PRINCE OF SONGKLA UNIVERSITY
FACULTY OF ENGINEERING

Midterm Examination: Semester II — Academic Year: 2010
Date: December 19, 2010 — Time: 13.30-16.30
Subject: 210-555 Modern Communication Networks — Room: R201

Instructions:
Allow a student to use his/her own calculator and dictionary.

Attempt all four problems

1. Define the following parameters for a switching network:
   N: number of hops between two given end systems
   L: message length, in bits
   B: transmission rate, in bits per second, on all links
   P: packet size, in bits
   H: overhead (header) bits per packet
   S: call setup time (circuit switching), in seconds
   D: propagation delay per hop, in seconds

   Assume that there is no acknowledgment. Derive general expressions of end-to-end delay for
   a. circuit switching
   b. packet switching

(20 points)

2. One is given a communication link that can transmit 10 kbps. The objective is to transmit a file of *B* bits. The bits are sent in packets of *P* bits. Each packet contains 16 extra bits which are used for error control. Two packets must be separated by at least 10 ms.
   a. Find the total time taken to transmit the file as a function of *P* and *B*.
   b. Assume that a packet may be in error with probability *E*. Find the total time taken to transmit the file as a function of *P*, *B*, and *E*.

(20 points)

3. Consider a window flow control packet switching going over a terrestrial link followed by a satellite link. We assume the following:
   - The transmission time on the terrestrial link is 20 ms and the processing and propagation delays are negligible,
   - The round-trip processing time and propagation delay on the satellite link is 0.5 sec,
   - All packets have a transmission time of 5 ms, and
   - The transmission time of an acknowledgement is negligible.

a. What is the maximum transmission rate in packets per second that can be attained for this connection assuming no flow control?
b. Find a lower bound to an end-to-end window size that will allow maximum transmission rate assuming no other traffic on the links.
c. Does it make a difference whether the terrestrial link is before or after the satellite link?

(20 points)

4. Consider a time-division multiplexer multiplexing data packets from four sources onto a shared output line as shown in Figure 1. Let all data packets have the same fixed size (i.e. a constant number of bits in a packet). If exactly one packet arrives at each of the four inputs every second, the multiplexer must have an output rate of at least 4 packets per second, and each input buffers at most one packet. Because a packet has to wait for at most three other packets to be transmitted, a source would have a queueing delay of at most three packet service times. **Now, assume that packets arrive in bursts**, where each burst has 10 packets evenly spaced 1 second apart, corresponding to a peak rate of 1 packet per second. Let the mean interval between the end of a burst and the start of the next burst be 100 seconds, so that the average rate is 0.09 packets per second (10 packets arrive every 110 seconds).

a. What should be the speed of the output line when the traffic is bursty?
b. Discuss tradeoff occurring from setting speed of the output line
   i. lower than your answer in a.
   ii. higher than your answer in a.

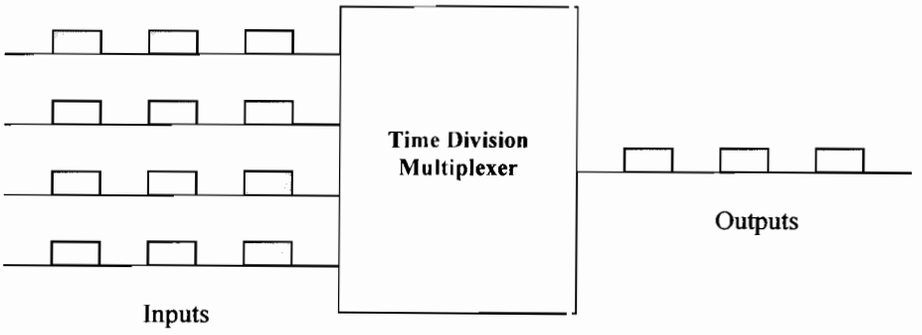

Figure 1 Time Division Multiplexer

(20 points)