CSE 322

Networking Sessional

Assignment 3

NS2 SIMULATOR REPORT

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1 Introduction

For this assignment , we were tasked with Wireless 802.11 static network and Wireless 802.15.4 mobile network.

2 Parameters Variation and Metrics Measured

For Wireless Static (802.11) network, we have varied 4 parameters. These are number of nodes, number of flows, packet rate (number of packets per second) and coverage area. For Wireless Mobile (802.15.4) network, we have varied 4 parameters. These are number of nodes, number of flows, packet rate (number of packets per second) and speed of nodes.

- Number of nodes were varied as 20, 40, 60, 80, 100.
- Number of flows were varied as 10, 20, 30, 40, 50.
- Packet rate was varied as 100, 200, 300, 400, 500.
- Coverage area (for 802.11 static only) was varied as square of 1 * TX Range, 2 * TX Range, 3 * TX Range, 4 * TX Range, 5 * TX Range.
- Speed of nodes (for 802.15.4 mobile only) was varied as 5, 10, 15, 20, 25 m/s.

Every time one parameter was varied, a constant parameter value for all the other parameters were used to preserve uniformity. In this assignment, we have measured various metrics as a means of evaluating the performance of our simulations. These metrics include but are not limited to Network Throughput, End-End Delay, Packet Delivery Ratio, Packet Drop Ratio, Energy Consumption.

2.1 Additional Metrics and Networks

We have also measured other metrics such as per-node throughput, residual energy per node, queue variation over time (using queue monitor and also using trace files). Additionally, we have also simulated other networks such as satellite network and LTE network. We have also evaluated above mentioned metrics for these networks. To monitor the queue size variation over time and to check for our modified queue, we have also simulated cross transmission of packets (wired-wireless packet transmission).

3 Modification

In our assignment, we experimented with these modifications:

- RTT calculation

- New Mac layer protocol addition
- Queue DropTail modification
- Congestion window modification

Files we Modified:

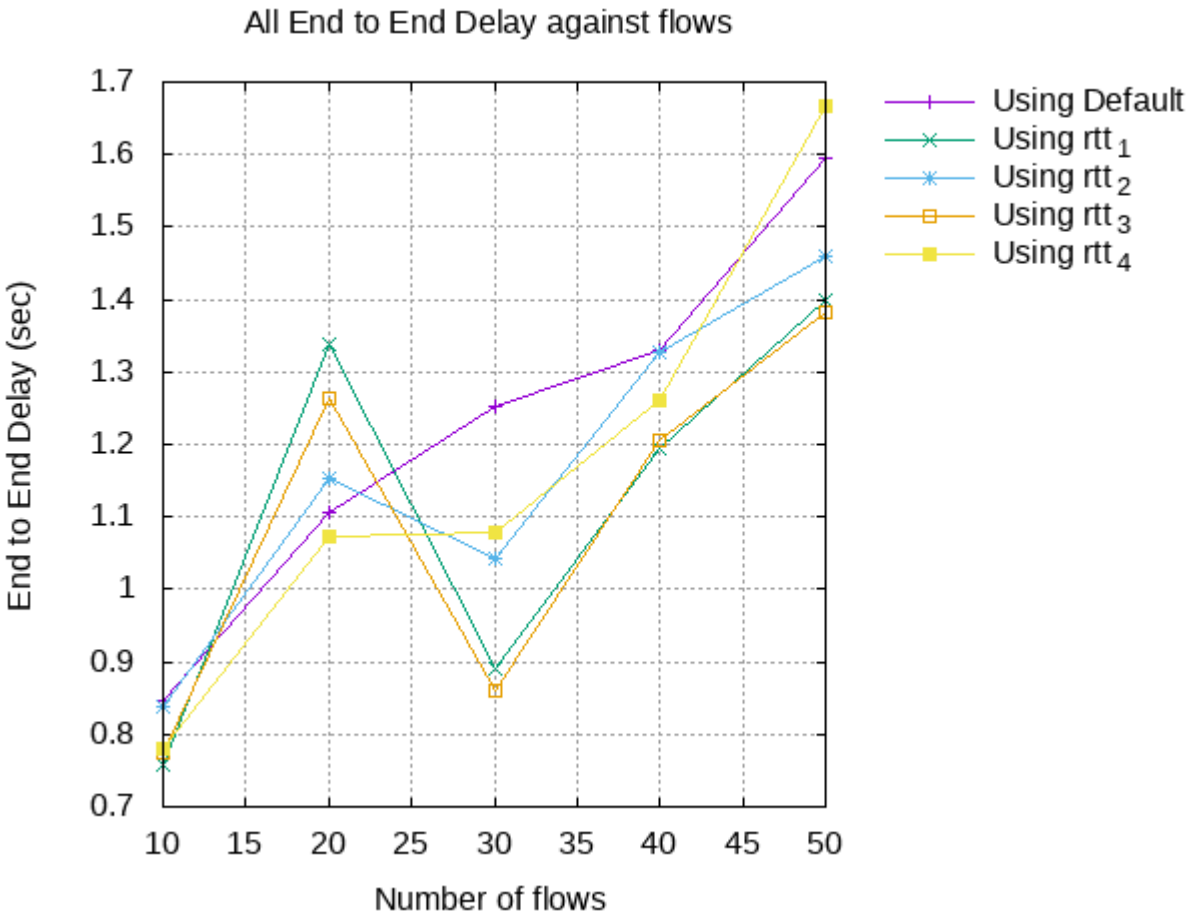
- tcp.cc
- tcp.h
- droptail.cc
- droptail.h
- ns default.tcl ns mac-802-11.tcl
- InitTcl.cc
- ns-mobilenode.tcl
- ns-mac.tcl

3.1 RTT Calculation Modification

We added four additional methods of Rtt calculation.

1. Average of last 20 samples
2. Average of samples within threshold and last 50 samples
3. Average without using an array of last 20 samples
4. Root mean square of last 20 samples

We have simulated the Wireless 802.11 static mode after each modification and plotted graphs for each of the modifications alongside the unmodified case to compare the results.



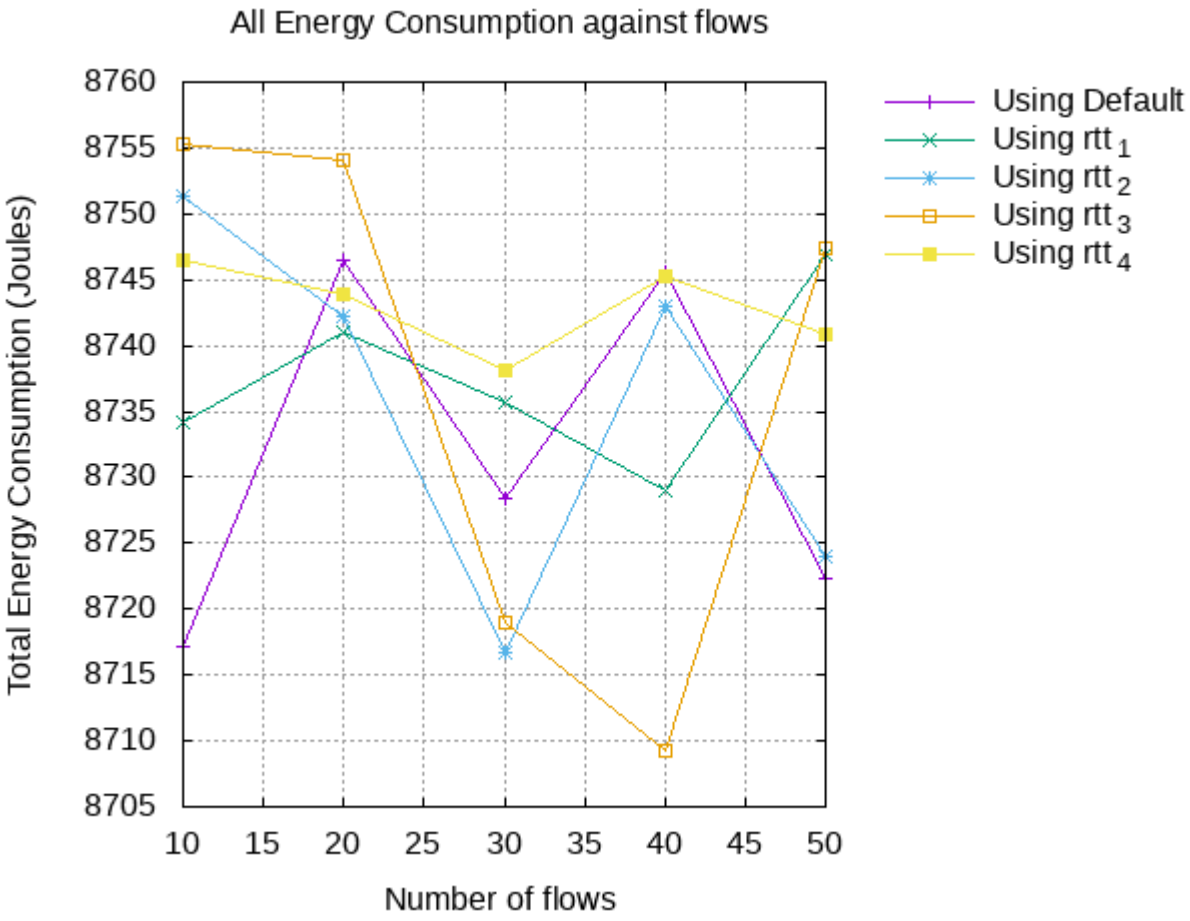
FlowVarying EndToEndDelay

3.1.1 Rtt Method 1

We have used the arithmetic mean of the previous 20 samples to calculate the RTT. In this modification packet delivery ratio is increased slightly and drop ratio is decreased.

3.1.2 Rtt Method 2

In this modification we only consider the samples which are under threshold defined by average*1.5. In this method although throughput is decreased , packet delivery ration against nodes is slightly improved.



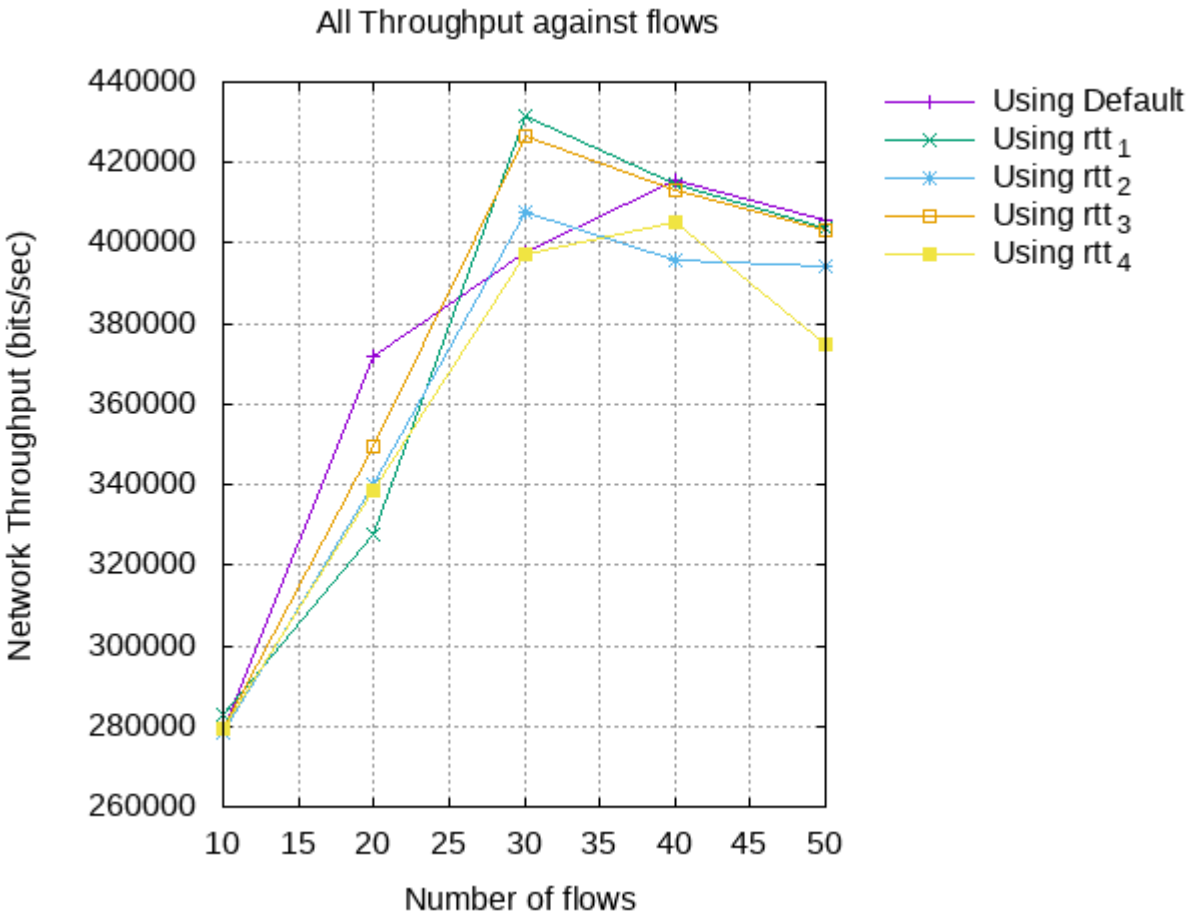
FlowVarying EnergyConsumption

3.1.3 Rtt Method 3

In this modification we have not used array.Rather we omit the average from the sum every time we reach 20 samples.Its performance is very much similar to the base.

3.1.4 Rtt Method 4

In this modification we take the root mean square of the last 20 samples.Its delivery ratio is normally lower, although at times,provides a higher throughput.



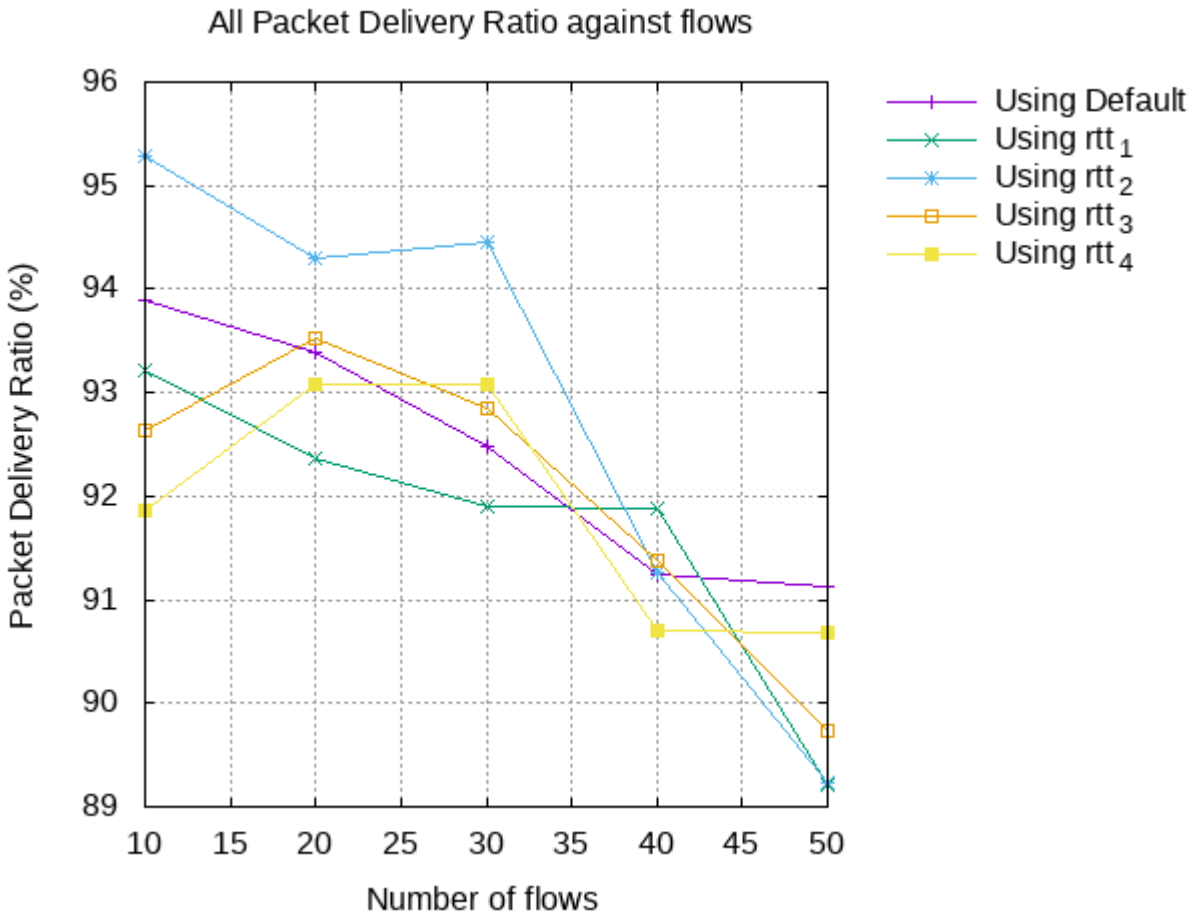
FlowVarying NetworkThroughput

3.2 Mac Layer

We added a new mac layer 802_11new.In this protocol previous **sifs_** and **diffs_** is halved, **pifs_**, **PreambleLength** and **datarate_** is doubled. The overall performance is better. We shall examine the graphs of the metrics obtained by using our modified Mac layer starting from figure 22.

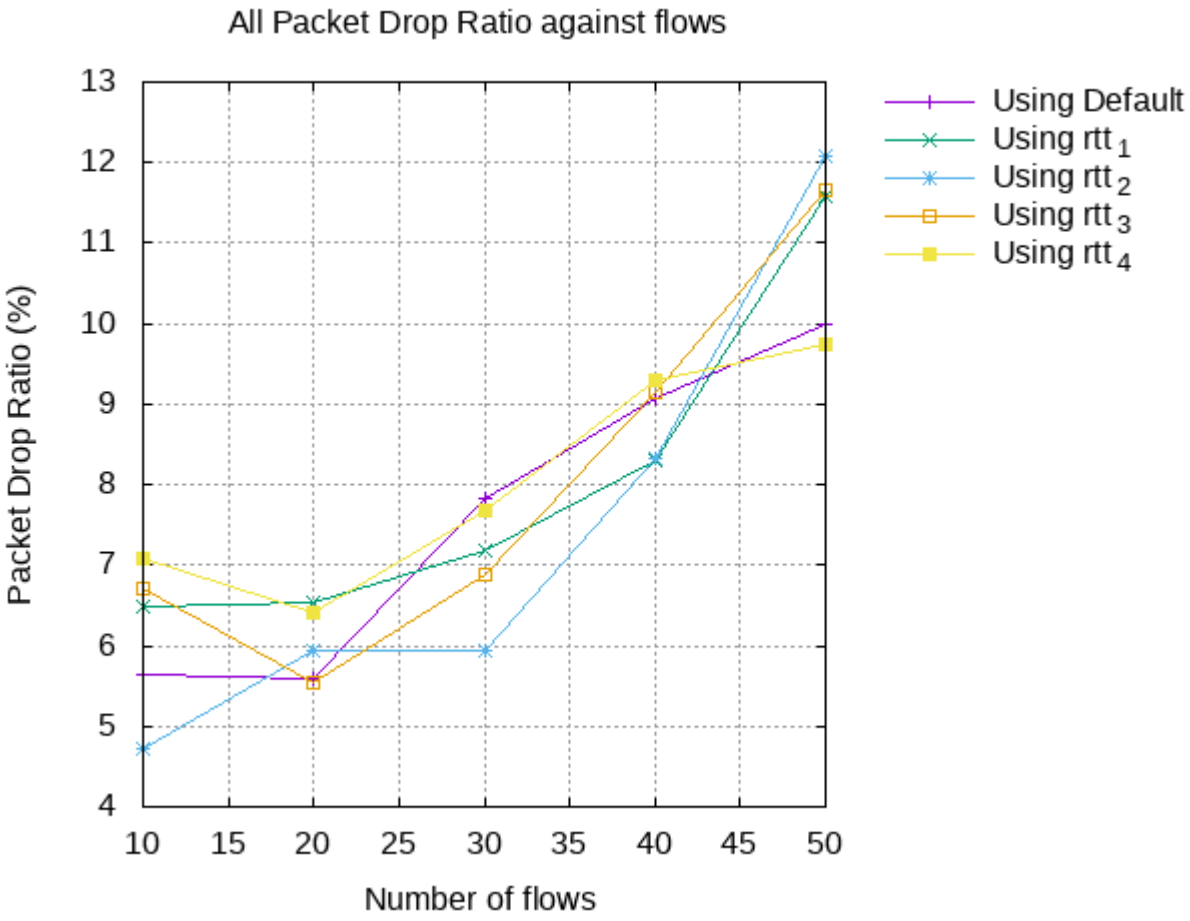
3.3 Queue DropTail Modification

We have modified the drop-tail queue, such that a packet will be dropped randomly instead of from the head i.e. the front or the tail i.e. the end when the queue is full.We have checked our results using cross transmission of packets i.e. wired-wireless network which was an additional (bonus) task. We have added



FlowVarying PacketDeliveryRatio

the graphs showing results of this modification.



FlowVarying PacketDropRatio

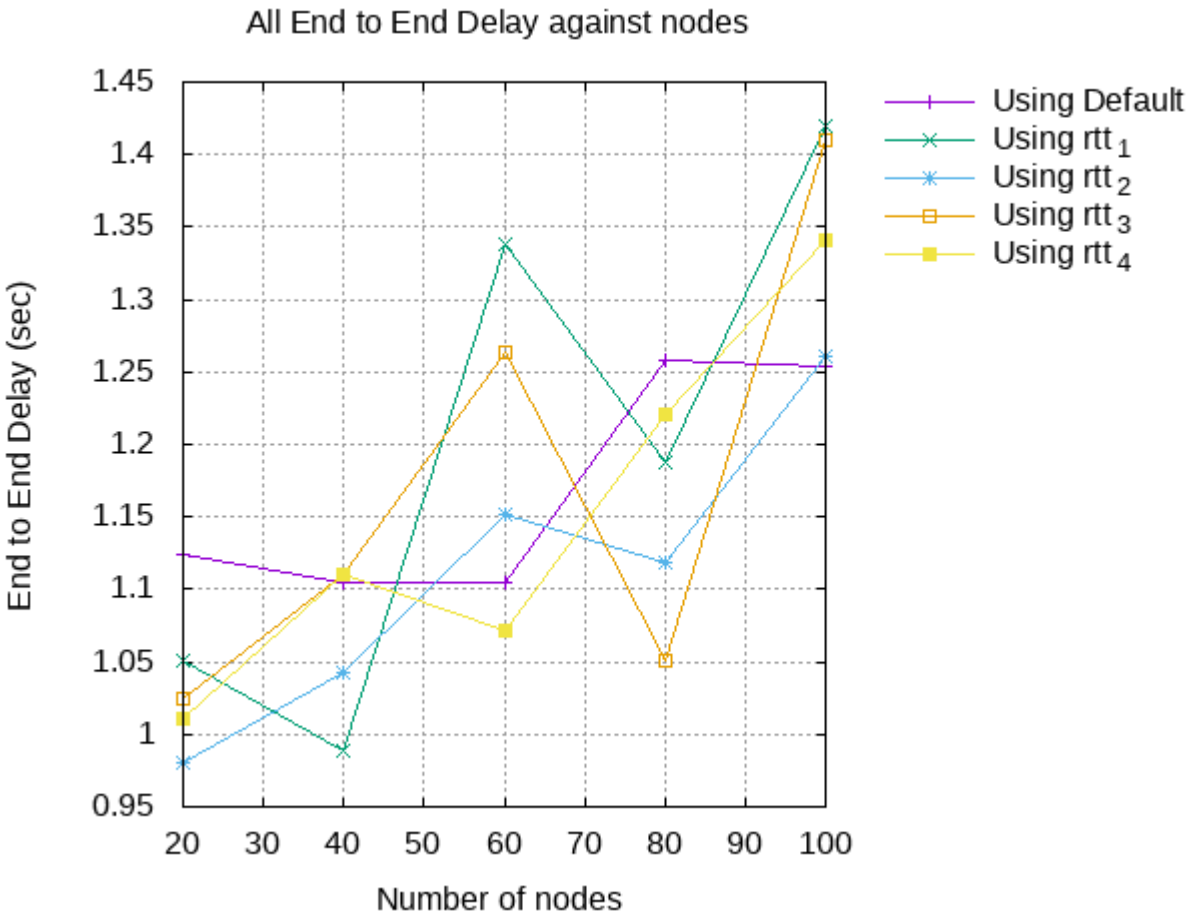
4 Additional Metrics Measured

4.1 Per Node Throughput

We have measured per node throughput for each iteration i.e. variation of parameters of our simulations of the network 802.11 static and 802.15.4 mobile. For simplicity we have shown only one graph.

4.2 Residual Energy Per Node

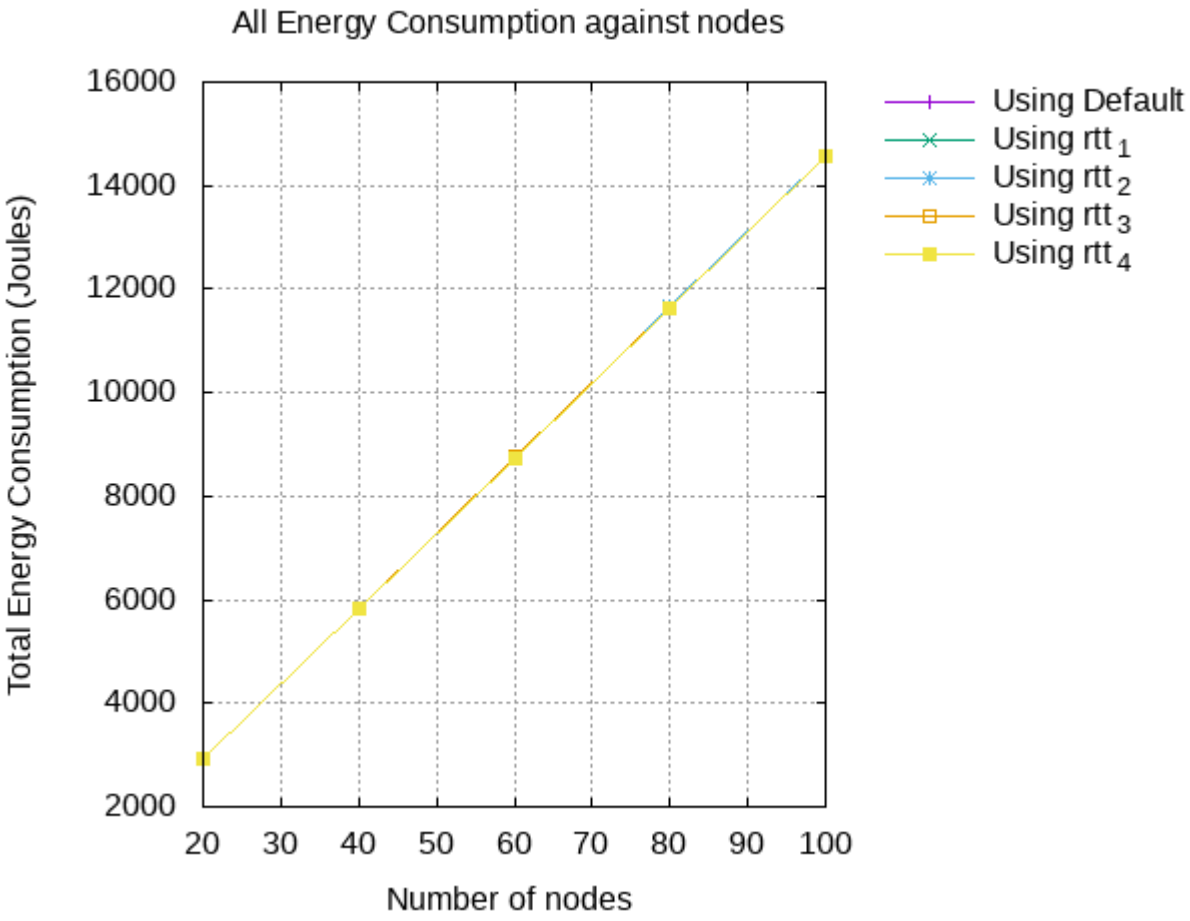
We have also measured the residual energy per node for each iteration i.e. variation of parameters of our simulations of the network 802.11 static and 802.15.4 mobile. Also for simplicity we have shown one graph only.



NodeVarying EndToEndDelay

4.3 Queue size variation over time

We have measured the queue size variation over time, both by using queue monitor in tcl and also by using the trace file. This was possible in wired to wireless cross transmission packet transfer scenario.



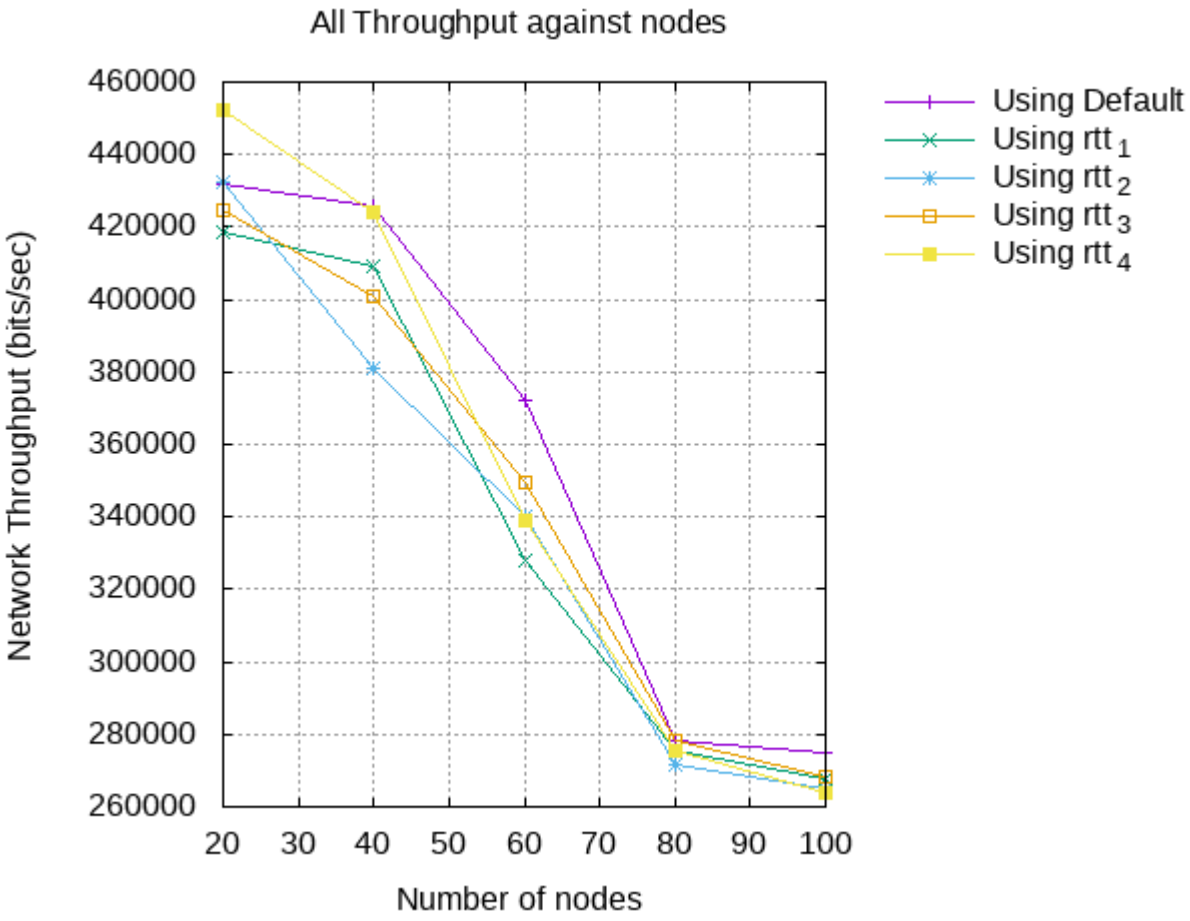
NodeVarying EnergyConsumption

5 LTE

In LTE simulation we experimented by varying amr,average page size and subscribers.In these cases only changing subscribers effects results.

