CN ASSIGNMENT 3

Monsoon 2022

Aayush Kumar

2020008

Q1.

a) The maximum expected value of throughput is *min(7mbps, 10mbps)* = ***7mbps***.

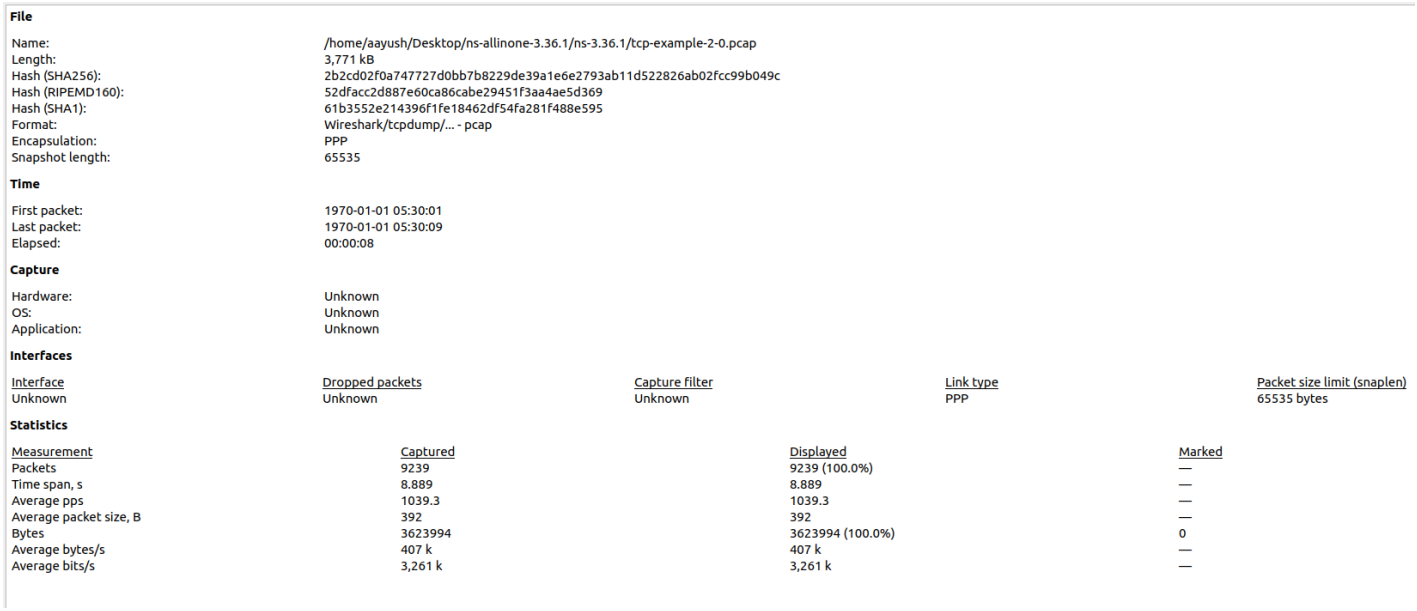
b) Number of packets transmitted per second = 7mbps/1460 bytes

= 7 x 10^6 / 1460 * 8

= 599.31 packets per second

Total RTT delay = (10+100)ms * 2 = 220ms =0.22s

BDP = 599.31 * 0.22 = **131.848 pack**



File

Name:	/home/aayush/Desktop/ns-allinone-3.36.1/ns-3.36.1/tcp-example-2-0.pcap
Length:	3,771 kB
Hash (SHA256):	2b2cd02f0a747727d0bb7b8229de39a1e6e2793ab11d522826ab02fcc99b049c
Hash (RIPEMD160):	52dfacc2d887e60ca86cabe29451f3aa4ae5d369
Hash (SHA1):	61b3552e214396f1fe18462df54fa281f488e595
Format:	Wireshark/tcpdump/... - pcap
Encapsulation:	PPP
Snapshot length:	65535

Time

First packet:	1970-01-01 05:30:01
Last packet:	1970-01-01 05:30:09
Elapsed:	00:00:08

Capture

Hardware:	Unknown
OS:	Unknown
Application:	Unknown

Interfaces

Interface	Dropped packets	Capture filter	Link type	Packet size limit (snaplen)
Unknown	Unknown	Unknown	PPP	65535 bytes

