

# **COMPUTER NETWORKS LAB**

## **WEEK #10**

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<b>NAME</b>	<b>SRN</b>
Shrikar Madhu	PES1UG19CS470
Siddanth Krishna	PES1UG19CS479
Siri S	PES1UG19CS485
Spandan Sar	PES1UG19CS498

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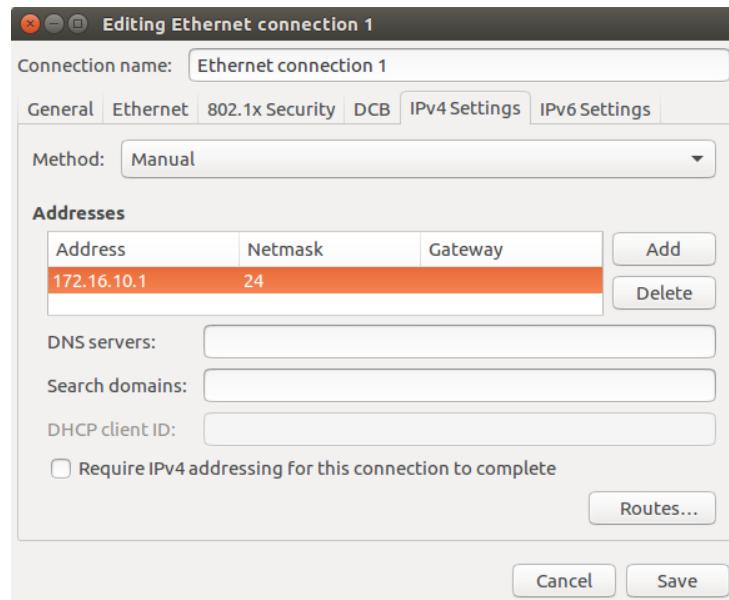
### **Objective:**

To understand ICMP Redirect and implement the following

- 1) ICMP Echo Request/reply
- 2) ICMP Redirect

## Step 1: Assigning IP addresses to each computer

**Ha:**



**R1:**

```
student@CSELAB: ~
student@CSELAB:~$ ip addr show
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default 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:a5:a5:ff brd ff:ff:ff:ff:ff:ff
    inet 172.16.10.2/24 brd 172.16.10.255 scope global enp2s0
        valid_lft forever preferred_lft forever
    inet6 fe80::35bb:8c3:281:5c15/64 scope link
        valid_lft forever preferred_lft forever
```

## R2:

```
student@CSELAB:~$ ifconfig
enp2s0    Link encap:Ethernet HWaddr b8:ae:ed:a5:a5:d9
          inet addr:172.16.11.2 Bcast:172.16.11.255 Mask:255.255.255.0
          inet6 addr: fe80::ef3e:a634:755a:82e6/64 Scope:Link
            UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
            RX packets:14664 errors:0 dropped:0 overruns:0 frame:0
            TX packets:5576 errors:0 dropped:0 overruns:0 carrier:0
            collisions:0 txqueuelen:1000
            RX bytes:11165326 (11.1 MB) TX bytes:811374 (811.3 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:1320 errors:0 dropped:0 overruns:0 frame:0
            TX packets:1320 errors:0 dropped:0 overruns:0 carrier:0
            collisions:0 txqueuelen:1
            RX bytes:141788 (141.7 KB) TX bytes:141788 (141.7 KB)
```

## Hb:

```
student@CSELAB:~$ ifconfig
enp2s0    Link encap:Ethernet HWaddr b8:ae:ed:a5:a6:6a
          inet addr:172.16.10.3 Bcast:172.16.10.255 Mask:255.255.255.0
          inet6 addr: fe80::e884:d003:928b:2815/64 Scope:Link
            UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
            RX packets:20806 errors:0 dropped:0 overruns:0 frame:0
            TX packets:7772 errors:0 dropped:0 overruns:0 carrier:0
            collisions:0 txqueuelen:1000
            RX bytes:18323273 (18.3 MB) TX bytes:1015130 (1.0 MB)

enx00594d6ea7c2 Link encap:Ethernet HWaddr 00:59:4d:6e:a7:c2
          inet addr:172.16.11.1 Bcast:172.16.11.255 Mask:255.255.255.0
          inet6 addr: fe80::f0c8:1a5c:7cc1:9aa/64 Scope:Link
            UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
            RX packets:9 errors:0 dropped:0 overruns:0 frame:0
            TX packets:42 errors:0 dropped:0 overruns:0 carrier:0
            collisions:0 txqueuelen:1000
            RX bytes:2388 (2.3 KB) TX bytes:6024 (6.0 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:4824 errors:0 dropped:0 overruns:0 frame:0
            TX packets:4824 errors:0 dropped:0 overruns:0 carrier:0
            collisions:0 txqueuelen:1
            RX bytes:369371 (369.3 KB) TX bytes:369371 (369.3 KB)
```

