## Mini Project 1

## Two-Transmission-Link Queueing System Simulator and Output Instructions

In this mini-project, you will develop a discrete-event driven simulator for a two-queue transmission system described below, and analyze the simulation results for a number of different settings. To make your task easier, you will be provided with a simulation program written by a former student with his permission. You may refer to this program to understand the overall structure of your program. However, please do not directly copy portions of the program, but instead use it as a guide.

### System Description:

* Packets arrive (avg. interrarrival time: 1/lambda) to a router with two outgoing transmission links.
* Packets arrive to the router according to a Poisson Process. Each arriving packet is instantaneously placed on one of the two outgoing transmission link queues.
* Service times are distributed exponentially at each transmission link with different average service rates mu1 and mu2.
* An arriving packet joins link i with a fixed probability i independently of the other packets and the system state.

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### Numerical Results and Analysis:

You will use the two-queue system simulator that you develop to generate a set of results according to the following instructions.

For each simulation setting below, generate at least 6000 arrivals according to a Poisson Process with rate Lambda. Ignore at least the first 1000 packets to leave the system in your performance metric calculations. If you use simulation time as your stopping criterion, adjust your simulation time accordingly. You may need to increase these values further in order to obtain steady-state behavior. For each set of parameters, show the following metrics in a table:

1. the blocking probability (Pb) (at each queue, and in the system)
2. the average delay at each queue (and in the system)
3. the average throughput at each queue and in the system
4. the average number of packets in each queue and the system. You may use calculations based on your simulations for item number 4.

### Simulation settings:

* Set mu1 = 5 packets/s; mu2 = 5 packets/s. Set the arrival rate (Lambda) to 8 packets/s
* Set the buffer size at each queue to 20
* Simulate the system with the following Phi 1 (the probability of an arriving packet to choose queue 1) values: 0.4; 0.5 ; 0.6
* Repeat the experiments above with a buffer size of 5 at each queue

### Additional Questions:

1. How does the system behavior change with Phi? Explain your observations.
2. How does the system behavior change with the buffer size? Explain your observations.
3. Which setting results with the highest system (total) throughput? Which setting results with the lowest blocking probability? Explain.