COMPUTER NETWORKS LABORATORY

WEEK #7

NAME : SIRI S

SEMESTER : 4

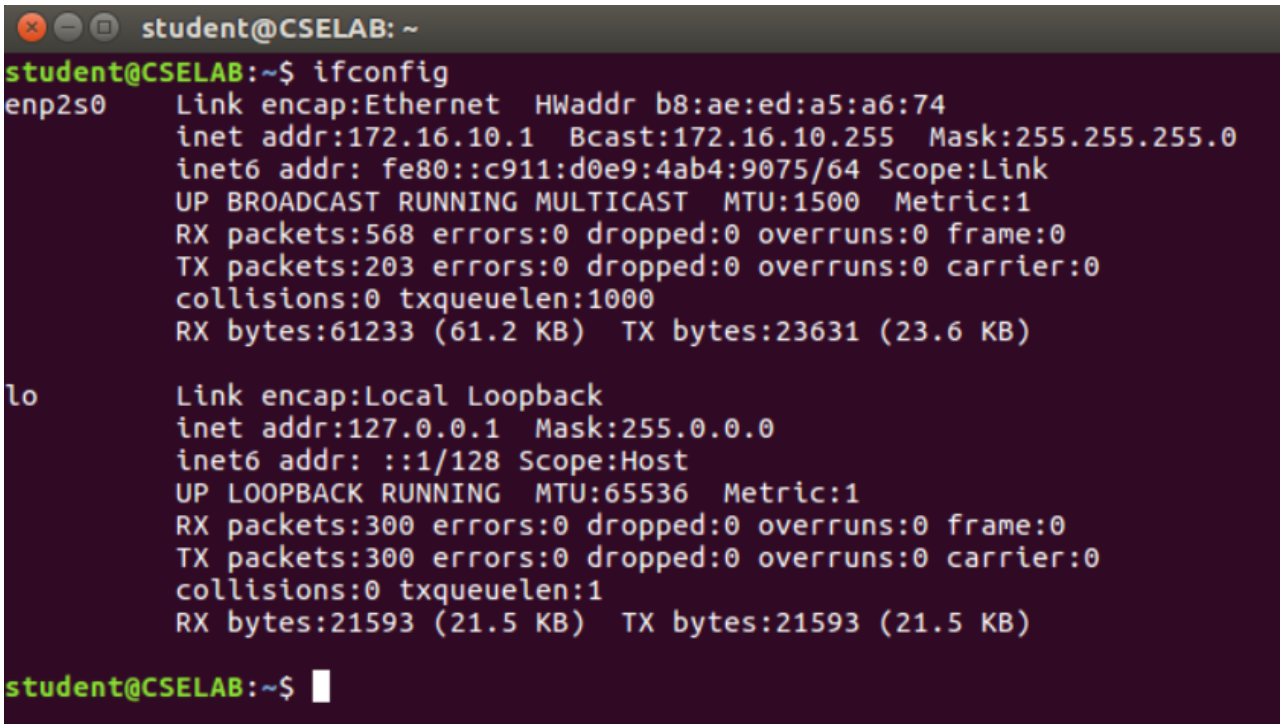
SECTION : H

SRN : PES1UG19CS485

IPv4 Addressing and Static Routing Hardware

Task 1: Assigning IP addresses to all the computers.

Ha:



R1:

```
student@CSELAB:~$ ifconfig
enp2s0    Link encap:Ethernet  HWaddr b8:ae:ed:a5:a5:b8
          inet addr:172.16.10.201  Bcast:172.16.10.255  Mask:255.255.255.0
          inet6 addr: fe80::e102:654e:cc6c:6cbd/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:5170 errors:0 dropped:0 overruns:0 frame:0
          TX packets:1353 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:691973 (691.9 KB)  TX bytes:144394 (144.3 KB)

enxd03745b8db55 Link encap:Ethernet  HWaddr d0:37:45:b8:db:55
          inet addr:172.16.11.1  Bcast:172.16.11.255  Mask:255.255.255.0
          inet6 addr: fe80::bb46:d1e2:1d6f:3e0c/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:112 errors:0 dropped:0 overruns:0 frame:0
          TX packets:154 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:19044 (19.0 KB)  TX bytes:24079 (24.0 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:410 errors:0 dropped:0 overruns:0 frame:0
          TX packets:410 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1
          RX bytes:33681 (33.6 KB)  TX bytes:33681 (33.6 KB)

student@CSELAB:~$
```

