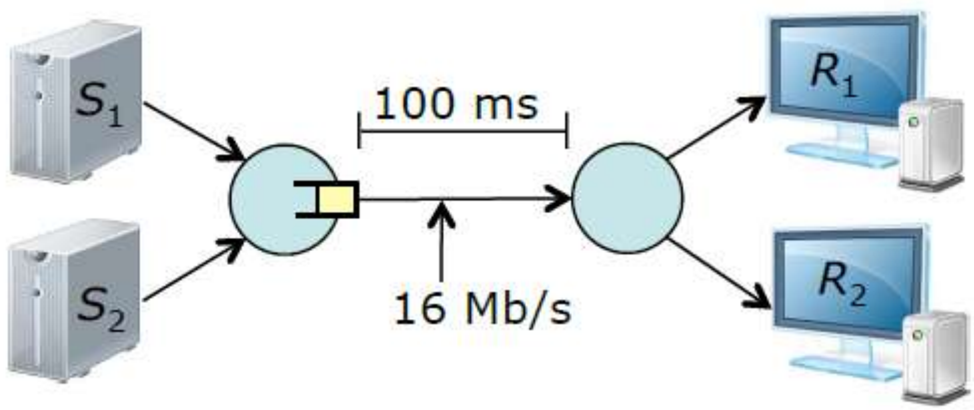
EE450: Sample Set #6: TCP Congestion Control

No Solutions. Will be glad to check your work

1. The diagram below shows two TCP senders at left and the corresponding receivers at right. Both senders use TCP Tahoe. Assume that the MSS is 1 KB, that the one-way propagation delay for both connections is 100 msec and that the link joining the two routers has a bandwidth of 16Mb/s. Let $cwnd_1$ and $cwnd_2$ be the values of the senders' congestion windows. What is the smallest value of $cwnd_1 + cwnd_2$ for which the link joining the two routers stays busy all the time?



a. Assume that the link buffer overflows whenever $cwnd_1 + cwnd_2 \geq 600$ KB and that at time 0, $cwnd_1 = 500$KB and $cwnd_2 = 100$ KB. Approximately, what are the values of $cwnd_1$ and $cwnd_2$one RTT later? Also, what are the values of ss-thresh for each of the two connections? Assume that all losses are detected by triple duplicate ACKs.

b. After 20more RTTs, approximately what are the values of $cwnd_1$ and $cwnd_2$?

c. Approximately, how many more RTTs before $cwnd_1+cwnd_2 \geq 600$KB again? What is difference of their congestion windows at this point?

2. Two hosts A and B are communicating through a TCP connection. The maximum segment size (MSS) has been negotiated to be 1kbyte, and the size of the receiver window of B is 50 Kbytes. The network capacity is 1 MBps, the round-trip time is 20ms, and the initial threshold of the Slow Start algorithm is set to 64 Kbytes. An expiration timer of 1s is engaged at the beginning of each transmission burst.

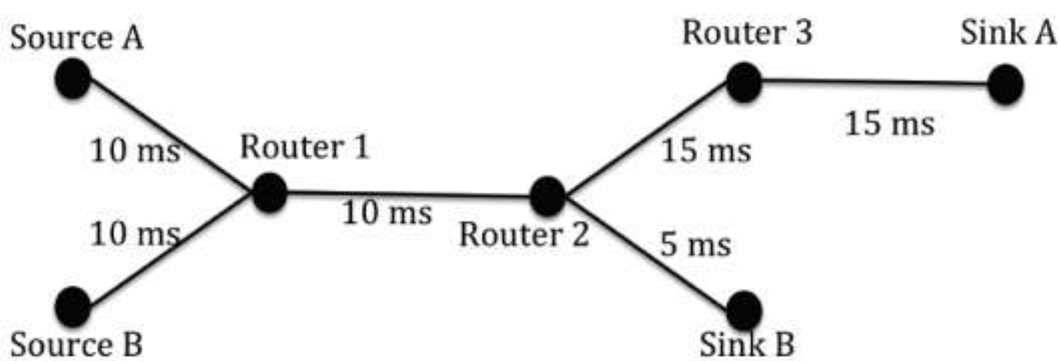
a. If the 4^{th} transmission round is completely lost, how long does it take to reach a congestion window of "maximum size" after the loss? Clearly illustrate your work (By just giving me a number will earn you NO points)

b. Now assume that the network has a capacity of 10 MBps. Find the Throughput of the session and the maximum efficiency (in the A---→B direction)

