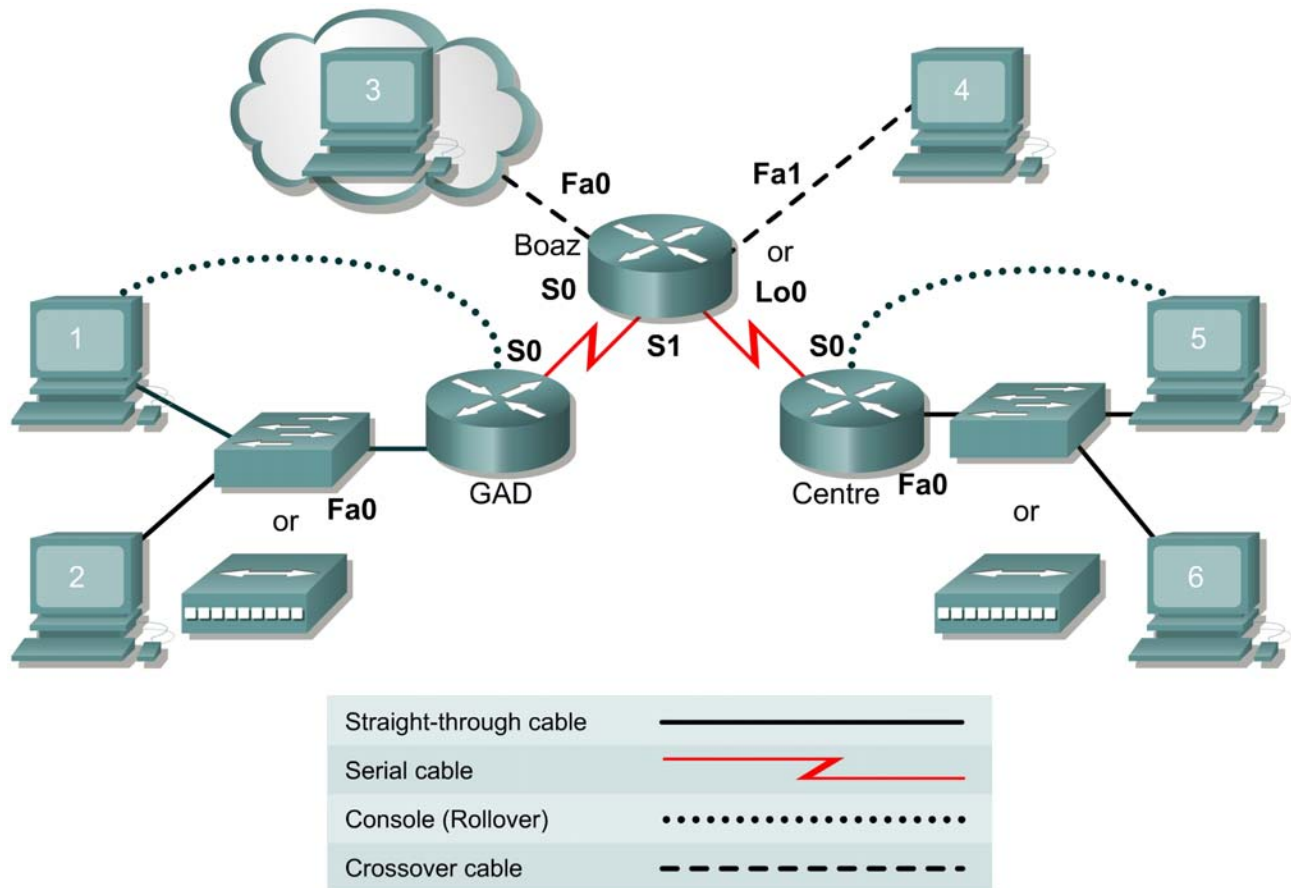
To properly protect enterprise networks, dedicated network devices such as Cisco PIX devices should be implemented. As well, advanced features such as Network Address Translation and advanced access lists options such as Reflexive access lists, Content Based Access Lists (CBAC), are strongly recommended and well beyond the scope of CCNA certification.

