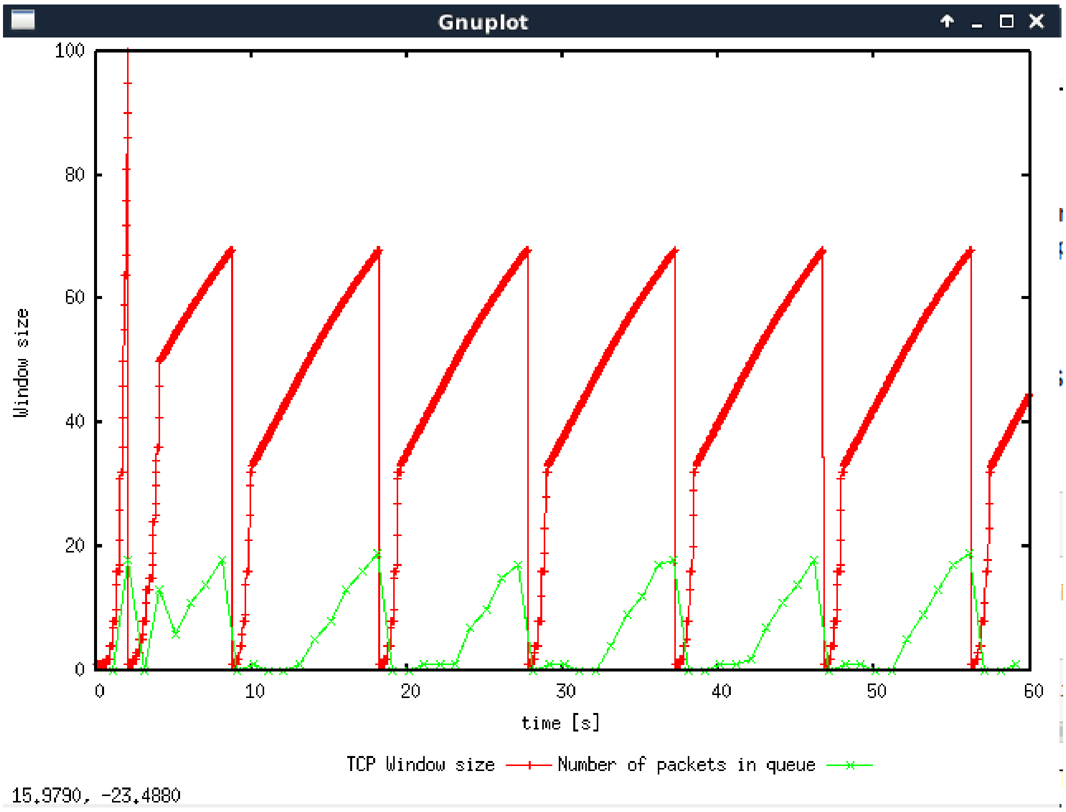
COMP3331 Lab 5

Exercise 1

1. The maximum size of the congestion window that the TCP flow reaches is about 100. When it reaches this value, the TCP flow meets its first loss event and reset its window size back to 0 since congestion has exceeded the size of the queue. This process keeps repeating i.e. from slow start phase to additive increase to loss event.



2. Average throughput (packets per second) = ~190

Average throughput (bps) = (ICP Header + TCP Header + Payload) * packets per second

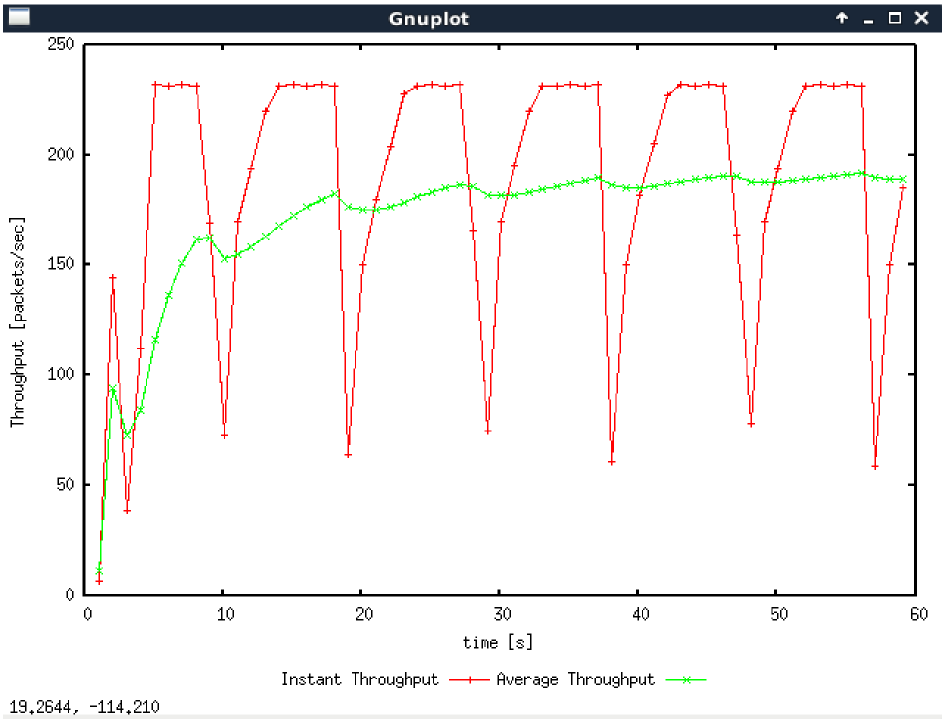
= (20 + 20 + 500) bytes * 190 packets per second

