CN Assignment 4
Report

Name - Himang Chandra Garg Roll no. - 2022214

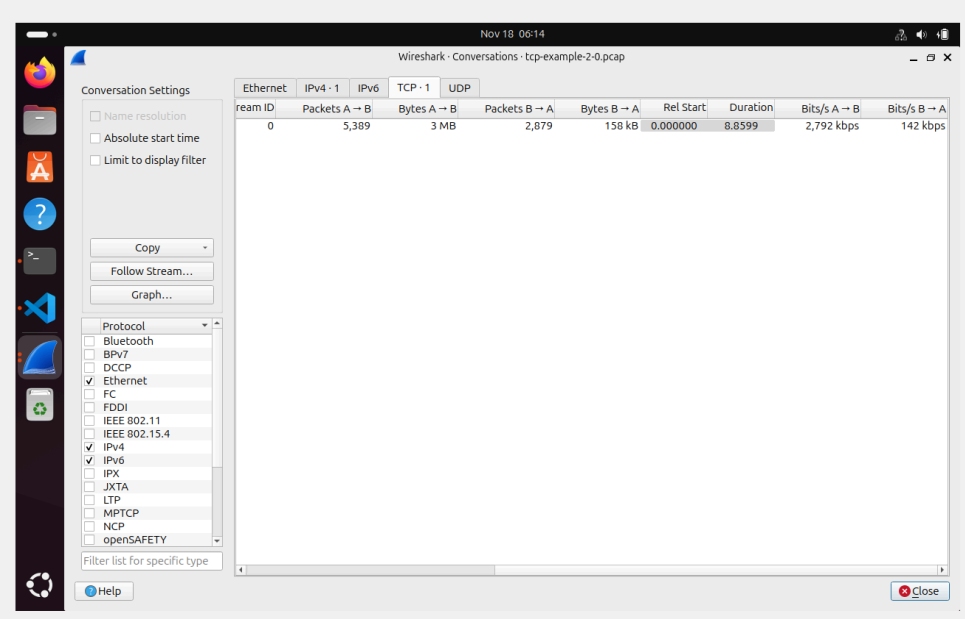
Q.1. Simulate with the default parameters (provided in the table) and answer the following questions:

a. What is the maximum expected value (theoretical) of throughput (in Mbps)? Why?
Ans. The maximum expected value of throughput is **7 Mbps** because, as given in the default parameters in the table, the bandwidth between the n0 and n1 nodes is 10 Mbps, and between n1 and n2 nodes is 7 Mbps. So, the connection between the n1 and n2 nodes acts as a bottleneck, and hence, the maximum throughput that can be achieved is 7 Mbps.

b. How much is Bandwidth-Delay-Product (BDP)? Express your answer in terms of the number of packets.
Ans.

Bandwidth delay product = bandwidth(bottleneck) * Round trip time
= (7*10^6) * ((100+10+100+10)/1000) bits
= 1.54 * 10^6 bits
= (1.54 * 10^6) / (1460*8) packets
= 132 packets (approx.)

c. What is the average computed throughput of the TCP transfer? [2]
Ans. using Wireshark, Screenshot:

