

Computer Networks

UE21CS252B

4th Semester, Academic Year 2022-23

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Week# 6

Program Number: 1

Title of the Program

IPV4 Routing

Description: Design a network with at least 2 router networks. Host Ha should be able to communicate with Host Hd using newly assigned addresses.

Note:

1. These commands have to be executed with the super user privilege.
2. To check interface and ip address configuration issue below command line. **\$ ip addr show**
3. We will not use ifconfig commands as that is deprecated.

Assigning Ip addresses to the PC's and routers using the following command

Ha: \$ sudo ip addr add 172.16.10.1/24 dev eth1

\$ ip addr show

R1: \$ sudo ip addr add 172.16.10.201/24 dev eth1

\$ sudo ip addr add 172.16.11.1/24 dev eth2

\$ ip addr show

R2: \$ sudo ip addr add 172.16.11.201/24 dev eth2

\$ sudo ip addr add 172.16.12.1/24 dev eth1

\$ ip addr show

Hd: \$ sudo ip addr add 172.16.12.201/24 dev eth1

\$ ip addr show

Note 1: 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 command line in Ha and Hd.

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

Note 2: Since machines are on same physical interface, the router is going to send ICMP redirect message disturbing the routing decision by hosts. Thus, disable sending of the ICMP redirect packets by these routers with aliased interfaces. To have precautionary measures issue below command line in R1 and R2

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

Here we are converting Systems PC's to routers:->

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

```
2.1      R1: $ sudo sysctl -w net.ipv4.ip_forward=1  
2.2      R2: $ sudo sysctl -w net.ipv4.ip_forward=1
```

Insert Routing Table entries on each system to direct ipv4 packets to ping across the networks

Ha:

\$ 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

R1:

\$ sudo ip route add 172.16.12.0/24 via 172.16.11.201

\$ ip route show

R2:

\$ sudo ip route add 172.16.10.0/24 via 172.16.11.1

\$ ip route show

Hd: \$ sudo ip route add 172.16.10.0/24 via 172.16.12.1

\$ sudo ip route add 172.16.11.0/24 via 172.16.2.1

\$ ip route show

Pinging the Ip addresses and WireShark Implementation with screenShots: ->Pinging Destination address and Routers from Source

```
rtt min/avg/max/ndev = 0.687/1.593/1.983/0.315 ms
(base) student@student-OptiPlex-5090:~$ sudo ip route add 172.16.12.0/24 via 172.16.10.201
(base) student@student-OptiPlex-5090:~$ ip route show
172.16.10.0/24 dev enp3s1f6 proto kernel scope link src 172.16.10.1
172.16.12.0/24 via 172.16.10.201 dev enp3s1f6
(base) student@student-OptiPlex-5090:~$ 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=1.33 ms
64 bytes from 172.16.10.201: icmp_seq=2 ttl=64 time=1.86 ms
64 bytes from 172.16.10.201: icmp_seq=3 ttl=64 time=1.88 ms
^C
--- 172.16.10.201 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2003ms
rtt min/avg/max/ndev = 1.327/1.719/1.955/0.279 ms
(base) student@student-OptiPlex-5090:~$ 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=4.75 ms
64 bytes from 172.16.12.201: icmp_seq=2 ttl=62 time=4.82 ms
64 bytes from 172.16.12.201: icmp_seq=3 ttl=62 time=5.58 ms
64 bytes from 172.16.12.201: icmp_seq=4 ttl=62 time=4.30 ms
64 bytes from 172.16.12.201: icmp_seq=5 ttl=62 time=5.49 ms
64 bytes from 172.16.12.201: icmp_seq=6 ttl=62 time=4.45 ms
64 bytes from 172.16.12.201: icmp_seq=7 ttl=62 time=4.73 ms
64 bytes from 172.16.12.201: icmp_seq=8 ttl=62 time=4.78 ms
64 bytes from 172.16.12.201: icmp_seq=9 ttl=62 time=4.67 ms
64 bytes from 172.16.12.201: icmp_seq=10 ttl=62 time=5.05 ms
64 bytes from 172.16.12.201: icmp_seq=11 ttl=62 time=4.97 ms
64 bytes from 172.16.12.201: icmp_seq=12 ttl=62 time=5.05 ms
64 bytes from 172.16.12.201: icmp_seq=13 ttl=62 time=4.96 ms
64 bytes from 172.16.12.201: icmp_seq=14 ttl=62 time=5.05 ms
64 bytes from 172.16.12.201: icmp_seq=15 ttl=62 time=5.12 ms
64 bytes from 172.16.12.201: icmp_seq=16 ttl=62 time=5.28 ms
64 bytes from 172.16.12.201: icmp_seq=17 ttl=62 time=4.83 ms
64 bytes from 172.16.12.201: icmp_seq=18 ttl=62 time=4.83 ms
^C
--- 172.16.12.201 ping statistics ---
19 packets transmitted, 19 received, 0% packet loss, time 10029ms
rtt min/avg/max/ndev = 3.674/4.853/5.550/0.481 ms
(base) student@student-OptiPlex-5090:~$ ip netsh show
172.16.10.201 dev enp3s1f6 linkid 0x18161816 STATE
(base) student@student-OptiPlex-5090:~$ sudo ip addr
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 ::1
        valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host
        valid_lft forever preferred_lft forever
2: enp3s1f6: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP group default qlen 1000
    link/ether 88:3f:43:26:0d:80 brd ff:ff:ff:ff:ff:ff
    inet 172.16.10.1/24 scope global enp3s1f6
        valid_lft forever preferred_lft forever
(base) student@student-OptiPlex-5090:~$
```

```
link/ether 88:3f:43:26:0d:80 brd ff:ff:ff:ff:ff:ff
    inet 172.16.11.1/24 scope global enp3s1f6
        valid_lft forever preferred_lft forever
student@student-OptiPlex-5090:~$ ping 172.16.11.201
PING 172.16.11.201 (172.16.11.201) 56(84) bytes of data.
From 172.16.11.1: icmp_seq=1 Destination Host Unreachable
From 172.16.11.1: icmp_seq=2 Destination Host Unreachable
From 172.16.11.1: icmp_seq=3 Destination Host Unreachable
^C
--- 172.16.11.201 ping statistics ---
3 packets transmitted, 0 received, 100% packet loss, time 111ms
ping 4
student@student-OptiPlex-5090:~$ ping 172.16.11.201
PING 172.16.11.201 (172.16.11.201) 56(84) bytes of data.
64 bytes from 172.16.11.201: icmp_seq=1 ttl=64 time=2.89 ms
64 bytes from 172.16.11.201: icmp_seq=2 ttl=64 time=1.72 ms
64 bytes from 172.16.11.201: icmp_seq=3 ttl=64 time=0.482 ms
^C
--- 172.16.11.201 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 362ms
rtt min/avg/max/ndev = 0.642/1.157/2.850/0.64 ms
student@student-OptiPlex-5090:~$ ip route show
169.248.0.0/16 dev enp3s1f6 scope link metric 1000
172.16.10.0/24 dev enp3s1f6 proto kernel scope link src 172.16.10.1
172.16.11.0/24 via 172.16.11.201 dev enp3s1f6
student@student-OptiPlex-5090:~$ ping 172.16.11.201
PING 172.16.11.201 (172.16.11.201) 56(84) bytes of data.
64 bytes from 172.16.11.201: icmp_seq=1 ttl=64 time=1.23 ms
64 bytes from 172.16.11.201: icmp_seq=2 ttl=64 time=1.74 ms
64 bytes from 172.16.11.201: icmp_seq=3 ttl=64 time=1.23 ms
^C
--- 172.16.11.201 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2803ms
rtt min/avg/max/ndev = 1.112/1.393/1.742/0.227 ms
student@student-OptiPlex-5090:~$ ip netsh show
172.16.11.201 dev enp3s1f6 linkid 0x18161816 STATE
172.16.10.1 dev enp3s1f6 linkid 0x18161816 STATE
student@student-OptiPlex-5090:~$ sudo ip addr
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 ::1
        valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host
        valid_lft forever preferred_lft forever
2: enp3s1f6: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP group default qlen 1000
    link/ether 88:3f:43:26:0d:80 brd ff:ff:ff:ff:ff:ff
    inet 172.16.10.1/24 scope global enp3s1f6
        valid_lft forever preferred_lft forever
3: enp3s1f6: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP group default qlen 1000
    link/ether 88:3f:43:26:0d:80 brd ff:ff:ff:ff:ff:ff
    inet 172.16.11.1/24 scope global enp3s1f6
        valid_lft forever preferred_lft forever
student@student-OptiPlex-5090:~$ ip netsh show
```


