Clustered P2P Architectures

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Outline

- Unstructured P2P
- DHT P2P (structured)
- Clustered P2P (hierarchically structured)
- ECSP/EFA/Performance
- Conclusions
- Hybrid P2P Issues

Unstructured P2P

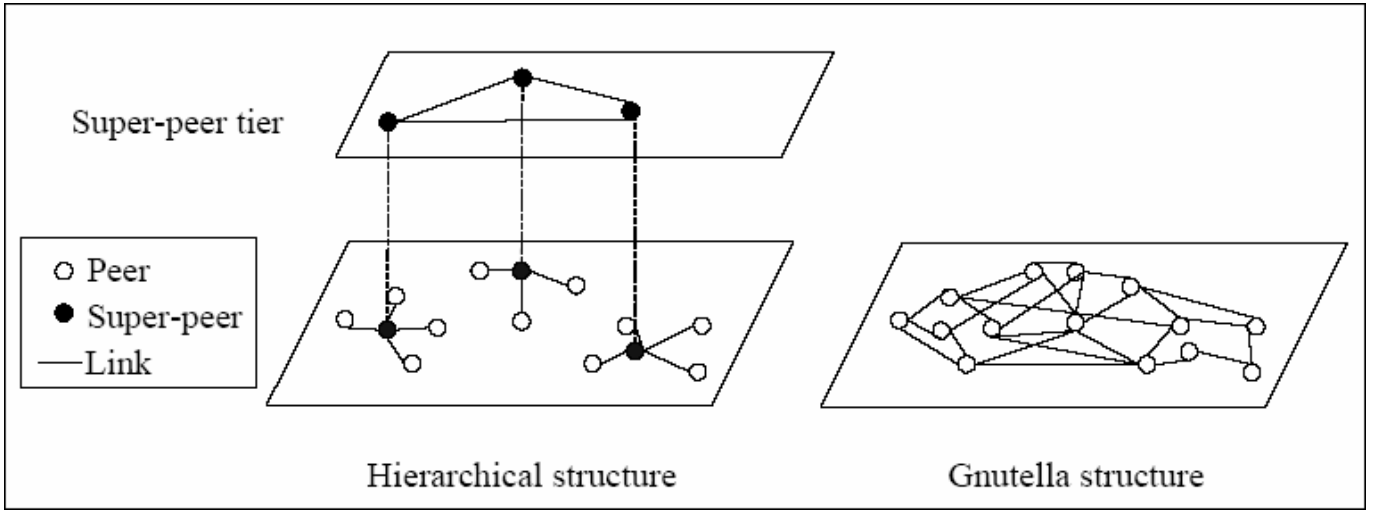
- Gnutella
- Adv.
  - resilience to dynamic peer join/leave
  - no overhead on peer failure
  - support for keyword search
- Disadv.
  - overhead of query messages
  - no guarantee on availability

DHT P2P

- DHT: Distributed Hash Table
- Pastry, Chord, CAN
- Adv.
  - scalable compared with unstructured P2P
  - guaranteed availability
- Disadv.
  - control overhead on frequent peer join/leave
  - only support for exact name match

Clustered P2P

- eDonkey[3], Kazaa[4]
- Clustered P2P systems improve message overhead of unstructured P2P without introducing control overhead as in DHT P2P.

