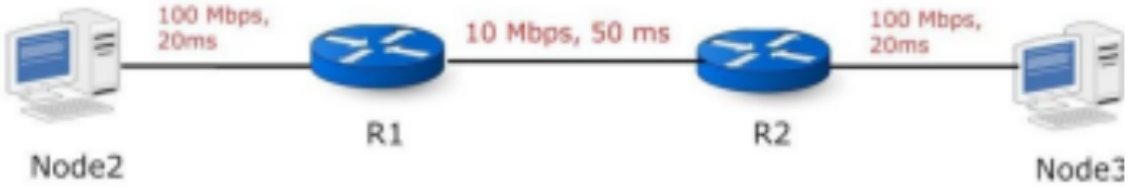
CS 558: Computer Systems Lab

Assignment 3: Network Simulation using NS-3

Wired TCP Network:

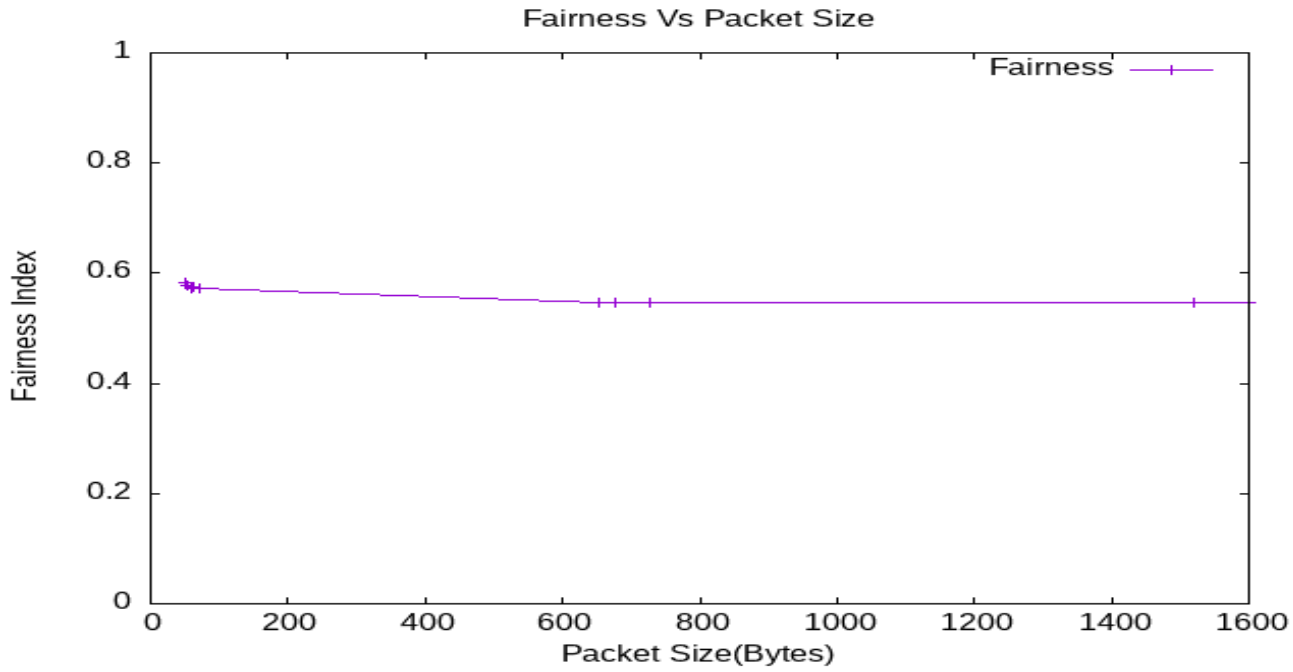


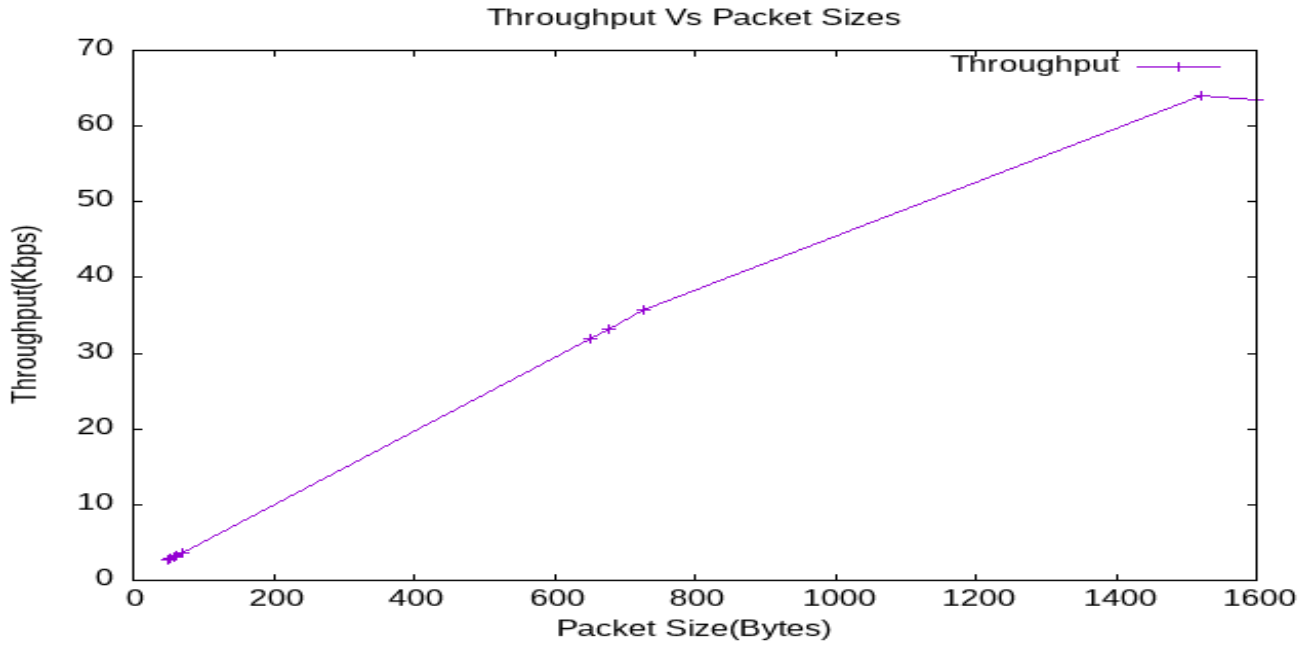
Packet Size	Fairness Index	Average Throughput (Kbps)
50	0.582	2.642
54	0.577	2.834
58	0.572	3.004
62	0.575	3.222
70	0.573	3.626
652	0.548	31.987
676	0.547	33.163
728	0.547	35.687
1520	0.546	63.929
1600	0.546	63.386

Observations:

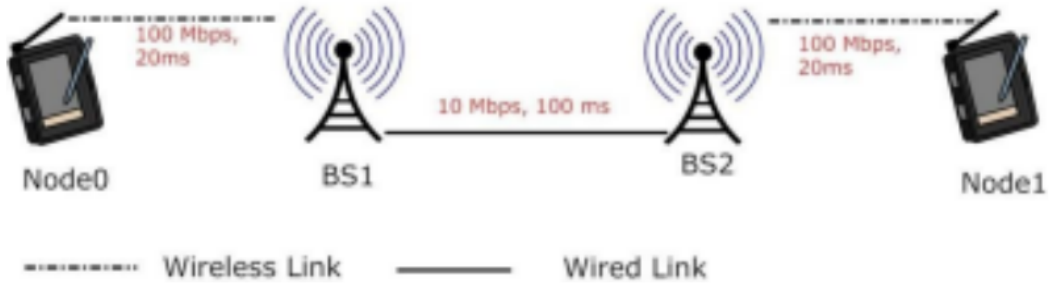
- Fairness index remains relatively constant for smaller packet sizes (up to around 600 bytes).
- Fairness index decreases slightly for larger packet sizes (above 600 bytes).
- Average throughput increases with packet size, reaching a peak around 1500 bytes.
- Average throughput decreases slightly for the largest packet size (1600 bytes).

These observations can be explained by the fact that smaller packet sizes experience less variation in queuing delays, leading to higher fairness. However, larger packet sizes can experience more variation in queuing delays due to head-of-line blocking, potentially reducing fairness. Additionally, larger packets can potentially utilize more of the available bandwidth due to reduced per-packet overhead. However, very large packets can also lead to increased queuing delays and potential bottlenecks, reducing throughput.





