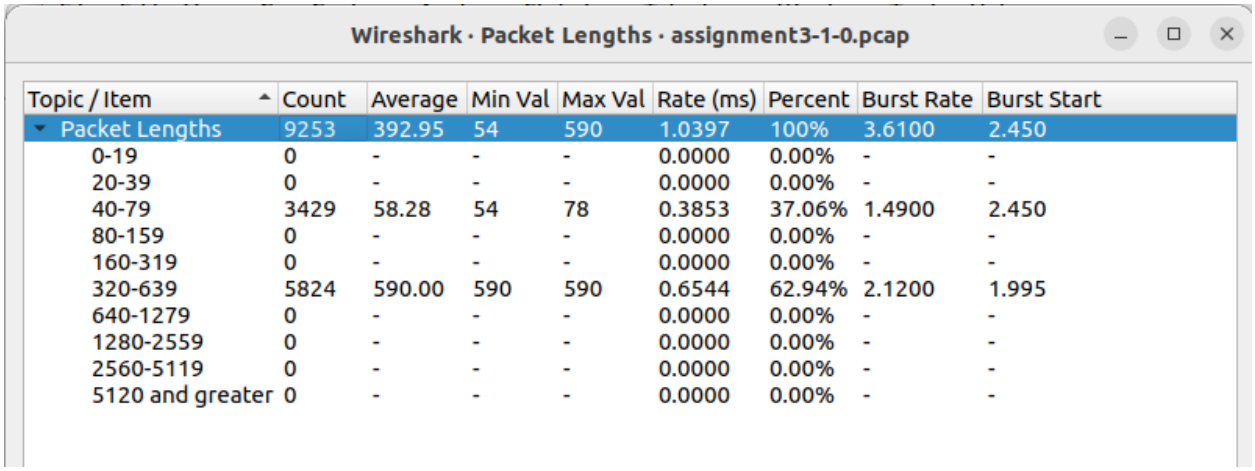
CN Assignment 3
Shivam Agarwal CSE 2020123

Answer 1

a) The maximum theoretical expected value of throughput is 7 mbps.
This is because the bandwidth of connection between n0-n1 , n1-n2 is 10,7 mbps respectively. So the connection between n1 and n2 acts as a bottleneck and limits the throughput to 7 mbps

b) Bandwidth delay product = bandwidth * delay
For node n0-n1 : BDP = 7 mbps * 100ms = 700 kb = 700000 / (590 *8)
= 149 packets
packets (from wireshark we can see that the size of tcp packets is 590 bytes)
For node n1-n2 : BDP = 7 mbps * 10ms = 70 kb = 70000 / (590 *8)
= 15 packets

c)