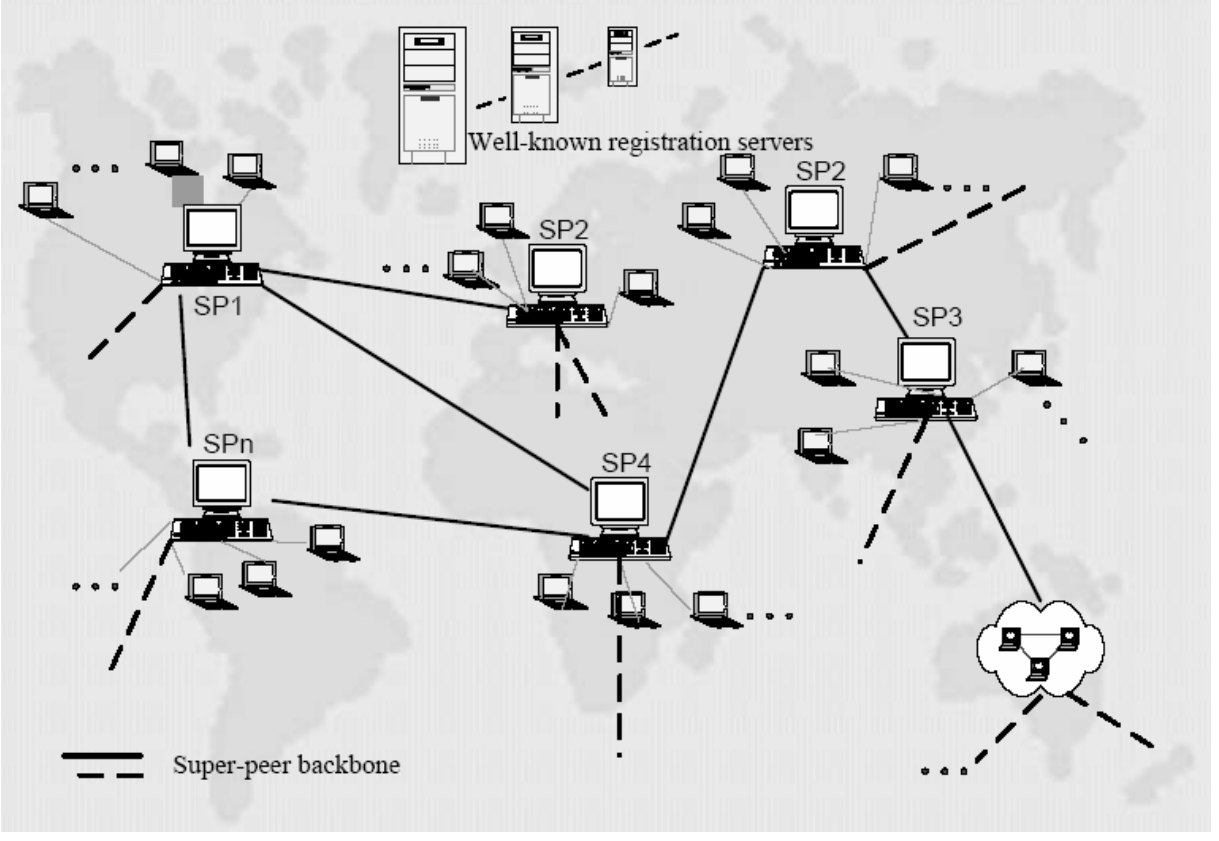


Clustered P2P

- Peers are grouped into clusters and connected to the superpeer of cluster.
- Peers with more resources, higher processing and network capacities are selected as superpeers of clusters.
- Superpeers act as local search hubs, building indices of the files share by each peer connected to them, and proxying search requests on behalf of theses peers.

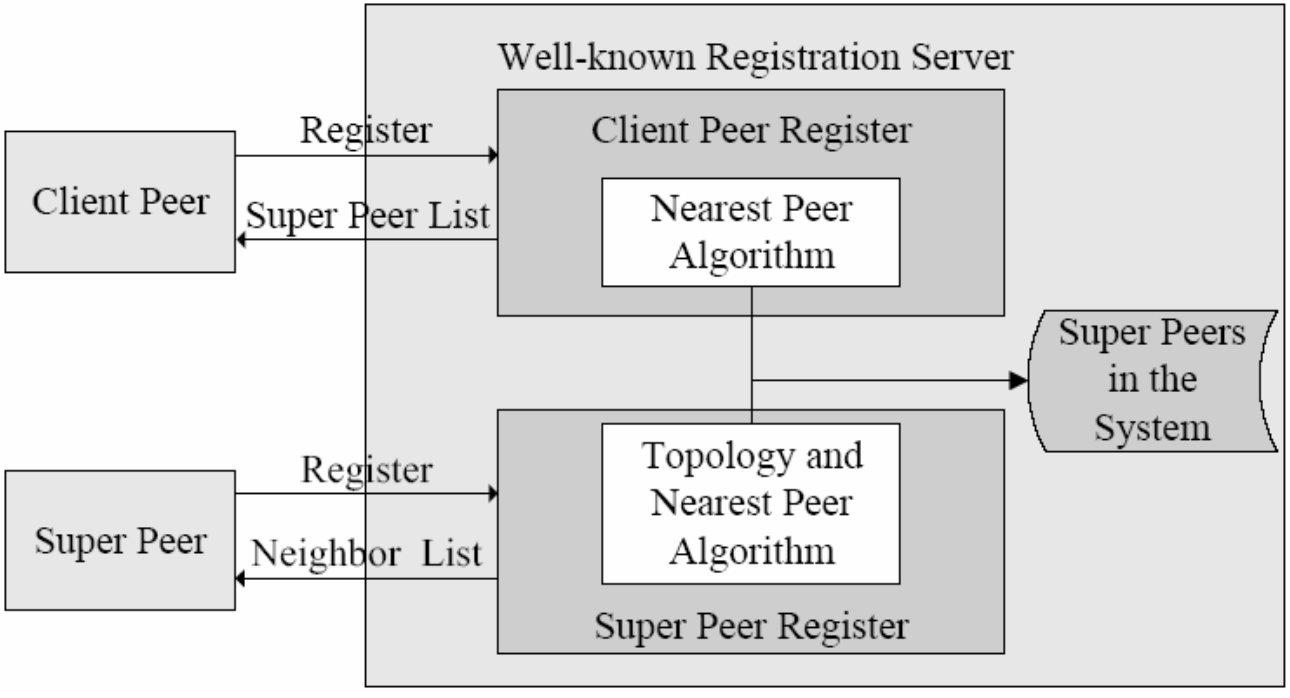
ECSP[1]

