# Report on Network Simulator (NS2) Offline-1

Submitted by Iftekhar E Mahbub Zeeon (1805038)

***<u>Assigned Parameters:</u>***

**Wireless Mac:** 802.15.4
**Routing Protocol:** AODV
**Agent:** TCP Reno
**Application:** FTP

## Wireless Max: 802.15.4

IEEE 802.15.4 is a standard for wireless personal area networks (WPANs) that defines the physical layer and medium access control (MAC) layer for low-rate wireless communications. It is commonly used for low-power, low-data rate applications such as home automation, industrial monitoring and control, and medical device communications.

IEEE 802.15.4 provides a variety of services to support low-rate wireless communications in personal area networks (WPANs). These services include:

1. **Data Link Layer:** The 802.15.4 MAC layer provides a data link layer service that allows devices to share the wireless channel in a fair and efficient manner using carrier sense multiple access with collision avoidance (CSMA-CA) algorithm.
2. **Security:** The 802.15.4 standard includes mechanisms for secure communications, including AES-based encryption and decryption, which can protect against unauthorized access and tampering.
3. **Addressing:** The 802.15.4 standard supports both short and extended addresses, allowing devices to be uniquely identified within a network.

4. **Networking:** The 802.15.4 standard includes support for both beacon-enabled and non-beacon-enabled modes, enabling the formation of wireless networks with different topologies.
5. **Power Management:** The 802.15.4 standard is designed to minimize power consumption, enabling devices to operate for extended periods on battery power.
6. **Quality of Service (QoS):** The 802.15.4 standard provides a means of controlling the quality of service (QoS) for different types of data, allowing for the prioritization of real-time or critical data over less important data.
7. **Low Latency:** Because of its low data rate, low power design, and low latency, 802.15.4 is well suited for control and monitoring applications where low latency and high reliability is required.

In summary, IEEE 802.15.4 provides a variety of services to support low-rate wireless communications in personal area networks (WPANs), including data link layer, security, addressing, networking, power management, Quality of Service (QoS), interoperability, and low latency.

## Routing Protocol: AODV

AODV (Ad hoc On-Demand Distance Vector) is a routing protocol for mobile ad-hoc networks (MANETs) and other wireless ad-hoc networks. It is a reactive protocol, which means that it only establishes a route to a destination when a source node requests one. AODV uses a destination-sequenced distance-vector (DSDV) algorithm to determine the best path to a destination. There are some other features like:

1. **On-demand:** AODV uses a route request/reply mechanism to establish and maintain routes, which allows it to quickly adapt to changes in the network topology.

2. **Loop-free:** AODV is designed to be loop-free, which prevents the formation of routing loops that can cause network congestion and slow down data transmission.
3. **Sequence numbers:** AODV uses destination sequence numbers to ensure that the most recent and up-to-date routes are used.
4. **Low overhead:** AODV has low control overhead, which makes it suitable for use in resource-constrained ad-hoc networks.
5. **Multicast support:** AODV can be extended to support multicast routing by using a multicast group ID in the RREQ packet.
6. **Security:** AODV can be secured using various security mechanisms like digital signature, encryption, etc.

