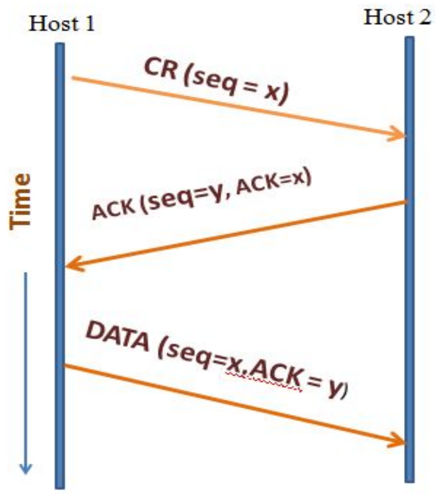
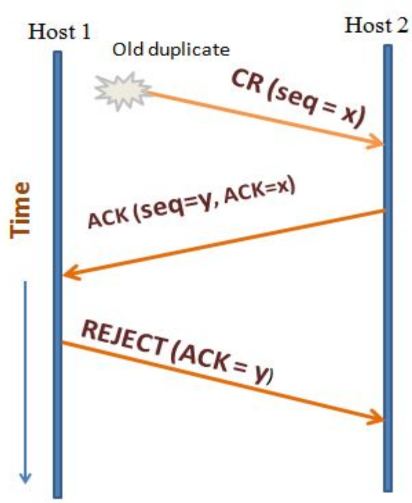
CS204 : Computer Networks Mid Sem Model Answers

Q1. Consider the 3-way handshake scheme for connection establishment between a client and server as shown below. (2 + 2 Marks)



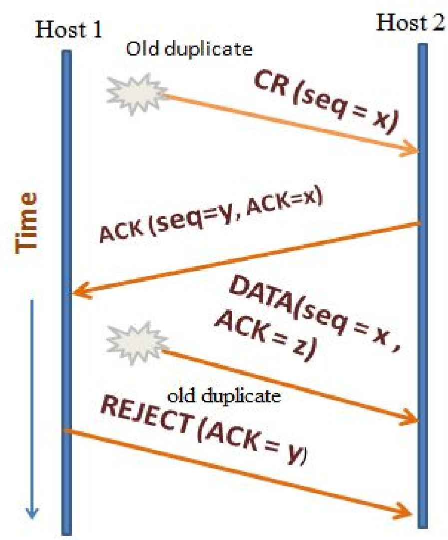
Explain what will happen in the following scenarios:

a. When an old duplicate request arrives at the server.



Ans : The first segment is a delayed duplicate CONNECTION REQUEST from an old connection. This segment arrives at host 2 without host 1's knowledge. Host 2 reacts to this segment by sending host 1 an ACK segment, in effect asking for verification that host 1 was indeed trying to set up a new connection. When host 1 rejects host 2's attempt to establish a connection, host 2 realizes that it was tricked by a delayed duplicate and abandons the connection. In this way, a delayed duplicate does no damage.

b. When both a duplicate request and the duplicate Data packet arrives at the server.



Ans : Host 2 has proposed using y as the initial sequence number for host 2 to host 1 traffic.Here that no segments containing sequence number y or acknowledgements to y are still in existence. When the second delayed segment arrives at host 2, the fact that z has been acknowledged rather than y tells host 2 that this, too, is an old duplicate. The important thing to realize here is that there is no combination of old segments that can cause the protocol to fail and have a connection set up by accident when no one wants it.

Q2. True or false? (1 + 1 + 1 + 1 + 1 Marks)
a. A user requests a Web page that consists of some text and three images. For this page, the client will send one request message and receive four response messages.
b. Two distinct Web pages (for example, www.mit.edu/research.html and www.mit.edu/students.html) can be sent over the same persistent connection.
c. With nonpersistent connections between browser and origin server, it is possible for a single TCP segment to carry two distinct HTTP request messages.
d. The *Date:* header in the HTTP response message indicates when the object in the response was last modified.
e. HTTP response messages never have an empty message body

