CS342 Assignment 4

Application - 1

Group Number 5

Group Members:

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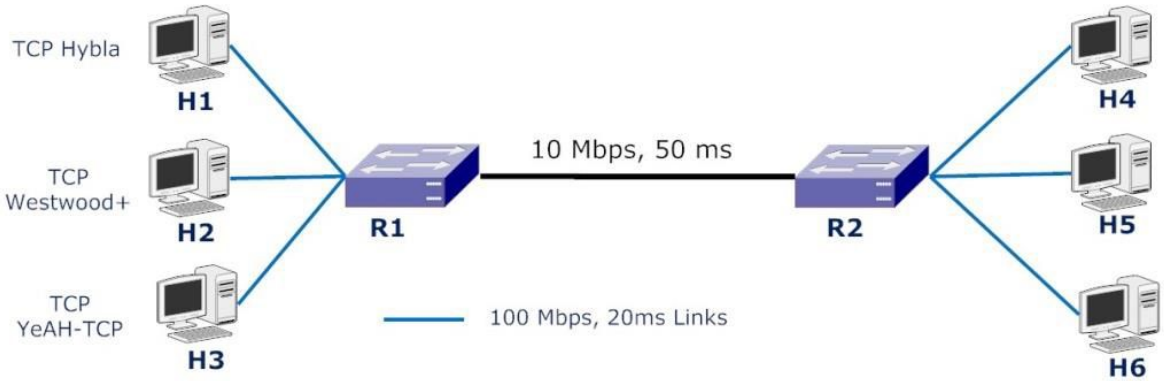
About the application:

- To analyse and compare TCP Hybla, TCP Westwood+, and TCP YeAH-TCP performance.
- Using a Dumbbell topology with two routers R1 and R2 connected by a (10 Mbps, 50 ms) wired link. Each of the routers is connected to 3 hosts, i.e. H1, H2, H3 (i.e. senders) are connected to R1, and H4, H5, H6 (i.e. receivers) are connected to R2.
- The hosts are attached with (100 Mbps, 20 ms) links. Both the routers use drop-tail queues with queue size set according to the bandwidth-delay product. Senders (i.e. H1, H2 and H3) are attached with TCP Hybla, TCP Westwood+, and TCP YeAH-TCP agents, respectively
- Packet size selected is 1.3 KB

Implementation(Dumbbell topology):



The left side is senders' side, the right side is the receivers' side. Router R1 and R2 form the bridge of the dumbbell.
H1 - H4 is TCP Hybla
H2 - H5 is TCP Westwood+
H3 - H6 is YeAH-TCP

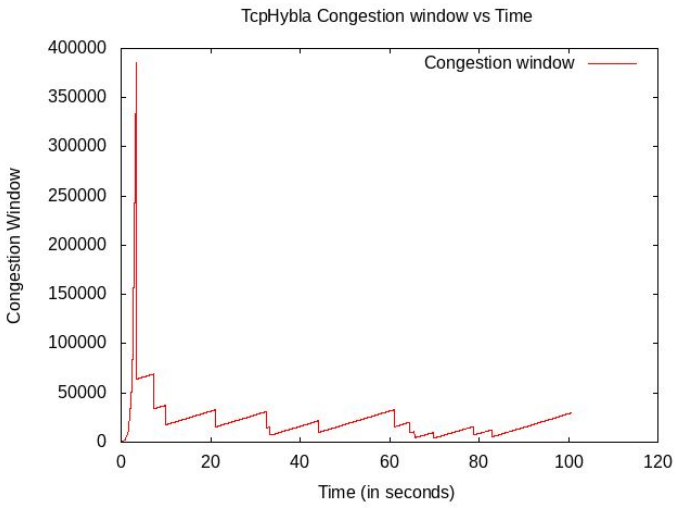
BDP(Bandwidth Delay Product) is the number of bits that can fill up a network link.
Formula: BDP = Bandwidth * Delay
BDP for link between host and router= 100 Mbps * 20 ms = 2000000 bits
BDP for link between the two routers = 10 Mbps * 50 ms = 500000 bits
Given Packet size = 1.3 KB
For the network simulation, we used ns-3 3.31.1 and gnuplot to plot the graphs based on the generated data files.
Drive link for data files:
https://drive.google.com/drive/folders/1smV9OkoC4oLayGW03rKVCrzJu39Qe2ox?usp=sharing

