Bangladesh University of Engineering & Technology

Report on NS3 Project

Submitted By:
Tanzim Hossain Romel
Student ID-1705069
Level-3 Term-2

Supervisor:
Syed Md. Mukit Rashid
Lecturer
CSE, BUET

February 23, 2022

Contents

1 Project Specifications

The networks that were assigned to me to be simulated for task A are the following ones:

- Wireless high-rate (802.11) (mobile)
- Wireless low-rate (802.15.4) (mobile)

A paper titled 'Analysis and Improvement of Fairness between TCP Reno and Vegas for Deployment of TCP Vegas to the Internet' [1] was chosen as a guide for making modifications to the built-in TCP Vegas algorithm in NS3.

2 Task A

2.1 Network 1 : Wireless High-rate (802.11) (mobile)

2.1.1 Topology

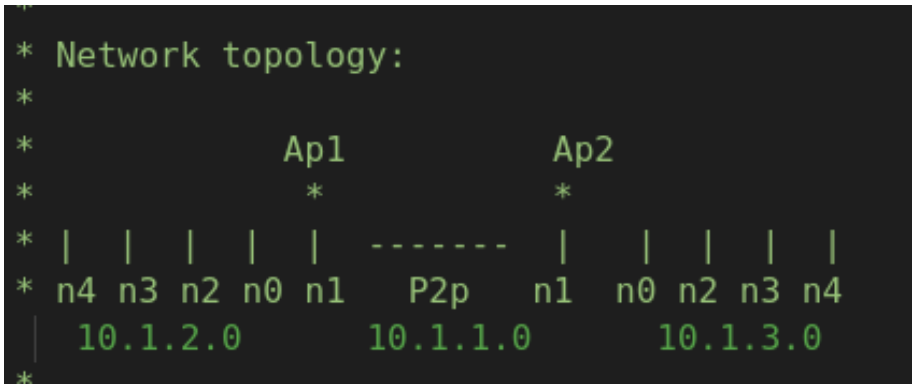

Figure 1: Topology

2.1.2 Varied Parameters

The parameters that were varied are the following:

- The number of nodes
- The number of flows
- The number of packets per second
- Speed of nodes

