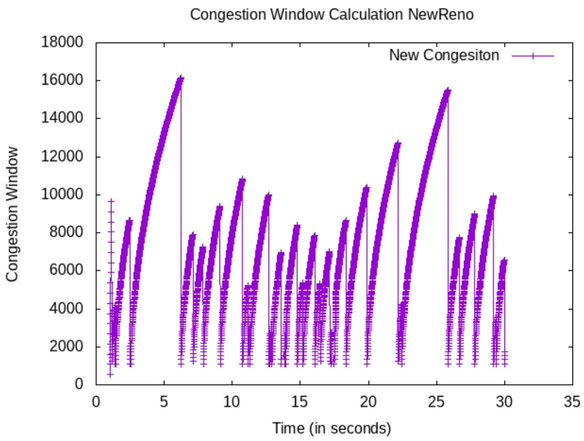
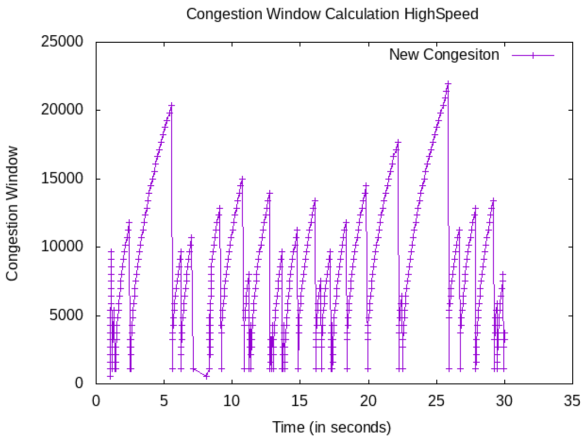
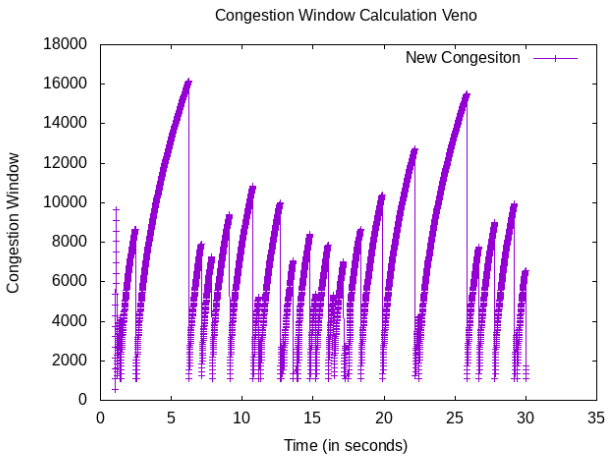
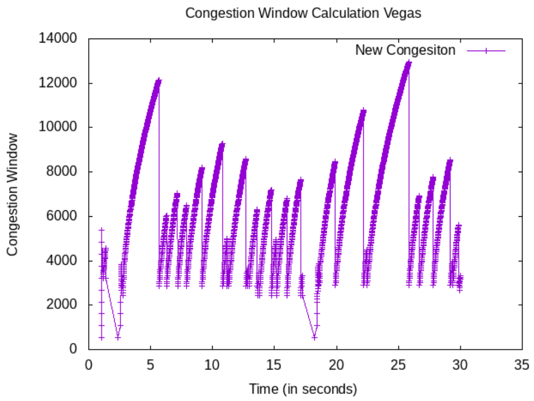
Q1

Protocol	Packets dropped	Plot
NewReno	38	
HighSpeed	38	
Veno	38	

Vegas	39	

Observations:

The SMSS is the size of the largest segment that the sender can transmit.

Newreno:

- Congestion avoidance – congestion window is increased by 1 full sized segment
- Slow start – congestion window is increased by min(number of bytes unacknowledged, maximum segment size)
- We can see that till ssthresh value the points are separated by much larger distance that is jump is higher. But when ssthresh is reached points are close as the increment is by 1 – fixed.

HighSpeed:

- Designed for high capacity channels, with large congestion windows.
- Cwnd grows much faster and accelerates from recovery faster.
- We see much higher jumps in the plot.
- The average window size is higher compare with any other protocol

Vegas:

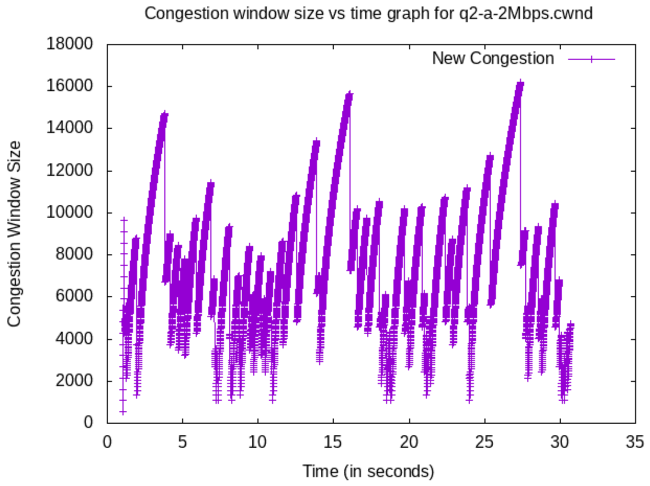
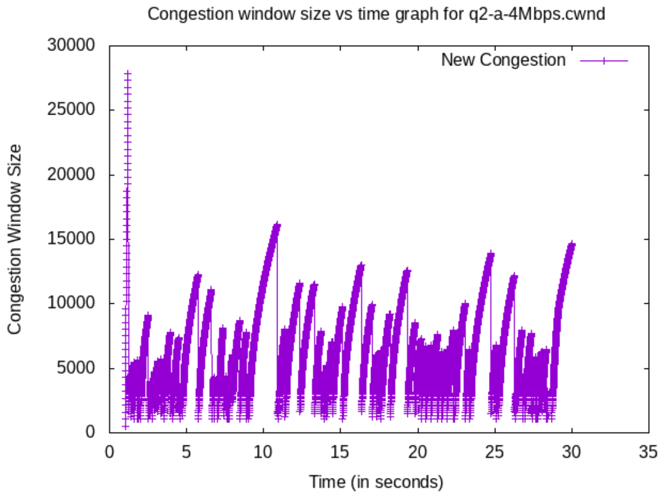
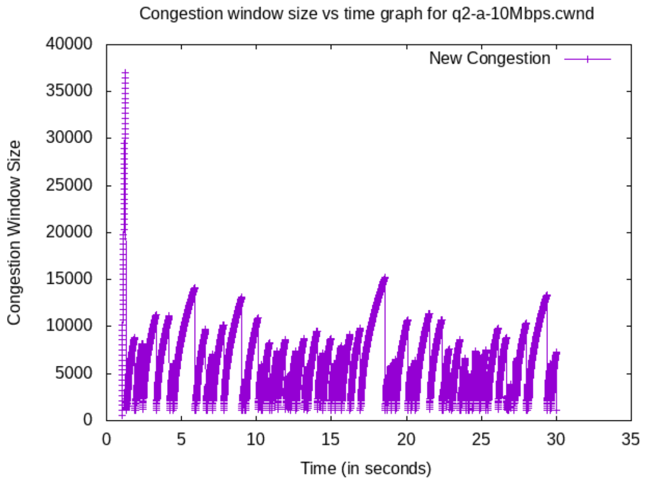
- Delay based congestion control protocol. Expected and actual throughputs are calculated to get the congestion queue at bottleneck and accordingly cwnd is adjusted
- Linear increase and linear decrease
- Plots show lowest average cwnd size

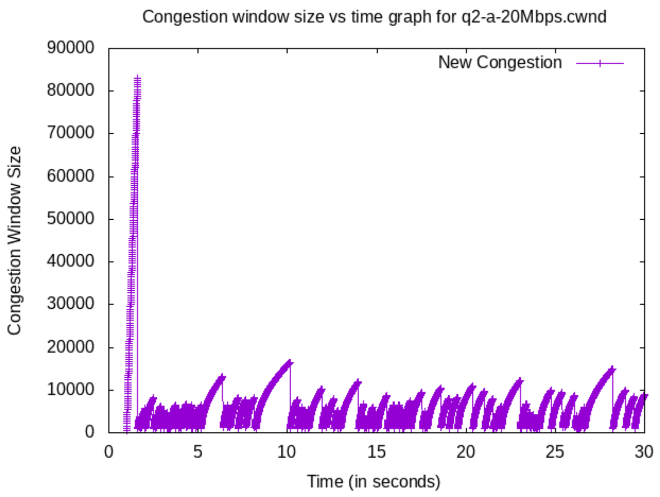
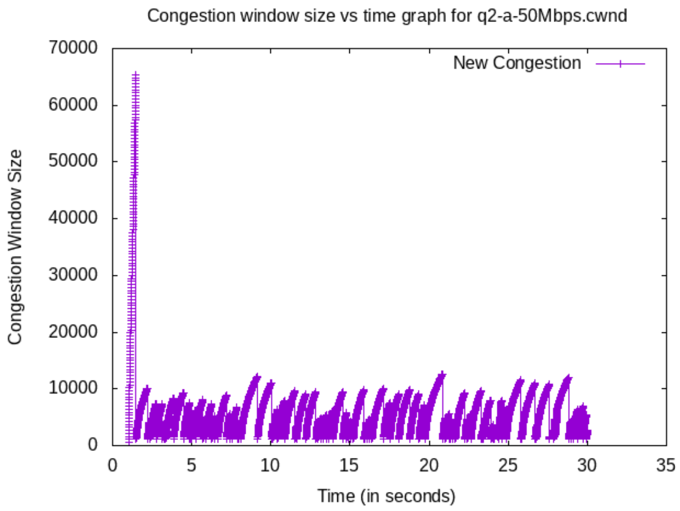
Veno:

- Uses prediction method similar to vegas.
- Refines additive increase algo of reno to increase duration of connection in stable state by increasing cwnd by 1/cwnd for every new ack after bandwidth is fully utilized
- Multiplicative decrease is by 1/5 as loss is assumed to be more likely due to corruption.
- The average window size is higher compare with any other protocol
- Plot is similar to newreno except for fully utilization part

