CSE322

Computer Networks Sessional

Offline-02

NS2

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Section: B2

Level - 3, Term - 2

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Assigned Parameters:

1. **Wireless MAC:** 802.15.4*
2. **Routing Protocol:** AODV
3. **Agent + Application:** TCP Reno + FTP
4. **Node Position:** Grid
5. **Flow:** 1 Source + Random Sink

** 802.15.4 + AODV produces 16 bytes TCP packets whereas the TCP packets are known to have a header of 20 bytes. Thus the throughput becomes negative. So 802.11 is used instead*

802.15.4:

A specification for low-rate wireless personal area networks is 802.15.4. (LR-WPANs). For short-range wireless communication between devices, including sensors, control systems, and other Internet of Things (IoT) devices, it offers a dependable and affordable way.

In an 802.15.4 network, communication between devices is controlled by the MAC (Media Access Control) layer. It specifies how to avoid collisions between devices, when a device can transmit, how to manage mistakes or retransmissions if necessary, and other guidelines for sending and receiving data.

The 802.15.4 MAC layer also offers tools for link management and device discovery, which makes it easier for networked devices to find one another and form safe and dependable connections.

Overall, the 802.15.4 MAC layer is widely utilized in IoT applications where low power consumption and cheap cost are key considerations and plays a significant role in allowing low-power, low-data rate wireless communication in LR-WPANs.

802.11:

802.11 MAC (Media Access Control) controls how wireless network devices exchange access to the wireless medium.

Data transmission and reception in a wireless network are governed by a set of rules that are defined by the MAC layer. This covers techniques for figuring out when a device can send, how to prevent collisions when several devices are trying to transmit at once, and how to deal with errors or retransmissions if necessary.

The MAC layer also ensures that the network is utilized effectively, giving each device an equal chance to send and receive data. This is crucial since the airwaves are a scarce shared resource and without adequate management, one device might take over the channel and obstruct communication between other devices.

AODV:

AODV (Ad hoc On-Demand Distance Vector) is a routing protocol for mobile ad hoc networks (MANETs). A MANET is a type of wireless network where devices can move freely and dynamically form networks without the need for a centralized infrastructure.

AODV is a reactive routing protocol, meaning that it only establishes routes when they are actually needed. When a source device wants to send data to a destination device, it broadcasts a route request (RREQ) message to its neighbors. These neighbors then forward the RREQ until it reaches the destination or an intermediate node that knows the route to the destination.

Once the route is established, the source device can use it to send data to the destination. If the route becomes broken due to a node moving or a change in network conditions, the source device can detect the break and initiate a new route discovery process to find a new route.

AODV provides efficient and scalable routing for MANETs, making it well suited for applications where nodes are constantly moving and network topology is highly dynamic.

TCP Reno:

TCP Reno is a specific implementation of the Transmission Control Protocol (TCP) congestion control algorithm. TCP is the standard protocol for reliable data transfer over the Internet, and its congestion control mechanism ensures that data is transmitted at a rate that the network can handle, without causing network congestion and degradation of performance.

It is one of the most widely used TCP congestion control algorithms and is the default congestion control mechanism in many operating systems.

TCP Reno operates by reducing the sending rate of a TCP flow (the amount of data being transmitted per unit of time) when network congestion is detected. This reduction is achieved by reducing the size of the congestion window, which limits the number of unacknowledged data segments that can be in transit at any one time. The algorithm adjusts the sending rate in a step-wise manner, reducing the congestion window by a fixed fraction (typically one half) whenever congestion is detected.

TCP Reno provides a balance between responsiveness to changing network conditions and stability in the face of network congestion. It has been widely studied and is well understood, making it a reliable and robust congestion control mechanism for the Internet.

FTP:

FTP (File Transfer Protocol) is a standard network protocol used for transferring files between computers over a network, such as the Internet. FTP was one of the first methods for transferring files over a network and is still widely used today for a variety of applications.

