COLLEGE OF ENGINEERING & TECHNOLOGY

Department: Computer Engineering

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Course: Final Exam. (Computer Networks 1)

Course No. CC512

Date: January, 2003 **Time:** 120 minutes **Grade:** 40

Answer only five of the following problems:

Problem (1):

Consider a slotted ALOHA network with 200 stations. Let p = 0.01 and $\alpha = 0.01$.

(One) Plot the equilibrium throughput curve and load line.

(Two) Discuss the cases that arise when the load line slope is varied so that it becomes tangential to the throughput curve at two different locations. Assume that the load line intersection with the backlogged stations axis remains the same in all cases.

(Three) Find the sensitivity of the throughput with respect to fluctuations in number of backlogged stations when these are equal to 10 stations.

Hint: for large N and small p take

$$S_{out,k} = k\,\alpha\,(1-\alpha)^{k-1}\,e^{-S} + (1-\alpha)^{k}\,S\,e^{-S},$$

$$S_{enter} = (N-k)\,p$$

Problem 2:

A four-channel FDM system is to be implemented using the following design strategy: channel 1 will be retained at base band, a guard band equal to 25 percent of the band width of channel 1 will be retained directly between the upper edge of channel 1 and the lower edge of channel 2. Similarly, a guard band equal to 25 percent of the bandwidth of channel 2will be maintained between the upper edge of channel 2 and the lower edge of channel 3, and so on.

(a) Draw a spectral diagram for the composite baseband spectrum, label the frequencies where the channels begin and end, and compute the transmission band width for four data channels each having 5 kHz band width.

Problem 3:

(3.1) Using Hamming error detection and correction code, find the transmitted code of character C of ASCII 67decimal. Find also the code rate in this case.

(3.2) Discuss, with schematics the following:

- Carrier-sense multiple access with collision detection CSMA/CD.
- TCP/IP layered architecture.

Problem 4:

(a) Show that the Channel Utilization factor (U) for an HDLC and Positive Acknowledgment Retransmission (PAR) protocol is given by:

$$U = D/\{[L/(1-L)](F + CT) + (F + A + 2CT)\}, \text{ where}$$

D = data in bits/frame, L = probability of lost or damaged frame ($L = 1 - (1- p_1)(1- p_2)$), p_1 = prob. Of lost frame, p_2 = prob. of damaged frame, F = frame length in bits, C = channel capacity in bps, I = propagation delay + message processing time in sec., A = number of bits in ACK frame, and T is the time out period.

(b) Find the largest data transfer efficiency that is possible for error-free channels.

(c) The channel utilization factor for a noisy channel.

(d) If the bit error rate in case (c) is one bit in every 100 000 bits, find the optimum data size and maximum frame length. Make any necessary assumptions.

Take: the error rate for data frames to be 2%, and for positive acknowledgement frames is 1%, the time out period to be equal to 50 ms. The channel capacity is 20 kbps, and the propagation delay is 10 ms.

Problem 5:
Given that the ASCII hexadecimal code for character C is 43, Sketch the NRZ-I, and differential Manchester data format for this character.

Problem 6:
6.1 Using the time sequence diagram explain the stop-and-wait ARQ protocol. Discuss some of the shortcomings of this protocol.
6.2 In this ARQ protocol $t_T = t_f + 2t_{prop}$ and the efficiency is defined as t_f/t_T.
If this efficiency is at least 50%, and the data is sent at 2 Mb/s over a transmission line wherein the propagation delay is 3.5 μs, find the range of frame size in the absence of errors.

Problem 7:

Explain using schematics whenever possible:

- Synchronous and asynchronous communications.
- Two different retransmission protocols with governing equations.
- Transfer rate of information bits and code rate.
- TCP/IP model versus ISO/OSI layered architecture.
- HDLC and LAPB frame formats.
- X-25 specifications
- HDLC frame format.
- Go-back N ARQ protocol.