- Efficient Clustered Superpeer P2P



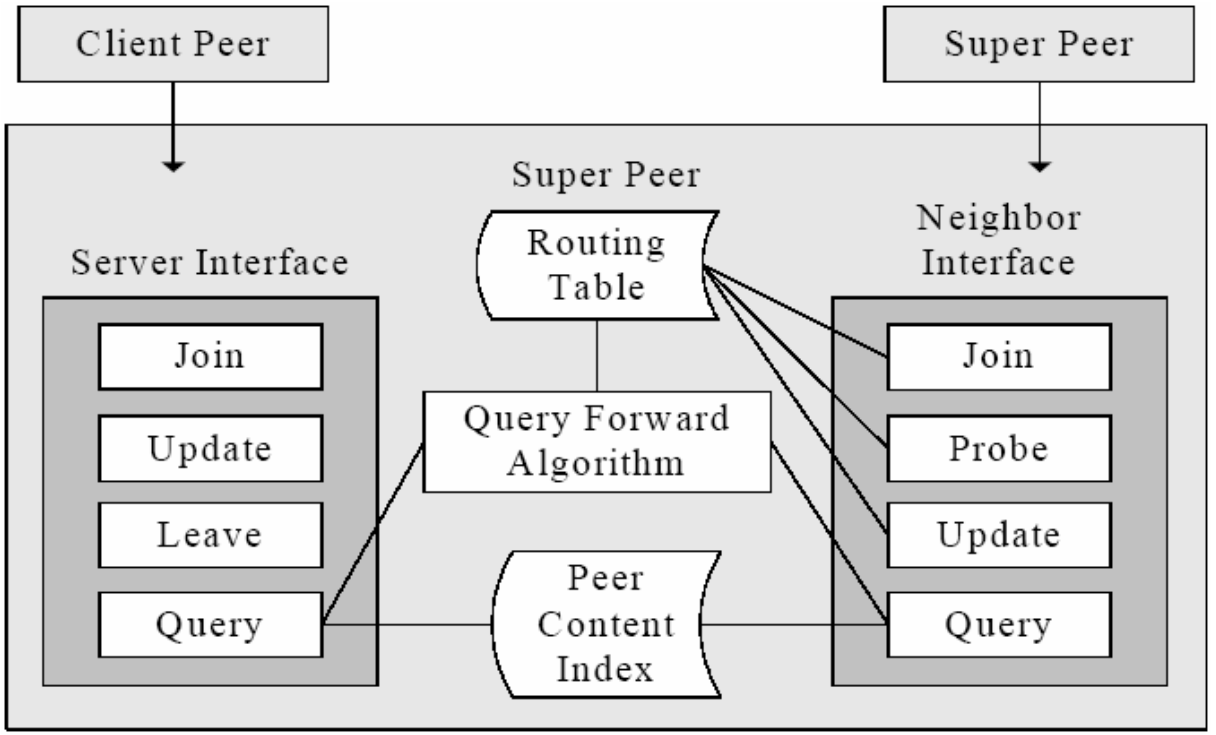
Registration Server

- Registration servers supply yellow page services to all nodes in the network.