R2:

```
student@CSELAB:~$ ifconfig
enp2s0    Link encap:Ethernet  HWaddr b8:ae:ed:a5:a6:4a
          inet addr:172.16.12.1    Bcast:172.16.12.255  Mask:255.255.255.0
          inet6 addr: fe80::babf:d1cd:8eaa:43eb/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:61740 errors:0 dropped:0 overruns:0 frame:0
          TX packets:34884 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:46889450 (46.8 MB)  TX bytes:4681470 (4.6 MB)

enxd03745b8db6a Link encap:Ethernet  HWaddr d0:37:45:b8:db:6a
          inet addr:172.16.11.201  Bcast:172.16.11.255  Mask:255.255.255.0
          inet6 addr: fe80::818b:affd:b491:c252/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:137 errors:0 dropped:0 overruns:0 frame:0
          TX packets:156 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:19909 (19.9 KB)  TX bytes:26866 (26.8 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:5484 errors:0 dropped:0 overruns:0 frame:0
          TX packets:5484 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1
          RX bytes:640362 (640.3 KB)  TX bytes:640362 (640.3 KB)

student@CSELAB:~$
```

Hd:

```
student@CSELAB: ~
student@CSELAB:~$ ifconfig
enp2s0    Link encap:Ethernet  HWaddr b8:ae:ed:a4:84:98
          inet addr:172.16.12.201  Bcast:172.16.12.255  Mask:255.255.255.0
          inet6 addr: fe80::4ab1:58f:32c3:1792/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:9887 errors:0 dropped:0 overruns:0 frame:0
          TX packets:1290 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:1045501 (1.0 MB)  TX bytes:133863 (133.8 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:369 errors:0 dropped:0 overruns:0 frame:0
          TX packets:369 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1
          RX bytes:32109 (32.1 KB)  TX bytes:32109 (32.1 KB)

student@CSELAB:~$
```

Note 1:

To avoid redirect messages from host A and B, we issue the following command on host.

```
student@CSELAB:~$ sudo sysctl -w net.ipv4.conf.all.accept_redirects=0
[sudo] password for student:
net.ipv4.conf.all.accept_redirects = 0
```

Note 2:

To disable sending ICMP redirect messages by the routers, we issue the following command on routers R1, R2 (machine B and C).

```
student@CSELAB:~$ sudo sysctl -w net.ipv4.conf.all.send_redirects=0
[sudo] password for student:
net.ipv4.conf.all.send_redirects = 0
```

Task2: Convert machine B and C to routers.

We enable IP forwarding by issuing the following command on router machines.

```
student@CSELAB:~$ sysctl net.ipv4.ip_forward
net.ipv4.ip_forward = 0
student@CSELAB:~$ cat /proc/sys/net/ipv4/ip_forward
0
student@CSELAB:~$ sudo sysctl -w net.ipv4.ip_forward=1
net.ipv4.ip_forward = 1
```

Task3: Verify the connection between Ha and Hd using ping command.

Ha:

```
student@CSELAB:~$ ping 172.16.10.201
PING 172.16.10.201 (172.16.10.201) 56(84) bytes of data.
64 bytes from 172.16.10.201: icmp_seq=1 ttl=64 time=0.324 ms
64 bytes from 172.16.10.201: icmp_seq=2 ttl=64 time=0.226 ms
64 bytes from 172.16.10.201: icmp_seq=3 ttl=64 time=0.251 ms
64 bytes from 172.16.10.201: icmp_seq=4 ttl=64 time=0.254 ms
^C
--- 172.16.10.201 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 2999ms
rtt min/avg/max/mdev = 0.226/0.263/0.324/0.041 ms
```

Hd:

```
student@CSELAB:~$ 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_req=1 ttl=63 time=0.486 ms
64 bytes from 172.16.12.1: icmp_req=2 ttl=63 time=0.446 ms
64 bytes from 172.16.12.1: icmp_req=3 ttl=63 time=0.442 ms
64 bytes from 172.16.12.1: icmp_req=4 ttl=63 time=0.451 ms
64 bytes from 172.16.12.1: icmp_req=5 ttl=63 time=0.447 ms
^C
--- 172.16.12.1 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 3998ms
rtt min/avg/max/mdev = 0.323/0.370/0.549/0.080 ms
```

Task4: Insert routing table entries on each system to direct ipv4 packets to ping across the networks.

Ha:

```
student@CSELAB:~$ sudo ip route add 172.16.12.0/24 via 172.16.10.201
student@CSELAB:~$ sudo ip route add 172.16.11.0/24 via 172.16.10.201
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 172.16.10.1  metric 100
172.16.11.0/24 via 172.16.10.201 dev enp2s0
172.16.12.0/24 via 172.16.10.201 dev enp2s0
```

R1:

```
student@CSELAB:~$ sudo ip route add 172.16.12.0/24 via 172.16.11.201
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 enxd03745b8db55  proto kernel  scope link  src 172.16.11.1  metric 100
172.16.12.0/24 via 172.16.11.201 dev enxd03745b8db55
```

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 enxd03745b8db6a  scope link  metric 1000
172.16.10.0/24 via 172.16.11.1 dev enxd03745b8db6a
172.16.11.0/24 dev enxd03745b8db6a  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
```

Hd:

```
student@CSELAB:~$ sudo ip route add 172.16.10.0/24 via 172.16.12.1
student@CSELAB:~$ sudo ip route add 172.16.11.0/24 via 172.16.12.1
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 connection from Ha and Hd using ping command.

