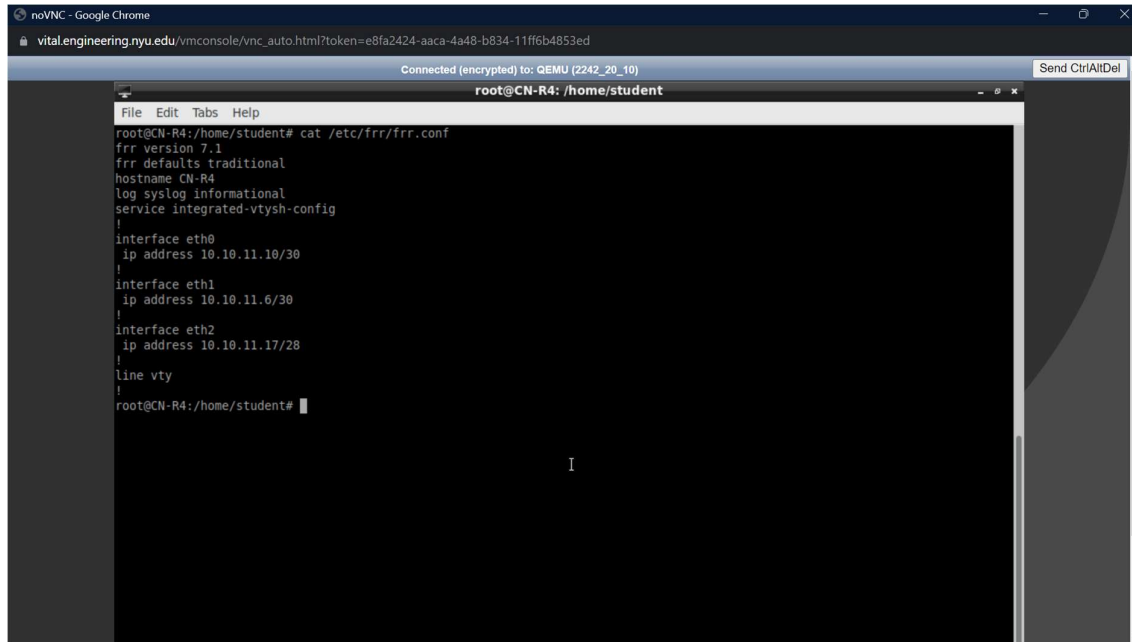


Submissions

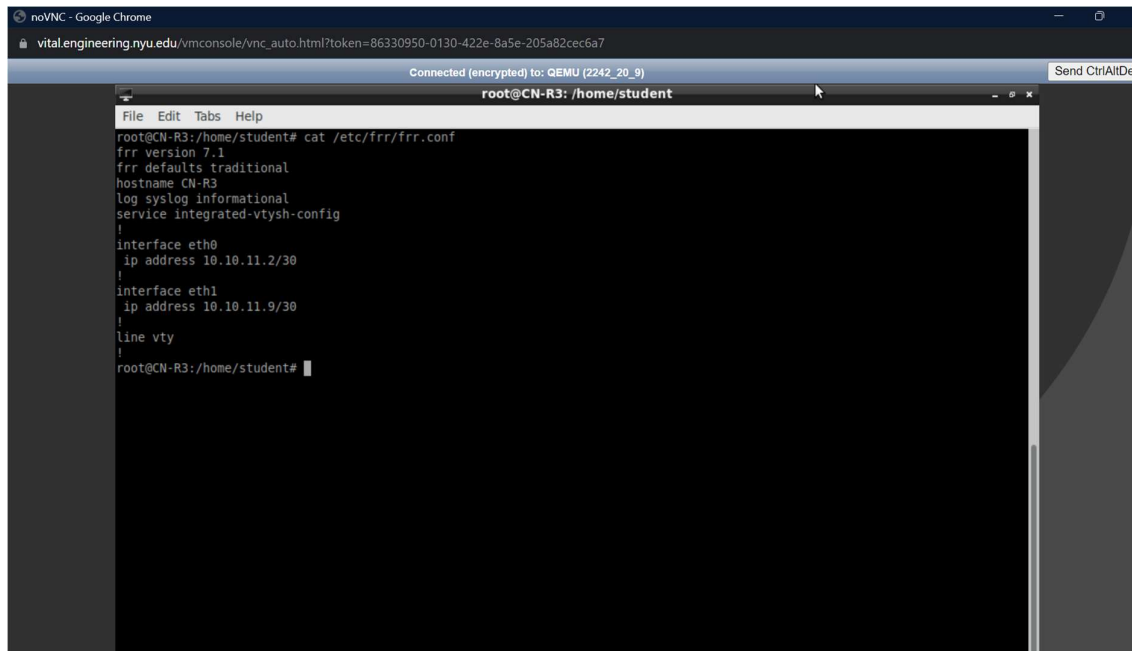
Screenshots of the .conf file under /etc/frr/frr.conf from R2, R3, and R4

Screenshot of .conf file of R4

A screenshot of a terminal window titled "root@CN-R4: /home/student" showing the contents of the file /etc/frr/frr.conf. The terminal output is as follows:

```
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 .conf file of R3

A screenshot of a terminal window titled "root@CN-R3: /home/student" showing the contents of the file /etc/frr/frr.conf. The terminal output is as follows:

