CIS 192 Linux Lab Exercise

Lab 4: Dynamic routing and tunnels
Spring 2010

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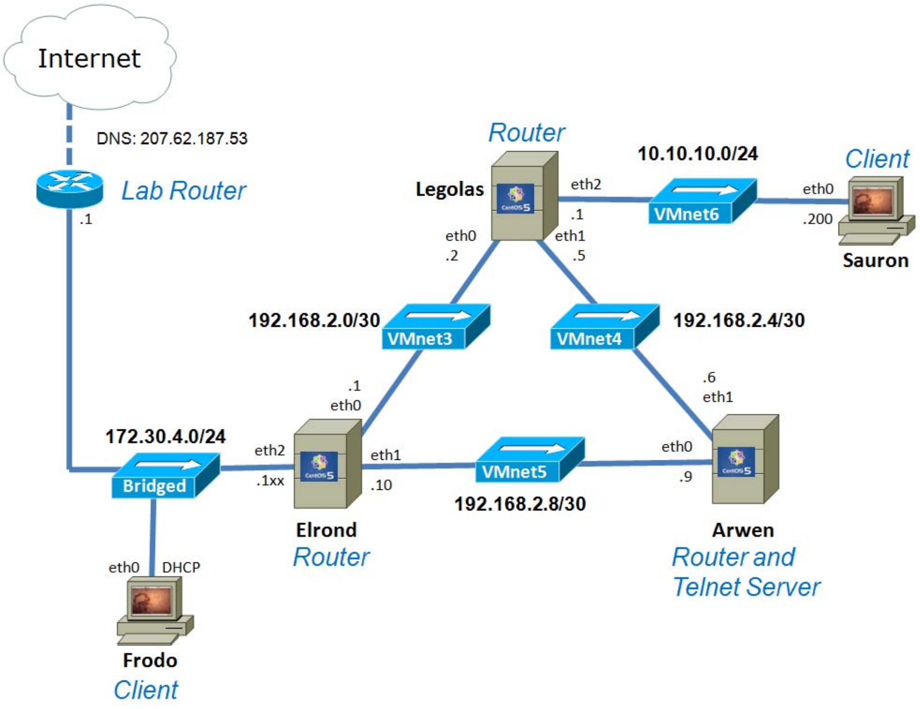
In this lab we will be using the Quagga package to implement dynamic routing across the three routers shown in the diagram below. For extra credit an SSH tunnel will be implemented through Elrond to the Telnet server on Arwen.



Supplies

- VMWare Server 1.08 or higher
- 192 VMs shown above

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/202-working-at-home-nat.pdf

Forum

Use the forum to ask questions, collaborate, post tips and any lessons learned when you have finished. Forum is at: http://opus.cabrillo.edu/forum/viewforum.php?f=5

Background

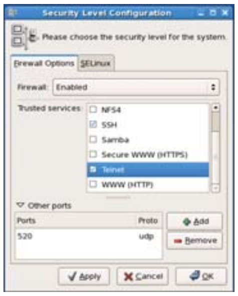
Quagga is a GPL licensed routing software suite that implements OSPF, RIP and BGP routing protocols on Linux. See http://www.quagga.net/ for details.

Part I – Revert VMs, add NIC cards, and cable

1. Revert the VMs back to their snapshots.
2. Add a third NIC to Elrond and Legolas.
3. Install some new software packages. Do the following steps on Elrond, Legolas and Arwen:
    a. Cable the eth0 Ethernet interface as bridged so these VMs are on the lab 172.30.4.0/24 Shire network.
    b. Power on the three VMs.
    c. Use **dhclient eth0** on each of the three VMs to get network settings temporarily.
    d. Install the Quagga dynamic routing package with **yum install quagga** on each of the three VMs.
4. On Arwen only, install the telnet server with **yum install telnet-server**
5. Release the DHCP address with **dhclient –r eth0** on each of the three VMs.
6. Now cable all VMs to the VMnets shown in the diagram above. This includes recabling the eth0 interfaces on Elrond, Legoas and Arwen.
7. Power on the remaining VMs in the diagram. If you run out of memory, modify the Host Settings (Memory Tab) to **Allow most virtual machine memory to be swapped.**

Part II – Punch some holes in the firewalls

1. On the Elrond, Legolas and Arwen routers go to run level 5 (use **init 5** or **startx**) and make the following firewall adjustments:
    a. Open a port for **RIP (UDP 520)** using the graphical **Security Level Configuration** utility. For **Arwen only**, make **Telnet** a trusted service which opens TCP port 23.



