

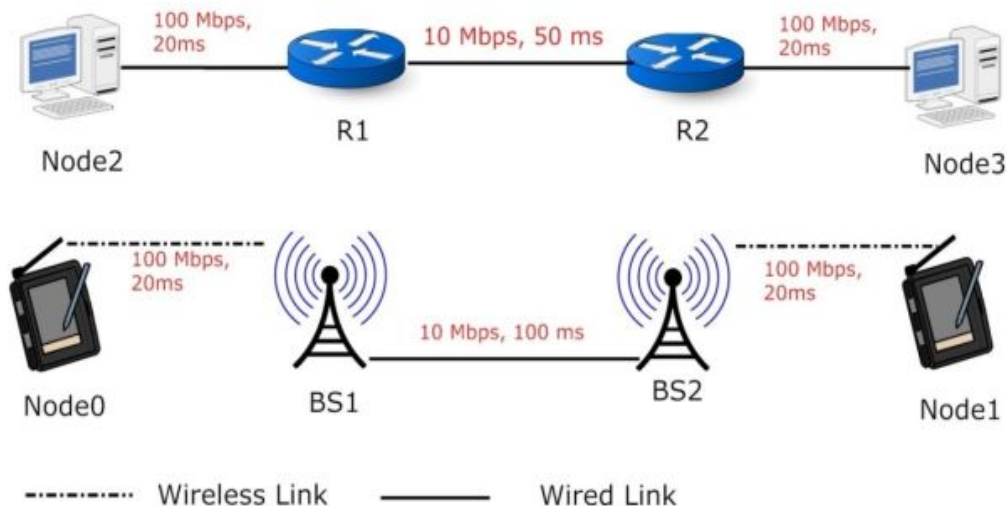
CS349: Networks Lab

Assignment – 4: Network Simulation Using ns-3

Group 38

Application #2:

Compare the performance of TCP over wired and wireless networks. Consider a topology as described below. The network consists of two TCP sources Node0 and Node2, corresponding to two TCP destinations Node1 and Node3 respectively. Node2 and Node3 come in wired domain with two routers R1 and R2 (connected by a {10 Mbps, 50 ms} wired link) between them. Both the routers use drop-tail queues with queue size set according to bandwidth-delay product. Node0 comes in domain of Base Station 1 (BS1) and Node1 comes in domain of Base Station 2 (BS2). BS1 and BS2 are connected by a (10 Mbps, 100 ms) wired link. The hosts, i.e. Node0, Node1, Node2, Node3 are attached with (100 Mbps, 20ms) links to routers or base stations (as shown in the figure below). The sources (Node0 and Node2)) use three TCP agents (i.e. TCP Westwood, TCP Veno and TCP Vegas) to generate three different TCP flows. Study and plot the fairness index (Jain's fairness index) and throughput change when the TCP packet size is varied; all the other parameter values are kept constant. You should use the following TCP packet size values (in Bytes): 40, 44, 48, 52, 60, 250, 300, 552, 576, 628, 1420 and 1500 for your experiments. The throughput (in Kbps) and fairness index must be calculated at steady-state. Make appropriate assumptions wherever necessary.



Glossary :

- **Fairness Measure:** It is to determine whether users or applications are receiving a fair share of system resources.
Congestion Control mechanisms for network transmission protocols or peer-to-peer applications must interact well with TCP. TCP fairness requires that a new protocol receive no larger share of the network than a comparable TCP flow. This is important as TCP is the dominant transport protocol on the Internet, and if new protocols acquire unfair capacity they tend to cause problems such as congestion collapse.
- **Jain's Fairness index:**
(n=2)