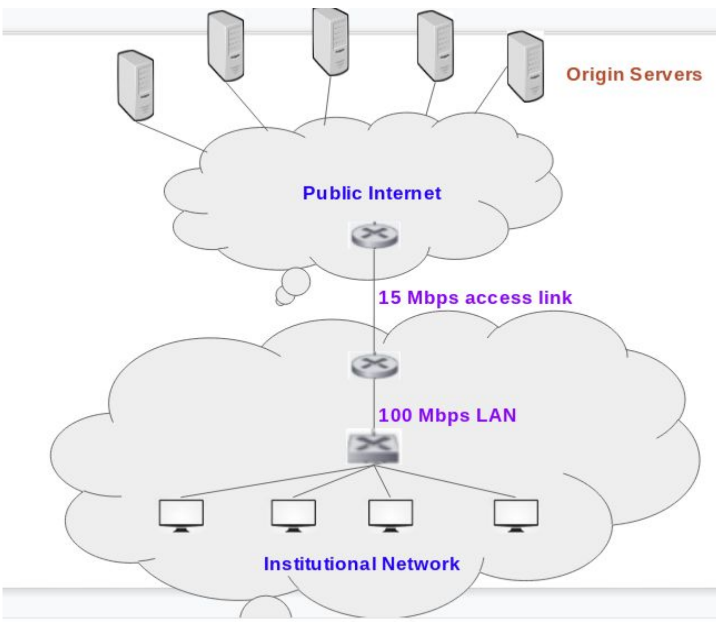
Answer:
a) F
b) T
c) F

d) F
e) F

Q3. 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? (2 + 2 Marks)

Answer: Application layer protocols: DNS and HTTP
Transport layer protocols: UDP for DNS; TCP for HTTP

Q4. Consider the figure given below, for which there is an institutional network connected to the Internet. (2 + 2 Marks)



Suppose that the average object size is 850,000 bits and that the average request rate from the institution's browsers to the origin servers is 16 requests per second. Also suppose that the amount of time it takes from when the router on the Internet side of the access link forwards an HTTP request until it receives the response is three seconds on average. Model the total average response time as the sum of the average access delay (that is, the delay from Internet router to institution router) and the average Internet delay. For the average access delay, use **Δ/(1 - ΔB**) where **Δ** is the average time required to send an object over the access link and **B** is the arrival rate of objects to the access link.

a. Find the total average response time.
b. Now suppose a cache is installed in the institutional LAN. Suppose the miss rate is 0.4. Find the total response time.

Ans:

a) The time to transmit an object of size L over a link or rate R is L/R. The average time is the average size of the object divided by R: Δ = (850,000 bits)/(15,000,000 bits/sec) = .0567 sec The traffic intensity on the link is given by $\beta\Delta$=(16 requests/sec)(.0567 sec/request) = 0.907. Thus, the average access delay is (.0567 sec)/(1 - .907) ≈ .6 seconds.
The total average response time = Average Access delay + Internet Delay
therefore .6 sec + 3 sec = 3.6 sec.

b) The traffic intensity on the access link is reduced by 60% since the 60% of the requests are satisfied within the institutional network. Thus the average access delay is (.0567 sec) /[1 – (.4)(.907)] = .089 seconds. The response time is approximately zero if the request is satisfied by the cache (which happens with probability .6).
The average response time = Average Access delay + Internet Delay
i.e .089 sec + 3 sec = 3.089 sec for cache misses (which happens 40% of the time).
So the average response time is (.6)(0 sec) + (.4)(3.089 sec) = 1.24 seconds.
Thus the average response time is reduced from 3.6 sec to 1.24 sec

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Q5. Consider the following string of ASCII characters that were captured by Wireshark when the browser sent an HTTP GET message (i.e., this is the actual content of an HTTP GET message). The characters <cr><lf> are carriage return and line-feed characters (that is, the initialized character string <cr> in the text below represents the single carriage-return character that was contained at that point in the HTTP header). Answer the following questions, indicating where in the HTTP GET message below you find the answer. (1 + 1 + 1 + 1 Marks)

