
Instructions:

Take this assignment as learning opportunity and attempt with full integrity.

The submitted files will be checked by a Plagiarism tool. Plagiarized submission will attract HUGE penalty. --

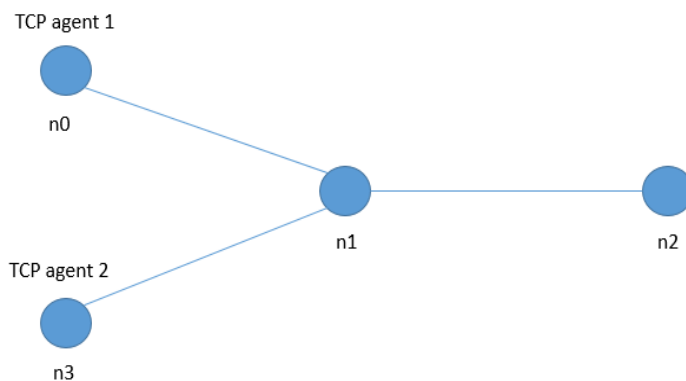
Submission: Create a zip file of all deliverables and upload to TAXILA.

Objective:

The objective of this assignment is to get acquainted with the ns-2 network simulator and TCP protocol fairness. The assignment focuses on fairness between TCP flows with equal and unequal RTTs.

Problem Statement: Create the network topology shown in below figure. Create two TCP flows (Reno), one between node n0 and n2 and another between n3 and n2. Attach a DropTail queue to the link n0— n1 and n3—n1. In your simulation script, start both the TCP flows at the same time. Run the simulation for 50-100 seconds duration. Keep same value of MSS (Maximum segment size) for both the TCP connections. Your simulation script should create trace file and NAM file for graphical visualization of the simulation.

Max. Marks: 15



a) Assign the link parameters values as mentioned in the below table.

Link	Latency/Delay (in milli sec)	Bandwidth/Data rate	Link type
n0—n1	100	2Mbps	Full duplex
n3—n1	100	2Mbps	Full duplex
n1—n2	100	2Mbps	Full duplex

Tasks to be performed:

1. Using Xgraph, plot the throughput of the TCP flows w.r.t. time together in a same plot.
2. In every TCP-type class, the congestion window size of the TCP module is available in the variable `cnwnd_`. Plot the variation of congestion window w.r.t. time for both the flows. (Hint: you will have to obtain the value of `cnwnd_` repeatedly)

b) Now change the link parameters as shown in the below table and repeat the tasks (1) and (2)

Analyze the plots to compare bandwidth share of both TCP connections for scenario (a) and (b). Write your observations in a doc file and convert it into pdf file.

Deliverables

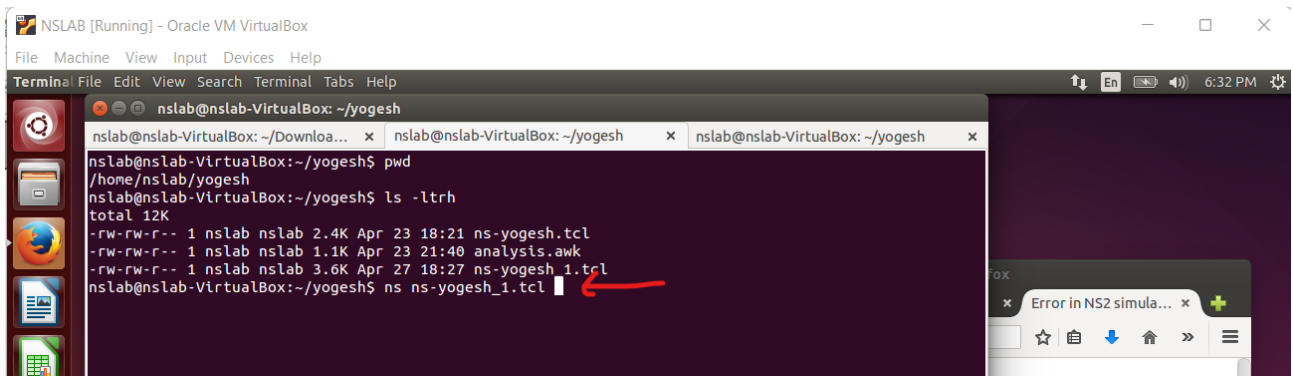
1. TCL script files (.tcl) for (a) and (b).
2. Plots for bandwidth and TCP window size for (a) and (b).
3. Trace file (.tr) for both simulations.
4. Observation file in pdf format.

