

REPORT

Submitted by :
Arpita Saha (1505033)
Faria Huq (1505052)
Roll % 8 : 1

NETWORK TOPOLOGIES UNDER SIMULATION

-> Wireless 802.11(static)

-> Wireless 802.15.4(static)

PARAMETERS UNDER VARIATION

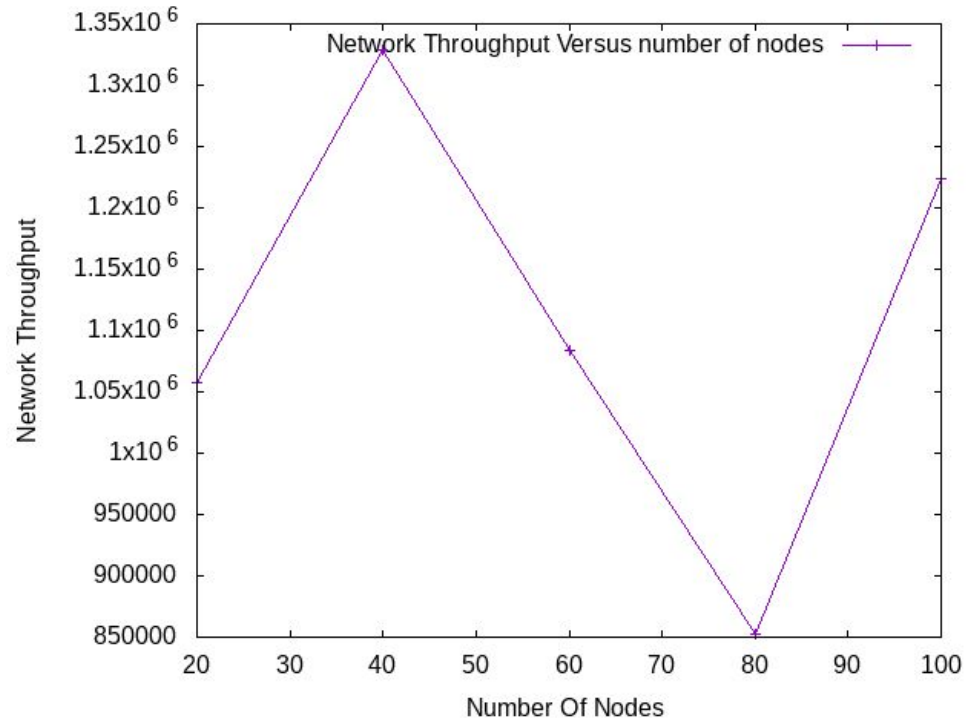
- Number of nodes (varied as 20, 40, 60, 80, and 100)
- Number of flows (varied as 10, 20, 30, 40, and 50)
- Number of packets per second (100, 200, 300, 400, and 500)
- Coverage area (square coverage are varying one side as Tx_range, 2 x Tx_range, 3 x Tx_range, 4 x Tx_range, and 5 x Tx_range)

GRAPHS WITHOUT MODIFICATION

For 802.11(static)

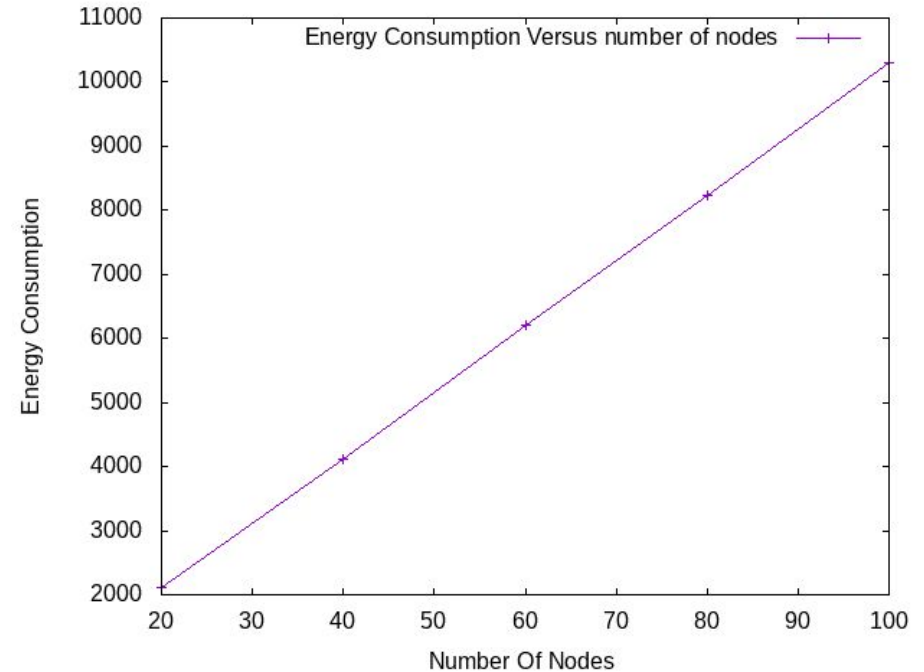
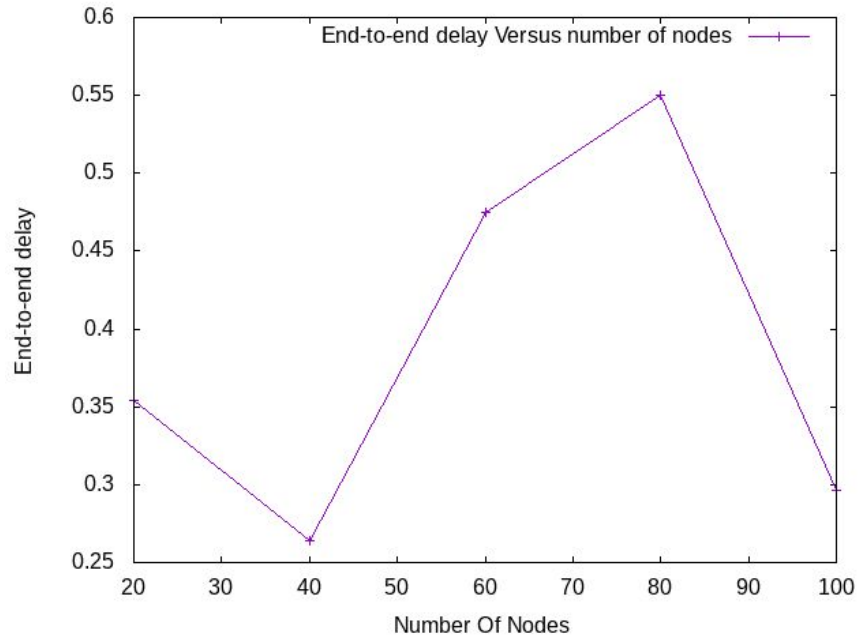
802.11

1. Variation in Node



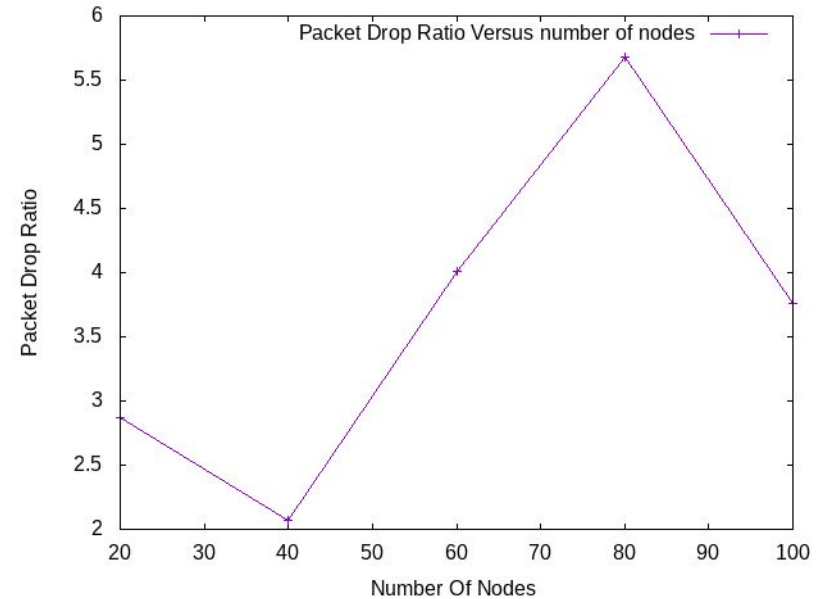
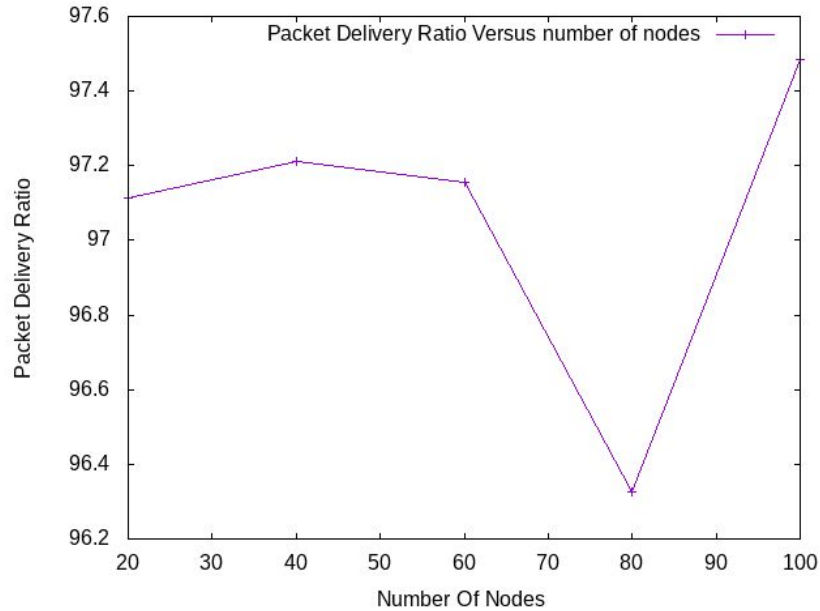
802.11

1. Variation in Node



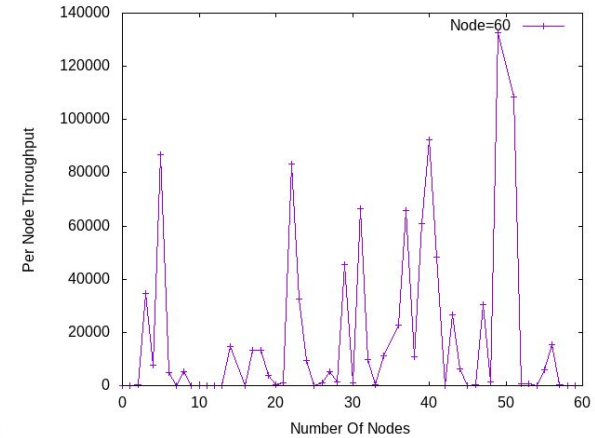
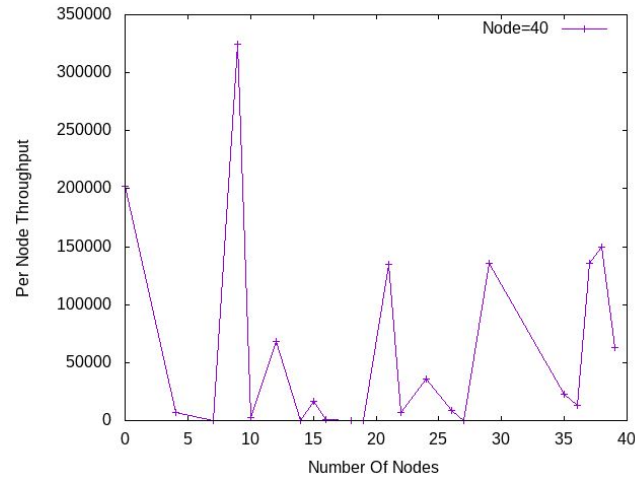
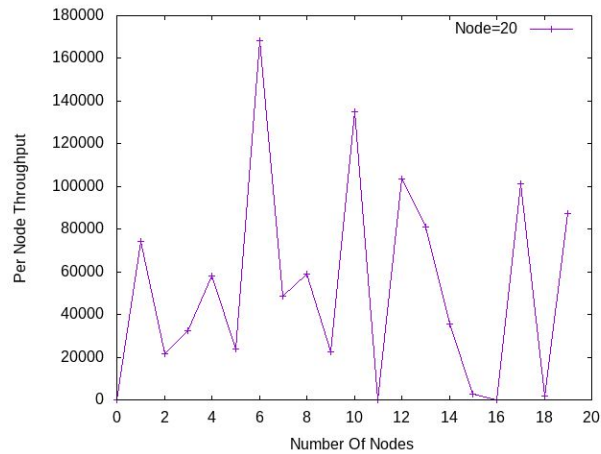
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1. Variation in Node



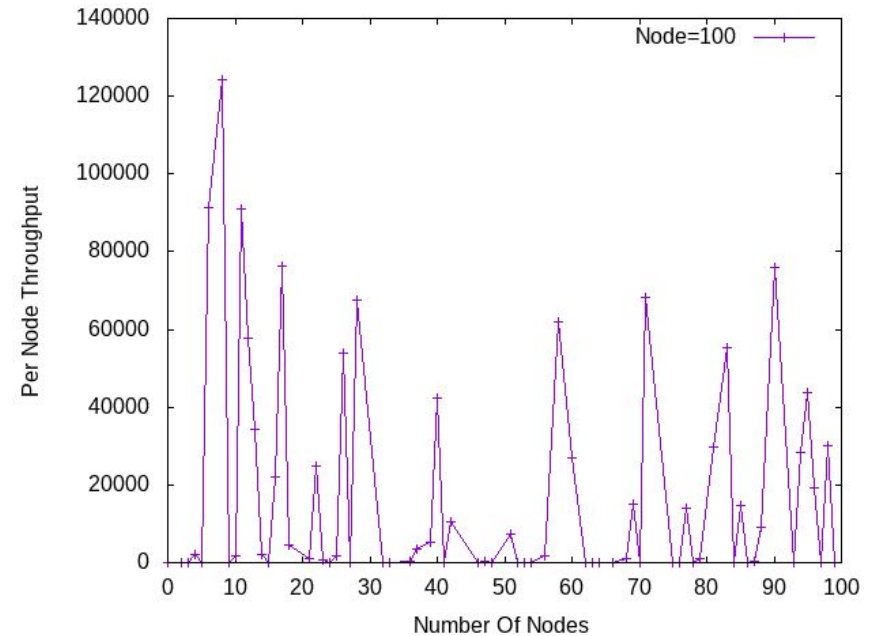
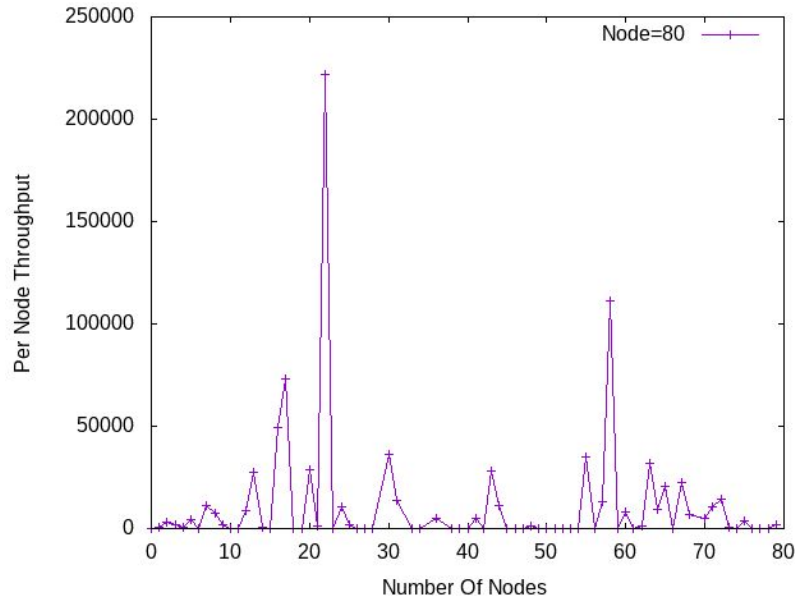
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1. Variation in Node



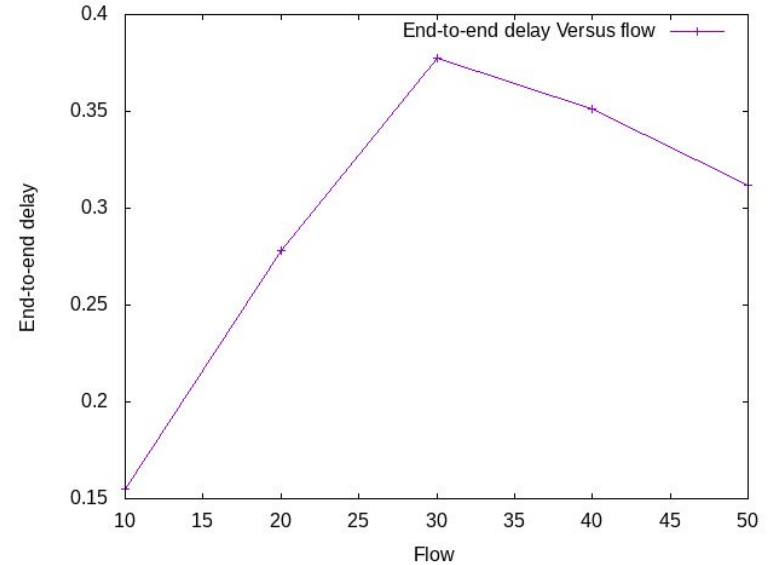
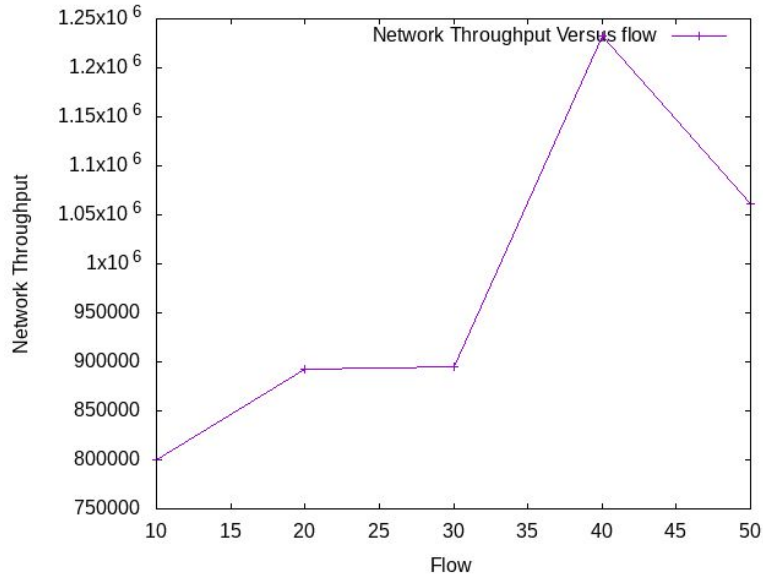
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1. Variation in Node



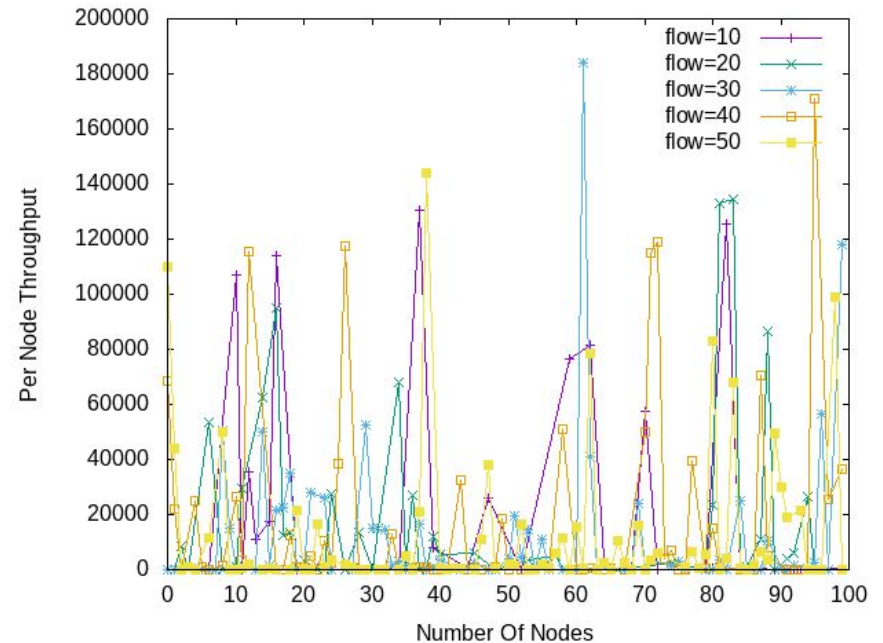
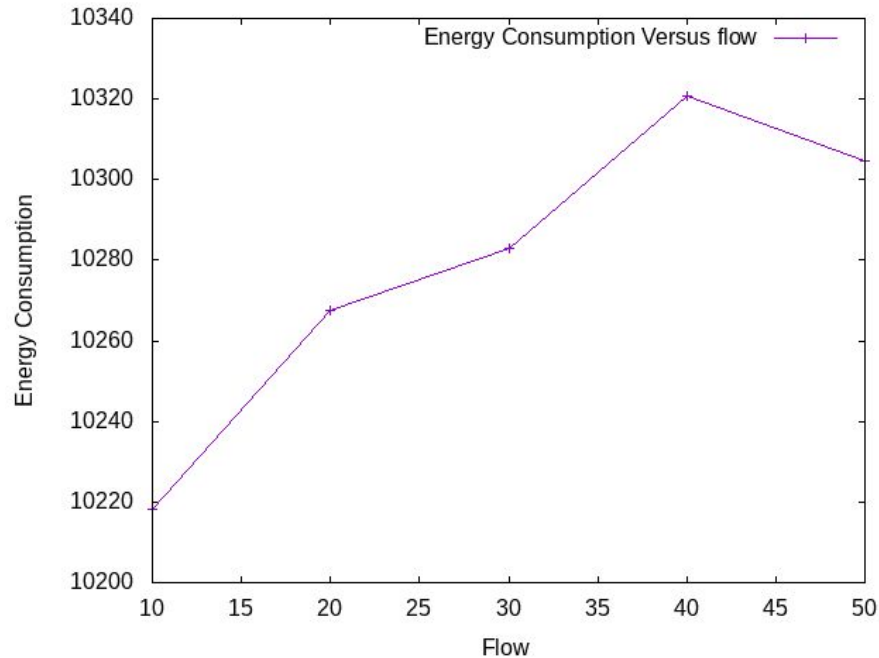
802.11

2. Variation in Flow



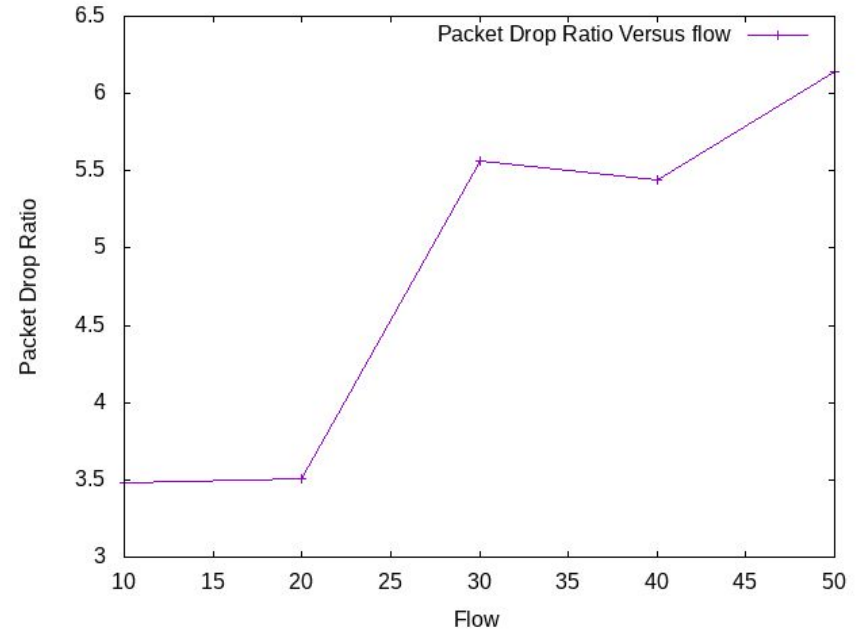
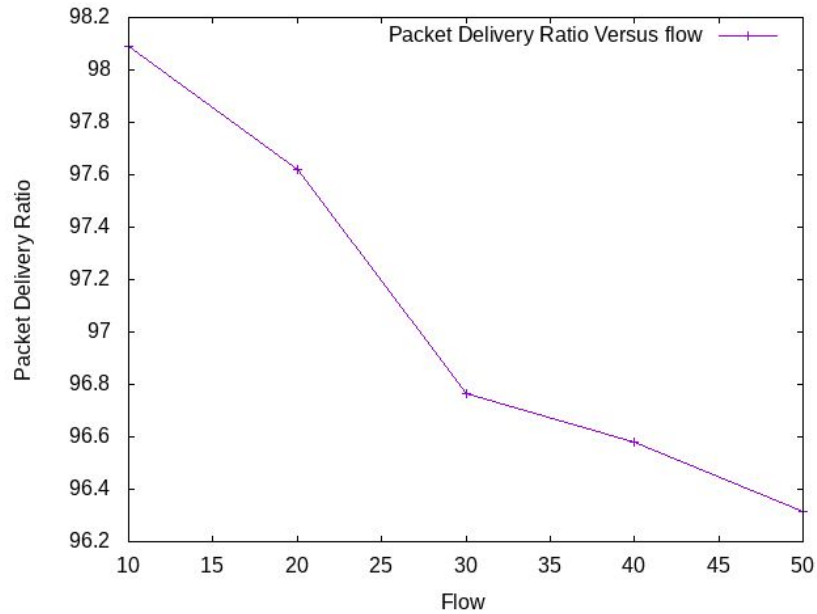
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2. Variation in Flow



