Sheet (3)

MCQs

1. Which of the following functionalities must be implemented by a transport protocol over and above the network protocol?
    a. Recovery from packet losses
    b. Detection of duplicate packets
    c. Packet delivery in the correct order
    d. End to end connectivity

2. Which of the following is **NOT** true about User Datagram Protocol in transport layer?
    a. Works well in unidirectional communication, suitable for broadcast information.
    b. It does three-way handshake before sending datagrams
    c. It provides datagrams, suitable for modeling other protocols such as in IP tunneling or Remote Procedure Call and the Network File System.
    d. The lack of retransmission delays makes it suitable for real-time applications.

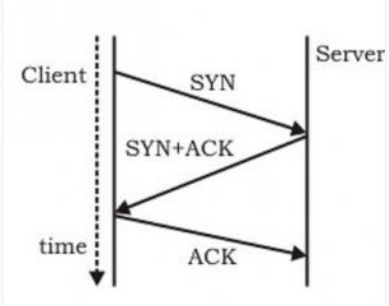
3. Suppose two hosts use a TCP connection to transfer a large file. Which of the following statements is/are **False** with respect to the TCP connection?
    i. If the sequence number of a segment is m, then the sequence number of the subsequent segment is always m+1.
    ii. If the estimated round-trip time at any given point of time is t sec, the value of the retransmission timeout is always set to greater than or equal to t sec.
    iii. The size of the advertised window never changes during the TCP connection.
    iv. The number of unacknowledged bytes at the sender is always less than or equal to the advertised window.
    a. iii only
    b. i and iii only
    c. i and iv only
    d. ii and iv only

4. A link has a transmission speed of 10^6 bits/sec. It uses data packets of size 1000 bytes each. Assume that the acknowledgment has negligible transmission delay, and that its propagation delay is the same as the data propagation delay. Also assume that the processing delays at nodes are negligible. The efficiency of the stop-and-wait protocol in this setup is exactly 25%. Then the value of the one-way propagation delay (in milliseconds) is _____.
    a. 4
    b. 8
    c. 12
    d. 1

5. Consider the following statements about the timeout value used in TCP.
   i. The timeout value is set to the RTT (Round Trip Time) measured during TCP connection establishment for the entire duration of the connection.
   ii. Appropriate RTT estimation algorithm is used to set the timeout value of a TCP connection.
   iii. Timeout value is set to twice the propagation delay from the sender to the receiver. Which of the following choices hold?
      a. i is false, but ii and iii are true.
      b. i and iii are false, but ii is true.
      c. i and ii are false, but iii is true.
      d. all statements are false.

6. Consider a TCP connection in a state where there are no outstanding ACKs. The sender sends two segments back-to-back. The sequence numbers of the first and second segments are 230 and 290 respectively. The first segment was lost, but the second segment was received correctly by the receiver. Let X be the amount of data carried in the first segment (in bytes), and Y be the ACK number sent by the receiver. The values of X and Y (in that order) are:
      a. 60 and 290
      b. 230 and 291
      c. 60 and 231
      d. 60 and 230

7. The three-way handshake for TCP connection establishment is shown below. Which of the following statements are **TRUE**?
   S1 Loss of SYN + ACK from the server will not establish a connection.
   S2 Loss of ACK from the client cannot establish the connection.
   S3 The server moves LISTEN → SYN_RCVD → SYN_SENT → ESTABLISHED in the state machine on no packet loss.
   S4 The server moves LISTEN → SYN_RCVD → ESTABLISHED in the state machine on no packet loss.



      a. S2 and S3 only
      b. S1 and S4
      c. S1 and S3
      d. S2 and S4

8. If Initial sequence number = 0, then An ACK number of 1000 in TCP always means that
      a. 999 bytes have been successfully received.
      b. 1000 bytes have been successfully received.
      c. 1001 bytes have been successfully received.
      d. None of the mentioned

9. Suppose you are browsing the world wide web using a web browser and trying to access the web servers. What is the underlying protocol and port number that are being used?
    a. UDP, 80
    b. TCP, 80
    c. TCP, 25
    d. UDP, 25

10. Which of the following is not a field in TCP header?
    a. Fragment offset
    b. Sequence number
    c. Checksum
    d. Window size