5.1 Satellite

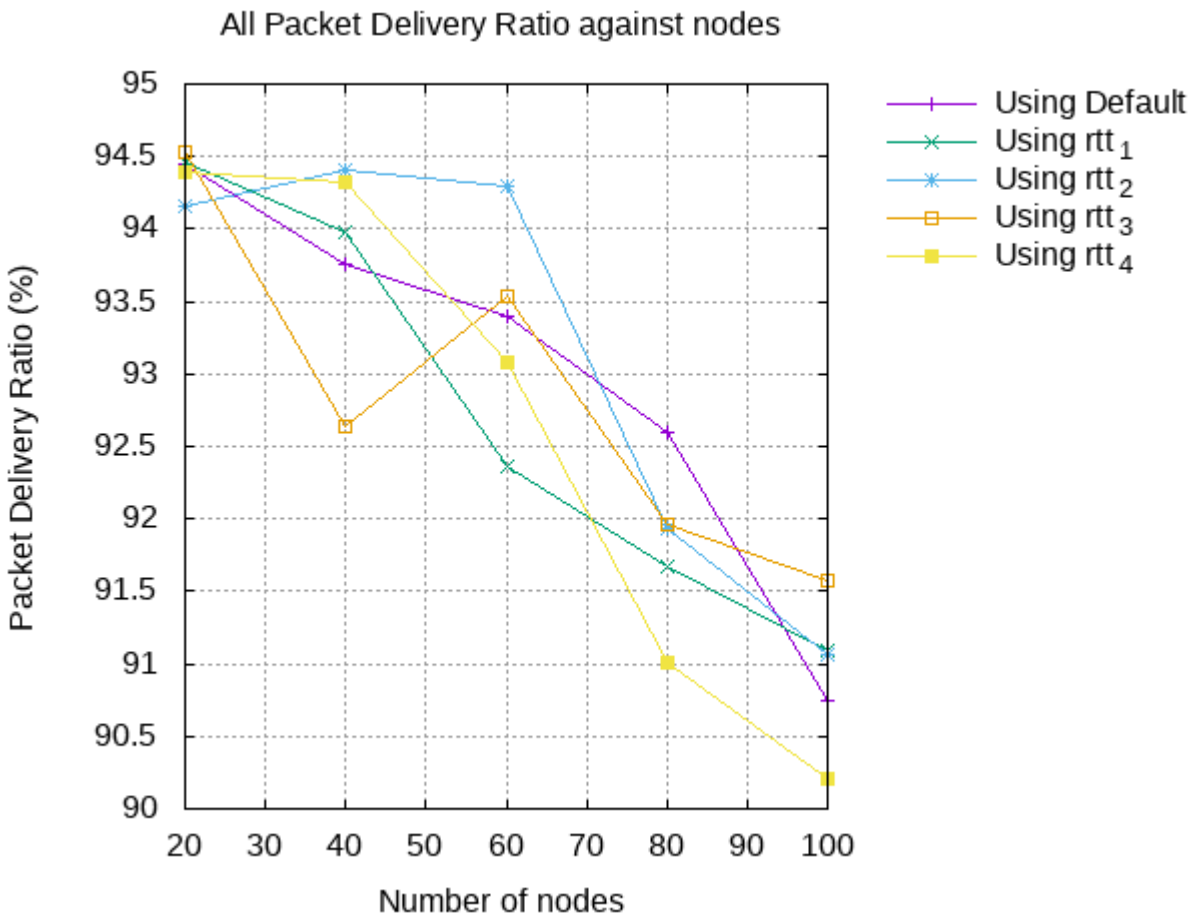
We have varied Orbital Inclination, Polar, and Link Bandwidth as parameters. We have measured, for each variation, the metrics Delivery Ratio, Drop Ratio, and Error Ratio. The following graphs were obtained from such simulations.



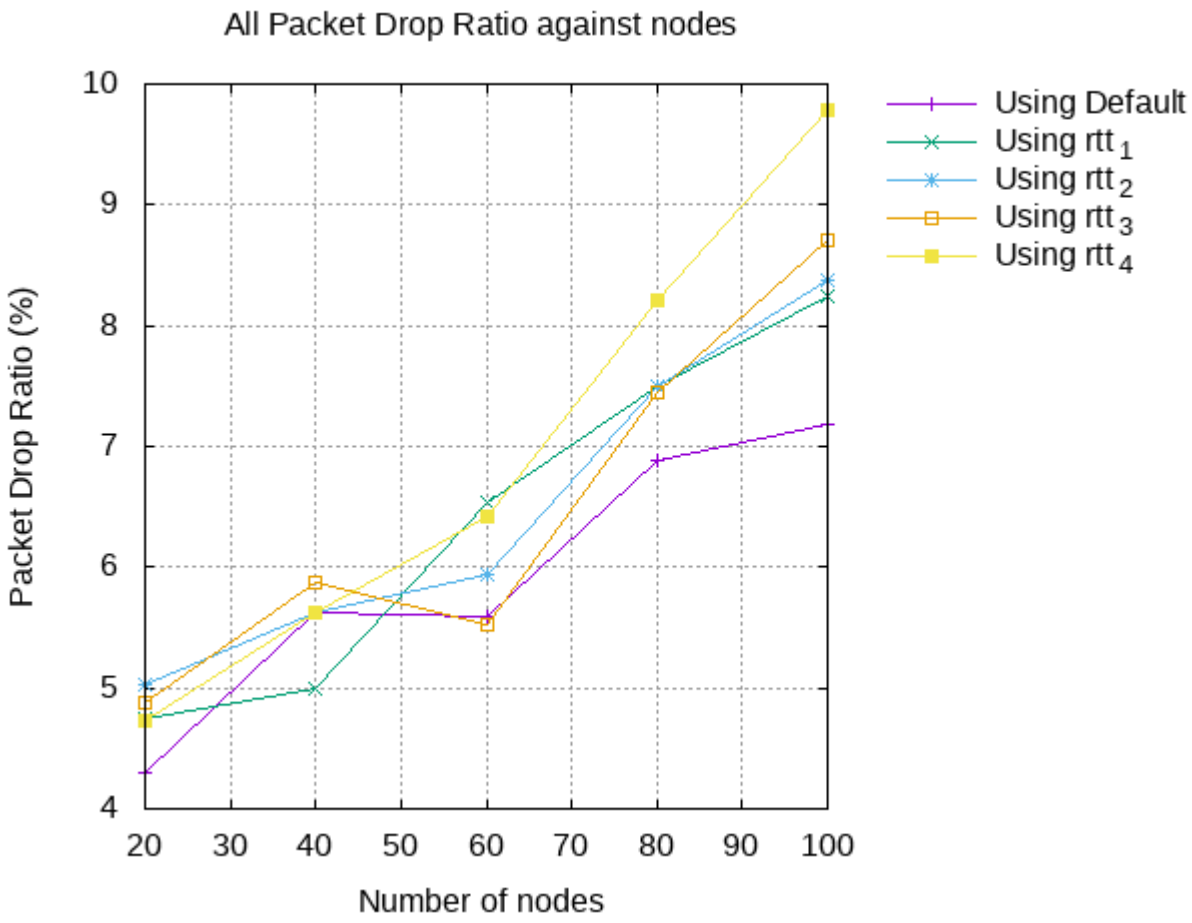
NodeVarying NetworkThroughput

6 Queue Size Variation

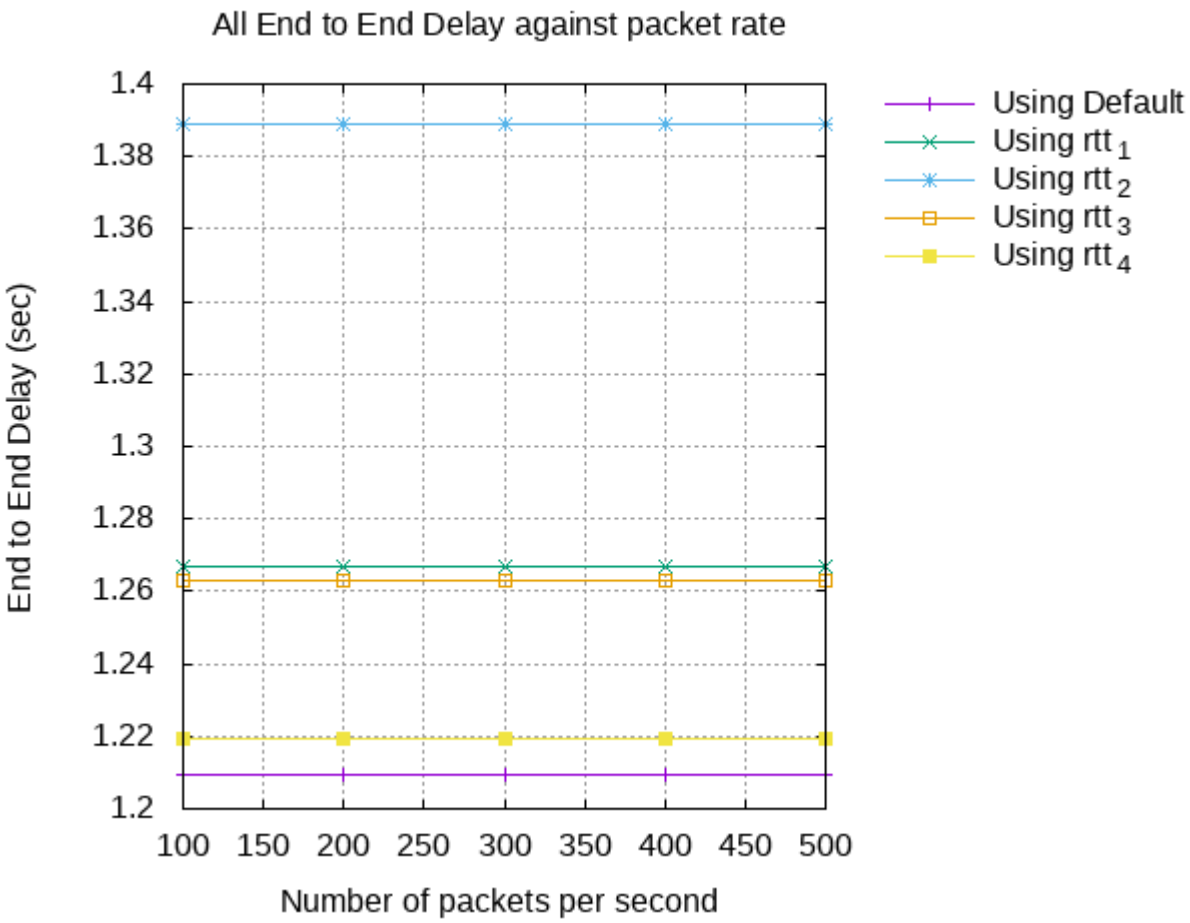
Using monitor queue we got this sort of result.



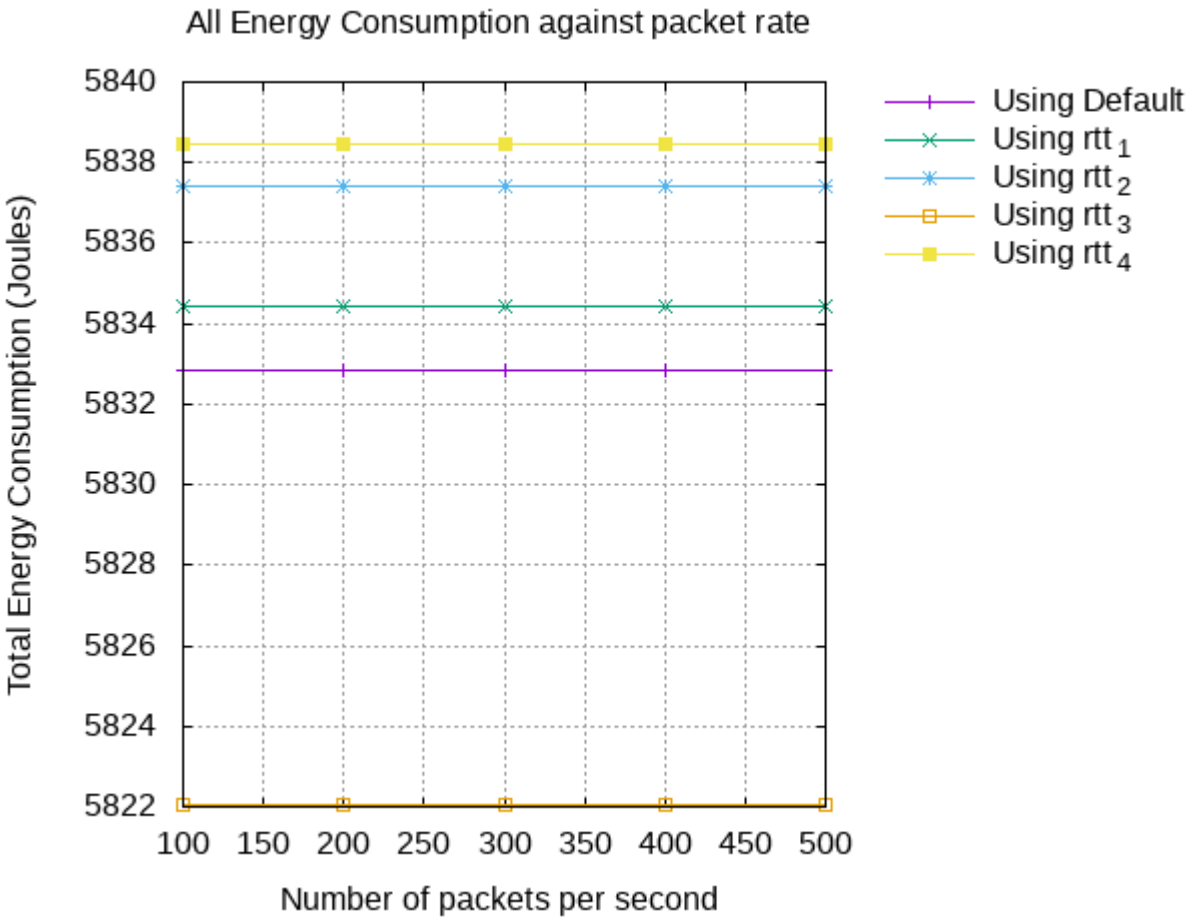
NodeVarying PacketDeliveryRatio



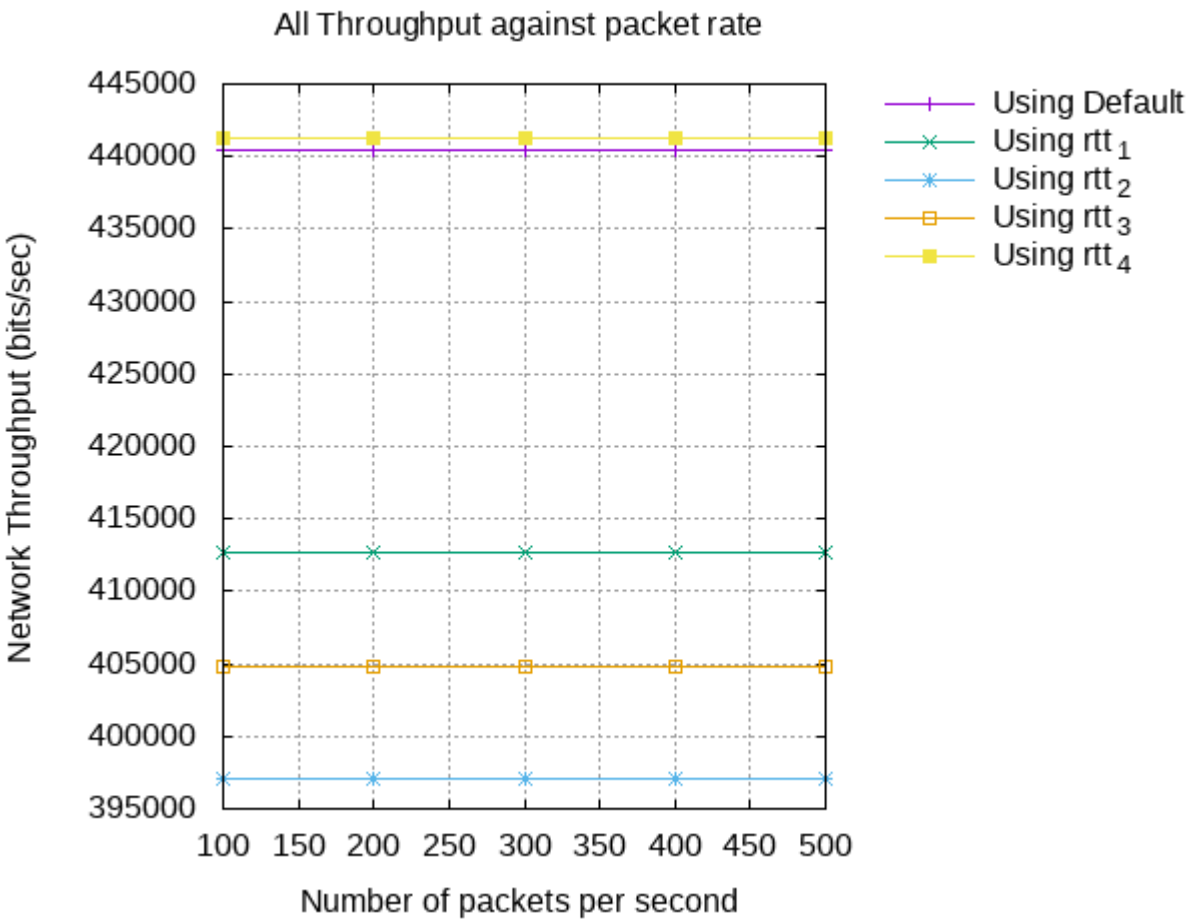
NodeVarying PacketDropRatio



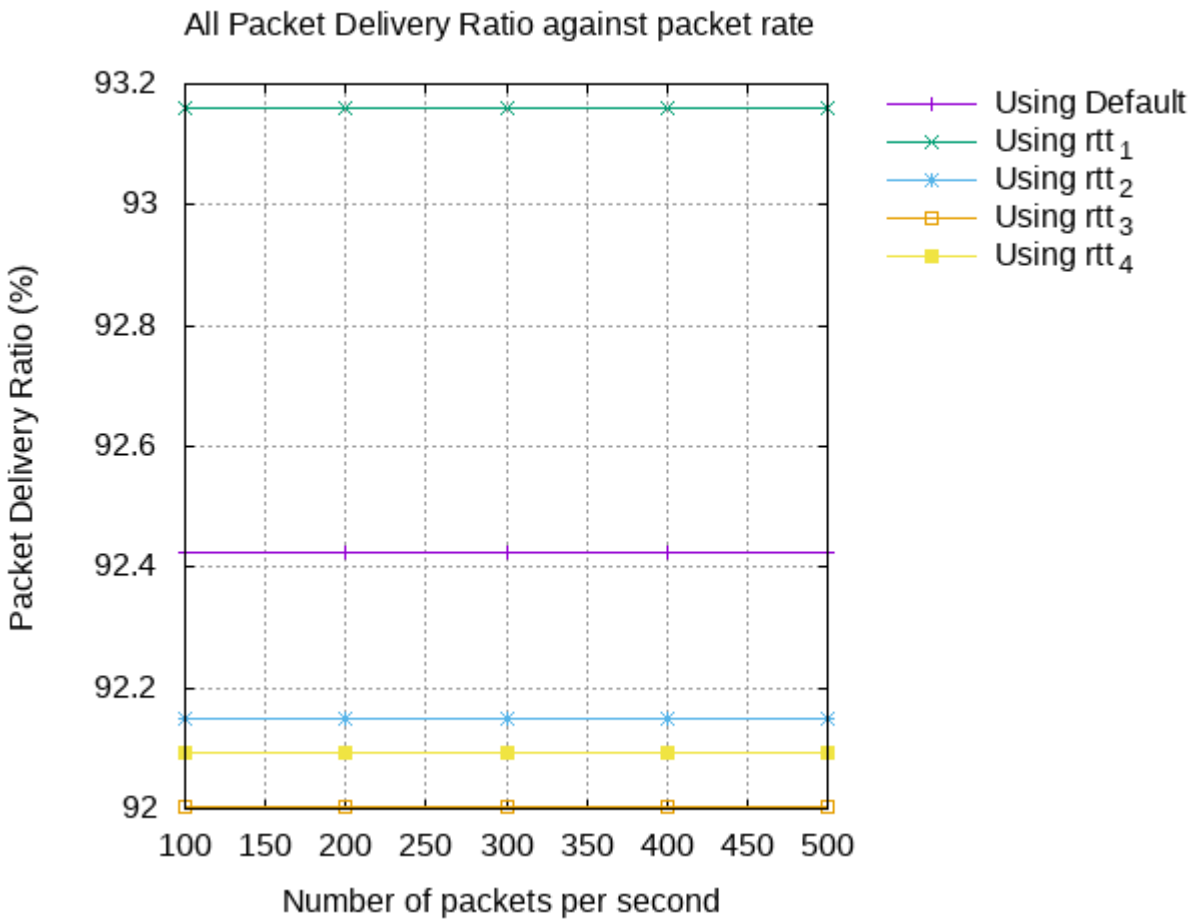
PacketsPerSecVarying EndToEndDelay



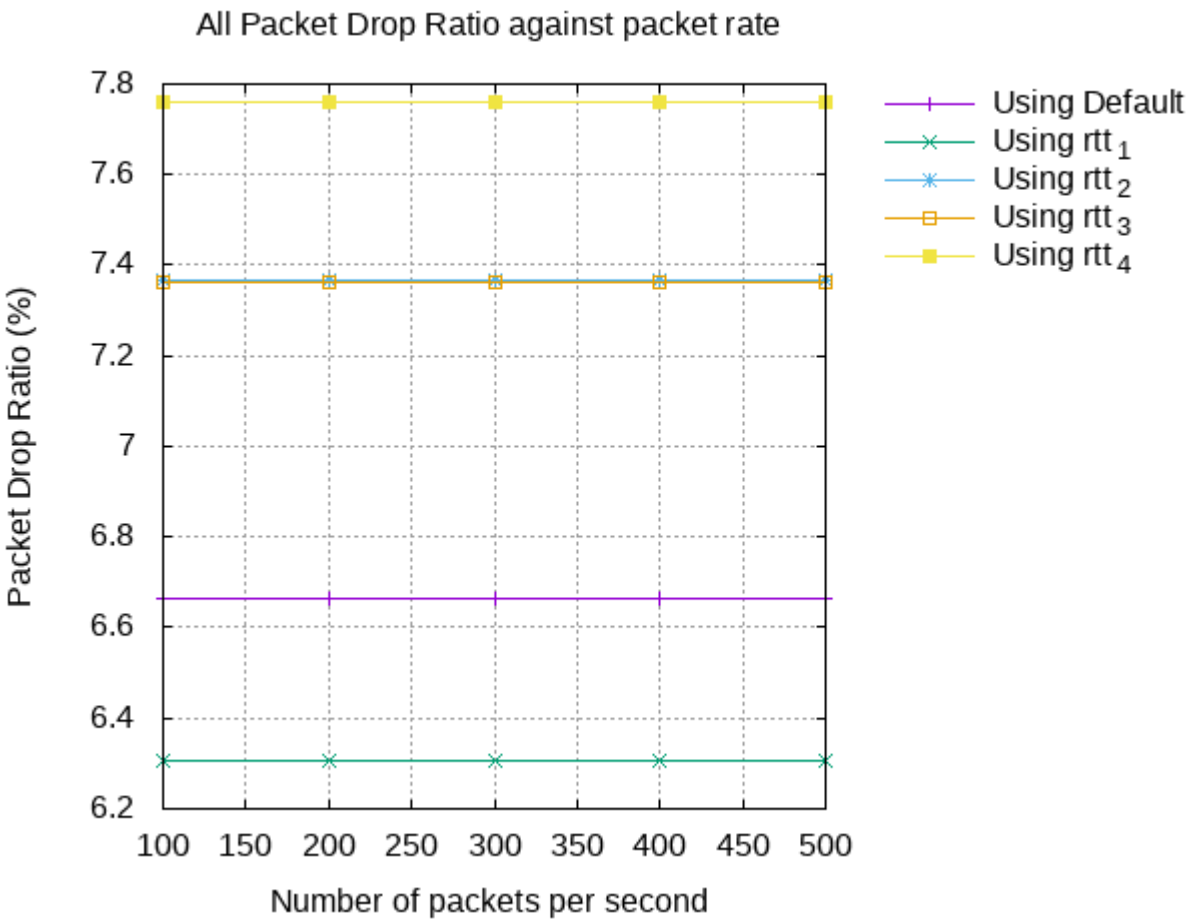
PacketsPerSecVarying EnergyConsumption



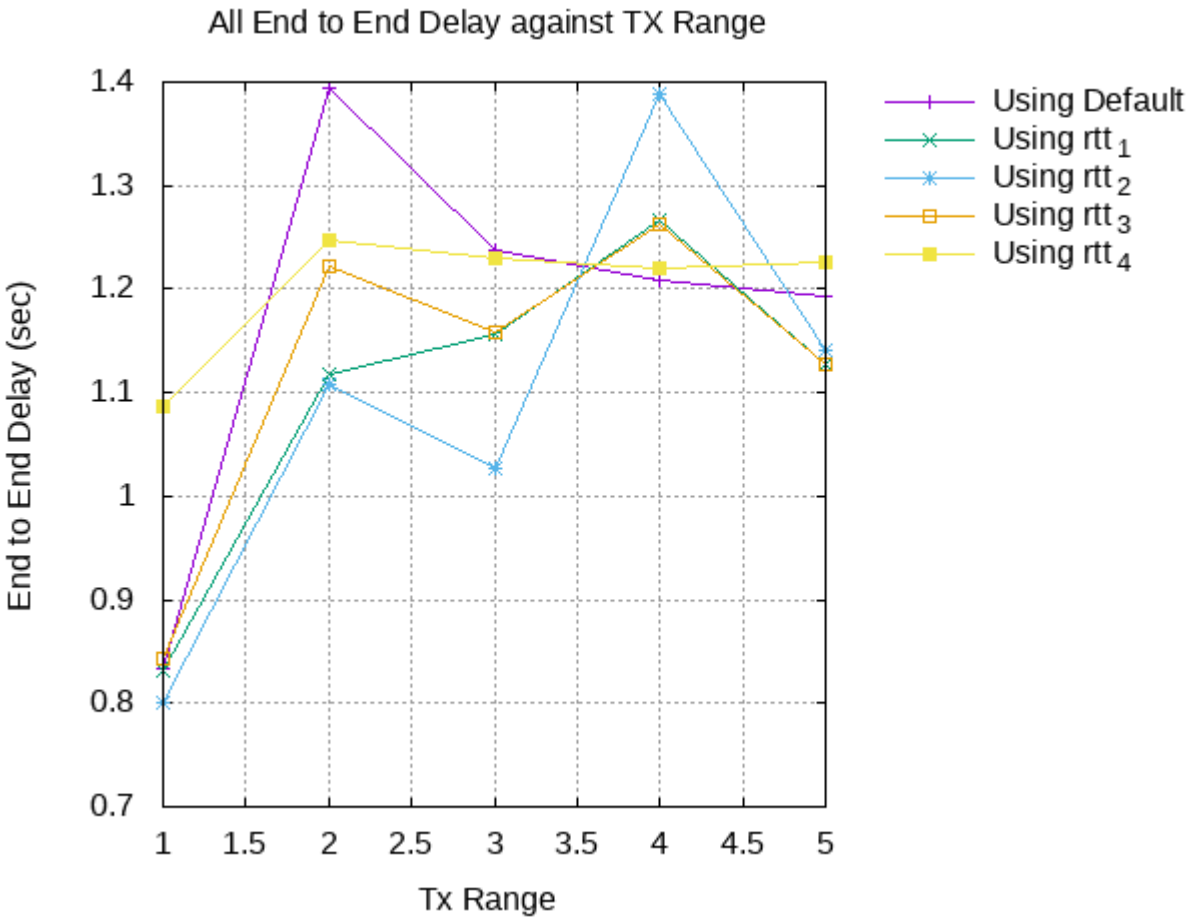
PacketsPerSecVarying NetworkThroughput



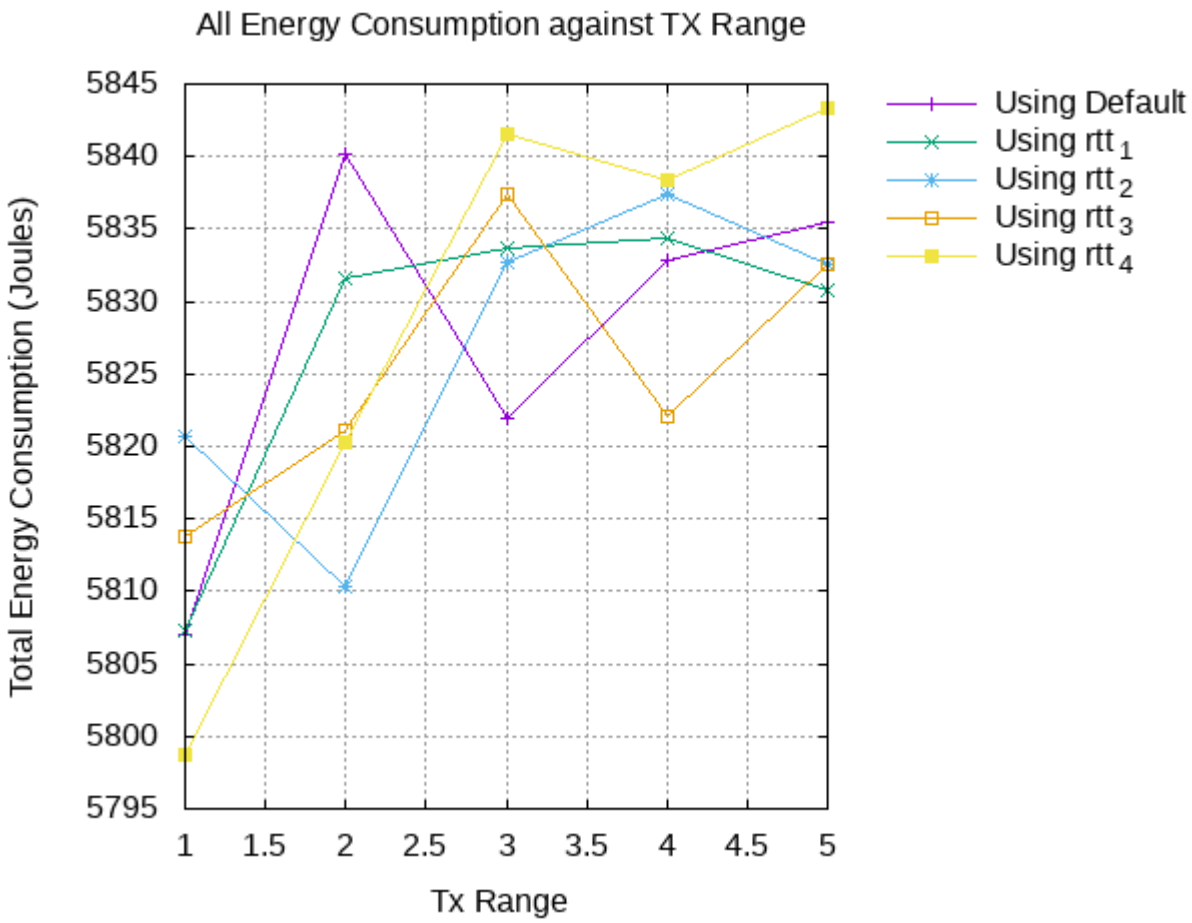
PacketsPerSecVarying PacketDeliveryRatio