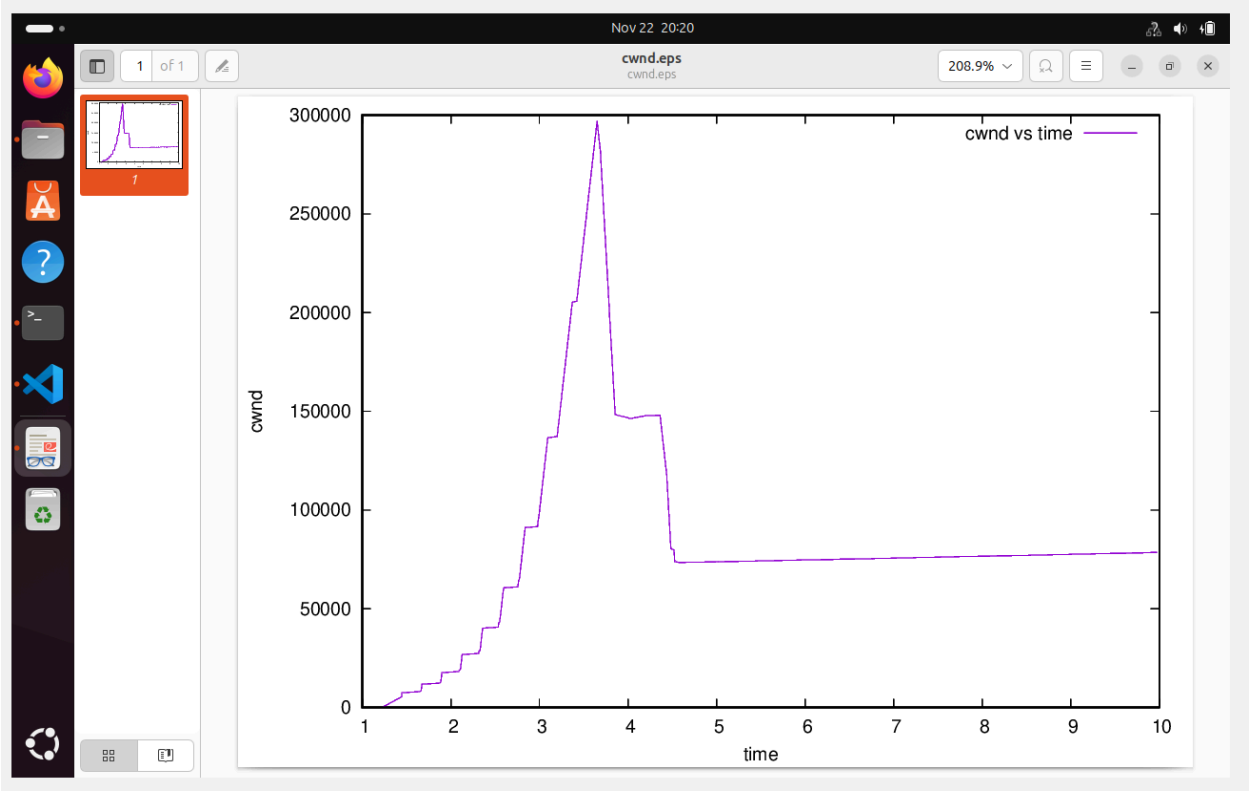


Throughput = Total bits received / Total Simulation Time
= 24 Mbits / 8.8599 sec
= 2.708834 Mbps

d. Is the achieved throughput approximately equal to the maximum expected value? If it is not, explain the reason for the difference. [1+1]

