

ECE3076, Internetwork Programming, QUIZ 1 Spring 2007

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RULES.

- i This quiz is **not** open book. One original sheet of hand-written notes may be used. Calculators are ok.
- ii Answer all questions and show all work to receive full credit. Use back of sheets only if necessary.
- iii All sub-questions have the same weight (3.3%).
- iv Please do not ask the proctors any questions during the exam about exam questions. Part of the test is understanding the question, as written, without supplemental information. If you feel additional data is needed to solve the problem, make (and state) an assumption and then work the problem.
- v This is a time-limited test. All papers must be turned in 70 minutes after the start. If you find you are taking more than 10 minutes on a particular problem, move on and come back to that problem after finishing the others. The Georgia Tech Honor Code applies (see last page).

Question 1 – The Internet

- a. Autonomous IANA assigns blocks of IP addresses to what kind of Systems (hint: abbreviation is AS)?
- b. Authoritative What type(s) of DNS Server has the IP addresses of all names in the AS?
- c. Top Level (TLD) What type of DNS Server has the IP addresses of every system DNS with a ".edu" ending.
- d. Root What type of DNS Server has the IP address for the DNS servers for .edu, .com, .gov, .mil,
- e. Connectionless Even though TCP can set up connections between hosts, the Internet itself (IP) is "_____"?
- f. TTL, Time to Live The "traceroute" program takes advantage of the fact that each router decrements which field in the IP header?

Question 2 – Bandwidth-Delay Product

- a. 37.5 (kbytes) If the round-trip time (RTT) for a dedicated 10 Mbit/s connection to California is 30 ms, what is minimum TCP window size that will allow this channel to be fully utilized? $Rate \times Delay = 10 \text{ Mbits/s} \times 0.030 \text{ s} / 8 \text{ b/Byte}$
- b. 10 (Mbits/s) What will the maximum throughput be if the window is 64 kbytes in the example above. *Any Window size larger than Rate x Delay will allow be limited by Rate, which is < Window / Delay*
- c. 1001 0001 What is the one's compliment 8-bit checksum of the following 8-bit binary numbers:

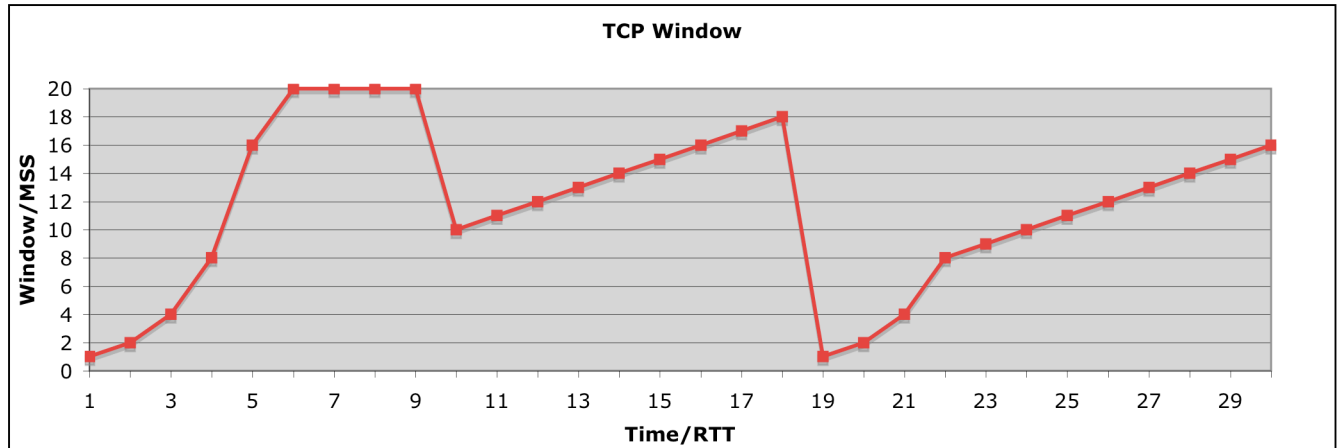
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  1 0 0 0  1 1 0 1
  1 1 1 0  0 0 0 0
  1 0 1 1 0  1 1 0 1 -> 0 1 1 0  1 1 1 0 then bit-wise compliment

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On a shared network, what two factors cause TCP sending hosts to slow down and relieve congestion:

- d. Buffer fill (Queuing) delays What change in the network (routers) causes RTT to increase?
- e. Lost packets What causes the TCP sender's window to decrease?

Question 3 – TCP Congestion and Flow Control

- a. 20 What is the Receiver Window / MSS ?
- b. 9 or 10 At what time (/RTT) did duplicate ACKs cause a successful Fast Retransmission & Fast Recovery?
- c. 18 or 19 At what time (/RTT) was there a Timeout?
- d. 22 At what time (/RTT) did Slow-Start (Multiplicative Increase) change to Additive Increase?

Receiver Flow Control

A TCP Receiver sends an ACK number of 4870 and a Window of 1000. It receives 200 more bytes in two new segments without being able to upload any bytes to the receiving application.

- e. 5070 What ACK number does it now send?
- f. 800 What Window number does it now send?

Question 4 – Calculating Round-Trip Time (12 points)

Between hosts A in Atlanta and B in Seattle there are 10 routers (X). All links are between routers (---) are 100 Mbps. The access links (LANs, ===) are 1000 Mbps. The distance from A to B is 2400 km. The average signal velocity is $2E8$ m/s. Host A starts to send a large file using TCP, sending 1460 byte packets to B. B ACKs with 40 byte packets. There is no other traffic on this network.

A ===X---X---X---X---X---X---X---X---X---X===B

- a. 24 ms What is the propagation delay for the round trip in milliseconds (ms)?
 $2 \times 2.4e6 \text{ m} / 2e8 \text{ m/s} = 2.4e-2 \text{ s}$
- b. 24.4 ms If the router buffers are empty, what is the total round trip delay (neglect processing delay)
 $0.024 \text{ s} + 2 \times 8 \times (1460+40)/1e9 + 9 \times 8 \times (1460+40)/1e8 = 0.00035$
- c. 21.3 Mb/s If the window size in 65 kbytes, what will be the maximum transfer rate?
 $65,000 \times 8 / 0.0244$
- d. 6.8 ms If each router's buffer had 14,600 bytes when A and B's packets got there, how much delay would be added to the RTT (note that the last router has a different output speed)?
 $2 \times (2 \times 8 \times 14,600 / 1e8 + 9 \times 8 \times 14,600 / 1e9) = 2 \times (0.002336 + .001050) = 0.0068$

Question 5– Running Average for Calculating the Retransmit Time Out (8 points)

Use bottom of page for calculations. Round results up to 1 ms.

Measured Round-Trip Time SampleRTT	A=Average RTT Alpha = 1/8 EstimatedRTT	Deviation (M - old-A) (+/-)	D = Average Deviation Beta = 1/4 DevRTT	RTO = A + 4D TimeOut
80	60	15	10	100
40	58	-20	13	110
90	62	+22	16	134

$$A = 0.875 * 60 + 0.125 * 40 = 57.5 \rightarrow 58$$

$$A = 0.875 * 58 + 0.125 * 90 = 62.0$$

$$D = 0.75 * 10 + 0.25 * |-20| = 12.5 \rightarrow 13$$

$$D = 0.75 * 13 + 0.25 * |32| = 17.75 \rightarrow 18$$

Honor Code - I affirm that I have obeyed the rules of the Georgia Tech Honor Code*.

Signature _____

*Basically, I did not cheat, and I reported any observed cheating. A grade will not be recorded if there is no signature.