**Precautionary Measure:** Disabling acceptance of ICMP redirect packets.

**Ha:**

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

**Hb:**

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

## **Step 2: Converting C and D systems into routers R2 and R1 respectively**

**R1:**

```
student@CSELAB:~$ sudo sysctl -w net.ipv4.ip_forward=1
net.ipv4.ip_forward = 1
student@CSELAB:~$ sudo ip route add 172.16.11.0/24 via 172.16.10.2
```

**R2:**

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

## Step 3: Verifying the Local Network connection using ping command

Ha:

```
student@CSELAB:~$ 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=64 time=0.439 ms
64 bytes from 172.16.11.1: icmp_seq=2 ttl=64 time=0.331 ms
64 bytes from 172.16.11.1: icmp_seq=3 ttl=64 time=0.351 ms
64 bytes from 172.16.11.1: icmp_seq=4 ttl=64 time=0.330 ms
64 bytes from 172.16.11.1: icmp_seq=5 ttl=64 time=0.347 ms
64 bytes from 172.16.11.1: icmp_seq=6 ttl=64 time=0.357 ms
^C
--- 172.16.11.1 ping statistics ---
6 packets transmitted, 6 received, 0% packet loss, time 4997ms
rtt min/avg/max/mdev = 0.330/0.359/0.439/0.038 ms
```

Hb:

```
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=64 time=0.047 ms
64 bytes from 172.16.10.1: icmp_seq=2 ttl=64 time=0.031 ms
64 bytes from 172.16.10.1: icmp_seq=3 ttl=64 time=0.050 ms
64 bytes from 172.16.10.1: icmp_seq=4 ttl=64 time=0.018 ms
64 bytes from 172.16.10.1: icmp_seq=5 ttl=64 time=0.032 ms
64 bytes from 172.16.10.1: icmp_seq=6 ttl=64 time=0.050 ms
```

## Step 4: Inserting Routing Table entries on each system to direct ipv4 packets

Ha:

```
student@CSELAB:~$ sudo ip route add 172.16.11.0/24 via 172.16.10.2
[sudo] password for student:
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 172.16.10.2 dev enp2s0
student@CSELAB:~$
```

## R1:

```
student@CSELAB:~$ sudo ip route add 172.16.11.0/24 via 172.16.10.3
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 172.16.10.2  metric 100
172.16.11.0/24 via 172.16.10.3 dev enp2s0
```

## Hb:

```
@CSELAB: ~
student@CSELAB:~$ sudo ip route add 172.16.10.0/24 via 172.16.11.1
[sudo] password for student:
student@CSELAB:~$ ip route show
169.254.0.0/16 dev enp2s0  scope link  metric 1000
172.16.10.0/24 via 172.16.11.1 dev enp2s0
172.16.11.0/24 dev enp2s0  proto kernel  scope link  src 172.16.11.2  metric 100
student@CSELAB:~$
```

