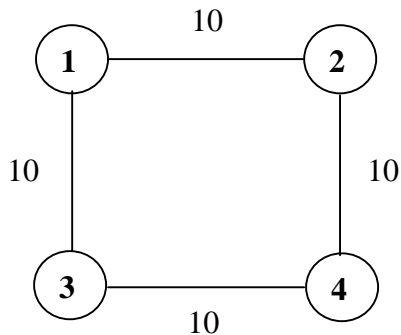


CS-470
Modeling and Simulation
Lab 4
OpNet Modeler

Date: Tuesday, April 23, 2002

Due: Tuesday, May 7, 2002

The purpose of this lab is to test the independence assumption of Kleinrock's Network Delay model. The network we will simulate is shown below:



The traffic matrix for all pair-wise traffic is shown below (in Mbps). When routing traffic between nodes 2 & 3, use node 1 as the intermediate node. When routing traffic between nodes 1 & 4, use node 2 as the intermediate node in the path from source to sink.

	1	2	3	4
1	0	1	2	3
2	1	0	4	5
3	2	4	0	6
4	3	5	6	0

Kleinrock's formula for network delay is as follows:

$$N_D = \frac{1}{\gamma} \sum_{i=1}^m \frac{f_i}{c_i - f_i}$$

The lab is done in two phases. In the first phase, use the Packet Switching tutorials in Opnet to learn how to simulate the actual traffic in the capacitated graph above. Compare your simulated network delay to the analytical result from the equation above. Then, in the second phase, simulate each edge in the network as a separate, independent M/M/1 system (exactly as you did in the last lab) and compute an average packet delay for the network. Compare these results to the results from phase one.