Open Shortest Path First (OSPF)

Instructions

In this lab, we will implement the OSPF routing protocol. If you recall from the first IP Interfaces lab, only R1 has a direct interface outside of the network. Your goal is to configure each router to communicate with the Internet.

Part 1: Enable the OSPF daemon

Beginning with R1, edit */etc/frr/daemons* to enable OSPF.

Restart frrouting by executing:

```
> systemctl restart frr
```

Repeat the steps in Part 1 in order to enable OSPF on R2, R3, and R4.

Part 2: Configure OSPF in Area 0

Now that we have enabled OSPF, we will need to use *vtysh* to configure R1 such that it advertises its routable networks. In *vtysh*, execute the following commands:

```
> configure terminal
> router ospf
# specify the network(s) and areas advertised by R1 (use CIDR
notation)
```

Hint: Run *ifconfig* and examine the interfaces to determine which network addresses to use.

For additional resources and configuration examples, consult the frrouting guide at: http://docs.frrouting.org/en/latest/ospfd.html#configuring-ospf

Part 3: Configure OSPF in Area 1

We will follow the same steps to configure each router in Area 1.

*Please note that we will not run OSPF on R4 (eth2) since this interface points to a terminal node (see ***passive-interface***).
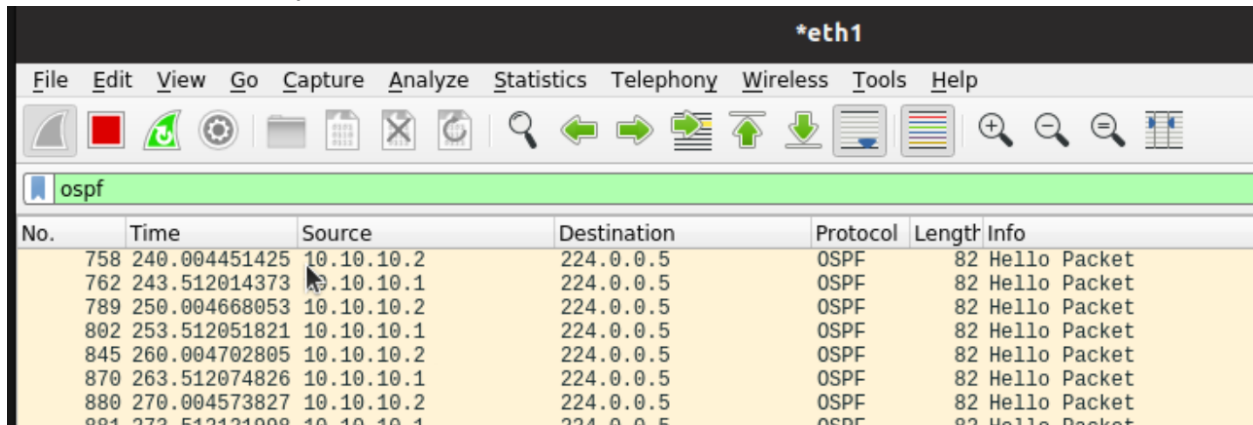
Part 4: Set Default IP Route to R1

The last step is to set the default IP route on R2, R3, and R4 so that they will go through R1 to access the Internet (i.e. all IP addresses outside of our network). You will have to browse through the FRR documentation to find the exact command.

You may verify that your configuration is correct by successfully pinging the SFTP server (128.238.77.36) from routers R2, R3, and R4.

Part 5: Questions

a) Power on all routers and run Wireshark on R1. Apply a filter for OSPF, and look at the Hello Packets. How frequently are these packets sent, and why must they be sent periodically? [10 points]
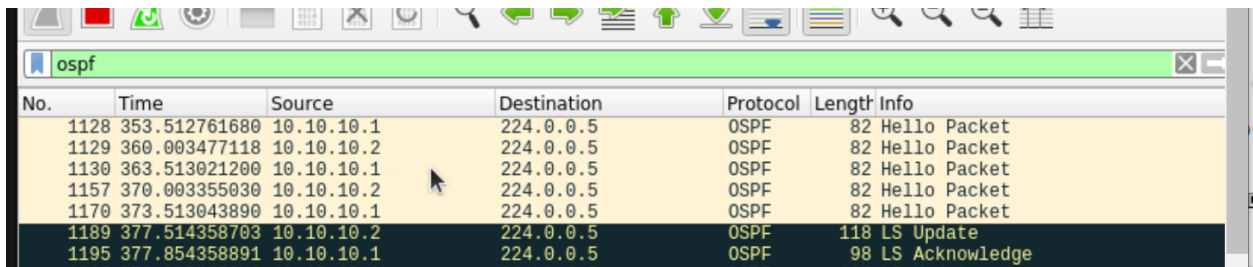

