

Computer Networks Lab

Week 7

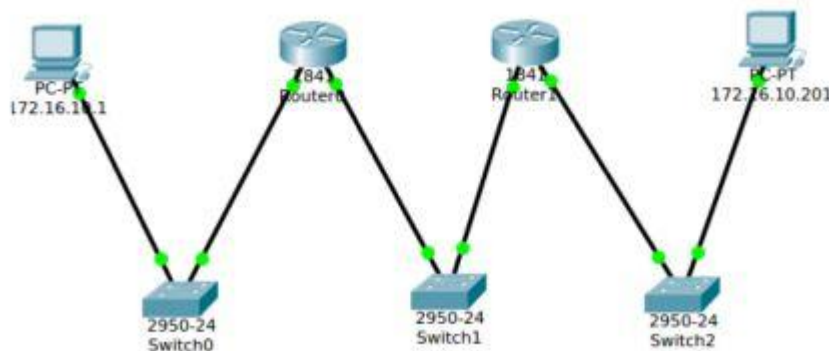
Name : Abhishek Aditya BS

SRN : PES1UG19CS019

Section : A

IPv4 Addressing and Static Routing

I. Topology



The following topology was used to rig up the network connections between four systems.

Task 1 : Assigning IP address to all four end systems (Ha,Hd,R1,R2)

1. Assign IP address to system Ha

The IP address on end system Ha were manually added using the Edit Connections Menu in Linux.

End System Ha was assigned the IP address **172.16.10.1/24**.

```
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:a0:6b:6f brd ff:ff:ff:ff:ff:ff
    inet 172.16.10.1/24 brd 172.16.10.255 scope global enp1s0
        valid_lft forever preferred_lft forever
    inet6 fe80::d633:3a8f:8d02:ff29/64 scope link
        valid_lft forever preferred_lft forever
student@pesu-OptiPlex-3070:~$
```

2. Assign IP address to system R1

On system R1, we will set the IP address manually. For the internal connection, we will use **172.16.10.201/24** as the IP address with the device being set as **enp1s0**.

For the external connection (connection between routers R1 and R2), we will use **172.16.11.1/24** as the IP address with the device being set as **enx00594d6e8e19**.

```
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:a4:1e:7b brd ff:ff:ff:ff:ff:ff
    inet 172.16.10.201/24 brd 172.16.10.255 scope global enp1s0
        valid_lft forever preferred_lft forever
    inet6 fe80::8aff:b205:d4e4:1d10/64 scope link
        valid_lft forever preferred_lft forever
3: enx00594d6e8e19: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
    link/ether 00:59:4d:6e:8e:19 brd ff:ff:ff:ff:ff:ff
    inet 172.16.11.1/24 brd 172.16.11.255 scope global enx00594d6e8e19
        valid_lft forever preferred_lft forever
    inet6 fe80::e2df:1b81:5fb2:c84f/64 scope link
        valid_lft forever preferred_lft forever
```

3. Assign IP address to system R2

On system R2, we will set the IP address manually as we did for others. For internal connection, we will use **172.16.12.1/24** as the IP address with the device being set as **enp1s0**.

For the external connection, we will use **172.16.11.201/24** as the IP address with the device being set as **enx000ec6877201**.

```
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:a0:63:92 brd ff:ff:ff:ff:ff:ff
    inet 172.16.12.1/24 brd 172.16.12.255 scope global enp1s0
        valid_lft forever preferred_lft forever
    inet6 fe80::e853:1969:648b:2214/64 scope link
        valid_lft forever preferred_lft forever
3: enx000ec6877201: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
    link/ether 00:0e:c6:87:72:01 brd ff:ff:ff:ff:ff:ff
    inet 172.16.11.201/24 brd 172.16.11.255 scope global enx000ec6877201
        valid_lft forever preferred_lft forever
    inet6 fe80::177f:1a1d:d40:ff64/64 scope link
        valid_lft forever preferred_lft forever
```

4. Assign IP address to end system Hd

On system Hd, we will set the IP address as **172.16.12.201/24** using the manual method.

Finally, on host machines Ha and Hd, we will type the following command, `$ sudo sysctl -w net.ipv4.conf.all.accept_redirects=0`. This will disable accepting the ICMP redirect packets.