Finally, it is recommended that network administrators maintain strong relationships with their service providers to help when network security is compromised.

### Step 7 Document the ACL

- a. As a part of all network management, documentation needs to be created. Using the text file created for the configuration, add additional comments. This file should also contain output from the `show access-list` and the `show ip interface` commands.
- b. The file should be saved with other network documentation. The file naming convention should reflect the function of the file and the date of implementation.
- c. Once finished, erase the start-up configuration on routers, remove and store the cables and Adapter. Also logoff and turn the router off.

### Lab 11.2.3c Multiple Access Lists Functions (Challenge Lab)



Router Name	Router Type	FA0 Address	FA1 Address	S0 Address	S1 Address	Subnet mask	Routing	Enable password	VTY password

Host	IP Address	Subnet Mask	Gateway

## Objective

Configure and apply an extended access control list to control Internet traffic using one or more routers.

## Scenario

The company has a regional office, Boaz, that provides services to two branch offices, Gadsden and Centre. These offices each have a branch manager and several people responsible for providing customer services. There has been a significant amount of turnover by the service personnel. After a security audit, it was discovered that there are no network restrictions on the computers used by the service personnel.

The network infrastructure team leader wants a plan created and implemented to enforce network security to prevent access.

## Infrastructure

Host #3 represents the Internet. An alternative is to use loopback 0 interface on Boaz and issue the `Boaz (config) #ip http server` command.

Host #4 represents an internal web server that has sensitive personnel and payroll information.

Host #4 will also represent the network administration computer

The lowest 4 host addresses in each subnet are all reserved for the branch managers' computers, hosts 1 and 5.

The router interfaces use highest addresses in the subnets.

The remaining address of the subnet in each branch is to be used for service personnel computers, hosts 2 and 6.

## Step 1 Basic Router Interconnection

- Interconnect the routers as shown in the diagram.

## Step 2 Internetwork Address Design

- Using a private class C IP address for the internal network, design and document the network. Complete the preceding charts and include the interface type and number, IP address, subnet

mask, and cable type. The “Internet” (cloud) network can be any private space address. Be sure that the address ranges assigned to the routers and hosts meet the criteria described in the infrastructure section above.

### Step 3 Basic Router Configuration

- a. The router may contain configurations from a previous use. For this reason, erase the startup configuration and reload the router to remove any residual configurations. Using the information previously created, setup the router configurations using RIP or IGRP and verify reachability by pinging all systems and routers from each system.

To simulate specific locations on the Internet, add the following configuration to the Boaz router.

```
Boaz (config) #interface loopback 1
Boaz (config-if) #ip address 192.168.255.1 255.255.255.255
Boaz (config-if) #exit
Boaz (config) #interface loopback 2
Boaz (config-if) #ip address 192.168.255.2 255.255.255.255
Boaz (config-if) #exit
Boaz (config) #interface loopback 3
Boaz (config-if) #ip address 192.168.255.3 255.255.255.255
Boaz (config-if) #exit
Boaz (config) #interface loopback 4
Boaz (config-if) #ip address 192.168.255.4 255.255.255.255
Boaz (config-if) #exit
Boaz (config) #interface loopback 5
Boaz (config-if) #ip address 192.168.255.5 255.255.255.255
Boaz (config-if) #exit
Boaz (config) #interface loopback 6
Boaz (config-if) #ip address 192.168.255.6 255.255.255.255
Boaz (config-if) #exit
Boaz (config) #interface loopback 7
Boaz (config-if) #ip address 192.168.255.7 255.255.255.255
Boaz (config-if) #exit
Boaz (config) #interface loopback 8
Boaz (config-if) #ip address 192.168.255.8 255.255.255.255
Boaz (config-if) #exit
Boaz (config) #interface loopback 9
Boaz (config-if) #ip address 192.168.255.9 255.255.255.255
Boaz (config-if) #exit
Boaz (config) #interface loopback 10
Boaz (config-if) #ip address 192.168.255.10 255.255.255.255
Boaz (config-if) #exit
```