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

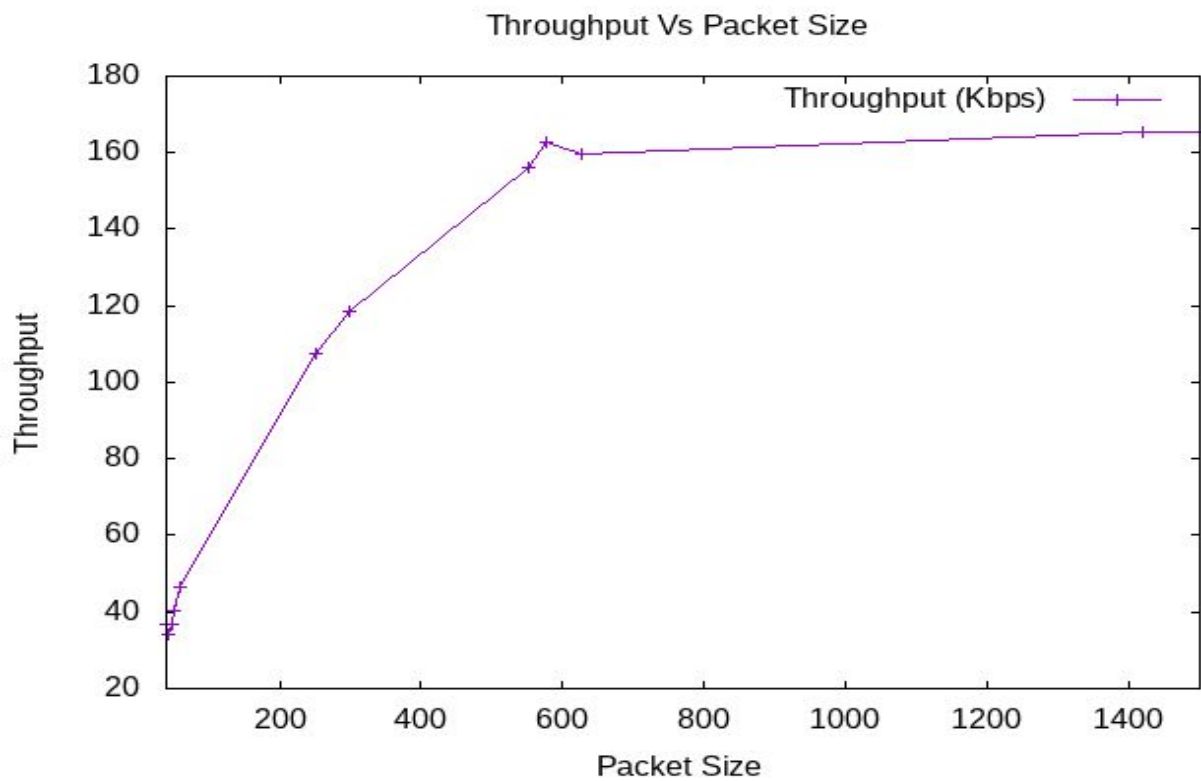
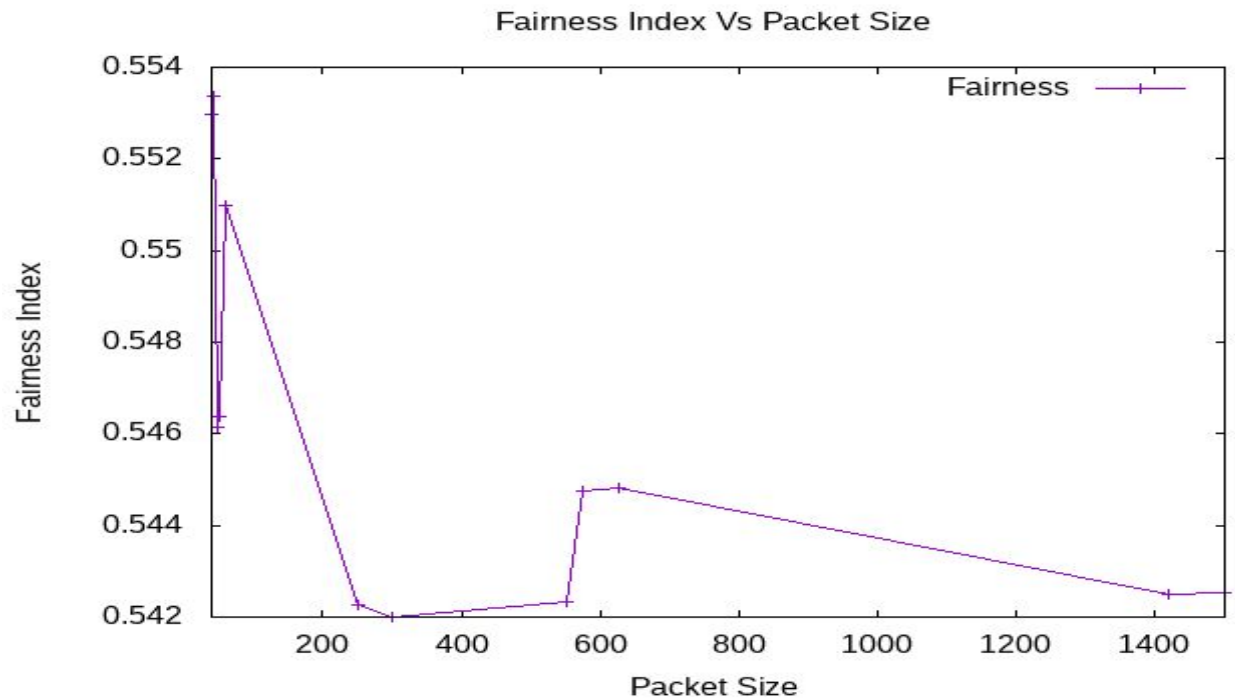
- **Throughput:** Amount of data transferred from a source at any given time.
 $\text{Throughput} \leq \text{Bandwidth}$