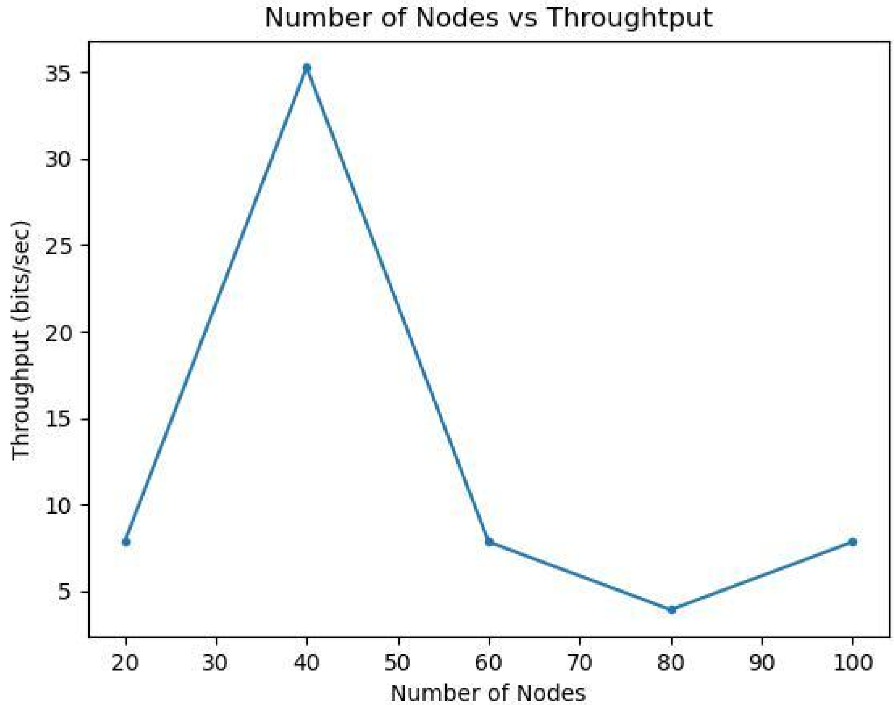
## Agent: TCP Reno

TCP Reno is a specific variant of the Transmission Control Protocol (TCP) congestion control algorithm. It is named after the city of Reno, Nevada, where it was first implemented. TCP Reno is designed to reduce the amount of congestion in a network by adjusting the rate at which packets are transmitted based on the amount of network congestion. It does this by implementing a fast retransmit and fast recovery mechanism, which helps to reduce the number of lost packets and improve overall network performance. TCP Reno is widely used in the Internet today and is considered to be one of the most effective congestion control algorithms.

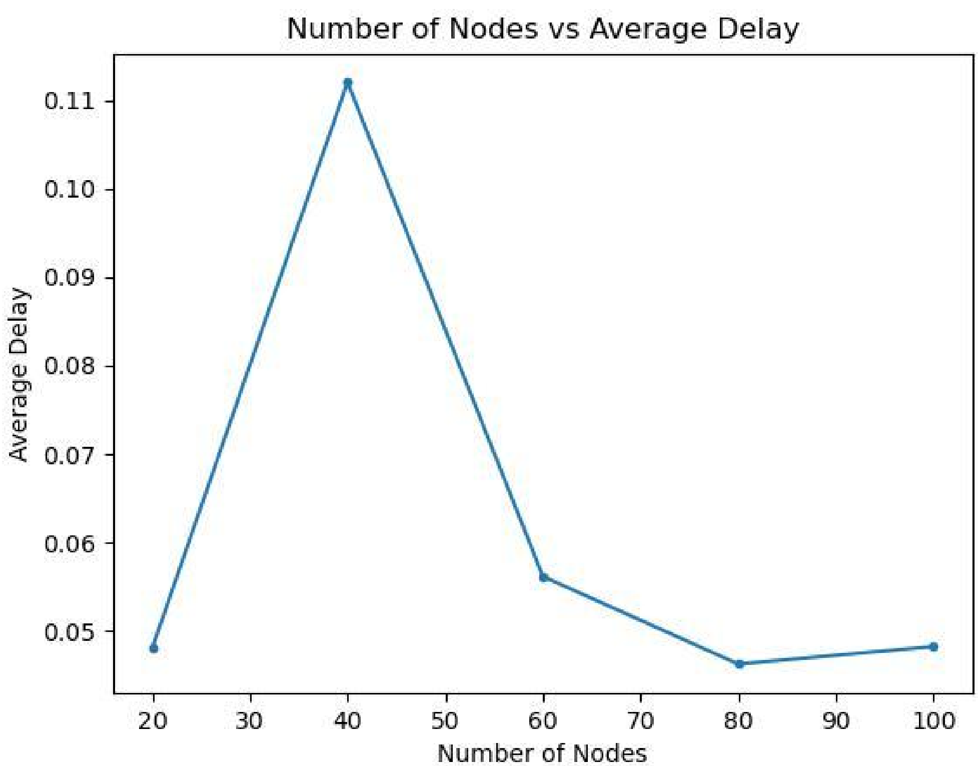
## Application: FTP

File Transfer Protocol (FTP) is a standard network protocol used to transfer files from one host to another over a TCP-based network, such as the Internet. FTP is built on a client-server architecture and uses separate control and data connections between the client and the server. The client establishes a control connection to the server, and then the client and server establish a data connection for the transfer of the files. FTP is commonly used to transfer website files from a development environment to a production environment, and to upload and download files to and from hosting servers and personal computers.