```
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 .conf file of R2

```

root@CN-R2: /home/student
File Edit Tabs Help
student@CN-R2:~$ sudo su
[sudo] password for student:
root@CN-R2:/home/student# clear
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 eth0
 ip address 10.10.10.2/29
!
interface eth1
 ip address 10.10.11.1/30
!
interface eth2
 ip address 10.10.11.5/30
!
line vty
!
root@CN-R2:/home/student#

```

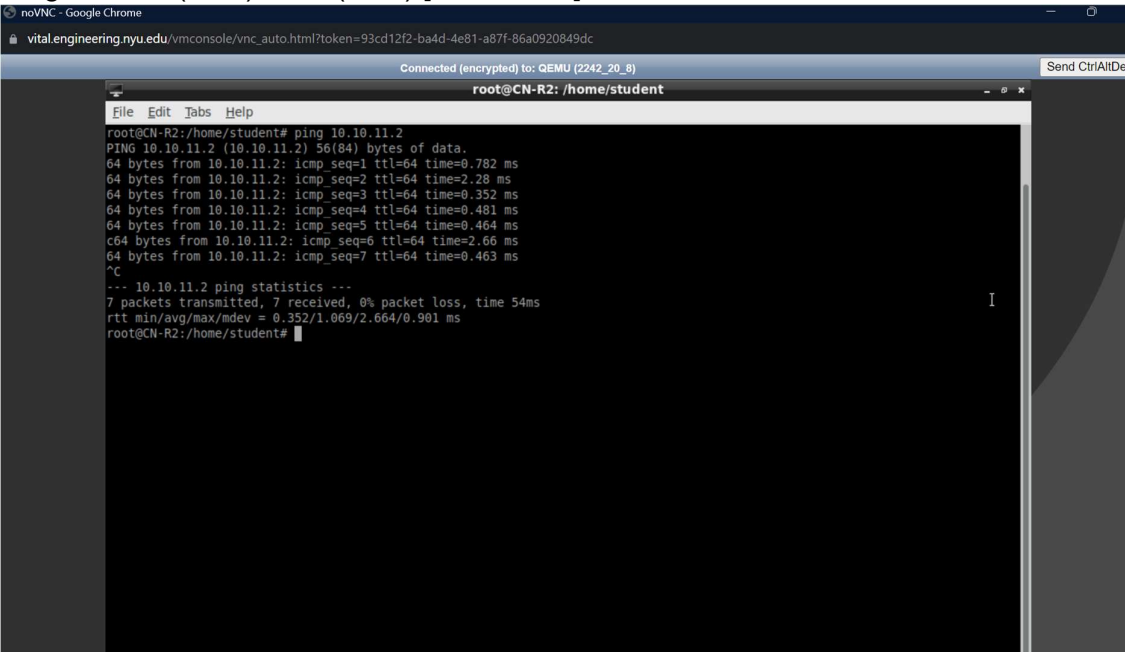
IP subnet table

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

Screenshot showing that pinging works between R2, R3, and R4

R2

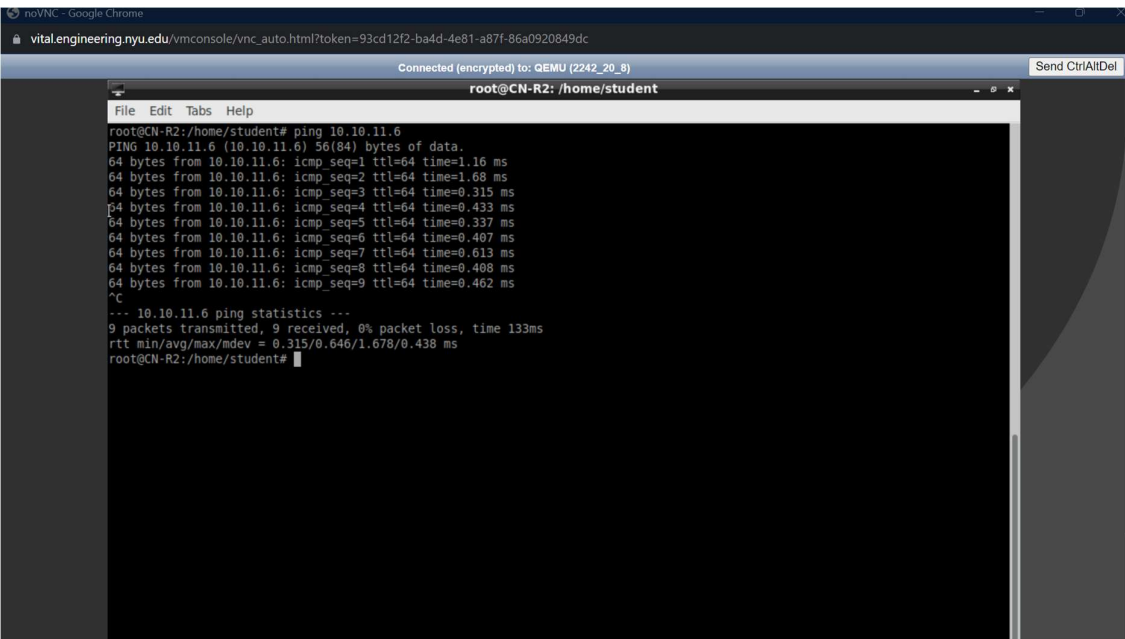
Ping from R2(eth1) to R3(eth0) [10.10.11.2]



