Exercise 6
4.3.2008

1. Consider the circuit switched trunk network presented in L10/9 with four nodes (a,b,c, and d), three links (a —- c, b — c, and ja c — d) and two traffic classes:

   - Class 1 uses route a — c — d
   - Class 2 uses route b — c — d

   Assume further that the traffic intensities for the two classes are $a_1 = 1$ and $a_2 = 2$. Compute the end-to-end blocking probabilities for each class separately using

   (a) the exact formula,

   (b) the approximative Product Bound method.

2. Consider the packet switched network presented in D10/3 with three nodes (a, b, and c) connected by six links to each other as a triangle. Assume now that the connection between nodes a and c breaks down so that the packets following route 2 (a → c → b) are rerouted to route 1 (a → b), and the packets following route 3 (a → c) are rerouted to a new route 6 (a → b → c). Compute the new mean end-to-end delays for each route r.

3. Consider the network specified in L12/26 with five nodes (a, b, c, d, and e) and 12 links. Links a → d and d → a are of capacity 1, while the other links have capacity 2. Assume now that the network is loaded only by OD-pair (a,d) with traffic $t_{\text{ad}} = x$.

   (a) Formulate the Load Balancing Problem (i.e., minimization of the maximum relative link load), and give the optimal solution with confirming arguments. In addition, determine the relative link loads resulting from this optimal routing scheme.

   (b) Assume now that (instead of optimal routing) the shortest path algorithm with unit weights ($w_j = 1$ for all j) is applied together with the ECMP principle. By modifying the link weights, it is possible to achieve four different maximum values for the relative link loads, namely x, $x/2$, $x/3$ ja $x/4$. Give four different sets of link weights that result in these four different maxima, respectively.