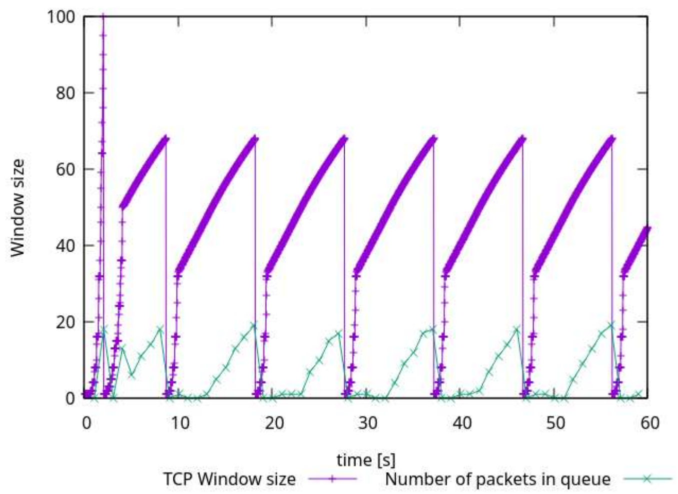
COMP9331 – Lab5

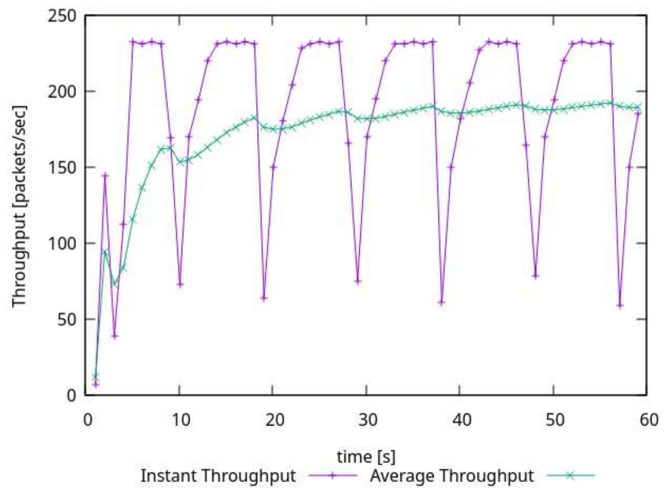
Exercise 1: Understanding TCP Congestion Control using ns-2

Question 1. (a) In this case, what is the maximum size of the congestion window that the TCP flow reaches? (b) What does the TCP flow do when the congestion window reaches this value? Why? (c) What happens next?



<u>*Answer:*</u> The max window size is 100. After timeout or triple dup ACK, the congestion window size dropped to 1 and the slow start threshold is set to 50 (100/2). Preventing a link between the sender and the receiver from becoming overloaded with too much traffic. Then, the slow start phase will start again with window size 1.

Question 2. From the simulation script we used, we know that the packet's payload is 500 Bytes. Keep in mind that the size of the IP and TCP headers is 20 Bytes each. Neglect any other headers. What is the average throughput of the TCP in this case? (both in number of packets per second and bps)



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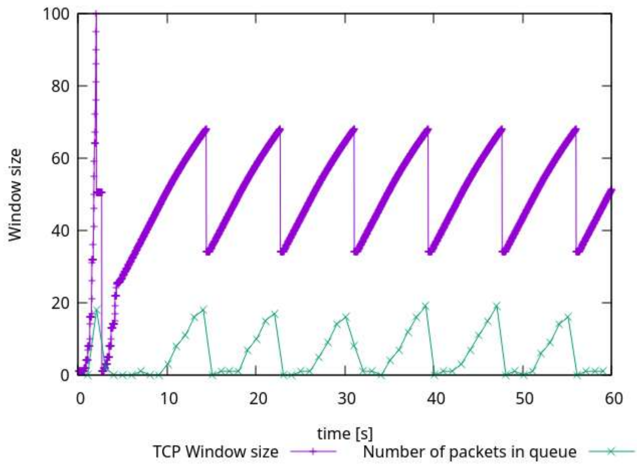
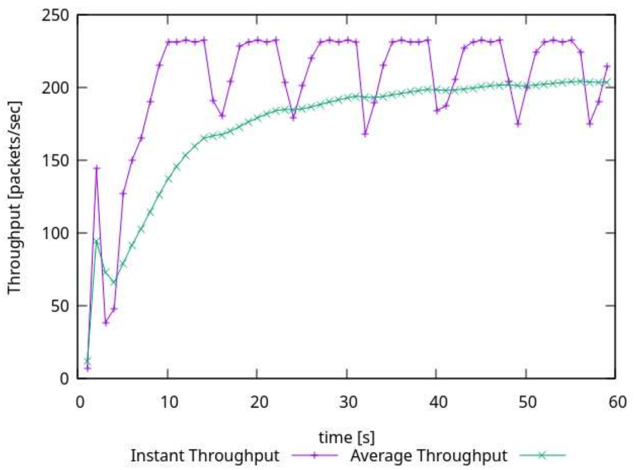
59.100000000000001 41  0.0036883771140698092 185.0 1 188.97610921501706
```

Answer: The average throughput is 188.9761092150176 packets per second

Average throughput = (500 + 20 + 20) * 188.9761092150176 = 102047.098976 bytes per second

Question 3. Repeat the steps outlined in Questions 1 and 2 but for TCP Reno. Compare the graphs for the two implementations and explain the differences. (Hint: compare the number of times the congestion window returns to zero in each case). How does the average throughput differ in both implementations?



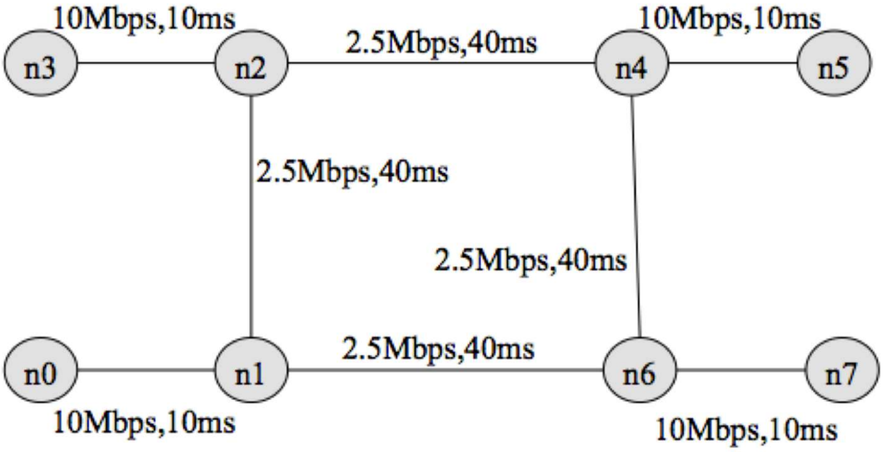


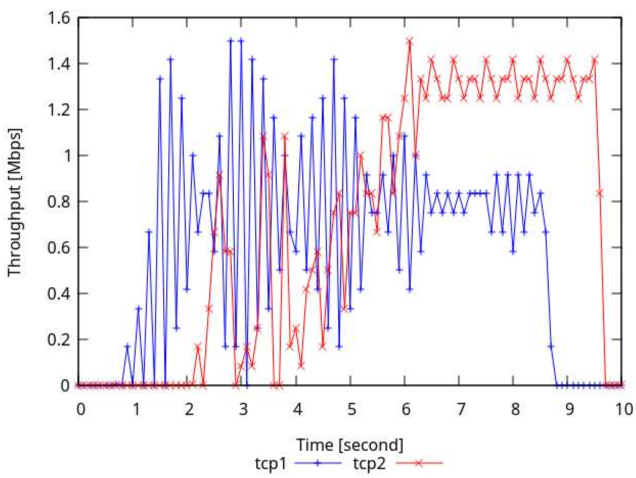