**Step 5: After adding routing table entries again verify the connection from Ha and Hb using ping command.**

**5.1 Opening Wireshark in all the systems to capture packets and set capture filter.**

**5.2 Testing path from Ha and Hd**

**Ha:**

```
student@CSELAB:~$ ping 172.16.11.2
PING 172.16.11.2 (172.16.11.2) 56(84) bytes of data.
From 172.16.10.2: icmp_seq=1 Redirect Host(New nexthop: 172.16.10.3)
64 bytes from 172.16.11.2: icmp_seq=1 ttl=63 time=1.32 ms
From 172.16.10.2: icmp_seq=2 Redirect Host(New nexthop: 172.16.10.3)
64 bytes from 172.16.11.2: icmp_seq=2 ttl=63 time=0.761 ms
From 172.16.10.2: icmp_seq=3 Redirect Host(New nexthop: 172.16.10.3)
64 bytes from 172.16.11.2: icmp_seq=3 ttl=63 time=0.670 ms
From 172.16.10.2: icmp_seq=4 Redirect Host(New nexthop: 172.16.10.3)
64 bytes from 172.16.11.2: icmp_seq=4 ttl=63 time=0.774 ms
From 172.16.10.2: icmp_seq=5 Redirect Host(New nexthop: 172.16.10.3)
64 bytes from 172.16.11.2: icmp_seq=5 ttl=63 time=0.831 ms
From 172.16.10.2: icmp_seq=6 Redirect Host(New nexthop: 172.16.10.3)
64 bytes from 172.16.11.2: icmp_seq=6 ttl=63 time=0.763 ms
64 bytes from 172.16.11.2: icmp_seq=7 ttl=63 time=0.768 ms
From 172.16.10.2: icmp_seq=8 Redirect Host(New nexthop: 172.16.10.3)
64 bytes from 172.16.11.2: icmp_seq=8 ttl=63 time=0.678 ms
64 bytes from 172.16.11.2: icmp_seq=9 ttl=63 time=0.615 ms
64 bytes from 172.16.11.2: icmp_seq=10 ttl=63 time=0.688 ms
From 172.16.10.2: icmp_seq=11 Redirect Host(New nexthop: 172.16.10.3)
64 bytes from 172.16.11.2: icmp_seq=11 ttl=63 time=0.724 ms
64 bytes from 172.16.11.2: icmp_seq=12 ttl=63 time=0.672 ms
64 bytes from 172.16.11.2: icmp_seq=13 ttl=63 time=0.671 ms
64 bytes from 172.16.11.2: icmp_seq=14 ttl=63 time=0.723 ms
64 bytes from 172.16.11.2: icmp_seq=15 ttl=63 time=0.593 ms
64 bytes from 172.16.11.2: icmp_seq=16 ttl=63 time=0.656 ms
From 172.16.10.2: icmp_seq=17 Redirect Host(New nexthop: 172.16.10.3)
64 bytes from 172.16.11.2: icmp_seq=17 ttl=63 time=0.493 ms
^C
--- 172.16.11.2 ping statistics ---
17 packets transmitted, 17 received, 0% packet loss, time 15999ms
rtt min/avg/max/mdev = 0.493/0.729/1.326/0.171 ms
student@CSELAB:~$
```