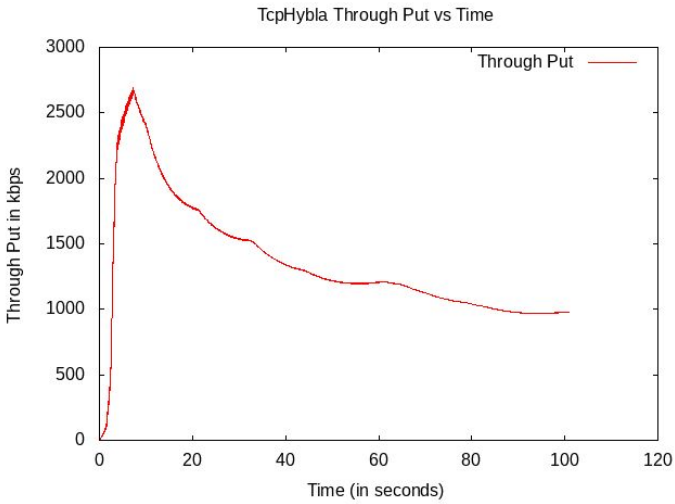
PART A:

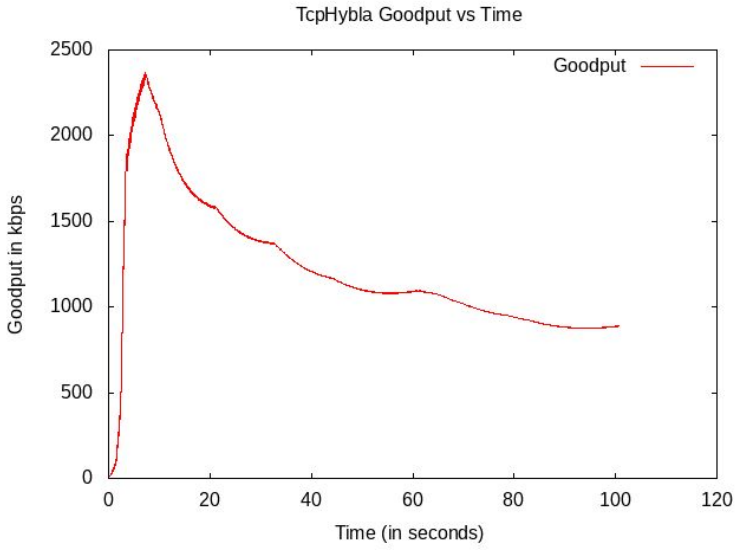
This is for part 1 of the question. We started only one flow and analyzed the throughput and goodput over a sufficiently long duration in addition to the congestion loss. We performed this experiment with all the flows attached to H1, H2 and H3.
Plots and observations: We noted the observations as long as there was an appreciable difference in the output pattern of the flow. As soon as we got the stable output, we started the next flow. Once we found a repetitive pattern, we stopped recording the observations.
The data for the various flows is collected from the .cl files generated.

TCP Hybla:

** TCP Hybla Flow **
Flow ID :1
Maximum throughput: 2696.19
Source IP: 15.1.0.1 -> Destination IP: 15.2.0.1
Total number of packets transmitted: 10000000
Total number of packets lost: 13
Number of packets transferred successfully: 9999987
Number of packets lost due to buffer overflow: 0
Number of packets lost due to congestion: 13
% loss due to buffer overflow: 0
% loss due to congestion: 0.00013