= 540 bytes * 190 packets per second

= 102,600 bytes per second

= 102,600 * 8 bits per second

= 820,800 bps



3. When setting max window size to 50, the TCP flow doesn't encounter any loss events, stops oscillating and becomes stable.

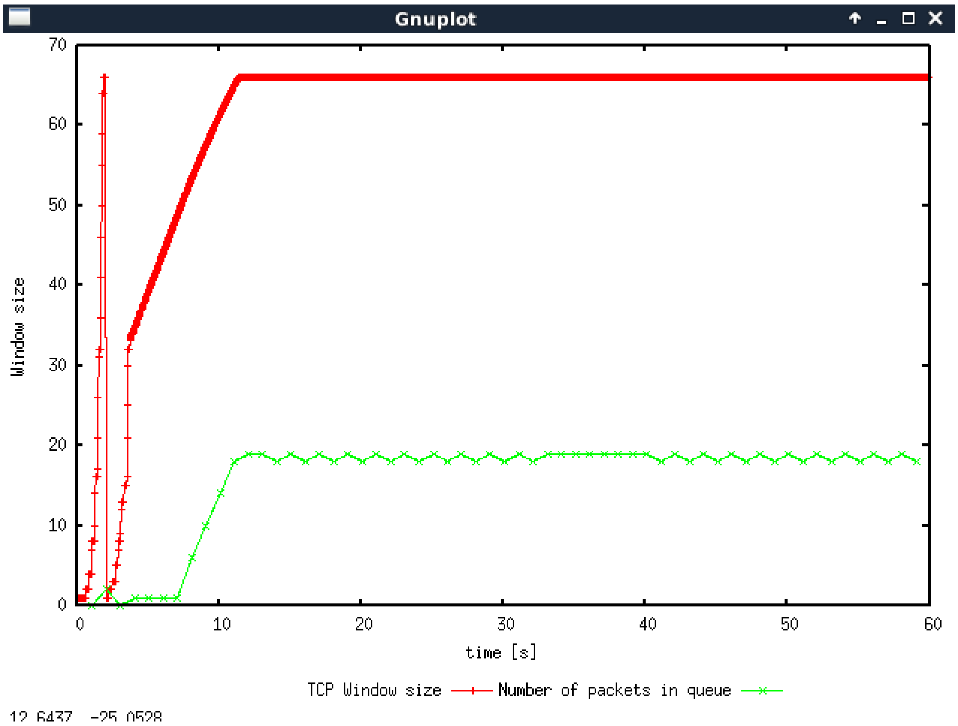
After setting max window size to anything over 67, the TCP flow starts oscillating again. From trial and error, I have found the maximum window size at which TCP stops oscillating to be 66.

