

REPORT

IAP Assignment 3

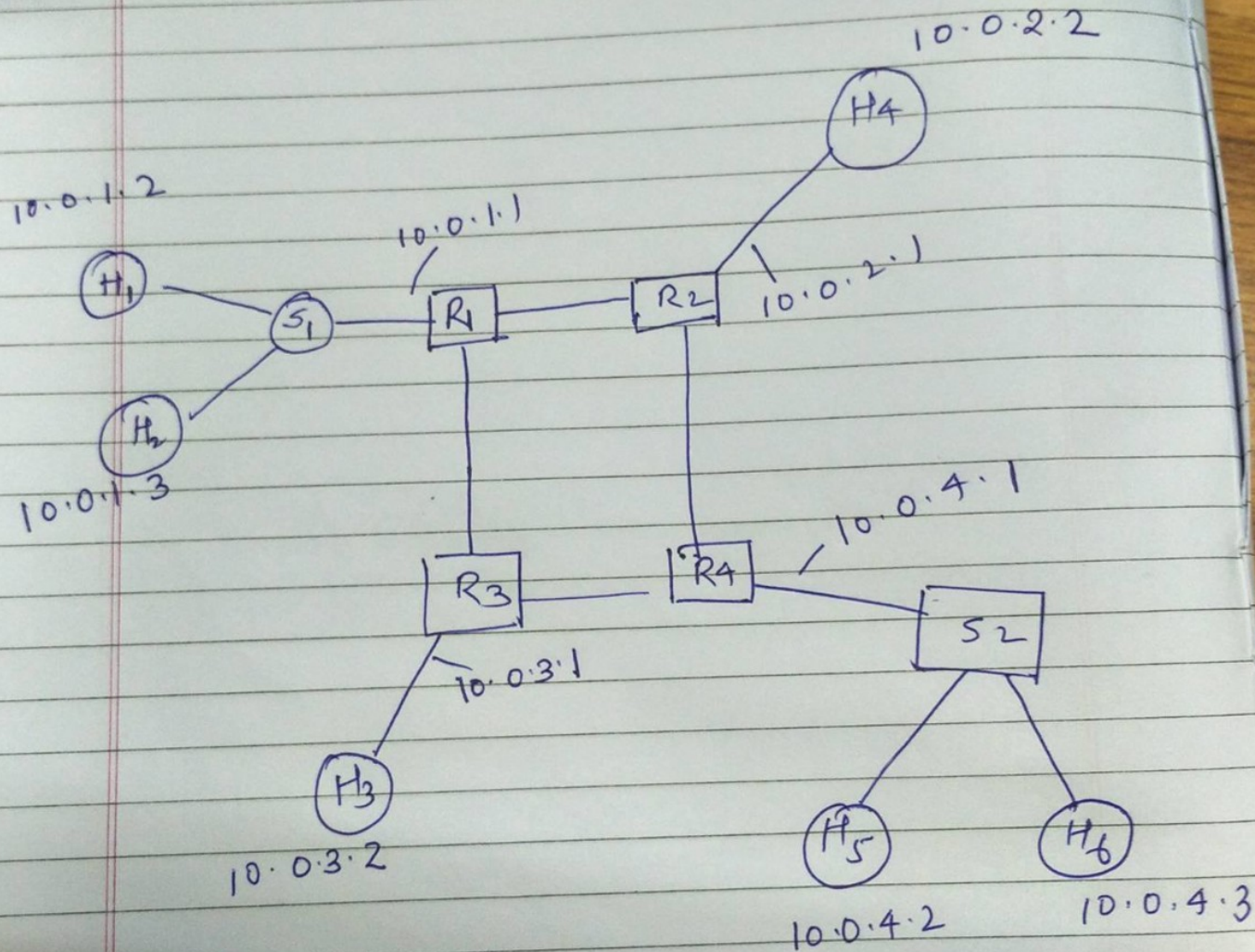
Group 14

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Q1)



