

Peer to Peer — P2P

- There are many non-technical questions around P2P because of the ease of use in distributing content.
- The technical aims of P2P can be summarised as follows:
 - Load balancing Get rid of central servers, less load on one node in the network.
 - Fault Tolerance No single point of failure, if the server goes down the network can still carry on.
 - Efficient use of resources There are often lots of wasted resources on network (spare file space, spare computation power).
- Also coupled with this is the fact in most P2P systems it is very easy for clients to participate (SETI@Home, folding@home), posting a torrent is easy.

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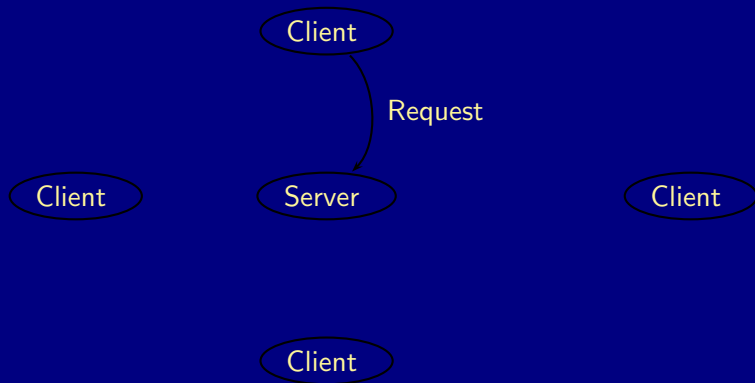
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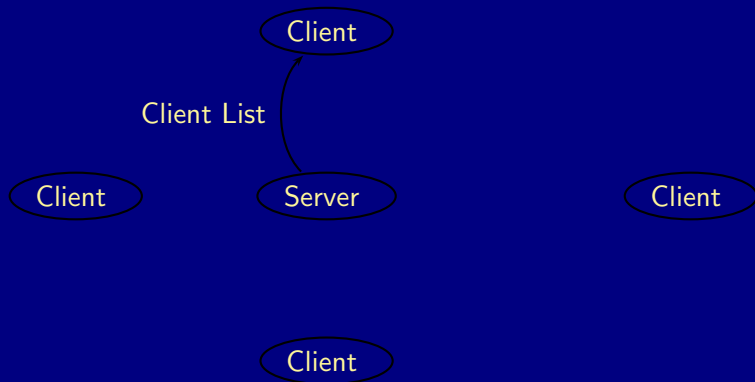
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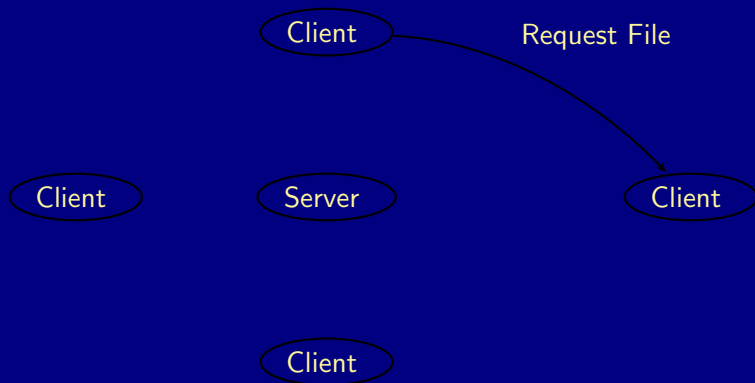
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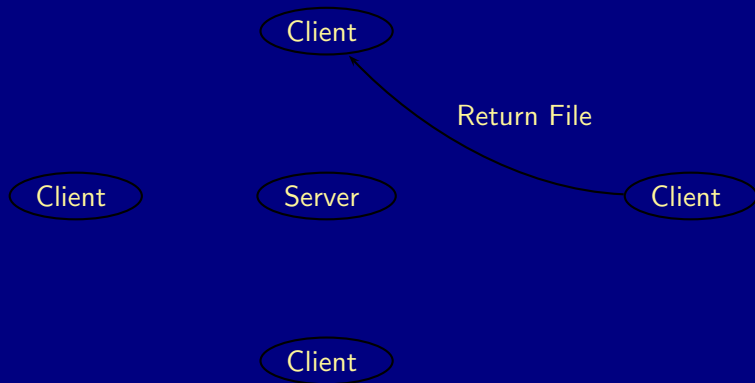
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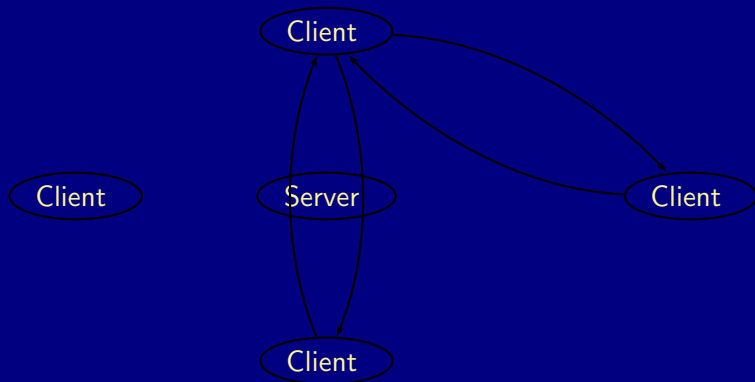
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 - Make the clients more complicated and download from multiple clients (essentially what Bit-torrent does)

