

Assignment 3

IP Interfaces: Part 2

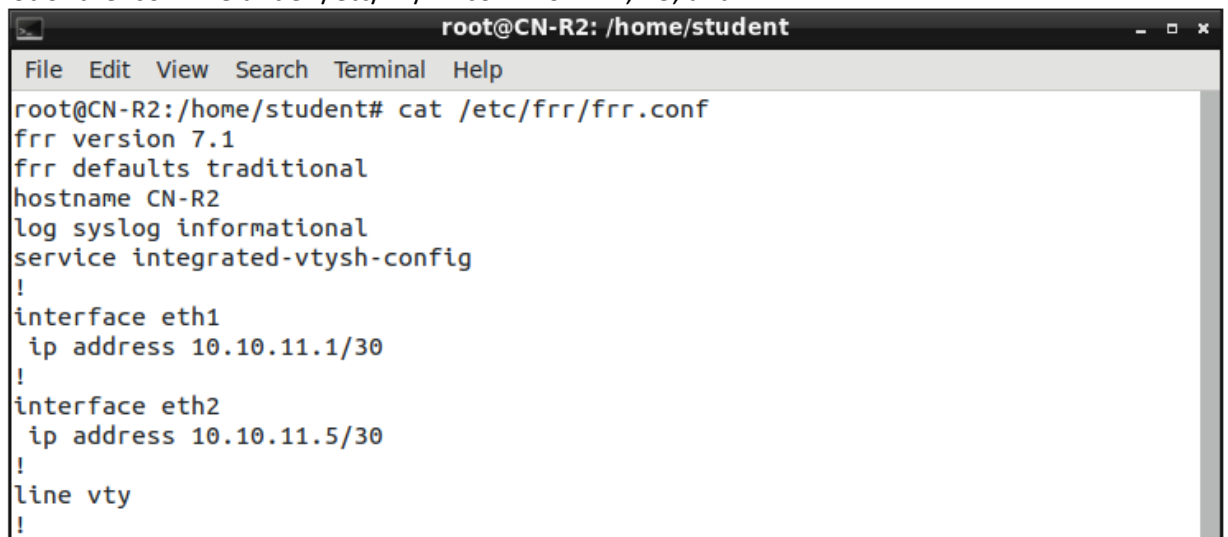
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VM (interface)	IP Address	Network Address	Broadcast Address	Range (usable addresses)
R2 (eth1)	10.10.11.1/30	10.10.11.0/30	10.10.11.3/30	10.10.11.1/30-10.10.11.2/30
R3 (eth0)	10.10.11.2/30			
R2 (eth2)	10.10.11.5/30	10.10.11.4/30	10.10.11.7/30	10.10.11.5/30-10.10.11.6/30
R4 (eth1)	10.10.11.6/30			
R3 (eth1)	10.10.11.9/30	10.10.11.8/30	10.10.11.11/30	10.10.11.9/30-10.10.11.10/30
R4 (eth0)	10.10.11.10/30			
R4 (eth2)	10.10.11.17/28	10.10.11.16/28	10.10.11.31/28	10.10.11.17/28-10.10.11.30/28