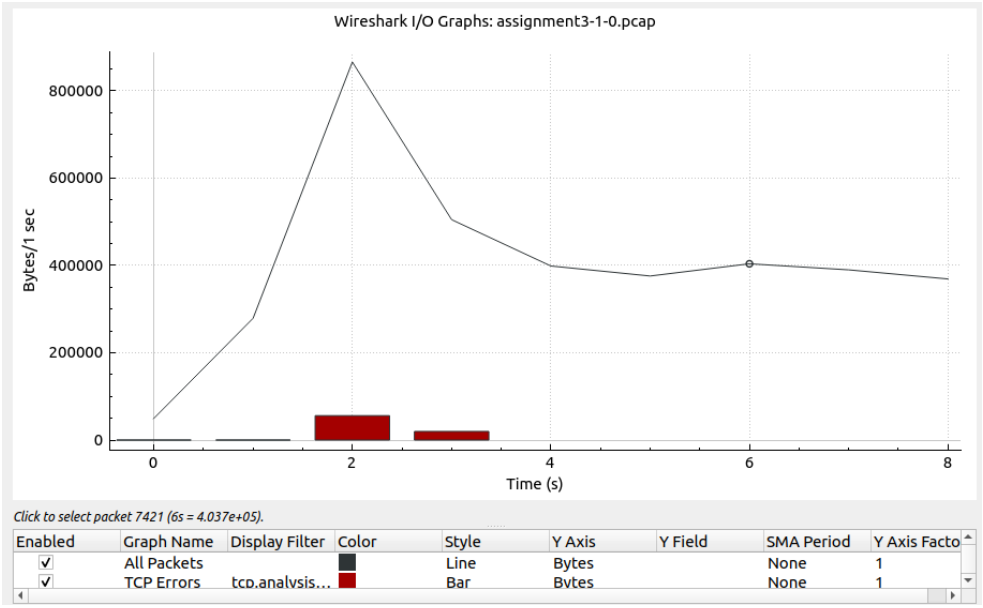


Topic / Item	Count	Average	Min Val	Max Val	Rate (ms)	Percent	Burst Rate	Burst Start
Packet Lengths	9253	392.95	54	590	1.0397	100%	3.6100	2.450
0-19	0	-	-	-	0.0000	0.00%	-	-
20-39	0	-	-	-	0.0000	0.00%	-	-
40-79	3429	58.28	54	78	0.3853	37.06%	1.4900	2.450
80-159	0	-	-	-	0.0000	0.00%	-	-
160-319	0	-	-	-	0.0000	0.00%	-	-
320-639	5824	590.00	590	590	0.6544	62.94%	2.1200	1.995
640-1279	0	-	-	-	0.0000	0.00%	-	-
1280-2559	0	-	-	-	0.0000	0.00%	-	-
2560-5119	0	-	-	-	0.0000	0.00%	-	-
5120 and greater	0	-	-	-	0.0000	0.00%	-	-

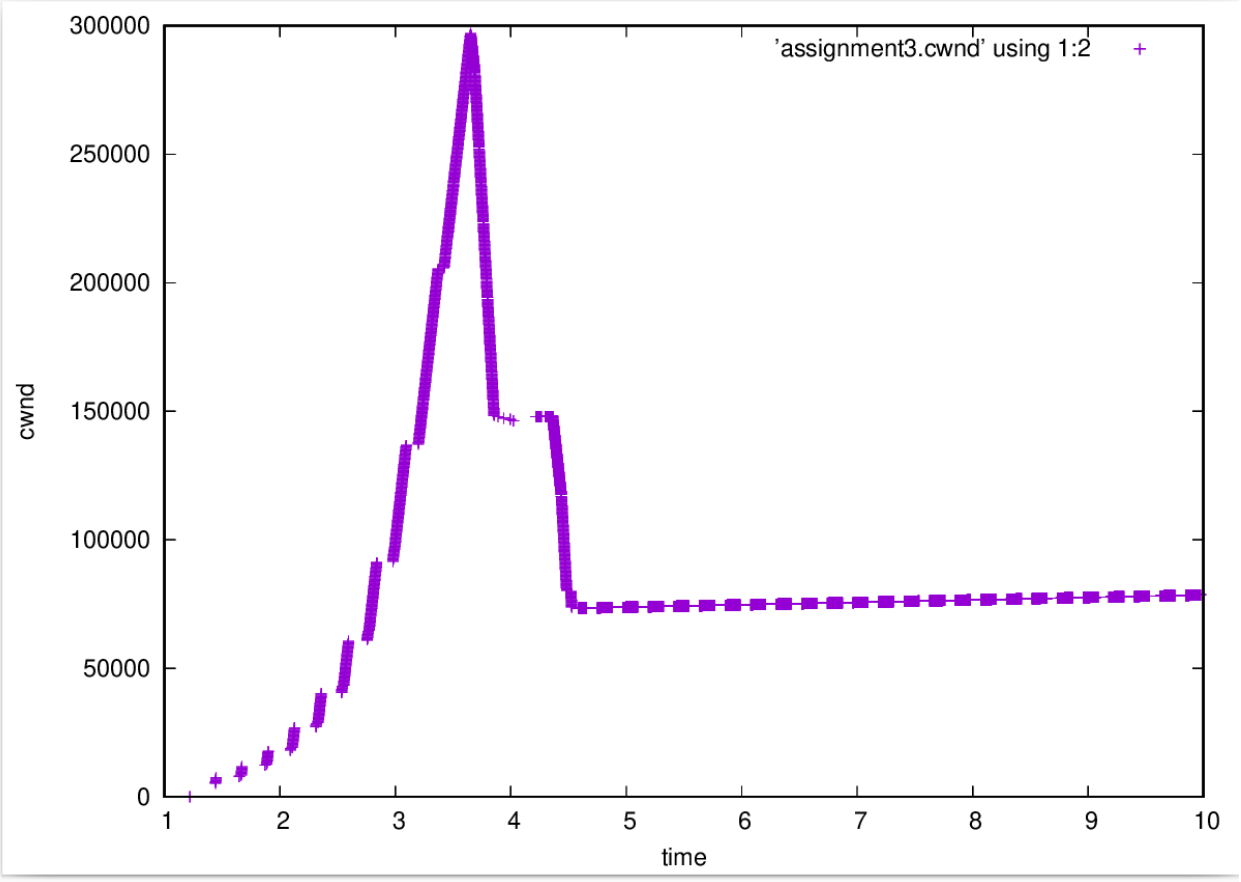
Avg throughput = avg packet size(in bits) * number of packets / time taken
= (392.95 * 8) * 9253 / 9
= 3.23 mbps

