# COMPUTER NETWORKS LABORATORY WEEK 10

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**Week number:** 10

**Date:** 30/3/2021

**Name of the experiment:** IPv4 Addressing and Static Routing

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**Objectives:**

To setup a network with two routers and exchange packets across routers.

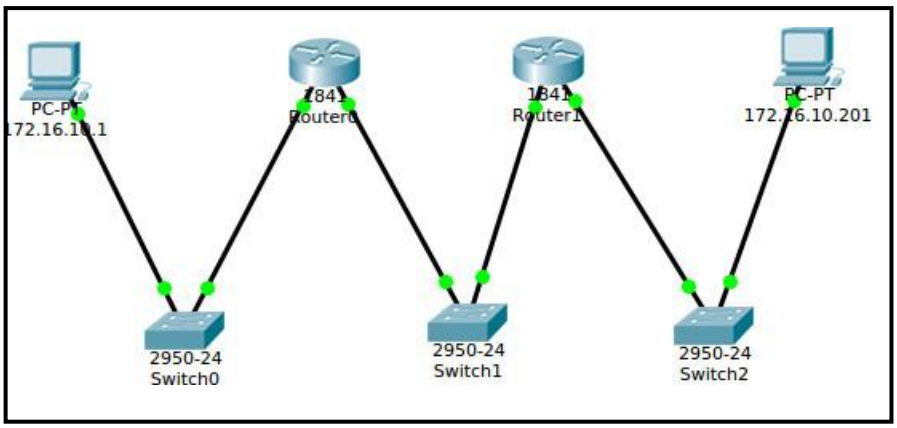
## Hardware Requirements:

1. Desktops/Laptops : 4
2. Switch : 3
3. Patch Cords (1.5m) : 6
4. External NIC : 2

## Software Requirements:

1. Wireshark Tool
2. Ubuntu Linux Operating System

**Topology Description:** Design a network with at least 2 router networks. Host *Ha* should be able to communicate with Host *Hd* using newly assigned addresses.




## Note:

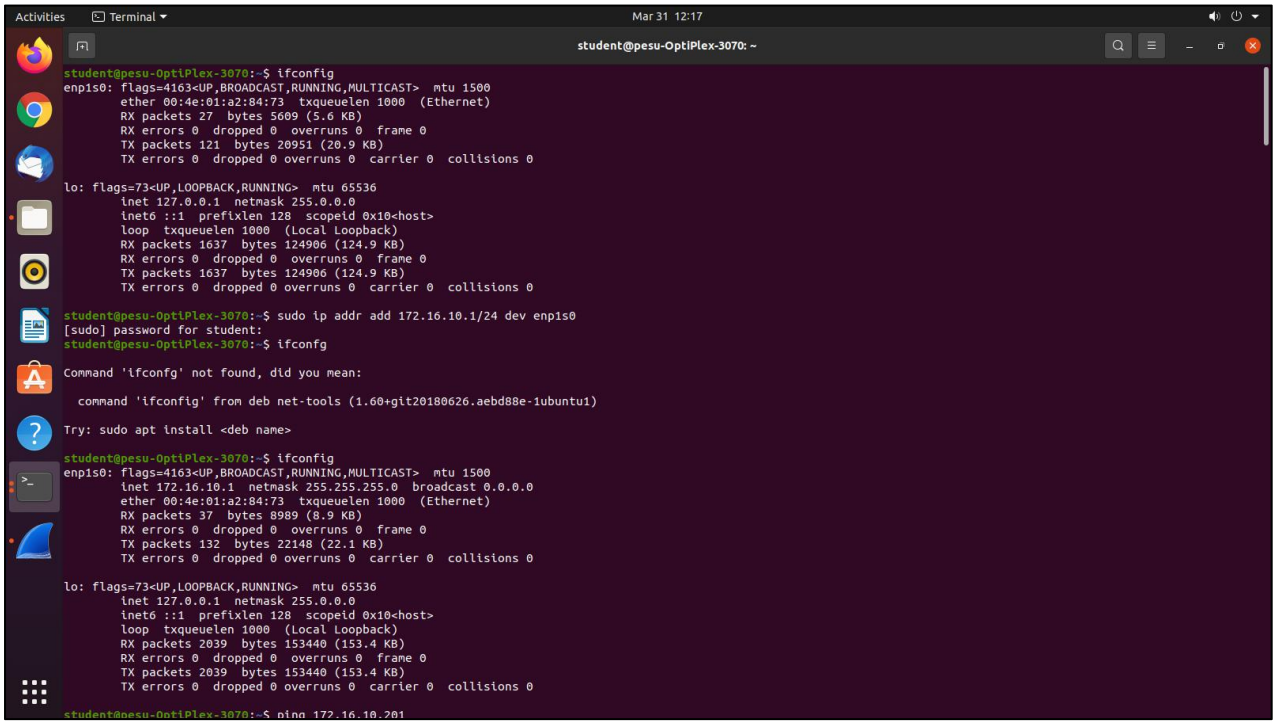
1. Experiment to be accomplished in a group of 4.
2. Make sure connections are flawless.
3. Assign the IP address using commands or 'Edit connections'.
4. Don't disturb existing hardware setup while setting IP address or doing experiment.
5. Choose your ethernet interface according to your

machine. All the connections were made.

**<u>Task 1</u>: Assigning of IP addresses to all computers A, B, C and D (Source Host Ha, Router R1, Router R2 & Destination Host Hd).**

**<u>Step 1</u>:** Assign the IP address to the Ha.

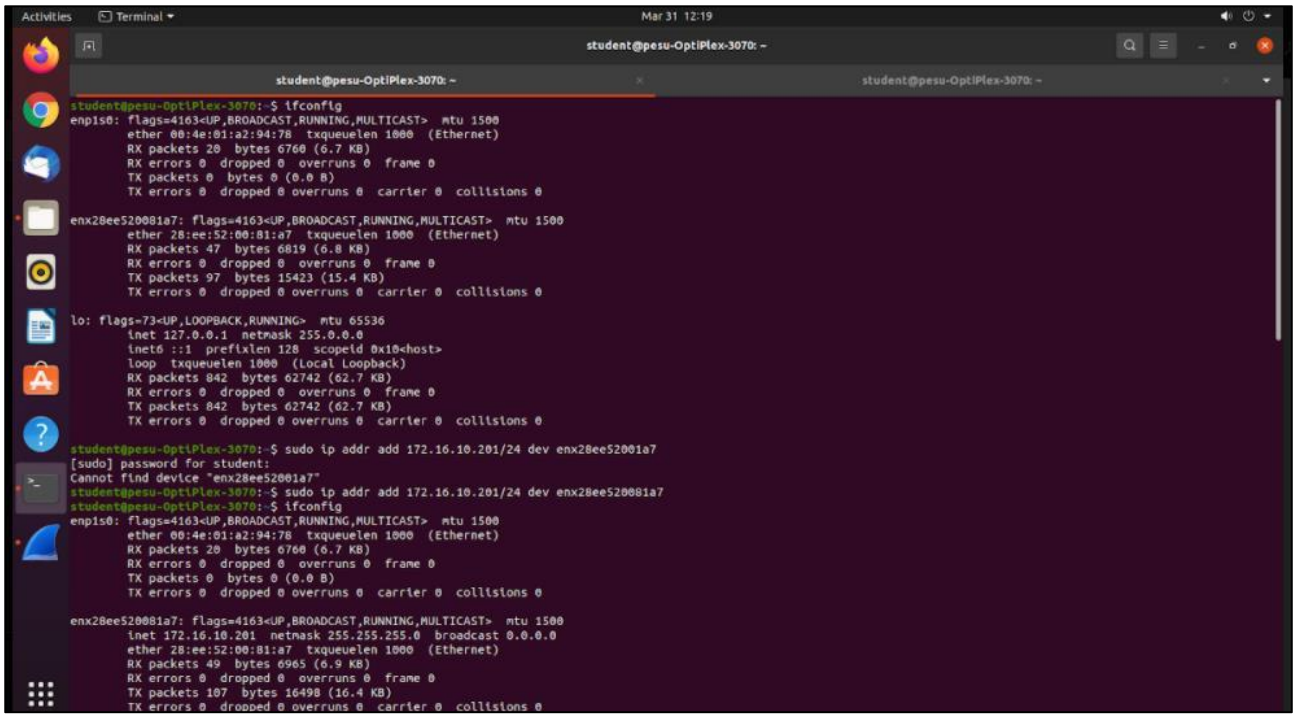
```
$ sudo ip addr add 172.16.10.1/24 dev eth1
$ ip addr show
```

