

# CS118 Homework 5

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## Problem 1

Since A is sending data faster than B can remove it, the receiver buffer will fill up. When the buffer is full, B will tell A to stop sending data until B can clear space in the buffer. Once B is ready to receive more data, it sends a segment to A. A will then send data (likely filling the buffer again) until all data has been sent from A to B.

## Problem 2

s port: 5670

d port: 2008

seq\_no: 3120

ack\_no: 981

control bits (all 6 bits): 010001

### Problem 3

a.

$$LossRate = 1/(W/2 + (W/2 + 1) + L + W)$$

$$= 1/(\sum_{n=0}^{W/2} (W/2 + n))$$

$$= 1/((W/2 + 1)W/2 + \sum_{n=0}^{W/2} n)$$

$$= 1/((W/2 + 1)W/2 + \frac{W/2(W/2+1)}{2})$$

$$= 1/(W^2/4 + W/2 + W^2/8 + W/4)$$

$$LossRate = 1/(3W^2/8 + 3W/4)$$

b. For large W,  $3W^2/8 \gg 3W/4$  so  $L \approx \frac{8}{3W^2}$

$$W = \sqrt{\frac{8}{3L}}$$

$$avgRate = 3/4 * W/RTT = 3/4 * \sqrt{\frac{8}{3L}} \frac{MSS}{RTT} = 1.22 \frac{MSS}{RTT * \sqrt{L}}$$

## Problem 4

a. To fully use the network, the **rwnd** must be larger than  $delay * bandwidth$ .

$$delay = \frac{800Mb}{s} * \frac{10^6 b}{1Mb} * \frac{1s}{10^3 ms} = 8 * 10^5 b/ms$$

$$RecieveWindow \geq 8 * 10^5 b/ms * 400ms = 3.2 * 10^8 b = 40MB$$

$$bits = \log_2(40MB) = 26 \text{ for RecieveWindow}$$

$$SequenceNum \geq maxLifetime * bandwidth = 25s * 800Mbps = 20Gbit = 2.5GB$$

$$bits = \log_2(2.5GB) = 32 \text{ for SequenceNum}$$

b. If RecieveWindow of 16 bits then it would be smaller than  $delay * bandwidth$

$$effective = RecieveWindow / RTT = 2^{16} B / 400ms = 163.84KB/s$$

# Problem 5

