COMP3721 – Introduction to Data Communications
Assignment Three – Fall 2008

General Instructions

- You may work with one partner for this assignment. Your partner may be from your set or another full-time CST set.
- You and your partner may discuss any and all details of each question freely. You may also discuss questions in broad terms with others, particularly in lab, but ultimately your answers should show sufficient individuation from others' answers reflecting your work in answering the questions.
- All work submitted is subject to the standards of conduct as specified in BCIT Policy 5002.

Submissions

- This assignment is due Monday, November 17, 2008 by 1230 hrs at the latest. Late assignments will not be accepted.
- Submit you assignment to your **lab instructor's** assignment box in the SW2 connector.
- Your submissions must include a cover page clearly specifying your name, student number and set. If working with a partner, this information should be provided for each partner.

Marking

The assignment consists of 10 questions totaling 50 marks.

1. Given the generator polynomial x^4+x^1+1,
    a. Show the transmitted codeword (data plus CRC) for the message 110111101110101. *[3 marks]*
    b. During propagation, the error 0000100000100000000 is introduced by the channel. Is the error detected or not? Show the receiver's calculation to substantiate your answer. *[2 marks]*

2. Calculate the 16-bit Internet checksum for the following data block: A01D, F0E3, 1246, 222B. *[5 marks]*

2. Ethernet uses CSMA/CD for media access.
    a. Explain the purpose of the CSMA/CD protocol, or more generally, media access.
    b. Consider the effectiveness of this protocol as more and more nodes are added to the network. What limits exists in terms of the number of nodes attached to a single Ethernet LAN? How can these limits be overcome?

3. Consider a reliable sliding window protocol where frame numbers are represented by *n* bits. For Go-Back-N ARQ, the sending windows size (SWS) must be strictly less than 2^n. For Selective Repeat, the SWS must be less than or equal to 2^{n-1}. Show a worst-case scenario (in terms of window positioning) for each ARQ strategy and how the above rules above ensure the no overlap of frame numbers.

4. Suppose that 80 percent of the traffic generated in the LAN is for stations in the LAN, and 20 percent is for stations outside the LAN. Is an Ethernet Hub preferable to an Ethernet switch? Does the answer change if the percentages are reversed?

5. A 5000-km long, full-duplex T1-trunk is used to transmit 128-byte frames using the go-back-n sliding window protocol. If the propagation speed is 6 microseconds/km, how many bits should the sequence numbers be? Repeat the calculation for selective-repeat? Assume ACKs are piggybacked, frames are always ready to be transmitted over the reverse channel and are also 128-bytes in size.

6. Two neighboring nodes (A and B) use a sliding window protocol with a 3-bit sequence number. As the ARQ mechanism, Go-Back-N is used with a window size of 4. Assume A is transmitting and B is receiving, show the window positions (for sender and receiver) for the following succession of events:
    a. before A sends any frames
    b. after A sends frames 0, 1, 2 and B acknowledges 0, 1 and the ACKS are received by A
    c. after A sends frames 3, 4, and 5 and B acknowledges 4 and the ACK is received by A

7. What role does the MAC address play in the delivery of a frame? Is it necessary if the link is multi-point? What if the link is point-to-point?

8. A primary responsibility of the data link layer is to provide reliable delivery of a frame over a link. Why then is inter-network delivery of a packet (the primary network-layer service) not already reliable? Stated otherwise, why must the transport layer be added to provide reliable end-to-end packet delivery?

9. Two stations wish to communicate over a network. There are 4 hops required to get from station to station. The data rate on all links is 1.544 Mbps. Message length is 8192 bits. If packet switching is used, each packet size is 1024 bits which includes 16 header bits. Call setup time is 0.25 seconds. Propagation delay per hop is 1 msec. Calculate the total end-to-end delay for:

a. Circuit switching
b. Message switching
c. Packet switching

Assume no buffering delay at the nodes. Use the following variable names for deriving your delay equations:

N : # of hops between two given stations.
L : Message length in bits.
B : Data rate, in bps, on all links.
P : Packet size in bits.
H : Overhead (header) in bits.
S : Call setup time (CS or VC) in sec's.
D : Propagation delay/hop in sec's.