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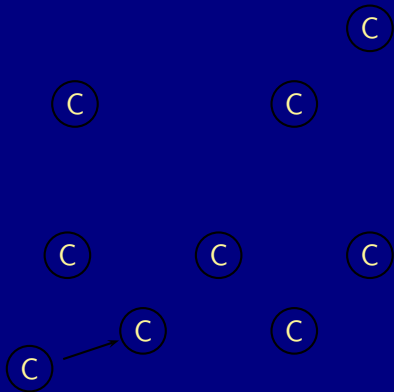
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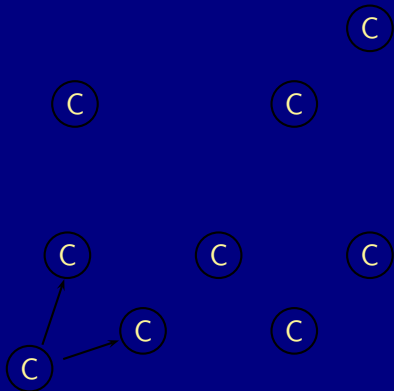
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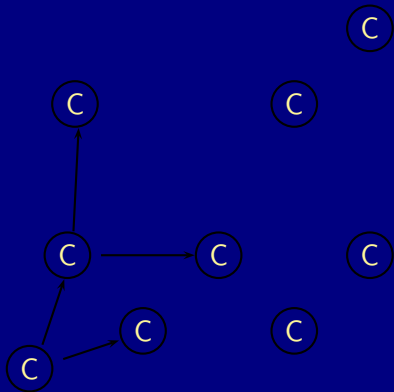
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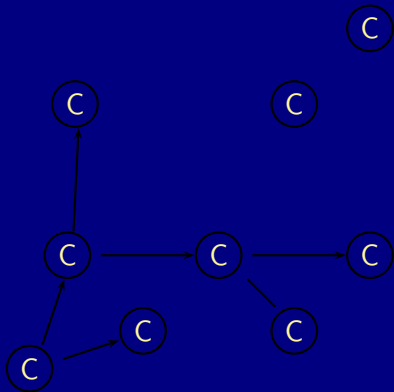
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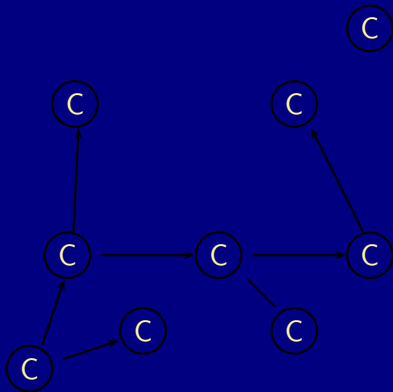
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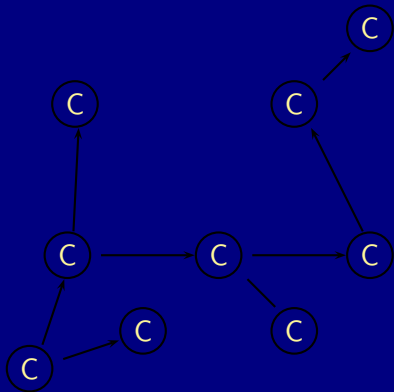
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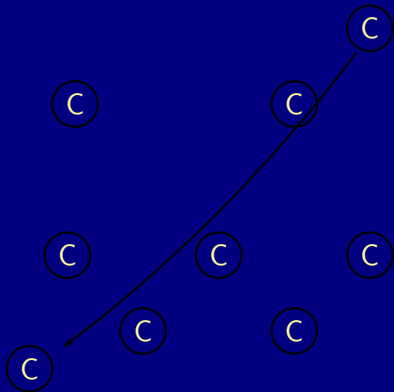
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- Gnutella can have the problem that the network has more request messages floating around than anything else.
- Instead of flooding do a random walk from node to node, works but it can take a can take a long time to find the file.