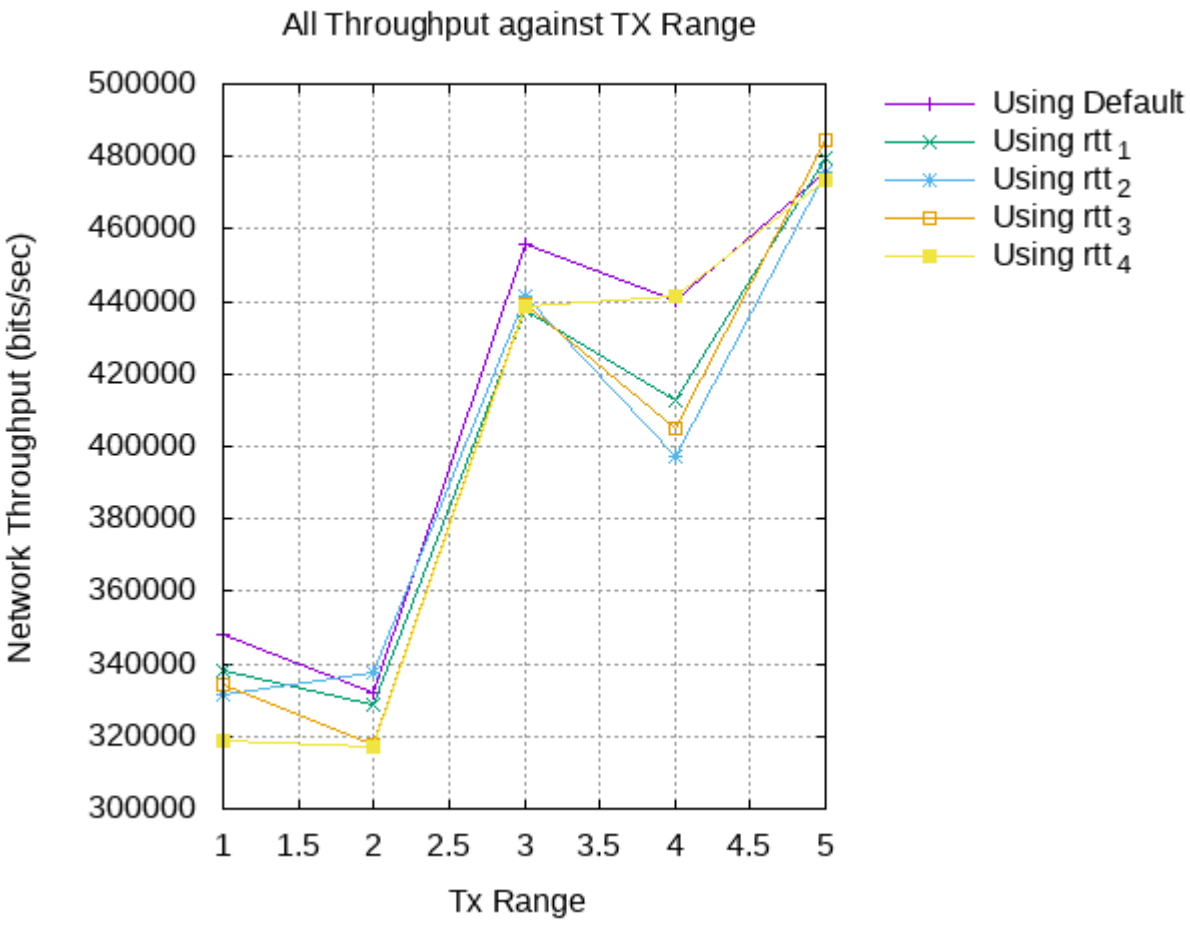
PacketsPerSecVarying PacketDropRatio



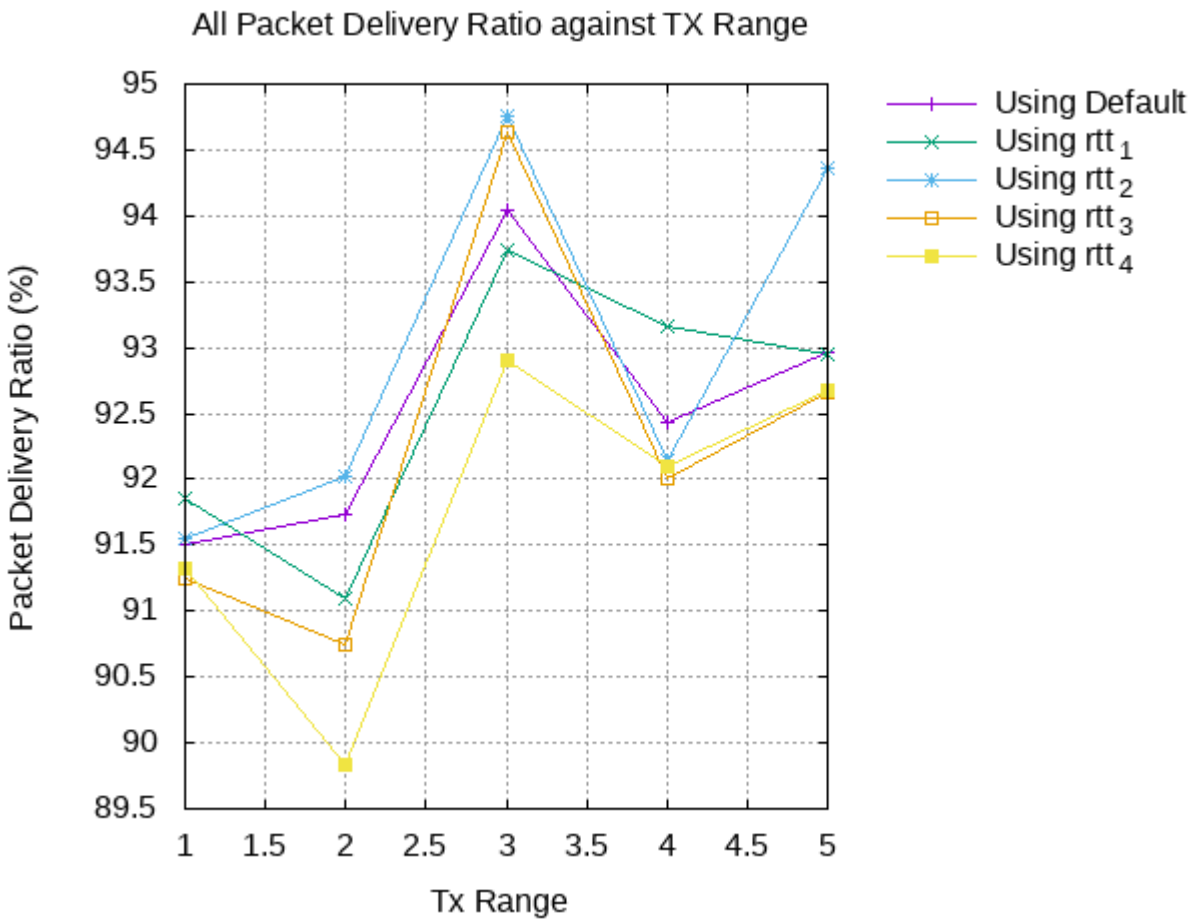
TxRangeVarying EndToEndDelay



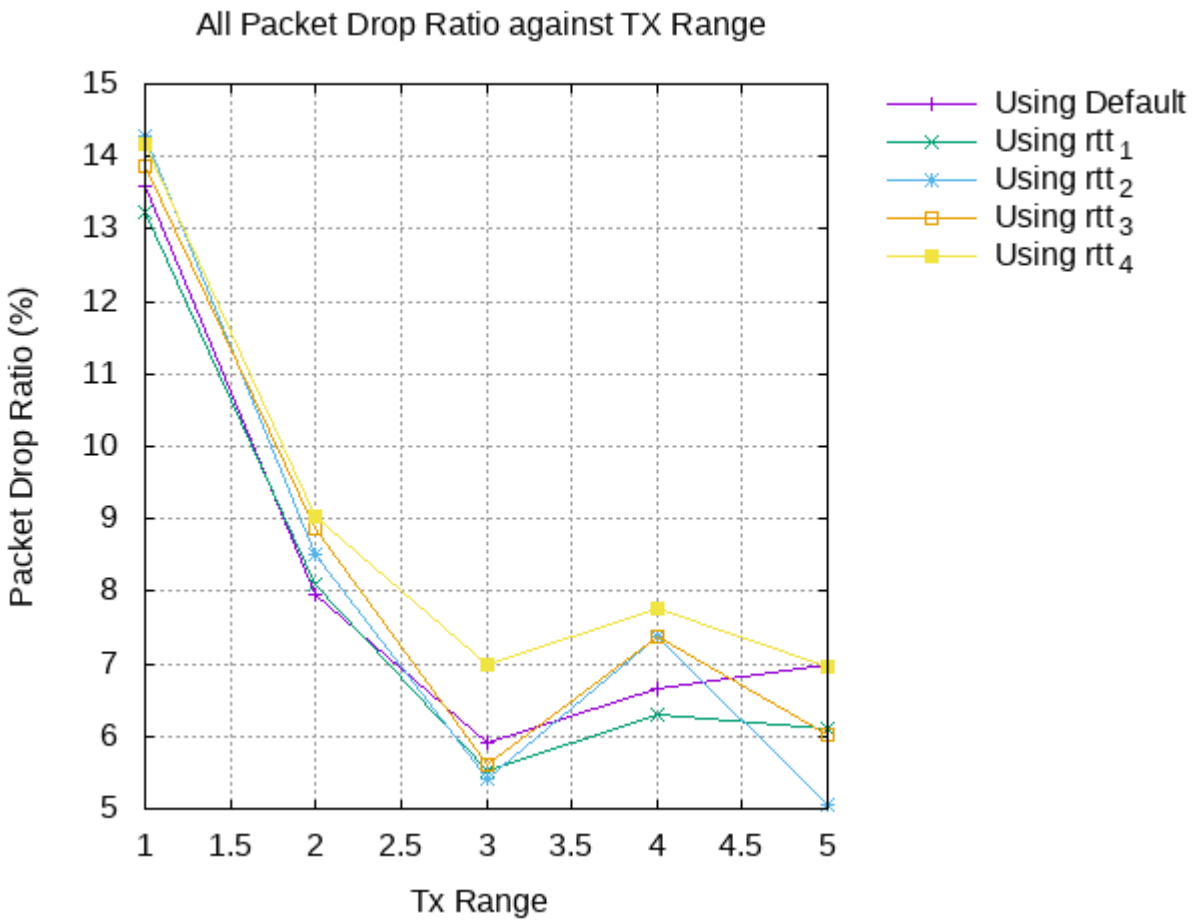
TxRangeVarying EnergyConsumption



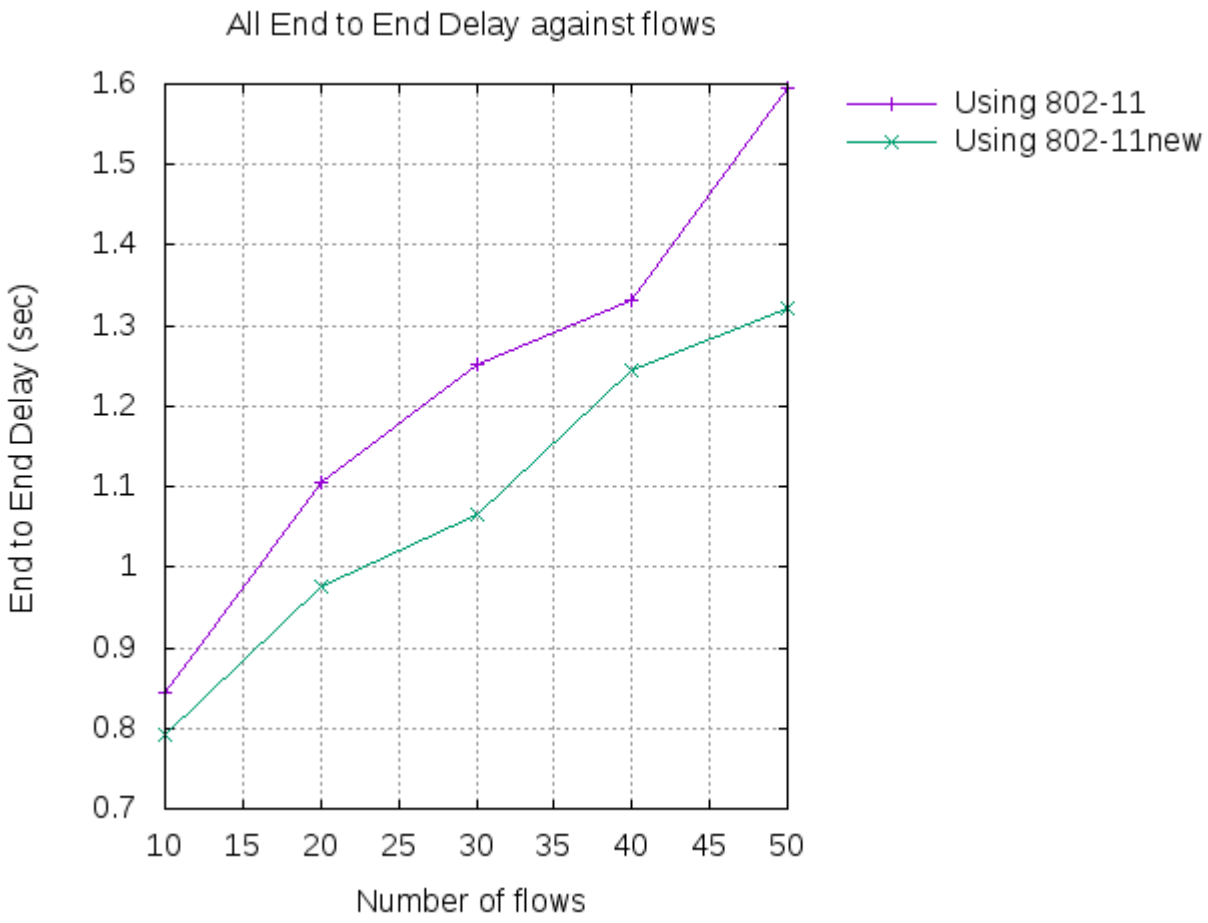
TxRangeVarying NetworkThroughput



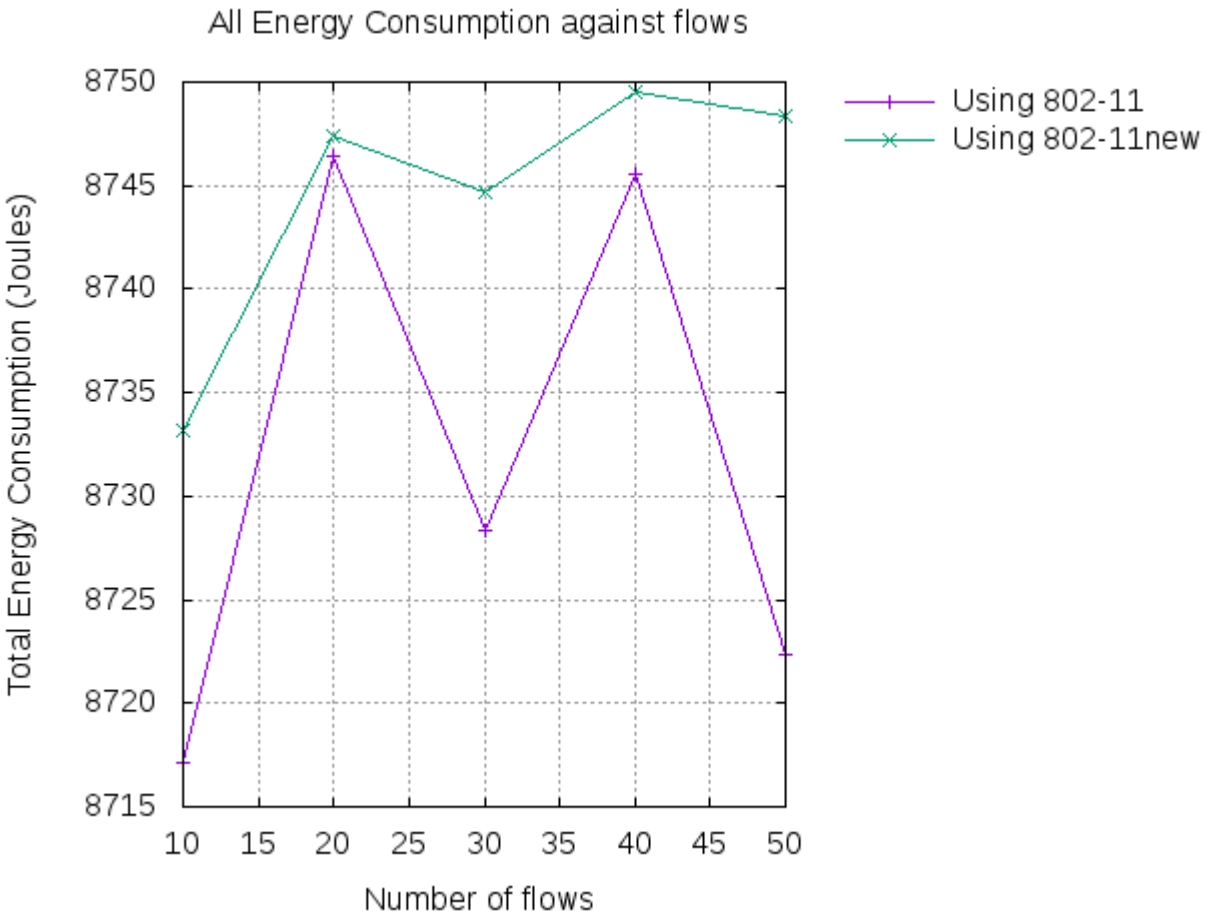
TxRangeVarying PacketDeliveryRatio



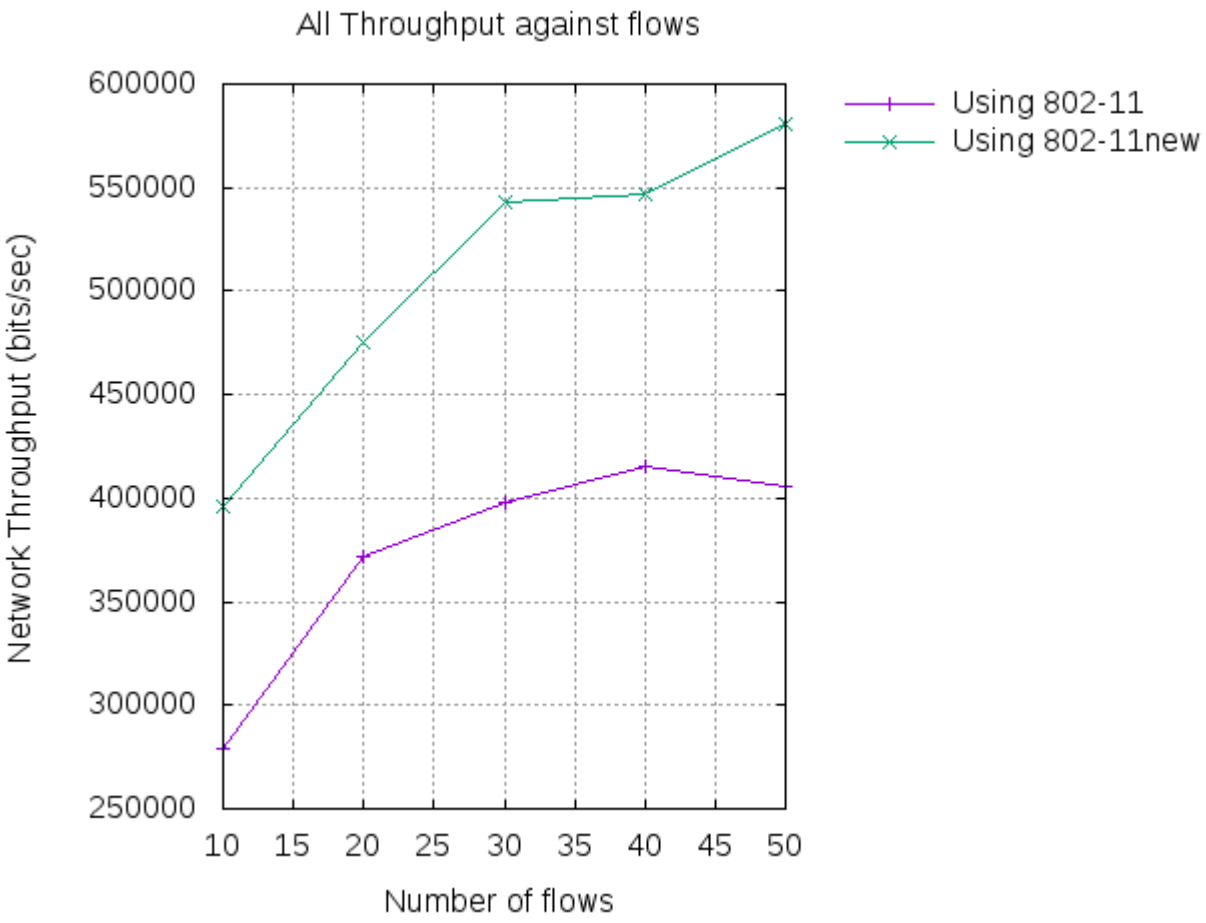
TxRangeVarying PacketDropRatio



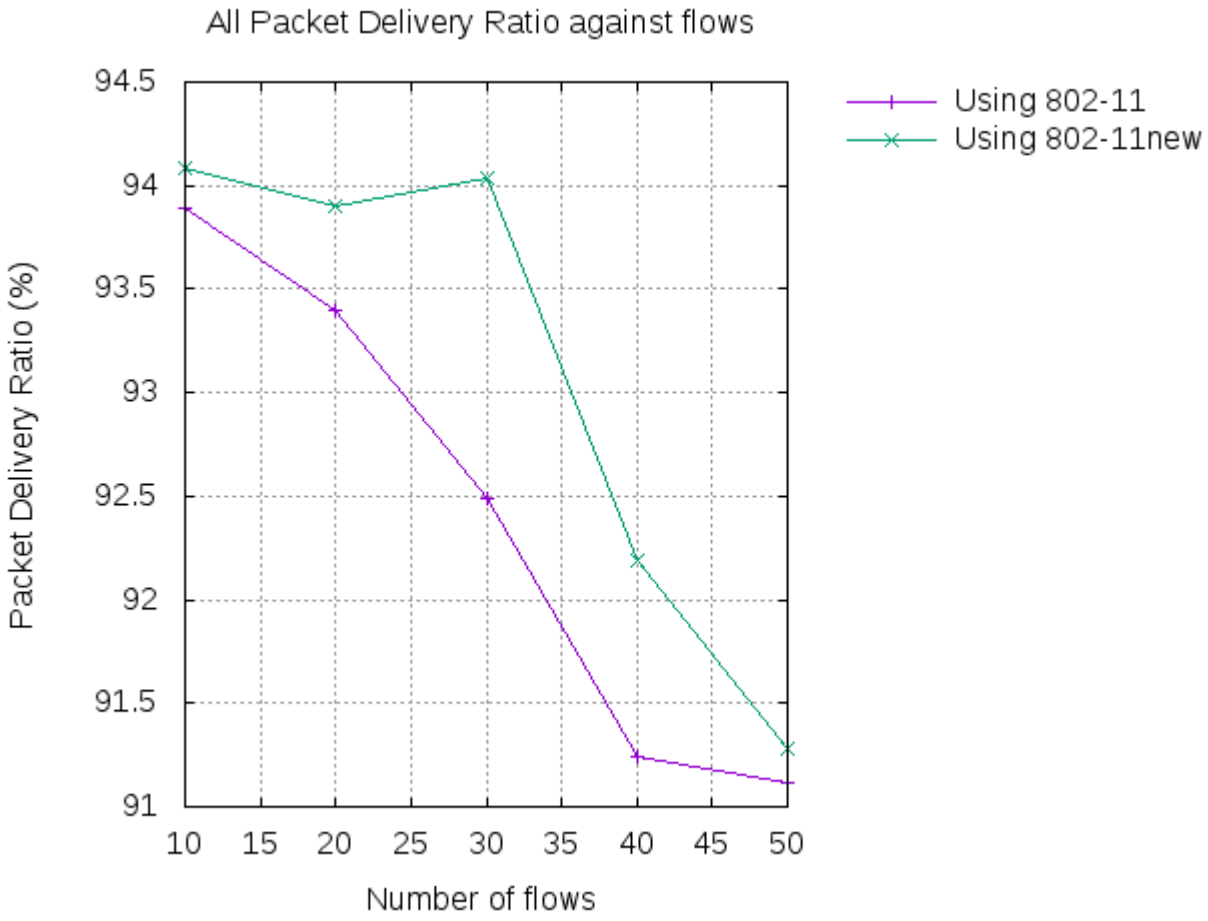
End-End Delay with varying Flow



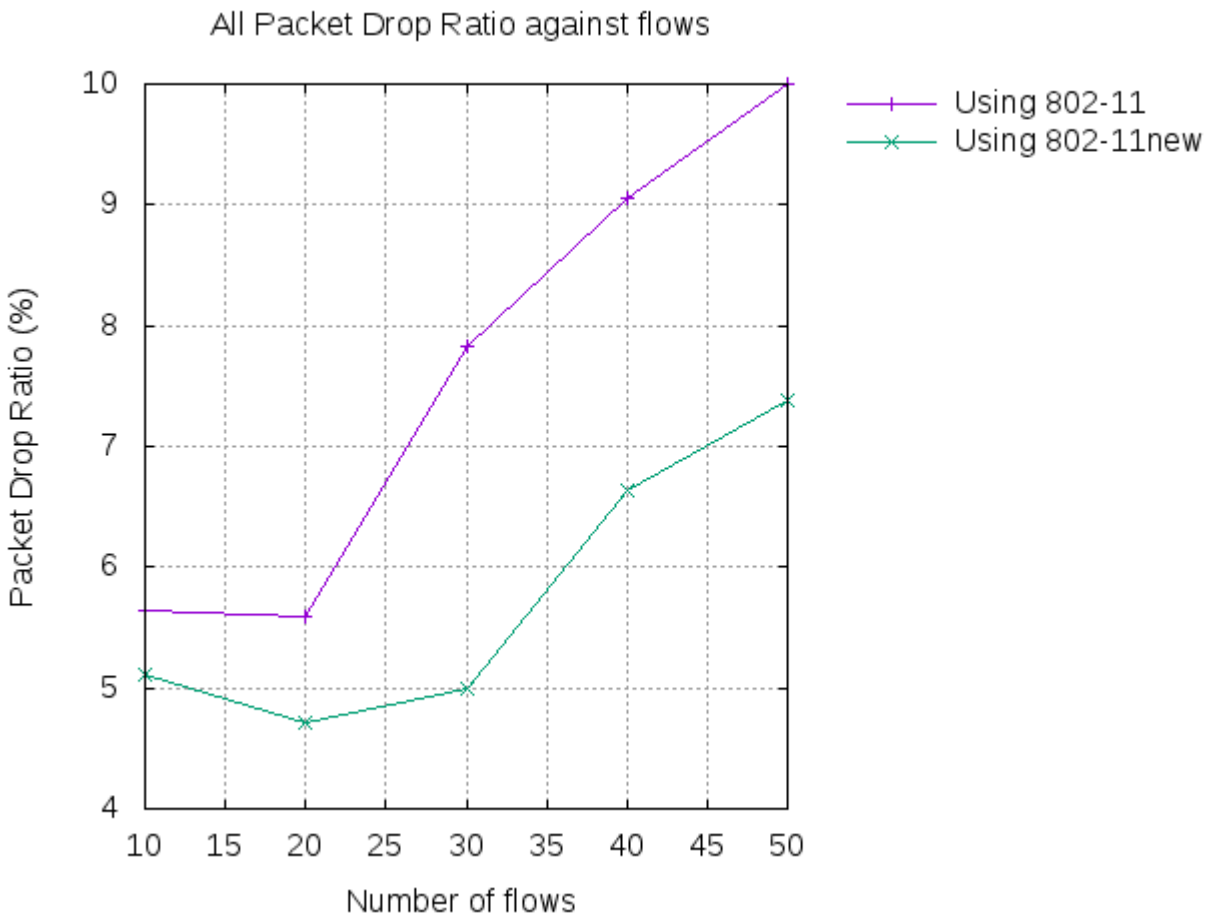
Energy Consumption with varying Flow



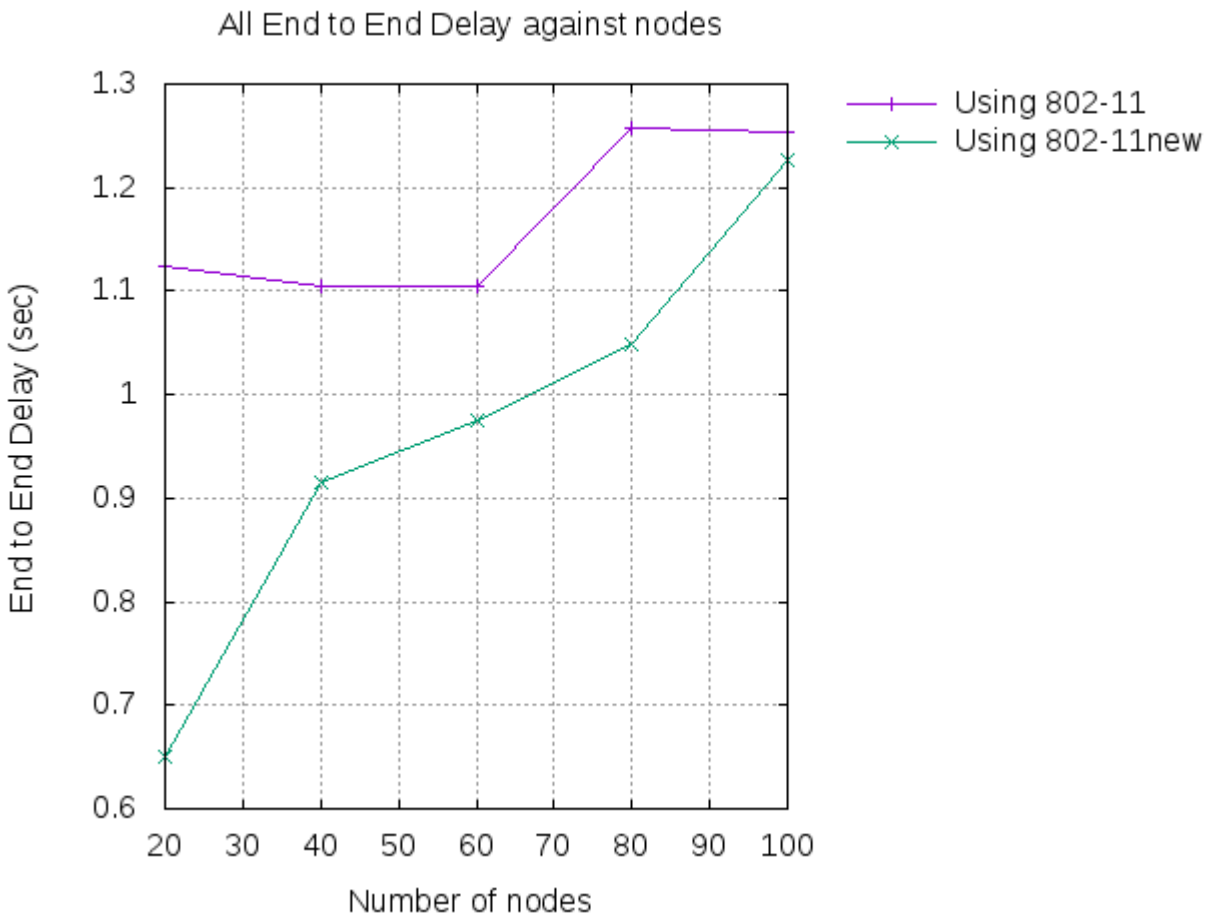
Network Throughput with varying Flow



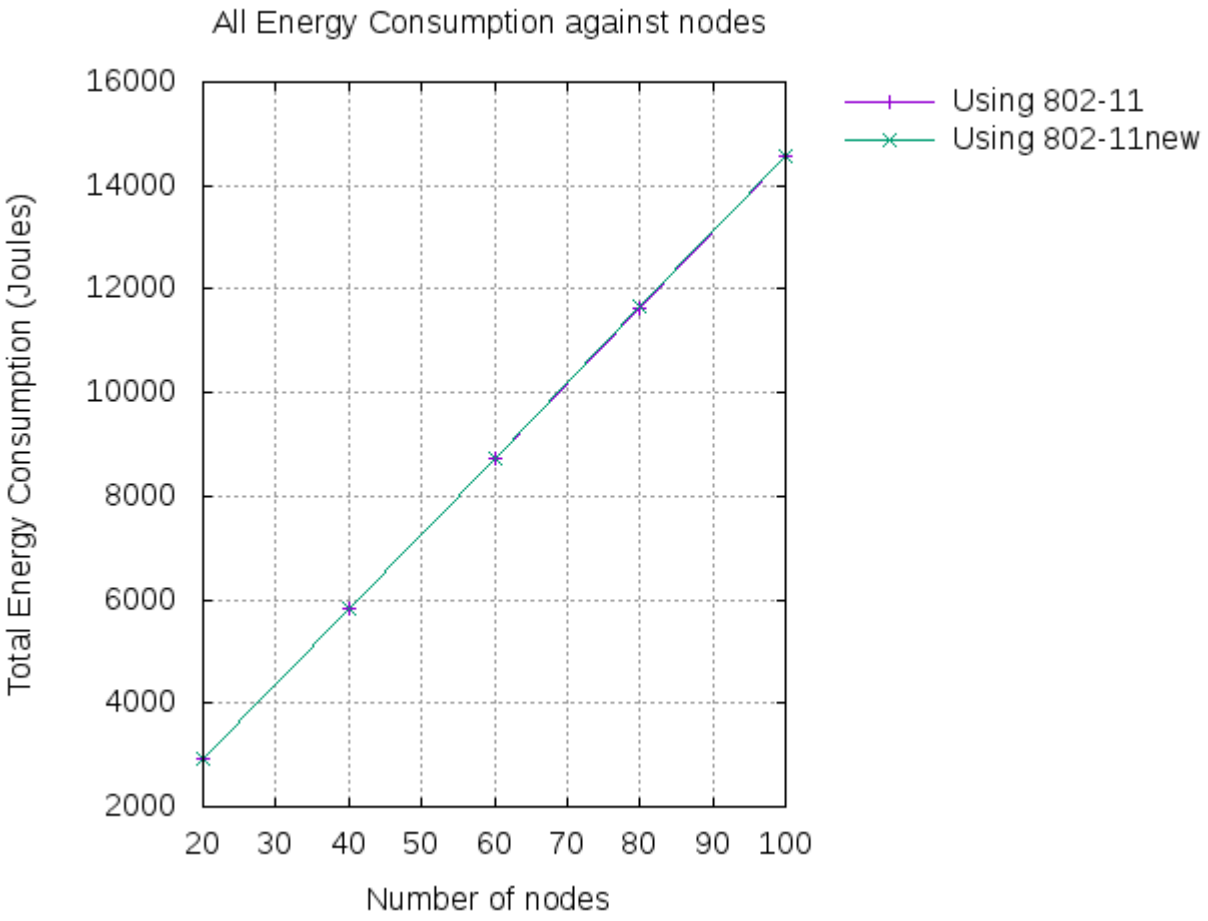
