Computer Networks Laboratory Week #7
IPv4 Addressing and Static Routing using Hardware

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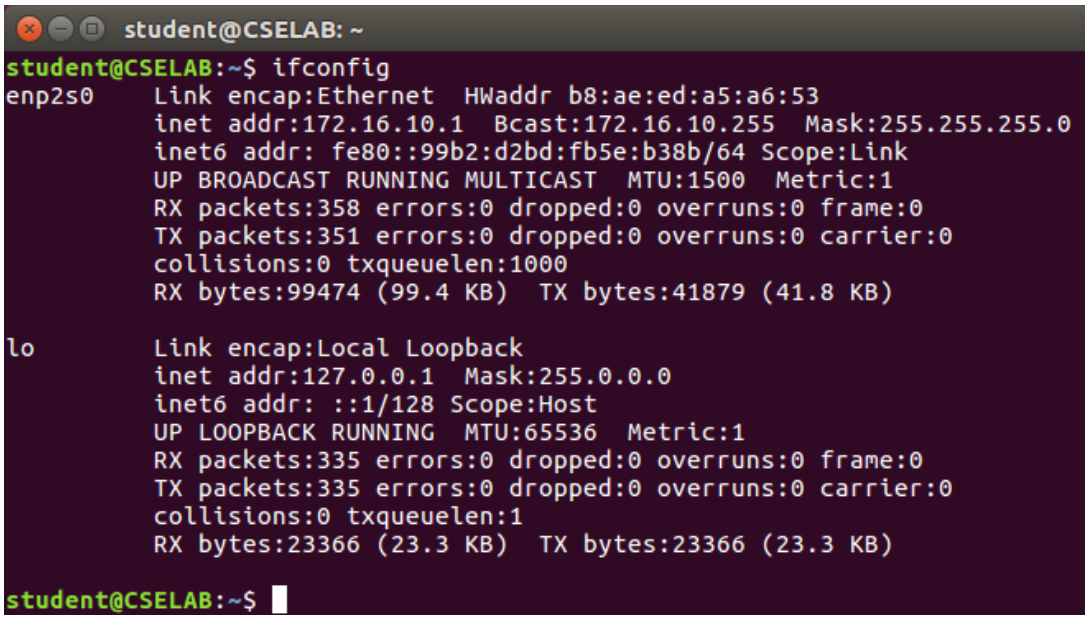
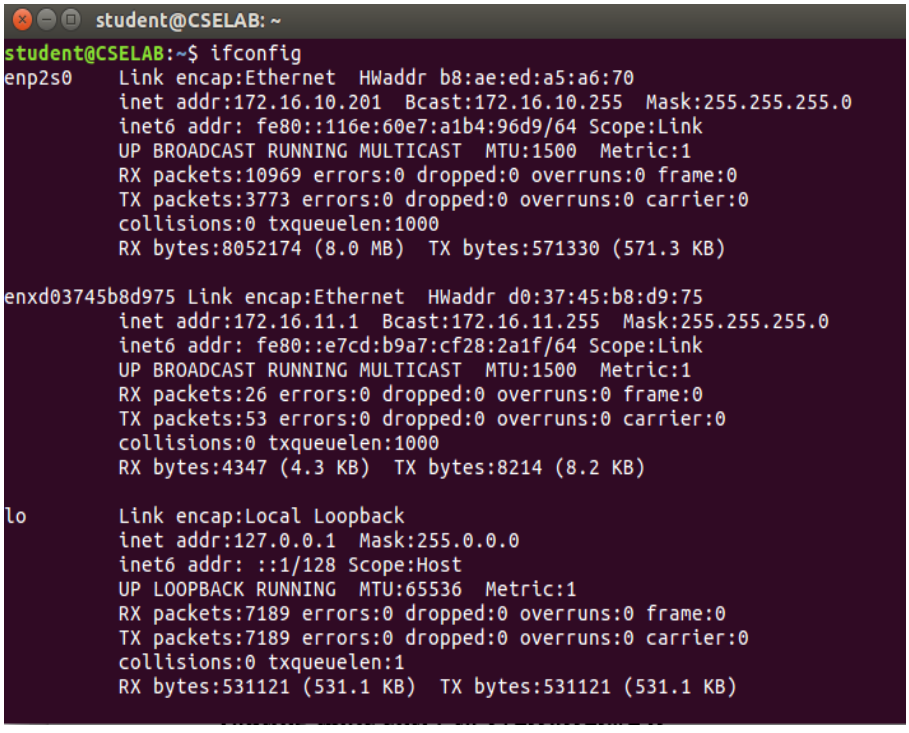
Task 1: Assigning IP addresses to all computers A, B, C and D (Source Host Ha, Router R1, Router R2, Destination Host Hd)

For Ha:



For R1:



For R2:

```
student@CSELAB:~$ ifconfig
enp2s0    Link encap:Ethernet  HWaddr b8:ae:ed:a5:a6:7a
          inet addr:172.16.12.1  Bcast:172.16.12.255  Mask:255.255.255.0
          inet6 addr: fe80::a6b:3f68:ffb7:7585/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:2508 errors:0 dropped:0 overruns:0 frame:0
          TX packets:439 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:258586 (258.5 KB)  TX bytes:53964 (53.9 KB)

enxd03745b7b332 Link encap:Ethernet  HWaddr d0:37:45:b7:b3:32
          inet addr:172.16.11.201  Bcast:172.16.11.255  Mask:255.255.255.0
          inet6 addr: fe80::8113:f0de:f59e:b7e/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:47 errors:0 dropped:0 overruns:0 frame:0
          TX packets:43 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:6298 (6.2 KB)  TX bytes:6205 (6.2 KB)

lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          inet6 addr: ::1/128 Scope:Host
          UP LOOPBACK RUNNING  MTU:65536  Metric:1
          RX packets:353 errors:0 dropped:0 overruns:0 frame:0
          TX packets:353 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1
          RX bytes:25880 (25.8 KB)  TX bytes:25880 (25.8 KB)
```

For Hd:

```
student@CSELAB:~$ ip addr show
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group defaul
t qlen 1
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
       valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host
       valid_lft forever preferred_lft forever
2: enp2s0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP
group default qlen 1000
    link/ether b8:ae:ed:f5:90:30 brd ff:ff:ff:ff:ff:ff
    inet 172.16.12.201/24 brd 172.16.12.255 scope global enp2s0
       valid_lft forever preferred_lft forever
    inet6 fe80::d793:85c3:c289:c4e2/64 scope link
       valid_lft forever preferred_lft forever
```

Task 2: Convert machines B and C into Routers

For both R1 and R2:

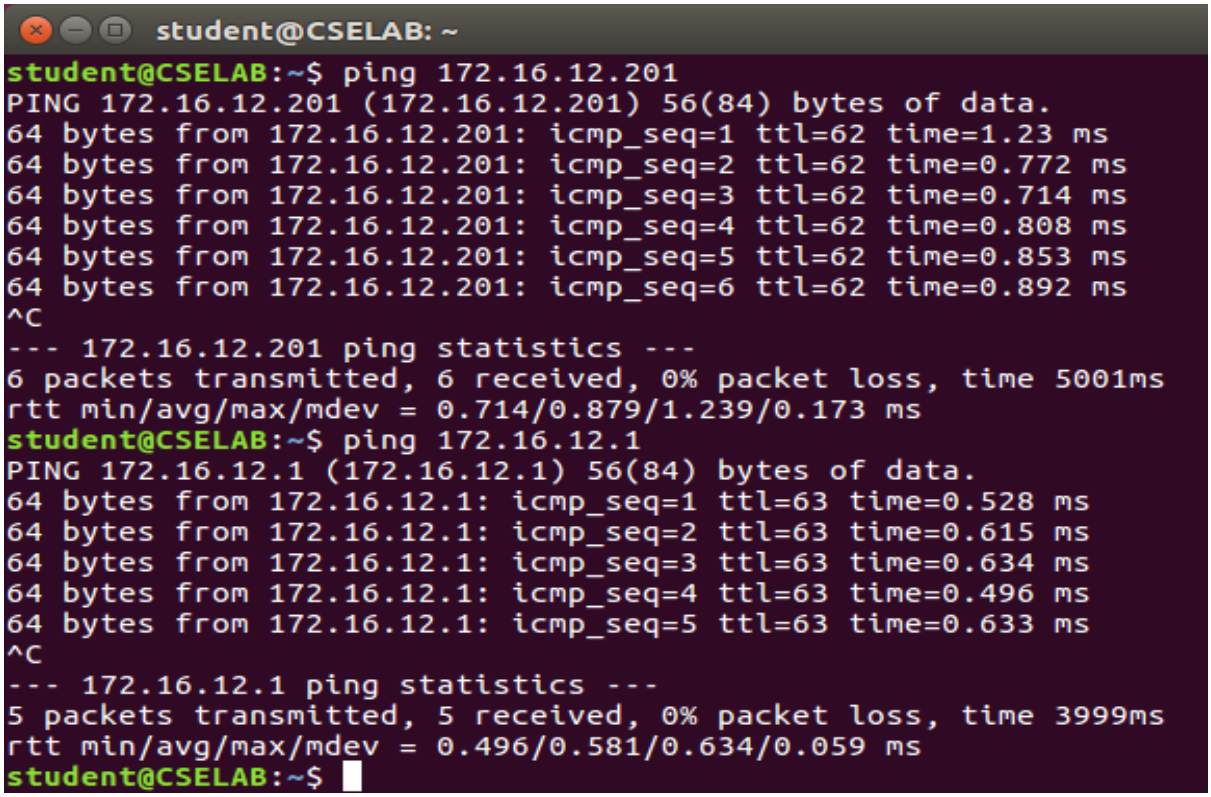
```
student@CSELAB:~$ sudo sysctl -w net.ipv4.conf.all.send_redirects=0
net.ipv4.conf.all.send_redirects = 0
student@CSELAB:~$ sudo sysctl -w net.ipv4.ip_forward=1
net.ipv4.ip_forward = 1
student@CSELAB:~$ sudo ip route add 172.16.12.0/24 via 172.16.11.201
student@CSELAB:~$ sudo ip route add 172.16.12.0/24 via 172.16.11.201
RTNETLINK answers: File exists
student@CSELAB:~$ ip route show
169.254.0.0/16 dev enp2s0  scope link  metric 1000
172.16.10.0/24 dev enp2s0  proto kernel  scope link  src 172.16.10.201  metric 100
172.16.11.0/24 dev enxd03745b8d975  proto kernel  scope link  src 172.16.11.1  metric 100
172.16.12.0/24 via 172.16.11.201 dev enxd03745b8d975
student@CSELAB:~$
```