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Overlay networks

- Gnutella type protocols flood the network with lots of request.

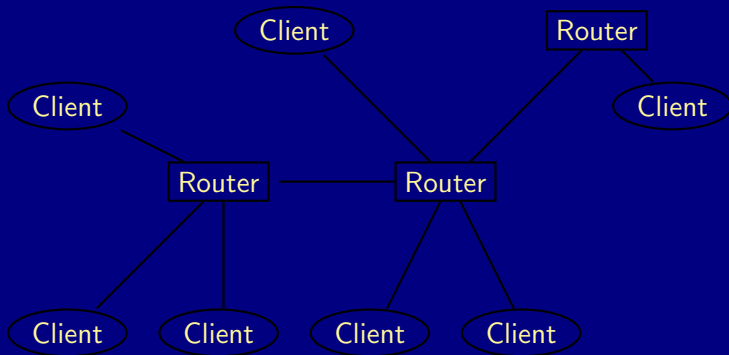
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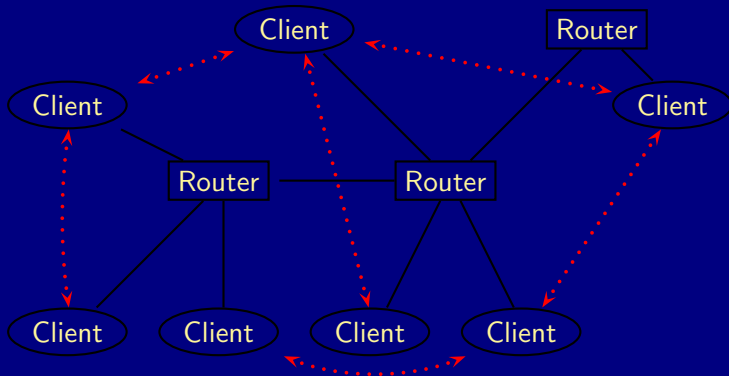
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- The basic idea is that of an overlay network, a network over a network.

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

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- In a N-node system a message can be routed in

$$O(\log_r N)$$

hops, where $r = 2^b$ and b is typically 4.

