CS 162 Section 8

True/False:

1. TCP guarantees reliable, in--order, and at most once delivery.
   True.
2. It is possible to solve the Two Generals Problem with certainty over a lossy channel.
   False
3. One computer can only have one network card.
   False: may have multiple, e.g. one card for wired network, and one for wireless network.
4. All hosts in a LAN can share same physical communication media.
   True.
5. BSD Socket API was created at Stanfurd.
   False. At Berkeley in 1980.

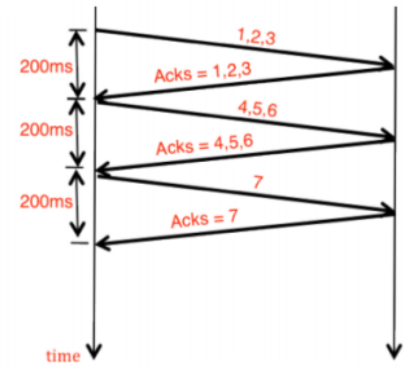
Short Answer:

1. What are the 5 layers of networking? Briefly describe each one.
   1. Physical: send bits
   2. Datalink: Connect two hosts on same physical media
   3. Network: Connect two hosts in a wide area network
   4. Transport: Connect two processes on (remote) hosts
   5. Applications: Enable applications running on remote hosts to interact
2. What are the drawbacks of layering?
   - Layering can hurt performance. e.g. hiding details about what is really going on
   - Headers start to get really big
   - Sometimes header byte size >> content size
   - Layer N may duplicate layer N--1 functionality. e.g., error recovery to retransmit lost data
   - Layers may need same information. e.g., timestamps, maximum transmission unit size

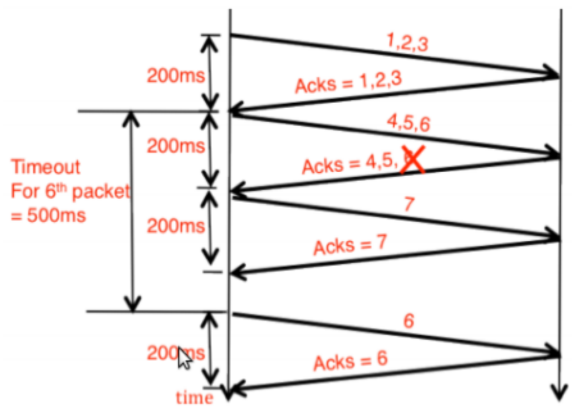
Long answer:

Assume two end-hosts using the sliding window protocol to implement flow control, and Selective Repeat to implement reliability. Assume sender sends 7 packets. The window size at the receiver is 3 packets, the round-trip time is 200ms, and the retransmission timeout is 500ms. The transmission time of the packet is negligible, i.e., assume the size of a packet is 0. The time to send all packets is the interval between the time the sender sends the first packet and the time the sender receives the ack from the last packet.

1. How long does it take to send all packets, assuming no losses? Draw the time diagram.
   600 ms

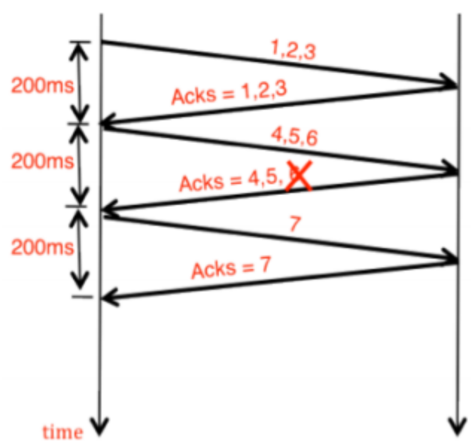


2. How long does it take to send all packets assuming the ack of the 6th packet is lost? Draw the time diagram.
   900 ms



Alternate answer (using cumulative acks): ??

600 ms



5. (16 points) Networking.

a. (4 points) Consider a TCP network connection with packet size 1000 bytes, and current receiver advertised window size of 100 packets, over a cross-country link with one-way latency (for a 0-byte packet) of 50 milliseconds in each direction, and a link bandwidth of 100 Mbit/second. You may assume that no packets are lost for this particular problem, and that the times to assemble, unpack and process packets at each end of the connection are negligible.

How long does it take TCP to transmit 1 million bytes across the link? That is, how much time elapses from when the first byte is sent by the sender to when the sender *knows* that the receiver has received the last byte?

A TCP transmission window size of 100 packets implies that the sender can send 100 packets before having to wait for an ACK message from the receiver that will allow it to continue sending again. Then the sequence for messages sent is:

1. *100 packets from sender to receiver: requires 50 ms for first packet to get there and another 800kb/(100 Mbpst) = 8 ms for the rest of the 100 packets to get there after that.*
2. *Sender stalls waiting for ACK.*
3. *ACK msg from receiver to sender sent at t=50ms from start: requires 50 ms to get there, now 100ms from time first packet was sent. Note that transmission does not stall for ACKs for the other packets (these should come "just in time" if there is no loss).*
4. *At t=100ms sender receives first ACK and sends next packet. The next 99 ACKs should arrive just in time and the sender should send the next 99 packets without stalling.*

Sending 1M bytes will require 10 round trips of this kind, plus the time to receive the acknowledgements for the last 99 packets in the last round.

*The total time required is: 10 * (2 * 50 ms) + 99 * (1000 * 8 / 100 Mb/sec) ~ 1,008 ms = 1.008 seconds*

-2 points for missing the time to transmit 1000 bytes -2 points for using one-way latency rather than round-trip-time (RTT) -1 for adding the window transmission time every round instead of only at the end (would give answers like 1.08 seconds).

b. (4 points) Assume that the receiver can process incoming data with zero latency, what is the optimal window size that the receiver should advertise?
The optimal window size will keep the "pipe" full during the time it takes for data to arrive at the receiver and the ACK to arrive back at the sender. Thus, the receiver should advertise the Bandwidth Delay Product:
(2 x 50 milliseconds x 100 Mbit/s) = 10 Mbits or 1.25 Mbytes, or 1250 packets.
-1 point for using the one-way latency rather than RTT -2 points for no justification and specifying any window larger than 1.25Mbytes