Computer Networks Lab

Week 10

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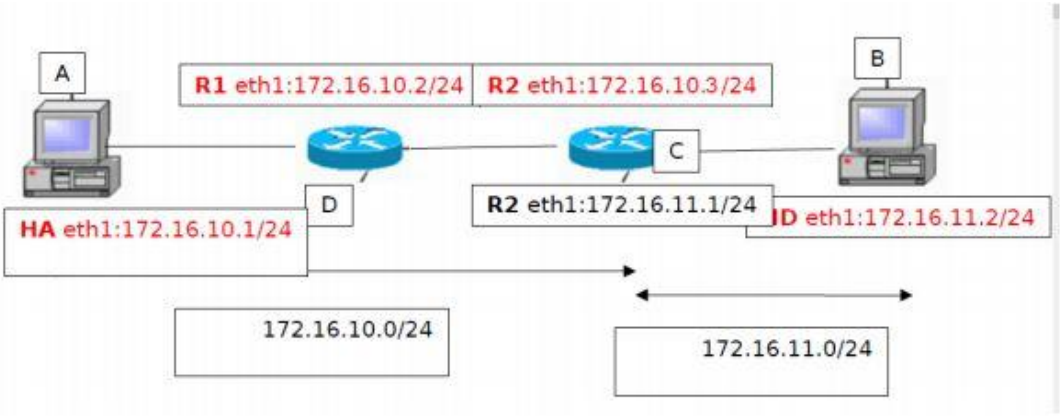
Section : A

Topology :



Step 1: Assign IP addresses to each computer

At Ha:

$ sudo ip addr add 172.16.10.1/24 dev enp1s0

$ ip addr show

```
student@pesu-OptiPlex-3070:~$ sudo ip addr add 172.16.10.1/24 dev enp1s0
student@pesu-OptiPlex-3070:~$ ip addr show
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
    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: enp1s0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
    link/ether 00:4e:01:a0:b6:31 brd ff:ff:ff:ff:ff:ff
    inet 172.16.10.1/24 scope global enp1s0
       valid_lft forever preferred_lft forever
student@pesu-OptiPlex-3070:~$
```

At Hd:

$ sudo ip addr add 172.16.11.2/24 dev enp1s0

$ ip addr show

```
student@pesu-OptiPlex-3070:~$ sudo ip addr add 172.16.11.2/24 dev enp1s0
student@pesu-OptiPlex-3070:~$ ifconfig
enp1s0    Link encap:Ethernet  HWaddr 00:4e:01:a3:dc:b4
          inet addr:172.16.11.2  Bcast:0.0.0.0  Mask:255.255.255.0
          inet6 addr: fe80::bcee:9544:e810:966/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:42153 errors:0 dropped:0 overruns:0 frame:0
          TX packets:9601 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:25182415 (25.1 MB)  TX bytes:967152 (967.1 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:3677 errors:0 dropped:0 overruns:0 frame:0
          TX packets:3677 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:338571 (338.5 KB)  TX bytes:338571 (338.5 KB)
```

At R2:

$ sudo ip addr add 172.16.11.1/24 dev enx4ce17342f08a

$ sudo ip addr add 172.16.10.3 /24 dev enp1s0

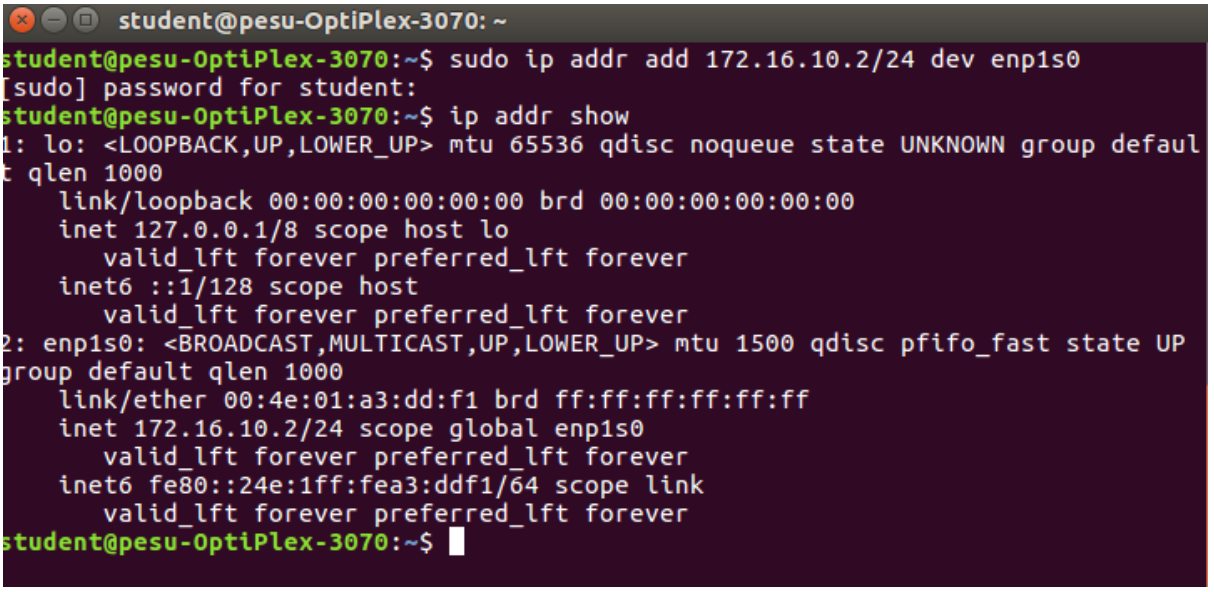
$ ip addr show

```
student@pesu-OptiPlex-3070: ~
a
student@pesu-OptiPlex-3070:~$ sudo ip addr add 172.16.10.3 /24 dev enp1s0
Error: either "local" is duplicate, or "/24" is a garbage.
student@pesu-OptiPlex-3070:~$ sudo ip addr add 172.16.10.3/24 dev enp1s0
student@pesu-OptiPlex-3070:~$ ip addr show
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group defaul
t qlen 1000
    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: enp1s0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP
group default qlen 1000
    link/ether 00:4e:01:9a:ae:6e brd ff:ff:ff:ff:ff:ff
    inet 172.16.10.3/24 scope global enp1s0
       valid_lft forever preferred_lft forever
    inet6 fe80::24e:1ff:fe9a:ae6e/64 scope link
       valid_lft forever preferred_lft forever
3: enx4ce17342f08a: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast
state UP group default qlen 1000
    link/ether 4c:e1:73:42:f0:8a brd ff:ff:ff:ff:ff:ff
    inet 172.16.11.1/24 scope global enx4ce17342f08a
       valid_lft forever preferred_lft forever
    inet6 fe80::4ee1:73ff:fe42:f08a/64 scope link
       valid_lft forever preferred_lft forever
student@pesu-OptiPlex-3070:~$
```

