CMPUT 313 Midterm Exam [Harms]
October 17, 2000
Closed Book

Comments:

- This exam is worth 22% of your final grade. There are 5 questions and 2 pages. The mark distribution is given beside the questions. The total number of marks is 40.

- This is closed book exam. Calculators are allowed but not necessary. For mathematical results, it is sufficient to just set up the equations.

- If you are concerned about an interpretation of an exam question, state your assumptions and then answer the question.

- Be sure to show your work! Good Luck!

(4 marks) Question 1.

Describe the responsibilities of each of following layers: physical, data link and medium access control. Place the following protocols in the appropriate layer: HDLC, PPP.
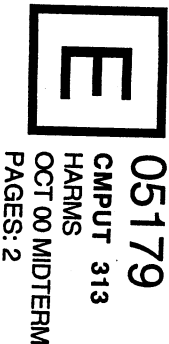
(10 marks) Question 2.

Suppose that a node receives the bits 110101000110.

a) If bit errors occur independently with probability p, what is the probability that there is exactly 1 bit error in this series of bits?

b) suppose this series of bits contains message bits and check bits produced by Hamming's single bit error correcting cod. Also suppose that at most 1 error could occur. Was there a bit error? If so, which bit? What are the message (data) bits? Show your work.

c) suppose instead that this series of bits contains message bits and the check bits produced by a cyclic redundancy code with generator 1010. Will an error be detected? What are the message bits that were transmitted by the sender? Discuss the effectiveness of this generator polynomial.

(4 marks) Question 3.

Suppose that slotted ALOHA is used for medium access control. If 2 stations have frames to send and collide in the current slot, what is the probability that when these stations transmit these frames again, they will collide again? Assume that for the backoff algorithm, each station chooses to retransmit in one of the next three slots (chosen with equal probability). Assume that there are no other frames to be sent in the system. Show your work.

(14 marks) Question 4.

Consider the following sliding window data link layer protocol:

-- a maximum sender window of 4 frames and a receiver window of 4 frames; sequence numbers range from 0 to 7.

-- assume error detection is used. If a frame (or ACK) is in error, it is discarded. The receiver will not send out ACKs until the missing frame arrives. NAKs are not used. Timeouts are 0.01 seconds.

-- ACKs are cumulative. That is, ACK(N) acknowledges receipt of frame N and all frames transmitted earlier by the sender.

-- the bit rate of the link is 10 Mbps (10×10^6 bps); the propagation delay of the link is 0.003 seconds (1 way).

-- to simplify things assume that all frames are 10,000 bits.

a) How much time will it take for frame 0 to be transmitted and its ACK to be received? Assume no errors occur and ignore the time to transmit the ACK and the processing time at sender and receiver. Will the protocol be able to transmit continuously if no errors occur? Show your work.

b) Using a diagram and keeping accuracy based on the above timing information, show the behaviour of the protocol for the following series of events:

-- the protocol starts by transmitting frame 0

-- frame 0, 1, 2 and 3 are transmitted without error but frame 4 has an error. After this all frames are transmitted without error.

-- ACK 0 and 1 are transmitted without error but ACK 2 has an error. After this all ACKs are delivered without error.

-- the sender has only 10 frames to send

What is the elapsed time from the start of transmitting frame 0 to the receipt of the ACK for the last frame?

(8 marks) Question 5.

Slots are used in several of the MAC layer protocols.

a) Explain how slots are used in Slotted ALOHA and describe why the use of slots improves throughput over Pure ALOHA.

b) Describe the ways that the slot is used in Ethernet. Explain why the slot is of length approximately equal to the round trip time on the transmission medium.

c) Describe the use of the slot in the Adaptive Tree Walk Protocol.