COMP 431 Internet Protocols & Services

Spring 2017  
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Worksheet 13, March 9

1) Consider a TCP Reno connection that is in congestion avoidance mode with a window of size *w*/2 segments. Assume that in the period of time when the connection’s congestion window grows from *w*/2 to *w* segments,only one packet is lost. (Assume this lost packet is lost during the transmission of the window of size *w*.)

*a*) Show that the loss rate is equal to

*L* = 

Using the sum of first n natural numbers = n(n+1)/2

w(w+1)/2 – (w/2 - 1)(w/2-1+1)/2 =3/8\*w^2 + ¾ \*w

*b*) Given this loss rate result, show that if a connection has loss rate *L*, then its average throughput is approximately equal to



Hint: For the approximation, consider large values of *w*. Also, start with the result from the lecture that without congestion-related loss, the throughput of a TCP Reno connection is ¾ *w* x *MSS*/*RTT.*

Throughput = ¾ \* w \* MSS/RTT = ¾ sqrt(8/3) \* MSS/(rtt\*sqrt(L)) = 1.22 MSS/(RTTsqrt(L))

2) Consider that a single TCP Reno connection uses one 10Mbps link which does not buffer any data. Suppose that this link is the only congested link between the sending and receiving hosts. Assume that the TCP sender has a huge file to send to the receiver, and the receiver’s receive buffer is much larger than the congestion window. Also assume that the TCP *MSS* size is 1,500 bytes, the *RTT* propagation delay of this connection is 150 *ms*, and that the TCP connection is always in congestion avoidance phase (*i.e.*, ignore slow start).

Server stalls until RTT + S/R <= wS/R. Once stop stalling, the ACK for the first segment in the window will come back before the window is done

*a*) What is the maximum window size (in segments) that this TCP connection can achieve?

W \*MSS/RTT = 10Mbps (the max rate.) solve for w, W =125 segments

*b*) What is the average window size (in segments) and average throughput (in bps) of this TCP connection?

The average window size will be halfway: ¾ W => 94 segments

*c*) How long would it take for this TCP connection to reach its maximum window again after recovering from a packet loss?

Loss recovery time => window grows 1 every RTT. We need to grow w/2. W/2\*RTT = 9.4s

3) Redo problem (2) but this assuming a 10 Gbps link instead of a 10 Mbps link.

W \* MSS/RTT = 10Gbps = 10000Mbps. Solve for W = 125,000 segments

b) ¾ \* W = 93,750 segments

c) W/2 \* RTT = 9,375s