Peer2Peer (P2P)

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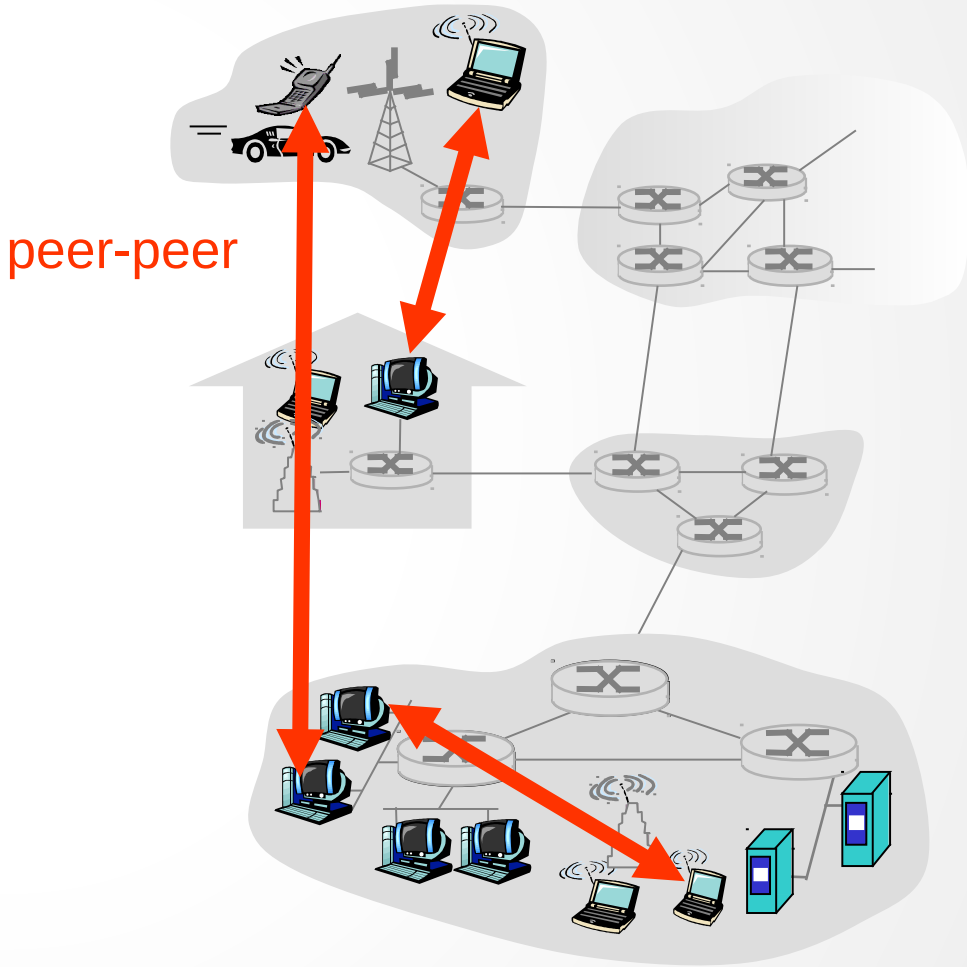
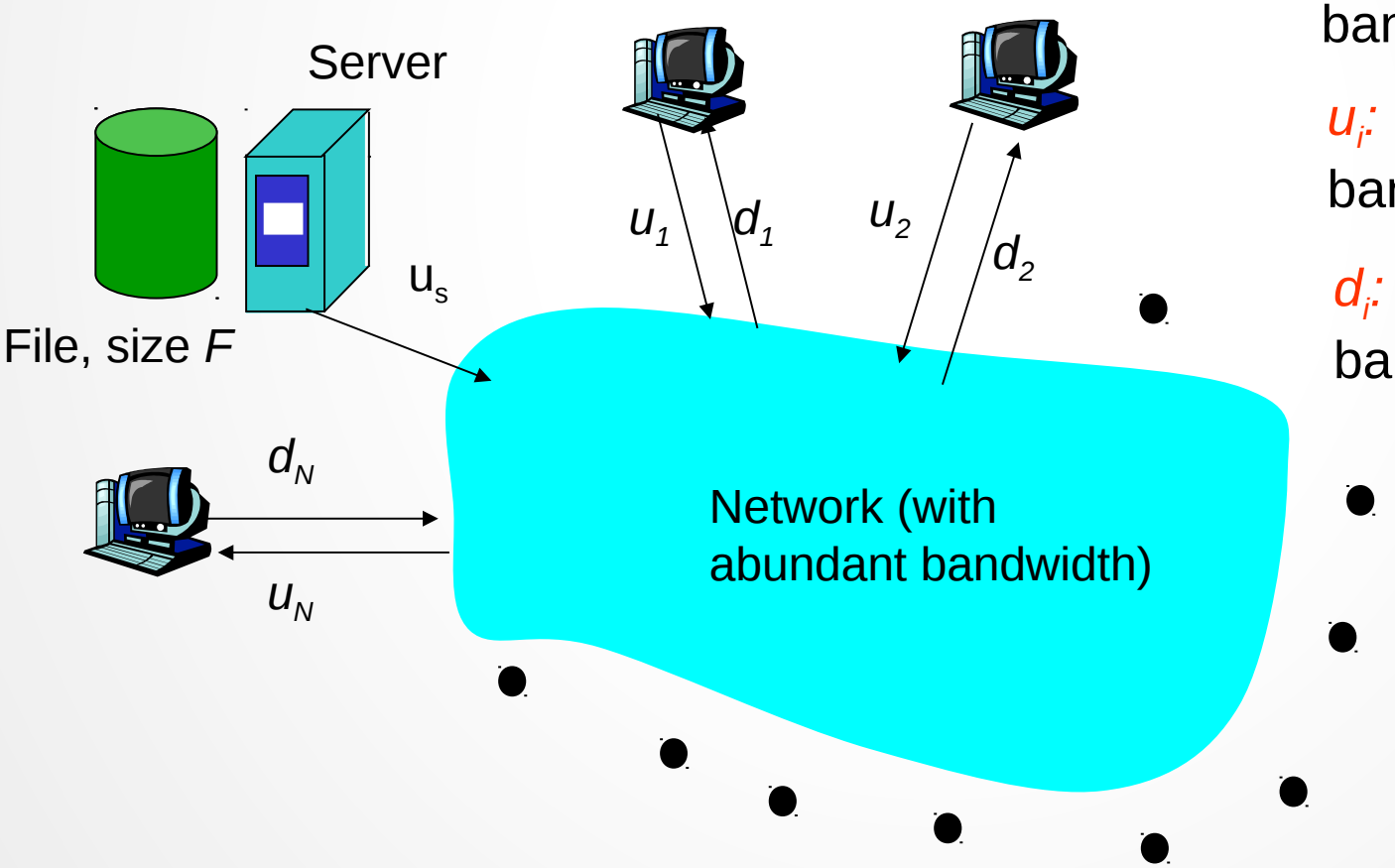
Pure P2P architecture

