EE511-F18 PROJECT 5: Switch Performance including Buffering
DUE: Tuesday November 13thth, 2018

As discussed in class, you are study the operation of an $N \times N$ switch with less than saturated traffic flows. This will build on project 4 and include monitoring the buffers or queues on the input side. The traffic pattern in terms of desired output ports will remain the same as in the last project, but now you will also simulate the arrival of packets to the input ports. A new packet will arrive to an input port in a slot with probability $p_{arrival}$. The packet arrival probability is the same for each input port (to keep the model manageable in terms of complexity). Each input port has a HOL slot and an additional number of buffers to store arriving traffic. Buffers are not shared between ports. If a packet arrives to find all the buffers for that input queue occupied, the packet is dropped – the number of dropped packets should be recorded and reported. To avoid excessive buffer overflows (drops) the rate of packet arrival should not exceed the maximum throughput capability of the switch (which you determined in Project 4). I suggest using 10 buffers per input port, but this should be a parameter in your simulation. You may want to try at least one run with a larger number of buffers (perhaps 50 per input) under a fairly heavily load scenario (perhaps 90% or 95% of the maximum through that the switch can support). It is not necessary to simulate the packets in the buffers, rather it is sufficient to just keep a count of the number of packets in the queue; the destination for a packet can be determined when the packet moves into the HOL slot.

Focus primarily on an 8x8 switch and explore the impact of traffic patterns as in the last project.

Simulate for 1) balanced traffic ($\alpha_j = 1/N \quad \forall j$)

And 2) Hot-spot traffic $\alpha_1 = 1/k, \quad \alpha_j = \left(\frac{1}{N-1}\right)\left(\frac{k-1}{k}\right) \text{ for } j \neq 1$.

Look at the cases $k = 2, 3, \text{ and } 8$ (the case of $k = N = 8$, reverts to being balanced traffic.)

More interesting in this simulation is to determine the queueing statistics of the traffic flows. You should monitor the buffer occupancy for each input on a slot by slot basis so that you can determine the "steady-state" queue size distribution and thus the mean queue length. You can then use Little's result $N = \lambda T$; where N is the average number in a system, λ is the arrival rate in packets per unit time (micro-seconds) , and T is the time an average packet spends in the system in micro-seconds. It is fairly straightforward to calculate mean times for the input queues, estimating delays based on output port requires a little more thought.

You should also monitor packet drops and the number of packet delays while in the HOL slot due to HOL output port blocking for each output port. By splitting the delays in the input queue (until reaching the HOL position) and estimating the delay due to HOL blocking, you can estimate the overall average delay for packets destined to each output port. As a check compare input and output queue statistics.