Q3)ping from h1-h2

```
gaurav@gaurav-Inspiron-5520: ~/IAP/IAP/IAP_3_14
gaurav@gaurav-Inspiron-5520: ~/IAP/IAP/IAP_3_14 162x42

64 bytes from 10.0.2.2: icmp_seq=75 ttl=62 time=50.4 ms
64 bytes from 10.0.2.2: icmp_seq=76 ttl=62 time=22.7 ms
64 bytes from 10.0.2.2: icmp_seq=77 ttl=62 time=13.2 ms
64 bytes from 10.0.2.2: icmp_seq=78 ttl=62 time=12.9 ms
64 bytes from 10.0.2.2: icmp_seq=79 ttl=62 time=35.8 ms
64 bytes from 10.0.2.2: icmp_seq=80 ttl=62 time=56.4 ms
64 bytes from 10.0.2.2: icmp_seq=81 ttl=62 time=28.2 ms
64 bytes from 10.0.2.2: icmp_seq=82 ttl=62 time=15.5 ms
64 bytes from 10.0.2.2: icmp_seq=83 ttl=62 time=15.0 ms
64 bytes from 10.0.2.2: icmp_seq=84 ttl=62 time=37.4 ms
64 bytes from 10.0.2.2: icmp_seq=85 ttl=62 time=9.35 ms
64 bytes from 10.0.2.2: icmp_seq=86 ttl=62 time=30.7 ms
^C
--- 10.0.2.2 ping statistics ---
86 packets transmitted, 84 received, 2% packet loss, time 85132ms
rtt min/avg/max/mdev = 8.426/34.839/111.600/16.823 ms
mininet> h1 ping h2
PING 10.0.1.3 (10.0.1.3) 56(84) bytes of data.
64 bytes from 10.0.1.3: icmp_seq=1 ttl=64 time=29.4 ms
64 bytes from 10.0.1.3: icmp_seq=2 ttl=64 time=0.524 ms
64 bytes from 10.0.1.3: icmp_seq=3 ttl=64 time=0.062 ms
64 bytes from 10.0.1.3: icmp_seq=4 ttl=64 time=0.045 ms
64 bytes from 10.0.1.3: icmp_seq=5 ttl=64 time=0.320 ms
64 bytes from 10.0.1.3: icmp_seq=6 ttl=64 time=0.061 ms
64 bytes from 10.0.1.3: icmp_seq=7 ttl=64 time=0.241 ms
64 bytes from 10.0.1.3: icmp_seq=8 ttl=64 time=0.062 ms
64 bytes from 10.0.1.3: icmp_seq=9 ttl=64 time=0.066 ms
64 bytes from 10.0.1.3: icmp_seq=10 ttl=64 time=0.054 ms
64 bytes from 10.0.1.3: icmp_seq=11 ttl=64 time=0.065 ms
64 bytes from 10.0.1.3: icmp_seq=12 ttl=64 time=0.058 ms
64 bytes from 10.0.1.3: icmp_seq=13 ttl=64 time=0.067 ms
64 bytes from 10.0.1.3: icmp_seq=14 ttl=64 time=0.066 ms
64 bytes from 10.0.1.3: icmp_seq=15 ttl=64 time=0.061 ms
64 bytes from 10.0.1.3: icmp_seq=16 ttl=64 time=0.065 ms
64 bytes from 10.0.1.3: icmp_seq=17 ttl=64 time=0.477 ms
64 bytes from 10.0.1.3: icmp_seq=18 ttl=64 time=0.046 ms
64 bytes from 10.0.1.3: icmp_seq=19 ttl=64 time=0.057 ms
64 bytes from 10.0.1.3: icmp_seq=20 ttl=64 time=0.097 ms
64 bytes from 10.0.1.3: icmp_seq=21 ttl=64 time=0.065 ms
64 bytes from 10.0.1.3: icmp_seq=22 ttl=64 time=0.067 ms
64 bytes from 10.0.1.3: icmp_seq=23 ttl=64 time=0.083 ms
```