- *no* always-on server
- arbitrary end systems directly communicate
- peers are intermittently connected and change IP addresses



File Distribution: Server-Client vs P2P

Question : How much time to distribute file from one server to *N peers*?



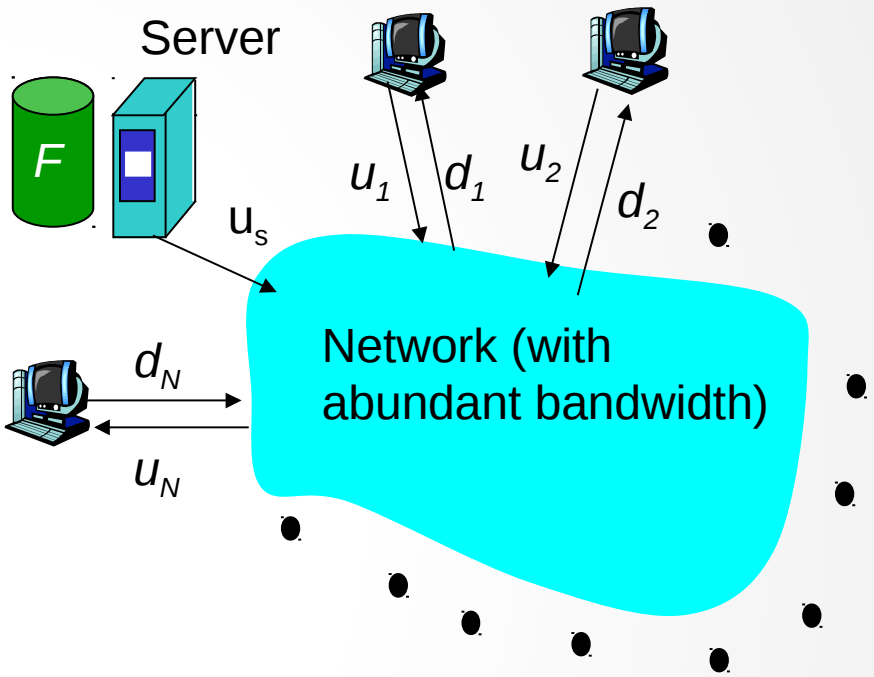
u_s: server upload bandwidth

u_i: peer i upload bandwidth

d_i: peer i download bandwidth

File distribution time: server-client

- server sequentially sends N copies:
  - NF/u_s time
- client i takes F/d_i time to download