The packets are sent periodically by the routers on all interfaces to form neighbor relationship with routers in the

same area and maintain that relationship. These hello packets are multicast on address 224.0.0.5.

The timer is the hello interval which is 10 seconds. It was send periodically to establish and confirm the network

adjacency relationship in the OSPF.

b) Continue running Wireshark and turn off R4. You should now see new OSPF packet types captured on R1. Explain why Hello, Link State Update, and Link State Acknowledgements use the same Destination IP address. [20 points]
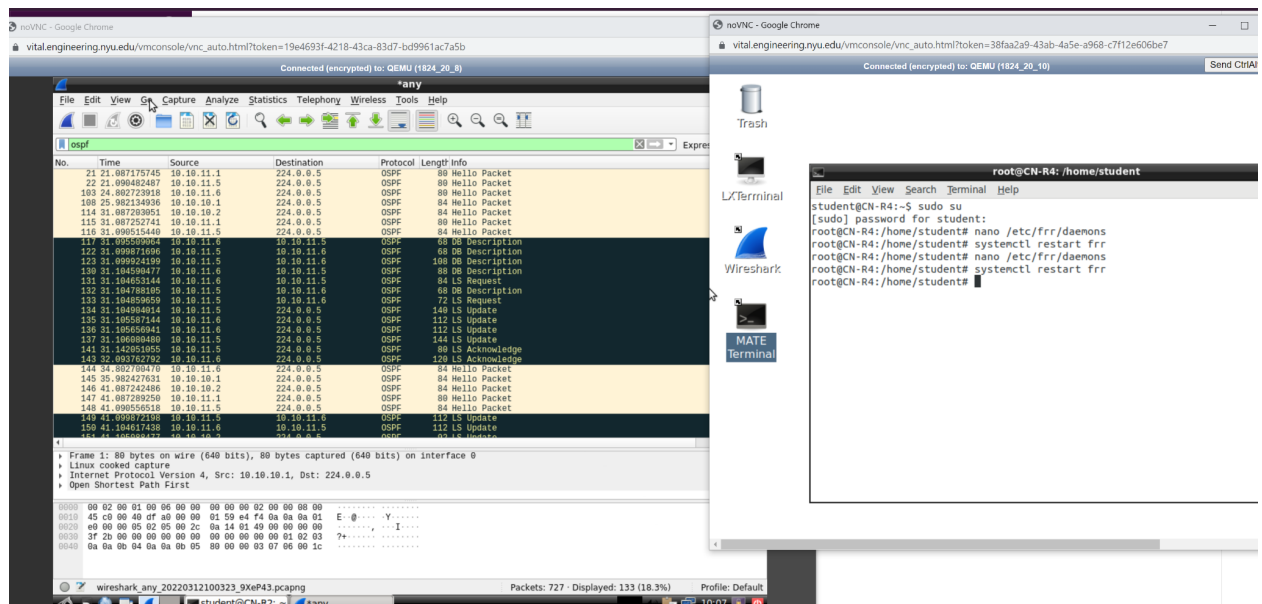

Link State Update and Link state acknowledgement are messages that communicate to other routers

through the multicast in the OSPF domain. They are sent from internal routers to announce changes though

Multicast channel 224.0.0.5.

c) Based on the above steps, explain why we do not see DB Descriptions and LS Requests on R1. Is there a situation in which we get all OSPF packet types on R1? [20 points]

We don't see DB Descriptors and LS requests on R1 because of the fact that these packets are required when a router detects that portions of it's topological database are out of date or at the time of initializing an adjacency. That did not happen during the process of this lab.