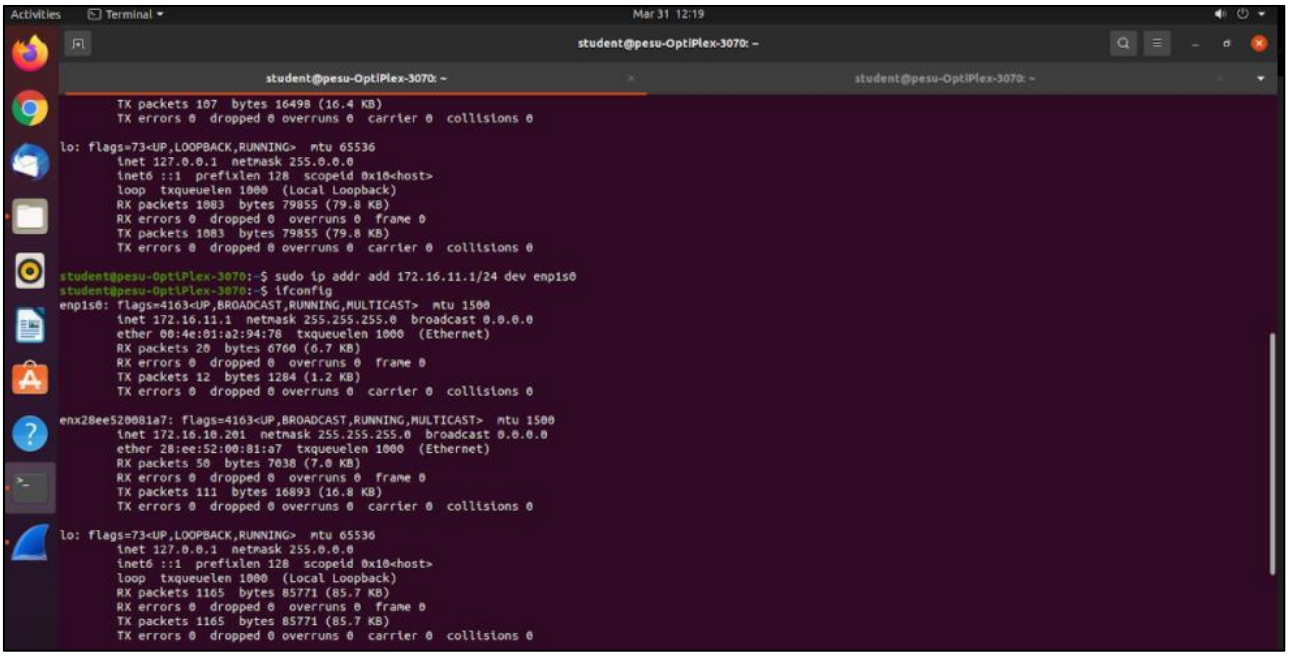



The IP address for the first host is successfully set.

**Step 2:** Assign the IP address to R1.

```
$ sudo ip addr add 172.16.10.201/24 dev eth1
$ sudo ip addr add 172.16.11.1/24 dev eth2
$ ip addr show
```

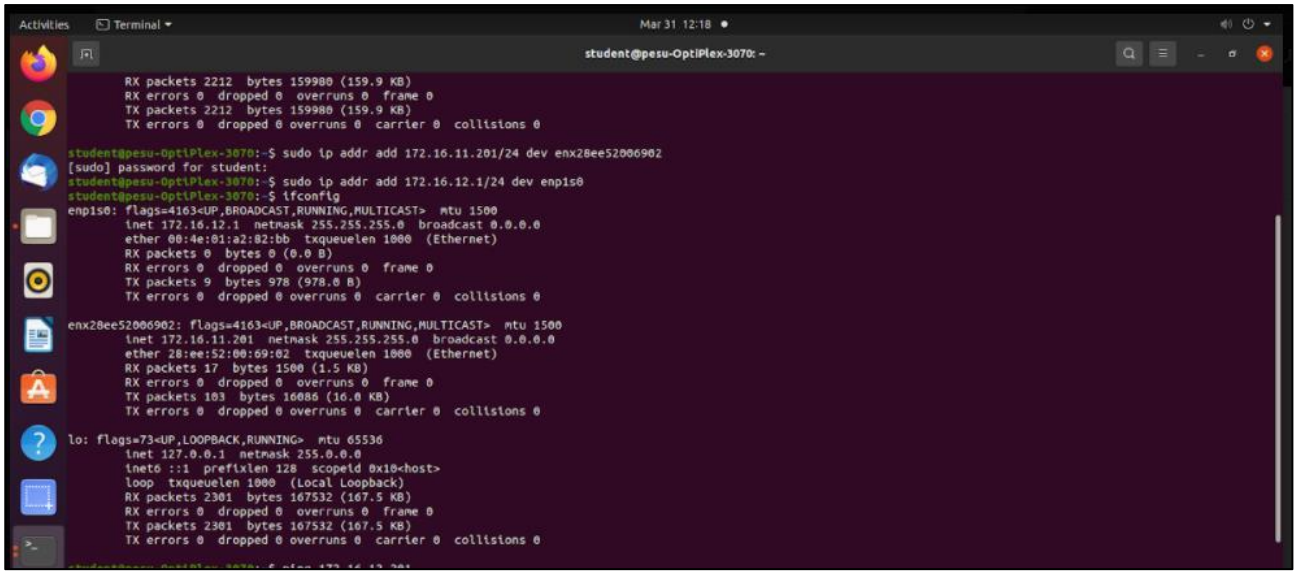



The first router, neighbour to host A, now possesses an IP address.

**Step 3:** Assign the IP address to R2.

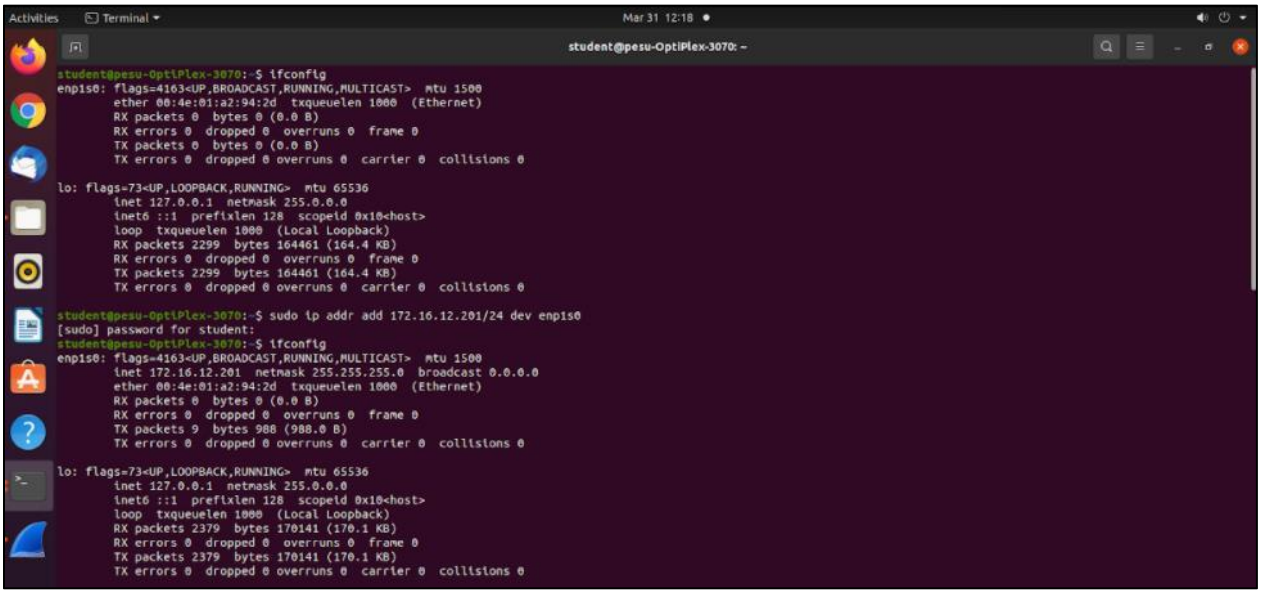
```
$ sudo ip addr add 172.16.11.201/24 dev eth2
$ sudo ip addr add 172.16.12.1/24 dev eth1
$ ip addr show
```