Task 3: Verifying the connection between Ha and Hd using ping command

At Ha:

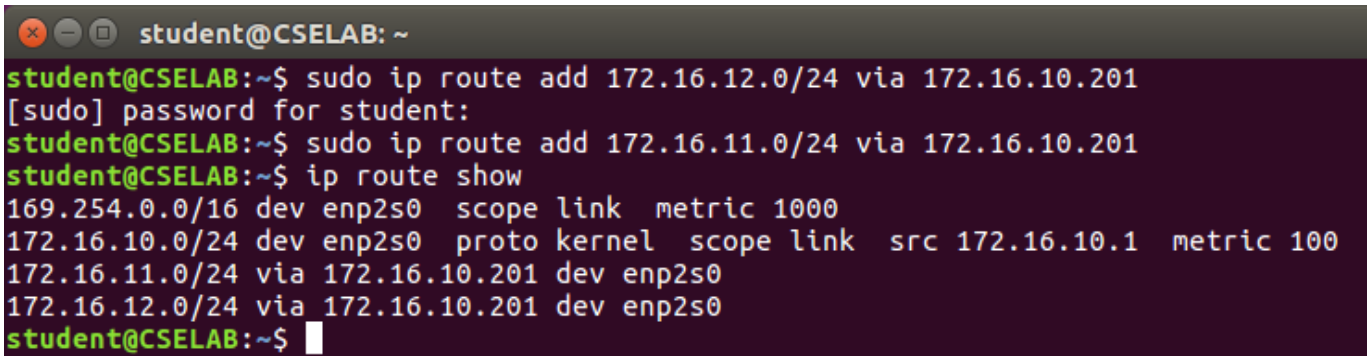
```
student@CSELAB:~$ ping 172.16.10.1
PING 172.16.10.1 (172.16.10.1) 56(84) bytes of data.
64 bytes from 172.16.10.1: icmp_seq=1 ttl=62 time=0.738 ms
64 bytes from 172.16.10.1: icmp_seq=2 ttl=62 time=0.805 ms
64 bytes from 172.16.10.1: icmp_seq=3 ttl=62 time=0.819 ms
64 bytes from 172.16.10.1: icmp_seq=4 ttl=62 time=0.794 ms
^C
--- 172.16.10.1 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 2999ms
rtt min/avg/max/mdev = 0.738/0.789/0.819/0.030 ms
```

At Hd:



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

At Ha:



At R1:

```
student@CSELAB:~$ sudo sysctl -w net.ipv4.conf.all.send_redirects=0
net.ipv4.conf.all.send_redirects = 0
student@CSELAB:~$ sudo sysctl -w net.ipv4.ip_forward=1
net.ipv4.ip_forward = 1
student@CSELAB:~$ sudo ip route add 172.16.12.0/24 via 172.16.11.201
student@CSELAB:~$ sudo ip route add 172.16.12.0/24 via 172.16.11.201
RTNETLINK answers: File exists
student@CSELAB:~$ ip route show
169.254.0.0/16 dev enp2s0  scope link  metric 1000
172.16.10.0/24 dev enp2s0  proto kernel  scope link  src 172.16.10.201  metric 100
172.16.11.0/24 dev enxd03745b8d975  proto kernel  scope link  src 172.16.11.1  metric 100
172.16.12.0/24 via 172.16.11.201 dev enxd03745b8d975
student@CSELAB:~$
```

At R2:

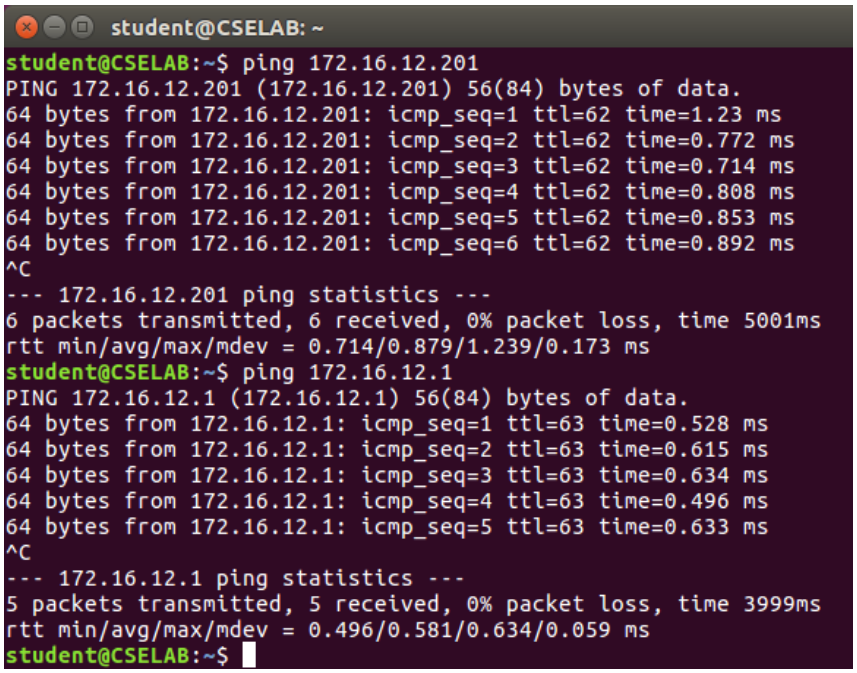
```
student@CSELAB:~$ sudo ip route add 172.16.10.0/24 via 172.16.11.1
student@CSELAB:~$ ip route show
169.254.0.0/16 dev enxd03745b7b332  scope link  metric 1000
172.16.10.0/24 via 172.16.11.1 dev enxd03745b7b332
172.16.11.0/24 dev enxd03745b7b332  proto kernel  scope link  src 172.16.11.201  metric 100
172.16.12.0/24 dev enp2s0  proto kernel  scope link  src 172.16.12.1  metric 100
```

At Hd:

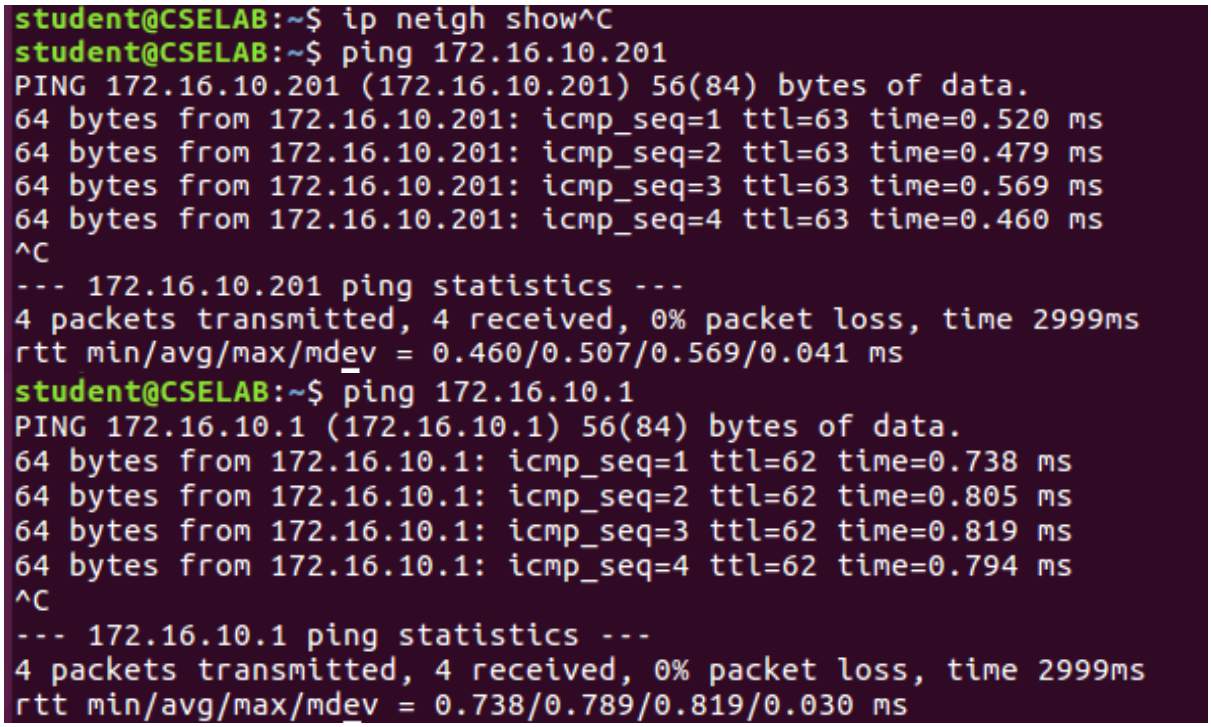
```
student@CSELAB:~$ sudo ip route add 172.16.10.0/24 via 172.16.12.1
RTNETLINK answers: File exists
student@CSELAB:~$ sudo ip route add 172.16.11.0/24 via 172.16.12.1
RTNETLINK answers: File exists
student@CSELAB:~$ ip route show
169.254.0.0/16 dev enp2s0  scope link  metric 1000
172.16.10.0/24 via 172.16.12.1 dev enp2s0
172.16.11.0/24 via 172.16.12.1 dev enp2s0
172.16.12.0/24 dev enp2s0  proto kernel  scope link  src 172.16.12.201  metric 1
00
```