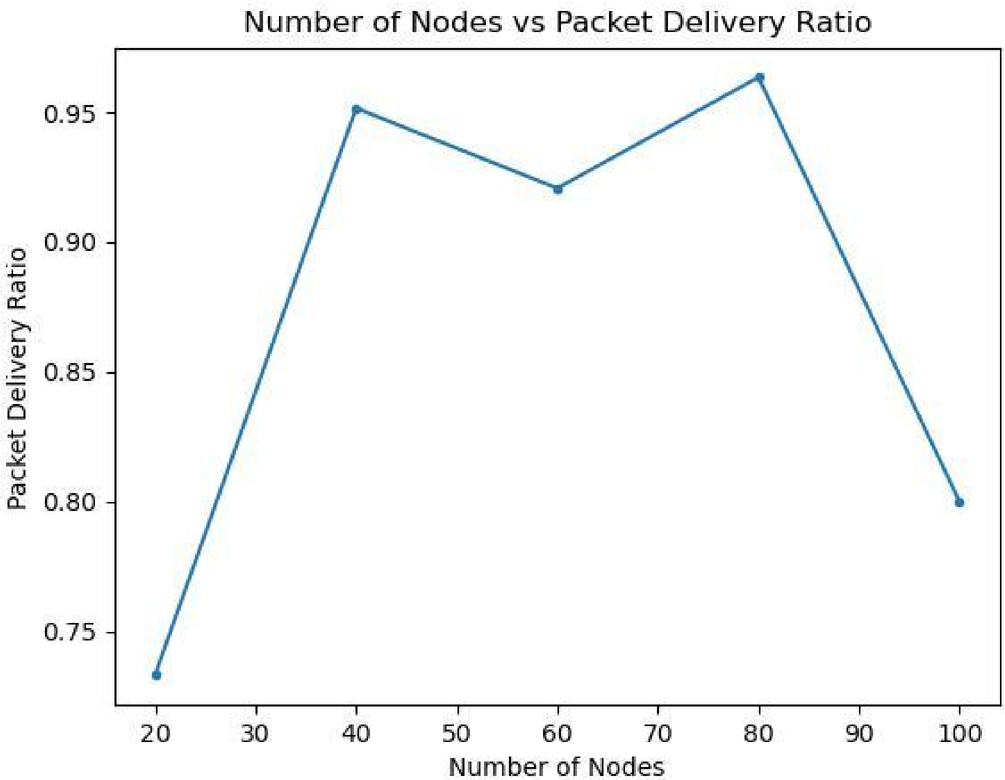
# Graphs

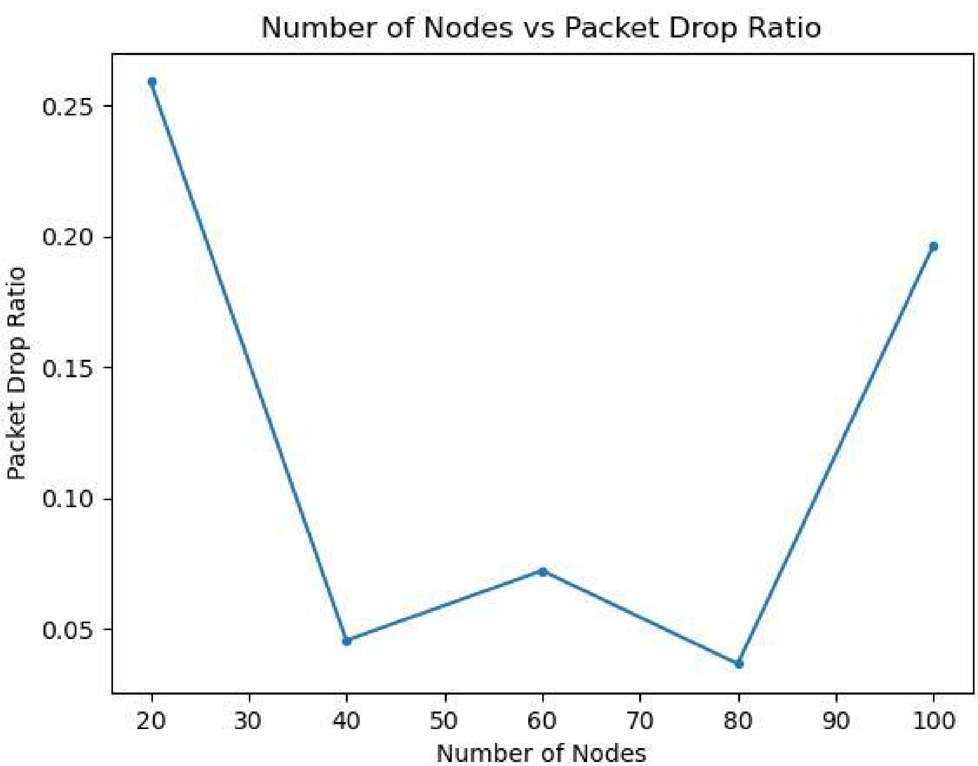


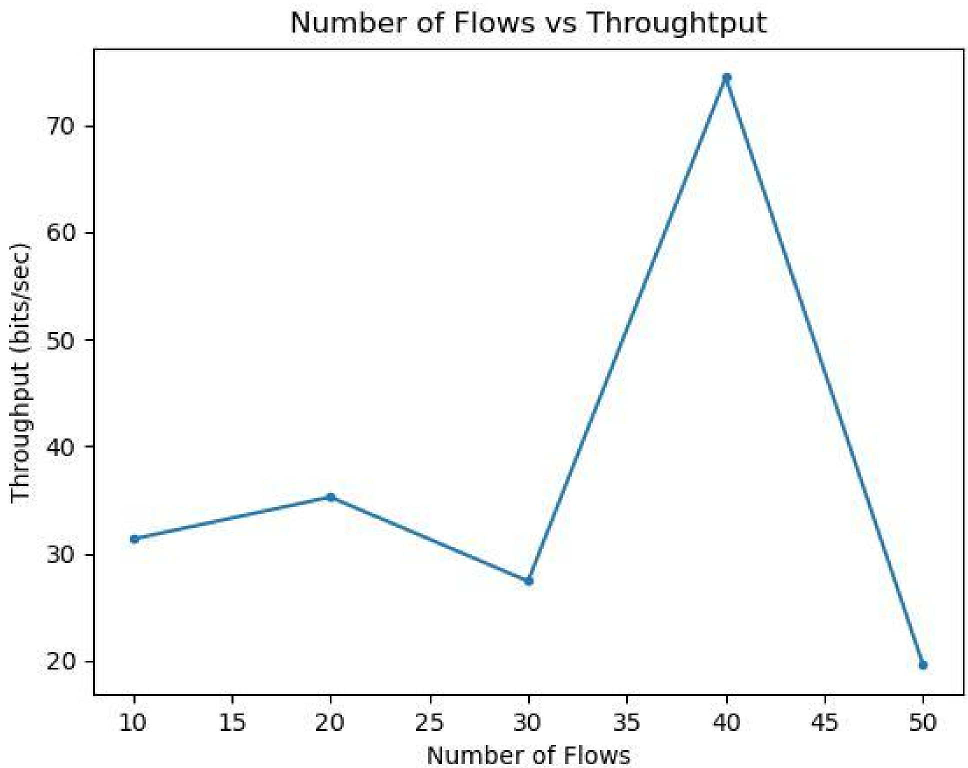
Number of Nodes vs Throughtput
Throughput (bits/sec)
Number of Nodes
5
10
15
