Computer Networks Assignment-4 Report

Q1. A

Installed GUI of mininet from commands given in assignment pdf.

Defined hosts and switches and linked them as per the topology given in the assignment.

```
topology enables one to pass in '--topo=mytopo' from the command line.
"""

from mininet.topo import Topo

class MyTopo( Topo ):
    "Simple topology example."

    def build( self ):
        "Create custom topo."
        h1 = self.addHost('h1')
        h2 = self.addHost('h2')
        h3 = self.addHost('h3')
        h4 = self.addHost('h4')
        h5 = self.addHost('h5')
        h6 = self.addHost('h6')
        h7 = self.addHost('h7')
        h8 = self.addHost('h8')

        s1 = self.addSwitch('s1')
        s2 = self.addSwitch('s2')
        s3 = self.addSwitch('s3')

        self.addLink(s1,s2)
        self.addLink(s2,s3)
        self.addLink(h1,s1)
        self.addLink(h2,s1)
        self.addLink(h3,s2)
        self.addLink(h4,s2)
        self.addLink(h5,s2)
        self.addLink(h6,s3)
        self.addLink(h7,s3)
        self.addLink(h8,s3)
topos = { 'mytopo': ( lambda: MyTopo() ) }
mininet@mininet-vm:~/mininet/custom$
```

Running Mininet

```
mininet@mininet-vm:~/mininet/custom$ sudo mn --custom topo-2sw-2host.py --topo mytopo
*** Creating network
*** Adding controller
*** Adding hosts:
h1 h2 h3 h4 h5 h6 h7 h8
*** Adding switches:
s1 s2 s3
*** Adding links:
(h1, s1) (h2, s1) (h3, s2) (h4, s2) (h5, s2) (h6, s3) (h7, s3) (h8, s3) (s1, s2) (s2, s3)
*** Configuring hosts
h1 h2 h3 h4 h5 h6 h7 h8
*** Starting controller
c0
*** Starting 3 switches
s1 s2 s3 ...
*** Starting CLI:
mininet> pingall
*** Ping: testing ping reachability
h1 -> h2 h3 h4 h5 h6 h7 h8
h2 -> h1 h3 h4 h5 h6 h7 h8
h3 -> h1 h2 h4 h5 h6 h7 h8
h4 -> h1 h2 h3 h5 h6 h7 h8
h5 -> h1 h2 h3 h4 h6 h7 h8
h6 -> h1 h2 h3 h4 h5 h7 h8
h7 -> h1 h2 h3 h4 h5 h6 h8
h8 -> h1 h2 h3 h4 h5 h6 h7
*** Results: 0% dropped (56/56 received)
mininet>
```

B. Verifying the topology using net

```
mininet> net
h1 h1-eth0:s1-eth2
h2 h2-eth0:s1-eth3
h3 h3-eth0:s2-eth3
h4 h4-eth0:s2-eth4
h5 h5-eth0:s2-eth5
h6 h6-eth0:s3-eth2
h7 h7-eth0:s3-eth3
h8 h8-eth0:s3-eth4
s1 lo:  s1-eth1:s2-eth1 s1-eth2:h1-eth0 s1-eth3:h2-eth0
s2 lo:  s2-eth1:s1-eth1 s2-eth2:s3-eth1 s2-eth3:h3-eth0 s2-eth4:h4-eth0 s2-eth5:h5-eth0
s3 lo:  s3-eth1:s2-eth2 s3-eth2:h6-eth0 s3-eth3:h7-eth0 s3-eth4:h8-eth0
c0
mininet>
```