Q2

A) Different channel rate

Channel data rate	Plot	Packet dropped
2 Mbps		66
4 Mbps		76
10 Mbps		75

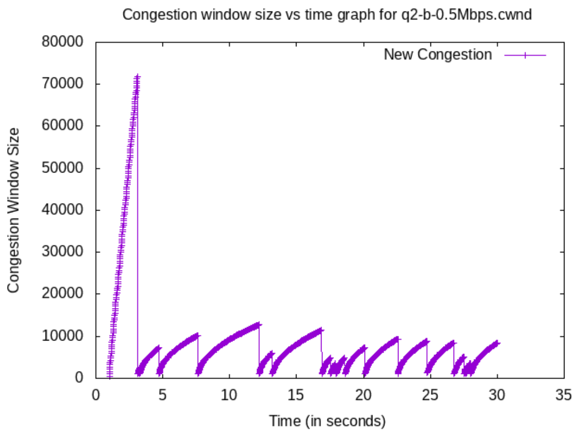
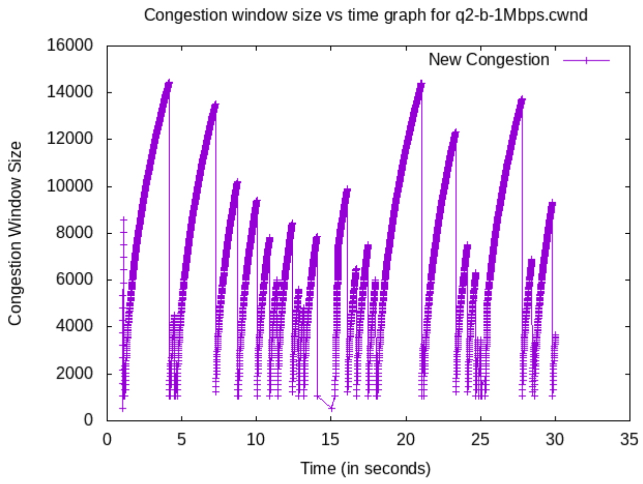
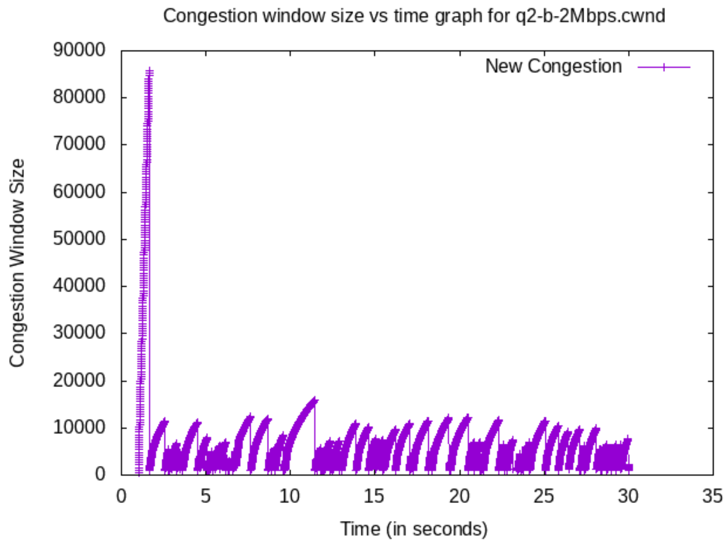
20 Mbps		89
50 Mbps		96

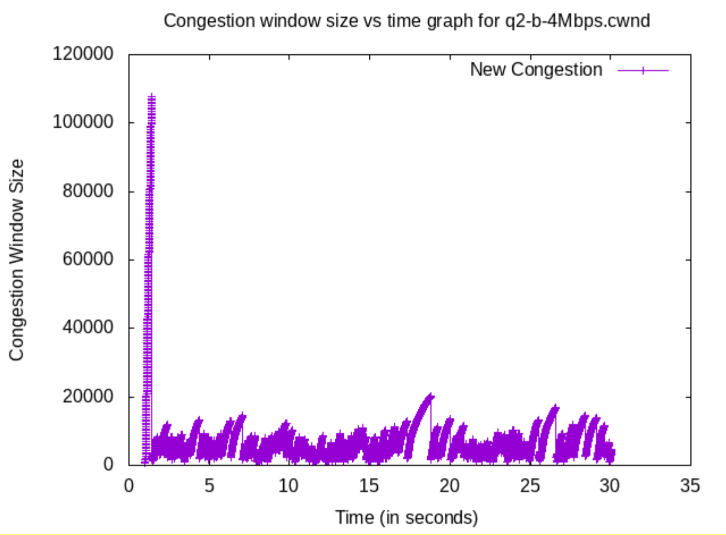
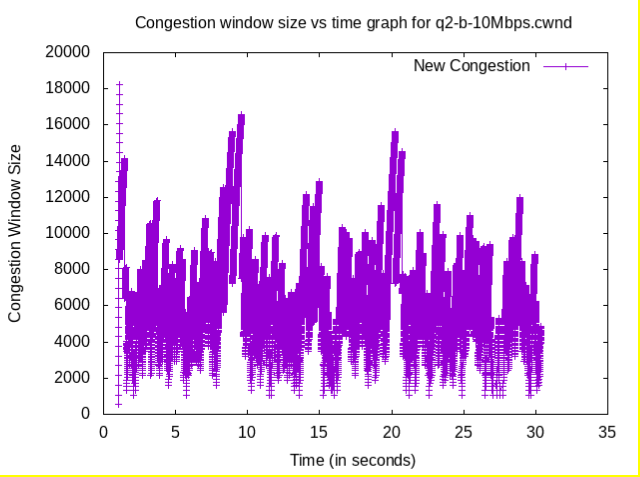
Channel rate is varied but the rate at which application is sending data is constant.

