CS 536 (Park) **Assignment I** **Due: Sep. 11 (Fri.), 1998**

PROBLEM 1

Read Chapt. 1 from Peterson & Davie (henceforth, P & D).

PROBLEM 2

Explain the motivation and principal driving factors behind the "evolution" of networking from TDM (time-division multiplexing) to packet switching to ATM networks. Why, in your opinion, is the transition going on now?

PROBLEM 3

(a) We occasionally make the analogy between networks and road systems including highways. Based on our discussion and present understanding of networks, list their commonalities and differences.

(b) Give a description of packet switching, circuit switching, and ATM in the framework and language of road systems. What about TDM? Is there a descriptive correspondence for TDM?

PROBLEM 4

(a) Consider the expression for message delay given by $d(M) = D_P + D_T(M) + D_Q(M, \mathcal{S})$ where D_P is the propagation time, D_T is the transmission time, and D_Q is the queueing delay. The *reliable message transmission completion time* of M is defined as the time interval between the transmission of the first bit of M at the sender and the receipt of the last bit of M at the receiver. What is the completion time when M is sent as a single packet? What is the expression for completion time when M is sent as a sequence of k packets each (except, possibly, for the last one) of size $\lceil M/k \rceil$ bits?

(b) As a continuation of part (a), why is the assumption of infinite buffer capacity at routers (if any) crucial for the expressions to hold? If not, what additional complication arises and why is it difficult to handle?

PROBLEM 5

Assume we have a point-to-point link and the task at hand is to transmit a sequence of k packets of equal size s bits reliably across the link. Assume that a packet gets corrupted while in transmission on the link with probability ε. Furthermore, assume that the corruption events are independent.

Assume that ARQ is used to achieve reliability over the unreliable medium. Let B (bps) be the bandwidth of the point-to-point link and let L be its link latency (sec). Assume that positive ACK packets (also of size s) are used to acknowledge the receipt of data packets by the receiver. The sender retransmits a packet if an ACK is not received within a single round trip time (RTT) which is the sum of the link latencies and transmission times over both directions.

First, for the special case when $\varepsilon = 0$, compute the utilization of the link when using the above retransmission scheme (assume k is infinite). Compute the utilization for the general case $\varepsilon \geq 0$. What is the expected completion time of sending k packets reliably across the channel? What is the expected total number of packets that would need to be sent to transmit k data packets reliably?