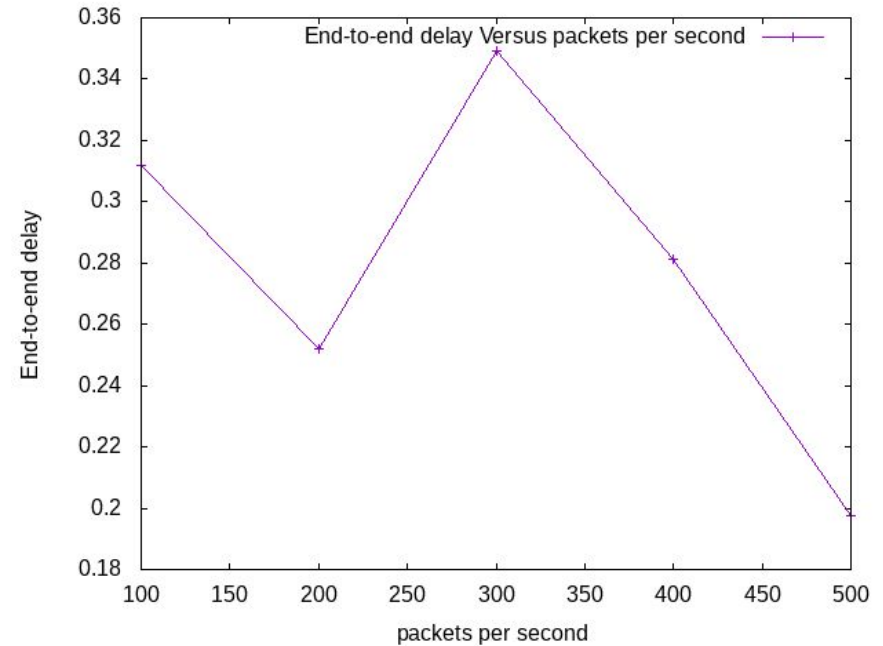
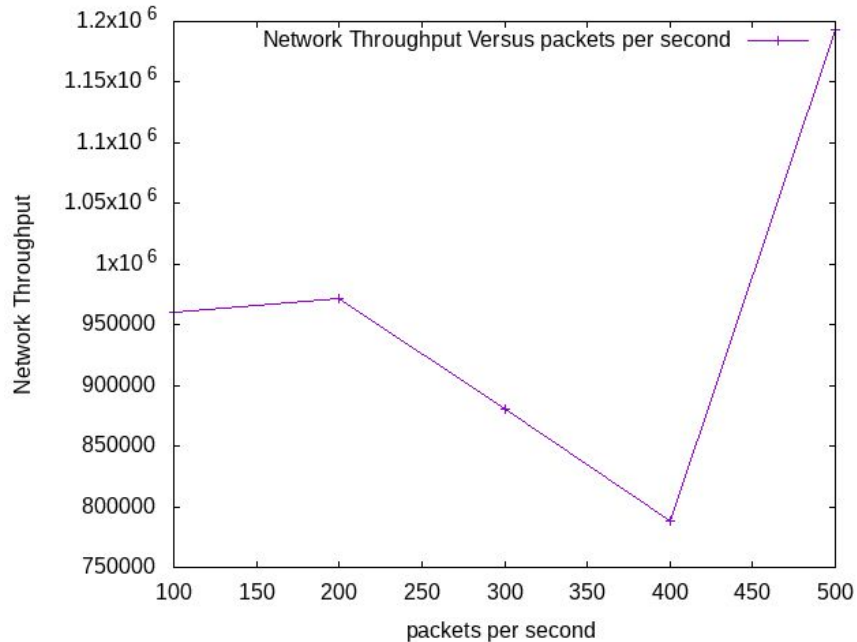
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2. Variation in Flow



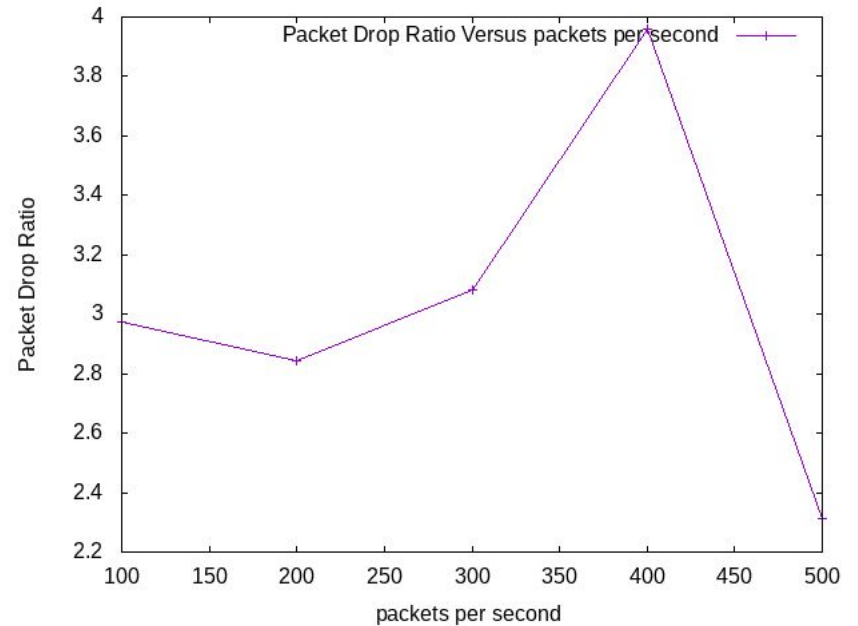
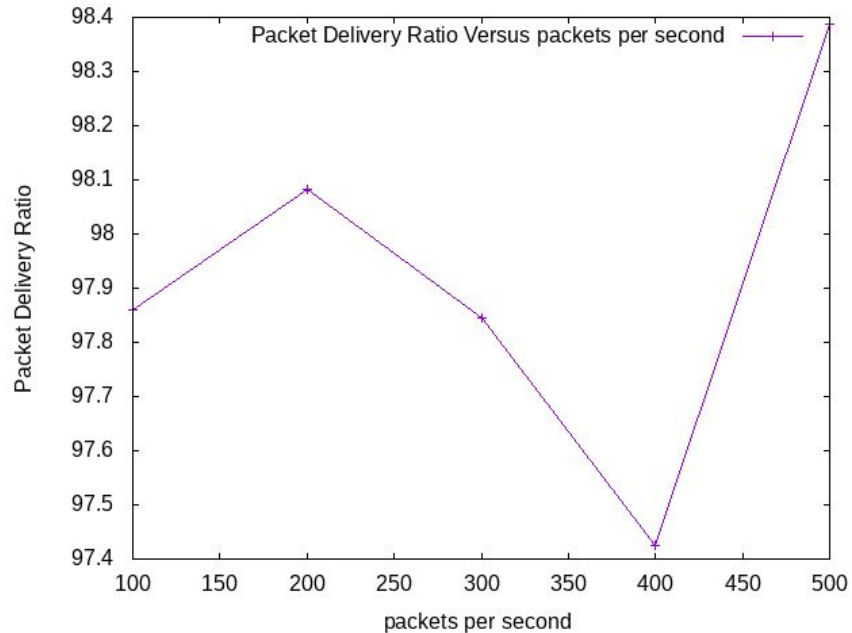
802.11

3. Variation in Packets per second



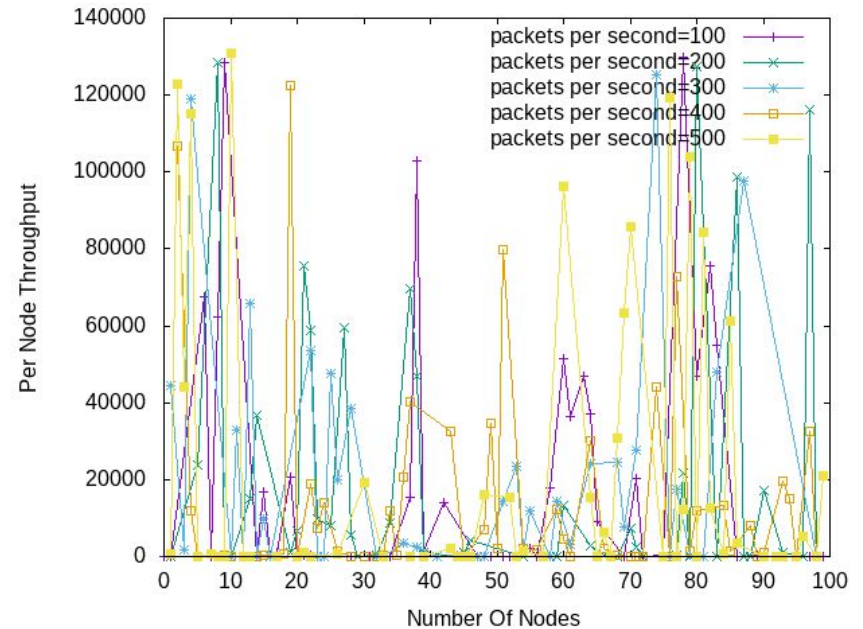
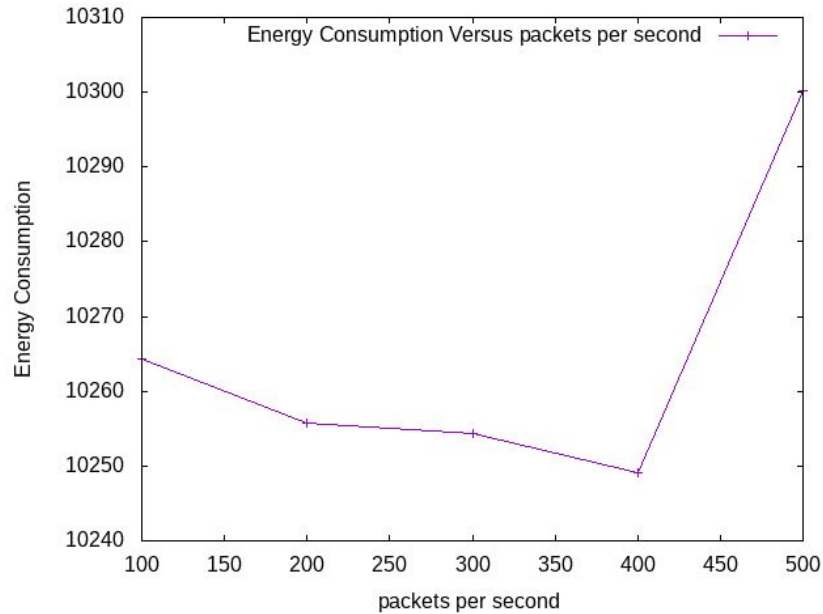
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3. Variation in Packets per second



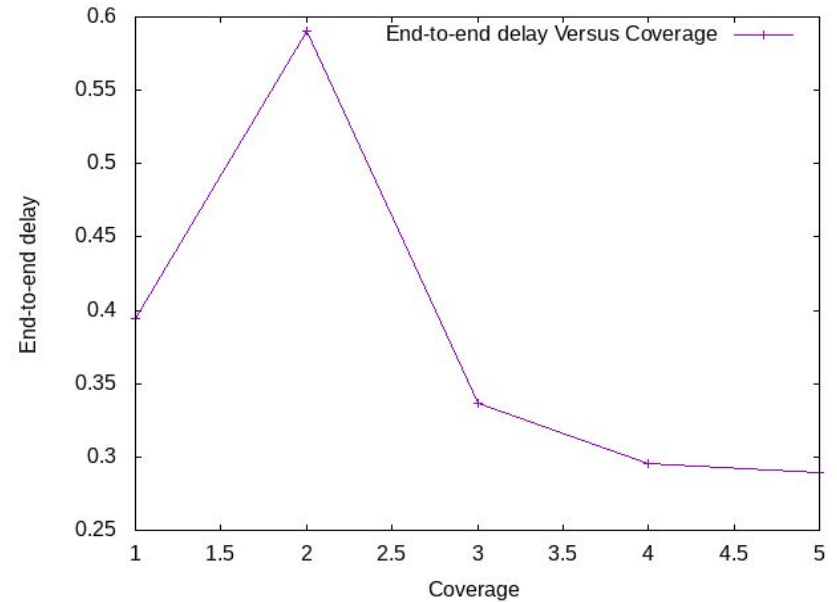
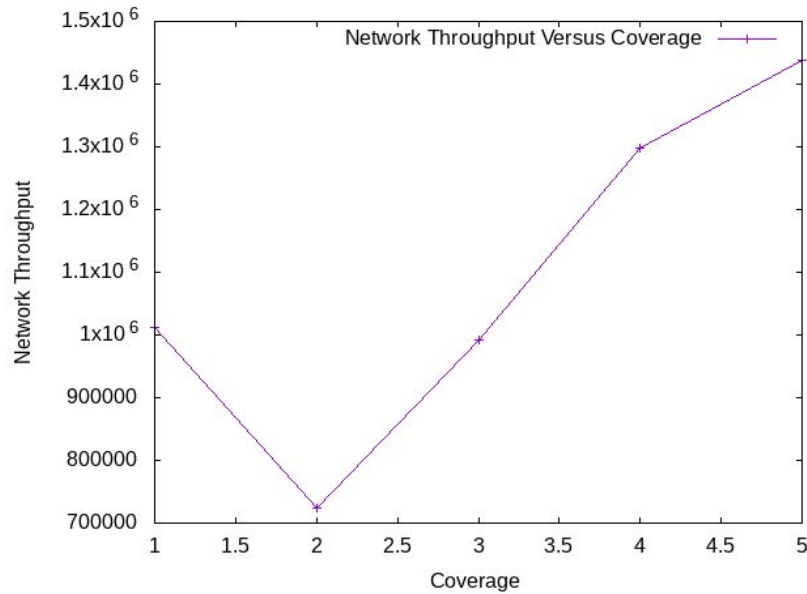
802.11

3. Variation in Packets per second



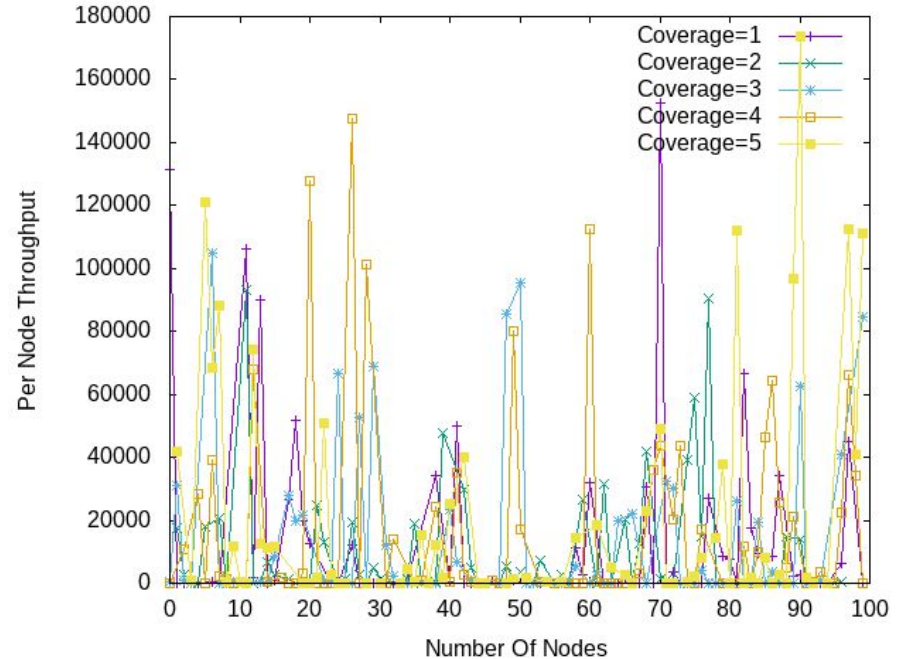
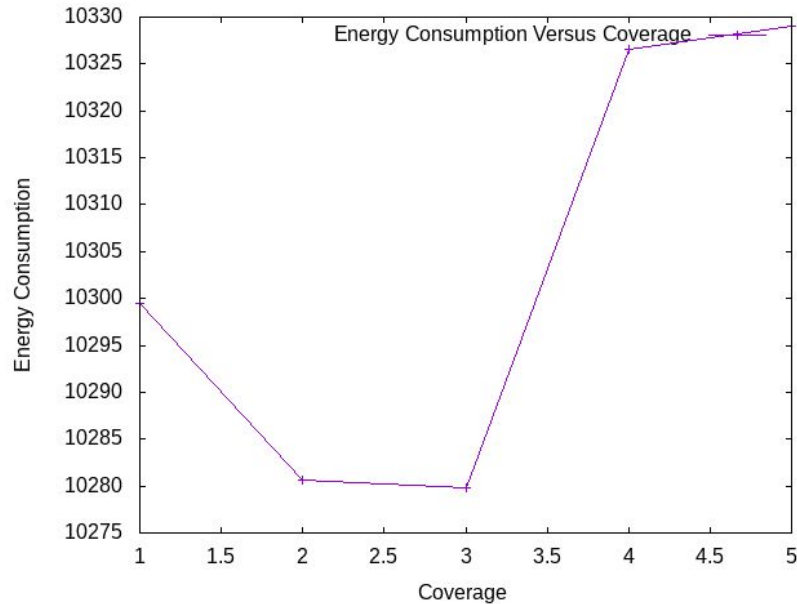
802.11

4. Variation in Coverage Area



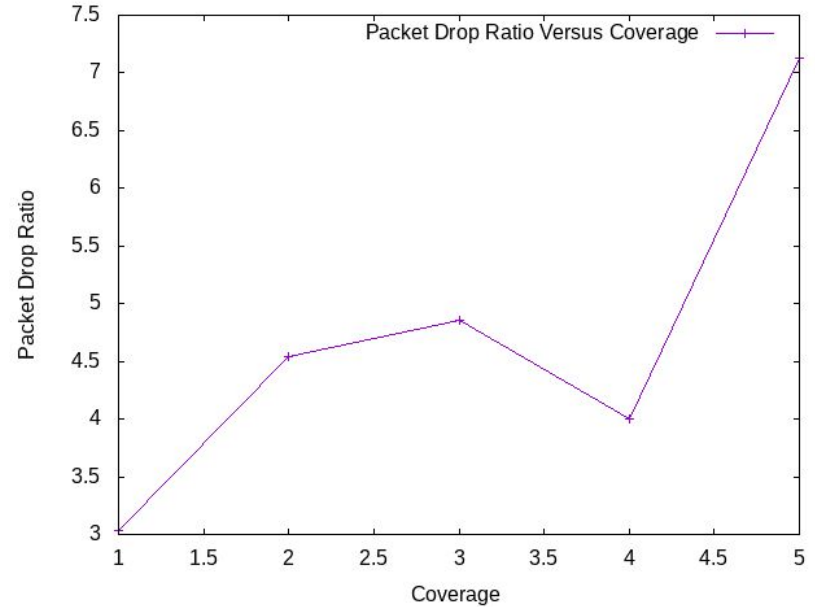
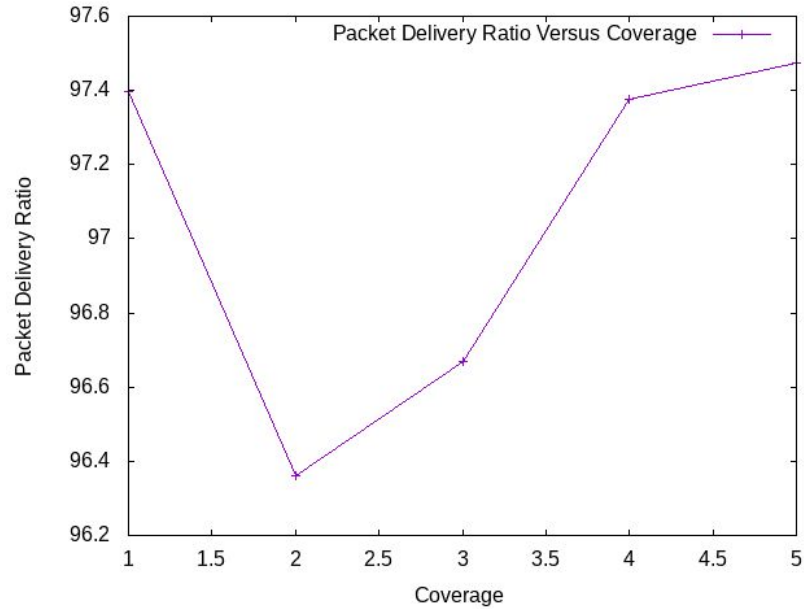
802.11

4. Variation in Coverage Area



802.11

4. Variation in Coverage Area



MODIFICATIONS MADE FOR 802.11

- In ns-allinone-2.35/ns-2.35/tcl/lib/ns-default.tcl we changed maxqueue_ from 40 to 50.
- In ns-allinone-2.35/ns-2.35/mobile/omni-antenna.cc we increased Gt_(the gain for a signal to a node from the transmitter at wavelength λ) and Gr_(the gain for a signal from a node from the receiver at wavelength λ) from 1.0 to 4.0.
- In ns-allinone-2.35/ns-2.35/tcp/tcp.cc we added case in opencwnd() function for congestion control:

case 9:

```
f = awnd_;
```

```
f *= f;
```

```
f *= wnd_const_;
```

```
f *= (t_srtt_ >> T_SRTT_BITS) * tcp_tick_;
```

```
f += fcnt_;
```

```
if (f > cwnd_) {
```

```
    fcnt_ = 0;
```

```
    ++cwnd_;
```

```
} else
```

```
    fcnt_ = f;
```

```
break;
```

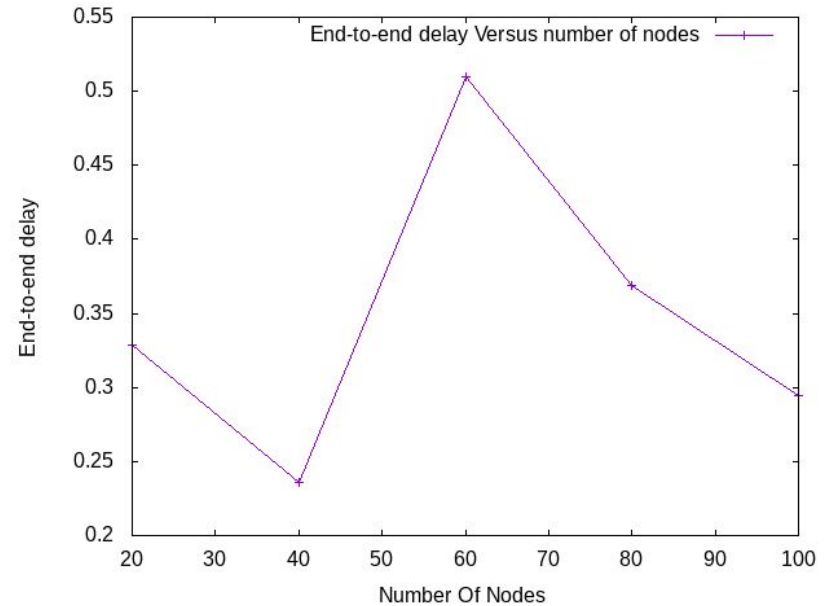
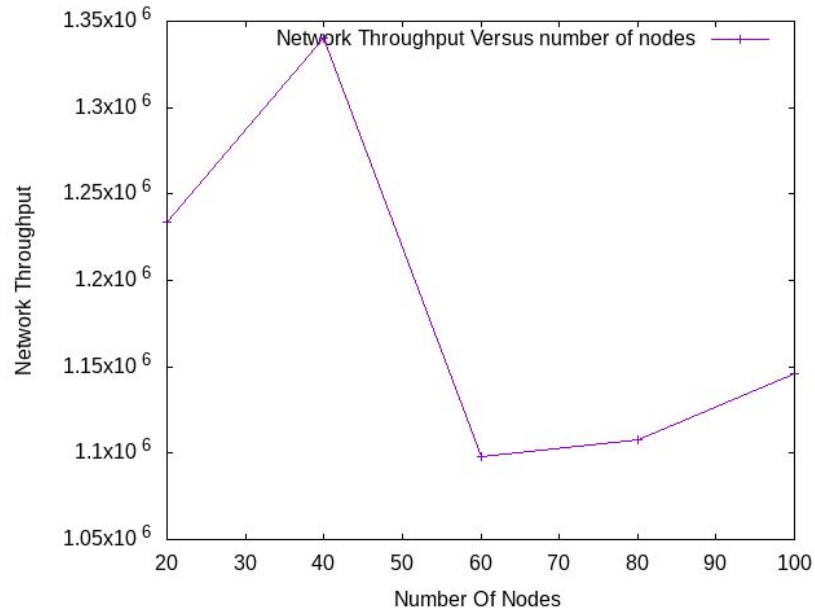
- In ns-allinone-2.35/ns-2.35/tcl/lib/ns-default.tcl we changed T_SRTT_BITS from 3 to 5.
- As a modified mechanism of rtt calculation, we followed a [paper](#) and changed the rtt_update() function in tcp.cc.