At R1:

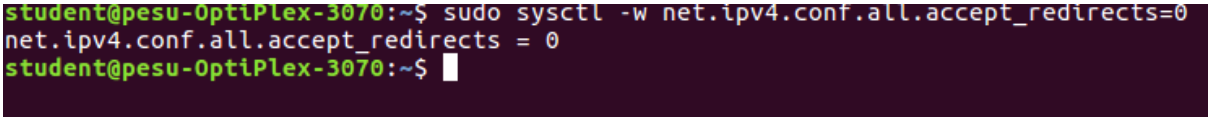
$ sudo ip addr add 172.16.10.2/24 dev enp1s0

$ ip addr show

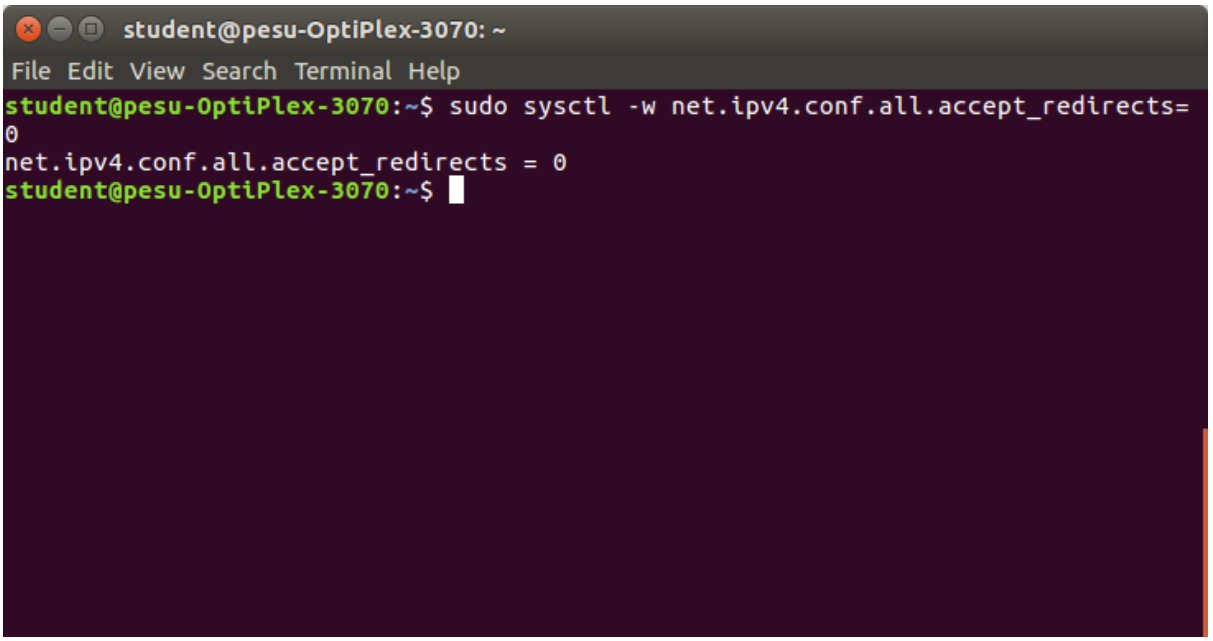


The machines are physically on the same LAN, thus you may get ICMP redirect messages from other machines (in case you make some configuration mistakes), so as a precautionary measure disable accepting the ICMP Redirect packets. By default, the linux enables accepting the ICMP redirect packets. To have precautionary measures issue below the command line in Ha and Hd.

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



At Ha



At Hd

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

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

```
student@pesu-OptiPlex-3070:~$ sudo sysctl -w net.ipv4.conf.all.send_redirects=0
net.ipv4.conf.all.send_redirects = 0
student@pesu-OptiPlex-3070:~$
```

At R1

```
student@pesu-OptiPlex-3070:~$ sudo sysctl -w net.ipv4.conf.all.send_redirects=0
net.ipv4.conf.all.send_redirects = 0
student@pesu-OptiPlex-3070:~$
```

At R2

Step 2: Convert C and D systems into routers R2 and R1 respectively by issuing below command.

We need to query the sysctl kernel value net.ipv4.ip_forward to see if forwarding is enabled or not.

$ sysctl net.ipv4.ip_forward

Other alternative to check out if IP forwarding is enabled or not through the value in the /proc system:

$ cat /proc/sys/net/ipv4/ip_forward

```
student@pesu-OptiPlex-3070:~$ sysctl net.ipv4.ip_forward
net.ipv4.ip_forward = 0
student@pesu-OptiPlex-3070:~$ cat /proc/sys/net/ipv4/ip_forward
0
```

The above command response states that forwarding is not enabled. So, we need to set ip_forward=1 to carry out IP forwarding.