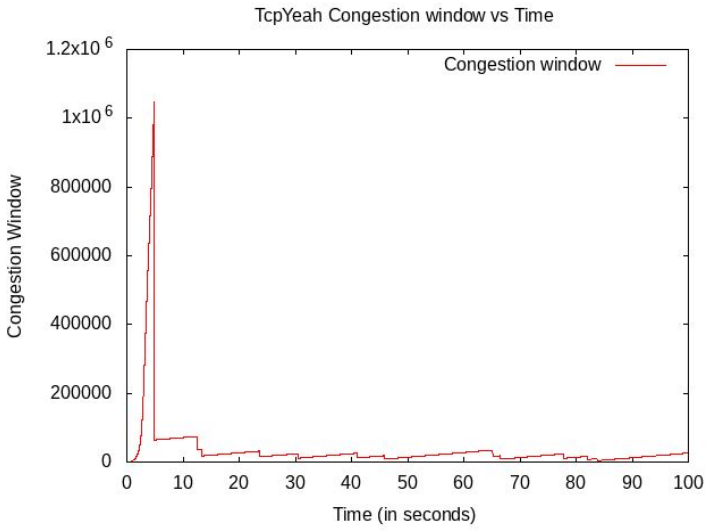


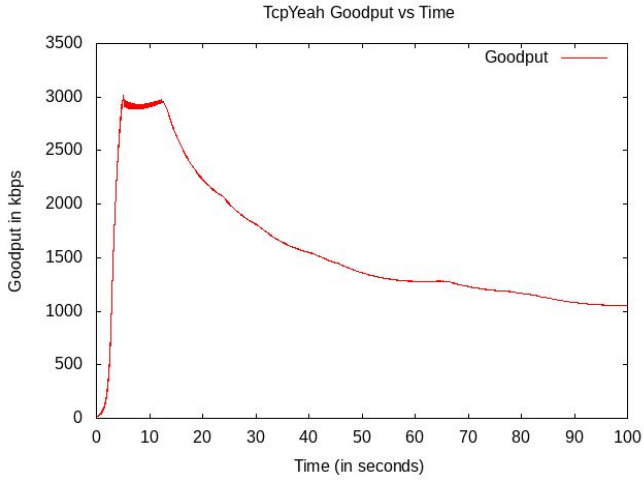


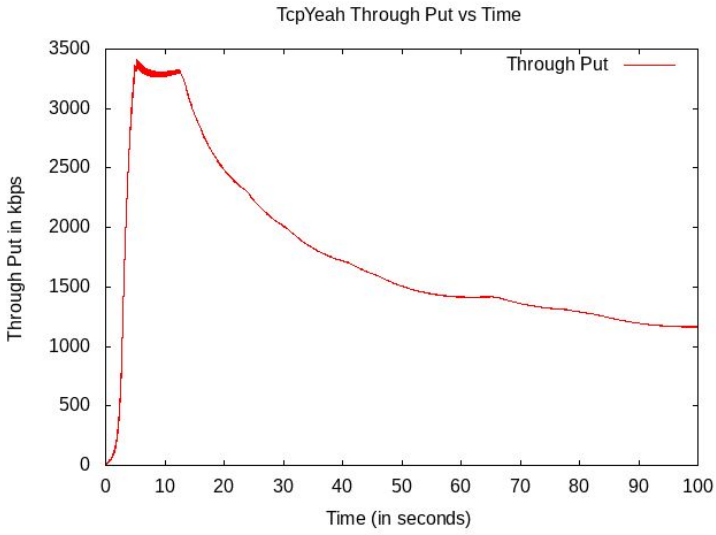


TCP Yeah Graphs:

** TCP YeAH-TCP Flow **
Flow ID :5
Maximum throughput: 3416.06
Source IP: 15.1.2.1 -> Destination IP: 15.2.2.1
Total number of packets transmitted: 10000000
Total number of packets lost: 12
Number of packets transferred successfully: 9999988
Number of packets lost due to buffer overflow: 0
Number of packets lost due to congestion: 12
% loss due to buffer overflow: 0
% loss due to congestion: 0.00012