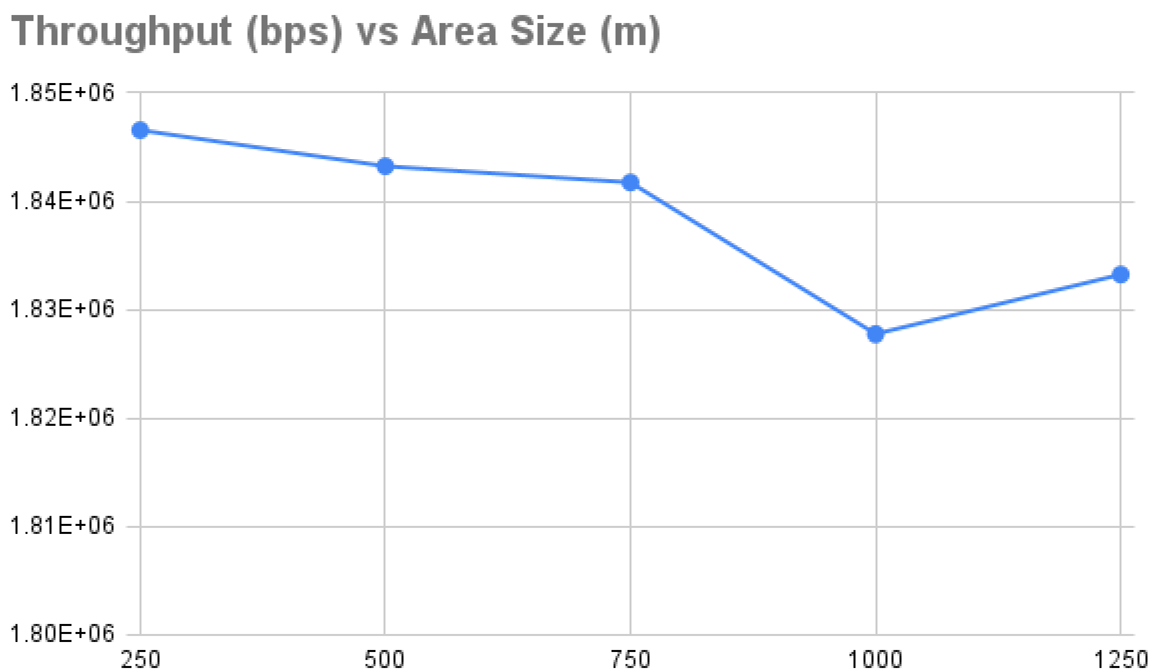
FTP works by establishing a connection between a client and a server, allowing the client to request files from the server and the server to send the requested files to the client. FTP uses a client-server architecture, where the client initiates the transfer and the server responds to the client's requests.

FTP supports a number of features, including the ability to transfer multiple files at once, resume interrupted transfers, and manage file and directory permissions. FTP also supports both active and passive modes, allowing the client and server to choose the most appropriate mode for the transfer.

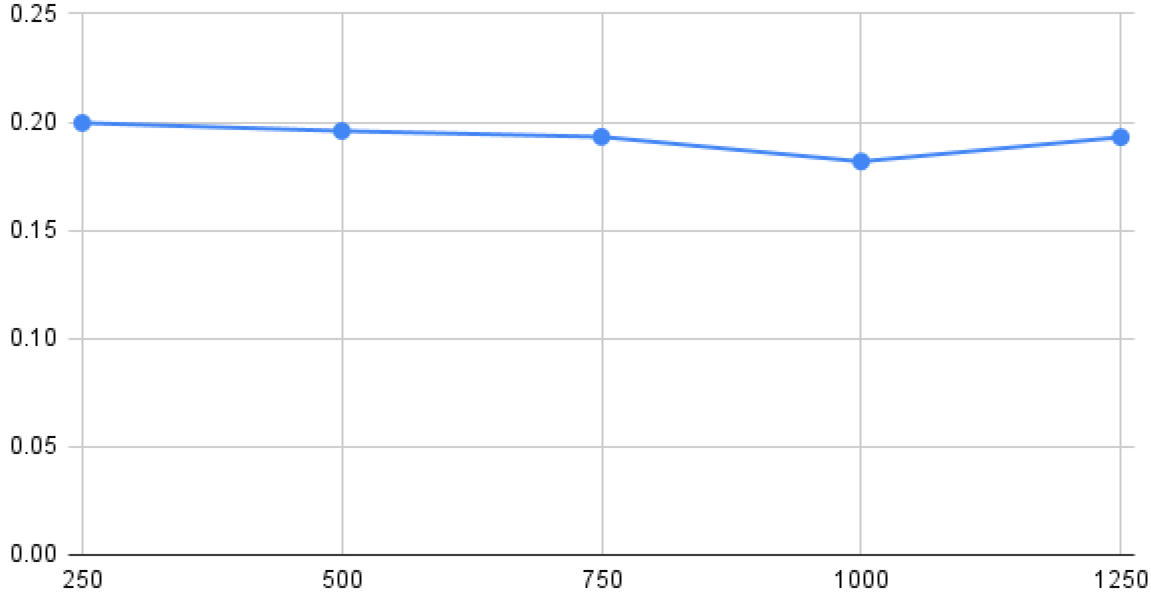
Overall, FTP is a reliable and well-established protocol for transferring files over a network. Despite its age, it is still widely used today, particularly for applications where the transfer of large files is required.