20
25
30
35
20
30
40
50
60
70
80
90
100

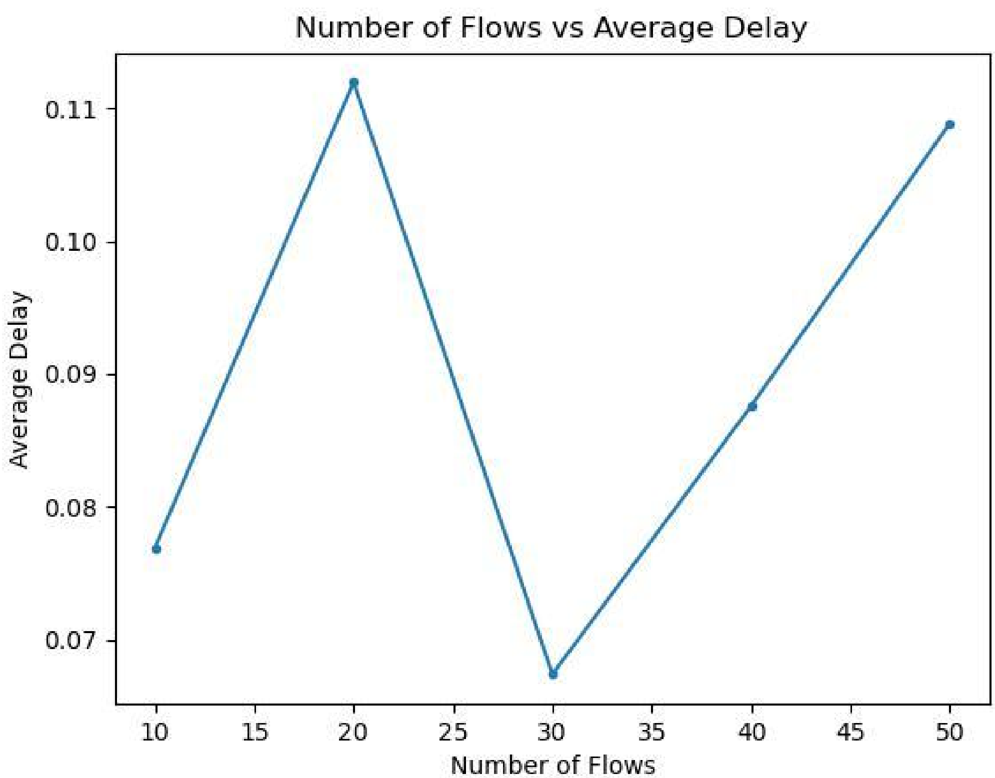
Number of Nodes vs Average Delay
Average Delay
Number of Nodes
0.05
0.06
0.07
0.08
0.09
0.10
0.11
20
30
40
50
60
70
80
90
100