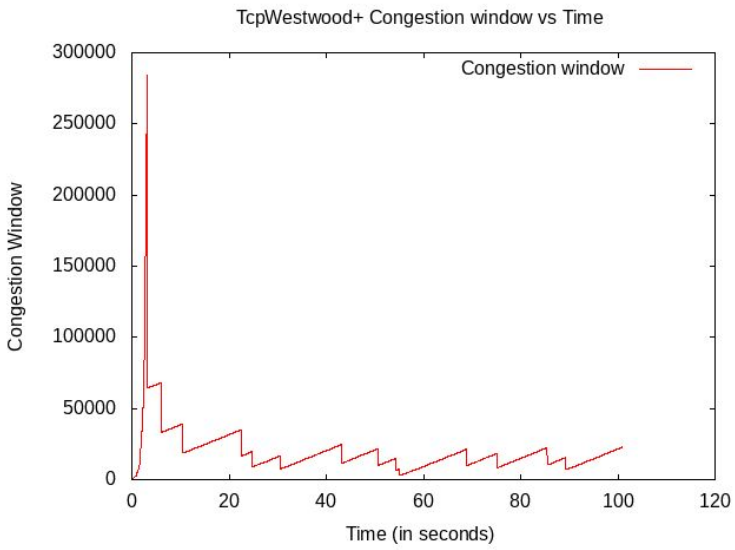


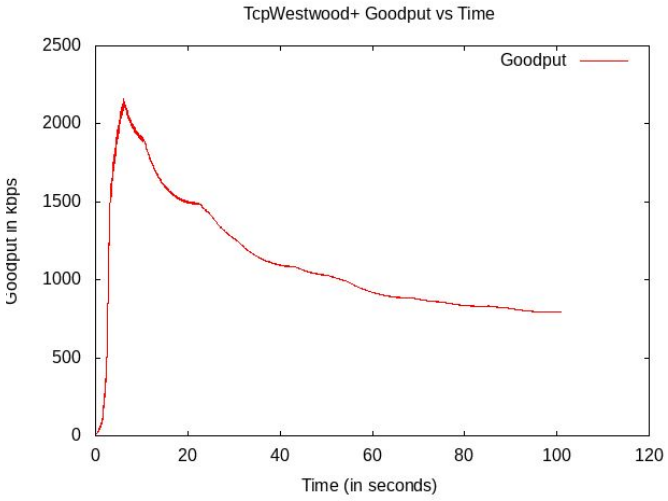


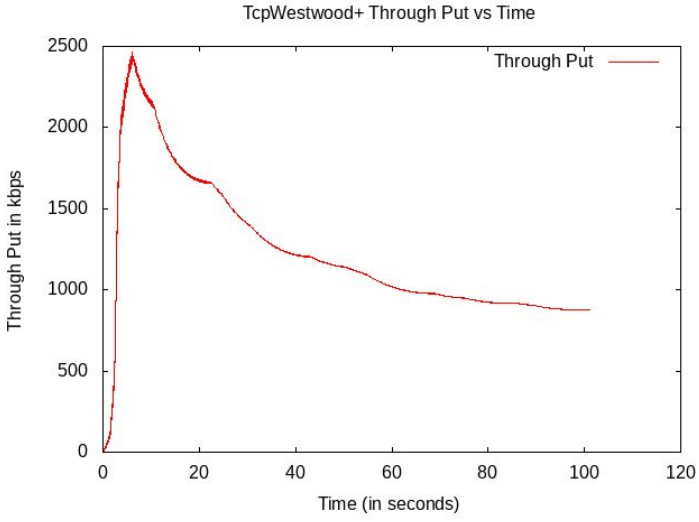


TCP Westwood+ Graphs:

** TCP Westwood+ Flow **
Flow ID :3
Maximum throughput: 2465.55
Source IP: 15.1.1.1 -> Destination IP: 15.2.1.1
Total number of packets transmitted: 10000000
Total number of packets lost: 14
Number of packets transferred successfully: 9999986
Number of packets lost due to buffer overflow: 0
Number of packets lost due to congestion: 14
% loss due to buffer overflow: 0
% loss due to congestion: 0.00014