GRAPHS WITH MODIFICATION

For 802.11 (static)

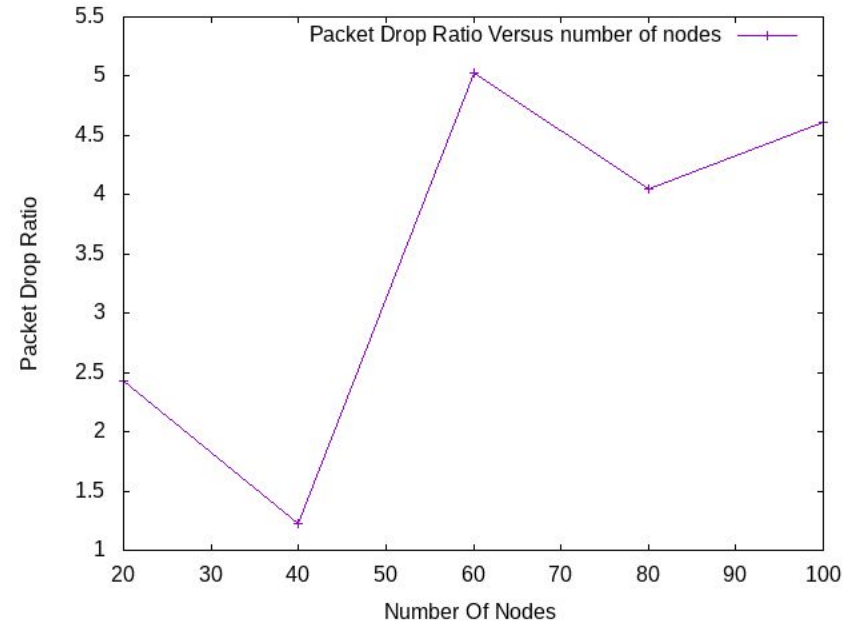
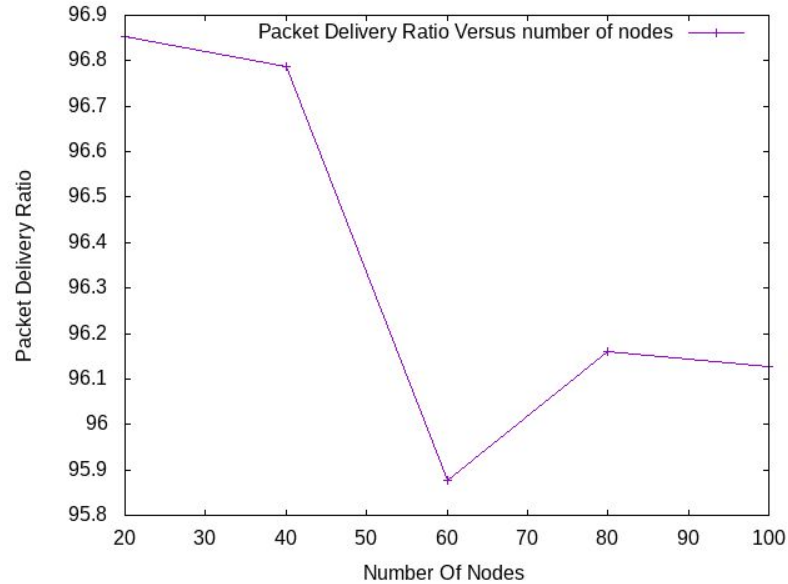
802.11

1. Variation in Node



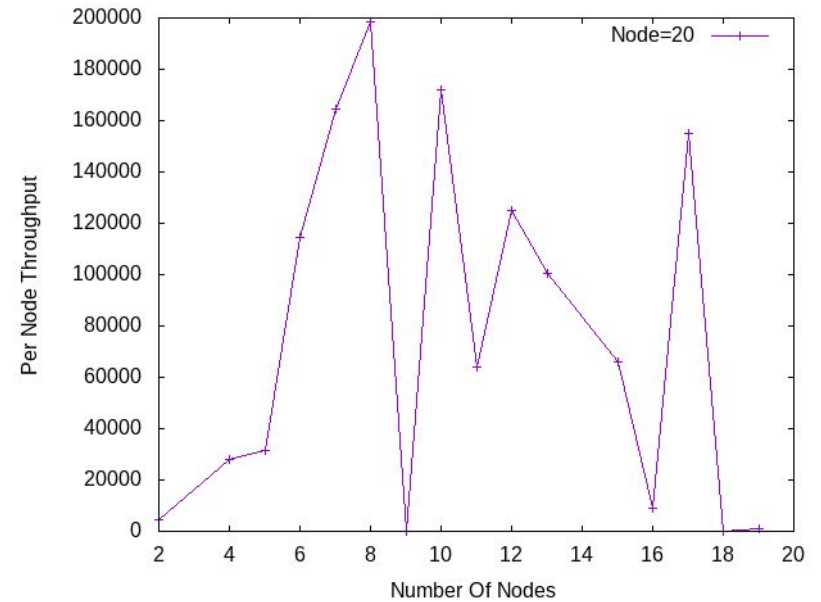
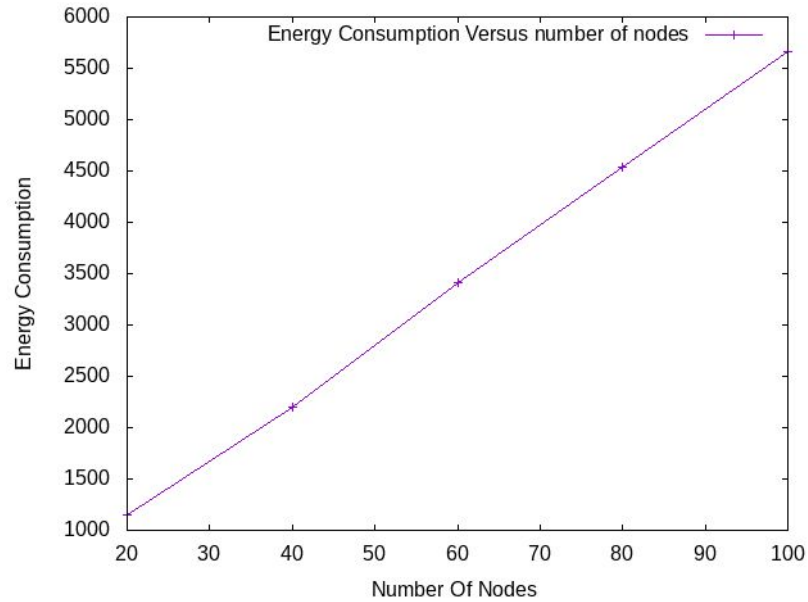
802.11

1. Variation in Node



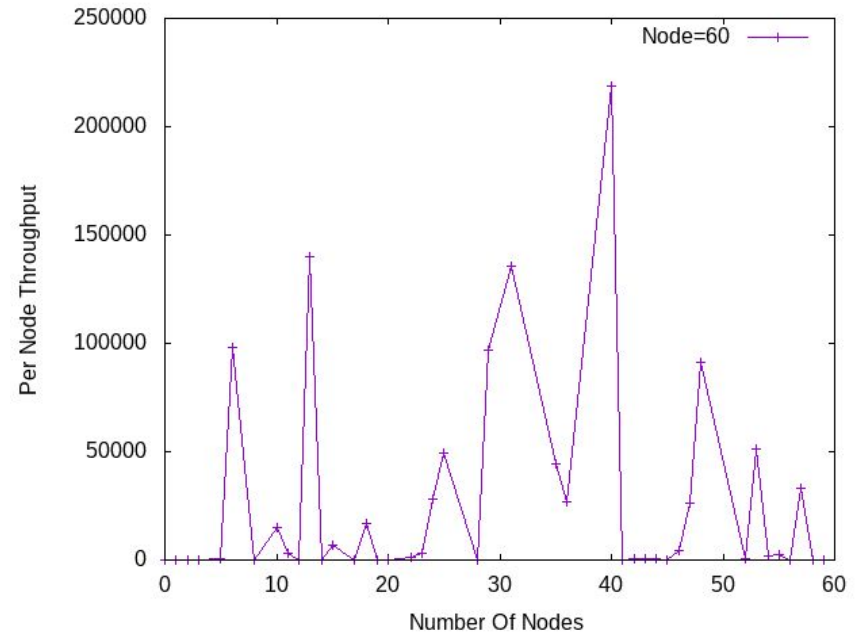
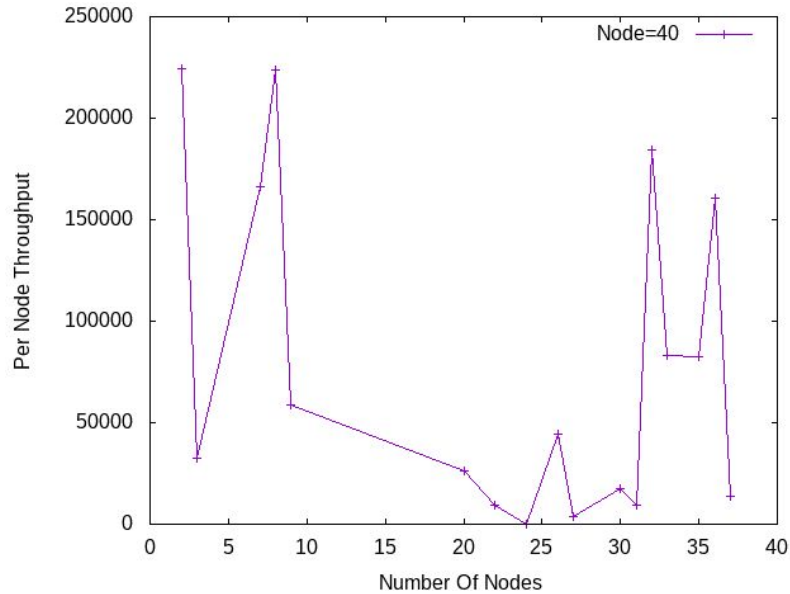
802.11

1. Variation in Node



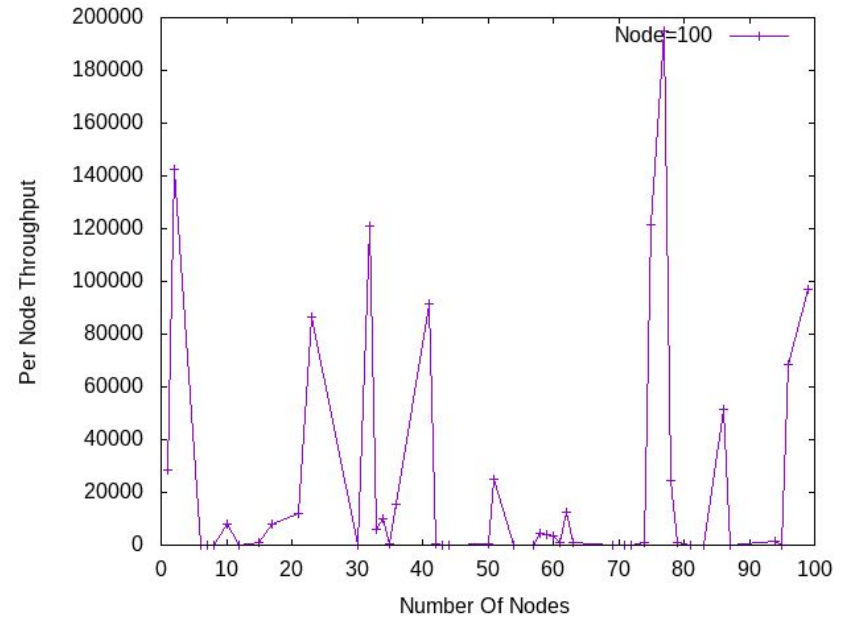
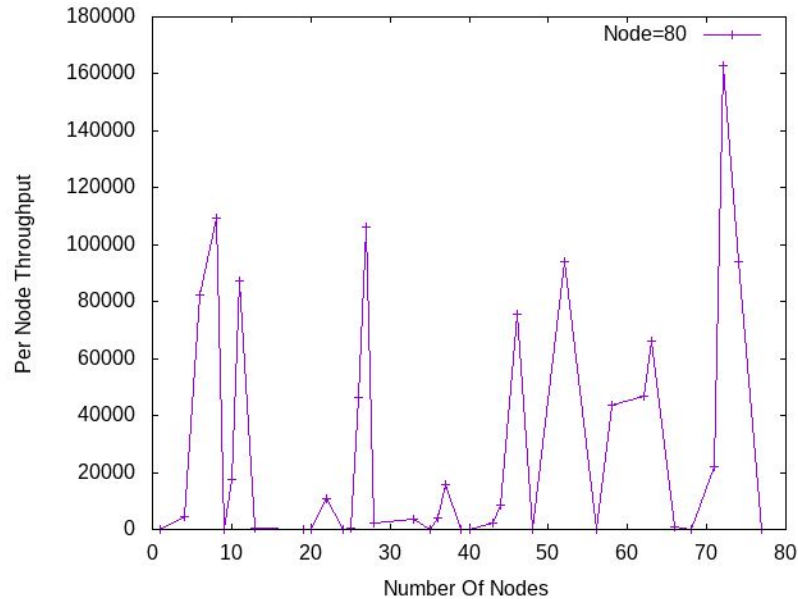
802.11

1. Variation in Node



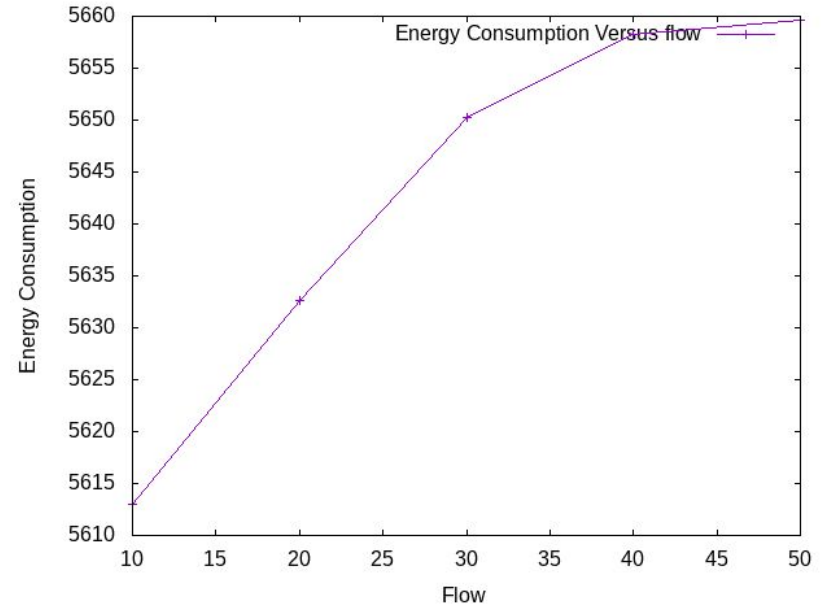
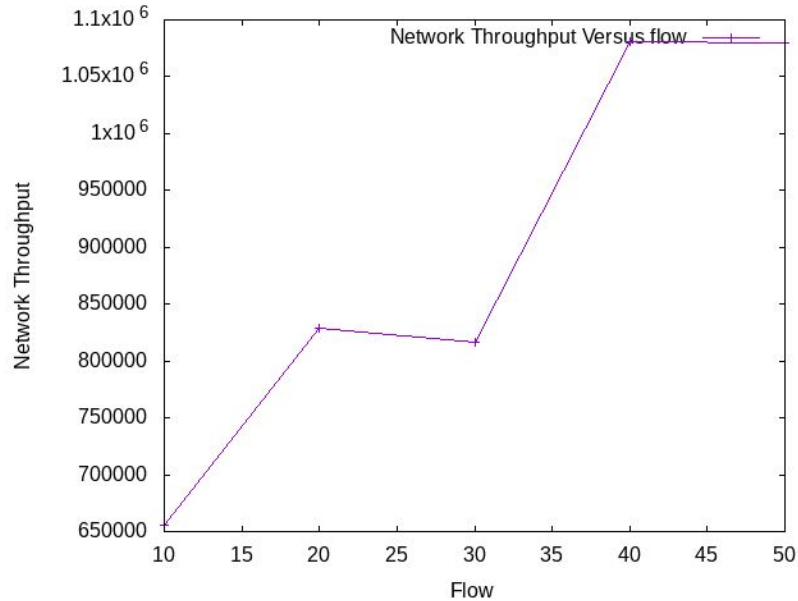
802.11

1. Variation in Node



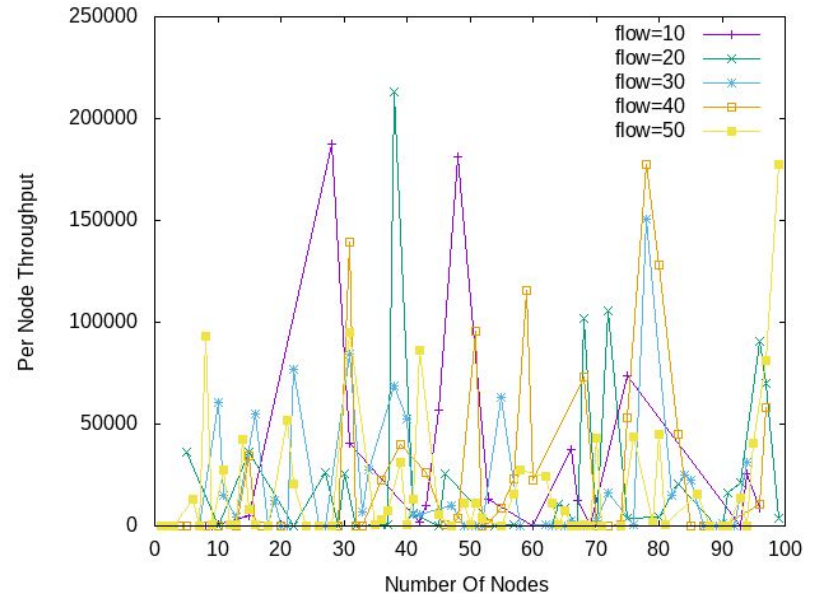
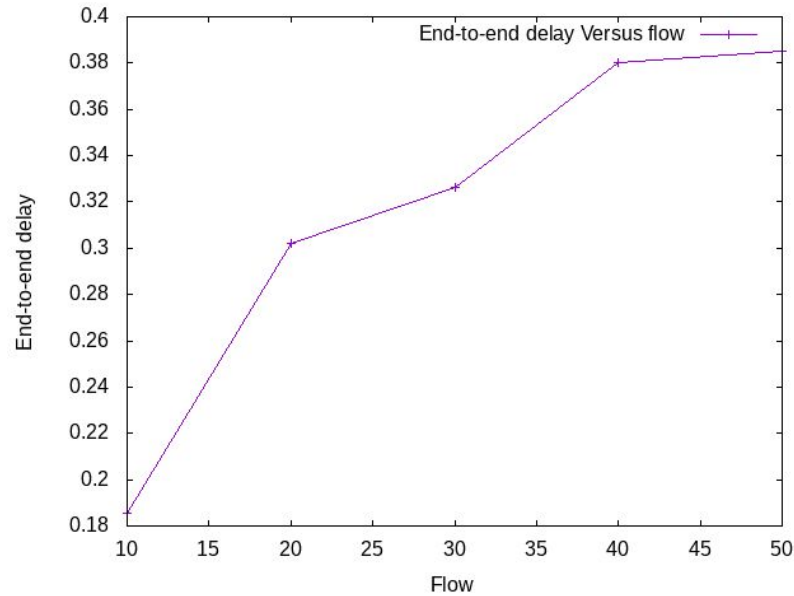
802.11

2. Variation in Flow



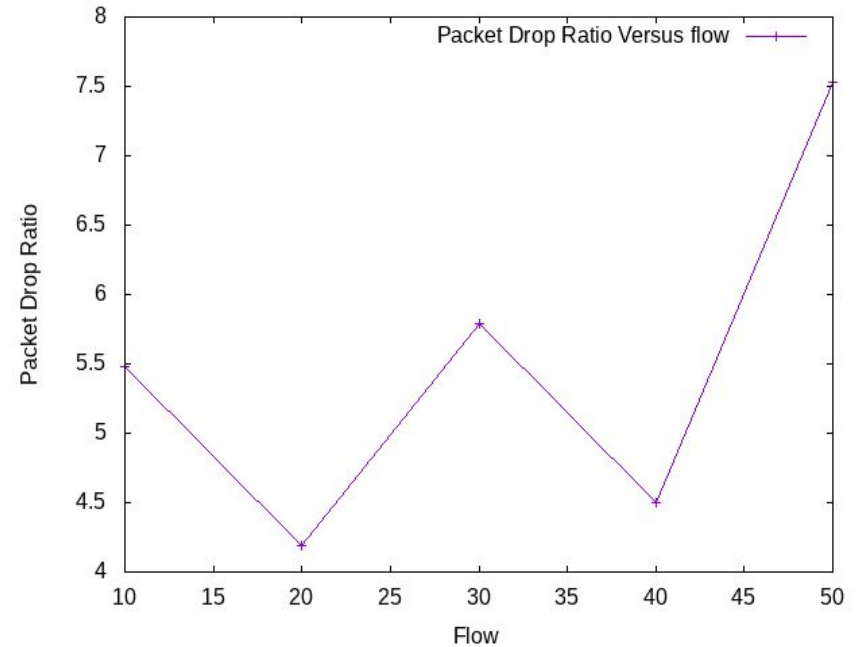
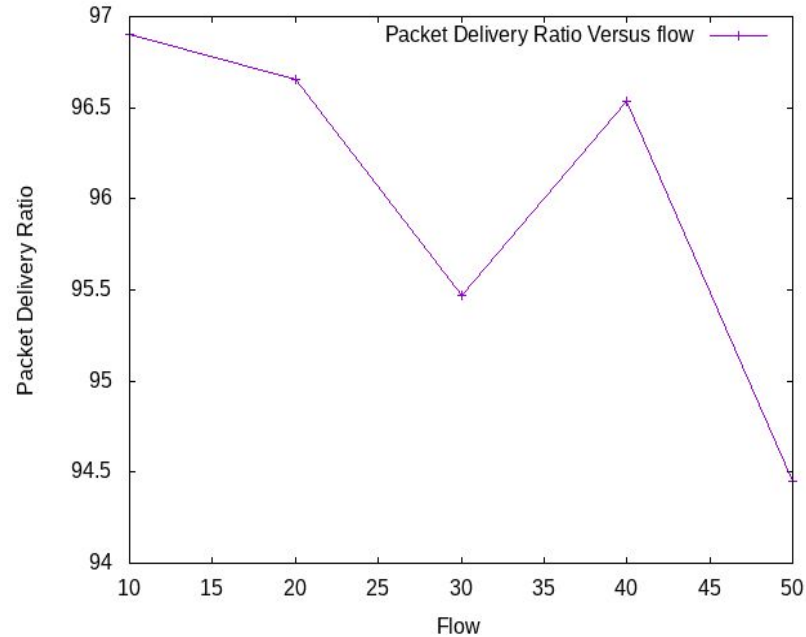
802.11

