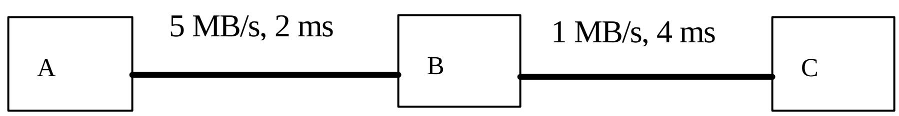
CSE/EE 461
Problem Set #1
Due Date: Thursday, January 31, in section

1. Suppose three computers (A, B, and C) are interconnected by two links as follows (note bandwidths and packet sizes are both given in bytes, not bits, to simplify the arithmetic):



a. How long does it take for A to send a 5KB packet to B so that B fully receives that packet?

b. How long does it take for A to send an 5KB packet to C (via B) and for C to fully receive that packet, assuming that B must receive the entire packet before forwarding it to C (the last bit from A has to arrive at B before B can send the first bit to C -- store and forward)?

c. How long does it take for A to send an 5KB packet to C (via B) and for C to fully receive that packet, assuming the 5KB packet was sent as 10 separate 512 byte chunks, again assuming B is store and forward?

d. Assume now that A sends packets to C continuously (i.e., back to back) at a rate dictated by the link between A and B. Assume B can queue at most 10 packets at any time. How long after A starts blasting packets will B be forced to drop a packet?

2. Suppose you are transmitting a light wave down a multimode fiber. Assume that each 1 is encoded as a pulse of light that splits into two signals, one which goes directly down the center of the fiber, the other that bounces off the walls of the fiber, thereby taking a longer route. Suppose the short route takes 100 nanoseconds and the long route takes 110 nanoseconds. What is the maximum bit rate we can use on the fiber without causing intersymbol interference? What happens if we triple the length of the fiber link?

3. Ethernets use Manchester encoding. Why does this allow for collisions to be detected soon after they occur, without waiting for the CRC to be computed at the end of the packet?

4. Some signalling errors can cause entire ranges of bits in a packet to be overwritten by all 0's or all 1's. Suppose all the bits in the packet including the Internet checksum are overwritten. Could a packet with all 0's or all 1's be a legal IP packet? Will the Internet checksum catch that error? Why or why not?

5. The questions below all concern Ethernet collision detection. Give your answer in terms of physical parameters as appropriate, such as distance (D), bit rate (R) and propagation speed (S).

a) Explain how Ethernet collision detection could fail if it was possible to send packets shorter than the allowed minimum.
b) Suppose station A sees the medium idle and begins transmitting. How long is the interval during which some other station might begin sending and cause a collision? This is also called the time to acquire the medium.
c) Suppose station A sees the medium idle and begins transmitting. How long is the interval during which A might hear of a collision with another station?
d) Give a formula for the minimum frame size required for successful collision detection.
e) Fast Ethernet operates at 100Mbps, ten times as fast as 10Mbps, yet both have the same minimum frame size. Explain how this can be the case.

6. The Internet architecture supports “probe” packets – on receipt of a probe packet, the destination immediately transmits a response to the source. Further, routers will reply immediately back to the source when a packet’s hop count reaches 0. Explain how a source can use the elapsed round-trip time for these probe packets to infer the bandwidth and delay of every link between the source and the destination. (First show how it can be done for the first hop, and then show how it can be done recursively.) Assume the rate and delay are the same in both directions.

7. A problem with many Internet routing protocols is that routing information can be temporarily inconsistent at different points in the network. For each of (i) link state, (ii) traditional distance vector, and (iii) path-based distance vector:

(a) Suppose that A and B are neighbors, but A thinks the cost of the link to B is x, and B thinks the cost to the link to A is y. Will this cause any problems? Explain in terms of an example.

(c) Give a topology in which, due to an inconsistency in the information about a single link, many routes are disrupted. Give a topology in which, despite an inconsistency in the information about a single link, no routes are disrupted.