## 5.3 Capture packets in all systems

**Ha:**

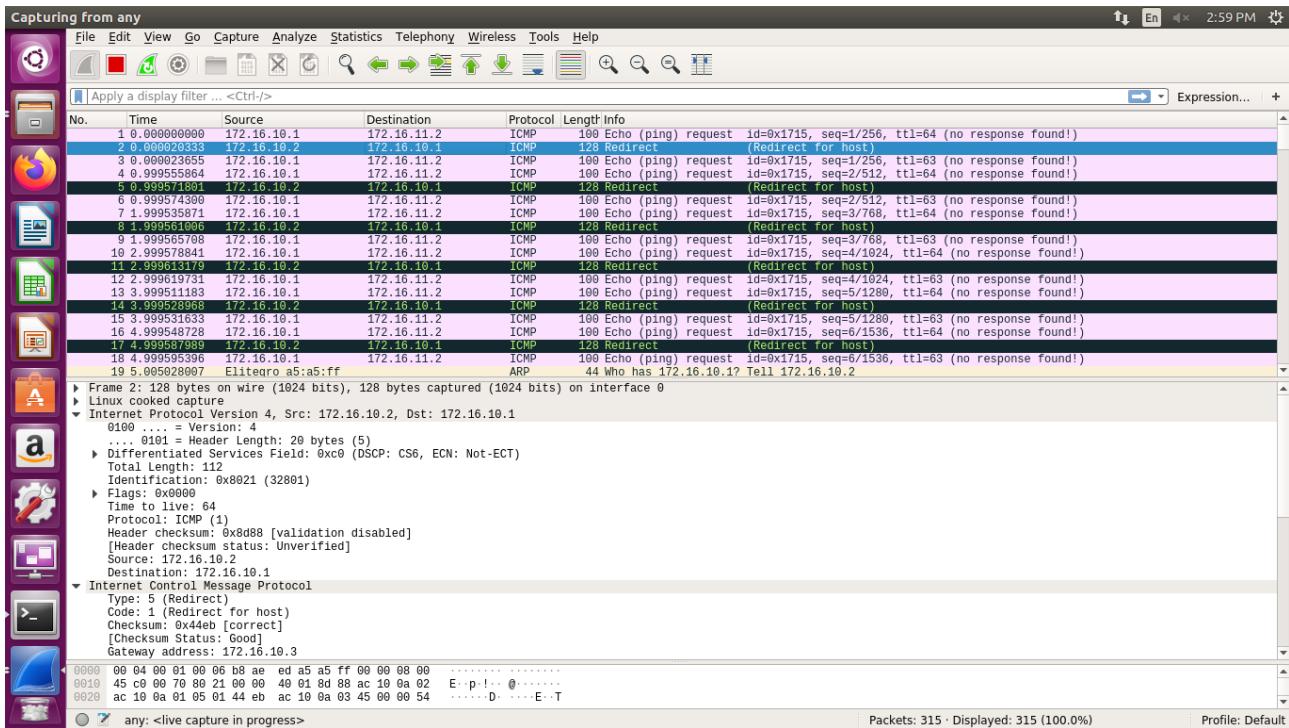
Apply a display filter ... <Ctrl-/>						
No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000000	172.16.10.1	172.16.11.2	ICMP	100	Echo (ping) request id=0x1715, seq=1/256, ttl=64 (reply in 3)
2	0.000283540	172.16.10.2	172.16.10.1	ICMP	128	Redirect (Redirect for host)
3	0.000636837	172.16.11.2	172.16.10.1	ICMP	100	Echo (ping) reply id=0x1715, seq=1/256, ttl=63 (request in 1)
4	0.999601191	172.16.10.1	172.16.11.2	ICMP	100	Echo (ping) request id=0x1715, seq=2/512, ttl=64 (reply in 6)
5	0.999744550	172.16.10.2	172.16.10.1	ICMP	128	Redirect (Redirect for host)
6	1.000205660	172.16.11.2	172.16.10.1	ICMP	100	Echo (ping) reply id=0x1715, seq=2/512, ttl=63 (request in 4)
7	1.999530671	172.16.10.1	172.16.11.2	ICMP	100	Echo (ping) request id=0x1715, seq=3/768, ttl=64 (reply in 9)
8	1.999846640	172.16.10.2	172.16.10.1	ICMP	128	Redirect (Redirect for host)
9	2.000144421	172.16.11.2	172.16.10.1	ICMP	100	Echo (ping) reply id=0x1715, seq=3/768, ttl=63 (request in 7)
10	2.999563615	172.16.10.1	172.16.11.2	ICMP	100	Echo (ping) request id=0x1715, seq=4/1024, ttl=64 (reply in 12)
11	2.999895419	172.16.10.2	172.16.10.1	ICMP	128	Redirect (Redirect for host)
12	3.000169741	172.16.11.2	172.16.10.1	ICMP	100	Echo (ping) reply id=0x1715, seq=4/1024, ttl=63 (request in 10)
13	3.999517672	172.16.10.1	172.16.11.2	ICMP	100	Echo (ping) request id=0x1715, seq=5/1280, ttl=64 (reply in 15)
14	3.999778678	172.16.10.2	172.16.10.1	ICMP	128	Redirect (Redirect for host)

Protocol: IPv4 (0x0800)