True or False

1. Transport services and protocols provide logical communication between hosts.
2. Suppose Client A initiates a Telnet session with Server S. At about the same time, Client B also initiates a Telnet session with Server S. If A and B are different hosts, is it permissible that the source port number in the segments from A to S is the same as that from B to S.
3. Both UDP and TCP require that the applications recognize their own data formats.
4. A TCP transmitter normally interprets three duplicate ACKs to mean that, while data packets have been received out of order, all data is successfully being delivered.
5. A transport protocol can be either connection oriented, such as UDP, or connectionless, such as TCP.
6. Suppose Host A sends one segment with sequence number 38 and 4 bytes of data over a TCP connection to Host B. In this same segment the acknowledgment number is necessarily 42.
7. There is not a need for connection establishment and termination procedures to support connection-oriented service with a reliable network service.
8. Connection establishment in TCP always uses a three-way handshake.
9. At the sender side, transport layer aggregates data from different applications into a single stream before passing it to network layer.
10. TCP groups several bytes together into a packet called packet.
11. Suppose a TCP connection is transferring a file of 1000 bytes. The first byte is numbered 10001. The sequence number of the segment if all data is sent in only one segment is 1000.
12. The size of the TCP rwnd never changes throughout the duration of the connection.

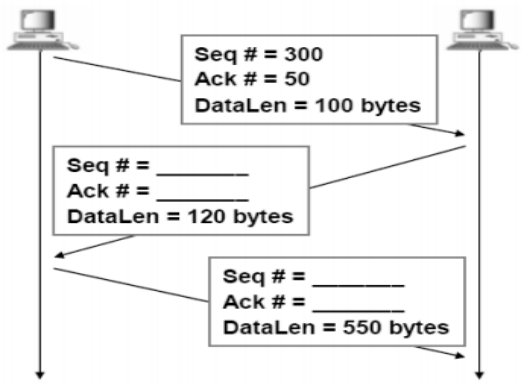
Problems

1. Consider a user on machine A requesting the web page http://SomeServer/something.html from the server named "SomeServer" that is on a different network. List the sequence of DNS, HTTP and TCP messages sent/received to serve this request from the moment the URL is entered to the browser until the file is completely received (the file doesn't have any embedded objects). Indicate the source and destination of each message. Assume recursive DNS queries.

2. UDP and TCP use 1s complement for their checksums. Suppose you have the following three 8-bit bytes: 01010011, 01100110, 01110100. What is the 1s complement of the sum of these 8-bit bytes? (Note that although UDP and TCP use 16-bit words in computing the checksum, for this problem you are being asked to consider 8-bit sums.) Show all work. Why is it that UDP takes the 1s complement of the sum; that is, why not just use the sum? With the 1s complement scheme, how does the receiver detect errors? Is it possible that a 1-bit error will go undetected? How about a 2-bit error?

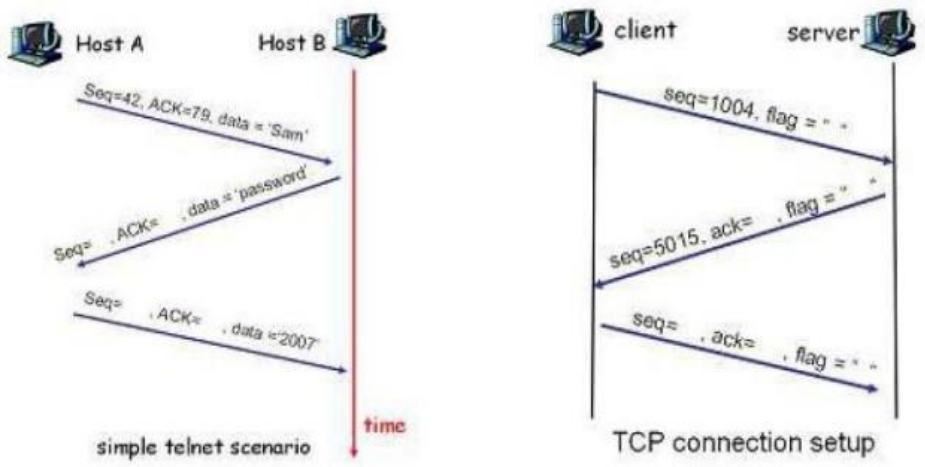
3. Assume rdt3.0, 1 Gbps link, 15 ms end-to-end propagation delay, and 1KB Packet. How large should the window be to allow for 90% link utilization?

4. For the TCP segments indicated below, specify the omitted values. Assume the packets are transmitted over a reliable link with no packet loss or corruption.