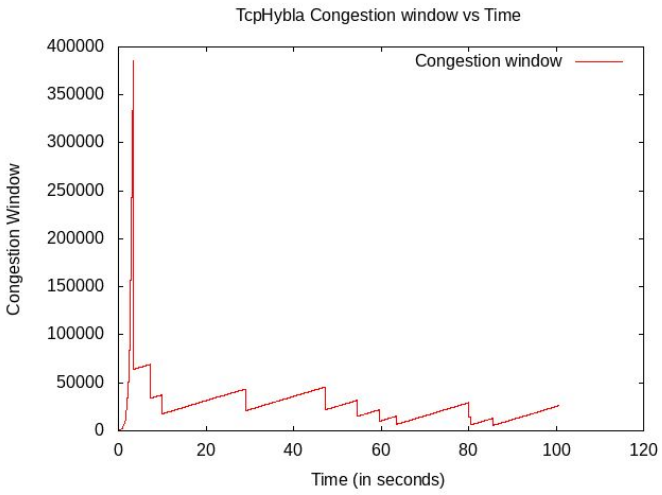


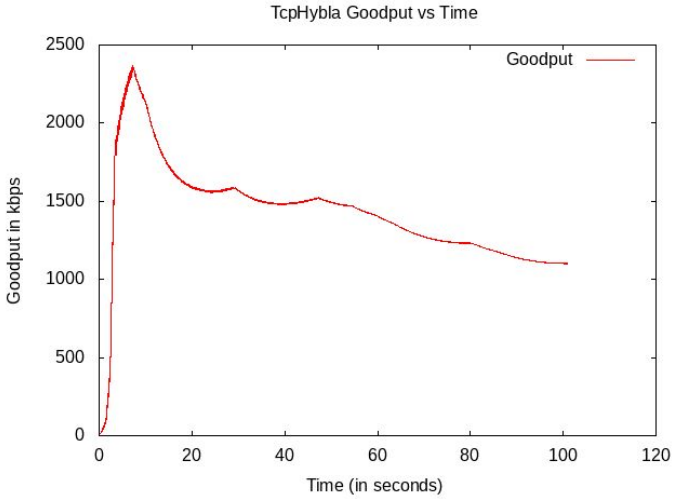
PART B:

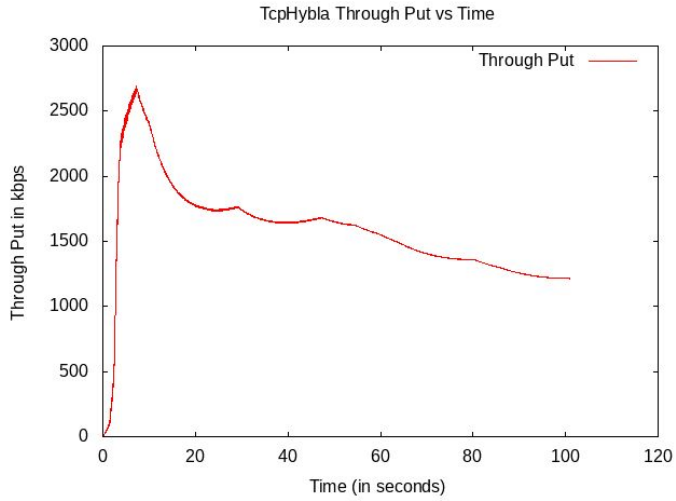
This is for part 2 of the question. We started two other flows along with the first one sharing the bottleneck link and analyzed the throughput and goodput over a sufficiently long duration in addition to the congestion loss at a steady state. We reported the maximum throughput observed for each of the flows. We performed this experiment with all the flows attached to H1, H2 and H3.
Plots and observations: We noted the observations as long as there was an appreciable difference in the output pattern of the flow. Once we found a repetitive pattern, we stopped recording the observations.

TCP Hybla Graphs:

** TCP Hybla Flow **
Flow ID :1
Maximum throughput: 2696.19
Source IP: 15.1.0.1 -> Destination IP: 15.2.0.1
Total number of packets transmitted: 10000000
Total number of packets lost: 12
Number of packets transferred successfully: 9999988
Number of packets lost due to buffer overflow: 0
Number of packets lost due to congestion: 12
% loss due to buffer overflow: 0
% loss due to congestion: 0.00012