Vary Area Size:

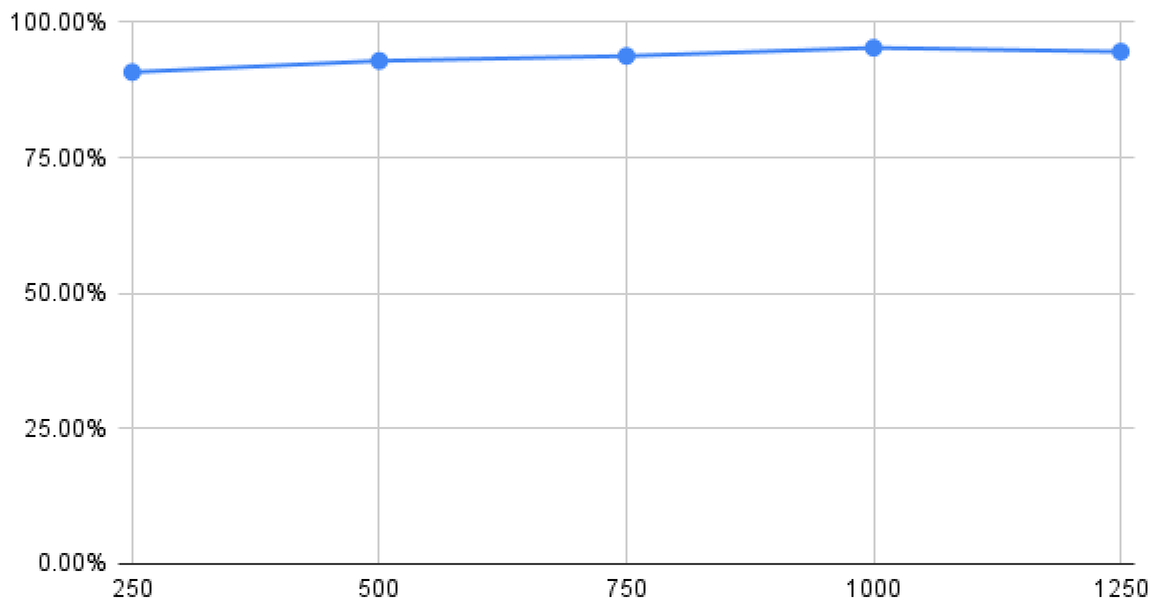
Area Size	Throughput	Average Delay	Delivery Ratio	Drop Ratio
250	1.85E+06	0.199569	90.79%	9.18%
500	1.84E+06	0.195859	92.87%	6.93%
750	1.84E+06	0.193143	93.77%	5.98%
1000	1.83E+06	0.181743	95.29%	3.67%
1250	1.83E+06	0.192976	94.57%	4.75%

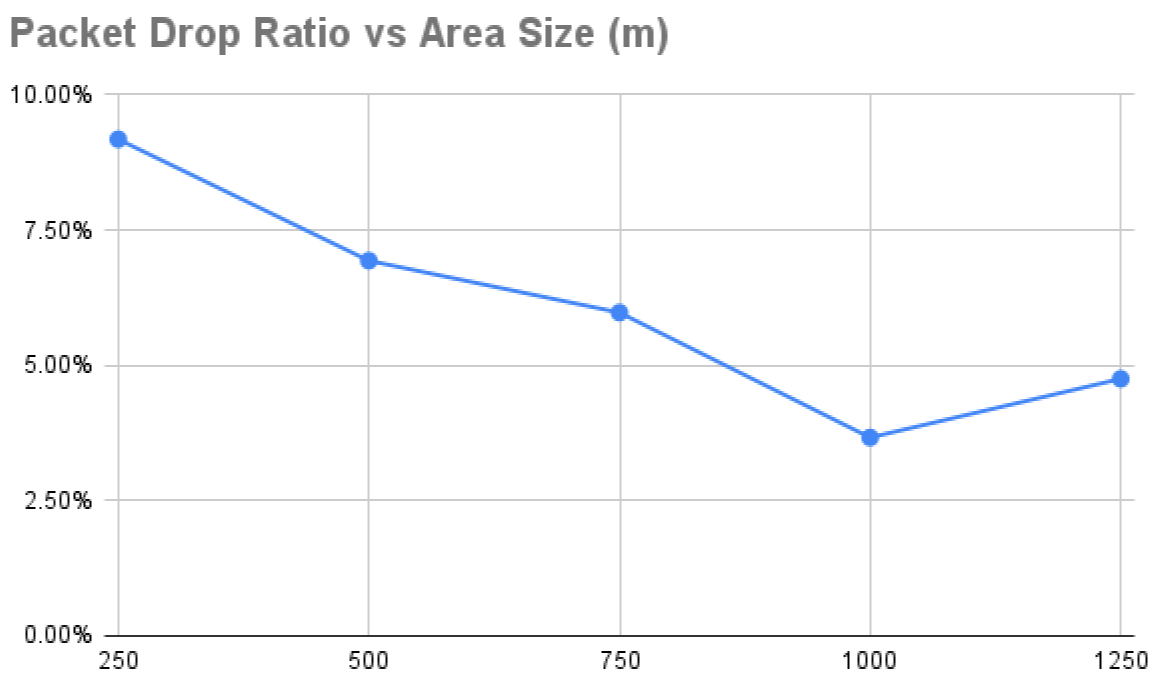


End-to-End Delay (s) vs Area Size (m)