Packet Delivery Ratio with varying Flow



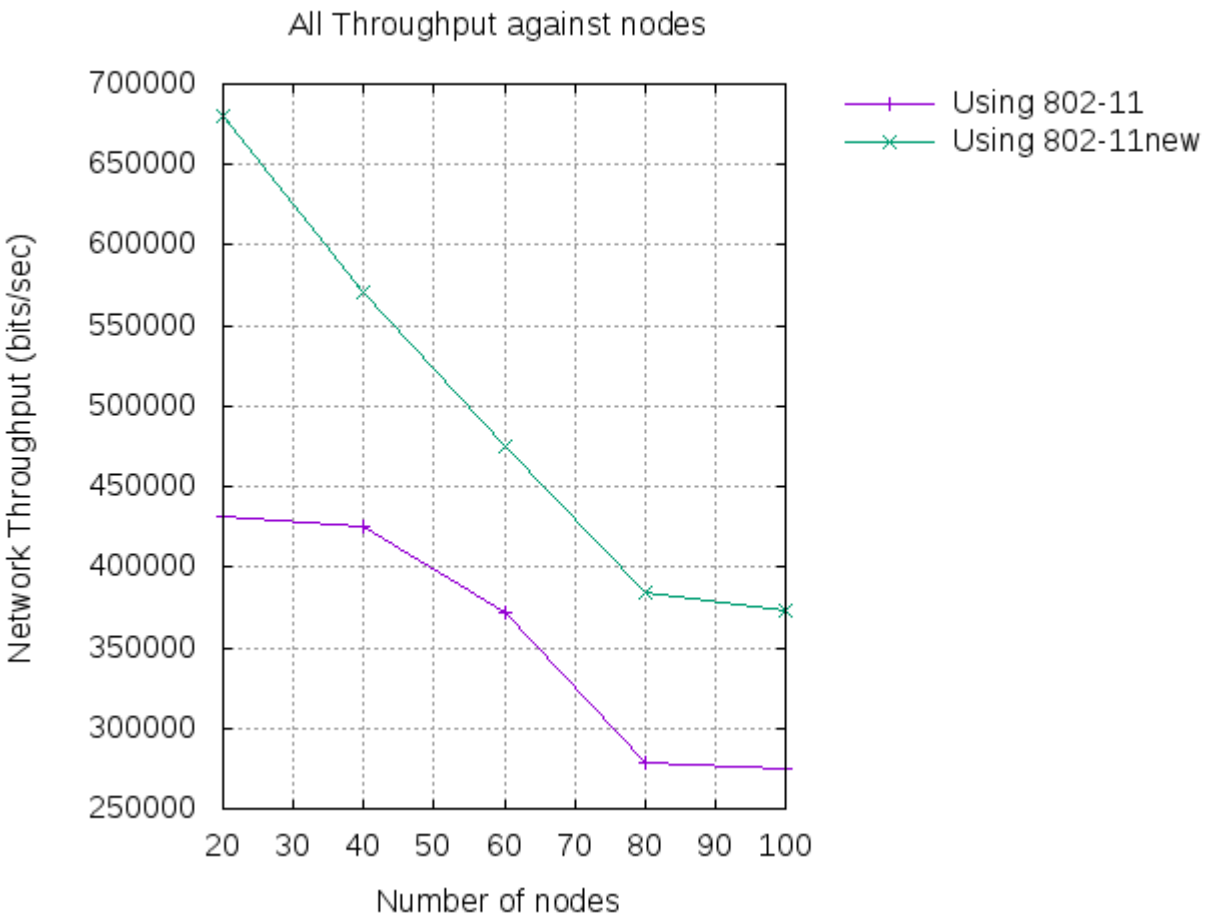
Packet Drop Ratio with varying Flow



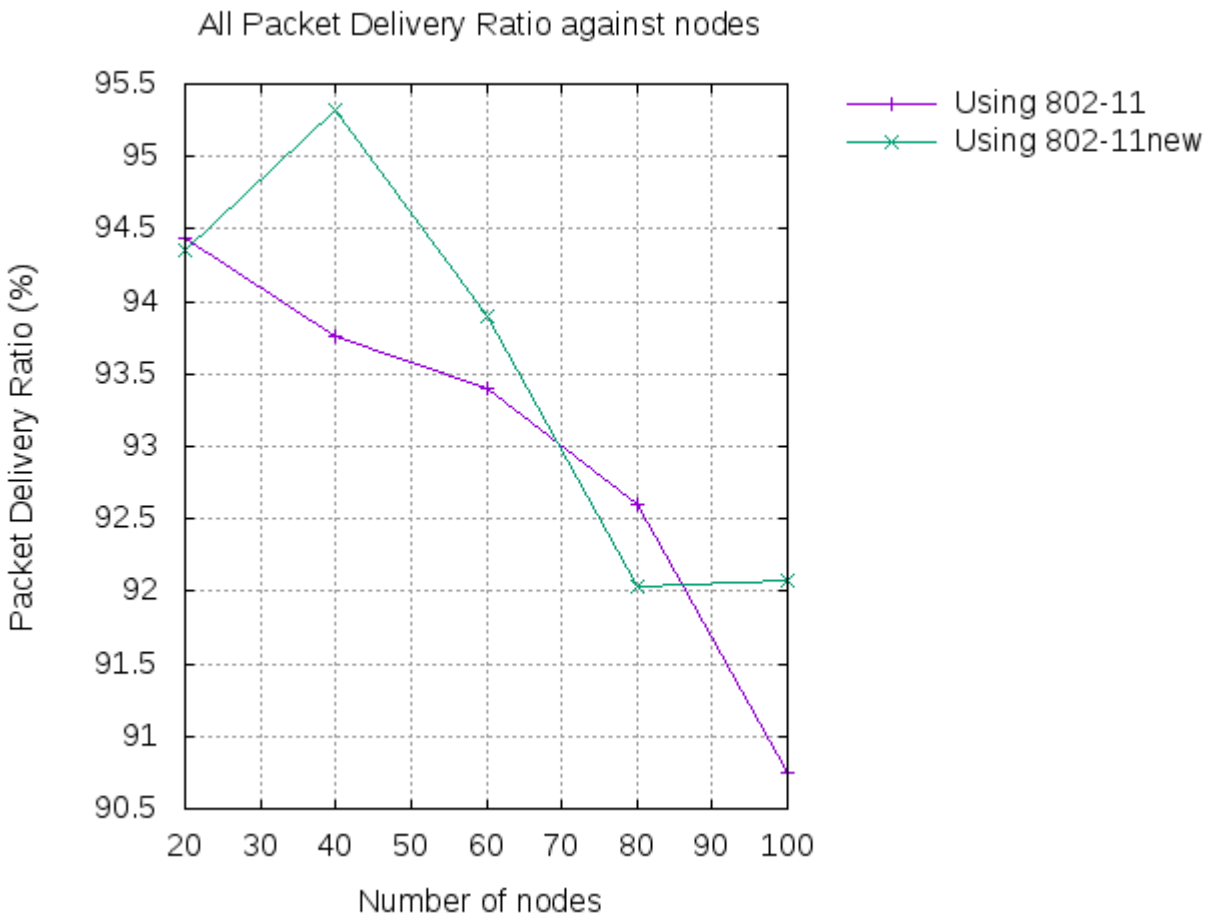
End-End Delay with varying nodes



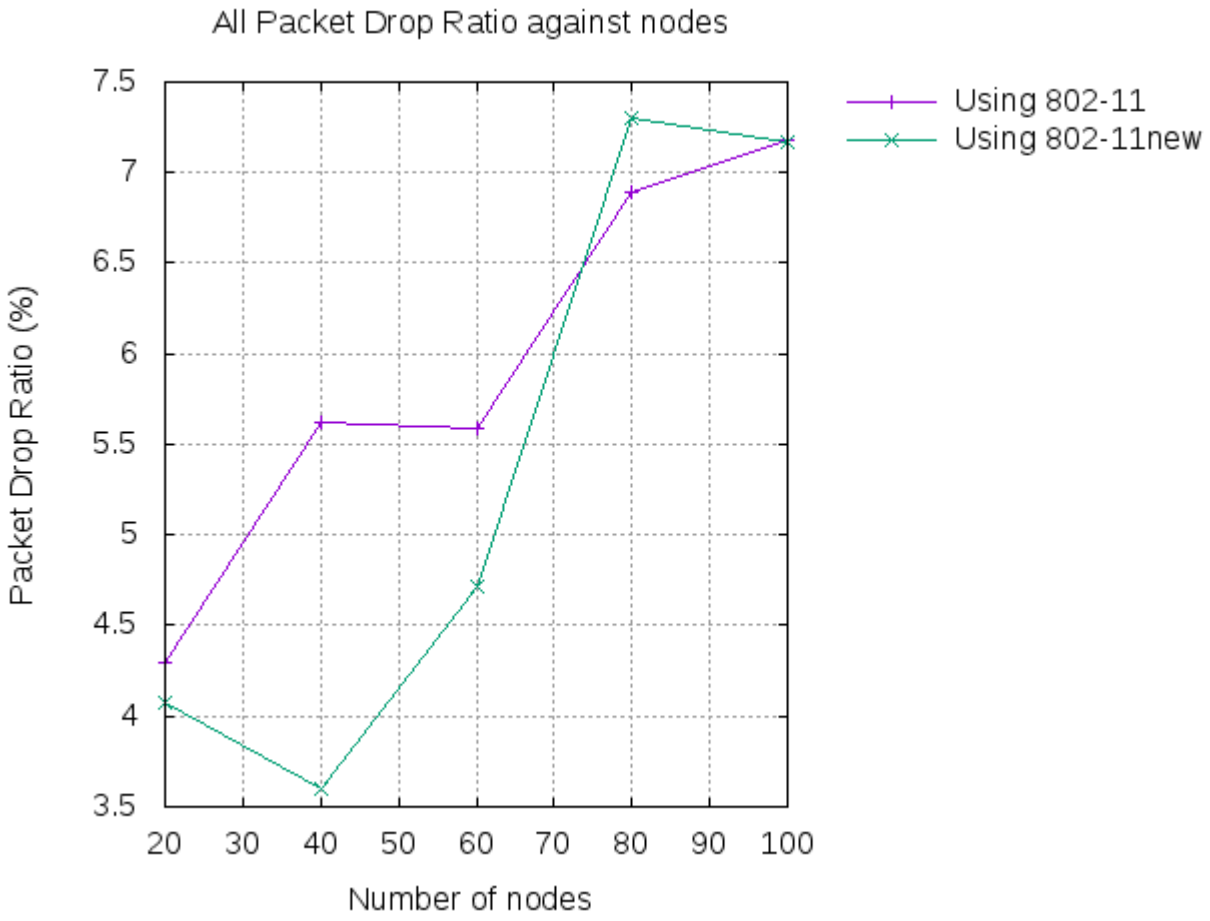
Energy Consumption with varying nodes



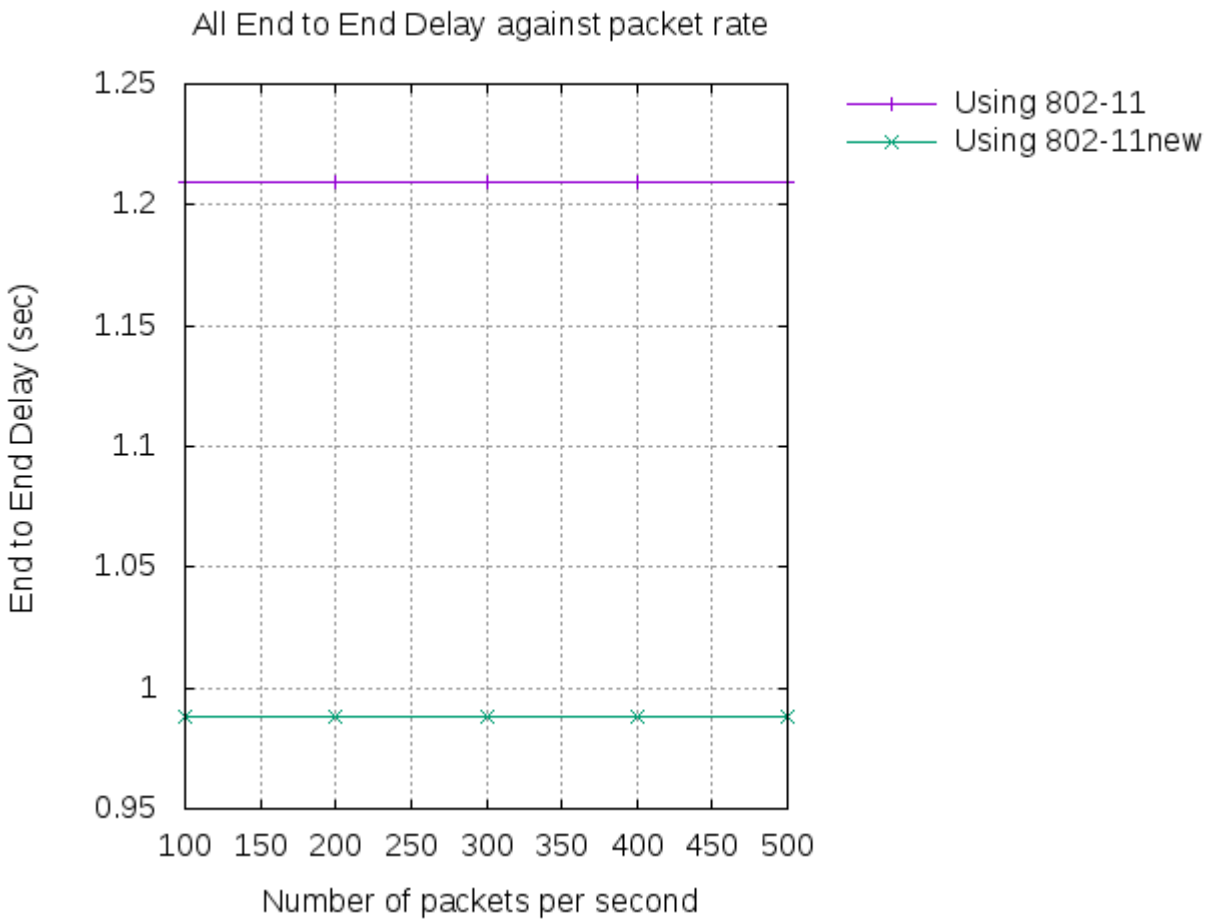
Network Throughput with varying nodes



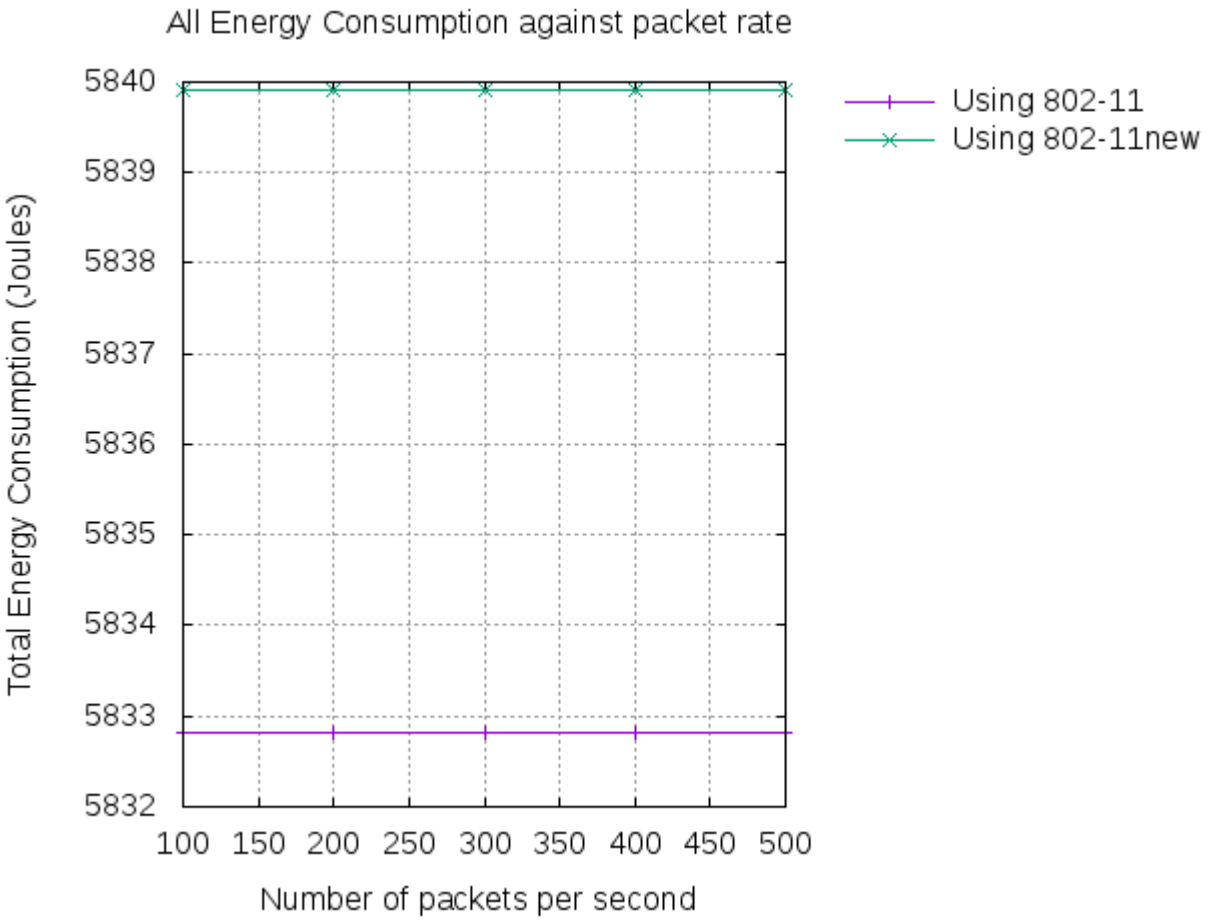
Packet Delivery Ratio with varying nodes



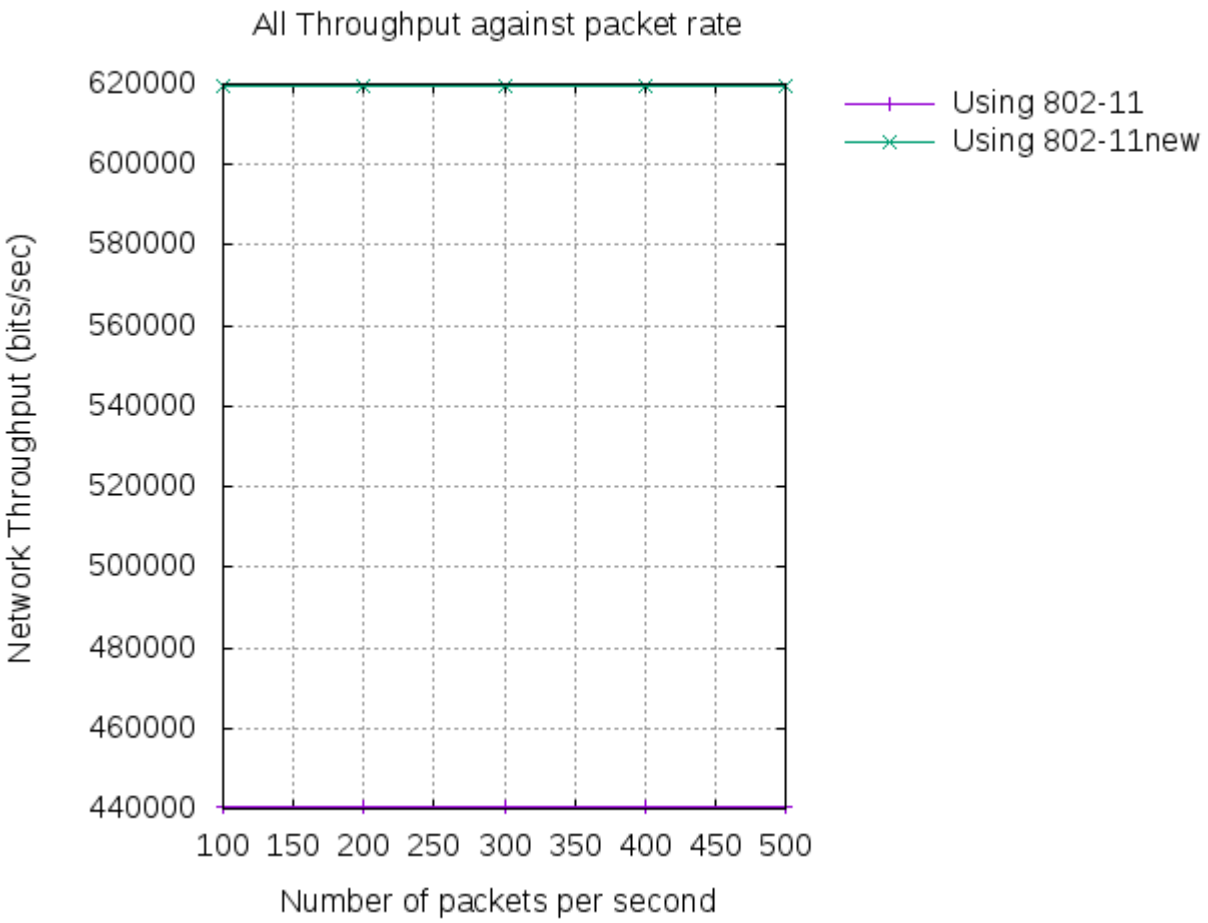
Packet Drop Ratio with varying nodes



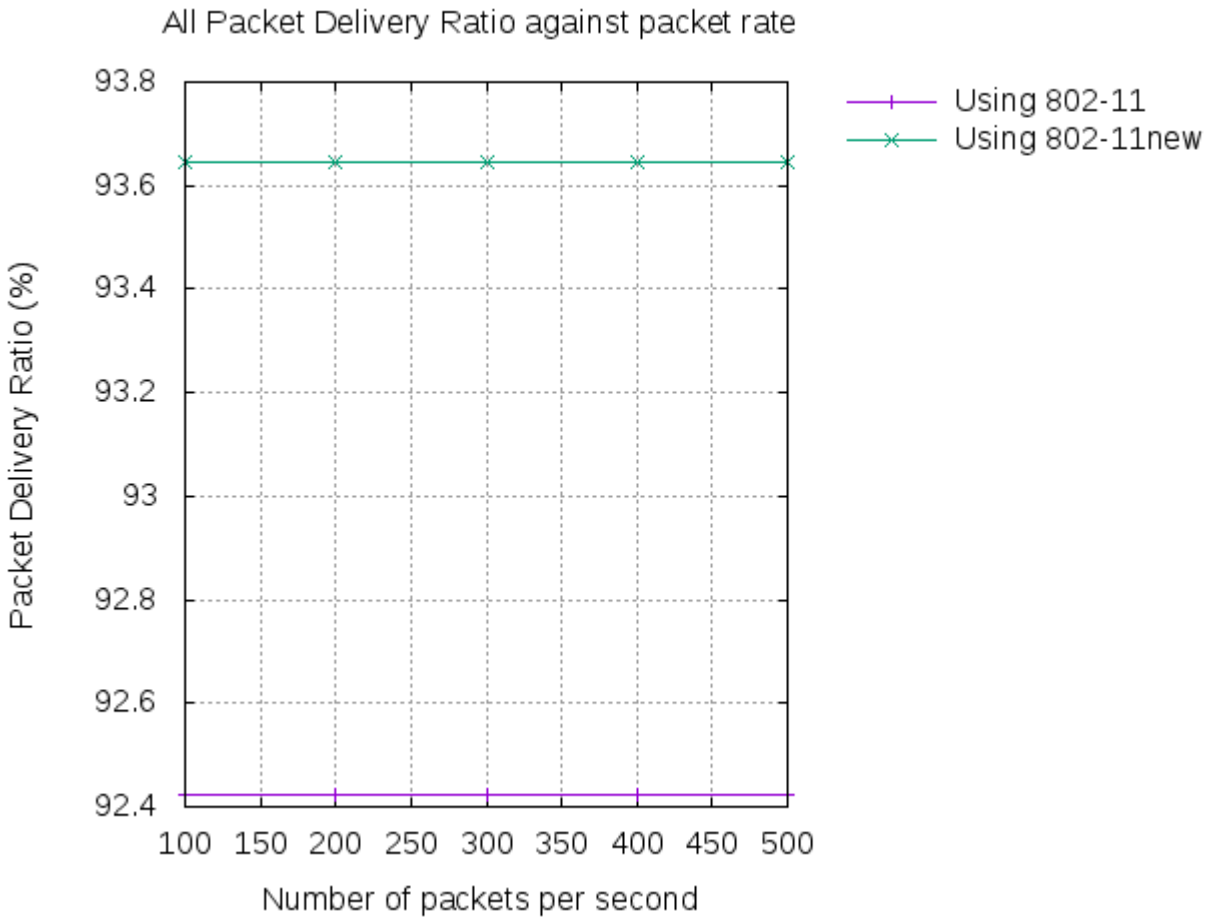
End-End Delay with varying packet rate



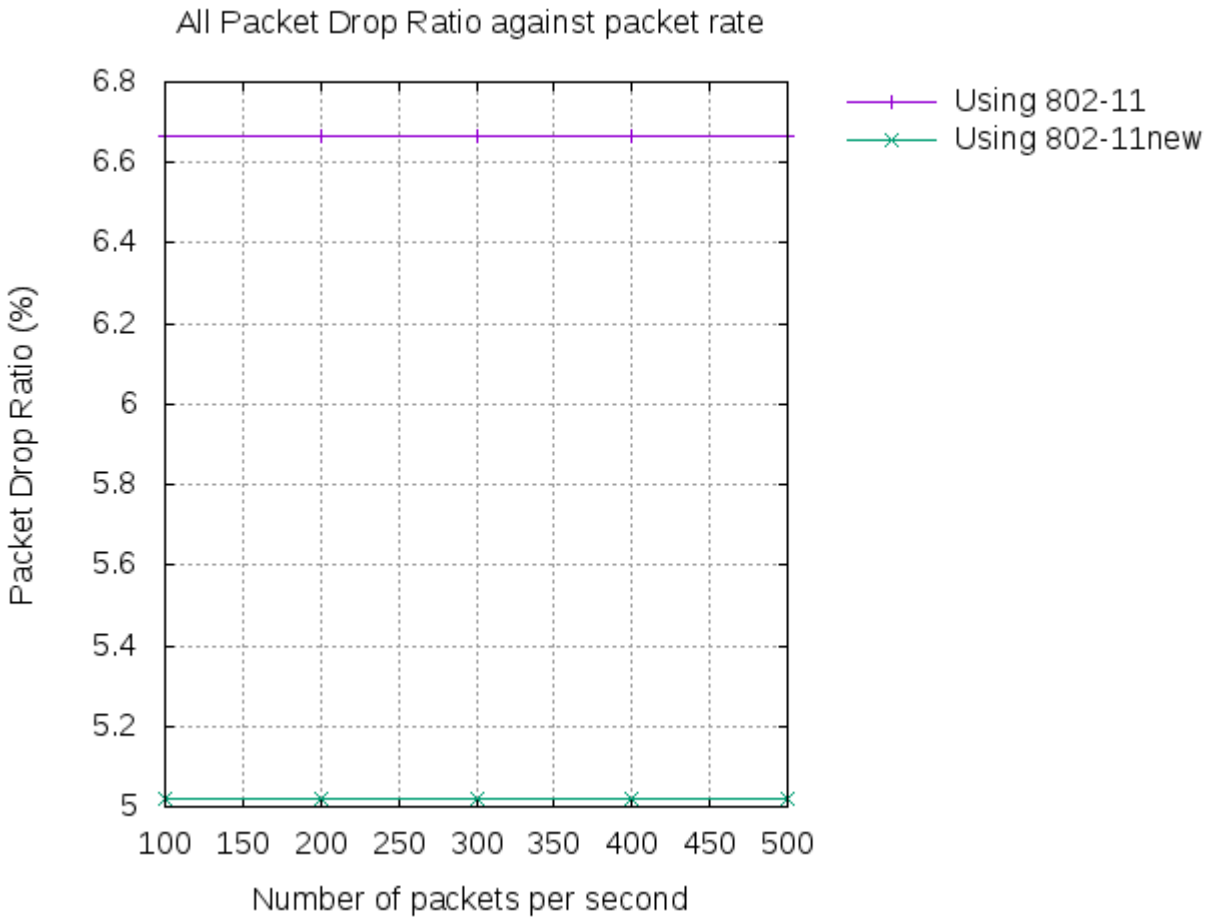
Energy Consumption with varying packet rate