2.1.3 Results with graphs

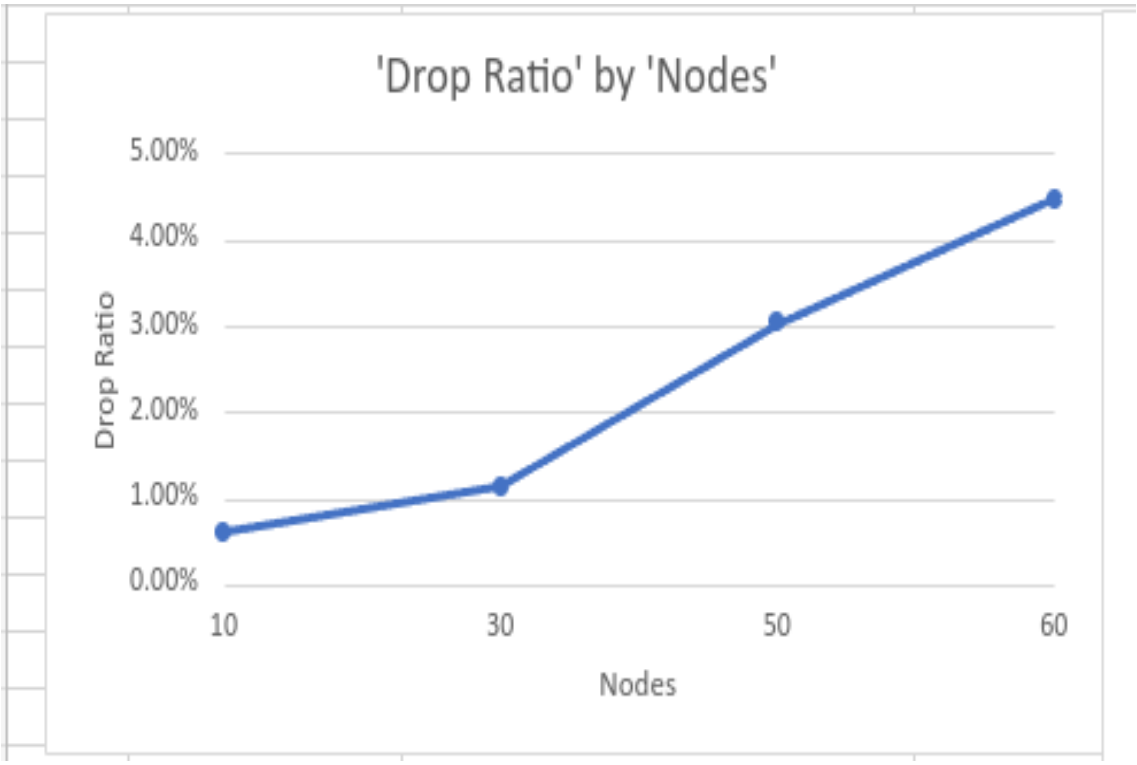

Figure 2: Varying Number of Nodes

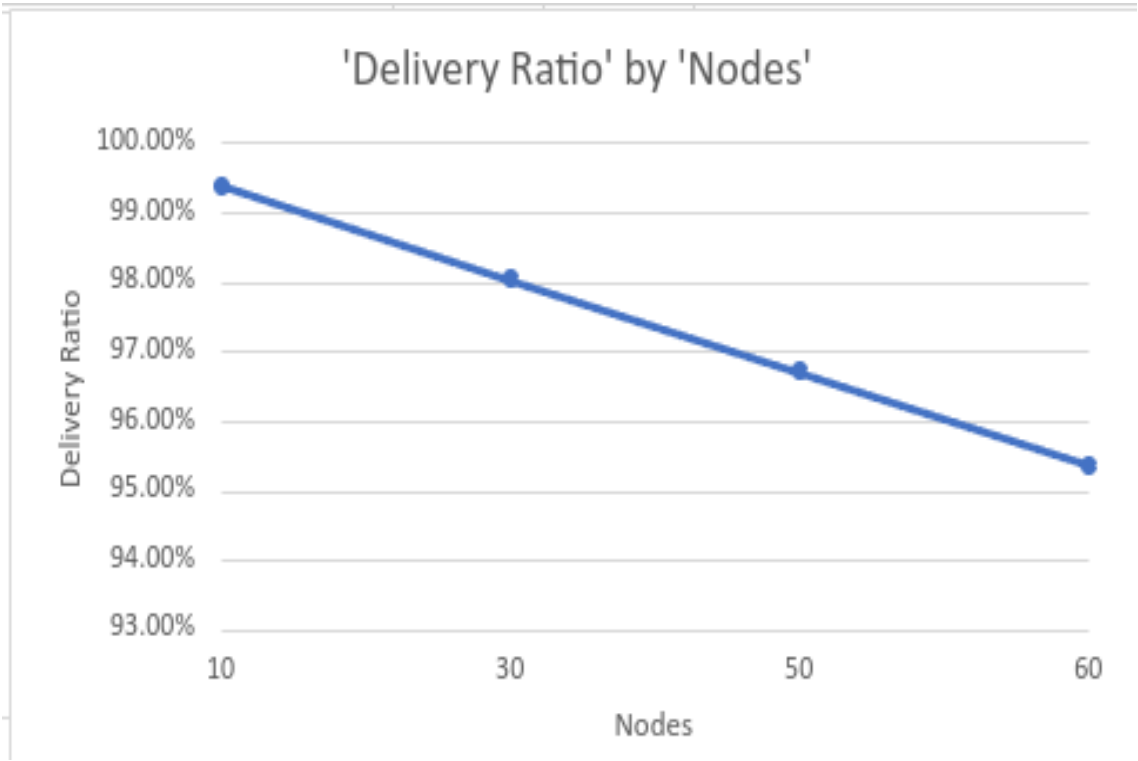

Figure 3: Varying Number of Nodes

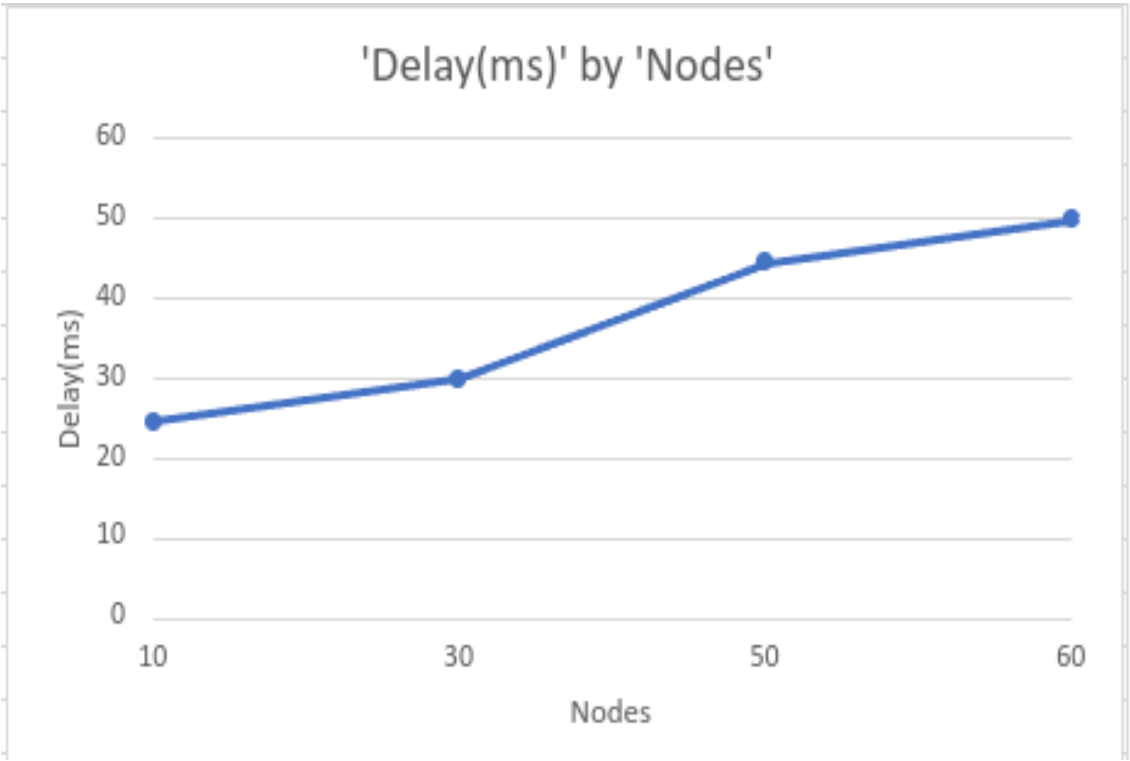

Figure 4: Varying Number of Nodes

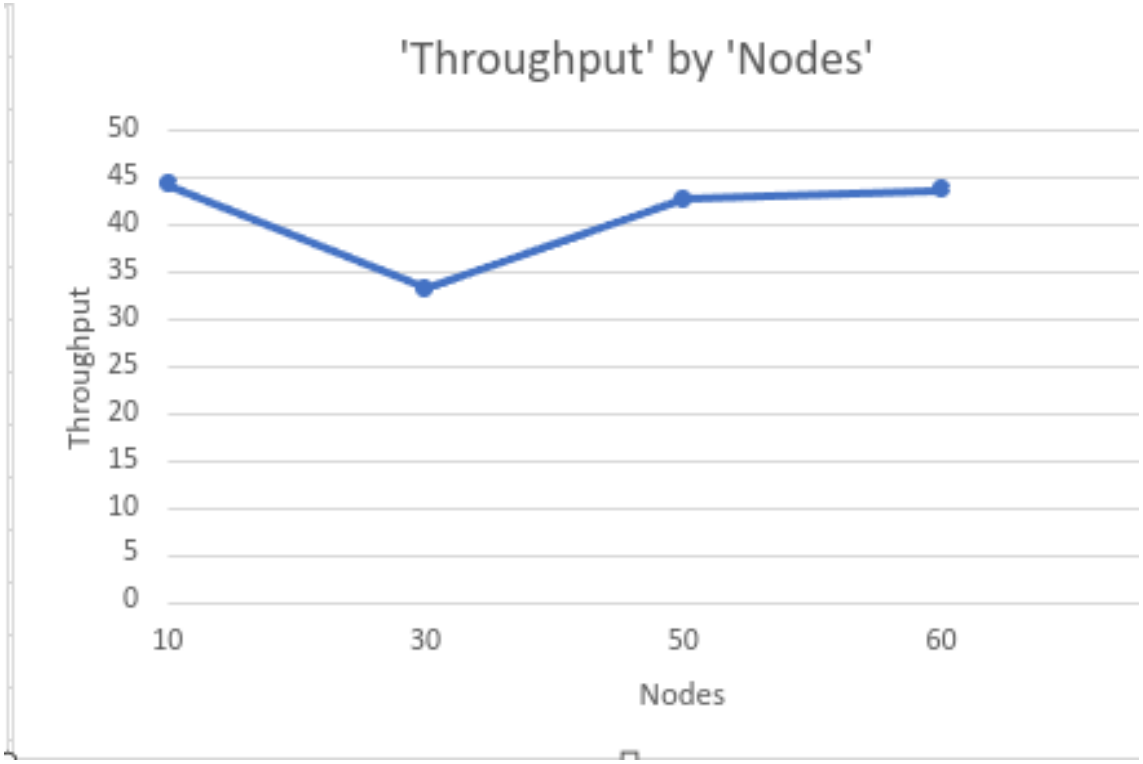

Figure 5: Varying Number of Nodes

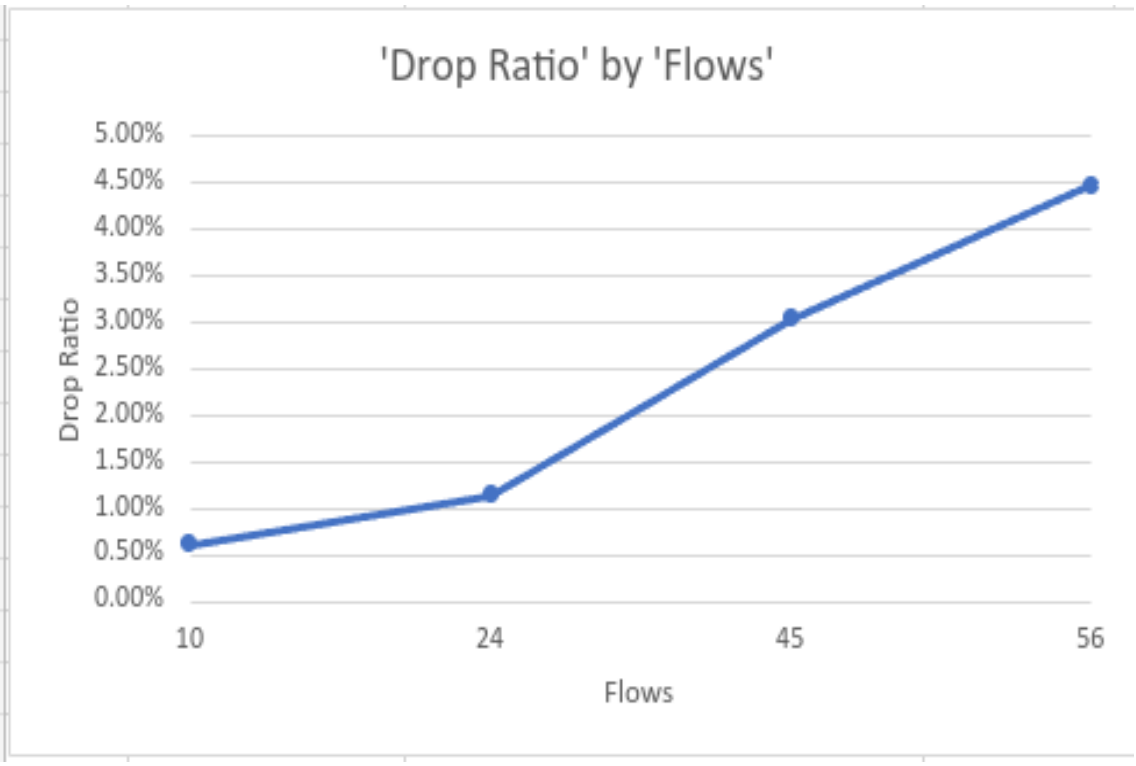

Figure 6: Varying Number of Nodes

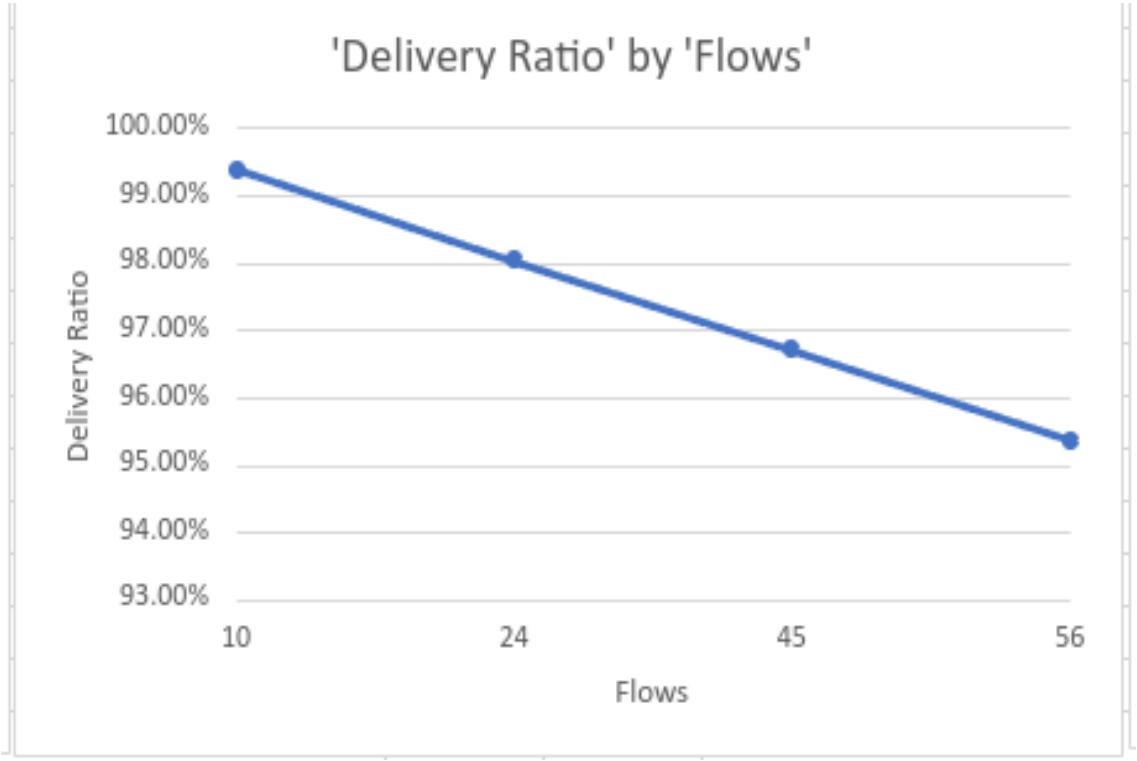

Figure 7: Varying Number of Nodes

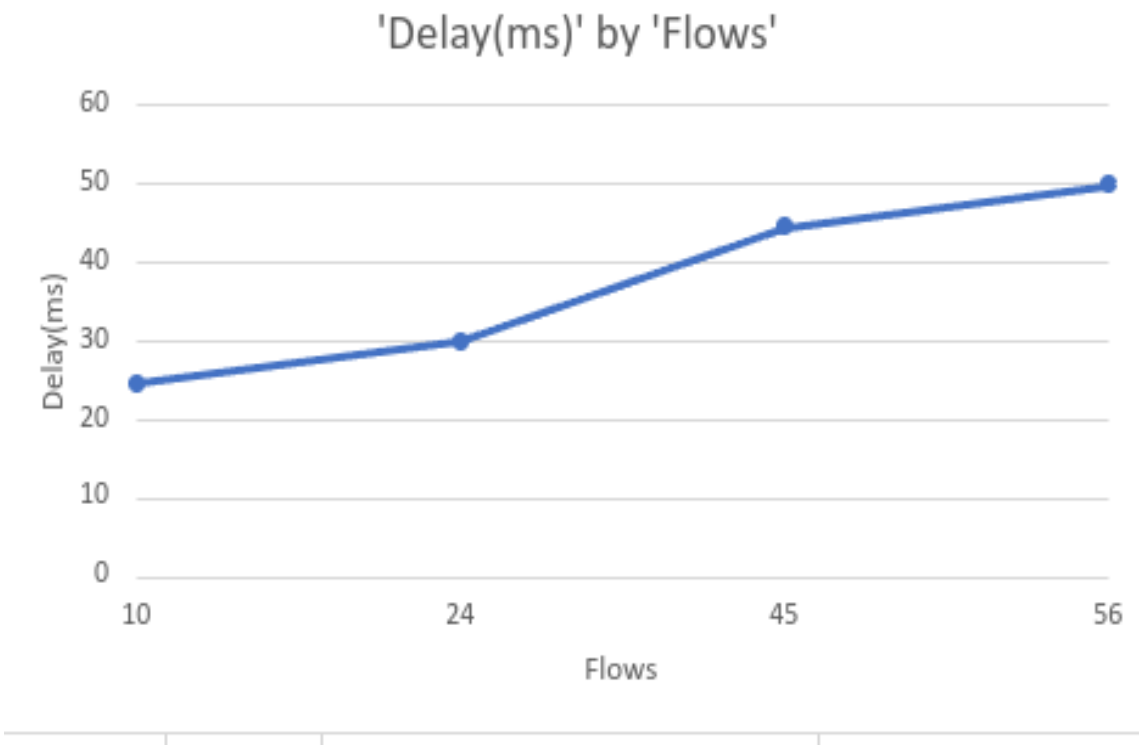

Figure 8: Varying Number of Nodes

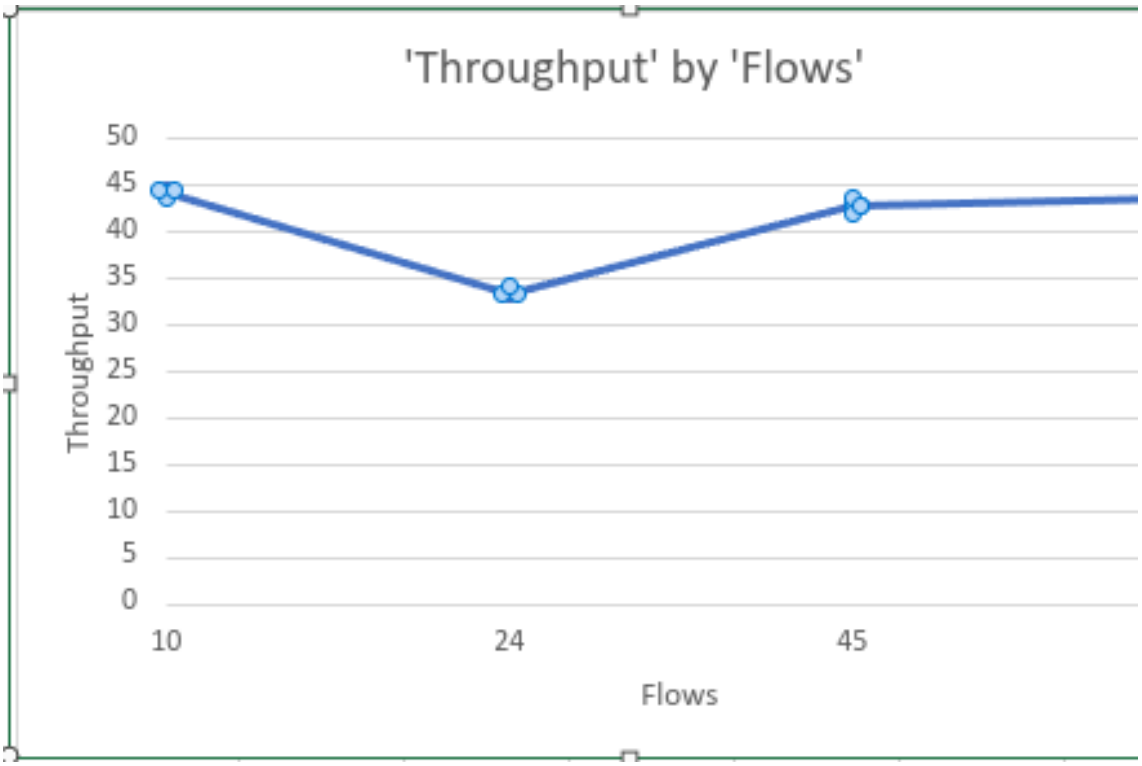

Figure 9: Varying Number of Nodes

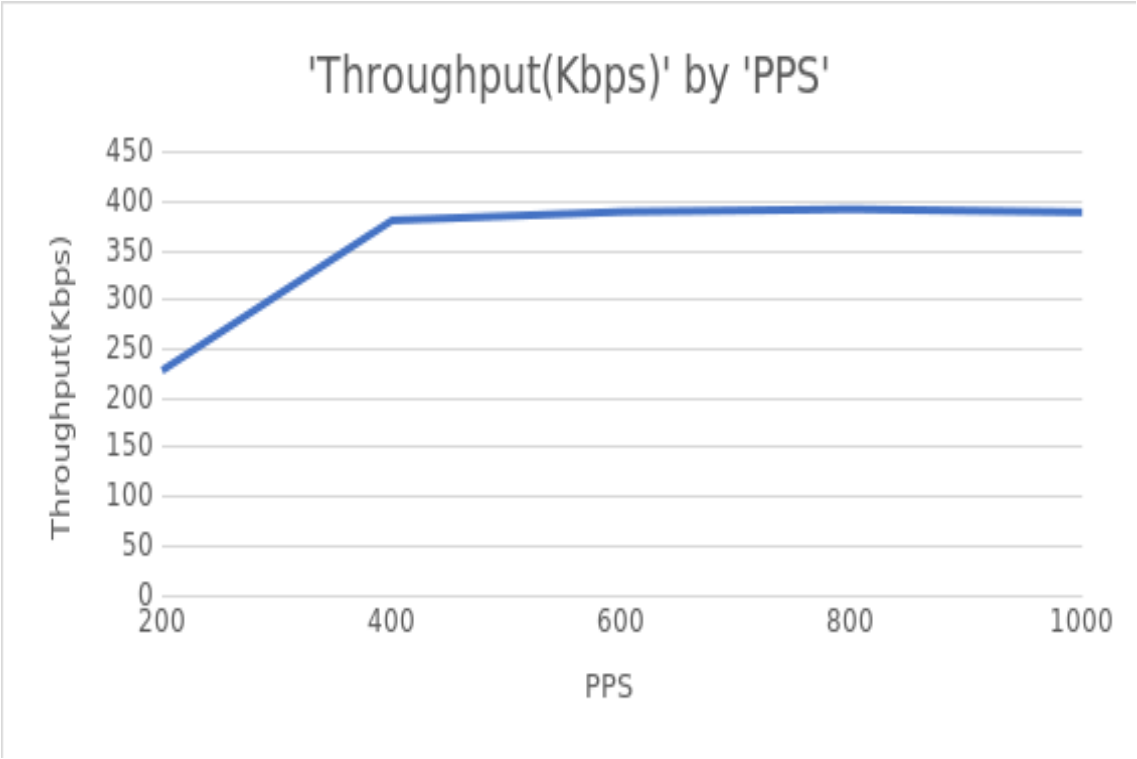