Packet Delivery Ratio vs Area Size (m)





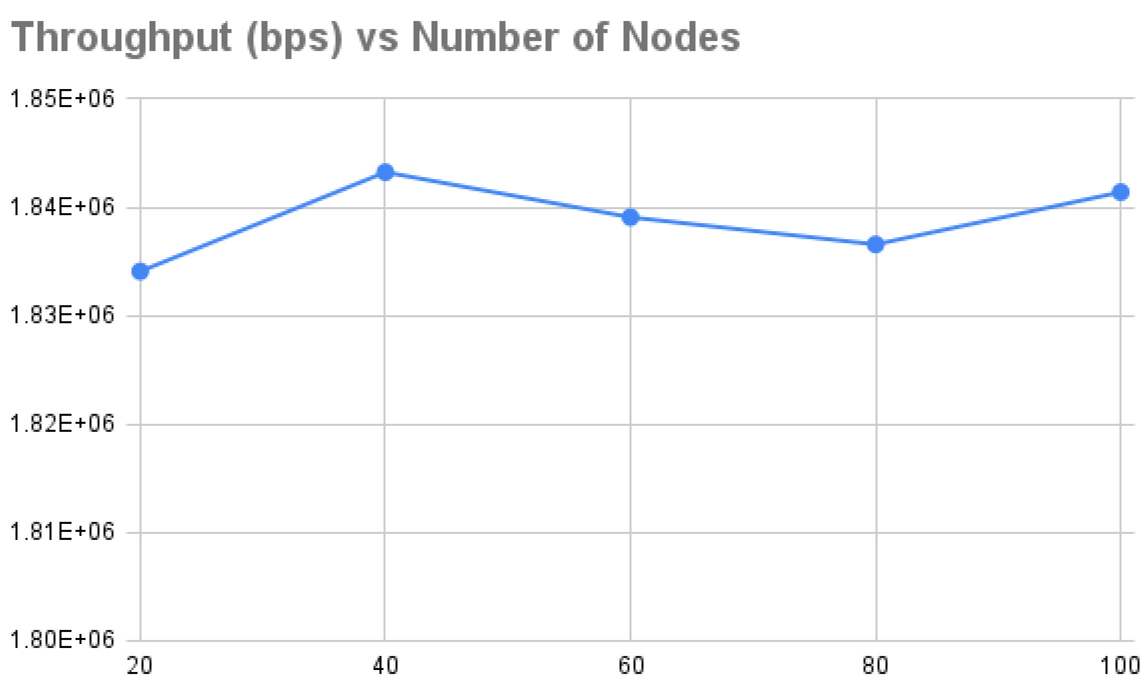
Observation:

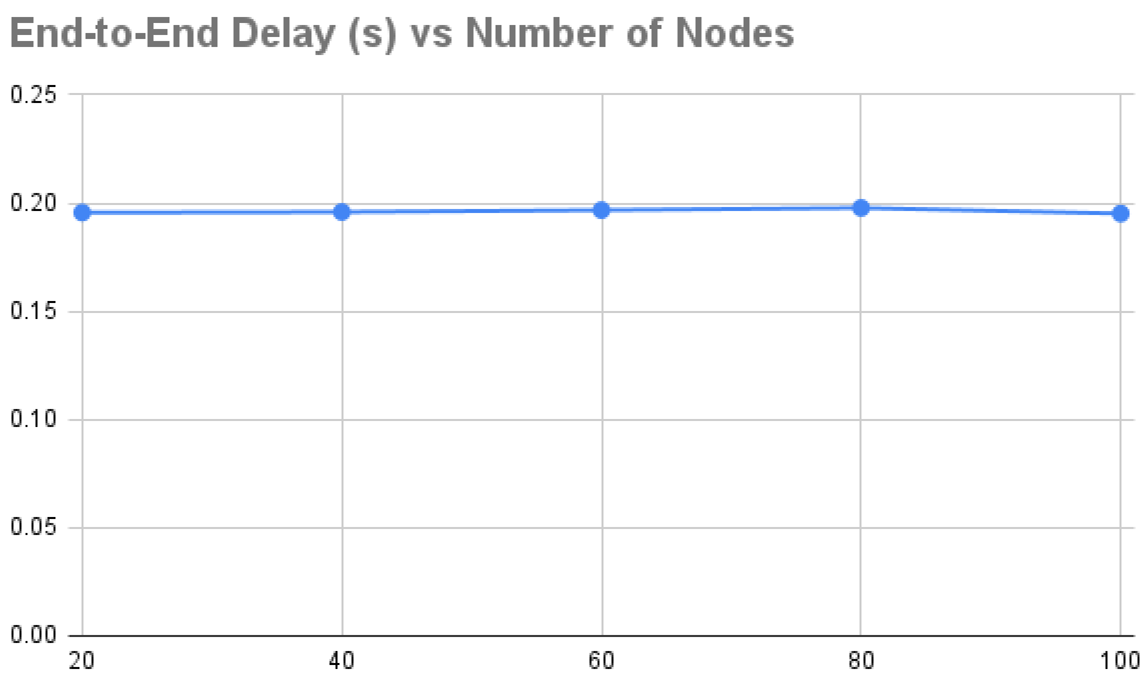
- Throughput drops with as area size increases
- End-to-End delay stays almost the same with slight tendency to decrease
- Packet delivery ratio increases with decreasing drop ratio as we increase the area size