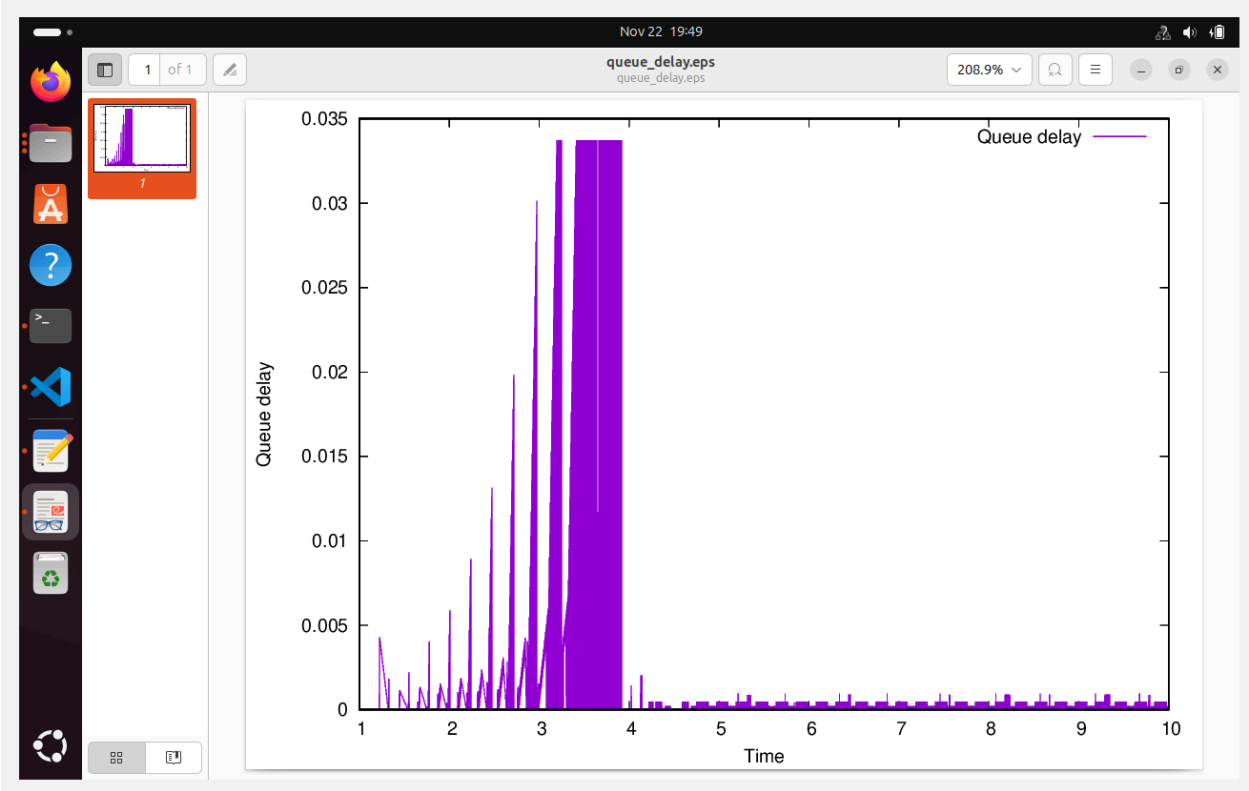
Ans. The achieved throughput is not equal to the maximum expected throughput, it is significantly lower than the theoretical throughput value. It is because of several reasons, such as high round trip time, which increases the time required to receive the acknowledgment, packet losses, buffer overflows, and congestion using slow start.

e. Plot Congestion Window (CWND) with time [1]
Ans. Using Gnuplot and Evince software in Linux:



f. Plot queueing delay with time [1]

Ans.

