COMP 790-088: Networked & Distributed Systems

Distributed "Peer-to-Peer" Systems

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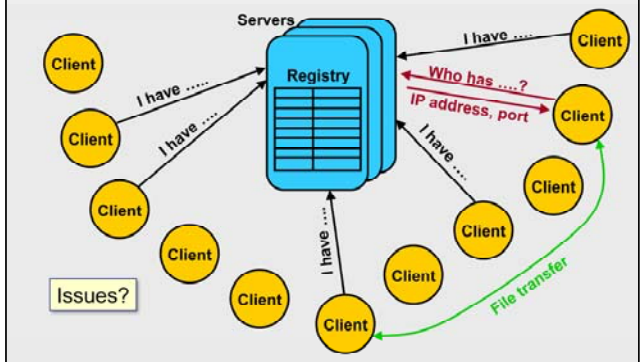
Object Discovery Protocols

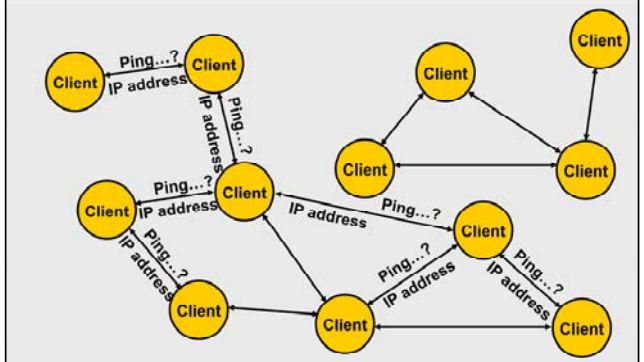
- How to design a distributed system that helps members share objects (by exchanging copies of objects between peers)?
  - » Objects could be files, music, video, …
    - ❖ e.g., distributed file systems, usenet, naming service, etc.
  - » Object could be available at one, many, or none of the peers
- How to quickly find (and retrieve) the object?
  - » Data is important (location isn't)
    - ❖ Query refers to data (and not location)
    - ❖ Data placement unrelated to overlay topology

In the Beginning ….Napster

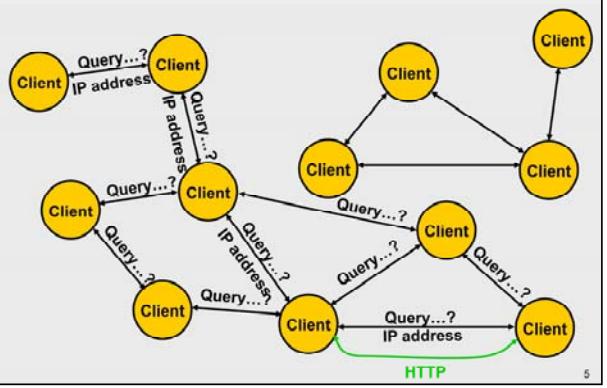


Gnutella – Discovery & Join Flooding

Self-organizing Overlay Network



Gnutella – Search Flooding



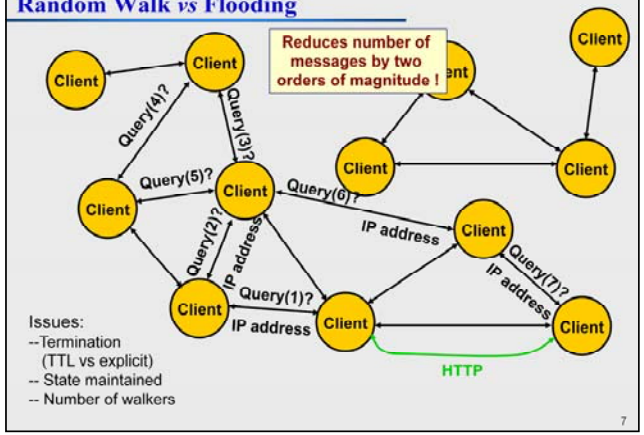
Gnutella – Rules for Flooding

- Hop-count in messages limits horizon for forwarding
  - » May cause search to fail even if target exists
- Incoming Ping or Query messages are forwarded on all connections except the one that sent it
- Incoming Ping or Query messages that are duplicates should be discarded
- Response messages should be forwarded only on the connection sending the original Ping or Query
- Response messages should be discarded if the node has not received the matching Ping or Query

Alternatives to flooding?