Add a network statement to the Boaz routing protocol to advertise this network.

```
Boaz (config-router) #network 192.168.255.0
```

### Step 4 Client Configurations

- a. Configure the hosts with the appropriate information using the information previously defined.  
[ ] Verify reachability by pinging all systems and routers from each system.
- b. On hosts 3 and 4 install and configure a Web server such as Tiny Web server.  
(<http://www.simtel.net/pub/pd/13103.html>) (Host 3 to represent the Internet. Host 4 to represent internal web server that has sensitive personnel and payroll information.) (Host 4 can be the Loopback of the Boaz router)

- ☐ Verify that all systems can use a web browser to access the web pages of both the intranet server (host 4) and the Internet server (host 3).
- c. On host 3, install and configure a Telnet server such as TelnetXQ ([http://www.datawizard.net/Free\\_Software/TelnetXQ\\_Free/telnetxq\\_free.htm](http://www.datawizard.net/Free_Software/TelnetXQ_Free/telnetxq_free.htm)).
  - ☐ Verify that all systems can Telnet to the Internet (host 3).
- d. Now that the infrastructure is in place, it is time to begin securing the internetwork.

### Step 5 Secure the Intranet Server

- a. Host #4 represents an internal web server that has sensitive personnel and payroll information. The information on this server should be accessible ONLY by the branch managers. Access control list(s) should be created to secure this server so that only branch managers' machines have web access (http protocol) to this internal server

How many access control lists will be used? \_\_\_\_\_

Where will the access control list(s) will be applied? \_\_\_\_\_

Which direction will the access control list(s) will be applied? \_\_\_\_\_

For what reasons might it be better to use multiple access control lists?

\_\_\_\_\_

\_\_\_\_\_

For what reasons might it be better to use a single access control lists?

\_\_\_\_\_

\_\_\_\_\_

- b. Using a text editor, such as Notepad, construct the logic of the access list(s) and then type the proper commands. When the list is properly constructed, paste it into the router configuration and apply it to the appropriate interfaces.
- c. Confirm that the ACL is functioning properly:
  - ☐ Verify reachability by pinging all systems and routers from each system.
  - ☐ Verify that all computers systems can use a web browser to access the web pages on the Internet (any where except internal web server).
  - ☐ Verify that the service personnel computers CANNOT use a web browser to access (http protocol) the intranet server.
  - ☐ Verify that the computers from the Internet (host 3) CANNOT use a web browser to access (http protocol) the intranet server.

### Step 6 Secure the Intranet Documents

- a. There is concern that internal policy and procedures documents are being shared outside of the company. To ensure that users in the internetwork cannot forward these documents, do not allow any Telnet or FTP access to the Internet.

Should a new ACL, or ACLs, be created or will the current list, or lists, be modified?

\_\_\_\_\_

If new list(s):

How many new access control lists will be created? \_\_\_\_\_

Where will the new access control list(s) will be applied?

\_\_\_\_\_



Which direction will the new access control list(s) will be applied?

---

- b. Again, use a text editor, such as Notepad, to construct the logic of the access list(s) and then type the proper commands. When the list is properly constructed, paste it to the router(s) and apply it to the appropriate interfaces.
- c. Confirm that the ACL is functioning properly:
  - ☐ Verify reachability by pinging all systems and routers from each system.
  - ☐ Verify that all computers systems can use a web browser to access the web pages on the Internet (any where except internal web server)
  - ☐ Verify that the service personnel computers CANNOT use a web browser to access (http protocol) the intranet server
  - ☐ Verify computers from the Internet (host 3) CANNOT use a web browser to access (http protocol) the intranet server
  - ☐ Verify that the computers CANNOT telnet to the Internet (host 3 and loopbacks interfaces on Boaz) but can telnet to the routers

### Step 7 Deter Internet Abuse

- a. There have also been some complaints that employees have been abusing Internet access. They have been accessing sites with questionable content. To help stop this practice, do not allow any IP traffic from the internetwork to the following sites:

192.168.255.1  
192.168.255.4  
192.168.255.8  
192.168.255.9

Will new access control list(s) be created or will the current list(s) be modified?