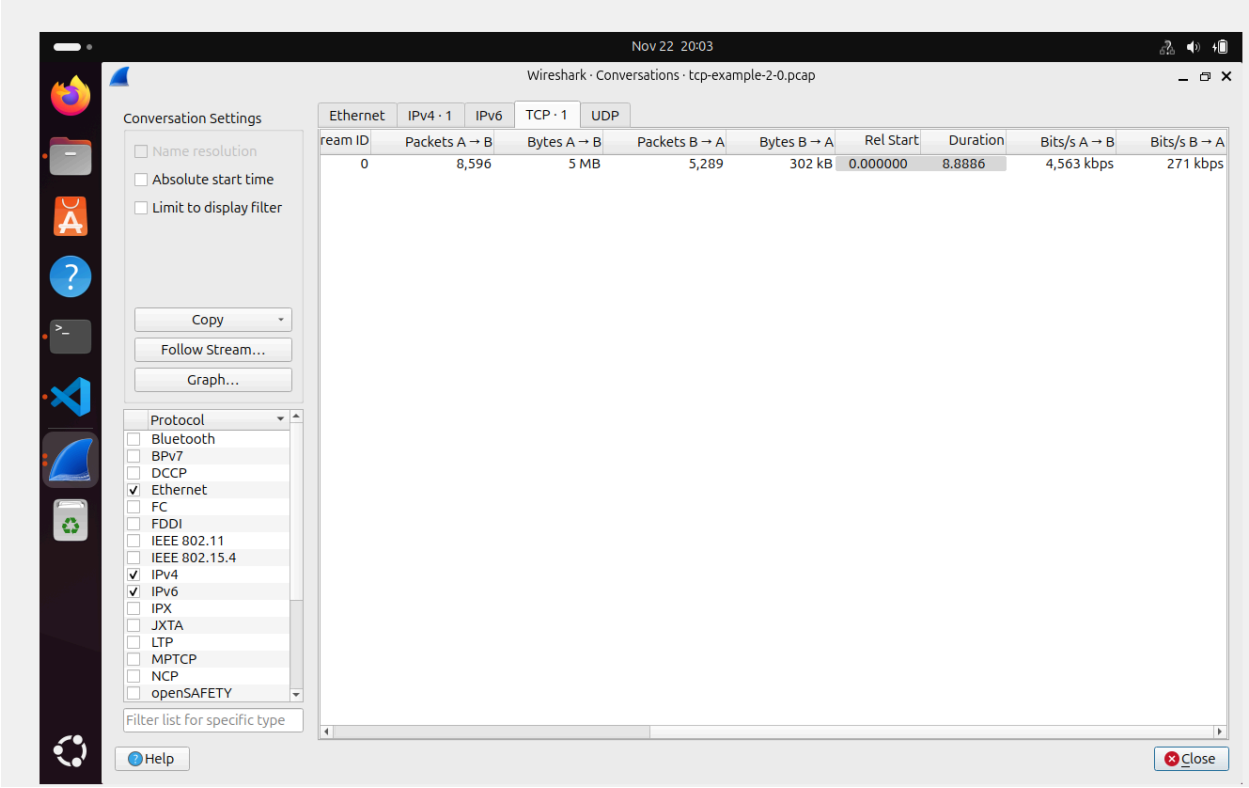


g. Are the plots in 1(e) and 1(f) related? [1]

Ans. Yes, both the plots, congestion window (CWND) and queueing delay are related to each other. The congestion window is the number of packets that can be sent together without waiting for an acknowledgment. When the CWND increases, more packets are send to the receiver, thus, the queueing delays also increases which is clearly visible from the two plots. Around 4 seconds, the CWND is dropped to a lower value and hence the queueing delay also decreases because now packets are reduced and hence they have to wait less. Thus the two plots are highly linked to each other.

Q.2. Change queue size to 1000 (rest of the parameter values are the same as default values)
a. What is the average computed throughput of the TCP transfer? [1]

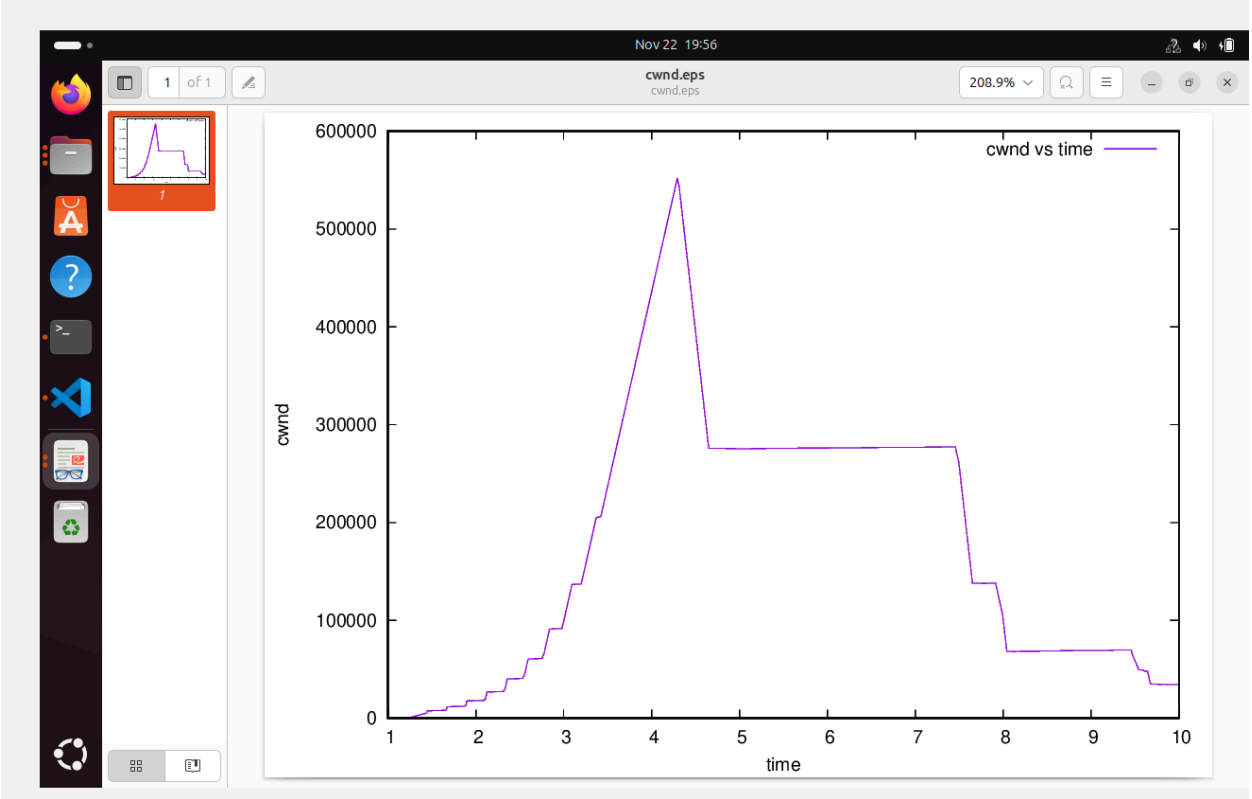
Ans.