Task 5: After adding routing table entries again verify the connections from Ha and Hd using ping command

1. Testing path from Ha and Hd

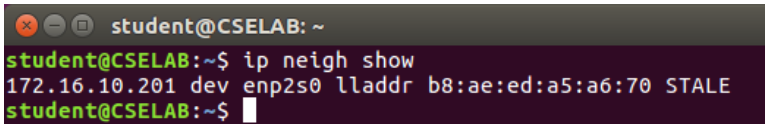


2. Testing path from Hd and Ha

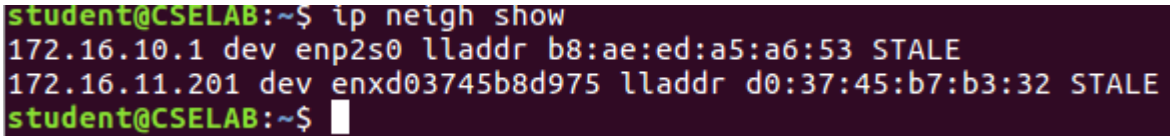


Task 6: Check each system neighbour to verify the connections

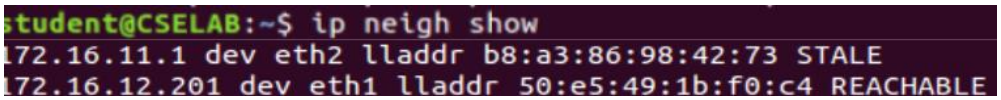
At Ha:



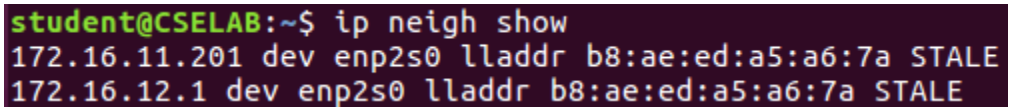
At R1:



At R2:



At Hd:

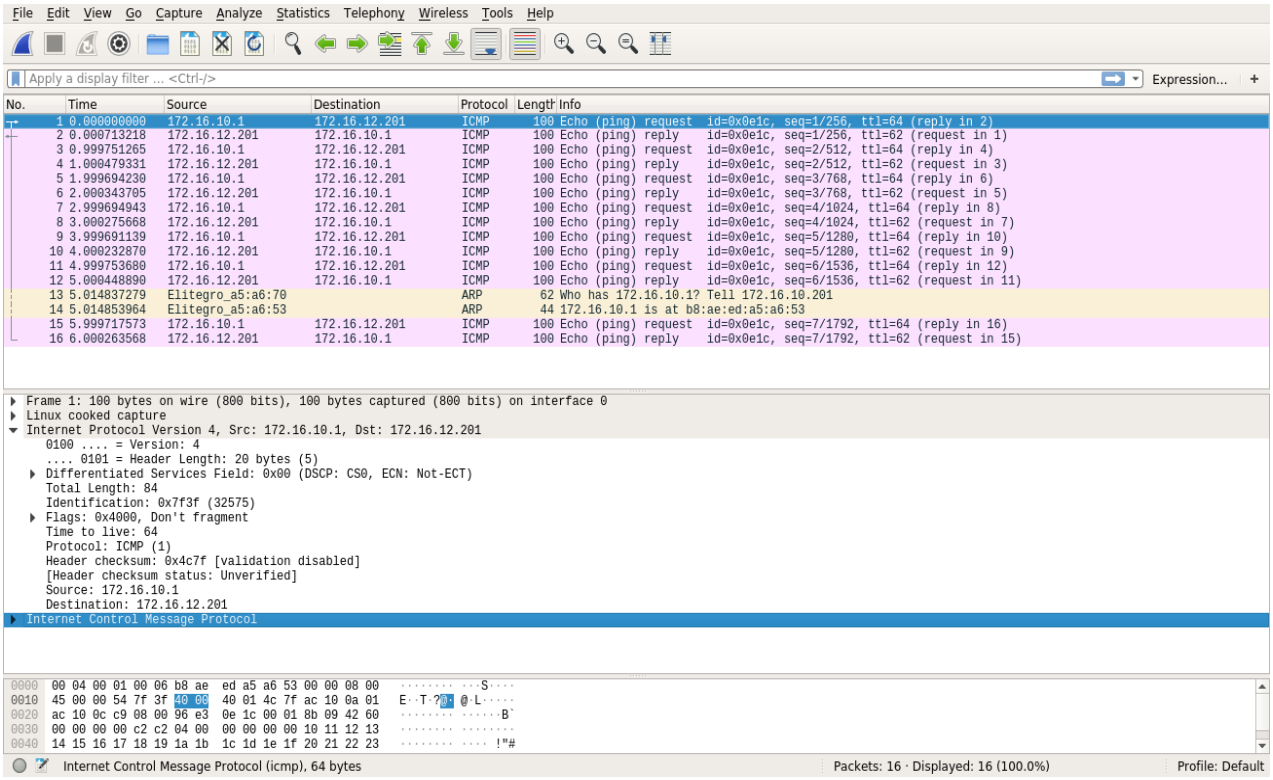


Task 7: Capture packets from Ha and Hd using Wireshark

At Ha:

Terminal 1: $ sudo wireshark

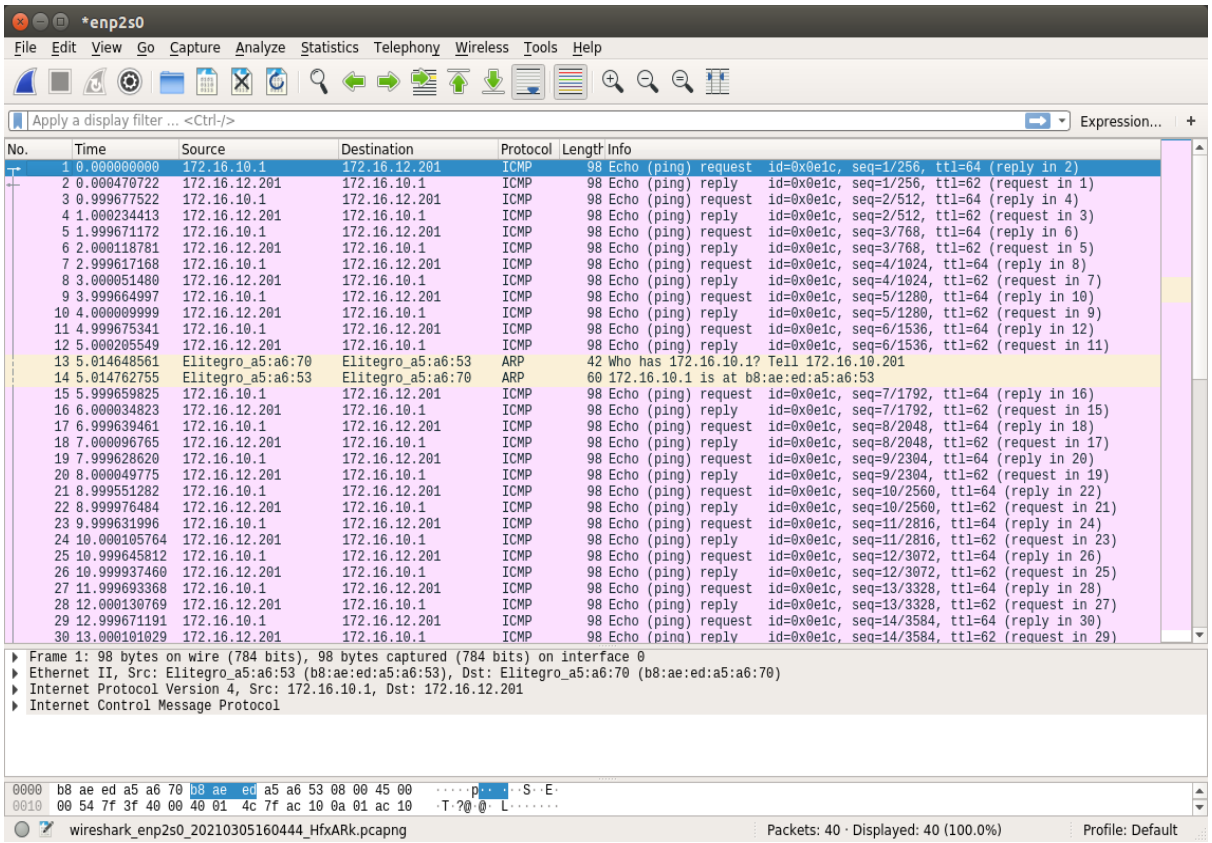
Terminal 2: $ ping 172.16.12.201



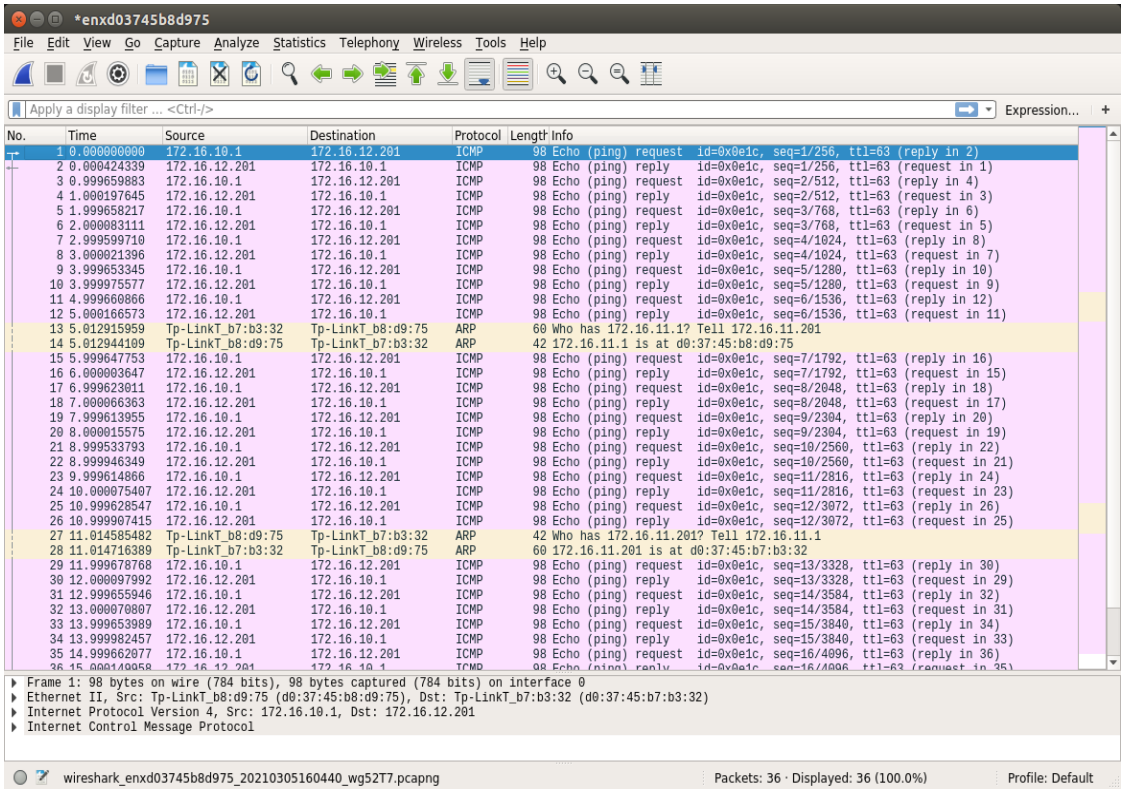
At R1:

$ sudo wireshark

At enp2s0 interface:



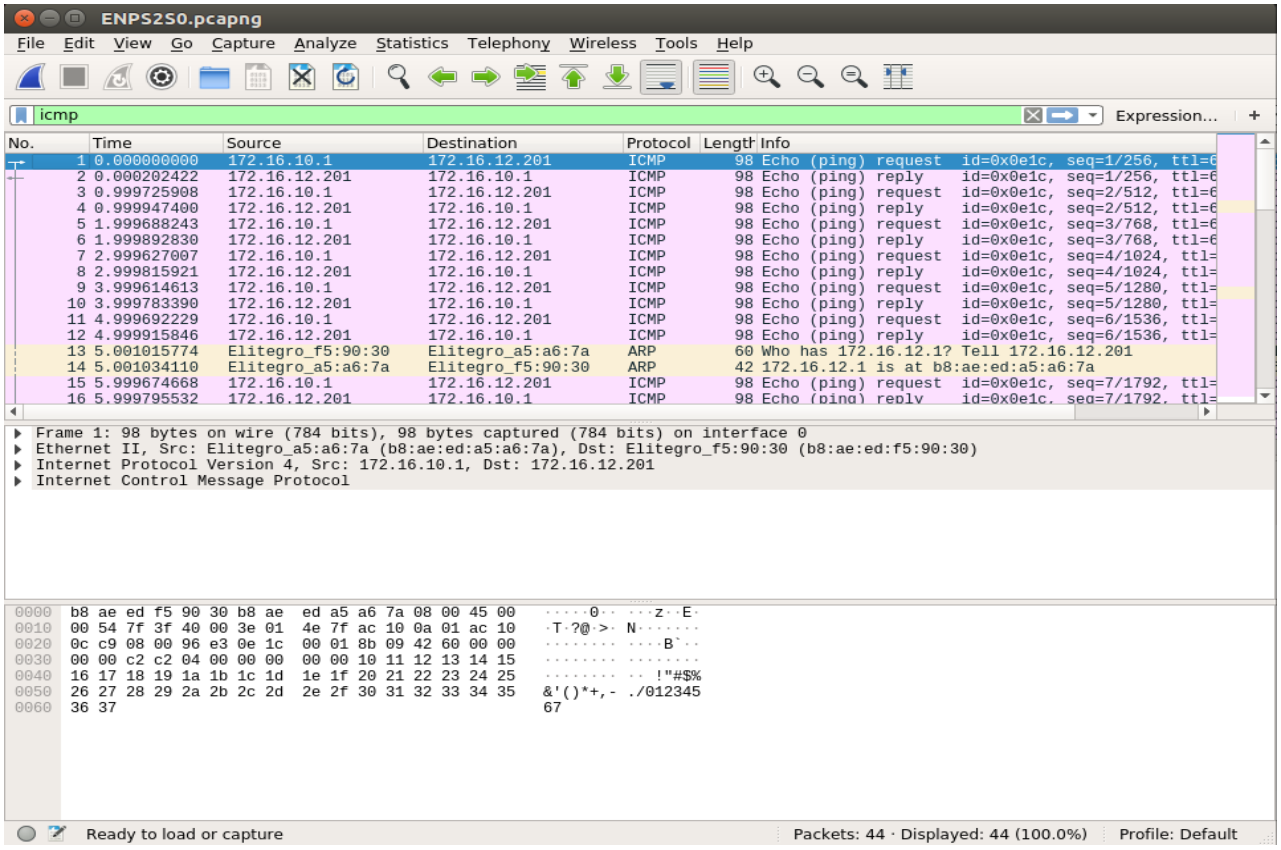
At enxd03745b8d975 interface:



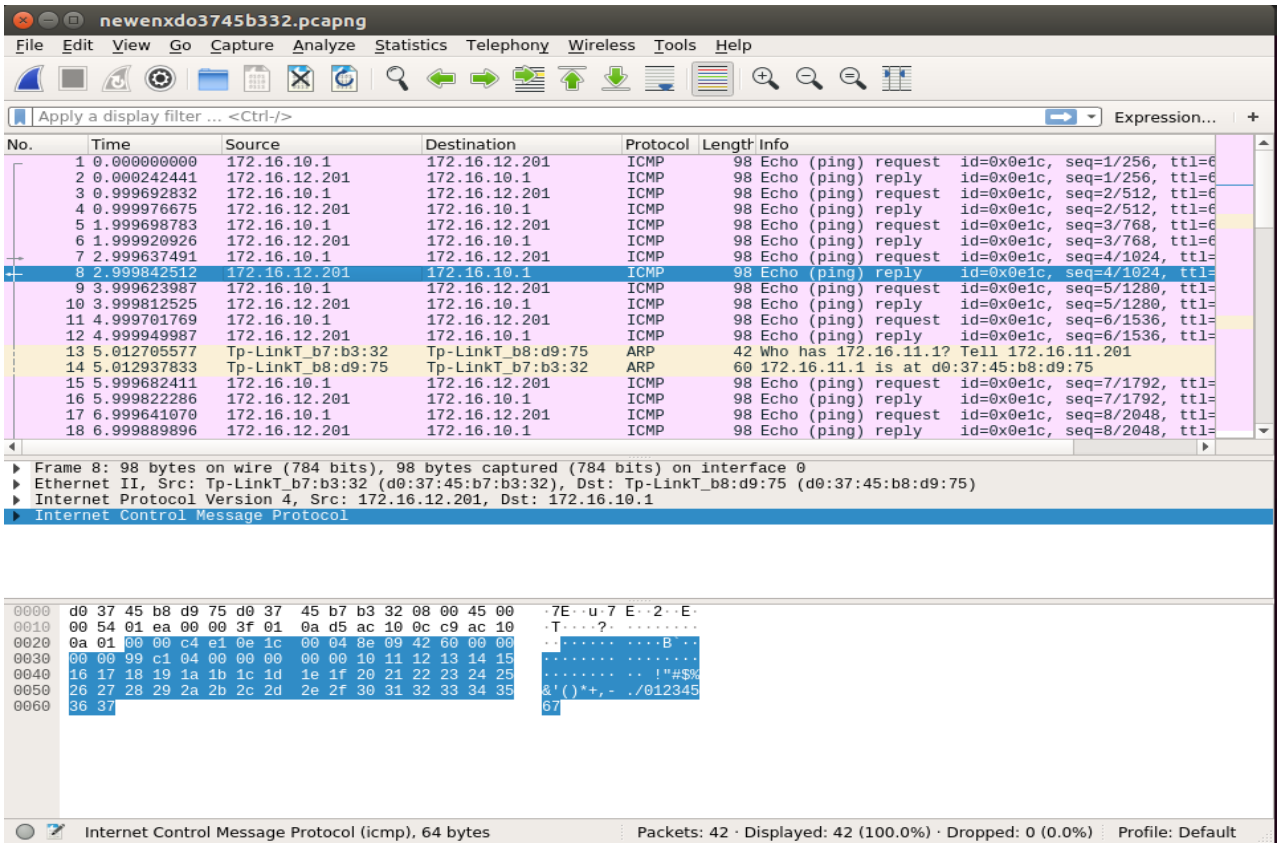
At R2:

$ sudo wireshark

At enp2s0 interface:



At newenxdo3745b332 interface:



At Hd:

Terminal 1: $ sudo wireshark