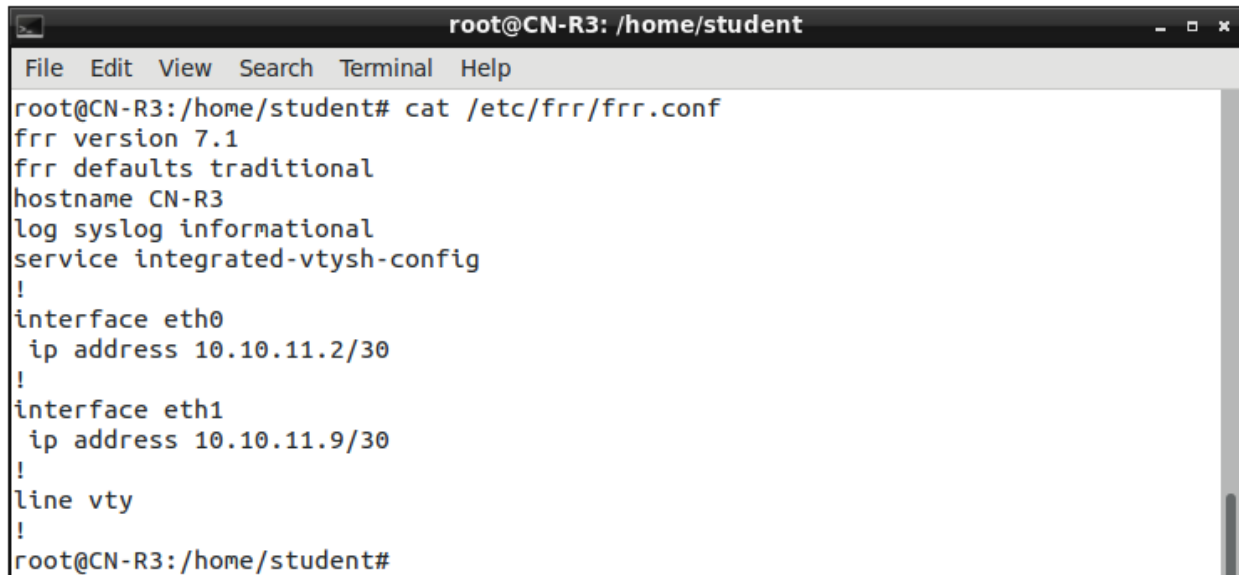
Part 1: Configuring Network Interfaces

Screenshot of the .conf file under /etc/frr/frr.conf from R2, R3, and R4:



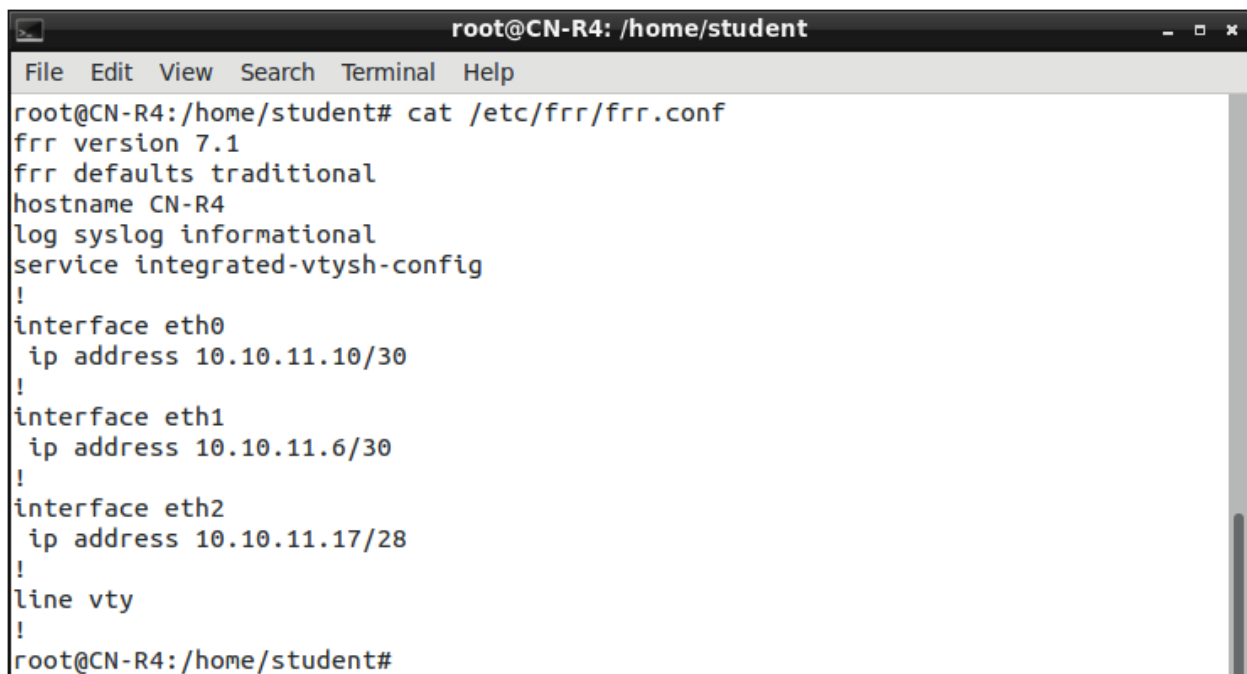
```
root@CN-R2: /home/student
File Edit View Search Terminal Help
root@CN-R2:/home/student# cat /etc/frr/frr.conf
frr version 7.1
frr defaults traditional
hostname CN-R2
log syslog informational
service integrated-vtysh-config
!
interface eth1
 ip address 10.10.11.1/30
!
interface eth2
 ip address 10.10.11.5/30
!
line vty
!
```

