Tutorial 3 & 4

Instructions

1. Form ad-hoc groups of 2 to 3 students to solve this week's exercise.
2. Each group must answer the following review Q's
3. Each group will use shared google docs to work with all group members and tutor. The document must include the group member's names and the tutorial sheet number.

Review Questions

1. Q3-3. Assume you need to write and test a client-server application program on two hosts you have at home.
   a. What is the range of port numbers you would choose for the client program?
   b. What is the range of port numbers you would choose for the server program?
   c. Can the two port numbers be the same?

2. Q3-5. In a network, the size of the receive window is 1 packet. Which of the following protocols is being used by the network?
   a) Stop-and-Wait
   b) Go-Back-N &
   c) Selective-Repeat

3. Q3-7. In a network with fixed value for windows size $m > 1$, we can use either the Go-Back-N or the Selective-Repeat protocol. Describe the advantage and the disadvantage of using each. What other network criteria should be considered to select either of these protocols?

4. Q3-11. Can you explain why some transport-layer packets may be lost in the Internet?

5. Q3-13. In the **Go-Back-N protocol**, the size of the send window can be $2^{m}-1$, while the size of the receive window is only 1. How can flow control be accomplished when there is a big difference between the size of the send and receive windows?

6. Q3-15. Some of the application programs can use the services of two transport-layer protocols (UDP or TCP). When a packet arrives at the destination, how can the computer find which transport layer is involved?

7. Q3-17. UDP is a message-oriented protocol. TCP is a byte-oriented protocol. If an application needs to protect the boundaries of its message, which protocol should be used, UDP or TCP?

8. Q3-19. Assume a private internet, which uses point-to-point communication between the hosts and needs no routing, has eliminated the use of the network layer. Can this internet still benefit from the service of UDP or TCP? In other words, can user datagrams or segments be encapsulated in the Ethernet frames?

9. Q3-21. Can you explain why we need four (or sometimes three) message-segments for connection termination in TCP?

10. Q3-25. In TCP, how many sequence numbers are consumed by each of the following segments:

    a. SYN b. ACK c. SYN+ACK d. Data

11. Q3-27. Looking at the TCP header (Figure 3.44), we find that the sequence number is 32 bits long, while the window size is only 16 bits long. Does this mean that TCP is closer to the Go-Back-Nor Select-Repeat protocol in this respect?

12. Q3-29. What is the maximum size of the TCP header? What is the minimum size of the TCP header?

13. Q3-31. In TCP, does a FIN segment close a connection in only one direction or in both directions?

14. Q3-35. Can you explain how TCP, which uses the services provided by the unreliable IP, can provide reliable communication?

15. Q3-37. Assume Alice uses her browser to open two connections to the HTTP server running on Bob's server. How can these two connections be distinguished by the TCP?

16. Q3-39. In TCP, can the sender window be smaller, larger, or the same size as the receiver window?

17. Q3-41. In a TCP segment, what does a **sequence number** identify?

18. Q3-43. Is the use of checksum for error control optional or mandatory in:

    a. UDP?
    b. TCP?

19. Q3-45. Assume a TCP client expects to receive byte 2001, but it receives a segment with sequence number 1201. What is the reaction of the TCP client to this event? Can you justify the reaction?

20. P3-1. Compare the range of 16-bit addresses, 0 to 65,535, with the range of 32-bit IP addresses, 0 to 4,294,967,295 (discussed in Chapter 4). Why do we need such a large range of IP addresses, but only a relatively small range of port numbers?