Q2

(a), (b) Generating TCP traffic between host h1 and h6 using iperf, After limiting the Bandwidth we can observe that there is a huge difference in the bandwidth and transferred bytes between host h1 and h6 as shown in below images:

```
mininet> h1 tc qdisc add dev h1-eth0 root tbf rate 1mbit burst 32kbit latency 400ms
mininet> h1 iperf -c 10.0.0.6 -t 10
------------------------------------------------------------
Client connecting to 10.0.0.6, TCP port 5001
TCP window size: 85.3 KByte (default)
------------------------------------------------------------
[  3] local 10.0.0.1 port 32992 connected with 10.0.0.6 port 5001
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0-11.2 sec  1.38 MBytes  1.03 Mbits/sec
mininet>
```

```
mininet> h6 iperf -s &
------------------------------------------------------------mininet> h1 iperf -c 10.0.0.6 -t 10
------------------------------------------------------------
Client connecting to 10.0.0.6, TCP port 5001
TCP window size: 85.3 KByte (default)
------------------------------------------------------------
[  3] local 10.0.0.1 port 32990 connected with 10.0.0.6 port 5001
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0-10.0 sec  38.3 GBytes  32.9 Gbits/sec
mininet>
```

(c) Generated pcap file using tcpdump as shown in below images and collected cwnd data from iperf3 and extracted cwnd to plot it against time

```
mininet> h1 tc qdisc add dev h1-eth0 root netem rate 1024kbit loss 5%
mininet> h6 iperf3 -s &
mininet> h1 iperf3 -c 10.0.0.6 -t 60
Connecting to host 10.0.0.6, port 5201
[  4] local 10.0.0.1 port 54374 connected to 10.0.0.6 port 5201
[ ID] Interval           Transfer     Bandwidth       Retr  Cwnd
[  4]   0.00-1.00   sec   283 KBytes  2.31 Mbits/sec    2   19.8 KBytes
[  4]   1.00-2.00   sec  63.6 KBytes   522 Kbits/sec    3   11.3 KBytes
[  4]   2.00-3.00   sec   127 KBytes  1.04 Mbits/sec   10   4.24 KBytes
[  4]   3.00-4.00   sec   127 KBytes  1.04 Mbits/sec    2   9.90 KBytes
[  4]   4.00-5.00   sec   127 KBytes  1.04 Mbits/sec    3   11.3 KBytes
[  4]   5.00-6.00   sec   127 KBytes  1.04 Mbits/sec    2   11.3 KBytes
[  4]   6.00-7.00   sec  63.6 KBytes   521 Kbits/sec    6   8.48 KBytes
[  4]   7.00-8.00   sec   127 KBytes  1.04 Mbits/sec    2   8.48 KBytes
[  4]   8.00-9.00   sec   127 KBytes  1.04 Mbits/sec    4   8.48 KBytes
[  4]   9.00-10.00  sec   127 KBytes  1.04 Mbits/sec    7   7.07 KBytes
[  4]  10.00-11.00  sec   127 KBytes  1.04 Mbits/sec    2   11.3 KBytes
[  4]  11.00-12.00  sec   127 KBytes  1.04 Mbits/sec    0   12.7 KBytes
[  4]  12.00-13.00  sec   127 KBytes  1.04 Mbits/sec    4   9.90 KBytes
[  4]  13.00-14.00  sec   127 KBytes  1.04 Mbits/sec    1   8.48 KBytes
[  4]  14.00-15.00  sec  63.6 KBytes   522 Kbits/sec    8   7.07 KBytes
[  4]  15.00-16.00  sec   127 KBytes  1.04 Mbits/sec    7   7.07 KBytes
[  4]  16.00-17.00  sec   127 KBytes  1.04 Mbits/sec    4   8.48 KBytes
[  4]  17.00-18.00  sec   127 KBytes  1.04 Mbits/sec    9   7.07 KBytes
[  4]  18.00-19.00  sec   127 KBytes  1.04 Mbits/sec    2   9.90 KBytes