Statistics

Measurement	Captured	Displayed	Marked
Packets	9239	9239 (100.0%)	—
Time span, s	8.889	8.889	—
Average pps	1039.3	1039.3	—
Average packet size, B	392	392	—
Bytes	3623994	3623994 (100.0%)	0
Average bytes/s	407 k	407 k	—
Average bits/s	3,261 k	3,261 k	—

c) No. of bits transmitted b/w N0-N2 = 3623994 bytes * 8

= 28991952 bits

= 28.991 Megabits

Time of transfer = 8.889 seconds

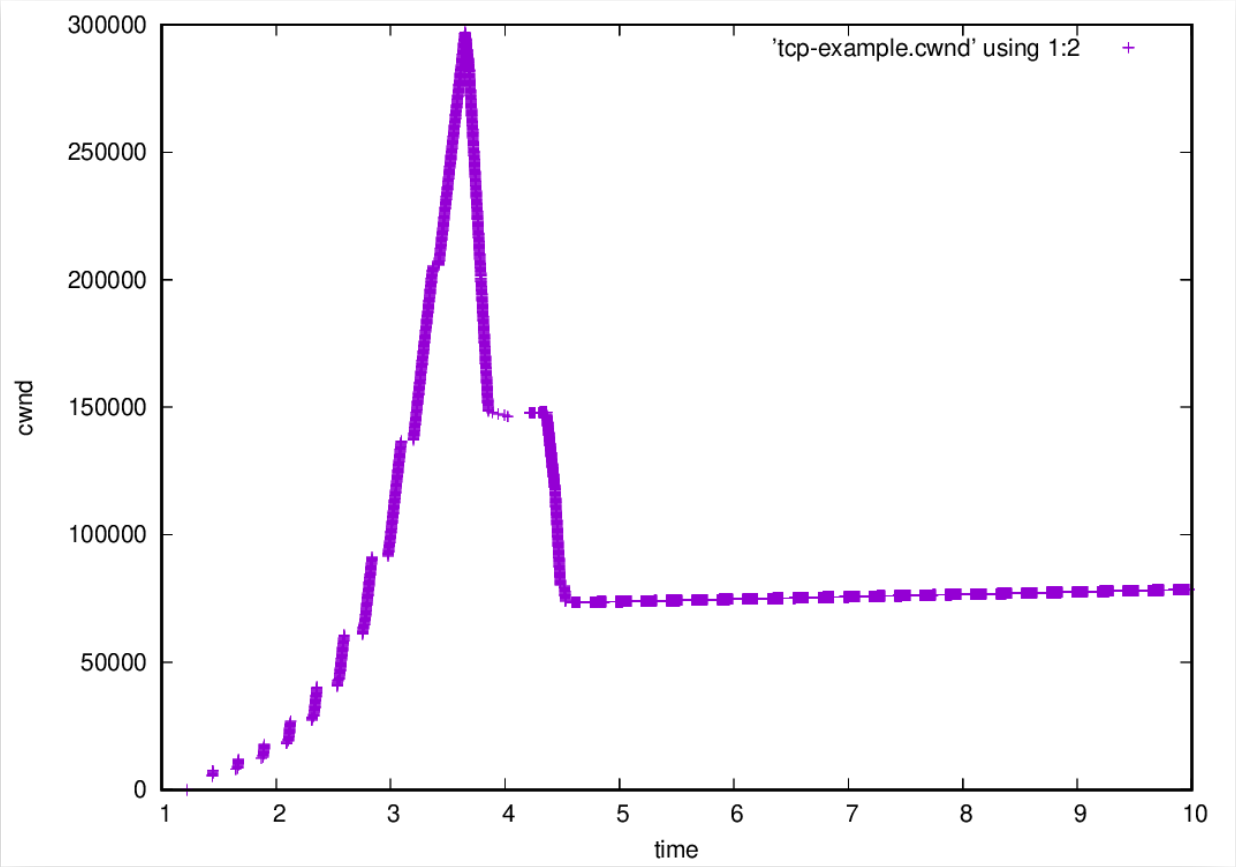
Avg. throughput = 28.991/8.889 = **3.261 Mbps (which is equal to average bits in the above screenshot)**.