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Compose a TCL file as per the requirements given in the question. And execute it, two times:

1. Experiment 1 (100 ms, 100 ms, 100 ms)
2. Experiment 2 (150 ms, 50 ms, 50 ms)



The screenshot shows a terminal window titled "NSLAB [Running] - Oracle VM VirtualBox". The terminal prompt is "nslab@nslab-VirtualBox: ~/yogesh". The user has entered the following commands and received the following output:

```
nslab@nslab-VirtualBox:~/yogesh$ pwd
/home/nslab/yogesh
nslab@nslab-VirtualBox:~/yogesh$ ls -ltrh
total 12K
-rw-rw-r-- 1 nslab nslab 2.4K Apr 23 18:21 ns-yogesh.tcl
-rw-rw-r-- 1 nslab nslab 1.1K Apr 23 21:40 analysis.awk
-rw-rw-r-- 1 nslab nslab 3.6K Apr 27 18:27 ns-yogesh_1.tcl
nslab@nslab-VirtualBox:~/yogesh$ ns ns-yogesh_1.tcl
```

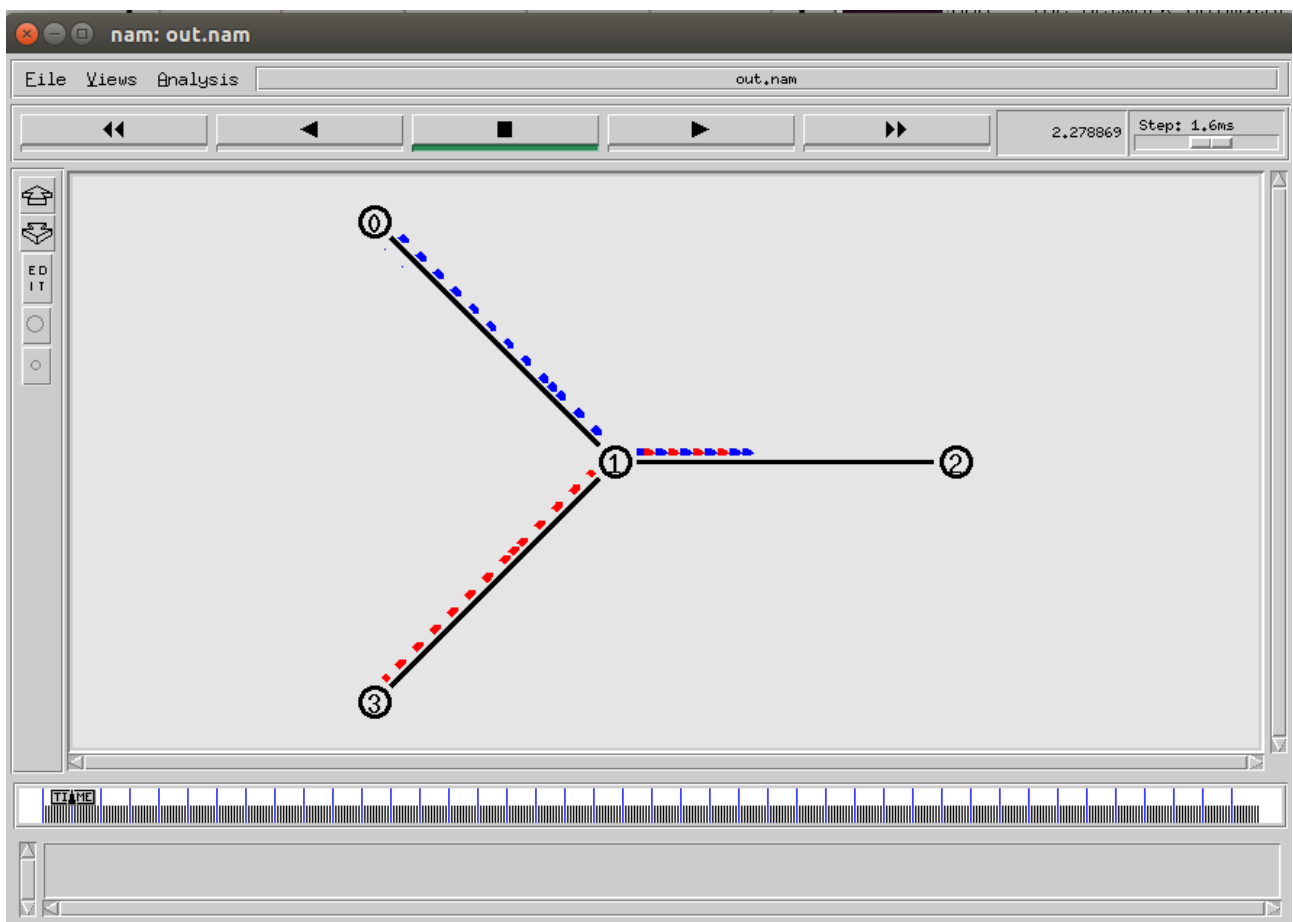
A red arrow points to the command "ns ns-yogesh_1.tcl". To the right of the terminal window, there is a small window titled "Error in NS2 simula..." with a close button and a plus sign.