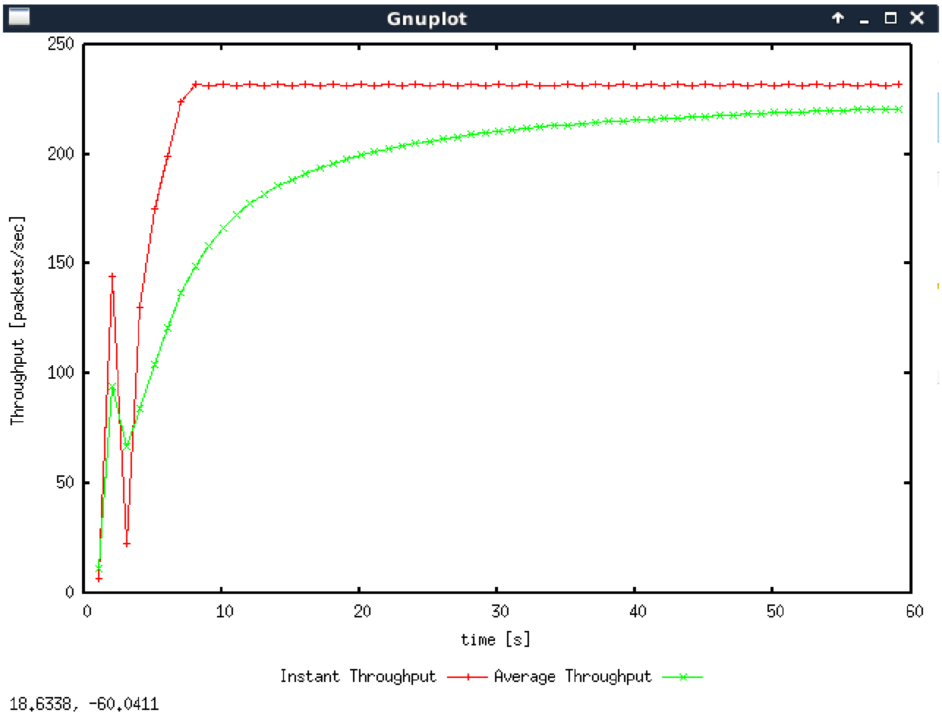
Average Throughput = ~220 pps

= 540 * 8 bits * 220 pps

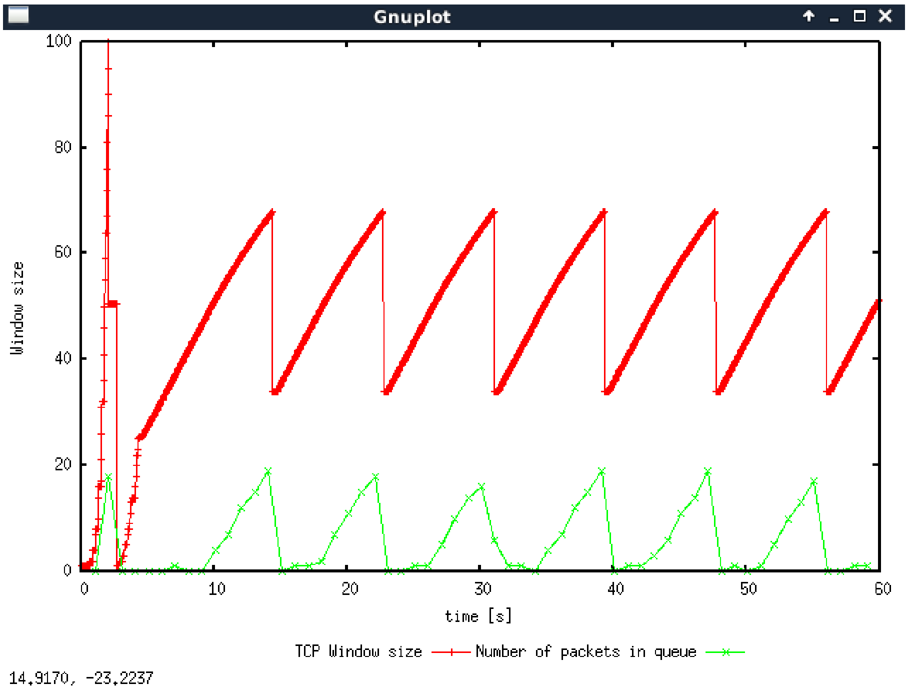
= 950,400 bps

This value is getting much closer to the link capacity (1 Mbps)





4. Maximum size of congestion window = ~100. Unlike TCP Tahoe, TCP Reno does not enter a slow start phase when a loss event occurs, but rather goes to additive increase straight away. TCP Reno also doesn't reset window size back to 0 after the first additive increase phase.

