Test Prep:

This is a Google Doc Shared with All of you.
You are to create your OWN copy; work out each solution with your partner; record your own solution on your Google Doc; and upload your completed Google Doc to the wiki as Lab 7.

These problems are (hopefully) direct copies of the indicated problems.

Chapter 1:

P6: This elementary problem begins to explore propagation delay and transmission delay, two central concepts in data networking. Consider two hosts, **A** and **B**, connected by a single link of rate ***R*** bps. Suppose that the two hosts are separated by ***m*** meters, and suppose the propagation speed along the link is ***s*** meters/sec. Host **A** is to send a packet of size ***L*** bits to Host B. Exploring propagation delay and transmission delay

1. Express the propagation delay, d_{prop}, in terms of m and s.
   a. Answer: dprop = m/s seconds
2. Determine the transmission time of the packet, d_{trans}, in terms of L and R.
   a. Answer: = L/R seconds
3. Ignoring processing and queuing delays, obtain an expression for the end-to-end delay.
   a. Answer: = (m/s + L/R) seconds
4. Suppose Host A begins to transmit the packet at time t=0t=0. At time t=t= d_{trans}, where is the last bit of the packet?
   a. Answer: The bit is just leaving Host A
5. Suppose d_{prop} is greater than d_{trans}. At time t=dtranst=dtrans, where is the first bit of the packet?
   a. Answer: The first bit is in the link and has not reached Host B
6. Suppose d_{prop} is less than d_{trans}. At time t=dtranst=dtrans, where is the first bit of the packet?
   a. Answer:The first bit has reached Host B
7. Suppose s=2.5⋅108s=2.5⋅108, L=120 bitsL=120 bits, and R=56kbps.R=56 kbps. Find the distance m so that d_{prop} equals d_{trans}.
   a. Answer: m = (L/R)s = 120/56*10**3 (2.5*10**8) = 536km

Chapter 2

P3: Consider an HTTP client that wants to retrieve a Web document at a given URL. The IP address of the HTTP server is initially unknown. What transport and application-layer protocols besides HTTP are needed in this scenario?

Answer: App Protocols: DNS and HTTP Trans Protocols: UDP for DNS; TCP for HTTP

P7. Suppose within your Web browser you click on a link to obtain a Web page. The IP address for the associated URL is not cached in your local host, so a DNS lookup is necessary to obtain the IP address. Suppose that *n* DNS servers are visited before your host receives the IP address from DNS; the successive visits incur an RTT of $RTT_1, . . ., RTT_n$.RTT1,. . .,RTTn.Further suppose that the Web page associated with the link contains exactly one object, consisting of a small amount of HTML text. Let RTT_0 denote the RTT between the local host and the server containing the object. Assuming zero transmission time of the object, how much time elapses from when the client clicks on the link until the client receives the object?

Answer: Total time is: $RTT_1 + . . . + RTT_n$ to get IP address Once IP address known, RTTo to set up connection, and another RTT to request and receive the object. Therefore: 2RITo + $RTT_1 + . . . + RTT_n$

P8. Referring to Problem P7, suppose the HTML file references eight very small objects on the same server. Neglecting transmission times, how much time elapses with

1. Non-persistent HTTP with no parallel TCP connections?
   Answer: Answer 7 above + 8*2RTTo or 18RTTo + $RTT_1 + . . . + RTT_n$
2. Non-persistent HTTP with the browser configured for 5 parallel connections?
   Answer: Answer 7 above + 2*2RTTo or 6RTTo + $RTT_1 + . . . + RTT_n$
3. Persistent HTTP?
   Answer: a) Persistent connection with pipelining. This is the default mode of HTTP.
   3RTTo + $RTT_1 + . . . + RTT_n$
4. Persistent connection without pipelining, without parallel connections. 10RTTo + $RTT_1 + . . . + RTT_n$
5.

Chapter 3

P25. We have said that an application may choose UDP for a transport protocol because UDP offers finer application control (than TCP) of what data is sent in a segment and when.

