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Homework 4: Transport Layer

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## Problem 1 (50 points)

Suppose that the five measured SampleRTT values (see Section 3.5.3) are 106 ms, 120 ms, 140 ms, 90 ms, and 115 ms. Compute the EstimatedRTT after each of these SampleRTT values is obtained, using a value of $\alpha = 0.125$ and assuming that the value of EstimatedRTT was 100 ms just before the first of these five samples were obtained. Compute also the DevRTT after each sample is obtained, assuming a value of $\beta = 0.25$ and assuming the value of DevRTT was 5 ms just before the first of these five samples was obtained. Last, compute the TCP TimeoutInterval after each of these samples is obtained.

**Answer:**

**EstimatedRTT = (1- $\alpha$)\*EstimatedRTT + $\alpha$\*SampleRTT**
EstimatedRTT0 = 100ms
EstimatedRTT1 = (1 - 0.125) \* 100 + 0.125 \* 106 = 100.75
EstimatedRTT2 = (1 - 0.125) \* 100.75 + 0.125 \* 120 = 103.15
EstimatedRTT3 = (1 - 0.125) \* 103.15 + 0.125 \* 140 = 107.75
EstimatedRTT4 = (1 - 0.125) \* 107.75 + 0.125 \* 90 = 105.53
EstimatedRTT5 = (1 - 0.125) \* 105.53 + 0.125 \* 115 = 106.71

**DevRTT = (1-$\beta$)\*DevRTT + $\beta$\*|SampleRTT-EstimatedRTT|**
DevRTT0 = 5ms
DevRTT1 = (1 - 0.25) \* 5 + 0.25 \* |106 - 100.75| = 5.0625
DevRTT2 = (1 - 0.25) \* 5.0625 + 0.25 \* |120 – 103.15| = 8.009
DevRTT3 = (1 - 0.25) \* 8.009 + 0.25 \* |140 – 107.75| = 14.069
DevRTT4 = (1 - 0.25) \* 14.069 + 0.25 \* |90 – 105.53| = 14.43
DevRTT5 = (1 - 0.25) \* 14.43 + 0.25 \* |115 – 106.71| = 12.895

**TimeoutInterval = EstimatedRTT + 4\*DevRTT**
TimeoutInterval0 = 100 + 4 \* 5 = 120
TimeoutInterval1 = 100.75 + 4 \* 5.0625 = 121.0
TimeoutInterval2 = 103.15 + 4 \* 8.009 = 135.186
TimeoutInterval3 = 107.75 + 4 \* 14.069 =164.026
TimeoutInterval4 = 105.53 + 4 \* 14.43 = 163.25
TimeoutInterval5 = 106.71 + 4 \* 12.895 = 158.20

**Problem 2 (50 points)**

Host A and B are communicating over a TCP connection, and Host B has already received from A all bytes up through byte 126. Suppose Host A then sends two segments to Host B back-toback. The first and second segments contain 80 and 40 bytes of data, respectively. In the first segment, the sequence number is 127, the source port number is 302, and the destination port number is 80. Host B sends an acknowledgment whenever it receives a segment from Host A.

    a.  In the second segment sent from Host A to B, what are the sequence number, source port number, and destination port number?

        **Answer:**
        Sequence number: 127
        Source port number: 302
        Destination port number: 80

    b.  If the first segment arrives before the second segment, in the acknowledgment of the first arriving segment, what is the acknowledgment number, the source port number, and the destination port number?

        **Answer:**
        Acknowledgement number: 207
        Source port number: 80
        Destination port number: 302

    c.  If the second segment arrives before the first segment, in the acknowledgment of the first arriving segment, what is the acknowledgment number?
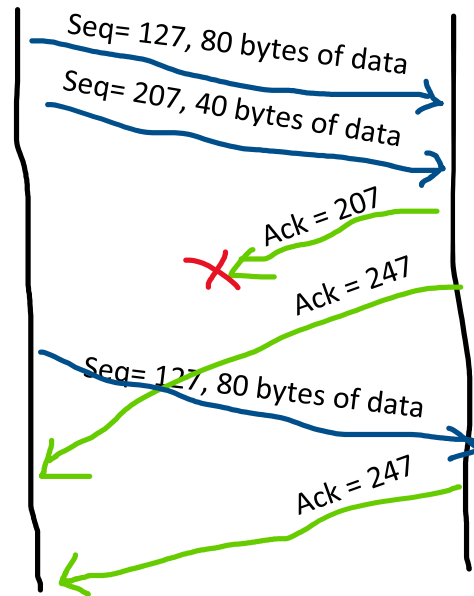
        **Answer:**
        Host B has now received the first and second segment meaning she has received 126 bytes, 80 bytes, and 40 bytes. A total of 246 bytes have been acknowledged.

        Acknowledgment number: 247

    d.  Suppose the two segments sent by A arrive in order at B. The first acknowledgment is lost and the second acknowledgment arrives after the first time- out interval. Draw a timing diagram, showing these segments and all other segments and acknowledgments sent. (Assume there is no additional packet loss.) For each segment in your figure, provide the sequence number and the number of bytes of data; for each acknowledgment that you add, pro- vide the acknowledgment number.

        **Answer:**
        **Diagram is shown below**

Seq= 127, 80 bytes of data
Seq= 207, 40 bytes of data
Ack = 207
Ack = 247
Seq= 127, 80 bytes of data
Ack = 247