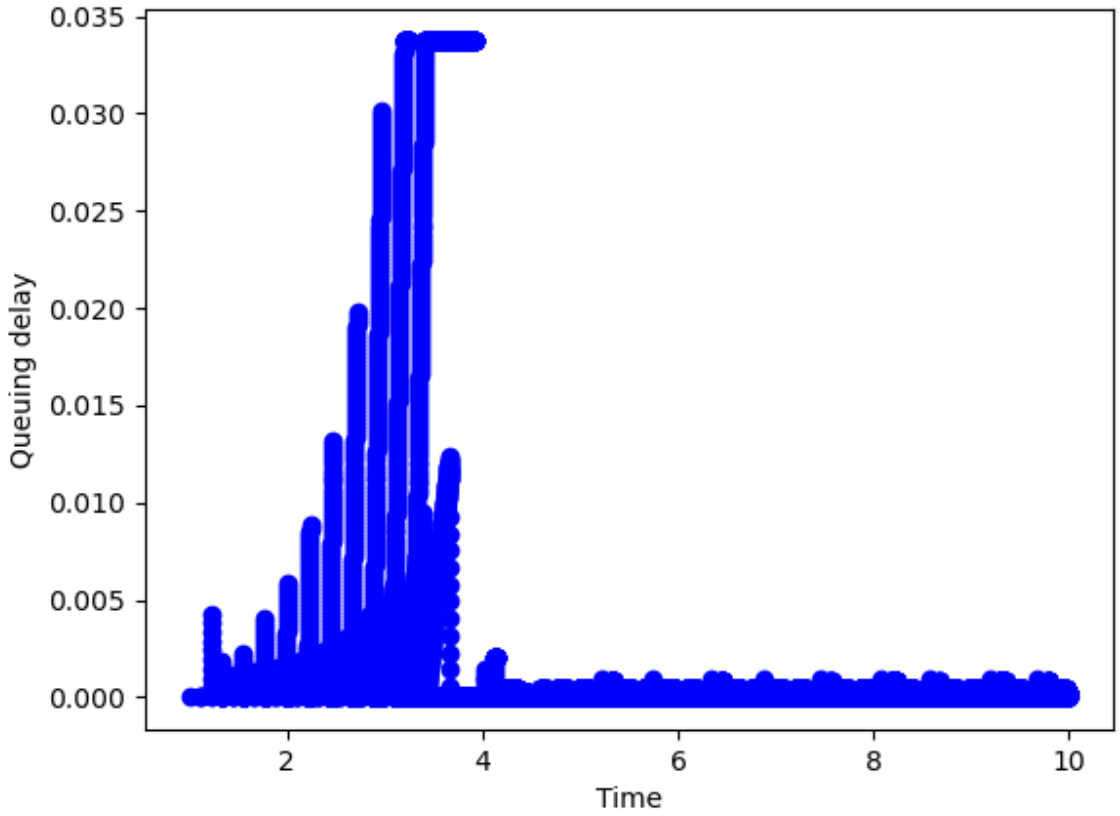
d) Actual throughput is lesser than the theoretical throughput as stated in the reasons mentioned below :-

i) The sender must retransmit the dropped packets because of buffer overflow which basically adds additional time to packet transmissions and increases the total duration.

ii) When a packet is dropped, the link's transmission capacity is reduced and by consequence there is a loss of time, which could have been used to send other packets. As a result, Throughput was reduced.

e)


'tcp-example.cwnd' using 1:2
cwnd
time
300000
250000
200000
150000
100000
50000
0
1
2
3
4
5
6
7
8
9
10



f)

g) Yes, the two graphs are related. Following could be the possible reasons:-

i) With increase in congestion window, queuing delay increases.

ii) There are no limits to the size of the CWND until it reaches its maximum capacity

iii) It eventually increases the queuing delays over the network.

Q2.

