COMP 361 Computer Communications Networks

Fall Semester 2003

Midterm Examination

Date: October 23, 2003, Time 18:30pm --19:50pm

Name:______________________Student ID:________________Email:_______________

Instructions:

1. This is a closed book exam
2. This examination paper consists of 8 pages and 7 questions
3. Please write your name, student ID and Email on this page.
4. For each subsequent page, please write your student ID at the top of the page in the space provided.
5. Please answer all the questions within the space provided on the examination paper. You may use the back of the pages for your rough work. Each question is on a separate page. This is for clarity and is not meant to imply that each question *requires* a full page answer. Many can be answered using only a few lines.
6. Please read each question very carefully and answer the question clearly and to the point. Make sure that your answers are neatly written, readable and legible.
7. Show all the steps you use in deriving your answer, where ever appropriate.
8. For each of the questions assume that the concepts are known to the graders. Concentrate on answering to the point what is asked. Do not define or describe the concepts unless specifically asked to do so.

Question	Points	Score
1	10	
2	10	
3	10	
4	15	
5	15	
6	20	
7	20	
TOTAL	100	

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1. Answer the following true/false questions by circling either T or F (10 points)

(a) The FTP protocol runs on top of TCP. **T**

(b) DNS runs on top of TCP **F**

(c) If HTTP uses persistent TCP connections only one object can be transferred over the connection before closing it. **F**

(d) UDP does not provide a congestion control scheme. **T**

(e) If a name server is authoritative for a particular hostname, it will contain a Type-A record for the hostname. **T**

(f) *Doubling the Timeout Interval* in TCP is a limited form of Flow-Control **F**

(g) HTTP uses out-of-band control **F**

(h) FTP uses out-of-band control **T**

(i) The user-agent (e.g., mail-reader) of the receiver of an email message uses SMTP to download the message from the receiver's mailbox. **F**

(j) *Selective-repeat* protocols keep only one timer, which is used to signal timeouts of the oldest unacknowledged packet. **F**

2. (10 points).
(a) Briefly explain the difference between *transmission delay* and *propagation delay*.

(b) Assume that two hosts, A and B are connected by a single link with rate R bps (bits per second). A and B are separated by *m* meters and the propagation speed along the link connecting them is *s* meters/second. Host A is sending a packet of L bits to host B. Ignoring processing and queuing time, obtain an expression for the end-to-end delay. That is, how much time passes from when the first bit leaves A to when the last bit arrives at B.

Solution:
(a) Transmission delay is the amount of time required to push all of a packet's bits onto the link.

Propagation delay is the time required for a bit to propagate (move) from the beginning of the link to the end of the link.

(b) L/R + m/s seconds

3. (10 points).

(a) Briefly define what is meant by a **packet-switched network.**

(b) Briefly define what is meant by a **circuit-switched network**.

(c) For each of these two types of network, describe one advantage and one disadvantage.

Solution:

The following is from Lab 1. Anything remotely similar was accepted as a correct answer.

- *Circuit Switching*: In this case, each exchange of data between any two nodes requires the set up of a connection between them. Once the circuit is established, resources are dedicated to this connection along the route for the duration of the communication. The advantage is that the connection can guarantee a level of service (e.g., bit rate) for the communication between the nodes. A disadvantage is that each exchange of data requires the establishment of the connection which is an overhead.

- *Packet Switching*: In packet switching the nodes exchange data without establishing the connection. The resources along the route are statistically multiplexed, which means that they are more efficiently utilized. A disadvantage is that the connection cannot guarantee a level of service because of the statistical multiplexing

4. Suppose within your Web browser you click on a link to obtain a Web page. The Web page you are getting is at server S0. Its size is very small, but it contains four objects stored at servers S1, S2, S3 and S4. Each object has size of 1000bits. Assume that each TCP connection established from your host has throughput of 10000bits/sec. Let RTTi denote the RTT between the local host and the server Si. How much time elapses from when the client clicks on the link until the client receives all the objects?
Note: In this question you should assume (i) that the IP addresses for all URLs are cached in your local host so no DNS lookup is required and (ii) your browser is NOT using persistent connections and also is Not using parallel connections.
(15 points).

