Assignment 4 : Network Simulation Using ns3 (Report)

Submitted By: Group 17

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Instructions for execution:

I have created a shell script for running.

The zip file contains 4 files namely - wirelessTCP.cc, wiredTCP.cc, run.sh, and this Report

For running, transfer wirelessTCP.cc and wiredTCP.cc to the scratch directory of ns3 and run.sh to the ns3 directory.

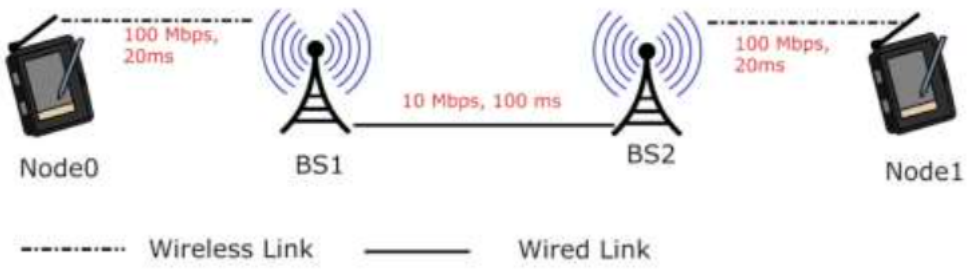
Now open the terminal in the ns3 directory and give the shell script permissions to run by running **chmod a+x run.sh**.Then, run the shell script using **./run.sh** in the terminal. This will generate the report in 6 separate plot files 3 for the 3 different variants of TCP each for wired and wireless networks. It will also produce 6 corresponding fairness and plot files. The results are summarised below in the report.

Report

In this assignment, we had to compare the wired and wireless networks over 3 different TCP variants namely, TCP Westwood, TCP Veno, and TCP Vegas over a range of different packet sizes.

The wired connection specifications were:

And that of the wireless one was:



I used throughput as the evaluation metric and plotted the throughput v/s different packet sizes. The fairness index will be 1 in all the cases as there is just one connection setup in the network. Therefore, the complete share of the network is given to that TCP connection, hence giving a fairness index of 1. The formula for the fairness index is

$$\mathcal{J}(x_1, x_2, \ldots, x_n) = \frac{(\sum_{i=1}^{n} x_i)^2}{n \cdot \sum_{i=1}^{n} {x_i}^2} = \frac{\overline{\mathbf{x}}^2}{\overline{\mathbf{x}^2}} :$$

Where n is the total number of connections, and x_i is the throughput of the ith connection. Therefore, for n=1, the fairness index is 1.

TCP Westwood

TCP Westwood represents an attempt to use the RTT-monitoring strategies of TCP Vegas to address the high-bandwidth problem; recall that the issue there is to distinguish between congestive and non-congestive losses. TCP Westwood can also be viewed as a refinement of TCP Reno's cwnd=cwnd/2 strategy, which is a greater drop than necessary if the queue capacity at the bottleneck router is less than the transit capacity.

TCP Veno

TCP Veno is a synthesis of TCP Vegas and TCP Reno, which attempts to use the RTT-monitoring ideas of TCP Vegas while at the same time remaining about as "aggressive" as TCP Reno in using queue capacity. TCP Veno has generally been presented as an option to address TCP's lossy-link problem, rather than the high-bandwidth problem per se

