# ECE 537: Communication Networks

(Fall 2015)

## PROBLEM SET 1

Due: September 25, 2015

**Note**: You are allowed to discuss the problems with other students in class. However, each student is expected to do the homework individually and submit.

1. (**5 points**) Suppose $N$ users share a 10 Mbps link. Also suppose that each user transmits continuously at 1 Mbps when transmitting, but each user transmits only 20% of the time. Assume that transmission by one user is independent of other users.

   - When circuit switching is used, how many users can be supported?
   - Suppose packet switching is used. What is the probability of $k$ users transmitting at the same? Express your answer in terms of $N$ and $k$. For $N = 20$, plot the probability as a function of $k$.

2. (**5 points**) Suppose host $A$ wants to send a large file to host $B$. The path from $A$ to $B$ goes through router $R$. The link from $A$ to $R$ has a bandwidth of 1 Mbps (i.e., $2^{20} bps$) whereas the link from $R$ to $B$ has a bandwidth of 2 Mbps (i.e., $2^{21} bps$). The physical distance between $A$ and $R$ is such that the propagation delay is 2 ms. The physical distance between $R$ and $B$ is such that the propagation delay is 1 ms.

   - If packet switching is used, what is the minimum end-to-end delay for a 1024-byte packet to traverse from $A$ to $B$?
   - If packet switching is used, what is the maximum throughput between hosts $A$ and $B$?
   - If router $R$ has a maximum queue size of 8 1024-byte packets, what is the maximum end-to-end delay of a delivered 1024-byte packet to traverse from $A$ to $B$? Assume that the link from $R$ to $B$ is shared with other traffic whereas the link from $A$ to $R$ is not shared with any other traffic.

3. (**20 points**) For this problem, you write two programs (in a language of your choice), a client and server. The client and server communicate using User Datagram Protocol (UDP) sockets. The client and server programs must run on two different hosts on CAE. The programs must do the following. The client first sends a request for a movie to the server. The request packet must contain the following information: your name, the name of the movie (pick your favorite movie), and the time at which the movie should begin (pick a start time that is in the future). Upon receiving the request, the server must send a response to the client. The response must contain the following information: hostname of server, the name of the movie (mentioned in the request from the client), the time at which the movie begins (equal to or greater than the time mentioned in the request), the cost for watching the movie (pick as you wish), and a 8-bit integer which will serve as password for decoding the movie (use a random number generator

uniformly selecting between 0 and $2^8 - 1$). Upon receiving the response, the client should print out the information it received to a client_log file. After sending a response, the server should also print out the information to a server_log file.

Submit a print out of your code and the two logfiles. Comment your code well so that it is easy to grade.