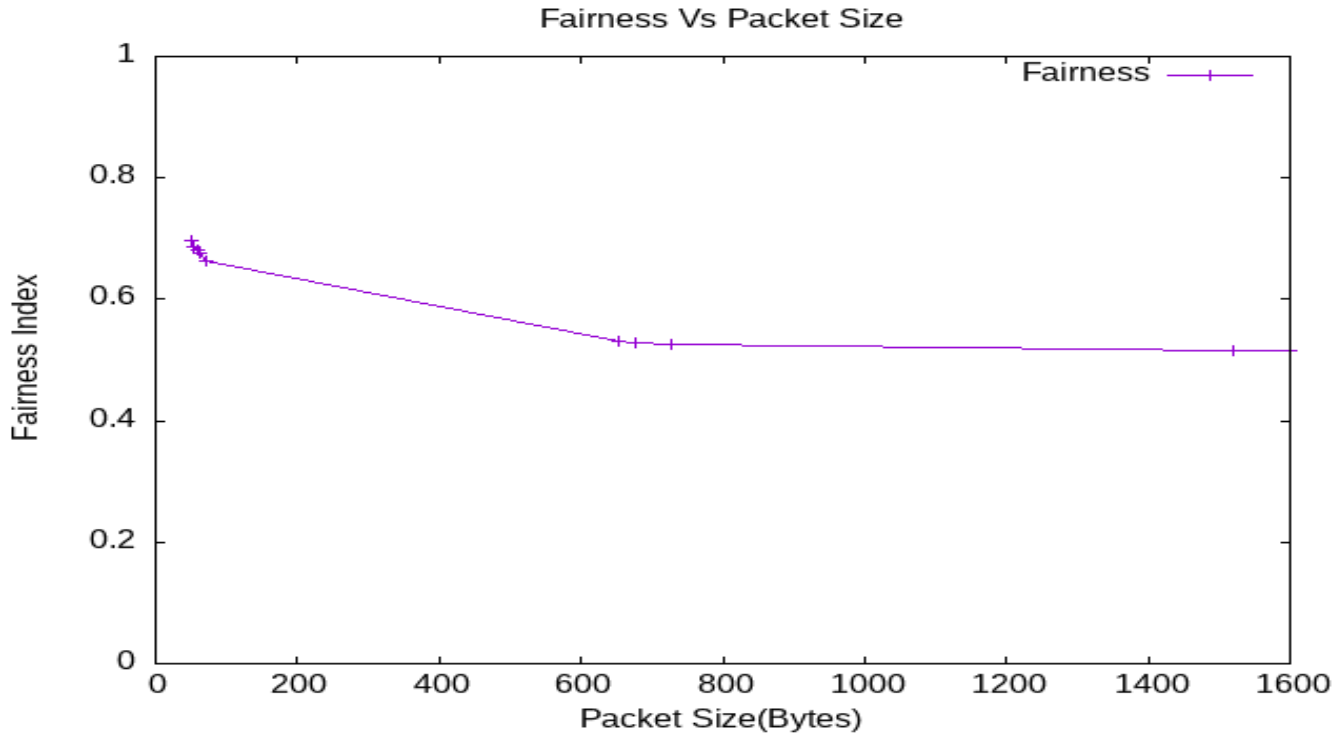
Wireless TCP Network:

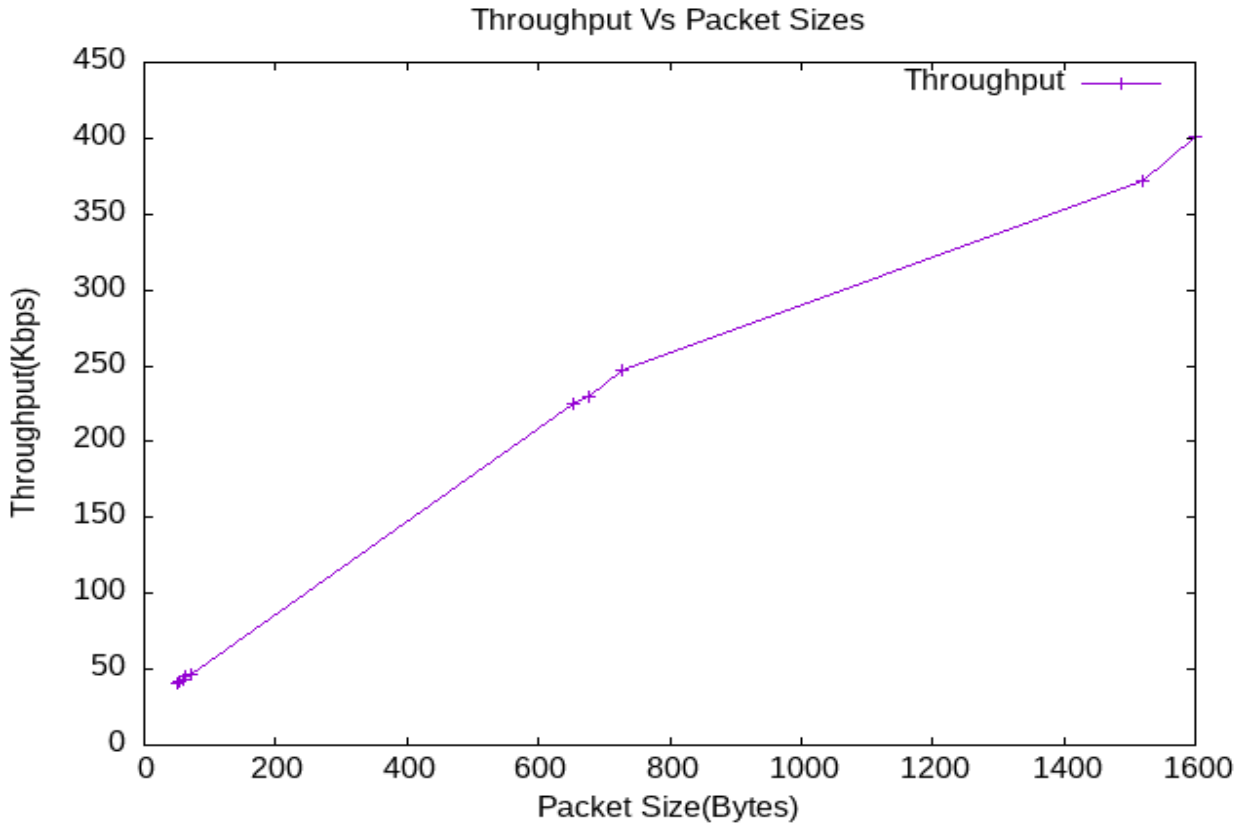


Packet Size	Fairness Index	Average Throughput (Kbps)
50	0.696	40.582
54	0.687	42.062
58	0.682	43.255
62	0.677	44.894
70	0.664	46.945
652	0.529	225.416
676	0.528	230.229
728	0.526	247.021
1520	0.516	372.366
1600	0.515	400.58

Observations:

- Fairness index remains relatively high for smaller packet sizes .
- Fairness index decreases significantly for larger packet sizes (above 600 bytes).
- The significant increase in throughput for larger packet sizes (above 600 bytes) is likely due to the larger packets being able to better exploit the available bandwidth due to reduced per-packet overhead.


Fairness Vs Packet Size
Fairness
Fairness Index
Packet Size(Bytes)
0
0.2
0.4
0.6
0.8
1
0
200
400
600
800
1000
1200
1400
1600


Throughput Vs Packet Sizes
Throughput
Throughput(Kbps)
Packet Size(Bytes)
0
50
100
150
200
250
300
350
400
450
0
200
400
600
800
1000
1200
1400
1600

Overall Observations:

- Both wired and wireless networks show an almost increasing trend in throughput as the packet size increases. This is a common behavior, as larger packets can be transmitted more efficiently, resulting in higher throughput.

- By using the three different TCP agents i.e TCP Westwood, TCP Vegas and TCP Veno in both wired TCP and wireless TCP networks we got the same results for fairness and throughput in corresponding networks.

- The throughput of wireless TCP network is more compared to the wired TCP network because:
    - The 802.11n Wi-Fi standard introduced several advancements over its predecessors, including Multiple Input Multiple Output (MIMO) technology, which enables the use of multiple antennas for improved data rates and reliability. This can contribute to higher throughput under certain conditions.

- Wireless networks, by nature, provide more flexibility and mobility compared to wired networks. Users can move within the coverage area without being physically connected to a cable. This flexibility can make it seem like wireless networks have higher throughput in certain use cases .

- Fairness suffers more in wireless networks, especially for larger packets, due to increased delay variations caused by the channel.