The simulation of the given topology has been done on three different TCP agents over wired and wireless networks :

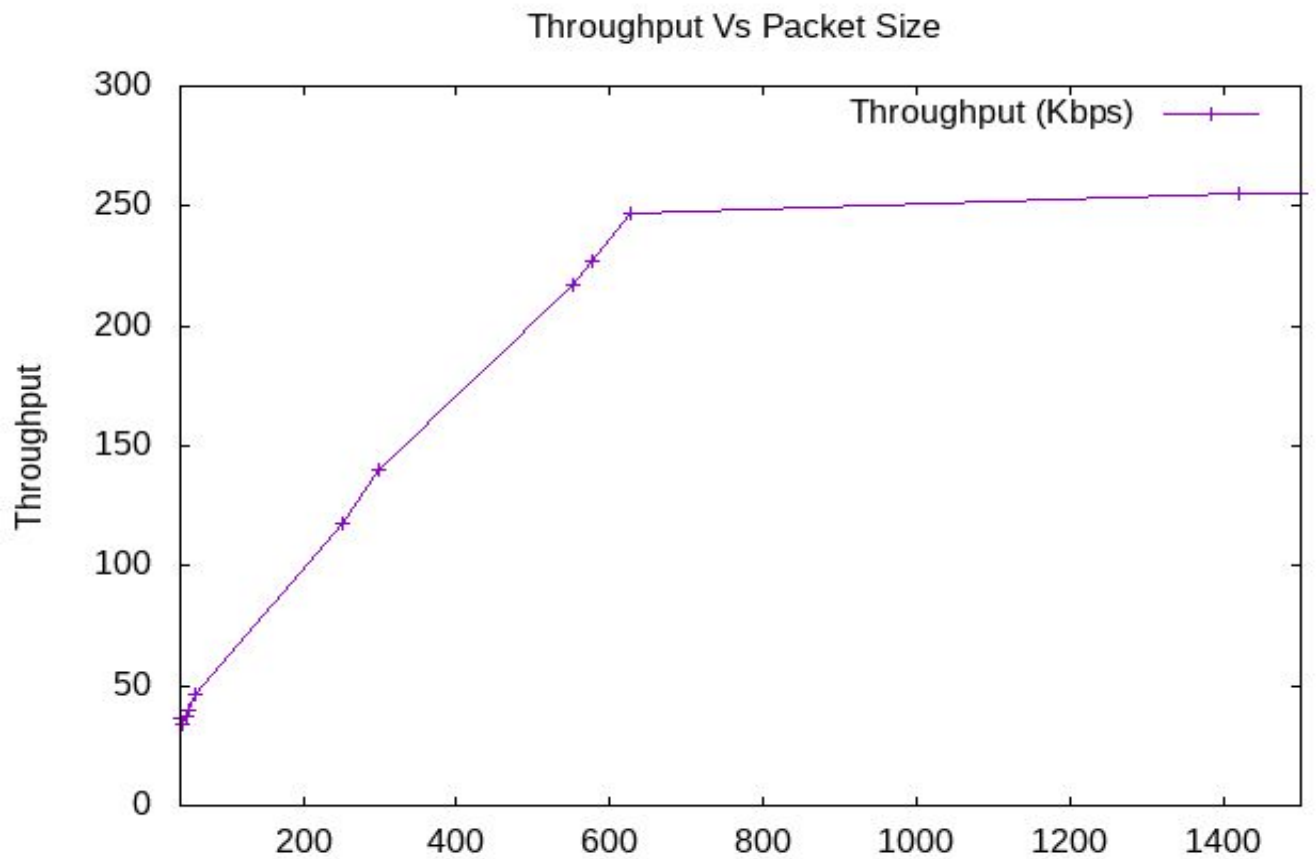
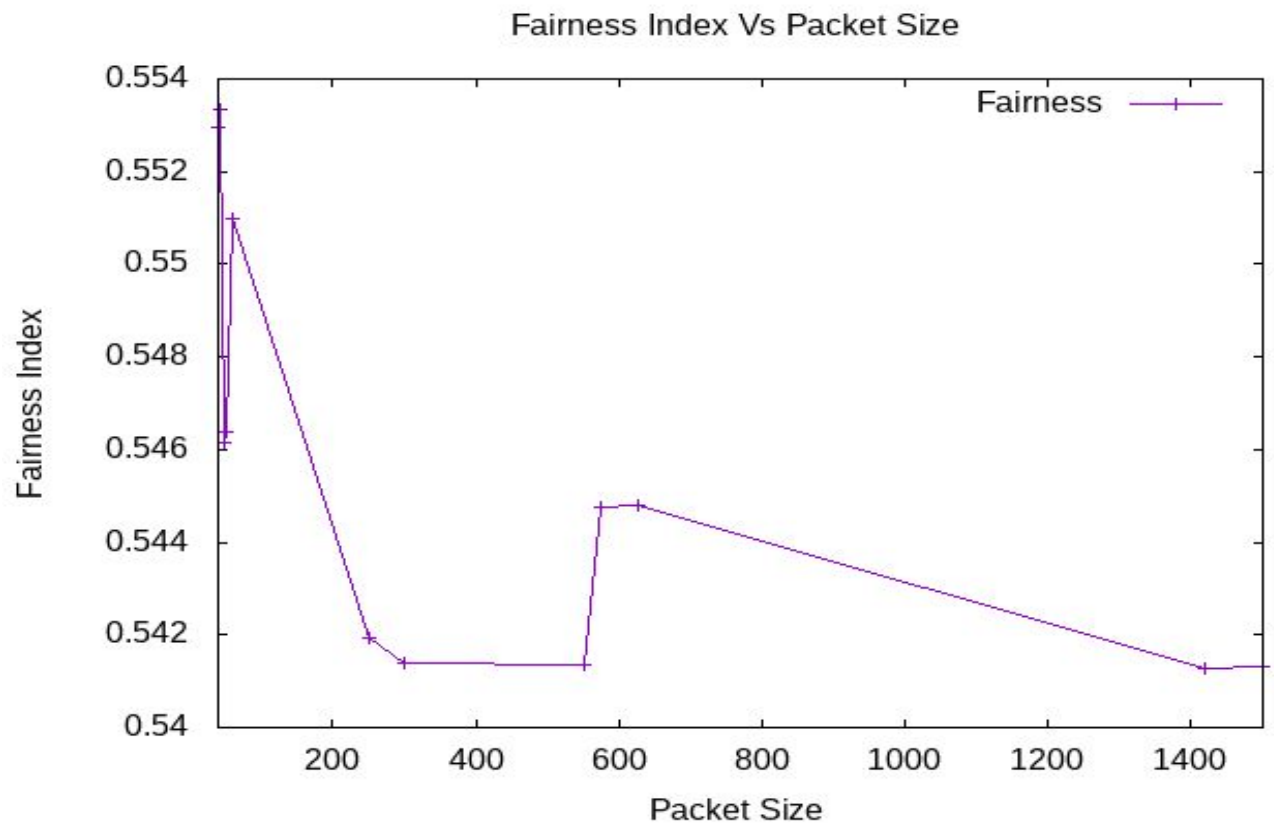
1. TCP Vegas : it is a congestion avoidance algorithm that emphasizes packet delay, rather than packet loss, as a signal to help determine the rate at which to send packets.
 2. TCP Westwood : It handle large bandwidth-delay product paths (large pipes), with potential packet loss due to transmission or other errors (leaky pipes), and with dynamic load (dynamic pipes).
 3. TCP Veno : A simple and effective for dealing with random packet loss. It monitors the network congestion level and uses that information to decide whether packet losses are likely to be due to congestion or random bit errors
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1. Study of Wired Networks:

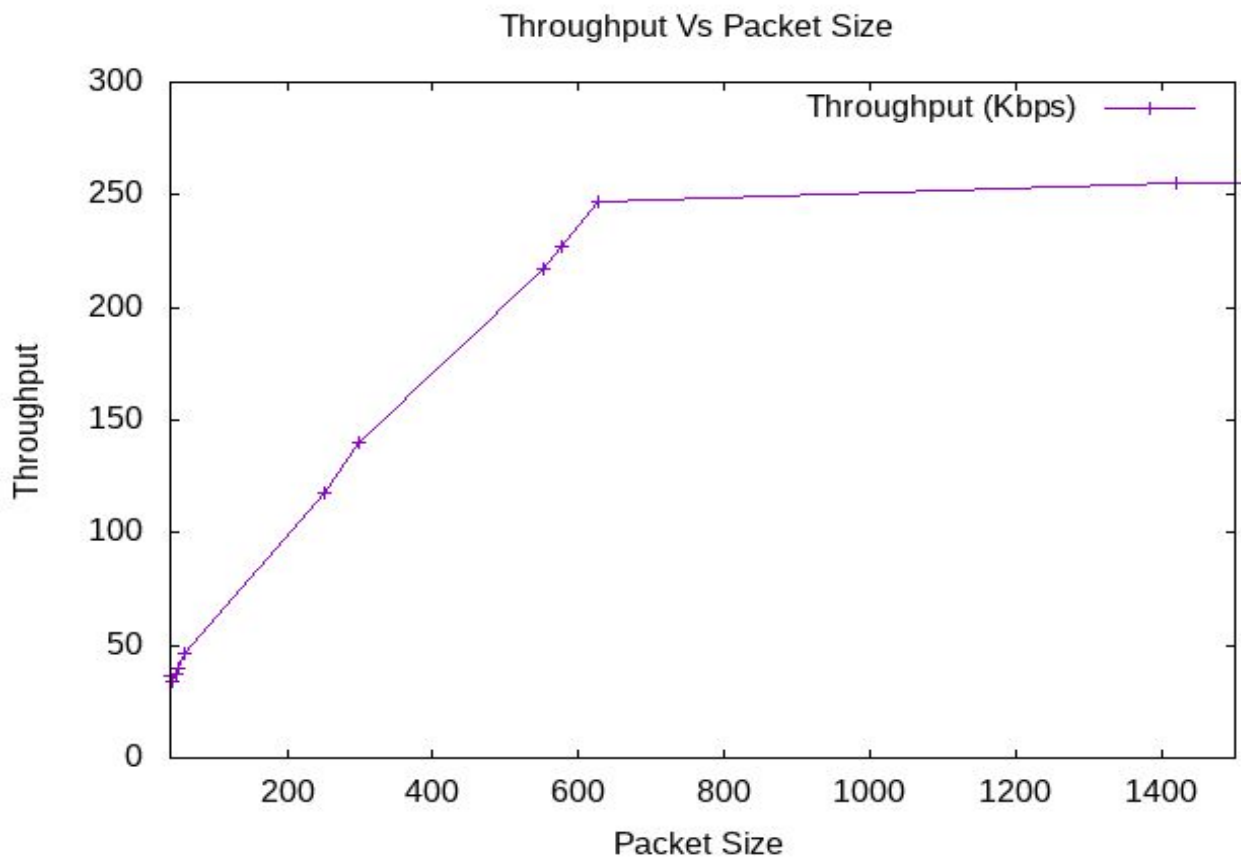
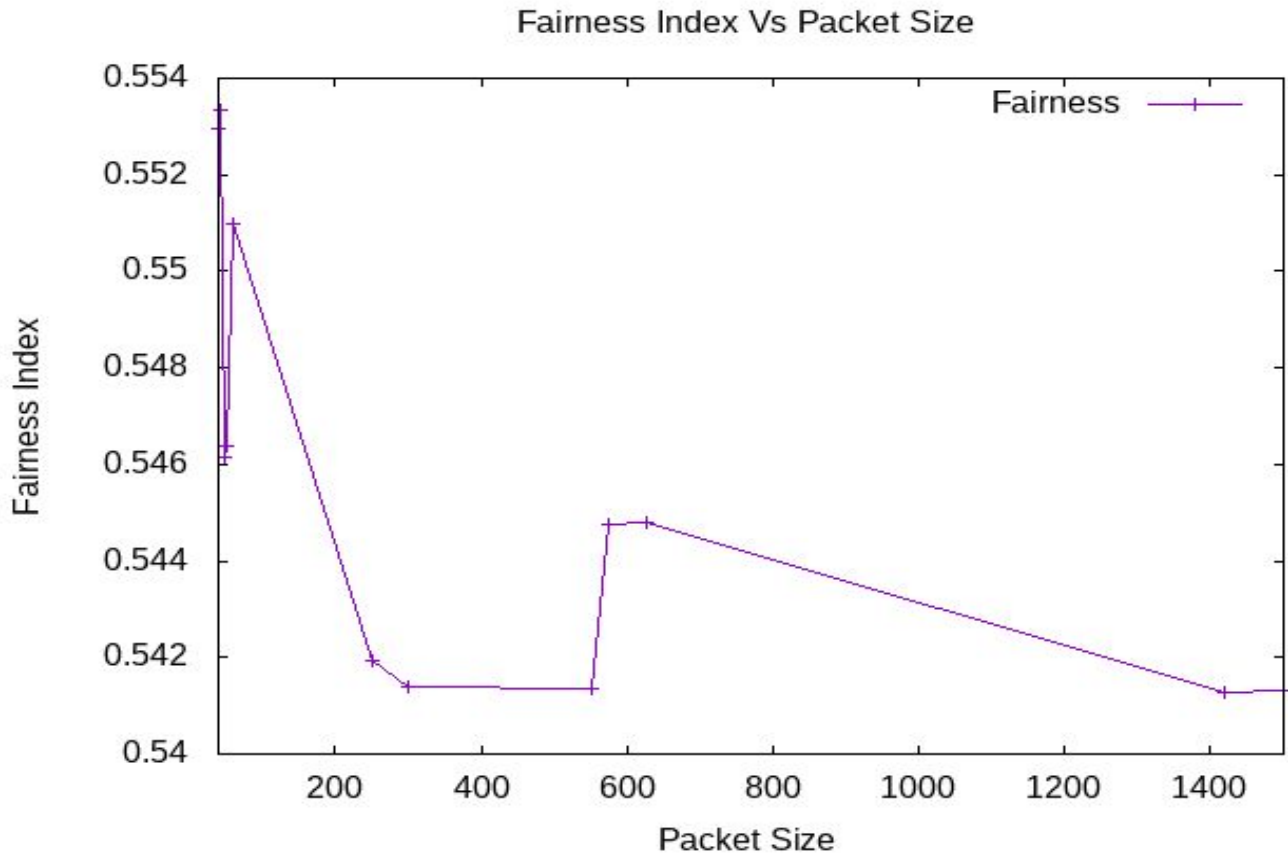
A. TCP Vegas:



B. TCP Westwood:

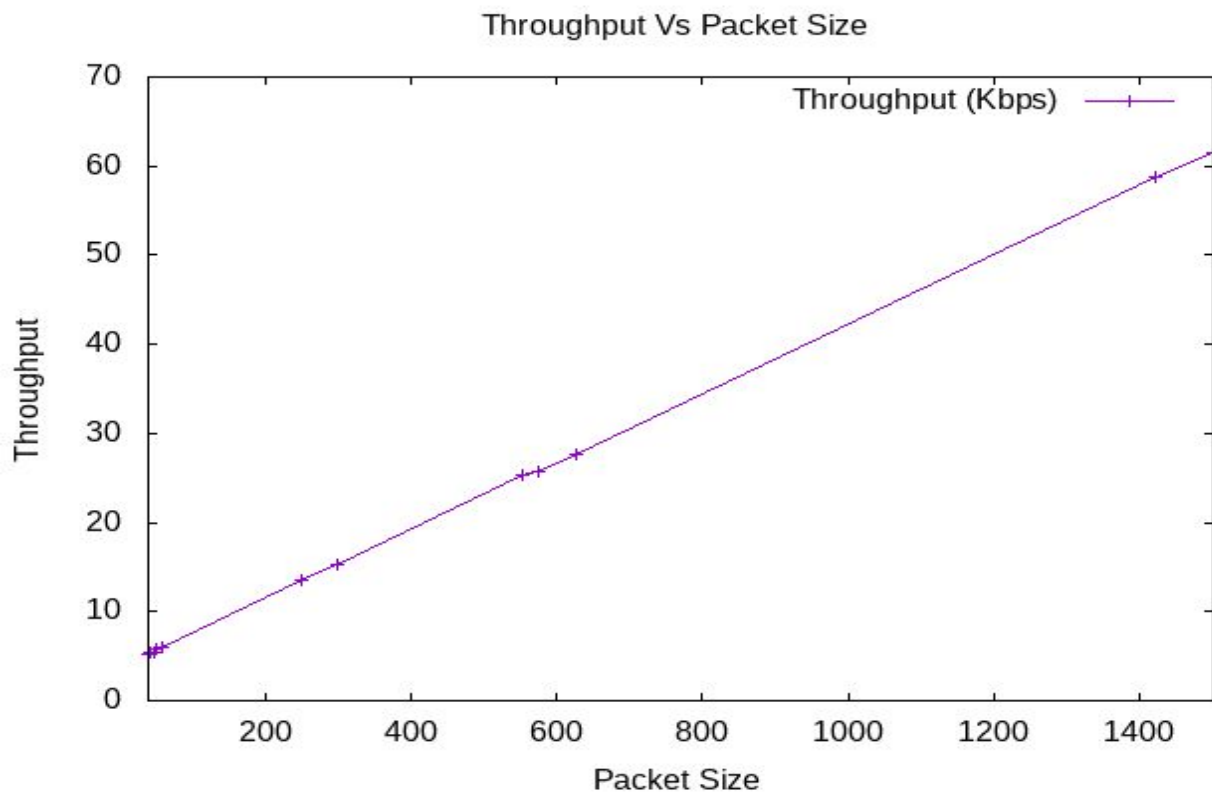
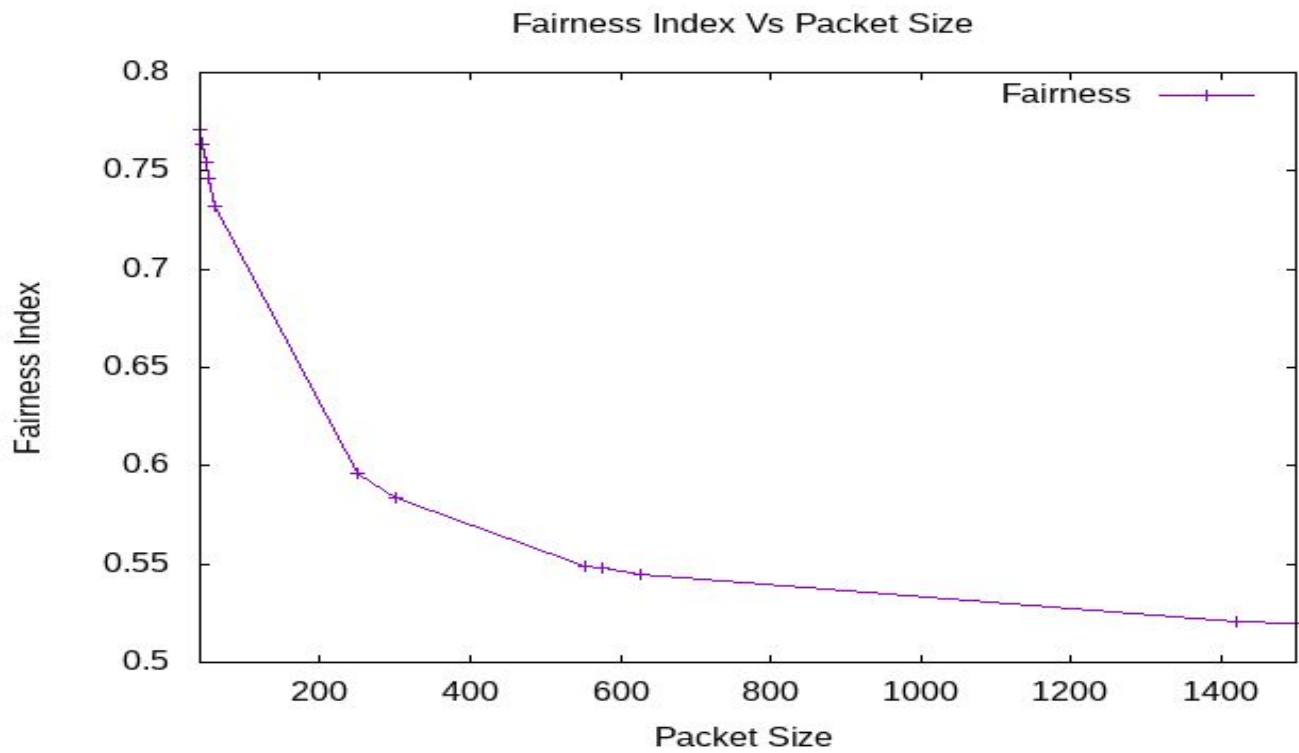