GET /cs453/index.html HTTP/1.1<cr><lf>
Host: gaia.cs.umass.edu<cr><lf>
User-Agent: Mozilla/5.0 (Windows;U; Windows NT 5.1;
en-US;rv:1.7.2)Gecko/20040804Netscape/7.2 (ax) <cr><lf>
Accept:ext/xml, application/xml, application/xhtml+xml, text/html;q=0.9, text/plain;q=0.8, image/png,/*;q=0.5<cr><lf>*
Accept-Language: en-us, en;q=0.5<cr><lf>Accept-Encoding: zip, eflate<cr><lf>
Accept-Charset: ISO-8859-1, utf-8;q=0.7,;q=0.7<cr><lf>*
Keep-Alive: 300<cr><lf>Connection:keep-alive<cr><lf><cr><lf>

a. What is the URL of the document requested by the browser?
b. What version of HTTP is the browser running?
c. Does the browser request a non-persistent or a persistent connection?
d. What type of browser initiates this message? Why is the browser type needed in an HTTP request message?

Ans:
a) The document request was http://gaia.cs.umass.edu/cs453/index.html. The Host : field indicates the server's name and /cs453/index.html indicates the file name.
b) The browser is running HTTP version 1.1, as indicated just before the first <cr><lf> pair.
c) The browser is requesting a persistent connection, as indicated by the Connection: keep-alive.
d) This is a trick question. This information is not contained in an HTTP message anywhere. So there is no way to tell this from looking at the exchange of HTTP messages alone. One would need information from the IP datagrams (that carried the TCP segment that carried the HTTP GET request) to answer this question.
e) Mozilla/5.0. The browser type information is needed by the server to send different versions of the same object to different types of browsers.

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Q6. The text below shows the reply sent from the server in response to the HTTP GET message in the question above. Answer the following questions, indicating where in the message below you find the answer. (1 + 1 + 1 + 1 Marks)

HTTP/1.1 200 OK<cr><lf>
Date: Tue, 07 Mar 2008 12:39:45GMT<cr><lf>
Server: Apache/2.0.52 (Fedora)<cr><lf>
Last-Modified: Sat, 10 Dec2005 18:27:46 GMT<cr><lf>
ETag: ”526c3-f22-a88a4c80”<cr><lf>
Accept-Ranges: bytes<cr><lf>
Content-Length: 3874<cr><lf>
Keep-Alive: timeout=max=100<cr><lf>
Connection: Keep-Alive<cr><lf>
Content-Type: text/html; charset=
ISO-8859-1<cr><lf><cr><lf>

<!doctype html public ”-
//w3c//dtd html 4.0 transitional//en”><lf><html><lf>
<head><lf> <meta http-equiv=”Content-Type”
content=”text/html; charset=iso-8859-1”><lf> <meta
name=”GENERATOR” content=”Mozilla/4.79 [en] (Windows NT
5.0; U) Netscape]”><lf> <title>CMPSCI 453 / 591 /
NTU-ST550ASpring 2005 homepage</title><lf></head><lf>

<much more document text following here (not shown)>

a. Was the server able to successfully find the document or not? What time was the document reply provided?
b. When was the document last modified?
c. How many bytes are there in the document being returned?
d. What are the first 5 bytes of the document being returned? Did the server agree to a persistent connection?

Ans:
a) The status code of 200 and the phrase OK indicate that the server was able to locate the document successfully. The reply was provided on Tuesday, 07 Mar 2008 12:39:45 Greenwich Mean Time.
b) The document index.html was last modified on Saturday 10 Dec 2005 18:27:46 GMT.
c) There are 3874 bytes in the document being returned.
d) The first five bytes of the returned document are : <!doc. The server agreed to a persistent connection, as indicated by the Connection: Keep-Alive field

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Q7. A process on host 1 has been assigned port p, and a process on host 2 has been assigned port q. Is it possible for there to be two or more TCP connections between these two ports at the same time? Justify your answer. (2 Marks)

Ans:
The Scenario:

- Host 1 process assigned to port "p"
- Host 2 process assigned to port "q"

The possibility for the two or more TCP connections between ports p and q:

No, there is no possibility for two or more TCP connections between these two ports simultaneously; this is so because a connection is only identified by the sockets.