Ping from h1-h3

gaurav@gaurav-Inspiron-5520: ~/IAP/IAP/IAP_3_14

gaurav@gaurav-Inspiron-5520: ~/IAP/IAP/IAP_3_14 162x42

```
64 bytes from 10.0.1.3: icmp_seq=51 ttl=64 time=0.068 ms
64 bytes from 10.0.1.3: icmp_seq=52 ttl=64 time=0.053 ms
64 bytes from 10.0.1.3: icmp_seq=53 ttl=64 time=0.041 ms
64 bytes from 10.0.1.3: icmp_seq=54 ttl=64 time=0.061 ms
64 bytes from 10.0.1.3: icmp_seq=55 ttl=64 time=0.085 ms
64 bytes from 10.0.1.3: icmp_seq=56 ttl=64 time=0.101 ms
64 bytes from 10.0.1.3: icmp_seq=57 ttl=64 time=0.297 ms
64 bytes from 10.0.1.3: icmp_seq=58 ttl=64 time=0.059 ms
64 bytes from 10.0.1.3: icmp_seq=59 ttl=64 time=0.067 ms
64 bytes from 10.0.1.3: icmp_seq=60 ttl=64 time=0.060 ms
64 bytes from 10.0.1.3: icmp_seq=61 ttl=64 time=0.058 ms
64 bytes from 10.0.1.3: icmp_seq=62 ttl=64 time=0.080 ms
64 bytes from 10.0.1.3: icmp_seq=63 ttl=64 time=43.1 ms
64 bytes from 10.0.1.3: icmp_seq=64 ttl=64 time=0.449 ms
64 bytes from 10.0.1.3: icmp_seq=65 ttl=64 time=0.058 ms
64 bytes from 10.0.1.3: icmp_seq=66 ttl=64 time=0.052 ms
64 bytes from 10.0.1.3: icmp_seq=67 ttl=64 time=0.071 ms
^C
--- 10.0.1.3 ping statistics ---
67 packets transmitted, 67 received, 0% packet loss, time 66001ms
rtt min/avg/max/mdev = 0.041/1.376/43.128/6.432 ms
mininet> h1 ping h3
PING 10.0.3.2 (10.0.3.2) 56(84) bytes of data:
64 bytes from 10.0.3.2: icmp_seq=1 ttl=62 time=42.8 ms
64 bytes from 10.0.3.2: icmp_seq=2 ttl=62 time=15.1 ms
64 bytes from 10.0.3.2: icmp_seq=3 ttl=62 time=58.3 ms
64 bytes from 10.0.3.2: icmp_seq=4 ttl=62 time=41.9 ms
64 bytes from 10.0.3.2: icmp_seq=5 ttl=62 time=8.94 ms
64 bytes from 10.0.3.2: icmp_seq=6 ttl=62 time=13.6 ms
64 bytes from 10.0.3.2: icmp_seq=7 ttl=62 time=15.0 ms
64 bytes from 10.0.3.2: icmp_seq=8 ttl=62 time=13.2 ms
64 bytes from 10.0.3.2: icmp_seq=9 ttl=62 time=12.8 ms
64 bytes from 10.0.3.2: icmp_seq=10 ttl=62 time=11.6 ms
64 bytes from 10.0.3.2: icmp_seq=11 ttl=62 time=27.0 ms
64 bytes from 10.0.3.2: icmp_seq=12 ttl=62 time=33.3 ms
64 bytes from 10.0.3.2: icmp_seq=13 ttl=62 time=49.3 ms
64 bytes from 10.0.3.2: icmp_seq=14 ttl=62 time=57.2 ms
64 bytes from 10.0.3.2: icmp_seq=15 ttl=62 time=55.5 ms
64 bytes from 10.0.3.2: icmp_seq=16 ttl=62 time=42.1 ms
64 bytes from 10.0.3.2: icmp_seq=17 ttl=62 time=14.3 ms
64 bytes from 10.0.3.2: icmp_seq=18 ttl=62 time=14.8 ms
```

