

Computer Networks

Spring 2002

Assignment 1

Problem 1 (4 points):

Design an application-level protocol to be used between an automatic teller machine and a bank's centralized computer. Your protocol should allow a user's card and password to be verified, the account balance (which is maintained at the centralized computer) to be queried, and an account withdrawal to be made (that is, money disbursed to the user). Your protocol entities should be able to handle the case in which there is not enough money in the account to cover the withdrawal. First, specify your protocol by listing and explaining all messages (commands and their parameters) from the ATM machine to the server and the server to the ATM machine necessary to perform the operations above. Sketch the operation of your protocol for the case of a simple withdrawal with no errors and for the case that there is not enough money.

Problem 2 (2 points):

Consider an application that transmits data at a steady rate (for example, the sender generates a N -bit unit of data every k time units, where k is small and fixed). Also, when such an application starts, it will stay on for a relatively long period of time. Answer the following questions, briefly justifying your answer:

- (a) Would a packet-switched network or a circuit-switched network be more appropriate for this application? Why?
- (b) Suppose that a packet-switching network is used and the only traffic in this network comes from such applications as 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?

Problem 3 (4 points):

Consider sending a file of $F = M \cdot L$ bits over a path of Q links. Each link transmits R bps. The network is lightly loaded so that there are no queuing delays. When a form of packet switching is used, the $M \cdot L$ bits are broken up into M packets, each packet with L bits. Propagation delay is negligible.

- (a) Suppose the network is a packet-switched virtual circuit network. Denote the VC set-up time by t_s seconds. Suppose the sending layers add a total of h bits of header to each packet. How long does it take to send the file from source to destination?

- (b) Suppose the network is a packet-switched datagram network and a connectionless service is used. Now suppose each packet has $2h$ bits of header. How long does it take to send the file?
- (c) Repeat (b), but assume message switching is used (that is, $2h$ bits are added to the message, and the message is not segmented).
- (d) Finally, suppose that the network is a circuit-switched network. Further suppose that the transmission rate of the circuit between source and destination is R bps. Assuming t_s set-up time and h bits of header appended to the entire file, how long does it take to send the file?