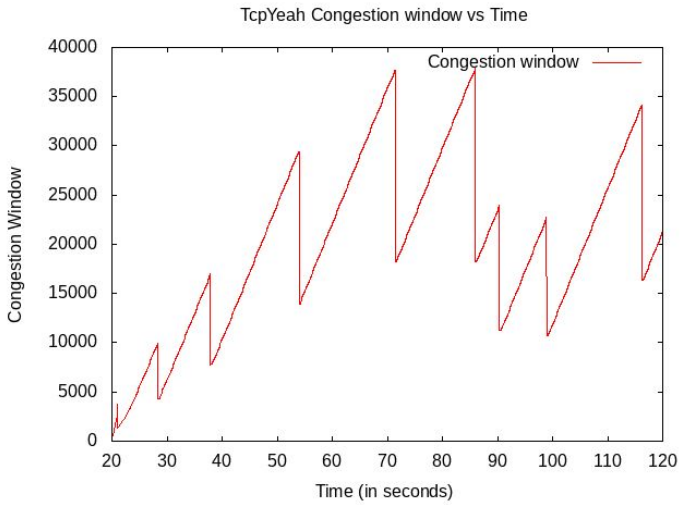


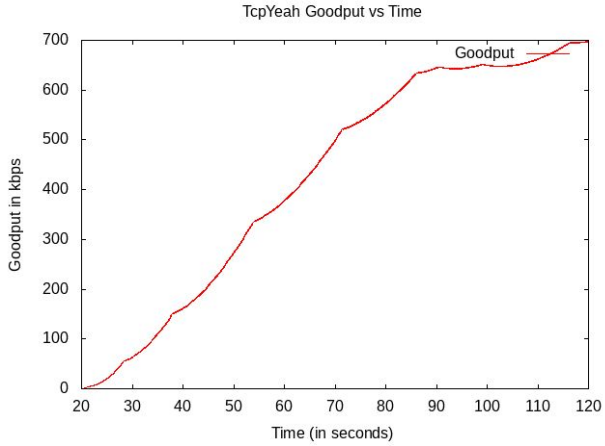


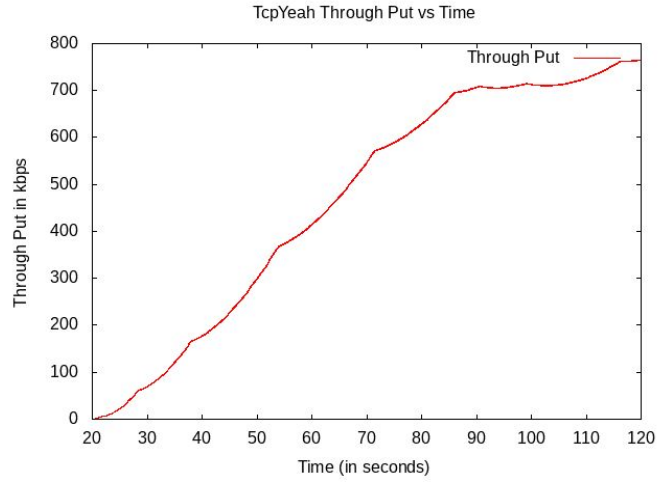


TcpYeah Graphs:

** TCP YeAH-TCP Flow **
Flow ID :4
Maximum throughput: 765.846
Source IP: 15.1.2.1 -> Destination IP: 15.2.2.1
Total number of packets transmitted: 10000000
Total number of packets lost: 8
Number of packets transferred successfully: 9999992
Number of packets lost due to buffer overflow: 0
Number of packets lost due to congestion: 8
% loss due to buffer overflow: 0
% loss due to congestion: 8e-05