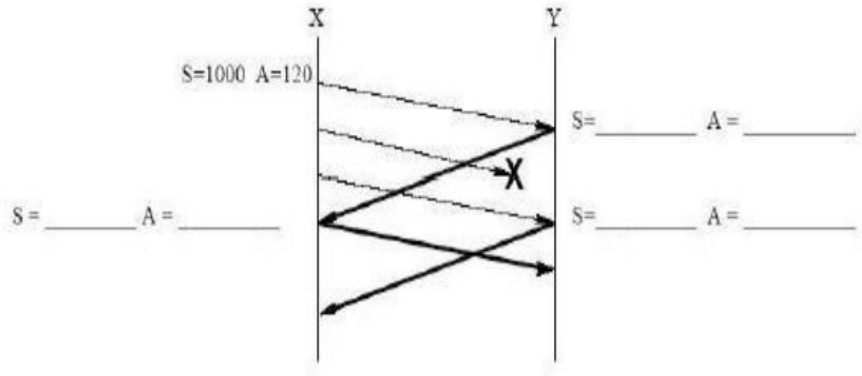


5. Suppose Host A sends two TCP segments back-to-back to Host B over a TCP connection. The first segment has sequence number 90; the second has sequence number 110.
    a. How much data is in the first segment?
    b. Suppose that the first segment is lost but the second segment arrives at B. In the acknowledgment that Host B sends to Host A, what will be the acknowledgment number?

6. Fill in the missing sequence numbers and acknowledgment numbers, knowing that each character is 1 byte long.



7. The following figure shows two hosts X and Y communicating over a channel using TCP. Hosts X and Y are sending data to each other. If each TCP segment contains 100 bytes of data and the 2nd segment sent by X is lost, complete the below figure by adding the missing sequence numbers and acknowledgment numbers. Assume Go-Back-N scenario.



8. 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.
    a. In the second segment sent from Host A to B, what are the sequence number, source port number, and destination port number?

b. 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?
c. If the second segment arrives before the first segment, in the acknowledgment of the first arriving segment, what is the acknowledgment number?
d. 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.

9. Consider transferring an enormous file of L bytes from Host A to Host B. Assume an MSS of 536 bytes.
    a. What is the maximum value of L such that TCP sequence numbers are not exhausted? Recall that the TCP sequence number field has 4 bytes.
    b. For the L you obtain in (a), find how long it takes to transmit the file. Assume that a total of 66 bytes of transport, network, and data-link header are added to each segment before the resulting packet is sent out over a 155 Mbps link. Ignore flow control and congestion control so A can pump out the segments back-to-back and continuously.

10. Consider the GBN protocol with a sender window size of 4 and a sequence number range of 1,024. Suppose that at time t, the next in-order packet that the receiver is expecting has a sequence number of k. Assume that the medium does not reorder messages. Answer the following questions.
    a. What are the possible sets of sequence numbers inside the sender's window at time t? Justify your answer.
    b. What are all possible values of the ACK field in all possible messages currently propagating back to the sender at time t? Justify your answer.

11. Suppose that the five measured SampleRTT values (see Section 3.5.3) are 106 ms, 120 ms, 140 ms, 90 ms, and 115 ms. Compute the EstimatedRTT after each of these SampleRTT values is obtained, using a value of $\alpha = 0.125$ and assuming that the value of EstimatedRTT was 100 ms just before the first of these five samples were obtained. Compute also the DevRTT after each sample is obtained, assuming a value of $\beta = 0.25$ and assuming the value of DevRTT was 5 ms just before the first of these five samples was obtained. Last, compute the TCP TimeoutInterval after each of these samples is obtained.

12. Consider Figure 3.58. Assuming TCP Reno is the protocol experiencing the behavior shown above, answer the following questions. In all cases, you should provide a short discussion justifying your answer.
    a. Identify the intervals of time when TCP slow start is operating.
    b. Identify the intervals of time when TCP congestion avoidance is operating.

c. After the 16th transmission round, is segment loss detected by a triple duplicate ACK or by a timeout?
d. After the 22nd transmission round, is segment loss detected by a triple duplicate ACK or by a timeout?
e. What is the initial value of ssthresh at the first transmission round?
f. What is the value of ssthresh at the 18th transmission round?
g. What is the value of ssthresh at the 24th transmission round?
h. During what transmission round is the 70th segment sent?
i. Assuming a packet loss is detected after the 26th round by the receipt of a triple duplicate ACK, what will be the values of the congestion window size and of ssthresh?