Testing path from Ha to Hd

```
student@CSELAB:~$ 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=0.753 ms
64 bytes from 172.16.12.201: icmp_seq=2 ttl=62 time=0.764 ms
64 bytes from 172.16.12.201: icmp_seq=3 ttl=62 time=0.717 ms
64 bytes from 172.16.12.201: icmp_seq=4 ttl=62 time=0.705 ms
64 bytes from 172.16.12.201: icmp_seq=5 ttl=62 time=0.732 ms
^C
--- 172.16.12.201 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 3999ms
rtt min/avg/max/mdev = 0.705/0.734/0.764/0.027 ms
```

Testing path from Hd to 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=0.816 ms
64 bytes from 172.16.10.1: icmp_seq=2 ttl=62 time=0.869 ms
64 bytes from 172.16.10.1: icmp_seq=3 ttl=62 time=0.836 ms
64 bytes from 172.16.10.1: icmp_seq=4 ttl=62 time=0.803 ms
64 bytes from 172.16.10.1: icmp_seq=5 ttl=62 time=0.862 ms
64 bytes from 172.16.10.1: icmp_seq=6 ttl=62 time=0.859 ms
64 bytes from 172.16.10.1: icmp_seq=7 ttl=62 time=0.785 ms
^C
--- 172.16.10.1 ping statistics ---
7 packets transmitted, 7 received, 0% packet loss, time 6000ms
rtt min/avg/max/mdev = 0.785/0.832/0.869/0.048 ms
```

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

Ha:

```
student@CSELAB:~$ ip neigh show
172.16.10.201 dev enp2s0 lladdr b8:ae:ed:a5:a5:b8 STALE
```

R1:

```
student@CSELAB:~$ ip neigh show
192.168.3.5 dev enp2s0  FAILED
172.16.11.201 dev enxd03745b8db55 lladdr d0:37:45:b8:db:6a STALE
202.138.103.100 dev enp2s0  FAILED
172.16.10.1 dev enp2s0 lladdr b8:ae:ed:a5:a6:74 STALE
202.138.96.2 dev enp2s0  FAILED
4.2.2.2 dev enp2s0  FAILED
```

R2:

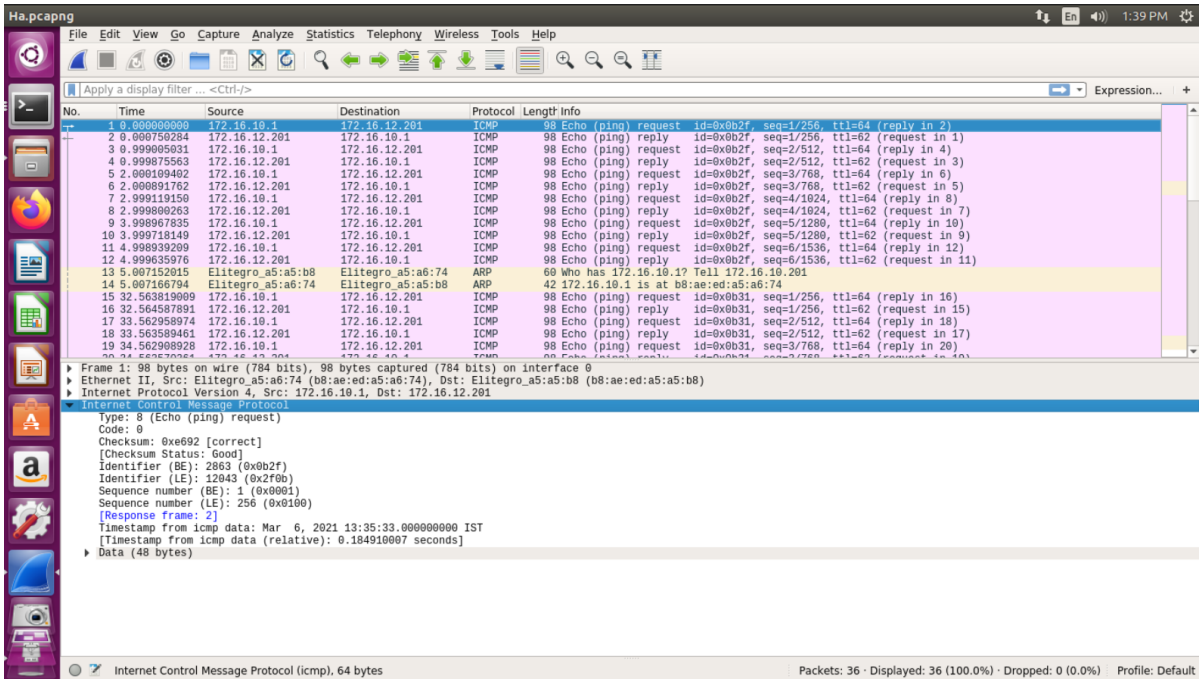
```
student@CSELAB:~$ ip neigh show
172.16.12.201 dev enp2s0 lladdr b8:ae:ed:a4:84:98 STALE
172.16.11.1 dev enxd03745b8db6a lladdr d0:37:45:b8:db:55 STALE
```

Hd:

```
student@CSELAB:~$ ip neigh show
172.16.12.1 dev enp2s0 lladdr b8:ae:ed:a5:a6:4a STALE
```

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

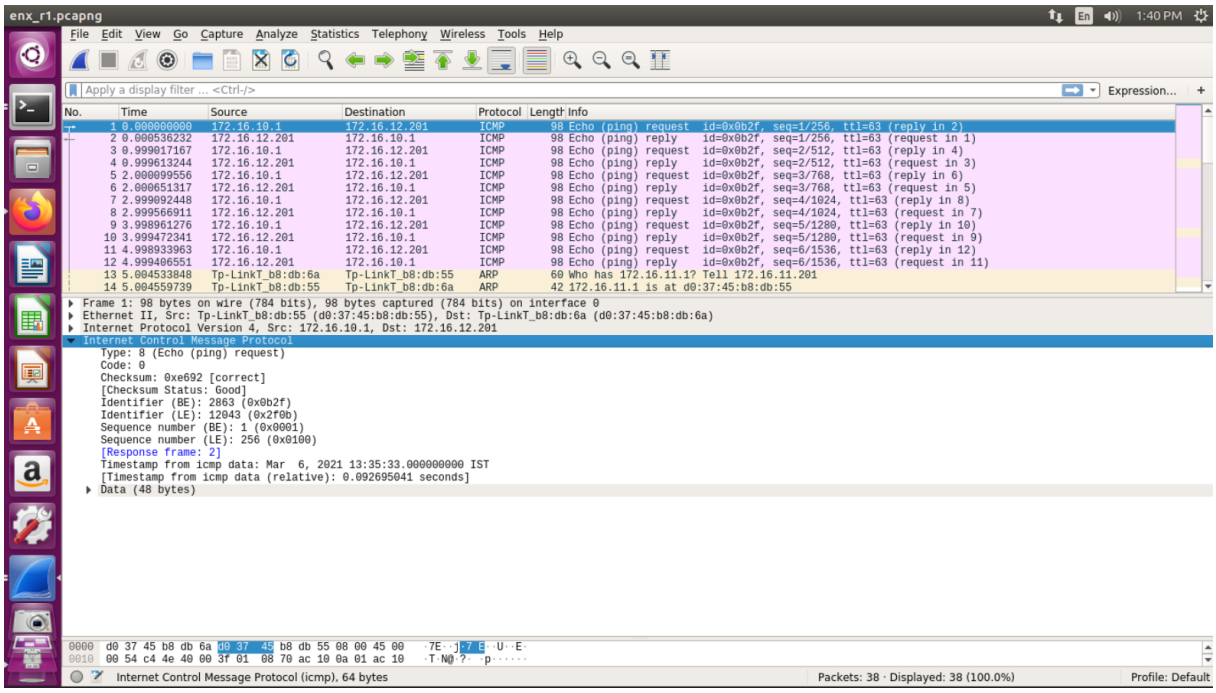
Ha:



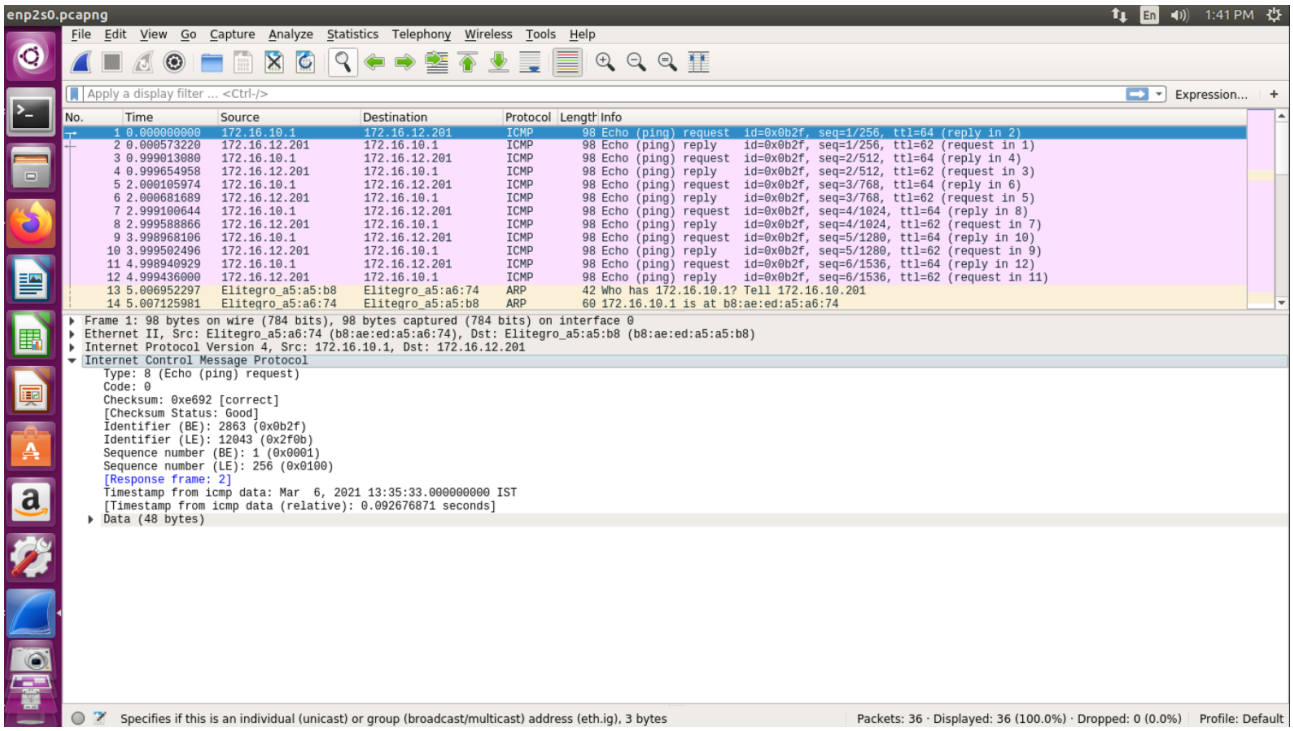
R1:

At eth

1:

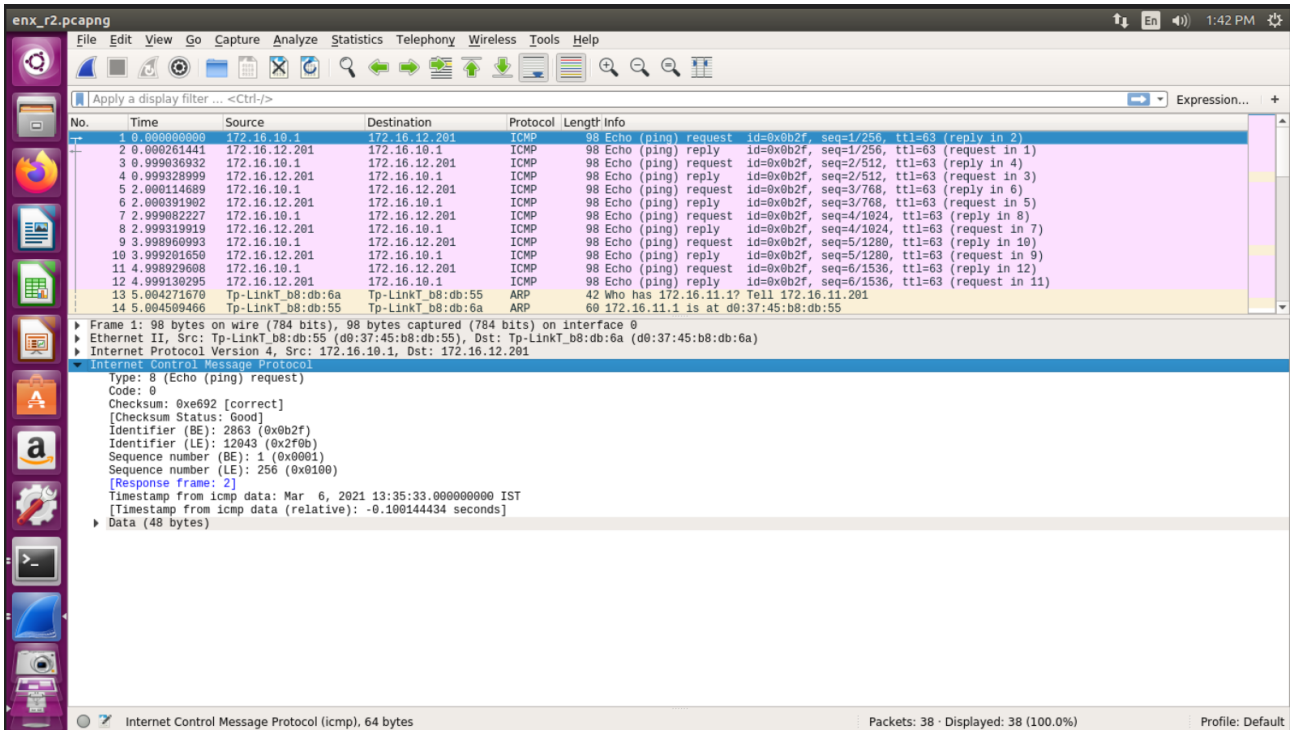


At eth2:

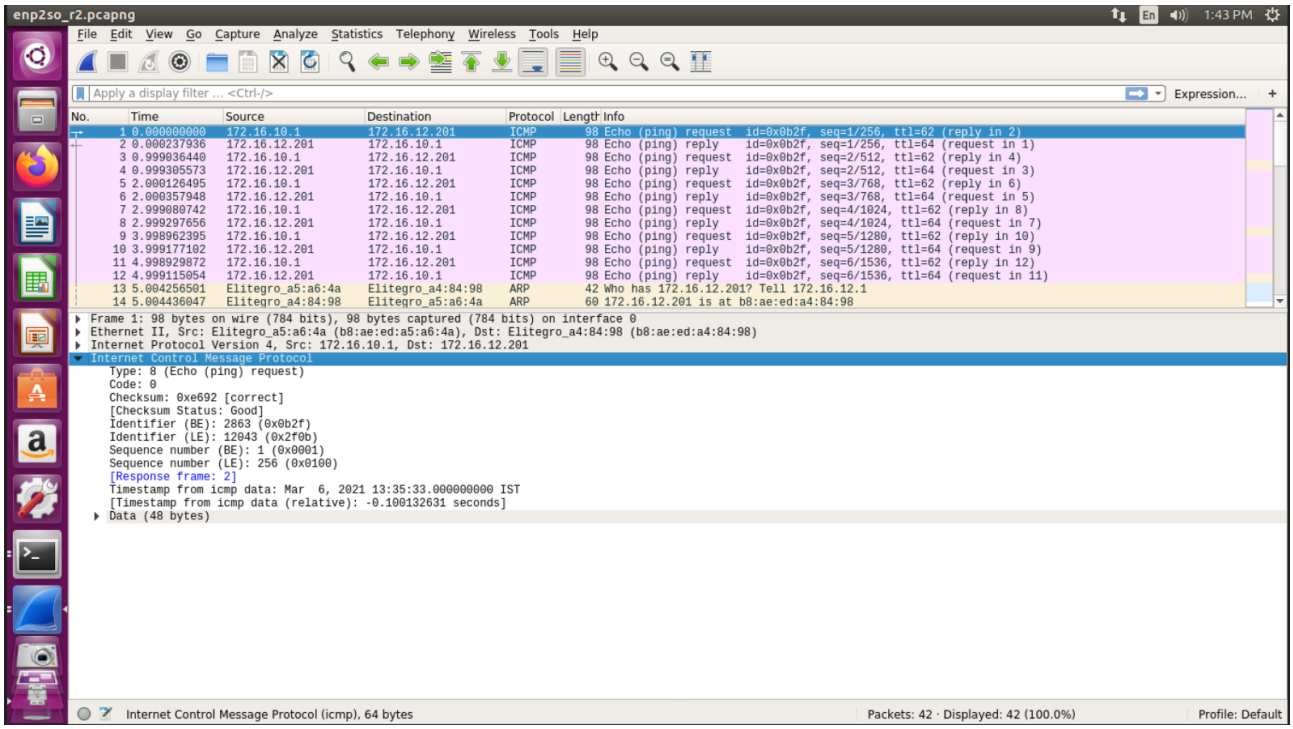


R2:

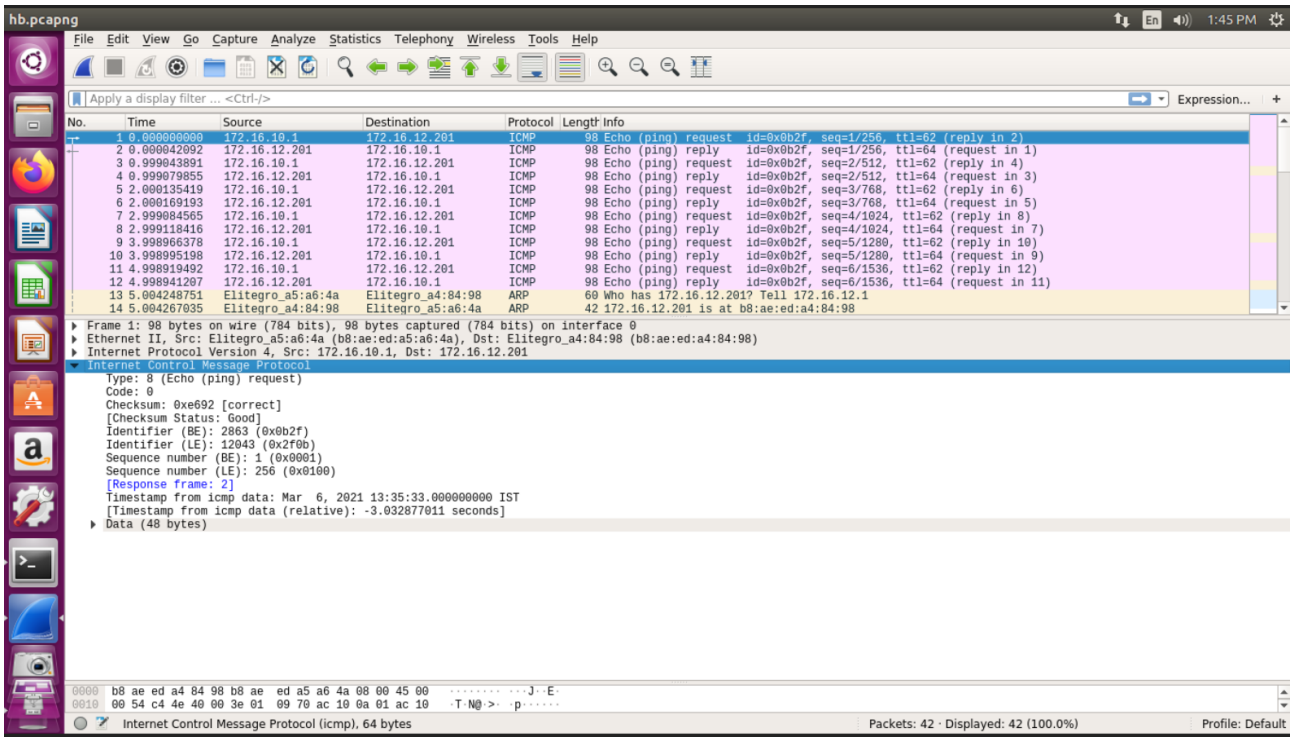
At eth1:



At eth2:


enp2so_r2.pcapng
1:43 PM
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
Apply a display filter ... <Ctrl-/>
Expression...
No. Time Source Destination Protocol Length Info
1 0.000000000 172.16.10.1 172.16.12.201 ICMP 98 Echo (ping) request id=0x0b2f, seq=1/256, ttl=62 (reply in 2)
2 0.000237936 172.16.12.201 172.16.10.1 ICMP 98 Echo (ping) reply id=0x0b2f, seq=1/256, ttl=64 (request in 1)
3 0.999036440 172.16.10.1 172.16.12.201 ICMP 98 Echo (ping) request id=0x0b2f, seq=2/512, ttl=62 (reply in 4)
4 0.999305573 172.16.12.201 172.16.10.1 ICMP 98 Echo (ping) reply id=0x0b2f, seq=2/512, ttl=64 (request in 3)