Screenshot of the .conf file under /etc/frr/frr.conf from R2

A terminal window titled 'root@CN-R3: /home/student' with a menu bar (File, Edit, View, Search, Terminal, Help). The terminal shows the command 'cat /etc/frr/frr.conf' and its output: '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', '!', 'line vty', '!', and the prompt 'root@CN-R3: /home/student#'.

```
root@CN-R3: /home/student# cat /etc/frr/frr.conf
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
!
line vty
!
root@CN-R3: /home/student#
```

Screenshot of the .conf file under /etc/frr/frr.conf from R3

A terminal window titled 'root@CN-R4: /home/student' with a menu bar (File, Edit, View, Search, Terminal, Help). The terminal shows the command 'cat /etc/frr/frr.conf' and its output: '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', '!', 'line vty', '!', and the prompt 'root@CN-R4: /home/student#'.

```
root@CN-R4: /home/student# cat /etc/frr/frr.conf
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
!
line vty
!
root@CN-R4: /home/student#
```

Screenshot of the .conf file under /etc/frr/frr.conf from R4

Address of R2,R3 and R4:

```
root@CN-R2: /home/student
File Edit View Search Terminal Help
root@CN-R2:/home/student# ifconfig
eth1: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 10.10.11.1 netmask 255.255.255.252 broadcast 10.10.11.3
    inet6 fe80::200:ff:fe00:5 prefixlen 64 scopeid 0x20<link>
    ether 00:00:00:00:00:05 txqueuelen 1000 (Ethernet)
    RX packets 71 bytes 6846 (6.8 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 50 bytes 6251 (6.2 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

eth2: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 10.10.11.5 netmask 255.255.255.252 broadcast 10.10.11.7
    inet6 fe80::200:ff:fe00:9 prefixlen 64 scopeid 0x20<link>
    ether 00:00:00:00:00:09 txqueuelen 1000 (Ethernet)
    RX packets 69 bytes 6680 (6.6 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 48 bytes 6099 (6.0 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING> mtu 65536
    inet 127.0.0.1 netmask 255.0.0.0
    inet6 ::1 prefixlen 128 scopeid 0x10<host>
    loop txqueuelen 1000 (Local Loopback)
    RX packets 3513 bytes 216205 (216.2 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 3513 bytes 216205 (216.2 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

root@CN-R2:/home/student#
```

Screenshot of address of R2

```
root@CN-R3: /home/student
File Edit View Search Terminal Help
root@CN-R3:/home/student# ifconfig
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 10.10.11.2 netmask 255.255.255.252 broadcast 10.10.11.3
    inet6 fe80::200:ff:fe00:6 prefixlen 64 scopeid 0x20<link>
    ether 00:00:00:00:00:06 txqueuelen 1000 (Ethernet)
    RX packets 21 bytes 1434 (1.4 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 49 bytes 6164 (6.1 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

eth1: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 10.10.11.9 netmask 255.255.255.252 broadcast 10.10.11.11
    inet6 fe80::200:ff:fe00:7 prefixlen 64 scopeid 0x20<link>
    ether 00:00:00:00:00:07 txqueuelen 1000 (Ethernet)
    RX packets 67 bytes 6579 (6.5 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 48 bytes 6099 (6.0 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING> mtu 65536
    inet 127.0.0.1 netmask 255.0.0.0
    inet6 ::1 prefixlen 128 scopeid 0x10<host>
    loop txqueuelen 1000 (Local Loopback)
    RX packets 2952 bytes 182532 (182.5 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 2952 bytes 182532 (182.5 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

root@CN-R3:/home/student#
```