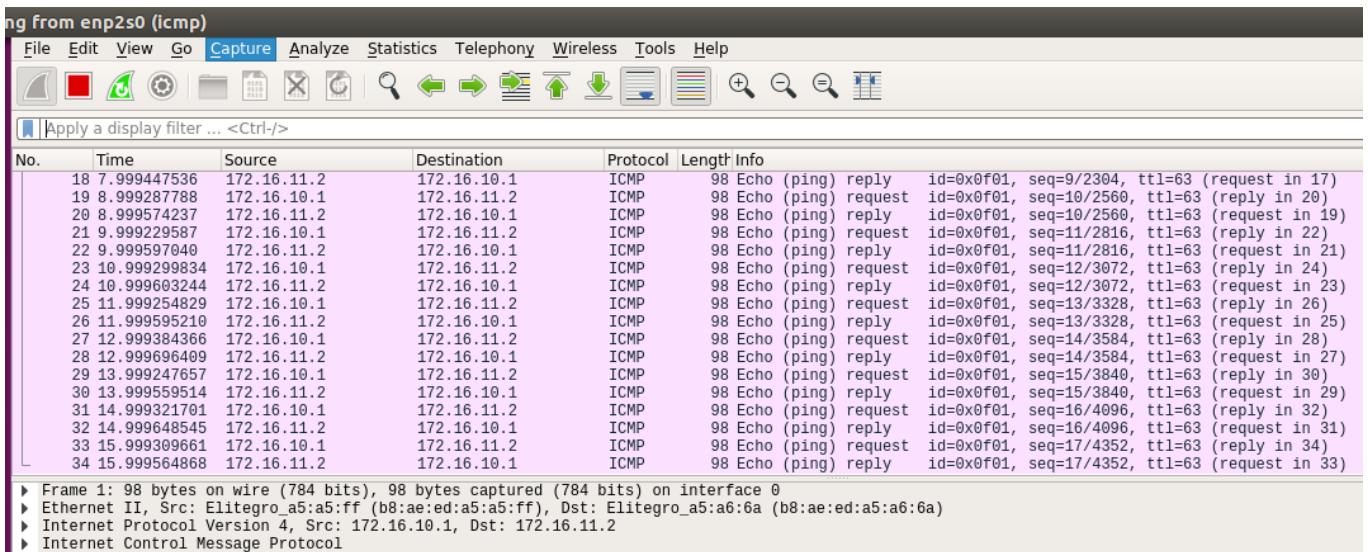
Internet Protocol Version 4, Src: 172.16.10.1, Dst: 172.16.11.2

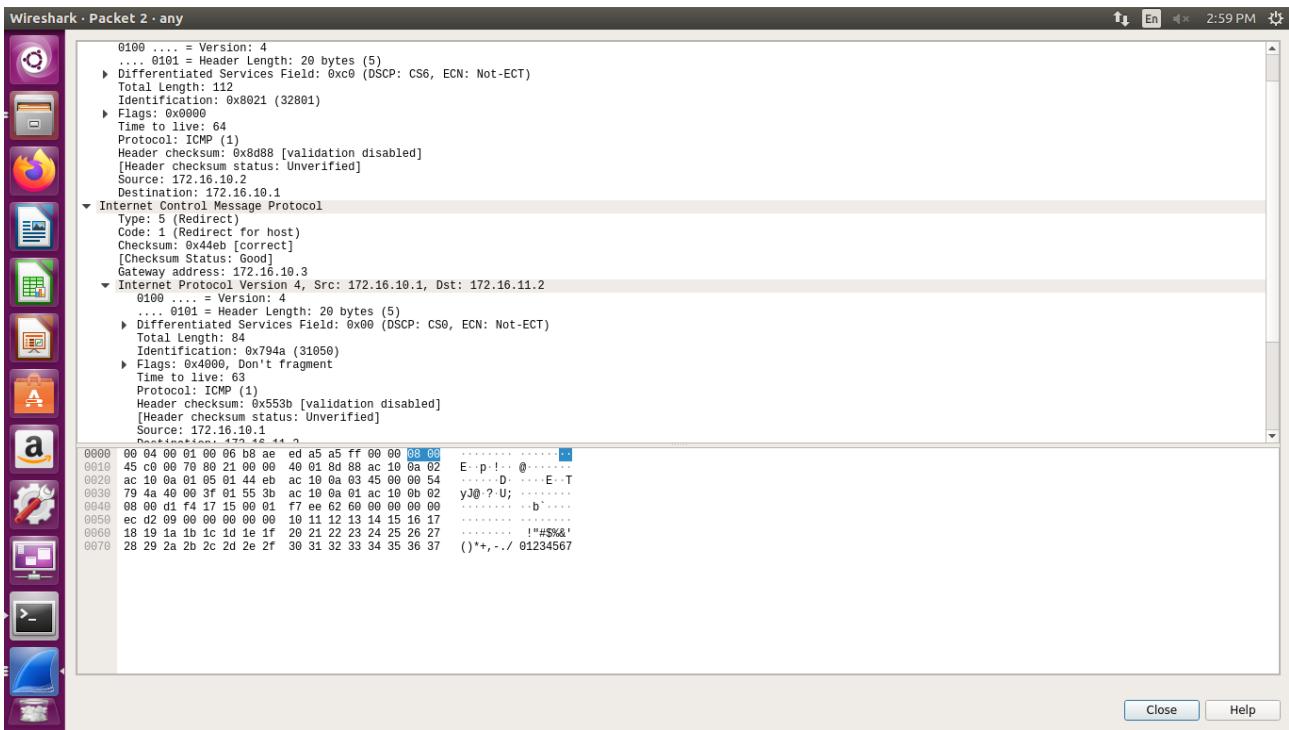
0100 .... = Version: 4  
.... 0101 = Header Length: 20 bytes (5)  
► Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)  
Total Length: 84  
Identification: 0x794a (31050)  
► Flags: 0x4000, Don't fragment  
Time to live: 64  
Protocol: ICMP (1)  
Header checksum: 0x543b [validation disabled]  
[Header checksum status: Unverified]  
Source: 172.16.10.1  
Destination: 172.16.11.2  
Internet Control Message Protocol