Ping from h1 to h4

gaurav@gaurav-Inspiron-5520: ~/IAP/IAP/IAP_3_14

gaurav@gaurav-Inspiron-5520: ~/IAP/IAP/IAP_3_14 162x42

```
64 bytes from 10.0.3.2: icmp_seq=45 ttl=62 time=13.5 ms
64 bytes from 10.0.3.2: icmp_seq=46 ttl=62 time=34.9 ms
64 bytes from 10.0.3.2: icmp_seq=47 ttl=62 time=55.2 ms
64 bytes from 10.0.3.2: icmp_seq=48 ttl=62 time=74.2 ms
64 bytes from 10.0.3.2: icmp_seq=49 ttl=62 time=48.7 ms
64 bytes from 10.0.3.2: icmp_seq=50 ttl=62 time=20.3 ms
64 bytes from 10.0.3.2: icmp_seq=51 ttl=62 time=42.1 ms
64 bytes from 10.0.3.2: icmp_seq=52 ttl=62 time=16.5 ms
64 bytes from 10.0.3.2: icmp_seq=53 ttl=62 time=56.3 ms
^C
--- 10.0.3.2 ping statistics ---
53 packets transmitted, 51 received, 3% packet loss, time 52086ms
rtt min/avg/max/mdev = 8.905/33.442/74.202/15.838 ms
mininet> h1 ping h4
PING 10.0.2.2 (10.0.2.2) 56(84) bytes of data.
64 bytes from 10.0.2.2: icmp_seq=3 ttl=62 time=40.3 ms
64 bytes from 10.0.2.2: icmp_seq=4 ttl=62 time=11.1 ms
64 bytes from 10.0.2.2: icmp_seq=5 ttl=62 time=32.3 ms
64 bytes from 10.0.2.2: icmp_seq=6 ttl=62 time=58.0 ms
64 bytes from 10.0.2.2: icmp_seq=7 ttl=62 time=46.7 ms
64 bytes from 10.0.2.2: icmp_seq=8 ttl=62 time=14.0 ms
64 bytes from 10.0.2.2: icmp_seq=9 ttl=62 time=36.5 ms
64 bytes from 10.0.2.2: icmp_seq=10 ttl=62 time=8.42 ms
64 bytes from 10.0.2.2: icmp_seq=11 ttl=62 time=30.7 ms
64 bytes from 10.0.2.2: icmp_seq=12 ttl=62 time=19.4 ms
64 bytes from 10.0.2.2: icmp_seq=13 ttl=62 time=20.4 ms
64 bytes from 10.0.2.2: icmp_seq=14 ttl=62 time=43.7 ms
64 bytes from 10.0.2.2: icmp_seq=15 ttl=62 time=16.6 ms
64 bytes from 10.0.2.2: icmp_seq=16 ttl=62 time=38.6 ms
64 bytes from 10.0.2.2: icmp_seq=17 ttl=62 time=26.3 ms
64 bytes from 10.0.2.2: icmp_seq=18 ttl=62 time=28.2 ms
64 bytes from 10.0.2.2: icmp_seq=19 ttl=62 time=50.9 ms
64 bytes from 10.0.2.2: icmp_seq=20 ttl=62 time=23.4 ms
64 bytes from 10.0.2.2: icmp_seq=21 ttl=62 time=45.7 ms
64 bytes from 10.0.2.2: icmp_seq=22 ttl=62 time=34.7 ms
64 bytes from 10.0.2.2: icmp_seq=23 ttl=62 time=29.8 ms
64 bytes from 10.0.2.2: icmp_seq=24 ttl=62 time=32.5 ms
64 bytes from 10.0.2.2: icmp_seq=25 ttl=62 time=54.0 ms
64 bytes from 10.0.2.2: icmp_seq=26 ttl=62 time=26.3 ms
64 bytes from 10.0.2.2: icmp_seq=27 ttl=62 time=10.9 ms
64 bytes from 10.0.2.2: icmp_seq=28 ttl=62 time=31.8 ms
```