So when there is a new router added to the connection or the neighbor's topological database are out of date we get all the OSPF packet types on R1.

For example I'm running wireshark on R2, and as I disable the OSPF in R4 and restart the FRR, the DB Descriptions and LS Requests were popped showing in screenshot above(disable the OSPF was like removing the device in the area)

Submissions

[20 points] Screenshot configurations of R1, R2, R3, and R4

```
root@CN-R1:/home/student# cat /etc/frr/daemons
# This file tells the frr package which daemons to start.
#
# Sample configurations for these daemons can be found in
# /usr/share/doc/frr/examples/.
#
# ATTENTION:
#
# When activating a daemon for the first time, a config file, even if it is
# empty, has to be present *and* be owned by the user and group "frr", else
# the daemon will not be started by /etc/init.d/frr. The permissions should
# be u=rw,g=r,o=.
# When using "vtysh" such a config file is also needed. It should be owned by
# group "frrvty" and set to ug=rw,o= though. Check /etc/pam.d/frr, too.
#
# The watchfrr and zebra daemons are always started.
#
bgpd=no
ospfd=yes
ospf6d=no
```

R1

```
root@CN-R2:/home/student# cat /etc/frr/daemons
# This file tells the frr package which daemons to start.
#
# Sample configurations for these daemons can be found in
# /usr/share/doc/frr/examples/.
#
# ATTENTION:
#
# When activating a daemon for the first time, a config file, even if it is
# empty, has to be present *and* be owned by the user and group "frr", else
# the daemon will not be started by /etc/init.d/frr. The permissions should
# be u=rw,g=r,o=.
# When using "vtysh" such a config file is also needed. It should be owned by
# group "frrvty" and set to ug=rw,o= though. Check /etc/pam.d/frr, too.
#
# The watchfrr and zebra daemons are always started.
#
bgpd=no
ospfd=yes
ospf6d=no
ripd=no
ripngd=no
```

