HELSINKI UNIVERSITY OF TECHNOLOGY
Networking Laboratory
S-38.1145 Introduction to Teletraffic Theory, Spring 2007

Exercise 2
30.1.2007

Problems 3, 4 and 6 are homework exercises. Return your answers into the course box of the laboratory (G-wing, 2. floor) latest at 10.00 on Tuesday 30.1.

1. *Demo*
   Consider telephone traffic carried by a 5-channel link in the telephone network. Use a pure loss system model. New calls arrive according to a Poisson process at rate 2 calls per minute, and call holding times are independently and identically distributed with mean 3 minutes. Compute

   (a) offered traffic,

   (b) carried traffic, and

   (c) lost traffic.

2. *Demo*
   Consider telephone traffic carried by a link in a packet switched network. A single call is modelled as a streaming CBR flow with a fixed transmission rate of 64 kbps. The link speed is $5 * 64$ kbps. Use the infinite system model. New calls arrive according to a Poisson process at rate 2 calls per minute, and the average flow duration is 3 minutes. Compute

   (a) offered traffic,

   (b) carried traffic, and

   (c) loss ratio.

3. *Homework exercise*
   Consider the processor of a packet router in a packet switched data network. Traffic consists of data packets to be processed. Use a pure waiting system model with a single server. New packets arrive according to a Poisson process at rate 2000 packets/second, and packet processing times are independently and exponentially distributed with mean 0.4 ms.

   (a) What is the traffic load?

   (b) What is the probability that a packet has to wait longer than 2 ms?

   (c) Assume that the traffic arrival rate increases to 3000 packets/second. How big should the service rate μ of the processor be, if we require that with probability 0.1 packets should not wait longer than 2 ms.

4. *Homework exercise*
   Consider elastic data traffic carried by a 100-Mbps link in a packet switched network. Use a pure sharing system model with a single server. New flows arrive according to a Poisson process at rate 9 flows per second, and the average size of the files to be transferred is 10 Mbit.

   (a) What is the traffic load?

   (b) What is the throughput of a flow and the average file transfer time?

   (c) Assume that flow arrival rate λ increases to 15 flows per second. How much capacity is needed on the link if we require that the per-flow throughput $\theta = 5$ Mbps?

5. *Demo*
   Let X and Y be independent random variables. Consider then the random variable $Z = aX + bY$, where a, b are real numbers.

   (a) Determine the mean and variance of Z.

   (b) Assume that $X \sim$ Poisson(3) and $Y \sim$ Poisson(2), $a = b = 5$. What is the probability $P\{Z = 0\}$?

6. *Homework exercise*
   Let X denote call holding time in minutes. Assume that $X \sim \text{Exp}(\lambda)$ and $P\{X > 3\} = 1/2$.

   (a) Determine parameter λ.

   (b) What is the average holding time?

   (c) What is the probability that the call duration is more than 6 minutes?