**Assignment #004**

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1. **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)**

根据假设连接不会丢失任何数据或经历任何超时，每过一个RTT拥塞窗口将翻倍，且起始阈值为32KB。CongWin从1×MSS开始由慢启动增长：

经过第一个RTT后，CongWin为2\*MSS，未达到阈值。经过第二个RTT后，CongWin为4\*MSS，未达到阈值。以此，当经过第四个RTT时，CongWin为16\*MSS，即16KB。

所以答案为400ms。

**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?**

发生超时事件，则CongWin设置为1\*MSS，阈值为16/2=8KB。然后进入慢启动阶段，先以指数速率增长，经过3\*RTT，CongWin达到8\*MSS，达到阈值，则阈值翻倍，变成16KB。此后线性速率增加，要达到14KB，则需要14-8=6\*RTT，所以答案为6+3=9\*RTT，即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?**

Reno版：

此时阈值为14/2=7KB，CongWin以线性增长，需要经过9-7=2\*RTT，即经过200ms能达到9\*MSS。

1. **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.**
2. **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应该为561。

rcvr window size 应该为 1024-（561-60）=523bytes.

**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?**

Bob不接受的最小字节数为700 + 512= 1212

**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?**

512+700=1212

**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?**

512 – (901 - 701) = 312bytes