CN assignment 4
Parth Sandeep Rastogi
2022352

Q1)
a) 7 Mbps as it is bottleneck bandwidth
b) d trans = (1460*8)/(7*10^6) sec = 1.67 ms
D_ete = d prop 1 + d prop 2 + 2* d trans + d prop 1 + d prop2 (assuming d trans is 0 for ack)
= 223.34 ms
Bdp = d_ete * bottleneck bw = 223.34*10^(-3)*7*10^6 = 1563380bits
Packets = BDP/packet size = 1563380/(1460 *8) = 133.851
c) for calculating tpt i used

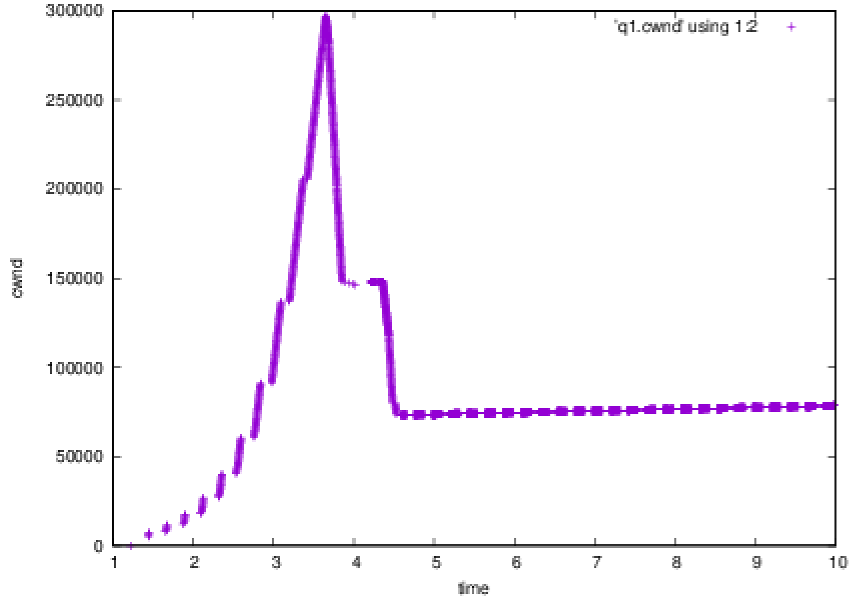
```
tshark -r q1-2-0.pcap -T fields -e frame.time_epoch -e tcp.len > q1tshark.txt
```

Then read the txt and then count total bytes divided by time

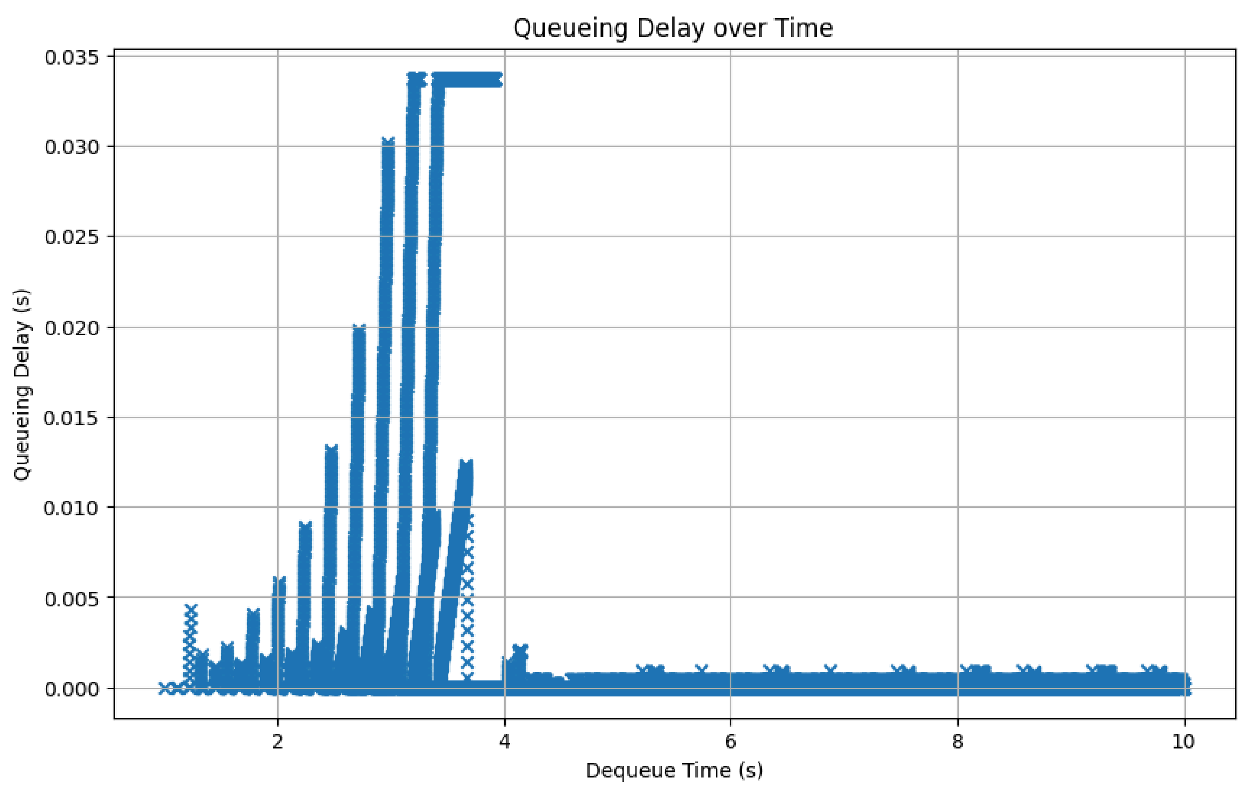
Average Throughput = 2.80 Mbps
d)
1)TCP Congestion Control:
TCP NewReno's conservative congestion window growth and AIMD mechanism limit the ability to fully utilize the 7 Mbps bandwidth.
2)High RTT and Buffer Limitations:
A high RTT (223.34 ms) and the small buffer size at N1 (50 packets) cause delays, packet drops, and retransmissions, reducing throughput.