Command to set the value of net.ipv4.ip_forward is as given below:

At R1:

$ sudo sysctl –w net.ipv4.ip_forward=1

At R2:

$ sudo sysctl –w net.ipv4.ip_forward=1

```
student@pesu-OptiPlex-3070:~$ sudo sysctl -w net.ipv4.ip_forward=1
net.ipv4.ip_forward = 1
student@pesu-OptiPlex-3070:~$
```

Step 3: Verify the Local Network connection using ping command

At Ha:

$ ping 172.16.10.1(Local network)

```
student@pesu-OptiPlex-3070:~$ 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=0.058 ms
64 bytes from 172.16.10.1: icmp_seq=2 ttl=64 time=0.050 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=0.050 ms
64 bytes from 172.16.10.1: icmp_seq=5 ttl=64 time=0.044 ms
64 bytes from 172.16.10.1: icmp_seq=6 ttl=64 time=0.050 ms
^C
--- 172.16.10.1 ping statistics ---
6 packets transmitted, 6 received, 0% packet loss, time 5117ms
rtt min/avg/max/mdev = 0.044/0.050/0.058/0.007 ms
```

At Hd:

$ ping 172.16.11.1(Local network)

```
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=64 time=0.647 ms
64 bytes from 172.16.11.1: icmp_seq=2 ttl=64 time=0.769 ms
64 bytes from 172.16.11.1: icmp_seq=3 ttl=64 time=0.866 ms
64 bytes from 172.16.11.1: icmp_seq=4 ttl=64 time=0.764 ms
64 bytes from 172.16.11.1: icmp_seq=5 ttl=64 time=0.730 ms
64 bytes from 172.16.11.1: icmp_seq=6 ttl=64 time=0.861 ms
64 bytes from 172.16.11.1: icmp_seq=7 ttl=64 time=0.871 ms
64 bytes from 172.16.11.1: icmp_seq=8 ttl=64 time=0.847 ms
^C
--- 172.16.11.1 ping statistics ---
8 packets transmitted, 8 received, 0% packet loss, time 7161ms
rtt min/avg/max/mdev = 0.647/0.794/0.871/0.079 ms
```

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

At Ha:

$ sudo ip route add 172.16.11.0/24 via 172.16.10.2

$ ip route show

```
student@pesu-OptiPlex-3070:~$ sudo ip route add 172.16.11.0/24 via 172.16.10.2
student@pesu-OptiPlex-3070:~$ ip route show
169.254.0.0/16 dev enp1s0  scope link  metric 1000
172.16.10.0/24 dev enp1s0  proto kernel  scope link  src 172.16.10.1
172.16.11.0/24 via 172.16.10.2 dev enp1s0
student@pesu-OptiPlex-3070:~$
```

At R1:

$ sudo ip route add 172.16.11.0/24 via 172.16.10.3

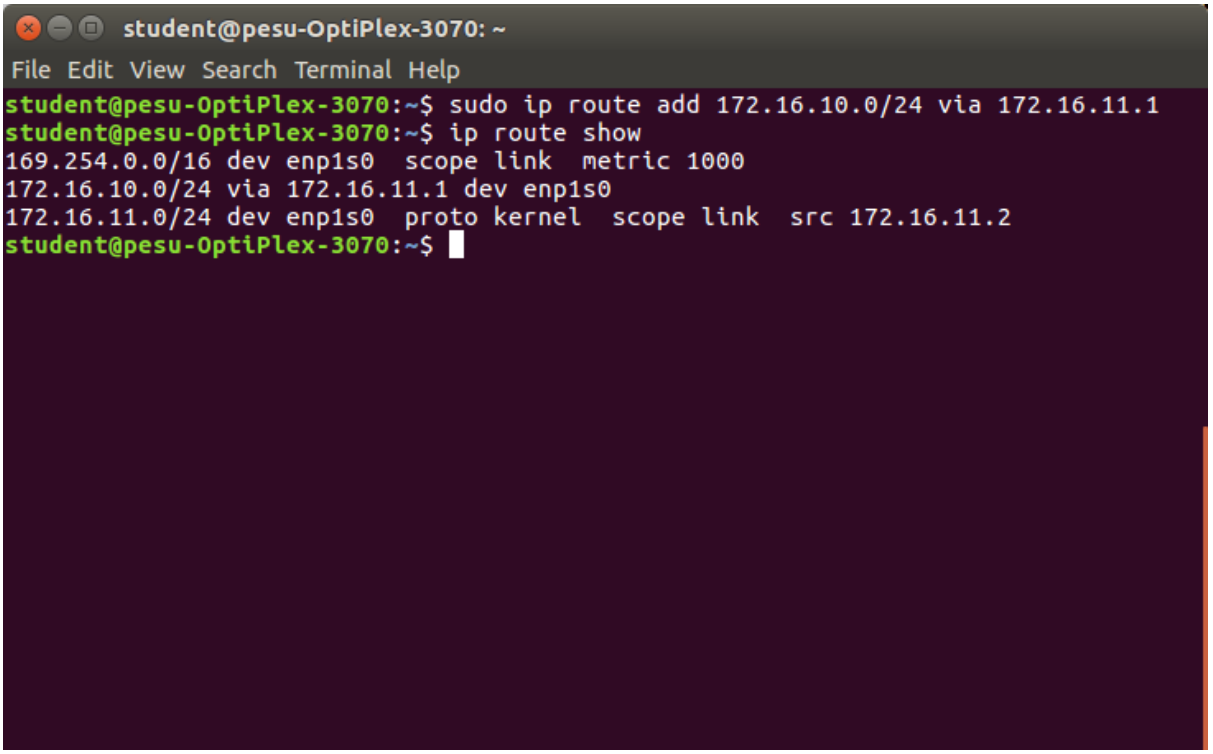
$ ip route show

```
student@pesu-OptiPlex-3070:~$ sudo ip route add 172.16.11.0/24 via 172.16.10.3
student@pesu-OptiPlex-3070:~$ ip route show
169.254.0.0/16 dev enp1s0  scope link  metric 1000
172.16.10.0/24 dev enp1s0  proto kernel  scope link  src 172.16.10.2
172.16.11.0/24 via 172.16.10.3 dev enp1s0
student@pesu-OptiPlex-3070:~$
```

At Hd:

$ sudo ip route add 172.16.10.0/24 via 172.16.11.1

$ ip route show



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

5.1 Testing path from Ha and Hd

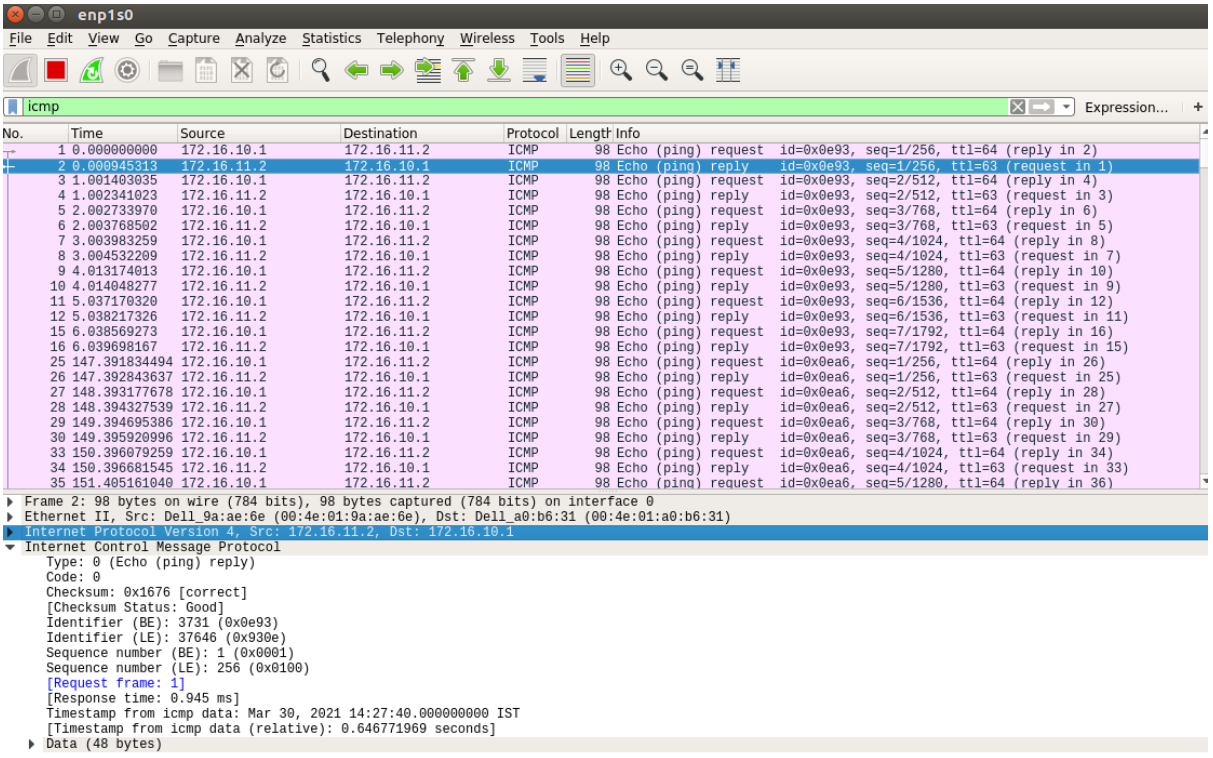
From Ha:

$ ping 172.16.11.2

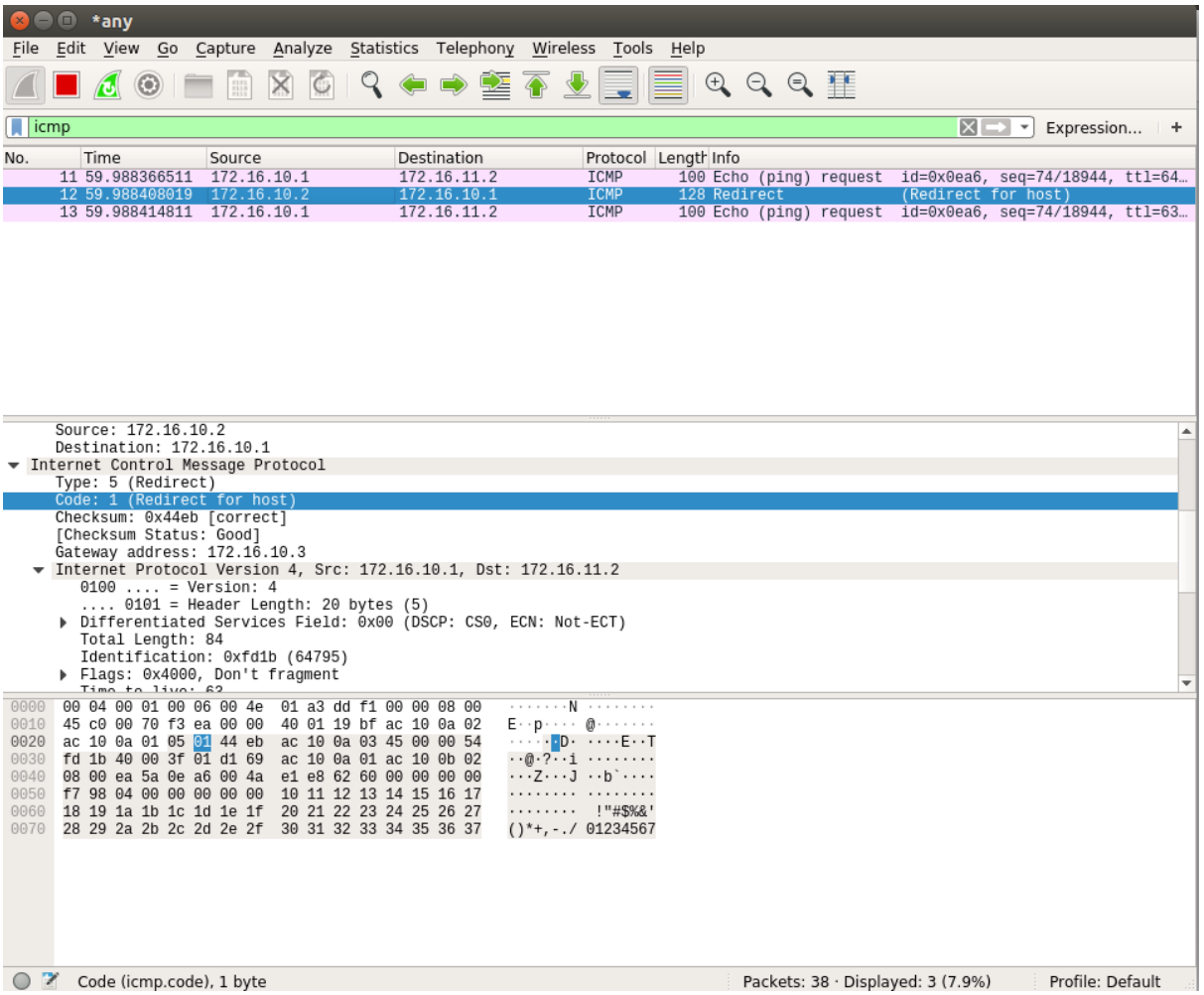
```
student@pesu-OptiPlex-3070:~$ ping 172.16.11.2
PING 172.16.11.2 (172.16.11.2) 56(84) bytes of data.
64 bytes from 172.16.11.2: icmp_seq=1 ttl=63 time=1.03 ms
64 bytes from 172.16.11.2: icmp_seq=2 ttl=63 time=1.18 ms
64 bytes from 172.16.11.2: icmp_seq=3 ttl=63 time=1.25 ms
64 bytes from 172.16.11.2: icmp_seq=4 ttl=63 time=0.633 ms
64 bytes from 172.16.11.2: icmp_seq=5 ttl=63 time=1.30 ms
64 bytes from 172.16.11.2: icmp_seq=6 ttl=63 time=1.16 ms
64 bytes from 172.16.11.2: icmp_seq=7 ttl=63 time=1.49 ms
64 bytes from 172.16.11.2: icmp_seq=8 ttl=63 time=1.28 ms
64 bytes from 172.16.11.2: icmp_seq=9 ttl=63 time=1.22 ms
64 bytes from 172.16.11.2: icmp_seq=10 ttl=63 time=1.02 ms
64 bytes from 172.16.11.2: icmp_seq=11 ttl=63 time=1.09 ms
64 bytes from 172.16.11.2: icmp_seq=12 ttl=63 time=1.17 ms
64 bytes from 172.16.11.2: icmp_seq=13 ttl=63 time=1.28 ms
64 bytes from 172.16.11.2: icmp_seq=14 ttl=63 time=1.44 ms
64 bytes from 172.16.11.2: icmp_seq=15 ttl=63 time=1.06 ms
64 bytes from 172.16.11.2: icmp_seq=16 ttl=63 time=0.723 ms
64 bytes from 172.16.11.2: icmp_seq=17 ttl=63 time=1.15 ms
64 bytes from 172.16.11.2: icmp_seq=18 ttl=63 time=0.955 ms
64 bytes from 172.16.11.2: icmp_seq=19 ttl=63 time=1.46 ms
64 bytes from 172.16.11.2: icmp_seq=20 ttl=63 time=1.14 ms
64 bytes from 172.16.11.2: icmp_seq=21 ttl=63 time=1.09 ms
64 bytes from 172.16.11.2: icmp_seq=22 ttl=63 time=0.802 ms
64 bytes from 172.16.11.2: icmp_seq=23 ttl=63 time=1.21 ms
64 bytes from 172.16.11.2: icmp_seq=24 ttl=63 time=0.695 ms
64 bytes from 172.16.11.2: icmp_seq=25 ttl=63 time=0.928 ms
64 bytes from 172.16.11.2: icmp_seq=26 ttl=63 time=0.746 ms
```

5.2 Capture packets in all systems using Wireshark

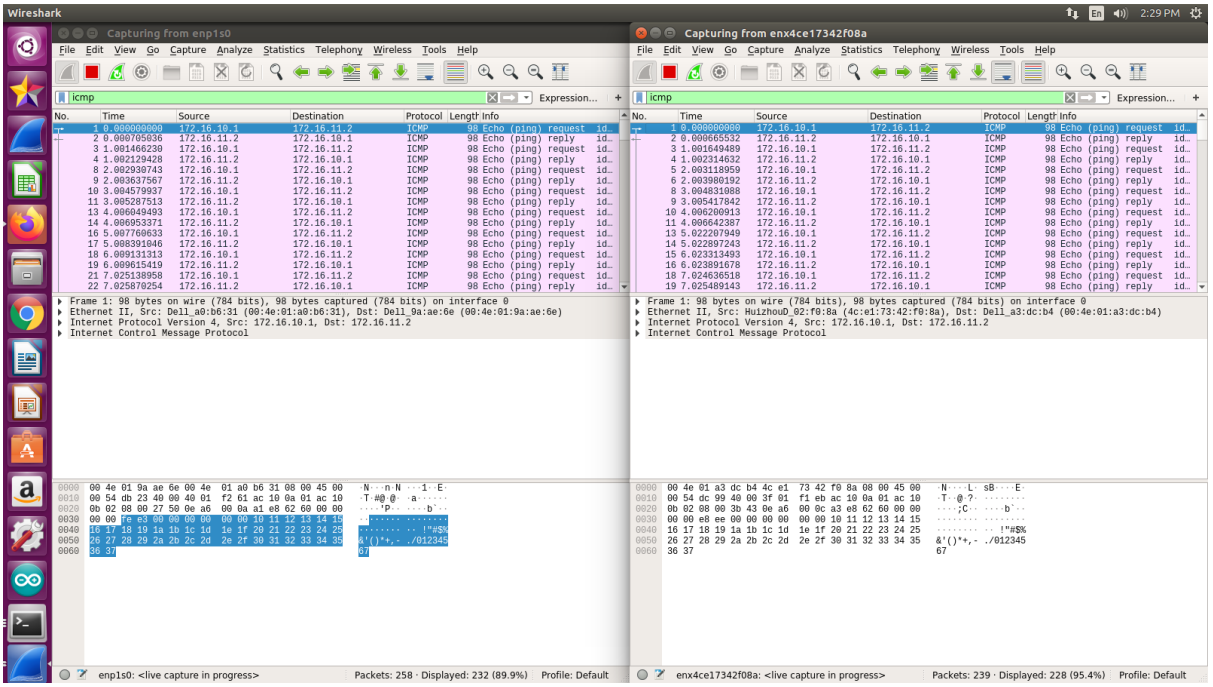
Ha:



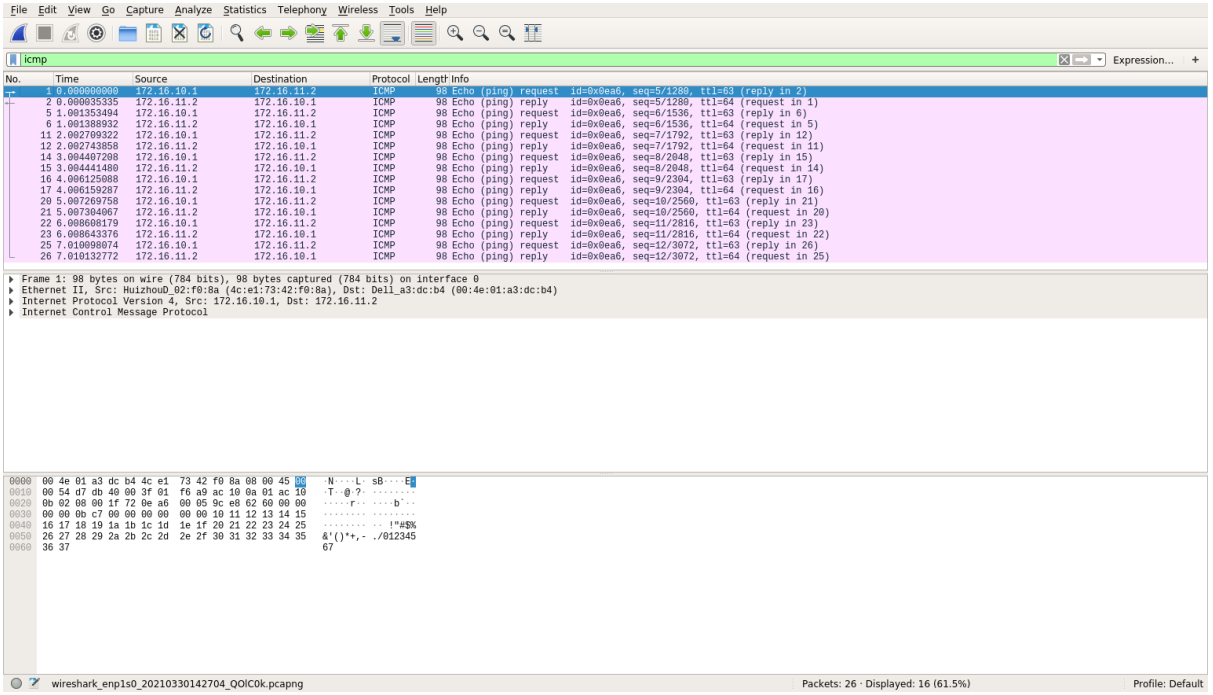
R1:


*any
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
icmp
Expression...
No. Time Source Destination Protocol Length Info
11 59.988366511 172.16.10.1 172.16.11.2 ICMP 100 Echo (ping) request id=0x0ea6, seq=74/18944, ttl=64…
12 59.988408019 172.16.10.2 172.16.10.1 ICMP 128 Redirect (Redirect for host)
13 59.988414811 172.16.10.1 172.16.11.2 ICMP 100 Echo (ping) request id=0x0ea6, seq=74/18944, ttl=63…
Source: 172.16.10.2
Destination: 172.16.10.1
Internet Control Message Protocol
Type: 5 (Redirect)
Code: 1 (Redirect for host)
Checksum: 0x44eb [correct]
[Checksum Status: Good]
Gateway address: 172.16.10.3
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: 0xfd1b (64795)
Flags: 0x4000, Don't fragment
0000 00 04 00 01 00 06 00 4e 01 a3 dd f1 00 00 08 00
0010 45 c0 00 70 f3 ea 00 00 40 01 19 bf ac 10 0a 02
0020 ac 10 0a 01 05 01 44 eb ac 10 0a 03 45 00 00 54
0030 fd 1b 40 00 3f 01 d1 69 ac 10 0a 01 ac 10 0b 02
0040 08 00 ea 5a 0e a6 00 4a e1 e8 62 60 00 00 00 00
0050 f7 98 04 00 00 00 00 00 10 11 12 13 14 15 16 17
0060 18 19 1a 1b 1c 1d 1e 1f 20 21 22 23 24 25 26 27
0070 28 29 2a 2b 2c 2d 2e 2f 30 31 32 33 34 35 36 37
Code (icmp.code), 1 byte
Packets: 38 · Displayed: 3 (7.9%)
Profile: Default

R2:

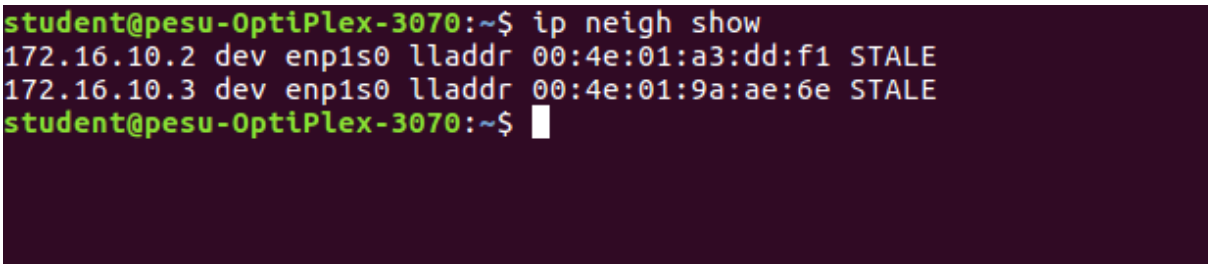

Wireshark
Capturing from enp1s0
Capturing from enx4ce17342f08a
enp1s0: <live capture in progress>
Packets: 258 · Displayed: 232 (89.9%)
Profile: Default
enx4ce17342f08a: <live capture in progress>
Packets: 239 · Displayed: 228 (95.4%)
Profile: Default