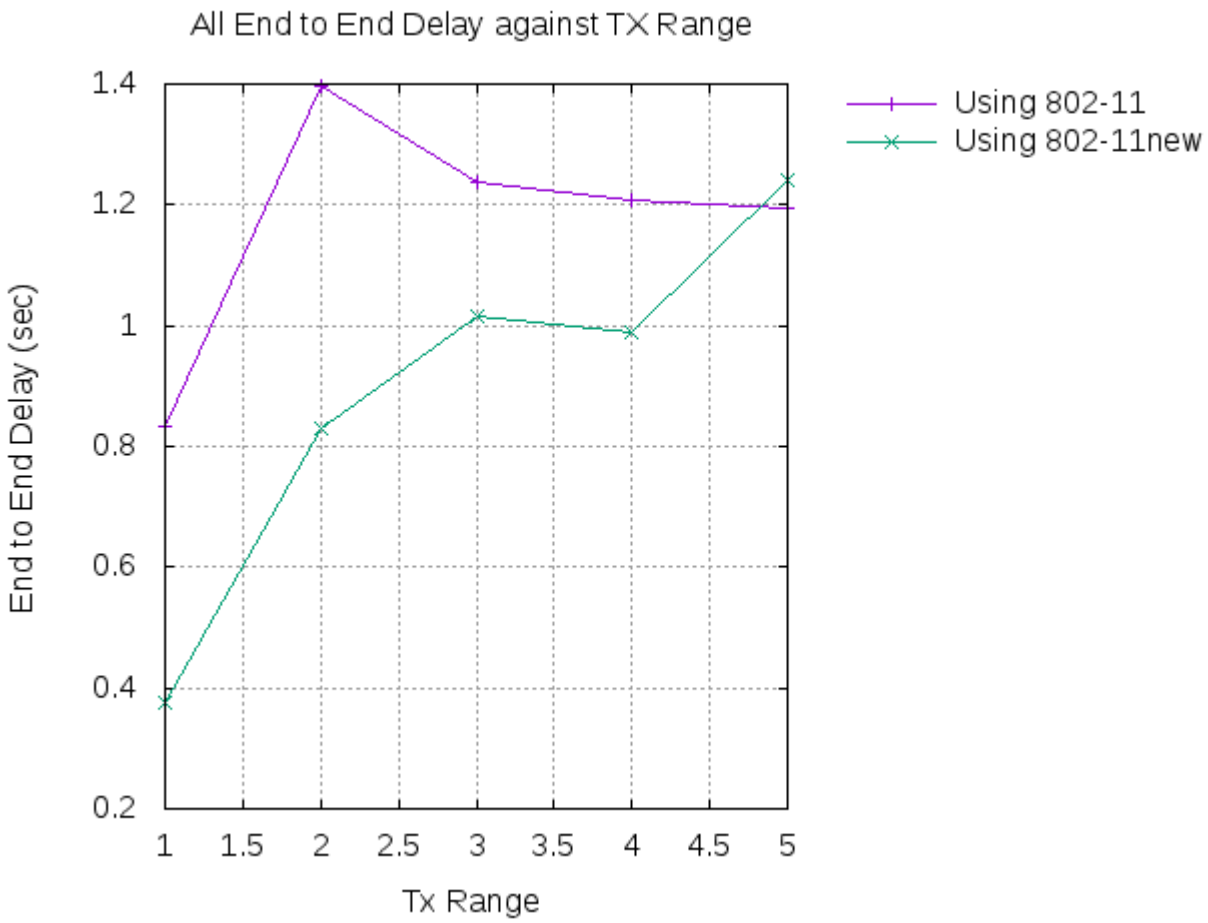
Network Throughput with varying packet rate



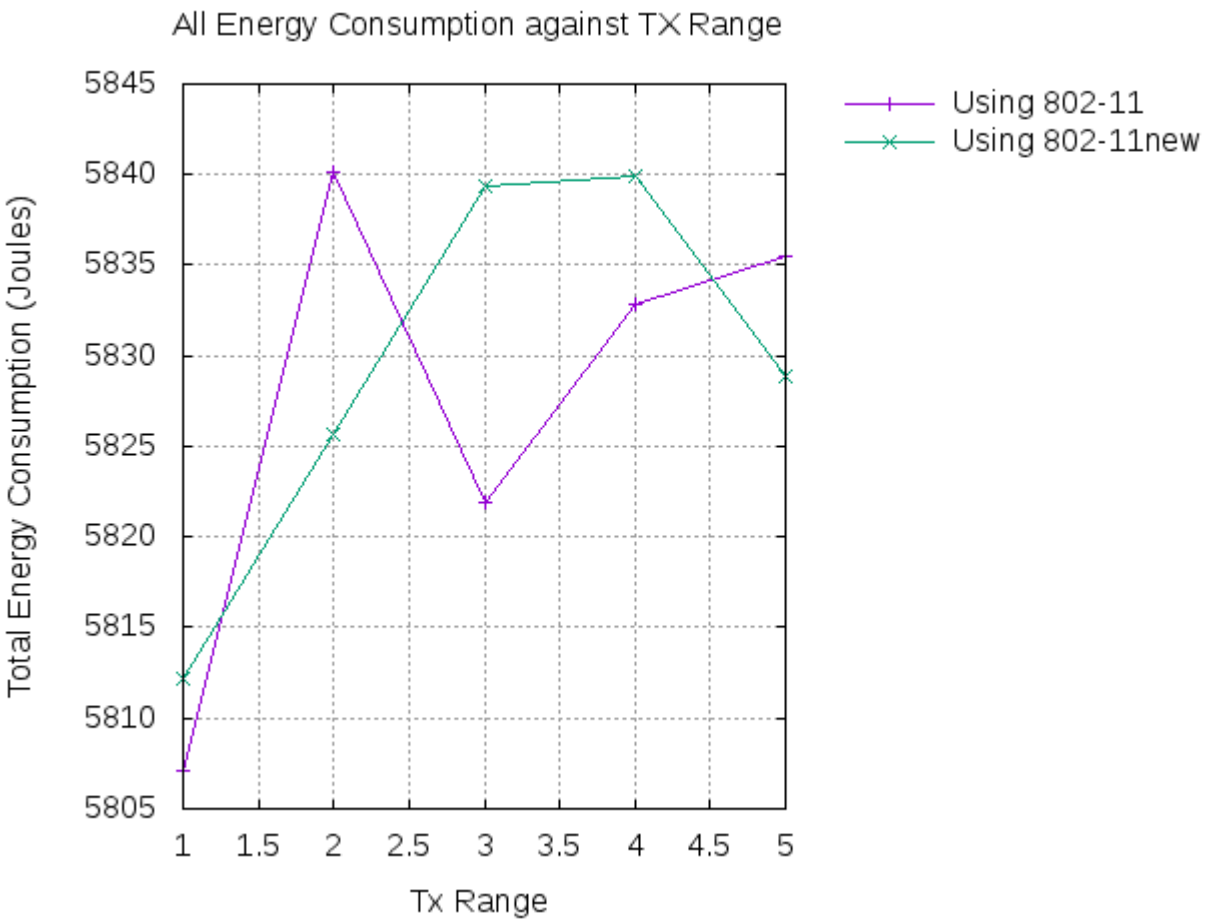
Packet Delivery Ratio with varying packet rate



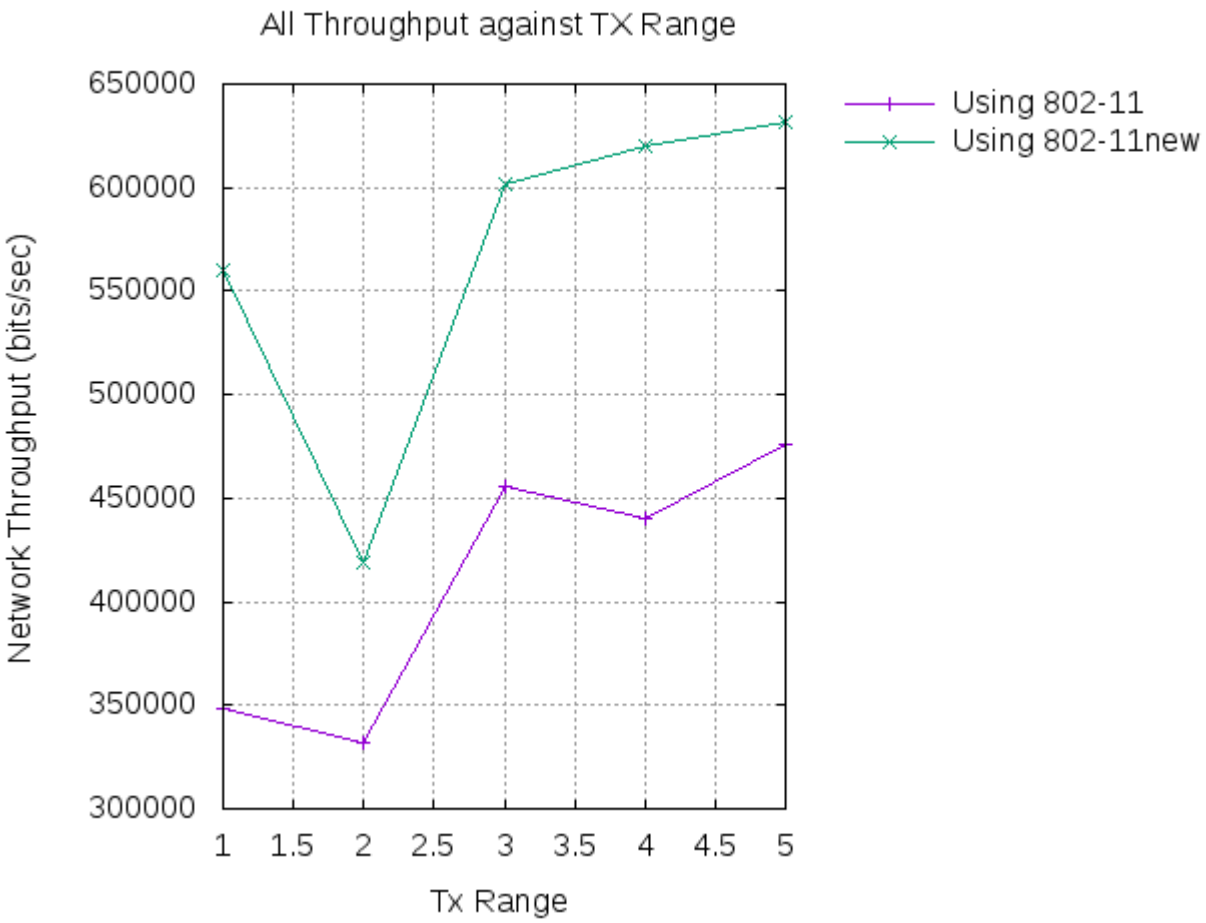
Packet Drop Ratio with varying packet rate



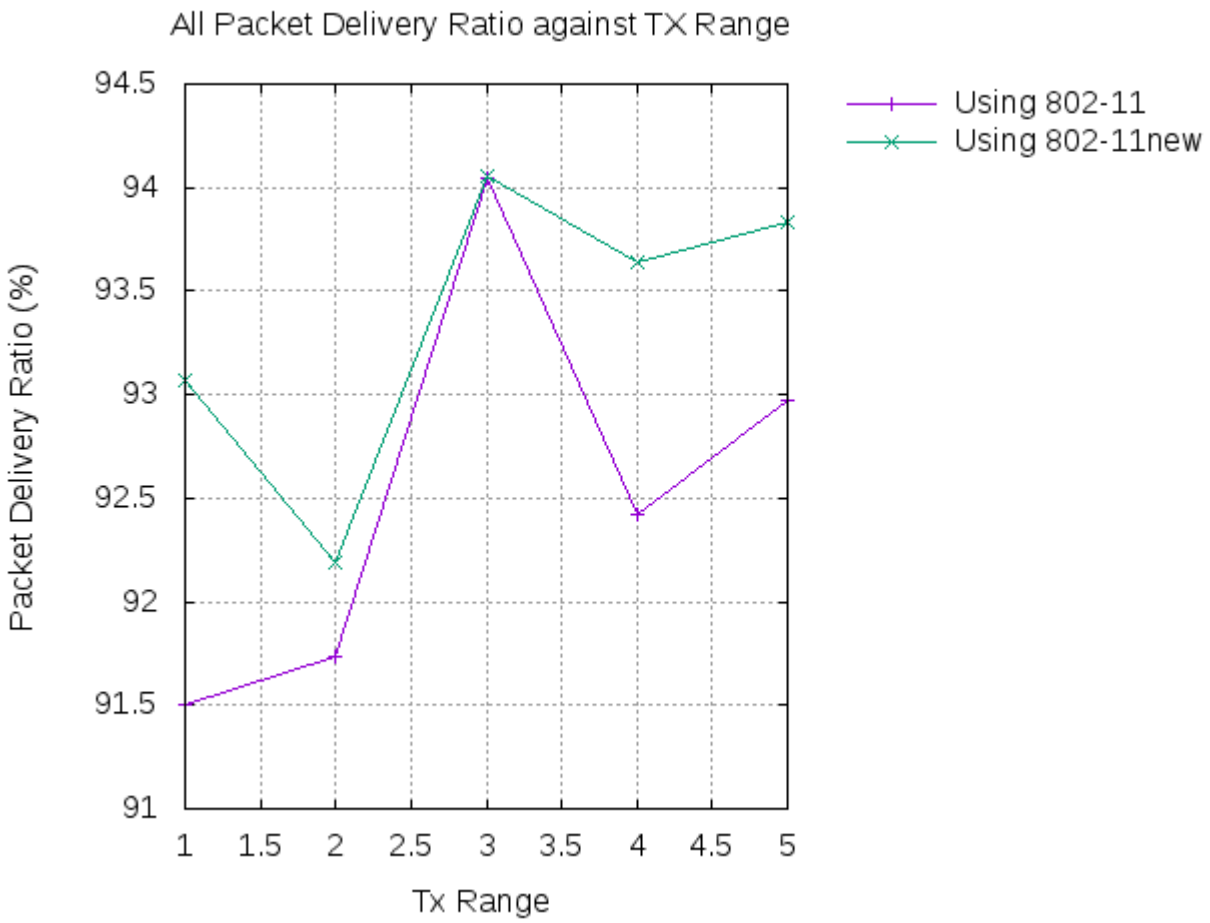
End-End Delay with varying Coverage Area



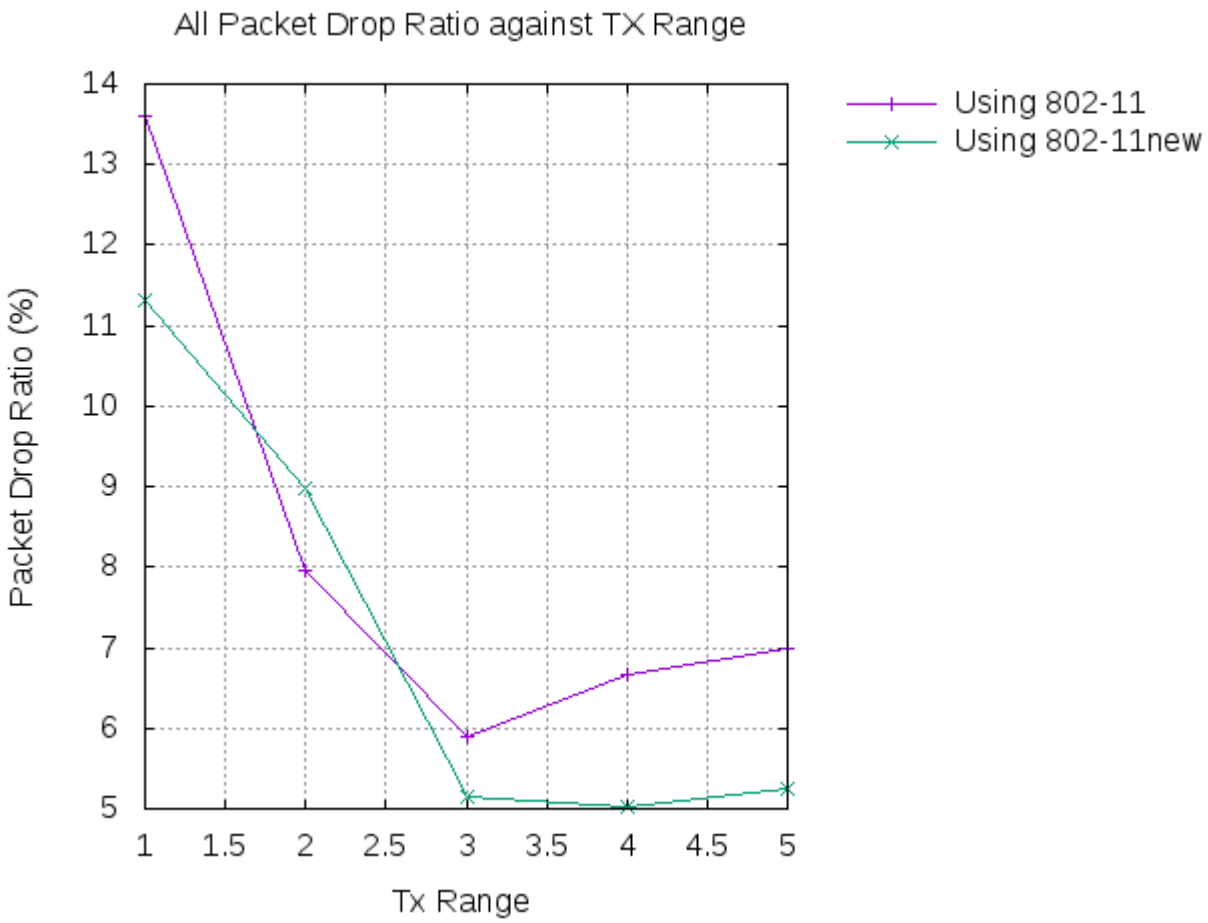
Energy Consumption with varying Coverage Area



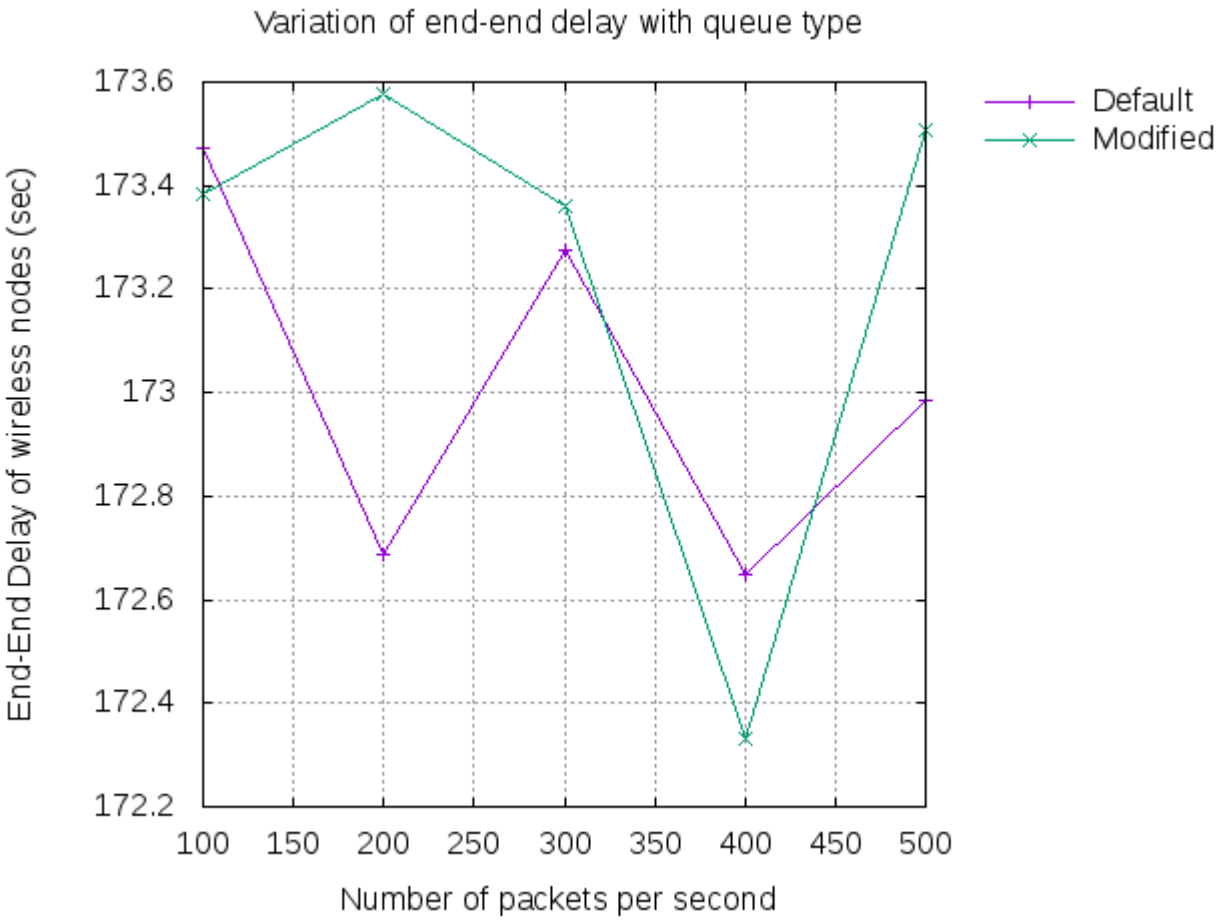
Network Throughput with varying Coverage Area



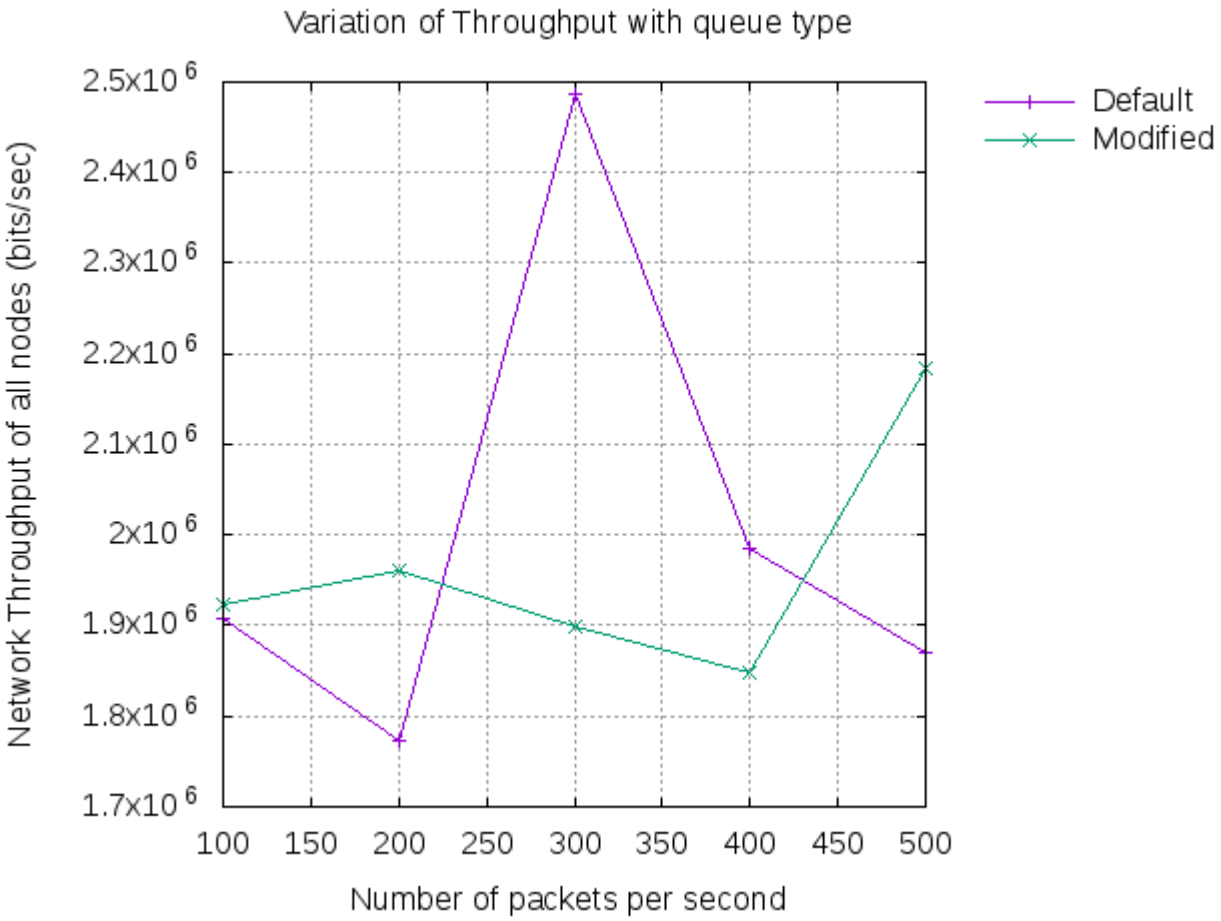
Packet Delivery Ratio with varying Coverage Area



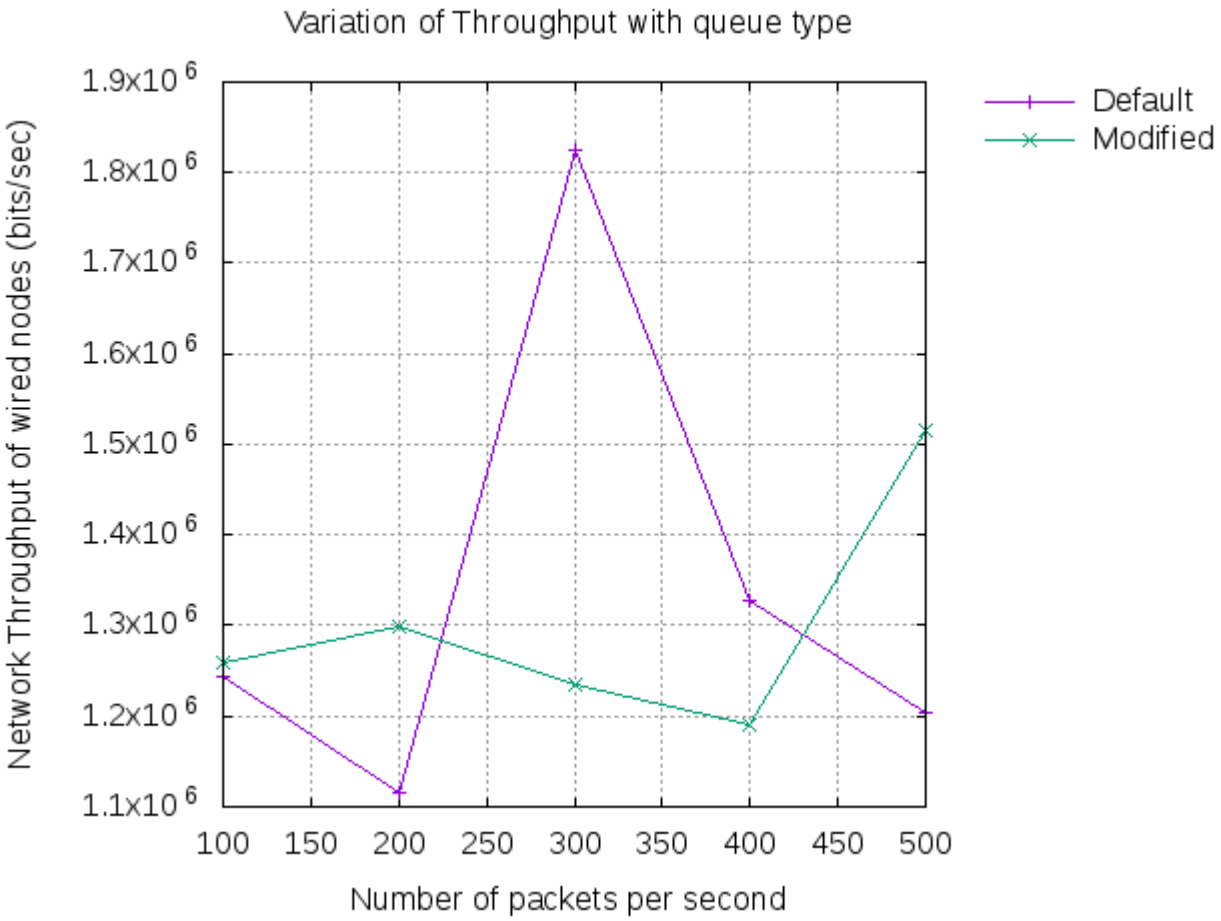
Packet Drop Ratio with varying Coverage Area