R2

```
root@CN-R3:/home/student# nano /etc/frr/daemons
root@CN-R3:/home/student# systemctl restart frr
root@CN-R3:/home/student# cat /etc/frr/daemons
# This file tells the frr package which daemons to start.
#
# Sample configurations for these daemons can be found in
# /usr/share/doc/frr/examples/.
#
# ATTENTION:
#
# When activating a daemon for the first time, a config file, even if it is
# empty, has to be present *and* be owned by the user and group "frr", else
# the daemon will not be started by /etc/init.d/frr. The permissions should
# be u=rw,g=r,o=.
# When using "vtysh" such a config file is also needed. It should be owned by
# group "frrvty" and set to ug=rw,o= though. Check /etc/pam.d/frr, too.
#
# The watchfrr and zebra daemons are always started.
#
bgpd=no
ospfd=yes
ospf6d=no
```
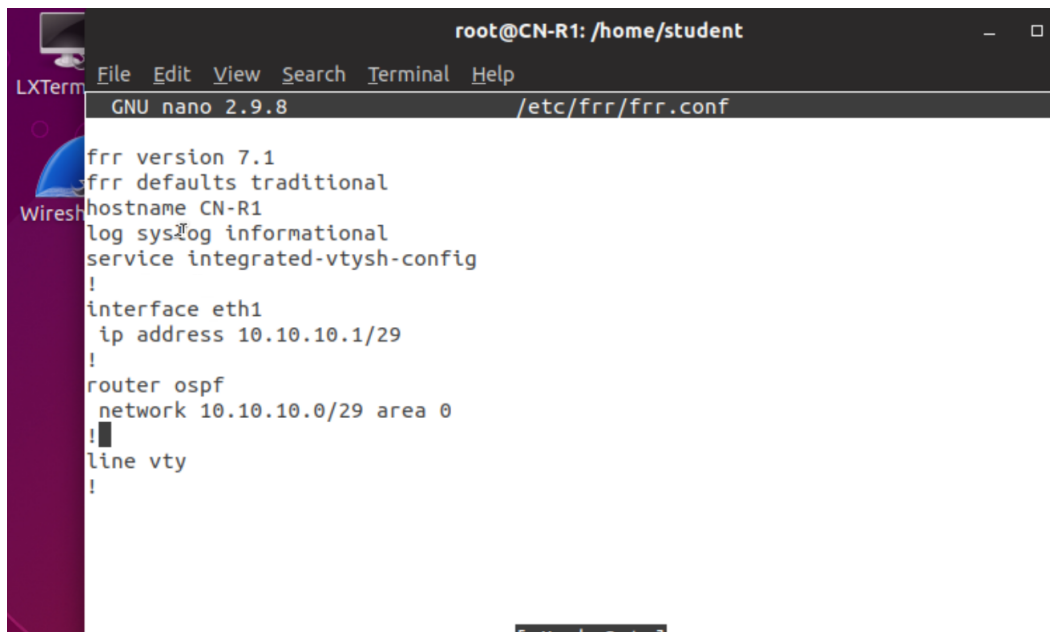
R3

```
root@CN-R4:/home/student# nano /etc/frr/daemons
root@CN-R4:/home/student# systemctl restart frr
root@CN-R4:/home/student# cat /etc/frr/daemons
# This file tells the frr package which daemons to start.
#
# Sample configurations for these daemons can be found in
# /usr/share/doc/frr/examples/.
#
# ATTENTION:
#
# When activating a daemon for the first time, a config file, even if
# empty, has to be present *and* be owned by the user and group "frr",
# the daemon will not be started by /etc/init.d/frr. The permissions s
# be u=rw,g=r,o=.
# When using "vtysh" such a config file is also needed. It should be c
# group "frrvty" and set to ug=rw,o= though. Check /etc/pam.d/frr, too
#
# The watchfrr and zebra daemons are always started.
#
bgpd=no
ospfd=yes
ospf6d=no
```
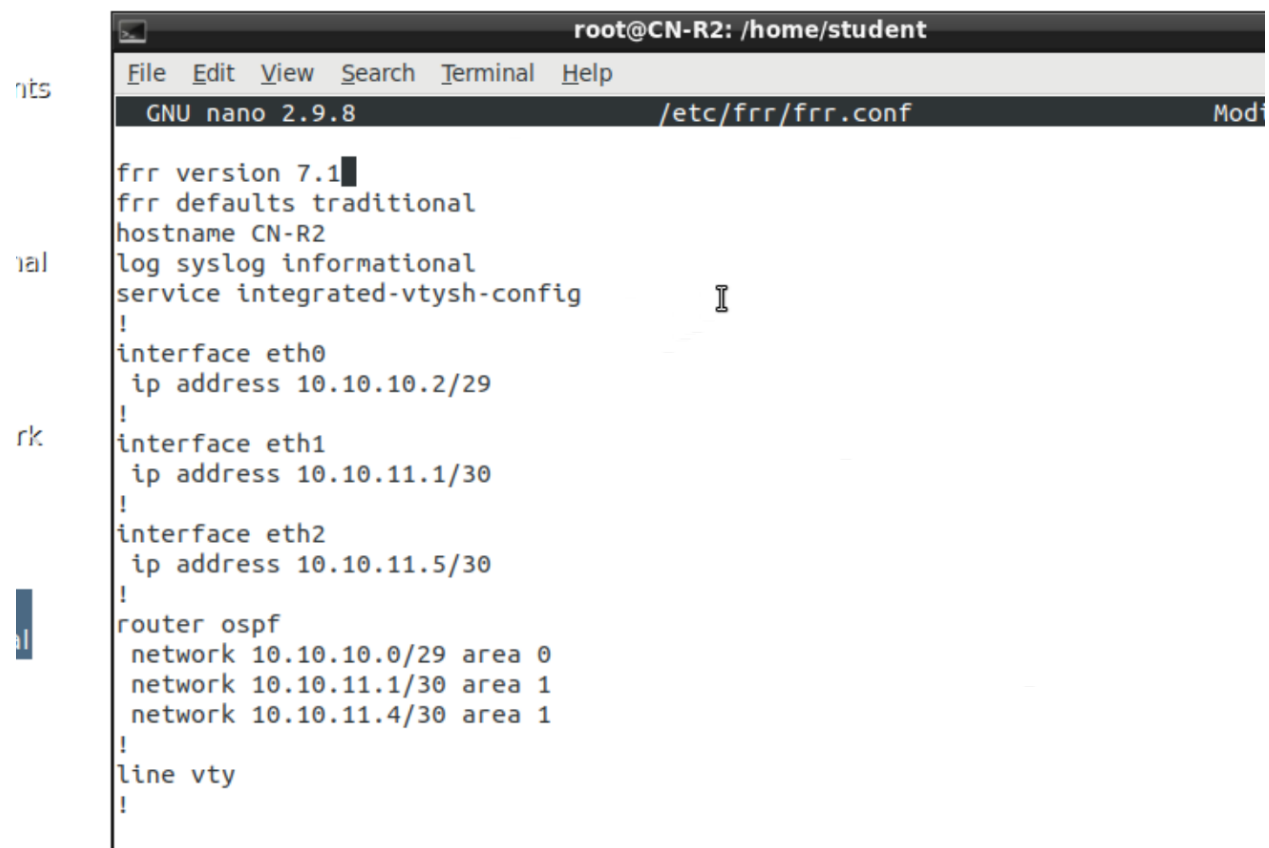
R4

