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ASSIGNMENT – 3

- **PART – C**
  - For this part, I ran the myRIP file with nodes set up with the given configurations.
    - Bandwidth: 100Mb
    - Delay: 30ms
    - Buffer sizes: 10K, 5Mb, and 25Mb
  - Ran the node H2 as server using the command:
    - **H2 iperf -s**
    - Redirected the output using the '>' operator into a file called, myout.out
  - Ran the node H1 as host using the command:
    - **H1 iperf -c 125.0.0.1 -t 10** -i 1
    - i 1 will print the output every second.
  - The myout.out file has the server-side log, and I print it using the "cat" command:
    - H2 cat myout.out
  - I used the following commands for configuring the nodes in each case,
    - rX tc qdisc add dev rX-eth0 root handle 1: tbf rate **X**mbit buffer **X** limit **X**
  - Outputs:
    - **10K:**

```
*** Starting CLI:
mininet> h2 iperf -s > myout.out &
mininet> h1 iperf -c 125.0.0.1 -t 10 -i 1
------------------------------------------------------------
Client connecting to 125.0.0.1, TCP port 5001
TCP window size: 85.3 KByte (default)
------------------------------------------------------------
[  3] local 120.0.0.1 port 35694 connected with 125.0.0.1 port 5001
[ ID] Interval        Transfer     Bandwidth
[  3]  0.0- 1.0 sec  11.5 MBytes  96.5 Mbits/sec
[  3]  1.0- 2.0 sec  11.4 MBytes  95.4 Mbits/sec
[  3]  2.0- 3.0 sec  11.4 MBytes  95.4 Mbits/sec
[  3]  3.0- 4.0 sec  11.2 MBytes  94.4 Mbits/sec
[  3]  4.0- 5.0 sec  11.4 MBytes  95.4 Mbits/sec
[  3]  5.0- 6.0 sec  11.4 MBytes  95.4 Mbits/sec
[  3]  6.0- 7.0 sec  11.4 MBytes  95.4 Mbits/sec
[  3]  7.0- 8.0 sec  11.4 MBytes  95.4 Mbits/sec
[  3]  8.0- 9.0 sec  11.4 MBytes  95.4 Mbits/sec
[  3]  9.0-10.0 sec  11.2 MBytes  94.4 Mbits/sec
[  3]  0.0-10.0 sec   114 MBytes  95.2 Mbits/sec
mininet> h2 cat myout.out
------------------------------------------------------------
Server listening on TCP port 5001
TCP window size: 85.3 KByte (default)
------------------------------------------------------------
[  4] local 125.0.0.1 port 5001 connected with 120.0.0.1 port 35694
[ ID] Interval        Transfer     Bandwidth
[  4]  0.0-10.0 sec   114 MBytes  95.1 Mbits/sec
mininet>
```

- On ping,

```
mininet> h1 ping -c 10 h2
PING 125.0.0.1 (125.0.0.1) 56(84) bytes of data.
64 bytes from 125.0.0.1: icmp_seq=1 ttl=61 time=0.037 ms
64 bytes from 125.0.0.1: icmp_seq=2 ttl=61 time=0.128 ms
64 bytes from 125.0.0.1: icmp_seq=3 ttl=61 time=0.131 ms
64 bytes from 125.0.0.1: icmp_seq=4 ttl=61 time=0.153 ms
64 bytes from 125.0.0.1: icmp_seq=5 ttl=61 time=0.130 ms
64 bytes from 125.0.0.1: icmp_seq=6 ttl=61 time=0.175 ms
64 bytes from 125.0.0.1: icmp_seq=7 ttl=61 time=0.135 ms
64 bytes from 125.0.0.1: icmp_seq=8 ttl=61 time=0.170 ms
64 bytes from 125.0.0.1: icmp_seq=9 ttl=61 time=0.195 ms
64 bytes from 125.0.0.1: icmp_seq=10 ttl=61 time=0.133 ms

--- 125.0.0.1 ping statistics ---
10 packets transmitted, 10 received, 0% packet loss, time 9205ms
rtt min/avg/max/mdev = 0.037/0.138/0.195/0.042 ms
mininet>
```

- Observations:
    - Bandwidth = 95.1 Mbits/sec
    - RTT = 138 millisec
- BDP = Bandwidth * RTT
- BDP = 95.1 * 138 * 10^{-3} = 13.1 Mb

- **5 Mb:**

```
*** Starting CLI:
mininet> h2 iperf -s > myout.out &
mininet> h1 iperf -c 125.0.0.1 -t 10 -i 1
------------------------------------------------------------
Client connecting to 125.0.0.1, TCP port 5001
TCP window size: 85.3 KByte (default)
------------------------------------------------------------
[  3] local 120.0.0.1 port 35698 connected with 125.0.0.1 port 5001
[ ID] Interval        Transfer      Bandwidth
[  3]  0.0- 1.0 sec  19.9 MBytes   167 Mbits/sec
[  3]  1.0- 2.0 sec  13.4 MBytes   112 Mbits/sec
[  3]  2.0- 3.0 sec  15.2 MBytes   128 Mbits/sec
[  3]  3.0- 4.0 sec  12.5 MBytes   105 Mbits/sec
[  3]  4.0- 5.0 sec  15.5 MBytes   130 Mbits/sec
[  3]  5.0- 6.0 sec  10.5 MBytes  88.1 Mbits/sec
[  3]  6.0- 7.0 sec  10.6 MBytes  89.1 Mbits/sec
[  3]  7.0- 8.0 sec  10.5 MBytes  88.1 Mbits/sec
[  3]  8.0- 9.0 sec  9.98 MBytes  83.7 Mbits/sec
[  3]  9.0-10.0 sec  14.2 MBytes   120 Mbits/sec
[  3]  0.0-10.3 sec   132 MBytes   108 Mbits/sec
mininet> h2 cat myout.out
------------------------------------------------------------
Server listening on TCP port 5001
TCP window size: 85.3 KByte (default)
------------------------------------------------------------
[  4] local 125.0.0.1 port 5001 connected with 120.0.0.1 port 35698
[ ID] Interval        Transfer      Bandwidth
[  4]  0.0-11.2 sec   132 MBytes  99.2 Mbits/sec
mininet>
```