---

If new list(s):

How many new access control lists will be created?

---

Where will the new access control list(s) will be applied?

---

Which direction will the new access control list(s) will be applied?

---

- b. Again, use a text editor, such as Notepad, to construct the logic of the access list(s) and then type the proper commands. When the list is properly constructed, paste it to the router(s) and apply it to the appropriate interfaces.
- c. Confirm that the ACL is functioning properly:
  - ☐ Verify service personnel computers CANNOT use a web browser to access (http protocol) the intranet server.
  - ☐ Verify that the computers from the Internet (host 3) CANNOT use a web browser to access (http protocol) the intranet server.
  - ☐ Verify that the computers CANNOT telnet Internet (host 3 and loopbacks interfaces on Boaz) but can telnet to routers.

- [ ] Verify that the computers CANNOT telnet, use a web browser to access, nor ping 192.168.255.1.
- [ ] Verify that the computers CANNOT telnet, use a web browser to access, nor ping 192.168.255.4.
- [ ] Verify that the computers CANNOT telnet, use a web browser to access, nor ping 192.168.255.8.
- [ ] Verify that the computers CANNOT telnet, use a web browser to access, nor ping 192.168.255.9.
- [ ] Verify reachability by pinging all other systems and routers from each system.
- [ ] Verify all computers systems can use a web browser to access the other web pages on the Internet (host 3 and loopbacks interfaces on Boaz).

## Step 8 Deter Denial of Service (DoS) Attacks

- a. In the last few weeks the company's internetwork has been the subject to numerous denial of service attacks. Most have taken the form of sending "Ping of Death" (oversized ICMP echo packets) or directed broadcasts (x.x.x.255). To help stop the "Ping of Death" attacks, do not allow any ICMP echo packets into the internetwork. Also to stop the directed broadcast, stop all IP packets from entering the internetwork addressed to the directed broadcast address.

Will new access control list(s) be created or will the current list(s) be modified?

---

If new list(s):

How many new access control lists will be created?

---

Where will the new access control list(s) will be applied?

---

Which direction will the new access control list(s) will be applied?

---

- b. Again, use a text editor, such as Notepad, to construct the logic of the access list(s) and then type the proper commands. When the list is properly constructed, paste it to the router(s) and apply it to the appropriate interfaces.
- c. Confirm that the ACL is functioning properly:
  - [ ] Verify service personnel computers CANNOT use a web browser to access (http protocol) the intranet server.
  - [ ] Verify that the computers from the Internet (host 3) CANNOT use a web browser to access (http protocol) the intranet server.
  - [ ] Verify that the computers CANNOT telnet Internet (host 3 and loopbacks interfaces on Boaz) but can telnet to routers.
  - [ ] Verify that the computers CANNOT telnet, use a web browser to access, nor ping 192.168.255.1.
  - [ ] Verify that the computers CANNOT telnet, use a web browser to access, nor ping 192.168.255.4.
  - [ ] Verify that the computers CANNOT telnet, use a web browser to access, nor ping 192.168.255.8.
  - [ ] Verify that the computers CANNOT telnet, use a web browser to access, nor ping 192.168.255.9.

- [ ] Verify that all computers systems can use a web browser to access the other web pages on the Internet (host 3 and loopbacks other interfaces on Boaz).
- [ ] Verify that host 3 CANNOT successfully ping anything in the internetwork.
- [ ] Verify that the systems can successfully ping to the other internet hosts.
- [ ] Verify reachability by pinging all other systems and routers from each system.

## Step 9 Stop Telnet into the Routers

- a. There have also been some attempts to telnet into the routers from both inside and outside the internetwork. The only host that should have telnet access to the routers is the network administration computer. To stop telnet access to the routers create an access control list and apply it to the VTY lines of the routers that will permit only the network administration computer to telnet.

What type of access list will be used?

---

What command will be used to apply the list to the VTY lines?