1. Why does an application have more control of what data is sent in a segment?
   Answer: a) Consider sending an application message over a transport protocol. With TCP, the application writes data to the connection send buffer and TCP will grab bytes without necessarily putting a single message in the TCP segment; TCP may put more or less than a single message in a segment. UDP, on the other hand, encapsulates in a segment whatever the application gives it; so that, if the application gives UDP an application message, this message will be the payload of the UDP segment. Thus, with UDP, an application has more control of what data is sent in a segment.
2. Why does an application have more control on when the segment is sent?
   Answer: a) With TCP, due to flow control and congestion control, there may be significant delay from the time when an application writes data to its send buffer until when the data is given to the network layer. UDP does not have delays due to flow control and congestion control.

P27. Host A and B are communicating over a TCP connection, and Host B has already received from A all bytes up through byte 126. Suppose Host A then sends two segments to Host B back-to-back. The first and second segments contain 80 and 40 bytes of data, respectively. In the first segment, the sequence number is 127, the source port number is 302, and the destination port number is 80. Host B sends an acknowledgment whenever it receives a segment from Host A.

(1). In the second segment sent from Host A to B, what are the sequence number, source port number, and destination port number?
Answer: In the second segment from Host A to B, the sequence number is 207, source port number is 302 and destination port number is 80.

(2) If the first segment arrives before the second segment, in the acknowledgment of the first arriving segment, what is the acknowledgment number, the source port number, and the destination port number?
Answer: If the first segment arrives before the second, in the acknowledgement of the first arriving segment, the acknowledgement number is 207, the source port number is 80 and the destination port number is 302.

(3) If the second segment arrives before the first segment, in the acknowledgment of the first arriving segment, what is the acknowledgment number?
Answer: If the second segment arrives before the first segment, in the acknowledgement of the first arriving segment, the acknowledgement number is 127, indicating that it is still waiting for bytes 127 and onwards.

(4) Suppose the two segments sent by A arrive in order at B. The first acknowledgment is lost and the second acknowledgment arrives after the first timeout interval. Draw a timing diagram, showing these segments and all other segments and acknowledgments sent. (Assume there is no additional packet loss.) For each segment in your figure, provide the sequence number and the number of bytes of data; for each acknowledgment that you add, provide the acknowledgment number. Answer:

Chapter 4

P2. Suppose two packets arrive to two different input ports of a router at exactly the same time. Also suppose there are no other packets anywhere in the router.

1. Suppose the two packets are to be forwarded to two different output ports. Is it possible to forward the two packets through the switch fabric at the same time when the fabric uses a shared bus?

Answer: No, you can only transmit one packet at a time over a shared bus.

2. Suppose the two packets are to be forwarded to two different output ports. Is it possible to forward the two packets through the switch fabric at the same time when the fabric uses switching via memory?
   Answer: No, as discussed in the text, only one memory read/write can be done at a time over the shared system bus.
3. Suppose the two packets are to be forwarded to the same output port. Is it possible to forward the two packets through the switch fabric at the same time when the fabric uses a crossbar?
   Answer: No, in this case the two packets would have to be sent over the same output bus at the same time, which is not possible.

P6. Consider a datagram network using 8-bit host addresses. Suppose a router uses longest prefix matching and has the following forwarding table:

Prefix Match	Interface
00 - 00000000 thu 00111111	0 64
010 - 01000000 thu 01011111	1 32
011 - 01100000 thu 01111111	2 32
10 - 10000000 thru 10111111	2 64
11 - 11000000 thru 11111111	3 64

For each of the four interfaces, give the associated range of destination host address and the number of addresses in the range.

Answer: you can add answers to the above table

P11. Consider a subnet with prefix 128.119.40.128/26. Give an example of one IP address (of form xxx.xxx.xxx.xxx) that can be assigned to this network. Suppose an ISP owns the block of addresses of the form 128.119.40.64/26. Suppose it wants to create four subnets from this block, with each block having the same number of IP addresses. What are the prefixes (of form a.b.c.d/x) for the four subnets?

Answer: Any IP address in range 128.119.40.128 to 128.119.40.191

For each of the four interfaces, give the associated range of destination host addresses and the number of addresses in the range.

Four equal size subnets: 128.119.40.64/28, 128.119.40.80/28, 128.119.40.96/28, 128.119.40.112/28