The initial maximum congestion window size varies as 15000, 27000, 37000, 85000, 65000

The total packets loss increases as we increase the channel rate

B) Different application data rate

Channel data rate	Plot	Packet dropped
0.5 Mbps	 Congestion window size vs time graph for q2-b-0.5Mbps.cwnd 	17
1 Mbps	 Congestion window size vs time graph for q2-b-1Mbps.cwnd 	36
2 Mbps	 Congestion window size vs time graph for q2-b-2Mbps.cwnd 	83

4 Mbps		144
10 Mbps		179

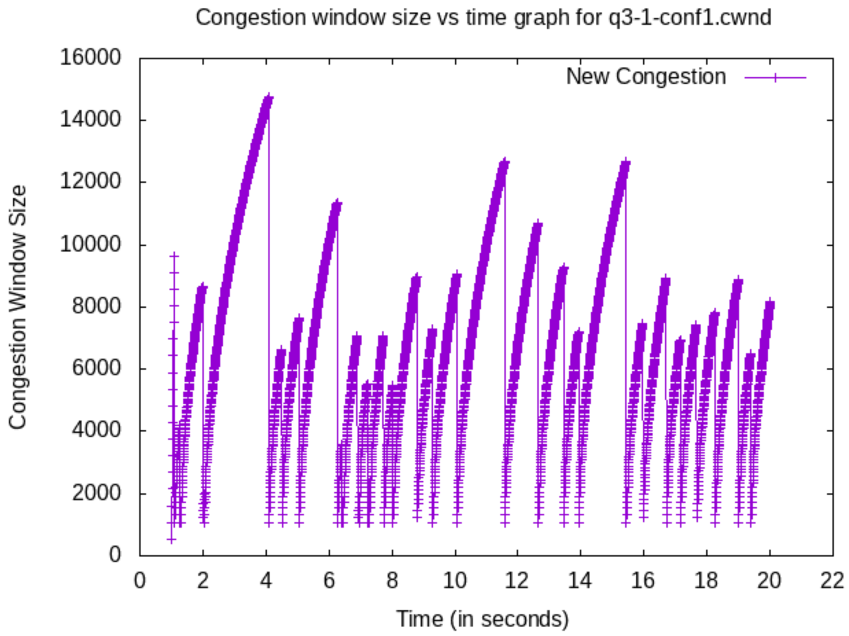
Here channel rate is fixed but application rate is varied.

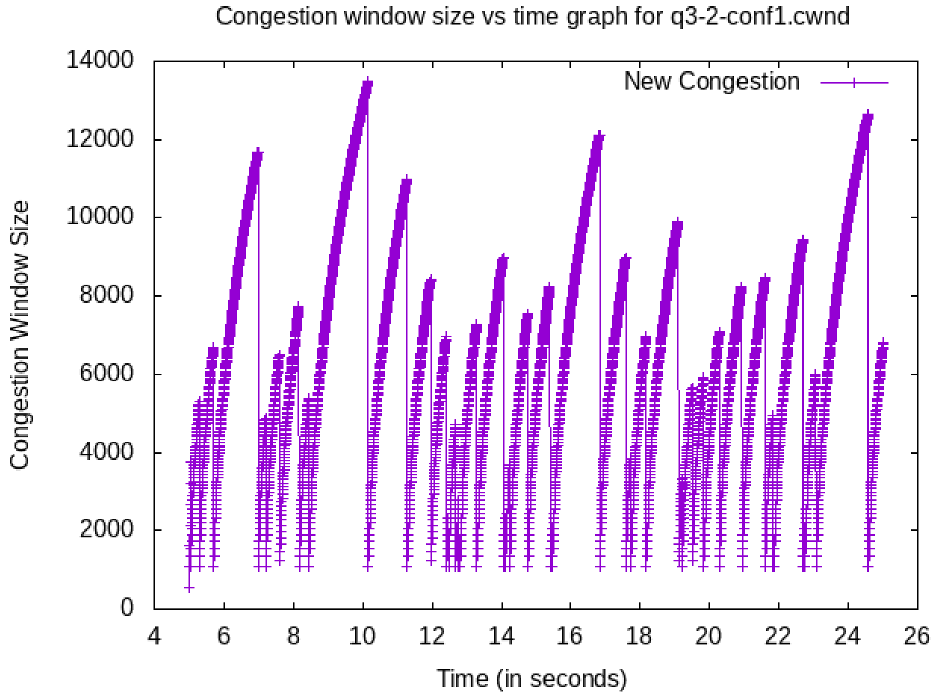
Total number of packets lost increases with the increase in application data rate. Large number of packets lost increases the noise in the graph. This is expected as the channel gets over occupied

