Peer-to-Peer (P2P) Systems:

Peer-to-Peer (P2P) systems are a type of network architecture where computers, or "peers," in the network act as both clients and servers. In a P2P network, each computer can share resources (such as files or processing power) and request resources from other computers directly, without the need for a centralized server. P2P systems are often associated with file sharing and decentralized communication.

Key Characteristics of P2P Systems:

1. Decentralization: In P2P systems, there is no central server that controls or manages the network. Instead, all peers have equal status, and they can communicate and share resources directly with one another.
2. Shared Resources: Peers in a P2P network can share files, data, or services with other peers. This makes P2P networks efficient for tasks like file sharing, where users can upload and download content from each other.
3. Scalability: P2P networks are often scalable because adding new peers to the network does not require significant changes to the existing infrastructure.
4. Redundancy: P2P networks can be more robust because multiple copies of resources can exist on different peers. If one peer goes offline, others can still provide the same resources.

Aspect	P2P Model	Client-Server Model
Resource Sharing	All peers share resources with each other.	Clients request resources from a central server.
Network Topology	Decentralized; no central server.	Centralized; a central server manages resources.
Scalability	Typically more scalable as new peers can be easily added.	May require more centralized infrastructure to scale.
Dependency on Server	No central server dependency.	Clients depend on the central server.
Resource Availability	Resource availability depends on the presence of peers with the desired resources.	Resource availability depends on the server's availability.
Network Traffic	Peers communicate directly, resulting in distributed traffic.	Traffic is routed through the central server, which can lead to bottlenecks.
Redundancy	Redundancy is achieved by the presence of multiple peers with the same resources.	Redundancy is achieved through backup servers.
Example Use Cases	File sharing (BitTorrent), distributed computing (SETI@home).	Web hosting, email services, online gaming.

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- Then the client picks a node from which to download the file.

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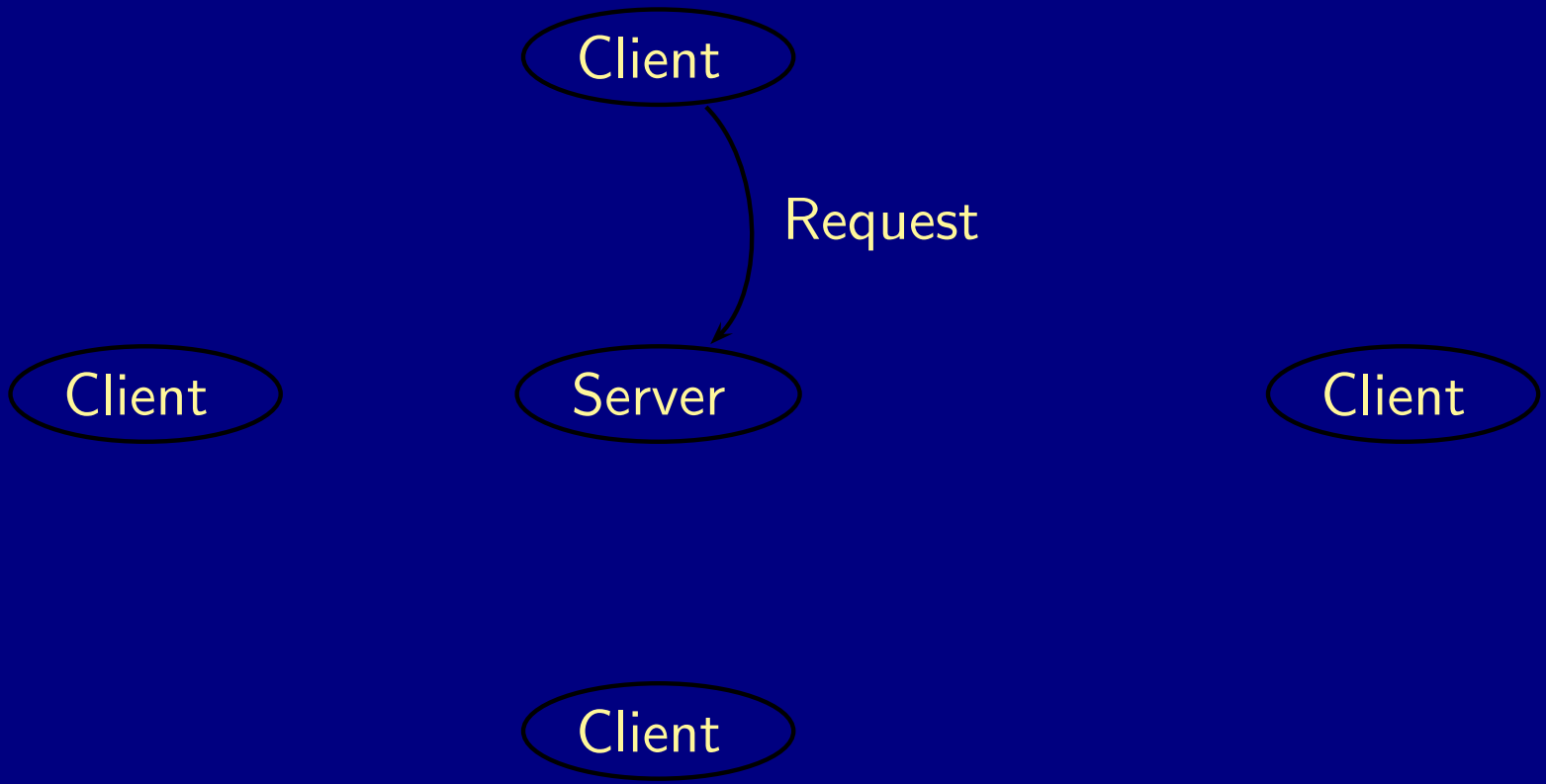

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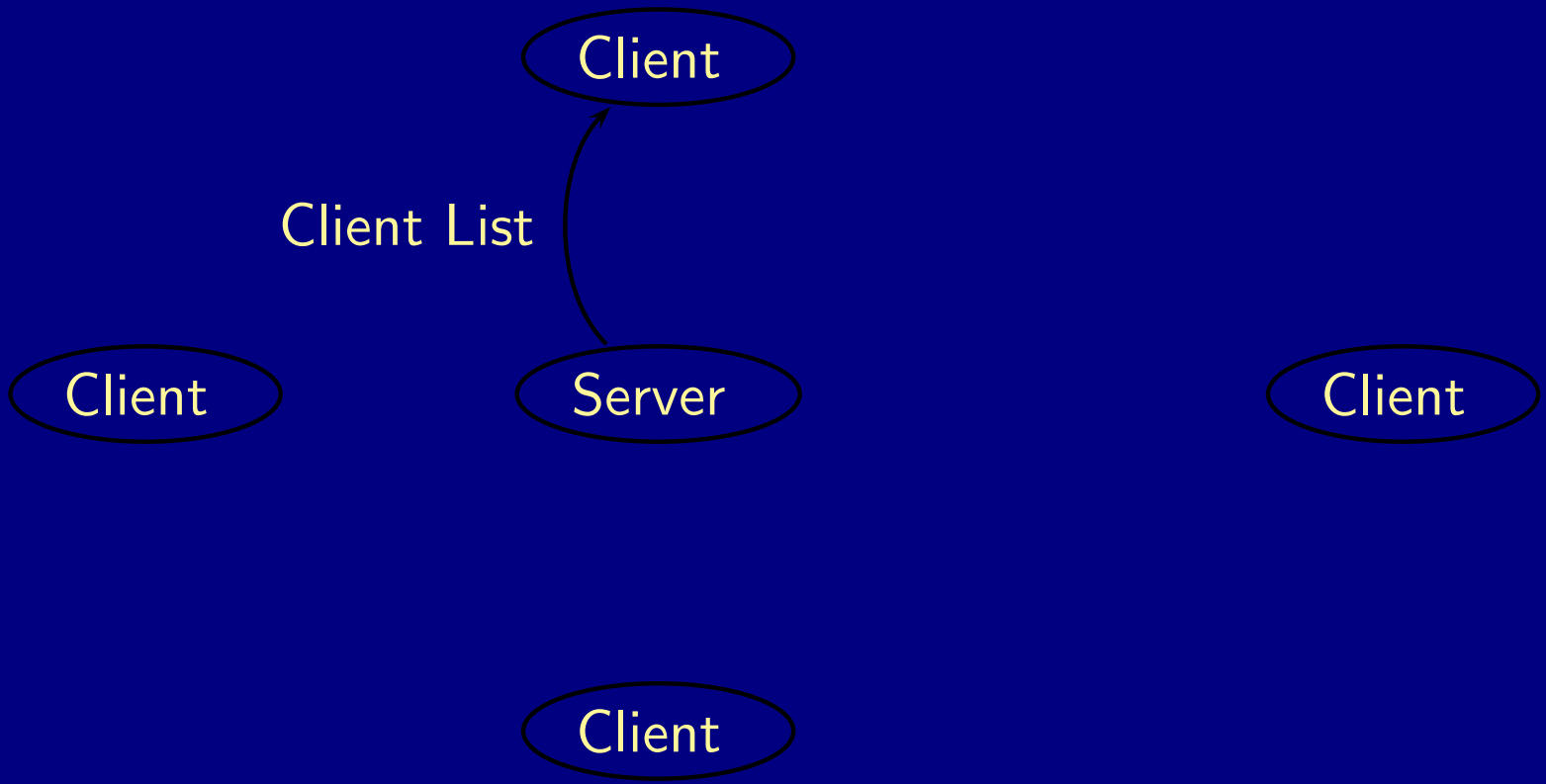