Number of Nodes vs Packet Delivery Ratio
Packet Delivery Ratio
0.95
0.90
0.85
0.80
0.75
20
30
40
50
60
70
80
90
100
Number of Nodes

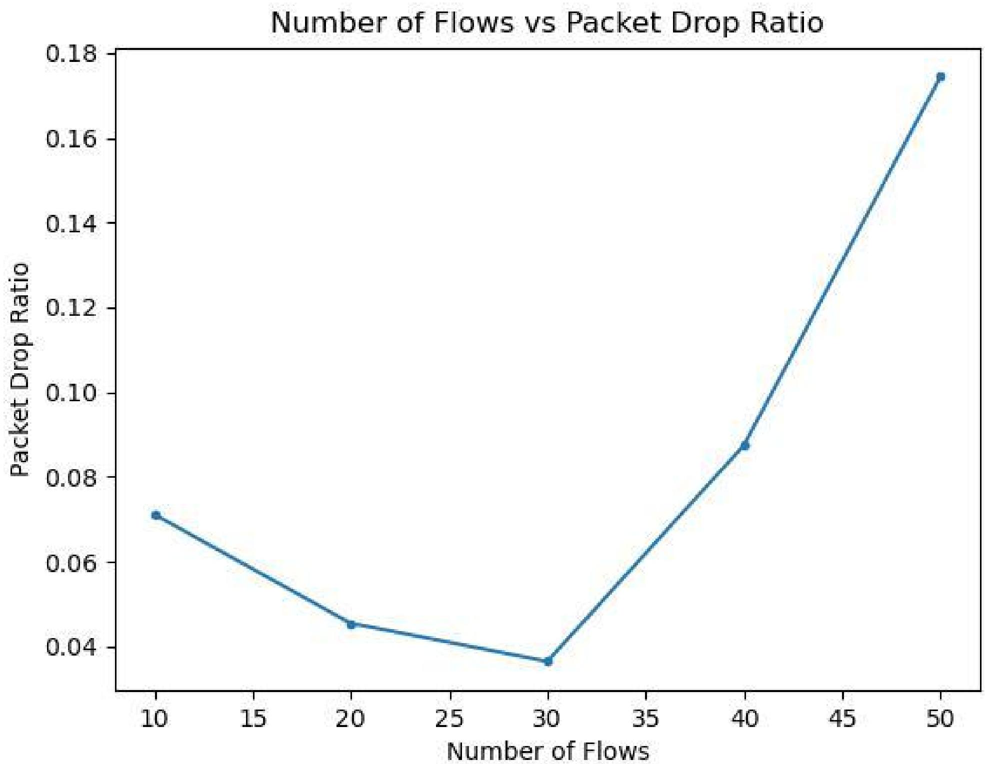

Number of Nodes vs Packet Drop Ratio
Packet Drop Ratio
0.25
0.20
0.15
0.10
0.05
20
30
40
50
60
70
80
90
100
Number of Nodes