Ping from h1 to h5

```
ankit@a: ~/Documents/IAP/IAP_3_14
ankit@a:~/Documents/IAP/IAP_3_14$ sudo mn --custom ./source/topology.py --topo=mytopo --controller=remote,ip=127.0.0.1,port=6633
[sudo] password for ankit:
*** Creating network
*** Adding controller
*** Adding hosts:
h1 h2 h3 h4 h5 h6
*** Adding switches:
R1 R2 R3 R4 s5 s6
*** Adding links:
(R1, R3) (R2, R1) (R2, R4) (R2, h4) (R3, R4) (h1, s5) (h3, R3) (s5, R1) (s5, h2) (s6, R4) (s6, h5) (s6, h6)
*** Configuring hosts
h1 h2 h3 h4 h5 h6
*** Starting controller
c0
*** Starting 6 switches
R1 R2 R3 R4 s5 s6 ...
*** Starting CLI:
mininet> h1 ping h5
PING 10.0.4.2 (10.0.4.2) 56(84) bytes of data.
64 bytes from 10.0.4.2: icmp_seq=5 ttl=61 time=63.2 ms
64 bytes from 10.0.4.2: icmp_seq=6 ttl=61 time=12.8 ms
64 bytes from 10.0.4.2: icmp_seq=7 ttl=61 time=39.4 ms
64 bytes from 10.0.4.2: icmp_seq=8 ttl=61 time=15.6 ms
64 bytes from 10.0.4.2: icmp_seq=9 ttl=61 time=59.9 ms
64 bytes from 10.0.4.2: icmp_seq=10 ttl=61 time=48.8 ms
64 bytes from 10.0.4.2: icmp_seq=11 ttl=61 time=36.5 ms
64 bytes from 10.0.4.2: icmp_seq=12 ttl=61 time=37.1 ms
64 bytes from 10.0.4.2: icmp_seq=13 ttl=61 time=58.3 ms
64 bytes from 10.0.4.2: icmp_seq=14 ttl=61 time=37.9 ms
64 bytes from 10.0.4.2: icmp_seq=15 ttl=61 time=16.8 ms
64 bytes from 10.0.4.2: icmp_seq=16 ttl=61 time=20.4 ms
64 bytes from 10.0.4.2: icmp_seq=17 ttl=61 time=48.5 ms
64 bytes from 10.0.4.2: icmp_seq=18 ttl=61 time=27.7 ms
^C
--- 10.0.4.2 ping statistics ---
18 packets transmitted, 14 received, 22% packet loss, time 17019ms
rtt min/avg/max/mdev = 12.897/37.389/63.262/16.373 ms
mininet>
```

