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Question 1:

If the IP address is known, it would theoretically take 2 RTT for the user to receive the object, as it would take 1 RTT to establish the connection of the already known DNS, then 1 RTT to request and receive the object.

Question 2:

For non-persistent HTTP, the TCP connection must be opened every time you retrieve an object.

(a) non-persistent HTTP with no parallel TCP connections?

Answer:

RTT = 2RTT (Base connection) + 9 * 2 RTT per object = 20 RTT with 10 TCP connections

(b) non-persistent HTTP with three parallel TCP connections?

Answer:

RTT = 2RTT + 3 (9 objects / 3 parallel) * 2RTT = 8 RTT with 10 TCP connections

(c) persistent HTTP without pipelining?

Answer:

RTT = RTT(TCP) + RTT(Index) + 9RTT for objects = 11RTT with 1 TCP

(d) persistent HTTP with pipelining?

Answer:

RTT = RTT(TCP) + RTT(Index) + 1RTT for object = 3RTT with 1 TCP

Question 3:

If the IP address is not known, then the RTT would be $2RTT_0 + RTT_1 + \ldots + RTT_n$ where 2RTT is the regular establish connection and requisition times, while the rest of the RTT is getting the DNS visited.

Question 4:

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 = (900,000 bits)/(1,500,000,000 bits/sec) = 0.0006 sec

The traffic intensity on the link is given by

$\beta\Delta=(1.66 \times 10^3$ requests/sec)(0.0006 sec/request) = 0.996 seconds.

The average access delay is (0.0006 sec)/(1 - .996) $\approx$ 0.15 seconds. There is a 100ms delay in addition so the total average response time is therefore 0.15 sec + 0.1 sec = 0.25sec.

b) Average access delay is (0.0006 sec) /[1 – (0.6)(0.996)] = .0015 seconds. The response time is basically zero if the request is satisfied by the cache (which happens with probability .4 for hit rate), the average response time is .0015 sec + 0.1 sec = 0.10015 sec for cache misses (which happens 60% of the time). So the average response time is (.4)(0 sec) + (.6)(0.100157 sec) = 0.06seconds.