CS 536 (Park) **Assignment II** **Due: Sep. 12 (Fri.), 1997**

PROBLEM 1

Read Chapt. 3 (pp. 88–121) from P & D. Read "Requirements for success in gigabit networking" by Samir Chatterjee (*Commun. ACM*, 40(7):64–73, 1997). Give a 1-page summary of the latter. Include your own viewpoints on whether you agree with the conclusions put forth in the paper.

PROBLEM 2

(a) Assume the following bandwidth/data rate combinations for the transmission media *twisted pair* (copper wire), *coaxial cable* (also copper), and *optical fiber*, respectively: 4 Mbps/3 MHz, 500 Mbps/350 MHz, 2 Gbps/2 GHz. Assuming these depict numbers close to the fundamental limitation imposed by Shannon's 2nd Theorem (Channel Coding Theorem), estimate the signal-to-noise ratio underlying the three combinations. What are the corresponding minimal sampling rates? Does the latter have any meaning in the context of data transmission? Explain your reasoning.

(b) We computed that assuming a telephone line has bandwidth capacity near 4 kHz and is subject to noise captured by a 30 dB signal-to-noise ratio (SNR), the maximum data rate achievable is around 30 kbps. Assuming a "reputable" manufaturer of telephone line modems claims their product is able to achieve a data rate of 100 kbps, how is this possible? The manufacturer's modem is specified to operate under regular telephone line conditions (4 kHz bandwidth and 30 dB SNR).

Assuming you have found an answer, describe a particular solution (i.e., algorithm operating in the modems) which is able to achieve higher rates than 30 kbps. State what, if any, additional assumptions you have made. Under what conditions is the manufacturer's claim false?

PROBLEM 3

(a) Assume you are asked to improve upon the notion of TDM by designing a version called *statistical* TDM (STDM) which operates like TDM except that now user A is allowed to "steal" user B's slot in the same frame if B is not using it. If a frame contains 16 slots, each slot encodes 8 bits of information, frames are transferred at the rate of 3000 frames per second, and up to 16 users are allowed to share the STDM channel at the same time, what is the maximum data rate (in bps) achievable noting that the *identity* of the user must now be specified on *every* slot? Sketch the multiplexing and demultiplexing procedures needed for this scheme.

(b) As a continuation of (a), if the behavior of the users in the pure TDM case were such that all 16 sources had data to transmit at every frame, what is the drop in performance (in %) as a result moving to STDM?

Describe a set-up (i.e., source behavior etc.) where an improvement in performance is achieved by going from TDM to STDM. Calculate the performance improvement (in %).

PROBLEM 4

Exercises from P & D: 1.12, 1.15