A Self-Organizing Overlay Network to Exploit the Locality of Interests for Effective Resource Discovery in P2P Systems

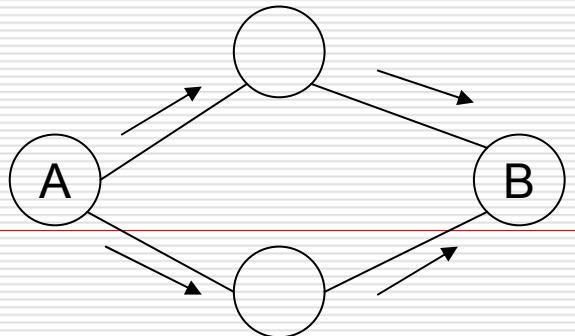
SAINT'05

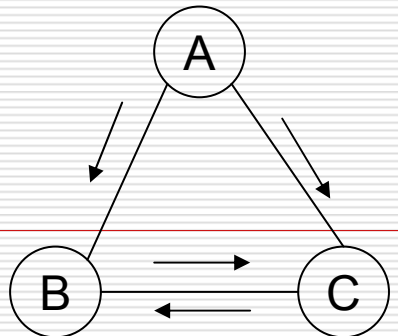
Outline

- Introduction
- SORMS: Self-Organized Resource Management System
- Simulation
- Conclusion
- Discussion

Introduction

- Unstructured P2P network use flooding based search mechanism
  - relays the query message to all its logical neighbors, except the incoming peer result in large volume of unnecessary traffic
- Not scalable [1]



