CS470/570 Fall 2003 NAME_____

570 students must do all 10 problems. 470 students must do problems 1-9. Each problem is worth 10 points (470 students get 10 points free).

No calculators.

Answers will be graded based on accuracy and completeness. If you need extra space to write, make a note on the front and use the back of the sheet.

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1. Define the terms "PAN" and "WAN" in terms of expected number of nodes, range or area covered, and bandwidth.

   See lecture notes

2. List the layers of the ISO OSI model and briefly describe the functionality of each layer.

   See lecture notes

3. Explain the reason (as discussed in class and the text) that a server opens a second socket for a client to communicate through.

   The original connection was made through the "well-known port" for connections to the server. If the entire session was done through this port, there would be no way for other clients to connect. So the session is moved to another port, freeing up the well-know port for other clients.

4. A point-to-point fiber link is 800Km long and has a bandwidth of 160Kbps. For 100-Byte packets, what is the total delay of this link in milliseconds? Ignore Queuing Delay.

   Prop delay = 800×10^3m / 2×10^8 m/s = 4 ms
   Xmit delay = (100B x 8 b/B) / 160×10^3 b/s = 5 ms
   Total = 9 ms

5. A voice modem uses FSK with 16 frequencies. What is the relationship between the Baud rate and the Bit rate for this modem?

   16 frequencies implies 4 bits / frequency, so the Bit rate = 4 x Baud rate.

6. An analog signal is sampled once each millisecond. Each sample is one byte of data. If the sampling is being done according to Nyquist's Theorem, what is the highest frequency in the analog signal? What bandwidth is needed to carry the digitized version of the signal?

   Sampling rate = 1 per 10^{-3}s = 1000/s = 1 kHz.

   This means that 1 kKz = twice the highest frequency, so the highest frequency is 500 Hz.

   Bandwidth = 1000 samples/s x 8 b/sample = 8 Kbps.

7. In class, we discussed a flow control algorithm that we called "Simplex + ACKs + timeouts." We found that this protocol fails when an ACK is lost. Describe what happens when an ACK is lost and what change we made to resolve the problem.

   When an ACK is lost, the sender times out and re-sends the frame. The receiver doesn't know that this is a duplicate of the last frame, so it treats it as a new one – the result is that the frame is duplicated in the receive buffer.

   The change we made was to add a one-bit flag that toggles between 0 and 1 for each frame. This allows the receiver to tell when it has received a duplicate of the last frame.

8. Sketch the basic Ethernet frame format, including the Preamble. Label and show the size of each field. What condition(s) must be met in order to avoid adding Pad bytes to the data field?

   See lecture notes.

9. Imagine that instead of using the Exponential Backoff algorithm, we design an Ethernet so that every time there is a collision (regardless of how many collisions in a row there have been), each node chooses a random number of slot times to wait from the interval 0-100. Discuss advantages and disadvantages of this algorithm with respect to the Exponential Backoff algorithm.

   Advantage: high probability (99%) of resolving the conflict on the first round.

   Disadvantage: # slot times waited for rounds 1-6 is greater than the number waited for the EB algorithm. Almost certainly, this algorithm would take longer to resolve a collision.

10. (570 STUDENTS ONLY)
In "Rethinking the Design of the Internet: The end to end arguments vs. the brave new world," Blumenthal and Clark say that one issue may be the most fundamental change that is transforming the Internet. What is this issue? List several ways in which this issue arises and discuss the ways that it affects the conclusions from Clark's earlier "end-to-end" paper that you read.

The issue is Trust. The paper discusses several ways that this issue arises.

One major affect on the earlier results is that it may not be feasible to move all of the intelligent parts of the network to the edge processing. In order to achieve trusted communication, we may need intelligent nodes inside the network.