---

- b. Use a text editor, such as Notepad, to construct the logic of the access list(s) and then type the proper commands. When the list is properly constructed, paste it to the router(s) and apply it to the VTY lines.
- c. Confirm that the ACL is functioning properly:
  - [ ] Verify that the service personnels' computers CANNOT use a web browser to access (http protocol) the intranet server.
  - [ ] Verify that the computers from the Internet (host 3) CANNOT use a web browser to access (http protocol) the intranet server.
  - [ ] Verify that the computers CANNOT telnet Internet (host 3 and loopbacks interfaces on Boaz) but can telnet to routers.
  - [ ] Verify that the computers CANNOT telnet, use a web browser to access, nor ping 192.168.255.1.
  - [ ] Verify that the computers CANNOT telnet, use a web browser to access, nor ping 192.168.255.4.
  - [ ] Verify that the computers CANNOT telnet, use a web browser to access, nor ping 192.168.255.8.
  - [ ] Verify that the computers CANNOT telnet, use a web browser to access, nor ping 192.168.255.9.
  - [ ] Verify that all computers systems can use a web browser to access the other web pages on the Internet (host 3 and loopbacks other interfaces on Boaz).
  - [ ] Verify that host 3 CANNOT successfully ping anything in the internetwork.
  - [ ] Verify that systems can successfully ping to the other internet hosts.
  - [ ] Verify that systems can successfully ping host 3.
  - [ ] Verify that the network administration computer (host 4) can telnet to all of the routers.
  - [ ] Verify that other internal computers CANNOT telnet to any of the routers.
  - [ ] Verify that other external computers (host 3) CANNOT telnet to any of the routers.

## Step 10 Verify the Access Lists

- a. Now that the access lists have been applied, they need to be verified.

First, verify what lists have been defined. From a CLI session on one of the routers with access lists, display the access lists with the `Boaz#show ip access-lists` command. Record the information about one of the access lists.

---

---

---

---

---

---

---

What does the “(# matches)” in the output represent?

---

- b. Next, confirm which access list is applied to each interface. This is done from the terminal session of one of the routers with access lists, with the `Boaz#show ip interface` command. Look at the output from each interface and record the lists applied to each interface.

Interface \_\_\_\_\_  
Outgoing access list is \_\_\_\_\_  
Inbound access list is \_\_\_\_\_

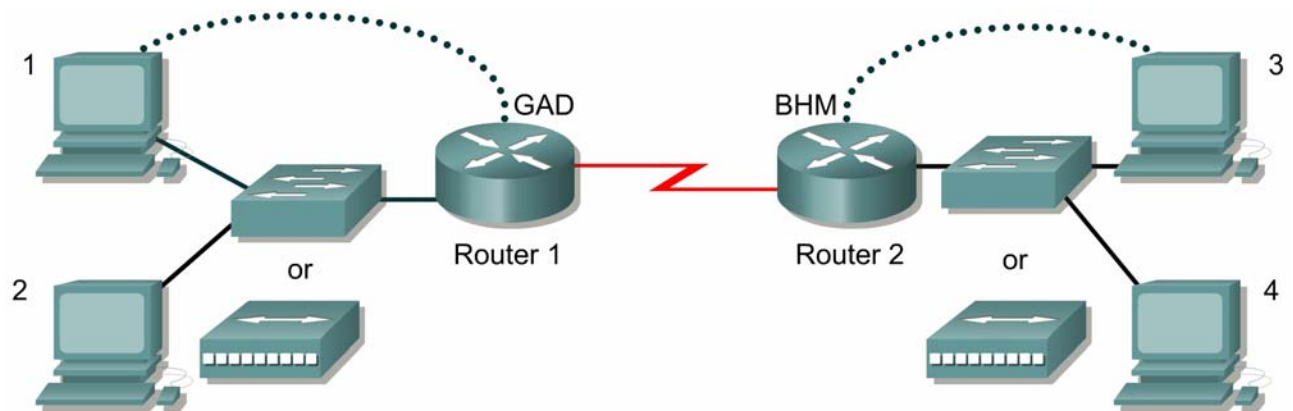
Interface \_\_\_\_\_  
Outgoing access list is \_\_\_\_\_  
Inbound access list is \_\_\_\_\_

Interface \_\_\_\_\_  
Outgoing access list is \_\_\_\_\_  
Inbound access list is \_\_\_\_\_

Interface \_\_\_\_\_  
Outgoing access list is \_\_\_\_\_  
Inbound access list is \_\_\_\_\_

- c. Once the lab is complete, erase the start-up configuration on routers, remove and store the cables and adapter. Also logoff and turn the router off.