```
59    59.100000000000001 41  0.0034275204815248286 214.0 1 203.41296928327645
```

Answer: The window size only hits zero once after the slow start phase for Reno. The average throughput is higher for Reno (203.41) greater than Tahoe (188.97). Mainly because TCP Reno doesn't need to enter slow start phase after congestion.

Exercise 2: Setting up NS2 simulation for measuring TCP throughput

Consider the topology in the following figure, where bandwidth and delay for each link are shown.





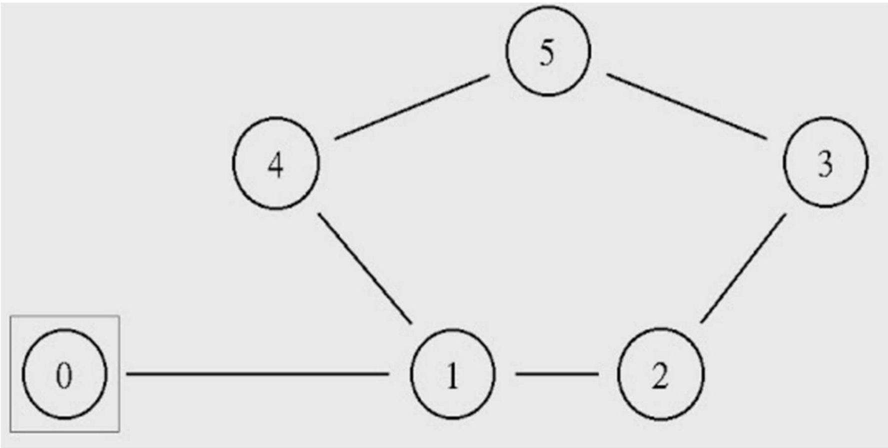
Question 1. Why is the throughput achieved by flow tcp2 higher than tcp1 between 6 sec to 8 sec?

Answer: The throughput of the tcp2 is larger than tcp1 between 6-8s because tcp2 has a lower RTT and competing for link bandwidth.

Question 2. Why does the throughput for flow tcp1 fluctuate between a time span of 0.5 sec to 2 sec?

Answer: Because of congestion control, it is adjusting its congestion window and on starting slow start phase.

Exercise 3: Understanding the Impact of Network Dynamics on Routing



Question 1. Which nodes communicate with which other nodes? Which route do the packets follow? Does it change over time?

Answer: Node 0 and node 2 communicate with node 5. The routes that the packets take are 0 → 1 → 4 → 5 and 2 → 3 → 5, and these routes do not change over time.

Question 2. What happens at time 1.0 and time 1.2? Does the route between the communicating nodes change as a result?

Answer: The link 1 → link 4 is down. The route between the communicating nodes will not change and the packets are waiting.

Question 3. Did you observe additional traffic compared to Step 3 above? How does the network react to the changes that take place at time 1.0 and time 1.2 now?

Answer: Yes, additional traffic compared to Step 3. And reroute the packets from 1 → 2 cause 1 → 4 is down.

Question 4. How does this change affect the routing? Explain why.

Answer: The cost of 1 → 4 increases from 1 to 3, while the total cost of 1 → 2 → 3 → 5 is 3 compared to 1 → 4 → 5 is 4. It is cheaper to take 1 → 2 → 3 → 5 and 1 → 4 → 5 has less link nodes.

Question 5. Describe what happens and deduce the effect of the line you just uncommented.

Answer: 1 → 2 → 3 → 5 and 1 → 4 → 5 will have the same cost equal to 4, there are multiple routes that can be selected.