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ECE3076, Internetwork Programming, QUIZ 1
Summer 2006

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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.

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 (20 points). Choose the best answer from the list. Answers may be used 0, 1, or more times.
{most wrong answers count -2. As indicated, some count only -1}

__n (j:-1)__ Buffer with packets stored in order to be sent on a link

__i, b,(c:-1)__ Store and forwards link-layer (MAC) frames

__g, k, m__ Has a range of IP addresses, and an authoritative DNS server

__b (h:-1)__ Lets users time-share circuits, greatly lowers cost per user.

__j, b, a__ Forwards datagrams along the route with least-delay

__d_____ Uses dedicated links directly connected from end-to-end

__m (k:-1)__ Internet backbone system

__k (m:-1)__ Connects customers to the Internet for a fee

__f_____ Body that publishes Physical- and Link-Layer spec.s

__e_____ Body that publishes IP and transport layer spec.s

a. Internet Protocol
b. Packet switching
c. Ethernet
d. Circuit switched network
e. IETF
f. IEEE
g. Autonomous System
h. Connectionless
i. Switch
j. Router
k. Tier-3 ISP
m. Tier-1 ISP
n. Queue
o. URL

Question 2 – TCP with no Congestion (14 points). A 10 Mbps network connection has a 50 ms round trip time (RTT). A server begins sending maximum-size packets (after the initial SYN-ACK). The client ACK's every packet, and has a receiver-window which holds 18 maximum-size packets. Show how many packets are sent in each RTT period below:

Time Period Start (ms)	No. Segments sent
0	1 (SYN-ACK)
50	1
100	**2**
150	**4**
200	**8**
250	**16**
300	**18**

__42 or 90 kB/s_____ If the MSS is 1200 bytes, what is the average transmission rate during the first 200 ms?
{depends on whether the 8 segments sent after 200 ms are counted. Is interval 0-200 or 50-250 ms?}

__432 kB/s__ What is the maximum transfer rate (bytes/second)?

Question 2 – Bandwidth-Delay Product (12 points)

a. What does TCP guarantee that UDP does not (for bytes stream sent in multiple packets)? **Complete, in order delivery**
b. If the round-trip time (RTT) for a dedicated 10 Mbit/s connection to California is 100 ms, what is minimum TCP widow size that will allow this channel to be fully utilized? **125 k** (bytes) *{ 0.1 s * 10 Mbit/s * (1 byte/8 bits) }*

c. What will the maximum throughput be if the window is 62.5 kbytes in the example above. **5 *Mbps*** *(half of 10 Mbps)* (bits/s)

d. What is the one's compliment 8-bit checksum of the following 8-bit binary numbers: **1011 1111**

```
  1 0 0 1  0 1 0 1
  1 0 1 0  1 0 1 0
1 0 0 1 1  1 1 1 1 -> 0 1 0 0  0 0 0 0, compliment = 1011 1111
```

e. On a shared network, the buffer delay may increase due to congestion. Circle the right answer:

This will _ **decrease** _ the packets being sent into the network, and _ **hurt** _ the congestion {*problem*}.

Question 3 – TCP Response to Congestion - Lost and Out-of-Order Packets (12 points)

Once a TCP segment times out, a variable collision window-size is *CongWin* is used. SMSS (sender maximum segment size) was called *segsize* in the class slides, MSS in some of the books. Conditions at the sender may require SMSS to be smaller than the MSS value received for the other TCP host.

After a time-out, the value of *threshold* drops to __ **one half** ____ times the previous value of *CongWin*.

After a time-out, the value of *CongWin* drops to ____**one**____ times the maximum segment size (SMSS)

CongWin then grows in __**Slow Start** (*exponential*)__ mode until it reaches *threshold*. which is reduced to ___**one half**___ times the value of ___ **CongWin** _____ before the time-out.

After CongWin reaches threshold, CongWin grows linearly by adding SMSS bytes for approximately every __ **CongWin** ___ number of bytes) *{ = one RTT }*.

Question 4 – Telnet, Streaming Media, HTTP, FTP, IMAP, SMTP, SSL, POP, DNS (20 points)

Normally your PC specifies a _**recursive**____ mode IP address lookup from a local DNS server.

Normally your local DNS server specifies a __**non-recursive**__ mode IP address lookup from higher DNS servers.

HTTP command to get a server to download a page: **_____GET_____**

Protocol used to send mail: **____smtp_____**

Mode of FTP that can be used to avoid firewall problems (client doesn't open a listen port): **_____passive*_____**
{*because of slide error, active accepted*}

Application-level protocol that adds encryption security to Web and email connections. **____*SSL or TLS*___**

Three protocols used to obtain email from to an email server: HTTP, **____POP___**, **___IMAP____**

Protocols that normally use UDP (rather than TCP): _ **Streaming Media** ___, __**DNS**____ { *or NTP* }

Question 5 – Calculating Round-Trip Time (12 points)

Between hosts A in Atlanta and B in Las Vegas 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 2000 km. A starts to send a large file using TCP, sending 1500 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

What is the propagation delay for the round trip in milliseconds (ms): __ 2 * 2E6 m / 2E8m/s * 1E3 ms/s = __ **20** _ ms

If the router buffers are empty, what is the total round trip transmission delay (neglect processing delay)? ___**1.13**____ ms
*[9 * 1500 B * 8 b/B /100 Mb/s + 2 * 1500 B * 8 b/B /1000 Mb/s] * [1 + 40/1500] = 0.00112 s*

If the window size in 65 kbytes, what will be the initial attempted transmission rate: **___24 Mbps**_____ bits/sec
{*initially buffers empty: R = W/RTT = 8 b/B * 65,000 B/(0.020+0.00113 s)* }

What will happen to reduce the rate A sends to fit the lowest link rate? **Nothing - Rate is lower than slowest link.** _
{ *On the exam, the initial rate will be higher than the minimum link speed , so buffers will fill to a certain level* }

How large a buffer is needed by the first router to avoid packet loss after equilibrium is reached? _ **0** *(or 1.500)* kbytes
*If there were congestion, WINDOW / [8 (*Bytes-in Buffer) / 100 Mbps + 0.02113 s] = Slowest-link-in-bps* }

If the buffer is smaller and packets are lost at 100 Mbps, what happens? The average _____**CongWin**_____decreases causing the __ **Rate** { *CongWin/RTT* }__ to decrease.

Question 6– Running Average for Calculating the Retransmit Time Out (8 points)

Use back of page for calculations. Round results up to 1 ms. *{Values of A and D were graded}*

Measured Round-Trip Time **SampleRTT**	A=Average RTT Alpha = 1/8 **EstimatedRTT**	Deviation (+/-)	D = Average Deviation Beta = ¼ **DevRTT**	**RTO** = A + 4D **TimeOut**
40	60	15	10	100
90	**64**	+30 *(M - old-A)*	**15**	124
30	**60**	-34 *(M - old-A)*	**20**	140

*A = 0.875 * 60 + 0.125 * 90 = 63.75 -> 64*
*A = 0.875 * 64 + 0.125 * 30 = 59.75 -> 60*

*D = 0.75 * 10 + 0.25 * |30| = 15*
*D = 0.75 * 15 + 0.25 * |-34| = 19.75 -> 20*

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.