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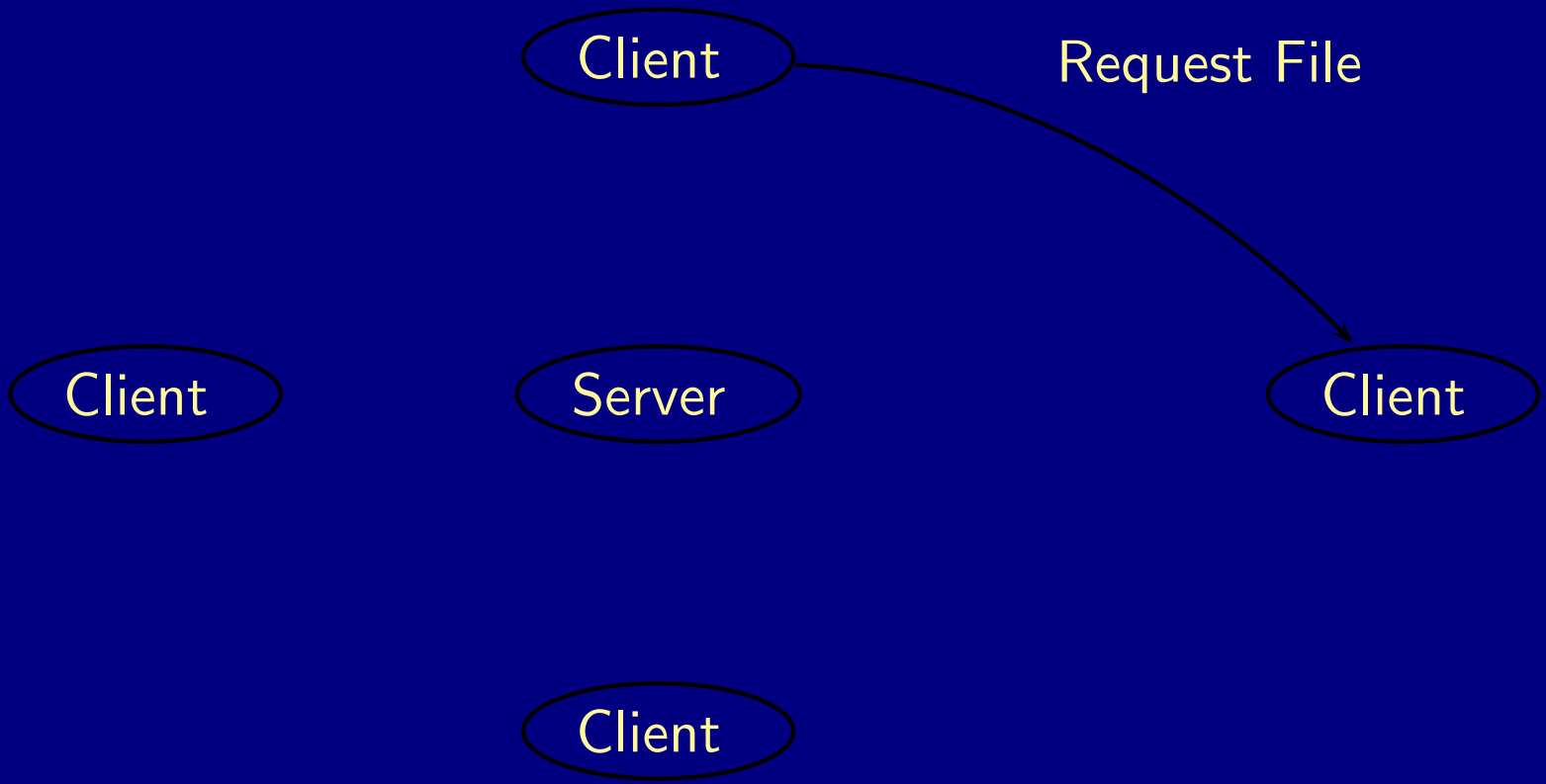

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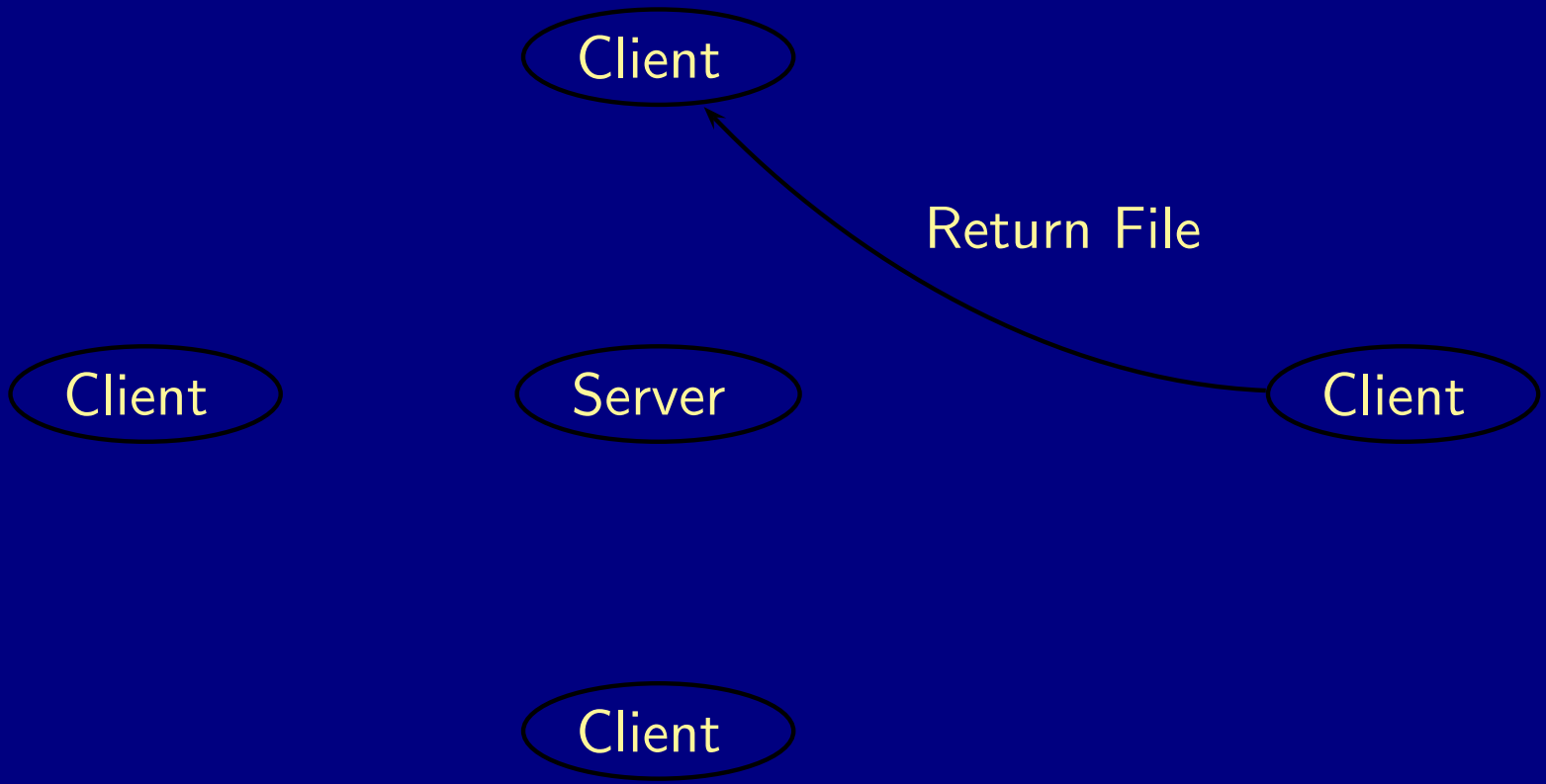

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  - Make the clients more complicated and download from multiple clients (essentially what Bit-torrent does)

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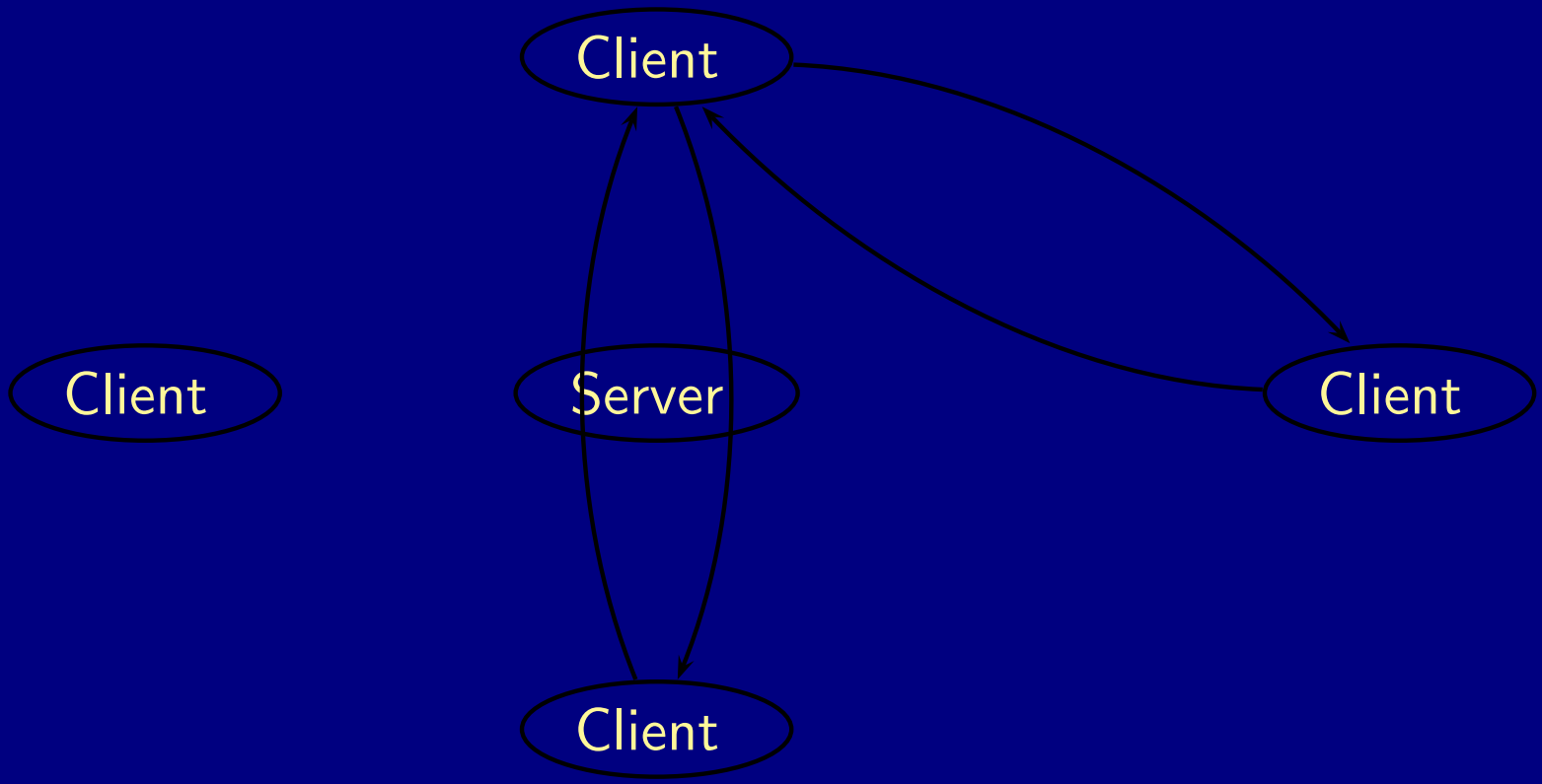