File

Name:	/home/aayush/Desktop/ns-allinone-3.36.1/ns-3.36.1/tcp-example-2-0.pcap
Length:	5,594 kB
Hash (SHA256):	90719b9646ac5b30cc066ec1e99ba892a3befae2b154c41cfb75ace5e402097c
Hash (RIPEMD160):	23a05bb936c63c648496ec0ccbb6884c4c60470a
Hash (SHA1):	e808ab12e5b47e26eb0fae8b8279d1ecd8cf7d19
Format:	Wireshark/tcpdump/... - pcap
Encapsulation:	PPP
Snapshot length:	65535

Time

First packet:	1970-01-01 05:30:01
Last packet:	1970-01-01 05:30:09
Elapsed:	00:00:08

Capture

Hardware:	Unknown
OS:	Unknown
Application:	Unknown

Interfaces

Interface	Dropped packets	Capture filter	Link type	Packet size limit (snaplen)
Unknown	Unknown	Unknown	PPP	65535 bytes

Statistics

Measurement	Captured	Displayed	Marked
Packets	13885	13885 (100.0%)	—
Time span, s	8.889	8.889	—
Average pps	1562.1	1562.1	—
Average packet size, B	387	387	—
Bytes	5372342	5372342 (100.0%)	0
Average bytes/s	604 k	604 k	—
Average bits/s	4,835 k	4,835 k	—