2. Variation in Flow



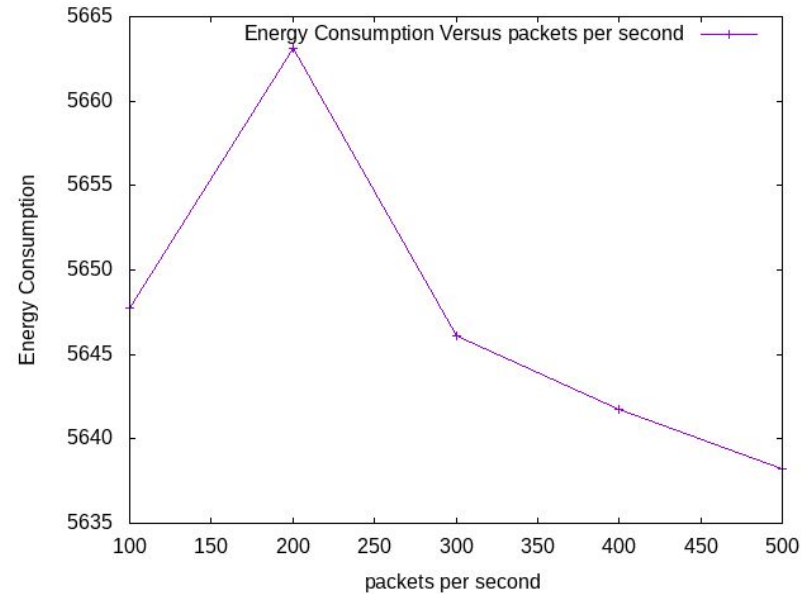
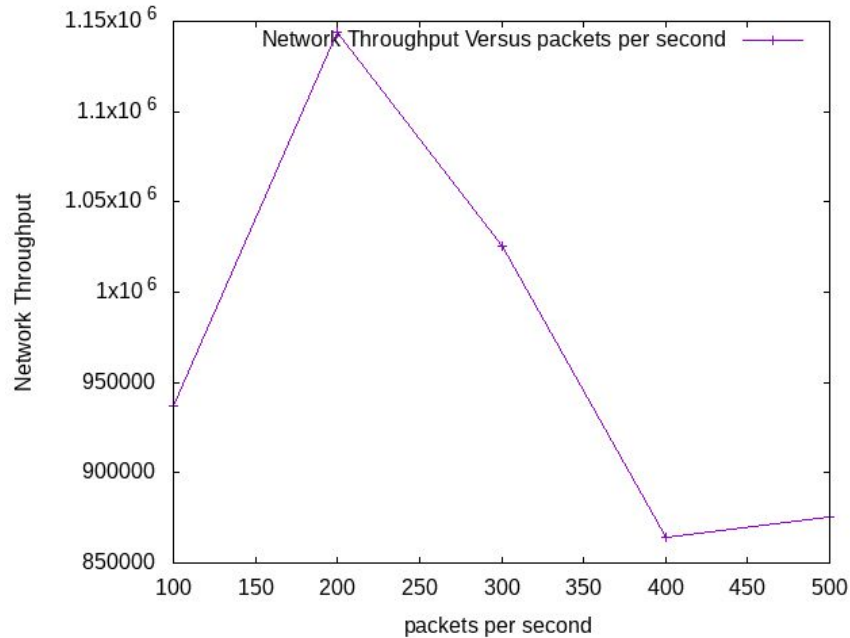
802.11

2. Variation in Flow



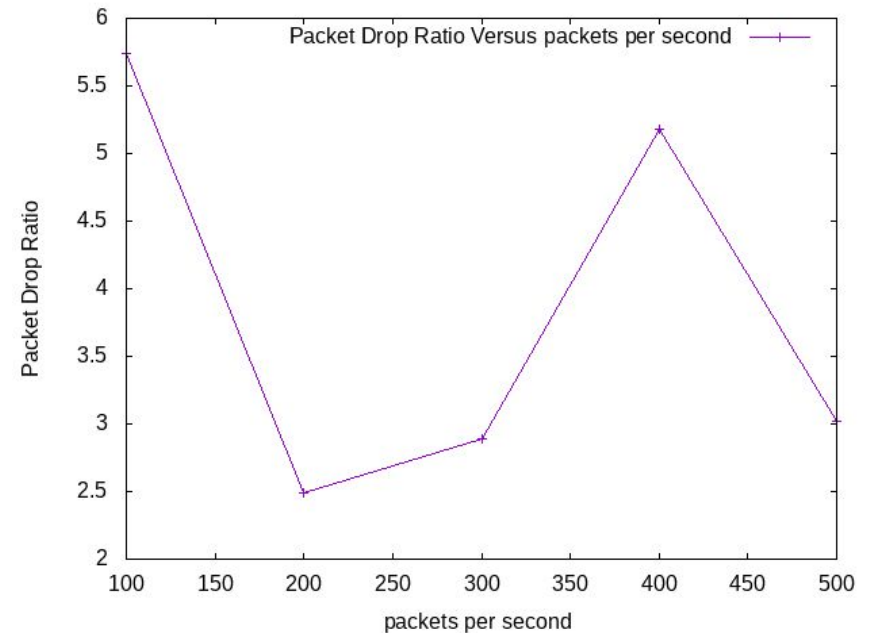
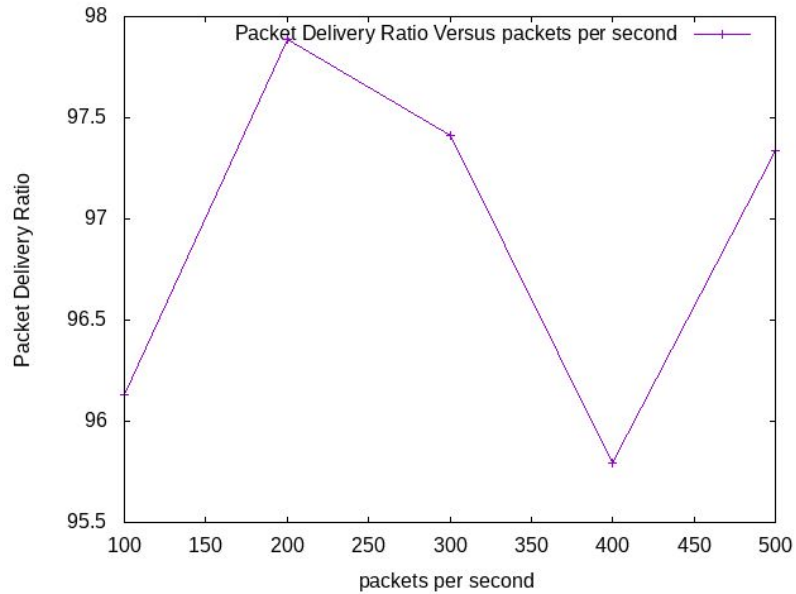
802.11

3. Variation in Packets per second



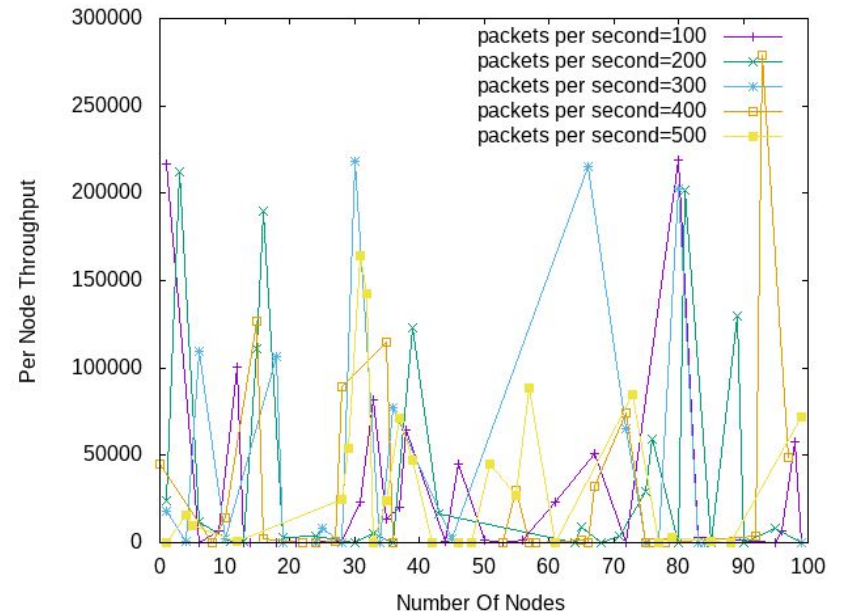
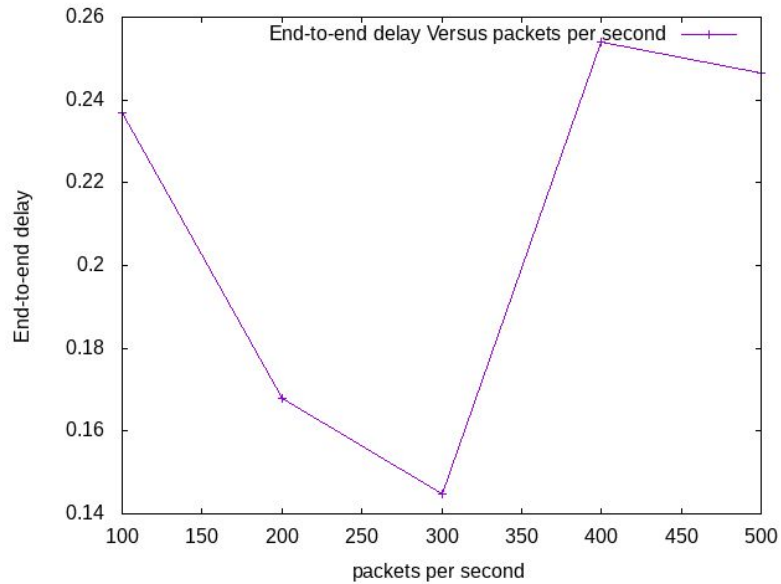
802.11

3. Variation in Packets per second



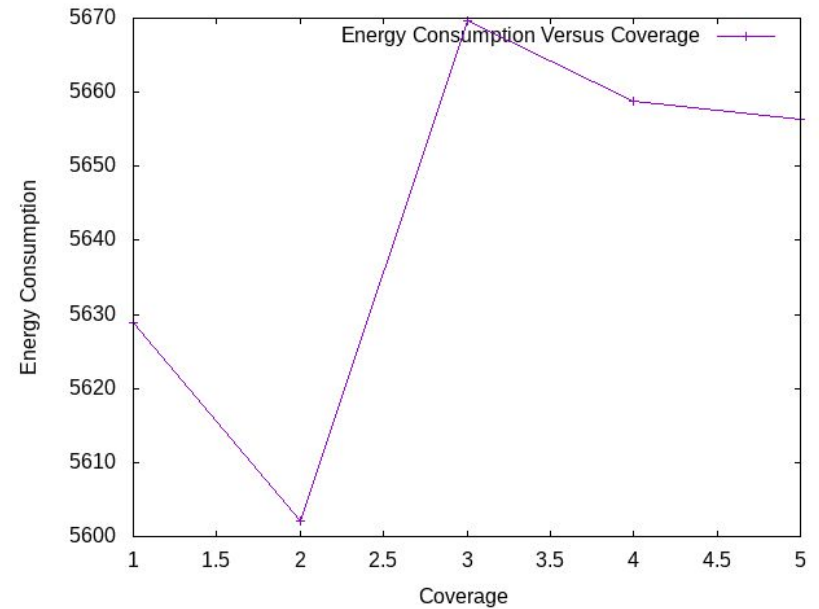
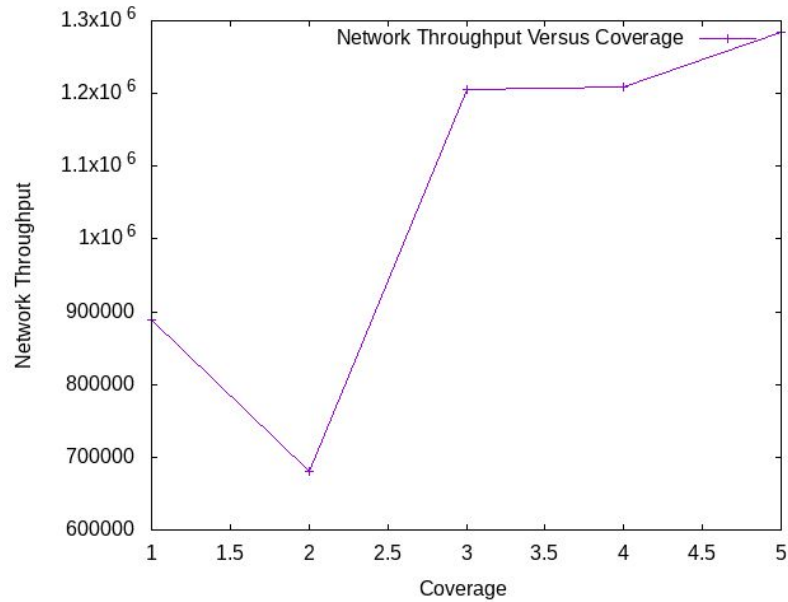
802.11

3. Variation in Packets per second



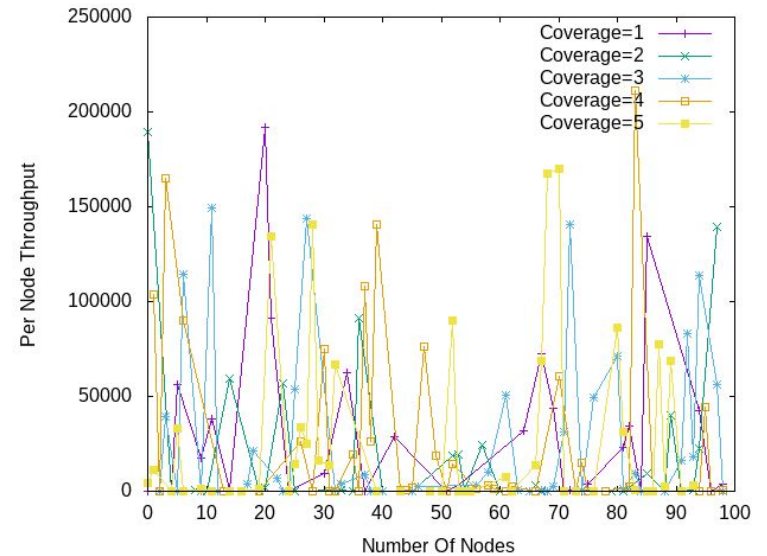
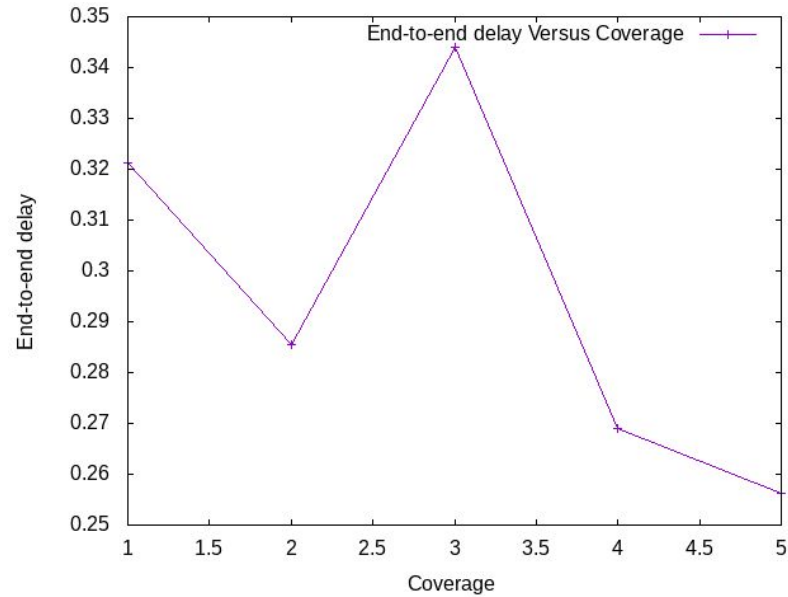
802.11

4. Variation in Coverage Area



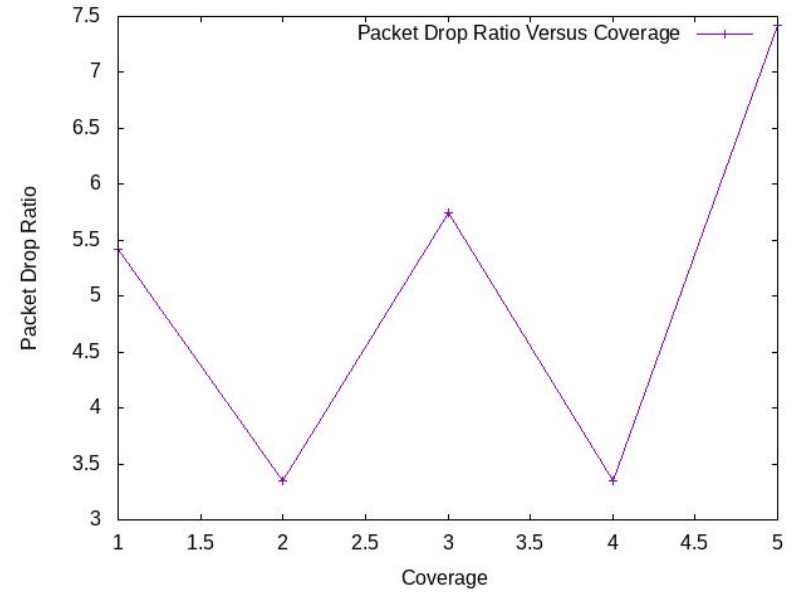
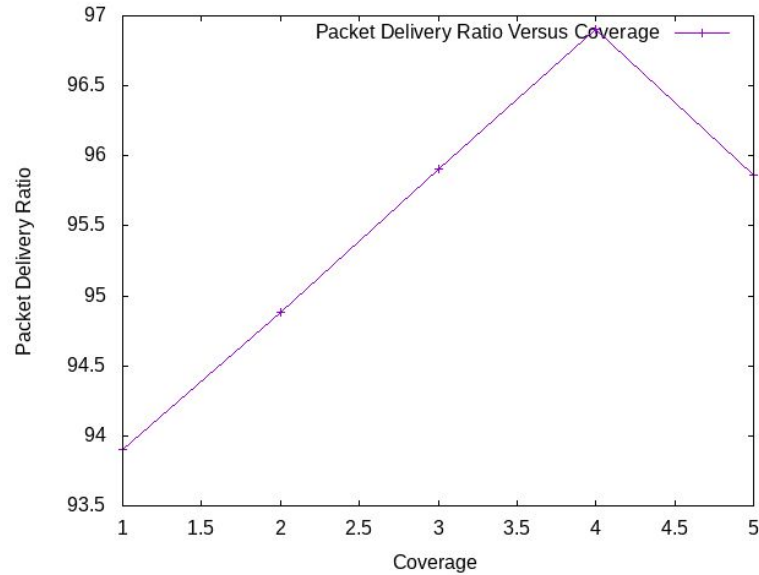
802.11

4. Variation in Coverage Area



802.11

4. Variation in Coverage Area



Summary for 802.11(static)

Reason for modifications:

We have added a different mechanism for rtt calculation which uses dynamic values of alpha and beta calculated using previous values of rtt, instead of using constant values. These help to make a better approximation of the current rtt value.

We have added a different mechanism for congestion control, according to our intuition which is to increase the congestion window by as small amount as possible whenever it exceeds the threshold value. This is done to avoid congestion as much as possible.

We have used droptail queue, so we have experimented by increasing queue size to see whether it really has any effect on all network metrics.

Finally we have increased power of antenna by increasing G_r and G_t .

Summary for 802.11(static)

Summary of findings (effects of modifications made)

Metric varied	Network Throughput	End-to-end Delay	Energy Consumption	Packet Delivery Ratio
Node	(850000-1350000) to (1050000-1350000), so increased on the average	Remained almost same (0.25-0.55)	(2000-10000) to (1000-5500), almost halved.	(96.2-97.6) to (95.9-96.9), decreased
Flow	(800000-1250000) to (650000-1100000), so decreased on the average	(0.15-0.375) to (0.18-0.39) Almost similar	(10220-10320) to (5615-5660), Almost halved, variation is also low	(98.1-96.2)to (97-94.5) Delivery ratio decreases as flow increases in both cases

Summary for 802.11(static)

Summary of findings (effects of modifications made)

Metric varied	Network Throughput	End-to-end Delay	Energy Consumption	Packet Delivery Ratio
Packets per second	(760000-1200000) to (860000-1150000)	(0.2-0.36, decreased->increased ->decreased) (0.14-0.26, Decreased and then increased)	(10250-10300) to (5636-5665) Decreased to almost half	(97.4-98.4) to (95.75-98) Variation increased
Coverage area	(700000-1500000) to (650000-1300000) Decreased on the average	(0.6-0.275) to (0.35-0.275) Decreased on the average so got better	(10280-10330) To (5600-5670) Almost halved	(96.3-97.5) to (93.75-97) Decreased on the average

GRAPHS WITHOUT MODIFICATION

For 802.15.4(static)