The screenshot shows a terminal window titled "root@CN-R2: /home/student". The user has executed the command "ping 10.10.11.2". The output shows 7 successful pings to 10.10.11.2 with varying response times. The statistics at the bottom indicate 7 packets transmitted, 7 received, 0% packet loss, and a time of 54ms.

```
root@CN-R2: /home/student# ping 10.10.11.2
PING 10.10.11.2 (10.10.11.2) 56(84) bytes of data:
64 bytes from 10.10.11.2: icmp_seq=1 ttl=64 time=0.782 ms
64 bytes from 10.10.11.2: icmp_seq=2 ttl=64 time=2.28 ms
64 bytes from 10.10.11.2: icmp_seq=3 ttl=64 time=0.352 ms
64 bytes from 10.10.11.2: icmp_seq=4 ttl=64 time=0.481 ms
64 bytes from 10.10.11.2: icmp_seq=5 ttl=64 time=0.464 ms
64 bytes from 10.10.11.2: icmp_seq=6 ttl=64 time=2.66 ms
64 bytes from 10.10.11.2: icmp_seq=7 ttl=64 time=0.463 ms
^C
--- 10.10.11.2 ping statistics ---
7 packets transmitted, 7 received, 0% packet loss, time 54ms
rtt min/avg/max/mdev = 0.352/1.069/2.664/0.901 ms
root@CN-R2: /home/student#
```

Ping from R2 to R4 (eth1) [10.10.11.6]

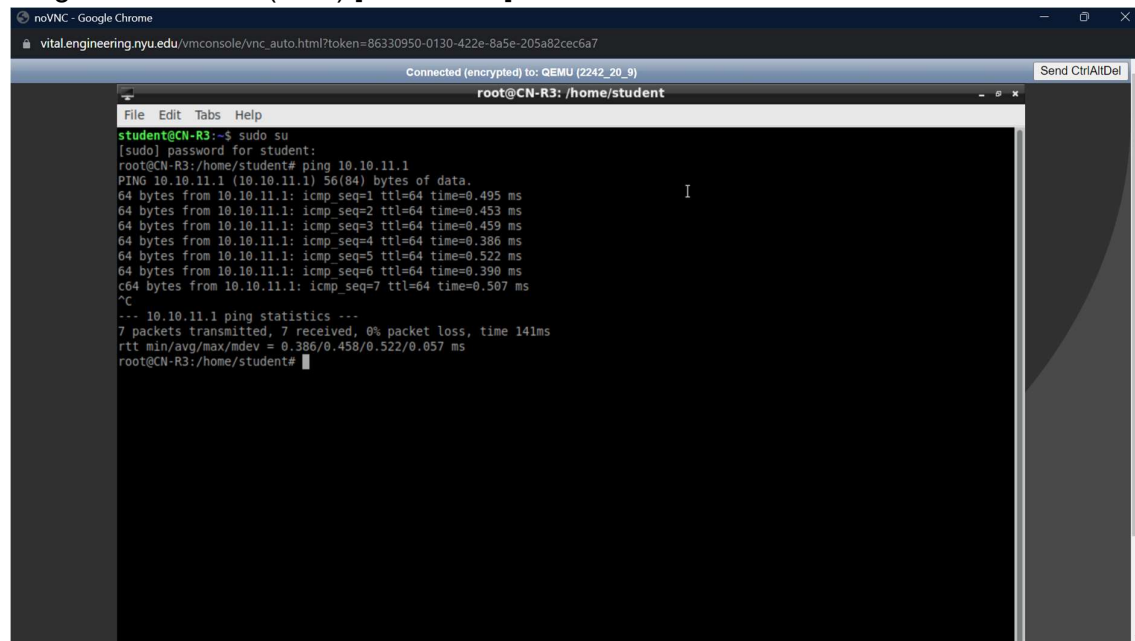


The screenshot shows a terminal window titled "root@CN-R2: /home/student". The user has executed the command "ping 10.10.11.6". The output shows 9 successful pings to 10.10.11.6 with varying response times. The statistics at the bottom indicate 9 packets transmitted, 9 received, 0% packet loss, and a time of 133ms.

```
root@CN-R2: /home/student# ping 10.10.11.6
PING 10.10.11.6 (10.10.11.6) 56(84) bytes of data:
64 bytes from 10.10.11.6: icmp_seq=1 ttl=64 time=1.16 ms
64 bytes from 10.10.11.6: icmp_seq=2 ttl=64 time=1.68 ms
64 bytes from 10.10.11.6: icmp_seq=3 ttl=64 time=0.315 ms
64 bytes from 10.10.11.6: icmp_seq=4 ttl=64 time=0.433 ms
64 bytes from 10.10.11.6: icmp_seq=5 ttl=64 time=0.337 ms
64 bytes from 10.10.11.6: icmp_seq=6 ttl=64 time=0.407 ms
64 bytes from 10.10.11.6: icmp_seq=7 ttl=64 time=0.613 ms
64 bytes from 10.10.11.6: icmp_seq=8 ttl=64 time=0.408 ms
64 bytes from 10.10.11.6: icmp_seq=9 ttl=64 time=0.462 ms
^C
--- 10.10.11.6 ping statistics ---
9 packets transmitted, 9 received, 0% packet loss, time 133ms
rtt min/avg/max/mdev = 0.315/0.646/1.678/0.438 ms
root@CN-R2: /home/student#
```