R1

R2

```
                          root@CN-R3: /home/student                          _  □
File   Edit   View   Search   Terminal   Help
   GNU nano 2.9.8                    /etc/frr/frr.conf                    Modified

frr version 7.1
frr defaults traditional
hostname CN-R3
log syslog informational
service integrated-vtysh-config
!
interface eth0
 ip address 10.10.11.2/30
!
interface eth1
 ip address 10.10.11.9/30
!
router ospf
 network 10.10.11.0/30 area 1
 netowkr 10.10.11.8/30 area 1█
!
line vty
```

R3

Trash

Terminal

ireshark

MATE
erminal


```
                          root@CN-R4: /home/student
File   Edit   View   Search   Terminal   Help
   GNU nano 2.9.8                    /etc/frr/frr.conf                    Mod

frr version 7.1
frr defaults traditional
hostname CN-R4
log syslog informational
service integrated-vtysh-config
!
interface eth0
 ip address 10.10.11.10/30
!
interface eth1
 ip address 10.10.11.6/30
!
interface eth2
 ip address 10.10.11.17/28
!
router ospf
 network 10.10.11.8/30 area 1
 network 10.10.11.4/30 area 1█
!
```

R4

[10 points] ICMP results from R3 to R1

```
root@CN-R3:/home/student# ping 10.10.10.1
PING 10.10.10.1 (10.10.10.1) 56(84) bytes of data.
64 bytes from 10.10.10.1: icmp_seq=1 ttl=63 time=0.781 ms
64 bytes from 10.10.10.1: icmp_seq=2 ttl=63 time=0.983 ms
^C
--- 10.10.10.1 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 10ms
rtt min/avg/max/mdev = 0.781/0.882/0.983/0.101 ms
root@CN-R3:/home/student# ping 128.238.
^C
```

[10 points] Wireshark screenshots on R1
All router on

Turn off R4

[10 points] Screenshots depicting successful ping requests to the SFTP server (128.238.77.36) from R1, R2, R3, and R4

```
student@CN-R1:~$ sudo wireshark
[sudo] password for student:
QStandardPaths: XDG_RUNTIME_DIR not set, defaulting to '/tmp/runtime-root'
QStandardPaths: XDG_RUNTIME_DIR not set, defaulting to '/tmp/runtime-root'
student@CN-R1:~$ ping 128.238.77.36
PING 128.238.77.36 (128.238.77.36) 56(84) bytes of data.
64 bytes from 128.238.77.36: icmp_seq=1 ttl=63 time=0.609 ms
64 bytes from 128.238.77.36: icmp_seq=2 ttl=63 time=0.350 ms
64 bytes from 128.238.77.36: icmp_seq=3 ttl=63 time=0.610 ms
64 bytes from 128.238.77.36: icmp_seq=4 ttl=63 time=0.629 ms
64 bytes from 128.238.77.36: icmp_seq=5 ttl=63 time=0.570 ms
64 bytes from 128.238.77.36: icmp_seq=6 ttl=63 time=0.604 ms
^C
--- 128.238.77.36 ping statistics ---
6 packets transmitted, 6 received, 0% packet loss, time 129ms
rtt min/avg/max/mdev = 0.350/0.562/0.629/0.096 ms
student@CN-R1:~$
```