Hd:

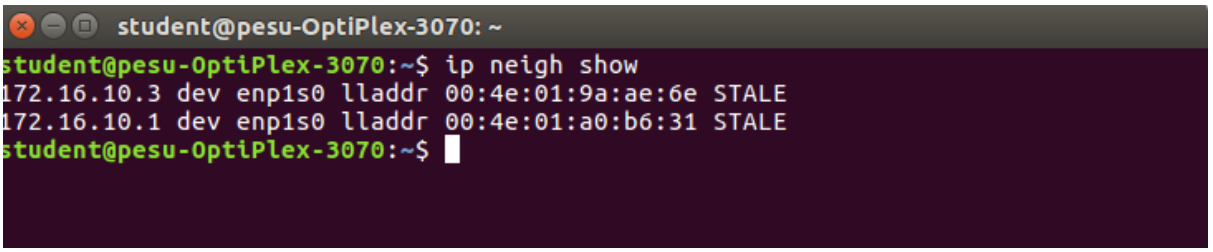


Step 6: Check each system neighbors to verify the connection

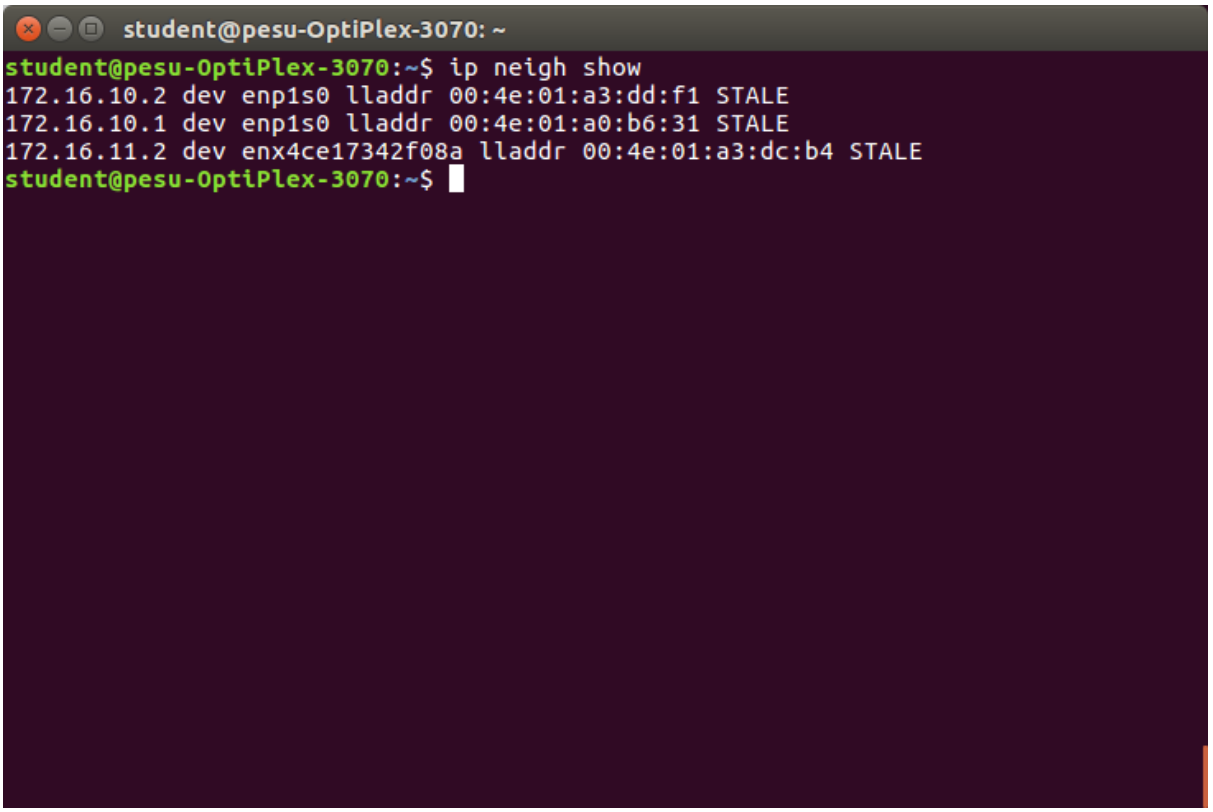
Ha: $ ip neigh show



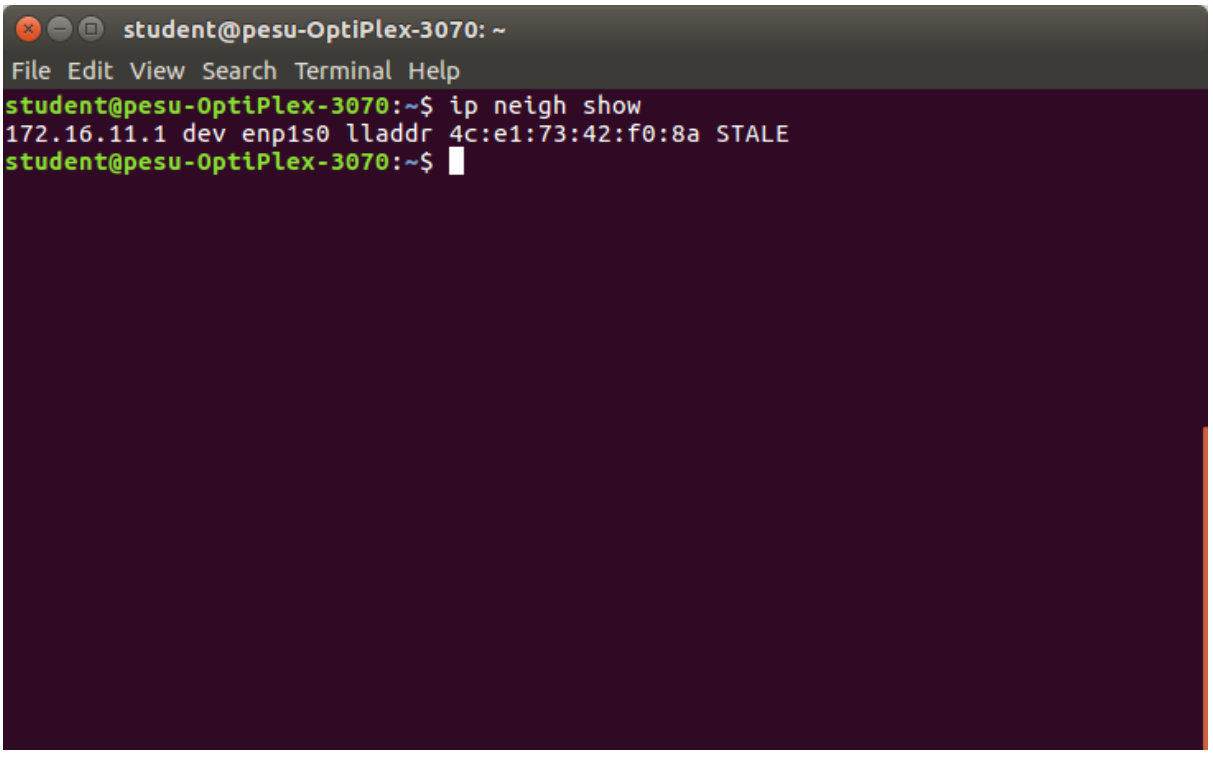
R1: $ ip neigh show



R2: $ ip neigh show



Hd: $ ip neigh show



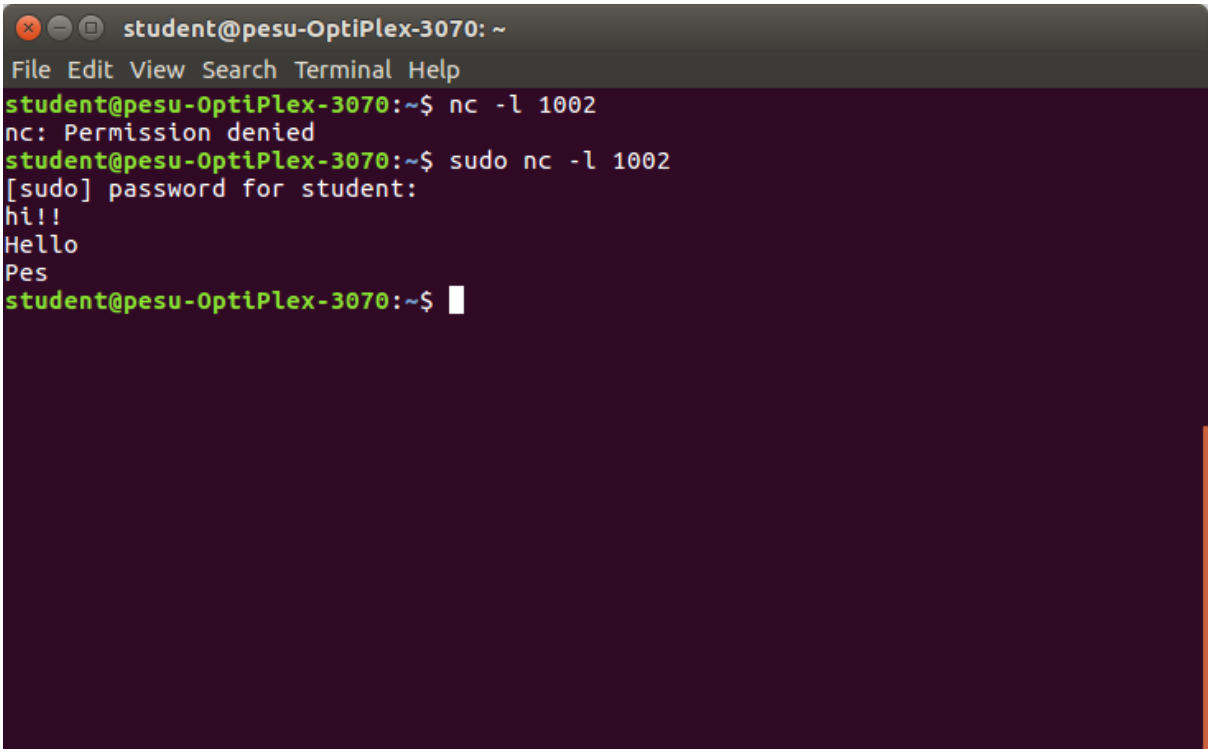
PORT Unreachable

We are trying to send data from System Ha and Hb using nc command. nc (or netcat) utility is used for just about anything under the sun involving TCP or UDP. It can open TCP connections, send UDP packets, listen