Homework Assignment 1

1. If the data flows require certain amount of guaranteed bandwidth, is a packet switched network or a circuit switched network a better choice for data delivery? (2 points)

2. List the five-layer protocol stack that is used by the Internet. (10 points)

3. Consider a satellite link with a distance of 100 kilometers and a transmission rate of 1 Mbps. The signal propagation speed is $2.5 \times 10^8$ meters/sec. What is the maximum number of bits that the link carries on the fly during transmission? (5 points)

4. Page 68, Problem 16 (6e, Page 69, Problem 16) (10 points)

   Consider sending a packet from a source host to a destination host over a fixed route. List the delay components in the end-to-end delay. Which of these delays are constant and which are variable?
Consider the throughput example corresponding to the following figure. Now suppose that there are $M$ client-server pairs rather than 10. Denote $R_s$, $R_c$, and $R$ for the rates of the server links, client links, and network link. Assumes all other links have abundant capacity and that there is no other traffic in the network besides the traffic generated by the $M$ client-server pairs. Derive a general expression for throughput in terms of $R_s$, $R_c$, $R$ and $M$.

In modern packet-switched networks, the source host segments long, application-layer messages (for example, an image or a music file) into smaller packets and sends the packets into the network. The receiver then reassembles the packets back into the original message. We refer to this process as message segmentation. Figure 1.27 illustrates the end-to-end transport of a message with and without message segmentation. Consider a message that is 8 · 10 bits long that is to be sent from source to destination in Figure 1.27. Suppose each link in the figure is 2 Mbps. Ignore propagation, queuing, and processing delays.

a. Consider sending the message from source to destination without message segmentation. How long does it take to move the message from the source host to the first packet switch? Keeping in mind that each switch uses store-and-forward packet switching, what is the total time to move the message from source host to destination host?

b. Now suppose that the message is segmented into 800 packets, with each packet being 10,000 bits long. How long does it take to move the first packet from source host to the first switch? When the first packet is being sent from the first switch to the second switch, the second packet is being sent from the source host to the first switch. At what time will the second packet be fully received at the first switch?

c. How long does it take to move the file from source host to destination host when message segmentation is used? Compare this result with your answer in part (a) and comment.

d. In addition to reducing delay, what are the reasons to use message segmentation?

e. Discuss the drawbacks of message segmentation.
Skype offers a service that allows you to make a phone call from a PC to an ordinary phone. This means that the voice call must pass through both the Internet and through telephone network. Discuss how this might be done.

**Homework Submission: Hard Copy**