Similarly, on the systems R1 and R2, we will type the following command, `$ sudo sysctl -w net.ipv4.conf.all.send_redirects=0`. This will disable sending of the ICMP redirect packets by these routers with aliased interfaces.

Task 2 : Converting systems R1 and R2 to routers

In both the systems, we will enable IP forwarding. To do this, we will execute the command, `$ sudo sysctl -w net.ipv4.ip_forward=1` on both the systems.

Task 3 : Verify the connection between Ha and Hd

Testing the connection of systems within the same networks.

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

```
student@pesu-OptiPlex-3070:~$ ping -c 3 172.16.10.1
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=1.72 ms
64 bytes from 172.16.10.1: icmp_seq=2 ttl=62 time=1.68 ms
64 bytes from 172.16.10.1: icmp_seq=3 ttl=62 time=1.29 ms

--- 172.16.10.1 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2004ms
rtt min/avg/max/mdev = 1.290/1.566/1.724/0.201 ms
```

At Hd : `$ ping 172.16.12.1` (local network)

```
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_seq=1 ttl=64 time=0.301 ms
64 bytes from 172.16.12.1: icmp_seq=2 ttl=64 time=0.229 ms
64 bytes from 172.16.12.1: icmp_seq=3 ttl=64 time=0.220 ms
64 bytes from 172.16.12.1: icmp_seq=4 ttl=64 time=0.234 ms
64 bytes from 172.16.12.1: icmp_seq=5 ttl=64 time=0.227 ms
64 bytes from 172.16.12.1: icmp_seq=6 ttl=64 time=0.247 ms
64 bytes from 172.16.12.1: icmp_seq=7 ttl=64 time=0.248 ms
64 bytes from 172.16.12.1: icmp_seq=8 ttl=64 time=0.247 ms
64 bytes from 172.16.12.1: icmp_seq=9 ttl=64 time=0.251 ms
^C
--- 172.16.12.1 ping statistics ---
9 packets transmitted, 9 received, 0% packet loss, time 7999ms
rtt min/avg/max/mdev = 0.220/0.244/0.301/0.030 ms
```

Task 4 : Insert routing table entries on each system to direct IPv4 packets to ping across the networks.

In order for packets to be able to reach other end systems, we need to add routing tables to both the routers and both the end systems as well.

At Ha : The following commands were entered.

\$ 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

```
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 172.16.10.201 dev enp1s0
172.16.12.0/24 via 172.16.10.201 dev enp1s0
```

At R1 : The following commands were entered

\$ sudo ip route add 172.16.12.0/24 via 172.16.11.201

\$ ip route show

```
student@pesu-OptiPlex-3070:~$ sudo ip route add 172.16.12.0/24 via 172.16.11.201
student@pesu-OptiPlex-3070:~$ ip route show
169.254.0.0/16 dev enx00594d6e8e19 scope link metric 1000
172.16.10.0/24 dev enp1s0 proto kernel scope link src 172.16.10.201 metric 100
172.16.11.0/24 dev enx00594d6e8e19 proto kernel scope link src 172.16.11.1 metric 100
172.16.12.0/24 via 172.16.11.201 dev enx00594d6e8e19
student@pesu-OptiPlex-3070:~$ █
```

At R2 : The following commands were executed

\$ sudo ip route add 172.16.10.0/24 via 172.16.11.1

\$ ip route show

```
student@pesu-OptiPlex-3070:~$ ip route show
169.254.0.0/16 dev enp1s0 scope link metric 1000
172.16.10.0/24 via 172.16.11.1 dev enx000ec6877201
172.16.11.0/24 dev enx000ec6877201 proto kernel scope link src 172.16.11.201 metric 100
172.16.12.0/24 dev enp1s0 proto kernel scope link src 172.16.12.1 metric 100
```

At Hd : The following commands were executed

\$ 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

```
student@pesu-OptiPlex-3070:~$ ip route show
169.254.0.0/16 dev enp1s0 scope link metric 1000
172.16.10.0/24 via 172.16.12.1 dev enp1s0
172.16.11.0/24 via 172.16.12.1 dev enp1s0
172.16.12.0/24 dev enp1s0 proto kernel scope link src 172.16.12.201 metric 100
```