The second router, neighbour to host b, now got its IP address assigned

**Step 4:** Assign the IP address to the Hd.

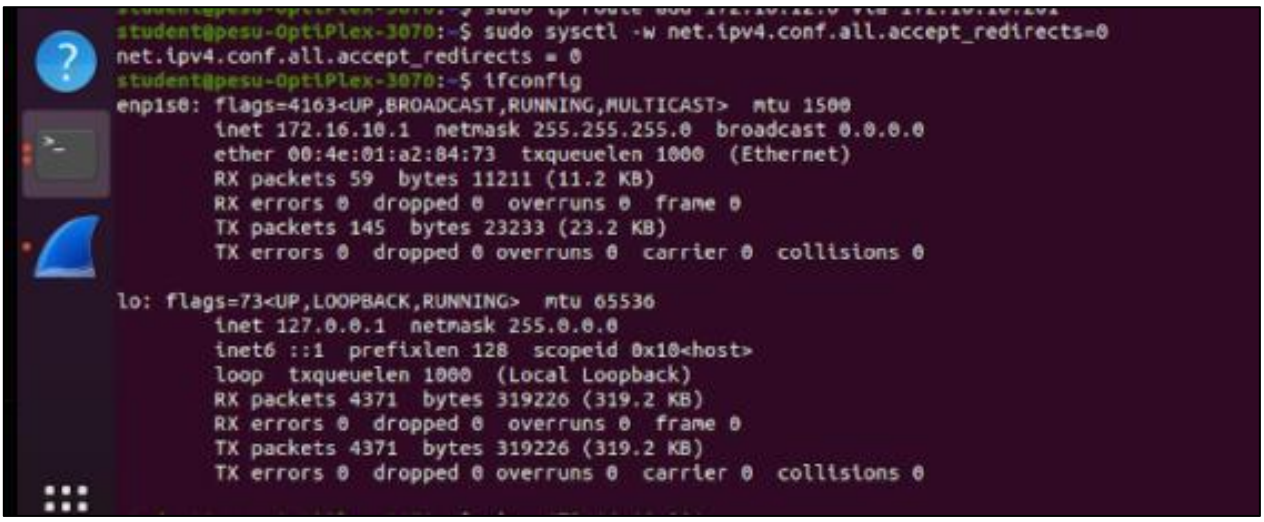
```
$ sudo ip addr add 172.16.12.201/24 dev eth1
$ ip addr show
```



**Note 1:** The machines are physically on the same LAN, thus you may get ICMP to redirect messages from other machines (in case you make some configuration mistakes). So, as a precautionary measure disable accepting the ICMP redirect packets. By default, Ubuntu Linux enables accepting the ICMP redirect packets. On host machines Ha and Hd, issue the following command:

```
$ sudo sysctl –w
net.ipv4.conf.all.accept_redirects=0
```

Host A:

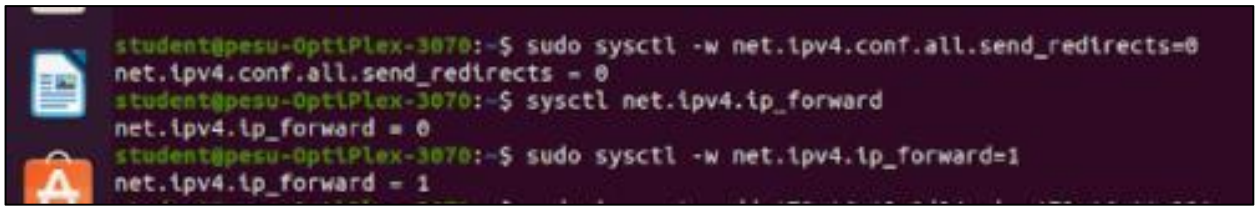



Host D:

**Note 2:** Since machines are on the same physical interface, the router is going to send ICMP to redirect message disturbing the routing decision by hosts.
Thus, disable sending of the ICMP redirect packets by these routers with aliased interfaces. To have precautionary measures issue below command in router machines R1 and R2.

```
$ sudo sysctl –w
net.ipv4.conf.all.send_redirects=0
```

Router 1:



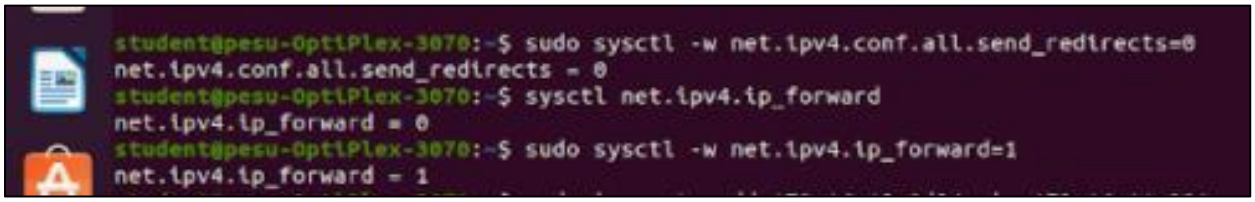

Router 2:

**Task 2:** Conversion of the machines B and C into routers.

**Note 1:** Check if IP forwarding is enabled or not. We need to query the sysctl kernel value net.ipv4.ip_forward to see if forwarding is enabled or not using sysctl:

```
$ sysctl net.ipv4.ip_forward
```

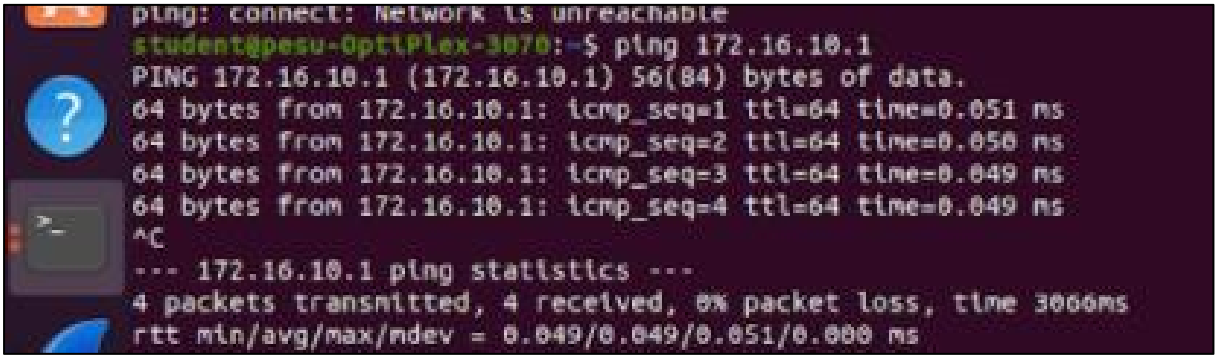
Router 1:



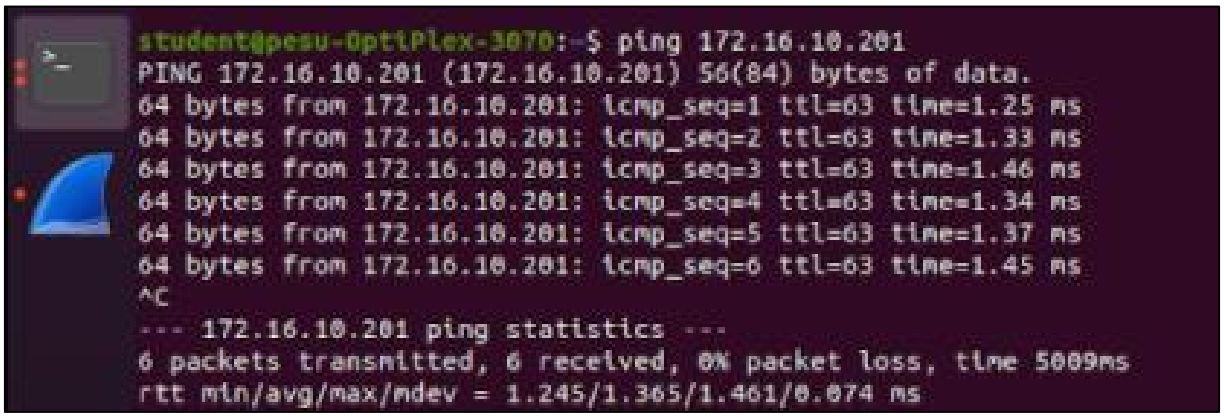

Router 2:

**Task 3:** Verify the connection between Ha and Hd using ping command. Initially test the connection of systems within the same network.

At Ha: `$ ping 172.16.10.1 (Local network)`




At Hd: `$ ping 172.16.10.201(Local network)`



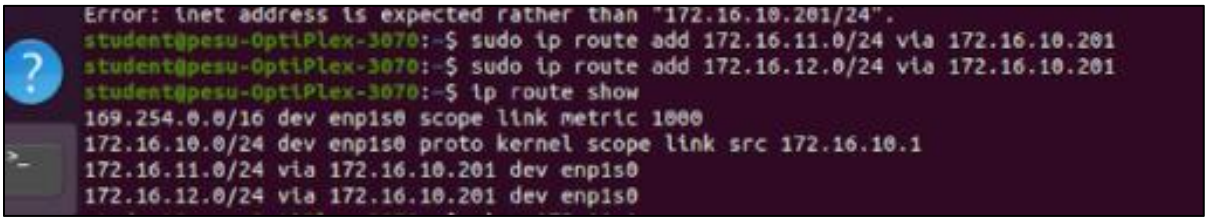
**Task 4:** Insert routing table entries on each system to direct ipv4 packets to ping across the networks.

**At Ha:**

```
$ sudo ip route add 172.16.12.0/24 via
            172.16.10.201

$ sudo ip route add 172.16.11.0/24 via
            172.16.10.201

            $ ip route show
```




In the first host since 172.16.10.0/24 network is a local network, we don't need any routing table entry. We need to have routing table entries for other networks such as 172.16.11.0/24 and 172.16.12.0/24.

**At R1:**

```
$ sudo ip route add 172.16.12.0/24 via
            172.16.11.201

            $ ip route show
```


Since R1 is connected to 172.16.10.0/24 and 172.16.11.0/24 networks we need to have one routing table entry to 172.16.12.0/24.

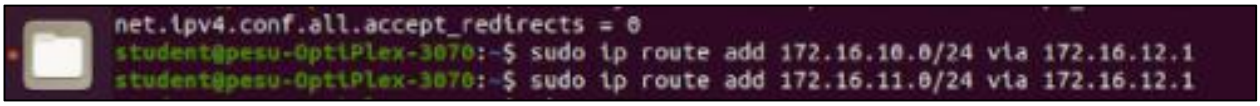
**At R2:**

```
$ sudo ip route add 172.16.10.0/24 via
172.16.11.1

$ ip route show
```

**At Hd:**

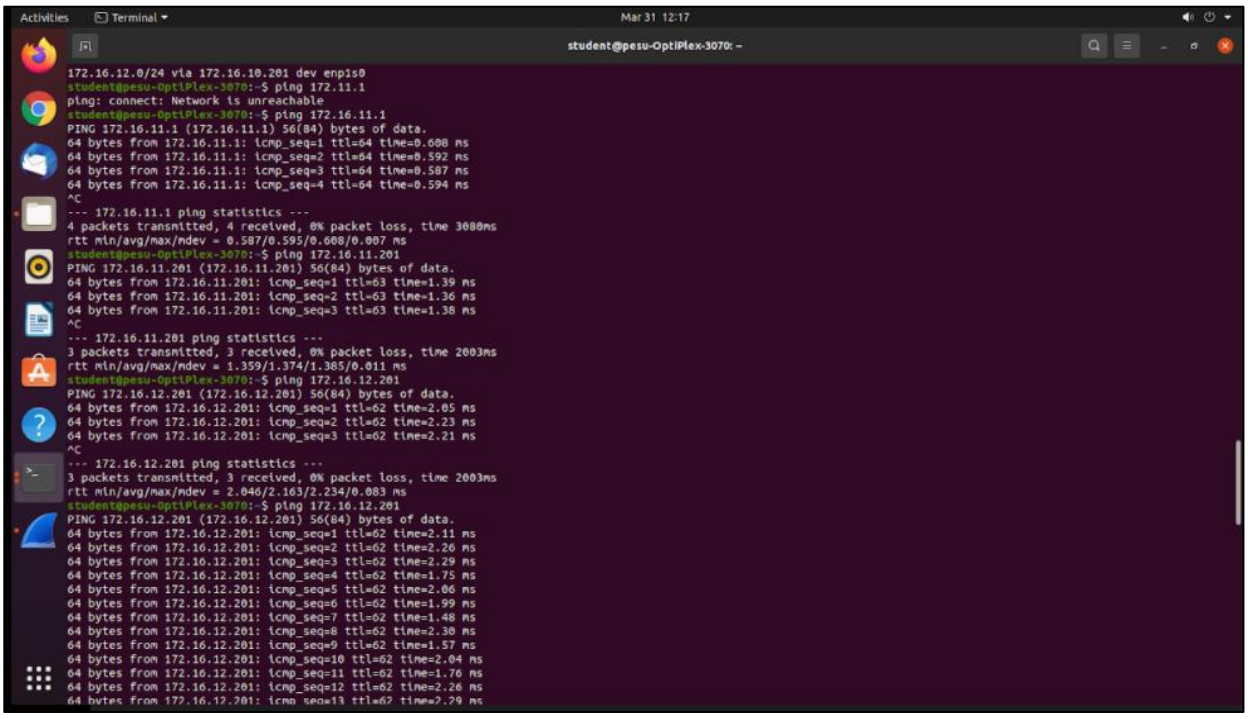
```
$ sudo ip route add 172.16.10.0/24 via
                    172.16.12.1
$ sudo ip route add 172.16.11.0/24 via
                    172.16.12.1
$ ip route show
```