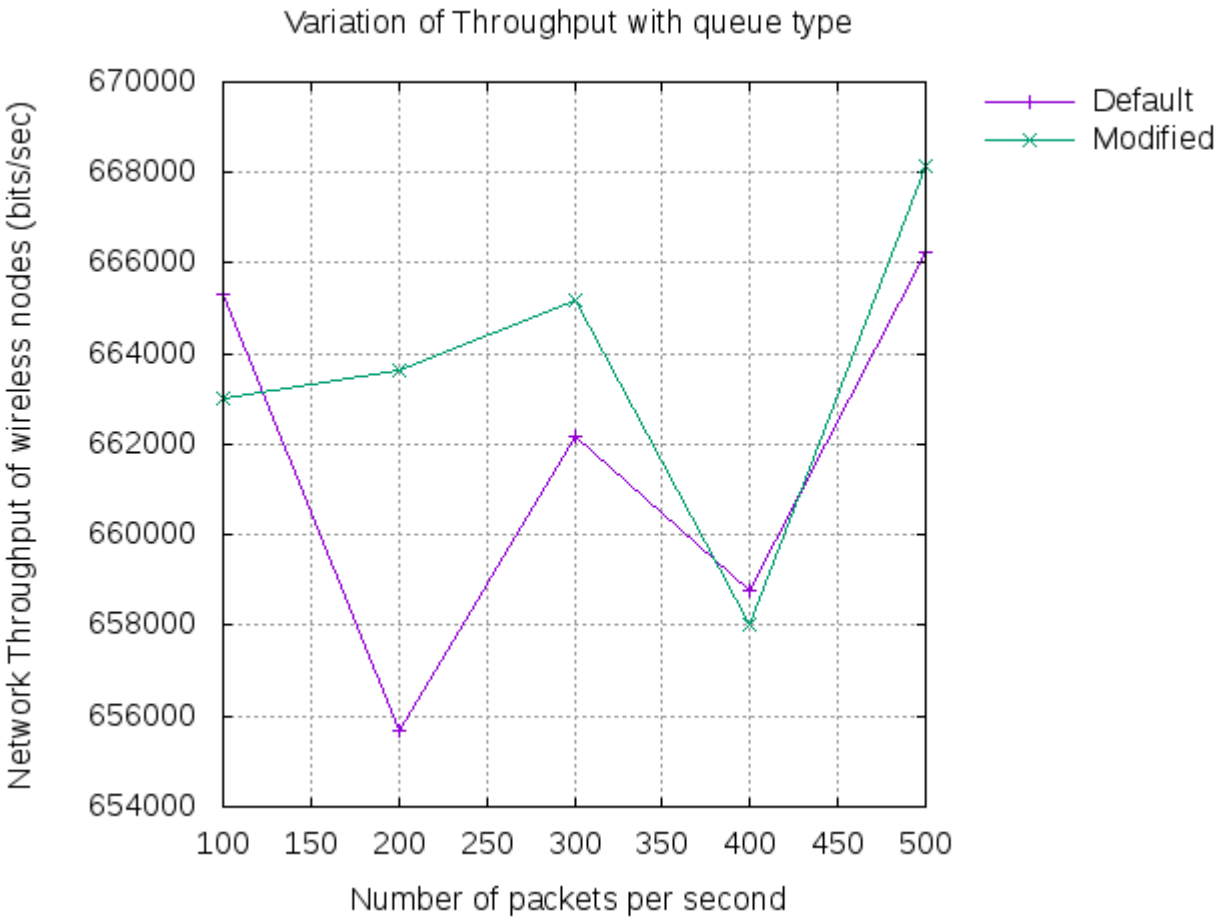
End-End Delay with varying packet rate



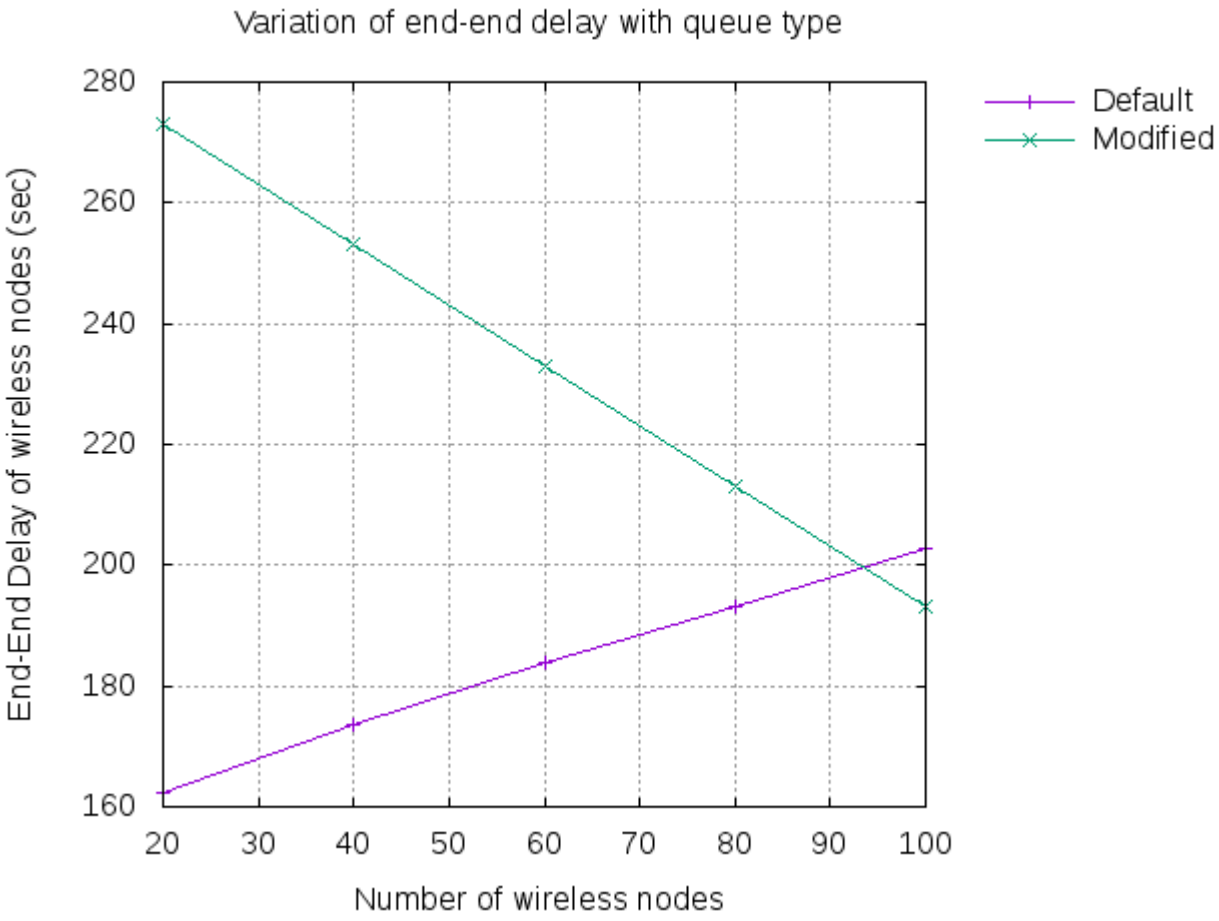
Total Throughput with varying packet rate



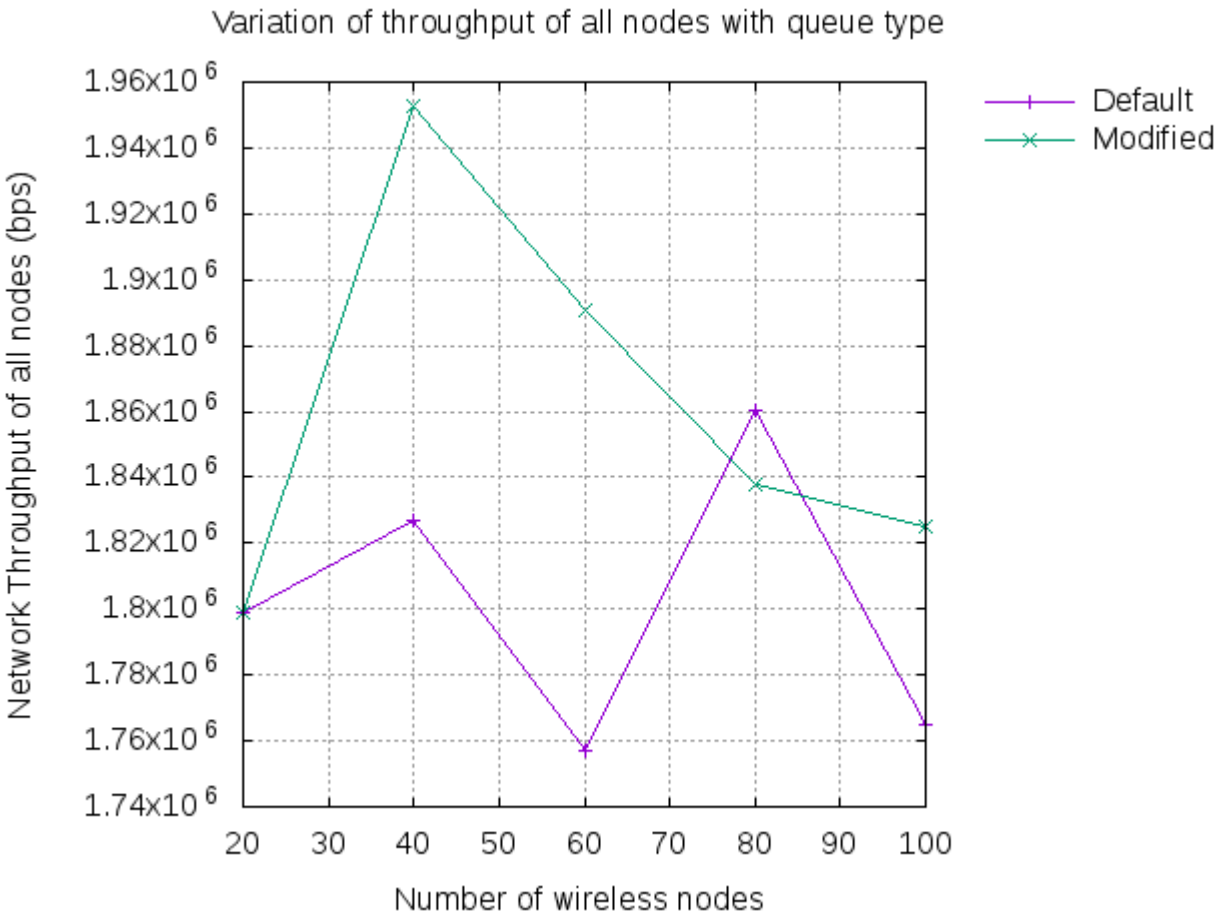
Throughput for Wired nodes only with varying packet rate



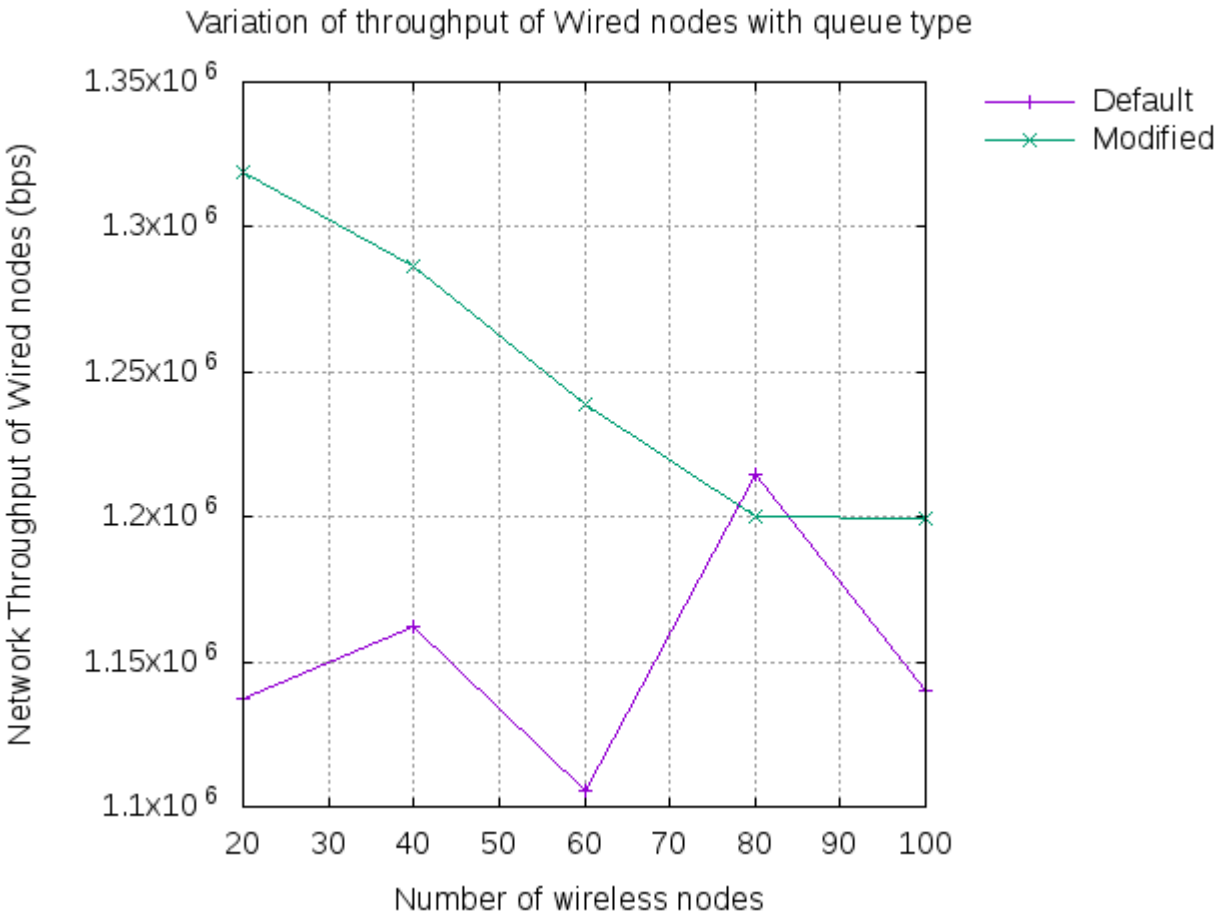
Throughput for wireless nodes only with varying packet rate



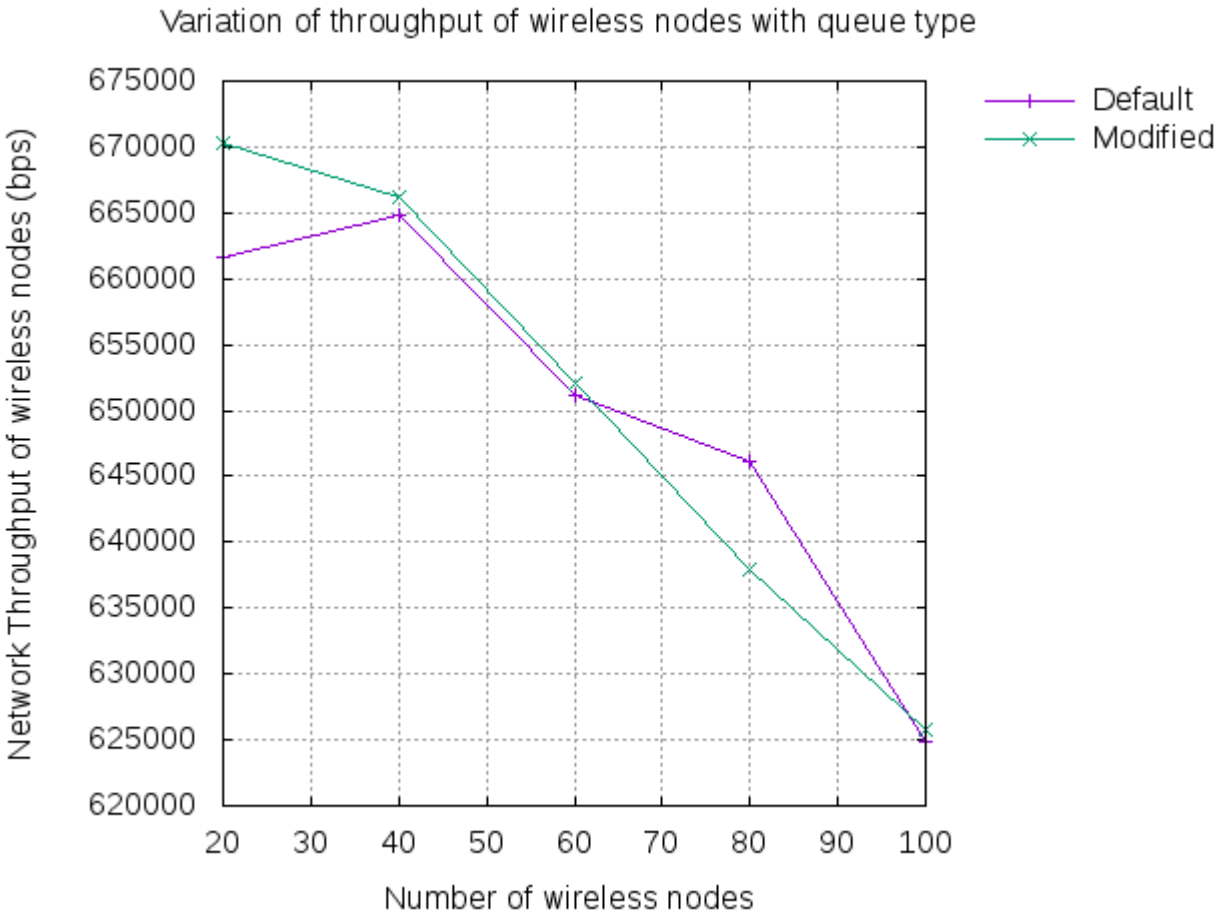
End-End Delay for varying the number of wireless nodes used



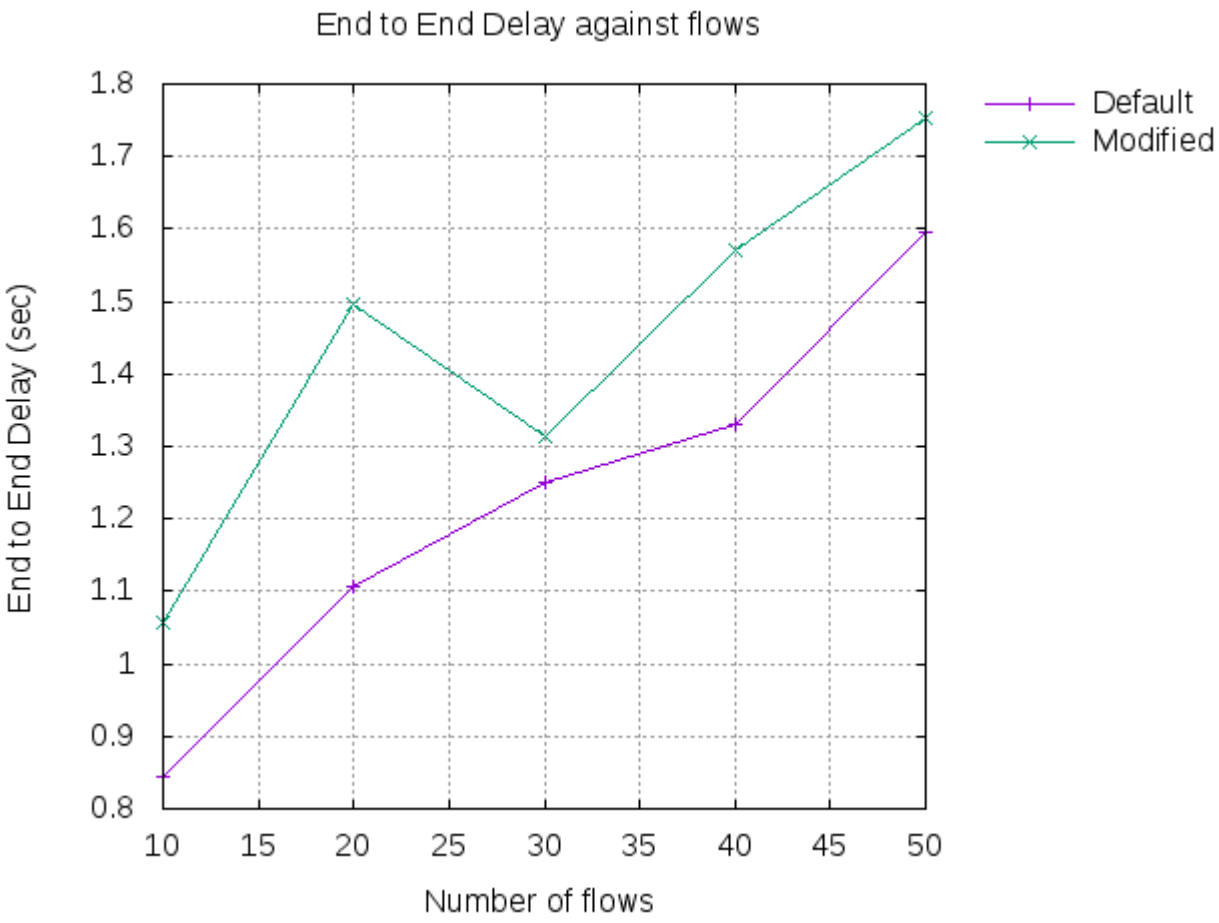
Total Throughput for varying the number of wireless nodes used



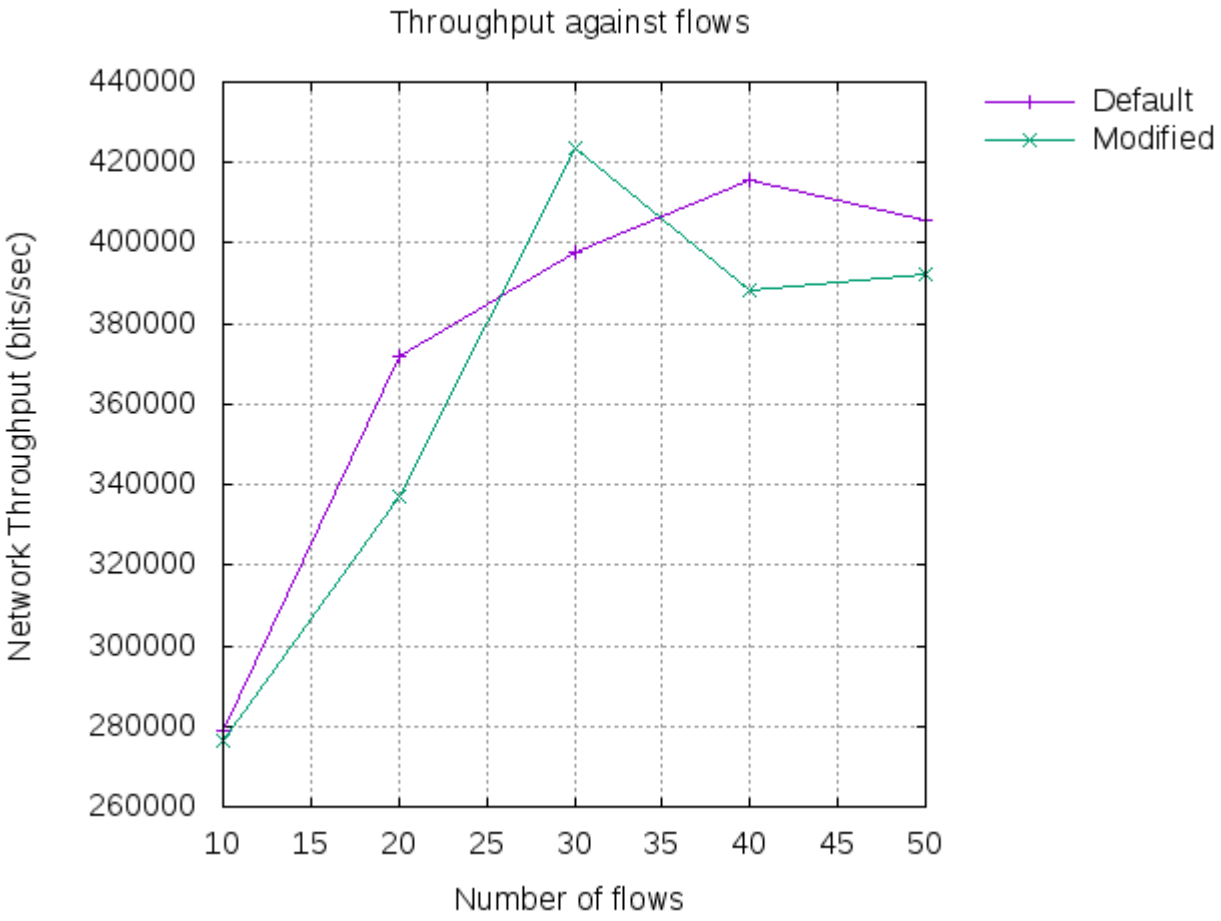
Throughput for wired nodes only for varying the number of wireless nodes used



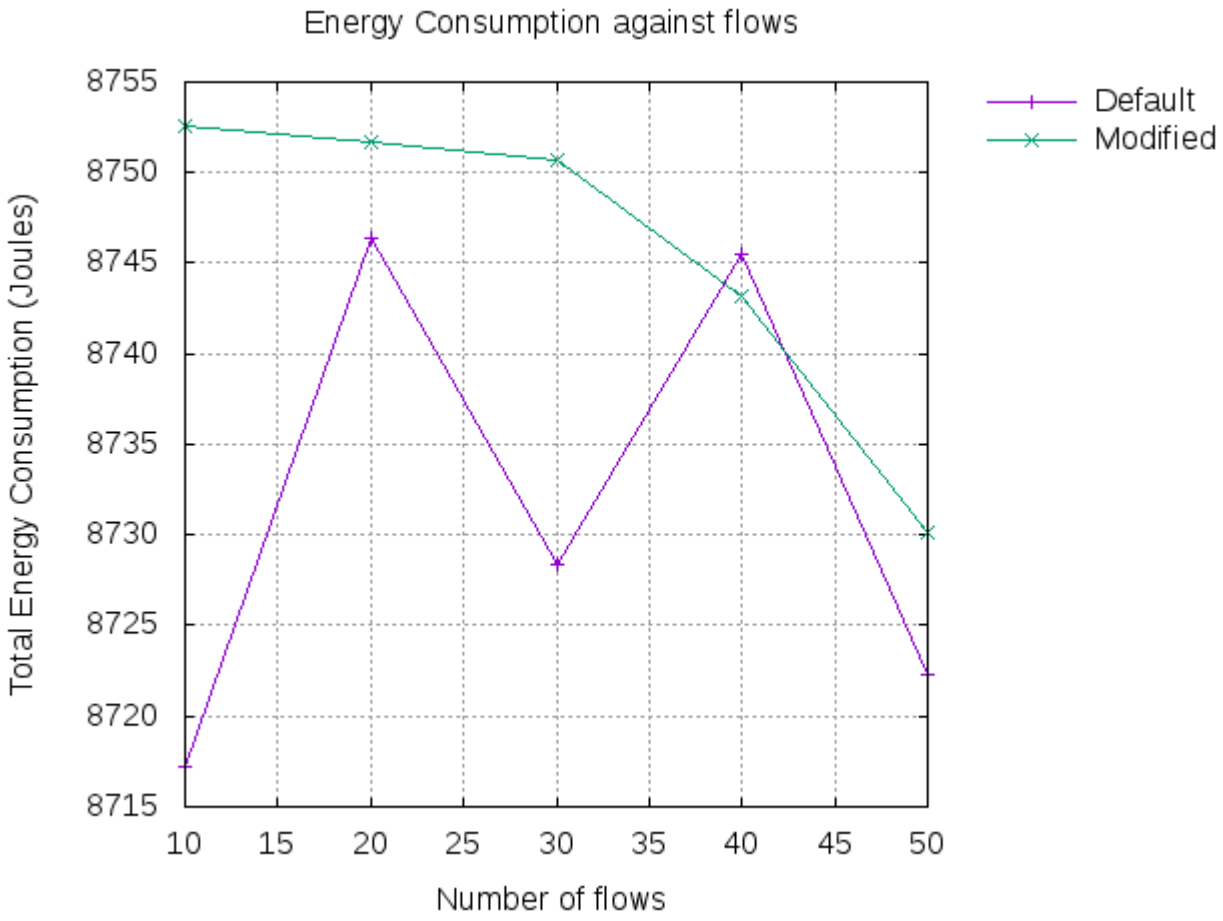
Throughput for wireless nodes only for varying the number of wireless nodes used