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

1. Testing connectivity between Ha and Hd

To test if all our configuration steps we performed above is correct or not, we will ping the other end system from the first end system

To do this, **\$ ping 172.16.12.201** was executed in the terminal of Ha

```
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=1.93 ms
64 bytes from 172.16.12.201: icmp_seq=2 ttl=62 time=1.42 ms
64 bytes from 172.16.12.201: icmp_seq=3 ttl=62 time=1.78 ms
64 bytes from 172.16.12.201: icmp_seq=4 ttl=62 time=2.16 ms
64 bytes from 172.16.12.201: icmp_seq=5 ttl=62 time=2.22 ms
64 bytes from 172.16.12.201: icmp_seq=6 ttl=62 time=2.01 ms
^C
--- 172.16.12.201 ping statistics ---
6 packets transmitted, 6 received, 0% packet loss, time 5007ms
rtt min/avg/max/mdev = 1.427/1.924/2.226/0.270 ms
```

2. Testing connectivity between Hd and Ha

To test the connectivity between Hd and Ha, we will ping Ha from Hd and check if we get a reply

```
student@pesu-OptiPlex-3070:~$ ping -c 3 172.16.10.1
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=1.72 ms
64 bytes from 172.16.10.1: icmp_seq=2 ttl=62 time=1.68 ms
64 bytes from 172.16.10.1: icmp_seq=3 ttl=62 time=1.29 ms

--- 172.16.10.1 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2004ms
rtt min/avg/max/mdev = 1.290/1.566/1.724/0.201 ms
```

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

To check the neighbor, we need to execute the command **\$ ip neigh show**

At Ha : **\$ ip neigh show**

```
student@pesu-OptiPlex-3070:~$ ip neigh show
172.16.10.201 dev enp1s0 lladdr 00:4e:01:a4:1e:7b STALE
student@pesu-OptiPlex-3070:~$
```

At R1 : **\$ ip neigh show**

```
student@pesu-OptiPlex-3070:~$ ip neigh show
172.16.10.1 dev enp1s0 lladdr 00:4e:01:a0:6b:6f STALE
172.16.11.201 dev enx00594d6e8e19 lladdr 00:0e:c6:87:72:01 STALE
student@pesu-OptiPlex-3070:~$
```

At R2 : \$ ip neigh show

```
student@pesu-OptiPlex-3070:~$ ip neigh show
172.16.12.201 dev enp1s0 lladdr 00:4e:01:a4:21:17 DELAY
172.16.11.1 dev enx000ec6877201 lladdr 00:59:4d:6e:8e:19 REACHABLE
student@pesu-OptiPlex-3070:~$
```

At Hd : \$ ip neigh show

```
student@pesu-OptiPlex-3070:~$ ip neigh
172.16.12.1 dev enp1s0 lladdr 00:4e:01:a0:63:92 REACHABLE
student@pesu-OptiPlex-3070:~$
```

Task 7 : Capture packets from Ha and Hd using WireShark

1. Capturing packets from Ha and Hd

To capture packets, we will open wireshark on all four systems and from Ha we will ping Hd (\$ ping 172.16.12.201)

```
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=1.93 ms
64 bytes from 172.16.12.201: icmp_seq=2 ttl=62 time=1.42 ms
64 bytes from 172.16.12.201: icmp_seq=3 ttl=62 time=1.78 ms
64 bytes from 172.16.12.201: icmp_seq=4 ttl=62 time=2.16 ms
64 bytes from 172.16.12.201: icmp_seq=5 ttl=62 time=2.22 ms
64 bytes from 172.16.12.201: icmp_seq=6 ttl=62 time=2.01 ms
^C
--- 172.16.12.201 ping statistics ---
6 packets transmitted, 6 received, 0% packet loss, time 5007ms
rtt min/avg/max/mdev = 1.427/1.924/2.226/0.270 ms
```