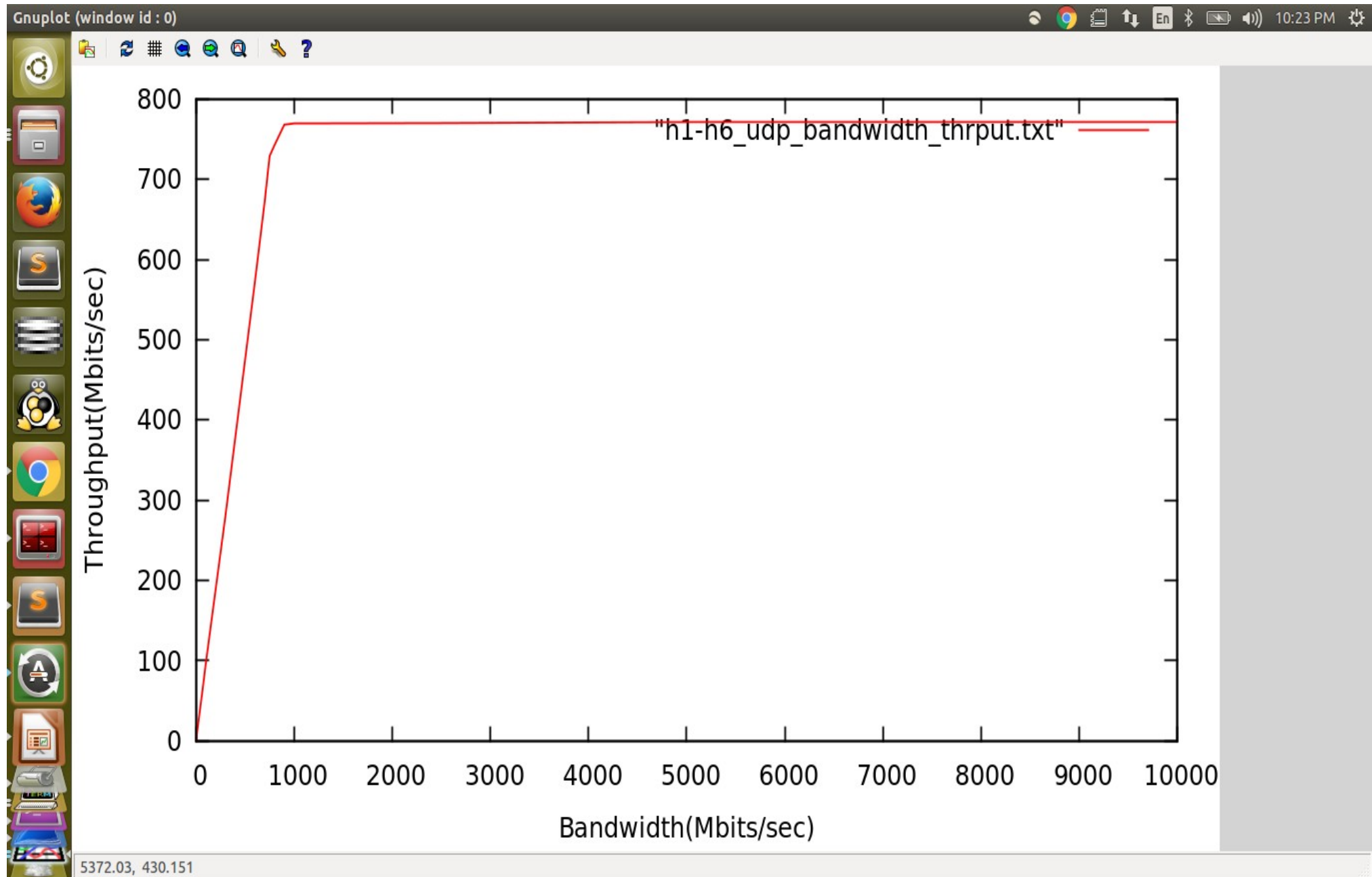
Ping from h1 to h6

```
ankit@a: ~/Documents/IAP/IAP_3_14
R1 R2 R3 R4 s5 s6 ...
*** Starting CLI:
mininet> h1 ping h5
PING 10.0.4.2 (10.0.4.2) 56(84) bytes of data.
64 bytes from 10.0.4.2: icmp_seq=5 ttl=61 time=63.2 ms
64 bytes from 10.0.4.2: icmp_seq=6 ttl=61 time=12.8 ms
64 bytes from 10.0.4.2: icmp_seq=7 ttl=61 time=39.4 ms
64 bytes from 10.0.4.2: icmp_seq=8 ttl=61 time=15.6 ms
64 bytes from 10.0.4.2: icmp_seq=9 ttl=61 time=59.9 ms
64 bytes from 10.0.4.2: icmp_seq=10 ttl=61 time=48.8 ms
64 bytes from 10.0.4.2: icmp_seq=11 ttl=61 time=36.5 ms
64 bytes from 10.0.4.2: icmp_seq=12 ttl=61 time=37.1 ms
64 bytes from 10.0.4.2: icmp_seq=13 ttl=61 time=58.3 ms
64 bytes from 10.0.4.2: icmp_seq=14 ttl=61 time=37.9 ms
64 bytes from 10.0.4.2: icmp_seq=15 ttl=61 time=16.8 ms
64 bytes from 10.0.4.2: icmp_seq=16 ttl=61 time=20.4 ms
64 bytes from 10.0.4.2: icmp_seq=17 ttl=61 time=48.5 ms
64 bytes from 10.0.4.2: icmp_seq=18 ttl=61 time=27.7 ms
^C
--- 10.0.4.2 ping statistics ---
