CPSC 317, 2014W Term 2— Quiz 3 — Solutions

Date: March 19, 2015; Instructor: Norm Hutchinson

1. **(8 marks)** Short Answers {2 marks per question} Answer each question with at most one or two sentences. Be as brief and clear as possible while still being complete.

1a. **(2 marks)** When doing a traceroute, suppose that the time for hop 10 is 100ms and for hop 11 it is 120ms. Of the different types of delays, what is the type of delay that is most likely the largest contributor to the time difference between this two hops if there is very little jitter. Explain briefly.

Propagation delay. It is likely that router 11 is a long way away. Since jitter is small, it is unlikely to be queuing delay. Processing and transmission delays are usually very small.

1b. **(2 marks)** Why is our specific rationale for not explicitly considering corrupt packets in our reliable protocol state machines; instead treating them as lost packets.

A corruption in a destination address or other critical protocol field will cause the packet to be mis-delivered or not delivered at all.

1c. **(2 marks)** If host A is connected to router B with a 80Mb/s link, and router B is connected to host C wih a 100Mb/s link, what is the maximum bandwidth between hosts A and C. Explain briefly.

80Mb/s. This is the slower link and is therefore the bottleneck.

1d. **(2 marks)** Suppose that in a packet switched network traffic intensity over a long time exceeds 1 for a particular path. Does this imply that there are: 1) minimal delays for packets using that path, 2) "normal" delays, 3) long delays but no dropped packets, or 4) long delays and dropped packets? Justify your answer.

4) long delays and dropped packets. With traffic intensity over 1 for a long time, queues will overflow and packets will get dropped.

2. **(10 marks)**

Suppose that we have a router that can handle 100 packets per second, and that all packets are 1000 bytes).

2a. **(2 marks)** We are receiving packets that are perfectly spaced at a 0.02s interval. What is the traffic intensity? Show your work.

50 packets arrive per second out of a possible 100, so intensity is 0.50 or 50%.

2b. **(2 marks)** Suppose that the packets are now arriving perfectly spaced at a 0.05s interval. What is the traffic intensity now? Show your work.

20 packets arrive per second out of a possible 100, so intensity is 0.20 or 20%.

2c. **(2 marks)** How does the average queuing delay of an arriving packet vary between 2a and 2b above?

There is no queuing in either scenario because all packets arrive perfectly spaced.

2d. **(2 marks)** Suppose that instead of arriving perfectly spaced, packets now arrive randomly with an average of 1 packet every 0.05s. What is the traffic intensity now? Show your work.

The average will be 20 packets per second, so intensity is 0.2 or 20%

2e. **(2 marks)** Which of scenario 2a or 2d above will have a higher average queuing delay? Explain your answer briefly.

2d. With perfectly spaced packets there is no queuing. Despite the much slower rate of packets in 2d, the random nature of arrivals will cause some queuing.

3. **(12 marks)** This question concerns GBN. You should assume a sending window size of 4, an unlimited sequence number space, and the sender with an unlimited number of packets to send. Also assume that packets are not delivered out of order; that is, they are either delivered in the order they were sent or not delivered at all.

3a. **(3 marks)** If the receiver is expecting sequence number 8, what are all of the possible sequence numbers that could be included in the sender's window? Explain your answer briefly.

4-7, 5-8, 6-9, 7-10, 8-11
Each is possible with the loss of 4, 3, 2, 1, or 0 ACKs.

3b. **(3 marks)** If the sender sends packets 15, 16, 17, and 18 but packet 17 is lost, what 5 packets will the receiver see next (after seeing 18) assuming no further packets or ACKs are lost? Explain your answer briefly.

19, 20, 17, 18, 19. The receiver will ACK 15 and 16 when it receives them, then continue to ACK 16 when it receives later packets until it receives 17. The sender will send 19 and 20 when it sees ACKs for 15 and 16, then will timeout and resend starting at 17.

3c. **(3 marks)** If the receiver sees packets 15, 16, 17, 18 and sends ACKs for them all, but ACK 17 is lost, what 5 packets will the receiver see next (after seeing 18) assuming no further packets or ACKs are lost? Explain your answer briefly.

19, 20, 21, 22, 23. The ACK for 18 will be cumulative, so the sender will just continue to send packets.

3d. **(3 marks)** Suppose that packets are sent every 0.25s, the round trip time is 1s and the timeout is 4s. If packet 5 is lost and no other packets or ACKs are lost, how much time will elapse from when packet 5 is first sent until the sender receives an ACK for packet 5? Explain your answer briefly.

5.75 seconds. At time 0 packet 5 is sent. At time 0.75 the ACK for packet 4 is received and the timer is reset. At time 4.75 the sender times out and resends packet 5. At time 5.75 the sender receives the ACK for 5.

Alternatively: 5.0 seconds. At time 0 packet 5 is sent. At time 4.0 the sender times out and resends packet 5. At time 5.0 the sender receives the ACK for packet 5.

4. **(12 marks)** This question concerns SR. You should assume a sending window size of 4, a receiving window size of 4, an unlimited sequence number space, and the sender with an unlimited number of packets to send. Also assume that packets are not delivered out of order; that is, they are either delivered in the order they were sent or not delivered at all.

4a. **(3 marks)** If the receiver's window is 8, 9, 10, 11, what are all of the possible sequence numbers that could be included in the sender's window? Explain your answer briefly.

4-7, 5-8, 6-9, 7-10, 8-11
Each is possible with the loss of 4, 3, 2, 1, or 0 ACKs.

4b. **(3 marks)** If the sender sends packets 15, 16, 17, and 18 but packet 17 is lost, what 5 packets will the receiver see next (after seeing 18) assuming no further packets or ACKs are lost? Explain your answer briefly.

19, 20, 17, 21, 22. The receiver will ACK 15, 16, and 18 (and later 19 and 20) when it receives them. The sender will send 19 and 20 when it sees ACKs for 15 and 16, then will see ACKs for 18, 19, and 20. Finally it will timeout and resend 17. After receiving the ACK for 17 it will send 21 and 22.

4c. (3 marks) If the receiver sees packets 15, 16, 17, 18 and sends ACKs for them all, but ACK 17 is lost, what 5 packets will the receiver see next (after seeing 18) assuming no further packets or ACKs are lost? Explain your answer briefly.

19, 20, 17, 21, 22. SR treats lost packets and lost ACKs identically.

4d. (3 marks) Suppose that packets are sent every 0.25s, the round trip time is 1s and the timeout is 4s. If packet 5 is lost and no other packets or ACKs are lost, how much time will elapse from when packet 5 is first sent until the sender receives an ACK for packet 5? Explain your answer briefly.

5.0 seconds. At time 0 packet 5 is sent. At time 4.0 the sender times out and resends packet 5. At time 5.0 the sender receives the ACK for packet 5.