Router B

Names: _____ and _____

Section: 1001 3003^{F} 3004^{B} 5002

Lab #9 – Configuring Networks (Router B)

IC 322 – Computer Networks

Week 12

This lab is to be completed in groups of two. Collaborative conversations with regard to syntax, strategies and methods for accomplishing the goal of the lab are encouraged; however design and implementation must be the work of the individual student that is handing in the final product.

The lab is due at the beginning of next week's first class. You may wish to review Section 4.4.2 and read ahead into 4.5 in your textbook before completing this lab.

In this lab, we'll investigate the behavior of IP and Routers in detail. We'll do so by doing some basic subnetting and network design exercises and then setting up a small router based network.

Pre-lab Information

Static vs. Dynamic

There are two types of routing that can be configured on a network device- static and dynamic. Static routes are hard-coded on a network device. They tell the device exactly where to send traffic, no matter what. Dynamic routes, on the other hand, use a routing protocol to determine the best path. Updates are made based on information that the routers share with each other. If one route becomes less preferred, the route being used may change. Examples of dynamic routing protocols are RIP, EIGRP, OSPF, and BGP.

Basics of Static Routes

Now that you know the difference between static and dynamic routes, let's learn the basics of static routes. When there are two or more possible routes to the same destination, routers use *administrative distance* to decide which routing protocol (or static route) to trust more. For example, here are some administrative distances (the lower the number, the more trustworthy the type of route is):

- Static Route to a connected interface = 0
- Static Route to a IP address = 1
- Internal EIGRP = 90
- OSPF = 110
- RIP = 120

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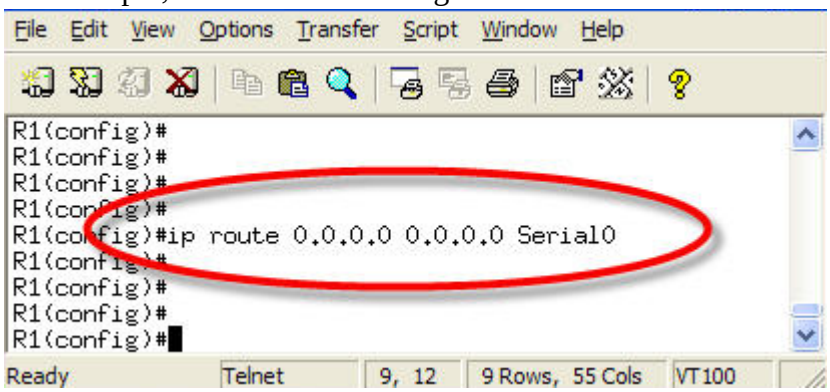
Because of how administrative distance works, when you enter static routes that are the same as a dynamic route (learned from another router), your static route will be used over the dynamic route. As you may be overriding routes manually, you must make sure your routes are accurate.

As you may have noticed above, there are static routes that point to an interface on the router, and static routes that point to an IP address on the network. For example, a static route to an interface may tell a router "send all traffic going to X network out interface Ethernet0/0". A static route to an IP address may tell a router "send all traffic going to X network to IP address 1.1.1.1". Either of these types of routes can be used, depending on the situation.

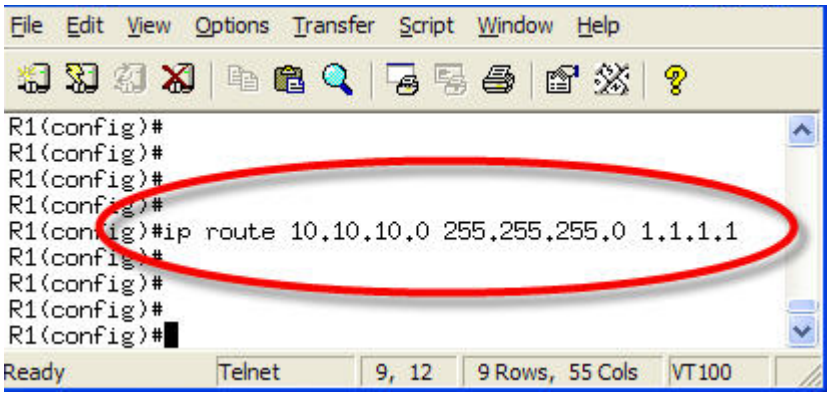
There is a special kind of static route called a default route. Sometimes a default route is called a "zero / zero" route. This is because the network and subnet you are specifying, as the destination for the traffic it would match, are all zeros. A default route says "for any traffic that does not match a specific route in the routing table, send that traffic to this destination". In other words, a default route is a "catch-all".

