CSC358 Tutorial 5

Question 1: Concept Review

(a) What are the pros and cons between Go-Back-N and Selective Repeat?

(b) What's purpose of "delayed ACK" and "triple duplicate ACK"?

(c) Why is a 2-way handshake is not enough for establishing a TCP connection but a 3-way handshake is?

(d) What's different between flow control and congestion control?

Question 2: Estimating RTT and the Exponential Moving Average

Recall the TCP's formula for estimating RTT:

$$\texttt{EstimatedRTT} = (1 - \alpha) \cdot \texttt{EstimatedRTT} + \alpha \cdot \texttt{SampleRTT}$$

In this question, suppose that $\alpha = 0.1$. Let S_1 be the most recent sample RTT, let S_2 be the next most recent sample RTT, and so on.

(a) Suppose that there have been four packets acknowledged with the RTTs being S_1, S_2, S_3, and S_4. Express `EstimatedRTT` in terms of these four sample RTTs.

(b) Generalize your formula for n sample RTTs.

(c) Let n approach infinity. Comment on why this averaging procedure is called an exponential moving average.

Question 3: Fairness of Additive Increase Additive Decrease

Refer to the lecture slide that illustrates the convergence to fairness of the AIMD algorithm (Page 66 of Week 5). Now suppose that instead of multiplicative decrease, TCP does additive decrease, i.e., it decreases the window size by a constant amount each time. Would the resulting AIAD algorithm still converge to fairness? Justify your answer using a diagram similar to the one in the lecture slide. More specifically, consider the following two cases:

(a) The two connections decrease by the same constant each time, i.e., they linearly decrease with the same slope.

(b) The two connections decrease by different constants each time, e.g., one connection's constant is twice of the other connection's constant.

Question 4: Average Throughput of TCP

Recall the macroscopic description of TCP throughput. In the period of time from when the connection's rate varies from $W \cdot MSS/(2RTT)$ to $W \cdot MSS/RTT$, only one packet is lost (right before the decrease).

(a) Show that the loss rate (fraction of packets lost) is equal to

$$L = \frac{1}{(3/8)W^2 + (3/4)W}$$

(b) Use the result above to show that if a connection has loss rate L, then its average throughput is approximated given by

$$\text{Average throughput} \approx \frac{1.22 \times \text{MSS}}{\text{RTT}\sqrt{L}}$$

You may assume that W is very large so that $W^2 \gg W$.

(c) Assuming, realistically, an MSS of 1500 bytes and a RTT of 100 milliseconds, in order to achieve a throughput of 10 Mbps, what's the requirement on the loss rate L? How about achieving a 10 Gbps throughput? Discuss the potential issues of the current version of TCP.