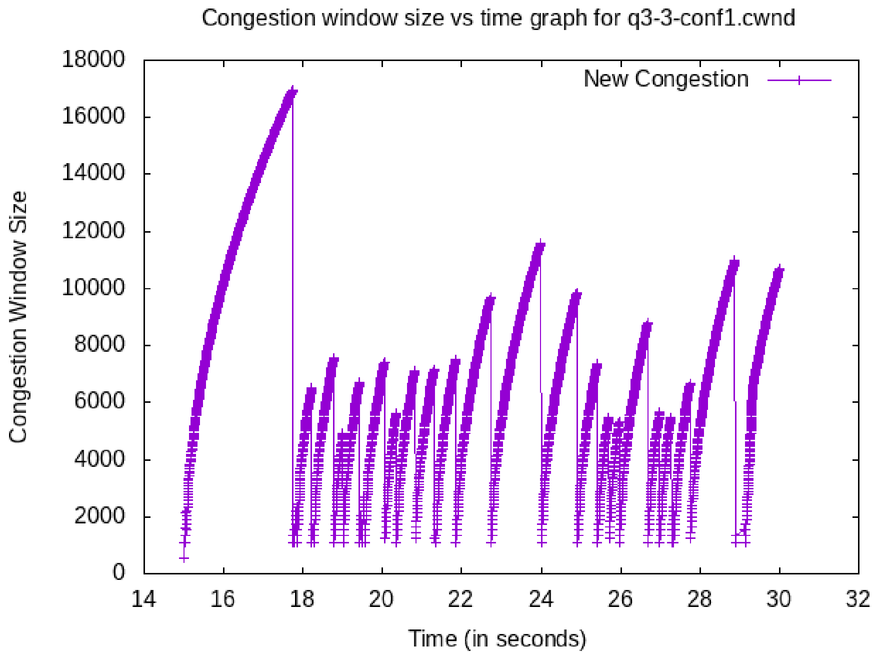
Q3

Implementation: By inheritance

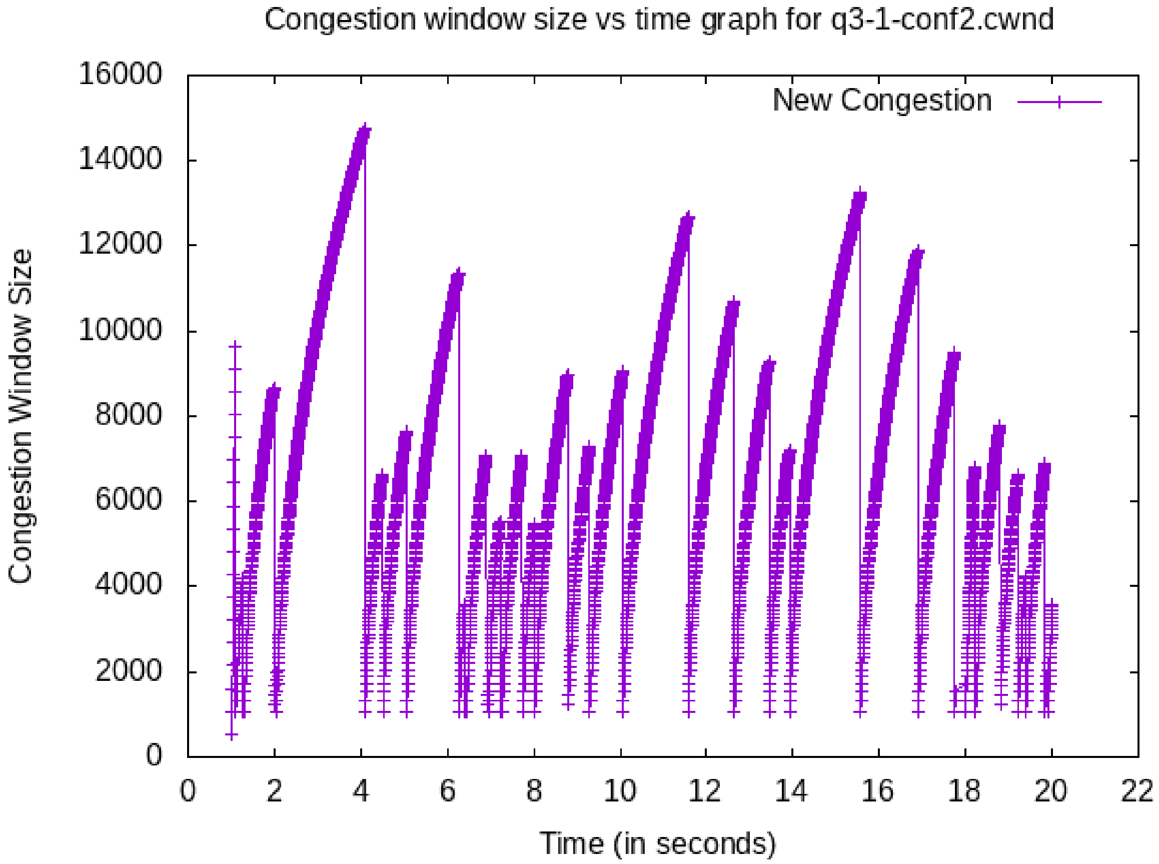
Configuration1:

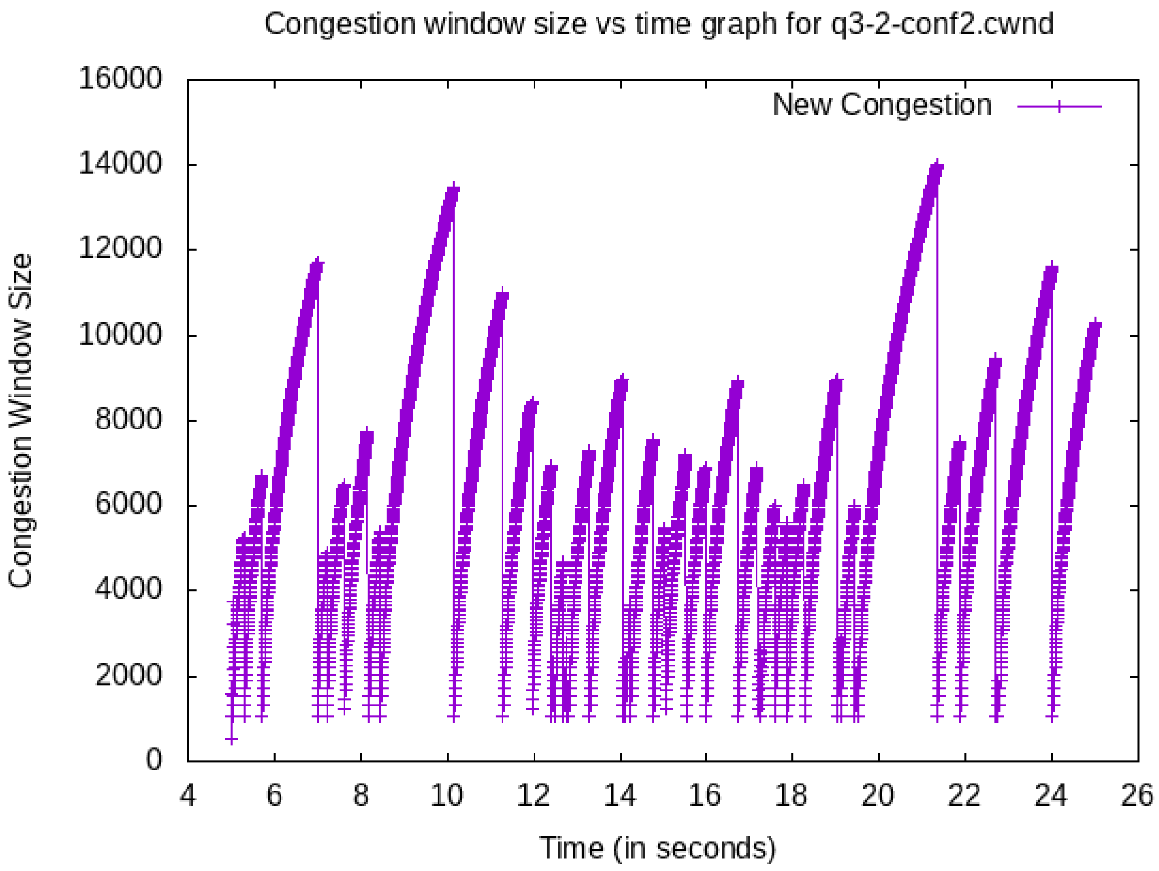


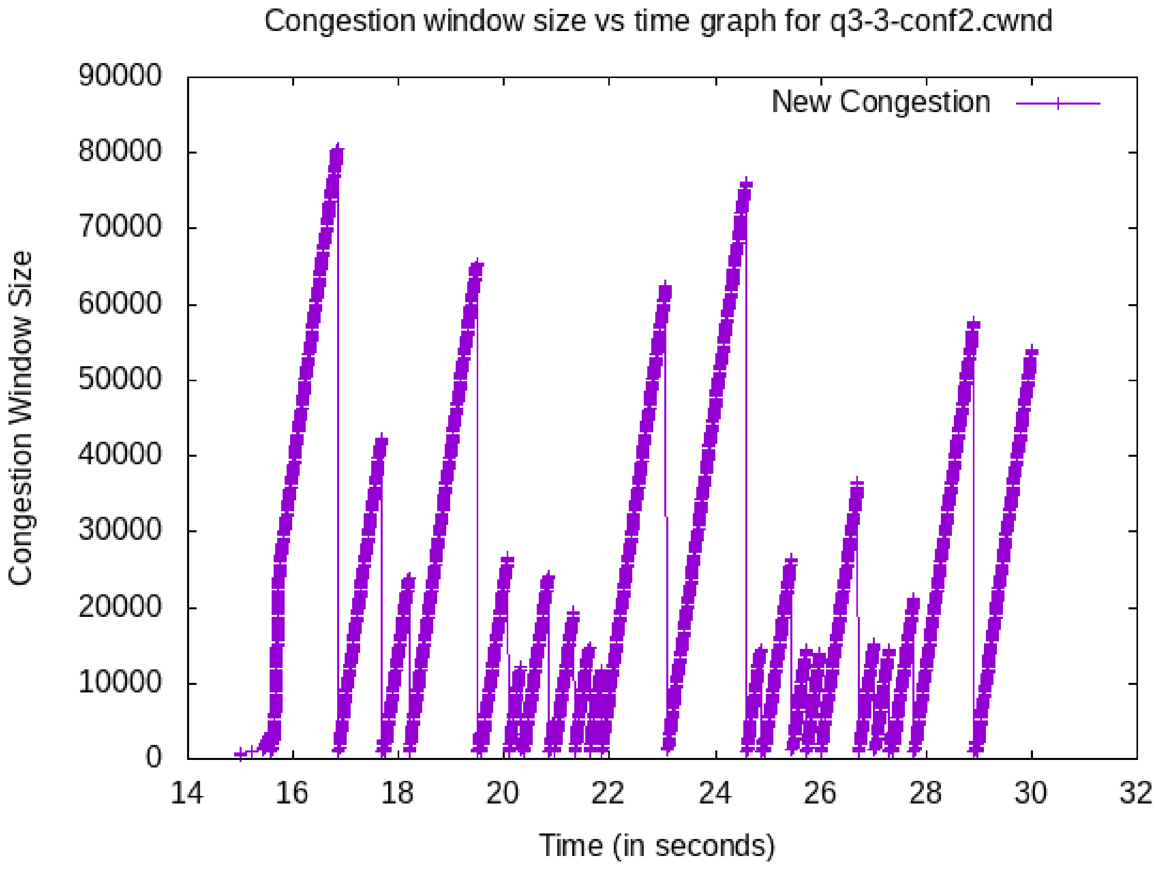




