PROGRAMMING ASSIGNMENT-1

CS544: Topic in Networks

GROUP-11

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Introduction to the problem:
We require scheduling algorithms that have the following properties- High Throughput, Starvation Free, Fast, and Simple to Implement. We aim to analyse and compare different queueing and scheduling techniques based on parameters like Packet Delay and Link Utilization for an NxN Crossbar Switch.

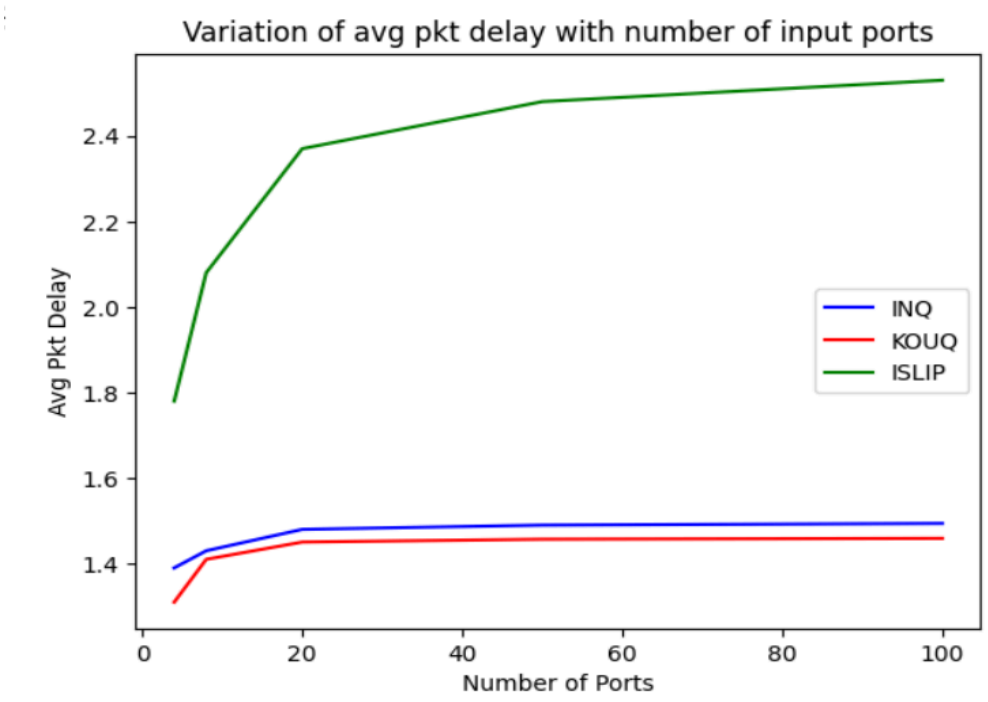
Approach:
Packets are being generated and queued at every input port with some given probability. The scheduling technique chosen is applied to the given set of generated packets. Buffer is added to input and output ports.

Assumptions:

- It is assumed that the scheduling process will take one time slot and whatever packets are transmitted will be transmitted at the end of a time slot.
- At most 1 packet can be generated at an input port in a given time slot.
- The output port of the generated packets is chosen uniformly at random.