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000000	172.16.10.1	172.16.12.201	ICMP	100	Echo (ping) request id=0x09b2, seq=1/256, ttl=64 (reply in 2)
2	0.001740044	172.16.12.201	172.16.10.1	ICMP	100	Echo (ping) reply id=0x09b2, seq=1/256, ttl=62 (request in 1)
3	1.002118936	172.16.10.1	172.16.12.201	ICMP	100	Echo (ping) request id=0x09b2, seq=2/512, ttl=64 (reply in 4)
4	1.003935733	172.16.12.201	172.16.10.1	ICMP	100	Echo (ping) reply id=0x09b2, seq=2/512, ttl=62 (request in 3)
5	2.004390399	172.16.10.1	172.16.12.201	ICMP	100	Echo (ping) request id=0x09b2, seq=3/768, ttl=64 (reply in 6)
6	2.006281491	172.16.12.201	172.16.10.1	ICMP	100	Echo (ping) reply id=0x09b2, seq=3/768, ttl=62 (request in 5)
7	3.005483118	172.16.10.1	172.16.12.201	ICMP	100	Echo (ping) request id=0x09b2, seq=4/1024, ttl=64 (reply in 8)
8	3.007169313	172.16.12.201	172.16.10.1	ICMP	100	Echo (ping) reply id=0x09b2, seq=4/1024, ttl=62 (request in 7)
9	4.007601666	172.16.10.1	172.16.12.201	ICMP	100	Echo (ping) request id=0x09b2, seq=5/1280, ttl=64 (reply in 10)
10	4.009245465	172.16.12.201	172.16.10.1	ICMP	100	Echo (ping) reply id=0x09b2, seq=5/1280, ttl=62 (request in 9)
11	5.201834260	Dell_a4:1e:7b		ARP	62	Who has 172.16.10.1? Tell 172.16.10.201
12	5.201855844	Dell_a0:6b:6f		ARP	44	172.16.10.1 is at 00:4e:01:a0:6b:6f

▶ 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: 172.16.12.201

▶ Internet Control Message Protocol

At Ha - Wireshark Packet Capture, capturing packets during the ping operation

At R1 :

We will open wireshark in both the interfaces using by internal and external connections and observe the packets captured during ping operation from Ha to Hd

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000000	172.16.10.1	172.16.12.201	ICMP	98	Echo (ping) request id=0
2	0.001901841	172.16.12.201	172.16.10.1	ICMP	98	Echo (ping) reply id=0
3	1.002015860	172.16.10.1	172.16.12.201	ICMP	98	Echo (ping) request id=0
4	1.003244738	172.16.12.201	172.16.10.1	ICMP	98	Echo (ping) reply id=0
5	2.004257341	172.16.10.1	172.16.12.201	ICMP	98	Echo (ping) request id=0
6	2.005534032	172.16.12.201	172.16.10.1	ICMP	98	Echo (ping) reply id=0
7	3.005442947	172.16.10.1	172.16.12.201	ICMP	98	Echo (ping) request id=0
8	3.006664482	172.16.12.201	172.16.10.1	ICMP	98	Echo (ping) reply id=0
9	4.007564174	172.16.10.1	172.16.12.201	ICMP	98	Echo (ping) request id=0
10	4.008540529	172.16.12.201	172.16.10.1	ICMP	98	Echo (ping) reply id=0
11	5.201041158	Dell.a4:1e:7b	Dell.a4:1e:7b	ARP	42	Who has 172.16.10.1? Tell...
12	5.201693592	Dell.a4:1e:7b	Dell.a4:1e:7b	ARP	60	172.16.10.1 is at 00:4e:0...
13	33.050808151	172.16.10.1	172.16.10.255	NBNS	92	Name query NB.WORKGROUP<...
14	33.050857079	172.16.10.1	172.16.10.255	BROWSER	284	Host Announcement PESU-OP...
15	35.053892596	172.16.10.1	172.16.10.255	NBNS	92	Name query NB.WORKGROUP<...
16	35.053924711	172.16.10.1	172.16.10.255	NBNS	92	Name query NB.WORKGROUP<...
17	37.056595523	172.16.10.1	172.16.10.255	NBNS	92	Name query NB.WORKGROUP<...

Frame 1: 98 bytes on wire (784 bits), 98 bytes captured (784 bits) on interface 0
Ethernet II, Src: Dell.a4:1e:7b (00:4e:01:a0:6b:6f), Dst: Dell.a4:1e:7b (00:4e:01:a4:1e:7b)
Internet Protocol Version 4, Src: 172.16.10.1, Dst: 172.16.12.201
Internet Control Message Protocol

Wireshark Packet Capture in both interfaces used by internal (left) and external (right) connections.