5 2.000126495 172.16.10.1 172.16.12.201 ICMP 98 Echo (ping) request id=0x0b2f, seq=3/768, ttl=62 (reply in 6)
6 2.000357948 172.16.12.201 172.16.10.1 ICMP 98 Echo (ping) reply id=0x0b2f, seq=3/768, ttl=64 (request in 5)
7 2.999080742 172.16.10.1 172.16.12.201 ICMP 98 Echo (ping) request id=0x0b2f, seq=4/1024, ttl=62 (reply in 8)
8 2.999297656 172.16.12.201 172.16.10.1 ICMP 98 Echo (ping) reply id=0x0b2f, seq=4/1024, ttl=64 (request in 7)
9 3.998962395 172.16.10.1 172.16.12.201 ICMP 98 Echo (ping) request id=0x0b2f, seq=5/1280, ttl=62 (reply in 10)
10 3.999177102 172.16.12.201 172.16.10.1 ICMP 98 Echo (ping) reply id=0x0b2f, seq=5/1280, ttl=64 (request in 9)
11 4.998929872 172.16.10.1 172.16.12.201 ICMP 98 Echo (ping) request id=0x0b2f, seq=6/1536, ttl=62 (reply in 12)
12 4.999115054 172.16.12.201 172.16.10.1 ICMP 98 Echo (ping) reply id=0x0b2f, seq=6/1536, ttl=64 (request in 11)
13 5.004256501 Elitegro_a5:a6:4a Elitegro_a4:84:98 ARP 42 Who has 172.16.12.201? Tell 172.16.12.1
14 5.004436047 Elitegro_a4:84:98 Elitegro_a5:a6:4a ARP 60 172.16.12.201 is at b8:ae:ed:a4:84:98
Frame 1: 98 bytes on wire (784 bits), 98 bytes captured (784 bits) on interface 0