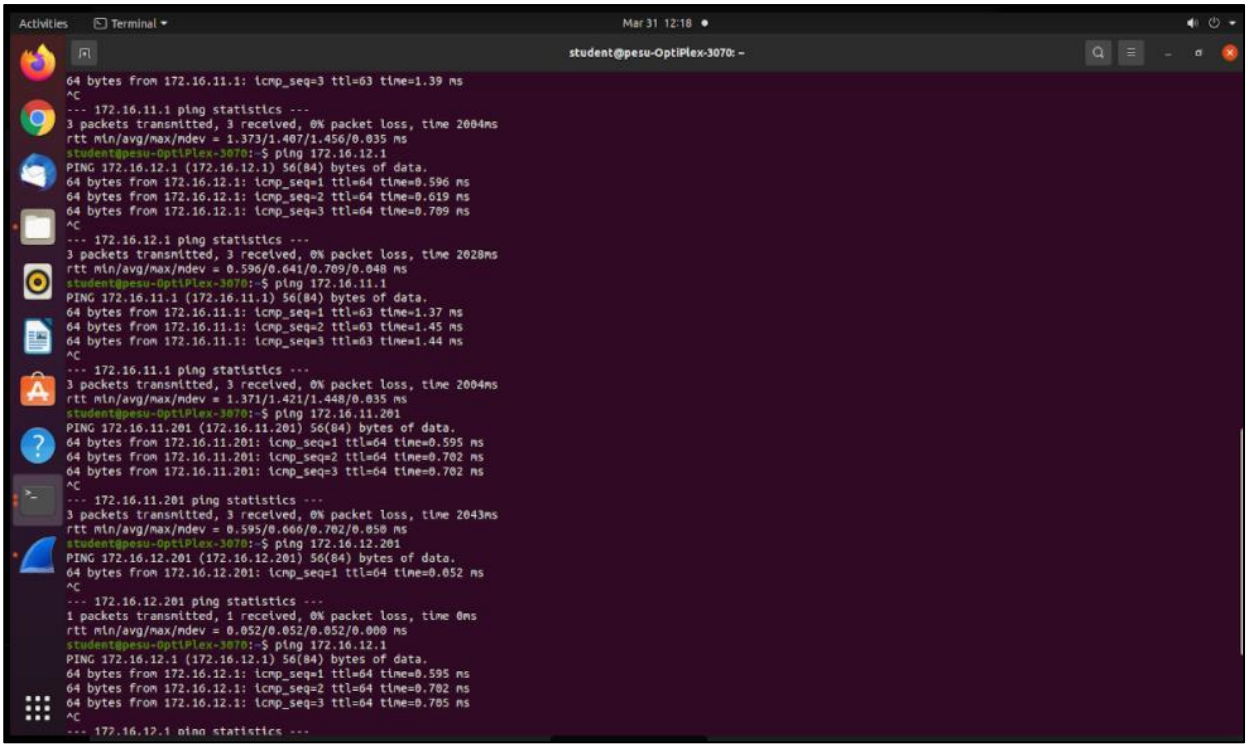

**Task 6:** Check each system neighbour to verify the connection.

ip neighbour provides a command-line interface to display the neighbour table (ARP cache)

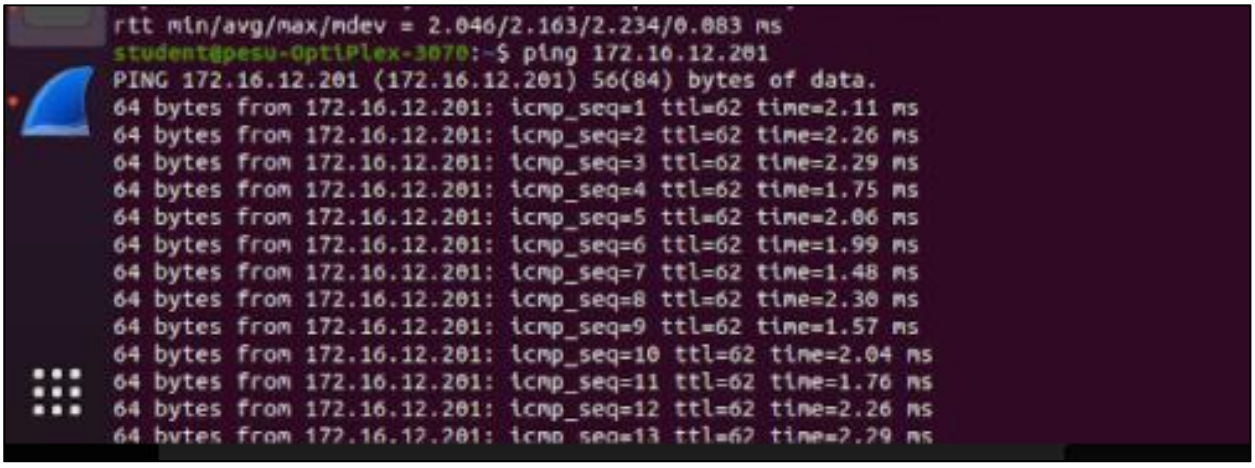
At Ha:



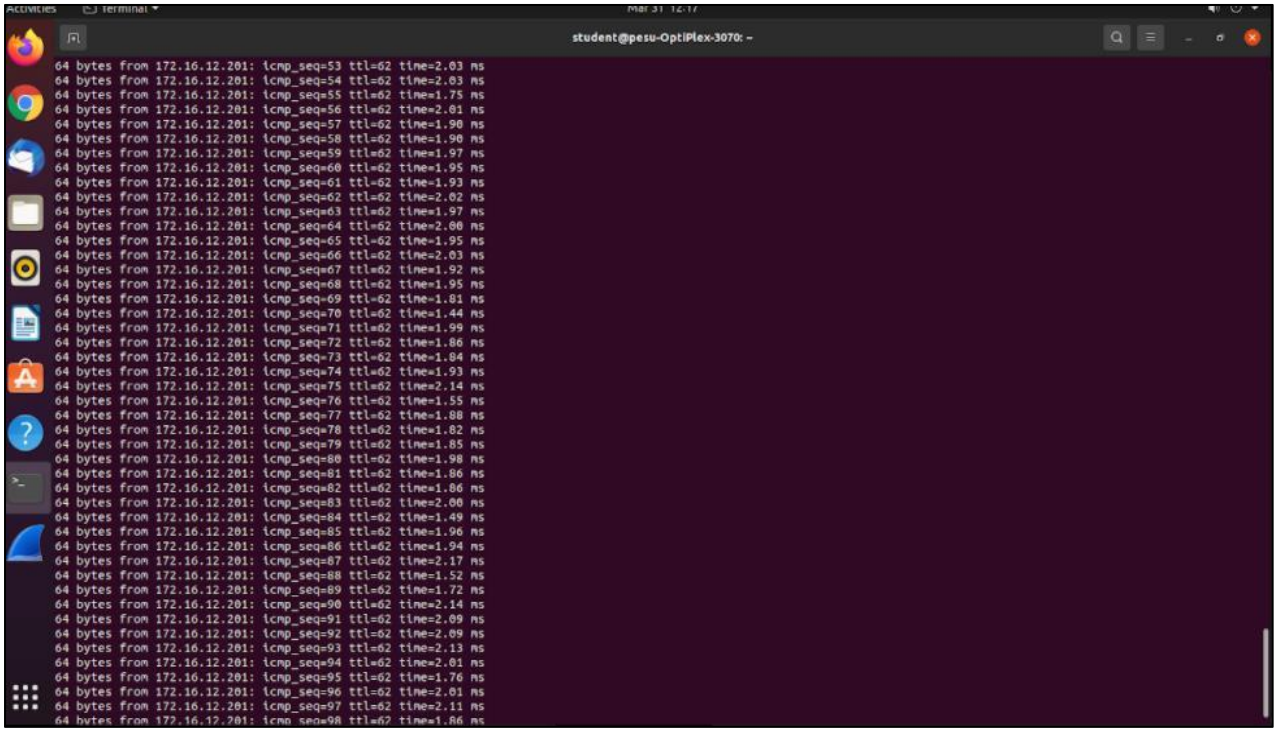
At R1:


Activities
Terminal
Mar 31 12:18
student@pesu-OptiPlex-3070: ~
64 bytes from 172.16.11.1: icmp_seq=3 ttl=63 time=1.39 ms
^C
--- 172.16.11.1 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2004ms
rtt min/avg/max/mdev = 1.373/1.407/1.456/0.035 ms
student@pesu-OptiPlex-3070:~$ ping 172.16.12.1
PING 172.16.12.1 (172.16.12.1) 56(84) bytes of data.
64 bytes from 172.16.12.1: icmp_seq=1 ttl=64 time=0.596 ms
64 bytes from 172.16.12.1: icmp_seq=2 ttl=64 time=0.619 ms
64 bytes from 172.16.12.1: icmp_seq=3 ttl=64 time=0.709 ms
^C
--- 172.16.12.1 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2028ms
rtt min/avg/max/mdev = 0.596/0.641/0.709/0.048 ms
student@pesu-OptiPlex-3070:~$ ping 172.16.11.1
PING 172.16.11.1 (172.16.11.1) 56(84) bytes of data.
64 bytes from 172.16.11.1: icmp_seq=1 ttl=63 time=1.37 ms
64 bytes from 172.16.11.1: icmp_seq=2 ttl=63 time=1.45 ms
64 bytes from 172.16.11.1: icmp_seq=3 ttl=63 time=1.44 ms
^C
--- 172.16.11.1 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2004ms
rtt min/avg/max/mdev = 1.371/1.421/1.448/0.035 ms
student@pesu-OptiPlex-3070:~$ ping 172.16.11.201
PING 172.16.11.201 (172.16.11.201) 56(84) bytes of data.
64 bytes from 172.16.11.201: icmp_seq=1 ttl=64 time=0.595 ms
64 bytes from 172.16.11.201: icmp_seq=2 ttl=64 time=0.702 ms
64 bytes from 172.16.11.201: icmp_seq=3 ttl=64 time=0.702 ms
^C
--- 172.16.11.201 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2043ms
rtt min/avg/max/mdev = 0.595/0.666/0.702/0.050 ms
student@pesu-OptiPlex-3070:~$ ping 172.16.12.201
PING 172.16.12.201 (172.16.12.201) 56(84) bytes of data.
64 bytes from 172.16.12.201: icmp_seq=1 ttl=64 time=0.052 ms
^C
--- 172.16.12.201 ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 0.052/0.052/0.052/0.000 ms
student@pesu-OptiPlex-3070:~$ ping 172.16.12.1
PING 172.16.12.1 (172.16.12.1) 56(84) bytes of data.
64 bytes from 172.16.12.1: icmp_seq=1 ttl=64 time=0.595 ms
64 bytes from 172.16.12.1: icmp_seq=2 ttl=64 time=0.702 ms
64 bytes from 172.16.12.1: icmp_seq=3 ttl=64 time=0.705 ms
^C
--- 172.16.12.1 ping statistics ---

At R2:


rtt min/avg/max/mdev = 2.046/2.163/2.234/0.083 ms
student@pesu-OptiPlex-3070:~$ ping 172.16.12.201
PING 172.16.12.201 (172.16.12.201) 56(84) bytes of data.
64 bytes from 172.16.12.201: icmp_seq=1 ttl=62 time=2.11 ms
64 bytes from 172.16.12.201: icmp_seq=2 ttl=62 time=2.26 ms
64 bytes from 172.16.12.201: icmp_seq=3 ttl=62 time=2.29 ms
64 bytes from 172.16.12.201: icmp_seq=4 ttl=62 time=1.75 ms
64 bytes from 172.16.12.201: icmp_seq=5 ttl=62 time=2.06 ms
64 bytes from 172.16.12.201: icmp_seq=6 ttl=62 time=1.99 ms
64 bytes from 172.16.12.201: icmp_seq=7 ttl=62 time=1.48 ms
64 bytes from 172.16.12.201: icmp_seq=8 ttl=62 time=2.30 ms
64 bytes from 172.16.12.201: icmp_seq=9 ttl=62 time=1.57 ms
64 bytes from 172.16.12.201: icmp_seq=10 ttl=62 time=2.04 ms
64 bytes from 172.16.12.201: icmp_seq=11 ttl=62 time=1.76 ms
64 bytes from 172.16.12.201: icmp_seq=12 ttl=62 time=2.26 ms

At Hd:


Activities
Terminal
Mar 31 12:17
student@pesu-OptiPlex-3070: ~
64 bytes from 172.16.12.201: icmp_seq=53 ttl=62 time=2.03 ms
64 bytes from 172.16.12.201: icmp_seq=54 ttl=62 time=2.03 ms
64 bytes from 172.16.12.201: icmp_seq=55 ttl=62 time=1.75 ms
64 bytes from 172.16.12.201: icmp_seq=56 ttl=62 time=2.01 ms
64 bytes from 172.16.12.201: icmp_seq=57 ttl=62 time=1.90 ms
64 bytes from 172.16.12.201: icmp_seq=58 ttl=62 time=1.90 ms
64 bytes from 172.16.12.201: icmp_seq=59 ttl=62 time=1.97 ms
64 bytes from 172.16.12.201: icmp_seq=60 ttl=62 time=1.95 ms
64 bytes from 172.16.12.201: icmp_seq=61 ttl=62 time=1.93 ms
64 bytes from 172.16.12.201: icmp_seq=62 ttl=62 time=2.02 ms
64 bytes from 172.16.12.201: icmp_seq=63 ttl=62 time=1.97 ms
64 bytes from 172.16.12.201: icmp_seq=64 ttl=62 time=2.00 ms
64 bytes from 172.16.12.201: icmp_seq=65 ttl=62 time=1.95 ms
64 bytes from 172.16.12.201: icmp_seq=66 ttl=62 time=2.03 ms
64 bytes from 172.16.12.201: icmp_seq=67 ttl=62 time=1.92 ms
64 bytes from 172.16.12.201: icmp_seq=68 ttl=62 time=1.95 ms
64 bytes from 172.16.12.201: icmp_seq=69 ttl=62 time=1.81 ms
64 bytes from 172.16.12.201: icmp_seq=70 ttl=62 time=1.44 ms
64 bytes from 172.16.12.201: icmp_seq=71 ttl=62 time=1.99 ms
64 bytes from 172.16.12.201: icmp_seq=72 ttl=62 time=1.86 ms
64 bytes from 172.16.12.201: icmp_seq=73 ttl=62 time=1.84 ms
64 bytes from 172.16.12.201: icmp_seq=74 ttl=62 time=1.93 ms
64 bytes from 172.16.12.201: icmp_seq=75 ttl=62 time=2.14 ms
64 bytes from 172.16.12.201: icmp_seq=76 ttl=62 time=1.55 ms
64 bytes from 172.16.12.201: icmp_seq=77 ttl=62 time=1.88 ms
64 bytes from 172.16.12.201: icmp_seq=78 ttl=62 time=1.82 ms
64 bytes from 172.16.12.201: icmp_seq=79 ttl=62 time=1.85 ms
64 bytes from 172.16.12.201: icmp_seq=80 ttl=62 time=1.98 ms
64 bytes from 172.16.12.201: icmp_seq=81 ttl=62 time=1.86 ms
64 bytes from 172.16.12.201: icmp_seq=82 ttl=62 time=1.86 ms
64 bytes from 172.16.12.201: icmp_seq=83 ttl=62 time=2.00 ms
64 bytes from 172.16.12.201: icmp_seq=84 ttl=62 time=1.49 ms
64 bytes from 172.16.12.201: icmp_seq=85 ttl=62 time=1.96 ms
64 bytes from 172.16.12.201: icmp_seq=86 ttl=62 time=1.94 ms
64 bytes from 172.16.12.201: icmp_seq=87 ttl=62 time=2.17 ms
64 bytes from 172.16.12.201: icmp_seq=88 ttl=62 time=1.52 ms
64 bytes from 172.16.12.201: icmp_seq=89 ttl=62 time=1.72 ms
64 bytes from 172.16.12.201: icmp_seq=90 ttl=62 time=2.14 ms
64 bytes from 172.16.12.201: icmp_seq=91 ttl=62 time=2.09 ms
64 bytes from 172.16.12.201: icmp_seq=92 ttl=62 time=2.09 ms
64 bytes from 172.16.12.201: icmp_seq=93 ttl=62 time=2.13 ms
64 bytes from 172.16.12.201: icmp_seq=94 ttl=62 time=2.01 ms
64 bytes from 172.16.12.201: icmp_seq=95 ttl=62 time=1.76 ms
64 bytes from 172.16.12.201: icmp_seq=96 ttl=62 time=2.01 ms
64 bytes from 172.16.12.201: icmp_seq=97 ttl=62 time=2.11 ms
64 bytes from 172.16.12.201: icmp_seq=98 ttl=62 time=1.86 ms