Security Level Configuration

Please choose the security level for the system.

Firewall Options | SELinux

Firewall: Enabled

Trusted services:
☐ NFS4
☑ SSH
☐ Samba
☐ Secure WWW (HTTPS)
☑ Telnet
☐ WWW (HTTP)

Other ports

Ports	Proto
520	udp

b. From the command line, backup the firewall settings, then disable filtering forwarded packets with:

```
iptables-save > /etc/sysconfig/iptables.bak
iptables -D FORWARD 1
iptables-save > /etc/sysconfig/iptables
```

The default CentOS firewall filters all forwarded packets using the firewall INPUT filter. Unfortunately this blocks any DNS queries so we will just remove the rule that does this.

Part III – Configure Network Settings

Use the diagram above to configure each host. Frodo uses DHCP and should not need any additional configuration.

1. For all other hosts, configure:
   - IP Address, subnet mask, broadcast address on each interface
   - Default gateway on each host
     - Elrond to 172.30.4.1
     - Legolas and Arwen both to Elrond
     - Sauron to Legolas
   - DNS server (**207.62.187.53)** on each host
2. For Elrond's eth2 interface on Shire, use the **Static IP Address Table** on page 2 of http://simms-teach.com/docs/static-ip-addrs.pdf.
3. Here is an example of the NIC configuration files Legolas. Note: **your MAC addresses will be different**:

Default Gateway	[root@legolas ~]# cat /etc/sysconfig/network
	NETWORKING=yes
	NETWORKING_IPV6=no
	HOSTNAME=legolas.localdomain
	GATEWAY=192.168.2.1

DNS	[root@legolas ~]# cat /etc/resolv.conf **nameserver 207.62.187.53**

eth0	[root@legolas ~]# cat /etc/sysconfig/network-scripts/ifcfg-eth0
	# Advanced Micro Devices [AMD] 79c970 [PCnet32 LANCE]
	DEVICE=eth0
	HWADDR=00:0C:29:7C:18:F5
	ONBOOT=**yes**
	BOOTPROTO=static
	IPADDR=192.168.2.2
	NETMASK=255.255.255.252
	[root@legolas ~]#

eth1	[root@legolas ~]# cat /etc/sysconfig/network-scripts/ifcfg-eth1
	# Advanced Micro Devices [AMD] 79c970 [PCnet32 LANCE]
	DEVICE=eth1
	HWADDR=00:0C:29:7C:18:FF
	ONBOOT=**yes**
	BOOTPROTO=static
	IPADDR=192.168.2.5
	NETMASK=255.255.255.252
	[root@legolas ~]#

eth2	[root@legolas ~]# cat /etc/sysconfig/network-scripts/ifcfg-eth2 # Advanced Micro Devices [AMD] 79c970 [PCnet32 LANCE]

	DEVICE=eth2 HWADDR=00:0c:29:7c:18:09 ONBOOT=**yes** **BOOTPROTO=static** **IPADDR=10.10.10.1** **NETMASK=255.255.255.0** [root@legolas ~]#

Note: Be sure and use **service network restart** so the NIC settings take effect.

Part IV – Enable Packet Forwarding

Enable packet forwarding on Elrond, Legolas and Arwen so they can function as routers.