Results:
Avg Packet Delay: is calculated in timeslot units

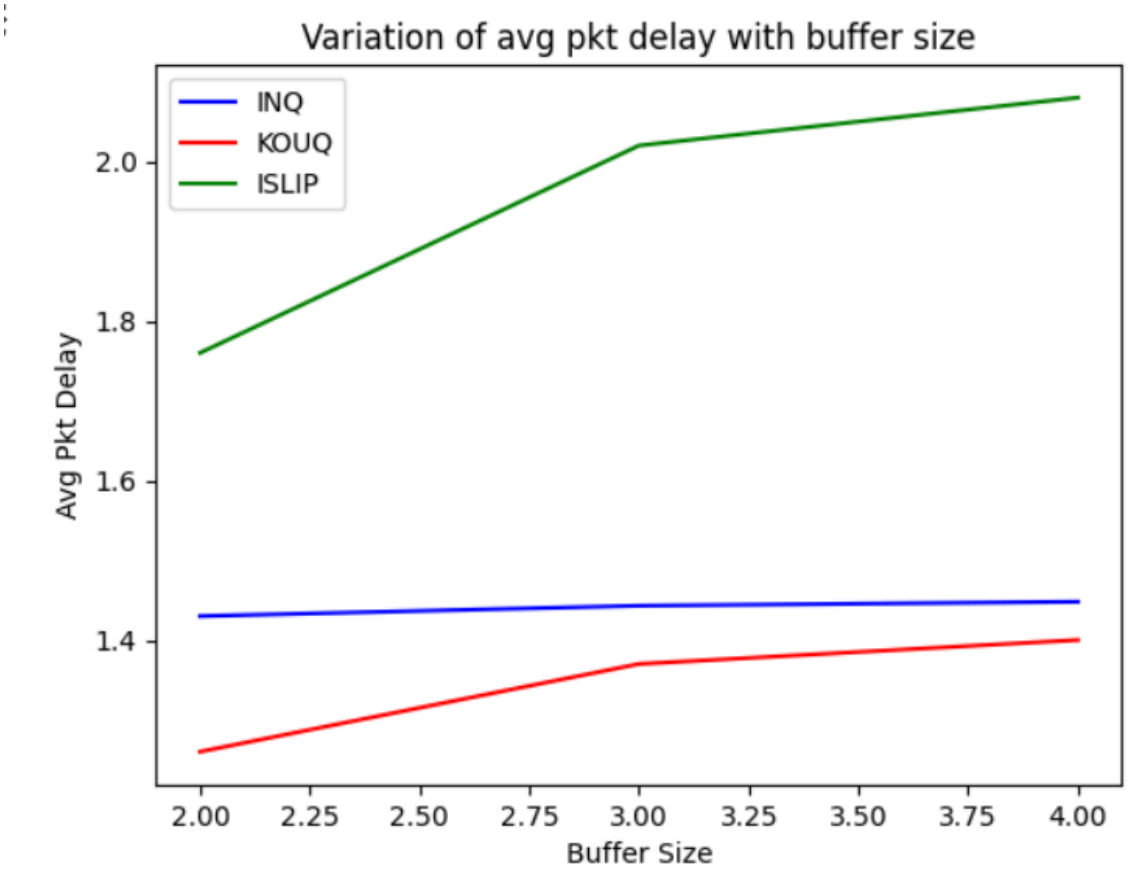
Variation of Average Packet Delay with Number of Input Ports:



Observations:

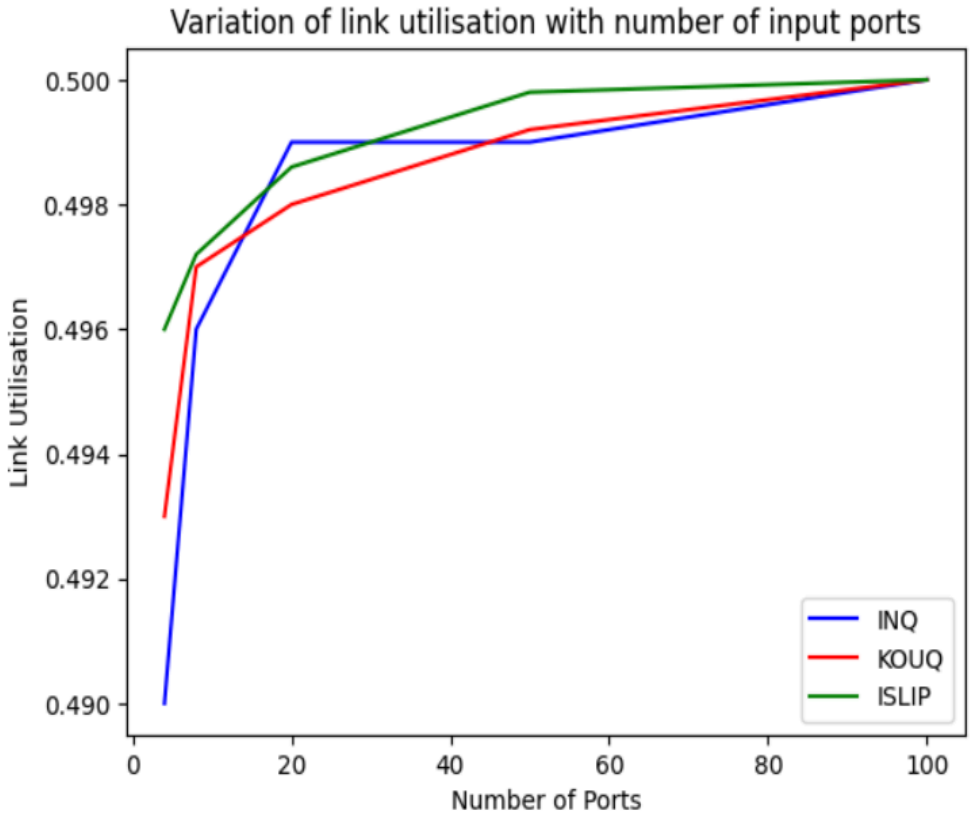
1. KOUQ has the least delay as the packets do not wait before being queued.
2. iSlip has a higher delay as packets have to wait for their turn in round robin.