R3

Ping from R3 to R2(eth1) [10.10.11.1]

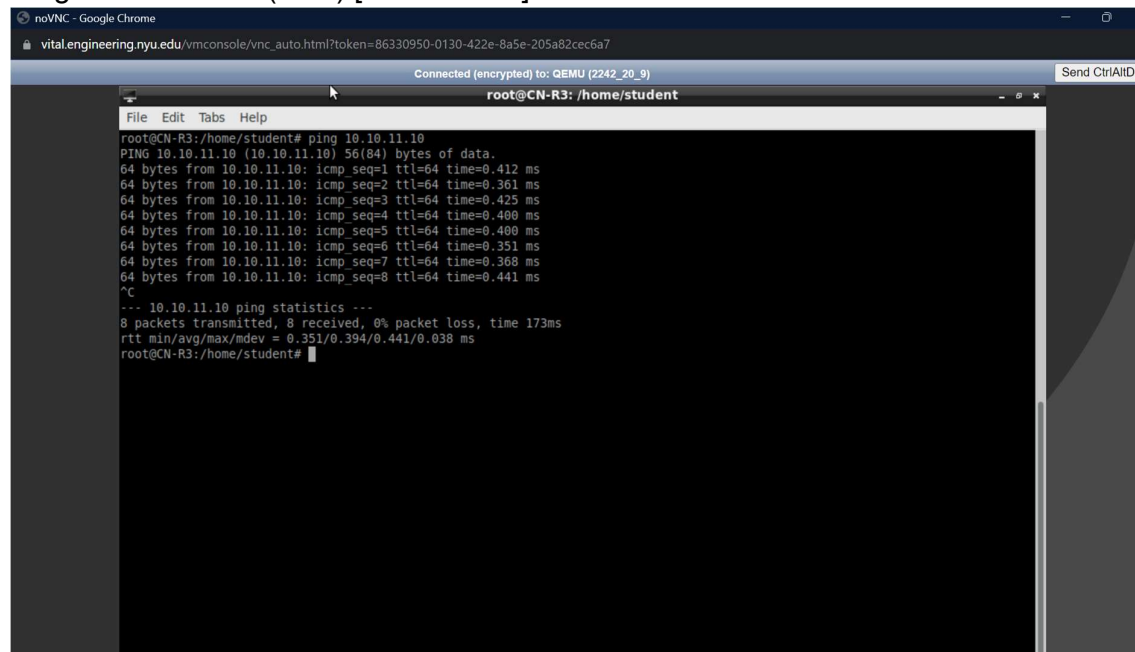


```
noVNC - Google Chrome
vital.engineering.nyu.edu/vmconsole/vnc_auto.html?token=86330950-0130-422e-8a5e-205a82cec6a7

Connected (encrypted) to: QEMU (2242_20_9)
root@CN-R3: /home/student

File Edit Tabs Help
student@CN-R3:~$ sudo su
[sudo] password for student:
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=0.495 ms
64 bytes from 10.10.11.1: icmp_seq=2 ttl=64 time=0.453 ms
64 bytes from 10.10.11.1: icmp_seq=3 ttl=64 time=0.459 ms
64 bytes from 10.10.11.1: icmp_seq=4 ttl=64 time=0.386 ms
64 bytes from 10.10.11.1: icmp_seq=5 ttl=64 time=0.522 ms
64 bytes from 10.10.11.1: icmp_seq=6 ttl=64 time=0.390 ms
64 bytes from 10.10.11.1: icmp_seq=7 ttl=64 time=0.507 ms
^C
--- 10.10.11.1 ping statistics ---
7 packets transmitted, 7 received, 0% packet loss, time 141ms
rtt min/avg/max/mdev = 0.386/0.458/0.522/0.057 ms
root@CN-R3:/home/student#
```

Ping from R3 to R4(eth0) [10.10.11.10]