The execution will produce following files:-

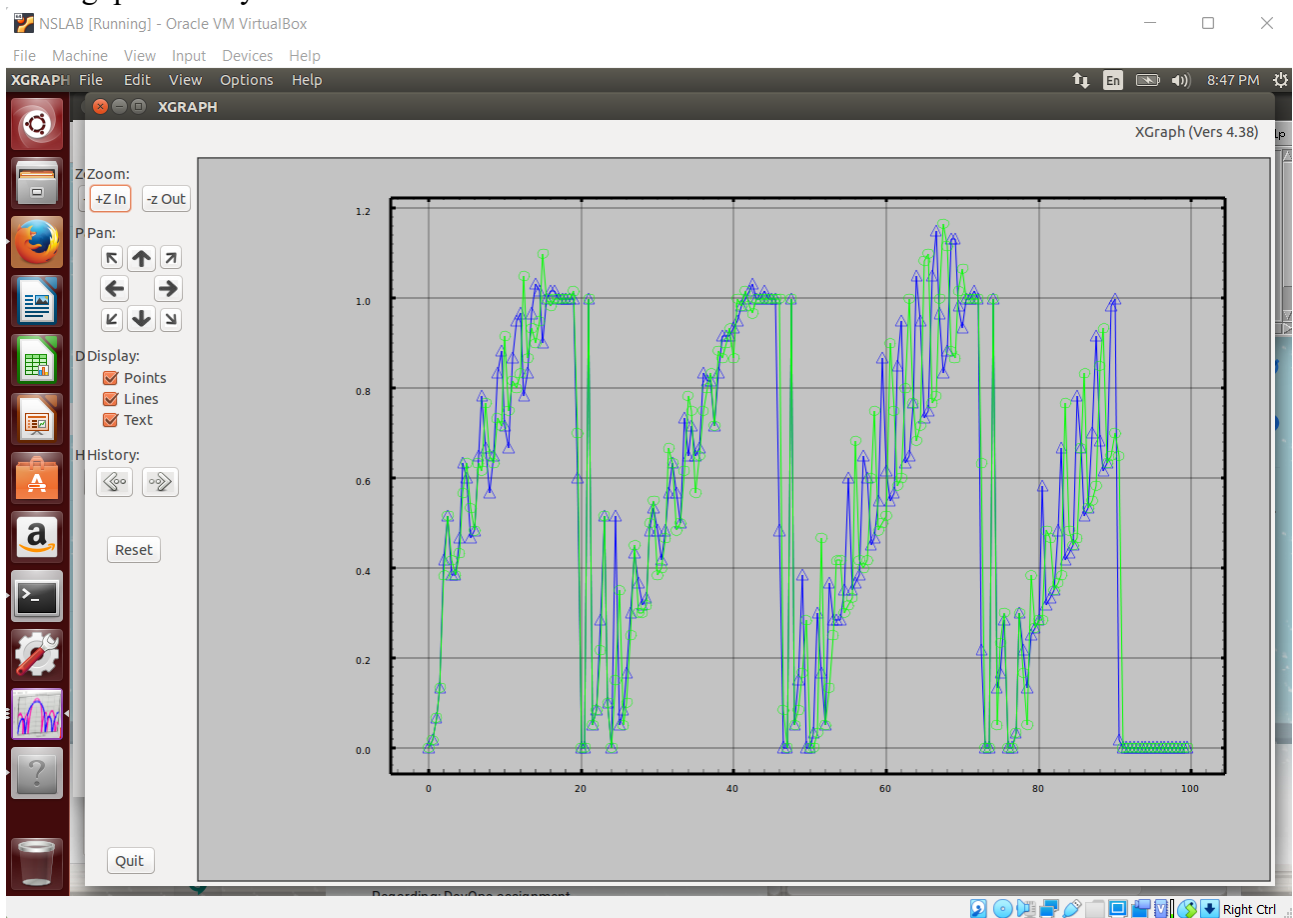
1. NAM file
2. Xgraph – throughput (green for tcp1 and blue for tcp2)
3. Xgraph – CNWD (red for tcp1)
4. Xgraph – CNWD (orange for tcp2)