Ethernet II, Src: Elitegro_a5:a6:4a (b8:ae:ed:a5:a6:4a), Dst: Elitegro_a4:84:98 (b8:ae:ed:a4:84:98)
Internet Protocol Version 4, Src: 172.16.10.1, Dst: 172.16.12.201
Internet Control Message Protocol
Type: 8 (Echo (ping) request)
Code: 0
Checksum: 0xe692 [correct]
[Checksum Status: Good]
Identifier (BE): 2863 (0x0b2f)
Identifier (LE): 12043 (0x2f0b)
Sequence number (BE): 1 (0x0001)
Sequence number (LE): 256 (0x0100)
[Response frame: 2]
Timestamp from icmp data: Mar 6, 2021 13:35:33.000000000 IST
[Timestamp from icmp data (relative): -0.100132631 seconds]
Data (48 bytes)
Internet Control Message Protocol (icmp), 64 bytes
Packets: 42 · Displayed: 42 (100.0%)
Profile: Default

Hd:


hb.pcapng
1:45 PM
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
Apply a display filter ... <Ctrl-/>
Expression...
No. Time Source Destination Protocol Length Info
1 0.000000000 172.16.10.1 172.16.12.201 ICMP 98 Echo (ping) request id=0x0b2f, seq=1/256, ttl=62 (reply in 2)
2 0.000042092 172.16.12.201 172.16.10.1 ICMP 98 Echo (ping) reply id=0x0b2f, seq=1/256, ttl=64 (request in 1)