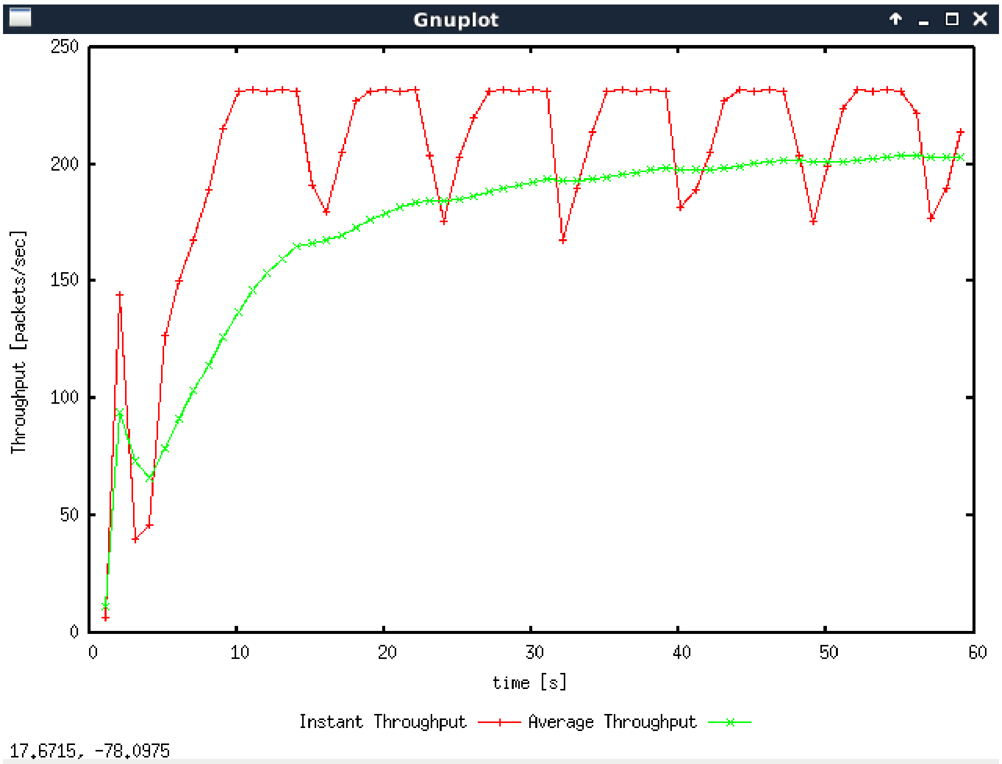


Average throughput = ~200 pps

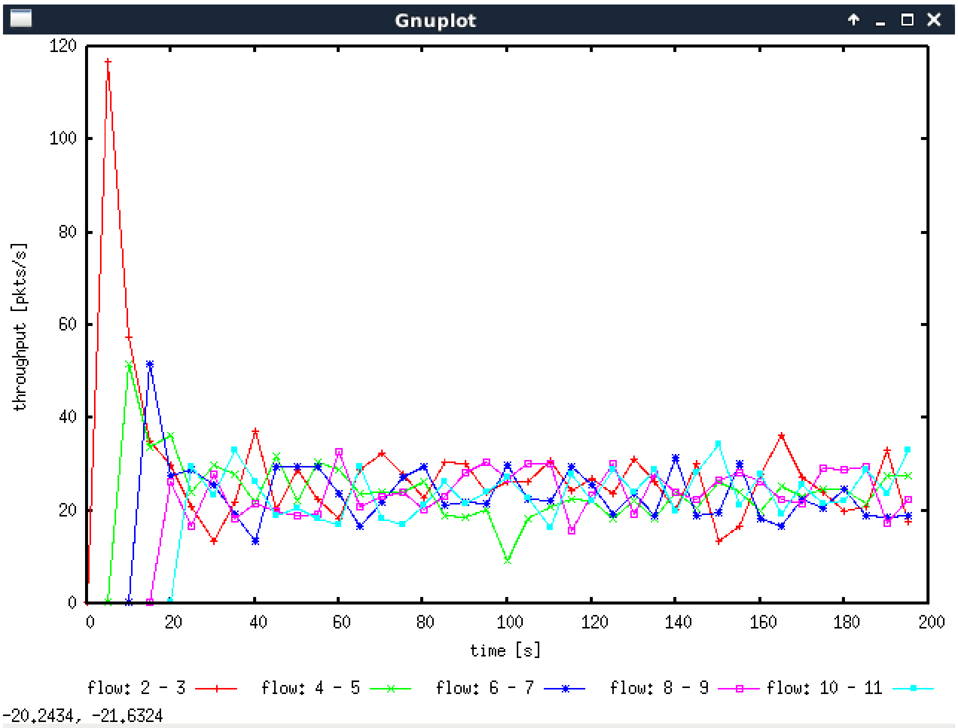
= 540 * 8 bits * 200 pps

= 864,000 bps

Average throughput of TCP Reno is higher than average throughput of TCP Tahoe (820,800 bps). Therefore TCP Reno generally performs better.



Exercise 2



1. Yes, each flow gets an equal share of the common link. Aside from the fluctuations and the starting throughputs, the average throughputs of the five TCP flows are roughly equal.

2. Throughput for the pre-existing connections start off quite high, but decreases significantly for each new flow that is created since it needs to share bandwidth with the new flows. Additive Increase Multiplicative Decrease (AIMD) is the mechanism that contributes to this behaviour. It is fair behaviour since each connection shares the common link with the new connection as it is established.

Exercise 3

1. The UDP throughput should be higher than the TCP throughput. Blue should represent TCP since TCP has congestion control

2. Since TCP has congestion control, this slows down the throughput, whereas UDP should not be affected by packet loss. Therefore, UDP throughput should be higher than TCP throughput.

3. When using UDP, file transfer will be much faster than TCP, but not as reliable as TCP. The network would die if everyone started using UDP since it is unable to process so many UDP packets.