

# Computer Networks Fall 2016

## Project 2: Part 1

### Simulation of a Single Server Finite Buffer Queue

## 1 Project Overview

This is the first part of a 2-part project. The first part is the simulation of a simple queueing system with a finite buffer to study the packet loss probability as a function of the buffer size and the traffic intensity. The second part is the simulation of the random access LAN MAC protocol. This will be described in a separate document. We will implement both project in Python using SimPy. You will find the required documentation at the following site <https://simpy.readthedocs.org/en/latest/contents.html#>. The site contains instructions to install SimPy and many examples.

## 2 Part 1

Figure 1 shows a simple queueing system model of output port of a router.

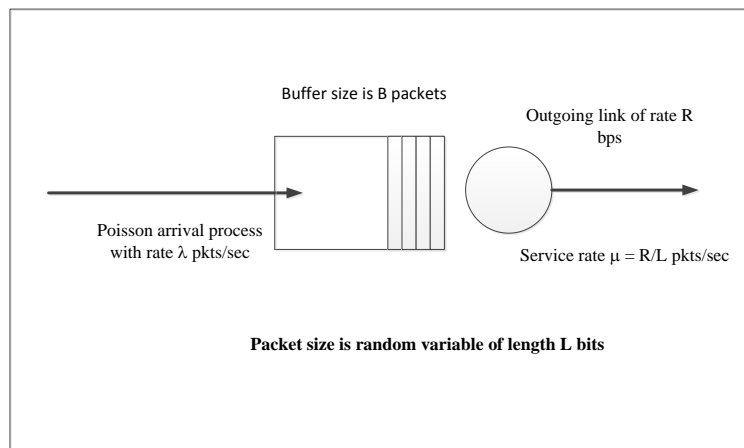


Figure 1: A finite buffer queue

Packets arrive following a Poisson process with rate  $\lambda$  packets per seconds (pkts/sec). Packets are of variable length and transmitted on the link of rate  $R$  bps. We will assume that the effective service time of a packet is negative exponentially distributed with rate parameter  $\mu$  pkts/sec. To keep things simple we will assume that  $\mu = 1$  pkts/sec. The buffer size is  $B$  packets.

You are required to write a Python code using SimPy to simulate the above system. To help you along this process, we have given you the Python code that simulates a infinite buffer queue that we had studied in class. Here are the following steps:

1. Run the given code for different values of  $\lambda = 0.2, 0.4, 0.6, 0.8, 0.9, 0.99$  pkts/sec and obtain the mean delay. Make a table that compares the simulated value with the theoretical value using the formula that we had derived in class.
2. Using the Markov Chain method derive the packet loss probability  $P_d$  as a function of buffer size  $B$  packet, arrival rate  $\lambda$  pkts/sec, and service rate  $\mu$  pkts/sec.
3. Modify the given simulation code to simulate a finite buffer system with buffer size  $B$ . For  $\lambda = 0.2, 0.4, 0.6, 0.8, 0.9, 0.99$  and  $B = 10, 50$ , using the simulation, determine the packet loss probability  $P_d$ .
4. Compare the above results using the theoretical formula derived in Step 2.

## **2.1 Deliverables for Part 1**

1. Group size: 2. One submission per group.
2. Due date for Part 1: 11/8/2016 by 4 PM.
3. Report should include 1) the derivation of the theoretical formula to calculate  $P_d$ , 2) the simulation code, and 3) tables (or plots) of the results.
4. Submit a hard copy in the homework box in Kemper 2131.