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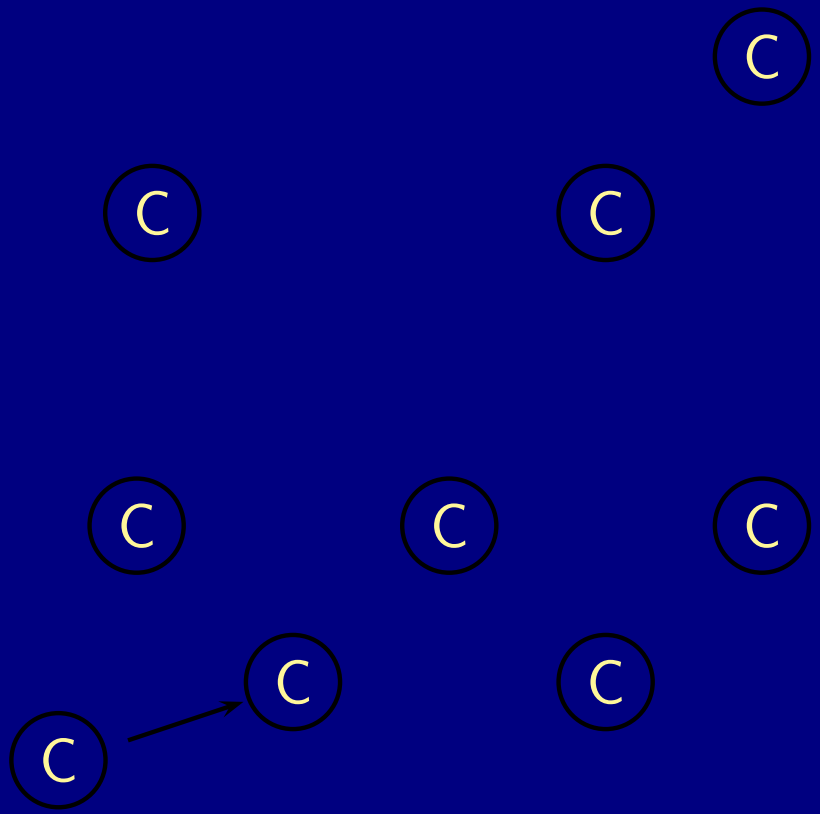

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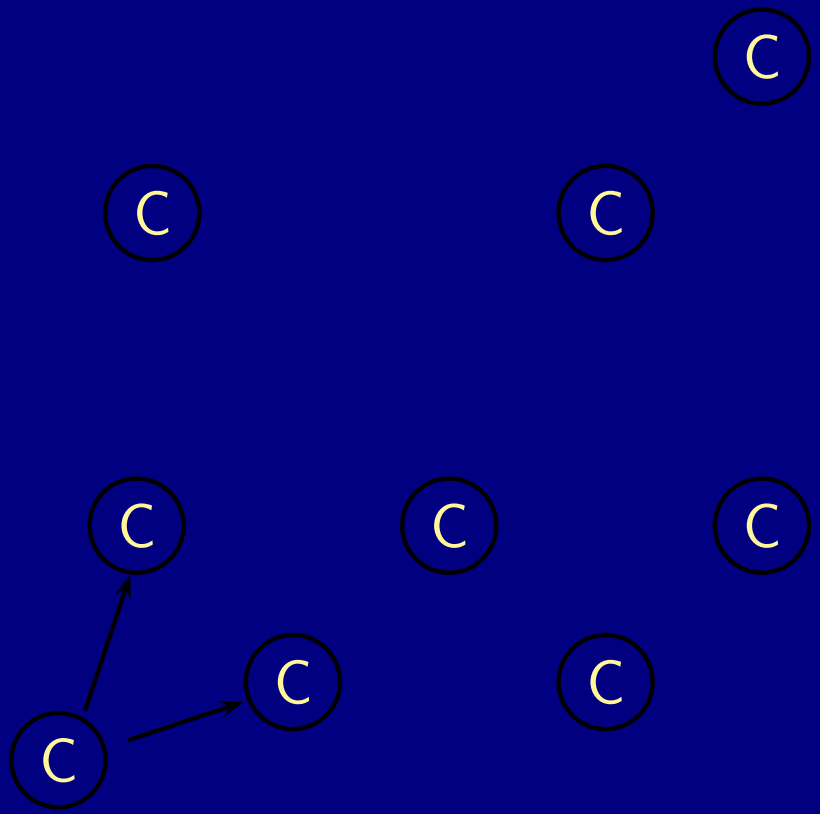

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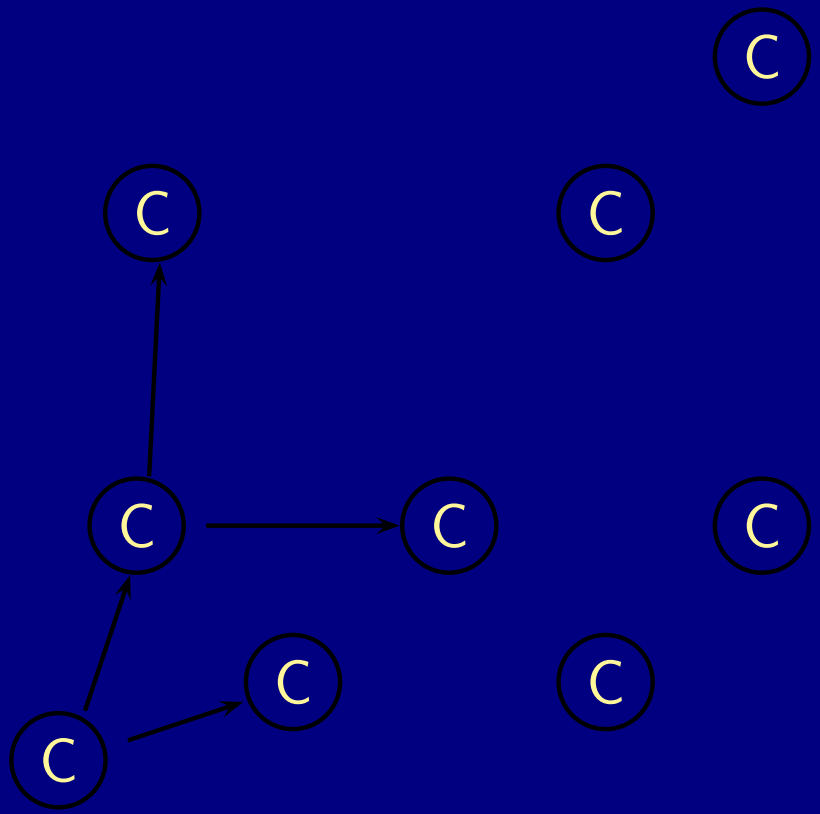

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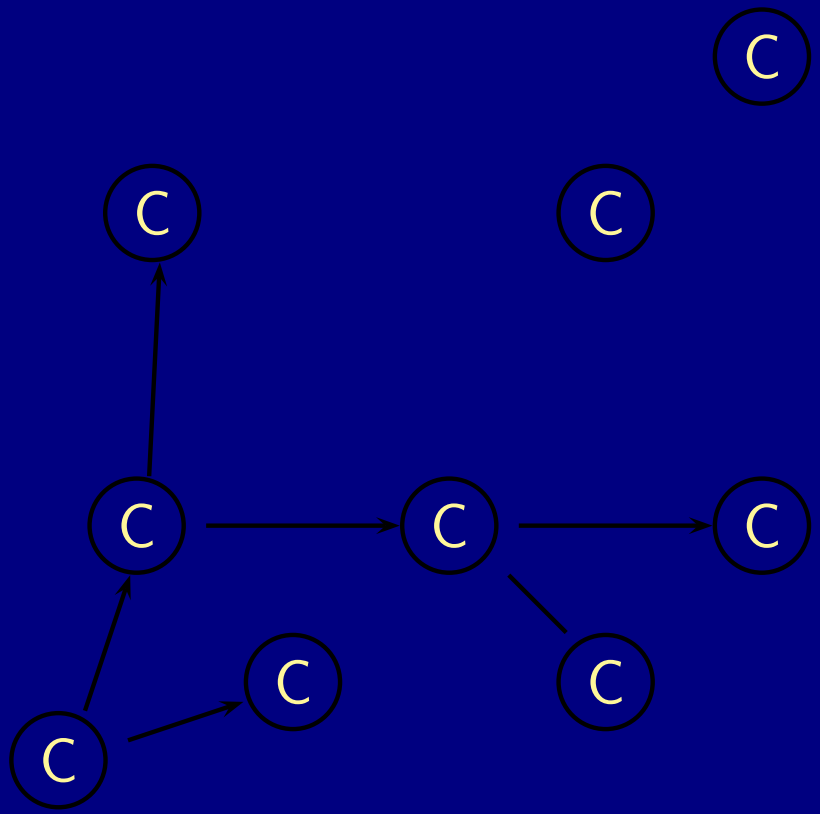