Therefore, the (1-p) - (2,q) are the only attainable connections between the ports p and q.

Q8. Consider the 3-way handshake based connection release scheme for releasing connections between two hosts (H1 and H2). In such a scheme, H1 requests for disconnection to H2, followed by H2 sending the disconnection request to H1. Finally, H1 sends an ACK to H2 and releases the connection. H2 on receiving the ACK also releases the connection. (2+2 Marks)

With relation to the above, explain what will happen in the following 2 scenarios:

a. Suppose, the second DISCONNECTION REQUEST (DR) from H2 to H1 gets lost and hence never reaches H1. In such a case, how will the connection between H1 and H2 be released.
b. If the final Acknowledgement (ACK) from H1 to H2 gets lost, then how will connection be released.

Ans :

a. If DISCONNECTION REQUEST (DR) from H2 to H1 gets lost , H1 will not receive the expected response, will time out, and will start all over again.
b. If final Acknowledgement (ACK) from H1 to H2 gets lost, H1 will release the connection after sending ACK.The situation in H2 is saved by the timer. When the timer expires, the connection is released anyway.

Q9. Consider a very basic procedure of Connection establishment - Sender (Client) sends a CONNECTION REQUEST segment to destination and waits for a CONNECTION ACCEPTED reply. With respect to the above, answer the following: (2 + 2 + 2 Marks)

a. What problem will you see if we execute the connection establishment procedure mentioned above?
b. How do we tackle this problem?
c. Based on the problem identified in (a) and the solution mentioned in (b), can you propose a scheme for efficient and correct connection establishment between sender and receiver. [The word “scheme” here means a sequence of message exchanges which can help successfully establish a connection between client and server, while avoiding the problem mentioned in (a).]

Answer:

a.Delayed Duplicates problem -Packets may be delayed and got struck in the network congestion,after the timeout, the sender assumes that the packets have been dropped, and retransmits the packets.Delayed duplicates create a huge confusion in the packet switching network.

b. Sequence number and Packet lifetime -

Solution 1: Give each connection a unique identifier chosen by the initiating party and put in each segment.

Solution 2: Two ways

- Putting a hop count in each packet – initialize to a maximum value and decrement each time the packet traverses a single hop (most feasible implementation)

- Timestamping each packet – define the lifetime of a packet in the network, need time synchronization across each router.

c. 3-way handshake scheme

- Host 1 chooses a sequence number x, and sends a CONNECTION REQUEST segment containing it to host 2.
- Host 2 replies with an ACK segment acknowledging x and announcing its own initial sequence number, y.
- Finally, Host 1 acknowledges (y) Host 2's choice of an initial sequence number x in the first data segment that it sends.

Q10. This elementary problem explores 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.
(1 + 1 + 1 + 1 + 1 + 1 + 1 Mark)

a. Express the propagation delay, ***dprop***, in terms of **m** and **s**.
b. Determine the transmission time of the packet, ***dtrans***, in terms of **L** and **R**.
c. Ignoring processing and queuing delays, obtain an expression for the end-to-end delay.
d. Suppose Host **A** begins to transmit the packet at time **t = 0**. At time **t=*dtrans***, where is the last bit of the packet?
e. Suppose ***dprop*** is greater than ***dtrans***. At time **t = *dtrans***,where is the first bit of the packet?
f. Suppose ***dprop*** is less than ***dtrans***. At time **t = *dtrans***, where is the first bit of the packet?
g. Suppose **s = 2.5 x 10^8 meters/second**, **L=120 bits**, and **R=56 Kbps**. Find the distance **m** so that ***dprop*** equals ***dtrans***.

Answer:

a) $d_{prop} = m / s$ seconds.

b) $d_{trans} = L / R$ seconds.

c)) $d_{end\text{-}to\text{-}end} = (m / s + L / R)$ seconds.

d) The bit is just leaving Host A.

e) The first bit is in the link and has not reached Host B.

f) The first bit has reached Host B.

g) Want

$m = (L / R) * S = (120 / 56 * 10^3) * (2.5 * 10^8) =5.357 \times 10^5$ meters

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