d) No, the achieved throughput is not approximately equal to the maximum expected throughput.
The reasons for this are the delays between the nodes and the errors caused by this which can be seen from the below graph of instantaneous

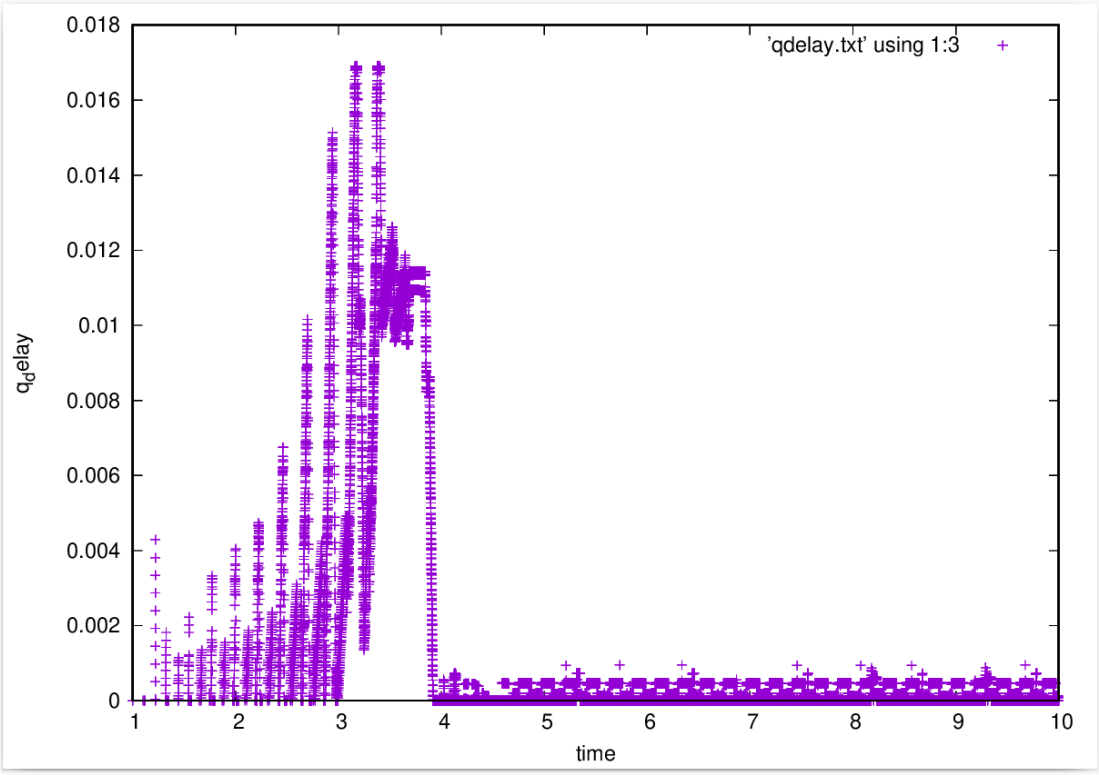
throughput. Our instantaneous throughput decreased due to the high number of errors.



e)



