Computer Networks HW2

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1. (1) The minimum time needed to distribute this file from a server to all clients in a client-server model is D_{cs}

$$D_{cs} = max(\frac{NF}{u_s}, \frac{F}{d_{min}})$$

With N equal to the number of clients (7), F is equal to the file size (4 Gigabits), u_s is equal to the upload rate of the server (94 Megabits per second), and d_{min} is equal to the lowest download rate out of all clients (c_1 in this case, 15 Megabits per second). Using these numerical values, the solution to D_{cs} can be simplified to

$$D_{cs} = max(297.87, 266.67)$$

Which means the minimum time needed to distrubute F to all clients will be 297.87 seconds

(2) The server, s, is the cause for the final minimum time. The server is guaranteed to take longer to upload the file F to each individual client than the slowest client is to download that file

(3) The minimum time needed to distribute this file from a server to all clients in a peer to peer model is D_{P2P}

$$D_{P2P} = max(\frac{F}{u_s}, \frac{F}{d_{min}}, \frac{NF}{u_s + \sum_{i=1}^{N} u_i})$$

With N equal to the number of clients (7), F is equal to the file size (4 Gigabits), u_s is equal to the upload rate of the server (94 Megabits per second), d_{min} is equal to the lowest download rate out of all clients (c_1 in this case, 15 Megabits per second), and $\sum_{i=1}^{N} u_i$ is equal to the combined

upload bandwith of all clients in the system (135 Megabits per seond). Using these numerical values, the solution to D_{P2P} can be simplified to

$$D_{P2P} = max(42.55, 266.67, 122.27)$$

Which means the minimum time needed to distrubute F to all clients will be 266.67 seconds

(4) The client, c_1, is the cause for the final minimum time. The client is guaranteed (assuming all clients are utilizing their full upload speed) to take longer to download the file F than it will take the other clients to upload/share the file with each other

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