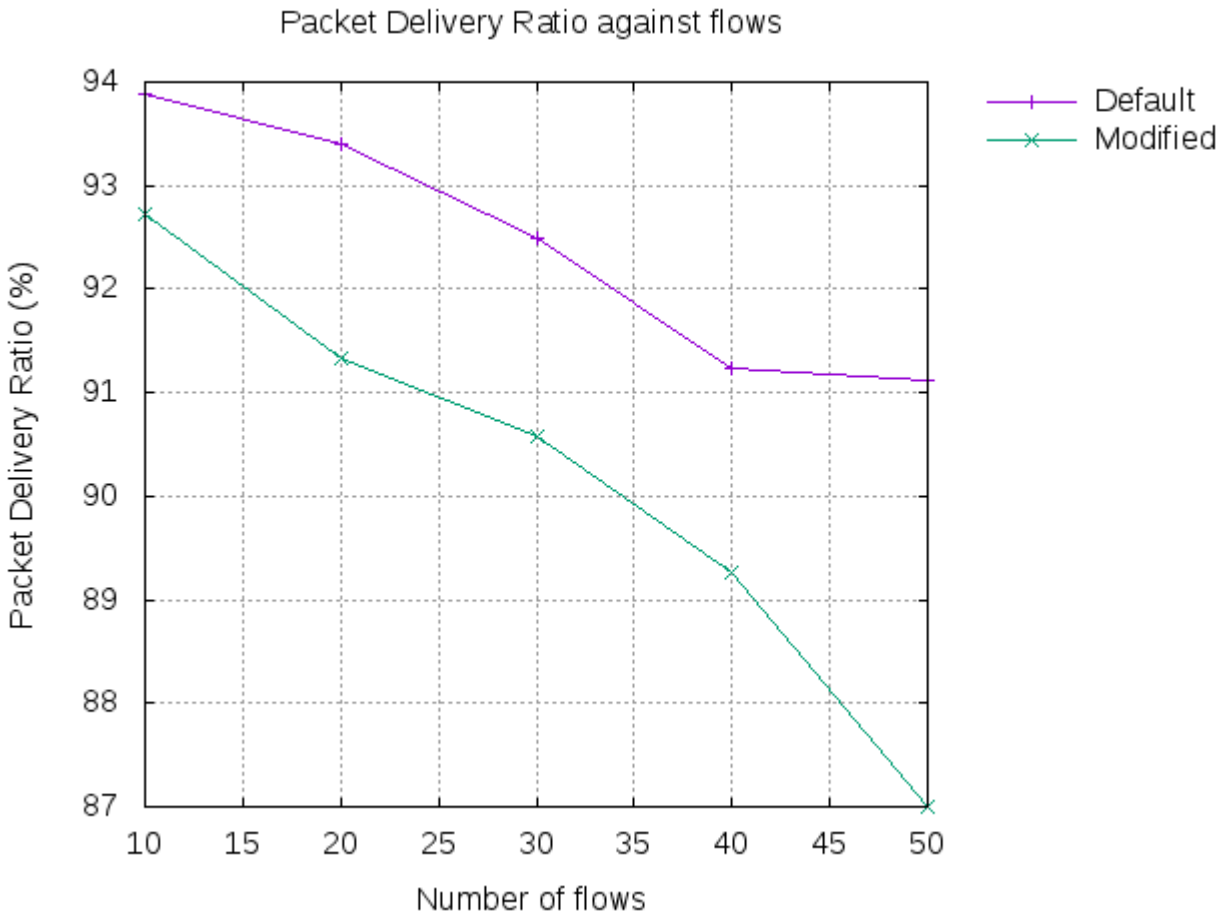
End-End Delay with varying Flow



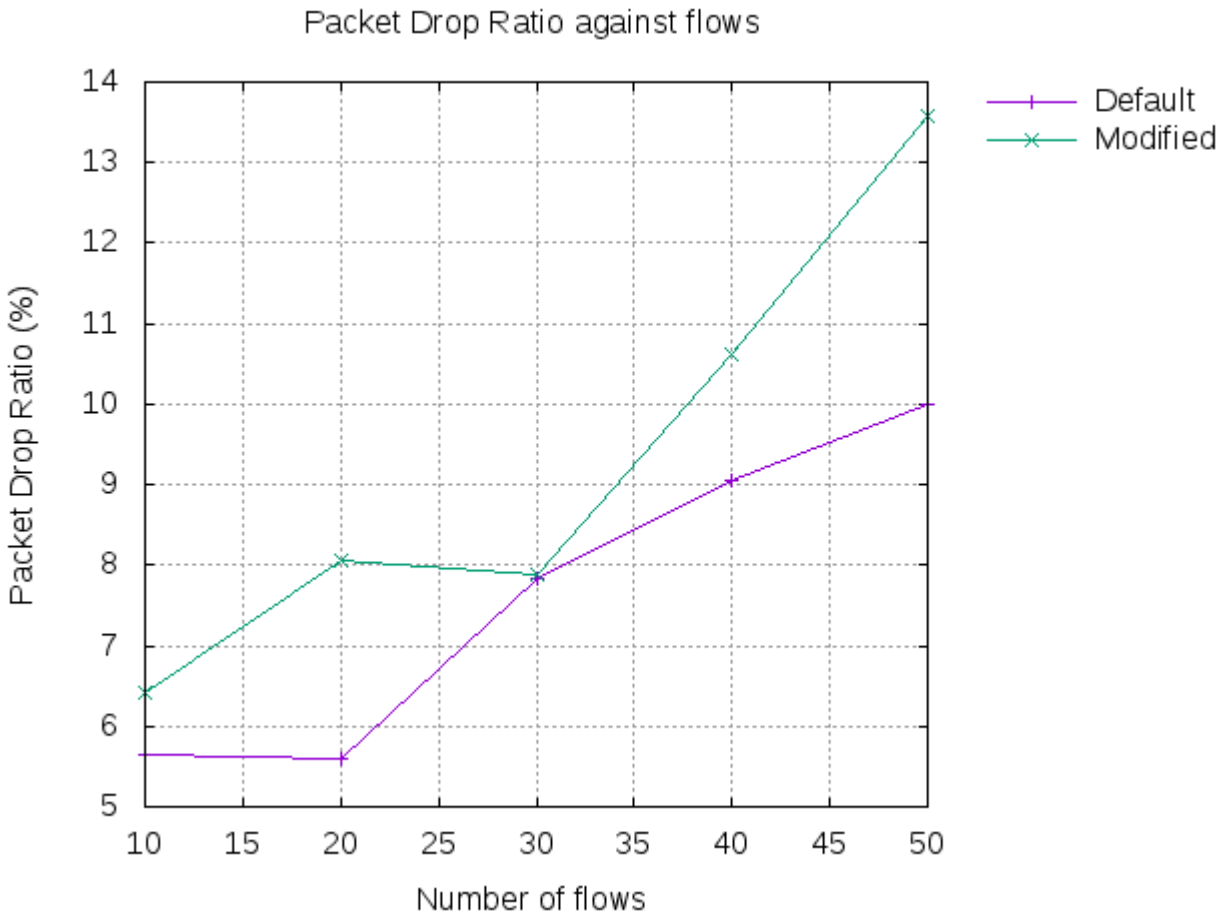
Network Throughput with varying Flow



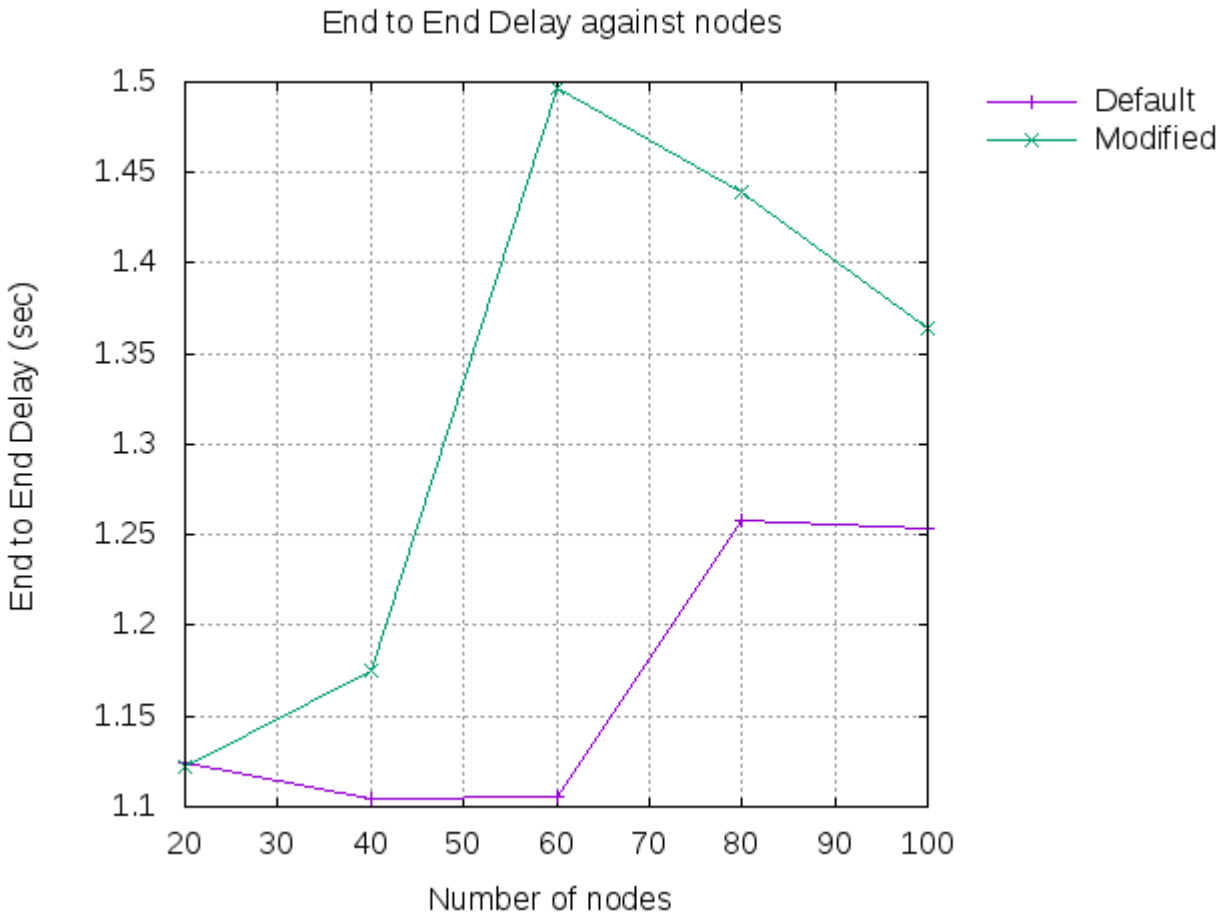
Energy Consumption with varying Flow



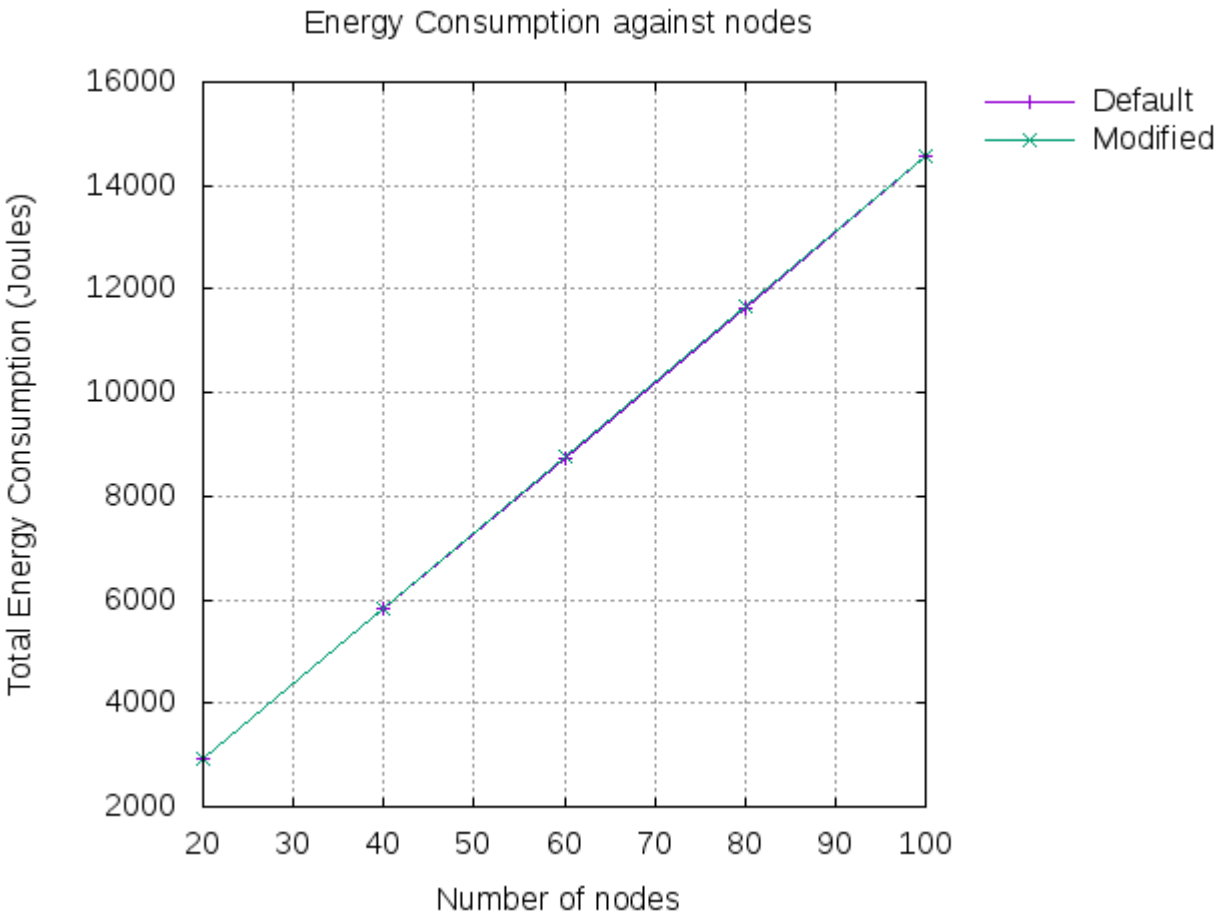
Packet Delivery with varying Flow



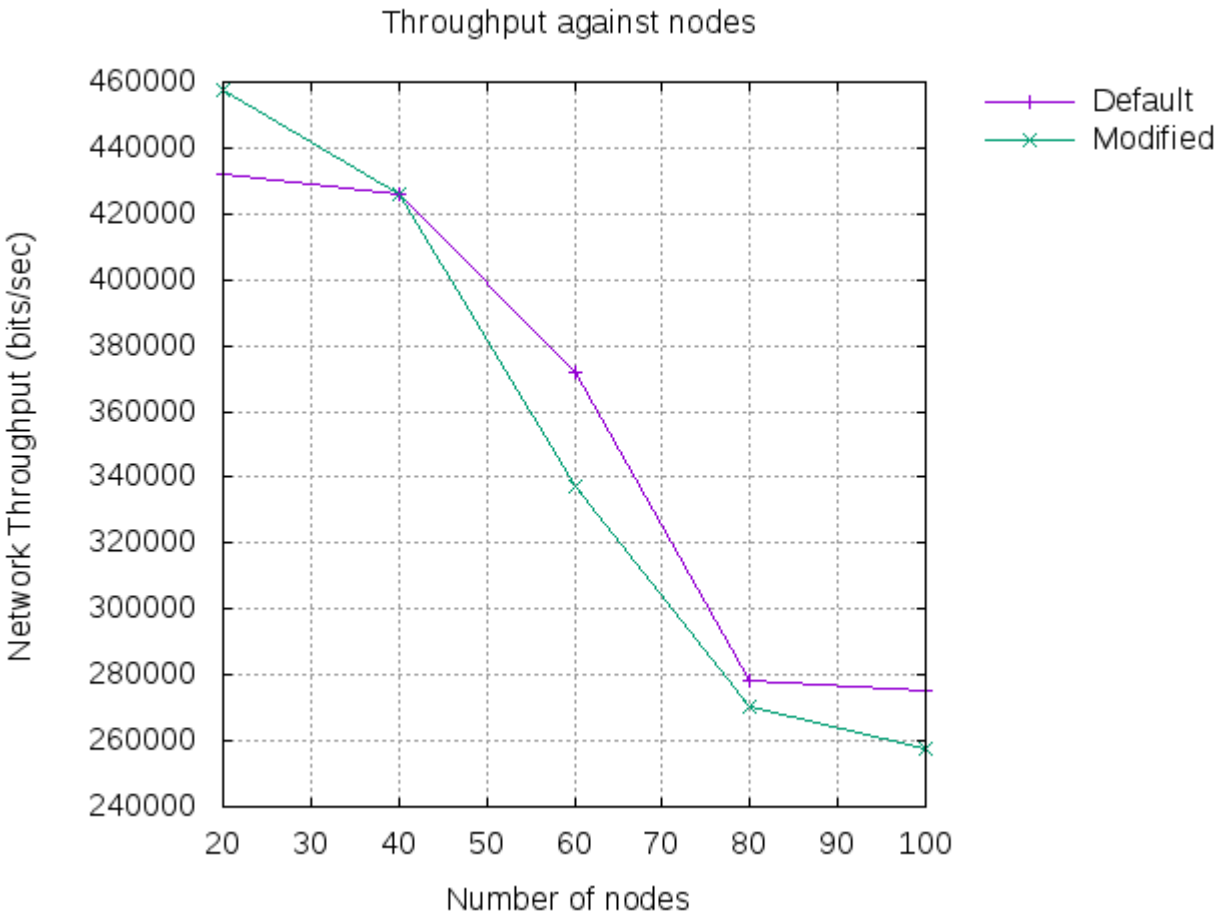
Drop Ratio with varying Flow



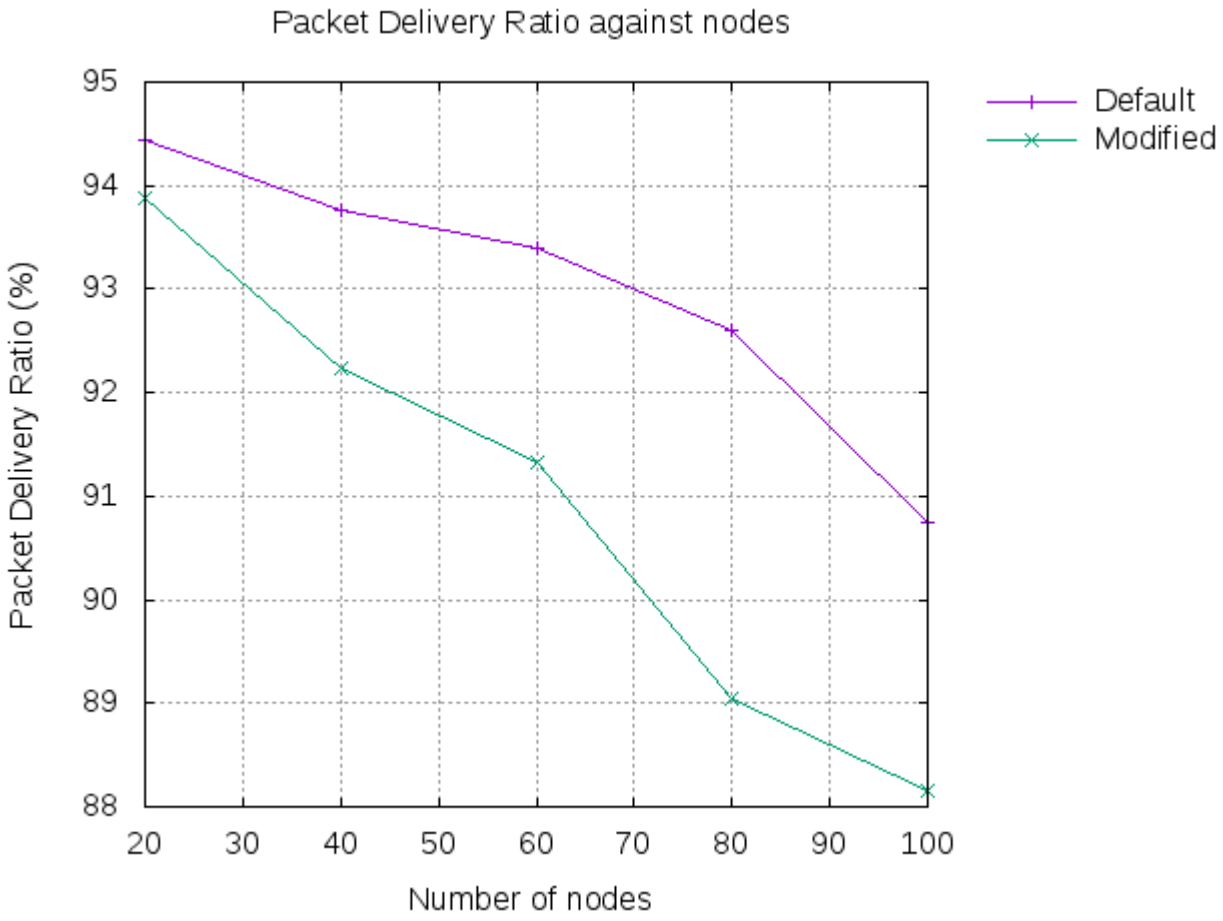
End-End Delay with varying Nodes



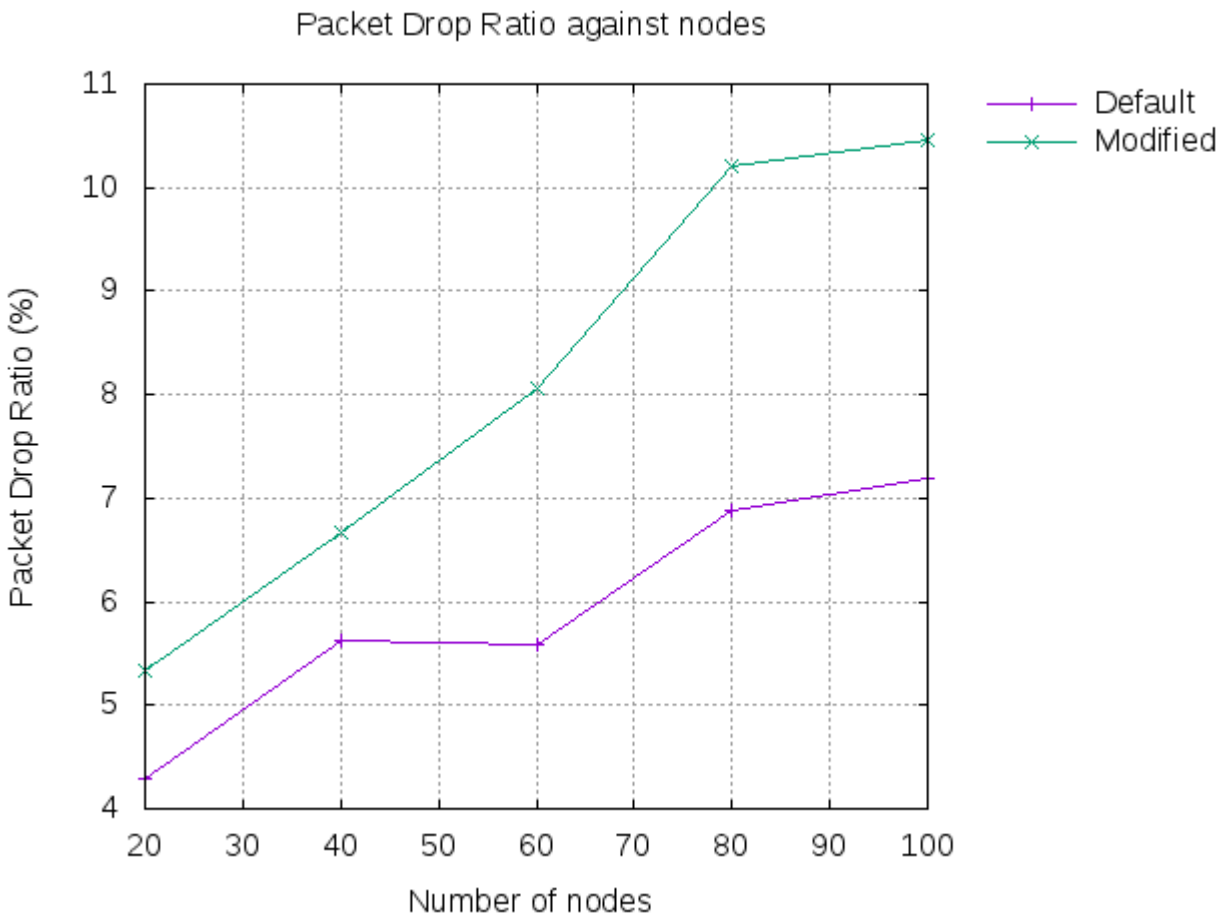
Energy Consumption with varying Flow



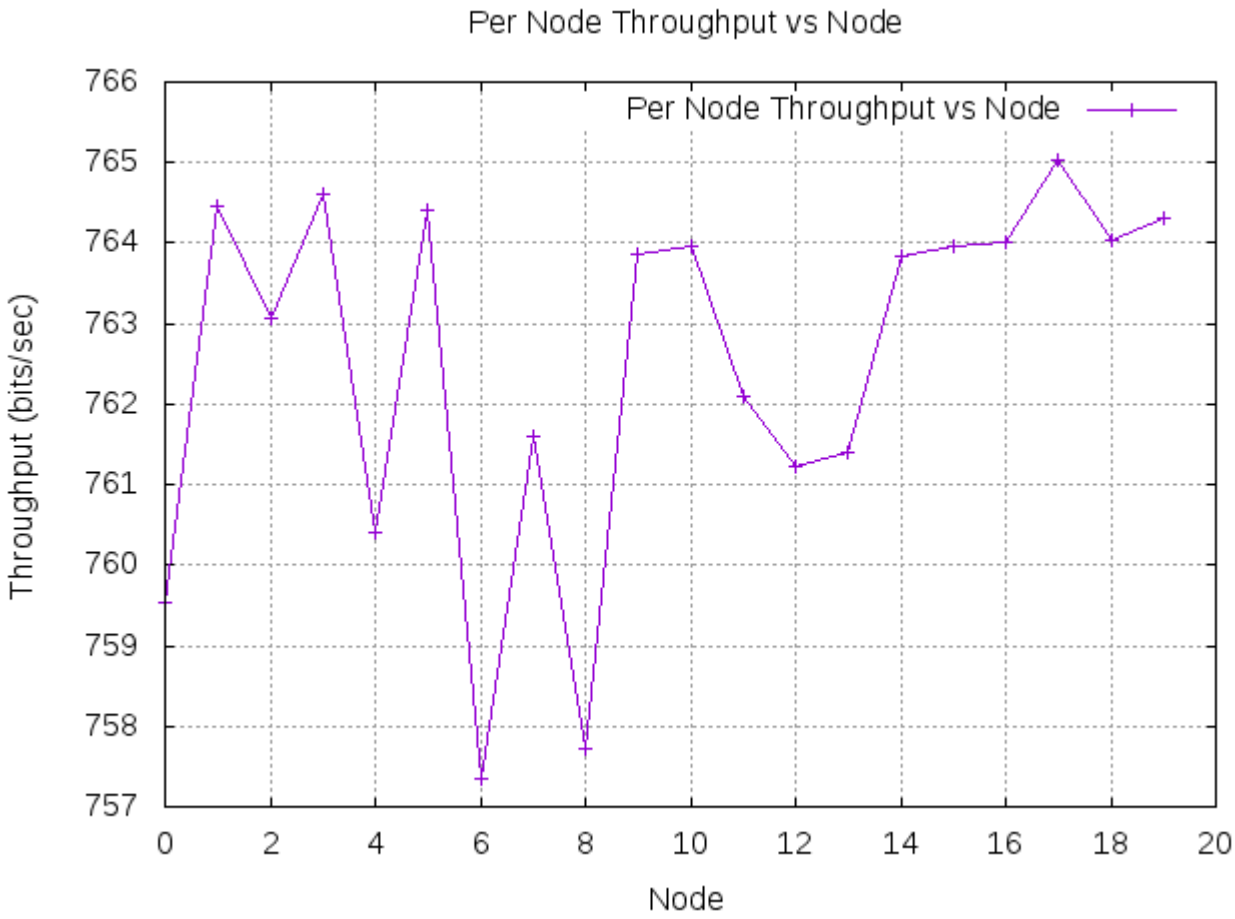
Network Throughput with varying Flow



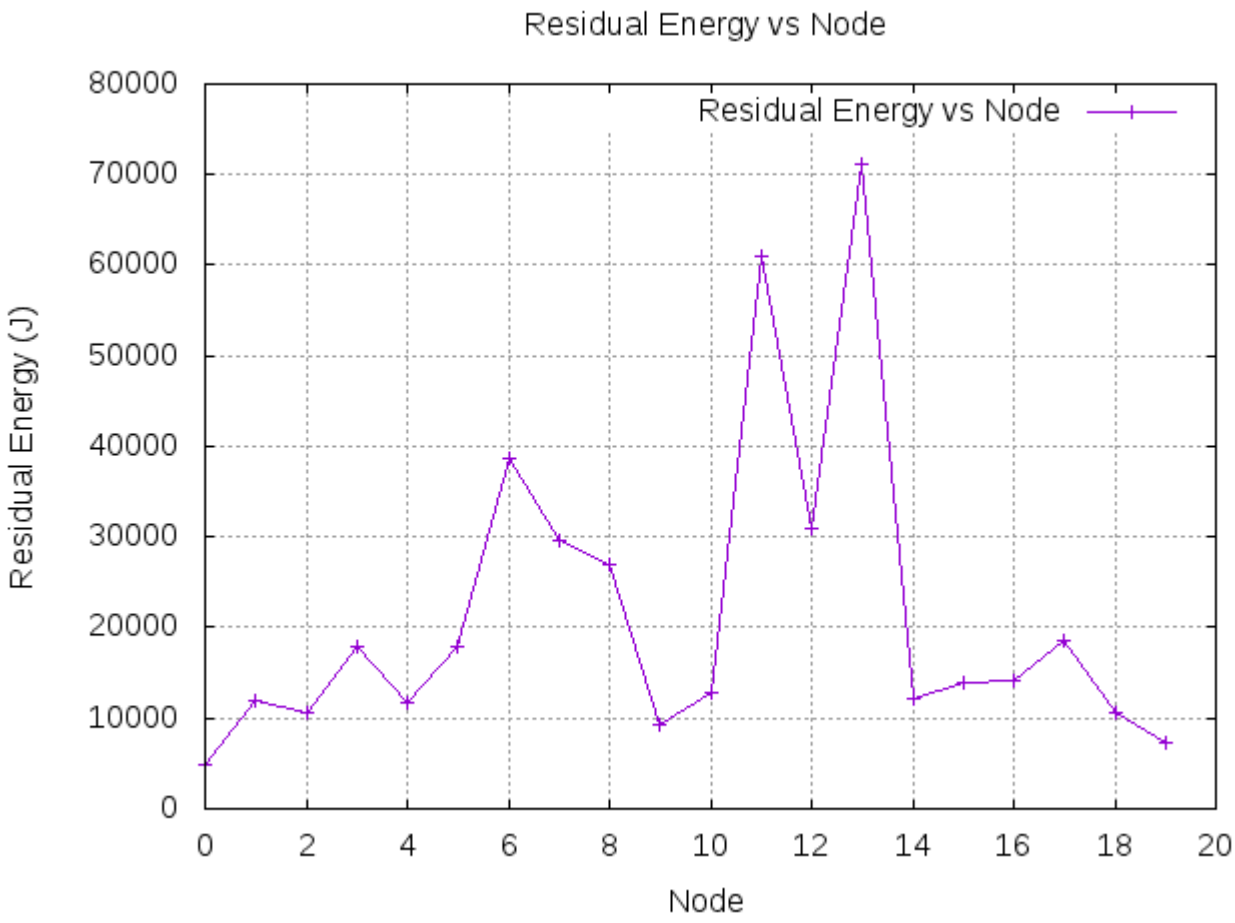
Packet Delivery with varying Flow



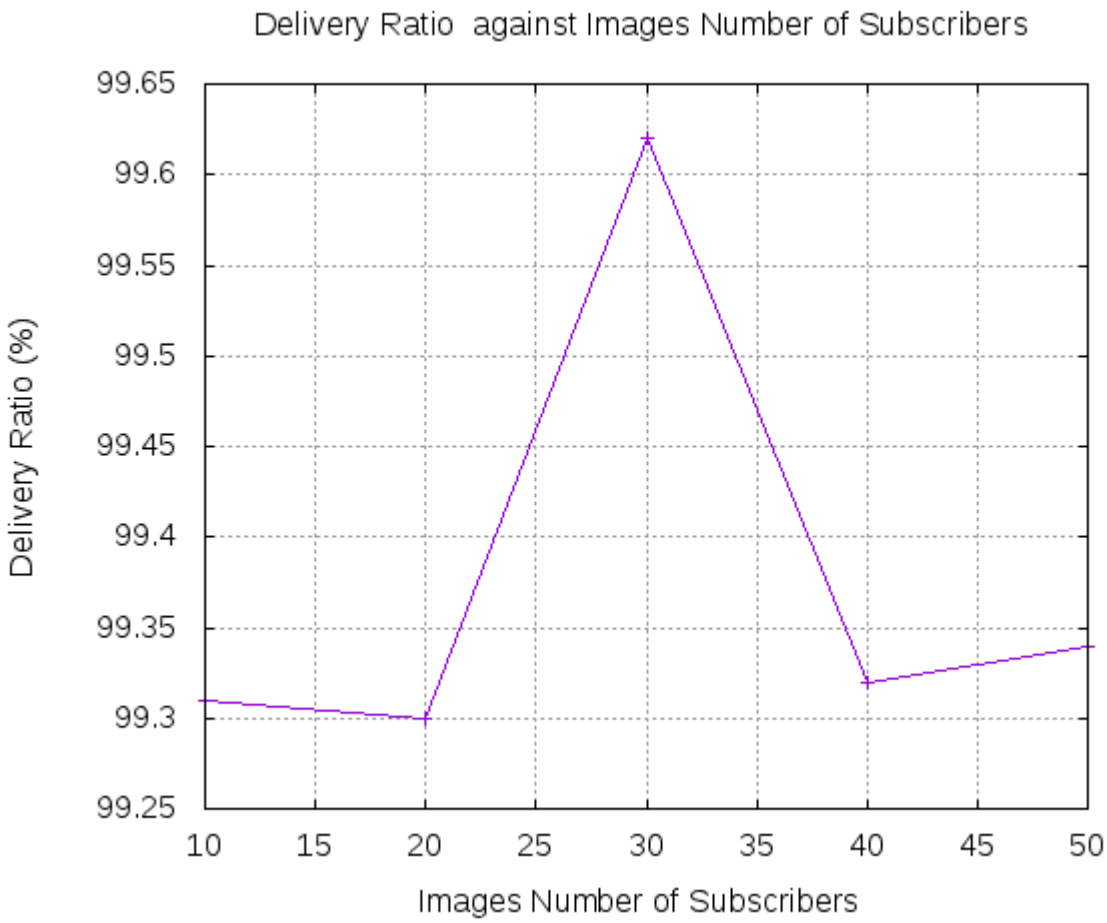
Packet Drop Ratio with varying Flow



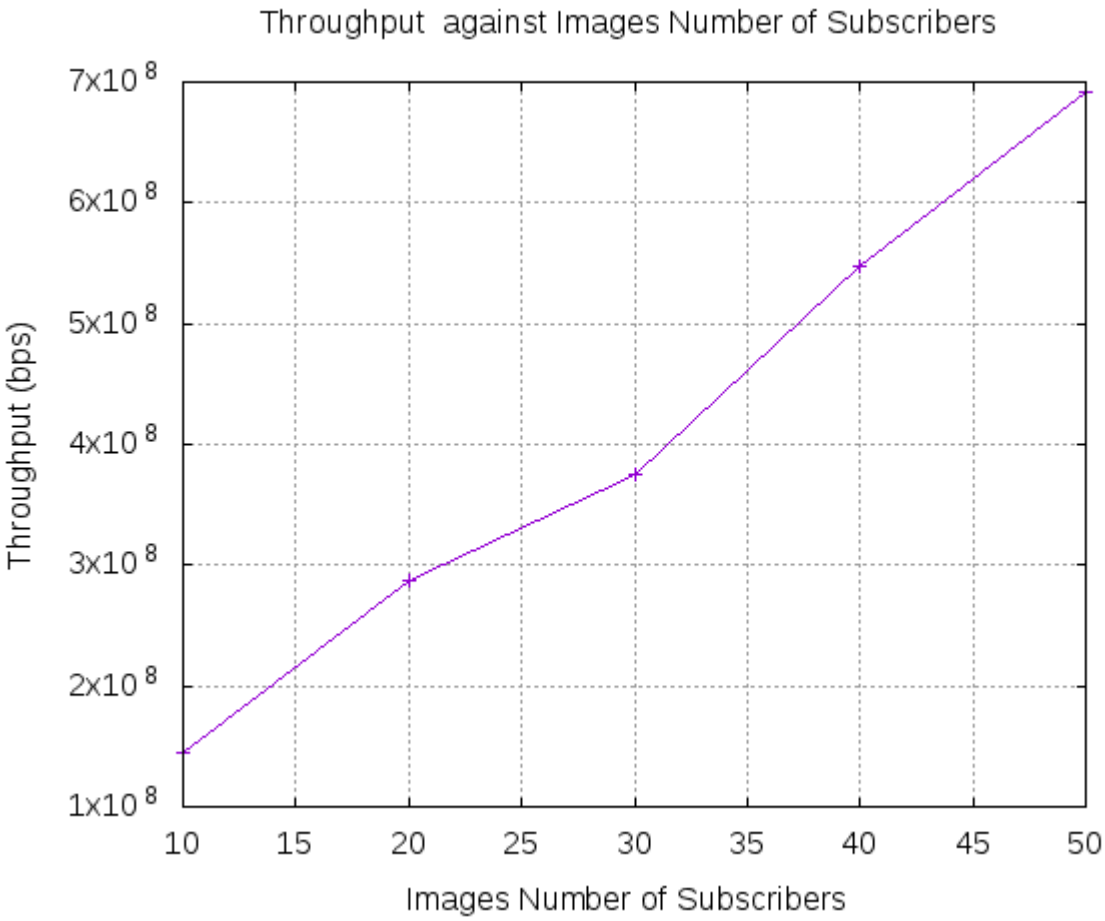