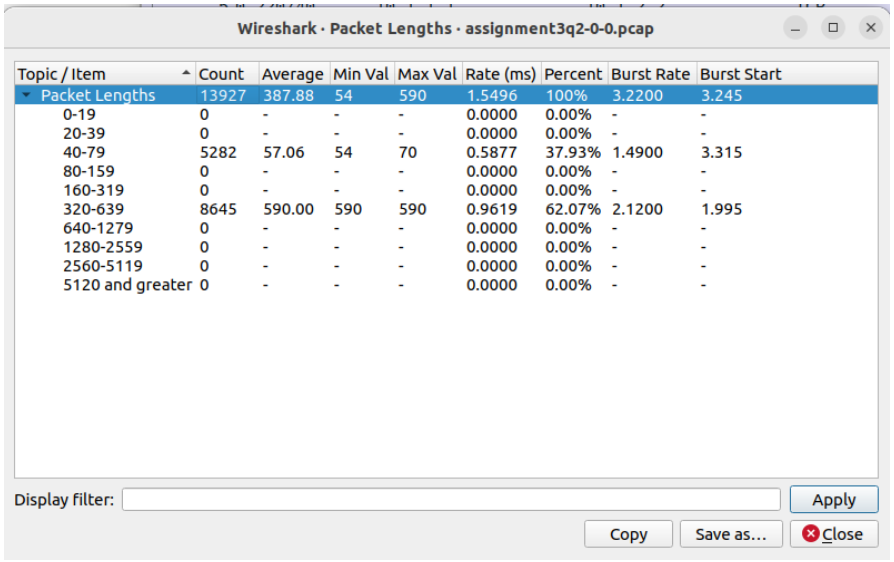
f)



g) Yes, both graphs are related as we can see that the increase in queuing delay leads to a decrease in CWND. After 3 seconds, due to high queuing delay we went into fast recovery mode, the cwnd window was halved and again after the 4 second mark. After recovering from this it goes into congestion avoidance(as linear growth in cwnd)

Answer 2

a)