Figure 10: Varying Number of Nodes

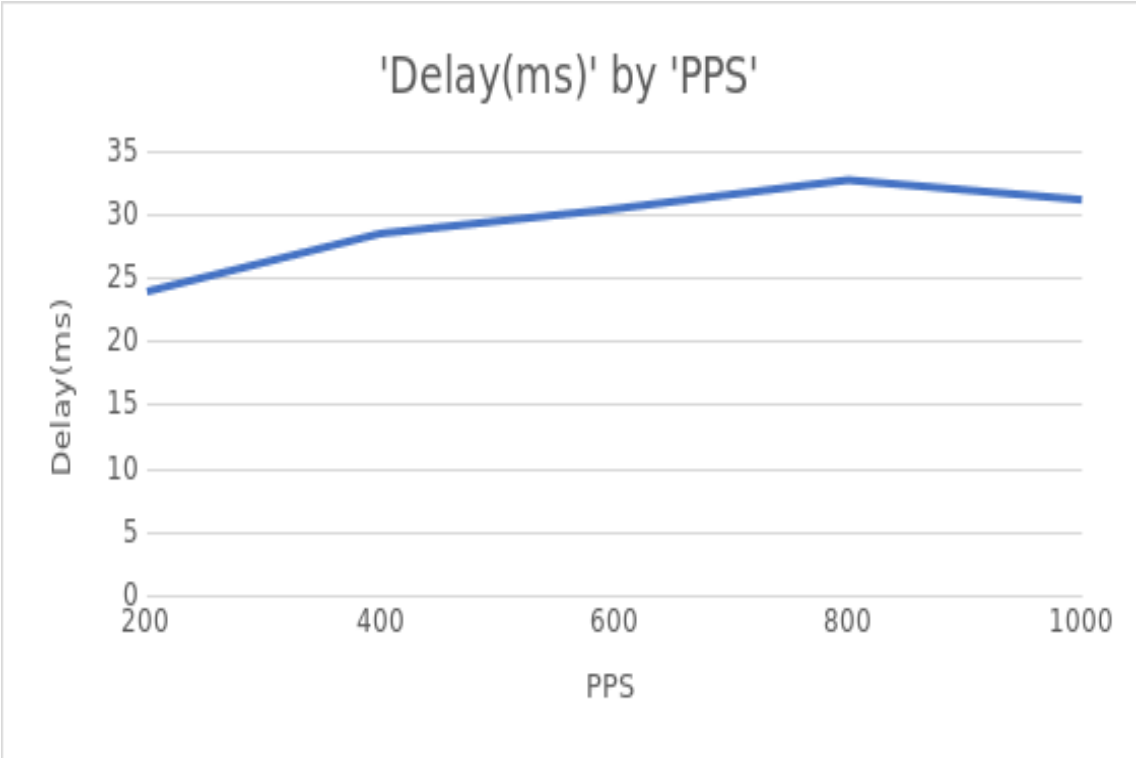

Figure 11: Varying Number of Nodes

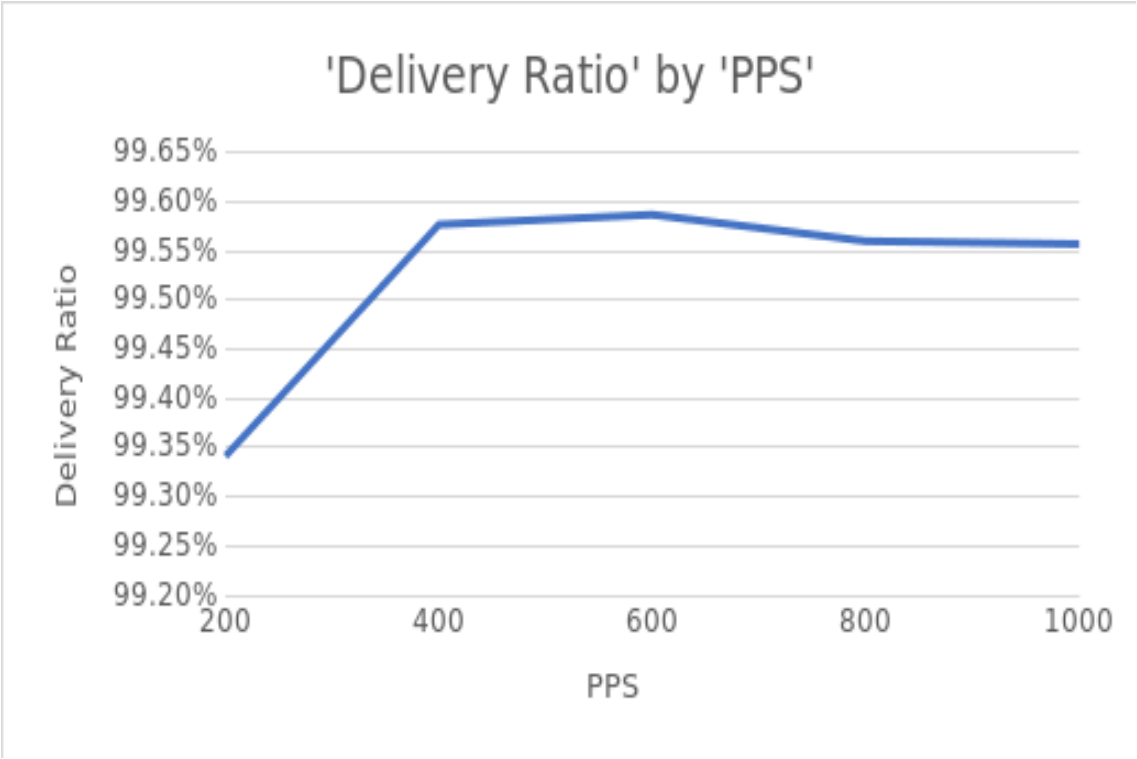

Figure 12: Varying Number of Nodes

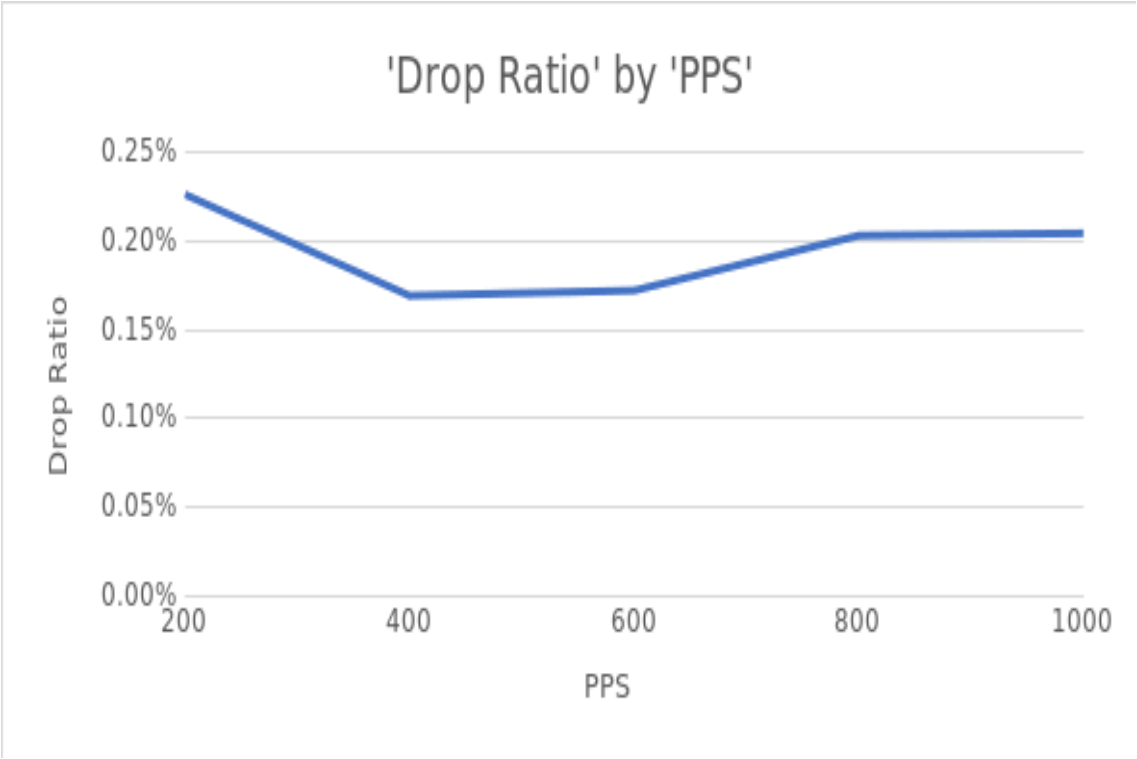

Figure 13: Varying Number of Nodes

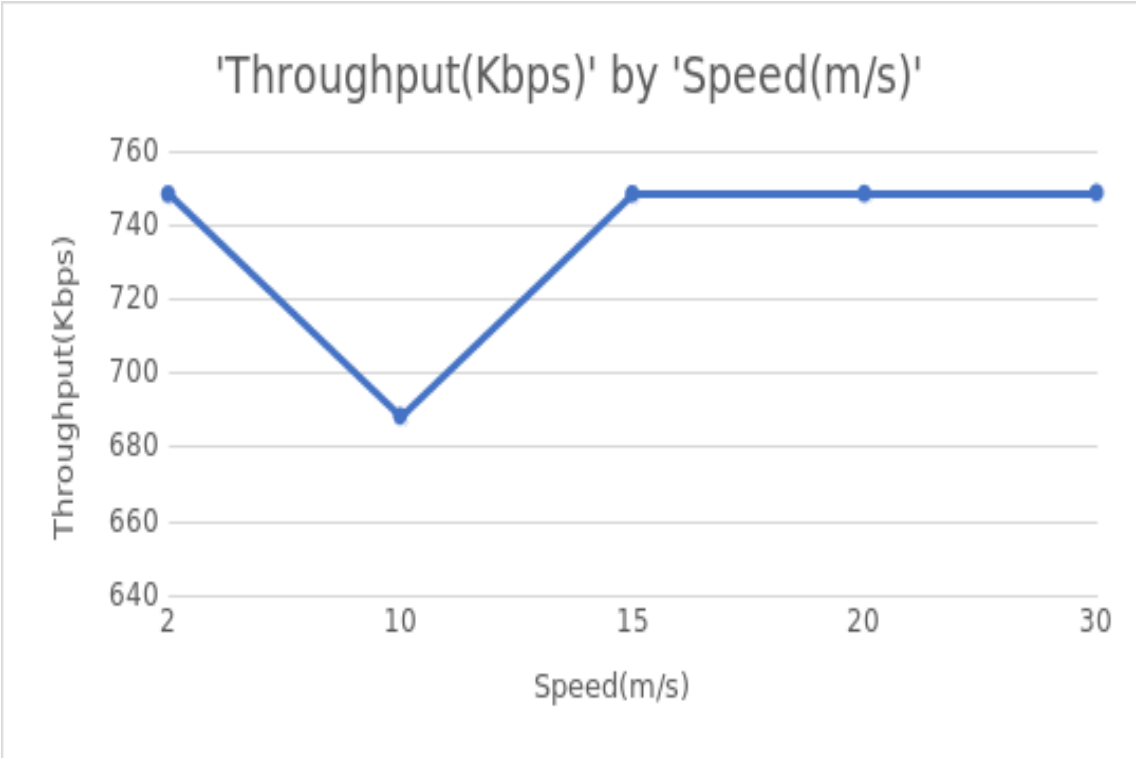

Figure 14: Varying Number of Nodes

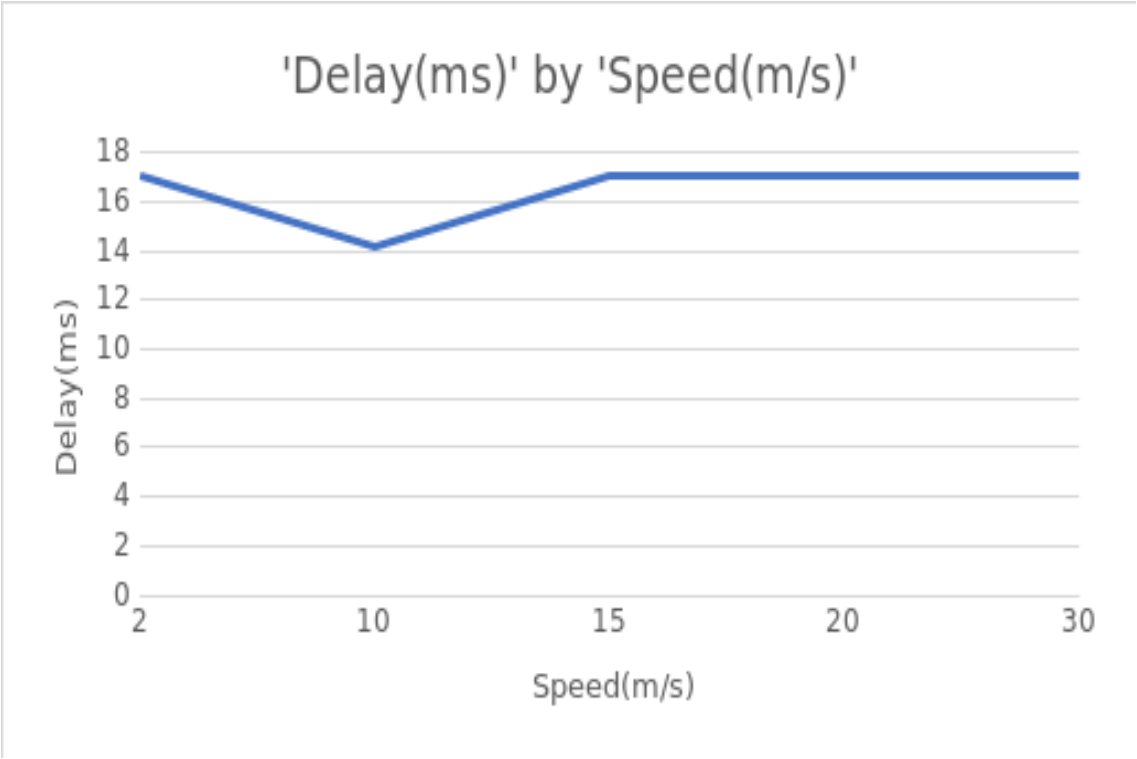

Figure 15: Varying Number of Nodes

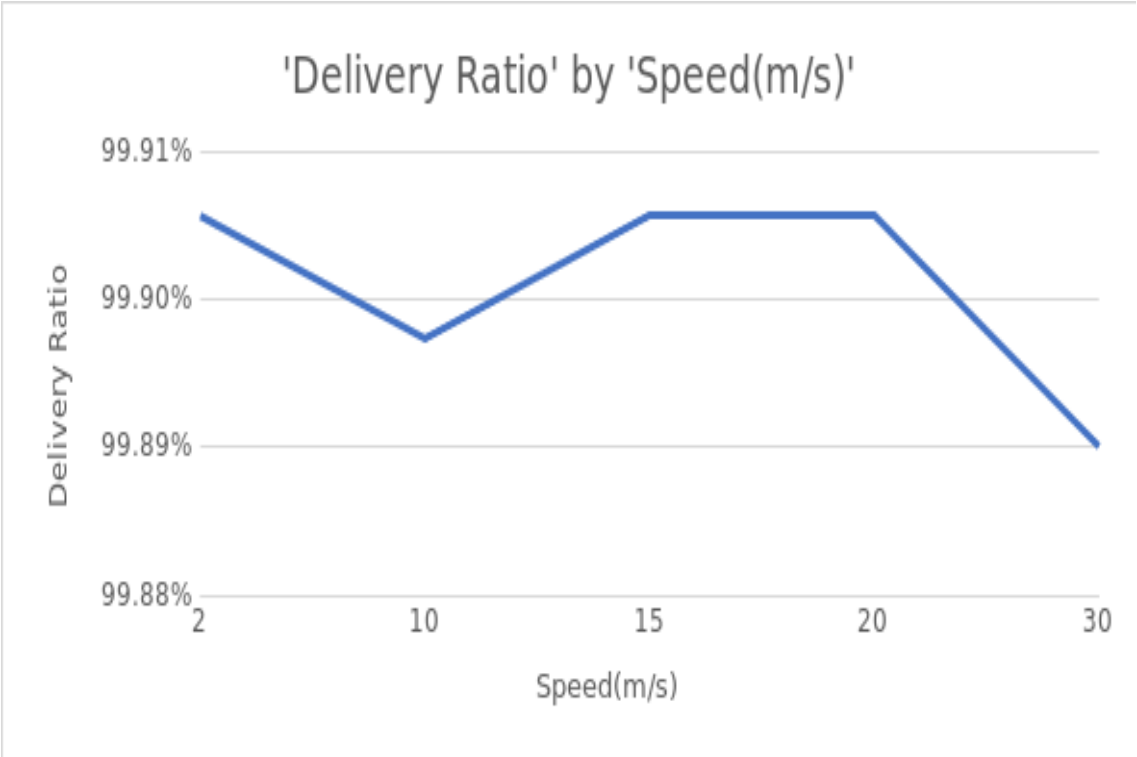

Figure 16: Varying Number of Nodes

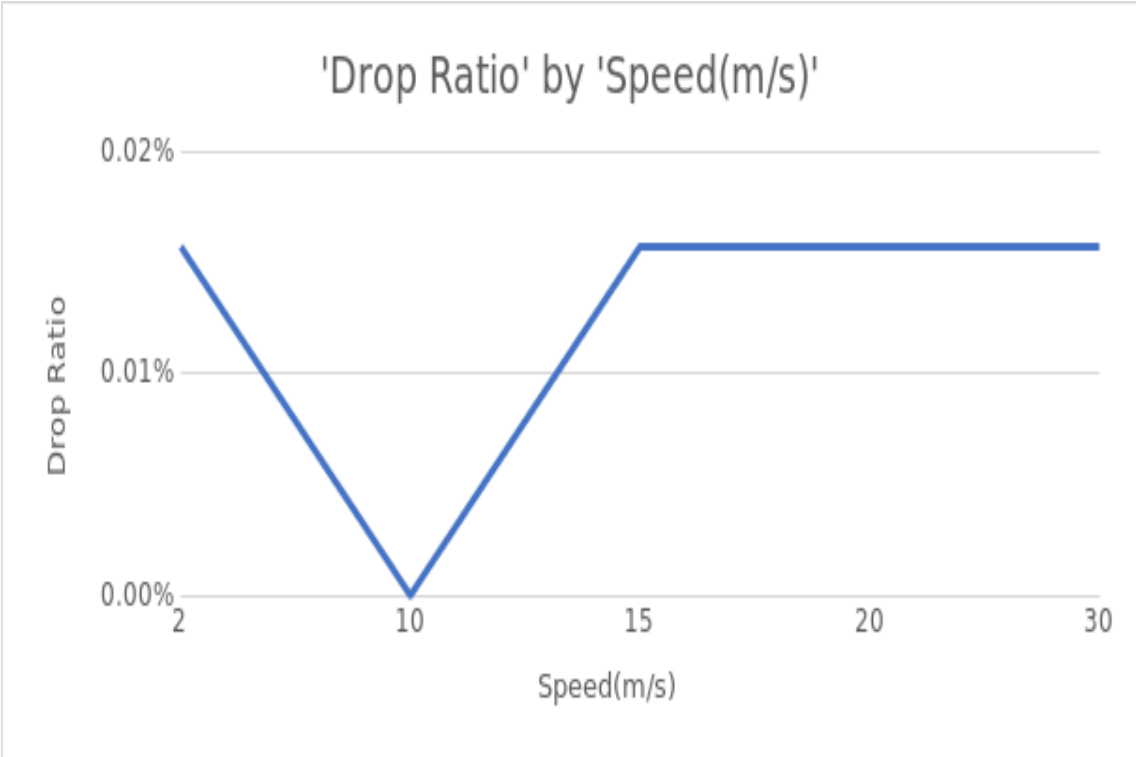

Figure 17: Varying Number of Nodes

2.1.4 Summary

Observation from running the experiments:

1. TCP NewReno performs doesn't perform as well in wireless medium as it does in wired medium, because of higher chances of packet drop
2. Since TCP New Reno doesn't perform as well, the differences between TCP NewReno and TCP Vegas are not as prevalent.
3. Increasing nodes and flows results in larger probability of packet drop hence the higher drop ratio and lower delivery ratio.
4. Increasing packets per second results in higher delivery ratio.

2.2 Network 2 : Wireless Low-rate (802.15.4) (mobile)

2.2.1 Topology

2.2.2 Varied Parameters

The parameters that were varied are the following:

- The number of nodes
- The number of flows
- The number of packets per second
- Speed of nodes