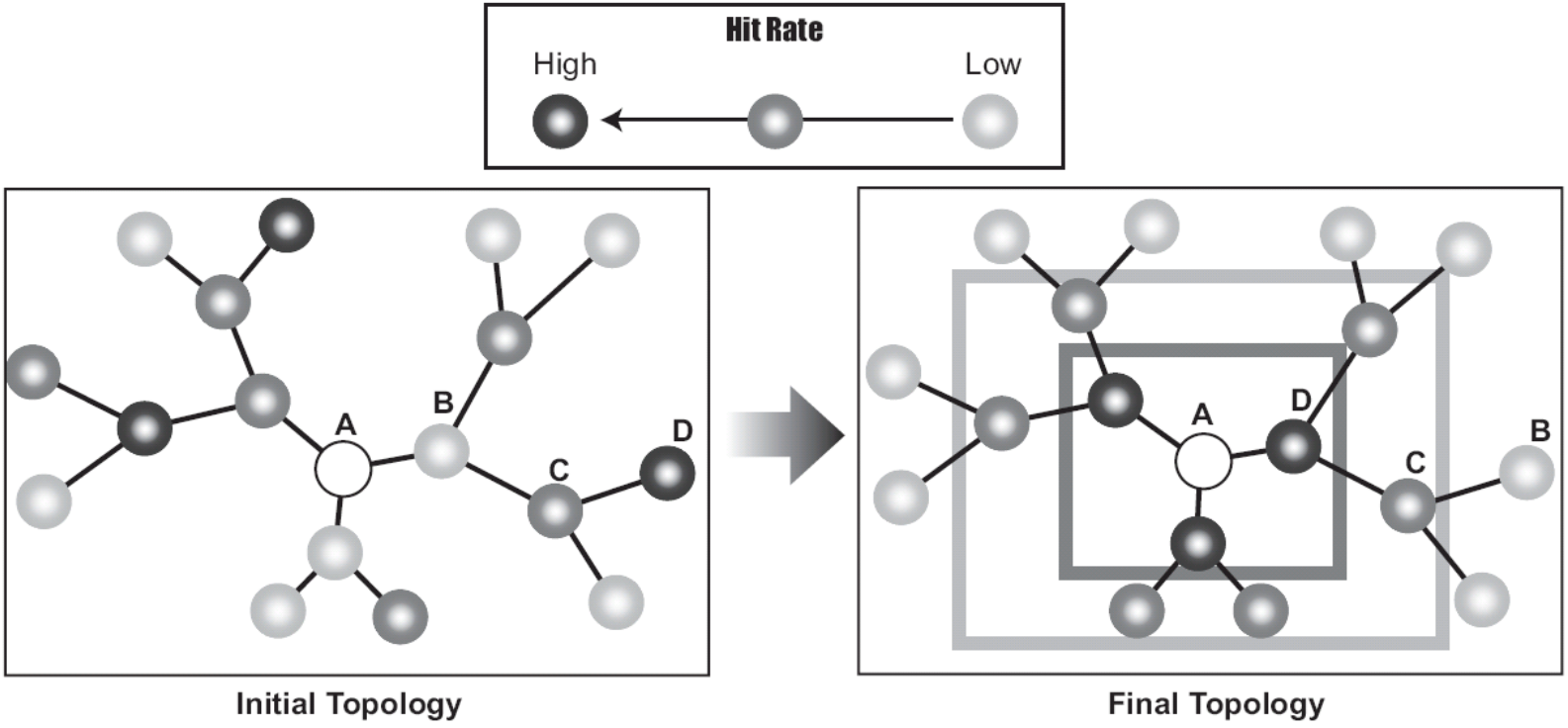


Introduction

- If a peer has a particular piece of content that one is interested in, it is very likely that it will have other items that one is interested in as well.
- Interest group
  - Meta data [2]
  - Stored files [3]
  - Ranking [4]

SORMS

- Let resource providers closer to requesting peers.

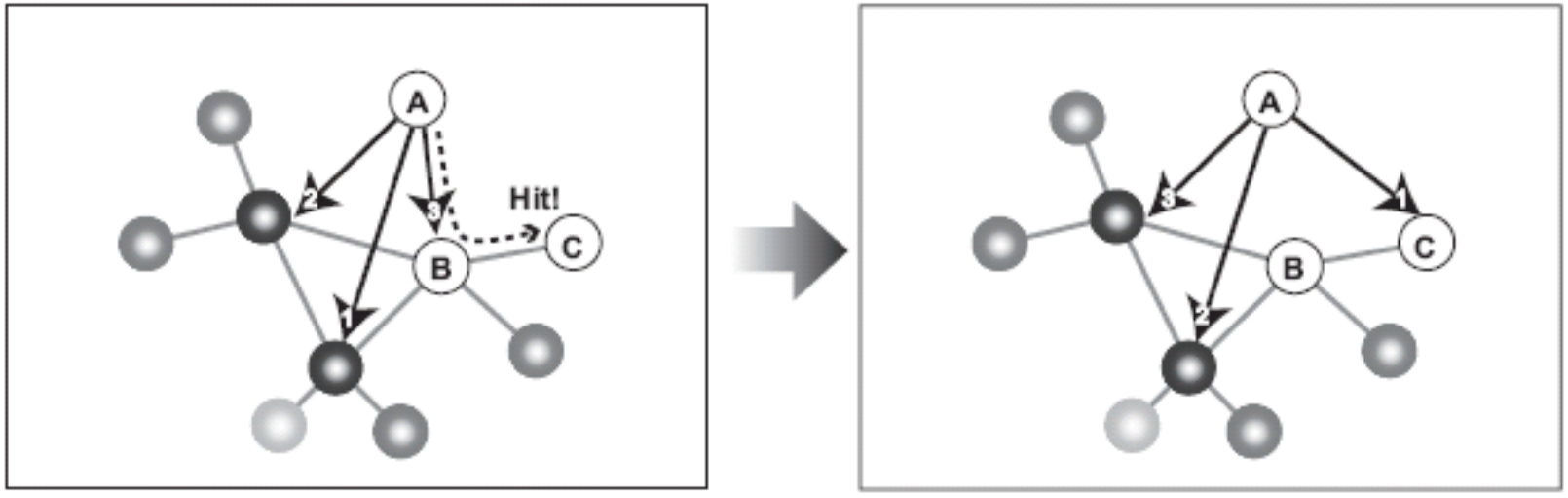


SORMS

- Access link
  - The concept that a resource that is referenced at one point in time will be referenced again sometime in the near future.
- Forward link
  - The concept that likelihood of referencing a resource is higher if a resource near it was just referenced