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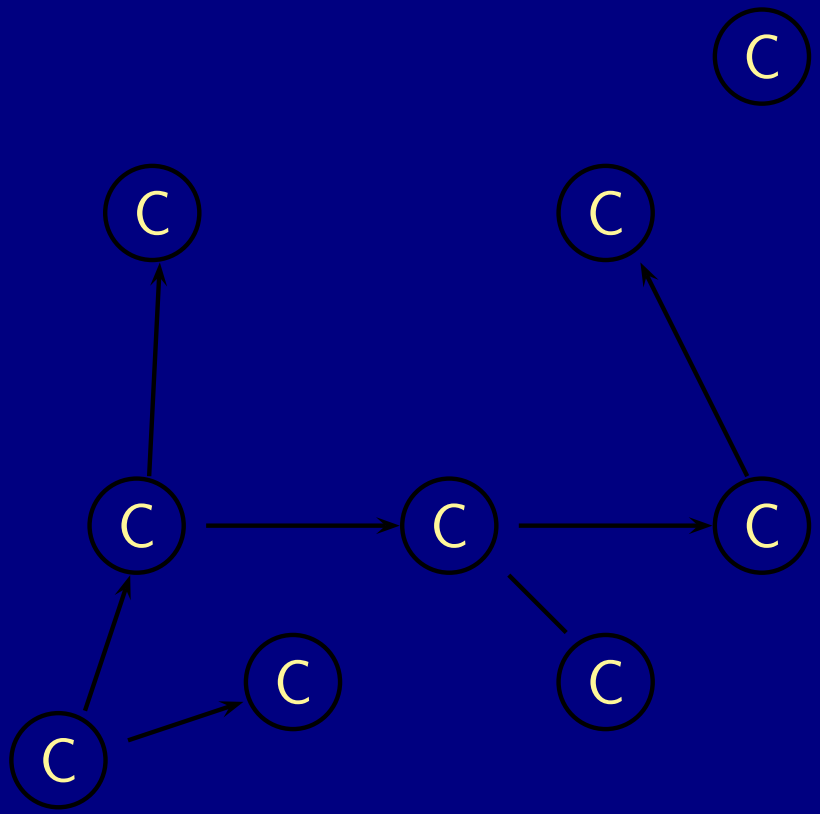

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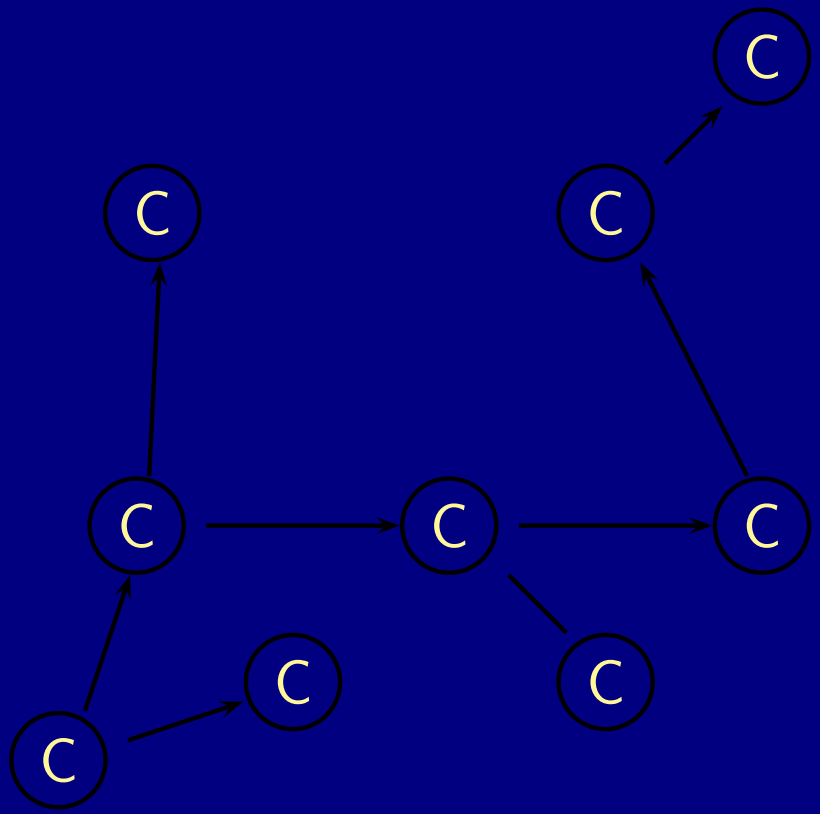

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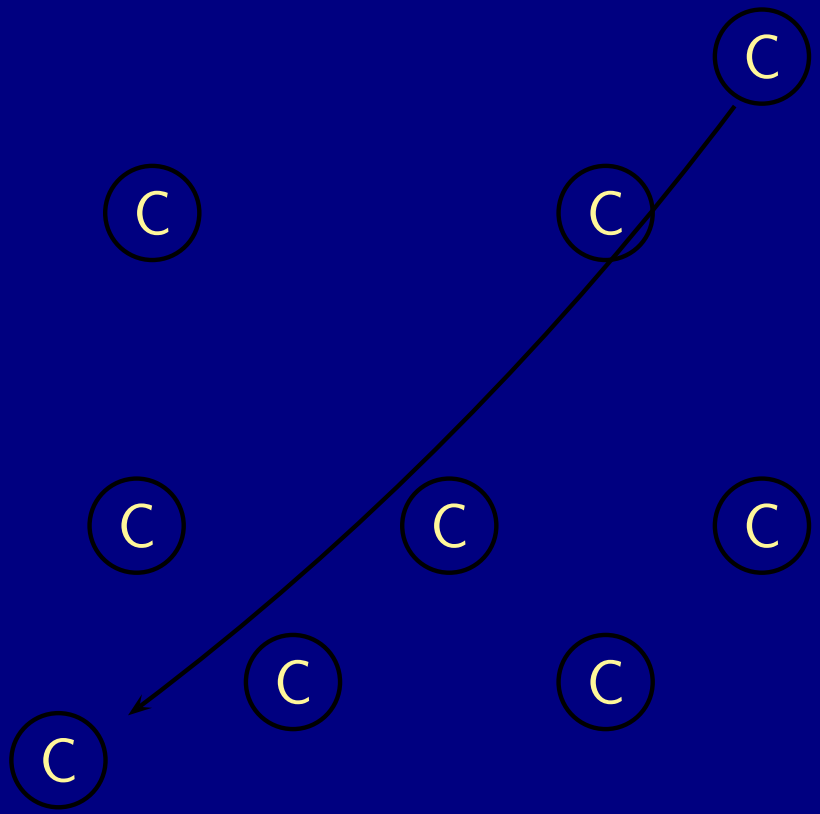

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- Instead of flooding do a random walk from node to node, works but it can take a can take a long time to find the file.

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- The basic idea is that of an overlay network, a network over a network.

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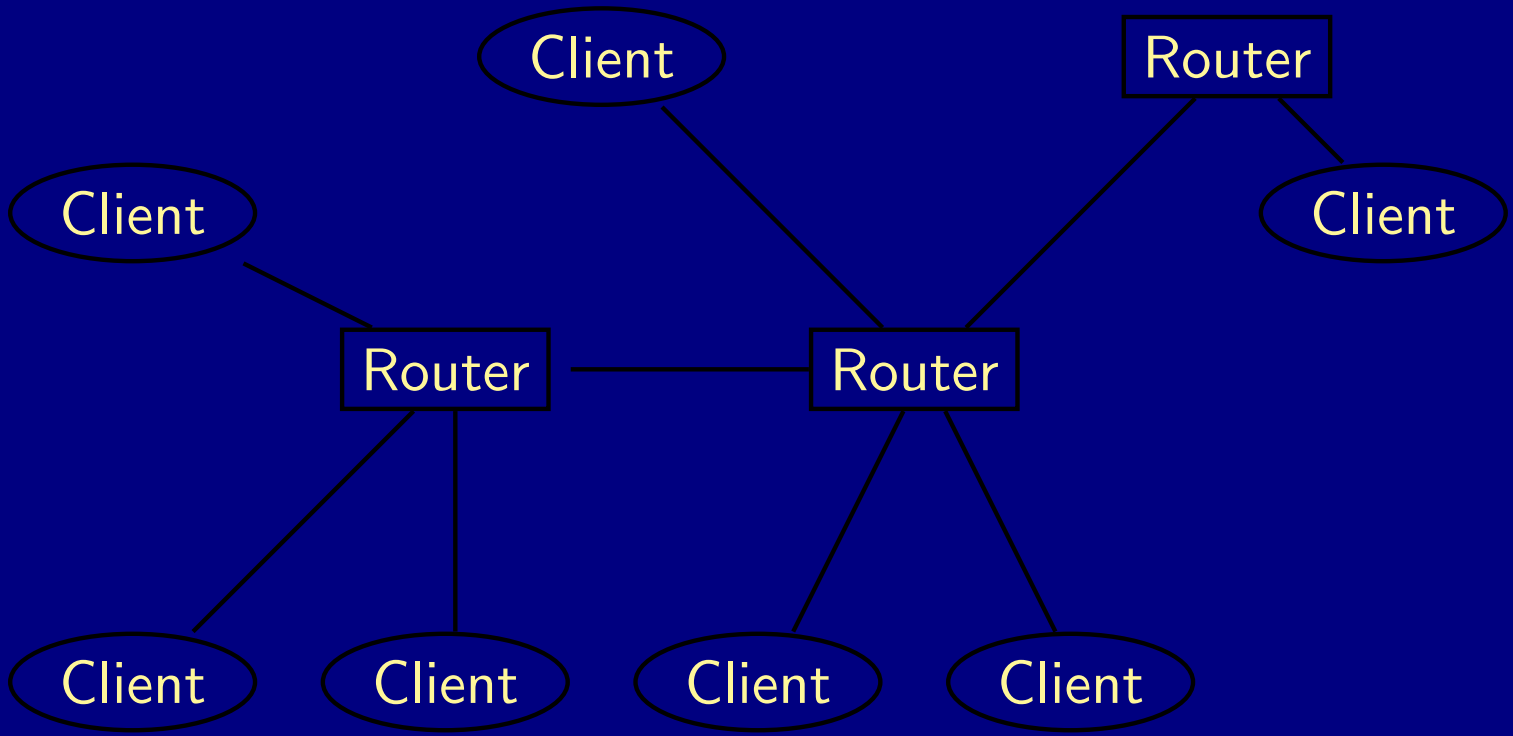