e) for cwnd plot used gnuplot script then

gs q1.eps



f)



g) Yes, both concepts are interconnected. As the congestion window (cwnd) increases, the amount of data transmitted per time segment also increases. This rise in data flow leads to an increase in the queue size, as additional time is required to process the incoming data. Consequently, the queuing delay also increases.

Q2)

a)for calculating tpt i used

tshark -r Q2-2-0.pcap -T fields -e frame.time_epoch -e tcp.len > q2tshark.txt

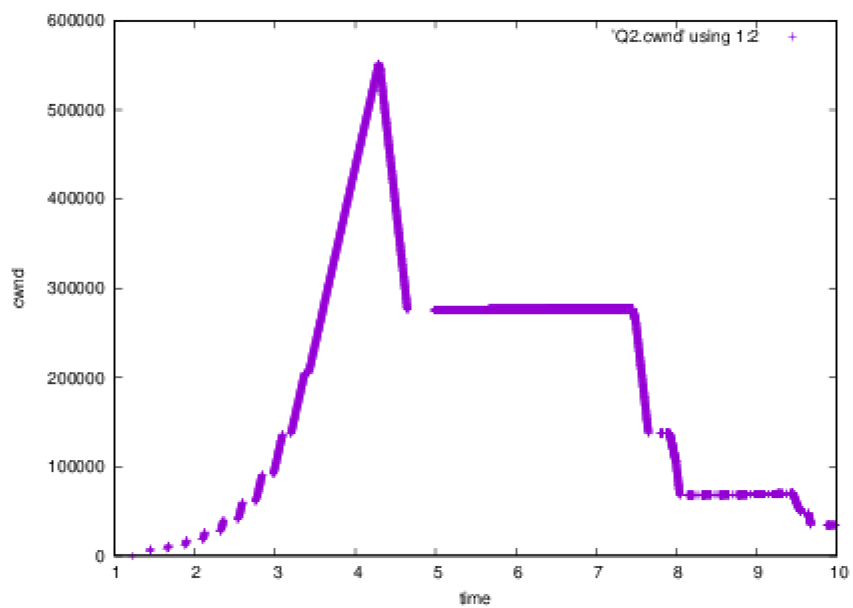
Then read the txt and then count total bytes divided by time

