

CS118 Homework 1 Due: Apr.9, 2014 Wednesday

1. What are network protocols? Please write down the definition of network protocols.
2. Tell the following statements true or false.
  - ( ) End systems are just hosts. There are no differences between the two terms.
  - ( ) In packet switching transmissions, bandwidth is divided into pieces and each packet uses one or several pieces of bandwidth.
  - ( ) Full buffer is the only reason that causes packet loss.
3. Consider an application that transmits data at a steady rate (e.g., the sender generates an  $N$ -bit unit of data every  $k$  time units, where  $k$  is small and fixed). Also, when such an application starts, it will continue running for a relatively long period of time. Answer the following questions, briefly justifying your answers:
  - (a) Would a packet-switched network or a circuit-switched network be more appropriate for this application? Why?
  - (b) Suppose that a packet-switched network is used and the only traffic in this network comes from such applications described above. Furthermore, assume that the sum of the application data rates is less than the capacities of each and every link. Is some form of congestion control needed? Why?
4. Suppose  $N$  packets arrive simultaneously to a link at which no packets are currently being transmitted or queued. Each packet is of length  $L$  and the link has transmission rate  $R$ . What is the average queuing delay for the  $N$  packets?
5. Suppose users share a 1 Mbps link. Also suppose each user requires 100kbps when transmitting, but each user transmits only 10 percent of the time. (See the discussion of statistical multiplexing in Section 1.3.)
  - (a) When circuit switching is used, how many users can be supported?
  - (b) For the remainder of the problem, suppose packets switching is used. Find the probability that a given user is transmitting.
  - (c) Suppose there are 40 users. Find the probability that at any given time, exactly  $n$  users are transmitting simultaneously. (Hint: Use the binomial distribution.)
  - (d) Find the probability that there are 11 or more users transmitting simultaneously.