# R1:



# R2:





Hb:

Capturing from any

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000000	172.16.10.1	172.16.11.2	ICMP	100	Echo (ping) request id=0x1715, seq=1/256, ttl=62
2	0.000036539	172.16.11.2	172.16.10.1	ICMP	100	Echo (ping) reply id=0x1715, seq=1/256, ttl=64
3	0.999512561	172.16.10.1	172.16.11.2	ICMP	100	Echo (ping) request id=0x1715, seq=2/512, ttl=62
4	0.999532440	172.16.11.2	172.16.10.1	ICMP	100	Echo (ping) reply id=0x1715, seq=2/512, ttl=64
5	1.999502432	172.16.10.1	172.16.11.2	ICMP	100	Echo (ping) request id=0x1715, seq=3/768, ttl=62
6	1.999525124	172.16.11.2	172.16.10.1	ICMP	100	Echo (ping) reply id=0x1715, seq=3/768, ttl=64
7	2.999526913	172.16.10.1	172.16.11.2	ICMP	100	Echo (ping) request id=0x1715, seq=4/1024, ttl=62
8	2.999543392	172.16.11.2	172.16.10.1	ICMP	100	Echo (ping) reply id=0x1715, seq=4/1024, ttl=64
9	3.999417390	172.16.10.1	172.16.11.2	ICMP	100	Echo (ping) request id=0x1715, seq=5/1280, ttl=62
10	3.999435754	172.16.11.2	172.16.10.1	ICMP	100	Echo (ping) reply id=0x1715, seq=5/1280, ttl=64
11	4.999499498	172.16.10.1	172.16.11.2	ICMP	100	Echo (ping) request id=0x1715, seq=6/1536, ttl=62
12	4.999530111	172.16.11.2	172.16.10.1	ICMP	100	Echo (ping) reply id=0x1715, seq=6/1536, ttl=64
13	5.000500104	Elitegro_a5:a6:6a		ARP	62	Who has 172.16.11.2? Tell 172.16.11.1
14	5.0005033094	Elitegro_a5:a5:d9		ARP	44	172.16.11.2 is at b8:ae:ed:a5:a5:d9
15	5.999429619	172.16.10.1	172.16.11.2	ICMP	100	Echo (ping) request id=0x1715, seq=7/1792, ttl=62
16	5.999464972	172.16.11.2	172.16.10.1	ICMP	100	Echo (ping) reply id=0x1715, seq=7/1792, ttl=64
17	6.999544022	172.16.10.1	172.16.11.2	ICMP	100	Echo (ping) request id=0x1715, seq=8/2048, ttl=62
18	6.999563646	172.16.11.2	172.16.10.1	ICMP	100	Echo (ping) reply id=0x1715, seq=8/2048, ttl=64
19	7.999493384	172.16.10.1	172.16.11.2	ICMP	100	Echo (ping) request id=0x1715, seq=9/2304, ttl=62
20	7.999513274	172.16.11.2	172.16.10.1	ICMP	100	Echo (ping) reply id=0x1715, seq=9/2304, ttl=64
21	8.999537421	172.16.10.1	172.16.11.2	ICMP	100	Echo (ping) request id=0x1715, seq=10/2560, ttl=62
22	8.999563154	172.16.11.2	172.16.10.1	ICMP	100	Echo (ping) reply id=0x1715, seq=10/2560, ttl=64