Can Gnutella Be Made Scalable?

Random Walk *vs* Flooding

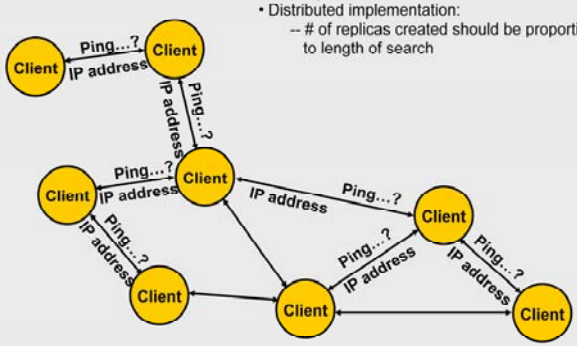


Issues:
--Termination
(TTL vs explicit)
-- State maintained
-- Number of walkers

Can Gnutella Be Made Scalable?

Degree of Replication

- Replication should be proportional to square-root of query rate
- Distributed implementation:
  -- # of replicas created should be proportional to length of search

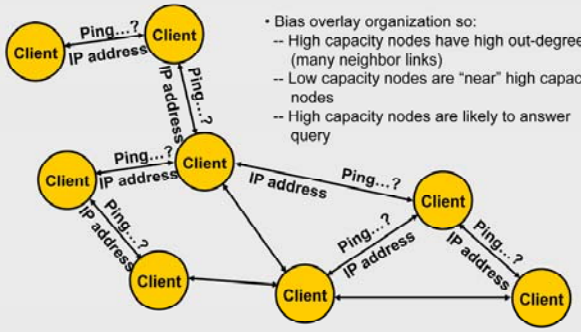


Can Gnutella Be Made Scalable?

Topology Adaptation

- High degree nodes observe high query loads
- Random walks that seek out high-degree nodes lead to superior scaling to large systems

- Bias overlay organization so:
  - -- High capacity nodes have high out-degree (many neighbor links)
  - -- Low capacity nodes are "near" high capacity nodes
  - -- High capacity nodes are likely to answer query



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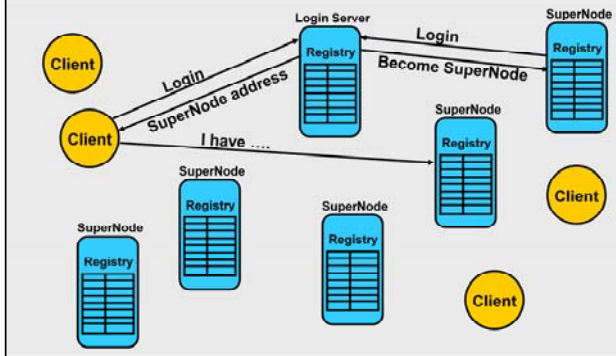
KaZaA (Fasttrack)



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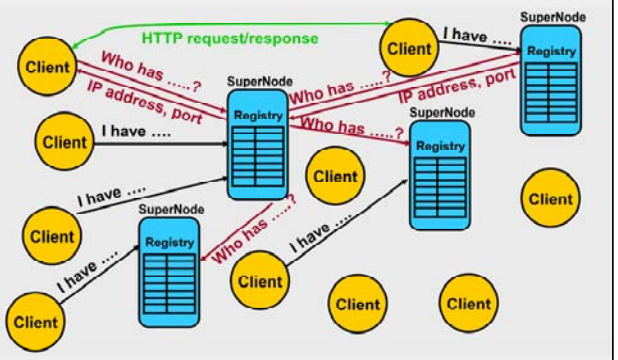
KaZaA


HTTP request/response
Client
Who has .....?
IP address, port
SuperNode
Registry
I have ....
Client
I have ....
Client
I have ....
SuperNode
Registry
Client
I have ....
Client
Who has .....?
Client
Client
Client
Who has .....?
IP address, port
SuperNode
Registry
Client
I have ....
SuperNode
Registry
Who has .....?
Client
Client
SuperNode
Registry
Client