a) No. of bits transmitted b/w N0-N2 =5372342 bytes * 8

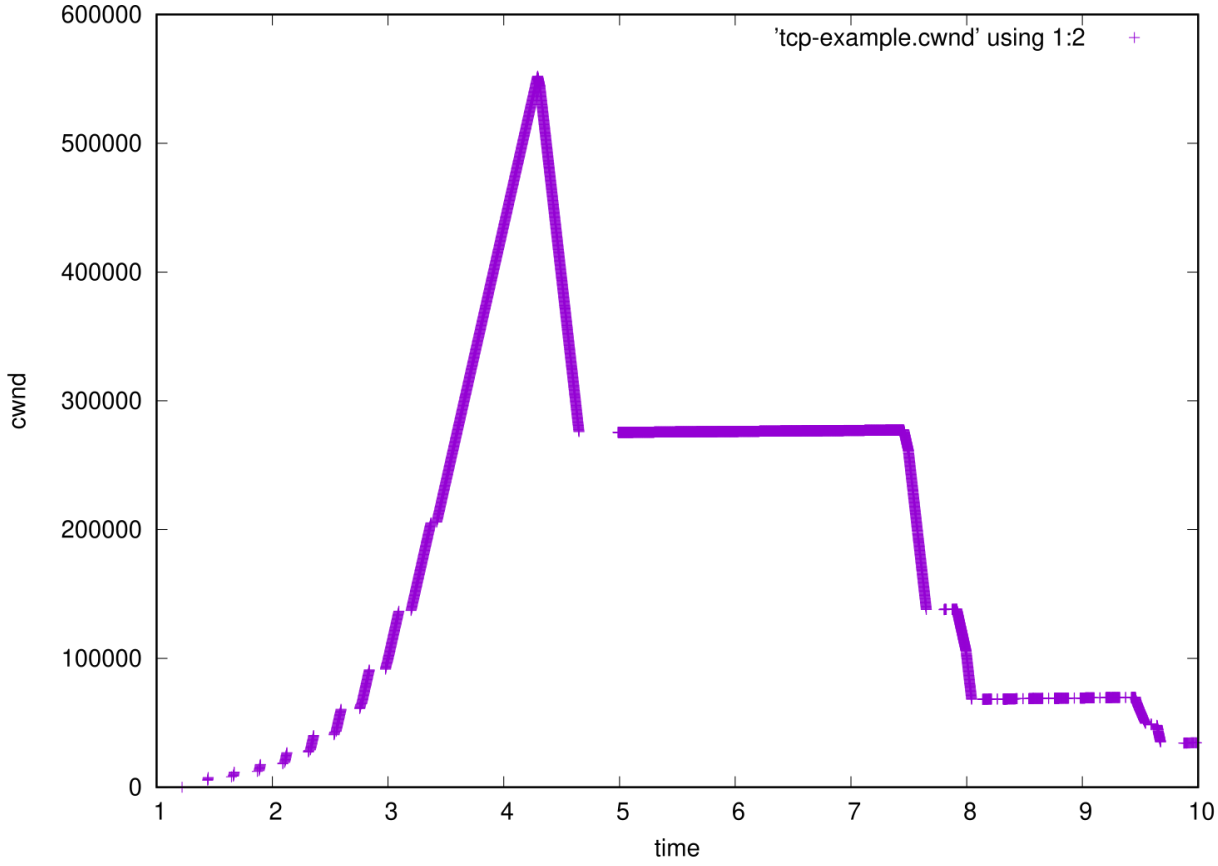
= 42978736 bits

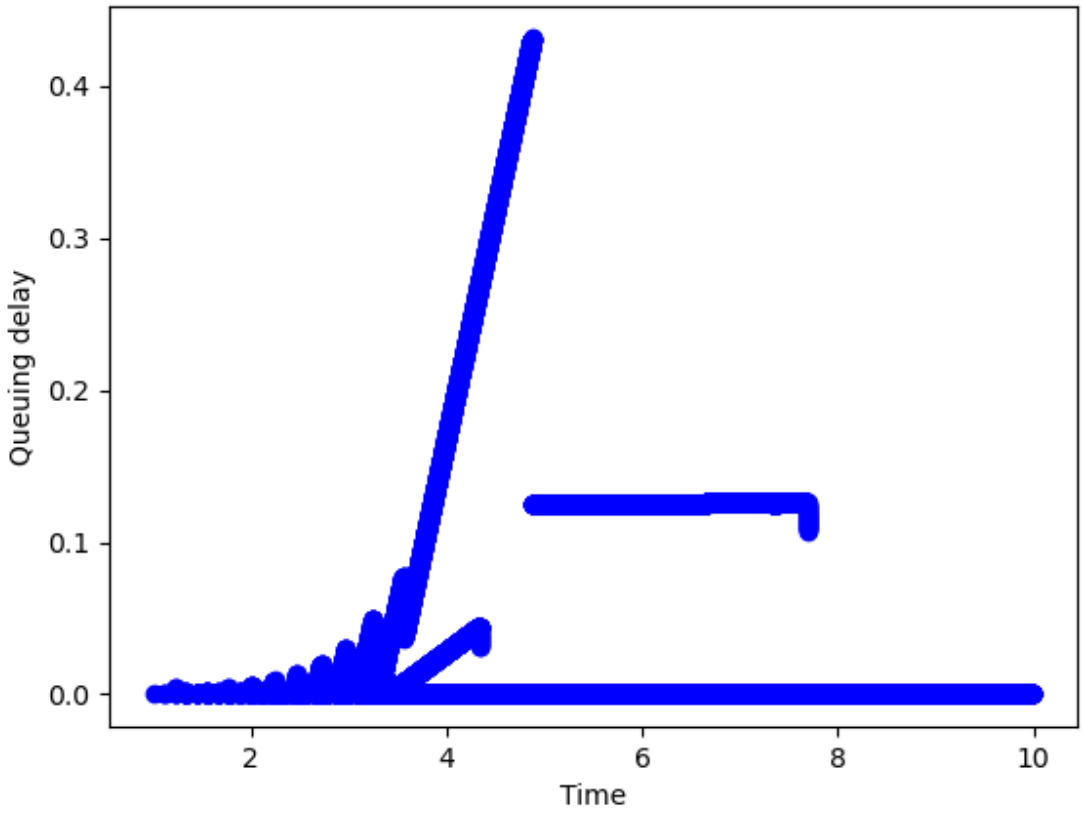
= 42.978 Megabits

Time of transfer = 8.889 seconds

Avg. throughput = 42.978/8.889 = **4.835 Mbps (which is equal to average bits in the above screenshot)**.

b)


'tcp-example.cwnd' using 1:2
cwnd
time
600000
500000
400000
300000
200000
100000
0
1
2
3
4
5
6
7
8
9
10



c)

d) This can be observed from the above graphs that at 50 packets, we had 300000 bytes of cwnd size and when the packets were 1000p, the size became 5700000.

This is because with the increase in queueing size, packet storage capacity increased. When the data flow increased, the queuing time increased, thus resulting in longer time for packet transfer.

Q3.