2.2.3 Results with graphs

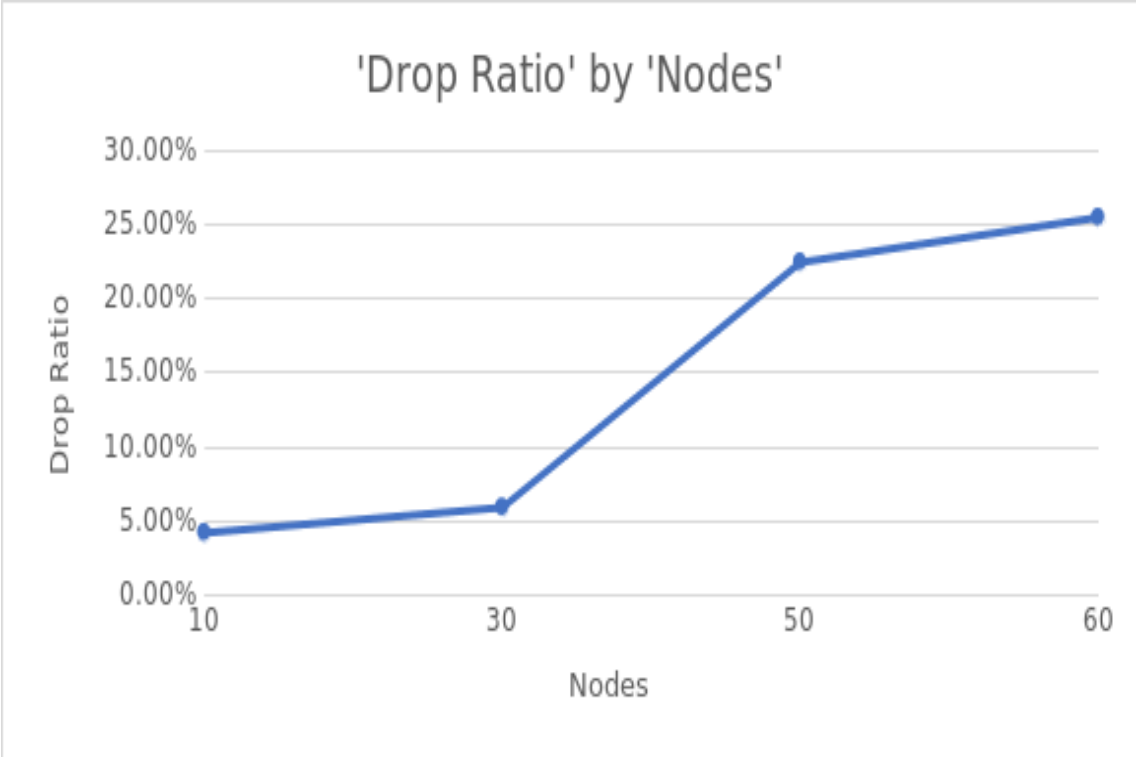

Figure 18: Varying Number of Nodes

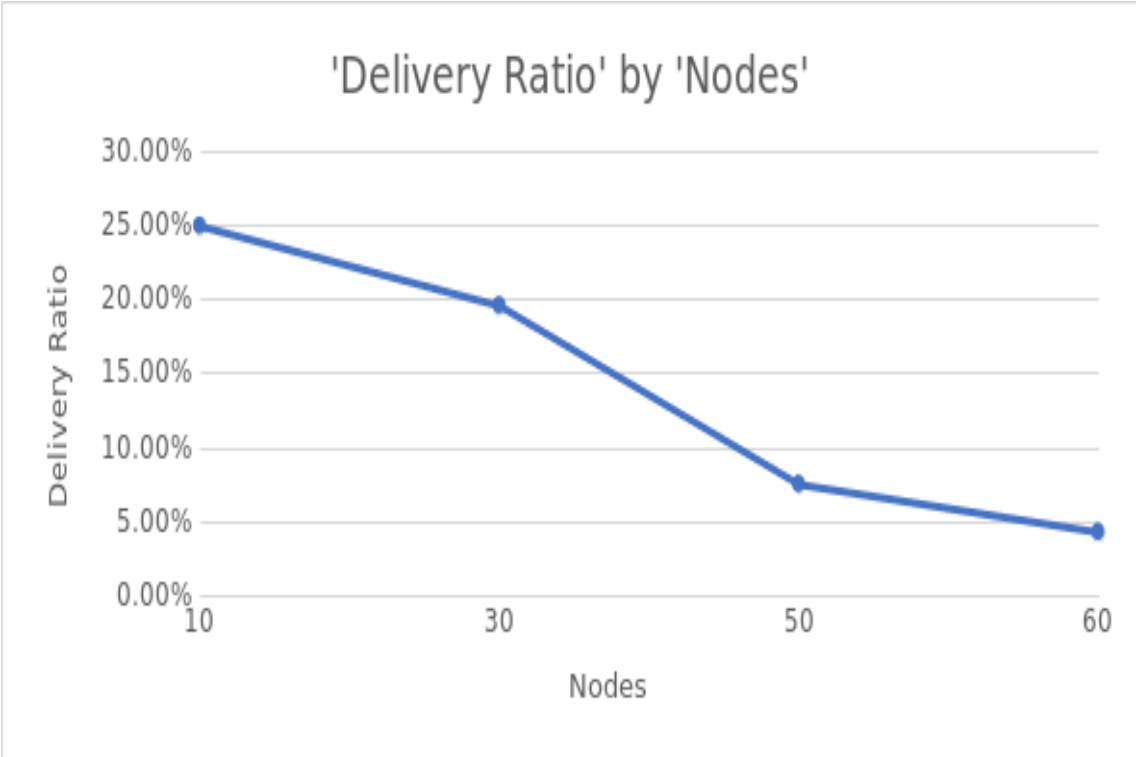

Figure 19: Varying Number of Nodes

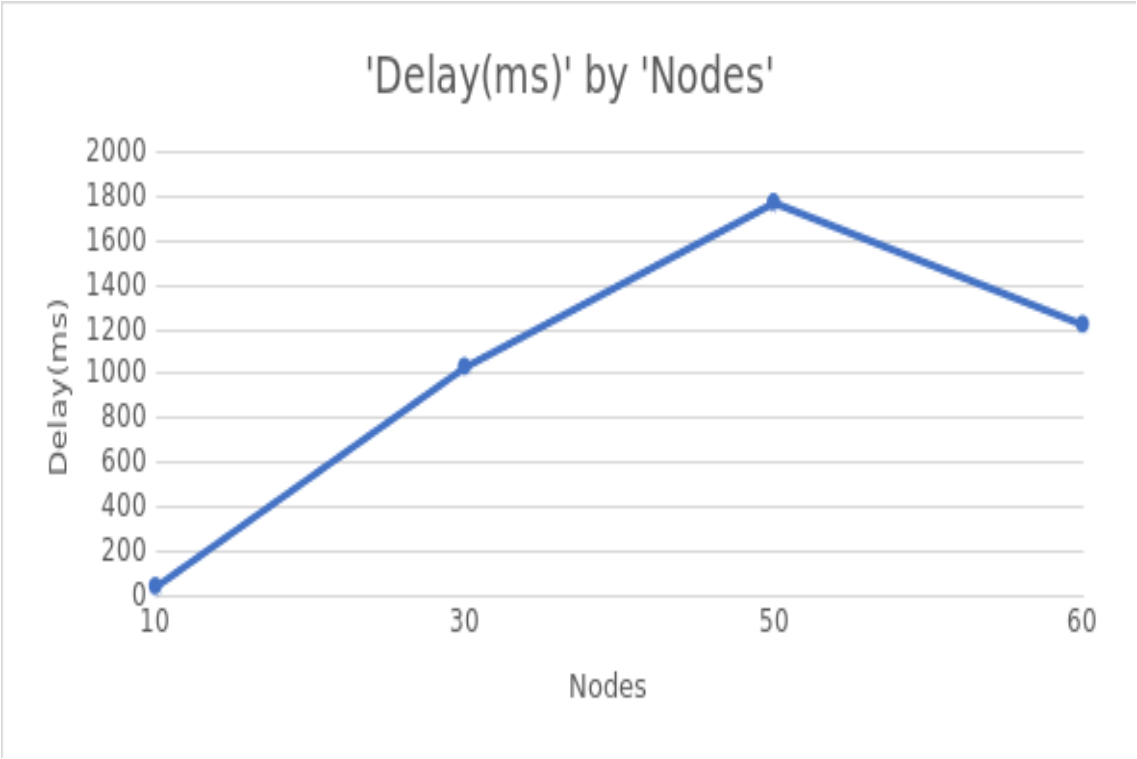

Figure 20: Varying Number of Nodes

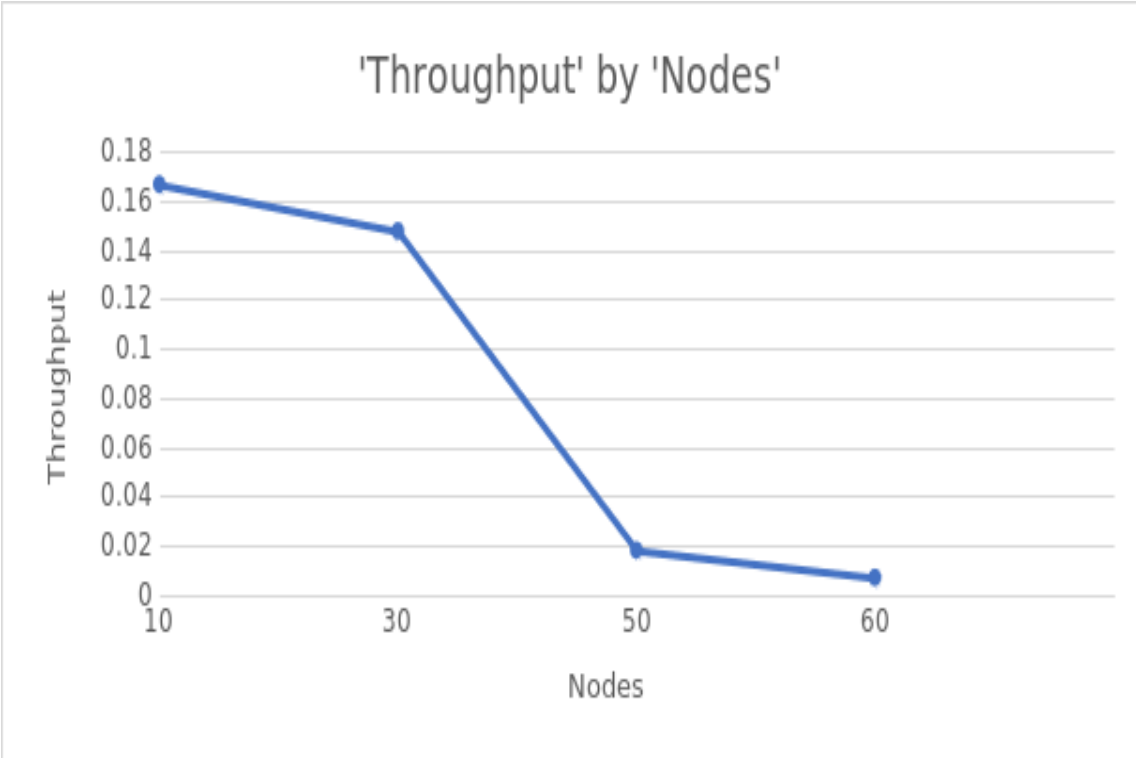

Figure 21: Varying Number of Nodes

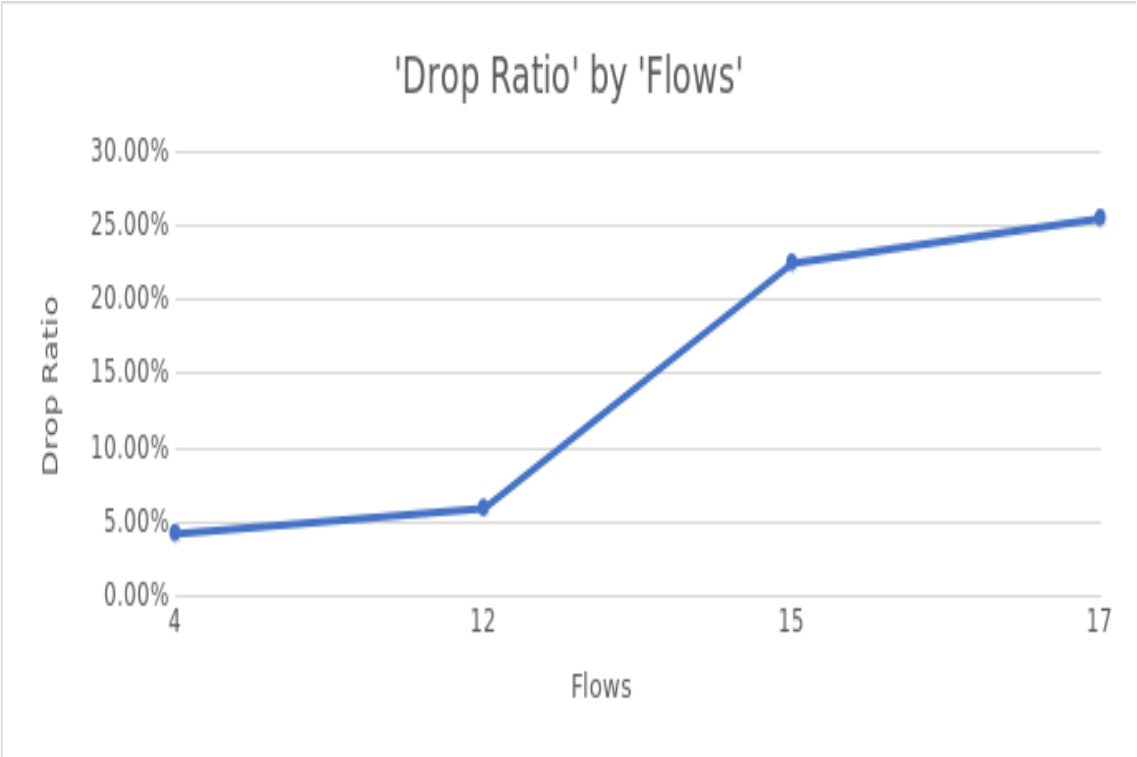

Figure 22: Varying Number of Nodes

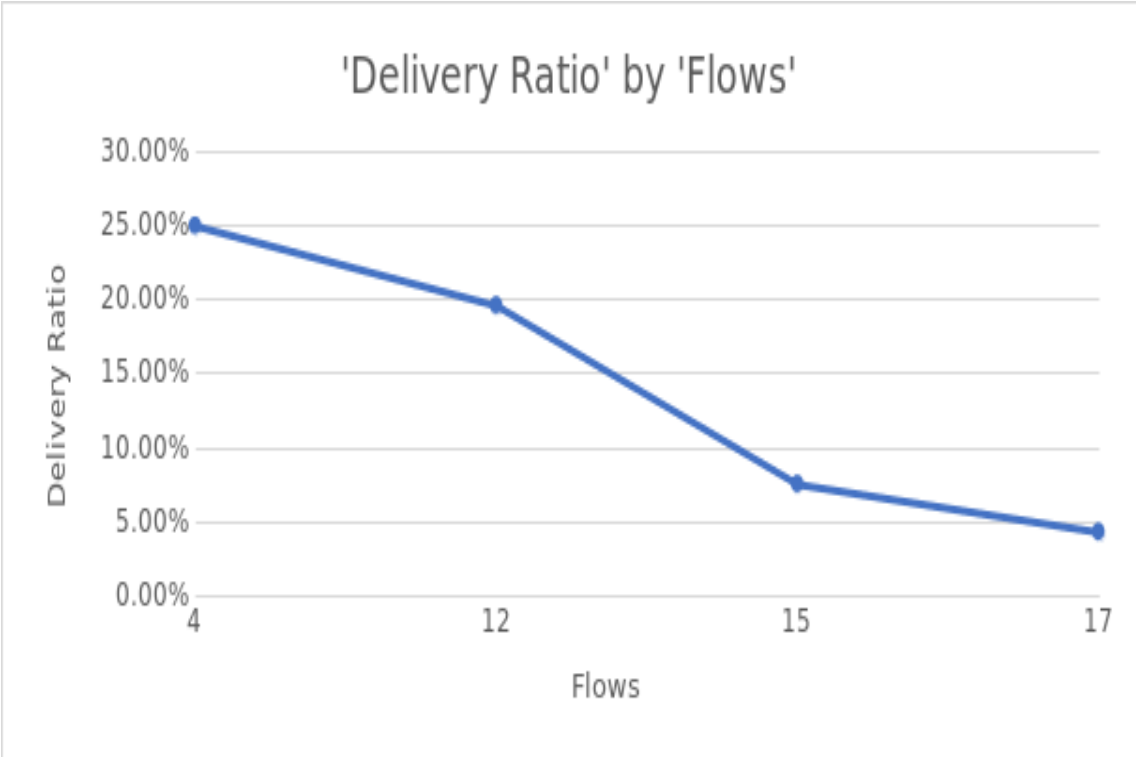