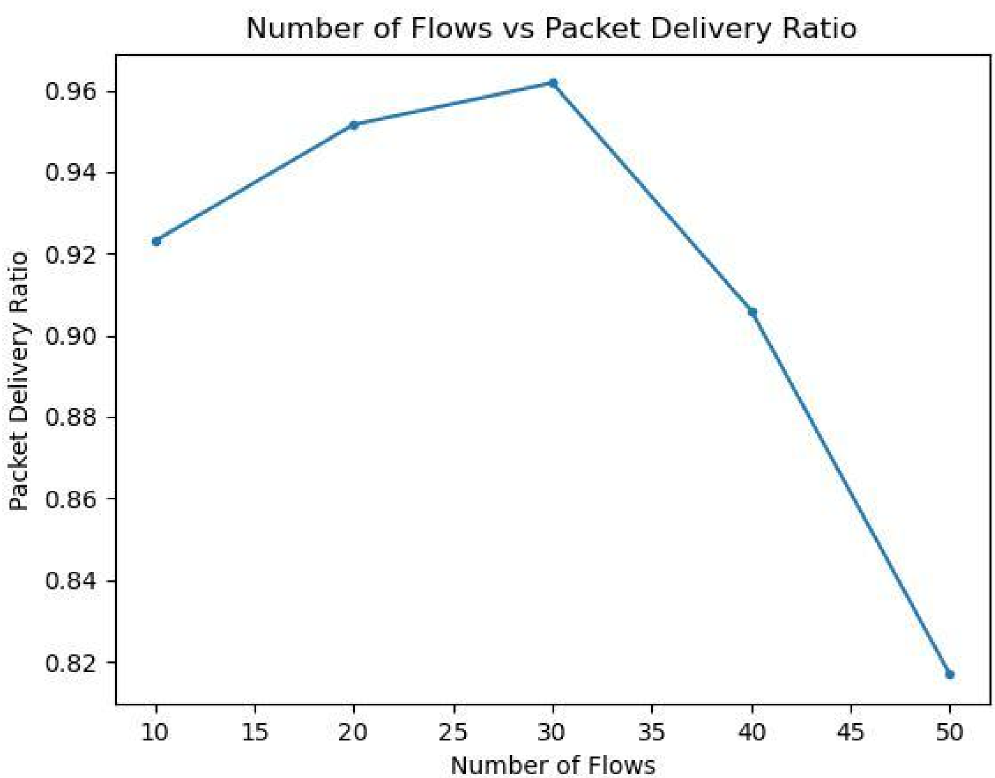


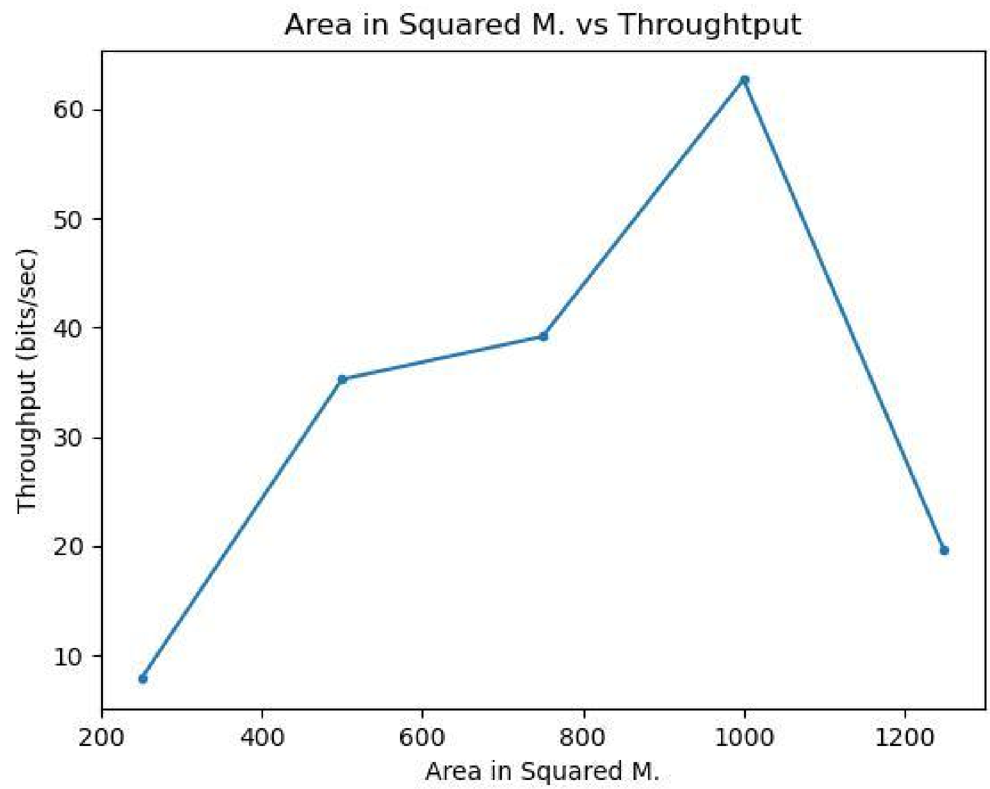
Number of Flows vs Throughtput
Throughput (bits/sec)
20
30
40
50
60
70
10
15
20
25
30
35
40
45
50
Number of Flows

