# Homework 1 assignment for ECE374

**Posted: 02/02/15**

**Due: 02/09/15**

**Note:** *In all written assignments, please show as much of your work as you can. Even if you get a wrong answer, you can get partial credit if you show your work. If you make a mistake, it will also help the grader show you where you made a mistake.*

**Problem 1 (10 Points):**

Consider an application that transmits data at a steady rate (for example, the sender generates an *N*-bit unit of data every *k* time units, where *k* is small and fixed). Also, when such an application starts, it will continue running for a relatively long period of time. Answer the following questions, briefly justifying your answer:

a. Would a packet–switched network or a circuit-switched network be more appropriate for this application? Why?
b. Suppose that a packet-switched network is used and the only traffic in this network comes from such applications as described above. Furthermore, assume that the sum of the application data rates is less than the capacities of each and every link. Is some form of congestion control needed? Why?

**Problem 2 (20 Points):**

This elementary problem begins to explore propagation delay and transmission delay, two central concepts in data networking. Consider two hosts, A and B, connected by a single link of rate *R* bps. Suppose that the two hosts are separated by *m* meters, and suppose the propagation speed along the link is *s* meters/sec. Host A is to send a packet of size *L* bits to Host B.

a. Express the propagation delay, $d_{prop}$, in terms of *m* and *s.*
b. Determine the transmission time of the packet, $d_{trans}$, in terms of *L* and *R.*
c. Ignoring processing and queuing delays, obtain an expression for the end-to-end delay.
d. Suppose Host A begins to transmit the packet at time *t=0*. At time $t=d_{trans}$, where is the last bit of the packet?
e. Suppose $d_{prop}$ is greater than $d_{trans}$. At time $t=d_{trans}$, where is the first bit of the packet?
f. Suppose $d_{prop}$ is less than $d_{trans}$. At time $t=d_{trans}$, where is the first bit of the packet?
g. Suppose $s=2*10^9$, *L=1024* bits, and *R=256* kbps. Find the distance *m* so that $d_{prop}$ equals $d_{trans}$.

**Problem 3 (15 Points):**

Consider the circuit-switched network shown in Figure 1. Recall that there are 4 circuits on each link. Label the switches A, B, C, and D starting at the top-left corner, going on clockwise direction.

a. What is the maximum number of simultaneous connections that can be in progress at any one time in this network?
b. Suppose that all connections are between switches A and C. What is the maximum number of simultaneous connections that can be in progress?
c. Suppose we want to make four connections between switches A and C, and another four connections between switches B and D. Can we route these calls through the four links to accomplish all eight connections?

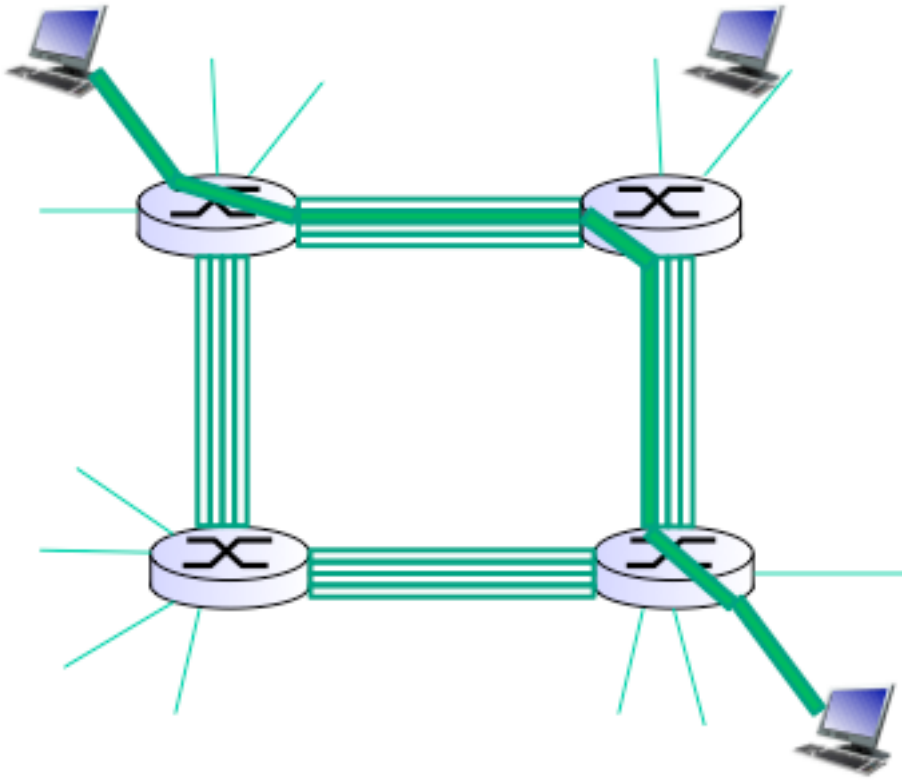

Figure 1

**Problem 4 (25 Points):**
Perform a Traceroute between your computer and *www.ucsd.edu* at three different hours of the day. (Add screenshots of the three Traceroutes to your answer!)

a. Find the average and standard deviation of the round-trip delays at each of the three hours.
b. Find the number of routers in the path at each of the three hours. Did the paths change during any of the hours?
c. Try to identify the number of ISP networks the Traceroute packets pass through from source to destination. Routers with similar names and/or similar IP addresses should be considered as part of the same ISP. In your experiments, do the largest delays occur at peering interfaces between adjacent ISPs?
d. Repeat the above for a destination on a continent different then the source. Compare the intra- and inter-continent results.

**Problem 5 (15 Points):**
Suppose you would like to urgently deliver 400 terabytes of data from Boston to Los Angeles. You have a 10 Gbps dedicated link for data transfer available. Would you prefer to transmit the data via this link or instead use FedEx overnight delivery? Explain.

**Problem 6 (15 Points):**
Suppose there is a 10 Mbps microwave link between a geostationary satellite and its base station on Earth. Every minute the satellite takes a digital photo and send it to the base station. Assume a propagation speed of $2.4 * 10^8$ meters/sec.

a. What is the propagation delay of the link?
b. What is the bandwidth-delay product, $R * d_{prop}$?
c. Let $x$ denote the size of the photo. What is the minimum value of $x$ for the microwave link to be continuously transmitting?