Solutions to the Sample Questions on Application Layer

Q1) Why is SMTP not used for transferring e-mail messages from the recipient's mail server to the recipient's personal computer?

Answer: SMTP is a push protocol; the task of transferring e-mail messages from the recipient's mail server to the recipient's personal computer is a pull operation.

Q2)

a) Answer: The time to transmit an object of size L over a link of rate R is L/R. The average time is the average size of the object divided by the transmission rate of the link, R: A= (900,000 bits)/(1,500,000 bits/sec) = .6 sec

The traffic intensity on the link is = AB= (.6 msec/request) (1.5 requests/sec) = .9. Thus, the average access delay is (.6 sec)/(1 - .9) = 6 seconds. The total average response time is therefore 6 sec + 2 sec = 8 sec.

b) Answer: The traffic intensity on the access link is reduced by 40% since the 40% of the requests are satisfied within the institutional network. Thus, the arrival rate of the objects to the link also changes since only 60% of the objects need to be fetched from the origin servers (the rest are obtained from the cache). As a result, B=1.5 x 0.6 = 0.9 requests/sec.

Thus the average access delay is (.6 sec)/[1 – (.6)(.9)] = ~~1.2~~ 1.3 seconds. The response time is approximately zero if the request is satisfied by the cache (which happens with probability .4); the average response time is ~~1.2~~ 1.3 sec + 2 sec = ~~3.2~~ 3.3 sec for cache misses (which happens 60% of the time). So the average response time is (.4)(0 sec) + (.6)(~~3.2~~ 3.3sec) = ~~1.92~~ 1.98 seconds. Thus, the average response time is reduced from 8 sec to 1.98 sec.

Q3) Why do you think DNS uses UDP, instead of TCP, for its query and response messages?

Answer: TCP involves a connection establishment phase while UDP does not. Using TCP for DNS may end up involving several TCP connections to be established since several name servers may have to be contacted to translate a name into an IP address. This imposes a high overhead in delay that is acceptable for larger transfers but not acceptable for very short messages such as DNS queries and responses. In addition, UDP affords a smaller packet size and also imposes a smaller load on name servers due to its simplicity in comparison to TCP.

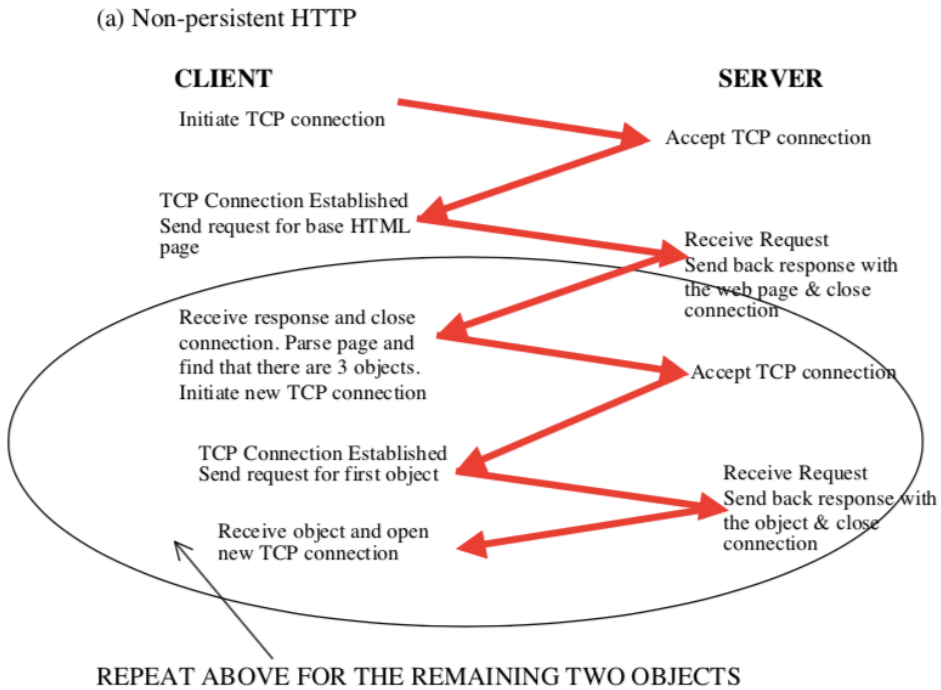
Q4) Suppose you are sending an email from your Hotmail account to your friend, who reads his/her e-mail from his/her mail server using IMAP. Briefly describe how your email travels from your host to your friend's host. Also, what are the application-layer protocols involved?

Answer: Message is sent from your host to your mail server over HTTP. Your mail server then sends the message to your friend's mail server over SMTP. Your friend then transfers the message from his/her mail server to his/her host over IMAP.