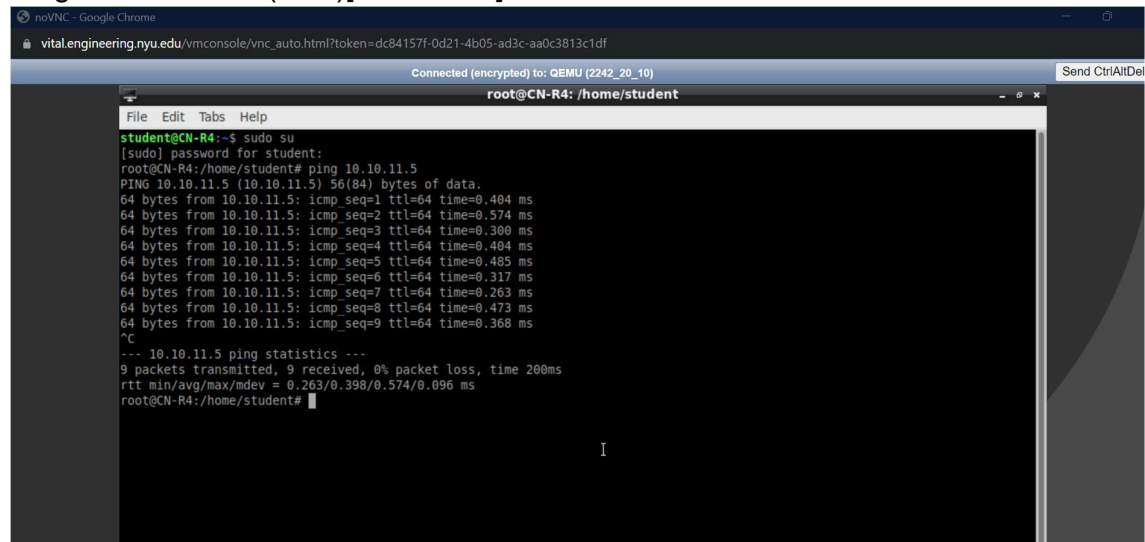
```
noVNC - Google Chrome
vital.engineering.nyu.edu/vmconsole/vnc_auto.html?token=86330950-0130-422e-8a5e-205a82cec6a7

Connected (encrypted) to: QEMU (2242_20_9)
root@CN-R3: /home/student

File Edit Tabs Help
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=0.412 ms
64 bytes from 10.10.11.10: icmp_seq=2 ttl=64 time=0.361 ms
64 bytes from 10.10.11.10: icmp_seq=3 ttl=64 time=0.425 ms
64 bytes from 10.10.11.10: icmp_seq=4 ttl=64 time=0.400 ms
64 bytes from 10.10.11.10: icmp_seq=5 ttl=64 time=0.400 ms
64 bytes from 10.10.11.10: icmp_seq=6 ttl=64 time=0.351 ms
64 bytes from 10.10.11.10: icmp_seq=7 ttl=64 time=0.368 ms
64 bytes from 10.10.11.10: icmp_seq=8 ttl=64 time=0.441 ms
^C
--- 10.10.11.10 ping statistics ---
8 packets transmitted, 8 received, 0% packet loss, time 173ms
rtt min/avg/max/mdev = 0.351/0.394/0.441/0.038 ms
root@CN-R3:/home/student#
```

