EE450 Introduction to Computer Networks - Fall 2019 - HW 8

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1 Chapter 3, Page 294: P24 (15 points) Answer true or false to the following questions and briefly justify your answer:

1.1 With the SR protocol, it is possible for the sender to receive an ACK for a packet that falls outside of its current window.

True. Suppose the sender has a window size of 3, and at t0 it began to send packet 1,2,3. The receiver received these 3 packets at time t1, and sent back ACKs for 1 through 3. But at time t2 the sender timed out and resent the 3 packets. The receiver got the resent packets at time t3 and re-ACK them again. At time point t4 the sender received the ACKs sent from the receiver at t1 and moved its window to 4,5,6; but at time t5 it received the ACKs sent at t2, these ACKs are already out of window.

1.2 With GBN, it is possible for the sender to receive an ACK for a packet that falls outside of its current window.

True, same scenario in 1.1 also compiles to GBN.

1.3 The alternating-bit protocol is the same as the SR protocol with a sender and receiver window size of 1.

True. Explanations are below.

1.4 The alternating-bit protocol is the same as GBN protocol with a sender and receiver window size of 1.

True, when the window size of GBN and SR goes down to 1, sender can only send 1 packet at a time and wait for the receiver's ACK, and the receiver will receive the packets in strict order, it will discard other packets except the one it waits for now. The two protocols are actually the alternating-bit protocol.

2 Chapter 3, Page 297: P40 (20 points) Consider Figure 3.58. Assuming TCP Reno is the protocol experiencing the behavior shown above, answer the following questions. In all cases, you should provide a short discussion justifying your answer.

2.1 Identify the intervals of time when TCP slow start is operating.

slow start: 1 - 6, 23 - 26.

2.2 Identify the intervals of time when TCP congestion avoidance is operating.

TCP avoidance: 16 - 17, 22 - 23.

2.3 After the 16th transmission round, is segment loss detected by a triple duplicate ACK or by a timeout?

duplicate ACK, because the window size was cut in half and back to linear increasement.

2.4 After the 22nd transmission round, is segment loss detected by a triple duplicate ACK or by a timeout?

timeout. Because the window size was set back to 1 and begins with slow start.

3 Chapter 4, Page 362: R3 (15 points) We made a distinction between the forwarding function and the routing function performed in the network layer. What are the key differences between forwarding and routing?

Forwarding is to move packets to another next interchange. Routing is about determining which interchange to move the packets.

4 Chapter 4, Page 362: R8 (15 points) What is meant by destination-based forwarding? How does this differ from generalized forwarding (assuming you have read Section 4.4, which of the two approaches are adopted by Software-Defined Networking)?

Destination-based forwarding is based only on destination's IP address, generalized forwarding is based on any set of header field values (TCP/UDP source/destination port number etc.).

5 Chapter 4, Page 365: P3 (20 points) In Section 4.2, we noted that the maximum queueing delay is $(n-1)D$ if the switching fabric is n times faster than the input line rates. Suppose that all packets are of the same length, n packets arrive at the same time to the n input ports, and all n packets want to be forwarded to different output ports. What is the maximum delay for a packet for the (a) memory, (b) bus, and (c) crossbar switching fabrics?

(a) For memory: all operations are under the command of CPU, max delay will be $(n-1)D$.

(b) For bus: All datagrams share the same bus, the switching spped of the router is limited to the bus speed. Max delay $= (n-1)D$.

(c) For interconnection network: It's capable of forwarding multiple packets in parallel. Therefore the delay could be 0.

6 Chapter 4, Page 366: P5 (15 points) Consider a datagram network using 32-bit host addresses. Suppose a route has four links numbered 0 through 3, and packets are to be forwarded to the link interfaces as follows:

6.1 Provide a forwarding table that has five entries, uses longest prefix matching, and forwards packets to the correct link interfaces.

Prefix Match	link interface
11100000 00	0
11100000 01000000	1
1110000	2
11100001 1	3
otherwise	3

6.2 Describe how your forwarding table determines the appropriate link interface for datagrams with destination addresses:

Address	Matched Prefix	Matched link interface
11001000 10010001 01010001 01010101	otherwise	3
11100001 01000000 11000011 00111100	1110000	2
11100001 10000000 00010001 01110111	11100001 1	3