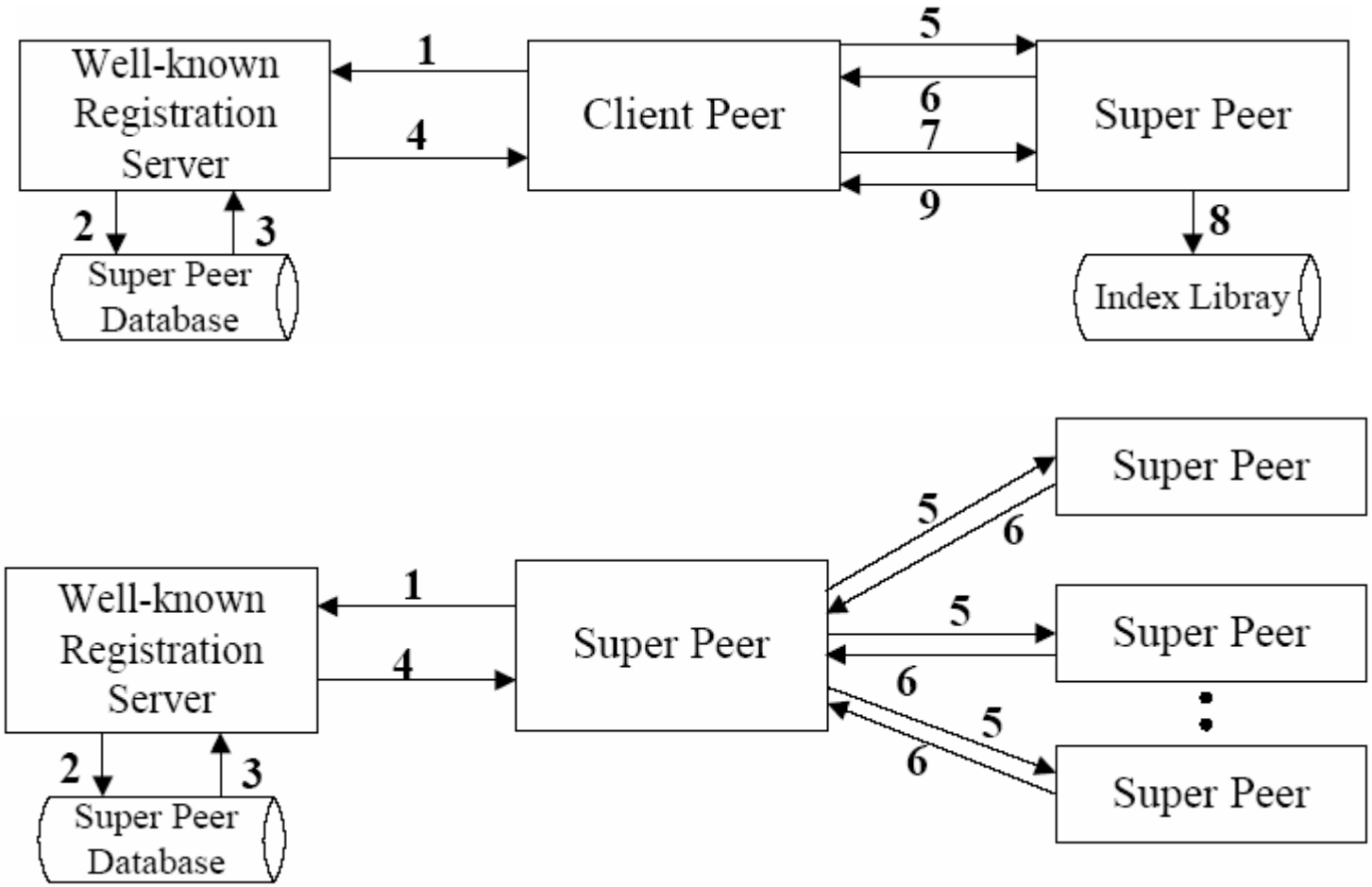


Superpeer

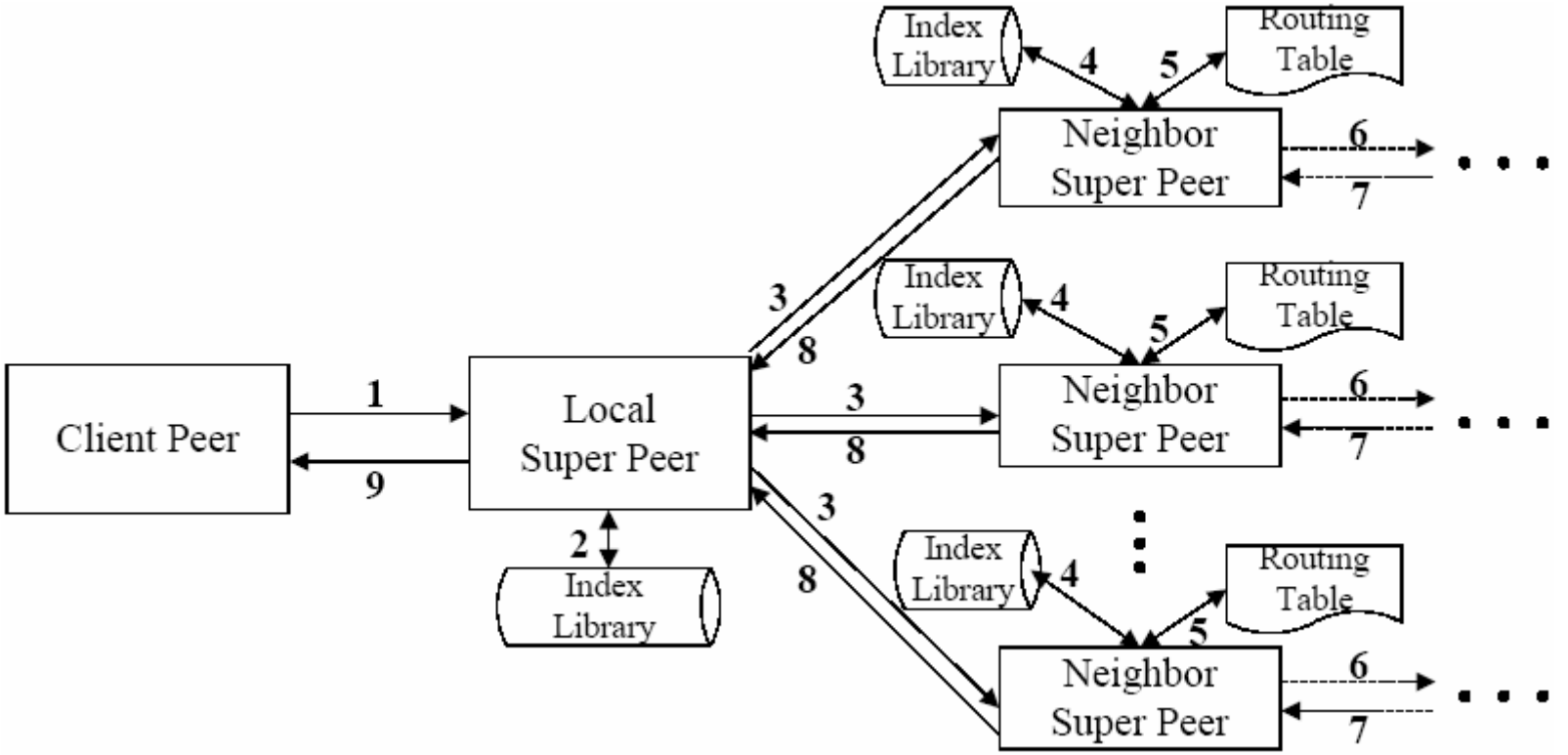
- Superpeers act as cluster leaders and service providers for peers in their clusters.