At R2 :

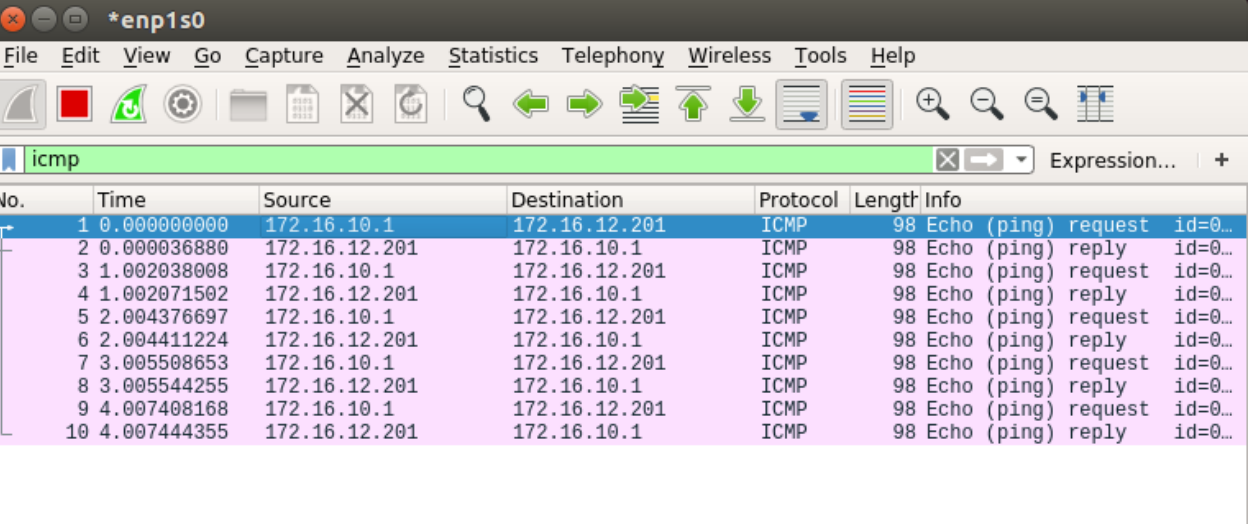
We will open wireshark in both the interfaces using internal and external connections and observe the packets captured during ping operation from Ha to Hd.

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000000	172.16.10.1	172.16.12.201	ICMP	98	Echo (ping) request id=0
2	0.000259123	172.16.12.201	172.16.10.1	ICMP	98	Echo (ping) reply id=0
3	1.002138914	172.16.10.1	172.16.12.201	ICMP	98	Echo (ping) request id=0
4	1.002512131	172.16.12.201	172.16.10.1	ICMP	98	Echo (ping) reply id=0
5	2.004415893	172.16.10.1	172.16.12.201	ICMP	98	Echo (ping) request id=0
6	2.004928471	172.16.12.201	172.16.10.1	ICMP	98	Echo (ping) reply id=0
7	3.005602630	172.16.10.1	172.16.12.201	ICMP	98	Echo (ping) request id=0
8	3.006072993	172.16.12.201	172.16.10.1	ICMP	98	Echo (ping) reply id=0
9	4.007488361	172.16.10.1	172.16.12.201	ICMP	98	Echo (ping) request id=0
10	4.007999611	172.16.12.201	172.16.10.1	ICMP	98	Echo (ping) reply id=0

Frame 1: 98 bytes on wire (784 bits), 98 bytes captured (784 bits) on interface 0
Ethernet II, Src: 00:59:4d:6e:8e:19 (00:59:4d:6e:8e:19), Dst: AsixElec.87:72:01 (00:0e:c6:87:72:01)
Internet Protocol Version 4, Src: 172.16.10.1, Dst: 172.16.12.201
Internet Control Message Protocol

Wireshark Packet Capture in both interfaces used by internal (right) and external (left) connections.