on arbitrary TCP and UDP ports, do port scanning, and deal with both IPv4 and IPv6.

At Hb (172.16.11.2):

$ nc –l 1002

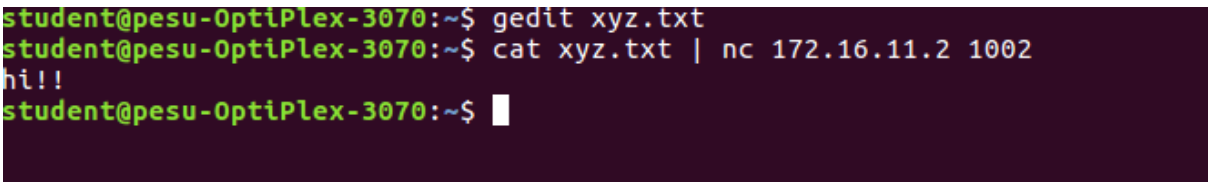
Here the Hd system acts as a server which is in listening mode through port 1002.



At Ha (172.16.10.2):

$ cat xyz.txt | nc 172.16.11.2 1002

Here Ha system acts as a client which is sending a file xyz.txt by identifying host 172.16.10.2 through port 1002.



Note: If we give the wrong port number which is not matching on both systems. Connection will fail and we get PORT UNREACHABLE error.