802.15.4

1 . variation in node

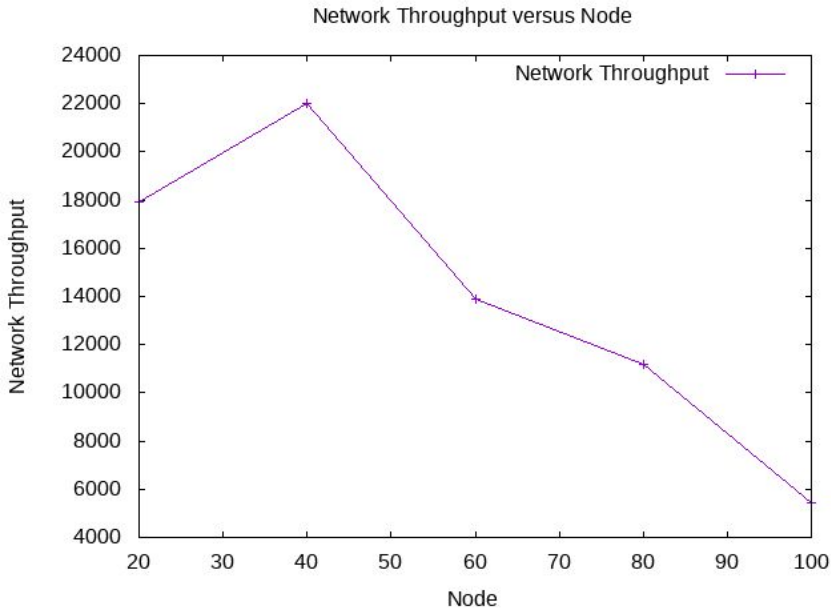


Fig : Network throughput vs node

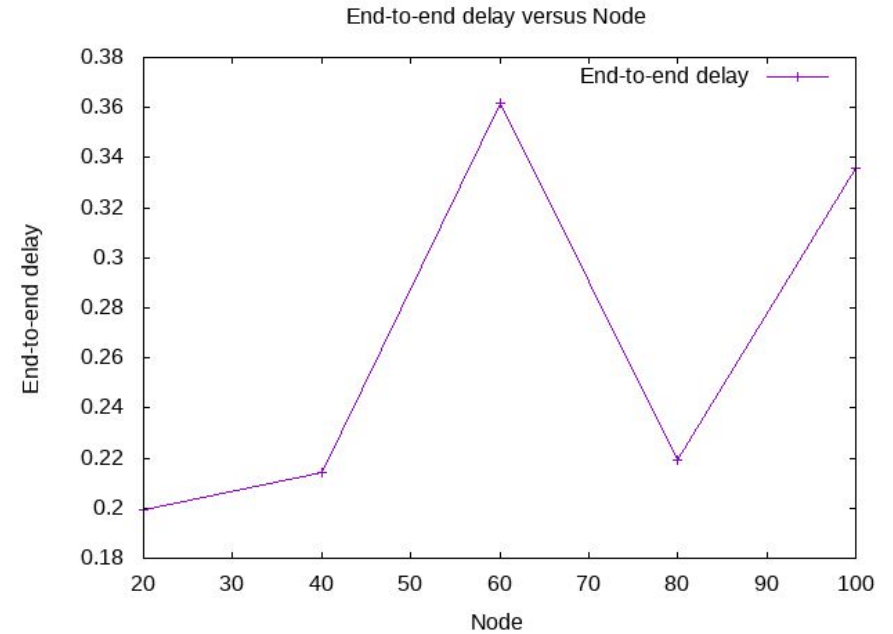


Fig : End-to-end delay vs node

802.15.4

1 . variation in node

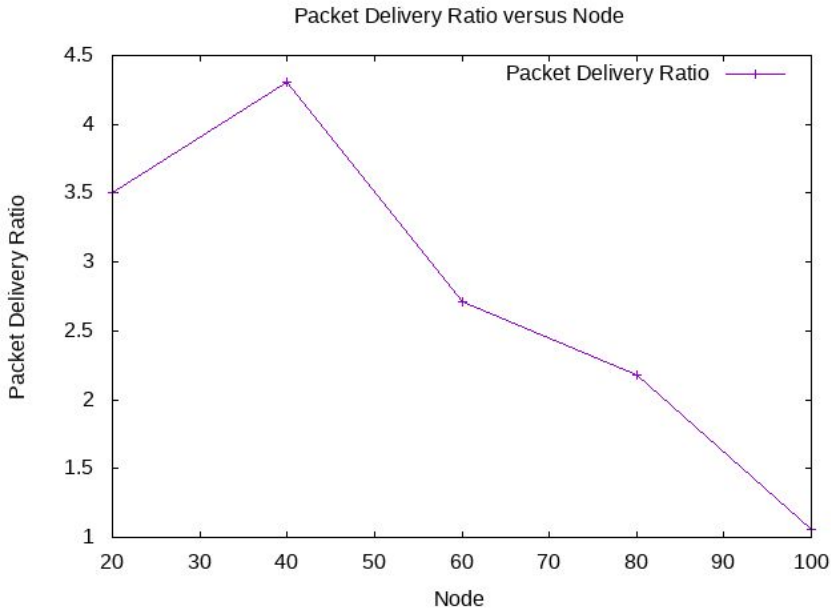


Fig : Delivery Ratio vs node

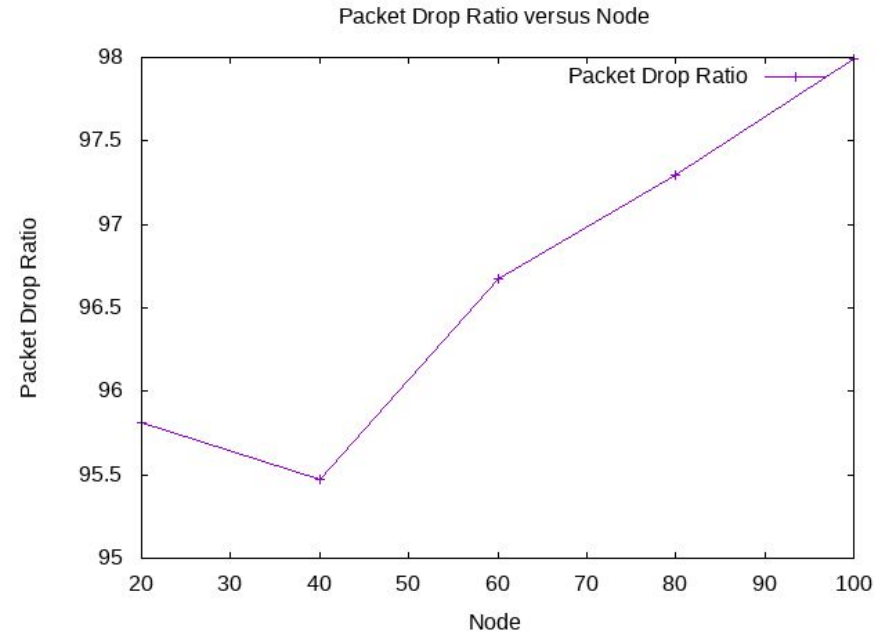


Fig : Drop Ratio vs node

802.15.4

1 . variation in node

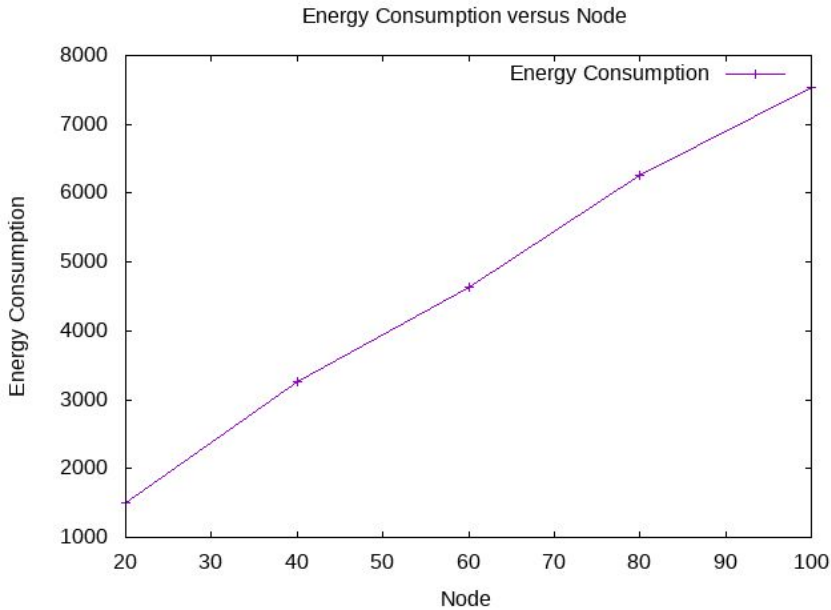


Fig : Energy Consumption vs node

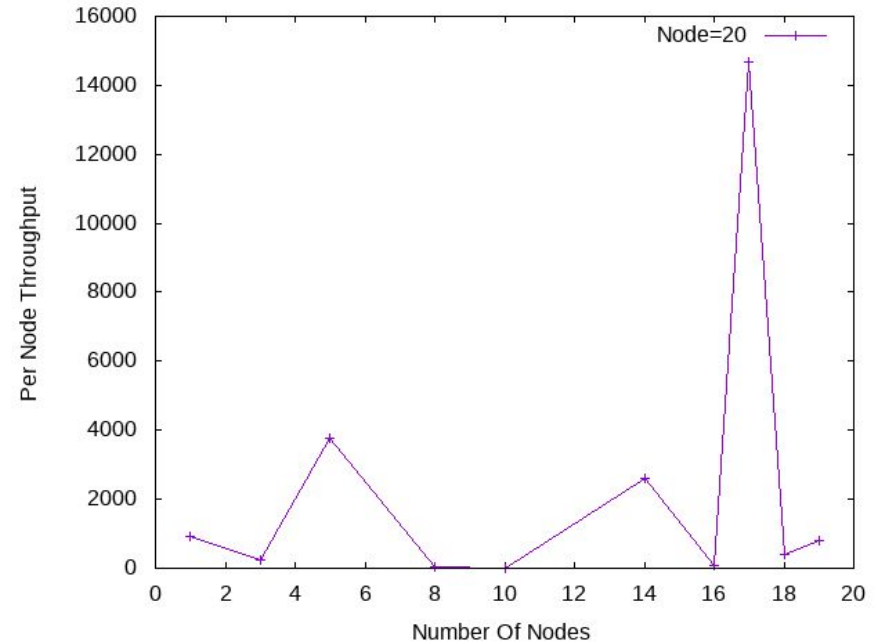


Fig : Per node throughput for node size = 20

802.15.4

1 . variation in node

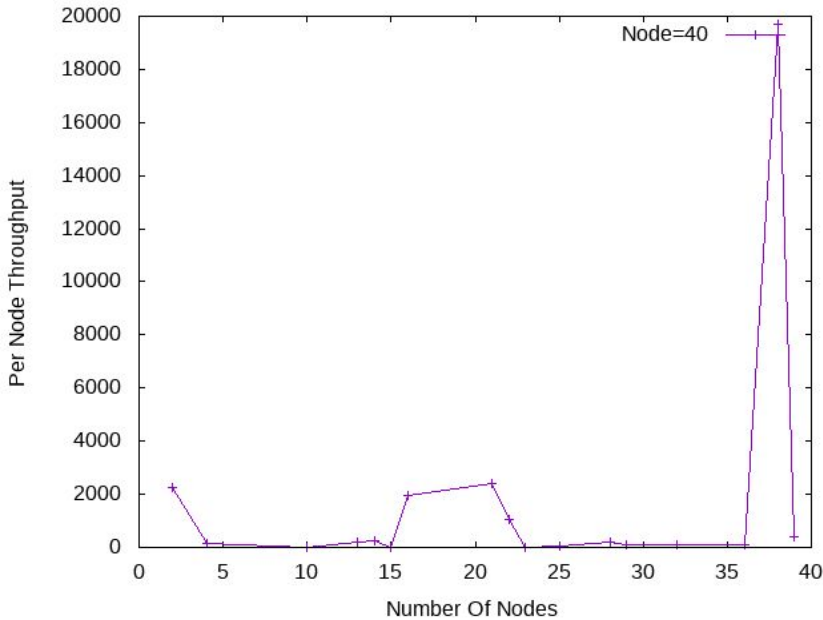


Fig : Per node throughput for node size = 40

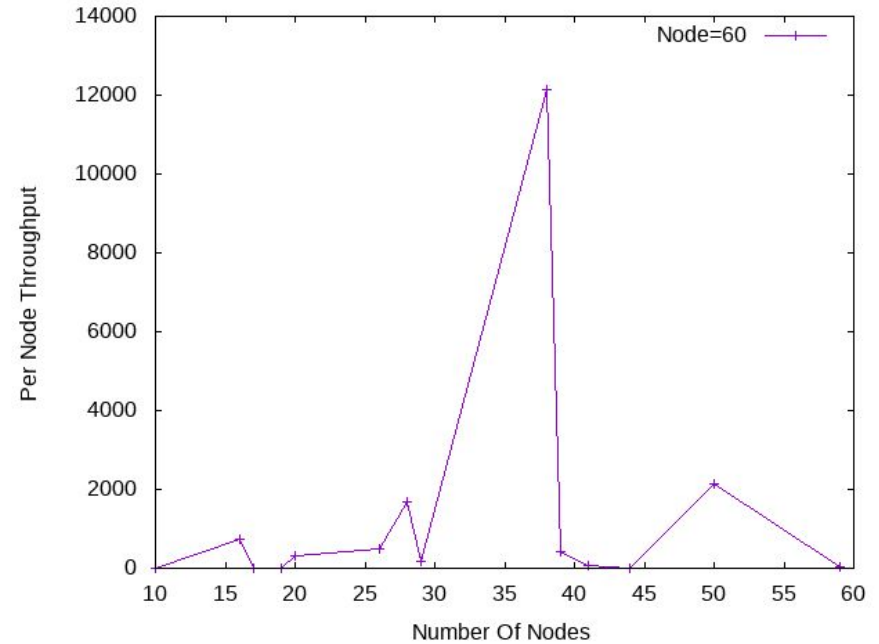


Fig : Per node throughput for node size = 60

802.15.4

1 . variation in node

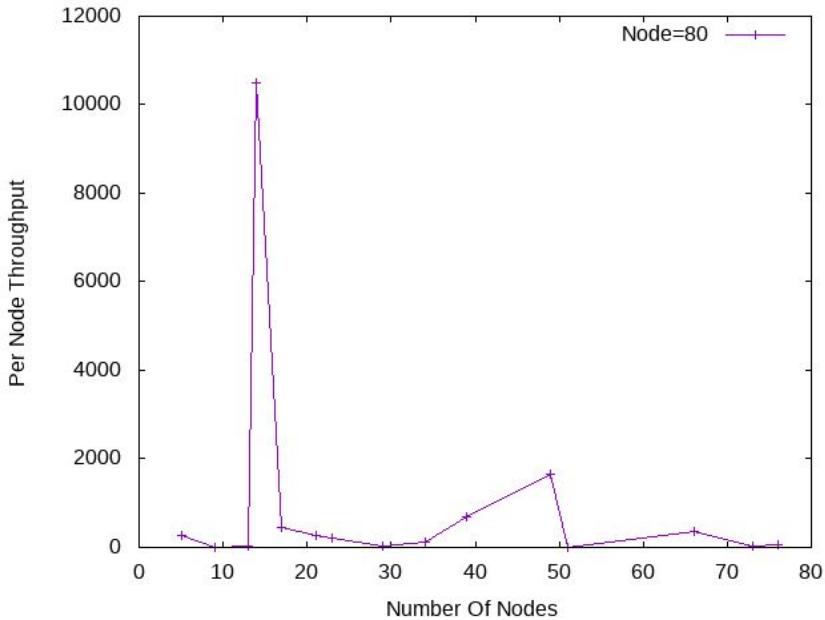


Fig : Per node throughput for node size = 80

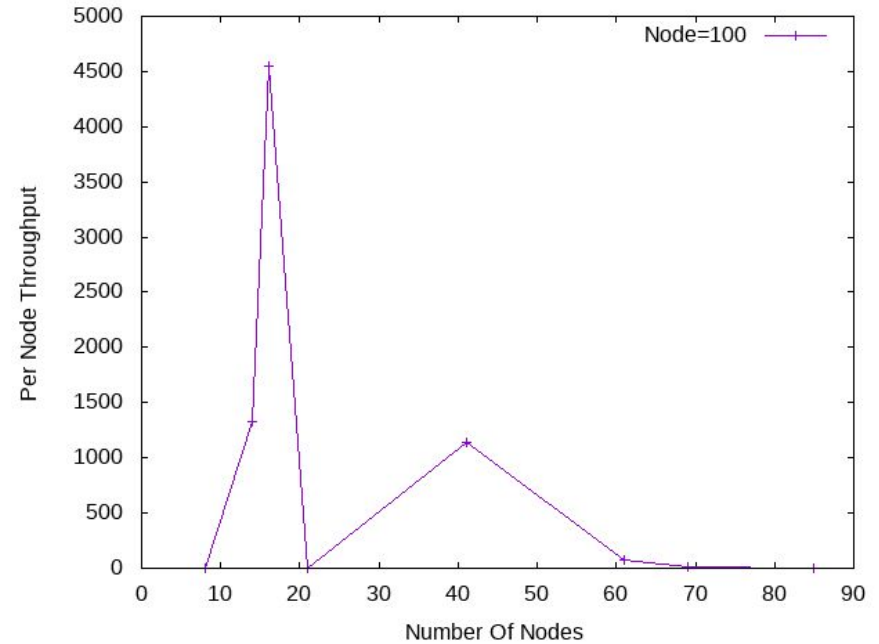


Fig : Per node throughput for node size = 100

802.15.4

2 . variation in flow

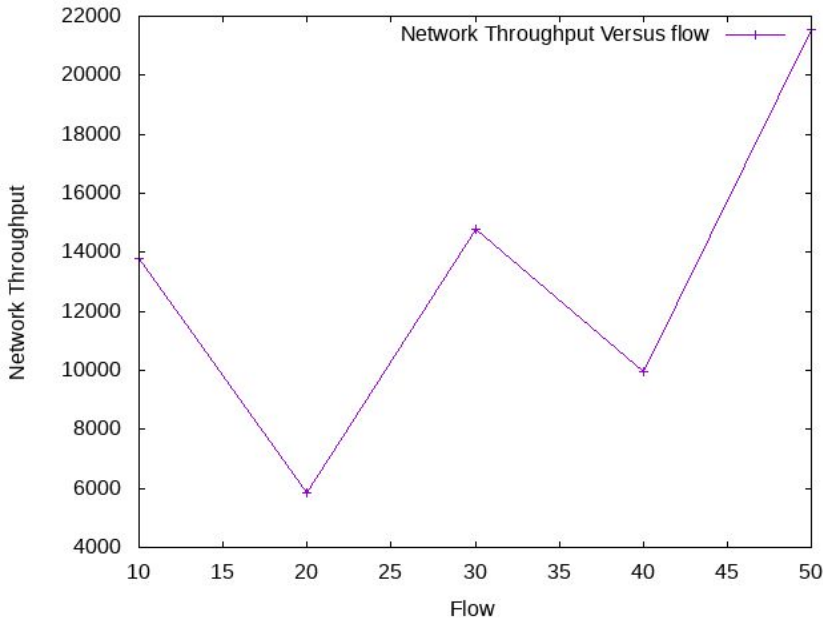


Fig : Network throughput vs flow

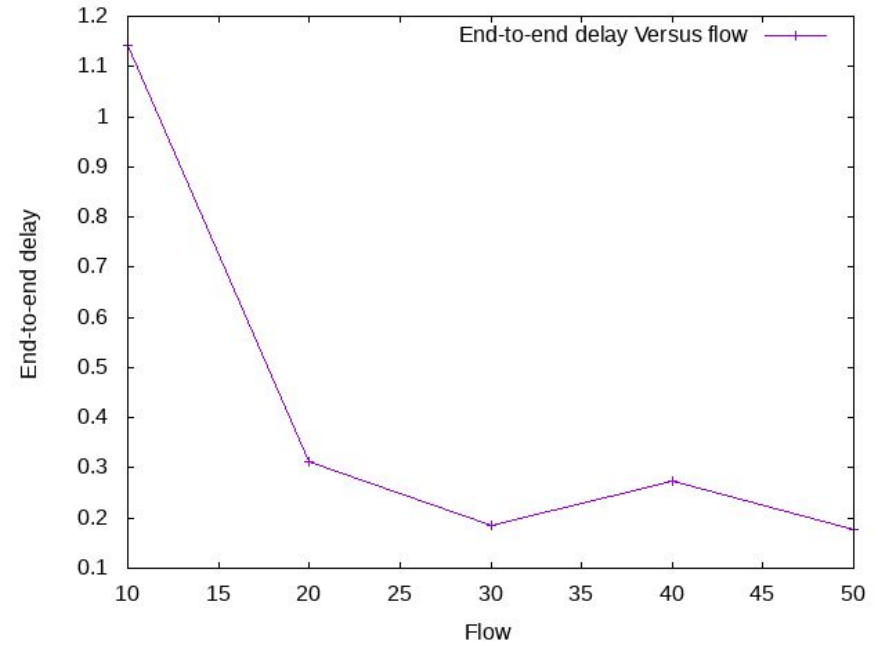


Fig : End-to-end delay vs flow

802.15.4

2 . variation in flow

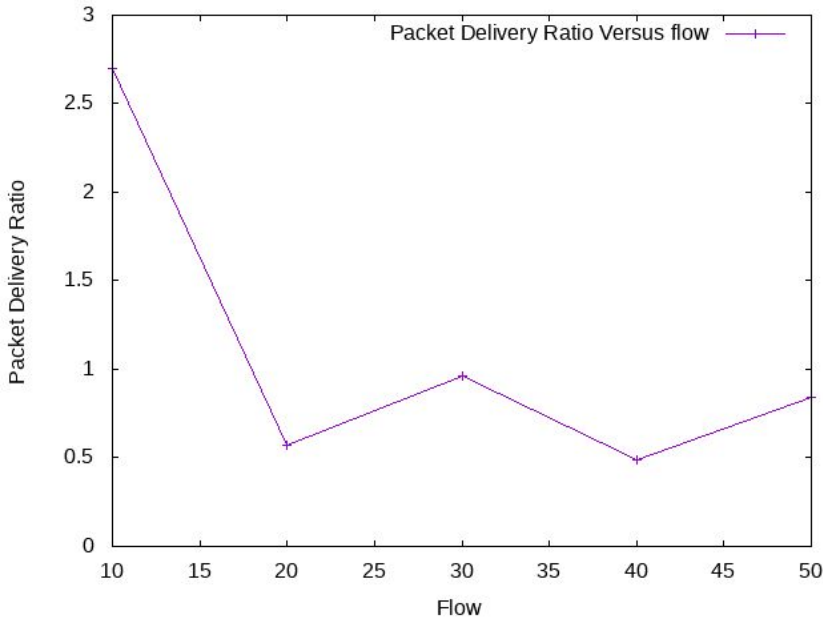


Fig : Delivery Ratio vs flow

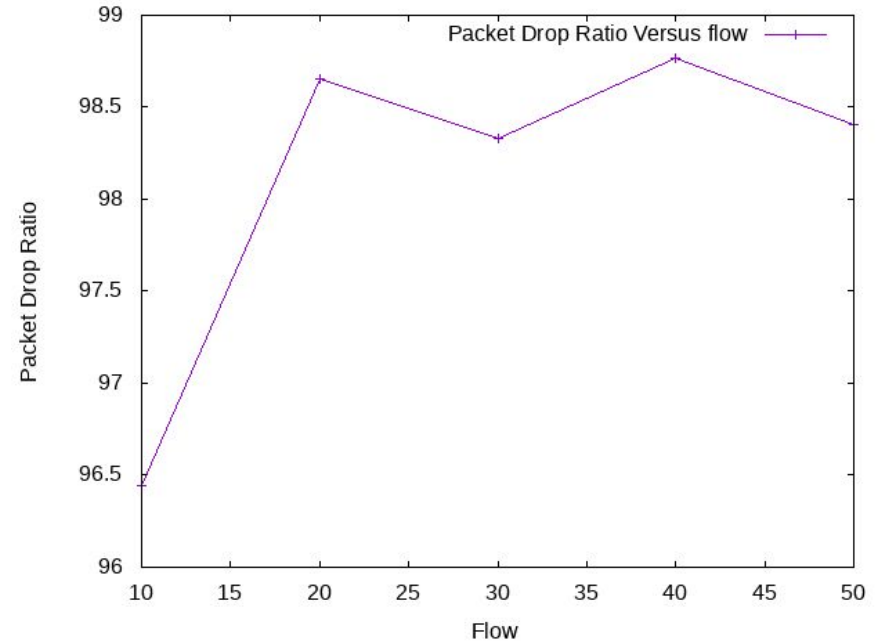


Fig : Drop Ratio vs flow

802.15.4

2 . variation in flow

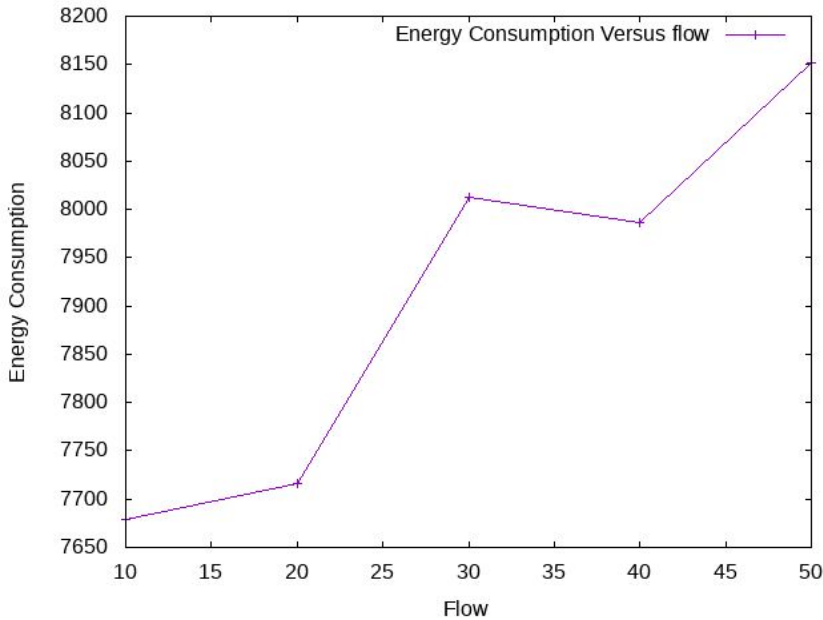


Fig : Energy Consumption vs flow

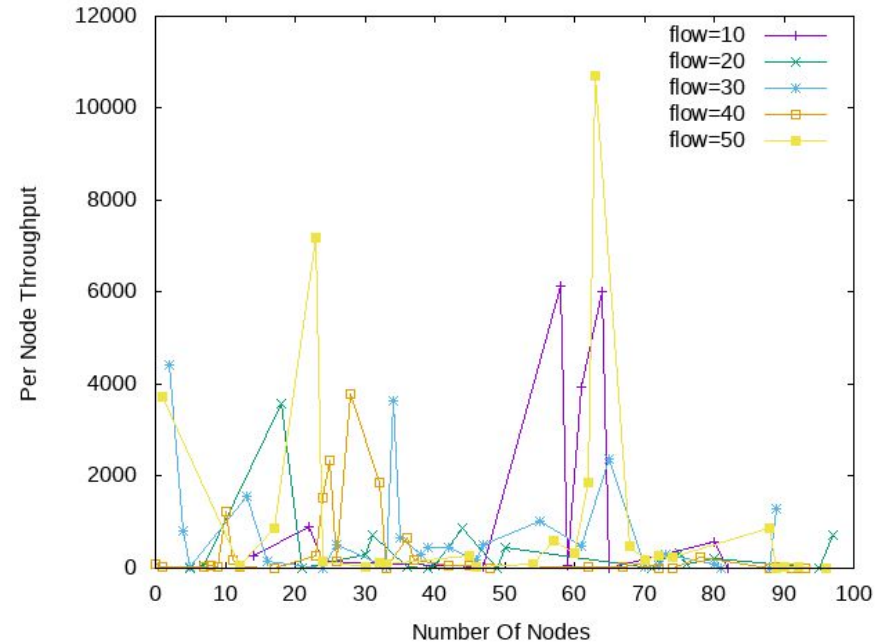


Fig : Per node throughput with flow varied

802.15.4

3 . variation in packet size

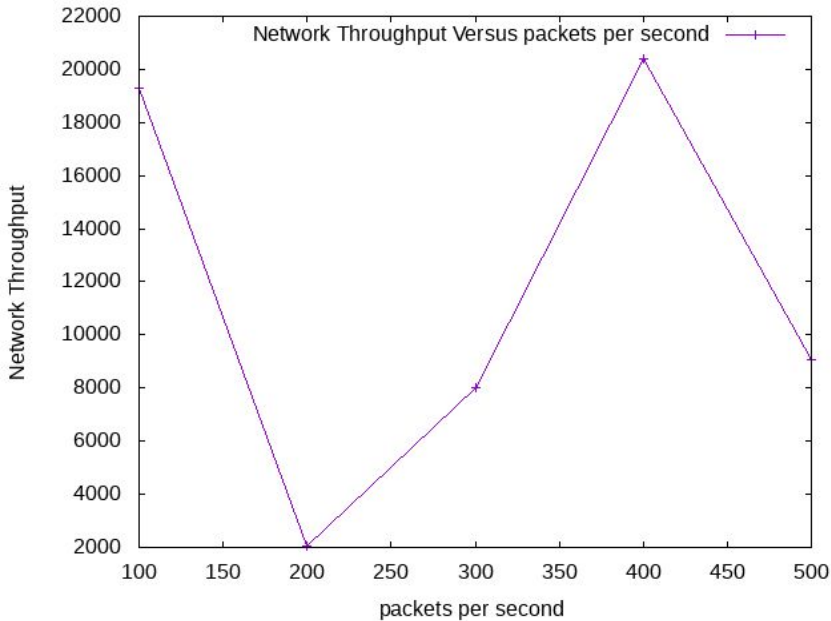


Fig : Network throughput vs packet per second

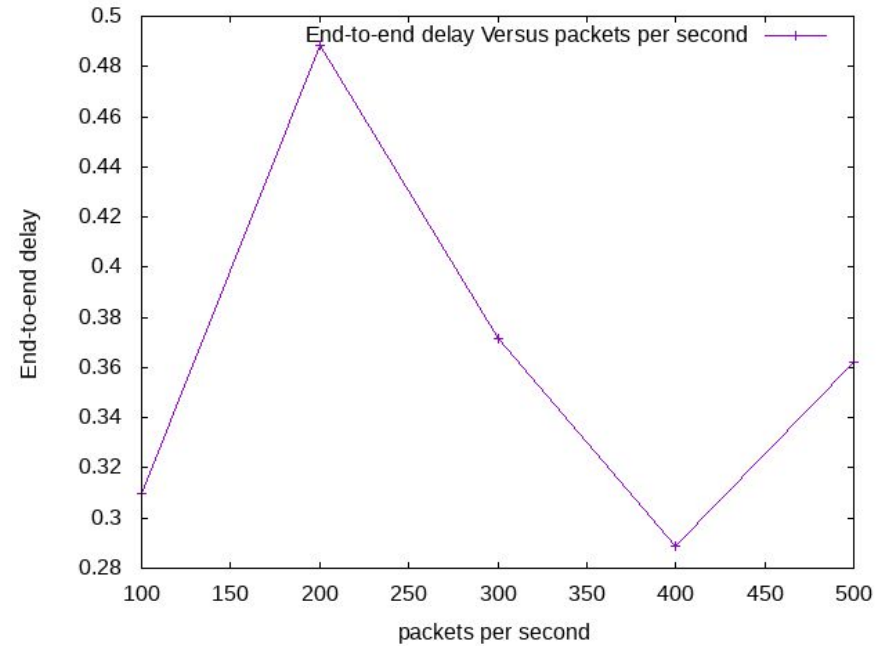


Fig : End-to-end delay vs packet per second

802.15.4

3 . variation in packet size

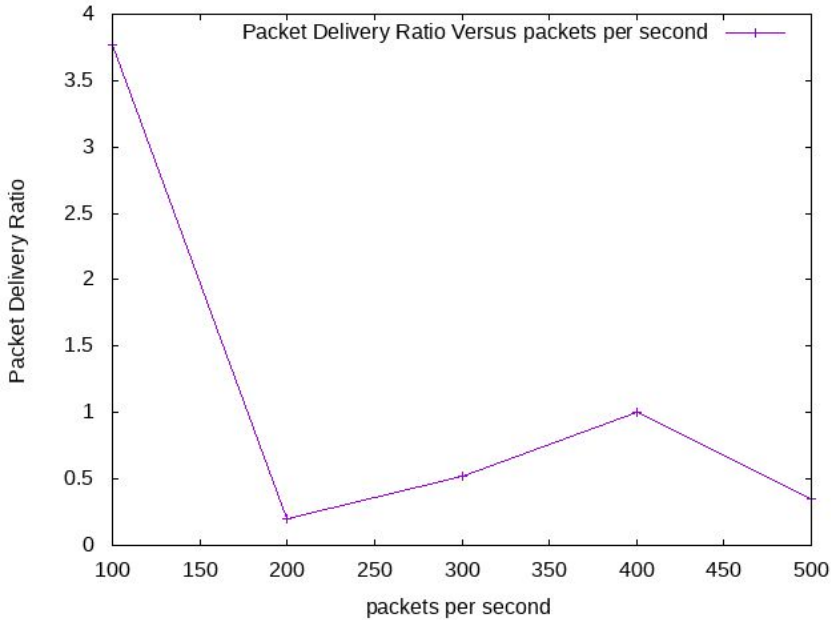


Fig : Delivery Ratio vs packet per second

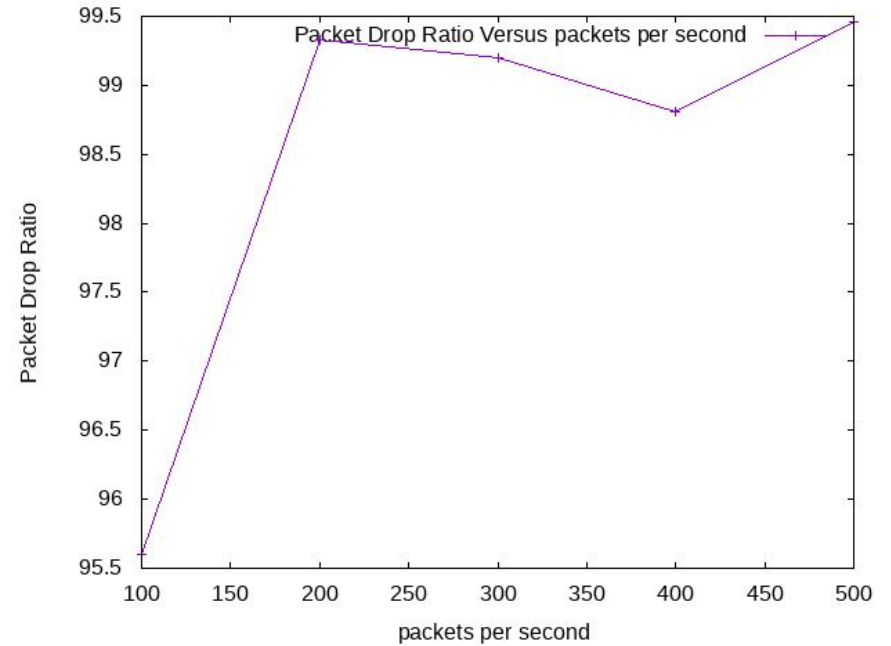


