Assignment-1 Report (CS-544)

Performance Evaluation of Packet Switch Scheduling Algorithms

By:-

Gautam Juneja (210101041)

Gaurav (210101040)

Introduction:

Packet switching is a fundamental mechanism in modern communication networks, allowing for efficient data transfer between nodes. Scheduling algorithms in packet switches determine how packets are routed from input to output ports, impacting crucial performance metrics such as delay, throughput, and fairness. In this report, we evaluate the performance of three scheduling algorithms in a crossbar switch scenario:

- INQ
- KOUQ
- iSLIP

Objective:

This assignment aims to understand the performance of queuing in a packet switch. This report aims to analyse and compare the performance of three queuing mechanisms, as mentioned above, in a packet switch environment. The study evaluates these algorithms based on average packet delay, average link utilisation, and drop probability. By conducting simulations across varying switch sizes and buffer capacities, the report seeks to provide insights into the effectiveness of each algorithm in managing network traffic. The findings will help understand the trade-offs in selecting the appropriate scheduling algorithm for packet-switched networks, aiding network engineers and researchers in optimising network performance.

Simulation Setup:

The simulation is conducted on a switch with N input and output ports, a default buffer size of 4, and a default packet generation probability of 0.5. Three queue scheduling techniques are implemented: Input Queue (INQ), Knockout Output Queue (KOUQ), and iSLIP. The simulation runs for a default of 10,000 time slots.

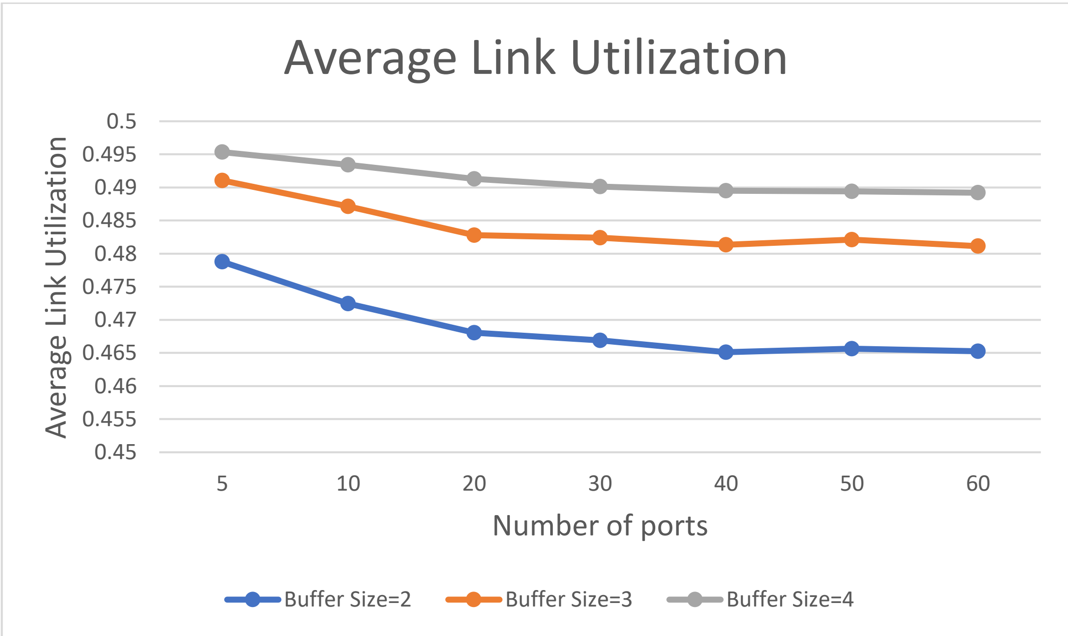
- Switch Size (N): 4 to as high as possible

