### Project 1: Report

In the first case, when the max window size is limited to 2000 we can see that the goodput obtained is also constrained by the window size. Some flows receive fair service while some of them suffer due to dropped packets. Specifically, the flows with the smaller start time have a greater goodput, this is possibly because of the fact that packets from the other flows might be dropped frequently.

### Effect of SEgment Size on the goodput:

In this case we can see that the queue size is large and the window size is small, this means that there is a small stream of packets from all the flows which are queued and serviced fairly. The average goodput is uniform over all flows. The segment size plays a major role in this case because TCP Tahoe tends to enter the ‘Slow Start’ phase a lot of times during retransmissions and hence the window size drops to 1xMSS (maximum segment size). Thus we see that the flows that have slightly better segment sizes have slightly better goodputs on average.

### Effect of Queue Size on the goodput:

In the case of the queue size being equal to the window size, the goodput is higher, on average for all flows. All flows are getting serviced fairly and equally on average. This might be because the queue is buffering exactly the right amount and there is no loss of packets from each of the flows. There still seem to be certain odd cases where there are peaks and drops but the average performance is evidently better than the other cases. Therefore, there seems to be both an upper and lower bounds for queue size to ensure optimal performance.

In the case of the queue size being much large, we see that it results in unfairness and poor performance amongst all the flows. This might be due to the fact that certain flows flood the queue and certain flows are not being served at all. This causes a large queueing delay to build up in the other flows and hence causes a lot of loss in goodput when viewed over a short timespan like 10 seconds, hence short term fairness is not present.

### Effect of Window Size on the goodput:

This is the case of a single flow in the case of the **queue size being fixed at 64000**. It is clear that window size is directly proportional to the goodput.

References:

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[2] Anshul Kantawala, Jonathan Turner. Department of Computer Science. Washington University. “*Efficient Queue Management for TCP Flows”*

[3] Chi Zhang, Lefteris Mamatas. School of Computer Science. Florida International University. Department of Electrical and Computer Engineering, Demokritos University. “*The Interaction between Window Adjustment Strategies and Queue Management Schemes*”.