CIS 192 Linux Lab Exercise

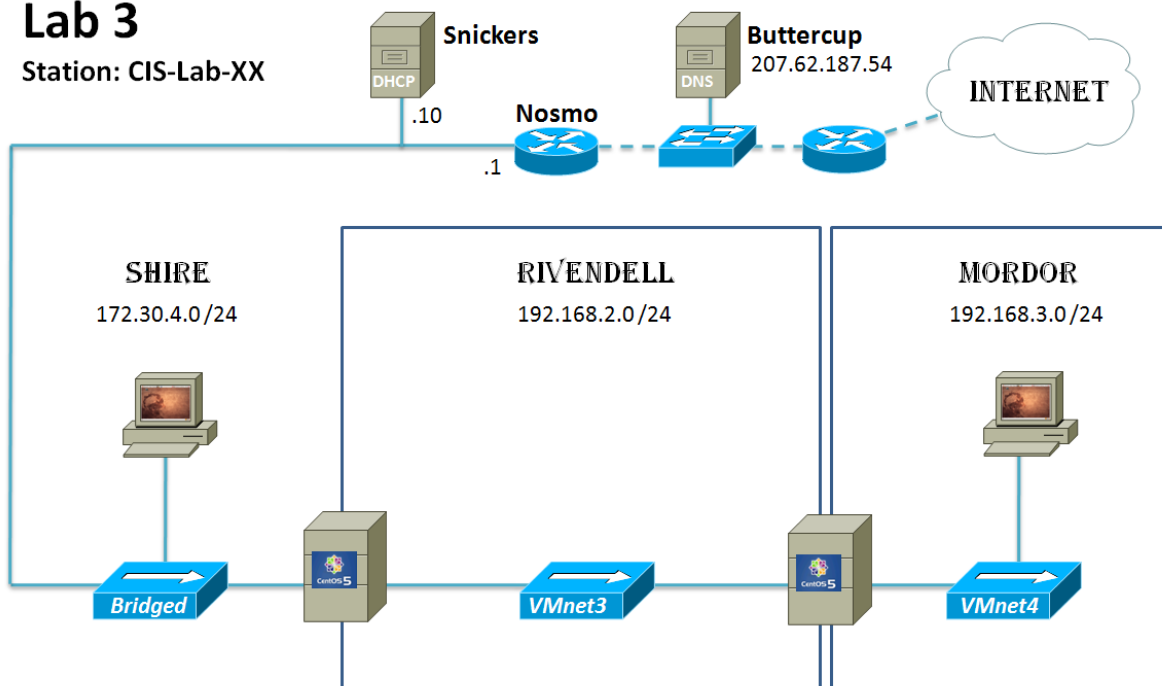## Lab 3: Configuring a Network Router
Spring 2009

Lab 3: Configuring a Network Router

The purpose of this lab is to join three network segments (Shire, Rivendell and Mordor) by configuring two routers between them. The three networks are shown below. You will be using four different systems: A Shire host, a Shire-Rivendell router, a Rivendell-Mordor router and a Mordor host. The goal is to obtain connectivity between the host in Mordor with the host in the Shire by utilizing layer 3 routing. You will verify success by successfully pinging from one side of the network to the other.

I strongly suggest that you read through this lab before doing it. Making a good network diagram will help you immensely. Start with the diagram below and add to it as you design and implement the end-to-end solution.

Supplies

- VMWare Server 1.08 or higher
- 192 VMs: Frodo, Elrond or Celebrian, Legolas or Arwen, and Sauron

- Virtual networks: VMnet3 (Rivendell) and VMnet4 (Mordor)

Preconfiguration

- Original versions of all VMs. Note, this will set the network configurations back to down or DHCP settings.
- You will need access to a DHCP server to assign addresses for the 172.30.4.0/24 network. This is already configured if the lab is done using the CIS VMware Stations in the CIS Lab (room 2504) or the CTC. If you plan to do this lab at home see: http://simms-teach.com/howtos/129-working-at-home.pdf

Forum

Use the forum to ask questions, collaborate, post tips and any lessons learned when you have finished. Forum is at: http://simms-teach.com/forum/viewforum.php?f=18

Background

Setting up a router involves 3 steps:

1. Configuring appropriate IP addresses on the routers.
2. Configuring the routing table of each router and host
3. Turning on IP forwarding so that packets will travel through each router's two interfaces.