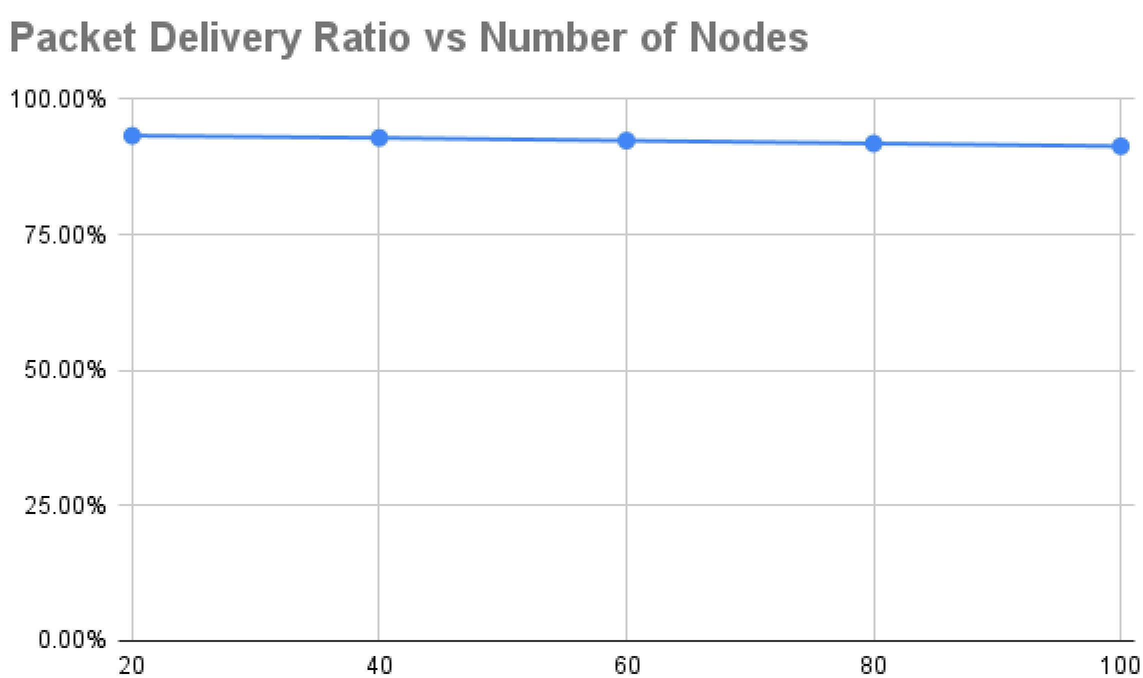
Improvement of packet delivery ratio and end-to-end delay, may be due to the fact that the distance between any two nodes increases, which reduces the chances of collisions between packets. With fewer collisions, there will be fewer packet drops, leading to a lower packet drop rate. A lower packet drop rate ensures fewer retransmissions. Thus we have slight improvement of average end-to-end delay as well.