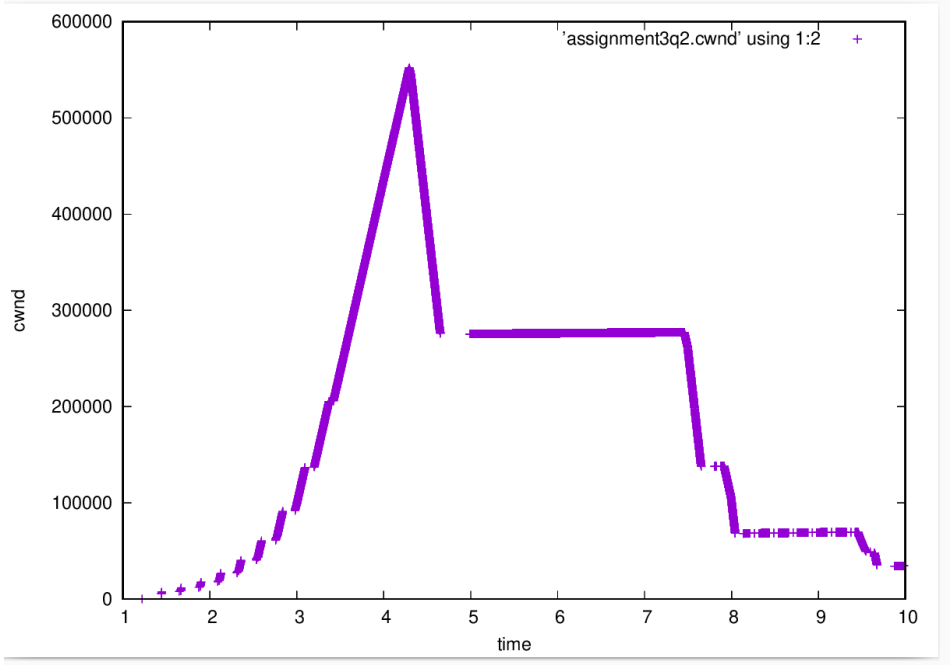


Avg throughput = avg packet size(in bits) * number of packets / time taken

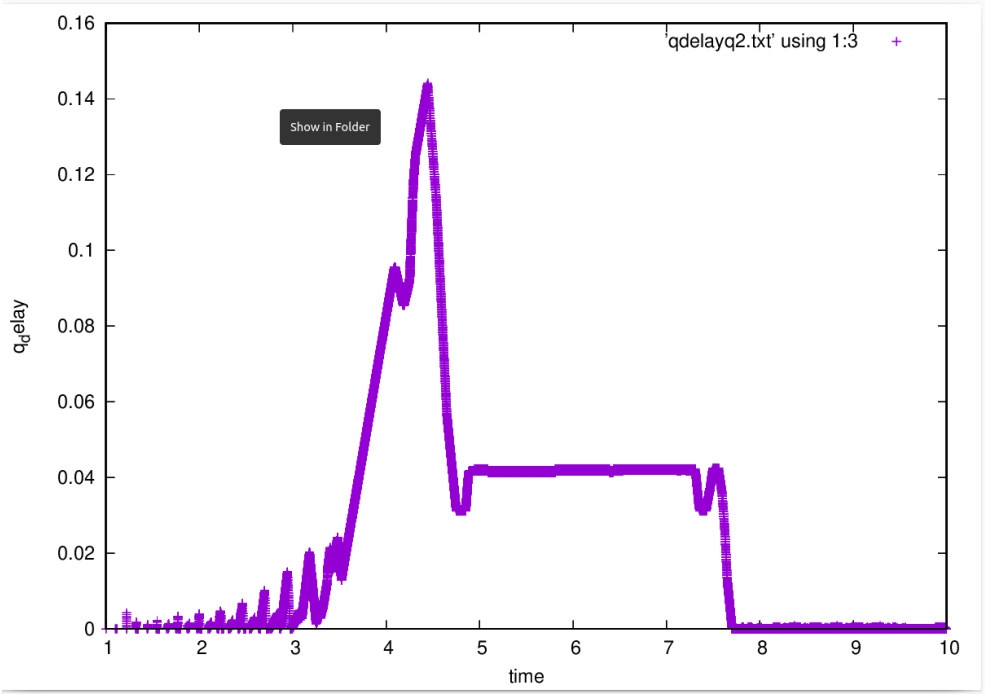
= (387.88 * 8) * 13927/ 9

= 4.8 mbps

b)



c)



d) From the cwnd and qdelay plots, we can see that the cwnd size is much larger in case of q2. This can be understood from the fact that due to a much larger queue size, a lot fewer packets were lost, resulting in packet losses at a much larger cwnd. But this also increased the queuing delay, in this case from from a few ms to around 100ms.

Answer 3

a)

Wireshark · Packet Lengths · assignment3q3-0-0.pcap

Topic / Item	Count	Average	Min Val	Max Val	Rate (ms)	Percent	Burst Rate	Burst Start
Packet Lengths	9588	401.27	54	590	1.0653	100%	4.2400	5.000
0-19	0	-	-	-	0.0000	0.00%	-	-
20-39	0	-	-	-	0.0000	0.00%	-	-
40-79	3400	57.78	54	78	0.3778	35.46%	2.1200	5.000
80-159	0	-	-	-	0.0000	0.00%	-	-
160-319	0	-	-	-	0.0000	0.00%	-	-
320-639	6188	590.00	590	590	0.6876	64.54%	2.1200	3.615
640-1279	0	-	-	-	0.0000	0.00%	-	-
1280-2559	0	-	-	-	0.0000	0.00%	-	-
2560-5119	0	-	-	-	0.0000	0.00%	-	-
5120 and greater	0	-	-	-	0.0000	0.00%	-	-

