EECS-863 Analysis of Communication Networks
Spring Semester 2008
Project **#3** Due **4:30 pm on Friday 9 May 2008**

This project is on network design. The project goal is to give you an opportunity to try your hand at improving performance by changing topology and routing in addition to finding optimal capacities for each specific topology and routing combination.

We will consider the 5-city network that was handed out as a class example, but we will modify it as follows.

- Keep the 5 cities specified.
- Keep the traffic matrix given.
- Use city-to-city distances given in assignment 12. Here are the other city-to-city distances for you to use as needed: Los Angeles to Chicago is 2034 miles; Los Angeles to New York is 2824 miles; and Denver to New York is 1809 miles.
- For the initial network topology, use a bi-directional ring topology, with bi-directional links between the following pairs of cities (10 uni-directional links in all): L.A. and Denver, Denver and Chicago, Chicago and New York, New York and Houston, Houston and L.A.
- For the initial network routing, use fewest-link routing. Note that with the given topology and this routing, no packet will traverse more than 2 links.
- All arrival processes can be assumed to be Poisson.
- All packet distributions have a mean of 1000 bits (exponentially distributed for analysis models).
- Transmission link cost is 1 dollar per kb/s per mile.
- The design budget is 96,000 dollars for all of the links. This is twice the amount given in assignment 12 because I want you to consider links in both directions between the nodes in this project.
- The performance metric throughout this project will be network-wide mean packet delay.

In part 1, you will do an initial network capacity assignment (similar to what you did on assignment 12). In part 2, you will attempt to improve network performance by changing the network design. There will be significantly more weight (for grading) put on part 2 than on part 1.

There is no specific format for the project report, but it should be complete and professional. The body of the report should be computer generated and printed (no hand-drawn figures or tables). Your report does not need to re-derive or re-state any results that we derived in class, unless stating a result is important to understanding some point that you are making. This should minimize formatting tedium associated with equation editors or their equivalents. You are required to use spreadsheets for your capacity calculations.

The report should include a cover page, an introduction, sections for the two parts, and a conclusion section. The specific organization for each of the two project parts is up to you, but be sure to include brief discussions of your results in addition to just presenting the results.

1. Initial design part: Using the above information, compute the optimal capacity assignments for the initial network design. Also compute the mean packet delay on each link (queuing plus transmission) and the network-wide mean packet delay.

2. Design improvement part: See how much you can reduce the network-wide mean packet delay (while staying within budget) by changing network topology (change only the placement of links: you may not change the placement of the nodes), network routing, and capacity assignments. You do *not* need to follow any formalized optimization procedure (except for the capacity calculations), but you *do* need to explain in your report whatever procedure you used. For example, if it was an iterative process (as it likely will be), explain the reasoning behind each design iteration and report the results obtained for each iteration. It is not likely that each iteration will result in an improvement, and there will not be any grading penalty in such a case, so you should feel free to report on each iteration that you tried and whether or not it resulted in an improvement. In this part, I am more interested in your *approach* (and reasons behind it) than I am in the *results* that you obtain. In other words, if Student X is able to find a lower network-wide mean packet delay than Student Y, but Student Y explains the procedure that he/she used more fully than Student X, then Student Y will get a higher score on this part.