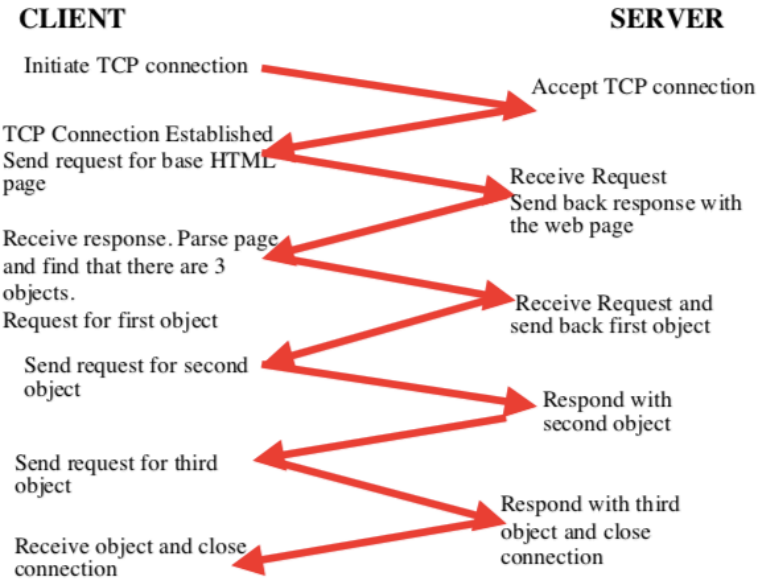
Q5) How can iterated DNS queries improve the overall performance?

Answer: Iterated request can improve overall performance by offloading the processing of requests from root and TLD servers to local servers. In recursive queries, root servers can be tied up ensuring the completion of numerous requests, which can result in a substantial decrease in performance. Iterated requests move that burden to local servers, and distributed the load more evenly throughout the Internet. With less work at the root servers, they can perform much faster.

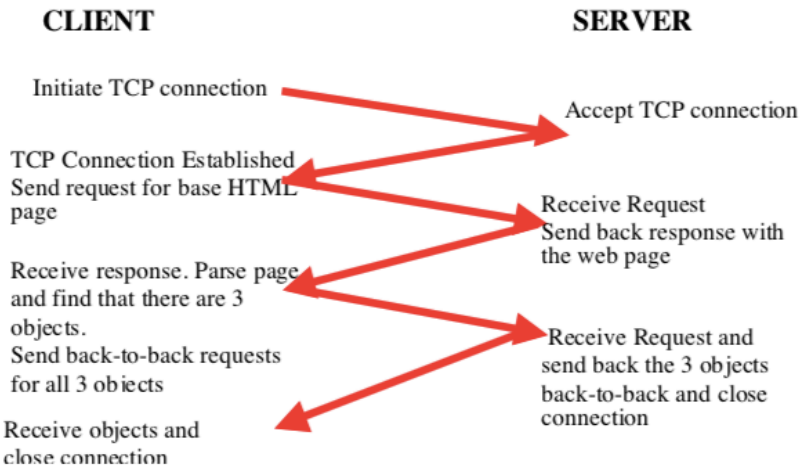
Q6) Suppose you needed to use HTTP to download a web page with three embedded images. Draw diagrams, similar to those from class, depicting the main interactions between the client and server when using non-persistent HTTP, persistent HTTP without pipelining, and persistent HTTP with pipelining.



(b) Persistent HTTP without pipelining



(c) Persistent HTTP with pipelining



Q7) Suppose within your Web browser you click on a link to obtain a web page. The IP address for the associated URL is not cached in your local host, so a DNS look-up is necessary to obtain the IP address. Suppose that *n* DNS servers are visited before your host receives the IP address from DNS; the successive visits incur an RTT of RTT_1, ..., RTT_n. Further suppose that the web page associated with the link contains exactly one object, consisting of a small amount of HTML text. Let RTT_0 denote the RTT between the local host and the server containing the object. Assuming zero transmission time of the object, how much time elapses from when the client clicks on the link until the client receives the *object*?

Answer: The total amount of time to get the IP address is $RTT_1 + RTT_2 + ... + RTT_n$.

Once the IP address is known, RTT_O elapses to set up the TCP connection and another RTT_O elapses to request and receive the small object. The total response time is

$2RTT_0 + RTT_1 + RTT_2 + ... + RTT_n$.

Q8) Multiple Choice Questions – Choose one from the possible choices:

A) correct answer is iii: between 1.0 to 1.1 sec

B) correct answer is i: 304 Not modified

C) correct answer is ii. False

D) correct answer is ii. False