File

Name:	/home/aayush/Desktop/ns-allinone-3.36.1/ns-3.36.1/tcp-example-2-0.pcap
Length:	3,911 kB
Hash (SHA256):	5aa18b35a6b0f43a30177ec80e79e158c4f25baf3a277f4d178e8b144af80161
Hash (RIPEMD160):	9b49a10a326b8f03c3766ccdf4e1fa769c3ec6e1
Hash (SHA1):	0350e3f0d1ab9d30617bddaa36189e1fa61a1a51
Format:	Wireshark/tcpdump/... - pcap
Encapsulation:	PPP
Snapshot length:	65535

Time

First packet:	1970-01-01 05:30:01
Last packet:	1970-01-01 05:30:09
Elapsed:	00:00:08

Capture

Hardware:	Unknown
OS:	Unknown
Application:	Unknown

Interfaces

Interface	Dropped packets	Capture filter	Link type	Packet size limit (snaplen)
Unknown	Unknown	Unknown	PPP	65535 bytes

Statistics

Measurement	Captured	Displayed	Marked
Packets	9549	9549 (100.0%)	—
Time span, s	8.714	8.714	—
Average pps	1095.8	1095.8	—
Average packet size, B	394	394	—
Bytes	3758974	3758974 (100.0%)	0
Average bytes/s	431 k	431 k	—
Average bits/s	3,450 k	3,450 k	—