Average Throughput = 4.15 Mbps

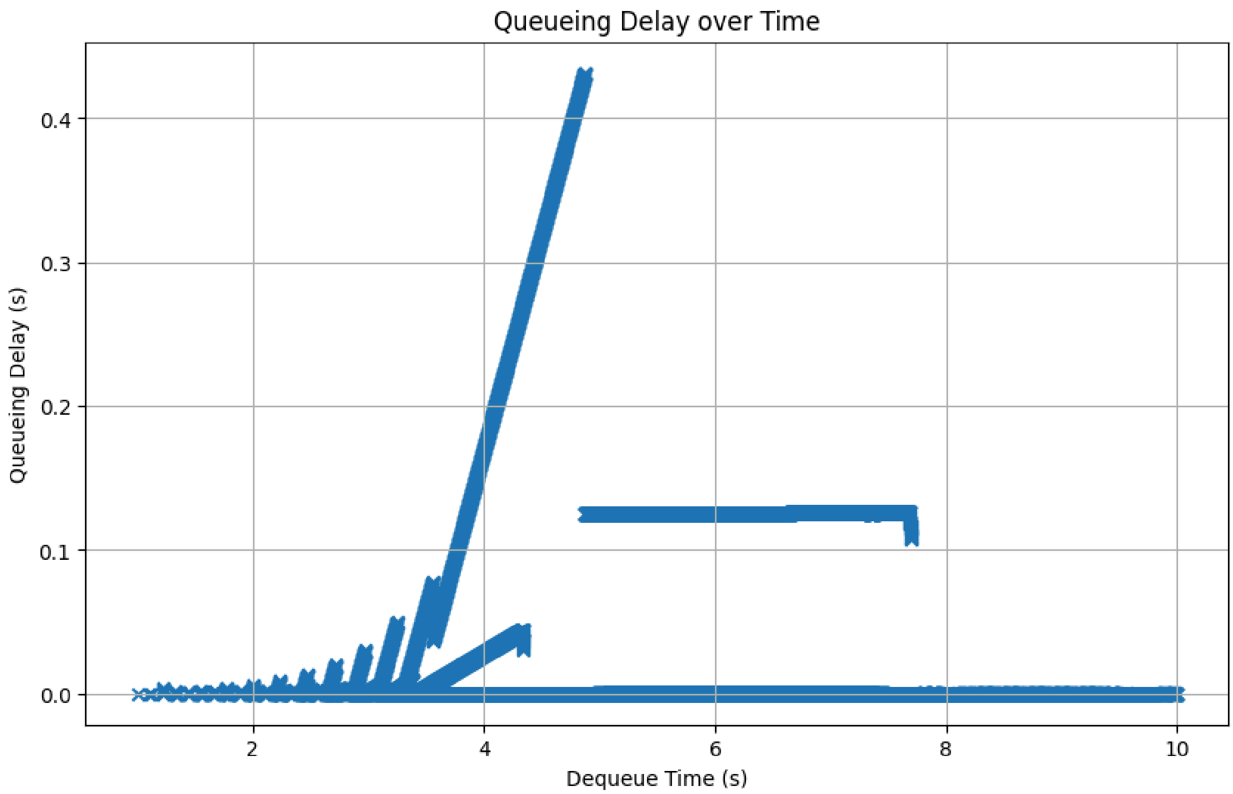
b)

for cwnd plot used gnuplot script then

gs q2.eps



c)



d)

When we increase the queue size from 50 to 1000, the behavior of the cwnd is noticeably affected. While the rate at which cwnd increases remains similar, the peak value is reached later, allowing it to achieve a higher cwnd. This is because a larger queue can accommodate more packets before becoming full, delaying packet drops and the corresponding congestion signals.

In a smaller queue (size 50), the buffer fills up quickly, leading to earlier packet drops. These drops trigger congestion control mechanisms such as reducing cwnd, thereby limiting its growth. On the other hand, with a larger queue (size 1000), the buffer provides greater capacity, allowing the cwnd to continue growing until the queue approaches its larger limit. Consequently, packet drops occur later, enabling the cwnd to reach a higher peak before congestion is detected.

Q3)