3 0.999043891 172.16.10.1 172.16.12.201 ICMP 98 Echo (ping) request id=0x0b2f, seq=2/512, ttl=62 (reply in 4)
4 0.999079855 172.16.12.201 172.16.10.1 ICMP 98 Echo (ping) reply id=0x0b2f, seq=2/512, ttl=64 (request in 3)
5 2.000135419 172.16.10.1 172.16.12.201 ICMP 98 Echo (ping) request id=0x0b2f, seq=3/768, ttl=62 (reply in 6)
6 2.000169193 172.16.12.201 172.16.10.1 ICMP 98 Echo (ping) reply id=0x0b2f, seq=3/768, ttl=64 (request in 5)
7 2.999084565 172.16.10.1 172.16.12.201 ICMP 98 Echo (ping) request id=0x0b2f, seq=4/1024, ttl=62 (reply in 8)
8 2.999118416 172.16.12.201 172.16.10.1 ICMP 98 Echo (ping) reply id=0x0b2f, seq=4/1024, ttl=64 (request in 7)
9 3.998966378 172.16.10.1 172.16.12.201 ICMP 98 Echo (ping) request id=0x0b2f, seq=5/1280, ttl=62 (reply in 10)
10 3.998995198 172.16.12.201 172.16.10.1 ICMP 98 Echo (ping) reply id=0x0b2f, seq=5/1280, ttl=64 (request in 9)
11 4.998919492 172.16.10.1 172.16.12.201 ICMP 98 Echo (ping) request id=0x0b2f, seq=6/1536, ttl=62 (reply in 12)
12 4.998941207 172.16.12.201 172.16.10.1 ICMP 98 Echo (ping) reply id=0x0b2f, seq=6/1536, ttl=64 (request in 11)