1. This is an example for Legolas:

Temporary	**echo 1 > /proc/sys/net/ipv4/ip_forward**
Permanent	[root@legolas ~]# cat /etc/sysctl.conf # Kernel sysctl configuration file for Red Hat Linux # # For binary values, 0 is disabled, 1 is enabled. # See sysctl(8) and # sysctl.conf(5) for more details. # Controls IP packet forwarding **net.ipv4.ip_forward = 1** *< snipped >* [root@legolas ~]# **sysctl -p**

2. Test what you have done so far using the ping command. You should be able to ping immediate neighbors. Because the routing tables are incomplete it is not yet possible to ping non-connected networks.

Part V – Dynamic routing table updates

Rather than use static routes, in this lab we will use dynamic routing. Quagga will be used to implement the RIPv2 protocol across Elrond, Legolas and Arwen.

1. Edit the two Quagga configuration files. Here is an example for Legolas:

Edit the **zebra** configuration file	[root@legolas ~]# cat **/etc/quagga/zebra.conf** **hostname legolas** **password** *<password>* **log file /var/log/quagga/zebra.log** [root@legolas ~]#
Create then edit the **ripd** configuration file	[root@legolas ~]# cat **/etc/quagga/ripd.conf** ! ! Zebra configuration saved from vty ! 2009/02/25 16:36:10 !

```
hostname legolas
password <password>
log file /var/log/quagga/ripd.log
!
debug rip events
debug rip zebra
!
interface eth0
 no ip rip authentication mode text
 no ip rip authentication mode md5
!
interface eth1
 no ip rip authentication mode text
 no ip rip authentication mode md5
!
router rip
 redistribute connected
 redistribute static
 network eth0
 network eth1
!
line vty
!
[root@legolas ~]#
```

2. Set ownership of the configuration files with:

```
cd /etc/quagga/
chown quagga:quaggavt ripd.conf zebra.conf
```

3. Start up the daemons:

```
service zebra start
service ripd start
```

4. Configure the daemons to run at system startup:

```
chkconfig zebra on
chkconfig ripd on
```

5. After all three routers have Quagga installed, configured and running, check the routing tables. On Legolas you should see:

```
[root@legolas ~]# route -n
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
192.168.2.8     192.168.2.1     255.255.255.252 UG    2      0        0 eth0
192.168.2.0     0.0.0.0         255.255.255.252 U     0      0        0 eth0
192.168.2.4     0.0.0.0         255.255.255.252 U     0      0        0 eth1
172.30.4.0      192.168.2.1     255.255.255.0   UG    2      0        0 eth0
10.10.10.0      0.0.0.0         255.255.255.0   U     0      0        0 eth2
169.254.0.0     0.0.0.0         255.255.0.0     U     0      0        0 eth2
0.0.0.0         192.168.2.1     0.0.0.0         UG    0      0        0 eth0
[root@legolas ~]#
```

6. Use Zebra to view the routing table. On Legolas you should see:

```
[root@legolas ~]# telnet localhost 2601
Trying 127.0.0.1...
Connected to localhost.localdomain (127.0.0.1).
Escape character is '^]'.

Hello, this is Quagga (version 0.98.6).
Copyright 1996-2005 Kunihiro Ishiguro, et al.
```

```
User Access Verification

Password:
legolas> enable
legolas# show ip route
Codes: K - kernel route, C - connected, S - static, R - RIP, O - OSPF,
       I - ISIS, B - BGP, > - selected route, * - FIB route

K>* 0.0.0.0/0 via 192.168.2.1, eth0
C>* 10.10.10.0/24 is directly connected, eth2
C>* 127.0.0.0/8 is directly connected, lo
K>* 169.254.0.0/16 is directly connected, eth2
R>* 172.30.4.0/24 [120/2] via 192.168.2.1, eth0, 09:37:17
C>* 192.168.2.0/30 is directly connected, eth0
C>* 192.168.2.4/30 is directly connected, eth1
R>* 192.168.2.8/30 [120/2] via 192.168.2.1, eth0, 09:37:17
```

7. We still need to add some static routes on Frodo to Elrond. Use:
   route add –net 10.0.0.0 netmask 255.0.0.0 gw 172.30.4.1xx
   route add –net 192.0.0.0 netmask 255.0.0.0 gw 172.30.4.1xx
8. Test and make sure all the VMs can ping each other now.