Joining of Peers



Querying


Client Peer
Local Super Peer
Index Library
Routing Table
Neighbor Super Peer
Index Library
Routing Table
Neighbor Super Peer
Index Library
Routing Table
Neighbor Super Peer
1
9
2
3
8
3
8
3
8
4
5
6
7
4
5
6
7
4
5
6
7

EFA

- Efficient Flooding Algorithm
- EFA use limited topology information and simple computing to decrease the duplication queries created by flooding.
- If node *v* can anticipate that one of its neighbor *u*, receives query messages from another path, however, then *v* does not forward the query to *u*.

EFA

Symbol	Description
v	Current node
id(v)	Node *v*'s unique id
N(v)	Neighbor set of *v*
NN(v)	Neighbor's neighbor set of *v*
fr(u,v)	*v* is the current node, *u* is the node which forwards the query to *v*. *fr(u,v)* is the forward reaching set of *u* for the current node *v*, i.e. the immediate (no more than 2 hops away) set of nodes reached by the local flooding source *u*.
routing(u,v)	For local source *u*, current node *v*'s routing set. For example, if *u* forwards the query package to *v*, the set of nodes *v* forwards is decided by *routing (u, v)*

EFA

forward(u,v)
*/*when node v receives forwarded query from its neighbor u, this algorithm decides how v forwards this query */*

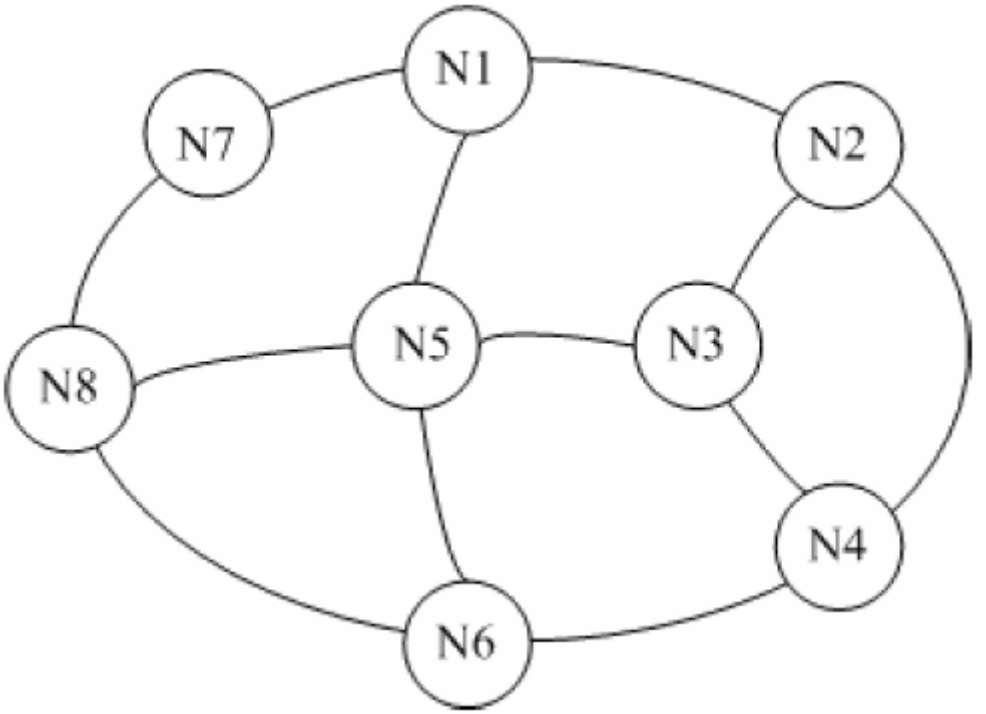
If the received query has been received before
discard it
else
if u is null / v is the node which initiates the query*/*
forward the query to N(v)
else
forward the query to routing(u,v)