13 5.004248751 Elitegro_a5:a6:4a Elitegro_a4:84:98 ARP 60 Who has 172.16.12.201? Tell 172.16.12.1
14 5.004267035 Elitegro_a4:84:98 Elitegro_a5:a6:4a ARP 42 172.16.12.201 is at b8:ae:ed:a4:84:98
Frame 1: 98 bytes on wire (784 bits), 98 bytes captured (784 bits) on interface 0
Ethernet II, Src: Elitegro_a5:a6:4a (b8:ae:ed:a5:a6:4a), Dst: Elitegro_a4:84:98 (b8:ae:ed:a4:84:98)
Internet Protocol Version 4, Src: 172.16.10.1, Dst: 172.16.12.201
Internet Control Message Protocol
Type: 8 (Echo (ping) request)
Code: 0
Checksum: 0xe692 [correct]
[Checksum Status: Good]
Identifier (BE): 2863 (0x0b2f)
Identifier (LE): 12043 (0x2f0b)
Sequence number (BE): 1 (0x0001)
Sequence number (LE): 256 (0x0100)
[Response frame: 2]
Timestamp from icmp data: Mar 6, 2021 13:35:33.000000000 IST
[Timestamp from icmp data (relative): -3.032877011 seconds]
Data (48 bytes)
0000 b8 ae ed a4 84 98 b8 ae ed a5 a6 4a 08 00 45 00
0010 00 54 c4 4e 40 00 3e 01 09 70 ac 10 0a 01 ac 10
Internet Control Message Protocol (icmp), 64 bytes
Packets: 42 · Displayed: 42 (100.0%)
Profile: Default