Screenshot of address of R3

```
root@CN-R4: /home/student
File Edit View Search Terminal Help
root@CN-R4:/home/student# ifconfig
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 10.10.11.10 netmask 255.255.255.252 broadcast 10.10.11.11
    inet6 fe80::200:ff:fe00:8 prefixlen 64 scopeid 0x20<link>
    ether 00:00:00:00:00:08 txqueuelen 1000 (Ethernet)
    RX packets 19 bytes 1268 (1.2 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 48 bytes 6105 (6.1 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

eth1: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 10.10.11.6 netmask 255.255.255.252 broadcast 10.10.11.7
    inet6 fe80::200:ff:fe00:a prefixlen 64 scopeid 0x20<link>
    ether 00:00:00:00:00:0a txqueuelen 1000 (Ethernet)
    RX packets 16 bytes 1046 (1.0 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 49 bytes 6164 (6.1 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

eth2: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 10.10.11.17 netmask 255.255.255.240 broadcast 10.10.11.31
    inet6 fe80::200:ff:fe00:b prefixlen 64 scopeid 0x20<link>
    ether 00:00:00:00:00:0b txqueuelen 1000 (Ethernet)
    RX packets 15 bytes 976 (976.0 B)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 49 bytes 6170 (6.1 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING> mtu 65536
    inet 127.0.0.1 netmask 255.0.0.0
    inet6 ::1 prefixlen 128 scopeid 0x10<host>
    loop txqueuelen 1000 (Local Loopback)
    RX packets 2234 bytes 139016 (139.0 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 2234 bytes 139016 (139.0 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
```

Screenshot of address of R4

Ping between R2,R3 and R4:

```
root@CN-R2: /home/student
File Edit View Search Terminal Help
root@CN-R2:/home/student# ping 10.10.11.2
PING 10.10.11.2 (10.10.11.2) 56(84) bytes of data. R2 to R3
64 bytes from 10.10.11.2: icmp_seq=1 ttl=64 time=0.734 ms
64 bytes from 10.10.11.2: icmp_seq=2 ttl=64 time=0.416 ms
64 bytes from 10.10.11.2: icmp_seq=3 ttl=64 time=0.479 ms
^C
--- 10.10.11.2 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 28ms
rtt min/avg/max/mdev = 0.416/0.543/0.734/0.137 ms
root@CN-R2:/home/student# ping 10.10.11.6
PING 10.10.11.6 (10.10.11.6) 56(84) bytes of data. R2 to R4
64 bytes from 10.10.11.6: icmp_seq=1 ttl=64 time=0.651 ms
64 bytes from 10.10.11.6: icmp_seq=2 ttl=64 time=0.264 ms
64 bytes from 10.10.11.6: icmp_seq=3 ttl=64 time=0.427 ms
64 bytes from 10.10.11.6: icmp_seq=4 ttl=64 time=0.433 ms
```

Screenshot of ping R2 to R3,R4

```
root@CN-R3: /home/student
File Edit View Search Terminal Help
root@CN-R3:/home/student# ping 10.10.11.1
PING 10.10.11.1 (10.10.11.1) 56(84) bytes of data.
64 bytes from 10.10.11.1: icmp_seq=1 ttl=64 time=0.390 ms
64 bytes from 10.10.11.1: icmp_seq=2 ttl=64 time=0.296 ms
64 bytes from 10.10.11.1: icmp_seq=3 ttl=64 time=0.376 ms
64 bytes from 10.10.11.1: icmp_seq=4 ttl=64 time=0.424 ms
^C
--- 10.10.11.1 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 67ms
rtt min/avg/max/mdev = 0.296/0.371/0.424/0.050 ms
root@CN-R3:/home/student# ping 10.10.11.10
PING 10.10.11.10 (10.10.11.10) 56(84) bytes of data.
64 bytes from 10.10.11.10: icmp_seq=1 ttl=64 time=0.663 ms
64 bytes from 10.10.11.10: icmp_seq=2 ttl=64 time=0.302 ms
64 bytes from 10.10.11.10: icmp_seq=3 ttl=64 time=0.295 ms
64 bytes from 10.10.11.10: icmp_seq=4 ttl=64 time=0.367 ms
^C
--- 10.10.11.10 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 52ms
rtt min/avg/max/mdev = 0.295/0.406/0.663/0.152 ms
```