SORMS

- Access link
  - one-way links connecting a client peer with MRU (Most-Recently Used) peers
  - managed by client peers

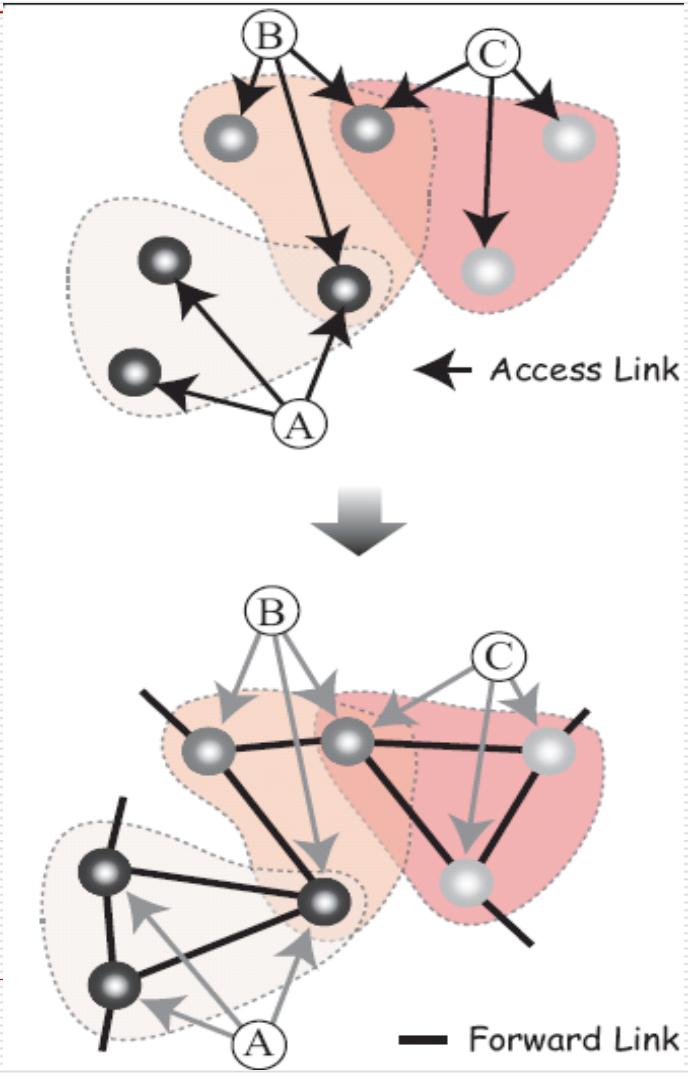


SORMS

- Access Link Control Algorithm
  1. Check whether there is an access link between A and C. Go to Step 3 if there is a link.
  2. Create a new access link that directly connects A with C. If the number of access links exceeds *LA*, delete the access link whose counter is maximum, i.e. the access link from A to B.
  3. Set the counter of the access link for C to zero.
  4. Finally, increment all counters.

SORMS

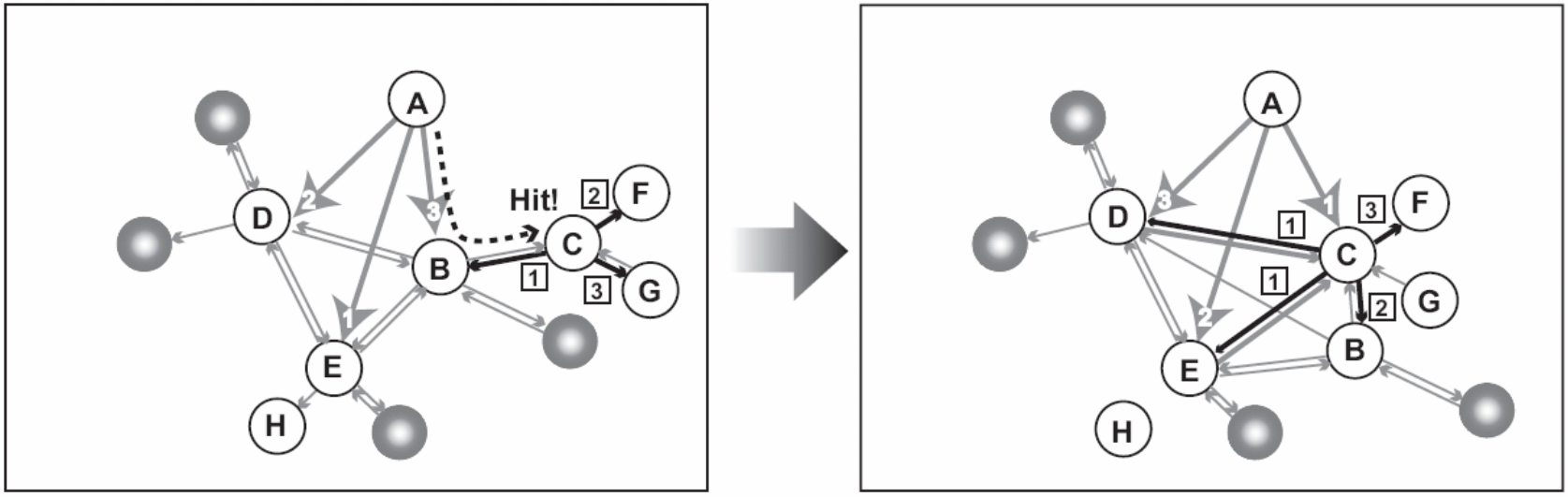
- Forward link
  - If two clusters of users A and B have a shared peer, they are connected with some similarity.
  - bi-directional links between two peers, which are recently used by the same client peer
  - managed by resource peers