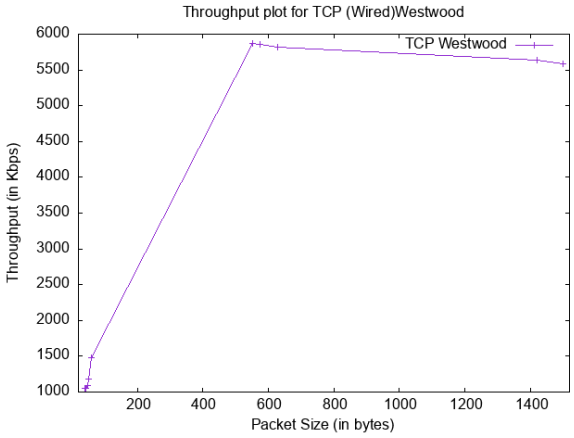
TCP Vegas

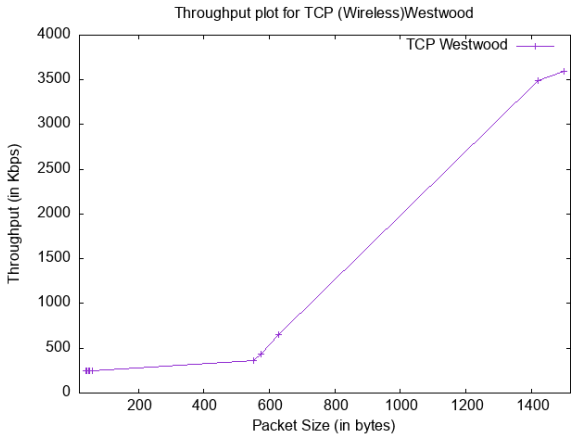
TCP Vegas detects congestion at an incipient stage based on increasing RTT values of the packets in the connection, unlike other flavours. which detects congestion only after it has actually happened via packet loss. The algorithm depends heavily on the accurate calculation of the Base RTT value. If it is too small then the throughput of the connection will be less than the bandwidth available while if the value is too large then it will overrun the connection.

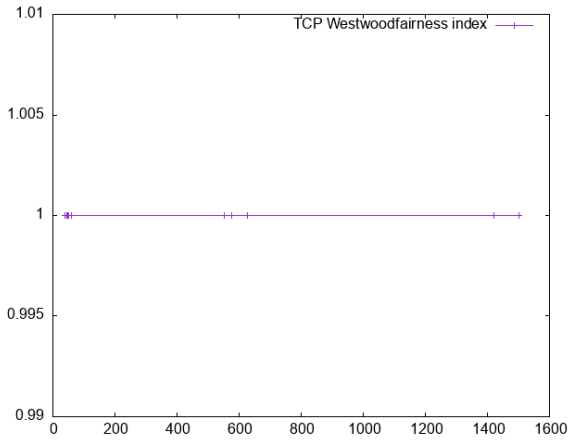
Here are the different values of throughput received for wired v/s wireless connection in TCP Westwood, TCP Veno and TCP Vegas respectively.

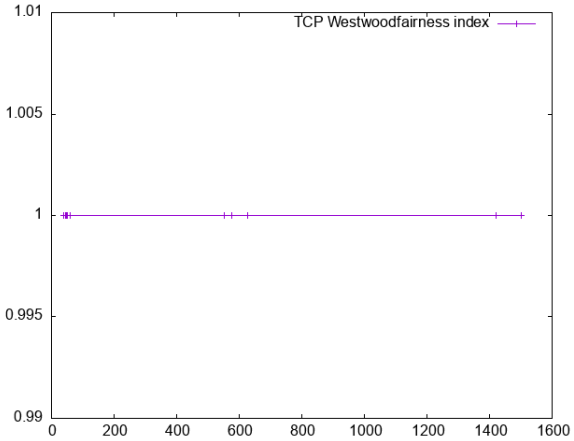
TCP Westwood

Packet Size	Wired Connection	Wireless Connedction
40	1047.344976	252.945097
44	1054.298401	253.018546
48	1095.663945	252.436431
52	1183.368704	252.827317
60	1484.050056	252.890805
552	5875.645855	365.177500
576	5854.369484	433.032034
628	5818.882816	652.020409
1420	5637.778996	3489.597333
1500	5583.032750	3598.050383