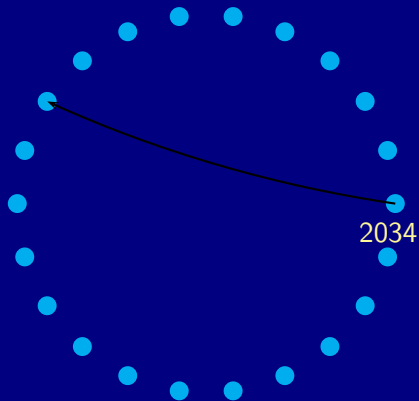
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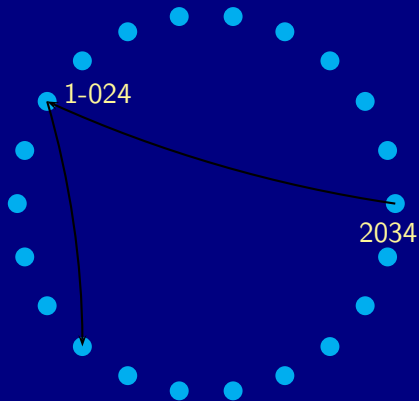
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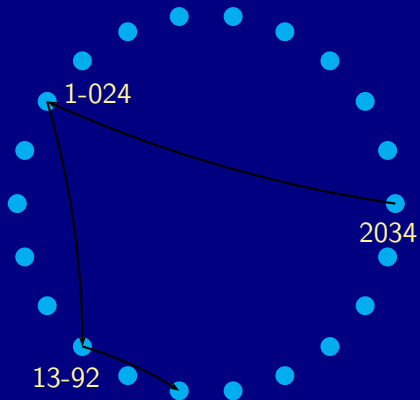
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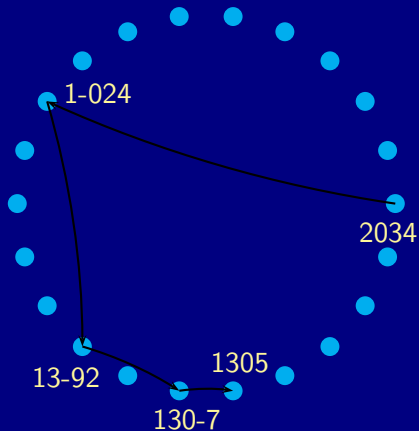
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Pastry Routing Implementation

- Each node maintains the following data:
 - Leaf Set L . Each node n maintains a list of nodes that are between $(n + L/2)$ and $(n - L/2)$
 - Routing Table R Each row j of the table points to a node whose id shares the first j digits with n with with digit $j + 1$ being different.
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- If a destination node is not in the leaf set then the node is forwarded to a node whose id shares a larger common prefix with the destination id.

Chord

- Chord uses an alternative addressing scheme based on a m -dimensional hypercube.
- Each node only connects via its outgoing edges.
- With $N = 2^m$ nodes a message can be sent in $m = \log_2 N$ hops.
- Chord distributes files over the hypercube.
 - A file with hash K is put in the node with address K otherwise the node with the closets higher key.
 - Each node has a routing table (called a finger table) with $m = \log_2 N$ entries, each entry directs it to the a neighbour.
 - Look up is in a greedy fashion, go via the neighbour which will get you there quickest.

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- Instead everybody downloading a popular file from a central server, we let clients host all or some of the file and other clients download not just from the central server.

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Currency Peers earn money by giving resources to the system and spend money by downloading and using resources.

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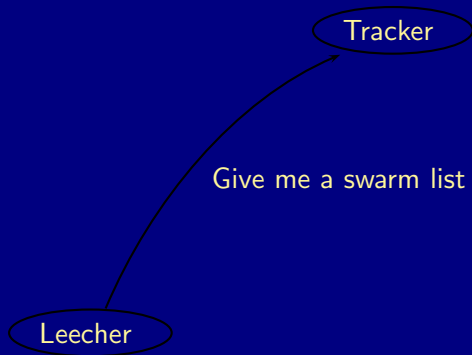
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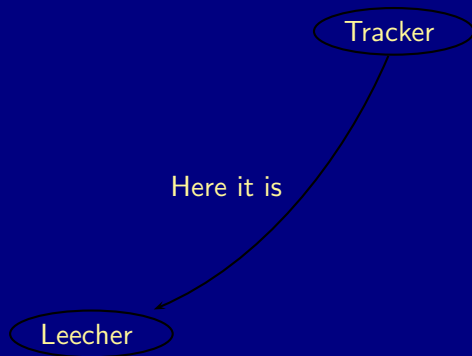
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- Each chunk has a hash to verify if it has been downloaded properly (stops people injecting bogus chunks).