Figure 23: Varying Number of Nodes

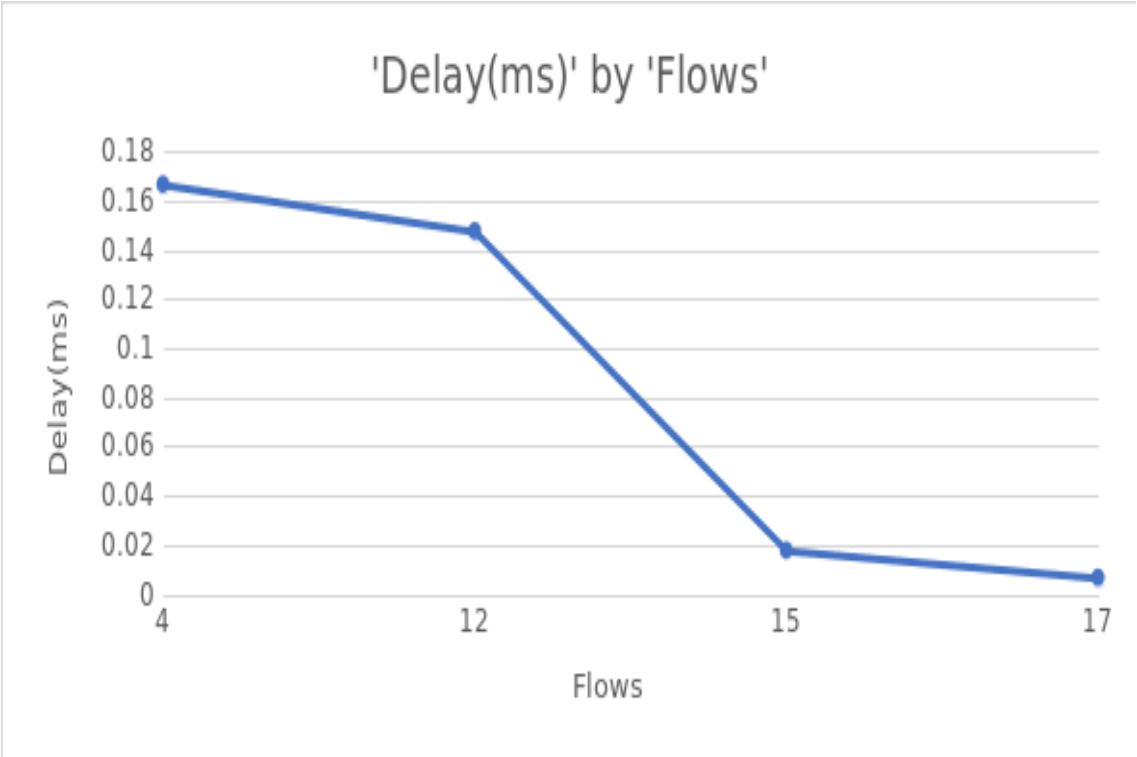

Figure 24: Varying Number of Nodes

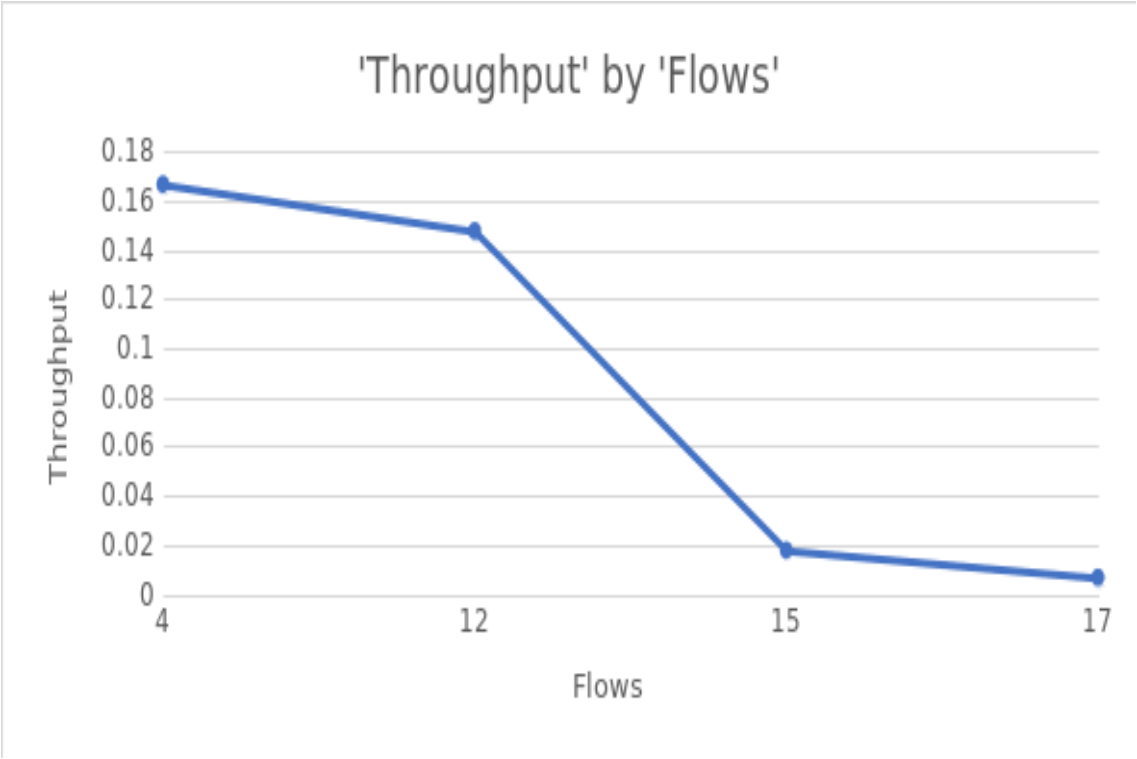

Figure 25: Varying Number of Nodes

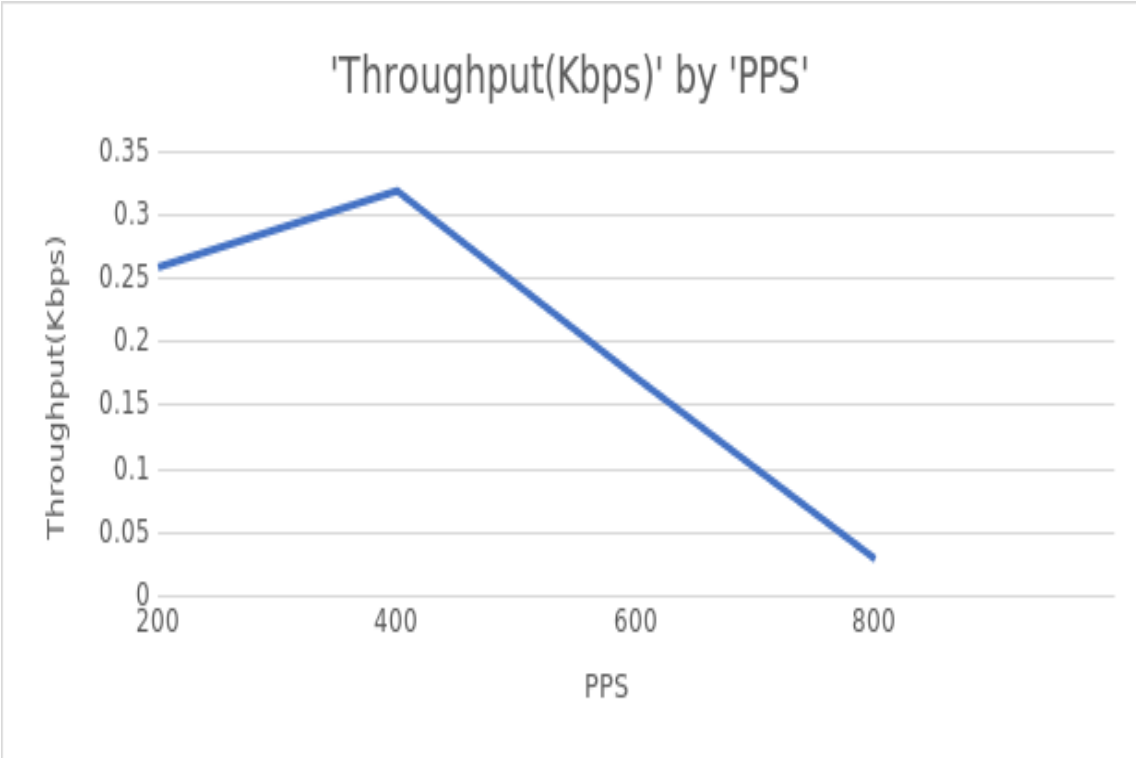

Figure 26: Varying Number of Nodes

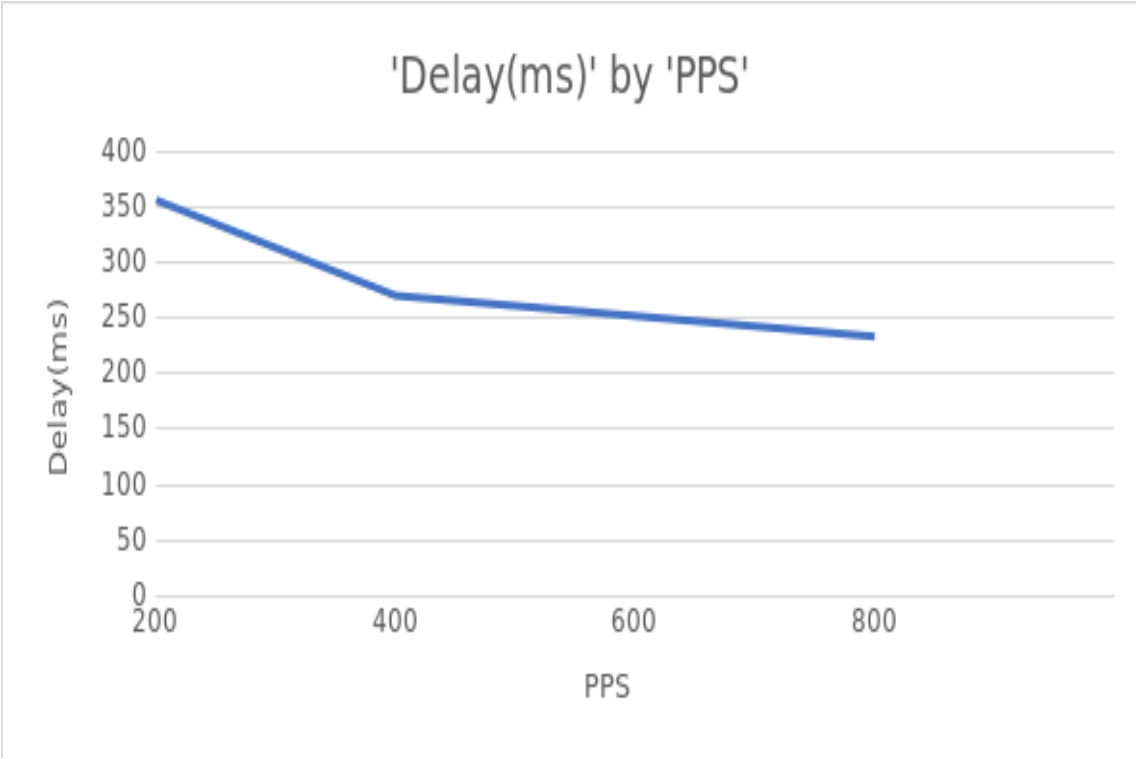

Figure 27: Varying Number of Nodes

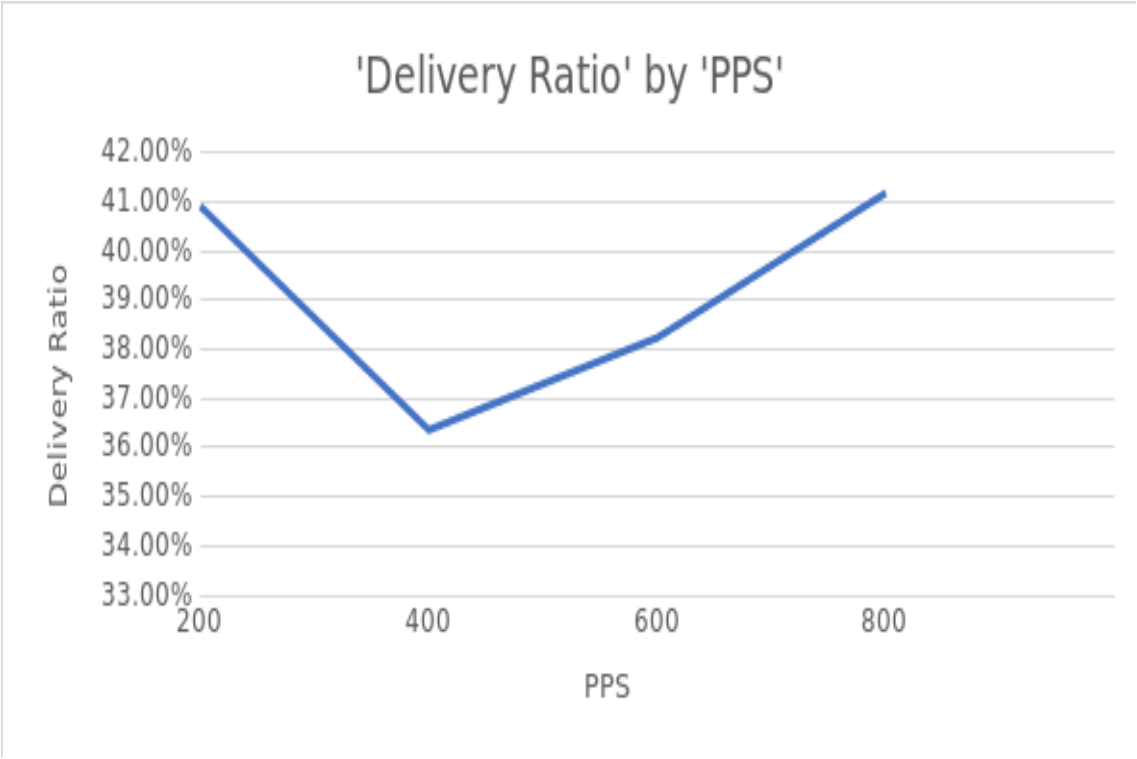

Figure 28: Varying Number of Nodes