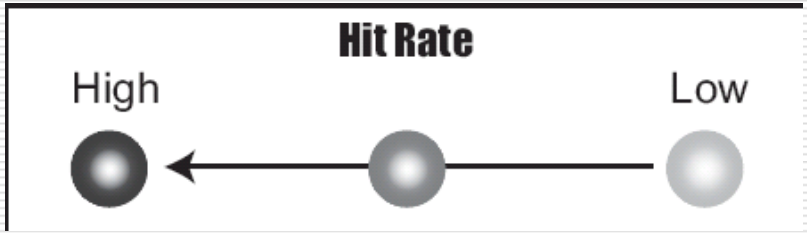
SORMS

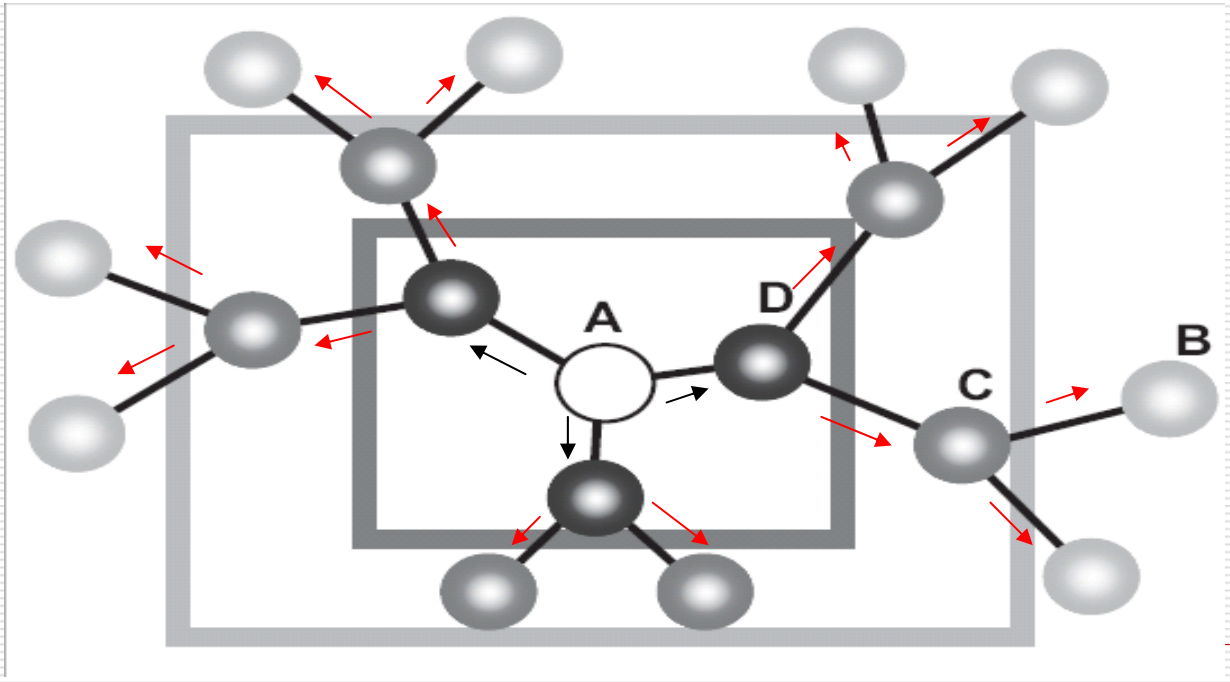
Forward Link Control Algorithm

1. Get the list of access links of A.
2. Check whether there are unconnected peers in the list. Go to Step 5 if all the peers in the list are connected with resource peer C.
3. Create a new forward link to one of the unconnected peers, i.e. either D or E. As a forward link is bi-directional, the newly connected peer also creates an opposite direction link to C.
4. Delete the forward link whose counter is maximum, and go to Step 2. In Figure 5, the forward link from C to G is deleted.
5. Set the counters of the forward links to the peers in the access link list to zero.
6. Finally, increment all counters.