a) No. of bits transmitted b/w N0-N2 =3758974 bytes * 8

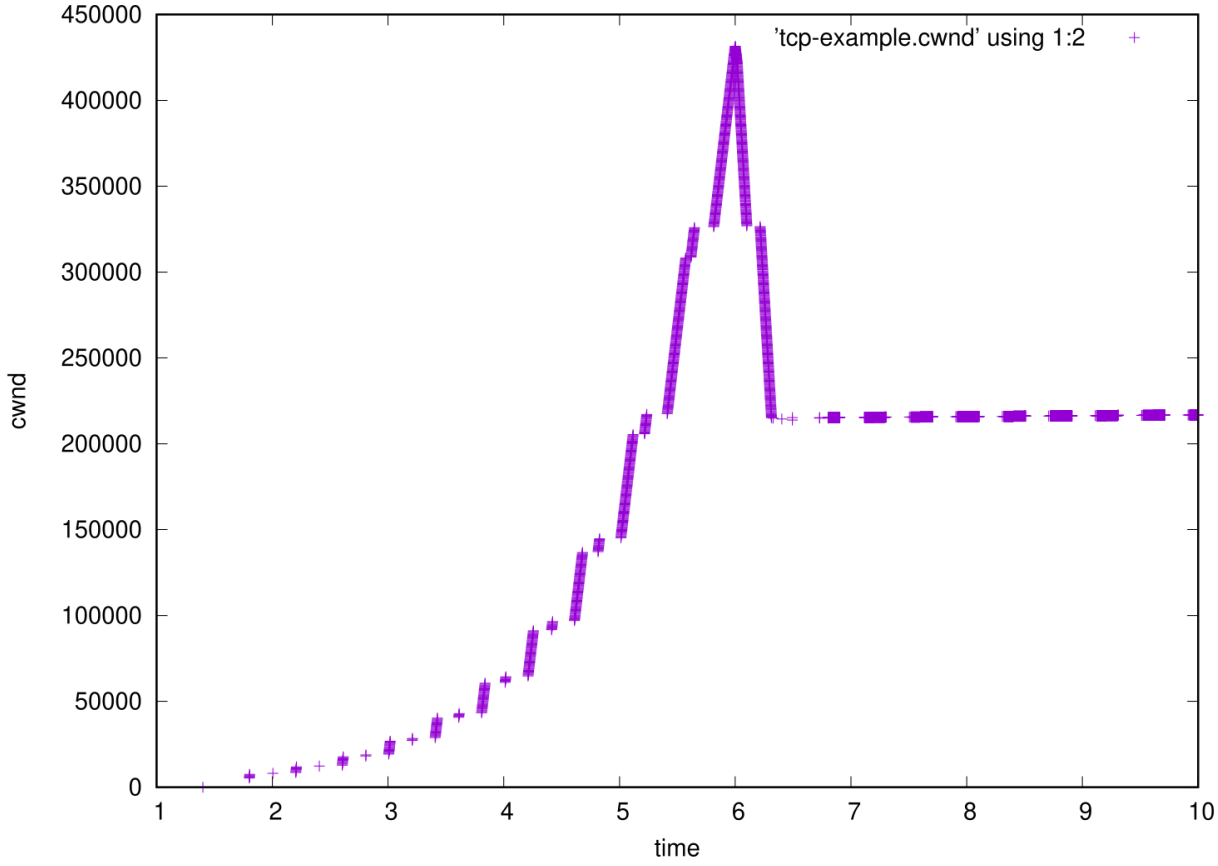
= 30071792 bits

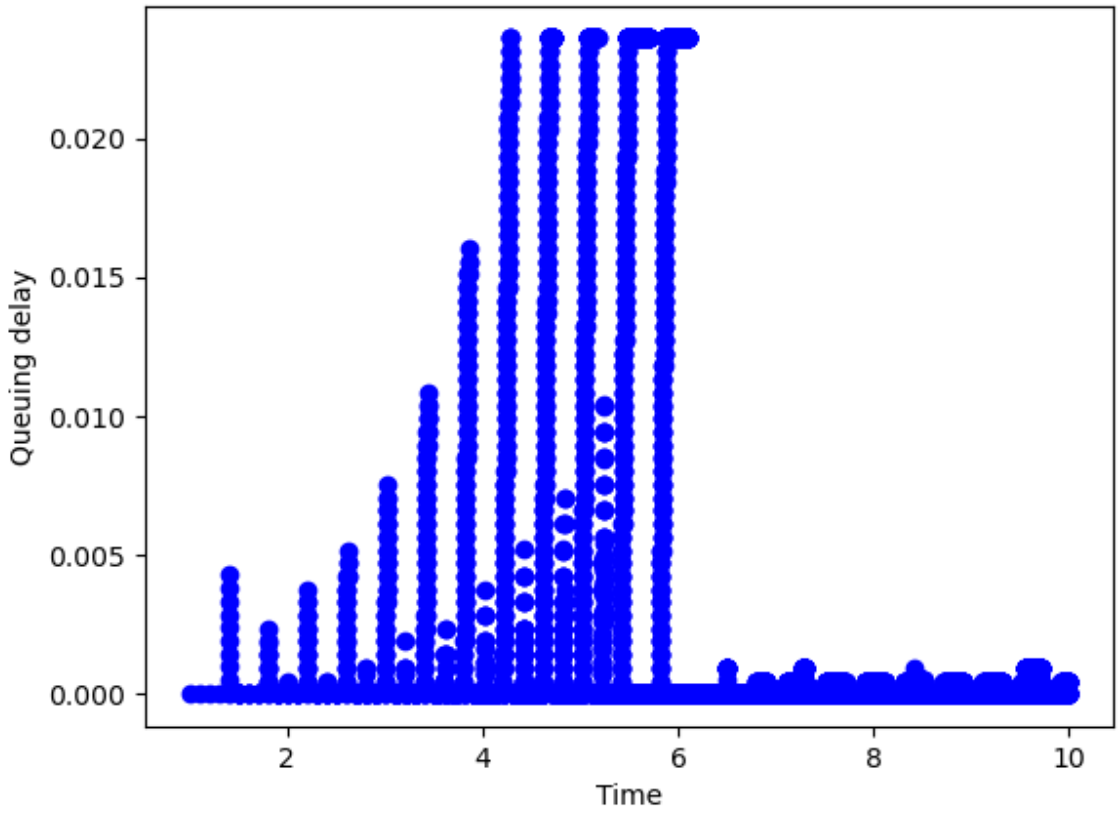
= 30.071 Megabits

Time of transfer = 8.714 seconds

Avg. throughput = 30.071/8.714 = **3.450 Mbps (which is equal to average bits in the above screenshot)**.

b)


'tcp-example.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)

d) Since the bandwidth is equal i.e10Mbps.This concludes that the rate of which the packets are coming and going is the same (at Node N1). Henceless queuing can be seen at the node N1 which further tells us that queuing delays are at a lower rate. Queue time will increase with increase in time & queuing delays.