18 packets transmitted, 14 received, 22% packet loss, time 17019ms
rtt min/avg/max/mdev = 12.897/37.389/63.262/16.373 ms
mininet> h1 ping h6
PING 10.0.4.3 (10.0.4.3) 56(84) bytes of data.
64 bytes from 10.0.4.3: icmp_seq=1 ttl=61 time=46.7 ms
64 bytes from 10.0.4.3: icmp_seq=2 ttl=61 time=38.5 ms
64 bytes from 10.0.4.3: icmp_seq=3 ttl=61 time=19.9 ms
64 bytes from 10.0.4.3: icmp_seq=4 ttl=61 time=39.1 ms
64 bytes from 10.0.4.3: icmp_seq=5 ttl=61 time=18.0 ms
64 bytes from 10.0.4.3: icmp_seq=6 ttl=61 time=56.7 ms
64 bytes from 10.0.4.3: icmp_seq=7 ttl=61 time=33.6 ms
64 bytes from 10.0.4.3: icmp_seq=8 ttl=61 time=61.9 ms
64 bytes from 10.0.4.3: icmp_seq=9 ttl=61 time=51.2 ms
64 bytes from 10.0.4.3: icmp_seq=10 ttl=61 time=27.9 ms
64 bytes from 10.0.4.3: icmp_seq=11 ttl=61 time=54.2 ms
64 bytes from 10.0.4.3: icmp_seq=12 ttl=61 time=32.0 ms
^C
--- 10.0.4.3 ping statistics ---
12 packets transmitted, 12 received, 0% packet loss, time 11015ms
rtt min/avg/max/mdev = 18.062/40.029/61.929/13.757 ms
mininet>
```

