Course: Computer Networks I

Assignment #3: Peer to Peer Protocols - Error Control Protocols

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1. Explain the difference between connectionless unacknowledged service and connectionless acknowledged service. How do the protocols that provide these services differ?
2. Suppose that the two end-systems α and β in Figure 1 communicate over a connection-oriented packet network. Suppose that station α sends a 10-kilobyte message to station β and that all packets are restricted to be 1000 bytes (neglect headers); assume that each packet can be accommodated in a data link frame. For each of the links, let p be the probability that a frame incurs errors during transmission.
   a. Suppose that the data link control just transfers frames and does not implement error control. Find the probability that the *message* arrives without errors at station β.
   b. Suppose that error recovery is carried out end to end and that if there are any errors, the entire message is retransmitted. How many times does the message have to be retransmitted on average?
   c. Suppose that the error recovery is carried out end to end on a packet-by-packet basis. What is the total number of packet transmissions required to transfer the entire message?

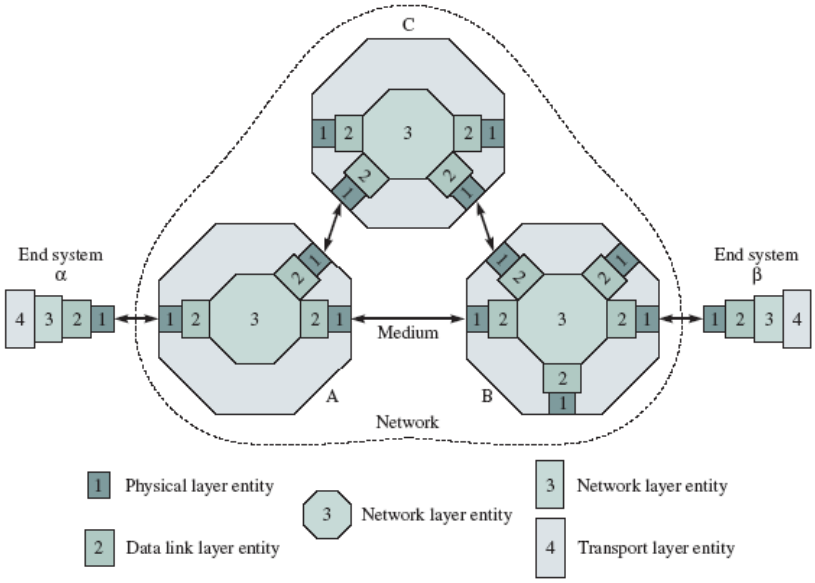

Figure 1

3. Discuss the merits of the end-to-end vs. hop-by-hop approaches to providing a constant transfer delay for information transferred from a sending end system to a receiving end system.
4. The Trivial File Transfer Protocol (RFC 1350) is an application layer protocol that uses the Stop-and-Wait protocol. To transfer a file from a server to a client, the server breaks the file into blocks of 512 bytes and sends these blocks to the client using Stop-and-Wait ARQ. Find the efficiency in transmitting a 1 MB file over a 10 Mbps Ethernet LAN that has a diameter of 300 meters. Assume the transmissions are error free and that each packet has 60 bytes of header attached.

5. Consider a bidirectional link that uses Selective Repeat ARQ with a window size of $N = 4$. Suppose that all frames are one unit long and use a time-out value of 2. Assume that the one-way propagation delay is 0.5 time unit, the processing times are negligible, and the ACK timer is one unit long. Assuming station A and B begin with their sequence numbers set to zero, show the pattern of transmissions and associated state transitions for the following sequences of events:
   a. Station A sends six frames in a row, starting at $t = 0$. All frames are received correctly.
   b. Station A sends six frame in a row, starting at $t = 0$. All frames are received correctly, except frame 3 is lost.
6. A channel has a bit rate of 4 kbps and a propagation delay of 20 msec. For what range of frame sizes does stop-and-wait give an efficiency of at least 50 percent?
7. A 3000-km-long T1 trunk is used to transmit 64-byte frames using protocol Go back n. If the propagation speed is 6 μsec/km, how many bits should the sequence numbers be?
8. In protocol selective repeat, when a data frame arrives, a check is made to see if the sequence number differs from the one expected and no_nak is true. If both conditions hold, a NAK is sent. Otherwise, the auxiliary timer is started. Suppose that the else clause were omitted. Would this change affect the protocol's correctness?
9. Frames of 1000 bits are sent over a 1-Mbps channel using a geostationary satellite whose propagation time from the earth is 270 msec. Acknowledgements are always piggybacked onto data frames. The headers are very short. Three-bit sequence numbers are used. What is the maximum achievable channel utilization for a. (a) Stop-and-wait. b. (b) Protocol Go back n. c. (c) Protocol Selective Repeat.