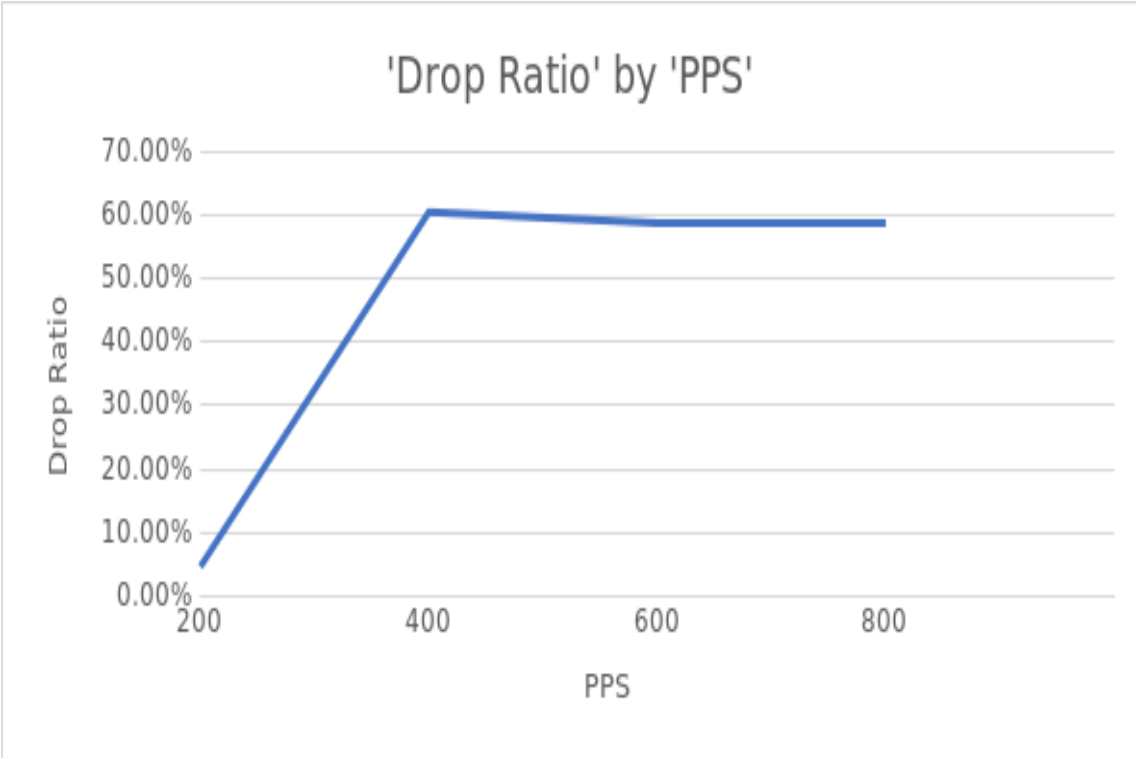

Figure 29: Varying Number of Nodes

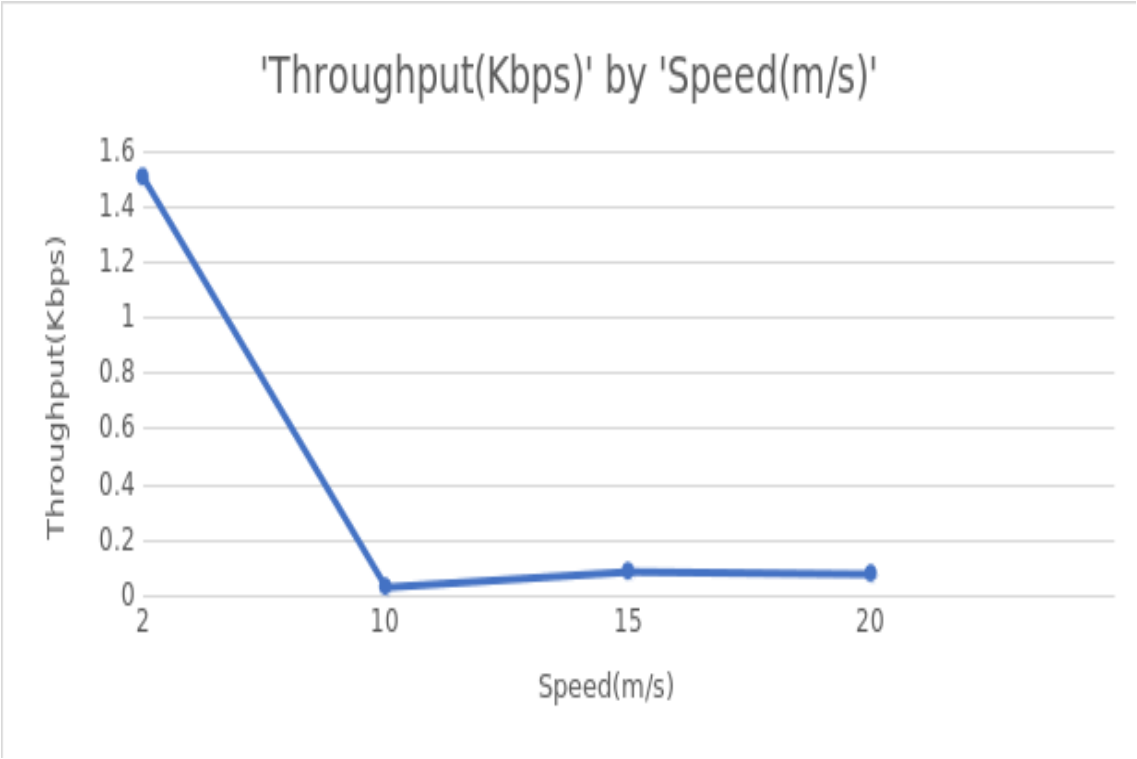

Figure 30: Varying Number of Nodes

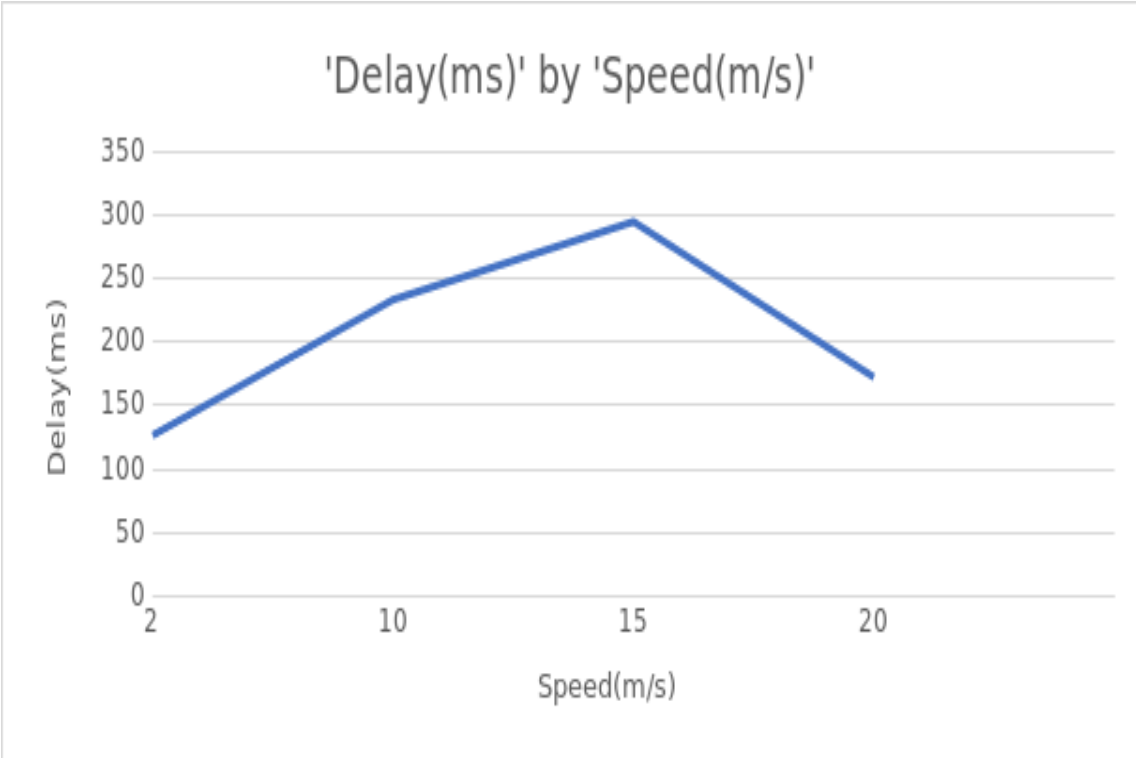

Figure 31: Varying Number of Nodes

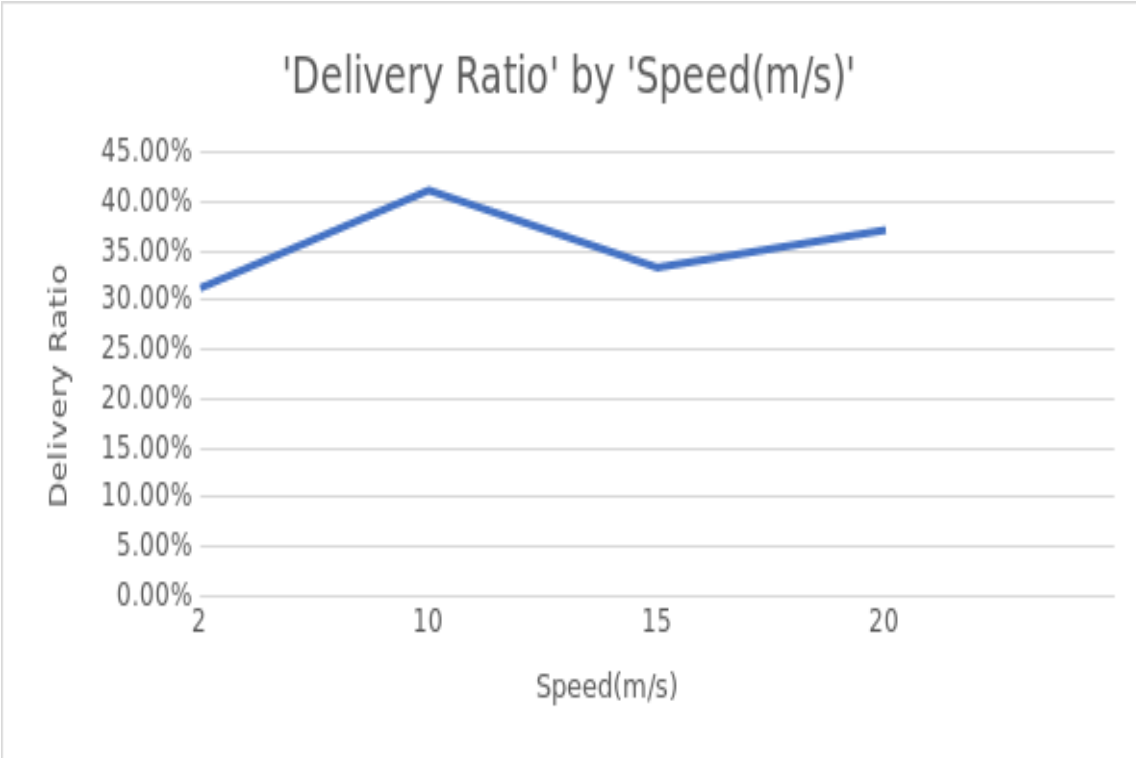

Figure 32: Varying Number of Nodes

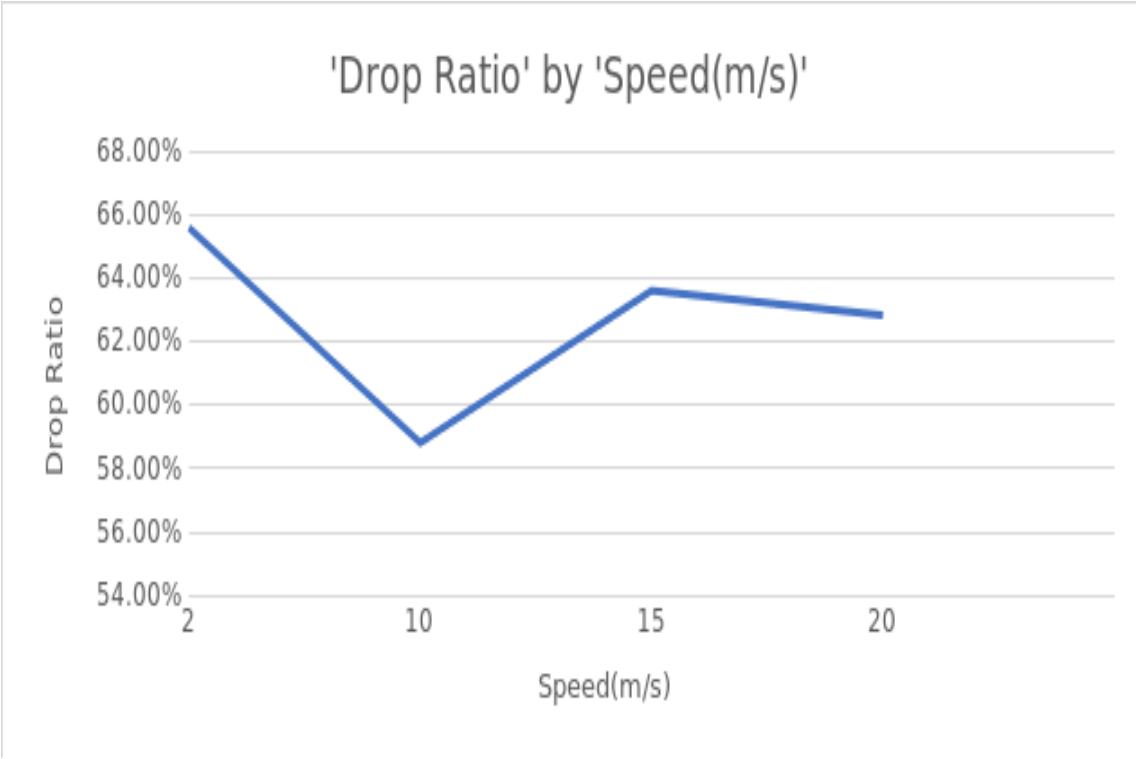

Figure 33: Varying Number of Nodes

2.2.4 Summary

Observation from running the experiments:

1. TCP NewReno performs doesn't perform as well in wireless medium as it does in wired medium, because of higher chances of packet drop
2. Since TCP New Reno doesn't perform as well, the differences between TCP NewReno and TCP Vegas are not as prevalent.
3. Increasing nodes and flows results in larger probability of packet drop hence the higher drop ratio and lower delivery ratio.
4. Increasing packets per second results in higher delivery ratio.
5. 802.15.4 gives very low throughput, high packet drop ratio, and low packet delivery ratio.
6. Higher speed causes more delay.

3 Task B

3.1 Modification

The modification requires us to modify algorithms in transport layer protocols (TCPL4Protocol) and few related classes.

3.1.1 Algorithm

One reason of the un- fairness between TCP Reno and Vegas is due to the difference of their congestion control algorithms. An aggressive increase of window sizes in TCP Reno much affects the performance of TCP Vegas controlling their window sizes moderately. Therefore, we modify TCP Vegas so that it has an ability to compete the link at least equally with TCP Reno connections, while preserving the merit of TCP Ve- gas of the stability of the window size

TCP Vegas+ has two modes for updating its window size;

- Moderate Mode: In the moderate mode, the TCP Vegas+ sender behaves identically to the original TCP Vegas, i.e., the window size is updated according to traditional TCPNewReno equation.
- Aggressive Mode: In the aggressive mode, the TCP Vegas+ sender host behaves identi- cally to TCP Reno. That is, it updates the window size according to Eq. (1). This mode is for TCP Vegas+ connections to keep fair throughput against TCP Reno connections.

3.1.2 Intuition

A rational behind the above algorithm is as follows; if the RTT value becomes larger whereas the window size is un- changed, it can be considered that the increase of RTT is not caused by the TCP Vegas+ connection itself, but by other TCP Reno connections, which increases its window size more aggressively than the TCP Vegas+ connection. Then the TCP Vegas+ connection should increase its win- dow size more aggressively to compete equally with the other connections.

When packet loss is detected, on the other hand, the TCP Vegas+ should change its mode from the aggressive mode to the moderate mode. It is because the packet loss indicates the network congestion occur- rence, and the congestion may be caused by the aggressive increase of the window size of itself.

3.1.3 Modified Files

The files that were modified are -

1. tcp-vegas.cc
2. tcp-socket-base.cc
3. tcp-socket-base.h

4. tcp-socket-state.h

3.2 Topology

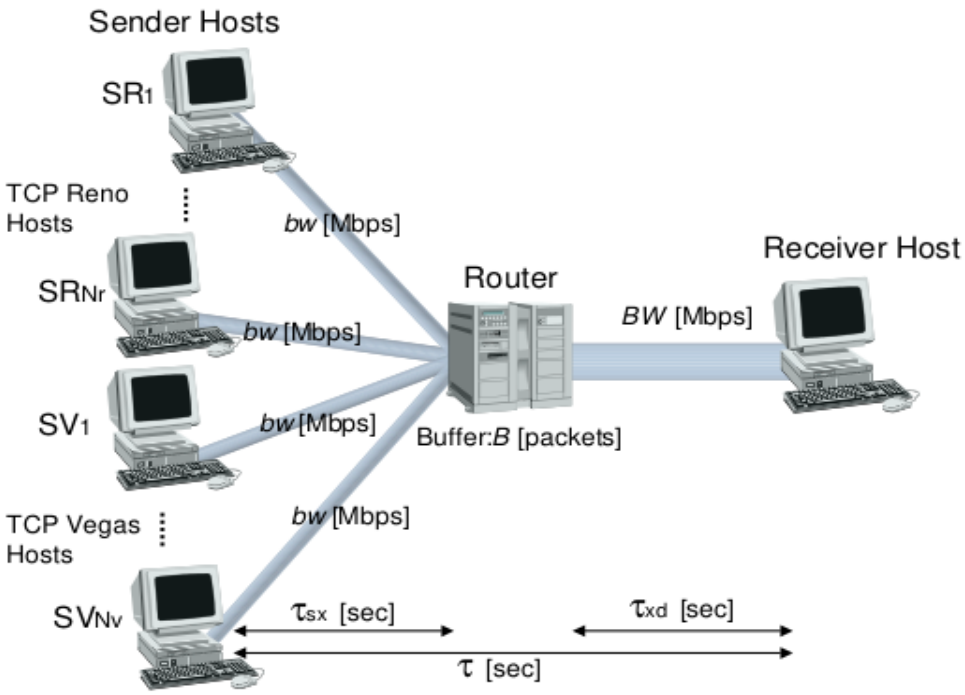

Figure 34: Topology used to test the modifications

3.3 Varied Parameters

The parameters that were varied are the following:

- The number of nodes

and the following metrics were taken into consideration to measure the effectiveness of modification

- Network Throughput
- Fairness Index

3.4 Results with graphs

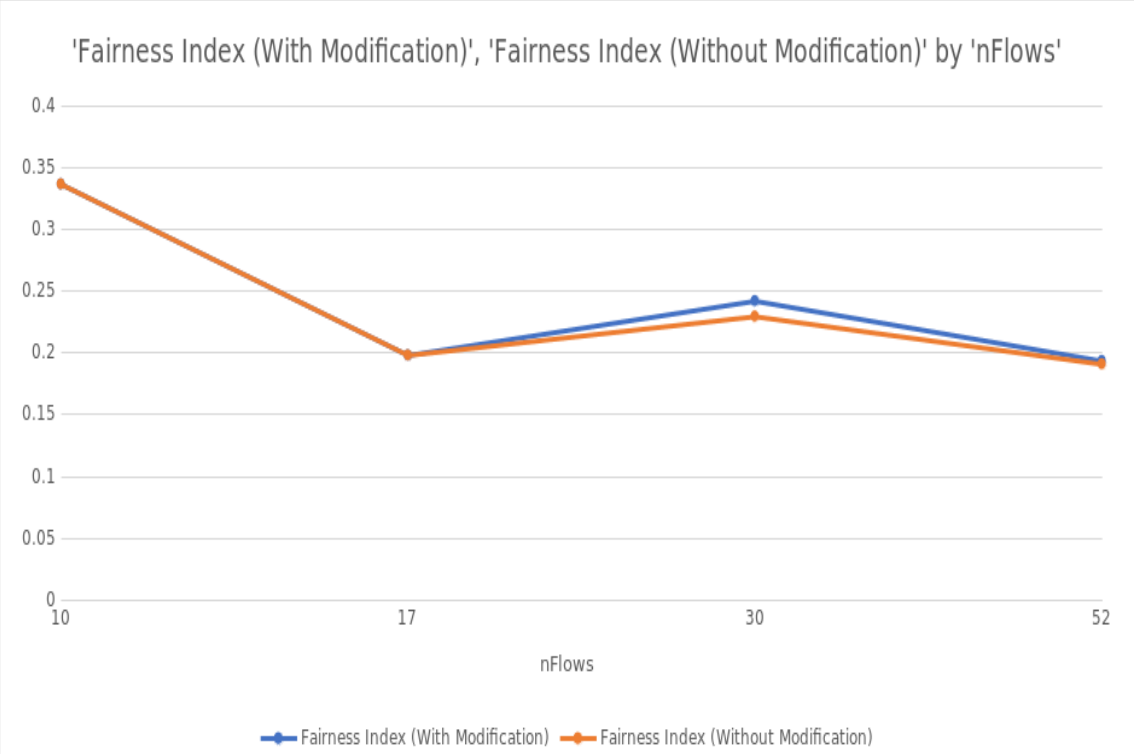

Figure 35: Varying Number of Flows

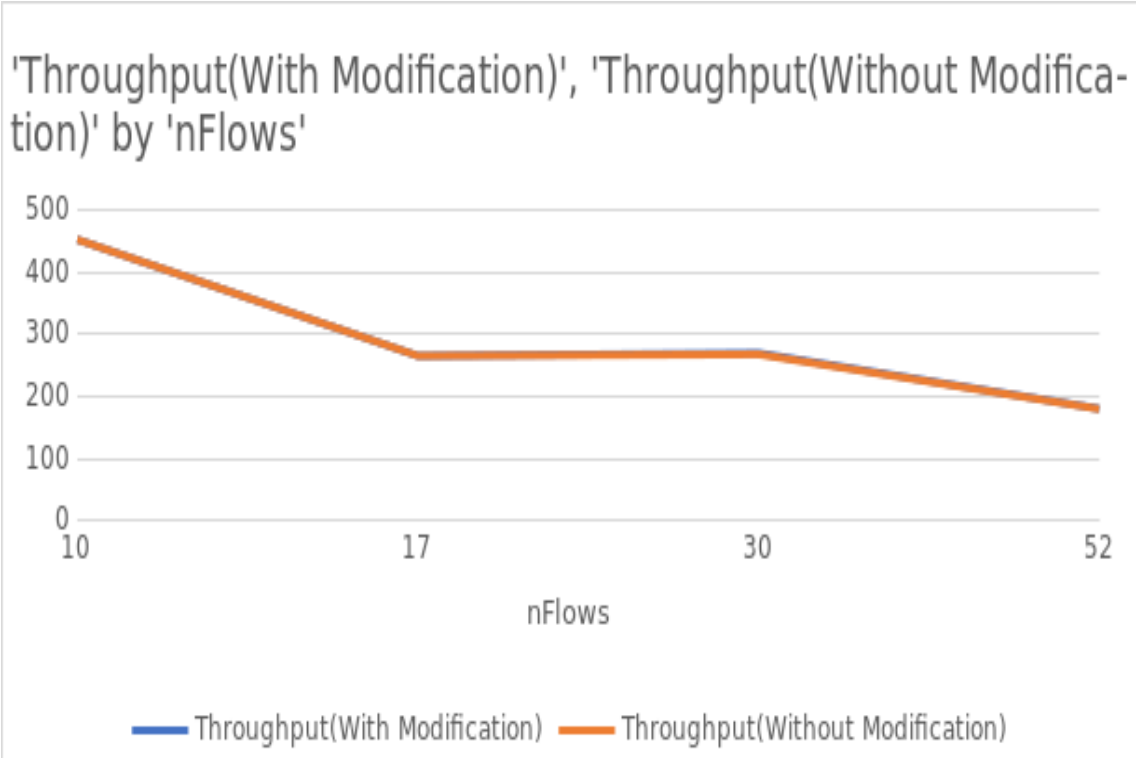

Figure 36: Varying Number of Flows

3.5 Summary of Experiment

1. The modification caused the overall Network throughput to stay large the same.
2. The modification caused a slight increase in fairness index.
3. Since the modification increases the aggressive behaviour of TCPVegas+ (which depends on the variable $count_{max}$), the packet drop ratio slightly increases. This is due to reactive nature of TCPNewReno. However, More number of packets are delivered at simulation time.
4. The aggressive behaviour of TCPVegas+ largely depends of how we set the threshold $count_{max}$, so tweaking $count_{max}$ may yield different results. For our experiment, we used $count_{max} = 5$.
5. Although we have seen slight improvement, the overall improvement could have been more significant had we used wired medium because TCP NewReno inherently performs worse in wireless mediums.

4 References

References

[1] Go Hasegawa, Kenji Kurata, Masayuki Murata (2000) *Analysis and Improvement of Fairness between TCP Reno and Vegas for Deployment of TCP Vegas to the Internet..*
`https://ieeexplore.ieee.org/document/896302/`