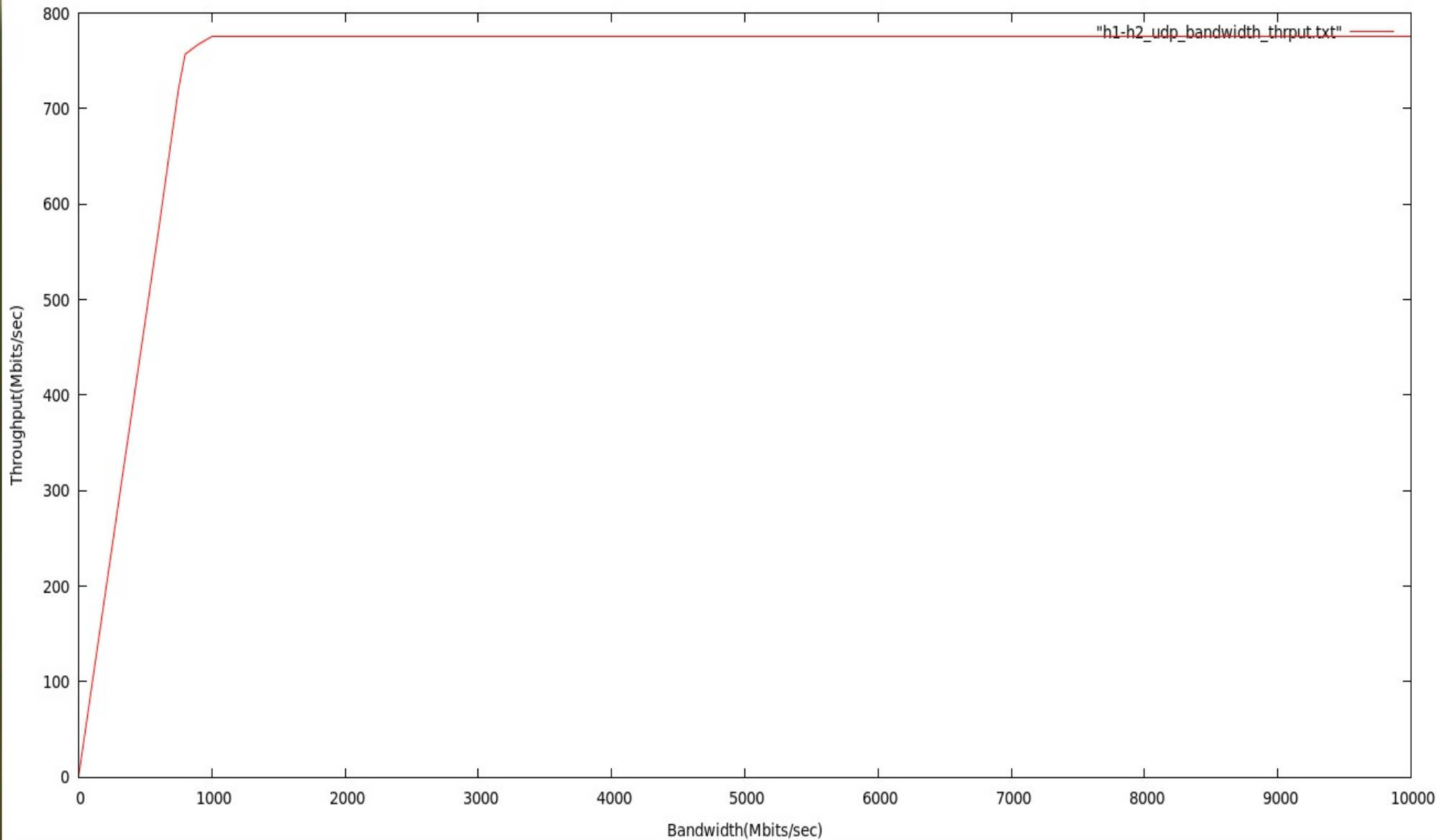
Q 5,6,7,8

- Refer folder wireshark_screenshot
- You can observe network and destination host unreachable behavior
- You can also see trace route behavior in pcap file
- Middle host are sending Time to live exceeded message and final destination is sending Echo Reply message

Plot of Bandwidth vs throughput (h1-h6) for UDP



Plot of bandwidth vs throughput (h1-h2) for UDP



2881.21, 523.378

Observations from ping h1-H*

- As you can see the ping screen shots that time taken for ping from h1-h* increases with number for hops between h1-h*.

so ping time for h1-h6 > h1-h2

- For any Ping H1-H* :

First ping taken more time than subsequent pings since in the first ping router does an ARP query to find next hop HW address after that it caches that address.

Observations from ping h2 to unreachable IP

- For this case ICMP reply type to `TYPE_DEST_UNREACH`
- And then we set code for unreachable in two ways
 - Network unreachable : router first checks whether the destination network exists or not. If it doesn't
it sets code to `CODE_UNREACH_NET`
 - Host unreachable : it destination network exists it forwards packet to the next Hop using routing table. Once the packet reaches to that networks gateway router it checks whether host exists or not. If destination Host doesn't exist set
code to `CODE_UNREACH_HOST`

You can see this behavior in the wireshark traces of that ping.

Observations from iperf with UDP

- Since every channel has a maximum data rate which it can support hence throughput does not always increase with bandwidth. After some bandwidth it becomes constant. Initially it increases linearly with bandwidth.
- Max. Throughput for H1-H6 UDP – 770 Mb/sec
- Max. Throughput for H1-H2 UDP – 776 Mb/sec
- Since H2 is near to h1 as compare to H6 and hence Max Throughput of H1-H2 > H1-H6

Contribution Table

- Every one equally contributed to assignment