## Lab 11.2.6 VTY Restriction



Straight-through cable	—————
Serial cable	————— ⚡
Console (Rollover)	.....
Crossover cable	- - - - -

Router Name	FA0/0 Address	Interface Type S0/0	S0/0 Address	LO0 Address	Routing	Enable password	VTY password
GAD	192.168.1.1 /24	DCE	192.168.2.1 /24	172.16.1.1 /24	RIP	cisco	class
BHM	192.168.3.1 /24	DTE	192.168.2.2 /24	--	RIP	cisco	class

Host	IP Address	Subnet Mask	Gateway
1	192.168.1.2	255.255.255.0	192.168.1.1
2	192.168.1.3	255.255.255.0	192.168.1.1
3	192.168.3.2	255.255.255.0	192.168.3.1
4	192.168.3.3	255.255.255.0	192.168.3.1

## Objective

Use the access-class and line commands to control Telnet access to the router.

## Scenario

The company home office in Gadsden (GAD) provides services to branch offices such as the Birmingham (BHM) office. Only systems within the local network should be able to Telnet to the router. To do this, a standard access-list will be created that will permit users on network the local

network to Telnet to local router. The access-list will then be applied to the Virtual Terminal (vty) lines.

### Step 1 Basic Router Interconnection

- a. Interconnect the routers as shown in the diagram.

### Step 2 Basic Configuration

- a. The router may contain configurations from a previous use. For this reason, erase the startup configuration and reload the router to remove any residual configurations. Using the information previously in the tables, setup the router and host configurations and verify reachability by pinging all systems and routers from each system.
- b. Telnet from the hosts to both the local router and the remote router.

### Step 3 Create the Access List that Represents the Gadsden LAN

- a. The Local Area Network in Gadsden has a network address of 192.168.1.0 /24. To create the access list to permit this use the following commands:

```
GAD(config) #access-list 1 permit 192.168.1.0 0.0.0.255
```

### Step 4 Apply the Access List to Permit Only the Gadsden LAN

- a. Now that the list is created to represent traffic, it needs to be applied to the vty lines. This will restrict any Telnet access to the router. While these could be applied separately to each interface, it is easier to apply the list to all vty lines in one statement. This is done by enter the interface mode for all 5 line with the global config command **line vty 0 4**.

For the Gadsden router type:

```
GAD(config) #line vty 0 4
GAD(config-line) #access-class 1 in
GAD(config-line) #^Z
```

### Step 5 Test the Restriction

- a. Test the functionality of the ACL by trying to telnet to the host and verify that the access-list is working correctly.

```
[ ] verify that host 1 CAN telnet GAD
[ ] verify that host 2 CAN telnet GAD
[ ] verify that host 3 CANNOT telnet GAD
[ ] verify that host 4 CANNOT telnet GAD
```

### Step 6 Create the Restrictions for Birmingham Router

- a. Repeat the above process to restrict the Telnet access to BHM. Thus restriction should allow only hosts in the Birmingham LAN to Telnet to BHM.
- b. Test the functionality of the ACL by trying to telnet to the host and verify that it is to be permitted or denied as appropriate.

```
[ ] verify that host 1 CANNOT telnet BHM
[ ] verify that host 2 CANNOT telnet BHM
[ ] verify that host 3 CAN telnet BHM
[ ] verify that host 4 CAN telnet BHM
```

## Step 7 Document the ACL

- a. As a part of all network management, documentation needs to be created. Capture a copy of the configuration and add additional comments to explain the purpose to ACL code.
- b. The file should be saved with other network documentation. The file naming convention should reflect the function of the file and the date of implementation.
- c. Once finished, erase the start-up configuration on routers, remove and store the cables and adapter. Also logoff and turn the router off.