HELSINKI UNIVERSITY OF TECHNOLOGY
Networking Laboratory
S-38.145 Introduction to Teletraffic Theory, Spring 2005

Exercise 1
3.2.2005

Problems 2–3 are homework exercises. Mark the problems you have solved in the beginning of the exercise class.

1. *Demo*
   Consider a part of a trunk network, which is connected to the rest of the network through four of its nodes. In this subnetwork, the average number of packets has been measured to be 1000. Let the arrival rates of the packets from other parts of the network to these four nodes be $\lambda_1 = 200$ pps, $\lambda_2 = 300$ pps, $\lambda_3 = 400$ pps, and $\lambda_4 = 500$ pps (pps = packets per second). How long does a packet stay in the subnetwork on average?

   (*Tip:* Use Little's formula)

2. *Homework exercise (1 point)*
   Consider a lossy queueing system (cf. Lectures: Slide 1/27) with 4 parallel servers and 6 waiting places. The average interarrival time between two customers is 2 minutes, and the loss ratio is 10%. In addition, the average waiting time (before service) is 5 minutes, and the average service time is 8 minutes.

   (a) What is the average number of waiting customers?

   (b) What is the average number of customers in service?

   (c) The customers departing from this system are directed to a pure queueing system (cf. Lectures: Slide 1/26) with only a single server. What should the service rate of this server be (at least) in order that the latter system be stable (which means that all waiting places become free from time to time)?

3. *Homework exercise (1 point)*
   Make a comparison between circuit and packet switching with the following assumptions. There is a message of length L kilobits to be sent. In the circuit switched system, the connection set-up takes D seconds, and the connection is carried by a channel of capacity C kbps (kbps = kilobits per second). In the packet switched system, the amount of overhead is qL kilobits, and the message (together with the overhead stuff) is carried with access link rate C kbps. Queueing and processing delays of packets are negligible with respect to the total message transfer time.

   (a) Express the message transfer time as a function of the parameters given for the two switching modes.

   (b) Assume that $C = 64$ kbps, $D = 5$ s, and $q = 0.2$. How long should the message be (at least) in order that the message transfer time be shorter in the circuit switched system?