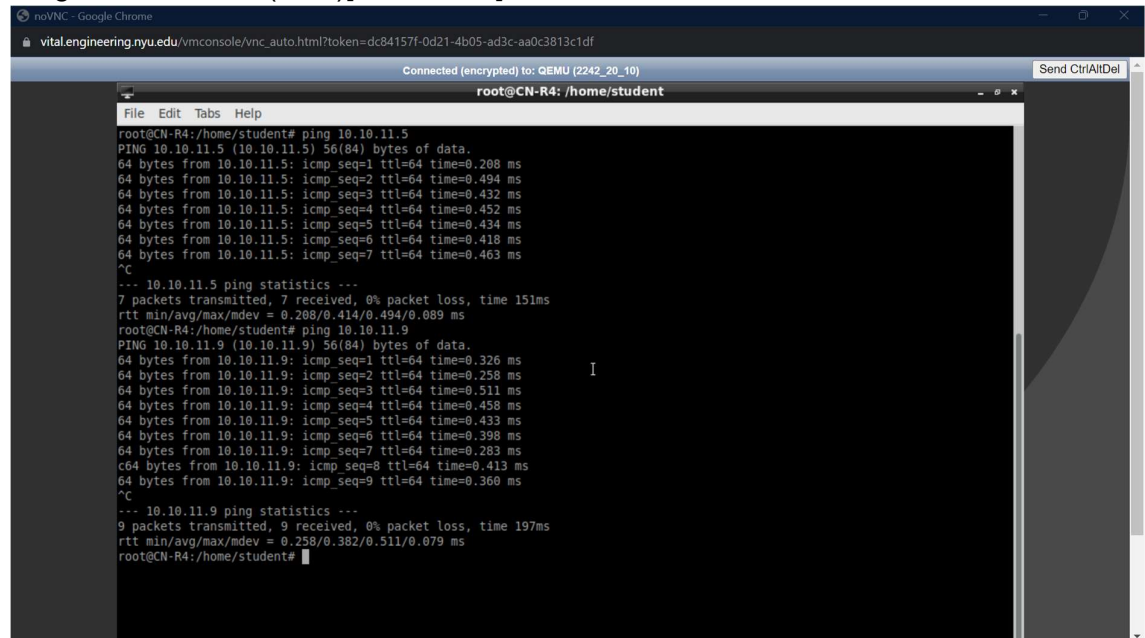
R4

Ping from R4 to R2(eth2)[10.10.11.5]



```
root@CN-R4: /home/student
File Edit Tabs Help
student@CN-R4:~$ sudo su
[sudo] password for student:
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=0.404 ms
64 bytes from 10.10.11.5: icmp_seq=2 ttl=64 time=0.574 ms
64 bytes from 10.10.11.5: icmp_seq=3 ttl=64 time=0.300 ms
64 bytes from 10.10.11.5: icmp_seq=4 ttl=64 time=0.404 ms
64 bytes from 10.10.11.5: icmp_seq=5 ttl=64 time=0.405 ms
64 bytes from 10.10.11.5: icmp_seq=6 ttl=64 time=0.317 ms
64 bytes from 10.10.11.5: icmp_seq=7 ttl=64 time=0.263 ms
64 bytes from 10.10.11.5: icmp_seq=8 ttl=64 time=0.473 ms
64 bytes from 10.10.11.5: icmp_seq=9 ttl=64 time=0.368 ms
^C
--- 10.10.11.5 ping statistics ---
9 packets transmitted, 9 received, 0% packet loss, time 200ms
rtt min/avg/max/mdev = 0.263/0.398/0.574/0.096 ms
root@CN-R4:/home/student#
```

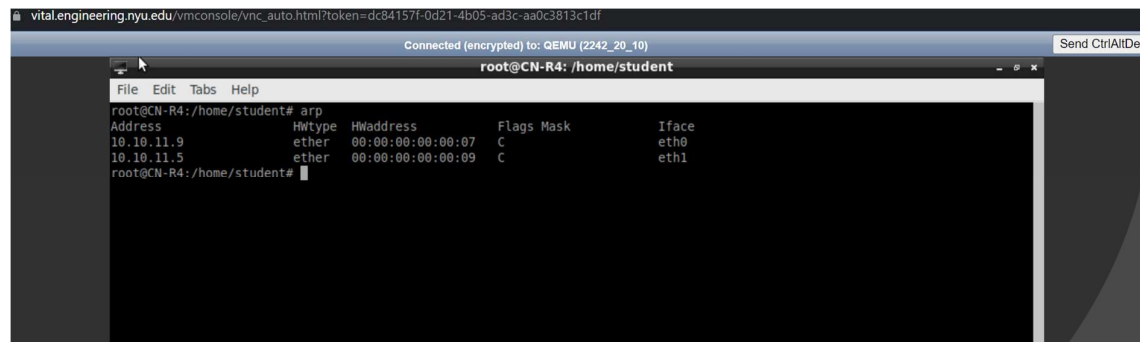
Ping from R4 to R3(eth1)[10.10.11.9]



```
root@CN-R4: /home/student
File Edit Tabs 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=0.208 ms
64 bytes from 10.10.11.5: icmp_seq=2 ttl=64 time=0.494 ms
64 bytes from 10.10.11.5: icmp_seq=3 ttl=64 time=0.432 ms
64 bytes from 10.10.11.5: icmp_seq=4 ttl=64 time=0.452 ms
64 bytes from 10.10.11.5: icmp_seq=5 ttl=64 time=0.434 ms
64 bytes from 10.10.11.5: icmp_seq=6 ttl=64 time=0.418 ms
64 bytes from 10.10.11.5: icmp_seq=7 ttl=64 time=0.463 ms
^C
--- 10.10.11.5 ping statistics ---
7 packets transmitted, 7 received, 0% packet loss, time 151ms
rtt min/avg/max/mdev = 0.208/0.414/0.494/0.089 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=0.326 ms
64 bytes from 10.10.11.9: icmp_seq=2 ttl=64 time=0.258 ms
64 bytes from 10.10.11.9: icmp_seq=3 ttl=64 time=0.511 ms
64 bytes from 10.10.11.9: icmp_seq=4 ttl=64 time=0.458 ms
64 bytes from 10.10.11.9: icmp_seq=5 ttl=64 time=0.433 ms
64 bytes from 10.10.11.9: icmp_seq=6 ttl=64 time=0.398 ms
64 bytes from 10.10.11.9: icmp_seq=7 ttl=64 time=0.283 ms
64 bytes from 10.10.11.9: icmp_seq=8 ttl=64 time=0.413 ms
64 bytes from 10.10.11.9: icmp_seq=9 ttl=64 time=0.360 ms
^C
--- 10.10.11.9 ping statistics ---
9 packets transmitted, 9 received, 0% packet loss, time 197ms
rtt min/avg/max/mdev = 0.258/0.382/0.511/0.079 ms
root@CN-R4:/home/student#
```