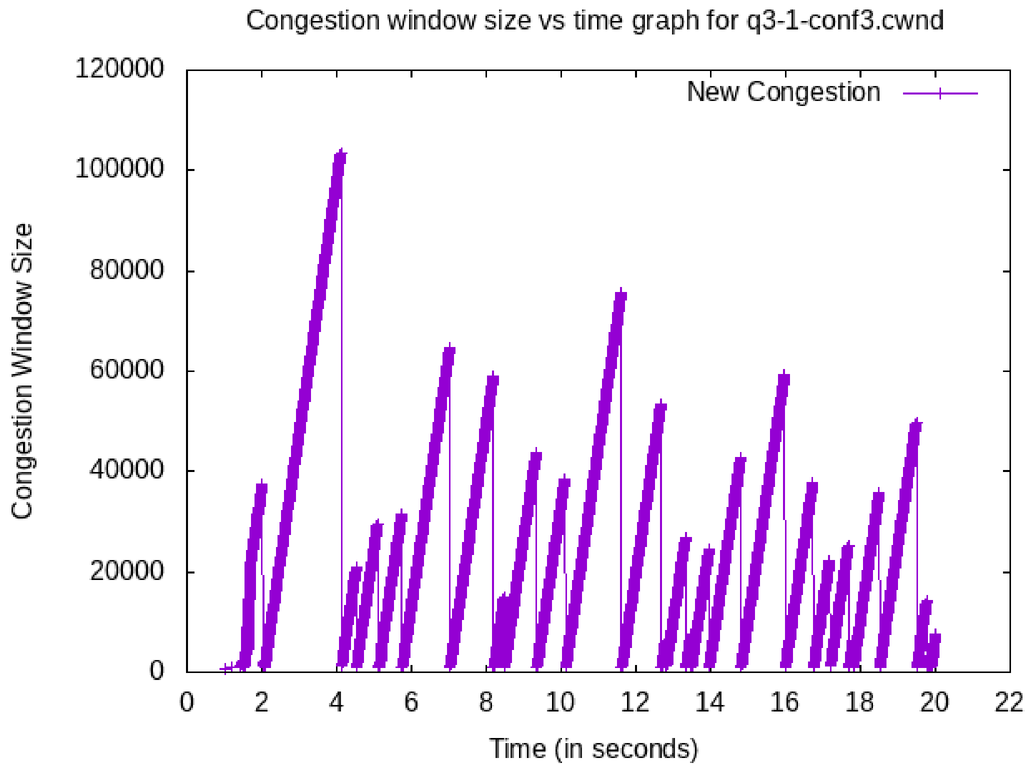
Configuration 2:

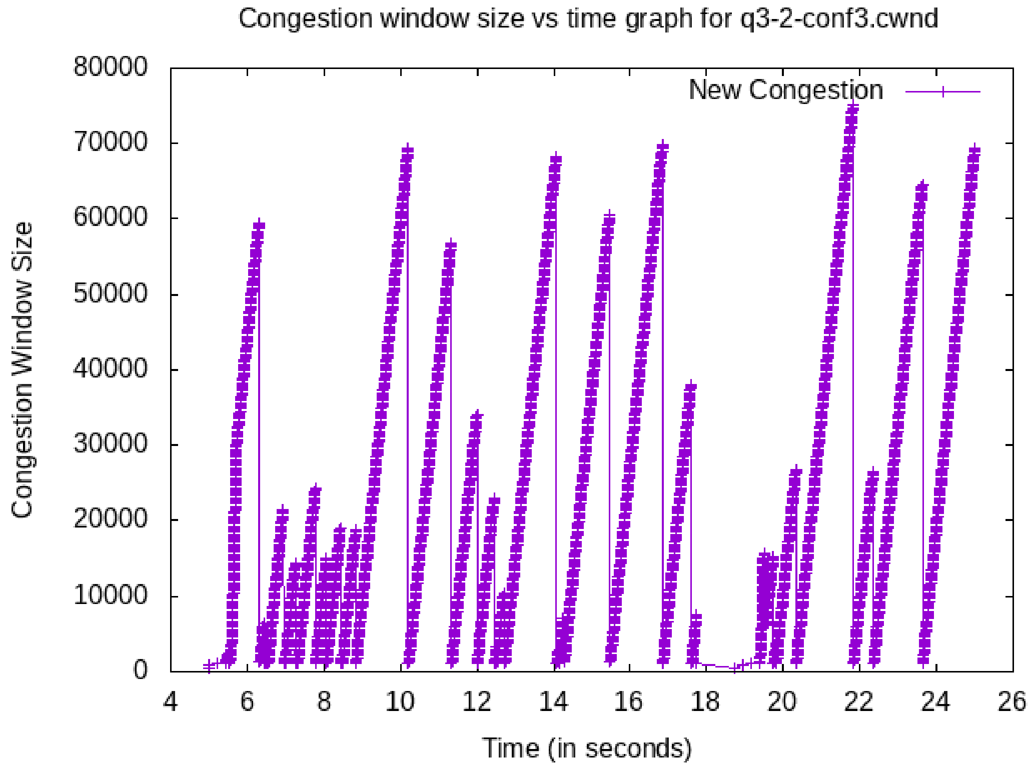


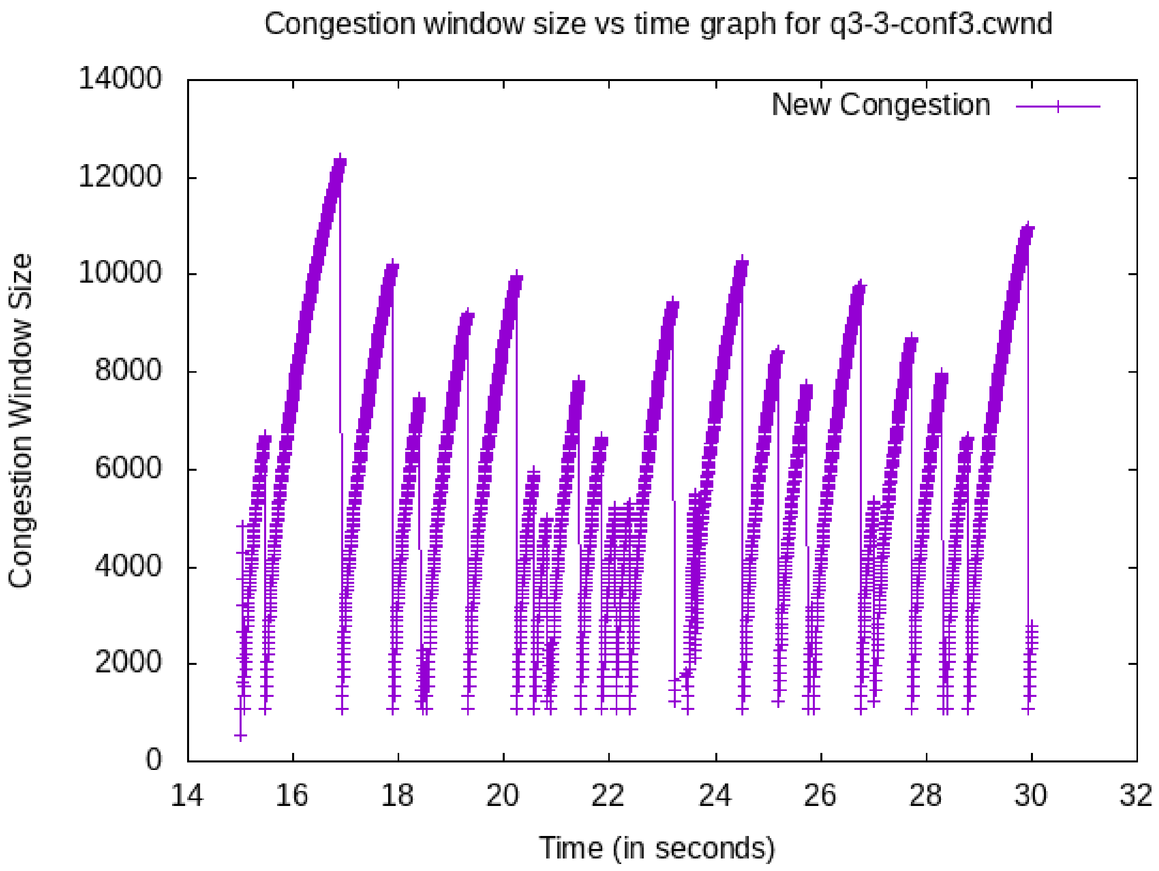

Congestion window size vs time graph for q3-2-conf2.cwnd
New Congestion
Congestion Window Size
0
2000
4000
6000
8000
10000
12000
14000
16000
4
6
8
10
12
14
16
18
20
22
24
26
Time (in seconds)


Congestion window size vs time graph for q3-3-conf2.cwnd
New Congestion
Congestion Window Size
0
10000
20000
30000
40000
50000
60000
70000
80000
90000
14
16
18
20
22
24
26
28
30
32
Time (in seconds)

Configuration 3:







Packet Loss

Config	Channel 1-3 loss	Channel 2-3 loss	Total Loss
1	0	0	0
2	80	30	110
3	72	32	104