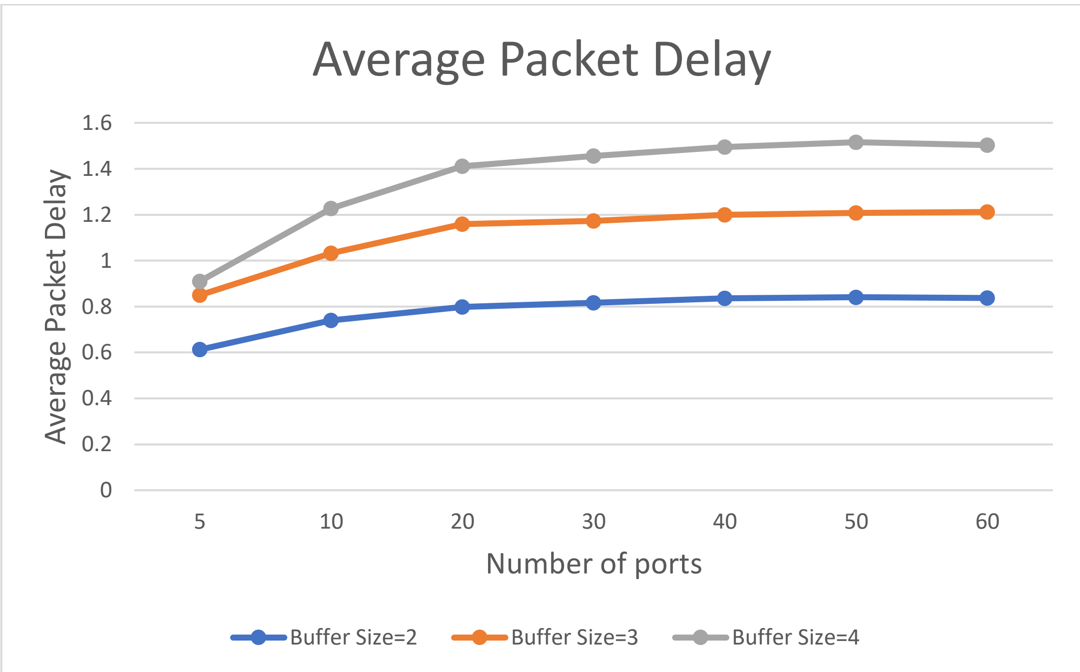
- Buffer Size (K): 0.6N, 0.8N, 1.0N
- Packet Generation Probability (p): 0.5
- Queue Scheduling Technique: INQ, KOUQ, iSLIP
- Maximum Time Slots: 10,000

Graphical Analysis:

1. Input Queuing Scheduling (INQ):-

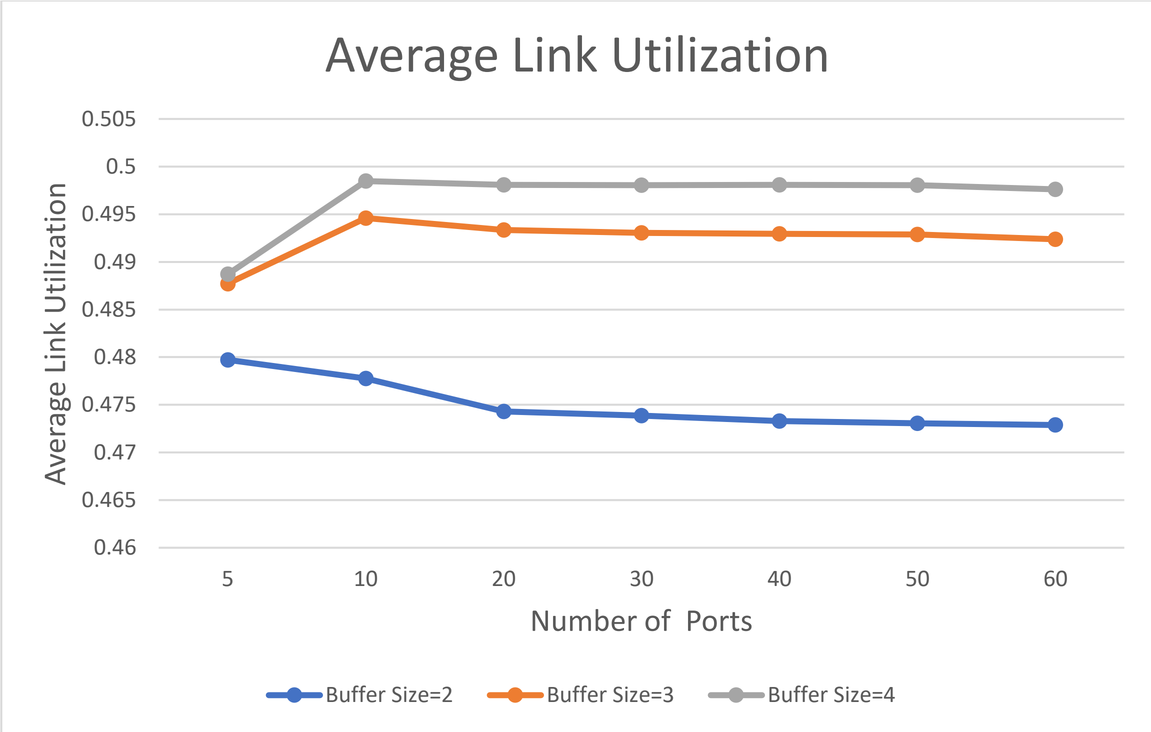
INQ with Packet generation probability=0.5, Buffer size= 2/3/4, Max time slots=1000