Throughput = Total bits received / Total Simulation Time
= 40 Mbits / 8.8886 sec
= 4.500146 Mbps

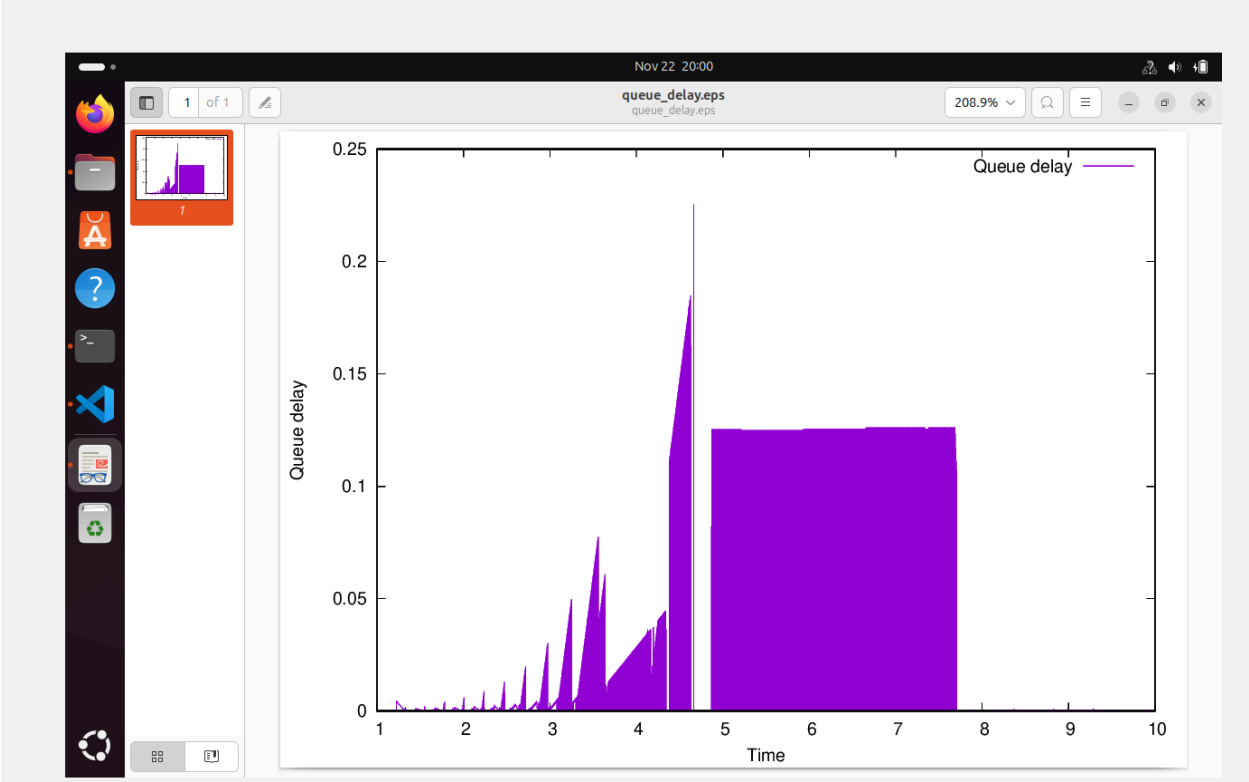
b. Plot CWND with time [1]