Variation of Average Packet Delay with Buffer Size:



The formula used for calculation of Link Utilization: Calculated as the number of packets sent/N*Timeslots as N*Timeslots is the maximum possible throughput.

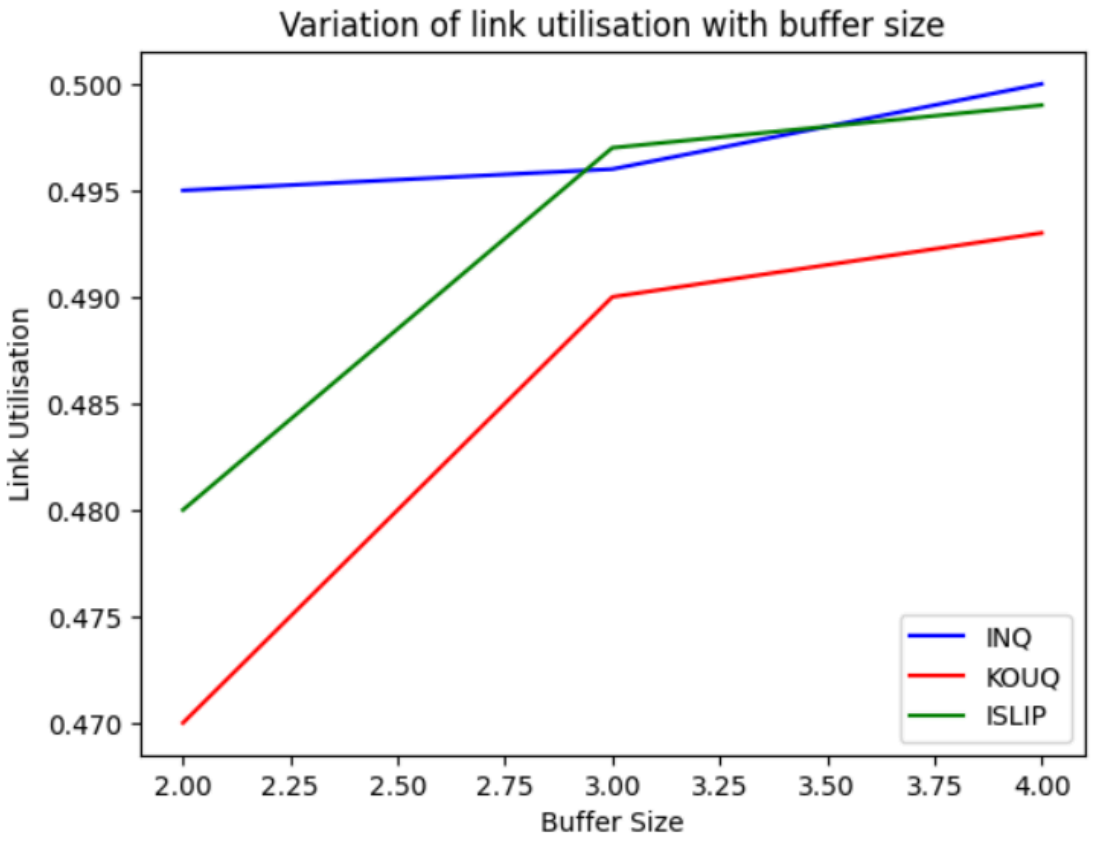
Variation of Link Utilisation with number of switch ports:



Observations:

Link utilization is high for all the methods (close to the probability of packet generation). This can be attributed to the uniform random distribution of output ports which highly reduces the contention between packets. Hence, packets are usually not dropped. If the distribution is non-uniform, we may see a change in the link utilization.

