PRINT FAMILY NAME:_____

Final Examination

CEN 4500C Computer Network Fundamentals
December 15, 1999

Instructions

1. **READ ALL INSTRUCTIONS.** Failure to follow instructions will result in loss of points.
2. This is a closed-book, 120-minute examination.
3. You may use two 8.5" by 11" sheets of notes for reference.
4. **Answer any FOUR (4) questions, and no more.**
5. Each question is worth fifteen (15) points.
6. Start the answer to each question on a new page (i.e., do **not** put the answer to more than one question on the same page).
7. Show your work. No work, no credit.
8. Assemble your answers in numerical order of the questions when you submit them.
9. **Do not turn the page and start until the proctor tells you to start.**
10. **Leave a 1" square in the upper left corner for a staple.**
11. **Read and sign the following statement.** You may write this on your exam and sign it there if you wish to take the exam questions home with you today. Do not discuss this exam with anyone in this course who has not yet taken this exam.

On my honor, I have neither given nor received unauthorized aid on this examination, and I will not discuss the contents of this examination with any student who has not yet taken this examination.

Signed:
Printed name:

1. (a) (5) Order the following media according to lowest SNR to highest SNR, and explain why you expect that to be the case: UTP, 75 Ohm Coax, 50 Ohm Coax, Ribbon Cable, Optic Fibre, STP.

   (b) (5) Consider the following signaling system, called Orthogonal Frequency Division Multiplexing (OFDM). In this system, some number k of carriers are used in parallel; each carrier is used to send a shift-key modulated signal (usually one of BPSK or QPSK). The sender and receiver can negotiate a subset of the carriers to use for a particular communication session (this is called a tone map). What are the advantages and disadvantages of this system?

   (c) (5) Suppose an OFDM system uses 2 MHz of bandwidth, multiplexed over 20 subbands with a 5 KHz guard band per subband, each using QPSK. What is the maximum raw data rate that this system can achieve? What SNR (in dB) is needed to achieve this? Show your work.

2. (a) (6) What are the three modes of HDLC. Describe each and indicate when each would be used.

   (b) (2) How is the P bit used in HDLC? Why is it used?

   (c) (4) Consider a link with transmission rate 1 Mbps, over which is sent data frames of 250 bytes each (including header, trailer and preamble) with 3-bit sequence numbers using GBN-ARQ. If the velocity of propagation is 2×10^8 m/s, what is the maximum length link for which the protocol utilization is at least 90%?

   (d) (3) Answer the same question for the case in which SR-ARQ is used with 7-bit sequence numbers.

3. (a) (4) What is the difference between a STDM multiplexor/demultiplexor and a TDM switch, if any?

   (b) (3) Consider an ATDM multiplexor whose output link is a T1 line (running at 1.544 Mbps), and whose input lines are all 64 Kbps with average utilization of 10% for each line. Assuming that a traffic intensity (load) of at most 80% gives acceptable buffer size and loss rate combinations for this system, what is the maximum number of input lines that can be accommodated. Assume that multiplexing is done using a one-byte address and a one-byte payload. Show your work.

   (c) (3) Repeat the previous problem but with the output link an OC-1 line (running at 55 Mbps).

   (d) (5) Describe Select and Fast Select: what are they, how are they used, when is one better than the other? Assuming that the data transfer size is L data bits, the size of the header and trailer is the same as an ACK or NAK and is 16 bytes, the propagation delay is τ seconds, and the data rate is R bps, when is Fast Select better than Select? Express your answer as an inequality for the probability p that the secondary is busy.

4. (a) (6) Describe and compare Frame Relay (FR) connection management with ATM connection management.

   (b) (6) Describe and compare ATM transmission over an SDH (SONET) physical layer with transmission of cells over a cell-based (native) physical layer. Discuss synchronization.

   (c) (3) Why is traffic shaping used in addition to reactive congestion control in both FR and ATM?

5. (a) (5) Compare and contrast centralize routing and distributed routing in packet-switched networks.

   (b) (3) Evaluate the use of hop-count as the metric for making routing tables.

   (c) (5) What is the oscillation problem encountered in the second generation ARPANET routing algorithm, why did it arise, and how was it solved in the third generation algorithm?

   (d) (2) Why is a time-to-live counter often included in the network layer header? When would it not be needed?

6. (a) (4) What are the differences between active and passive headend broadband bus LANs?

   (b) (5) Describe the dual bus LAN configuration, and how DQDB manages access to the buses.

   (c) (2) Why are the broadband buses unidirectional?

   (d) (4) What limitation is there on the frame length in CSMA/CD and why?

7. Describe and compare the priority mechanisms of the following: ATM, Token Ring (802.5), FDDI, Ethernet (802.3), 100VG-AnyLAN (802.12).

8. (a) (5) Why is ARC used as the checksum method in IP? Why is only the header checked?

   (b) (6) What are the three main functions of ICMP? Give examples of packet types for each type of function, and include the information sent each way (if two-way communication is used).

   (c) (4) How are ICMP packets sent over a network? How does the receiver know what to do with one when it receives it?

9. (a) (8) What is the 3-way handshake in TCP? How is it used? Why is it needed? Describe it for normal and abnormal operations and show what problems it solves and how it solves them.

   (b) (4) Name the ways in which a TCP connection can be terminated, and describe why and how this is done, including the relevant agents and header bits.

   (c) (3) What is the difference between passive open and active open in TCP?