Ans.



c. Plot queueing delay with time [1]

Ans.

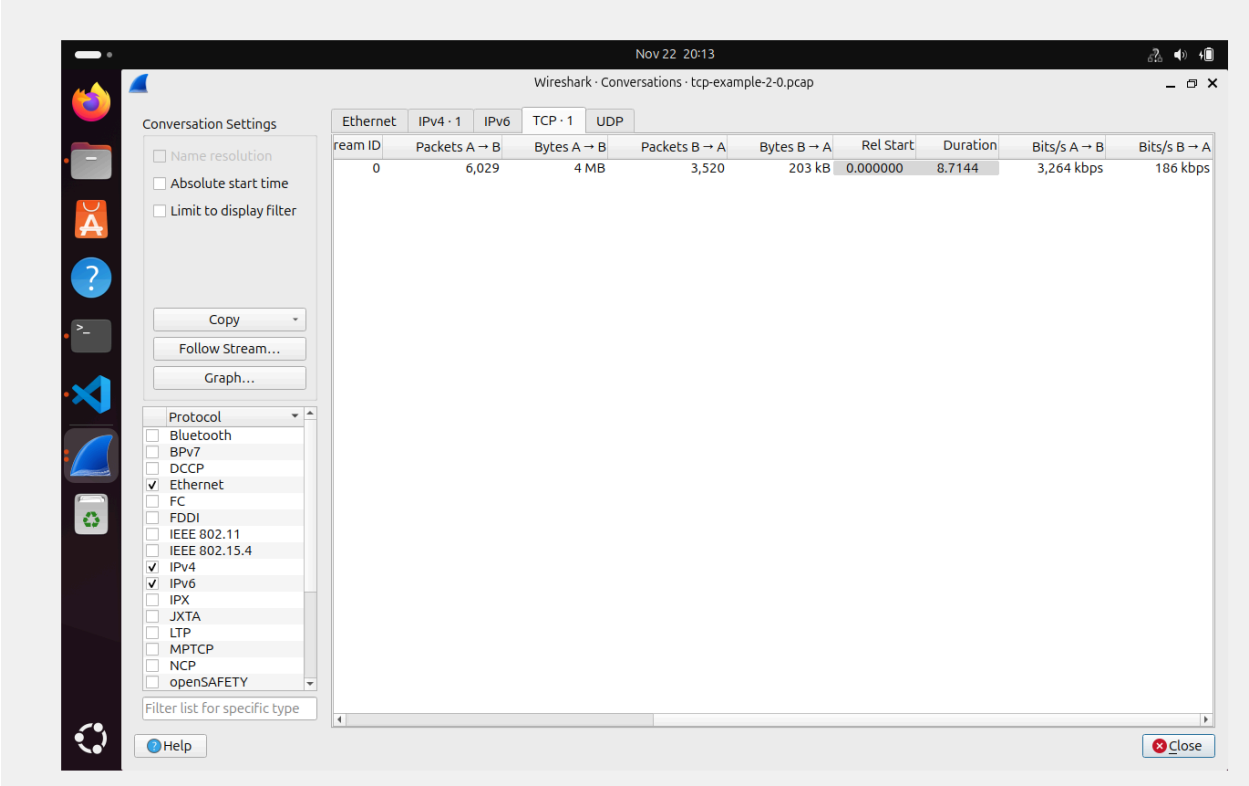


d. Compare CWND plots of Q.1. and Q.2; what insights did you gain? [1]

Ans. In Q1, the queue size is smaller that the queue size in Q2, hence the queue is filled faster.In Q1 the cwnd doesnt rise very much(only till 300000) whereas in Q1 it rises (around till 600000). Also, in Q1 the max cwnd value if reached faster(around 3.6 seconds) in contrast to (around 4.3 seconds) in Q2. But in both cases, the cwnd is finally dropped because of the congestion control phenomenon of TCP.