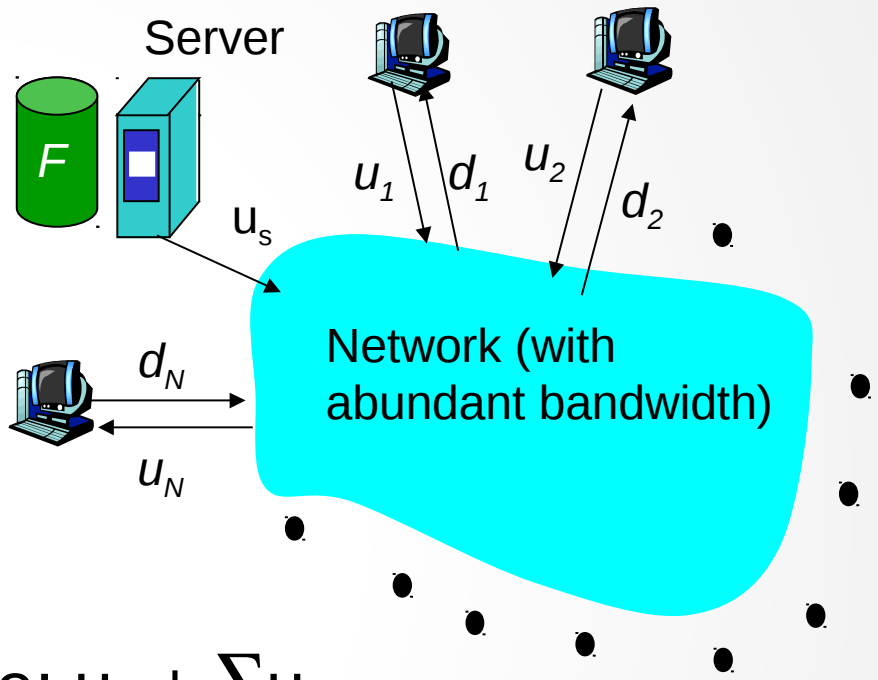
Time to distribute *F* to *N* clients using client/server approach

$$= d_{cs} = \max_i \{ NF/u_s, F/\min(d_i) \}$$

increases linearly in N (for large N)

File distribution time: P2P

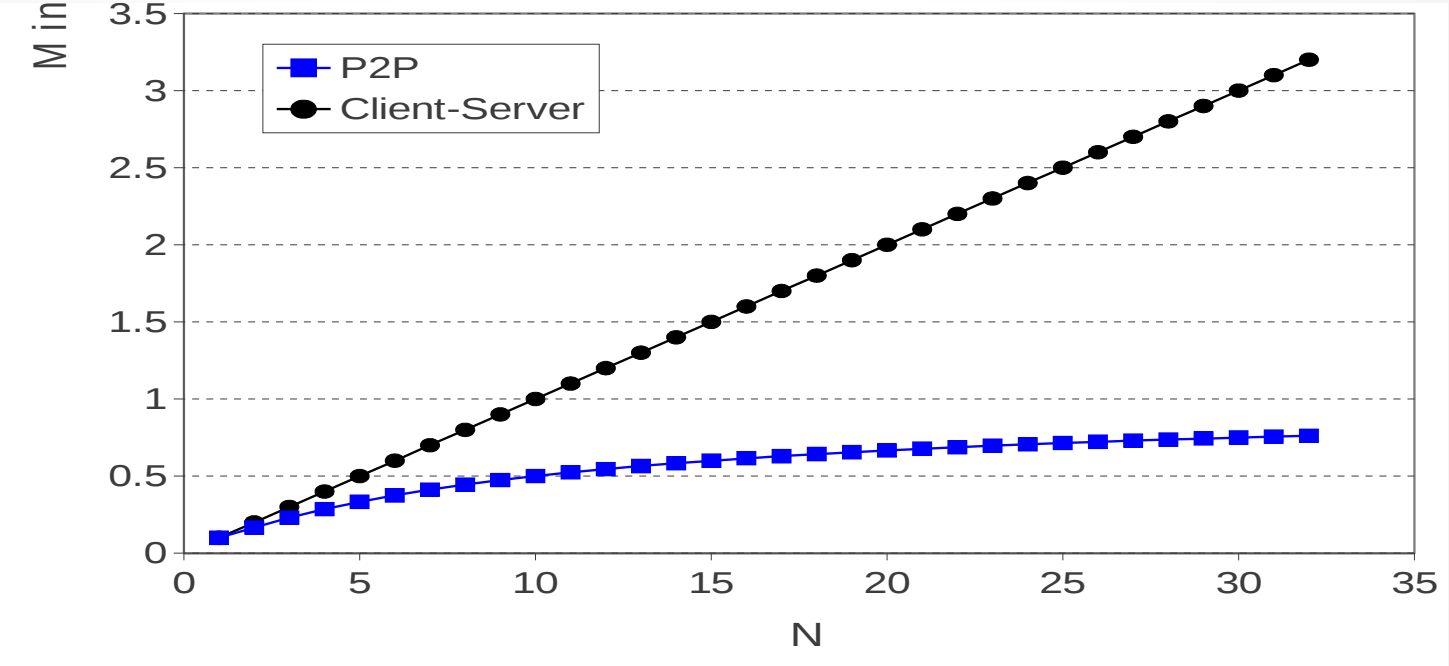
- server must send one copy: F/u_s time
- client i takes F/d_i time to download
- NF bits must be downloaded (aggregate)
  - fastest possible upload rate: $u_s + \Sigma u_i$