TCP Veno

Packet Size	Wired Connection	Wireless Connedction
40	1047.344976	252.945097
44	1054.298401	253.018546
48	1095.663945	252.436431
52	1183.368704	252.827317
60	1484.050056	252.890805
552	5875.645855	365.177500
576	5854.369484	433.032034
628	5818.882816	652.020409
1420	5637.778996	3489.597333
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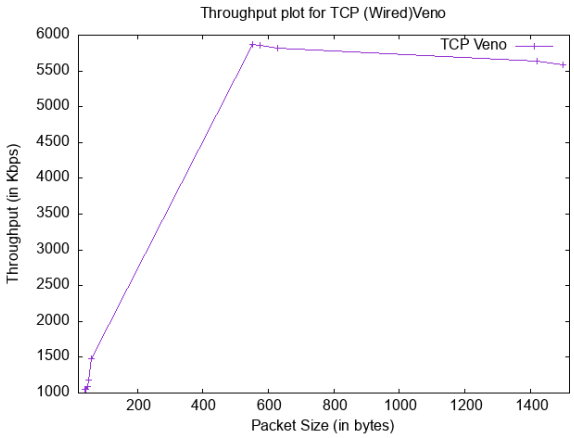
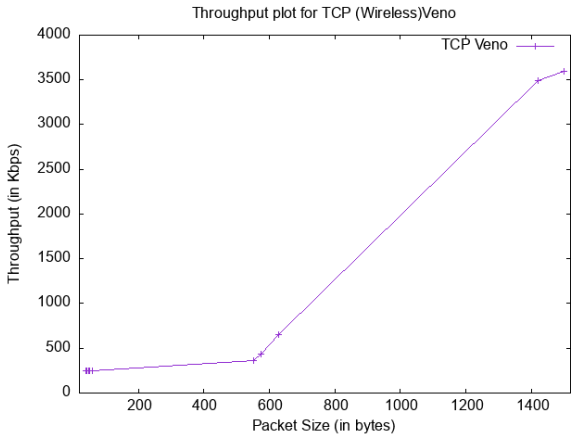
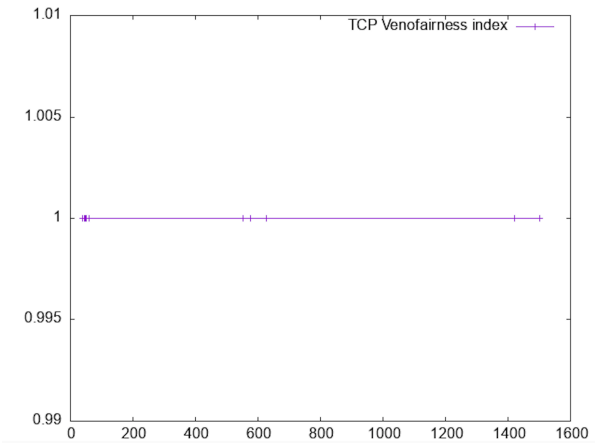
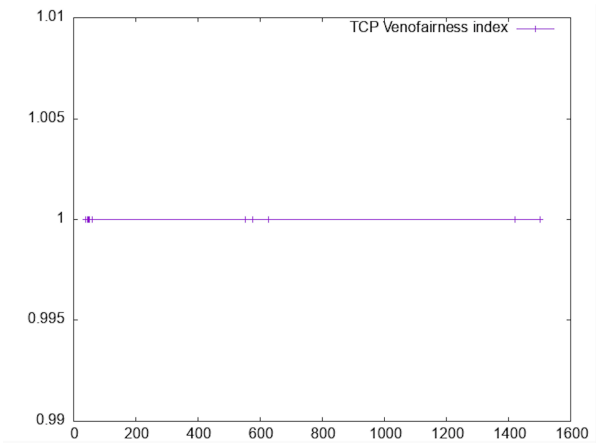