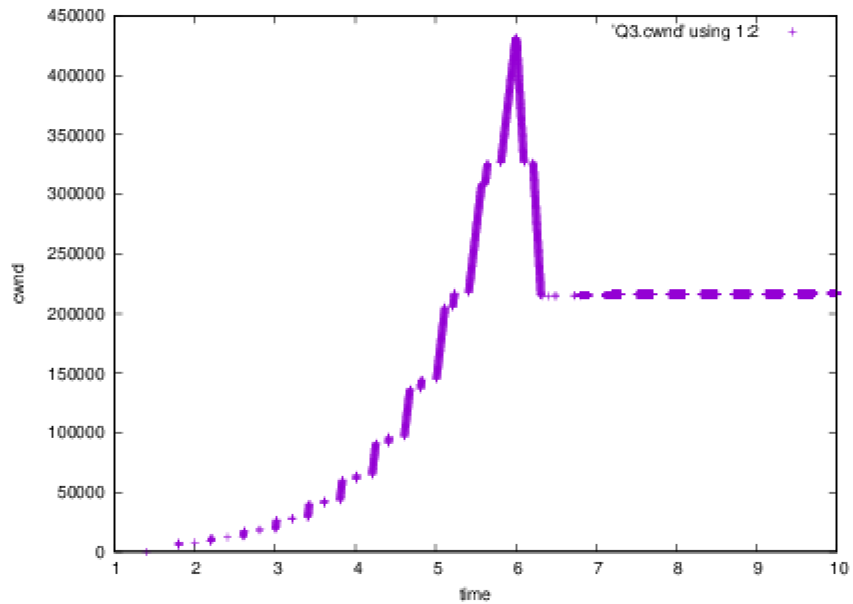
a)for calculating tpt i used

tshark -r Q3-2-0.pcap -T fields -e frame.time_epoch -e tcp.len > q3tshark.txt

Then read the txt and then count total bytes divided by time

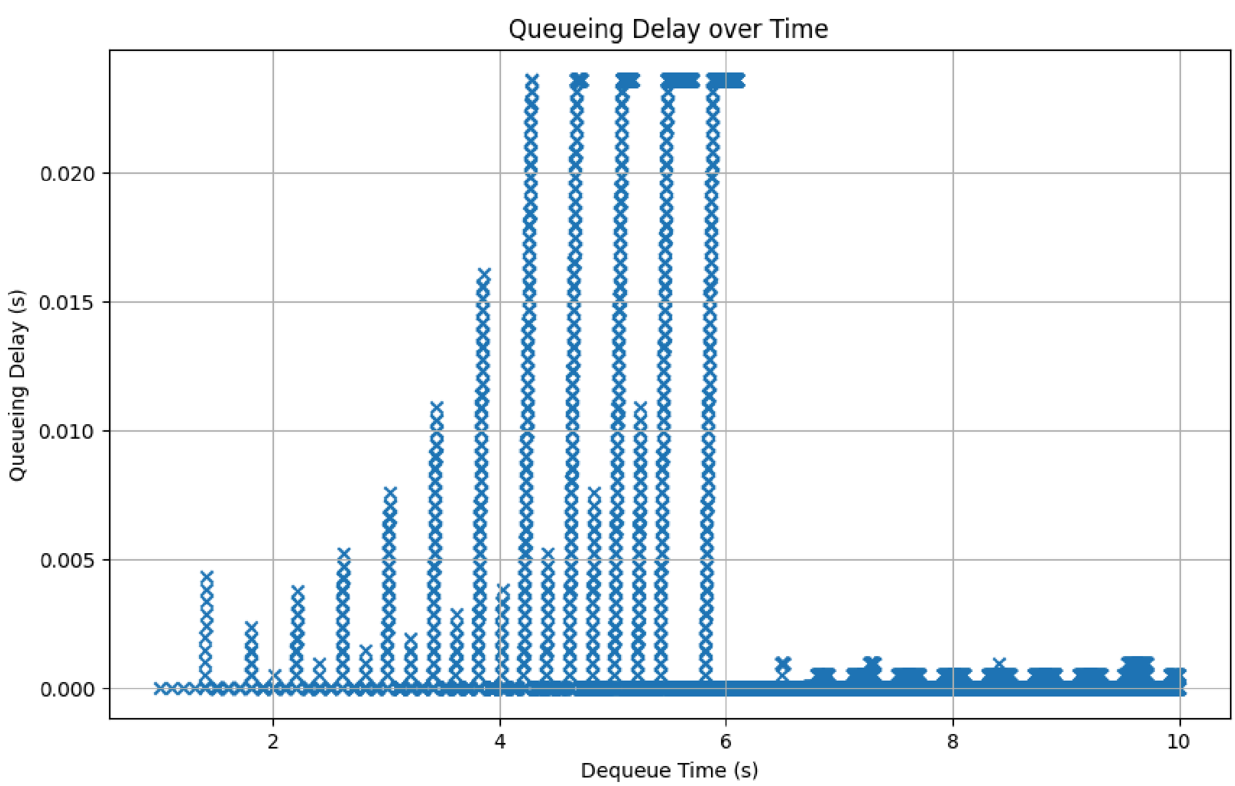
Average Throughput = 2.97 Mbps

b)for cwnd plot used gnuplot script then gs q3.eps



'Q3.cwnd' using 1:2
cwnd
time
450000
400000
350000
300000
250000
200000
150000
100000
50000
0
1
2
3
4
5
6
7
8
9
10

c)



Queueing Delay over Time
Queueing Delay (s)
Dequeue Time (s)
0.020
0.015
0.010
0.005
0.000
2
4
6
8
10

d)When the queue length is constant, increasing the delay of the second link while also increasing its throughput results in reduced queuing delay and a delayed peak in the congestion window (cwnd). The higher throughput enables the link to process packets more efficiently, reducing the time packets spend waiting in the queue and thereby lowering the queuing delay. Simultaneously, the increased delay in the second link contributes to a longer round-trip time (RTT), slowing down the feedback loop of the congestion control algorithm. This combination allows the cwnd to grow more steadily and reach its peak later, as the network takes longer to experience congestion signals like packet drops ..