Screenshot of the ARP tables on R2, R3, and R4

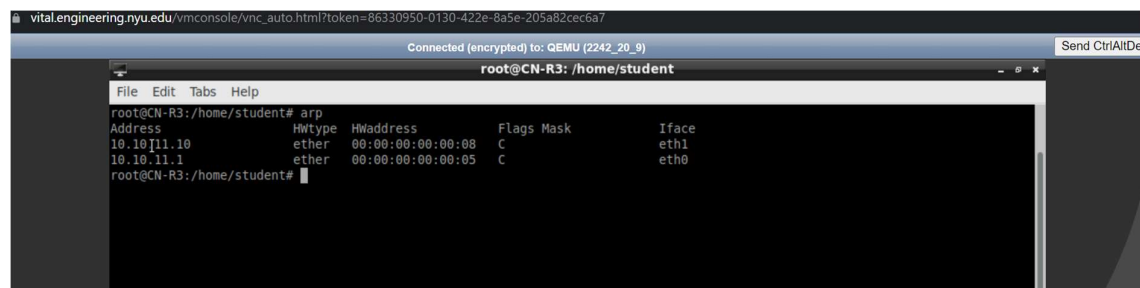
R4



A screenshot of a terminal window for R4. The window title is "vital.engineering.nyu.edu/vmconsole/vnc_auto.html?token=dc84157f-0d21-4b05-ad3c-aa0c3813c1df". The terminal shows the command "arp" being executed, displaying the ARP table with columns: Address, Hwtype, Hwaddress, Flags, Mask, and Iface. The table contains two entries: 10.10.11.9 on eth0 and 10.10.11.5 on eth1.

Address	Hwtype	Hwaddress	Flags	Mask	Iface
10.10.11.9	ether	00:00:00:00:00:07	C		eth0
10.10.11.5	ether	00:00:00:00:00:09	C		eth1

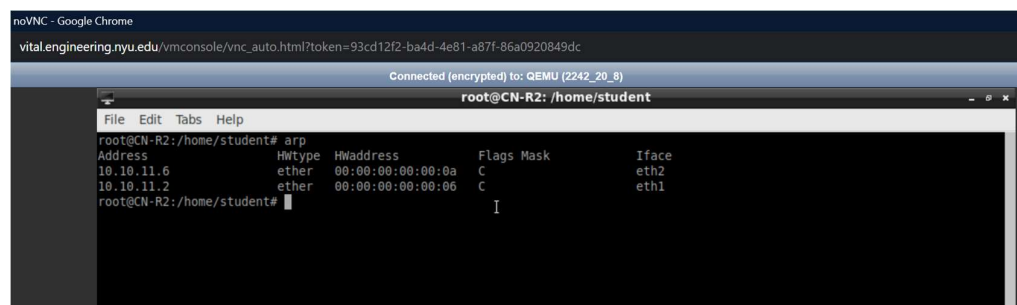
R3



A screenshot of a terminal window for R3. The window title is "vital.engineering.nyu.edu/vmconsole/vnc_auto.html?token=86330950-0130-422e-8a5e-205a82cec6a7". The terminal shows the command "arp" being executed, displaying the ARP table with columns: Address, Hwtype, Hwaddress, Flags, Mask, and Iface. The table contains two entries: 10.10.11.10 on eth1 and 10.10.11.1 on eth0.

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

R2



A screenshot of a terminal window for R2. The window title is "noVNC - Google Chrome" and "vital.engineering.nyu.edu/vmconsole/vnc_auto.html?token=93cd12f2-ba4d-4e81-a87f-86a0920849dc". The terminal shows the command "arp" being executed, displaying the ARP table with columns: Address, Hwtype, Hwaddress, Flags, Mask, and Iface. The table contains two entries: 10.10.11.6 on eth2 and 10.10.11.2 on eth1.

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

Part 2: Questions

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

Ans: When the same IP address is assigned to more than one application or node on a network, or when the same range of IPs is implemented on various networks,

overlapping subnets occur. Overlapping subnets should be avoided since they can cause a variety of problems, including:

Network Confusion: If two devices inside an overlapping subnet are assigned the same IP address, the network may become confused about where to send data. As a result, data may not arrive at its intended location, resulting in broken connections or delayed network performance.

Faulty Traffic Flows: Traffic flows caused by overlapping subnets might be faulty or unpredictable. For example, if two networks share the same IP range and are linked, a router may loop messages back into the same network rather than delivering them to the other network. This can cause massive network outages.

Security Concerns: Overlapping subnets might also cause security concerns. If a malicious actor acquires access to one network, they may be able to gain access to other networks with overlapping subnets.

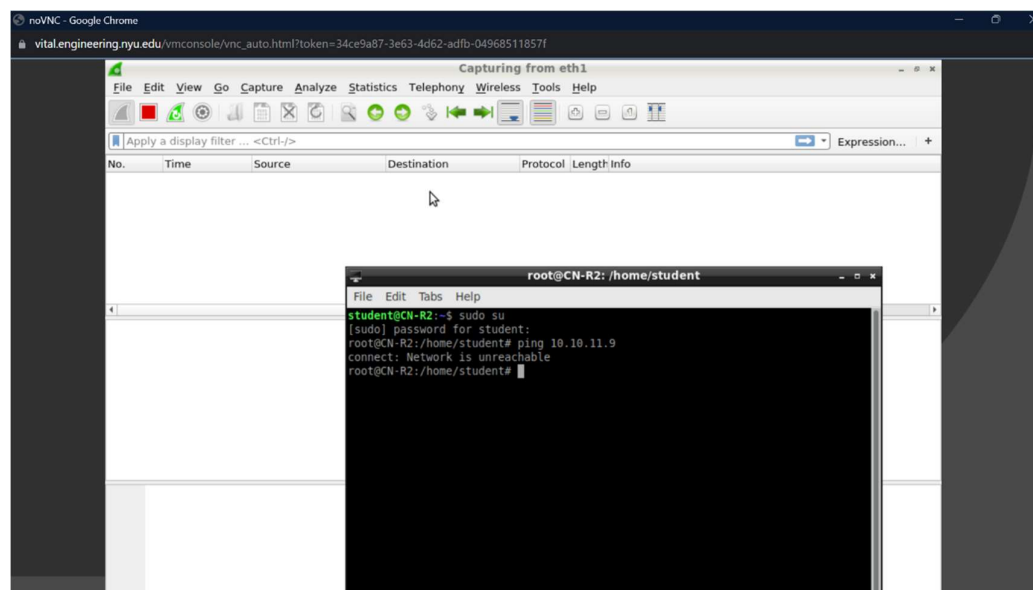
b) Suppose there is another Router (R5) directly connected to the HUB between R3 and R4. Explain whether or not we would need to reconfigure the IP subnets on R3 and R4 in order to communicate with R5.