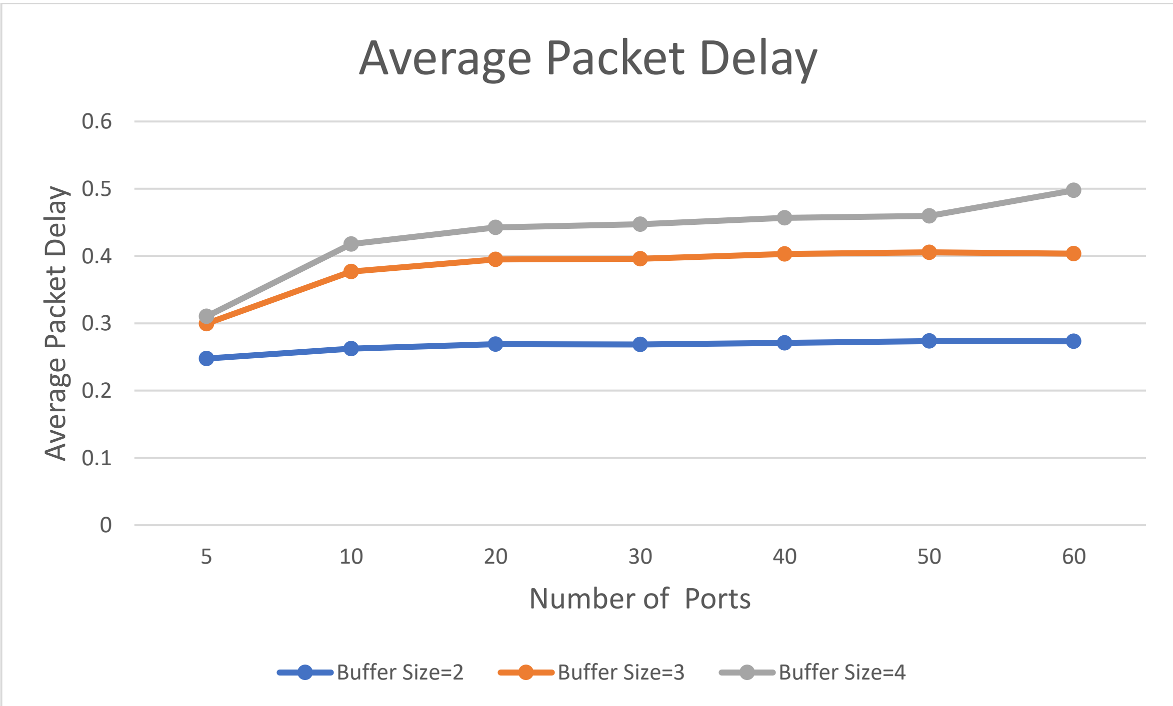




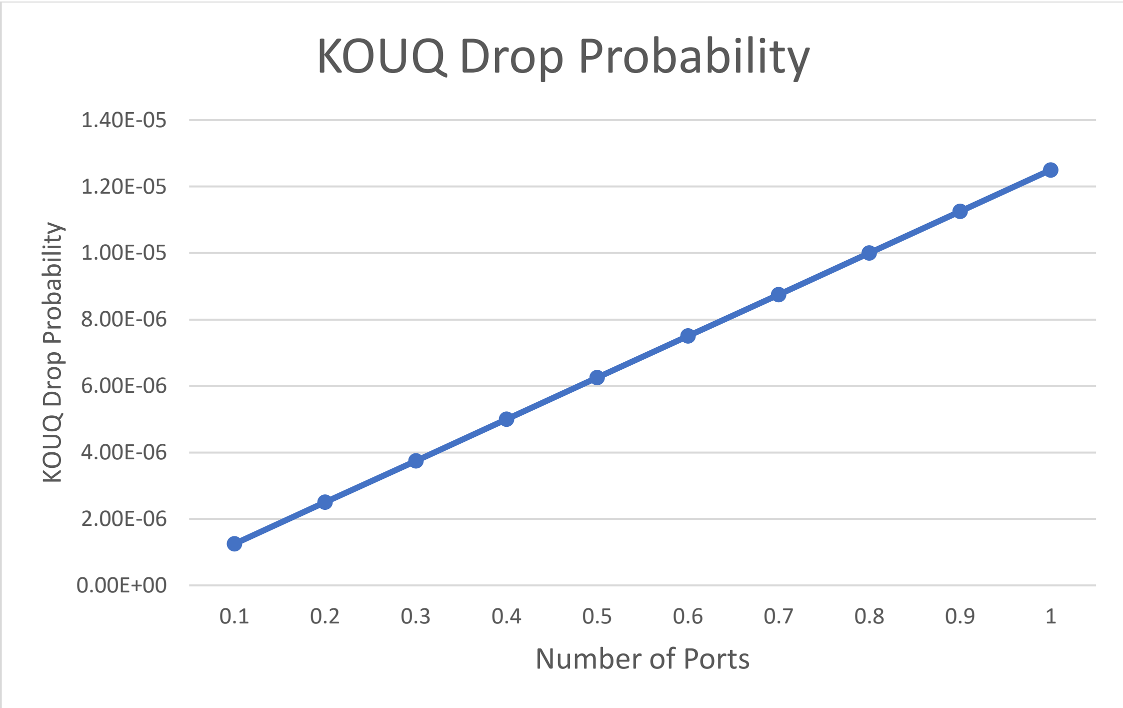
2. Knockout scheduling (KOUQ):-

(a) KOUQ with Packet generation probability=0.5, Buffer