Fig : Drop Ratio vs packet per second

802.15.4

3 . variation in packet size

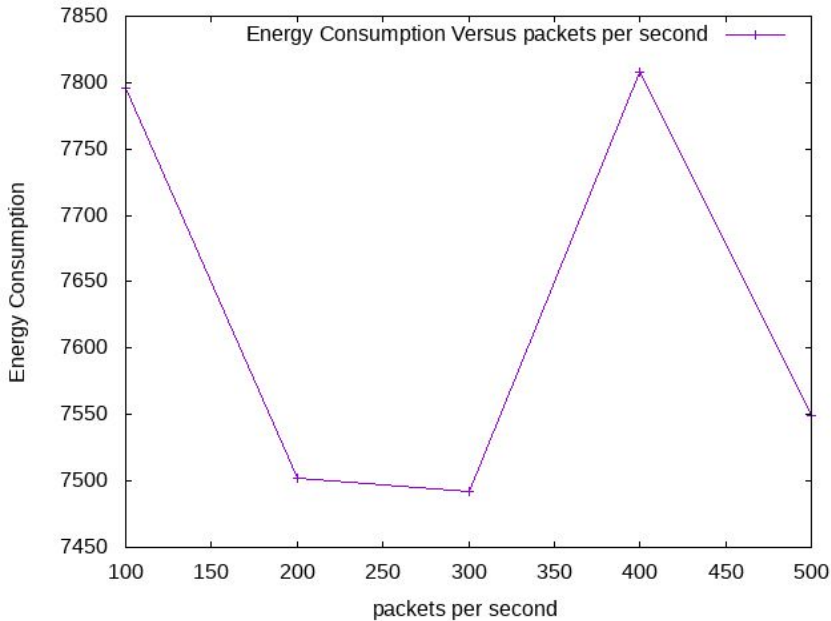


Fig : Energy Consumption vs packet per second

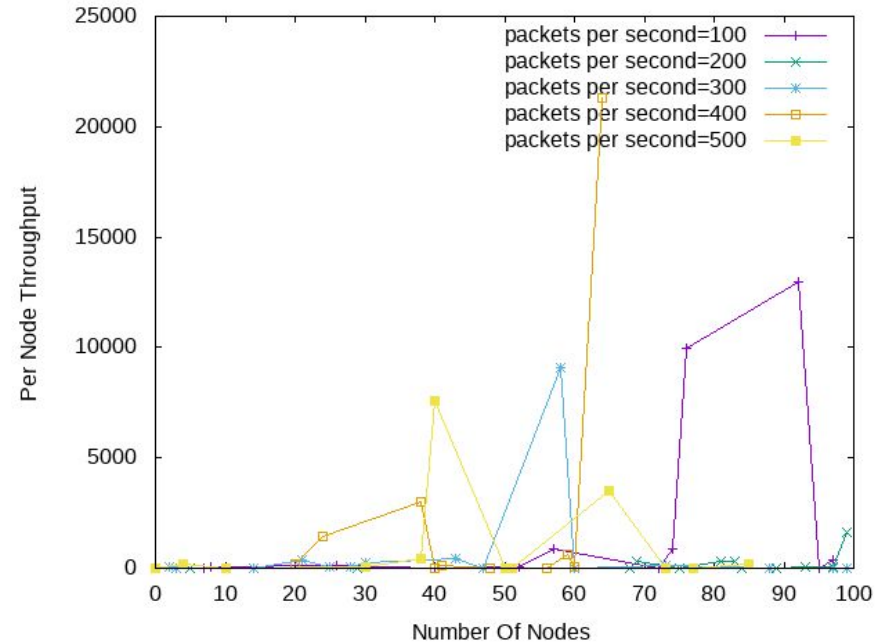


Fig : Per node throughput with packet per second varied

802.15.4

4 . variation in coverage area

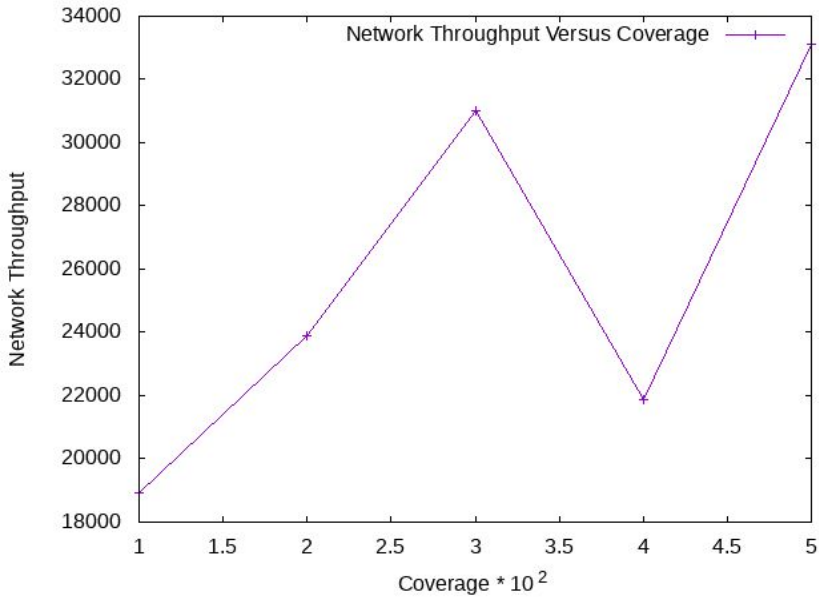


Fig : Network throughput vs coverage area

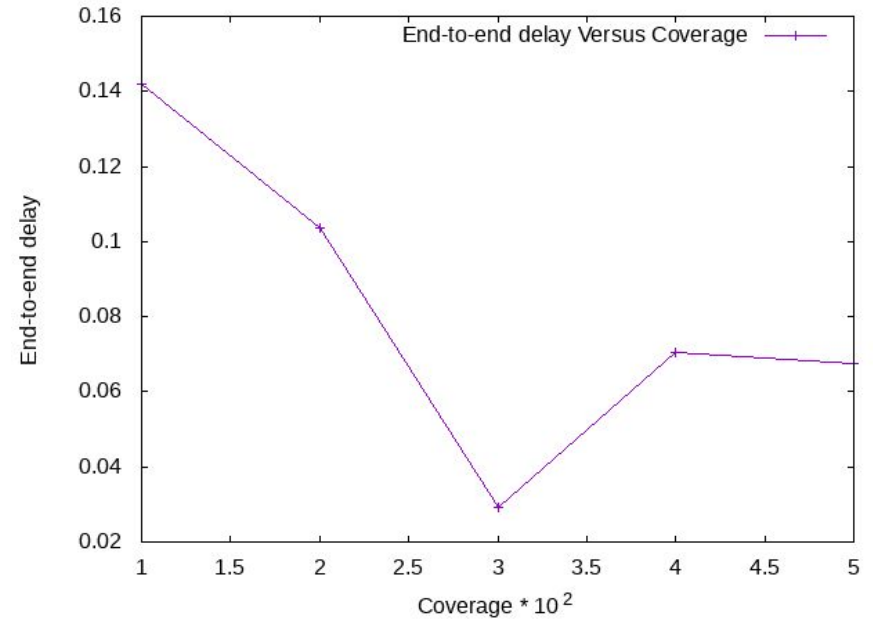


Fig : End-to-end delay vs coverage area

802.15.4

4 . variation in coverage area

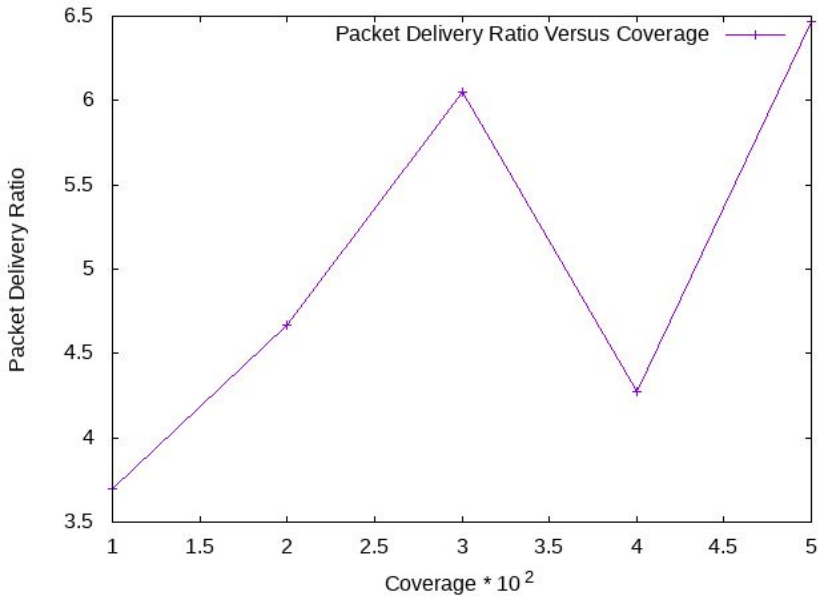


Fig : Delivery Ratio vs coverage area

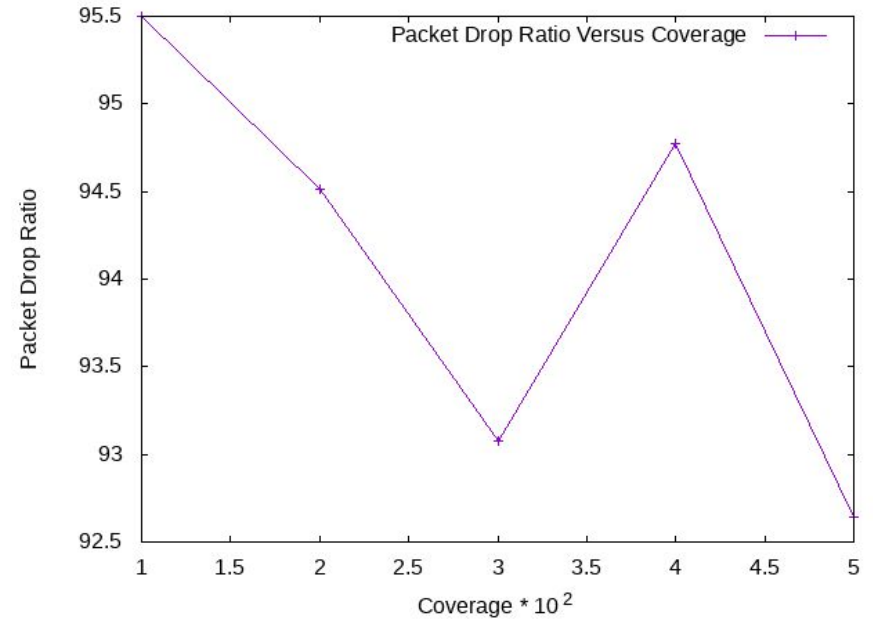


Fig : Drop Ratio vs coverage area

802.15.4

4 . variation in coverage area

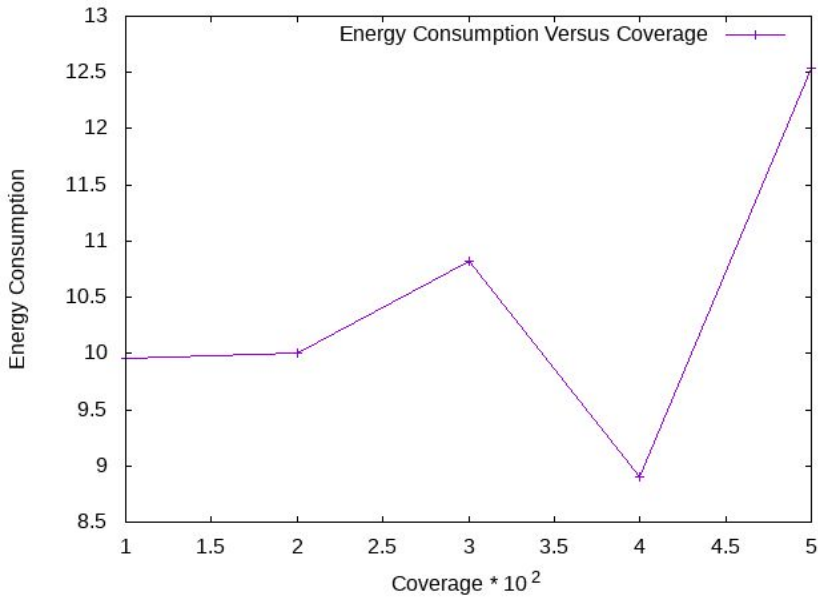


Fig : Energy Consumption vs coverage area

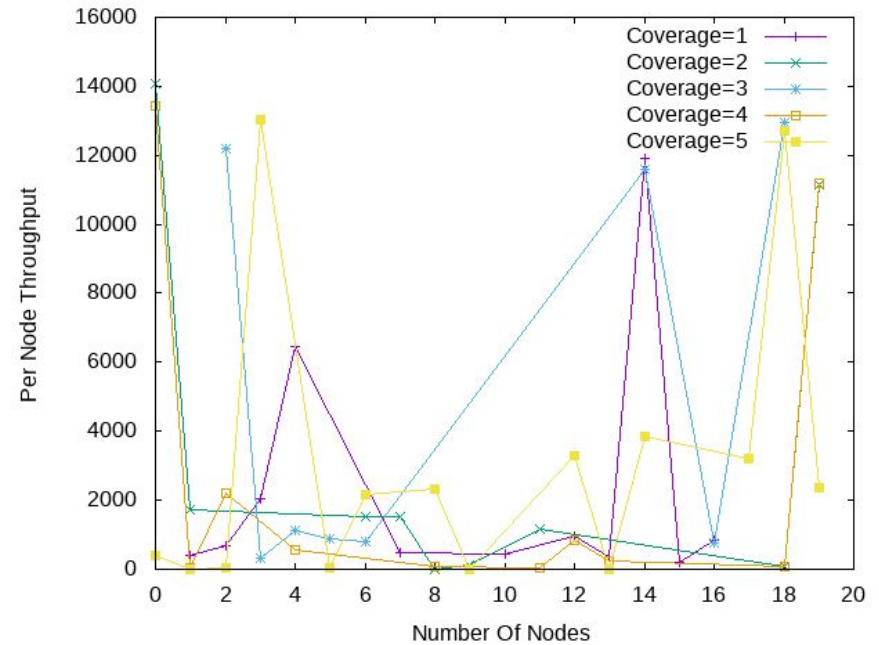


Fig : Per node throughput with coverage area varied

MODIFICATIONS MADE FOR 802.15.4

- In ns-allinone-2.35/ns-2.35/tcl/lib/ns-default.tcl we changed maxqueue_ from 40 to 50.
- In ns-allinone-2.35/ns-2.35/mobile/omni-antenna.cc we increased Gt_(the gain for a signal to a node from the transmitter at wavelength lambda) and Gr_(the gain for a signal from a node from the receiver at wavelength lambda) from 1.0 to 4.0.
- Modifications were done in AODV(AdHoc On Demand Distance Vector) routing protocol of network layer according to the research paper [“Improvement of AODV Routing Protocol Algorithm with Link Stability and Energy Efficient Routing for MANET”](#).

We implemented a simple version of their protocol where there was a limit imposed on the incoming RREQ packets. All the incoming RREQ packets under that limit were dropped. Significant Changes have been observed applying this protocol. Necessary changes were made in aadv.cc and aadv.h files.

- In ns-allinone-2.35/ns-2.35/tcl/lib/ns-default.tcl we changed T_SRTT_BITS from 3 to 5.