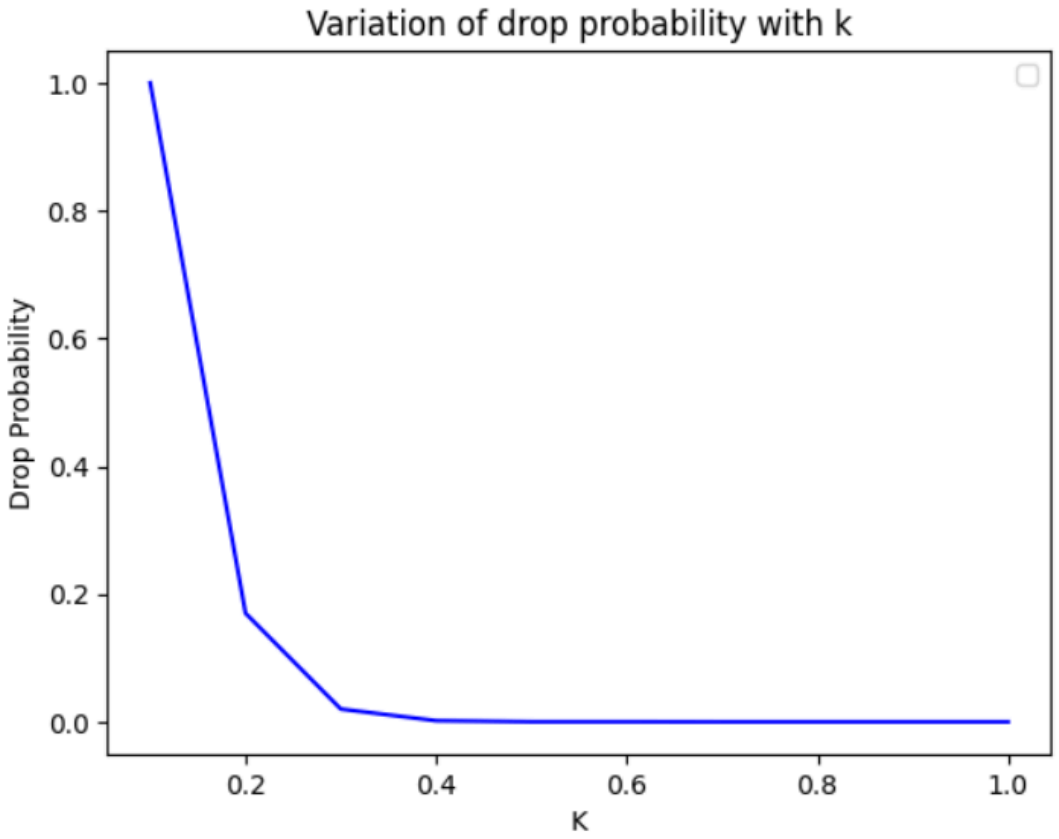
Variation of Link Utilisation with buffer size



Observations:

The link utilization increases with buffer size as the dropping of packets due to buffer overflow is reduced.

Variation of Drop Probability in KOUQ with K value



Observations:
At high K values, the probability that the number of packets destined to the output port exceeds K is much lower due to the lower probability of all the packets being sent to the same port in a uniform distribution.

Note: The parameters are set to the default value unless mentioned otherwise.

Standard Deviation of Packet Delays:

For iSlip- 1.71949
For INQ- 0.972371
For KOUQ- 0.683486
iSlip has the highest standard deviation. This is because of the Round-Robin nature of the algorithm, where an input port has to wait for its turn again if a packet from it has been recently served.

Conclusions and Comparison:

All 3 methods of scheduling provided high throughput for the given samples of inputs.
However, on closer inspection of the working of the algorithms, it is revealed that despite the higher packet delay of iSlip, it is fair and starvation-free, while INQ and KOUQ due to their random selection methods are not.
The distribution of the output ports is uniformly random in our simulation, which largely varies from a real-life scenario. The chances of contention at an output port are very low. Hence, the methods are not clearly distinguishable in this context.