The syntax for the global configuration command used to enter a static route is:
`ip route {destination prefix} {destination prefix mask} {interface OR forwarding router's IP address}`

For example, a static route sending all traffic out Serial 0/0 would look like this:



A specific route, sending traffic going to network 10.10.10.0, to router 1.1.1.1, would look like this:



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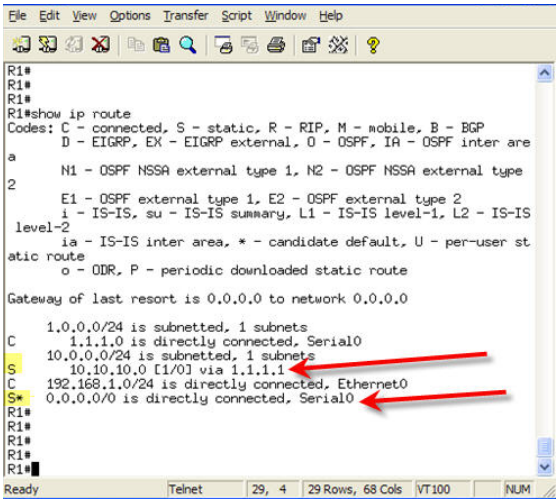
Once these routes are configured, you can use the `show ip route` command to see the routing table:



```
File Edit View Options Transfer Script Window Help
R1#
R1#
R1#
R1#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter are
a
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type
2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS
 level-2
       ia - IS-IS inter area, * - candidate default, U - per-user st
atic route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is 0.0.0.0 to network 0.0.0.0

     1.0.0.0/24 is subnetted, 1 subnets
C       1.1.1.0 is directly connected, Serial0
     10.0.0.0/24 is subnetted, 1 subnets
S       10.10.10.0 [1/0] via 1.1.1.1
C    192.168.1.0/24 is directly connected, Ethernet0
S*   0.0.0.0/0 is directly connected, Serial0
R1#
R1#
R1#
R1#
R1#
Ready   Telnet   29, 4   29 Rows, 68 Cols   VT100   NUM
```

Basics of Dynamic Routing

RIP (Routing Information Protocol) is a distance-vector routing protocol. It is a UDP-based protocol operating on top of the transport layer. For choosing the best route path using RIP, the protocol will choose the routing path route with the lowest Hop Count. Unfortunately, the maximum Hop Count of RIP is 15. If there are more that 15 'hops', RIP will be unable seek a path. RIP works well with small-sized networks, but loses its efficiency and capability the larger the network becomes. Another problem is that RIP updates its routing tables every 30 seconds. In large networks, this could cause a burst of information if all routers update themselves at the same time.

Pre-lab Questions:

1. What line of code would I use to send traffic going to network 15.15.15.0/24, to router 10.42.4.1?

2. What is the maximum hop count for RIP

3. What are two disadvantages to RIP?

Router B

A. Routers in Action

It is time once again to get our hands on some equipment. We will be building a simple router based network similar to the networks on page 349 and 351 in your book. The diagram for the network we are designing is shown in figure 1 below.