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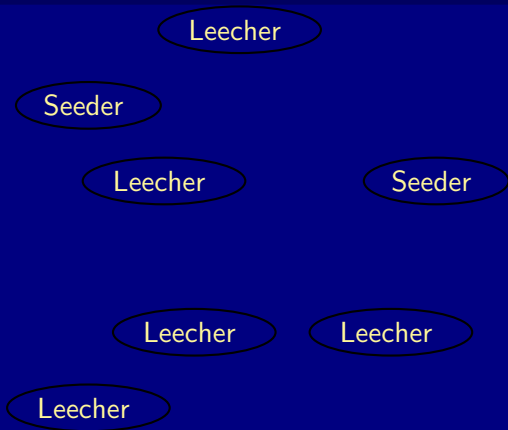


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Note that the tracker need not give all the files in the swarm.

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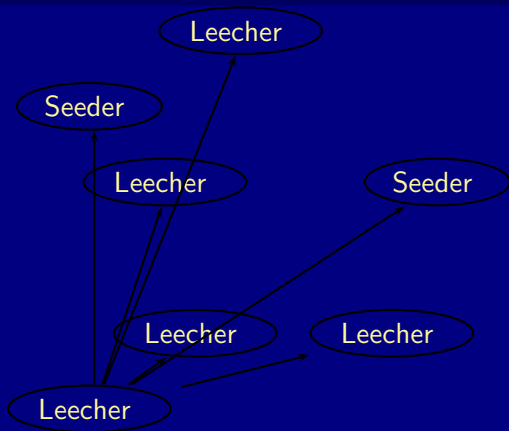
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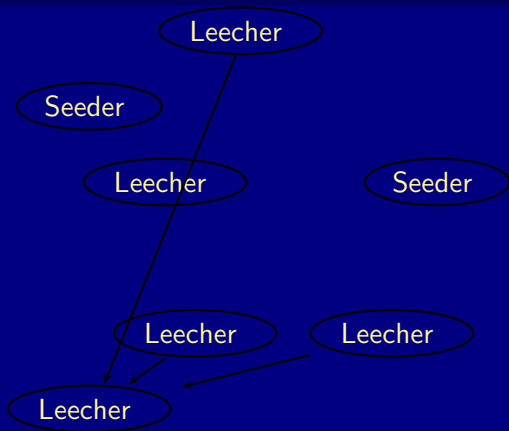
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- Then according to some strategy the client then asks for chunks form the other members of the swarm.
- Tit for Tat, means that you don't have to answer a request if you not getting something back from requester (bandwidth). This can make start up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

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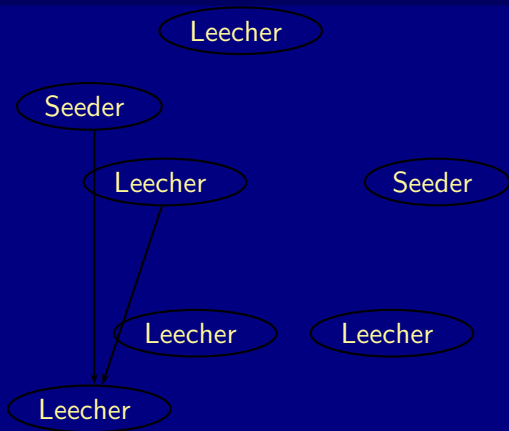
- What chunks do you have?