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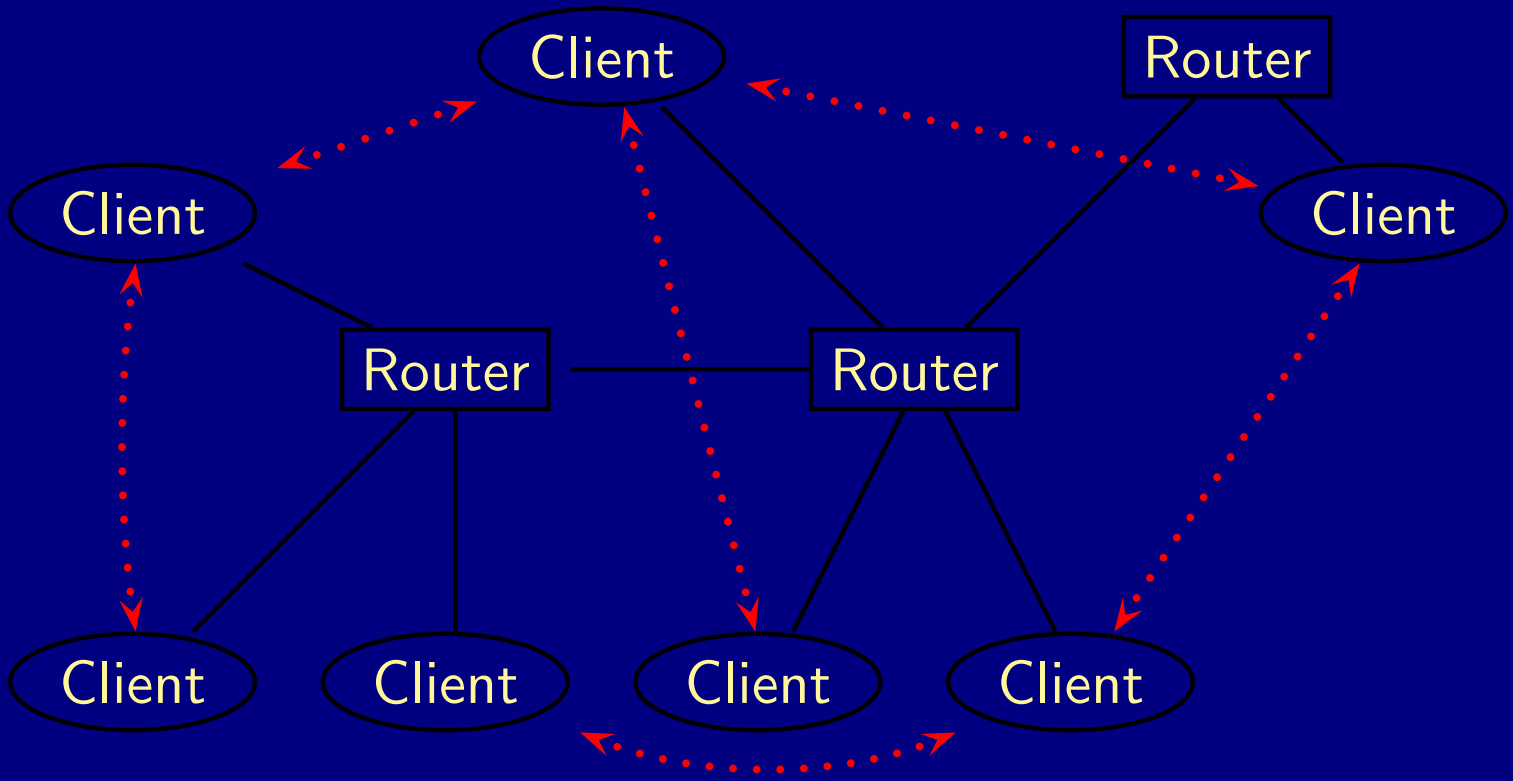

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- In the overlay network we need some way of storing routing tables and a routing algorithm.

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- Each chunk has a hash to verify if it has been downloaded properly (stops people injecting bogus chunks).

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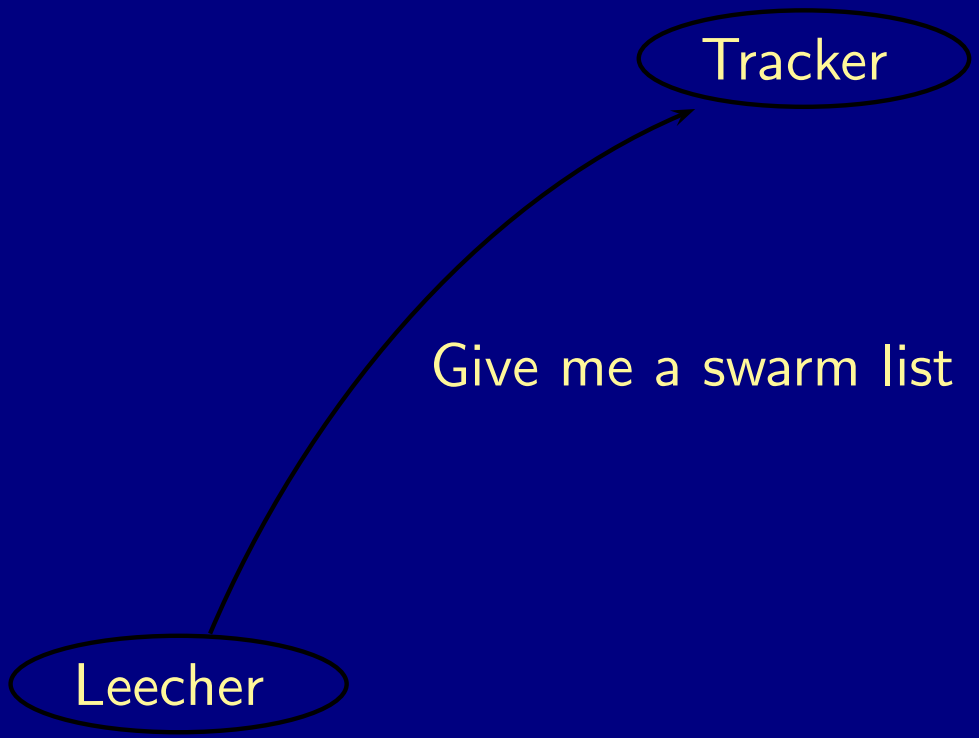

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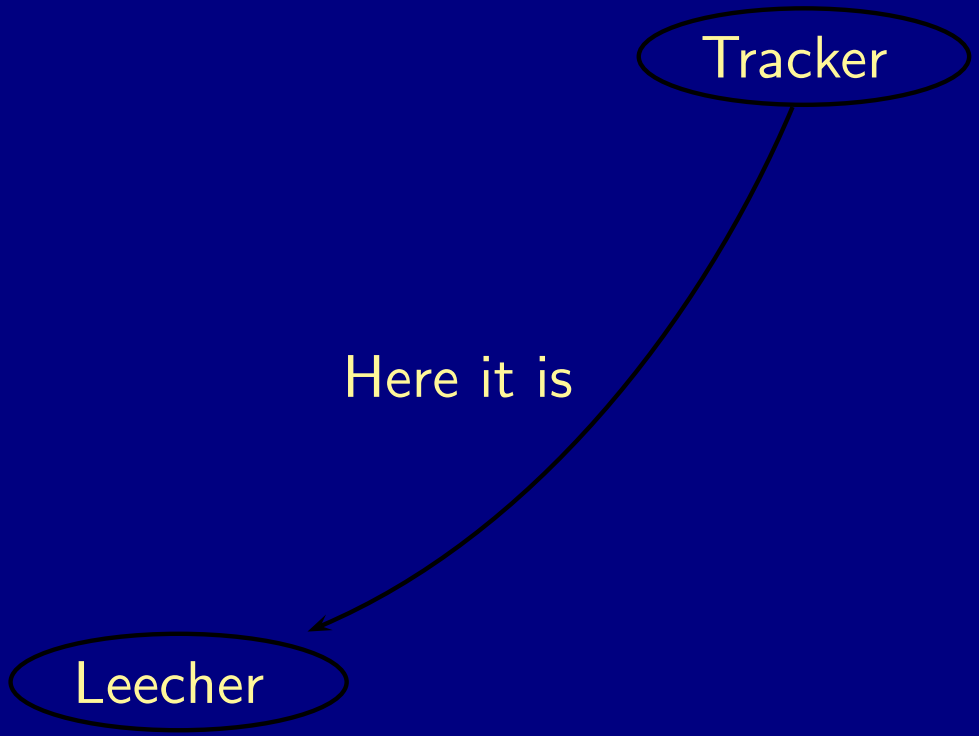

Note that the tracker need not give all the files in the swarm.