When another router is physically connected to the hub between R3 and R4, the IP subnets on R3 and R4 must be configured in order to interact with R5. Before R5, the subnet size was /30, which allowed just two hosts. So, in order to accommodate another host, we must update the configuration to /29.

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)?

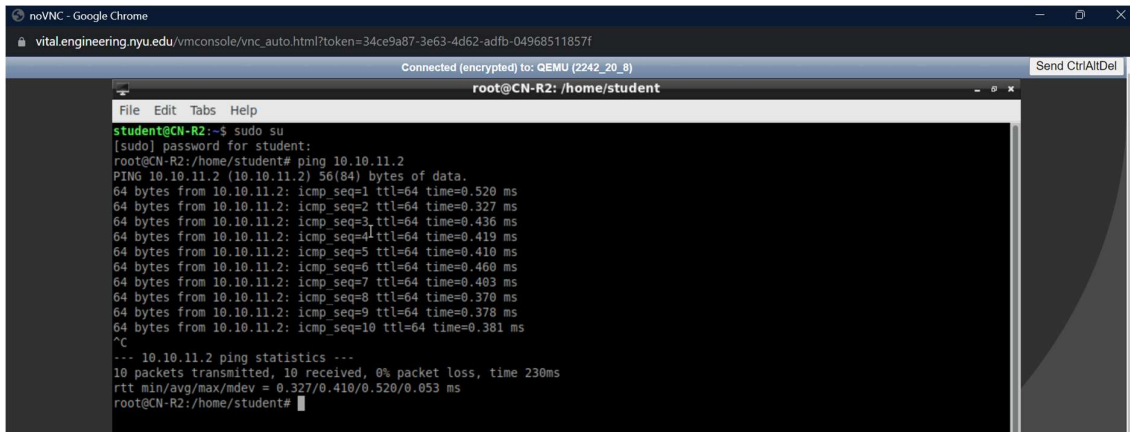
No packets are captured in Wireshark since R2 is unable to reach R3. R2 is unable to reach R3 (eth1) since both the interfaces are in different subnets and are connected via a hub. The packets used are ARP and ICMP.

After pinging R3(eth1) from R2(eth1)



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

When we ping R3 (eth0) from R2 (eth1), we can see ICMP packets being captured by Wireshark. This is because R3 (eth0) gets successfully pinged by R2. They have the same broadcast address. When R3 detects that the request is meant for it, they start communicating using ICMP packets and R3 sends R2 it's Mac address. In the Wireshark readings, we can see that first R2(eth1) sends R3(eth0) an ARP request asking who has that IP address.



```
root@CN-R2: /home/student
student@CN-R2:~$ sudo su
[sudo] password for student:
root@CN-R2: /home/student# ping 10.10.11.2
PING 10.10.11.2 (10.10.11.2) 56(84) bytes of data.
64 bytes from 10.10.11.2: icmp_seq=1 ttl=64 time=0.520 ms
64 bytes from 10.10.11.2: icmp_seq=2 ttl=64 time=0.327 ms
64 bytes from 10.10.11.2: icmp_seq=3 ttl=64 time=0.436 ms
64 bytes from 10.10.11.2: icmp_seq=4 ttl=64 time=0.419 ms
64 bytes from 10.10.11.2: icmp_seq=5 ttl=64 time=0.410 ms
64 bytes from 10.10.11.2: icmp_seq=6 ttl=64 time=0.460 ms
64 bytes from 10.10.11.2: icmp_seq=7 ttl=64 time=0.403 ms
64 bytes from 10.10.11.2: icmp_seq=8 ttl=64 time=0.370 ms
64 bytes from 10.10.11.2: icmp_seq=9 ttl=64 time=0.378 ms
64 bytes from 10.10.11.2: icmp_seq=10 ttl=64 time=0.381 ms
^C
--- 10.10.11.2 ping statistics ---
10 packets transmitted, 10 received, 0% packet loss, time 230ms
rtt min/avg/max/mdev = 0.327/0.410/0.520/0.053 ms
root@CN-R2: /home/student#
```

Wireshark shows ICMP packets exchanged between R2 and R3