GRAPHS WITH MODIFICATION

For 802.15.4(static)

802.15.4

1 . variation in node

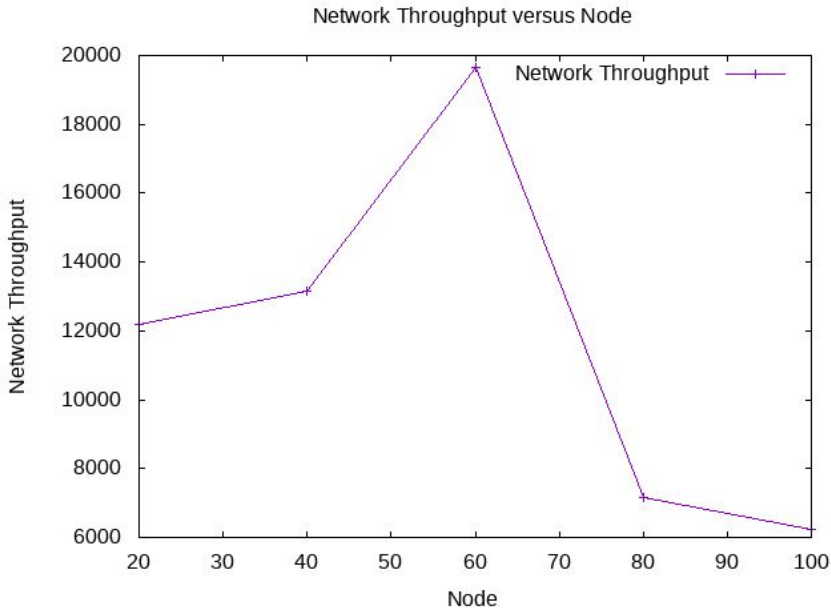


Fig : Network throughput vs node

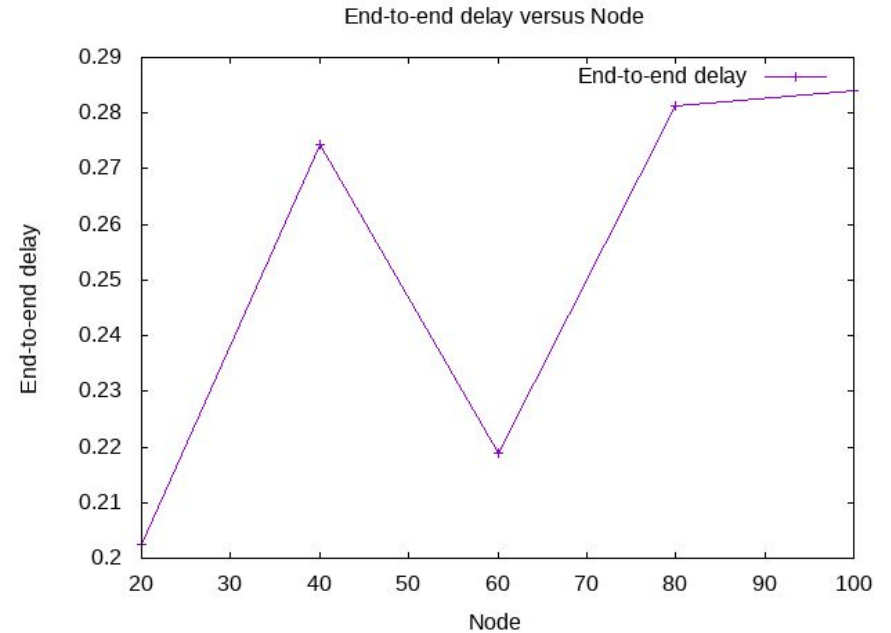


Fig : End-to-end delay vs node

802.15.4

1 . variation in node

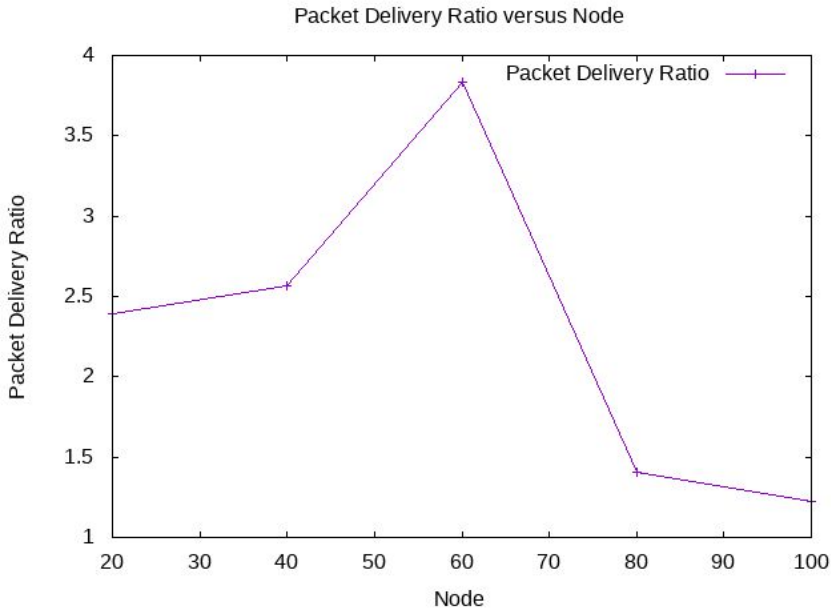


Fig : Delivery Ratio vs node

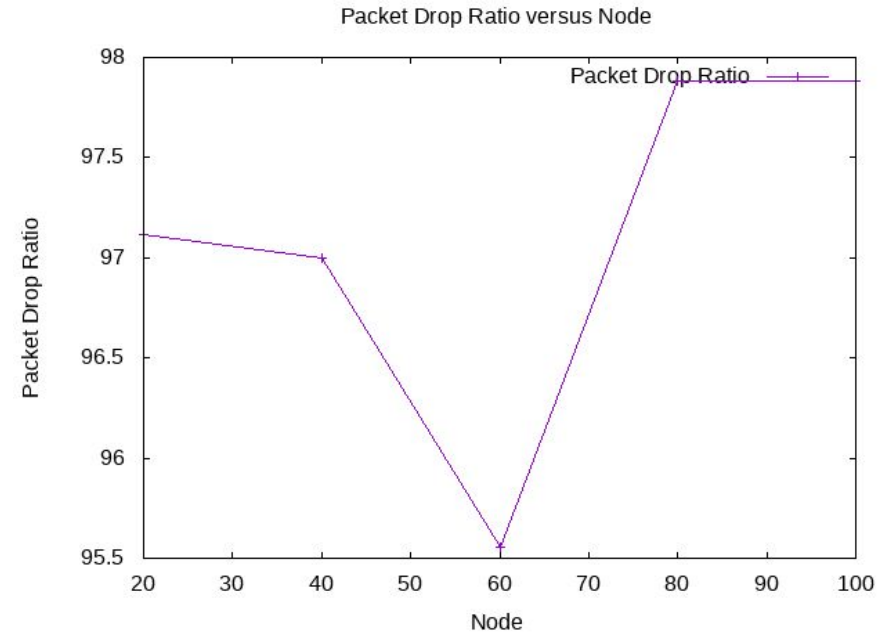


Fig : Drop Ratio vs node

802.15.4

1 . variation in node

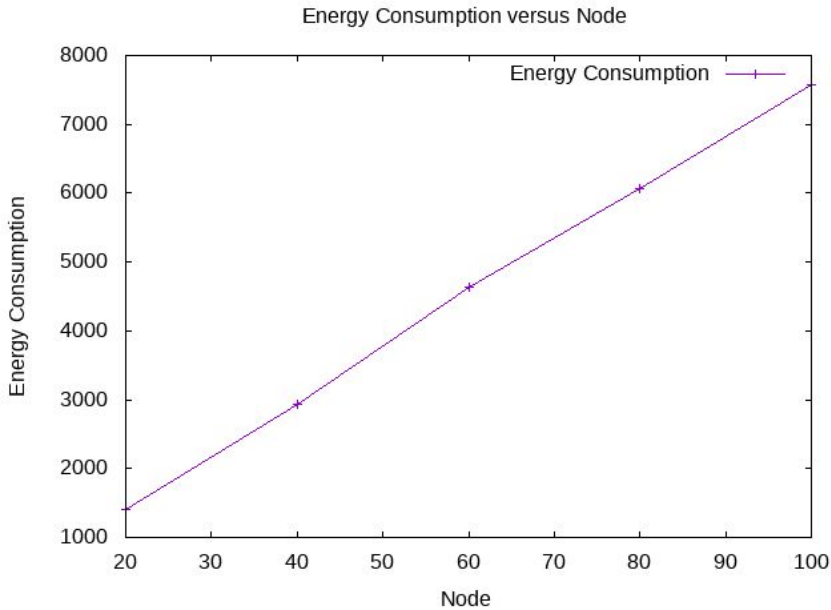


Fig : Energy Consumption vs node

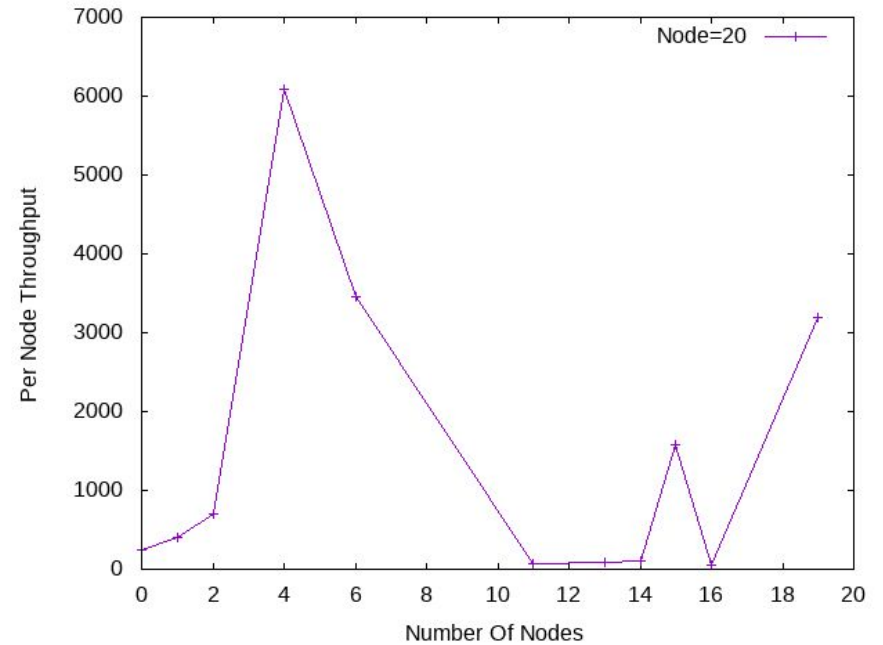


Fig : Per node throughput for node size = 20

802.15.4

1 . variation in node

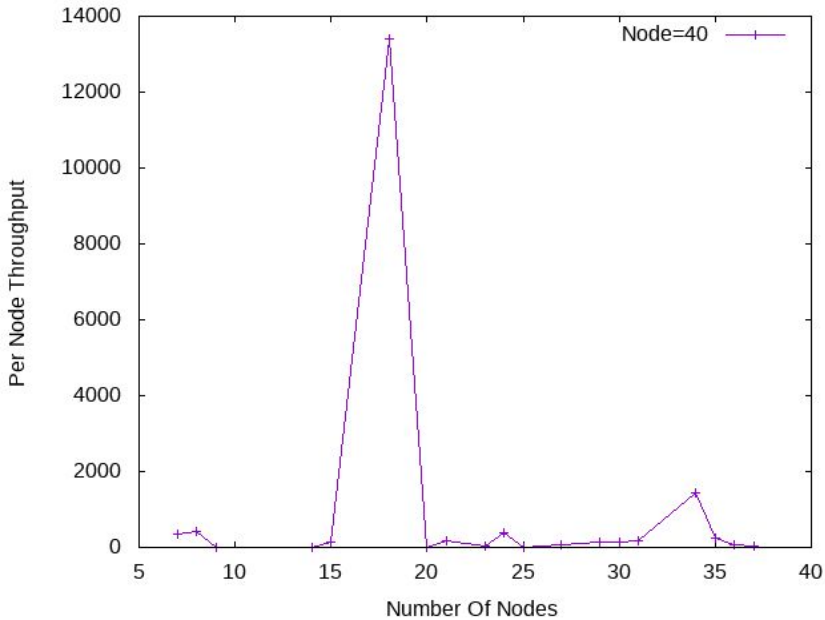


Fig : Per node throughput for node size = 40

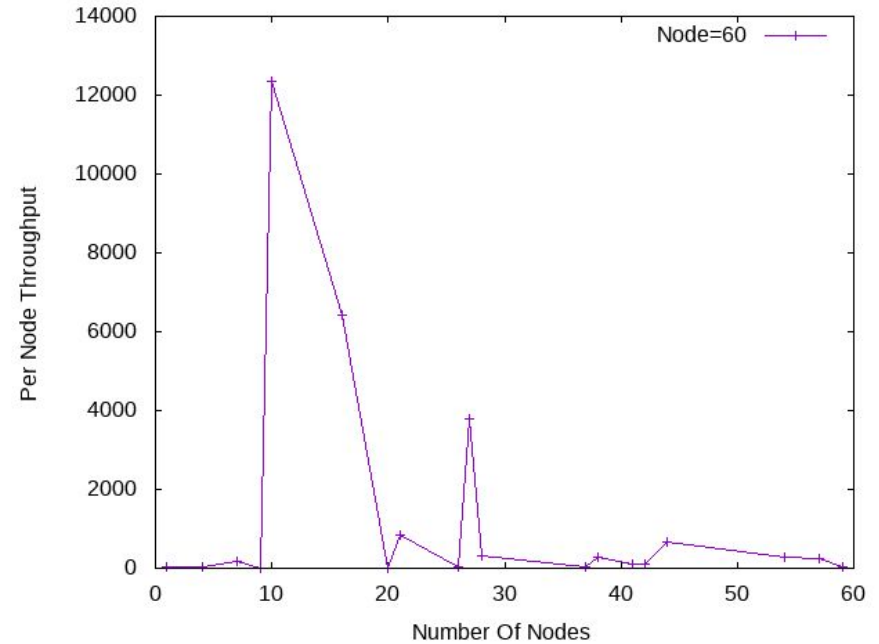


Fig : Per node throughput for node size = 60

802.15.4

1 . variation in node

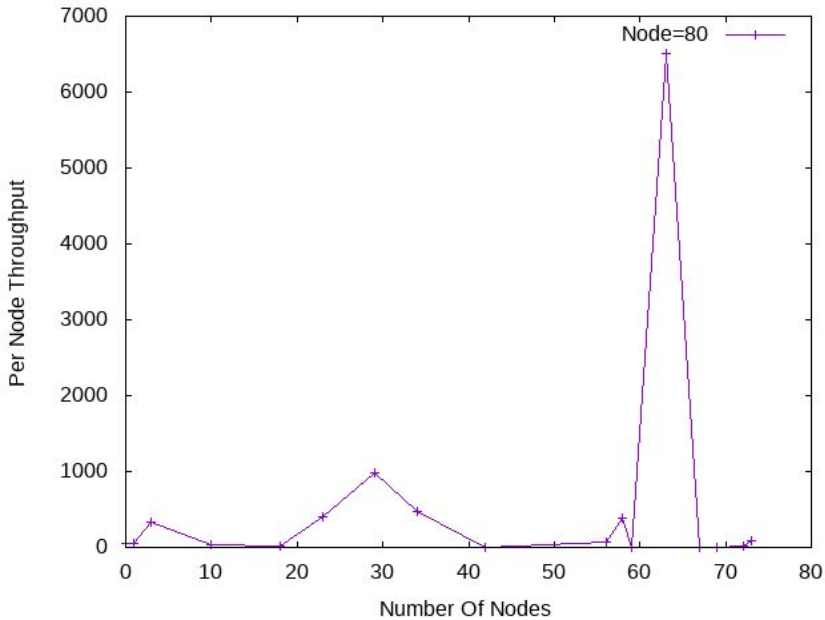


Fig : Per node throughput for node size = 80

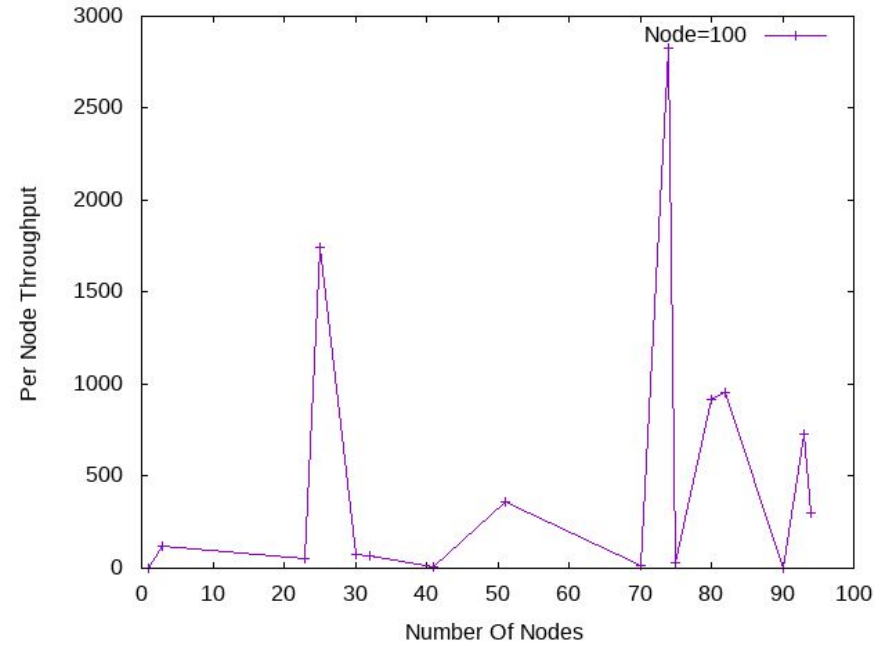


Fig : Per node throughput for node size = 100

802.15.4

2 . variation in flow

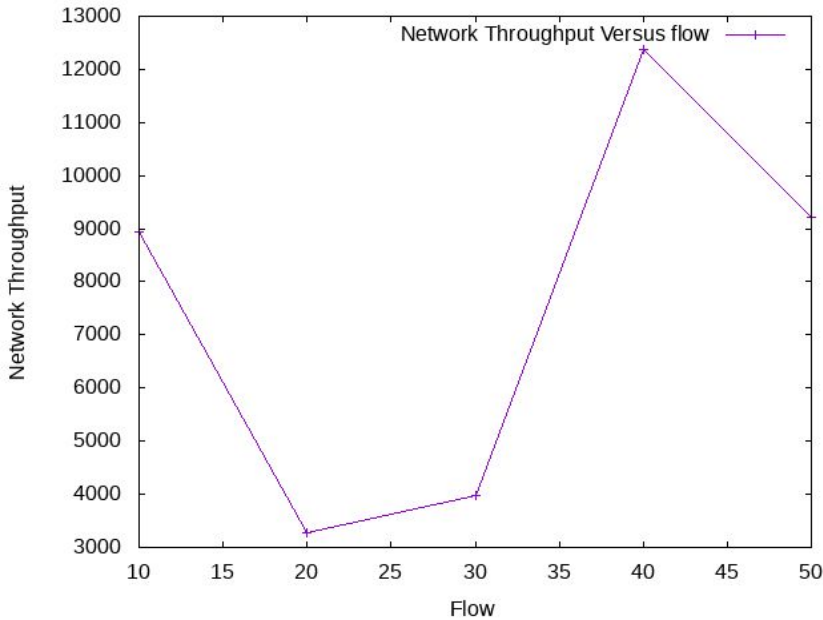


Fig : Network throughput vs flow

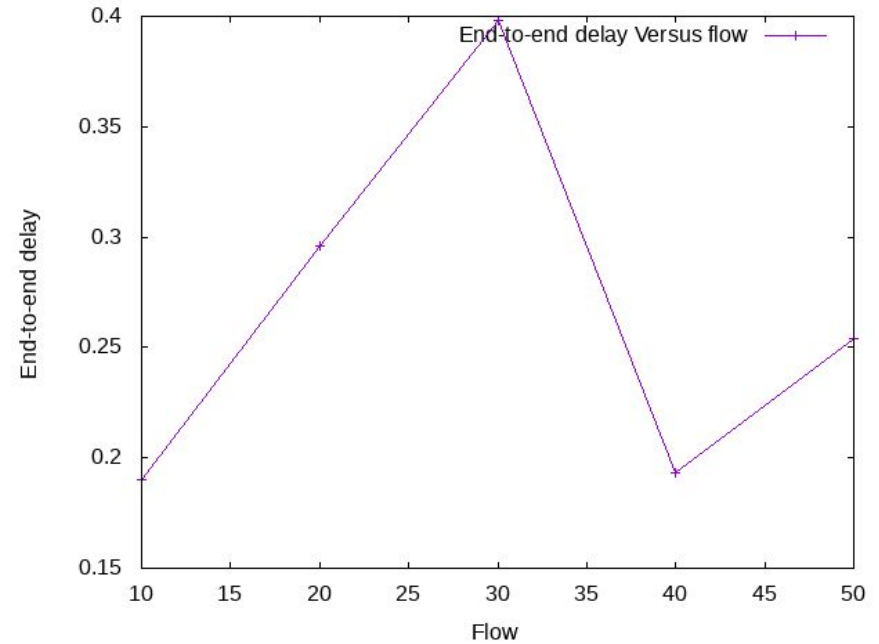


Fig : End-to-end delay vs flow

802.15.4

2 . variation in flow

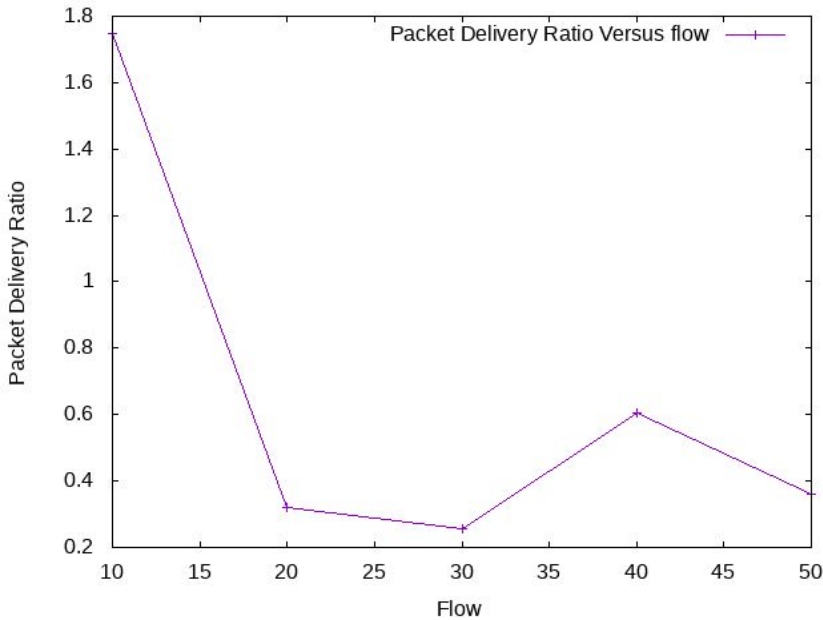


Fig : Delivery Ratio vs flow

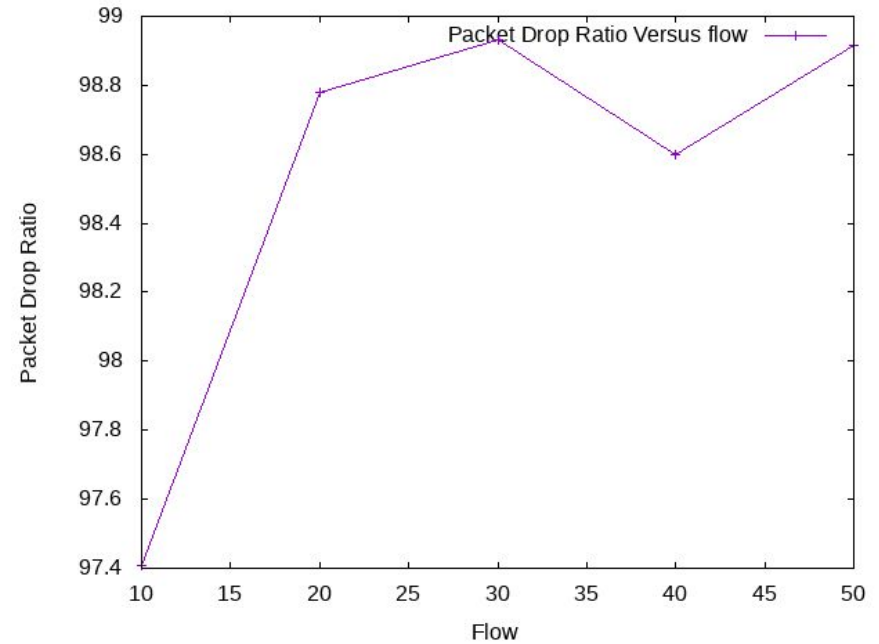


Fig : Drop Ratio vs flow

802.15.4

2 . variation in flow

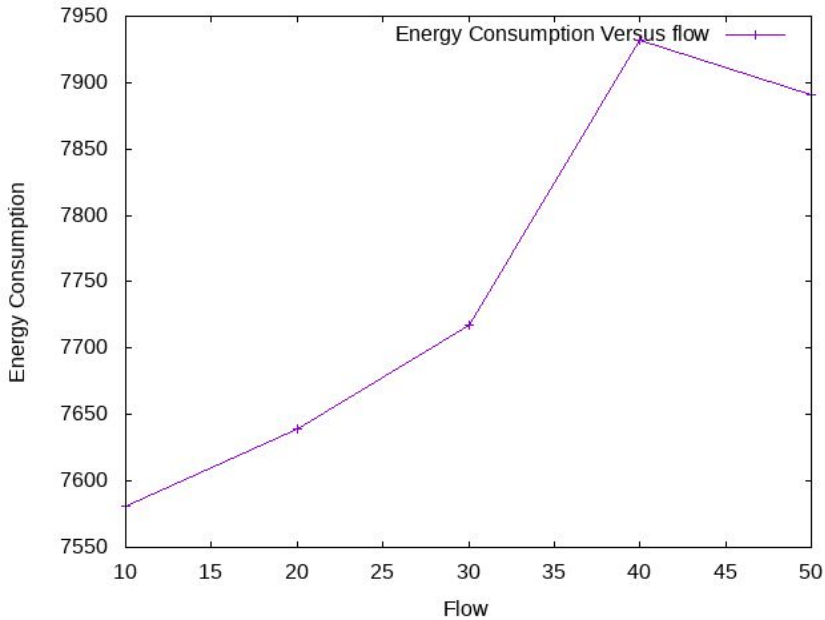


Fig : Energy Consumption vs flow

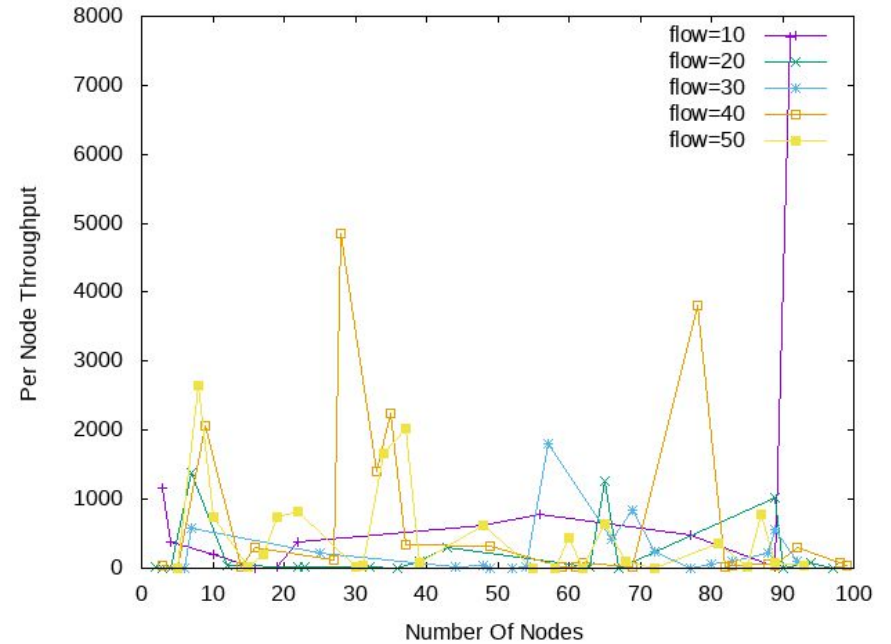


Fig : Per node throughput with flow varied

802.15.4

3 . variation in packet size

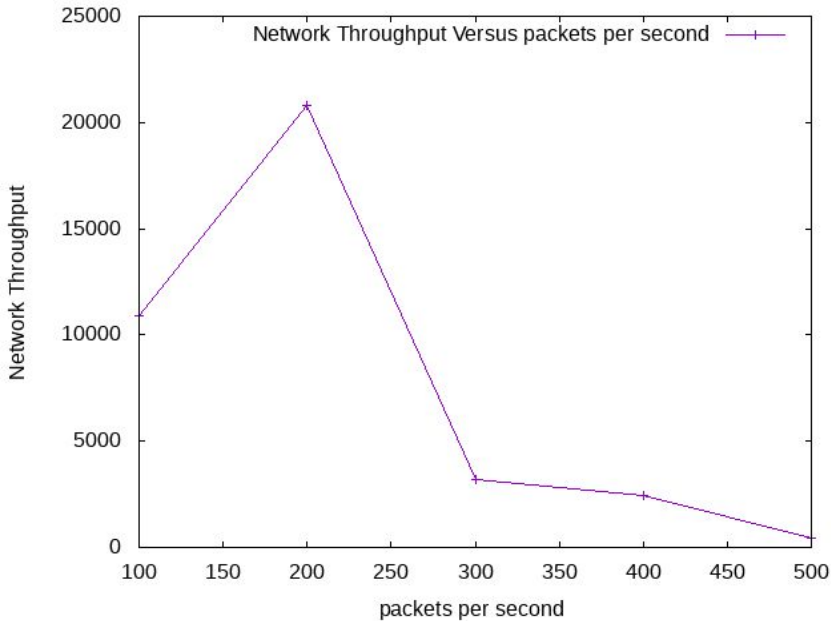


Fig : Network throughput vs packet per second

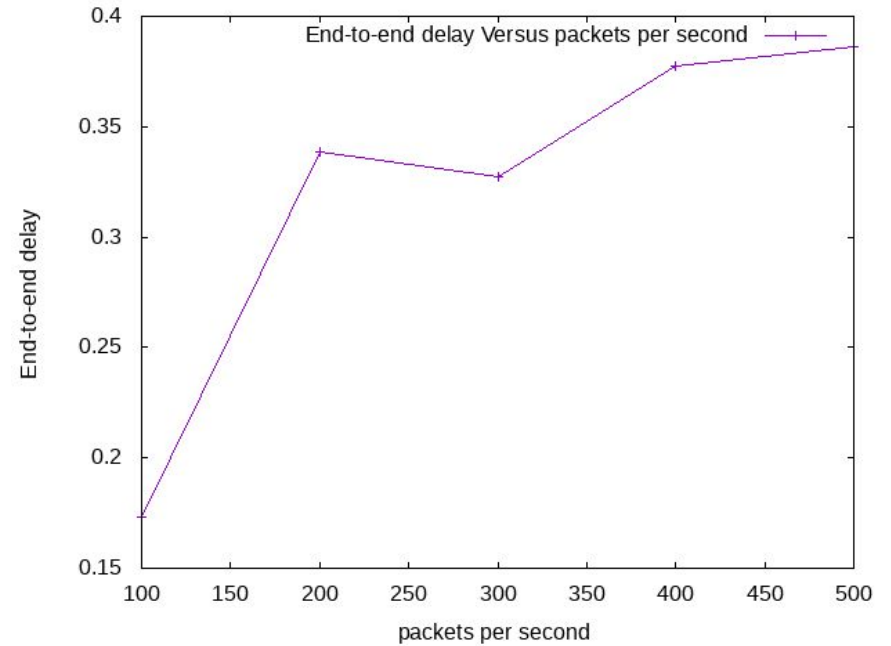


Fig : End-to-end delay vs packet per second

802.15.4

3 . variation in packet size

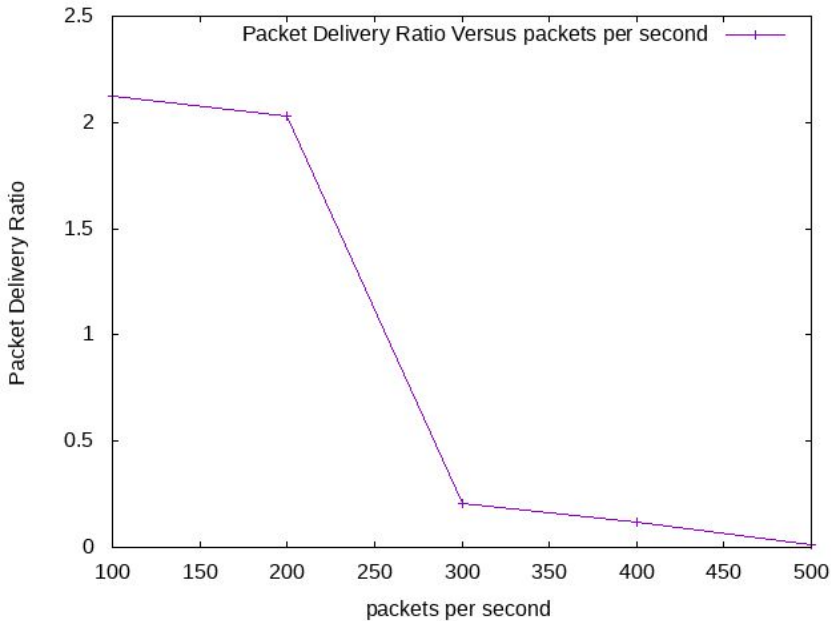


Fig : Delivery Ratio vs packet per second

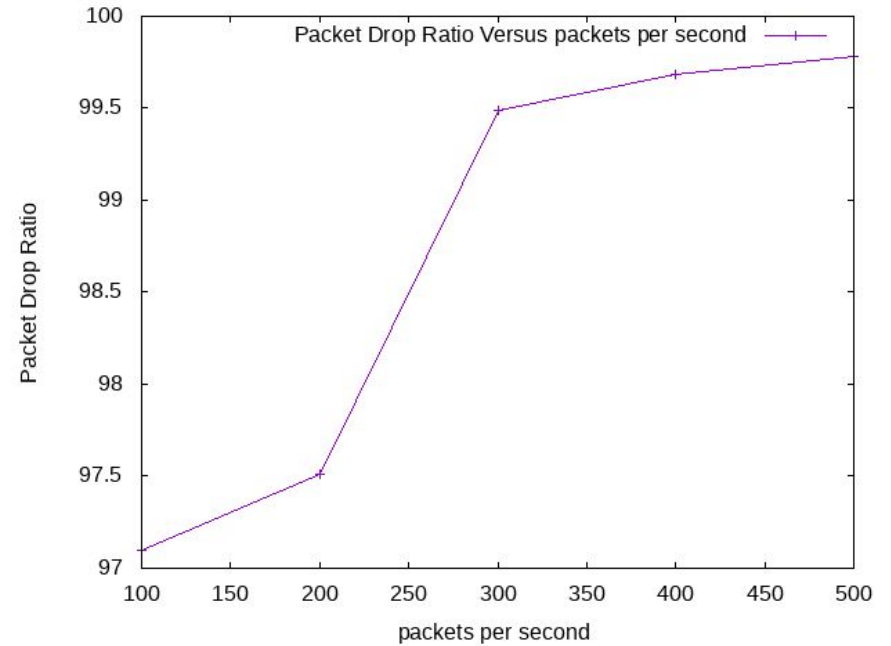


Fig : Drop Ratio vs packet per second

802.15.4

3 . variation in packet size

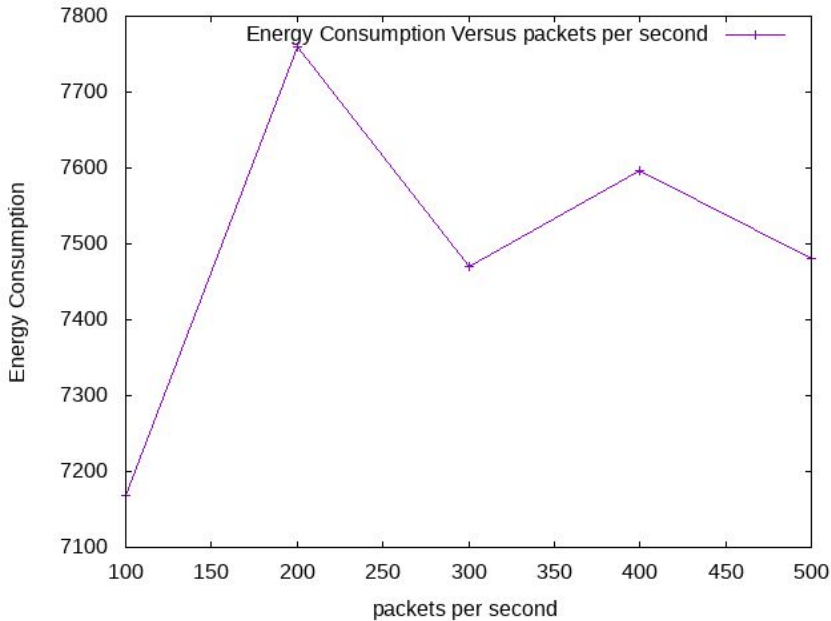


Fig : Energy Consumption vs packet per second

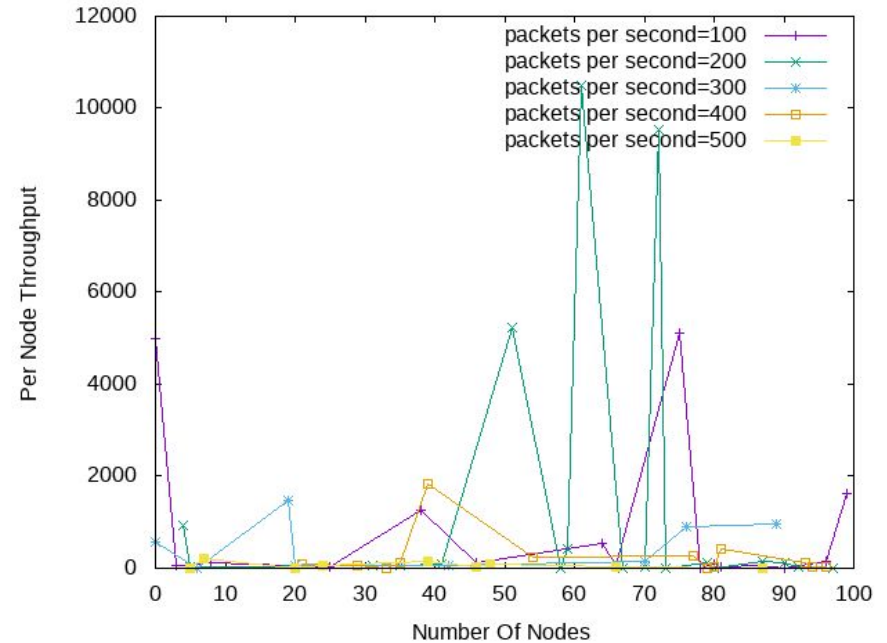


Fig : Per node throughput with packet per second varied

802.15.4

4 . variation in coverage area

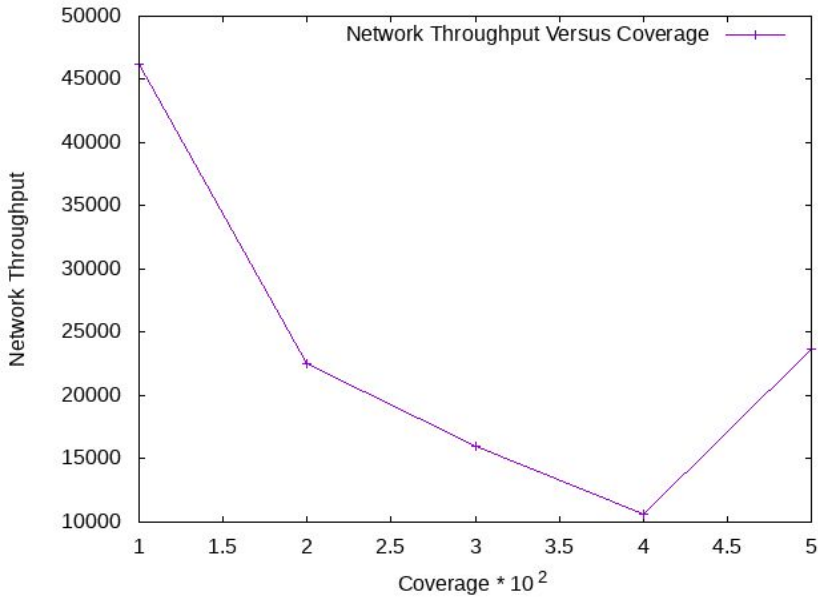


Fig : Network throughput vs coverage area