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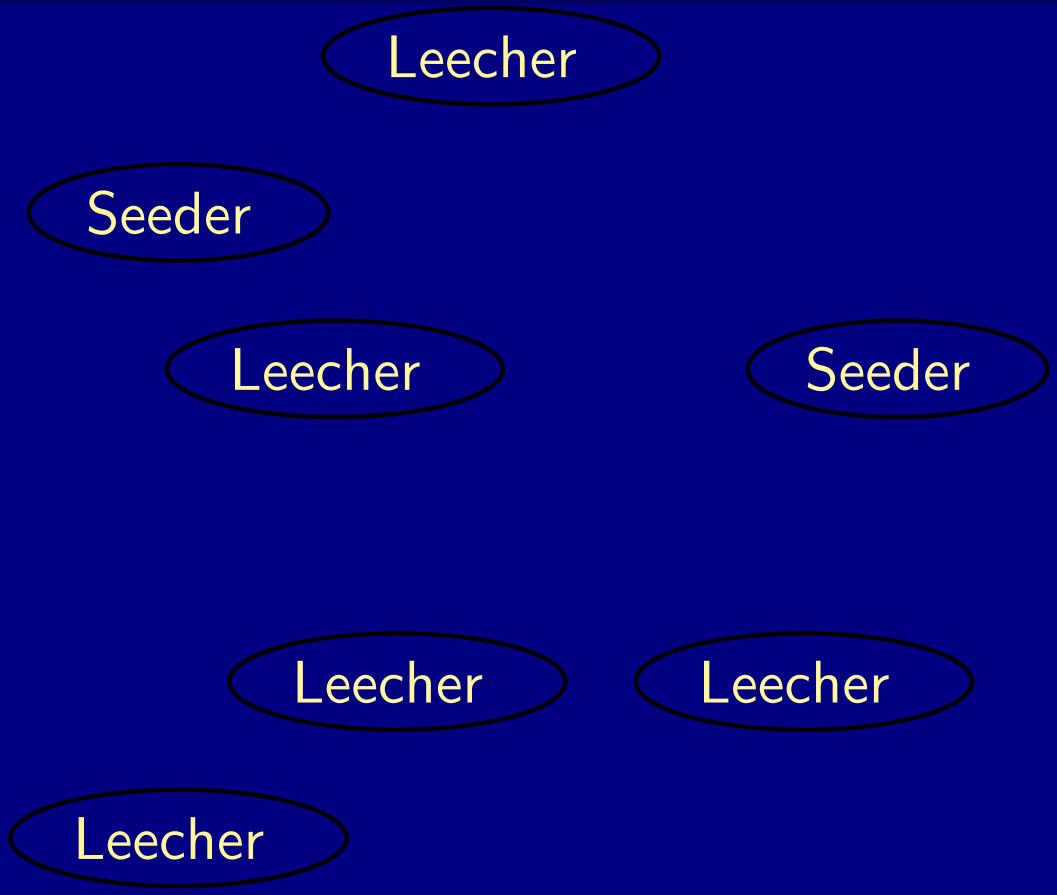

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- Then according to some strategy the client then asks for chunks form the other members of the swarm.
- Tit for Tat, means that you don't have to answer a request if you not getting something back from requester (bandwidth). This can make start up times a bit slow.

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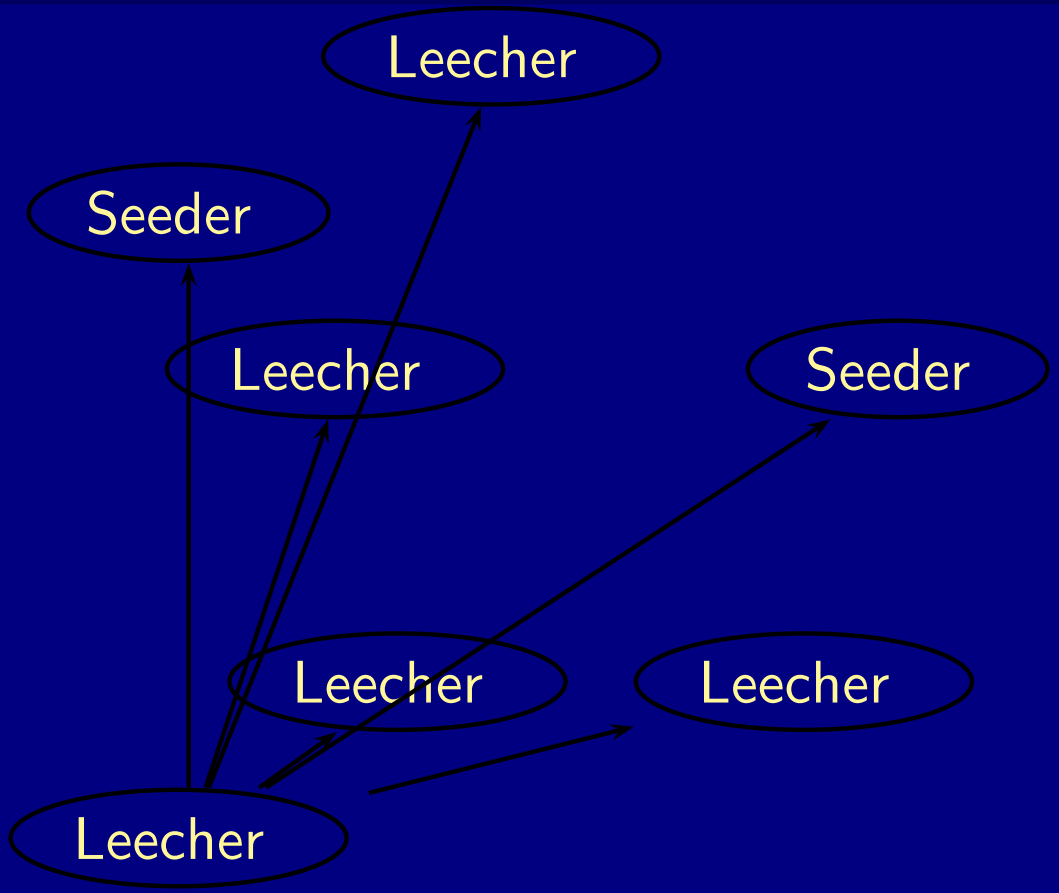

- What chunks do you have?

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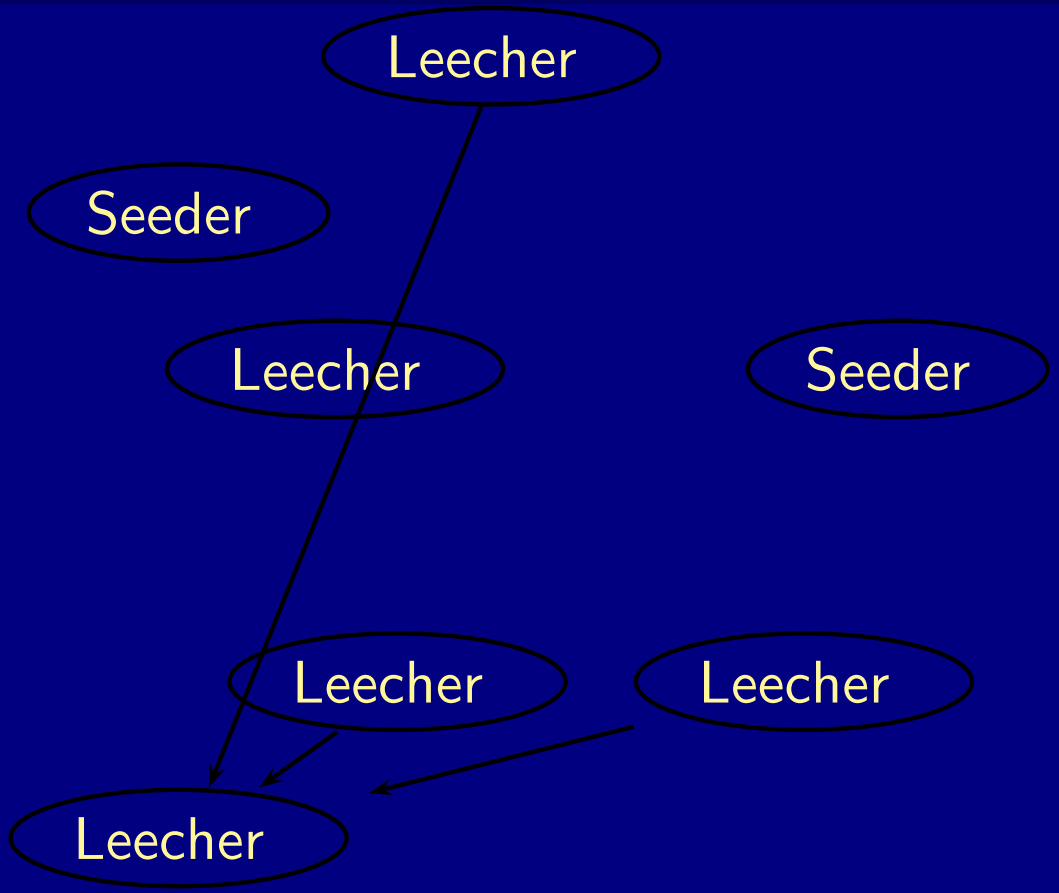