(a)

$fr(u,v) = N(u) \cup \{$ all v' in $NN(u) \mid id(v') < id(v)\}$
routing(u,v) = all v' in $N(v)$, such that
1. $v' \notin fr(u,v)$ AND
2. $\{N(v') \cap fr(u,v) = \varnothing\}$ OR $\{N(v') \cap fr(u,v) = A$ AND $(\forall v'' \in A$ AND $id(v'') > id(v))\}$

(b)

Example



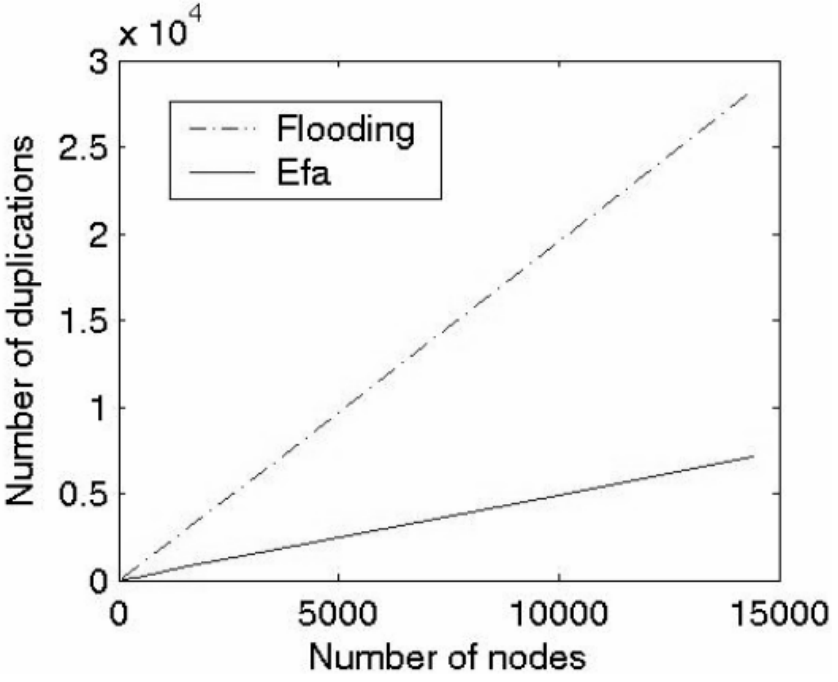
Forward(N1, N5)
N(N1)=N2, N7
NN(N1)=N3, N4, N8
fr(N1, N5)=N2, N3, N4, N7

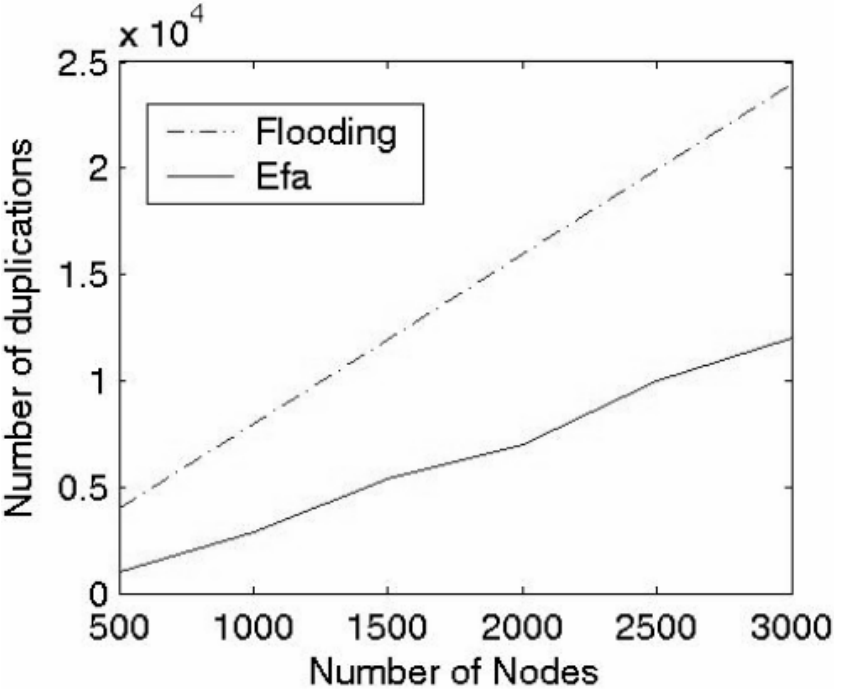
checking 1. = N6, N8
checking 2a. = *NONE*
checking 2b = N8