A
D
B
C
F
G
E
H
Hit!
1
2
3

SORMS

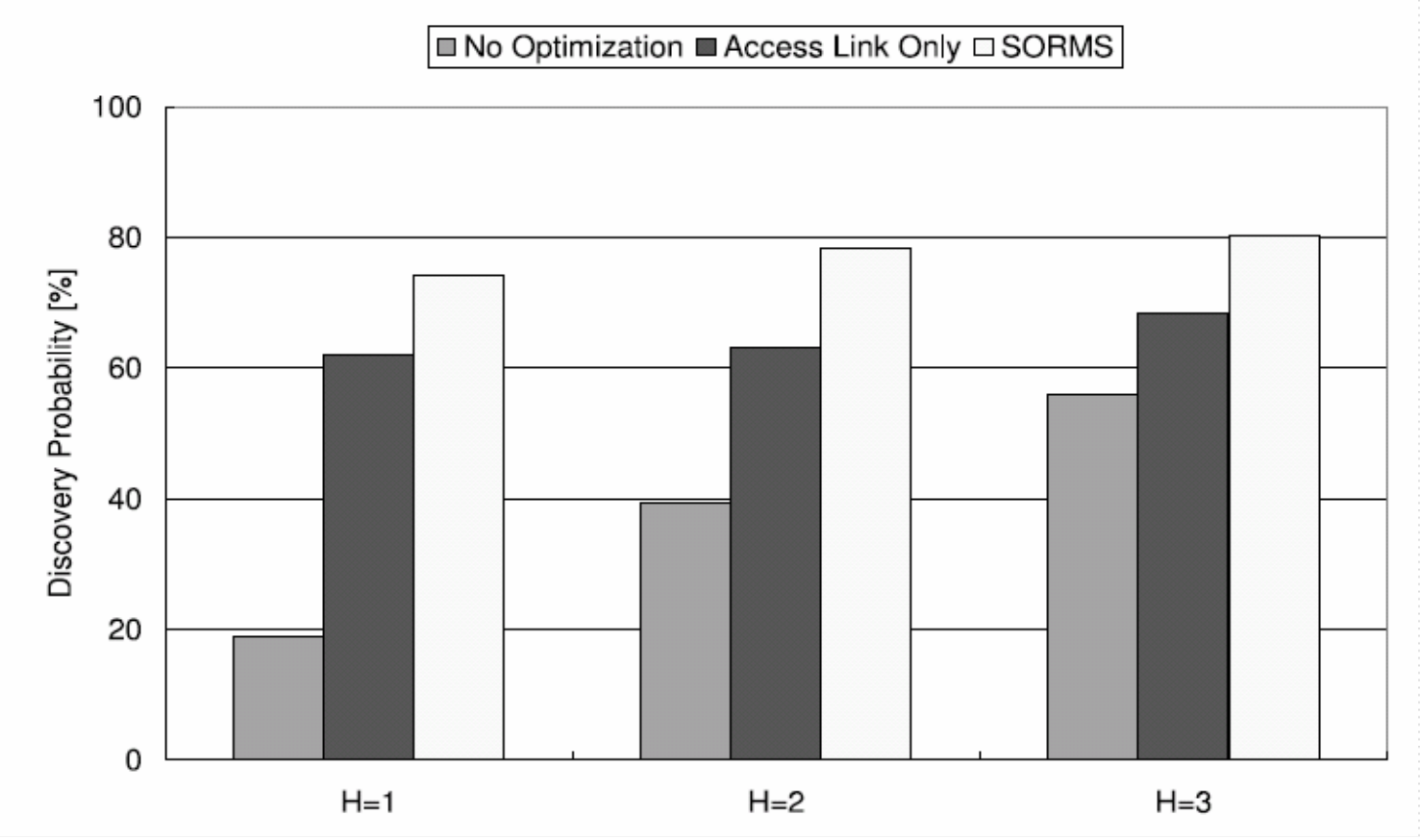




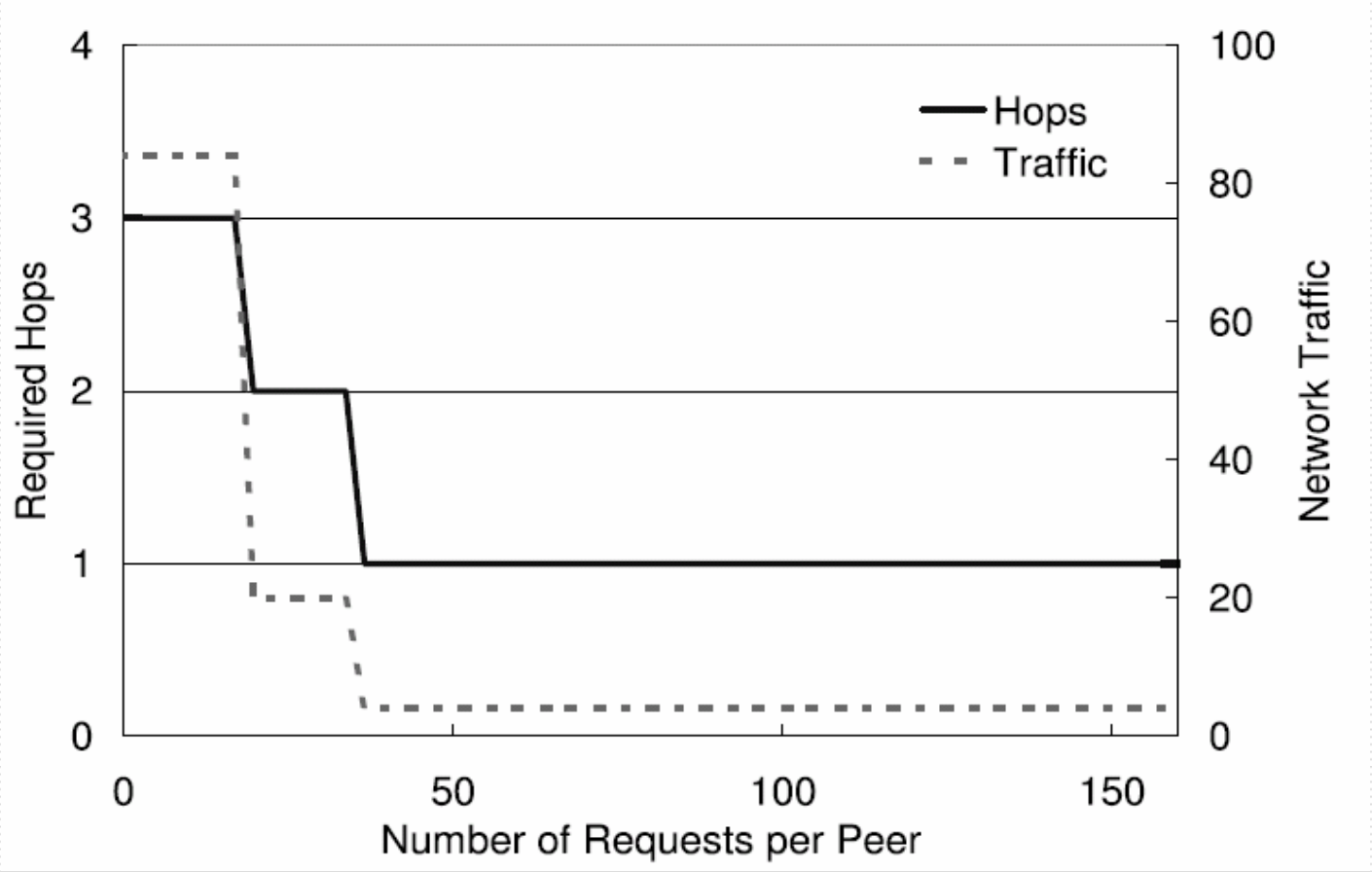
Access Link

Forward Link

Simulation


No Optimization
Access Link Only
SORMS
Discovery Probability [%]
100
80
60
40
20
0
H=1
H=2
H=3

Simulation


Hops
Traffic
Required Hops
Network Traffic
Number of Requests per Peer
0
1
2
3
4
0
20
40
60
80
100
0
50
100
150

Conclusion

- Designing a overlay network that effectively restricts search space configured based on the similarity and continuity of users' requests issued from individual peers.
- Self-organizing overlay network can remarkably decrease both messages for resource acquisition and hops a resource requesting query travels to reach the peer that satisfies the request.

Discussion

- Partial Coverage Problem
  - Large percentage of the peers may be unreachable no matter how large the TTL value is set
- If there are k neighbors
  - k/2 queries： use SORMS
  - k/2 queries： use blind flooding.

Reference

1. J.Ritter, “why gnutella cant scale.no,really”, http://www.tch.org/gnutella.html, 2001
2. Jian Yang, Yiping Zhong, Shiyong Zhang, “An Efficient Interest-Group Based Search Mechanism in Unstructured Peer-to-Peer Networks”, proceeding of ICCNMC’03
3. Marcelo Werneck Barbosa, Melissa Morgado Costa, Jussara M. Almeida, Virgflio A. F. Almeida, “Using Locality of Reference to Improve Performance of Peer-to-Peer Applications”, proceeding of WOSP'04.
4. Kunwadee Sripanidkulchai, Bruce Maggs, Hui Zhang, ” Efficient Content Location Using Interest-Based Locality in Peer-to-Peer Systems”, proceeding of IEEE INFOCOM,2003.
5. Adriana Iamnitchi, Matei Ripeanu, Ian Foster, “Small-World File-Sharing Communities”, proceeding of IEEE INFOCOM,2004.