The commands we will be using for this lab are:

- ifconfig
- route
- ping

Most of these commands require root access, so you will need to log on as root.

Part I

Design your overall network with the following requirements:

- Three /24 networks: 172.30.4.0/24 (Shire), 192.168.2.0/24 (Rivendell) and 192.168.3.0/24 (Mordor). Use VMnet3 for Rivendell and VMnet4 for Mordor.

- Use Elrond or Celebrian VMs for the Shire-Rivendell router. These are CentOS VMs.

- Use Legolas or Arwen VMs for the Rivendell-Mordor router. These are CentOS VMs.

- Make the Shire and Mordor hosts using the Ubuntu VMs (Frodo and Sauron).

- Assign IP addresses of your choice to interfaces on the Rivendell and Mordor networks.

- For the Shire network only use the static IP addresses in the table below for the Shire-Rivendell router. The Shire host should use DHCP (this is already configured on the Ubuntu VMs).

Station	IP	Static 1	Static 2
CIS-Lab-01	172.30.4.101	172.30.4.121	172.30.4.122
CIS-Lab-02	172.30.4.102	172.30.4.123	172.30.4.124
CIS-Lab-03	172.30.4.103	172.30.4.125	172.30.4.126
CIS-Lab-04	172.30.4.104	172.30.4.127	172.30.4.128
CIS-Lab-05	172.30.4.105	172.30.4.129	172.30.4.130
CIS-Lab-06	172.30.4.106	172.30.4.131	172.30.4.132
CIS-Lab-07	172.30.4.107	172.30.4.133	172.30.4.134
CIS-Lab-08	172.30.4.108	172.30.4.135	172.30.4.136
CIS-Lab-09	172.30.4.109	172.30.4.137	172.30.4.138
CIS-Lab-10	172.30.4.110	172.30.4.139	172.30.4.140
CIS-Lab-11	172.30.4.111	172.30.4.141	172.30.4.142
CIS-Lab-12	172.30.4.112	172.30.4.143	172.30.4.144
Pod 1		172.30.4.113	172.30.4.145
Pod 2		172.30.4.114	172.30.4.146
Pod 3		172.30.4.115	172.30.4.147
Pod 4		172.30.4.116	172.30.4.148

Design: Make a network diagram showing your design starting with the one above. Label the names of the 2 hosts, 2 routers, and 6 ethx interfaces. Label all static IP addresses, DHCP interfaces and gateways on each system. Your diagram may be done by hand or with your favorite diagramming tool (e.g. Visio, PowerPoint, etc.)

Implement: Don't rush to implement this lab. A complete design will save you a lot of time doing the implementation steps:

1. **Revert** the four VMs you selected to their snapshots.
2. **Cable** and configure the Shire host. Make sure it connects to the lab's Shire network properly using DHCP.
   - Use **ifconfig** and **route –n** to verify you have an IP address and a default route. Record the IP address to use later.
   - **Verify** you can **ping 172.30.4.1** (lab router) and **ping opus.cabrillo.edu**.

