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

Exercise 12
28.4.2005

Problems 2 and 3 are homework exercises. Mark the problems you have solved in the beginning of the exercise class.

1. *Demo*
   Consider the following network with 4 nodes and 10 links. The set of nodes is denoted by $\mathcal{N} = \{\mathrm{a}, \mathrm{b}, \mathrm{c}, \mathrm{d}\}$, and the set of links by $\mathcal{J} = \{1, 2, \dots, 10\}$. The properties of various links are given in the table below (j = link index, n_j = origin node, m_j = destination node, c_j = link capacity).

j	n_j	m_j	c_j
1	a	b	10
2	b	a	10
3	a	c	10
4	c	a	10
5	a	d	10
6	d	a	10
7	b	c	4
8	c	b	4
9	c	d	4
10	d	c	4

   Draw the network topology. What is the number of OD pairs? What is the total number of paths? What is the total number of shortest paths assumed that the links have unit weights ($w_j = 1$ for all j)?

2. *Homework exercise (2 points)*
   Consider still the network specified in the previous problem. The network is loaded by the traffic demands given by the traffic matrix

$$\mathbf{T} = \begin{pmatrix} 0 & 5 & 5 & 5 \\ 5 & 0 & 2 & 2 \\ 5 & 2 & 0 & 2 \\ 5 & 2 & 2 & 0 \end{pmatrix}.$$

   From this information, formulate a Load Balancing Problem given on Slide 25 of Lecture 12, and give the optimal solution with confirming arguments. Determine the link counts resulting from this optimal routing scheme.

3. *Homework exercise (2 points)*
   Consider still the network and traffic specified in the previous problems. Assume now that the shortest path alogorithm with unit weights ($w_j = 1$ for all j) is applied (instead of optimal routing) together with the ECMP principle presented on Slide 17. Determine the link counts resulting from this shortest path routing scheme. In addition, give a better routing scheme achieved by modifying the link weights.