Per node throughput with number of nodes = 20



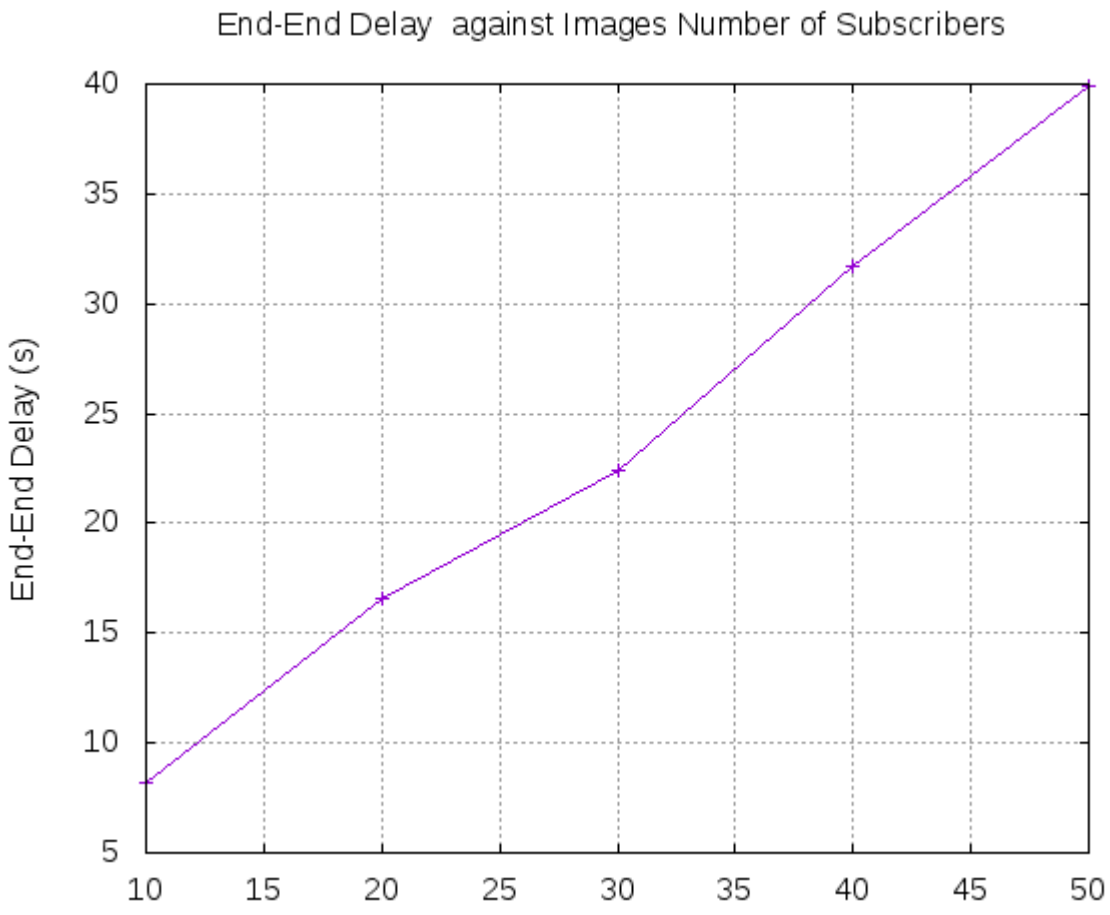
Residual Energy per node with number of nodes = 20



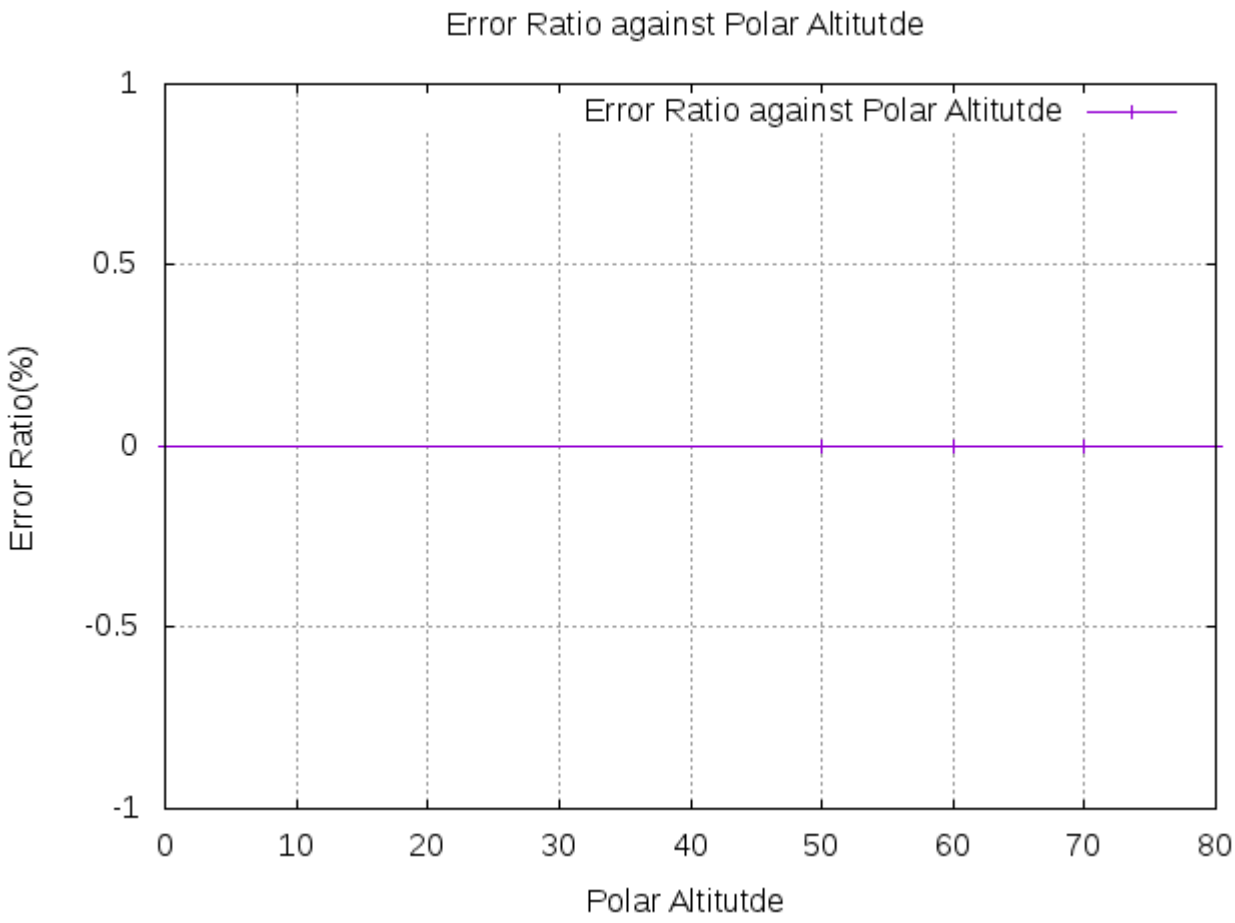
Delivery Ratio with subscriber variation



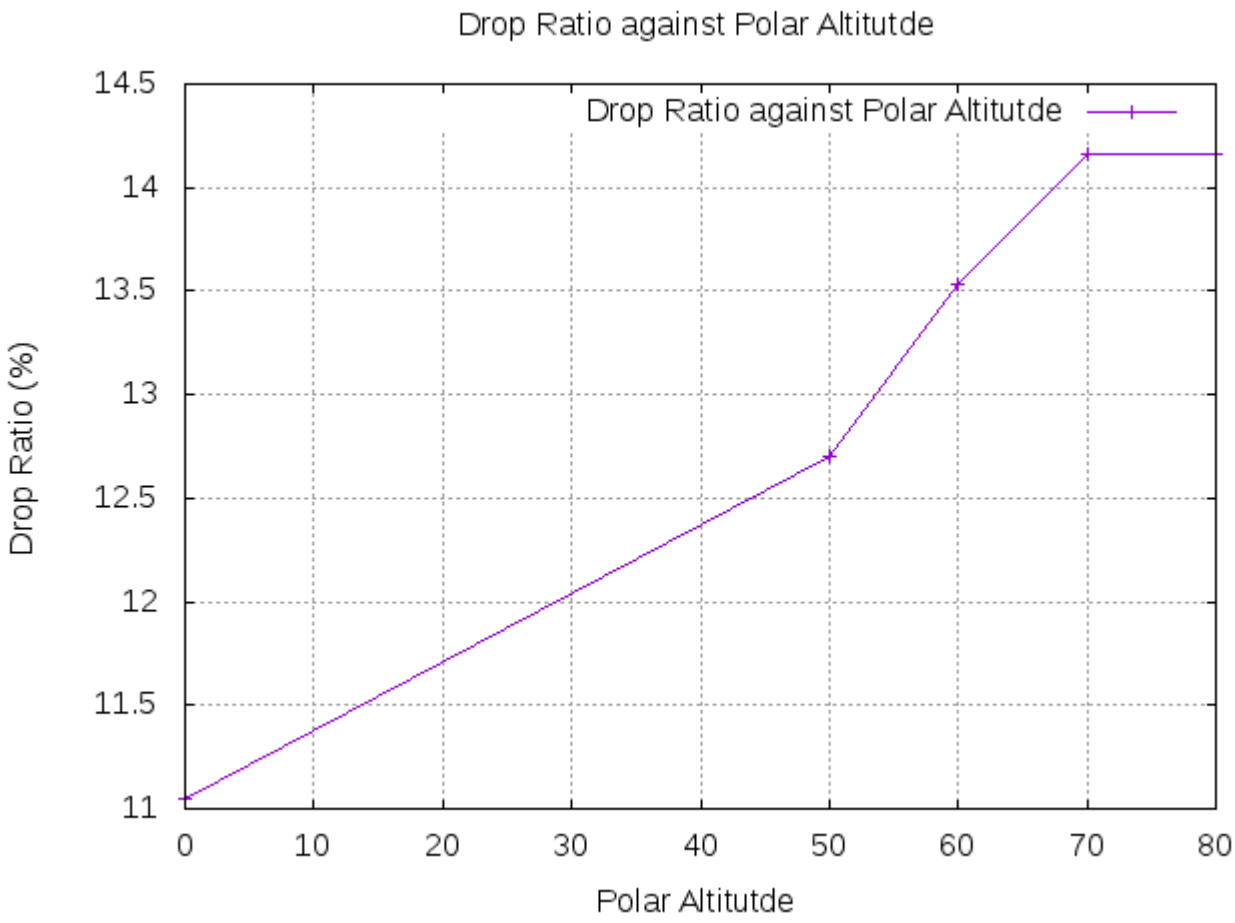
Throughput with subscriber variation



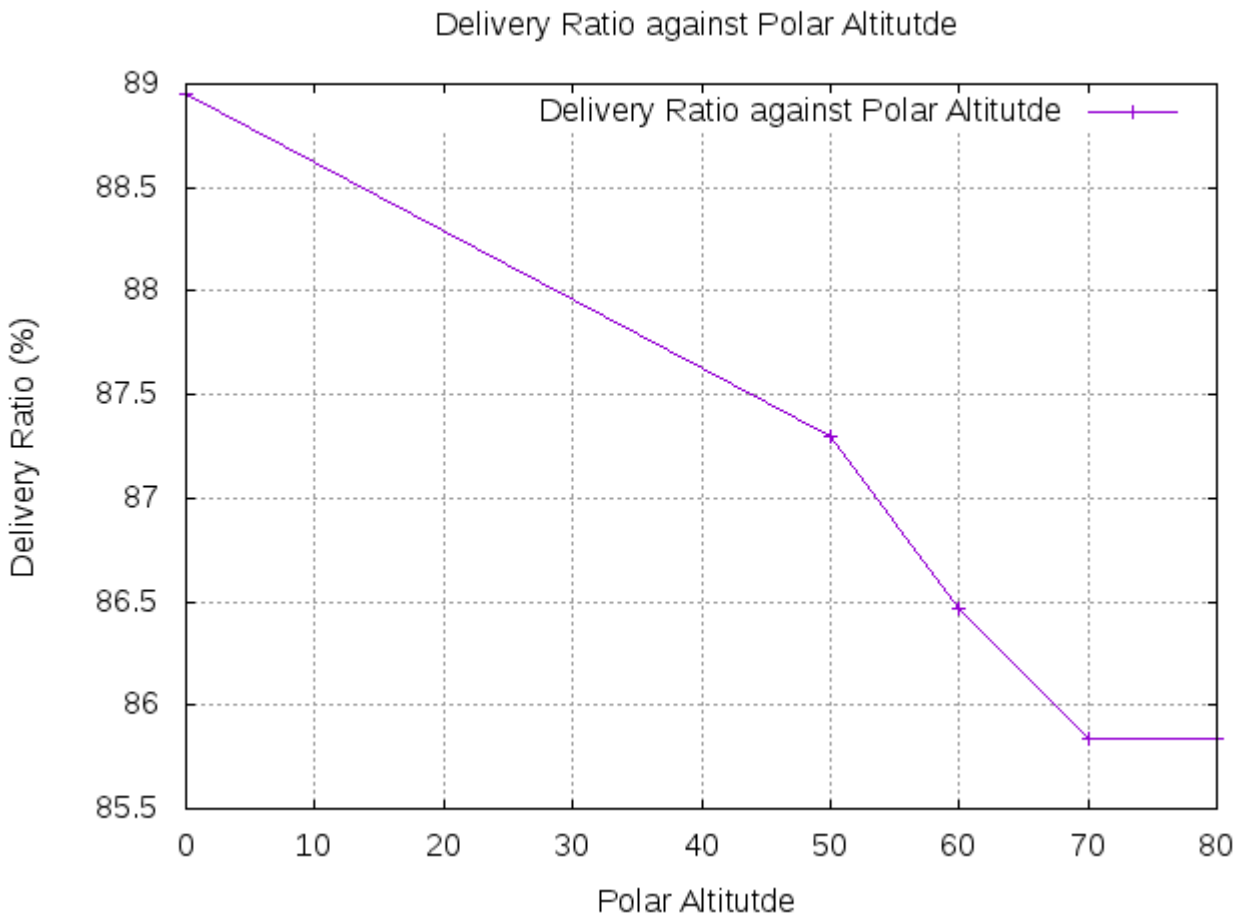
EndDelay with subscriber variation



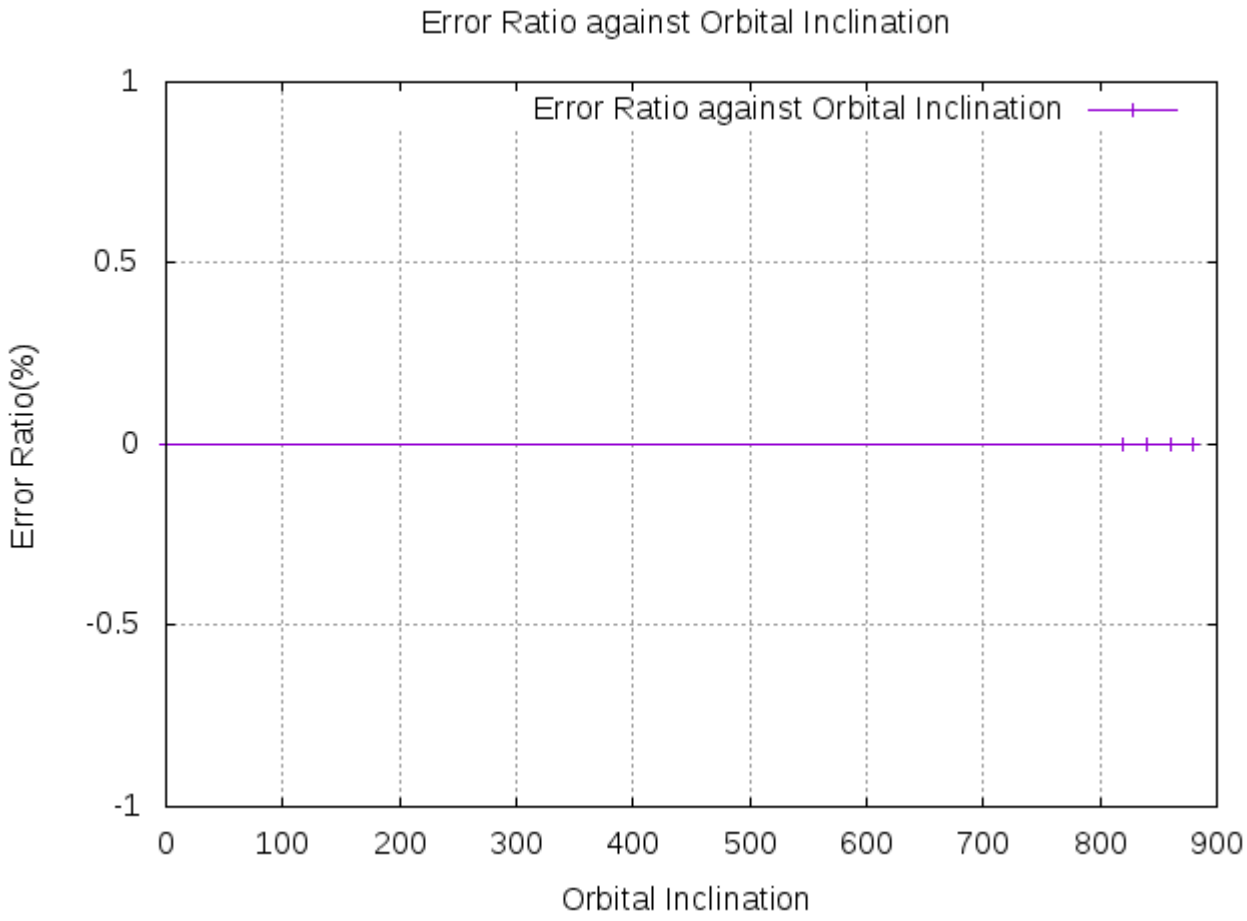
Error Ratio with Polar Altitude variation



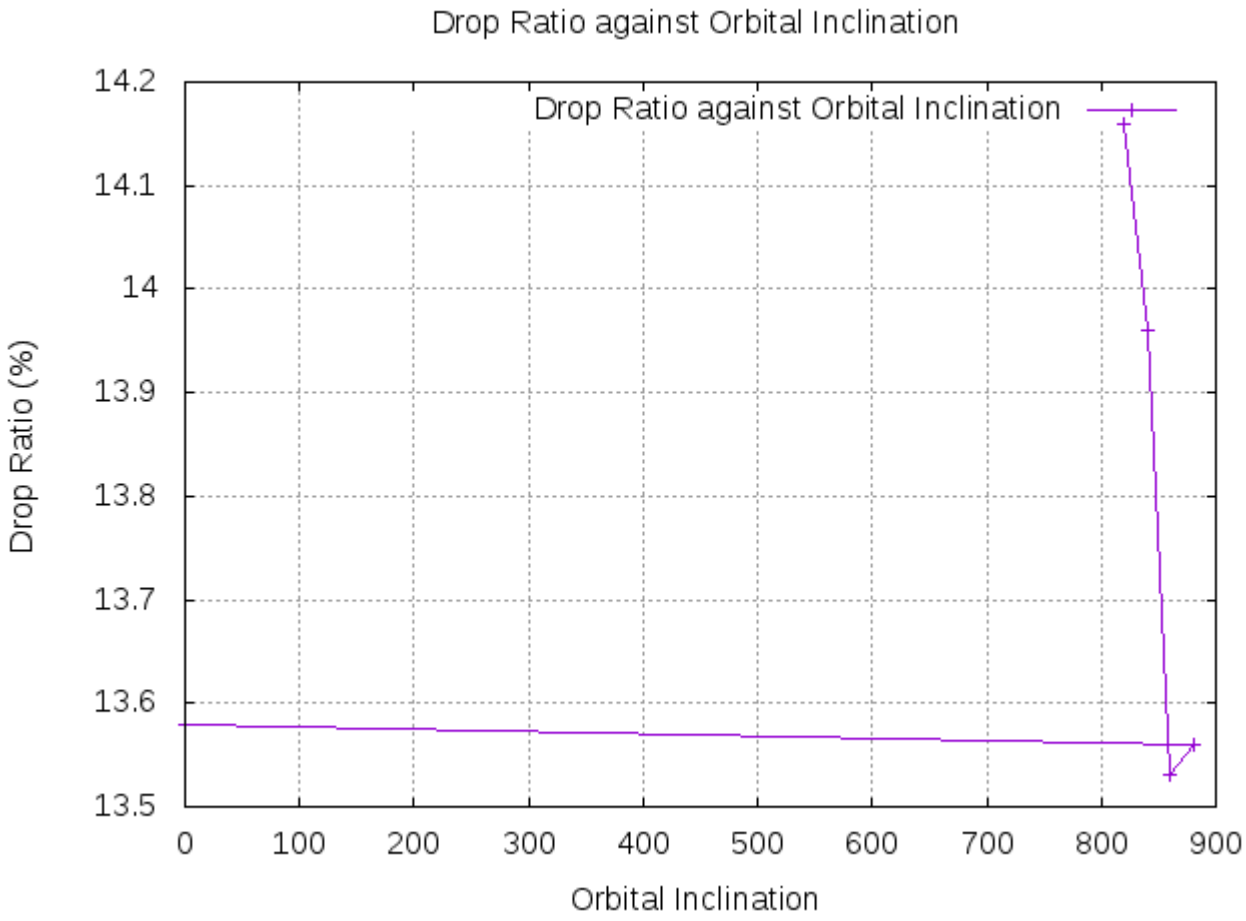
Drop Ratio with Polar Altitude variation



Delivery Ratio with Polar Altitude variation



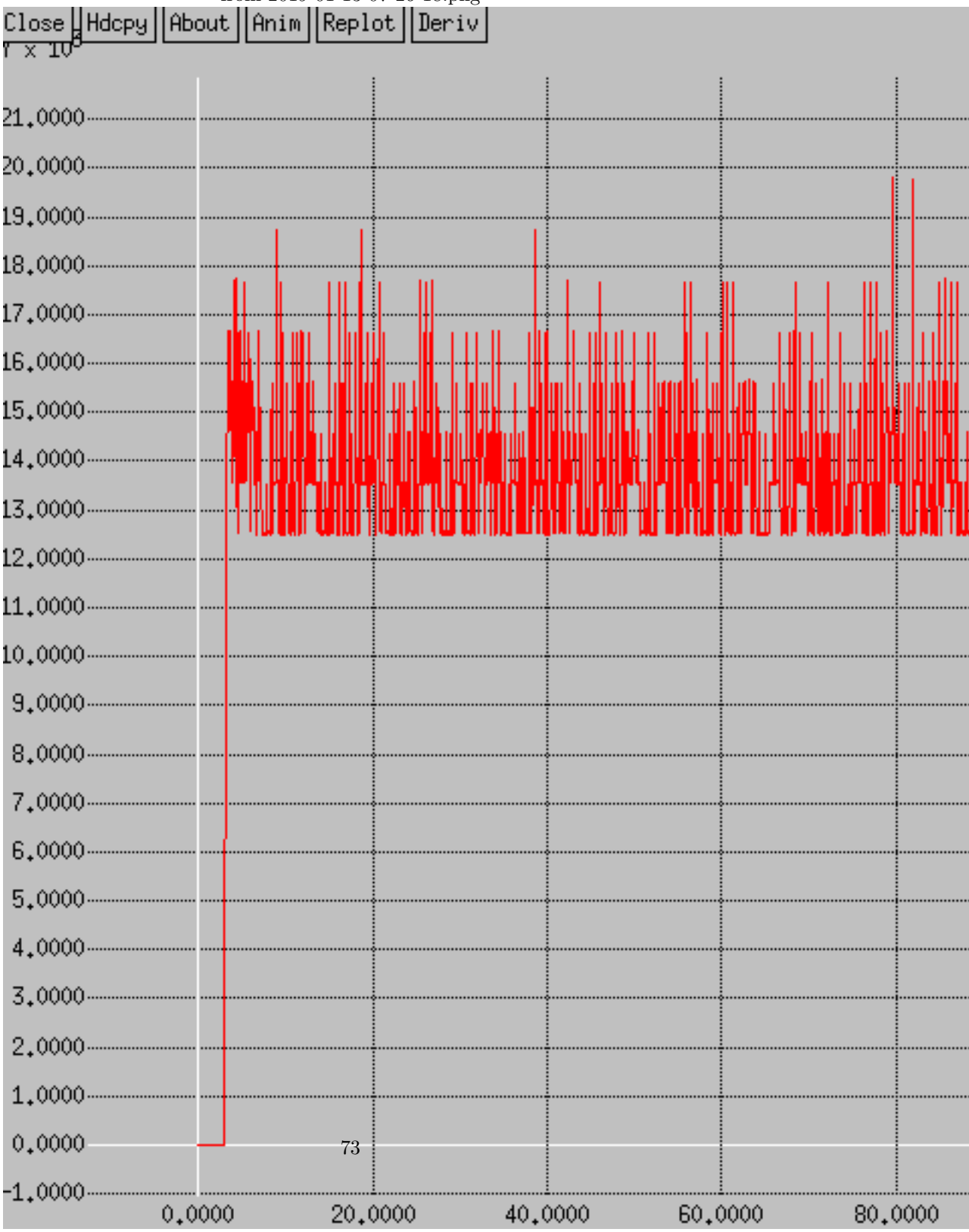
Error Ratio with Orbital Inclination variation



Drop Ratio with Orbital Inclination variation

Delivery Ratio with Orbital Inclination variation

from 2019-01-13 07-26-18.png



Queue size variation over time