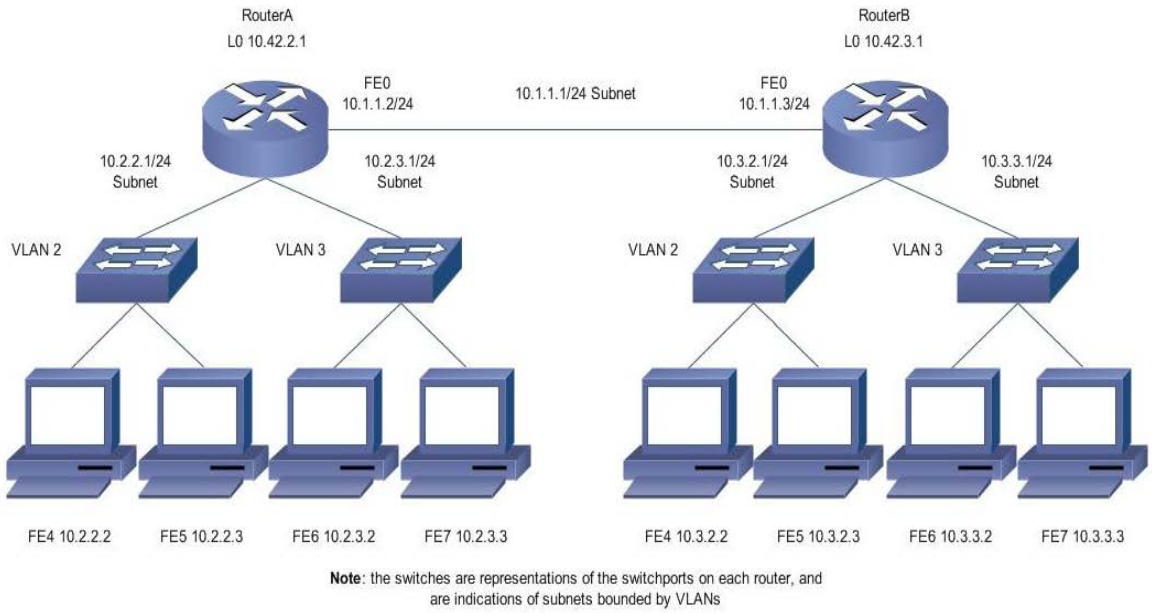


Figure 1

B. Physical Router Set-up

- Locate the light blue console cord. Connect the serial end into the corresponding female end on the computer
- Connect the Cat V cable end into the port on the back of the router labeled "console"
- Insert an AC power cord to the router and turn it on.

C. Connecting to the router through the console port

- Log in to the host computer
- Go to Start→All Programs→PuTTY→PuTTY
- Select the "Serial" radio button
- Ensure the following connection information is set:
- Serial line: COM1
- Speed: 9600

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- Click "Open"
- If needed, hit return to get a router prompt or a password request.
- The prompt should look like: `Router>`
- `Password if required: GoNavy1!`

*NOTE: If a username request comes up, `"cisco"` for the username, and `"cisco"` for the password.

D. Restoring the default factory settings on a Cisco 1811w Router

First, some important router tips:

Sometimes the terminal display make the router appear to be busy for no reason… you may hit the `Enter` key at any time to try to get a prompt.

The prompts that the router returns a one key to knowing what the router is expecting from you… watch them closely as you are entering the commands and make sure they match up to what the lab tells you to expect!

When you make changes and want to save configurations, use the command "copy run start" after the router has been enabled for editing. This will write your configurations to memory. Failure to do this would result in losing everything in the event of a power failure or powering down the router.

To begin, we need to eliminate any settings from previous labs. In order to restore the router to default factory settings, enter the commands displayed in **bold**.

- `Router>`**`enable`**
- `Router#`**`configure terminal`**
- `Router(config)#`**`config-register 0x2142`**
- `Router(config)#`**`end`**
- `Router#`**`reload`**
- `System configuration has been modified. Save? [yes/no]:` **`no`**
- `Proceed with reload? [confirm]`

- `Would you like to enter initial configuration dialog? [yes/no]:` **`no`**
- `Router>`**`enable`**
- `Router#`**`configure terminal`**
- `Router(config)#`**`config-register 0x2102`**
- `Router(config)#`**`end`**
- `Router#`**`write memory`**
- `Router#`**`reload`**
- `Proceed with reload? [confirm]`

Note: This works even if you do not see the word 'Router' at your login. Chances are, if you have to restore to the factory settings, then you are *not* going to see 'Router'. You do have to be logged into the IOS.

Highlights of Default Configuration:

- 9600 baud

Router B

- boots into ROM if initial boot fails
- no assigned ip addresses, subnets, vlans, etc.
- no access control lists
- no defined hostname

E. Setting up your network (RouterB):

Common Setup

- `Router>`**`enable`**
- `Router#`**`configure terminal`**
- `Router(config)#`**`hostname RouterB`**
- `RouterB(config)#`**`no ip domain-lookup`**

Adding password to privileged exec mode

- `RouterB(config)#`**`service password-encryption`**
- `RouterB(config)#`**`enable secret GoNavy1!`**

Adding password to console access

- `RouterB(config)#`**`line con 0`**
- `RouterB(config-line)#`**`password GoNavy1!`**