Below is the output for Experiment 1:-

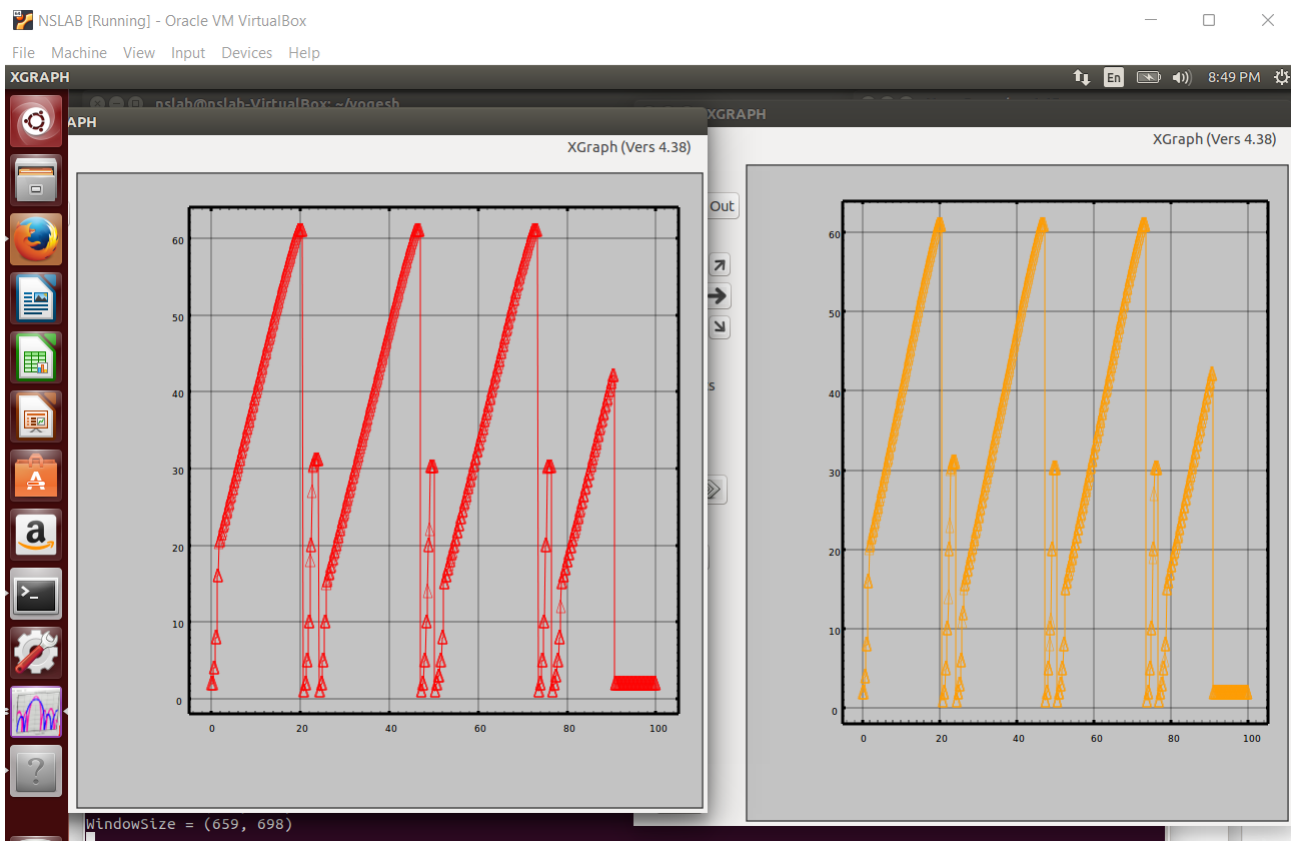
NAM:-



Throughput in Mbytes Per Second:-