size= 2/3/4, Max time slots=1000, K=0.5

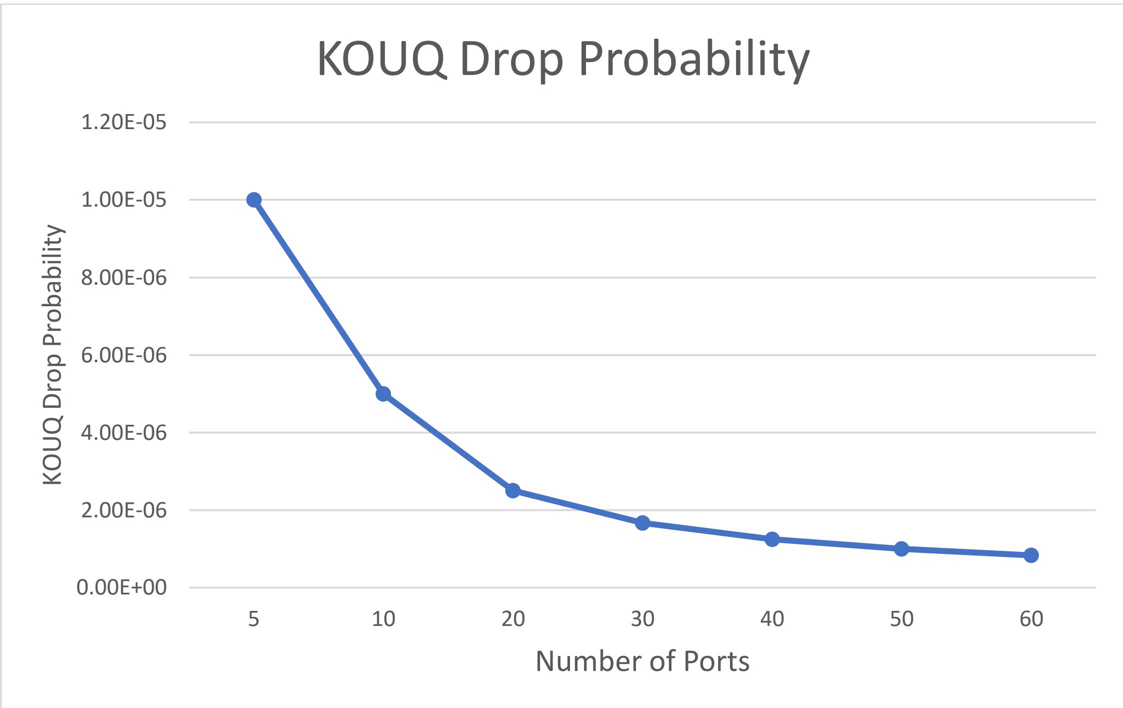




(b) KOUQ with number of Ports =8, Max time slots=1000, Buffer Size=4.