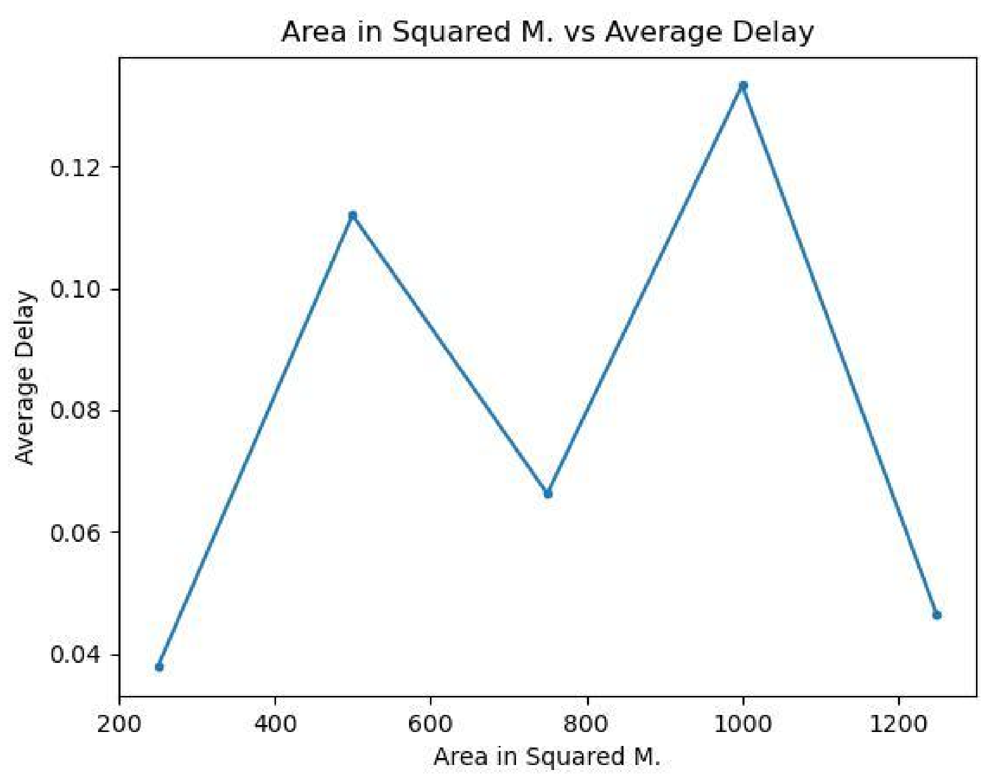



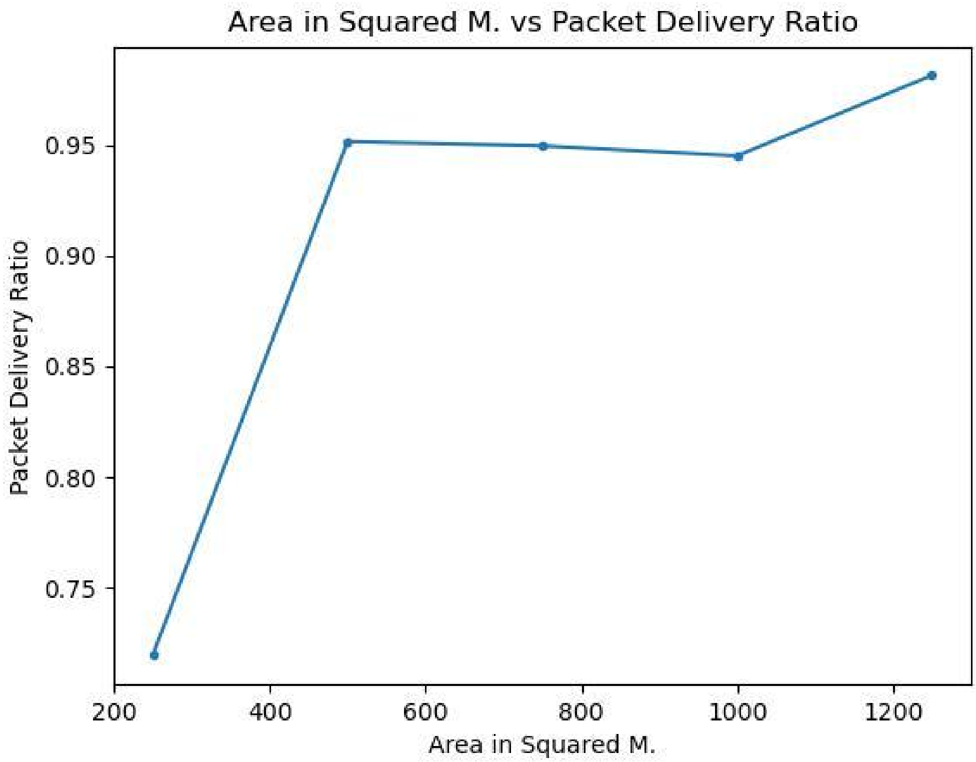
Number of Flows vs Average Delay
Average Delay
0.07
0.08
0.09
0.10
0.11
10
15
20
25
30
35
40
45
50
Number of Flows