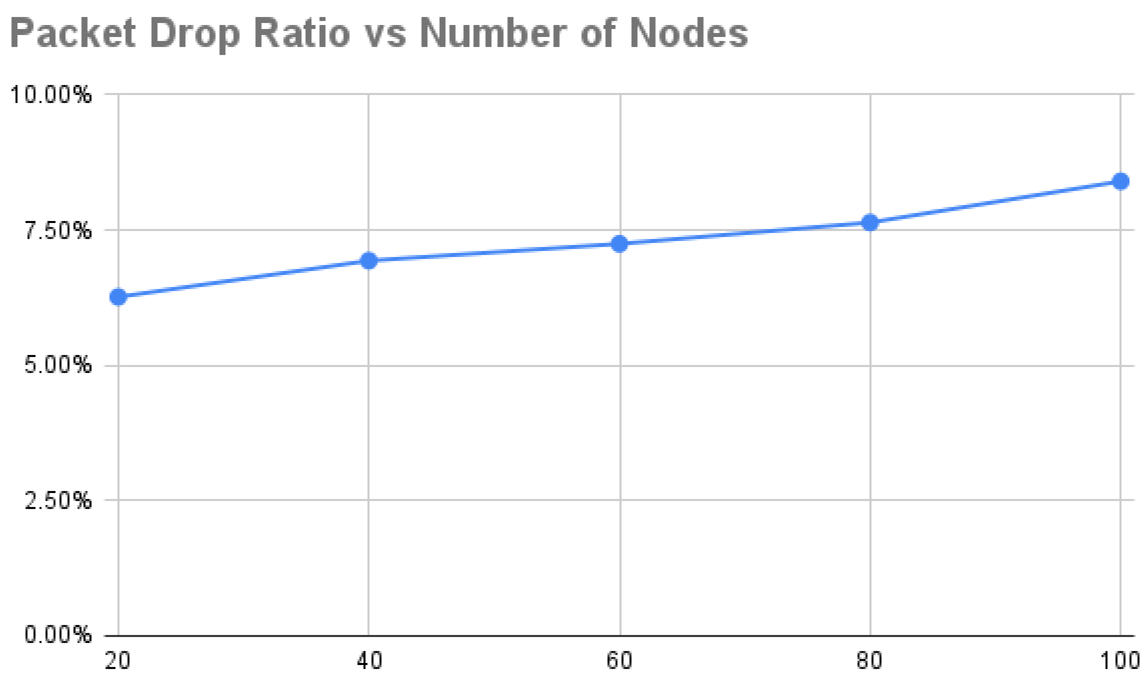
Vary Number of Nodes:

Number of Nodes	Throughput	Average Delay	Delivery Ratio	Drop Ratio
20	1.83E+06	0.195585	93.27%	6.26%
40	1.84E+06	0.195859	92.87%	6.93%
60	1.84E+06	0.196723	92.36%	7.25%
80	1.84E+06	0.197737	91.84%	7.64%
100	1.84E+06	0.195137	91.33%	8.40%




End-to-End Delay (s) vs Number of Nodes
0.25
0.20
0.15
0.10
0.05
0.00
20
40
60
80
100


Packet Delivery Ratio vs Number of Nodes
100.00%
75.00%
50.00%
25.00%
0.00%
20
40
60
80
100



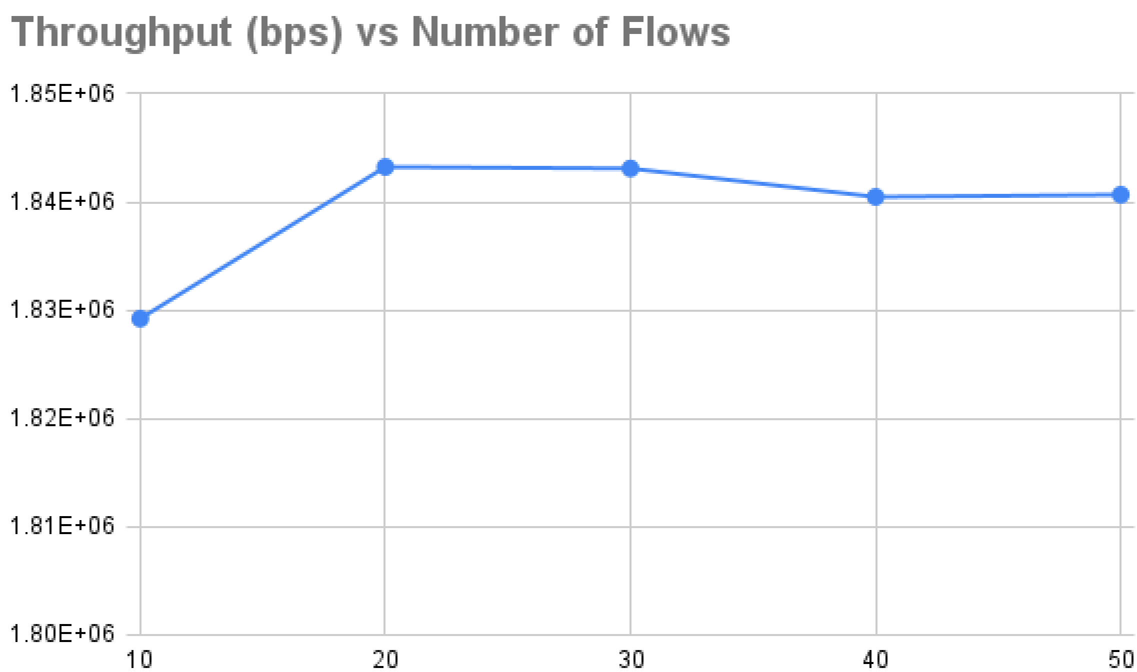
Observation:

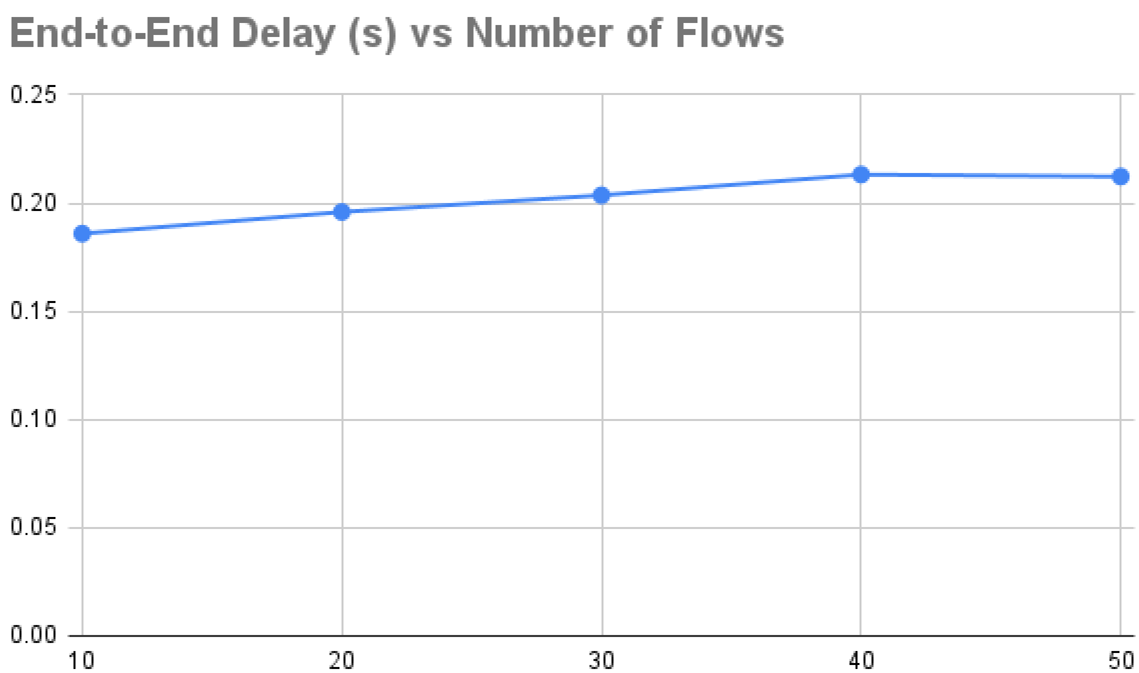
- Throughput has a tendency to increase as the node count increases
- End-to-End delay increases slightly
- Packet delivery ratio decreases with increasing drop ratio as we increase the number of nodes

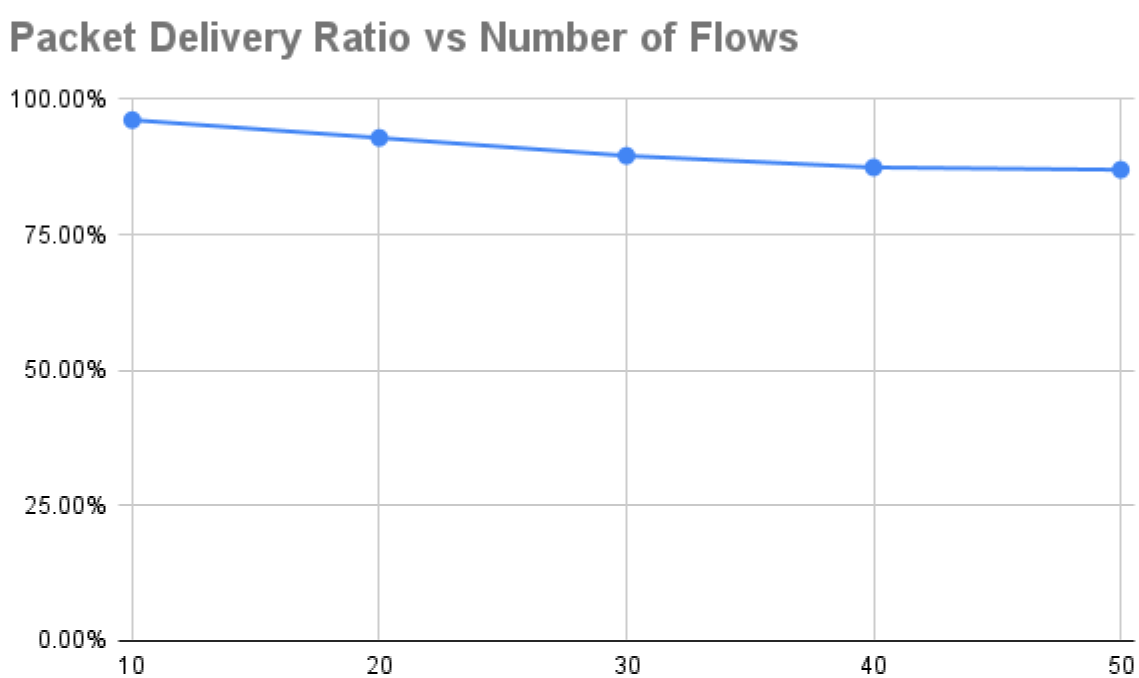
Here as we increase the node count there are more paths available for data transmission, thus the throughput increases. But more nodes in a fixed area means there would be more packet collisions, thus more drop rate. Increase in drop rate requires more retransmission. Thus the average delay is affected in a negative way.

