Assignment - 1

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Answer to the question no. Q. (1.) :—

(a.)

Layer responsible for hop-to-hop delivery is the Data Link Layer. It handles the hop-to-hop delivery. It ensures transmissions of frames between directly connected devices, providing framing, error detection and link-level flow control. These functions make sure data is correctly exchanged over a single physical link. Host-to-host delivery is the role of the Network Layer (eg. IP). The way it differs from host-to-host delivery is that the Network Layer forwards packets across multiple links and routers to reach a remote host while the Data Link layer manages neighbour-to-neighbour communication on one hop, the Network Layer focuses on end-to-end routing across the whole path. In short we can say that the Data Links connection works between neighbours whereas Network is end-to-end.

(b.)

When I request www.cinema.com, DNS is used to direct me to a nearby CDN node. The authoritative DNS server often in cooperation with the CDN provider, determines an appropriate edge server based on the requester's location (inferred from the resolver IP) and current server load. It then returns the IP address of the nearest or fastest CDN edge. The client connects to that edge for streaming, reducing latency and buffering. CDNs also use short-lived DNS TTLs and health checks to ensure users are routed to available nodes.

(c.)

The distribution times behaves differently in client-server and P2P systems because of where upload capacity comes from. In client-server, a single server must serve all clients, it's fixed upload bandwidth becomes a bottleneck as clients increase. In P2P, every peer contributes upload capacity by sharing file pieces with others as more peers join, aggregate upload capacity grows and therefore distribution scales much better. In short, as the number of users grow, the total distribution time increases much slower in P2P compared to Client-Server.

(d.)

Given,

Access delay = 44 ms^{-1}

Internet delay = 3.05 s

LAN delay = 50 ms^{-1}

Request distribution: 40% → Origin 20% → Proxy1, 40% → LAN

So,

Weighted delay = $(0.4 \times 3.05) + (0.2 \times 0.044) + (0.4 \times 0.050)$

$= 1.22 + 0.0088 + 0.02$

$= 1.2488$

≈ 1.25 s

Therefore, the total average delay is approximately 1.25 s (Answer)

Answer to the question no. Q.(2) :—

(a.)

If previous searches are not visible on revisiting a website, the likely cause is that persistence mechanisms were not retained. This may be due to session cookies that disappear after closing the browser, manual clearing of cookies, use of private/incognito mode or server-side policies which only keep short-lived session records. Any of these prevent the site from retrieving my earlier search history.

(b)

IMAP is preferable for mobile email because it keeps messages on the server and synchronizes status across devices. It allows selective downloading of headers or messages, conserving data and storage on phones. POP3, in contrast, typically downloads and often deletes messages from the server, making cross-device consistency difficult.

(c)

Given,

RTT for each recursive lookup = 26 ms

Assume 4 lookups (local → root → TLD → authoritative)

(i) RTT to fetch IP = 4×26 = 104 ms

After retrieving the IP, a 39 ms RTT is required to send a reque

The webpage contains 30 objects including the base HTML.

(ii) Each object takes: (2×39) + 4 + 215 = 297 ms

Total = 30 × 297 = 8910 ms = 8.91 s

(iii) Total time = DNS + Object retrieval

= 0.104 + 8.91

= 9.014

= 9.01 s

(Answer)

Answer to the question no. Q.(3):—

(a)

A client sending FIN and recieving ACK indicates the start of TCP's orderly connection shutdown. TCP uses a four-step closure to ensure both sides finish sending and acknowledge each other's closure. This occurs when one end point has finished sending application data and signals it no longer needs to transmit.

(b)

When opening multiple browser tabs, the destination port (server's point) remains the same (eg. 80/443), but the OS assigns different ephemeral source ports to each outgoing connection so responses can be demultiplexed to the correct tab. Sockets are identified by the tuple (source IP, source port, dest IP, dest port) unique source ports are therefore required for concurrent tabs. Without unique ports, the system couldn't seperate multiple active connections.

(c)

Given,

Client ISN = 1546

Server ISN = 9856

RWND (client) = 1684

Requests = 222 + 369 = 591 bytes

Data Segments: DS1 = 951, DS2 = 478, DS3 = 300, DS4 = 99, DS5 = 201

(i) DS3 sequence number = 9856 + 951 + 478 = 11285

Client acknowledgement = 1546 + 591 = 2137

(ii.) Updated RWND = 1684 - (951 + 478 + 300 + 99 + 201)

= 1684 - 2029 = 0 (window full)

(iii.) ACK after DS5 : last byte recieved = 9856 + 2029

= 11885

Thus, Seq = 2137, Ack = 11885

(Answer)