

CNT 5106

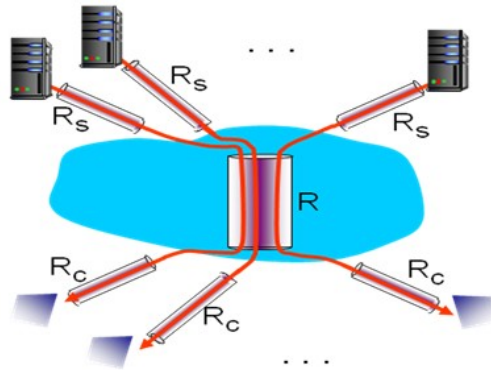
Spring 2023

Homework Assignment 1

Handout: 1/19, Due: 1/26/2023 on Canvas

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. List the five-layer protocol stack that is used by the Internet.
3. Consider a satellite link with a distance of 100 kilometers and a transmission rate of 1 Mbps. The signal propagation speed is 2.5×10^8 meters/sec. What is the maximum number of bits that the link carries on the fly during transmission?
4. 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?
5. Perform a Traceroute between source and destination on the same continent at three different hours of the day.
 - a. Find the average and standard deviation of the round-trip delays at each of the three hours.
 - b. Find the number of routers in the path at each of the three hours. Did the paths change during any of the hours?
 - c. Try to identify the number of ISP networks that the Traceroute packets pass through from source to destination. Routers with similar names and/or similar IP addresses should be considered as part of the same ISP. In your experiments, do the largest delays occur at the peering interfaces between adjacent ISPs?
 - d. Repeat the above for a source and destination on different continents. Compare the intra-continent and inter-continent results.

6. 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. Assume 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 .



7. 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 $8 \cdot 10^6$ 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.
- 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?
 - 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?
 - 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.
 - In addition to reducing delay, what are the reasons to use message segmentation?
 - Discuss the drawbacks of message segmentation.

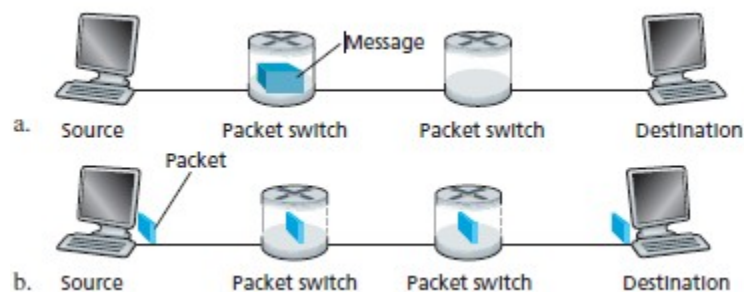


Figure 1.27 End-to-end message transport: (a) without message

segmentation; (b) with message segmentation.

8. 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 through Canvas:

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