Display filter: Apply

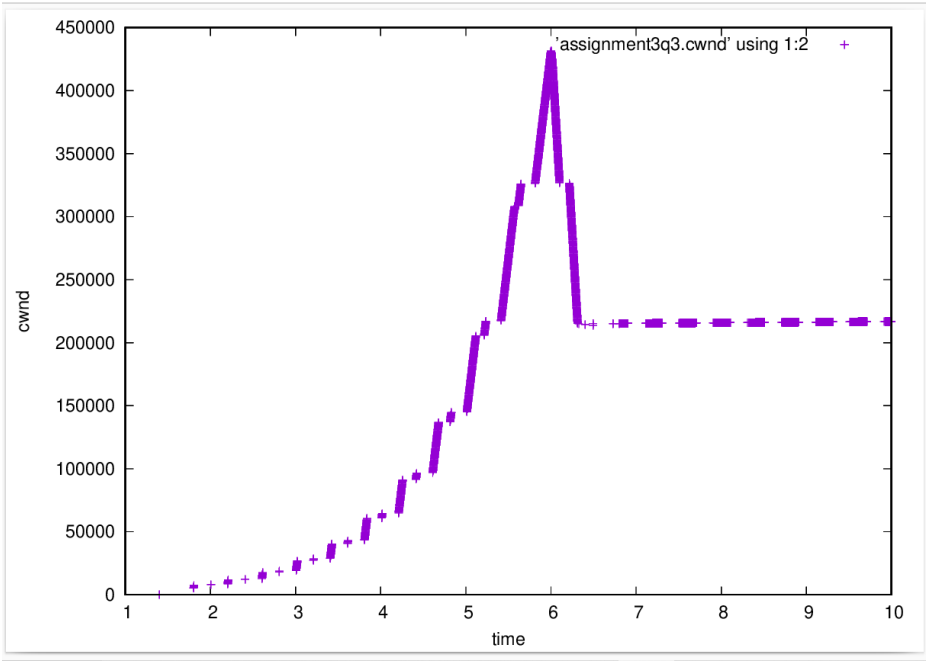
Copy Save as... Close

Avg throughput = avg packet size(in bits) * number of packets / time taken

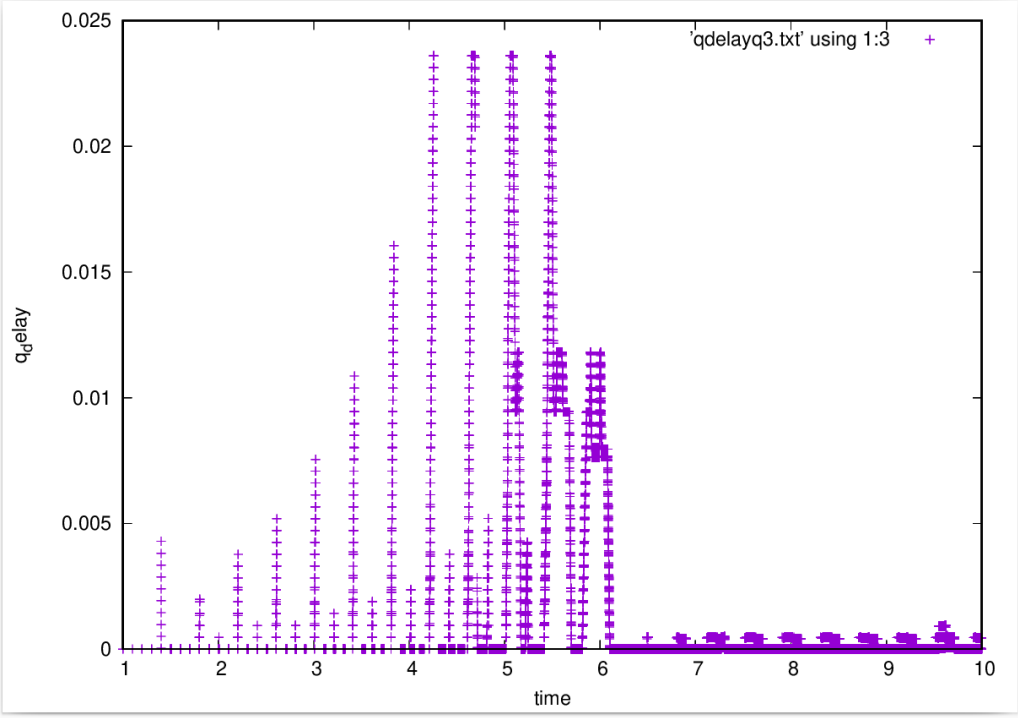
= (401.27 * 8) * 9588/ 9

= 3.42 mbps

b)



c)



d) Both plots are quite similar with the graph for q3 more spread over time due to almost doubling of delay in the network (from 110 ms to 200ms). So it took about 3 seconds for the network in Q1 to stabilize whereas it took about 6 seconds for the network in q3.