R1

```
--- 128.238.77.36 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 2ms
rtt min/avg/max/mdev = 0.899/0.945/0.991/0.046 ms
root@CN-R2:/home/student# ping 128.238.77.36
PING 128.238.77.36 (128.238.77.36) 56(84) bytes of data.
64 bytes from 128.238.77.36: icmp_seq=1 ttl=62 time=1.16 ms
64 bytes from 128.238.77.36: icmp_seq=2 ttl=62 time=1.18 ms
64 bytes from 128.238.77.36: icmp_seq=3 ttl=62 time=1.04 ms
64 bytes from 128.238.77.36: icmp_seq=4 ttl=62 time=1.02 ms
64 bytes from 128.238.77.36: icmp_seq=5 ttl=62 time=0.997 ms
64 bytes from 128.238.77.36: icmp_seq=6 ttl=62 time=1.02 ms
64 bytes from 128.238.77.36: icmp_seq=7 ttl=62 time=0.987 ms
64 bytes from 128.238.77.36: icmp_seq=8 ttl=62 time=1.04 ms
^C
--- 128.238.77.36 ping statistics ---
8 packets transmitted, 8 received, 0% packet loss, time 16ms
rtt min/avg/max/mdev = 0.987/1.056/1.182/0.072 ms
```

R2

```
root@CN-R3:/home/student# ping 128.238.
^C
root@CN-R3:/home/student# ping 128.238.77.36
PING 128.238.77.36 (128.238.77.36) 56(84) bytes of data.
64 bytes from 128.238.77.36: icmp_seq=1 ttl=61 time=2.06 ms
64 bytes from 128.238.77.36: icmp_seq=2 ttl=61 time=1.23 ms
64 bytes from 128.238.77.36: icmp_seq=3 ttl=61 time=1.24 ms
64 bytes from 128.238.77.36: icmp_seq=4 ttl=61 time=1.47 ms
64 bytes from 128.238.77.36: icmp_seq=5 ttl=61 time=1.35 ms
^C
--- 128.238.77.36 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 10ms
```

R3

```
3 packets transmitted, 3 received, 0% packet loss, time 5ms
rtt min/avg/max/mdev = 0.631/0.837/1.177/0.242 ms
root@CN-R4:/home/student# ping 128.238.77.36
PING 128.238.77.36 (128.238.77.36) 56(84) bytes of data.
64 bytes from 128.238.77.36: icmp_seq=1 ttl=61 time=1.90 ms
64 bytes from 128.238.77.36: icmp_seq=2 ttl=61 time=1.19 ms
64 bytes from 128.238.77.36: icmp_seq=3 ttl=61 time=1.40 ms
64 bytes from 128.238.77.36: icmp_seq=4 ttl=61 time=1.32 ms
64 bytes from 128.238.77.36: icmp_seq=5 ttl=61 time=1.43 ms
64 bytes from 128.238.77.36: icmp_seq=6 ttl=61 time=1.55 ms
64 bytes from 128.238.77.36: icmp_seq=7 ttl=61 time=1.49 ms
64 bytes from 128.238.77.36: icmp_seq=8 ttl=61 time=1.27 ms
64 bytes from 128.238.77.36: icmp_seq=9 ttl=61 time=1.31 ms
64 bytes from 128.238.77.36: icmp_seq=10 ttl=61 time=1.42 ms
64 bytes from 128.238.77.36: icmp_seq=11 ttl=61 time=1.48 ms
^C
--- 128.238.77.36 ping statistics ---
11 packets transmitted, 11 received, 0% packet loss, time 29ms
rtt min/avg/max/mdev = 1.191/1.432/1.898/0.181 ms
```

R4

[50 points] Answers to questions 5a-5c

Please remember to submit your lab results as a single PDF document. While you may work in groups, you **MUST** submit your own work.