At Hd :



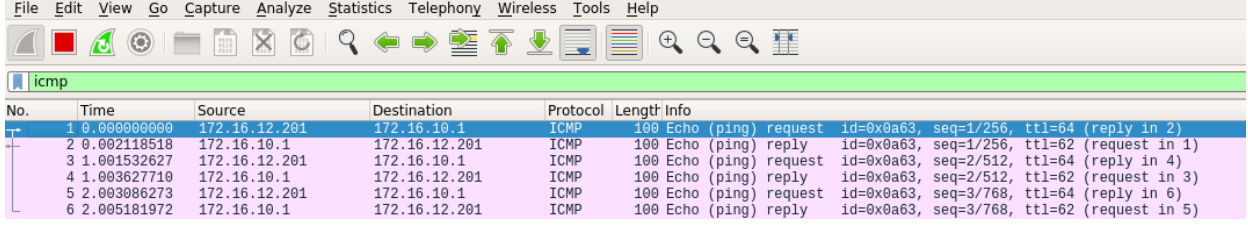
The screenshot shows the Wireshark interface with the packet list pane displaying 10 captured packets. The filter is set to 'icmp'. The packets are alternating requests and replies between 172.16.10.1 and 172.16.12.201.

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000000	172.16.10.1	172.16.12.201	ICMP	98	Echo (ping) request id=0...
2	0.000036880	172.16.12.201	172.16.10.1	ICMP	98	Echo (ping) reply id=0...
3	1.002038008	172.16.10.1	172.16.12.201	ICMP	98	Echo (ping) request id=0...
4	1.002071502	172.16.12.201	172.16.10.1	ICMP	98	Echo (ping) reply id=0...
5	2.004376697	172.16.10.1	172.16.12.201	ICMP	98	Echo (ping) request id=0...
6	2.004411224	172.16.12.201	172.16.10.1	ICMP	98	Echo (ping) reply id=0...
7	3.005508653	172.16.10.1	172.16.12.201	ICMP	98	Echo (ping) request id=0...
8	3.005544255	172.16.12.201	172.16.10.1	ICMP	98	Echo (ping) reply id=0...
9	4.007408168	172.16.10.1	172.16.12.201	ICMP	98	Echo (ping) request id=0...
10	4.007444355	172.16.12.201	172.16.10.1	ICMP	98	Echo (ping) reply id=0...

Wireshark Packet Capture at Hd capturing packets sent/received during ping

2. Capture packets from Hd and Ha

To do this, we will ping Ha from Hd and observe the packets we get in wireshark



The screenshot shows the Wireshark interface with the packet list pane displaying 6 captured packets. The filter is set to 'icmp'. The packets show a sequence of requests and replies with specific IDs, sequence numbers, and TTL values.

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000000	172.16.12.201	172.16.10.1	ICMP	100	Echo (ping) request id=0xa63, seq=1/256, ttl=64 (reply in 2)
2	0.002118518	172.16.10.1	172.16.12.201	ICMP	100	Echo (ping) reply id=0xa63, seq=1/256, ttl=62 (request in 1)
3	1.001532627	172.16.12.201	172.16.10.1	ICMP	100	Echo (ping) request id=0xa63, seq=2/512, ttl=64 (reply in 4)
4	1.003627710	172.16.10.1	172.16.12.201	ICMP	100	Echo (ping) reply id=0xa63, seq=2/512, ttl=62 (request in 3)
5	2.003086273	172.16.12.201	172.16.10.1	ICMP	100	Echo (ping) request id=0xa63, seq=3/768, ttl=64 (reply in 6)
6	2.005181972	172.16.10.1	172.16.12.201	ICMP	100	Echo (ping) reply id=0xa63, seq=3/768, ttl=62 (request in 5)

Wireshark Packet Capture at Hd during the ping operation

Additional Exercise

8. Send and Capture HTTP Packets from Ha to Hd

As we did before, we will request for a HTTP resource on the end system Hd from Ha. In the browser, we will request for **172.16.12.201/index.html** page.

The packets we receive during this request will be observed in wireshark.