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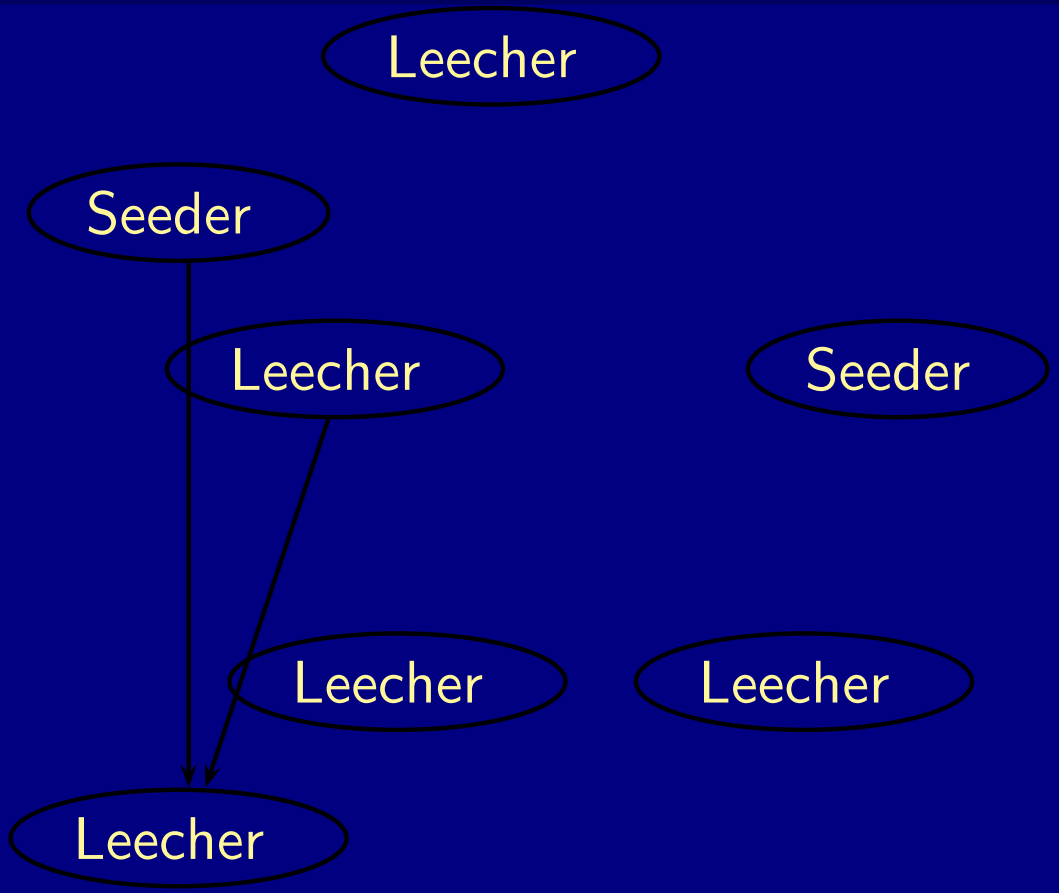

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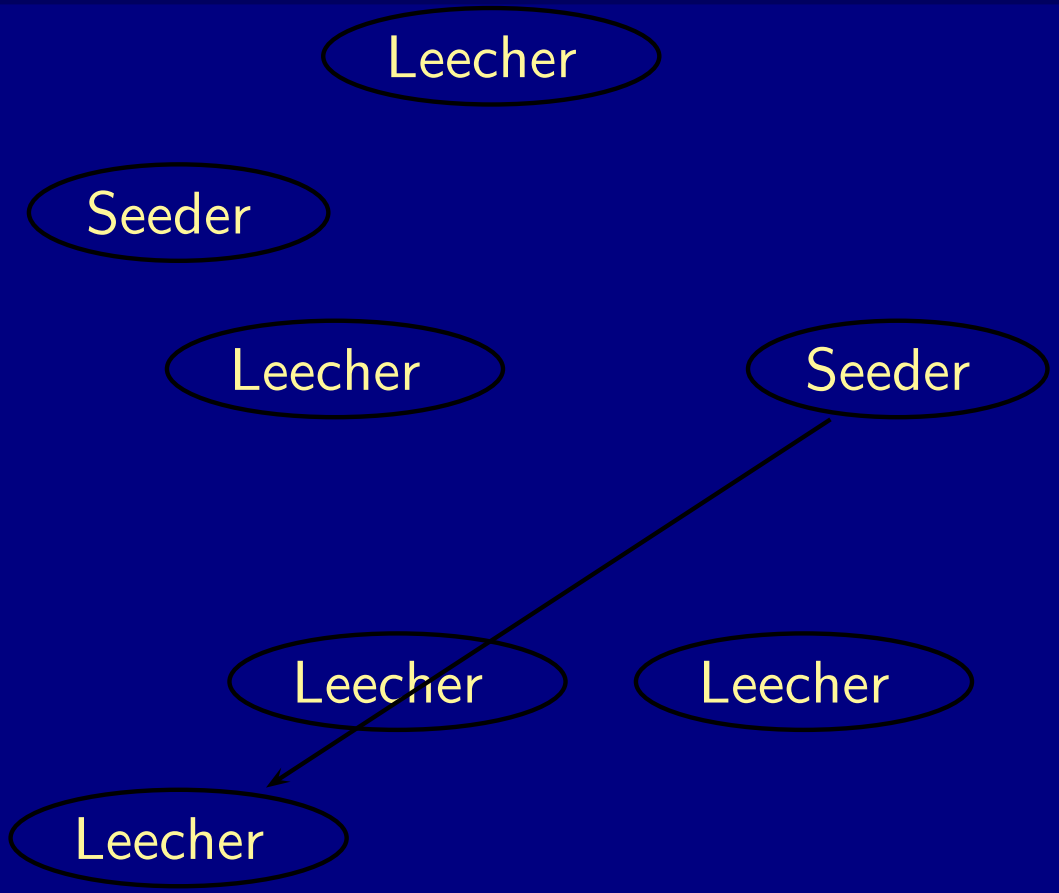

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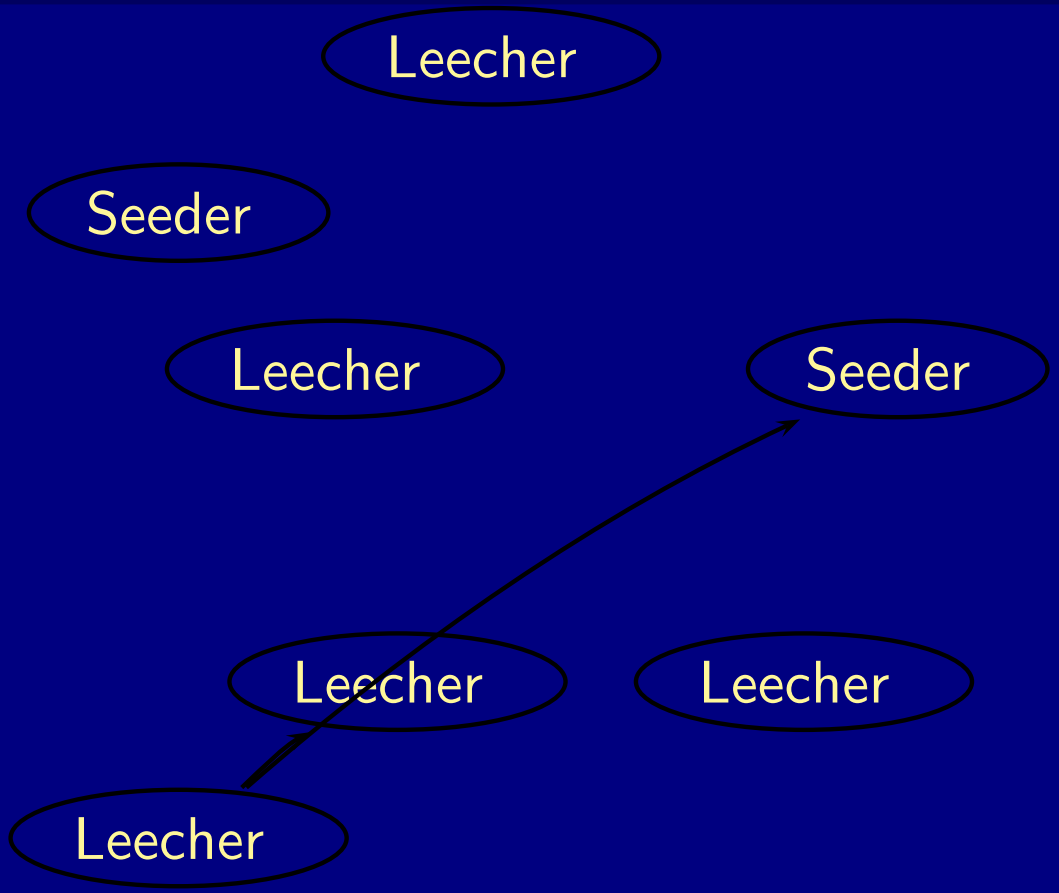