3. Assume that in the network shown there are two parallel TCP transmissions taking place. TCP1 is a transmission between Source A and Sink A that uses TCP Tahoe. TCP2 is a transmission between Source B and Sink B that uses TCP Reno. The Initial *ssthresh* for both TCP transmissions is set to 32. There are no additional delays other than propagation delays listed above each link.

a. For TCP1 transmission, draw the resulting congestion window assuming that a packet loss is detected via 3 duplicate Acks at t = 900 msec

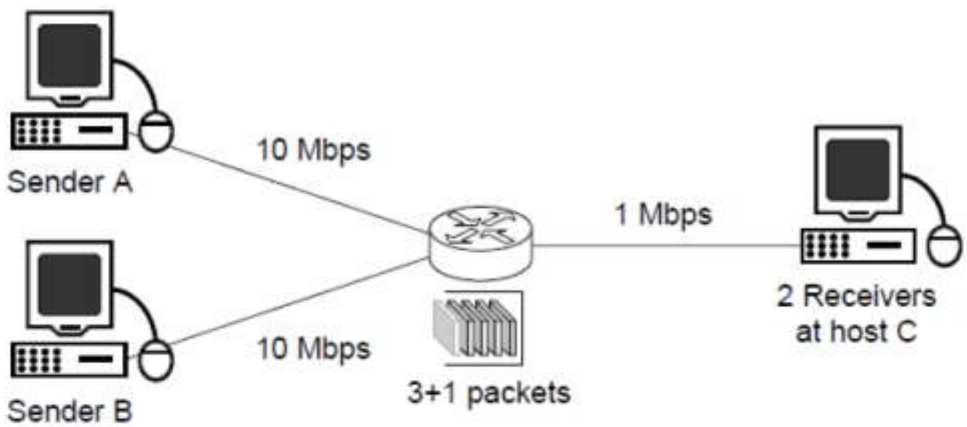
b. For TCP2 transmission, draw the resulting congestion window assuming that a packet loss is detected via 3 duplicate Acks at t = 650 msec



4. Consider a TCP Reno flow that has exactly 50 segments to send. Assume that during the transmission, exactly five segments are lost: the 4^{th}, 5^{th}, 6^{th} and 48^{th} (due to time out expiration) and segment 22^{nd} (due to 3-duplicate acknowledgements); no other losses occur. Plot the evolution of the congestion window as each segment is sent. Assume the RTO is set to 2RTT and assume that the RTT is 1 sec. Only lost segments are retransmitted. What is the throughput of the TCP session? Assume each segment is 1KByte long.

5.

1. Consider the following network. TCP senders at hosts A and B have 3.6 KB of data each to send to their corresponding TCP receivers, both running at host C. Assume MSS = 512 bytes and the RTO = 2×RTT = 2×1 sec. Router buffer size is 3 packets in addition to the packet currently being transmitted; The drop strategy is as follows: drop the last packet that arrived from the host which currently sent more packets. Sender A runs TCP Tahoe and sender B runs TCP Reno and assume that sender B starts transmission 2×RTTs after sender A.



a. Sketch the congestion window sizes on both senders until all segments are successfully transmitted.
b. Now assume the timeout is changed to 3×RTT = 3×1 sec? What will change?

In both cases, assume a large Receiver Window (i.e. No flow control problem) and error-free transmission on all the links. Also assume that all ACK arrivals occur exactly at unit increments of RTT and that the associated Congestion Window update occurs exactly at that time, too.