EECS 563
Project 2
FIFO or Active Queue Management
Non-Preemptive Priority

Provide your results in the form of a technical report using the provided format.
See: **Technical Report Format**

Also see this paper for advice on writing technical reports.
See: **Paper on writing technical reports**
Do not pad your reports, all figures and tables must be discussed in the text.

You are to report on the potential of using Active Queue Management, here non-preemptive priority queueing to provide Class-of-Service in the Internet and then design a statistical multiplexer using non-preemptive priority queueing that meets a service requirement. Differential services in the Internet use non-preemptive priority queueing to provide Class-of-Service. For this project you can modify an existing Extend simulation model from the class web page AQM with Non-preemptive Priority or FIFO or create your own Extend simulation model. Read the help on the Queue Block (labeled Buffer) to find out how to change one setting on this block to model a FIFO queue or a non-preemptive priority queue, that is only one setting needs to be changed to change the system from FIFO to non-preemptive priority queueing.

A router output port operates at R Mb/s and supports two traffic types:

VBR (Variable Bit Rate) video traffic given high priority – Here set priority level = 2.
Assume packet lengths fixed length of 2000 bits at an arrival rate of 2050 packets/sec. Assume exponential interarrival times.
Best-effort data traffic given low priority – Here set priority level = 1.
Assume exponentially distributed packet lengths with a mean of 10,000 bits at a rate of 410 packets/sec. Assume exponential interarrival times
System performance will be evaluated for link rates of
R= 8 Mb/s, 8.5 Mb/s, 10 Mb/s, 16.4 Mb/s, and 33 Mb/s.
The QoS metric is the average normalized delay.
Average normalized delay = (average end-to-end delay)/(Packet clocking time) where
Packet clocking time = packet length (bits)/link rate (b/s)

a) In your report explain non-preemptive priority queueing.
b) Calculate the bit rate for the VBR traffic.
c) Calculate the bit rate for the best effort traffic.
d) Calculate total the bit rate presented to this output port for transmission.
e) For each link rate calculate the load generated by each traffic class and the total load generated by both traffic class.
f) Set the simulation run time such that about 50,000 best-effort packets are generated.
g) Each simulation run is equivalent to conducting an experiment. Execute the simulation 5 times for each case and report the average and standard deviation of the measurement.
h) As a validation step, confirm that the expected total generated load matches the simulated load. The simulated load is the percent time busy reported by the Server (Open Server block, select the

Results tab, report the Active State Statistics: busy. Also displayed in the model.). For each simulation run and rate report the expected total generated load and simulated load.

i) Base case: first-in-first-out (FIFO), i.e., no non-preemptive priority queueing. Assume both traffic classes are statistically multiplexed in one buffer onto one link. Use simulation to determine the average normalized end-to-end delay for both classes taken as an aggregate, that is, without class distinction. The average normalized end-to-end delay for both classes taken as an aggregate = (average delay of both classes)/(average service time of both classes) as reported in the simulation. Use simulation to determine the average normalized end-to-end delay for each class taken separately, that is, with class distinction. The average normalized end-to-end delay per class =(average delay for that class) /(average service time for that class) where the average service time for per class= (Average packet length for that class)/(Link rate) and the average delay for that class is reported in the simulation. The average normalized end-to-end delay per class is calculated for you in the model. Indicate if the link is overloaded for any of the given link capacities. Do not simulate an overloaded FIFO queue, report that the delay is not estimated for any overloaded cases. ONLY simulate and discuss results for the delay vs R for cases where the link is not overloaded. The delay measurements should be taken from the source to the destination. Your report should contain plots of average normalized end-to-end delay vs load for both classes taken as an aggregate and for each class of traffic separately.

j) Repeat the simulation in part i) assuming non-preemptive priority service, with VBR given priority. Your report needs to address the validity of the delay measurements for each class of service at each value of R. Simulate all values of link rate R. In your report discuss the impact of priority service on the average delay as the link rate increases, that is, compare the normalized delays for each class with and without priority. Note there maybe cases where the high priority traffic has finite delay while the lower priority traffic has infinite (in theory) delay. Your report should contain plots of the normalized average end-to-end delay vs load for both classes taken as an aggregate and for each class of traffic separately. Anticipating part k) below, record the average delay for the best-effort traffic as a function of link rate.

k) In your report comment on the effectiveness of using non-preemptive priority service. Discuss the conditions under which AQM using a non-preemptive priority service can have a significant impact on performance.

l) For the system using non-preemptive priority service use simulation to design the output port, in this case find R, such that the average delay for the best-effort traffic is ~2 ms. (Approach, use results from Part i) as a starting point, and simulate for different link rates, R, to find one such that the average delay for the best-effort traffic is ~2 ms.)

Recommend you watch these videos before starting on this project:
Extendsim Video tutorials

- 1 Introduction
- 2 Model Basics
- 3 Tutorial Part 1
- 4 Tutorial Part 2