`Prevent the router from printing while you are logging in`

- `RouterB(config-line)#`**`login`**
- **`RouterB(config-line)#logging synchronous`**

Check your login passwords

- `RouterB(config-line)#`**`end`**
- `RouterB#`**`exit`**
- Enter your 'line con' password at the login
- `RouterB>`**`enable`**
- Enter your enable password
- `RouterB#`**`configure terminal`**

Add the ability to ping the router

- `RouterB(config)#`**`interface loopback0`**
- `RouterB(config-if)#`**`ip address 10.42.3.1 255.255.255.255`**
  *****A full mask is necessary in order to create the loopback function to allow the router to ping itself
- <u>On figure 1, box the area you have just programmed, and label it 'A'</u>

Add the switchports to vlans for subnetting

- `RouterB(config-if)#`**`interface FastEthernet4`**
- `RouterB(config-if)#`**`switchport access vlan 2`**
- `RouterB(config-if)#`**`interface FastEthernet5`**
- `RouterB(config-if)#`**`switchport access vlan 2`**
- `RouterB(config-if)#`**`interface FastEthernet6`**
- `RouterB(config-if)#`**`switchport access vlan 3`**

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- `RouterB(config-if)#`**`interface FastEthernet7`**
- `RouterB(config-if)#`**`switchport access vlan 3`**
- <u>On figure 1, box the area you have just programmed, and label it 'B'</u>

Create subnets from vlans

- `RouterB(config-if)#`**`interface vlan2`**
- `RouterB(config-if)#`**`ip address 10.3.2.1 255.255.255.0`**
- `RouterB(config-if)#`**`interface vlan3`**
- `RouterB(config-if)#`**`ip address 10.3.3.1 255.255.255.0`**
- <u>On figure 1, box the area you have just programmed, and label it 'C'</u>

Add a router port to a subnet that will connect routers

- `RouterB(config-if)#`**`interface FastEthernet0`**
- `RouterB(config-if)#`**`ip address 10.1.1.3 255.255.255.0`**
- `RouterB(config-if)#`**`no shutdown`**
- <u>On figure 1, box the area you have just programmed, and label it 'D'</u>

Check the running configuration to ensure that your changes worked

- `RouterB(config-if)#`**`end`**
- `RouterB#`**`show running-config`**
- Use the enter key to scroll down a line at a time and the spacebar to scroll down a page at a time. You should be checking that interface Loopback0 and interface FastEthernet0 both have IP addresses. You should also ensure that interfaces FastEthernet4 - FastEthernet7 all have associated vlans, and that vlans 2 & 3 have IP addresses.
- `RouterB#`**`configure terminal`**

Route all traffic not in the internal network to the next external router

- `RouterB(config)#`**`ip route 0.0.0.0 0.0.0.0 10.1.1.2`**

Set-up Static Route

- `RouterB(config)#ip route 10.2.2.0 255.255.255.0 10.42.2.1`
- `RouterB(config)#ip route 10.2.3.0 255.255.255.0 10.42.2.1`
- `RouterB(config-router)#end`
- <u>On figure 1, box the area you have just programmed, and label it 'E'</u>

Commit changes

- `RouterB#`**`copy run start`**
- Press enter to save changes

F. Testing router setup:

- `RouterB#`**`ping 10.42.3.1`**

4. Demonstrate successful ping attempts to instructor. Instructor Int_____

Router B

G. Setting up the test machines and testing the network:

Plug two host computers into ports FastEthernet4 and FastEthernet7 using LAN cables.

On the computer plugged into FastEthernet4:

- Go to start→Control Panel→Network Connections
- Open Local Area Connection
- Click on Properties
- Scroll down to Internet Protocol (TCP/IP) and select it
- Click on Properties
- Make the following changes:
    - IP: 10.3.2.2
    - Subnet mask: 255.255.255.0
    - Default gateway: 10.3.2.1
    - Leave the DNS spots blank
- Click on OK to confirm the changes
- Click on close to commit the changes

On the computer plugged into FastEthernet7:

- Go to start→Control Panel→Network Connections
- Open Local Area Connection
- Click on Properties
- Scroll down to Internet Protocol (TCP/IP) and select it
- Click on Properties
- Make the following changes:
    - IP: 10.3.3.3
    - Subnet mask: 255.255.255.0
    - Default gateway: 10.3.3.1
- Leave the DNS spots blank
- Click on OK to confirm the changes
- Click on close to commit the changes

Test your network

- Go to the Start menu
- Enter '**cmd**' to get a command 'shell'
- Navigate to the C directory
- Make sure you can 'see' the router
- C:\>**ping 10.42.3.1**
- Make sure you can 'see' the other machine
- C:\>**ping 10.3.2.2**

Connect to another network

- Run a LAN cable from FastEthernet0 on your router to FastEthernet0 on the router of a group working on 'RouterB'.

