Homework 1 – Whirlwind Intro

Assigned: Tuesday, Sept 2, 2008
Due: Tuesday, Sept 9, 2008 *at the beginning of class*

Review Questions

1. Why is it said that packet switching employs statistical multiplexing? Contrast statistical multiplexing with the multiplexing that takes place in TDM.

2. Suppose users share a 2 Mbps link. Also suppose each user requires 1 Mbps when transmitting, but each user transmits only 30% of the time.

    a. When circuit switching is used, how many users can be supported?

    b. If packet switching is used, can more users be supported than with circuit switching? How?

3. Explain the difference between flow control and congestion control.

4. Explain how packets using datagram routing over a packet-switched network can arrive to the destination in a different order than they were sent.

5. Consider sending a single packet from a source host to a destination host over a fixed route. List the delay components in the end-to-end delay. Which of these delays are constant and which are variable?

6. What are some differences between TCP and UDP? Which is connectionless? Which is connection-oriented?

7. List the five Internet protocol layers (top to bottom).

8. What is the difference between a virus, a worm, and a Trojan horse?

Problems

9. 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 that 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, give 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 (at Host A, in the network, or at Host B)?

10. Suppose two hosts, A and B, are separated by 7,500 kilometers and are connected by a direct link of R = 10 Mbps. Suppose the propagation speed over the link is 2.5×10^8 meters/sec.

    a. Calculate the bandwidth-delay product, $R * d_{prop}$.

    b. Consider sending a file of 500,000 bits from Host A to Host B. Suppose the file is sent continuously as one big message. What is the maximum number of bits that will be in the link at any given time?

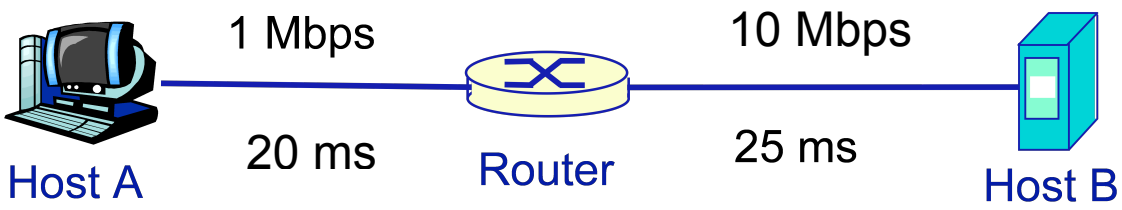
    c. Assuming the file is sent continuously, how long does it take before the receiver has received the entire 500,000-bit file?

11. Perform a `traceroute` between a source and far-away destination at three different hours of the same day.

    a. Give the IP address of the source and the time of day each traceroute was run. Submit a printout of the output of the three traceroutes.

    b. How many routers were in the path at each of the three hours? Did the paths change between any of the hours?

12. Consider the following network. Host A sends a 1500-byte packet to Host B. You may assume that the transmission time for a single bit is 0.



a. Compute the transmission delay of the packet from Host A.

b. Compute the transmission delay of the packet from the router.

c. Assume Host A sends the packet at time 0. When will the *first* bit arrive at Host B? **Hint:** Remember that the network is store-and-forward.

d. Assume Host A sends the packet at time 0. When will the *last* bit arrive at Host B? **Hint:** Remember that the network is store-and-forward.