**Task 7:** Capture packets from Ha and Hb using the Wireshark tool.

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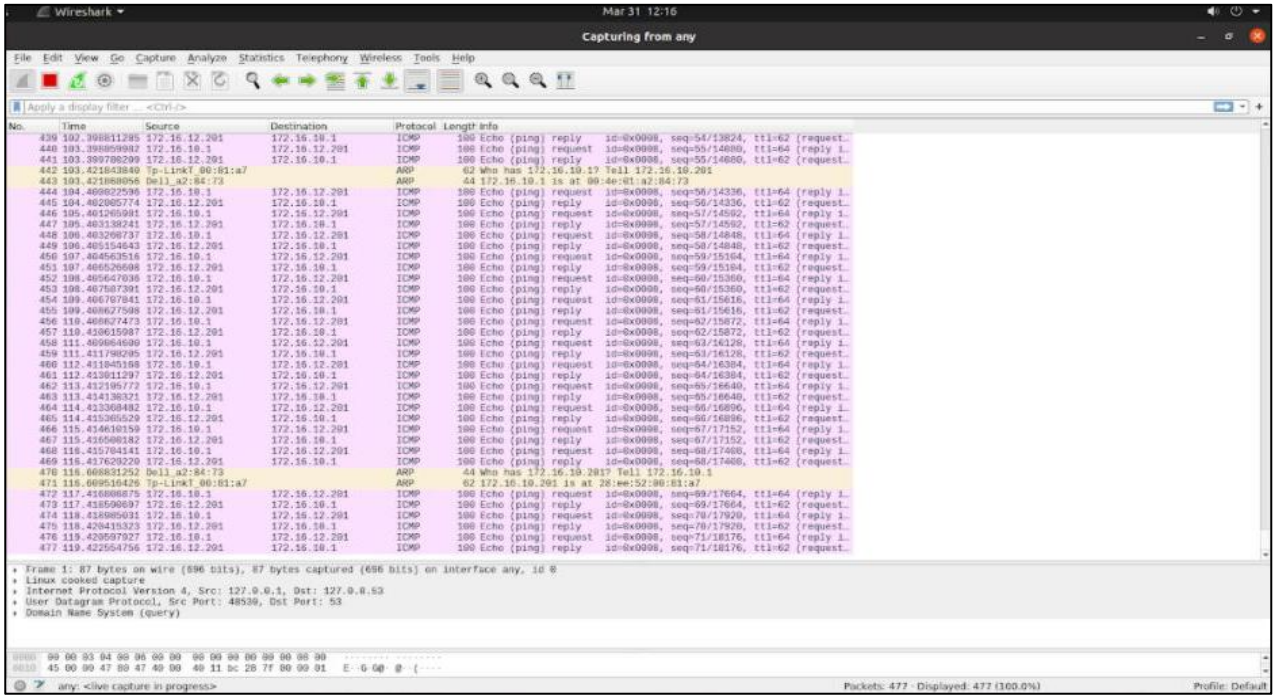
**Step 1:** Capture packets from Ha

and Hd. At Ha:

T1: `$ sudo wireshark`

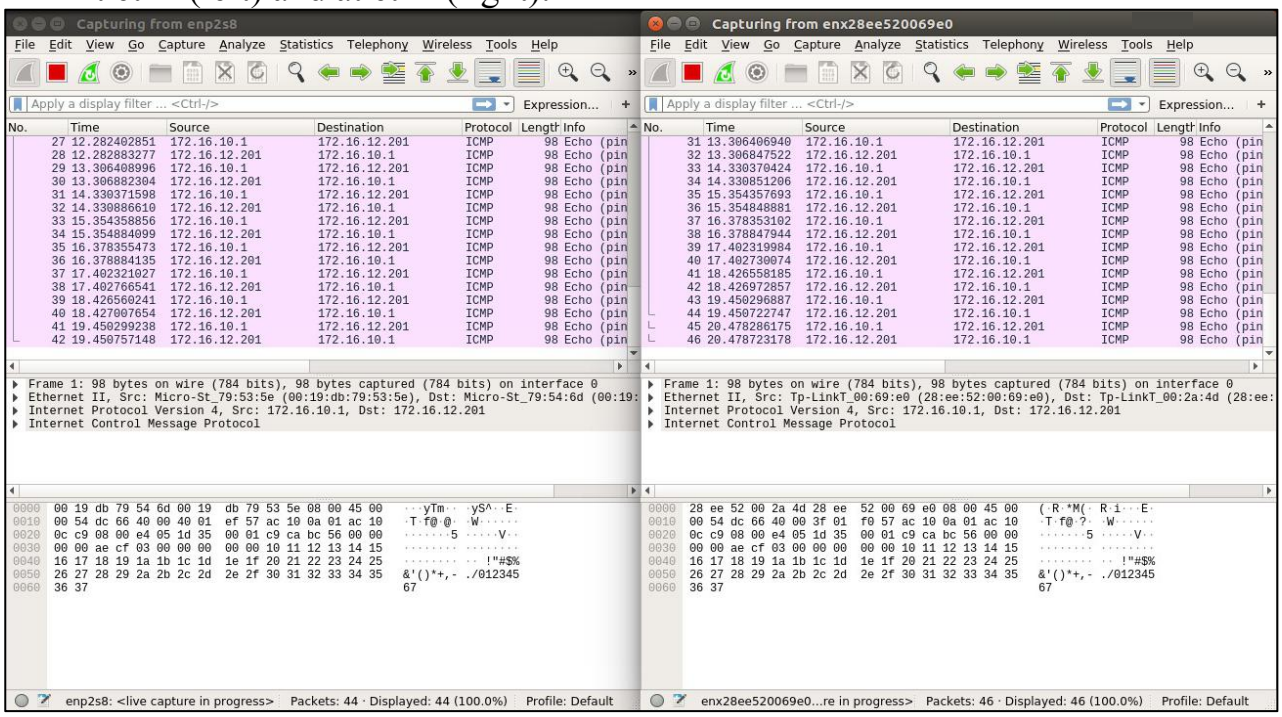
T2: `$ ping 172.16.12.201`



**Step 2:** Capture packets from R1 using both eth1 and eth2 interfaces.

```
$ sudo wireshark
```

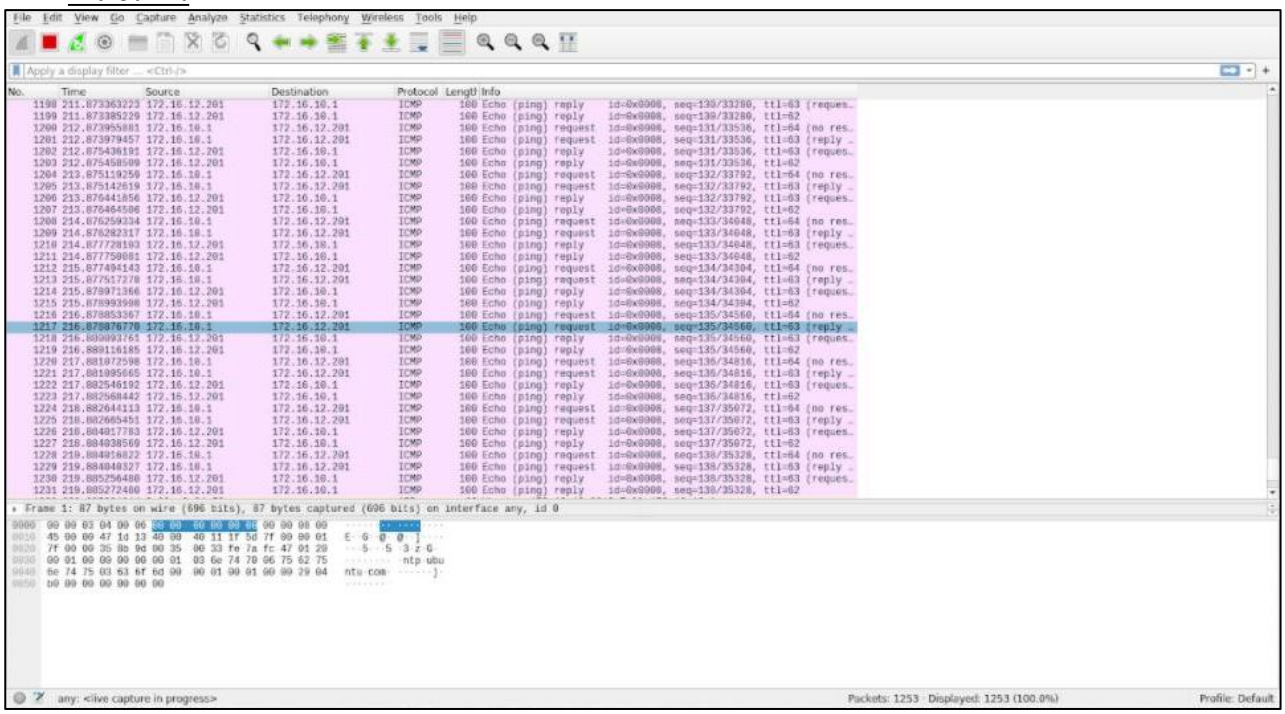
At eth1 (left) and at eth2 (right):



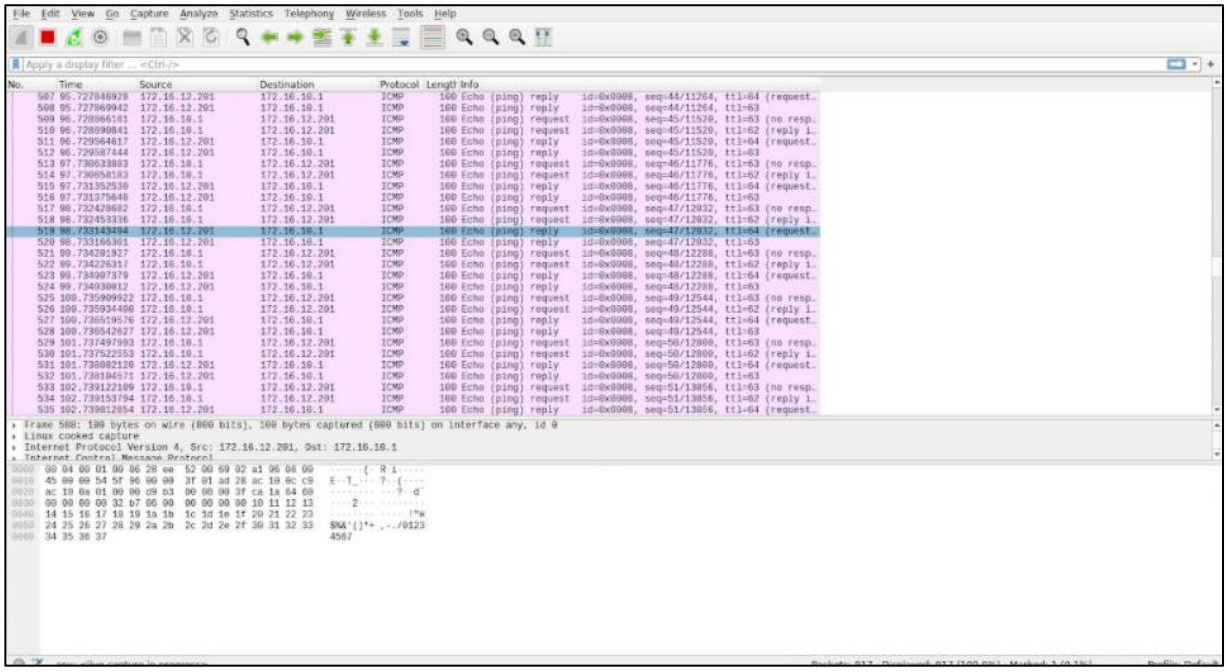

**Step 3:** Capture packets from R2 using both eth1 and eth2 interfaces.

```
$ sudo wireshark
```

At eth1:



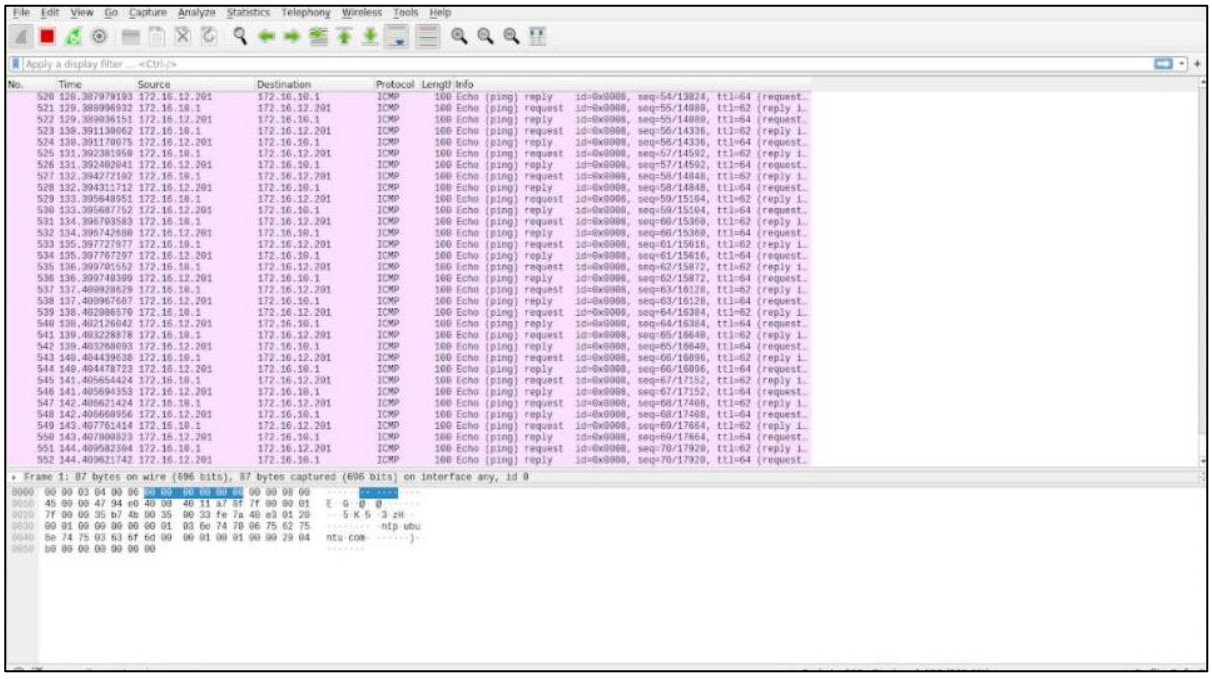
At eth2:



**Step 4:** Capture packets from Hd

and Ha. At Hd:

T1: `$ sudo wireshark`



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