HELSINKI UNIVERSITY OF TECHNOLOGY
Laboratory of Telecommunications Technology
S-38.145 Introduction to Teletraffic Theory, Fall 1999

Examination
19.5.1998
Aalto

Write on each paper
– S-38.145 Introduction to Teletraffic Theory, Examination 19.5.1998
– your student number
– your name
– signature

1. (a) Assume that the traffic remains unchanged. Does the level of service increase or decrease when the capacity of the system is increased?

   (b) Now assume that the capacity remains constant. Does the level of service increase or decrease when the traffic is increased?

   (c) Assume that the level of service has to remain unchanged when the traffic is increased. Does the system require more or less capacity?

   (d) Assume now that the traffic remains unchanged, but the level of service should be increased. How should the amount of capacity be altered?

2. Consider telephone traffic in a link between two telephone exchanges. During the time interval $[0, T]$, where $T = 16$ (time units), there are 7 new calls arriving at the moments

   - 1, 2, 4, 5, 6, 9 and 12 (time units).

   The holding times (if the calls are not blocked) are respectively

   - 9, 5, 4, 1, 7, 2 and 6 (time units).

   The link capacity is assumed to be $n = 3$ channels. Assume further that, at time $t = 0$, the system is empty (that is, all the three channels are free).

   Draw a picture describing the call arrival times, channel occupation (for each channel separately), and the number of occupied channels as a function of time $t \in [0, T]$. How many of the calls offered are blocked? What is the total traffic volume in this time interval $[0, T]$?

3. How would you define the total delay in a connectionless packet switched network? What is the total delay composed of (in a trunk network)? Which of these components does the traffic in the network affect and how? Which components can you, as a network designer affect by increasing capacity and how would you do i t?

4. Consider a n-channel link in a circuit switched network. Assume, that the traffic sources generate new calls according to a Poisson process (each call reserves one unit of capacity). The mean interarrival time is t time units and the mean holding time is h time units. Use the Erlang model to model this system. Calculate the time blocking and the call blocking in the following case: $n = 3$, $t = 3$ min, and $h = 3$ min.

5. Consider a M/M/1-FIFO queuing model. Let $X(t)$ denote the number of customers in the system at time t. Draw the state transition diagram of this Markov process. Determine the equilibrium distribution of $X(t)$. Calculate the mean number of customers and the mean time spent in the system.