Part VI – Set up a SSH tunnel through Elrond (Extra Credit)

This part of the lab covers the use of the utility secure shell (ssh) to forward ports. We'll use port 8000 to forward to the remote port 23, but any port can be substituted. However it is important to remember that ports 1023 and lower are considered reserved and require root access to forward. Because this lab uses only port 8000, root access is not required. You need a regular user (cis192) account on the destination and pass-through computers.

Forwarding ports using ssh is a convenient way to protect information sent over the Internet, because unlike telnet and ftp, ssh encrypts data to protect against eavesdropping programs. Port forwarding is required in situations in which normal connections cannot be established. If a computer is part of a LAN and cannot be reached directly because of a firewall or some other barrier, it might be easier to use port forwarding. Telnet traffic travels in clear text and is not secure.

We will configure **Arwen** to be a Telnet server and then set up a secure SSH tunnel through **Elrond** to access it from the outside.

1. If your haven't already, use **yum install telnet-server** to install the telnet service on Arwen. See the Appendix if you don't have Internet access on Arwen.
2. Earlier you poked a hole in the firewall for Telnet. You can check for this with **iptables –L** and look for:
   ACCEPT tcp -- anywhere anywhere state NEW tcp dpt:telnet
3. Configure the Telnet service to be enabled but only accept logins from Elrond:

Edit telnet configuration file

```
[root@arwen ~]# cat /etc/xinetd.d/telnet
# default: on
# description: The telnet server serves telnet sessions; it uses
# unencrypted username/password pairs for authentication.
service telnet
{
        flags           = REUSE
        socket_type     = stream
        wait            = no
        user            = root
        only_from       = 192.168.2.10
        server          = /usr/sbin/in.telnetd
        log_on_failure  += USERID
        disable         = no
}
[root@arwen ~]#
```

4. Finally, use **service xinetd restart** to make the settings take effect.
5. Go to **Frodo** now and let's try logging in through an SSH tunnel. Use the following to create the tunnel:

   ssh -L 8000:192.168.2.9:23 cis192@172.30.4.1xx

   (where 172.30.4.1xx is Elrond)
6. From a different terminal on Frodo, e.g. tty2, use the following to connect to the Telnet server and enter a command to sniff with Wireshark:

   telnet localhost 8000

   (login as cis192)

   echo this is a secret
7. Use Wireshark to capture the traffic on both sides of Elrond so you can see that it is encrypted from Frodo to Elrond and in clear text from Elrond to Arwen.

To turn in

Your *lab4* **text** file should contain the following sections. Replace items in blue below with your own specific information.

- Standard boilerplate information:
  - CIS 192 Lab *XX*
  - *Name*
  - *Date*
  - TBA hours*: X.X*
  - Station number: CIS-Lab-*XX*
- **ifconfig** and **route –n** output for Elrond
- **ifconfig** and **route –n** output for Legolas
- **ifconfig** and **route –n** output for Arwen
- Successful **ping -R** output from Frodo to Sauron
- Successful **ping -R** output from Sauron to Frodo
- 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.

[p]scp lab4 cis192@opus.cabrillo.edu:lab4.lastname

Grading rubric (30 points)

3 points for complete submittal, professional appearance and quality
8 points for correct routing tables on routers
8 points for correct interface configuration on routers
8 points for successful end-to-end pings

3 points for useful command summary

Extra Credit (10 points)

Email me at risimms@cabrillo.edu:

1) Two Wireshark screen captures showing:
   a) The encrypted (Frodo to Elrond) "Follow TCP stream" of logging in as cis192 and typing the **echo this is a secret** command.
   b) The clear text (Elrond to Arwen) "Follow TCP stream" of logging in as cis192 and typing the **echo this is a secret** command.
2) A third screen capture of your terminal showing the telnet session for 1a or 1b above