

CS 3251 Homework 3

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3.40

- (a) [1, 6] and [23, 26]. Because the window size is growing exponentially.
- (b) [6, 16], [17, 22]. Because the window size is growing linearly.
- (c) Triple duplicate ACK. Because the window size drops to roughly half of the original size.
- (d) Timeout. Because the window size drops to 1.
- (e) 32. That's where congestion avoidance begins.
- (f) 21. It's half of the `cwnd` at the 16th round.
- (g) 14. It's half of the `cwnd` at the 22nd round.
- (h) The 7th round.
- (i) The `cwnd` at the 26th round is 8.
So `ssthresh` = `cwnd`/2 = 4 and `cwnd` = `ssthresh` + 3 = 7.

3.45

Assuming that the window size grows by 1 every RTT, then the total number of packets is

$$\begin{aligned} & \frac{W}{2} + \left(\frac{W}{2} + 1\right) + \left(\frac{W}{2} + 2\right) + \cdots + W \\ &= \frac{1}{2} \left(\frac{W}{2} + W\right) \left(W - \frac{W}{2} + 1\right) = \frac{3}{8}W^2 + \frac{3}{4}W \end{aligned}$$

So the loss rate is

$$L = \frac{\# \text{ packets lost}}{\text{total } \# \text{ packets}} = \frac{1}{\frac{3}{8}W^2 + \frac{3}{4}W}$$

3.46

- (a) In one RTT, the link can transmit at most $10\text{Mbps} \cdot 150\text{msec} = 1500\text{kbit}$, which translates to

$$W = \frac{1500 \cdot 10^3}{1500 \cdot 8} = 125 \text{ segments}$$

- (b) The average window size is $3W/4 = 93.75$ segments. The average throughput is $93.75 \cdot 1500 \cdot 8\text{bit}/(1500 \cdot 10^{-3}\text{sec}) = 7.5\text{Mbps}$
- (c) Assuming the window size increases by 1 segment every RTT, then it takes $(W/2) \cdot RTT = (125/2) \cdot 150 \cdot 10^{-3}\text{sec} = 9.375\text{sec}$

4.4

The minimum number of time slots needed is 2. If we use a sequence of 3-tuples to denote the packets being transfered from input ports to output ports, then we can achieve this by $(X, Y, Z), (null, X, Y)$.

The maximum number of time slots needed is 4, which happens in the following senario: First (X, X, Z) and the second X is blocked, then $(null, Y, Y)$ and the first Y is blocked. Now there are still two packets X, Y in the second input queue, which will take 2 more time slots to transfer.

4.5

(a)

11100000 00***** ***** *****	0
11100000 01000000 ***** *****	1
11100000 ***** ***** *****	2
11100001 0***** ***** *****	2
otherwise	3

(b) The first one doesn't match any prefix, so it will be forwarded to link 3. The second one matches the 4th entry, so it will be forwarded to link 2. The third one doesn't match any prefix, so it will be forwarded to link 3.

4.8

Subnet 1: 223.1.17.0/26

Subnet 2: 223.1.17.128/25

Subnet 3: 223.1.17.64/28