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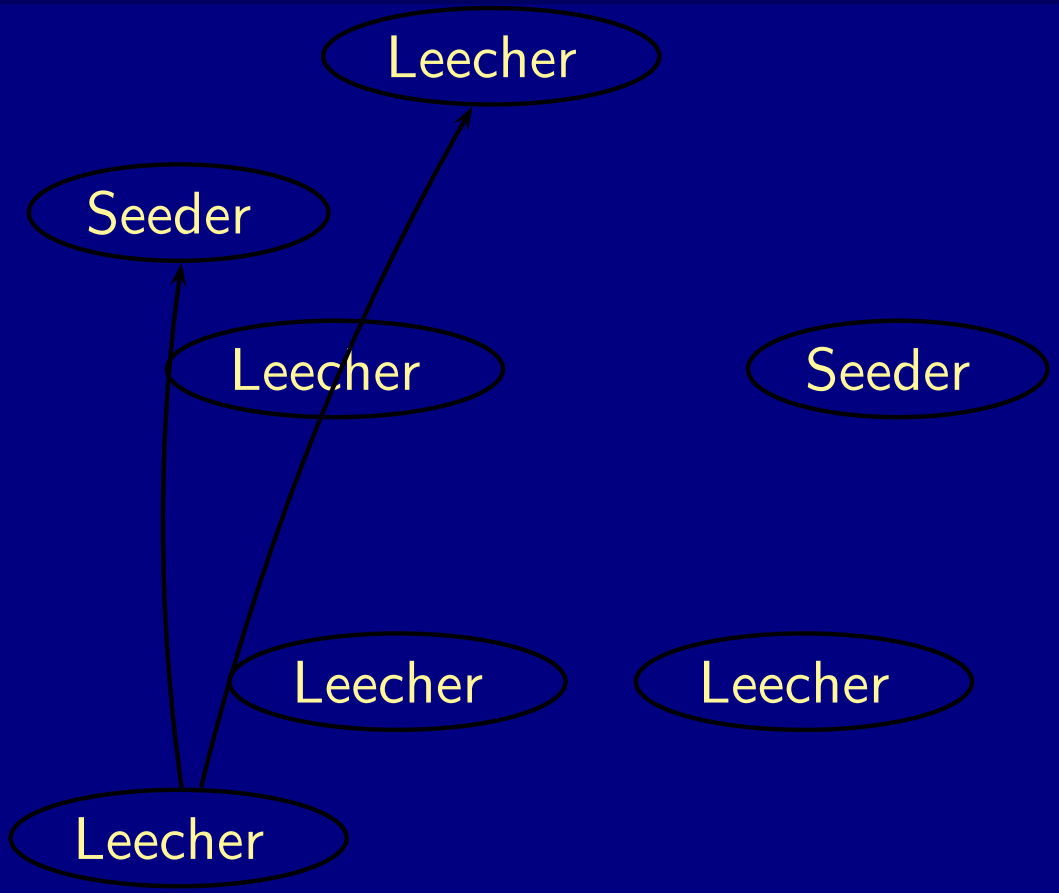

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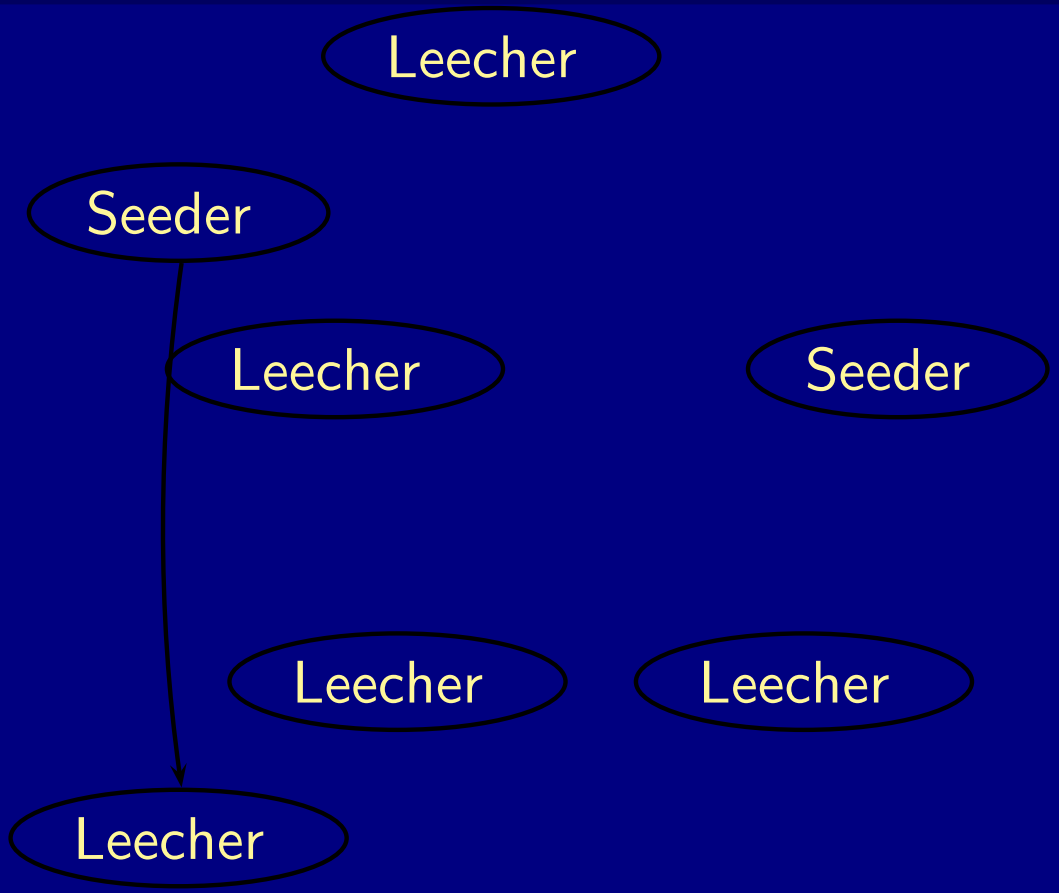

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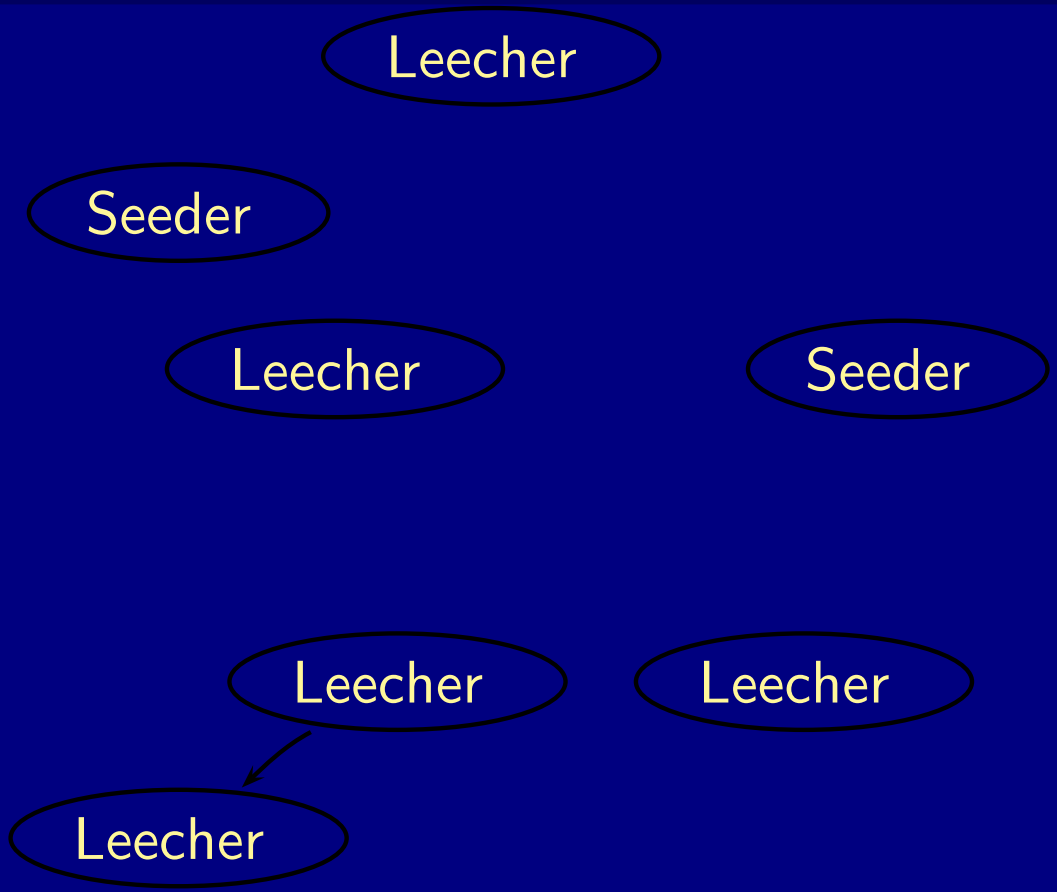

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  - Tit for tat scheme says no.
- The idea is that the more you upload the better service you have.

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Bit torrent like protocols are used in quite a few places:

- Games
  - Blizzard's World of Warcraft uses bit torrent to deliver updates
  - GnuZ The Duel (online multiplayer shot and kill game)
- Bit Torrent Inc. Legal version of Bit torrent download.
- Amazon S3 uses bit torrent in parts.
- Lots of Linux distributions offer bit-torrent downloads.

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Two aspects:

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Other topics, *secure routing*, *distributed stenographic file systems*

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- Various types of anonymity are desirable:
  - hide the author or publisher of the content
  - hide the identity of a node storing the content
  - hide the identity and details of the content
  - hide details of queries for content.

Anonymity

Freenet peer-to-peer content distribution system that makes it infeasible to discover the true origin or destination of a file passing through its network.

Onion routing provides a mechanism for anonymous connection between nodes (neither node knows the identity of each other but messages still get through).

Note that these schemes can be quite sophisticated. Via the use of techniques from cryptography it can be impossible (almost) to break the anonymity. It is more complex than just throwing away server logs.

Other uses of P2P

Skype uses peer-to-peer protocol to forward phone calls around the net. Closed protocol, not sure how it works.

Joost Peer-to-peer internet television.

OcenStore `http://oceanstore.cs.berkeley.edu/` large scalable, fault tolerant storage system.

Distributed Databases takes files up to the next level.

Distributed Computation Seti@Home, look for messages from the little green men, or folding@home find out how proteins fold.