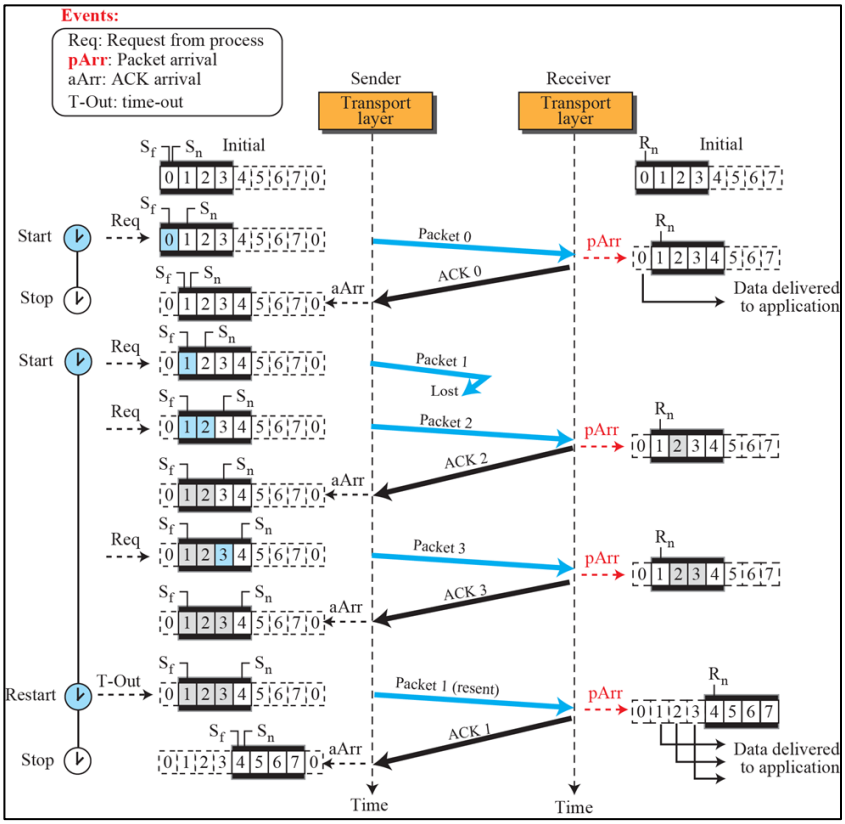
21. P3-5. Using 5-bit sequence numbers, what is the maximum size of the send-receive windows for each of the following protocols.

    a) Stop-and-Wait
    b) Go-Back-N
    c) Selective-Repeat

22. P3-9. In the Stop-and-Wait protocol, show the case in which the receiver receives a duplicate packet (which is also out of order). Hint: Think about a delayed ACK. What is the reaction of the receiver to this event?

23. P3-13. Create a scenario similar to Figure 3.22 in which the sender sends two packets. The first packet is received and acknowledged, but the acknowledgment is lost. The sender resends the packet after time-out. The second packet is lost and resent.

24. P3-15. Redraw **Figure 3.35** if the sender sends 5 packets (0, 1, 2, 3, and 4). Packet 1 and 2 are received in order and acknowledged, one by one. Packet 3 delayed and received after packet 4.



25. P3-19. . We can define the bandwidth-delay product in a network as the number of packets that can be in the pipe during the round-trip time (RTT). What is the bandwidth-delay product in each of the following situation s?

    a. Bandwidth: 1 Mbps, RTT: 20 ms, packet size: 1000 bits
    b. Bandwidth: 10 Mbps, RTT: 20 ms, packet size: 2000 bits
    c. Bandwidth: 1 Gbps, RTT: 4 ms, packet size: 10,000 bits

26. P3-21. Assume we need to design a **Selective-Repeat sliding-window** protocol for a network in which the bandwidth is 1 Gbps and the average distance between the sender and receiver is 5,000 Km. Assume the average packet size is 50,000 bits and the propagation speed in the media is 2×10^8 m.

    a. Find the maximum size of the send and receive windows,

    b. Find the number of bits in the sequence number field (m), and

    c. Appropriate time-out value for the timer.

27. P3-25. Answer the following questions:

    a. What is the minimum size of a UDP user datagram ?
    b. What is the maximum size of a UDP user datagram?
    c. What is the minimum size of the application-layer payload data that can be encapsulated in a UDP user datagram?
    d. What is the maximum size of the application-layer payload that can be encapsulated in a UDP user datagram?

28. P3-27. The following is a dump (contents) of a UDP header in hexadecimal format

    0045DF0000580000

    a. What is the source port number?
    b. What is the destination port number?
    c. What is the total length of the user datagram?
    d. What is the length of the data?
    e. Is the packet directed from a client to a server or vice versa?
    f. What is the application -layer protocol?
    g. Has the sender calculated a checksum for this packet?

29. P3-37. A client uses TCP to send data to a server. The data consist of 16 bytes. Calculate the efficiency of this transmission at the TCP level (ratio of useful bytes to total bytes).

30. P3-55. In a TCP connection, assume that maximum segment size (MSS) is 1000 bytes. The client process has 5400 bytes to send to the server process, which has no bytes to respond (unidirectional communication). The TCP server generates ACKs according to the rules we discussed in the text. Show the time line for the transactions during the slow start phase, indicating the value of ***cwnd*** at the beginning, at the end, and after each change. Assume that each segment header is only 20 bytes.