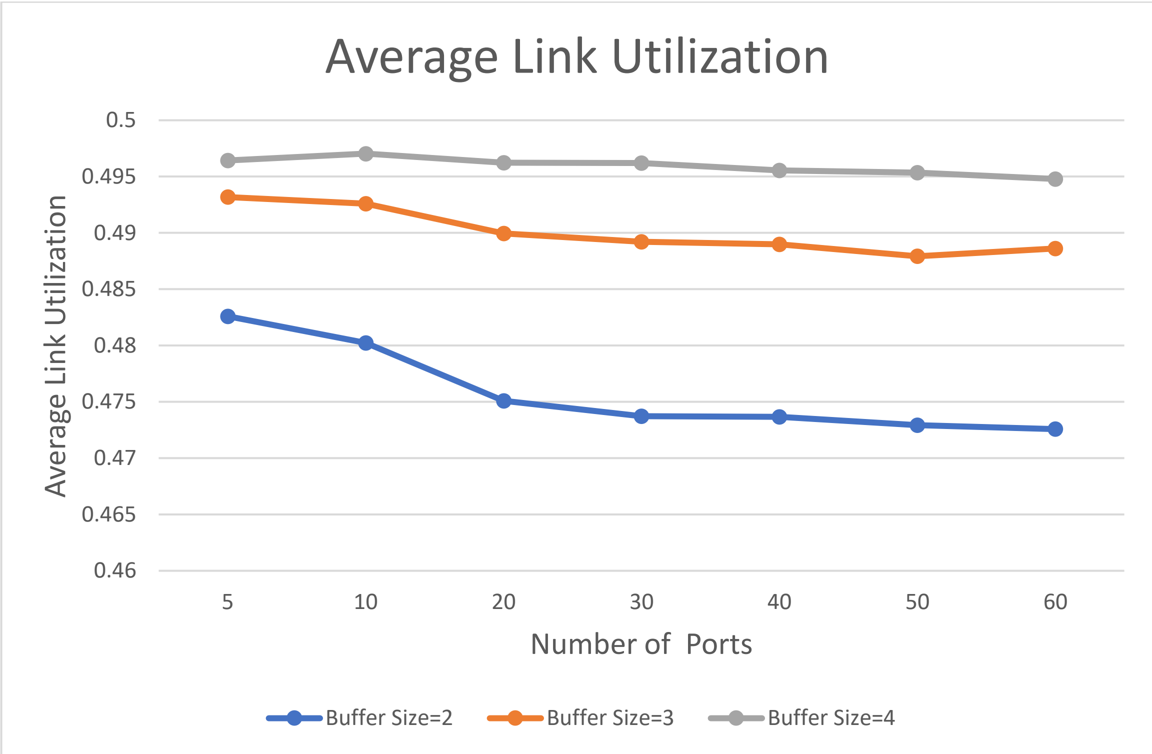


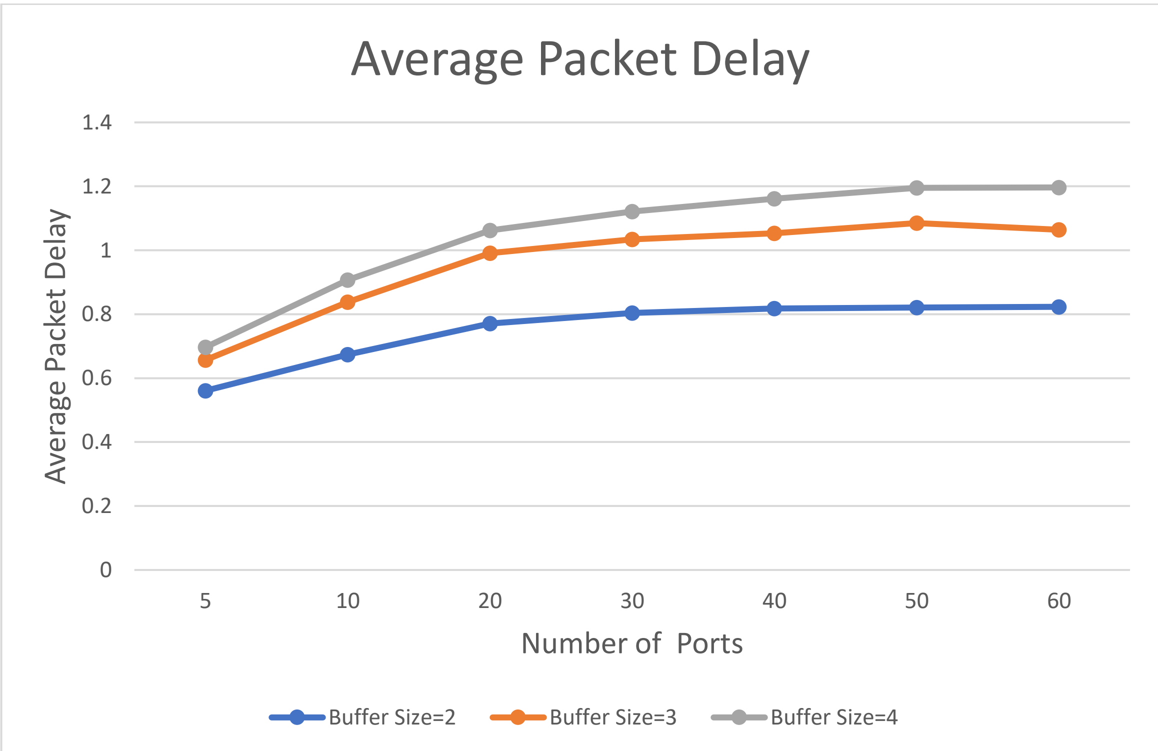
(c) KOUQ with Packet Generation Probabilty=0.5,Max time slots=1000, Buffer Size=4.