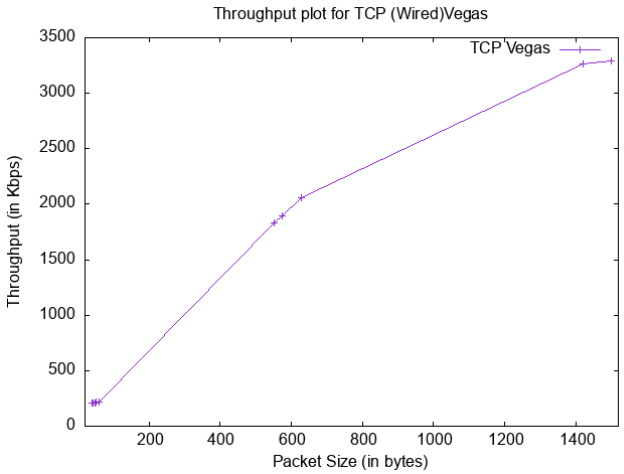


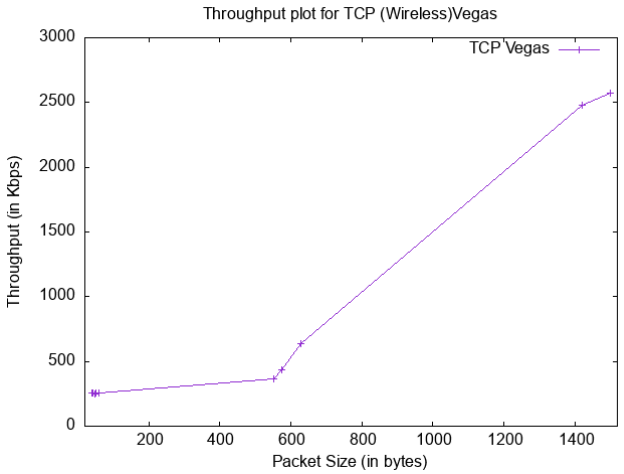


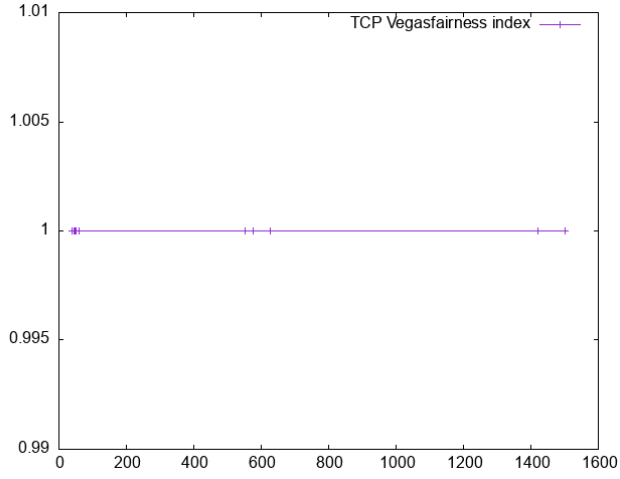


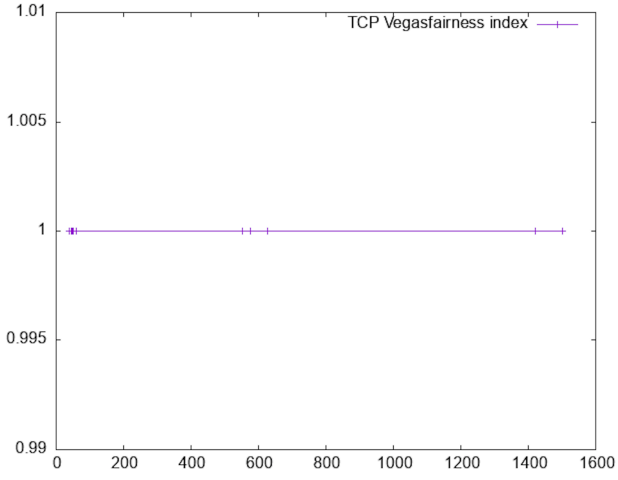
TCP Vegas

Packet Size	Wired Connection	Wireless Connedction
40	206.598905	252.945097
44	210.801215	253.018546
48	210.783918	252.436431
52	215.994052	252.827317
60	220.363185	252.890805
552	1833.724590	364.958987
576	1898.644424	433.032034
628	2062.482786	638.890434
1420	3267.097726	2477.656818
1500	3293.105385	2571.087541









Observations:

1. We can see that throughput increases with an increase in the packet size.
2. The throughput of wireless connections is lesser than that of wired connections.
3. The fairness index is always 1.
4. The throughput values for TCP Westwood and TCP Veno are the same.
5. TCP Vegas has the least throughput value among TCP Westwood and TCP Veno.

The explanation for the output:

TCP Vegas detects congestion by looking at the RTT values. Once the RTT values cross the threshold, it limits the flow of packets from the source. Therefore, giving the least throughput. The throughput for a wireless connection is less than that of a wired connection because the latter has low packet loss, and as the media is physical, data transfer is much faster. The fairness index is 1 because there is just one TCP connection present.