Frame 1: 100 bytes on wire (800 bits), 100 bytes captured (800 bits) on interface 0  
 ► Linux cooked capture  
 ► Internet Protocol Version 4, Src: 172.16.10.1, Dst: 172.16.11.2  
 ► Internet Control Message Protocol

```

0000 00 00 00 01 00 06 b8 ae ed a5 a6 6a 00 00 08 00  ....j.....
0010 45 00 00 54 79 4a 40 00 3e 01 56 3b ac 10 0a 01 E..TyJ@>V;...
0020 ac 10 00 02 08 00 d1 f4 17 15 00 01 f7 ee 62 60 .....b`....
0030 00 00 00 00 ec d2 09 00 00 00 00 00 10 11 12 13 .....
0040 14 15 16 17 18 19 1a 1b 1c 1d 1e 1f 20 21 22 23 ....!#...
0050 24 25 26 27 28 29 2a 2b 2c 2d 2e 2f 30 31 32 33 $%&'()++ ,./0123
0060 34 35 36 37 4567
  
```

## Step 6: Checking each system's neighbours to verify the connection

Ha:

```
student@CSELAB:~$ ip neigh show
202.138.96.2 dev enp2s0 FAILED
172.16.10.3 dev enp2s0 lladdr b8:ae:ed:a5:a5:c6 REACHABLE
192.168.3.5 dev enp2s0 FAILED
172.16.10.2 dev enp2s0 lladdr b8:ae:ed:a4:86:33 STALE
202.138.103.100 dev enp2s0 FAILED
4.2.2.2 dev enp2s0 FAILED
student@CSELAB:~$
```

R1:

```
student@CSELAB:~$ ip neigh show
172.16.10.3 dev enp2s0 lladdr b8:ae:ed:a5:a6:6a REACHABLE
172.16.10.1 dev enp2s0 lladdr b8:ae:ed:a5:a5:24 REACHABLE
student@CSELAB:~$
```

R2:

```
net.ipv4.ip_forward = 1
student@CSELAB:~$ ip neigh show
172.16.10.2 dev enp2s0 lladdr b8:ae:ed:a5:a5:ff STALE
172.16.11.2 dev enx00594d6ea7c2 lladdr b8:ae:ed:a5:a5:d9 STALE
172.16.10.1 dev enp2s0 lladdr b8:ae:ed:a5:a5:24 STALE
student@CSELAB:~$ ip neigh show
172.16.10.2 dev enp2s0 lladdr b8:ae:ed:a5:a5:ff STALE
172.16.11.2 dev enx00594d6ea7c2 lladdr b8:ae:ed:a5:a5:d9 REACHABLE
172.16.10.1 dev enp2s0 lladdr b8:ae:ed:a5:a5:24 REACHABLE
```

Hb:

```
student@CSELAB:~$ ip neigh show
172.16.11.1 dev enp2s0 lladdr 00:59:4d:6e:a7:c2 REACHABLE
```

## **PORT Unreachable**

**Hb:**

```
student@CSELAB:~$ nc -l 1002
nc: Permission denied
student@CSELAB:~$ sudo nc -l 1002
[sudo] password for student:
abcdef
[
```

**Ha:**