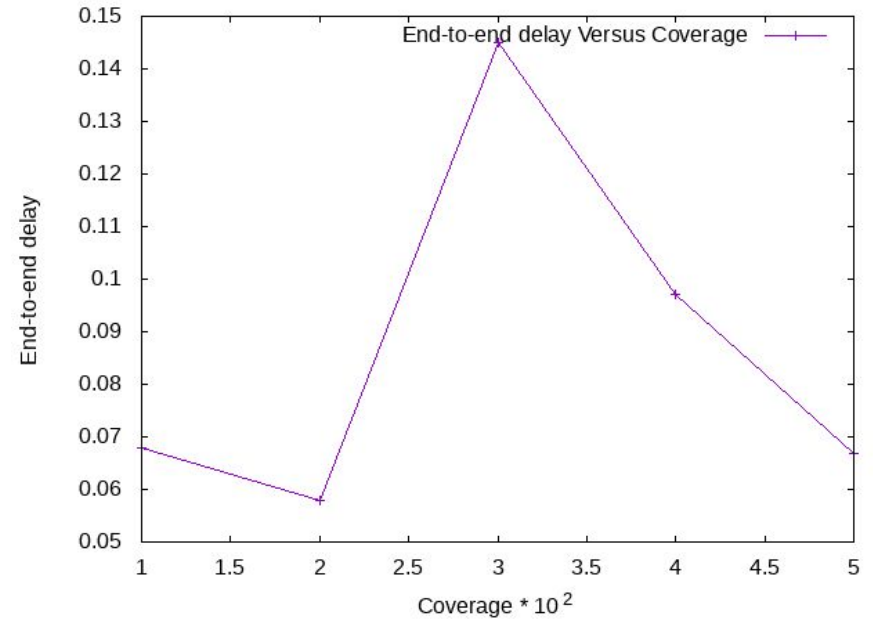


Fig : End-to-end delay vs coverage area

802.15.4

4 . variation in coverage area

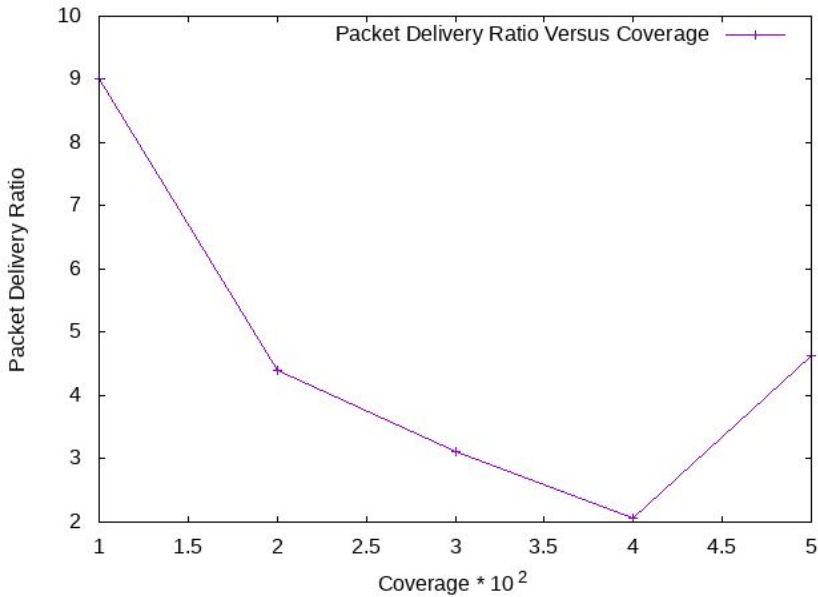


Fig : Delivery Ratio vs coverage area

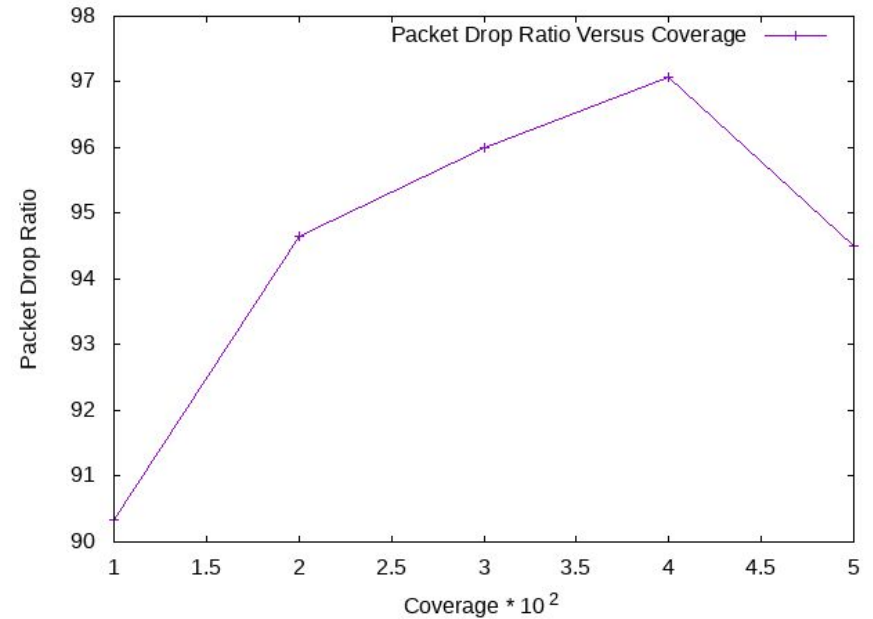


Fig : Drop Ratio vs coverage area

802.15.4

4 . variation in coverage area

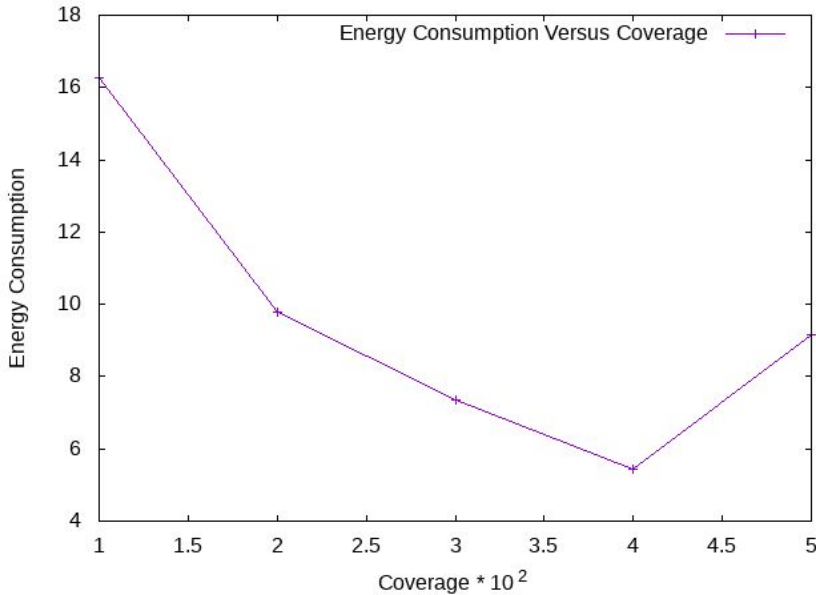


Fig : Energy Consumption vs coverage area

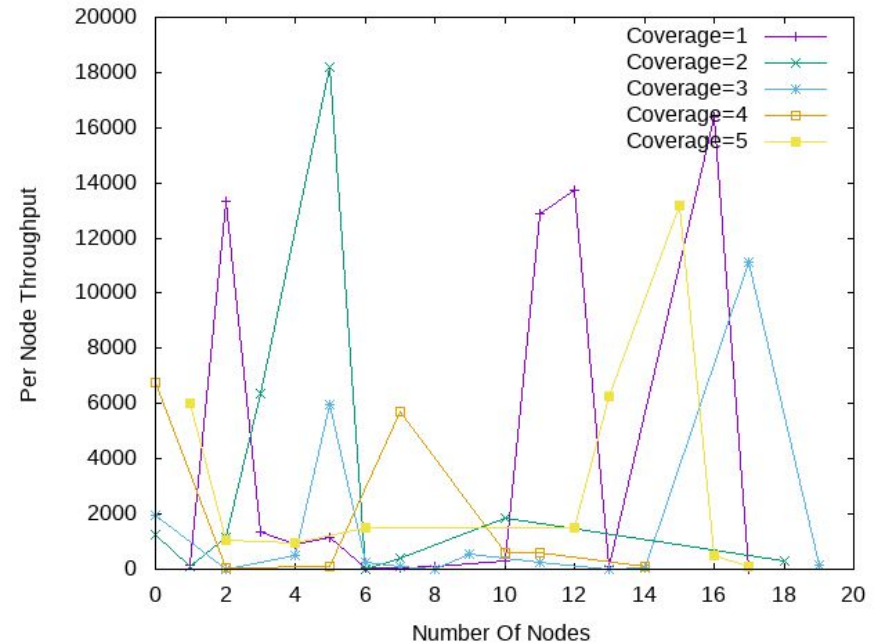


Fig : Per node throughput with coverage area varied

Summary for 802.15.4(static)

Reason for modifications:

In wireless network 802.15.4 (static) significant changes have occurred before and after the modification of aodv protocol. After the modification of aodv, RREQ packets are being dropped if it is under some certain calculated limit. So, less data travels through network decreasing the throughput. More RREQ packet drop introduces more drop ratio and less delivery ratio. However, the Hello packet transmission contributes to the increment of energy and throughput ; but in throughput, the drop of RREQ packet surpasses the effect of this.

Summary for 802.15.4(static)

Summary of findings (effects of modifications made)

Metric varied	Network Throughput	End-to-end Delay	Energy Consumption	Packet Delivery Ratio
Node	(6000-22000) to (6000-20000), so decreased on the average	(0.2-0.36) to (0.2-0.28), Compressed	(1500-7500), Remained same	(95.5 - 98) , Remained same
Flow	(6000-20000) to (3000-12000), So decreased on the average	(0.2-1.2) to (0.2-0.4), Compressed	(7600-8100) to (7500-7900), Decreased	(0.5-2.5)to (0.2-1.8), Decreased

Summary for 802.15.4(static)

Summary of findings (effects of modifications made)

Metric varied	Network Throughput	End-to-end Delay	Energy Consumption	Packet Delivery Ratio
Packets per second	(2000-20000) to (500-10000) Decreased on the average	(0.28-0.48) to (0.15-0.35), Decreased	(7500-7800) to (7200-7800) Remained same	(0.2-4) to (0.2-2) Decreased
Coverage area	(18000-32000) to (10000-45000) , increased then decreased	(0.02 - .14) to (0.06-0.14) Lower Bound Increased	(9-12.5) to (6- 16) Increased , then decreased	(3.5-6.5) to (2-9) Increased , then decreased

Bonus part

Wired->Wireless stats (2 wired nodes, 2 base-station nodes and a wireless hub)

Throughput = 261924.38

Average Delay = 20.44671

Packet Delivery Ratio = 62.74

Packet Drop Ratio = 0.00