CS 536 (Park) **Assignment III** **Due: Sep. 12 (Thu.), 1996**

PROBLEM 1

(a) Read the remainder of Chapt. 3 from P & D.

(b) Give a 3-page summary overview of the following aspects of UNIX system programming: introduction, file I/O (`open`, `read`, `write`, `dup`, `stat`, `chmod`), and process control (`fork`, `exit`, `waitpid`, `exec`-family, `getpid`). Spend 1 page on the introduction, giving your interpretation of what UNIX system programming is, and making precise what *system calls* are and how they differ from regular function calls. Organize your description around the main system calls (a subset is indicated in parenthesis).

PROBLEM 2

(a) Recall the TDM organization of a T1 link discussed in class. How was the bandwidth of 1.544Mbps arrived at? What aspect (i.e., variables used) in the set-up was arbitrary from a design point-of-view? What is the time duration of single channel (or slot)?

(b) Assume you are starting a business as a telecommunication service provider and your motto is: "super-fidelity" sound. In particular, you want to provide voice bandwidth up to 16kHz. Assuming TDM is your data transfer technology and you want to be able to carry 100 conversations simultaneously, give a concise description of your set-up and calculate the resultant bandwidth. You may assume that 16-bit quantization is being used. What is the time duration of a single channel in your scheme?

(c) Assume you are given a transmission medium of length ℓ which has the property that its signal-to-noise ratio (in decibels) is given by the formula $10 \log_{10} \ell$ dB. If your medium has a bandwidth specification of 16kHz and you want to support a data rate of x bps, what is the maximum distance that you can possibly cover?

PROBLEM 3

Problem 3.7, 3.8 from P & D.

PROBLEM 4 (This problem is due in two weeks.)

Assume you are asked to design the data link portion of a network simulator, call it *mysim*. Based upon your knowledge thus far, propose a design of *mysim*. Assume that events occur at the granularity of 1μsec, and you only need to worry about a point-to-point link between two hosts. Also, assume that the data link protocol format is something akin to HDLC but with a fixed-size payload. Identify the main variables of interest (e.g., link bandwidth, link latency, etc.) and give a procedural description of your simulation program from the time a "frame" or "packet" is processed at the source to the time it is received at the destination. Your design must be sufficiently well-thought-through such that if needed, it can be implemented as a C program. Try to modularize your design as best as you can. Your description must be clear and concrete, however, a pseudo-code formulation is not required.

PROBLEM 5

This is an extension of Problem 2 (b), Assignment II. Assume the same set-up as before except that now buffer capacity is 1. That is, whenever two packets arrive at the link at the same time and the buffer is empty, then one of them can be stored in the buffer for later use. A direct consequence is that if the buffer is full and two packets are arriving, then one packet must still be dropped. For convenience, let us assume that time increases by 1 (msec) and events occur at 1ms intervals too.

(a) Let $B(t)$ denote the buffer size at time t where $B(t) \in \{0, 1\}$. Assuming initial condition $B(0) = 0$, compute the (average) utilization at time 1, $\rho(1)$, and the average buffer size at time 1, $\mathbf{E}(B(1))$.

(b) Find a recursive expression of $\mathbf{P}(B(t+1) = 1)$ in terms of $\mathbf{P}(B(t) = 1)$. Express $\rho(t)$ as a function of $B(t)$. Explain, in your own words, why the problem has become a little more complicated than in Problem 2 (b) of Assignment II.

(c) Solve the recurrence for $\mathbf{P}(B(t+1) = 1)$ in part (b). Is $\mathbf{P}(B(t) = 1)$ a changing function of time? Give a closed-form solution for $\rho(t)$. Can we claim to understand this system completely?

Hint: Everything in Problem 5 can be solved from first principles; i.e., no specialized knowledge is needed.