- On ping,

```
mininet> h1 ping -c 10 h2
PING 125.0.0.1 (125.0.0.1) 56(84) bytes of data.
64 bytes from 125.0.0.1: icmp_seq=1 ttl=61 time=0.041 ms
64 bytes from 125.0.0.1: icmp_seq=2 ttl=61 time=0.046 ms
64 bytes from 125.0.0.1: icmp_seq=3 ttl=61 time=0.226 ms
64 bytes from 125.0.0.1: icmp_seq=4 ttl=61 time=0.130 ms
64 bytes from 125.0.0.1: icmp_seq=5 ttl=61 time=0.130 ms
64 bytes from 125.0.0.1: icmp_seq=6 ttl=61 time=0.138 ms
64 bytes from 125.0.0.1: icmp_seq=7 ttl=61 time=0.132 ms
64 bytes from 125.0.0.1: icmp_seq=8 ttl=61 time=0.273 ms
64 bytes from 125.0.0.1: icmp_seq=9 ttl=61 time=0.133 ms
64 bytes from 125.0.0.1: icmp_seq=10 ttl=61 time=0.137 ms

--- 125.0.0.1 ping statistics ---
10 packets transmitted, 10 received, 0% packet loss, time 9215ms
rtt min/avg/max/mdev = 0.041/0.138/0.273/0.067 ms
mininet>
```

- Observations:
  - Bandwidth = 99.2 Mbits/sec
  - RTT = 138 milli sec
- BDP = Bandwidth * RTT
- BDP = 99.2 * 138 * 10^{-3} = 13.68 Mbits
- **25 Mb:**

```
*** Starting CLI:
mininet> h2 iperf -s > myout.out &
mininet> h1 iperf -c 125.0.0.1 -t 10 -i 1
------------------------------------------------------------
Client connecting to 125.0.0.1, TCP port 5001
TCP window size: 85.3 KByte (default)
------------------------------------------------------------
[  3] local 120.0.0.1 port 35708 connected with 125.0.0.1 port 5001
[ ID] Interval        Transfer     Bandwidth
[  3]  0.0- 1.0 sec  38.6 MBytes   324 Mbits/sec
[  3]  1.0- 2.0 sec  14.2 MBytes   120 Mbits/sec
[  3]  2.0- 3.0 sec  16.2 MBytes   136 Mbits/sec
[  3]  3.0- 4.0 sec  13.2 MBytes   111 Mbits/sec
[  3]  4.0- 5.0 sec  10.5 MBytes  88.1 Mbits/sec
[  3]  5.0- 6.0 sec  10.6 MBytes  89.1 Mbits/sec
[  3]  6.0- 7.0 sec  10.5 MBytes  88.1 Mbits/sec
[  3]  7.0- 8.0 sec  15.9 MBytes   133 Mbits/sec
[  3]  8.0- 9.0 sec  10.5 MBytes  88.1 Mbits/sec
[  3]  9.0-10.0 sec  10.6 MBytes  89.1 Mbits/sec
[  3]  0.0-10.3 sec   151 MBytes   123 Mbits/sec
mininet> h2 cat myout.out
------------------------------------------------------------
Server listening on TCP port 5001
TCP window size: 85.3 KByte (default)
------------------------------------------------------------
[  4] local 125.0.0.1 port 5001 connected with 120.0.0.1 port 35708
[ ID] Interval        Transfer     Bandwidth
[  4]  0.0-11.1 sec   151 MBytes   114 Mbits/sec
mininet>
```

- On ping,

```
mininet> h1 ping -c 10 h2
PING 125.0.0.1 (125.0.0.1) 56(84) bytes of data.
64 bytes from 125.0.0.1: icmp_seq=1 ttl=61 time=0.045 ms
64 bytes from 125.0.0.1: icmp_seq=2 ttl=61 time=0.134 ms
64 bytes from 125.0.0.1: icmp_seq=3 ttl=61 time=0.311 ms
64 bytes from 125.0.0.1: icmp_seq=4 ttl=61 time=0.141 ms
64 bytes from 125.0.0.1: icmp_seq=5 ttl=61 time=0.148 ms
64 bytes from 125.0.0.1: icmp_seq=6 ttl=61 time=0.155 ms
64 bytes from 125.0.0.1: icmp_seq=7 ttl=61 time=0.136 ms
64 bytes from 125.0.0.1: icmp_seq=8 ttl=61 time=0.302 ms
64 bytes from 125.0.0.1: icmp_seq=9 ttl=61 time=0.155 ms
64 bytes from 125.0.0.1: icmp_seq=10 ttl=61 time=0.132 ms

--- 125.0.0.1 ping statistics ---
10 packets transmitted, 10 received, 0% packet loss, time 9202ms
rtt min/avg/max/mdev = 0.045/0.165/0.311/0.078 ms
mininet>
```

- Observations:
  - Bandwidth = 114 Mbits/sec
  - RTT = 165 millisec
- BDP = Bandwidth * RTT
- BDP = 114 * 165 * 10^-3 = 18.8 Mbits
- BDP has increased from 10K, 5Mb, and increased significantly for 25Mb. This implies that the packets are taking a larger time as the buffer size increases. This might be because of the retransmission time out might have occurred and the packets might have been retransmitted, RTT and BDP must've increased.