➔routing(N1, N5)=N8

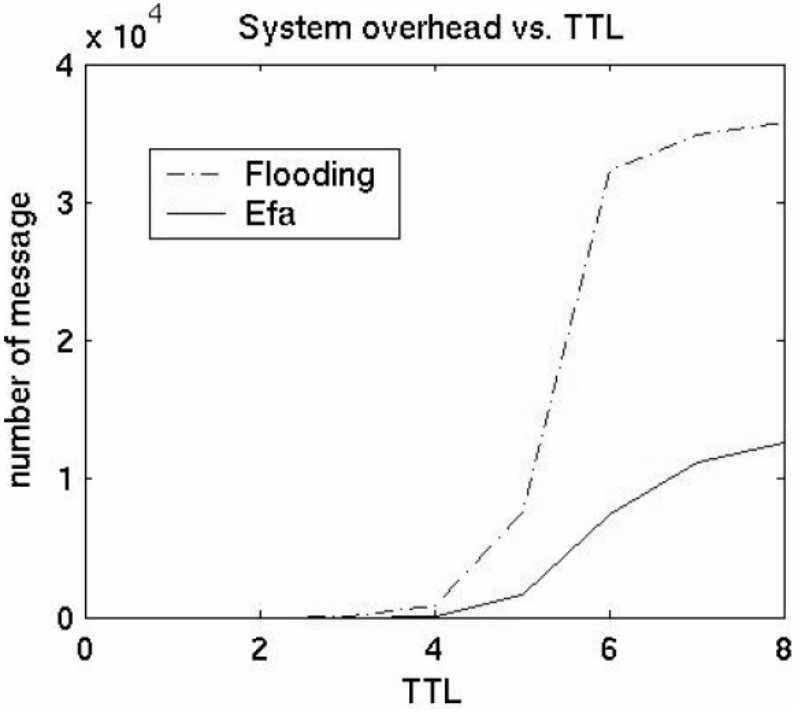
Performance

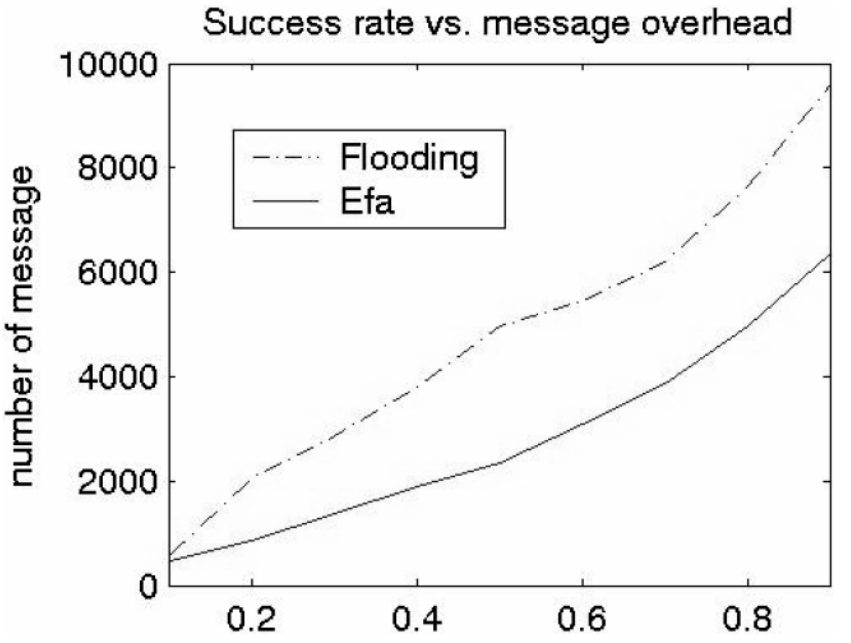
- Grid v.s. Random





Performance



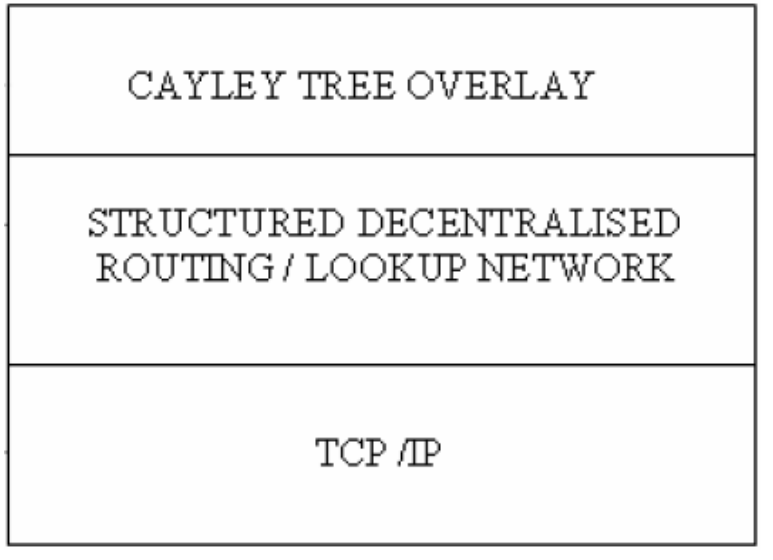


Conclusions

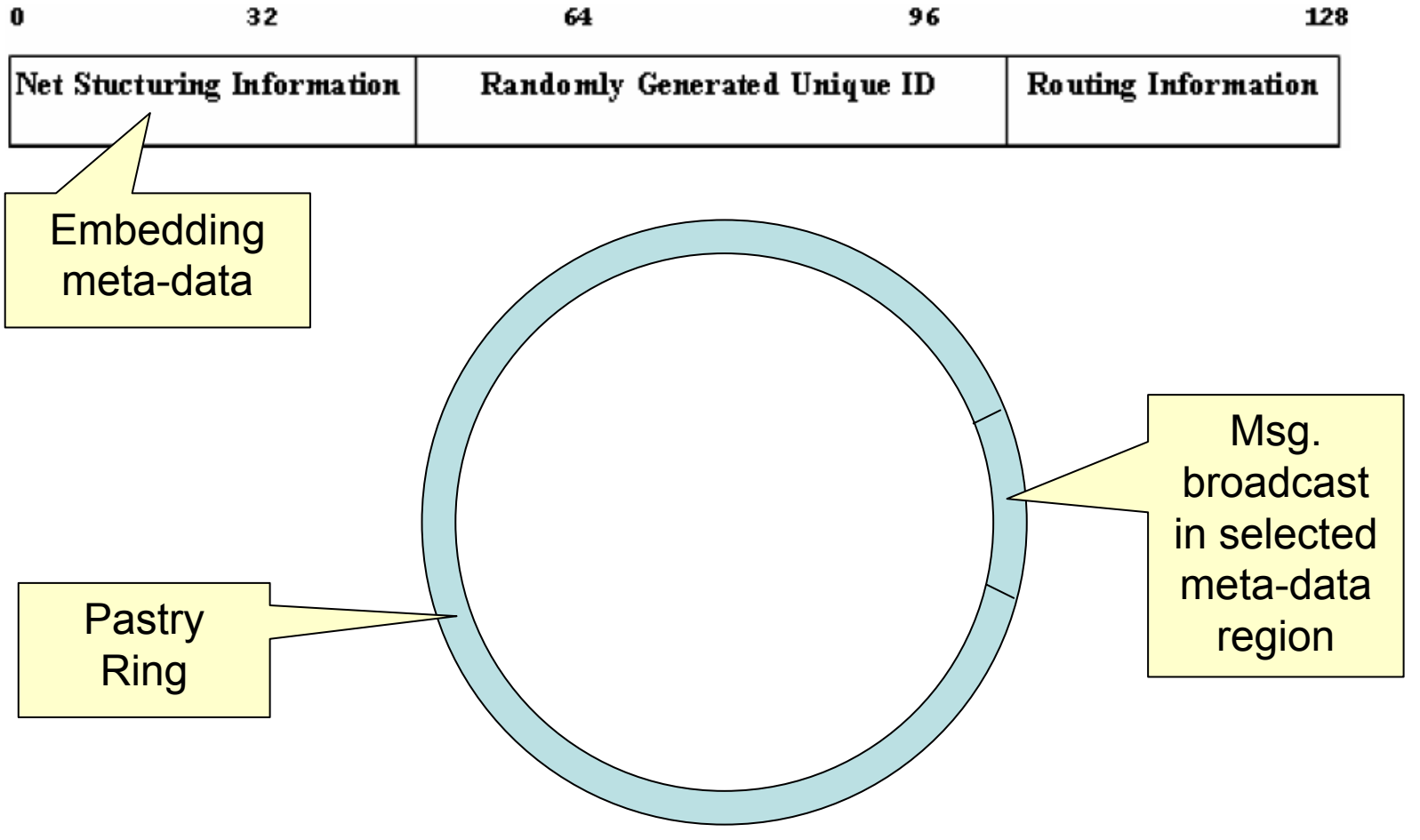
- Hierarchical clustered P2P architecture can improve flooding overhead in pure unstructured P2P.
- EFA prevents duplication instead of discarding duplicate messages as in flooding.
- This work resembles our GP2P project in the two-level architecture.

Hybrid P2P

- Hybrid P2P models is proposed in [2] that integrates unstructured and DHT to enable network restructuring and routing behavior adaptation.



Reflective Key



Discussions

- How to use meta-data?
  - RDF, File types
- How to define meta-data region?
  - Hashing
  - Explicit v.s. implicit
- How to define a peer of certain specialty?
  - Interest groups, content analysis
- Multiple overlays v.s. multiple keys?

References

1. J. Li and S. Vuong, An Efficient Clustered Architecture for P2P Networks, IEEE AINA'04.
2. D. Hughes, I. Warren, and G. Coulson, Improving QoS for Peer-to-Peer Applications through Adaptation, FTDCS'04.
3. eDonkey. http://www.edonkey.com/
4. KaZaA. http://www.kazaa.com/