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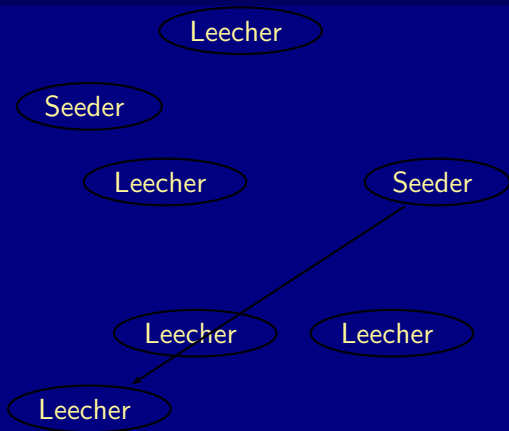
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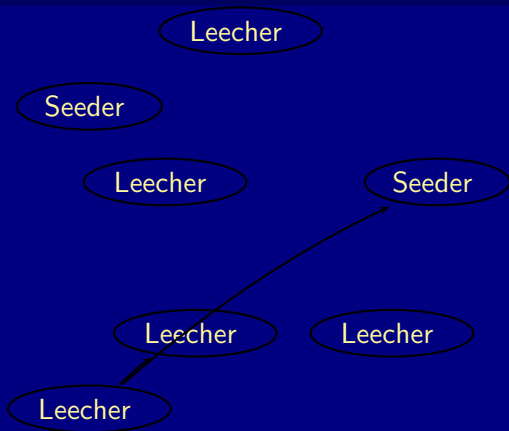
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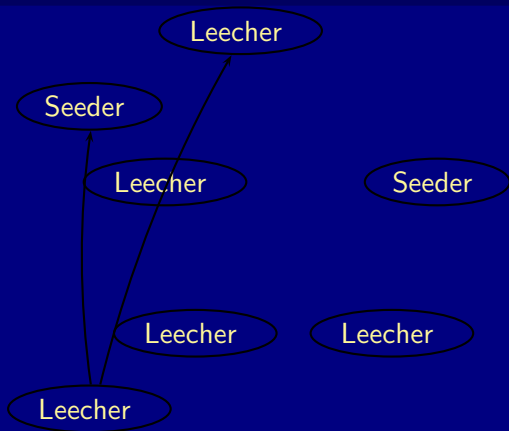
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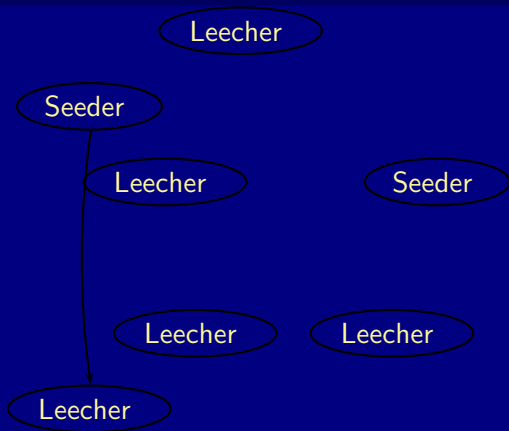
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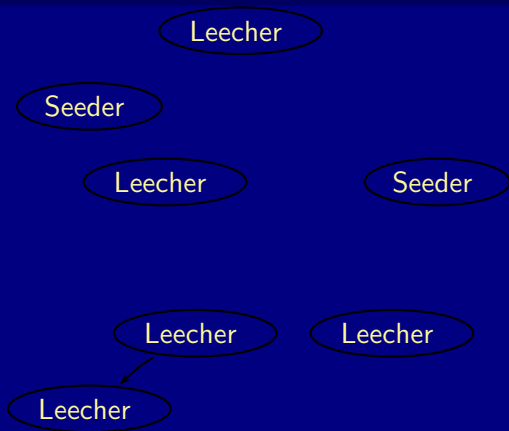
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- The idea is that the more you upload the better service you have.

Bit torrent

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

Anonymity

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 - 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.