At Ha :

No.	Time	Source	Destination	Protocol	Length	Info
3252	16.119255167	172.16.10.1	172.16.12.201	HTTP	400	GET / HTTP/1.1
3254	16.139381585	172.16.12.201	172.16.10.1	HTTP	3593	HTTP/1.1 200 OK (text/html)
3368	16.264970476	172.16.10.1	172.16.12.201	HTTP	363	GET /icons/ubuntu-logo.png HTTP/1.1
3373	16.292367688	172.16.12.201	172.16.10.1	HTTP	795	HTTP/1.1 200 OK (PNG)
3375	16.293536342	172.16.10.1	172.16.12.201	HTTP	353	GET /favicon.ico HTTP/1.1
3376	16.295989971	172.16.12.201	172.16.10.1	HTTP	559	HTTP/1.1 404 Not Found (text/html)

Frame 3252: 400 bytes on wire (3200 bits), 400 bytes captured (3200 bits) on interface 0
Linux cooked capture
Internet Protocol Version 4, Src: 172.16.10.1, Dst: 172.16.12.201
Transmission Control Protocol, Src Port: 52206, Dst Port: 80, Seq: 1, Ack: 1, Len: 332
Hypertext Transfer Protocol

Wireshark packet capture at Ha

At R1 :

Again we will open wireshark in both the interfaces using internal and external connections and observe the packets captured during GET requests made from Ha to Hd.

Capturing from enp1s0							Capturing from enx00594d6e8e19						
No.	Time	Source	Destination	Protocol	Length	Info	No.	Time	Source	Destination	Protocol	Length	Info
4	0.0001069203	172.16.10.1	172.16.12.201	HTTP	695	GET / HTTP/1.1	4	0.0001069203	172.16.10.1	172.16.12.201	HTTP	695	GET / HTTP/1.1
8	0.006395702	172.16.12.201	172.16.10.1	HTTP	695	HTTP/1.1 200 OK (text/html)	8	0.006395702	172.16.12.201	172.16.10.1	HTTP	695	HTTP/1.1 200 OK (text/html)
12	0.076326887	172.16.10.1	172.16.12.201	HTTP	361	GET /icons/ubuntu-logo.png	12	0.076326887	172.16.10.1	172.16.12.201	HTTP	361	GET /icons/ubuntu-logo.png
15	0.078843149	172.16.12.201	172.16.10.1	HTTP	793	HTTP/1.1 200 OK (PNG)	15	0.078843149	172.16.12.201	172.16.10.1	HTTP	793	HTTP/1.1 200 OK (PNG)
19	0.082318166	172.16.10.1	172.16.12.201	HTTP	353	GET /favicon.ico HTTP/1.1	19	0.082318166	172.16.10.1	172.16.12.201	HTTP	353	GET /favicon.ico HTTP/1.1
20	0.084947231	172.16.12.201	172.16.10.1	HTTP	557	HTTP/1.1 404 Not Found	20	0.084947231	172.16.12.201	172.16.10.1	HTTP	557	HTTP/1.1 404 Not Found

Frame 4: 398 bytes on wire (3184 bits), 398 bytes captured (3184 bits) on interface 0
Ethernet II, Src: Dell_A0:b0:60:6f (00:4e:01:a0:60:6f), Dst: Dell_A4:1e:7b (00:4e:01:a4:1e:7b)
Internet Protocol Version 4, Src: 172.16.10.1, Dst: 172.16.12.201
Transmission Control Protocol, Src Port: 52208, Dst Port: 80, Seq: 1, Ack: 1, Len: 332
Hypertext Transfer Protocol

Frame 4: 398 bytes on wire (3184 bits), 398 bytes captured (3184 bits) on interface 0
Ethernet II, Src: 00:59:4d:6e:8e:19 (00:59:4d:6e:8e:19), Dst: AsixElec_87:72:b1 (00:0e:c6:87:72:b1)
Internet Protocol Version 4, Src: 172.16.10.1, Dst: 172.16.12.201
Transmission Control Protocol, Src Port: 52208, Dst Port: 80, Seq: 1, Ack: 1, Len: 332
Hypertext Transfer Protocol

Wireshark packet capture at R1 in both interfaces internal (left) and external (right) connections.

At R2 :
As we did in R1, we will do the same in R2.