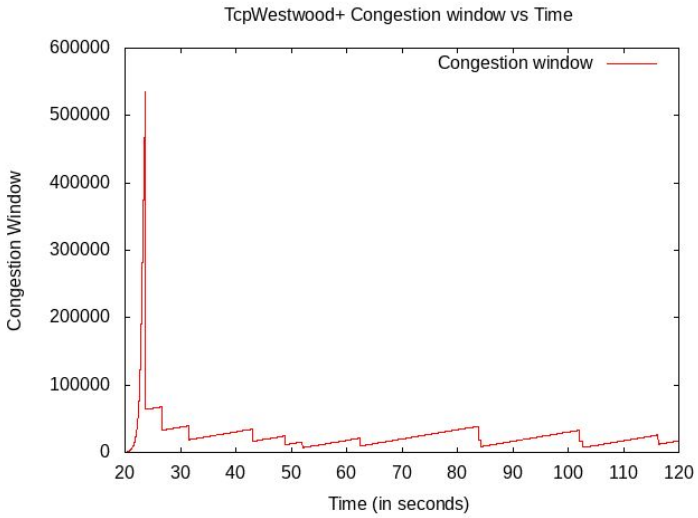


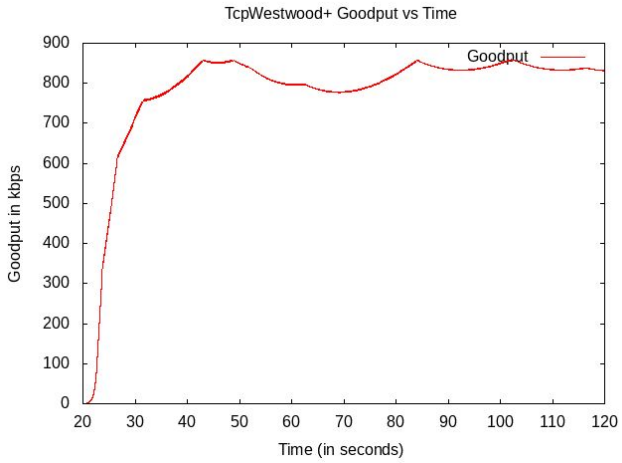


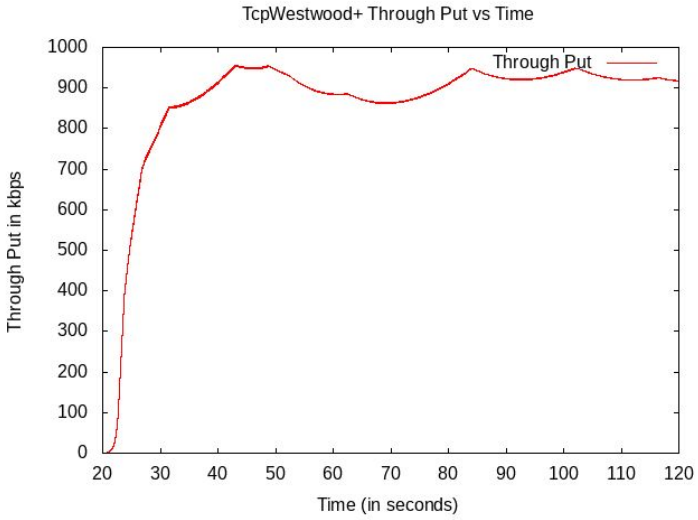


TCP Westwood+ Graphs:

** TCP Westwood+ Flow **
Flow ID :3
Maximum throughput: 956.869
Source IP: 15.1.1.1 -> Destination IP: 15.2.1.1
Total number of packets transmitted: 10000000
Total number of packets lost: 11
Number of packets transferred successfully: 9999989
Number of packets lost due to buffer overflow: 0
Number of packets lost due to congestion: 11
% loss due to buffer overflow: 0
% loss due to congestion: 0.00011







Guidelines:

For running the code follow the below guidelines:

1. Paste the files core.h and simulate.cc in the folder *nsallinone-3.31.1/ns-3.31.1/scratch*
2. Open terminal and type *cd ~/ns-/nsallinone-3.31.1/ns-3.31.1* to go to the folder ns-3.31.1
3. Now use the command *./waf --run scratch/simulate* in the terminal
4. You will be presented with guidelines to proceed, choose appropriate option.
5. Now you will be asked to run the simulation again, reply with 1 for yes or 0 for no
   Note: After a simulation twelve data/traces files will be generated in the folder on which you ran the command in line 3

For plotting we used gnuplot:

1) Open the terminal in which your .plt is located and run the command *gnuplot filename.plt*
2) Rename the filename, titles and output accordingly.

```
pulkit@pulkit-VirtualBox:~/ns-3/ns-allinone-3.31/ns-3.31$ ./waf --run scratch/simulate
Waf: Entering directory `/home/pulkit/ns-3/ns-allinone-3.31/ns-3.31/build'
[2675/2725] Compiling scratch/simulate.cc
[2686/2725] Linking build/scratch/simulate
Waf: Leaving directory `/home/pulkit/ns-3/ns-allinone-3.31/ns-3.31/build'
Build commands will be stored in build/compile_commands.json
'build' finished successfully (9.445s)
Choose one of the two: Part 1 or Part 2
1. Part 1 and 3
2. Part 2 and 3
2
*** Executing part 2 and 3 ***
Queue Size for Host to Router links: 1502 Packets
Queue Size for Router to Router link: 375 Packets

Initialising node containers...
Adding and configuring links between nodes...
Installing internet stack on the nodes...
Assigning IP addresses to the nodes and initialising network interfaces...
finished with initialisation of network


From H0 to H4 : Connection type: TcpHybla
From H1 to H5 : Connection type: TcpWestwood+
From H2 to H6 : Connection type: TcpYeah

Populating Routing Tables...
Setting up FlowMonitor to enable IP flow monitoring on all the nodes...
Starting Simulation!
Checking for lost packets...
Collecting flow statistics...
Simulation finished! Data has been stored.
Do you want to perform another simulation? (1/0)
0
Thank you!
pulkit@pulkit-VirtualBox:~/ns-3/ns-allinone-3.31/ns-3.31$
```