HELSINKI UNIVERSITY OF TECHNOLOGY
Networking Laboratory
S-38.1145 Introduction to Teletraffic Theory, Spring 2006

Exercise 2
31.1.2006

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 31.1.

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 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 2 packets per ms, 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 an arriving packet will be processed immediately after the arrival (without any waiting)?
   (c) What is the probability that a packet has to wait longer than 2 ms?

3. *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 6 flows per second, and the average size of the files to be transferred is 15 Mbit.
   (a) What is the traffic load?
   (b) What is the throughput of a flow?
   (c) What is the average file transfer time?

4. *Homework exercise*
   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.

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*
   Suppose that the lifetime X of a fuse (in kilohours) is exponentially distributed with $P\{X \leq 10\} = 0.8$.

   (a) Determine the rate parameter λ.

   (b) Determine the mean and variance of X.

   (c) Determine the median of the lifetime, i.e. such t for which $P\{X \leq t\} = 0.5$.