3. iSLIP scheduling (iSLIP):-

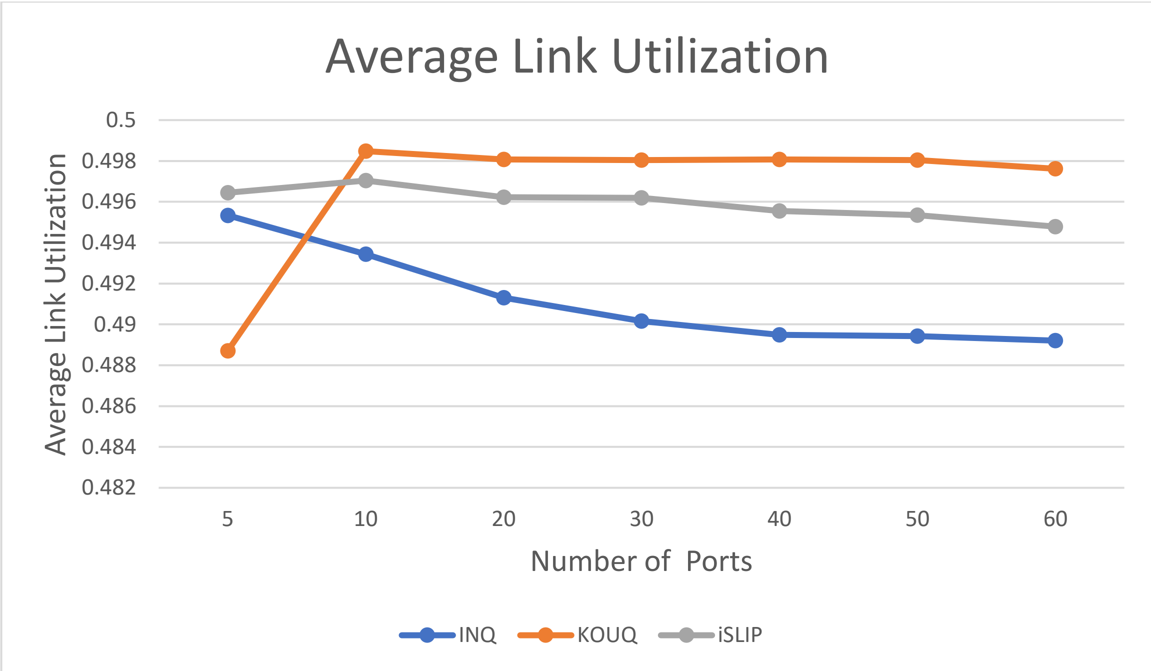
iSLIP with Packet generation probability=0.5, Buffer size= 2/3/4, Max time slots=1000

