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A20447935 Homework #2 Due Date: 2/12/23

Problems to be submitted.
Review Questions: R#
Problem Questions: P#

R# 4 No. In a P2P file-sharing application, there is a distinction between client and server sides of a communication session. The client acts as a consumer that requests a file from one or multiple peers (server side), while the server side acts as a provider that offers the file for download. Although there is no central authority or designated server in a P2P network, the distinction between client and server is still present in the context of a specific communication session.

R# 5 A process running on one host can identify a process running on another host using the following information:

- IP address: It is a unique numerical identifier assigned to each device connected to a network. It is used to identify and locate the host on the network.
- Port number: A port number is a 16-bit unsigned integer that identifies a specific process or service on a host. The combination of IP address & port number uniquely identifies a process running on a remote host.
- Protocol: It defines the rules for exchanging data between the processes on the two hosts.

R# 12 Upon a user's initial visit to the site, a unique identification number is generated by the server and recorded in its database. The number is then sent back to the user's device in the form of a cookie, which is managed by the browser and stored on the user's host. With every subsequent visit, including purchases, the browser automatically sends the cookie number back to the site, enabling it to identify the user whenever they visit.

R#13 Web caching can bring the requested content closer to the user by storing it on a server within the user's local network. This can significantly reduce the time required to retrieve the content. The reduction in delay applies not only to cached objects but also to objects that are not cached. This is because caching reduces the amount of traffic on the network links, leading to a more efficient and faster retrieval of content.

R#16 The message is initially transferred from Alice's host to her email server through HTTP. Then, the email server sends the message to Bob's email server through SMTP. Finally, Bob retrieves the message from his email server to his host via POP3.

R#23 The overlay network consists of nodes participating in the P2P file-sharing system and the logical connections between them. Each node has a logical link or 'edge' to another node, represented as a semi-permanent TCP connection. Unlike traditional networks, the overlay network does not include routers as intermediaries in data transmission.

R#25 There are several non-network related factors that are important in designing a CDN server selection strategy. These factors include:
- Cost; Reliability includes security, analytics, integration; Support; and Scalability includes geographic coverage, content management
- Server availability and capacity; content delivery speed.

P#1 a) False
b) True
c) False
d) False
e) False

P# 7 Consider the IP address of total amount of time:

$RTT_1 + RTT_2 + RTT_3 + \ldots + RTT_{n-1} + RTT_n$

Time elapses from when the client clicks on the link until the client receives the object:

$2RTT_0 + RTT_1 + RTT_2 + \ldots + RTT_{n-1} + RTT_n$

P# 8 a) Non-persistent HTTP with no parallel TCP connections:

$= RTT_1 + \ldots + RTT_n + 2RTT_0 + 3 \cdot 2RTT_0$

$= 8RTT_0 + RTT_1 + \ldots + RTT_n$ //

b) Non-persistent HTTP with the browser configured for 5 parallel connections $= RTT_1 + \ldots + RTT_n + 2RTT_0 + 2RTT_0$

$= 4RTT_0 + RTT_1 + \ldots + RTT_n$ //

c) Persistent HTTP: $RTT_1 + \ldots + RTT_n + 2RTT_0 + RTT_0$

$= 3RTT_0 + RTT_1 + \ldots + RTT_n$ //

P#9 a) Average request rate = 16 /s.

Average object size (L) = 8.5×10^5 bits

Average internet delay (I) = 3 sec.

Average Access Delay = $\frac{\Delta}{1 - \Delta\beta}$

$\therefore$ Average time = L/R

$\therefore \Delta = \frac{850000 \text{ b}}{15000000 \text{ b/s}}$

$= 0.0567$ sec

$\beta = 16$ req/sec.

Intensity of link $= 16 \times 0.0567$

$= 0.9072$

$\therefore$ Average Access delay $= \frac{0.0567}{1 - 0.9072}$

$D = 0.61099$ sec

So total average time $= D + I = 0.61099 + 3 \simeq 3.61$ sec //

b) Cache ratio = 0.4
Alternatively > 0.6 ≈ 60%
Average Access Delay $= \frac{0.0567}{(1-0.4)\times(0.9072)}$ — ①

$= \frac{0.0567}{0.63712}$

$= 0.0889$ sec

Probability = 0.6
Average response time = 0.089 + 3
= 3.089 sec.
Total Response Time = (0.6)×0 + (0.4)(3.089)
= 1.2356
≈ 1.2
So, the reduced average time response is = 3.61 to 1.24 sec.

P#25 In the overlay network, there are N nodes and N(N-1)/2 edges. Each node in the overlay network represents a peer and each edge represents a TCP connection between a pair of peers. The routers are not represented as nodes in the overlay network as they are not part of the overlay network.

P#27 a) The server will need to store N×N = N^2 files, one for each possible combination of video & audio version

b) The server will need to store N+N = 2N files, one for each of the N video versions and one for each N audio versions.