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

Exercise 10
14.4.2005

Problems 2 and 4 are homework exercises. Mark the problems you have solved in the beginning of the exercise class.

1. *Demo*
   Consider the following simple circuit switched trunk network. There are three nodes connected in a tandem by two links: a — b — c. Each link has capacity of 2 channels. In addition, there are three traffic classes:

   - Class 1 uses link a — b
   - Class 2 uses link b — c
   - Class 3 uses both link a — b and link b — c

   Determine the state space of this system. Furthermore, determine the blocking states for each class separately.

2. *Homework exercise (2 points)*
   Consider still the circuit switched trunk network defined in the previous problem. Assume that, for each class r, new calls arrive according to a Poisson process at rate λ_r. Let $\lambda_1 = \lambda_2 = 1/3$ calls per minute and $\lambda_3 = 2/3$ calls per minute. Call holding times (for all classes) are assumed to be independently and identically distributed with mean $h = 3$ min. Compute the end-to-end blocking probabilities for each class using both the exact formula and the approximative Product Bound method.

3. *Demo*
   Consider a connectionless packet switched trunk network with three nodes connected to each other as a triangle. Each node pair is connected with two one-way links (one in each direction) of capacity 155 Mbps. The following five routes are used in this network:

   - Route 1: a → b
   - Route 2: a → c → b
   - Route 3: a → c
   - Route 4: c → b
   - Route 5: b → a

   For each route, new packets arrive according to an independent Poisson process with intensities $\lambda(1) = 20$, $\lambda(2) = 10$, $\lambda(3) = \lambda(4) = \lambda(5) = 5$ packets per ms. The packet lengths are independent and exponentially distributed with mean 400 bytes. Draw a picture describing this queueing network model. Compute the traffic loads for each link j. In addition, compute the average end-to-end delays for each route r.

4. *Homework exercise (1 point)*
   Consider the queueing network model defined in the previous problem. Assume now that the connection between nodes a and b breaks down so that the packets following route 1 (a → b) are rerouted to route 2 (a → c → b) and the packets following route 5 (b → a) are rerouted to a new route 6 (b → c → a). Compute the new average end-to-end delays for each route r.