R3 to R2

R3 to R4

Screenshot of ping R3 to R2,R4

```
root@CN-R4: /home/student
File Edit View Search Terminal Help
root@CN-R4:/home/student# ping 10.10.11.5
PING 10.10.11.5 (10.10.11.5) 56(84) bytes of data.
64 bytes from 10.10.11.5: icmp_seq=1 ttl=64 time=0.357 ms
64 bytes from 10.10.11.5: icmp_seq=2 ttl=64 time=0.450 ms
64 bytes from 10.10.11.5: icmp_seq=3 ttl=64 time=0.400 ms
64 bytes from 10.10.11.5: icmp_seq=4 ttl=64 time=0.404 ms
^C
--- 10.10.11.5 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 74ms
rtt min/avg/max/mdev = 0.357/0.402/0.450/0.041 ms
root@CN-R4:/home/student# ping 10.10.11.9
PING 10.10.11.9 (10.10.11.9) 56(84) bytes of data.
64 bytes from 10.10.11.9: icmp_seq=1 ttl=64 time=0.353 ms
64 bytes from 10.10.11.9: icmp_seq=2 ttl=64 time=0.372 ms
64 bytes from 10.10.11.9: icmp_seq=3 ttl=64 time=0.373 ms
^C
--- 10.10.11.9 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 56ms
rtt min/avg/max/mdev = 0.353/0.366/0.373/0.009 ms
root@CN-R4:/home/student#
```

R4 to R2

R4 to R3

Screenshot of ping R4 to R2,R3

ARP tables on R2, R3, and R4:

```
root@CN-R2: /home/student
File Edit View Search Terminal Help
root@CN-R2:/home/student# arp
Address          HWtype  HWaddress      Flags Mask    Iface
10.10.11.6       ether   00:00:00:00:00:0a  C             eth2
10.10.11.2       ether   00:00:00:00:00:06  C             eth1
```

ARP table of R2

```
root@CN-R3: /home/student
File Edit View Search Terminal Help
root@CN-R3:/home/student# arp
Address          HWtype  HWaddress      Flags Mask    Iface
10.10.11.10      ether   00:00:00:00:00:08  C             eth1
10.10.11.1       ether   00:00:00:00:00:05  C             eth0
```

ARP table of R3

```
root@CN-R4: /home/student
File Edit View Search Terminal Help
root@CN-R4:/home/student# arp
Address          HWtype  HWaddress      Flags Mask    Iface
10.10.11.5       ether   00:00:00:00:00:09  C             eth1
10.10.11.9       ether   00:00:00:00:00:07  C             eth0
```

ARP table of R4

Part 2: Questions

- a. **Why must we ensure that our subnets do not overlap? Discuss one example of something that could go wrong.**

Because

- (1). Subnets overlap can lead to IP address conflicts and routing ambiguity. A device may receive conflicting routing information and may not know which subnet to use.
- (2). Subnets overlap will lead to security vulnerabilities. Devices in one subnet may unintentionally communicate with devices in another subnet, potentially leaking information.
- (3). Subnets overlap wastes address.

Example:

Subnet A: 10.10.11.0/30

Subnet B: 10.10.11.0/30

In this scenario, both A and B have been assigned the same subnet, which is an overlap. Devices in both A and B may be assigned IP addresses 10.10.11.1. When a device in A, for instance, tries to communicate with 10.10.11.1, the network does not know whether to route it to A or B, leading to IP address conflicts and communication issues.

