

Problem 1. Consider distributing a file of F bits to N peers using a client-server architecture. Assume a fluid model where the server can simultaneously transmit to multiple peers, transmitting to each peer at different rates, as long as combined rate does not exceed u_s .

- Suppose that $u_s/N < d_{\min}$. Specify a distribution scheme that has a distribution time of NF/u_s .
- Suppose that $u_s/N > d_{\min}$. Specify a distribution scheme that has a distribution time of F/d_{\min} .

Problem 2a. Consider distributing a file of $F = 15$ Gbits to N peers. The server has an upload rate of $u_s = 30$ Mbps, and each peer has a download rate of $d_i = 2$ Mbps and an upload rate of u . For $N = 100$, and $u = 700$ Kbps, what is the minimum distribution time for the client-server distribution?

- A) 7000 sec
- B) 15000 sec
- C) 50000 sec
- D) 68000 sec

Problem 2b what is the minimum distribution time for the P2P distribution?

- A) 7000 sec
- B) 15000 sec
- C) 50000 sec
- D) 68000 sec

Problem 3. Suppose Bob joins a BitTorrent torrent, but he does not want to upload any data to any other peers (so called free-riding).

- Bob claims that he can receive a complete copy of the file that is shared by the swarm. Is Bob's claim possible?

- A) No
- B) Yes

- Bob further claims that he can further make his "free-riding" more efficiently by using a collection of multiple computers (with different IP addresses) in his computer lab. Is Bob's claim possible?

- A) No
- B) Yes

Problem 4. Consider a DASH system for which there are N video versions (at N different rates and qualities) and N audio versions (at N different rates and qualities). Suppose we want to allow the player to choose at any time any of the N video versions and any of the N audio versions.

a. If we create files so that the audio is mixed in with the video, so server sends only one media stream at given time, how many files will the server need to store (each a different URL)? (Let's assume that there is a one-to-one matching by pairing video versions with audio versions in a decreasing order of quality and rate.)

- A) N
- B) $2N$
- C) N^2
- D) $2N^2$

b. If the server instead sends the audio and video streams separately and has the client synchronize the streams, how many files will the server need to store?

- A) N
- B) $2N$
- C) N^2
- D) $2N^2$