$$d_{P2P} = \max \left\{ F/u_s, F/min(d_i) , NF/(u_s + \sum_i u_i) \right\}$$

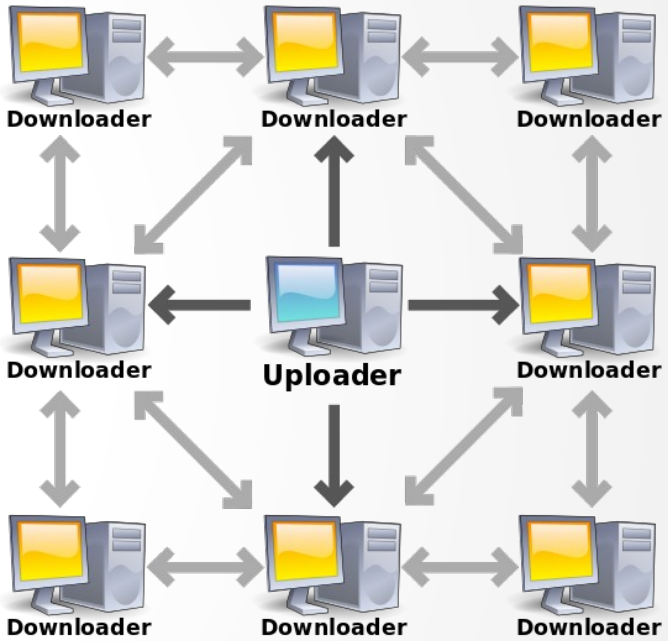
Server-client vs. P2P: example

Client upload rate = u, F/u = 1 hour, $u_s = 10u$, $d_{min} \geq u_s$



How Bit Torrent Works

- A user who wants to upload a file first creates a small torrent descriptor file that they distribute by conventional means (web, email, etc.).
- They then make the file itself available through a BitTorrent node acting as a seed.
- Those with the torrent descriptor file can give it to their own BitTorrent nodes, which—acting as peers or leechers—download it by connecting to the seed and/or other peers (see diagram on the right).



The middle computer is acting as a seed to provide a file to the other computers which act as peers.

Operations of Bit Torrent

Creating and publishing torrents

- Peers that provide a complete file are called seeders, and the peer providing the initial copy is called the initial seeder.
- The peer distributing a data file will create a torrent file with the suffix .torrent.
- Torrent files have an "announce" section, which specifies the URL of the tracker, and an "info" section, containing (suggested) names for the files, their lengths, the piece length used, and a SHA-1 hash code for each piece, all of which are used by clients to verify the integrity of the data they receive.
- Torrent files are typically published on websites or elsewhere, and registered with at least one tracker.
- The tracker maintains lists of the clients currently participating in the torrent.

Operations of Bit Torrent

Downloading torrents and sharing files

- Users find a torrent of interest, by browsing the web or by other means, download it, and open it with a BitTorrent client.
- The client connects to the tracker(s) specified in the torrent file, from which it receives a list of peers currently transferring pieces of the file(s) specified in the torrent.
- The client connects to those peers to obtain the various pieces.