14-740: Fundamentals of Computer and Telecommunication Networks

Fall 2017
Quiz #2
Duration: 75 minutes

Name:_ANSWER KEY_ Andrew ID: ______________________

Important:

- Each question is to be answered in the space provided. Material written on the back of the page or in space above or below the question will not be graded.
- This is a closed book exam -- you may not use any reference materials, crib sheets, or formula cards.
- Calculators are not needed, nor allowed.
- **Write legibly**. Unreadable work will be considered incorrect.
- At the end of the final duration, you will be told to “Cease Work.” Immediately stop writing and turn in your paper. Any writing after this point will result in a zero grade.

Page 2	____________ (20 possible)
Page 3	____________ (25 possible)
Page 4	____________ (20 possible)
Page 5	____________ (15 possible)
Page 6	____________ (20 possible)
Total	____________ (100 possible)

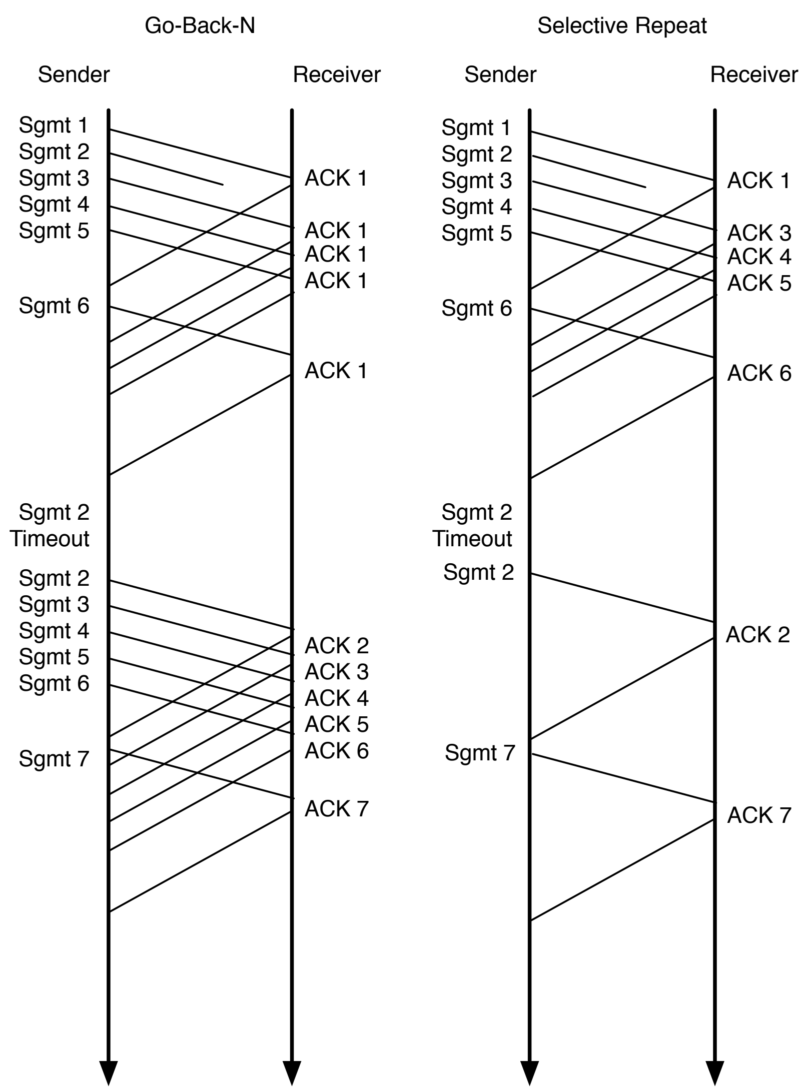
I understand that the CMU and course policies on cheating apply to this quiz.

signature date

1. What are "port numbers" used for in UDP? (5 points)

Port numbers are the transport layer's addresses. They identify the sending and receiving application.

2. Consider the Go-Back-N and Selective Repeat algorithms as discussed in class. Suppose the sender window is a fixed size of 5 segments. The sender has 7 segments to send (numbered 1-7) and the original transmission of segment #2 is the only loss. Draw a sequence diagram for each algorithm, clearly illustrating the sequence of transmissions between sender and receiver. Make sure each transmission is marked with sequence, type and any other necessary info. (15 points)



3. A TCP sender sends 5 segments with sequence numbers 100, 200, 250, 320 and 480. The last segment contained 20 bytes of data. The segments are ACKed individually, but the ACK segments are received after all 5 segments have been sent. There is no loss in either direction. When the second segment is ACKed, the receiver has space in the receive buffer equal to 600 bytes.

