Assignment #5

1. Suppose two hosts have a long-lived TCP session over a path with a 100ms round-trip time (RTT). Then, a link fails, causing the traffic to flow over a longer path with a 500ms RTT.



1. Suppose the router on the left recognizes the failure immediately and starts forwarding data packets over the new path, without losing any packets. (Assume also that the router on the right recognizes the failure immediately and starts directing ACKs over the new path, without losing any ACK packets.) Why might the TCP sender retransmit some of the data packets anyway?

**端端往返延时定时器是根据之前的RTT估计的，而此时换了一条较长的路径，因此定时器的值会偏小，引发数据包延时重传。**

1. Suppose instead that the routers do not switch to the new paths all that quickly, and the data packets (and ACK packets) in flight are all lost. What new congestion window size does the TCP sender use? Why?

**1个MSS**

**有数据丢失，发送方在定时器到时时还未收到ACK，认为网络拥塞，将拥塞控制窗口设置为1MSS，并将阈值设置为旧的CWND的一半。**

2. Consider the following behavior of a TCP connection (using the congestion control algorithm we learned in class).

At time 0, a TCP sender initiates a connection. As soon as the connection is established, the TCP sender will begin sending data. The MSS is 1KB and RTT is 100 ms.

1) Assuming the connection does not lose any data or experience any timeouts, at what time will the sender’s congestion window be 16KB? (Assuming *threshold* is 32MSS)

**建立连接一个需要RTT，慢启动阶段，每经过一个RTT，CWND翻倍，因此到32MSS，需要4个RTT，一共需要5个RTT=500ms。**

Right after the sender’s congestion window has reached a size of 16KB, a timeout occurs. After the timeout is detected, the sender continues sending more data over the established connection.

2) Assuming no additional packets loss or timeouts, how long (since the observed timeout) will it take for the congestion window to build to size 14KB?

**发生延时重传，CWND变为1MSS，阈值设置为8KB=8MSS，慢启动阶段，到8KB需要log28＝3RTT，**

**然后线性增长，到14KB需要6RTT，一共需要9RTT=900ms。**

3) While its congestion window is at 14KB, the sender receives triple duplicate acknowledgements for the same sequence number. How long after receiving the third duplicate acknowledgement will it take for the sender’s congestion window to be at least 9KB again?

**三次重复ACK，进入快速恢复阶段，阈值变为7KB=7MSS，然后线性增长，经过2RTT变为9MSS=9KB因此需要200ms。**

3. Consider a scenario with two hosts, Alice and Bob. A web server running on Alice is trying to send data to a browser on Bob. For each TCP connection, Alice’s TCP stack maintains a send buffer of 512 bytes and Bob’s TCP stack maintains a receive buffer of 1024 bytes. For simplicity, assume TCP sequence numbers began at 0 in this problem.

1) Bob’s stack received up to byte 560 in order from Alice, although its browser has only read up to the first 60 bytes. What will be the ***ACK#***and ***rcvr window size***in the TCP headers that Bob next sends to Alice?

**ACK=560+1=561;**

**Rcvr window size=1024-(561-60)=523 bytes。**

2) Later in the same connection, Alice’s congestion window is set to 1 MSS = 536 bytes and the advertised flow-control window from Bob is 560 bytes. The last ***ACK#*** that Alice received from Bob is byte 700, and the last byte that Alice sends to Bob is byte 900.

A) What is the smallest byte number that Bob will not accept?

**byte1260Bob将不会接收。ACK=700，说明0~699字节都已经被确认，Alice发送到了byte900，因此Bob将会接收到900-699=201bytes，此时接收缓冲区还有560-201=359bytes空闲，所以他做多收到byte 900+359，即byte1259，到byte1260时，Bob将不会接收，会丢弃掉。**

B) Assuming that Alice doesn’t receive any more ACKs and her window does not change, what is the greatest byte number that Alice can send?

**Alice现在最多可以继续发送min(536,512-201,560)=311bytes，**

**900+311=1211，因此Alice可以发送的最大字节序号为1211。**

C) Again assuming that Alice doesn’t receive any additional ACKs, how many more bytes can the web server running on Alice write to its network socket before blocking?

**由于Alice没有收到任何ACK，它还可以继续发送min(536,512-201,560)=311bytes，也就是此时Alice最多向套接字中写311个字节的数据。**