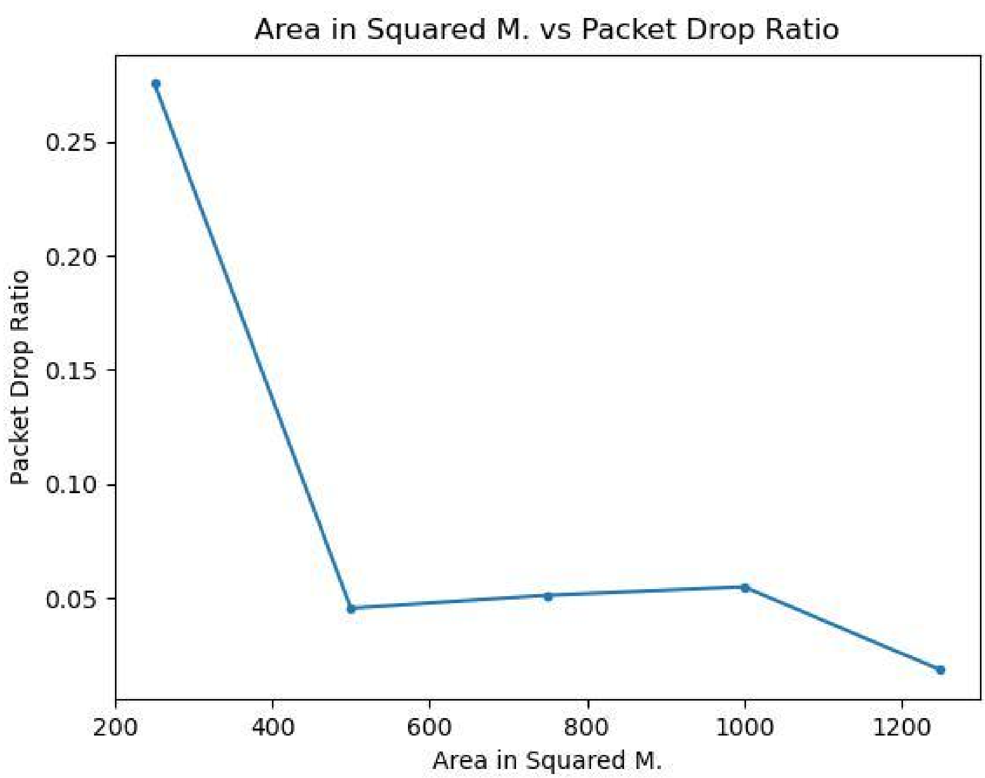

Number of Flows vs Packet Drop Ratio
Packet Drop Ratio
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
10
15
20
25
30
35
40
45
50
Number of Flows


Number of Flows vs Packet Delivery Ratio
Packet Delivery Ratio
0.96
0.94
0.92
0.90
0.88
0.86
0.84
0.82
10
15
20
25
30
35
40
45
50
Number of Flows


Area in Squared M. vs Throughtput
Throughput (bits/sec)
10
20
30
40
50
60
200
400
600
800
1000
1200
Area in Squared M.


Area in Squared M. vs Average Delay
Average Delay
0.04
0.06
0.08
0.10
0.12
200
400
600
800
1000
1200
Area in Squared M.


Area in Squared M. vs Packet Delivery Ratio
Packet Delivery Ratio
0.95
0.90
0.85
0.80
0.75
200
400
600
800
1000
1200
Area in Squared M.


Area in Squared M. vs Packet Drop Ratio
Packet Drop Ratio
0.25
0.20
0.15
0.10
0.05
200
400
600
800
1000
1200
Area in Squared M.

## Observations:

In NS2 2.35, Mac layer 802.15.4 with routing protocol AODV doesn't work always. Most of the time the generated trace file does not contain the complete simulation. During the assignment, after consecutively running the simulation for 5-6 times, I would get a decent trace file. In all other cases, the trace file would contain 0 packet drops, 0 sent packets or 0 received packets. Even the number of lines in the trace file would be so few that it wasn't enough to make a graph out of that.
So I ran the simulations couple of times and saved the trace file, then separately from these trace files generated these 12 graphs.
However, when I ran the simulation with Mac layer 802.11 instead of 802.15.4, then I would get output everytime and there was no problem generating graphs. I have also added the graph images generated by the mac layer 802.11 in different directory along with the submitted assignment.