[  4]  19.00-20.00  sec   127 KBytes  1.04 Mbits/sec    6   8.48 KBytes
[  4]  20.00-21.00  sec   127 KBytes  1.04 Mbits/sec    7   5.66 KBytes
[  4]  21.00-22.00  sec   127 KBytes  1.04 Mbits/sec    3   8.48 KBytes
[  4]  22.00-23.00  sec  63.6 KBytes   521 Kbits/sec    6   8.48 KBytes
[  4]  23.00-24.00  sec   127 KBytes  1.04 Mbits/sec    6   5.66 KBytes
[  4]  24.00-25.00  sec   127 KBytes  1.04 Mbits/sec    4   11.3 KBytes
[  4]  25.00-26.00  sec   127 KBytes  1.04 Mbits/sec    4   8.48 KBytes
[  4]  26.00-27.00  sec   127 KBytes  1.04 Mbits/sec    7   7.07 KBytes
[  4]  27.00-28.00  sec   127 KBytes  1.04 Mbits/sec    5   9.90 KBytes
[  4]  28.00-29.00  sec   127 KBytes  1.04 Mbits/sec    3   11.3 KBytes
[  4]  29.00-30.00  sec  63.6 KBytes   521 Kbits/sec    4   7.07 KBytes
[  4]  30.00-31.00  sec   127 KBytes  1.04 Mbits/sec    2   11.3 KBytes
[  4]  31.00-32.00  sec   127 KBytes  1.04 Mbits/sec    4   11.3 KBytes
[  4]  32.00-33.00  sec   127 KBytes  1.04 Mbits/sec    7   5.66 KBytes
[  4]  33.00-34.00  sec   127 KBytes  1.04 Mbits/sec    5   4.24 KBytes
[  4]  34.00-35.00  sec   127 KBytes  1.04 Mbits/sec    6   7.07 KBytes
[  4]  35.00-36.00  sec   127 KBytes  1.04 Mbits/sec    4   7.07 KBytes
[  4]  36.00-37.00  sec   127 KBytes  1.04 Mbits/sec    3   11.3 KBytes
[  4]  37.00-38.00  sec   127 KBytes  1.04 Mbits/sec   12   7.07 KBytes
[  4]  38.00-39.00  sec  63.6 KBytes   521 Kbits/sec   10   5.66 KBytes
[  4]  39.00-40.00  sec   127 KBytes  1.04 Mbits/sec    0   11.3 KBytes
[  4]  40.00-41.00  sec   127 KBytes  1.04 Mbits/sec    4   8.48 KBytes
[  4]  41.00-42.00  sec   127 KBytes  1.04 Mbits/sec    6   11.3 KBytes
[  4]  42.00-43.00  sec   127 KBytes  1.04 Mbits/sec    2   11.3 KBytes
[  4]  43.00-44.00  sec   127 KBytes  1.04 Mbits/sec    6   8.48 KBytes
[  4]  44.00-45.00  sec   127 KBytes  1.04 Mbits/sec    0   11.3 KBytes
[  4]  45.00-46.00  sec  63.6 KBytes   521 Kbits/sec    2   9.90 KBytes
[  4]  46.00-47.00  sec   127 KBytes  1.04 Mbits/sec    2   11.3 KBytes
[  4]  47.00-48.00  sec   127 KBytes  1.04 Mbits/sec    3   7.07 KBytes
[  4]  48.00-49.00  sec   127 KBytes  1.04 Mbits/sec    4   9.90 KBytes
```

```
mininet> h1 tc qdisc add dev h1-eth0 root tbf rate 1mbit burst 32kbit latency 40
0ms
mininet> h1 tcpdump -i h1-eth0 -w pkt.pcap &
mininet> h6 iperf -s &
mininet> h1 iperf -c 10.0.0.6 -t 10
tcpdump: listening on h1-eth0, link-type EN10MB (Ethernet), capture size 262144
bytes
------------------------------------------------------------
Client connecting to 10.0.0.6, TCP port 5001
TCP window size: 85.3 KByte (default)
------------------------------------------------------------
[  3] local 10.0.0.1 port 60764 connected with 10.0.0.6 port 5001
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0-11.9 sec  1.50 MBytes  1.06 Mbits/sec
mininet>
```

(d) As we can observe in the below plot cwnd (in KBytes) size increases with time and it suddenly drops as soon as it encounters congestion in the window and then again starts increasing until encounter congestion in window again.