Q.3. Change N1-N2 bandwidth to 10 Mbps and N1-N2 delay to 100ms (rest of the parameter values are same as default values)
a. What is the average computed throughput of the TCP transfer? [1]

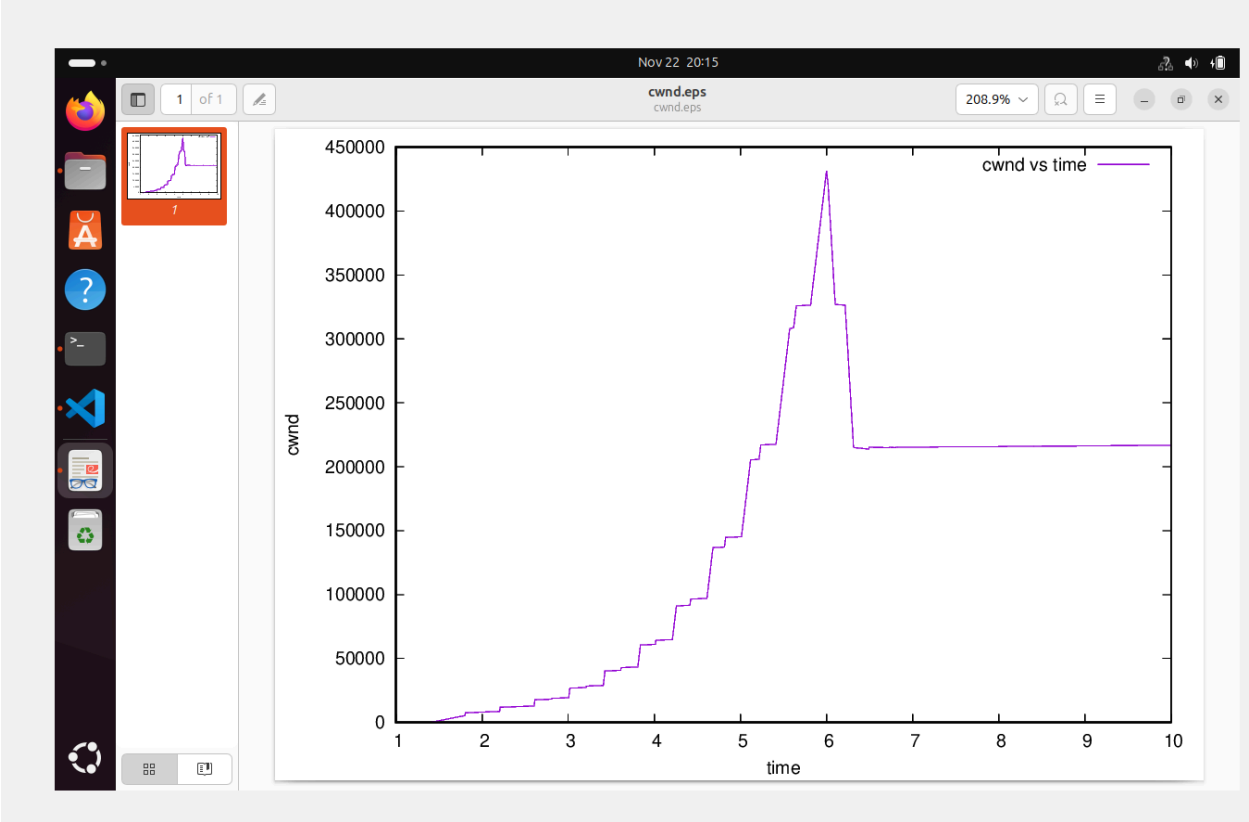
Ans.