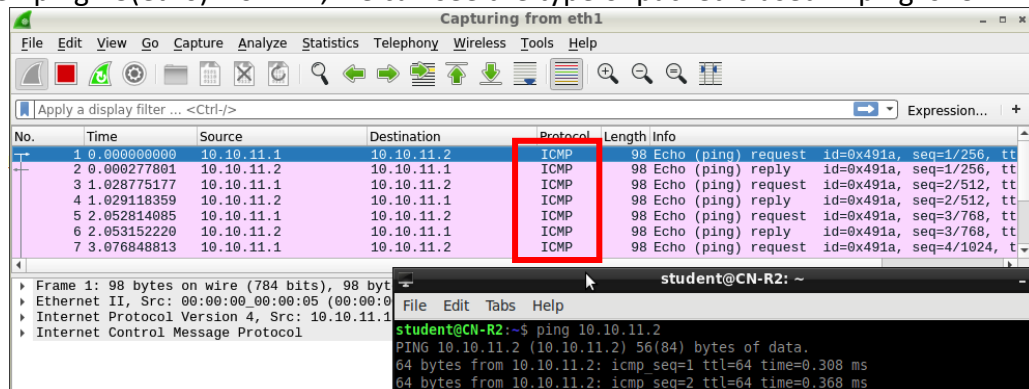
- b. Suppose there is another Router (R5) directly connected to the HUB between R3 and R4. Explain whether or not we would need to reconfigure the IP subnets on R3 and R4 in order to communicate with R5.

We don't need to reconfigure.

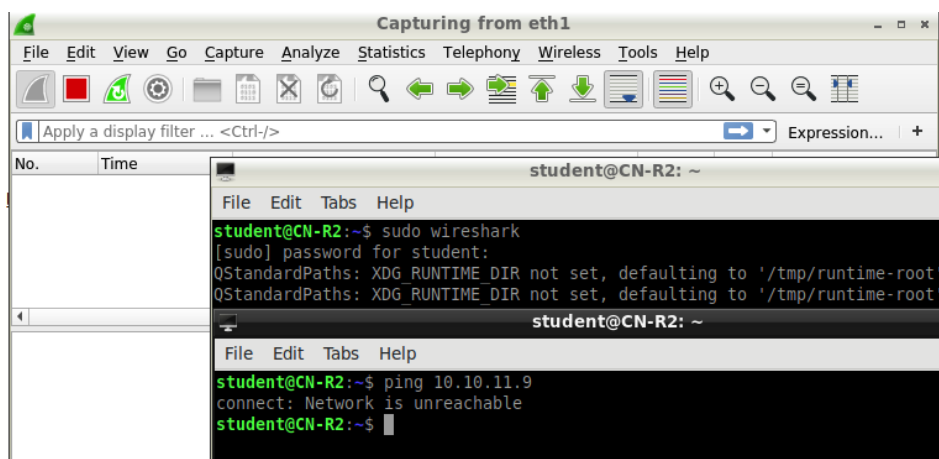
R3 and R4 are in the same subnet 10.10.11.8/30. R5 is directly connected to the HUB between R3 and R4, it should also be assigned an IP address within the same subnet for them to communicate. We could assign R5 the IP address 10.10.11.11/30, which is the next available address in the subnet after R4's address. And 10.10.11.12/30 can become the broadcast address.

- c. Run Wireshark on R2 (eth1). Now ping R3(eth1) from R2. Identify what type of packet is used in ping. Why is R2 unable to reach R3 (eth1)?

When ping R3(eth0) from R2, we can see the type of packet is used in ping is ICMP.



Screenshot of Wireshark result of pinging R3(eth0) from R2



Screenshot of R2 unable to reach R3 (eth1)

R2 unable to reach R3 (eth1) because R3 (eth1) is neither in the same subnet of R2(eth1) nor R2(eth2).

d. Briefly describe how Wireshark results compare when you ping R3 (eth0) from R2 (eth1).

(1). ICMP Echo Request packets originating from R2 (eth1) with a source IP address of R2's eth1 interface(10.10.11.1) and a destination IP address of R3's eth0 interface(10.10.11.2).

(2). In response to the ICMP Echo Request packets, R3(eth0) send ICMP Echo Reply packets back to R2(eth1) with a source IP address of R3's eth0 interface(10.10.11.2) and a destination IP address of R2's eth1 interface(10.10.11.1).

In both(1)(2), Ethernet frame headers for each packet shows source and destination MAC addresses, as well as other Ethernet-specific information. The MAC addresses correspond to the interfaces of R2 (eth1) and R3 (eth0) involved in the communication, ensure them transfer correctly. Timestamps and packet details are also given by Wireshark.