3. **Cable** the Shire-Rivendell router and configure both interfaces with static IP addresses using the **ifconfig** command (refer to your command summary from Lab 2). Be sure the Shire interface uses an IP address from the table above.
4. Ping the Shire host from the Shire-Rivendell router.
5. Does it work?
   Now try pinging the Shire host again from the Shire-Rivendell router, but this time pinging **from** its Rivendell IP address. **ping -I 192.168.2.*xxx shire-host-ip***, where xxx is the address you assigned the eth1 interface on the Shire-Rivendell router and shire-host-ip is the Shire host's IP address. Does this work? Why or why not?
6. Look at the Shire host's routing table with the **route -n** command. Notice that the default route is **172.30.4.1**
   The Shire computers don't know what to do with addresses from the **192.168.2.0** network, so they get sent out the default route, not back to the Shire-Rivendell router.
7. Let's fix this problem by adding a route to Shire Host's routing table. We want to make the Shire-Rivendell router be the gateway for any packets heading for 192.168.2.0/24:
   route add -net 192.168.2.0 netmask 255.255.255.0 gw 172.30.4.1xx
   Use **route –n** to verify. Note the gateway address should be the Shire-Rivendell router's Shire address.
8. Now go back and re-execute the ping command from the Shire-Rivendell router:
   ping -I 192.168.2.xxx *shire-host-ip*
   Does it work this time? It should.
9. **Cable and configure** the Rivendell interface on the Rivendell-Mordor router.
10. What should the default gateway be on the Rivendell-Mordor router?
11. Set the default gateway using the following command:
    route add default gw 192.168.2.xxx
12. Now try to ping the Shire host from the Rivendell-Mordor router:
    ping *shire-host-ip*
    Does it work?
13. If it doesn't work, it might be because **ip_forwarding** is not turned on. Back on the Shire-Rivendell router, execute the following commands:
    cd /proc/sys/net/ipv4
    echo 1 > ip_forward
14. Now you should be able to ping the Shire host from the Rivendell-Mordor router.

Part II

We now have the Shire and Rivendell network segments joined by the Shire-Rivendell router. For a third network, we are going to use the Rivendell-Mordor router to get to the Mordor host.

1. **Cable and configure** the second interface on the Rivendell-Mordor router.
2. **Cable and configure** the Mordor host.
3. On the Rivendell-Mordor router, turn on **ip-forwarding**.
4. Put a default route on the **Mordor** host; it should point to your Rivendell-Mordor router.
5. Are we done? Can you ping a machine in the Shire?
   Why doesn't it work?
   We've forgotten about the other machines in the network. They need to be able to send packets back to this new network!

6. **The Shire-Rivendell Router**:
   - We must configure this router to route 192.168.3.0 packets back to Mordor. Add this route:
     route add -net 192.168.3.0 netmask 255.255.255.0 gw 192.168.2.xxx (the Rivendell-Mordor router)
   - Set the default gateway:
     route add default gw 172.30.4.1
     Check the routing table to see that this has been done correctly.
7. **The Shire Host**:
   The Shire host must also be told where to route packets destined for this new 192.168.3.0 subnet:
   route add -net 192.168.3.0 netmask 255.255.255.0 gw 172.30.4.xxx (the Shire-Rivendell router)
8. Did we get everything? See if you can ping through all three networks. Make sure each computer knows what to do with packets from each of the three networks. Your ping packets should make two hops from Mordor to the Shire.
9. Note: You will not be able to ping opus or any internet computer from Mordor. Why not?
10. Note: if you make errors in the routing tables, these errors may be cached even though you have corrected them. To flush the routing table cache, use the command:
    ip route flush cache

To turn in

A) Results
   Your *lab3* **text** file should contain the following sections.

   - Standard boilerplate information:
     – CIS 192 Lab XX
     – Name
     – Date
     – TBA hours used
     – Station number (CIS-Lab-XX) used
   - ifconfig and route –n output for Shire Host
   - ifconfig and route –n output for Shire-Rivendell Router
   - ifconfig and route –n output for Rivendell-Mordor Router
   - ifconfig and route –n output for Mordor Host
   - The successful ping from Mordor Host to Shire Host
   - Command summary (documented examples of key commands for future reference)

   Check your work for completeness then submit as many times as you wish up until the due date deadline. Remember, **late work is not accepted**, so start early, plan ahead for things to go wrong and use the forum to ask questions.

   scp lab3 cis192@opus.cabrillo.edu:lab3.lastname

B) Your network diagram
   Email me an electronic version at **risimms@cabrillo.edu** or hand in a copy of your hand drawn map.

Grading rubric (30 points)

- 2 points for complete submittal, professional appearance and quality
- 3 points for correct routing table on Shire Host
- 3 points for correct routing table on Shire-Rivendell Router
- 3 points for correct routing table on Rivendell-Mordor Router
- 3 points for correct routing table on Mordor Host
- 4 points for successful ping
- 6 points for useful command summary
- 6 points for complete and accurate network map