At the time the sender is preparing to send a sixth segment, only the second ACK segment has been returned to the sender. But, the receiver may have more or less than 600 bytes of buffer available at this instance. It seems that the sender might not know how many bytes to send, given that he has already sent 3 more segments since the segment this one is ACKing.

Describe why this isn't a problem, and show how the calculation is performed. How many bytes can the sender put into this 6th segment? (15 points)

No problem! The receive window of 600 was included in the header of the second ACK. That segment had an ACK sequence number of 250, thus giving permission to send up to byte number 849. The sender knows it has already sent byte 499, so this next segment could include bytes 500-849, for a total of 350 bytes.

4. Describe how TCP sets the timeout value. You need not specify formulas, but your description should be thorough and specific.(10 points)

TCP measures RTT for original transmission segments. These samples are smoothed with an EWMA formula to form an estimate of RTT. The deviation of each sample from this estimate is also measured, and smoothed with EWMA. The final timeout value is the estimated RTT plus four smoothed deviations.

5. Match the following congestion control algorithms to one-or-more features from the list. (10 points)

Reno (D, F)	A) Introduced slow start
New Reno (C, F)	B) Delay = congestion
Compound (B, F)	C) Improves fast recovery
Tahoe (A, F)	D) Introduced fast retransmit
BIC (G, F)	E) Attacks LFN problem
Hybla (E, F)	F) Loss based
Vegas (B)	G) Uses max, min and target window variables
	H) BW-delay product doesn't apply
	I) None of the above

1 point each A-E, G. 3 points for getting F right, including not on Vegas

6. The IP layer has two main responsibilities. Name them. Then describe each clearly enough to show you know the differences between them. (10 points)

Routing — Running an algorithm that populates the forwarding table.

Forwarding — Using the forwarding table to determine a "next link" interface for each packet that arrives at the router.

7. Draw a Shortest Path Tree based on this data collected by a run of Djikstra's algorithm. (15 points)

N' = {u, v, w, x, y, z}

D(u) = 0, p(u) = u

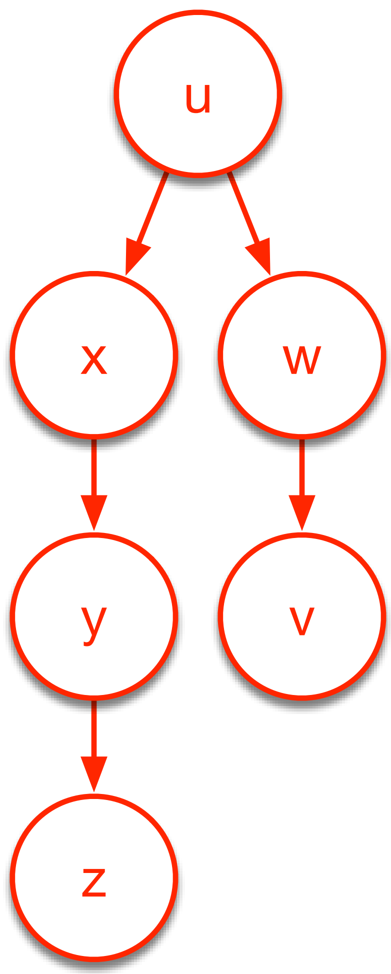
D(v) = 2, p(v) = w

D(w) = 1, p(w) = u

D(x) = 2, p(x) = u

D(y) = 3, p(y) = x

D(z) = 5, p(z) = y



8. Thoroughly describe two modifications to IPv4 that are included in IPv6. If appropriate to each, discuss motivations, mechanisms, sizes and values. (10 points)

Addresses: Now 128 bits, as the number of hosts needing addresses exceeds IPv4's 32 bit width. No classes, though there are a (very) few special values.

~~Options: Option processing is moved out of the header and into the payload. This smoothes the work of the router, as the header length is always 40 bytes~~

No Fragmentation: Fragmenting packets was a burden on router and end host. Also, a security vector. Now, if a packet size is > MTU, it is dropped and an ICMP error returned.

Autoconfiguration: If you have a "guaranteed to be unique" value, you can use it as a link-local IPv6 address. Just prepend it with a special 10-bit link-local address and a bunch of zeros. Not for use outside your subnet, as nobody will know how to route to it.

9. A router receives a BGP announcement for prefix A, located in some other AS, and decides this is the best path to that prefix. How does the router use that announcement and the IGP data available, to populate the forwarding table? Be specific, especially with respect to the BGP attribute that links BGP and IGP. (10 points)

The BGP update message contains the NEXT-HOP attribute, which will be the IP address of the border router on the neighboring AS where this message came from. The IGP will have already provided the routing metric to get to that IP address, since that IP address is contained in a subnet that one of the local routers (in fact, one of the local border routers) is a member. That means that this router knows which interface (or link) is the best to use to get to that IP address. So, fill the forwarding table with the prefix and the interface to that IP address.