DELL

again in a few moments.
s network connection.
proxy, make sure that Firefox i

->Pinging Source address from Destination address:

```
64 bytes from 172.16.12.1: icmp_seq=3 ttl=64 time=0.880 ms
^C
--- 172.16.12.1 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2003ms
rtt min/avg/max/mdev = 0.880/1.357/1.916/0.426 ms
(base) student@student-OptiPlex-5090:~$ sudo ip route add 172.16.10.0/24 via 172.16.12.1
(base) student@student-OptiPlex-5090:~$ sudo ip route add 172.16.11.0/24 via 172.16.12.1
(base) student@student-OptiPlex-5090:~$ ip route show
169.254.0.0/16 dev enp0s31f6 scope link metric 1000
172.16.10.0/24 via 172.16.12.1 dev enp0s31f6
172.16.11.0/24 via 172.16.12.1 dev enp0s31f6
172.16.12.0/24 dev enp0s31f6 proto kernel scope link src 172.16.12.201
(base) student@student-OptiPlex-5090:~$ 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=3.97 ms
64 bytes from 172.16.10.1: icmp_seq=2 ttl=62 time=5.45 ms
64 bytes from 172.16.10.1: icmp_seq=3 ttl=62 time=5.24 ms
64 bytes from 172.16.10.1: icmp_seq=4 ttl=62 time=4.13 ms
^C
--- 172.16.10.1 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3005ms
rtt min/avg/max/mdev = 3.967/4.697/5.447/0.653 ms
(base) student@student-OptiPlex-5090:~$ ip neigh show
172.16.12.1 dev enp0s31f6 lladdr 90:8d:6e:8c:64:af REACHABLE
(base) student@student-OptiPlex-5090:~$ ip addr
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: enp0s31f6: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP group default qlen 1000
    link/ether 90:8d:6e:8c:64:22 brd ff:ff:ff:ff:ff:ff
    inet 172.16.12.201/24 scope global enp0s31f6
        valid_lft forever preferred_lft forever
(base) student@student-OptiPlex-5090:~$ 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=4.16 ms
64 bytes from 172.16.10.1: icmp_seq=2 ttl=62 time=5.50 ms
64 bytes from 172.16.10.1: icmp_seq=3 ttl=62 time=5.15 ms
64 bytes from 172.16.10.1: icmp_seq=4 ttl=62 time=4.18 ms
64 bytes from 172.16.10.1: icmp_seq=5 ttl=62 time=4.17 ms
^C
--- 172.16.10.1 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4007ms
rtt min/avg/max/mdev = 4.161/4.630/5.495/0.574 ms
(base) student@student-OptiPlex-5090:~$ ip neigh show
172.16.12.1 dev enp0s31f6 lladdr 90:8d:6e:8c:64:af REACHABLE
(base) student@student-OptiPlex-5090:~$
```