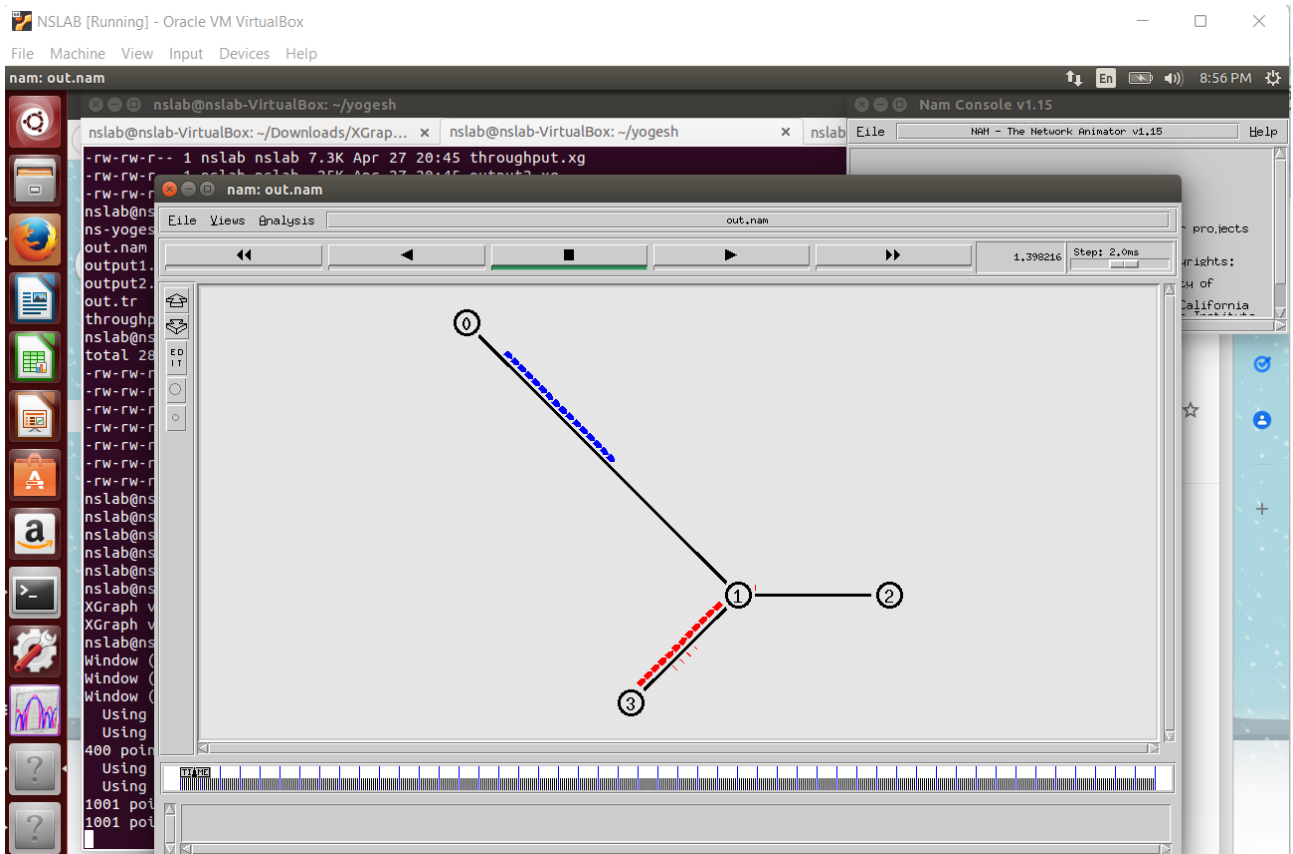


Congestion Window:-

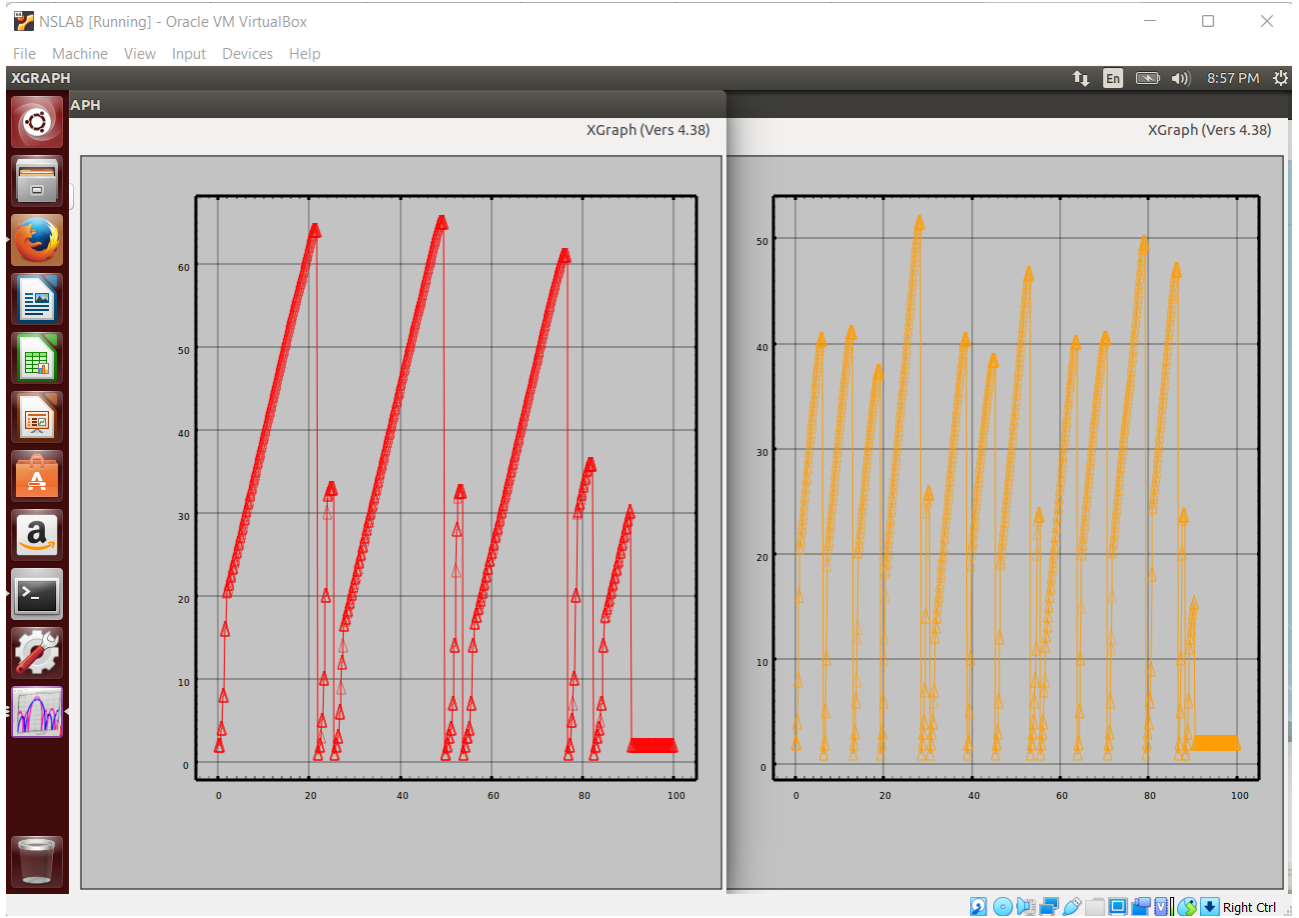


If you re-run the simulator after modifying the latency to 150, 50, 50 (Experiment 2) as per the question then the graph changes like below:

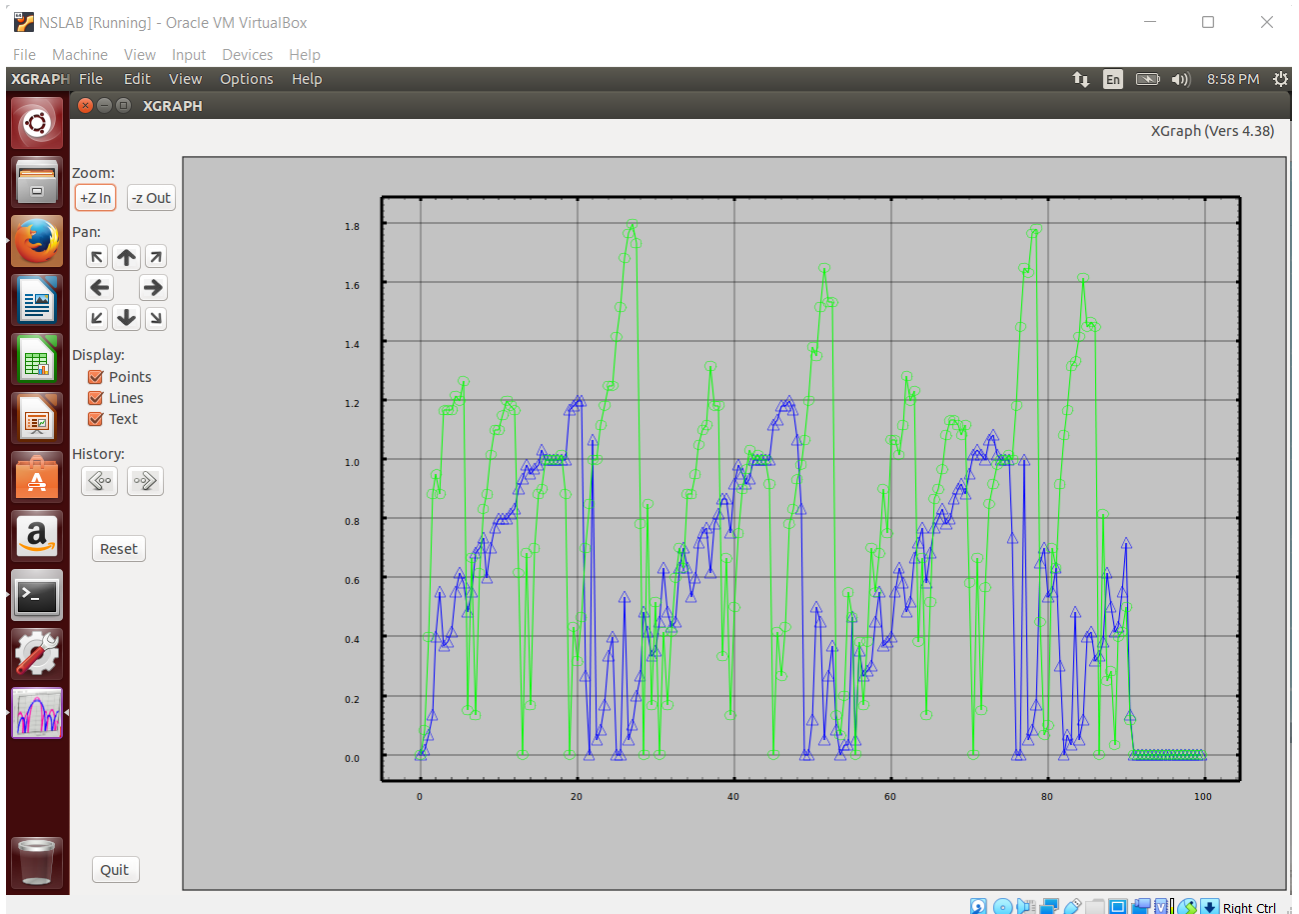
NAM:-



Congestion Window:-



Throughput:-



Observations:

1. In experiment 1, the throughput and congestion window for both tcp1 and tcp2 connections is almost same.
2. Max throughput is 1.2 Mega Bytes per second and max congestion window is 60
3. In experiment 2, the throughput of tcp1 connection (green) goes beyond throughput of tcp2 connection (blue) at times.
And the congestion window of tcp1 (red) goes 60+ while the congestion window of tcp2 (orange) is limited to lower 50s max.
4. Max throughput is 1.8 Mega Bytes per second (from tcp1 connection) and max congestion window is 65 (from tcp1 connection)