No.	Time	Source	Destination	Protocol	Length	Info
4	0.001913186	172.16.10.1	172.16.12.201	HTTP	398	GET / HTTP/1.1
8	0.005197452	172.16.12.201	172.16.10.1	HTTP	695	HTTP/1.1 200 OK (text/html)
12	0.076338523	172.16.10.1	172.16.12.201	HTTP	361	GET /icons/ubuntu-logo.png HTTP/1.1
15	0.077671288	172.16.12.201	172.16.10.1	HTTP	793	HTTP/1.1 200 OK (PNG)
19	0.082310814	172.16.10.1	172.16.12.201	HTTP	351	GET /favicon.ico HTTP/1.1
20	0.083178826	172.16.12.201	172.16.10.1	HTTP	557	HTTP/1.1 404 Not Found

Wireshark Packet Capture at R2 in both interfaces internal (left) and external (right) connections.

At Hd :

No.	Time	Source	Destination	Protocol	Length	Info
4	0.001797742	172.16.10.1	172.16.12.201	HTTP	400	GET / HTTP/1.1
8	0.004274801	172.16.12.201	172.16.10.1	HTTP	697	HTTP/1.1 200 OK (text/html)
12	0.076389116	172.16.10.1	172.16.12.201	HTTP	363	GET /icons/ubuntu-logo.png HTTP/1.1
15	0.076844332	172.16.12.201	172.16.10.1	HTTP	795	HTTP/1.1 200 OK (PNG)
19	0.082390650	172.16.10.1	172.16.12.201	HTTP	353	GET /favicon.ico HTTP/1.1
20	0.082487416	172.16.12.201	172.16.10.1	HTTP	559	HTTP/1.1 404 Not Found (text/html)

Frame 4: 400 bytes on wire (3200 bits), 400 bytes captured (3200 bits) on interface 0
Linux cooked capture
Internet Protocol Version 4, Src: 172.16.10.1, Dst: 172.16.12.201
Transmission Control Protocol, Src Port: 52200, Dst Port: 80, Seq: 1, Ack: 1, Len: 332
Hypertext Transfer Protocol

0000 00 00 00 01 00 06 00 4e 01 a0 63 92 00 00 00 00N.....
0010 45 00 01 80 90 cb 40 00 3e 06 3b c2 ac 10 0a 01 E.....>.....
0020 ac 10 0c c9 cb f0 00 50 ea 55 d3 d6 b4 18 5d 30P.U.....
0030 80 18 01 f0 00 3e 00 00 01 01 08 0a ca d7 53 80>.....C
0040 b0 42 e0 3e 47 45 54 20 2f 20 48 54 54 50 2f 31 ->GET / HTTP/1
0050 2e 31 0d 0a 48 6f 73 74 3a 20 31 37 32 2e 31 36 .1.Host: 172.16
0060 2e 31 32 2e 32 30 31 0d 0a 55 73 65 72 2d 41 67 .12.201 User-Ag
0070 65 6e 74 3a 20 4d 0f 7a 69 6c 6c 61 2f 35 2e 30 ent: Mozilla/5.0
0080 20 28 58 31 31 3b 20 55 62 75 6e 74 75 3b 20 4c (X11; Ubuntu; L
0090 69 6e 75 78 20 78 38 36 5f 36 34 3b 20 72 76 3a inux x86_64; rv:
00a0 38 37 2e 30 20 47 65 63 0b 0f 2f 32 30 31 30 87.0) Gecko/2010
00b0 30 31 30 31 20 46 69 72 65 66 6f 70 2f 30 37 2e 0101 Firefox/97.
00c0 30 0d 0a 41 63 63 65 70 74 3a 29 74 65 78 74 2f 0-Accept: text/
00d0 69 74 6d 6c 2e 61 70 79 6c 69 63 61 74 69 6f 6e html,application
00e0 2f 78 68 74 6d 6c 2b 78 6d 6c 2c 61 70 79 6c 69 /html+xml,appli
00f0 63 61 74 69 6f 6e 2f 78 6d 6c 3b 71 3d 30 2e 39 cation/xml;q=0.9
0100 2c 69 6d 61 67 65 2f 77 65 62 70 2c 2a 2f 2a 3b ,image/webp,*/*;
0110 71 3d 30 2e 38 0d 0a 41 63 63 65 70 74 2d 4c 61 q=0.8-Accept-La

Wireshark Packet Capture at Hd showing the packets sent and received during GET request made from Ha