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- C:\>**ping 10.42.2.1**
- C:\>**ping 10.2.2.2**
- C:\>**ping 10.2.3.3**

If you were successful, all four ping attempts should have resulted in ICMP replies. Demonstrate the pings to an instructor to get initialed.

5. Verify set up with your instructor. Instructor Int _____.

H. Setting up a Dynamic Network

Leave cables connected to the router. Just modify the router on your console

Clear current static IP routing tables:

- `RouterB>enable`
- `RouterB#configure terminal`
- `RouterB(config)#`**`no ip route 10.2.2.0 255.255.255.0 10.42.2.1`**
- `RouterB(config)#`**`no ip route 10.2.3.0 255.255.255.0 10.42.2.1`**
- `RouterB(config)#`**`no ip route 0.0.0.0 0.0.0.0 10.1.1.2`**

Ensure that the static routes have been cleared

- `RouterB(config)#`**`end`**
- `RouterB#`**`show ip route`**
- When entered, the command will show the different types of routing protocols designators at the top of the blurb, and what routing protocols are currently configured on the bottom
- Ensure that you have your **`loopback0`** and **`vlan2`** protocols currently stored

Enter RIP configurations

- `RouterB#`**`configure terminal`**
- `RouterB(config)#router rip`
- `RouterB(config-router)#version 2`
- `RouterB(config-router)#network 10.2.2.0`
- `RouterB(config-router)#network 10.2.3.0`
- `RouterB(config-router)#end`
- `RouterB#copy run start`

<u>Pause for 30 seconds. Allow for the routing tables to be built by the router.</u>

I. Setting up the test machines and testing the network:

Test your network from one of the PC hosts

- Go to the Start menu
- Enter '**cmd**' to get a command 'shell'

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- Navigate to the C directory
- Make sure you can 'see' the router
- C:\>**ping 10.42.3.1**
- Make sure you can 'see' the other machine
- C:\>**ping 10.3.2.2**

Connect to another network

- Run a LAN cable from FastEthernet0 on your router to FastEthernet0 on the router of a group working on 'RouterA'.
- C:\>**ping 10.42.2.1**
- C:\>**ping 10.2.2.2**
- C:\>**ping 10.2.3.3**

If you were successful, all four ping attempts should have resulted in ICMP replies. Demonstrate the pings to an instructor to get initialed.

6. Verify set up with your instructor. Instructor Int _____.

IMPORTANT: Before leaving, please refer to Part D to return your router the Default factory settings!

Return Sandbox computers to default settings as well. The convention is 10.10.10.<computer number> for the ip address and the appropriate subnet.

Disconnect any cables attached. Power down the router.

J. Understanding IP and Network design.

In order to configure a router, you must understand network design. Beginning with our exploration of IP, we'll do some exercises to understand networks and host in order to build our network and configure our routers.

Do the following exercises:

7. Fill out the chart below look at subnet mask to determine network bits and host bits (hint: convert the address AND masks to binary):

Address	131.122.89.8	131.122.89.8

Router B

Mask	255.255.255.0	255.255.252.0
Number of network bits		
Network address		
Number of host bits		
Hosts per subnet		

8. You are given an IP of 131.122.72.42. Currently, you have need for 27 hosts, but know that your network can get as large as 71 hosts. How many host bits are needed to represent the 71 hosts?

9. Using the IP from the previous question and the number of bits required for the 71 hosts, what is the prefix notation? (example: 10.10.10.3/16 would have a subnet mask of 255.255.0.0)

10. What is your subnet mask?

11. What are two interior routing protocols?

12. What are two exterior routing protocols?

13. What is the difference between classful and classless routing protocols?

14. What is the difference between a router and a switch?