Given Name Initial: ____ Family Name: _____

CEN 5501C Computer Networks
Examination 1

15 February 2007

Instructions

1. Read all instructions. Failure to follow instructions will result in loss of points.
2. This is a closed-book examination.
3. You are permitted one 8.5 by 11 inch sheet of notes, both sides, which you have prepared.
4. You are permitted 90 minutes to complete this examination.
5. **Do not start** the exam until the proctor has told you to start.
6. **Answer any three (3) questions, and no more**. All questions are of equal value.
7. **Leave sufficient room in the upper left-hand corner for the staple** and staple your answer sheets in the room you have left.
8. 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).
9. Use exactly one page of paper (both sides is OK, or two pages front side only) to hold the answer to each question, and please write legibly.
10. Put the **question number in the top center** of each answer page and label each part of the question answer.
11. Show your work.
12. Include your **family name and page number** in the upper right hand corner of each answer page.
13. **Assemble your answers in numerical order** of the questions when you submit them.
14. Print your family name and first initial in the upper right hand corner of this page, and complete the honor statement affirmation below.

Read and sign the following statement. This page **MUST** be attached to your examination answers and **MUST** be completed to obtain credit for this examination.

On my honor, I have neither given nor received unauthorized aid on this examination.

Signed: _____

Printed Name: _____

UFID: _____-_____

1. (10) Consider network architecture.
   a. (1) What is required for a layer to be considered chained?
   b. (3) Which layers in the OSI are chained layers and which are not?
   c. (6) What are the similarities and distinctions between layer1 switches, layer2 switches, and layer3 switches?

2. (10) Suppose there is a channel with 20 MHz bandwidth. What is the maximum data rate that can be achieved on that channel under each of the following three cases (give an estimate if you do cannot compute a needed function)?
   a. (2) There is no noise but 8 distinct signal elements are used?
   b. (2) There is noise and the signal to noise ratio is 20 dB?
   c. (2) If a link layer protocol uses robust error detection, how can there be errors in a packet that is sent end-to-end using that protocol on each link?
   d. (1) Under what circumstances do these conditions arise?
   e. (3) What can be done about this?

3. (10) Suppose there is a link that has a propagation delay of 3 milliseconds and a data rate of 14 Mbps. Assume the frame header size is 20 bytes, and assume negligible processing time.
   a. (2) What is the number of sequence number bits needed to maximize efficiency using GBN-ARQ on that link if the frames have a payload size of 855 octets?
   b. (2) What is the frame size needed for 3 bits of sequence number to suffice for maximum protocol efficiency using SR-ARQ?

   Now assume the frame payload size is 330 octets and the frame error rate is 5%.
   c. (2) What is the overall efficiency for SR-ARQ?
   d. (2) What is the overall efficiency for GBN-ARQ?
   e. (2) For what error rates will GBN-ARQ be more efficient than SR-ARQ?

4. (10) Consider multicast transmission.
   a. (2) How are IEEE 802 multicast addresses distinguished from regular addresses?
   b. (2) Give a situation in which advertisement is better than solicitation. Justify.
   c. (2) Give a situation in which solicitation is better than advertisement. Justify.
   d. (4) How can a receiver subscribe to more multicast addresses than can be stored in the hardware at one time without causing software processing for every multicast frame?

5. (10) Consider IEEE 802.3 LANs.
   a. (2) Why are there a minimum frame size and a maximum physical LAN diameter?
   b. (2) What is the minimum frame size for 10 Mbps 802.3?
   c. (2) What problem occurred when the data rate increased to 100 Mbps, and how was this problem resolved?
   d. (2) How was the problem resolved for gigabit Ethernet?
   e. (2) How can store-and-forward hubs help with this problem?

6. (10) Consider a source and destination that are K hops apart, with each hop having a packet error rate of P.
   a. (2) What is the probability that a packet is sent successfully over all K hops without error correction on each link?
   b. (3) What is the expected cost for a transmission attempt? (Measure this in number of packet-hops, that is, one packet sent 3 hops costs 3 units.)
   c. (3) What is the expected number of attempts needed to deliver a packet successfully to the destination?
   d. (2) What is the overall cost per successful packet delivery?

7. (10)
   a. (2) What are the advantages of Transparent Bridges (TBs) compared to Source Routing Bridges (SRBs)?
   b. (2) What are the advantages of SRBs compared to TBs?
   c. (2) How is coexistence managed for TBs and SRBs?
   d. (2) How do TB extended LANs cope with bridge failures?
   e. (2) How do SR extended LANs cope with bridge failures?

8. (10) Consider SR extended LANs.
   a. (3) How are routes found by end systems in SR LANs? What is the major disadvantage of this approach? How are loops avoided?
   b. (4) Examples were given for why LAN numbers alone were not enough for a source route in an extended LAN. Could bridge numbers alone suffice (assume they are large enough to be unique for the extended LAN)? Explain.
   c. (3) If only bridge numbers were used, how would SR-data frames have to be processed at each bridge?

9. (10)
   a. (2) What is the difference between a learning hub and a learning bridge, if any?
   b. (2) What negotiations must an intelligent hub perform with the station on a port?
   c. (1) When is half-duplex mode needed?
   d. (2) What are the two methods a hub can use to reduce the input rate on a port when it is overloaded?
   e. (3) What must a hub using cut-through routing do to transfer a 1000-octet frame from a 10 Mbps port to a 100 Mbps port?