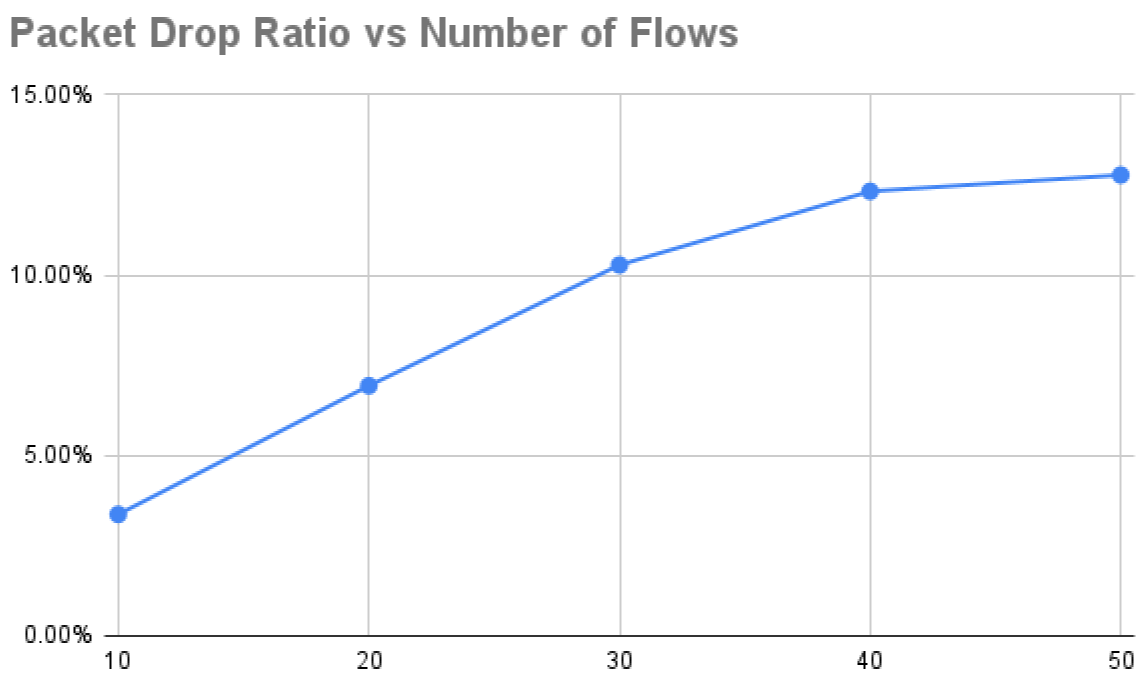
Vary Number of Flows:

Number of Flows	Throughput	Average Delay	Delivery Ratio	Drop Ratio
10	1.83E+06	0.185866	96.17%	3.37%
20	1.84E+06	0.195859	92.87%	6.93%
30	1.84E+06	0.203589	89.56%	10.28%
40	1.84E+06	0.213148	87.41%	12.32%
50	1.84E+06	0.212229	86.98%	12.78%




End-to-End Delay (s) vs Number of Flows
0.25
0.20
0.15
0.10
0.05
0.00
10
20
30
40
50


Packet Delivery Ratio vs Number of Flows
100.00%
75.00%
50.00%
25.00%
0.00%
10
20
30
40
50



Observation:

- Throughput increases sharply then follows a decreasing pattern
- There is an increase in End-to-End delay
- Packet delivery ratio decreases drastically with increasing drop ratio as we increase the number of flows

As in the case of throughput, the first sharp increase may be due to the fact that the network was "unsaturated" in the first place. So an increase in flow caused high throughput. However then as the flow started to increase even more the increase in throughput was hampered as there were more drop rates due to high traffic. Higher drop rate makes the average delay worse because of retransmission.

Conclusion:

Among all the changes, change in flow has the most effect on the network. As more flow means more traffic and more congestion.