Throughput = Total bits received / Total Simulation Time
= 32 Mbits / 8.7144 sec
= 3.672082 Mbps

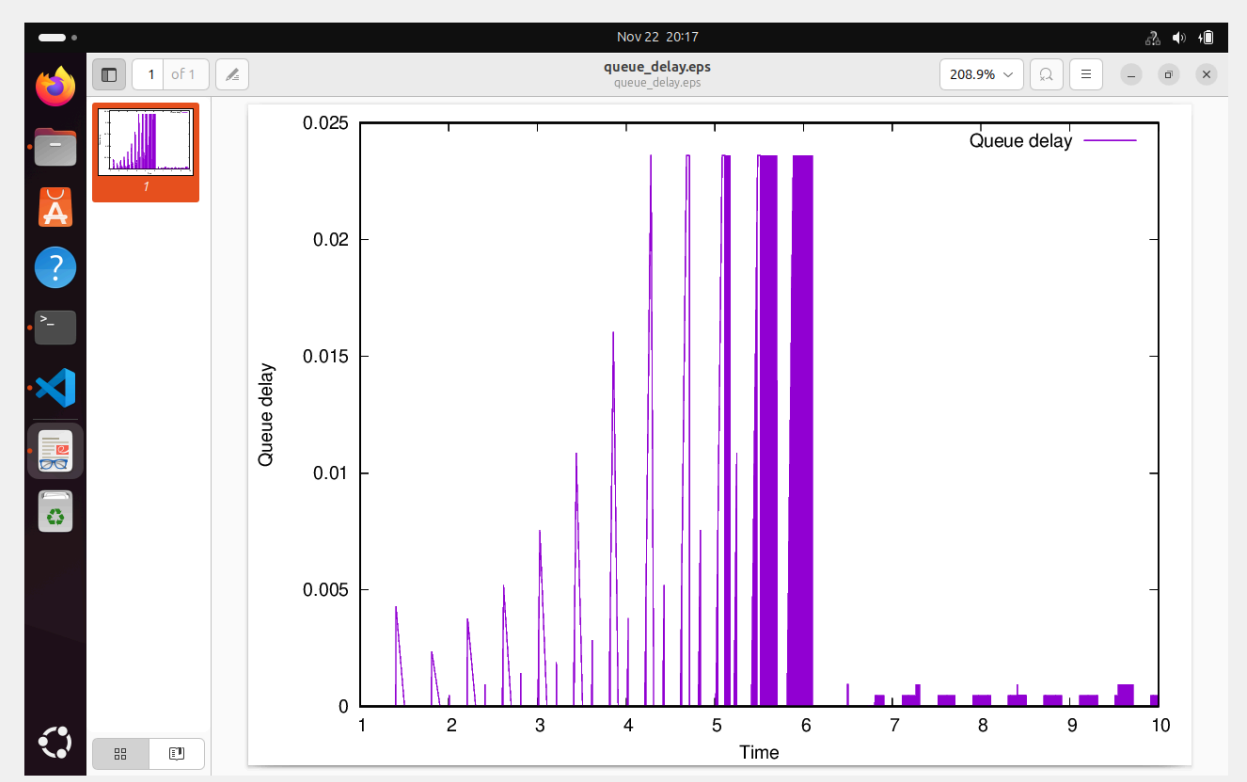
b. Plot CWND with time [1]

Ans.



c. Plot queueing delay with time [1]

Ans.



d. Compare queuing delay plots of Q.1. and Q.3; what insights did you gain? [1]

Ans. In Q1, the maximum queueing delay(0.035) is higher than the maximum queueing delay in Q3(0.025). This is so because in Q3, better handling of packets has been done by making the n1-n2 parameters equal to the n0-n1 parameters. Thus reducing the bottleneck. Also, as we can see in Q3, plots are more stable, and network flow is also smoother than in Q1 because the congestion builds up gradually (because of no bottleneck).