Wireshark - Capturing from any

Apply a display filter: <Ctrl>

No.	Time	Source	Destination	Protocol	Length	Info
57	24.838046705	172.16.10.1	172.16.12.201	ICMP	100	Echo (ping) request id=0x0004, seq=74/18944, ttl=62 (reply 1..
58	24.838134013	172.16.12.201	172.16.10.1	ICMP	100	Echo (ping) reply id=0x0004, seq=74/18944, ttl=62 (request..
59	25.03552479	172.16.10.1	172.16.12.201	ICMP	100	Echo (ping) request id=0x0004, seq=75/19200, ttl=62 (reply 1..
60	25.035649517	172.16.12.201	172.16.10.1	ICMP	100	Echo (ping) reply id=0x0004, seq=75/19200, ttl=62 (request..
61	26.041267504	172.16.10.1	172.16.12.201	ICMP	100	Echo (ping) request id=0x0004, seq=76/19456, ttl=62 (reply 1..
62	26.041358853	172.16.12.201	172.16.10.1	ICMP	100	Echo (ping) reply id=0x0004, seq=76/19456, ttl=62 (request..
63	27.842733552	172.16.10.1	172.16.12.201	ICMP	100	Echo (ping) request id=0x0004, seq=77/19712, ttl=62 (reply 1..
64	27.842821674	172.16.12.201	172.16.10.1	ICMP	100	Echo (ping) reply id=0x0004, seq=77/19712, ttl=62 (request..
65	28.043025723	172.16.10.1	172.16.12.201	ICMP	100	Echo (ping) request id=0x0004, seq=78/19968, ttl=62 (reply 1..
66	28.043098929	172.16.12.201	172.16.10.1	ICMP	100	Echo (ping) reply id=0x0004, seq=78/19968, ttl=62 (request..
67	29.045237300	172.16.10.1	172.16.12.201	ICMP	100	Echo (ping) request id=0x0004, seq=79/20224, ttl=62 (reply 1..
68	29.045321223	172.16.12.201	172.16.10.1	ICMP	100	Echo (ping) reply id=0x0004, seq=79/20224, ttl=62 (request..
69	30.046988883	172.16.10.1	172.16.12.201	ICMP	100	Echo (ping) request id=0x0004, seq=80/20480, ttl=62 (reply 1..
70	30.047077575	172.16.12.201	172.16.10.1	ICMP	100	Echo (ping) reply id=0x0004, seq=80/20480, ttl=62 (request..
71	31.048967242	172.16.10.1	172.16.12.201	ICMP	100	Echo (ping) request id=0x0004, seq=81/20736, ttl=62 (reply 1..
72	31.049046613	172.16.12.201	172.16.10.1	ICMP	100	Echo (ping) reply id=0x0004, seq=81/20736, ttl=62 (request..
73	32.049615290	172.16.10.1	172.16.12.201	ICMP	100	Echo (ping) request id=0x0004, seq=82/20992, ttl=62 (reply 1..
74	32.049703900	172.16.12.201	172.16.10.1	ICMP	100	Echo (ping) reply id=0x0004, seq=82/20992, ttl=62 (request..
75	33.05023811	172.16.10.1	172.16.12.201	ICMP	100	Echo (ping) request id=0x0004, seq=83/21248, ttl=62 (reply 1..
76	33.052113774	172.16.12.201	172.16.10.1	ICMP	100	Echo (ping) reply id=0x0004, seq=83/21248, ttl=62 (request..
77	34.053435279	172.16.10.1	172.16.12.201	ICMP	100	Echo (ping) request id=0x0004, seq=84/21504, ttl=62 (reply 1..
78	34.053525779	172.16.12.201	172.16.10.1	ICMP	100	Echo (ping) reply id=0x0004, seq=84/21504, ttl=62 (request..
79	35.054749903	172.16.10.1	172.16.12.201	ICMP	100	Echo (ping) request id=0x0004, seq=85/21760, ttl=62 (reply 1..
80	35.054831289	172.16.12.201	172.16.10.1	ICMP	100	Echo (ping) reply id=0x0004, seq=85/21760, ttl=62 (request..
81	36.056267252	172.16.10.1	172.16.12.201	ICMP	100	Echo (ping) request id=0x0004, seq=86/22016, ttl=62 (reply 1..
82	36.056357768	172.16.12.201	172.16.10.1	ICMP	100	Echo (ping) reply id=0x0004, seq=86/22016, ttl=62 (request..
83	37.057626172	172.16.10.1	172.16.12.201	ICMP	100	Echo (ping) request id=0x0004, seq=87/22272, ttl=62 (reply 1..
84	37.057713477	172.16.12.201	172.16.10.1	ICMP	100	Echo (ping) reply id=0x0004, seq=87/22272, ttl=62 (request..
85	37.289048898	99:8d:6e:8c:64:22	172.16.12.201	ARP	62	Who has 172.16.12.1? Tell 172.16.12.201
86	37.291595591	99:8d:6e:8c:64:af	172.16.12.201	ARP	62	172.16.12.1 is at 99:8d:6e:8c:64:af
87	38.059131454	172.16.10.1	172.16.12.201	ICMP	100	Echo (ping) request id=0x0004, seq=88/22528, ttl=62 (reply 1..
88	38.059189506	172.16.12.201	172.16.10.1	ICMP	100	Echo (ping) reply id=0x0004, seq=88/22528, ttl=62 (request..

Frame 1: 100 bytes on wire (800 bits), 100 bytes captured (800 bits) on interface any, id 0

- Linux cooked capture
- Internet Protocol Version 4, Src: 172.16.10.1, Dst: 172.16.12.201
- Internet Control Message Protocol

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