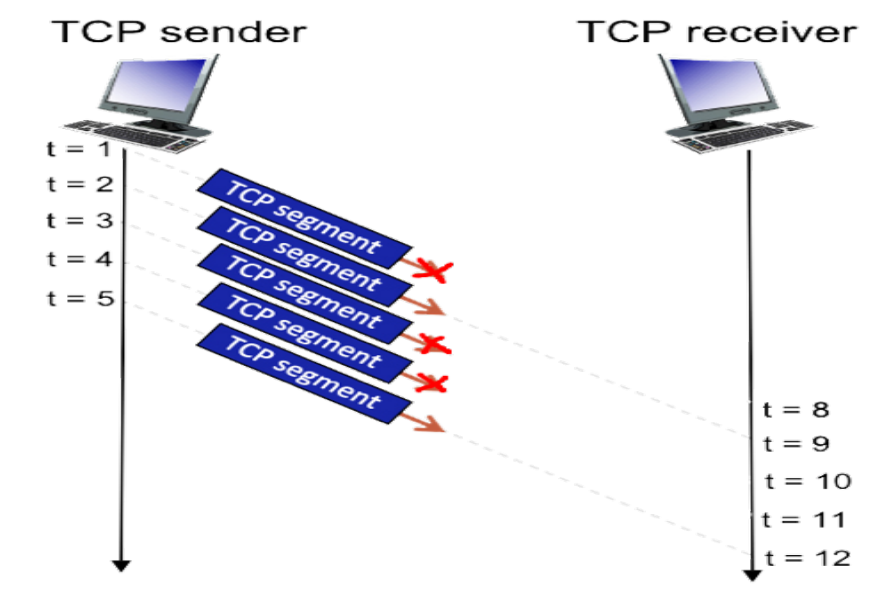


CS5222 Computer Networks and Internets

Tutorial 6 (Week 6)

1. Host A and B are directly connected with a 200 Mbps link. There is one TCP connection between the two hosts, and host A is sending to Host B an enormous file over this connection. Host A can send application data into the link at 100 Mbps but host B can read out of its TCP receive buffer at a maximum rate of 50 Mbps. Describe the effect of TCP flow control on the average sending rate at which A can send to B.
2. At time t , a TCP connection has a congestion window of 4000 bytes. The maximum segment size used by the connection is 1000 bytes. What is the congestion window after it sends out 4 packets and receives acks for all of them? Suppose there is one ack per packet.
 - a) If the connection is in slow start.
 - b) If the connection is in linear increase mode.
3. Consider sending a large file from a host to another over a TCP connection that has no loss. Suppose TCP's congestion control does not use slow start. We assume that $cwnd$ increases by 1 MSS every time a batch of ACKs is received and that the round-trip time is constant.
 - a) How long does it take for $cwnd$ to increase from 5 MSS to 11 MSS, assuming no loss events?
 - b) What is the average throughput (in terms of MSS and RTT) for this connection during the time period that $cwnd$ increases from 5MSS to 11MSS?
4. Consider the figure below in which a TCP sender and receiver communicate over a connection in which the sender->receiver segments may be lost. The TCP sender sends an initial window of 5 segments. Suppose the initial value of the sender->receiver sequence number is 45 and the first 5 segments each contain 462 bytes. The delay between the sender and receiver is 7 time units, and so the first segment arrives at the receiver at $t=8$. As shown in the figure below, 3 of the 5 segment(s) are lost between the segment and receiver.
 - a) Give the sequence numbers associated with each of the 5 segments sent by the sender.
 - b) Give the ACK numbers the receiver sends in response to each of the segments.



5. We learned that TCP never measures SampleRTT for retransmitted segments; it only does so for segments that are transmitted the first time. What is the reason for this?