Solution:
Once the IP address is known, RTT0 elapses to set up a TCP connection and another RTT0 elapses to request and receive the small object from S0. The time needed to bring an object of size 1000bits is 0.1s. For get object i it is necessary to use 2RTT_i (seeting up the connection) + transmission time for the object. So, the total response time is therefore;

2*RTT0 + 2RTT1 + 0.1 + 2RTT2 + 0.1 + 2RTT3+ 0.1 + 2RTT4+ 0.1

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5. Suppose that root name server has the two following records :
(umass.edu, dns.umass.edu, NS)
(dns.umass.edu, 128.119.40.111, A)
Also, suppose that machine dns.umass.edu has the following resource record:
(gaia.cs.umass.edu, 128.119.40.200, A)

Suppose that you are working at HKUST and your host machine needs to resolve the name *gaia.cs.umass.edu*. Describe the sequence of queries between your host and the servers involved in the query process. What is the number of communications needed to obtain the IP address of gaia.cs.umass.edu? You should assume that the resolved IP address is **not cached** at the local host and that the processing of all queries is **recursive**. (15 points)

1. Local host contacts the local name server.
    2. Local name server contacts the root server.
        3. Root server contacts the authoritative server.
        4. Authoritative server sends the resolved IP address.
    5. Root server forwards the answer to the local name server.
6. Local name server forwards the answer to the host.

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6. Recall the Go-Back-N (GBN) protocol studied in class. The sender in GBN must respond to three different types of events. These are

1. *Invocation from above (application process requests to send data)*
2. *Receipt of an ACK from the receiver*
3. *A timeout event*

Briefly describe what the sender's response is to each of these events. In your description you must specify which, if any, packets are sent out and how the timer(s) are (re)set.
(20 points).

Solution:

1. *Invocation from above (application process requests to send data)*
Sender checks to see if window is full
If it is full it returns data to upper level
If it is not full then a packet is created and sent out with next available seqnum.
If the window was empty and this new packet is the ONLY unacknowledged packet then the timer is set (otherwise nothing is done to the timer)

2. *Receipt of an ACK from the receiver*
If the received ACK is for SEQ# n then all packets with sequence # UP TO AND INCLUDING n are marked as acknowledged (cumulative acknowledgement).

If the window is now empty (no unacknowledged packets remaining) then the timer is stopped. Otherwise, the timer is started .

To get full credit for this problem you must describe (if not explicitly mention) cumulative acknowledgement.

3. *A timeout event*
Resend ALL unacknowledged packets in sender's window.
(re)start timer.

7. Recall that the TCP segment contains a field called **Receive-Window** which is used for flow control. Answer the following three questions. (20 points)

1. What is "**flow-control"**?
2. What is "**congestion-control**".
3. Briefly explain how the TCP Flow-Control algorithm works. To do this you should describe what information is passed between the sender/receiver and how this information is acted upon. *Note: to do this you do not need to remember the names of the variables involved, only their purposes.*

Solution

1. **Flow-control** is a speed matching service. It makes sure that the sender is not sending so fast that it is overwhelming the receiver's buffer.

2. The purpose of **congestion control** is to stop the NETWORK from being overwhelmed by too much traffic.

3. Every packet send by the receiver to the sender contains a value **Receive-Window,** which is the amount of free buffer space (in bytes) available in the receiver's window. The sender's policy is to ensure that it never has more than **Receive-Window** unacknowledged bytes sent at any given time.

In order to get full credit for this solution it was not enough to say that the sender used **Receive-Window** to avoid oveflowing the receiver's buffer. You must have explained **how** the sender used the value in **Receive-Window.**

Note: If **Receive-Window=0** there is special exception to this policy in that the sender will keep on sending packets with 1 byte. To get full credit for this question it was not necessary to mention this special case.