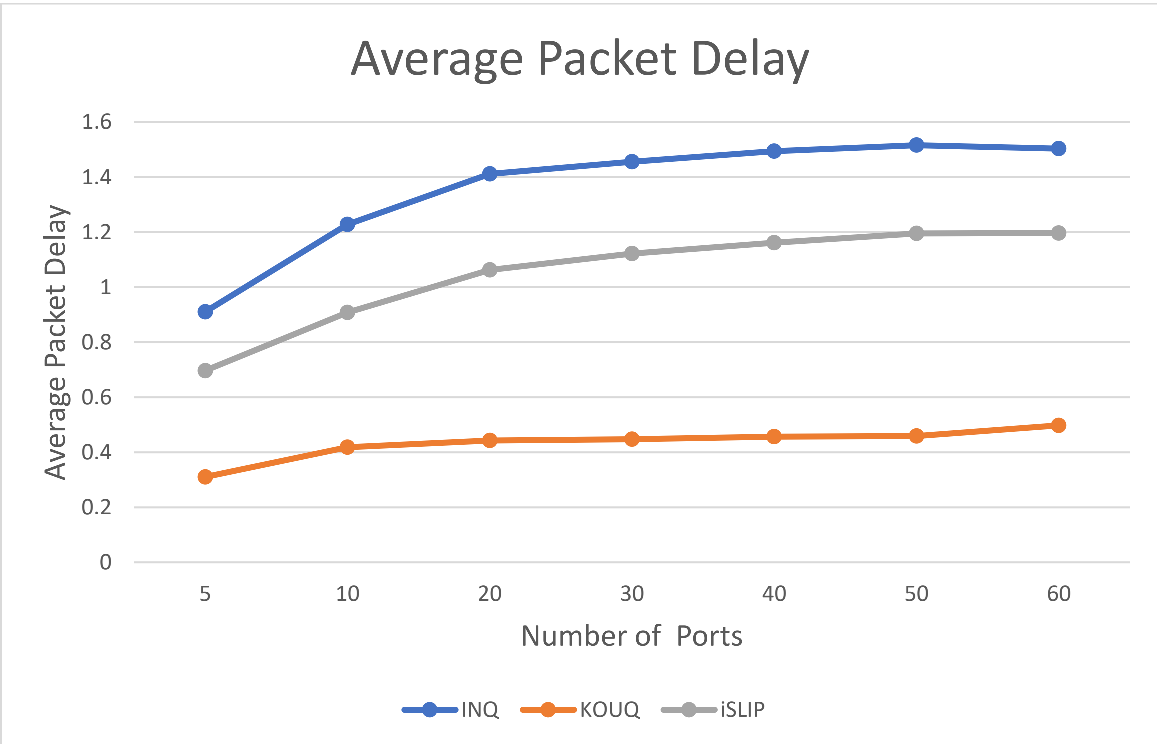




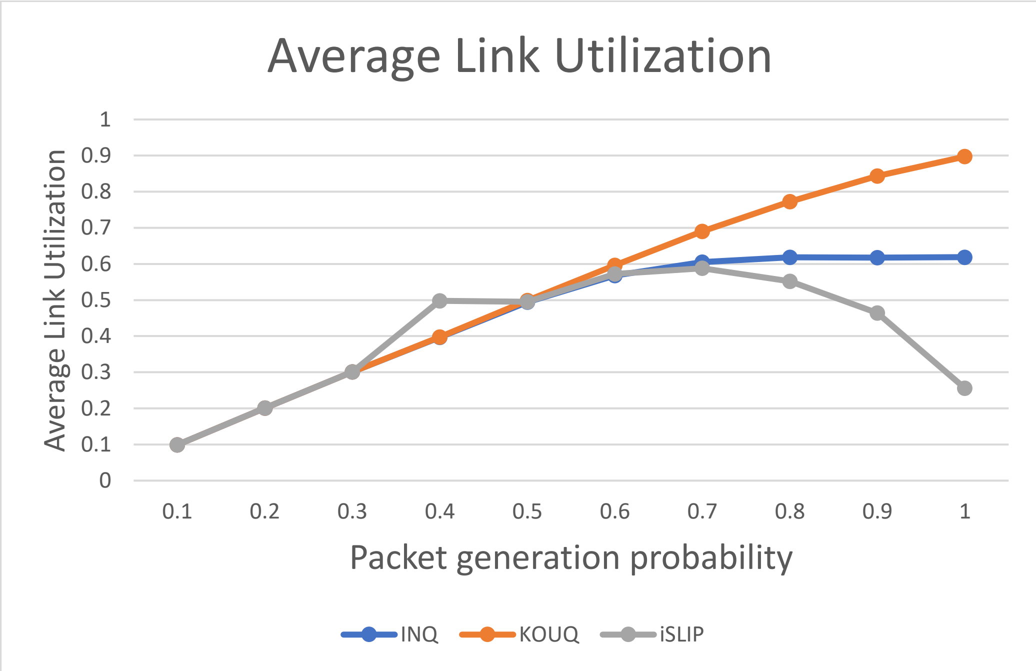
4. INQ vs KOUQ vs iSLIP:-

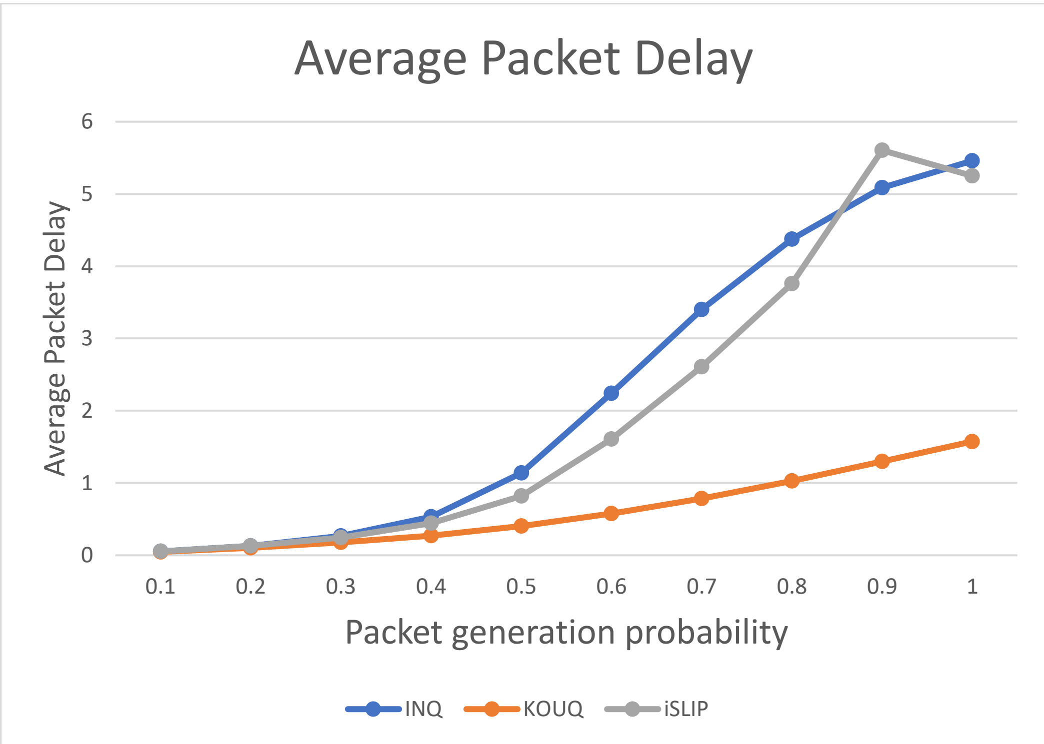
(a) Packet generation probability=0.5, Buffer size= 2/3/4, Max time slots=1000





(b) Buffer size= 4, Max time slots=1000, Number of ports =8.





Observations:

1. Average Packet Delay :-

- INQ tends to have lower packet delays compared to KOUQ and iSLIP, especially under low to moderate load conditions.
- KOUQ generally exhibits higher packet delays compared to INQ but can perform better than iSLIP under certain conditions.
- iSLIP offers competitive packet delay performance, especially under heavy load conditions.

2. Average Link Utilization :-

- INQ typically has lower link utilization compared to KOUQ and iSLIP.
- KOUQ demonstrates higher link utilization compared to INQ, especially under moderate to heavy load conditions.
- iSLIP offers competitive link utilization performance, especially under heavy load conditions.

3. Drop Probability (KOUQ only) :-

- The drop probability for KOUQ increases with higher buffer sizes (K), as expected.
- The drop probability can be controlled by adjusting the buffer size parameter (K).

Results:

Based on the observations, the performance of the three queuing mechanisms can be summarized as follows:

- INQ is suitable for applications where low packet delay is critical, as it offers lower delays compared to KOUQ and competitive performance with iSLIP under moderate to heavy loads.
- KOUQ is effective in maximizing link utilisation, especially under moderate to heavy load conditions, but may result in higher packet delays compared to INQ and iSLIP.
- iSLIP provides a balanced approach, offering competitive performance in terms of packet delay, link utilization, and drop probability across a range of load conditions.

Conclusion:

The choice of queuing mechanism (INQ, KOUQ, or iSLIP) should be based on the specific requirements of the network. For applications where low packet delay is critical, INQ may be preferred. KOUQ is suitable for maximizing link utilization, especially under moderate to heavy load conditions. iSLIP offers a balanced approach, providing competitive performance across various metrics and load conditions. By understanding the strengths and weaknesses of each queuing mechanism, network engineers can design and optimize packet-switched networks to meet the specific needs of their applications.

References:

1. The iSLIP Scheduling Algorithm for Input-Queued Switches Nick McKeown, Senior Member, IEEE.
2. Programming Assignment provided by the Instructor.