C. TCP Veno:

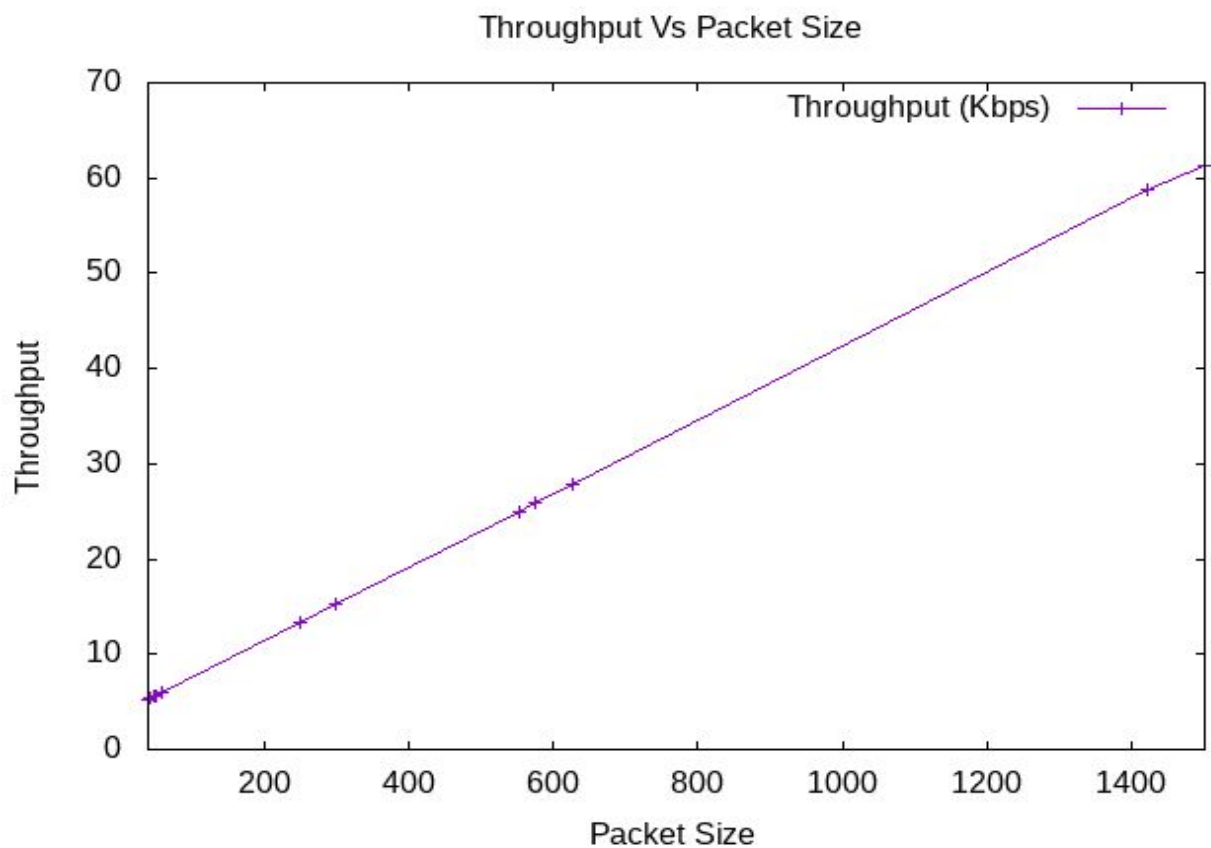
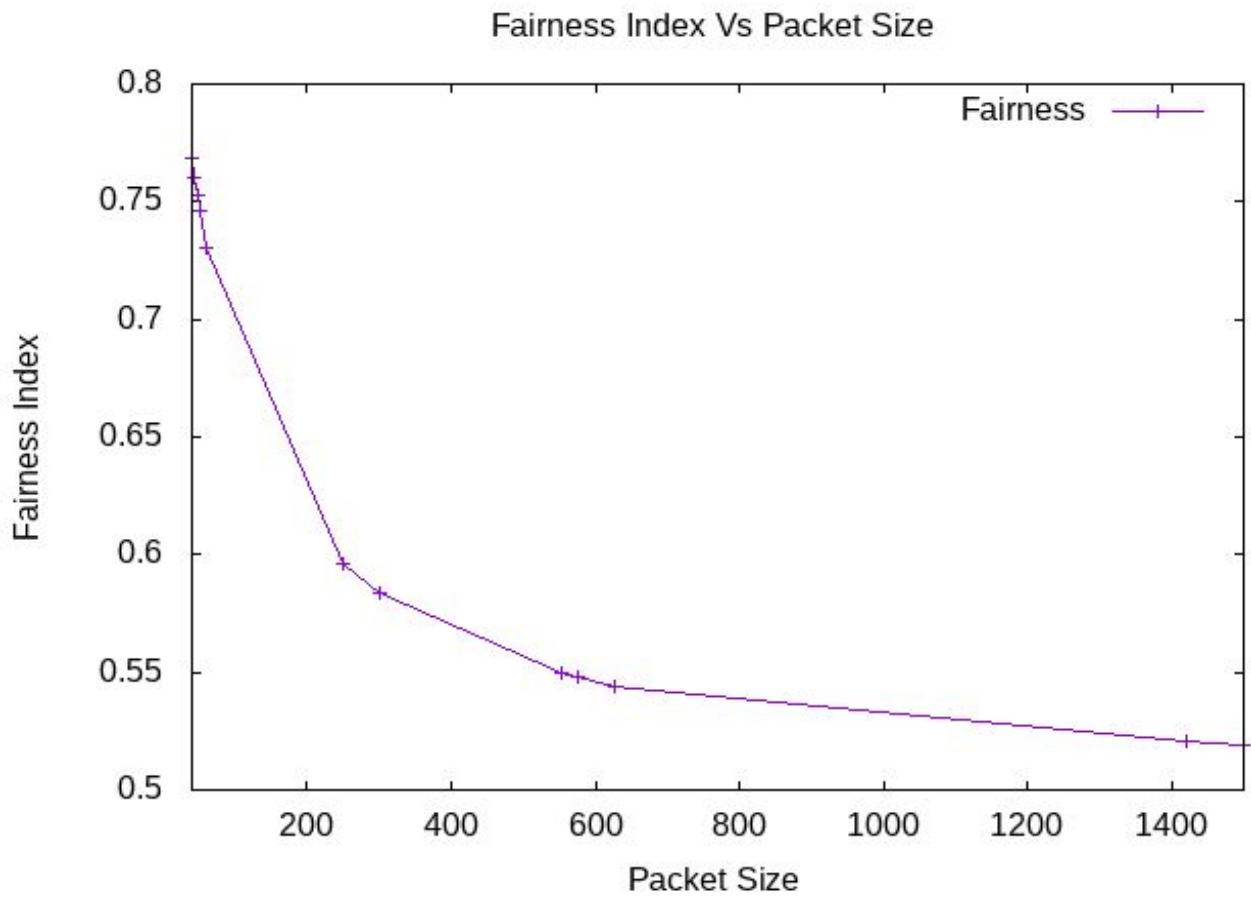


2. Study of Wireless Network:

A. TCP Vegas:



B. TCP Westwood:



C. TCP Veno:

