

Proposal and Evaluation of a Cooperative Mechanism for Pure P2P File Sharing Networks

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1

Outline

- Background and target
- Our goal and approach
- Cooperative mechanism for pure P2P file sharing networks
- Evaluations by simulation experiments
- Conclusions and future topics

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2

Background

- A variety of overlay networks are deployed over physical IP networks
 - e.g. CDN, Grid, P2P, VPN ...
- Each overlay network tries to satisfy application-level QoS selfishly
 - Measurements of the available bandwidth and latency
 - Traffic control, route selection, and topology changes
- Every overlay network competes for physical network resources such as links and routers

Their application-level QoS cannot be enhanced by selfish behavior !!

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3

Target

- Research group's theme
 - Establish symbiotic environments of overlay networks by taking inspirations from biology
 - In an ecosystem, organisms live together in the same environment with direct or indirect interactions with each other
 - Overlay networks cooperate with each other to enhance application-level QoS
 - The influence among overlay networks by selfish behavior is suppressed
- Our target
 - P2P file sharing networks
 - Hybrid P2P file sharing networks
 - e.g. Napster, WinMX ...
 - **Pure P2P file sharing networks**
 - e.g. Gnutella, Winny ...

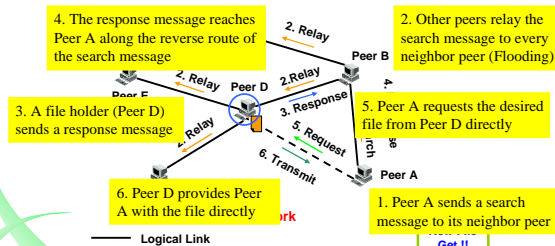
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4

Pure P2P File Sharing Networks

- In the case that Peer A requests a desired file ...



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5

Goal and Approach

- Problem of pure P2P networks
 - Flooding lacks scalability because the number of search messages significantly increases with the number of peers.
- If pure P2P networks cooperate with each other ...
 - Search messages are disseminated more effectively
 - Peers find more file holders
 - They can choose a more appropriate peer to retrieve a file.

We propose an efficient and effective cooperative mechanism for pure P2P file sharing networks.

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6

Overview of Our Proposed Cooperative Mechanism

- Candidate peers join in a candidate network to exchange information to select cooperative peers.
- A cooperative peer is selected among candidate peers.
- The cooperative peer connects with one in another P2P network.

Jan 26, 2006 Bio-ADIT 2006 7

1. Joining Candidate Network

- A peer introducing a cooperation program (candidate peer) joins in a candidate network.
 - By using the i3 network [3]
 - A network architecture to exchange service data among nodes by using service identifiers

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2. Selecting Cooperative Peers (1/2)

- To enhance the search efficiency and reduce the load, appropriate peers must be selected as cooperative peers.
 - Cooperative peers are selected from high-degree peers**
 - In recent studies, it is shown that many overlay networks have a power-law topology.
 - Cooperative peers are deployed apart from each other**
 - It is expected obviously that messages are concentrated on cooperative peers and peers near them.

Jan 26, 2006 Bio-ADIT 2006 9

2. Selecting Cooperative Peers (2/2)

- The procedure for selecting two cooperative peers
 - Every candidate peer advertises its degree
 - Each candidate peer ranks candidate peers in descending order of degree
 - The highest-degree candidate peer advertises a confirmation message
 - If cooperative peers receive the confirmation message, they send reject messages
 - After each candidate peer ranks again, a cooperative peer is selected

Jan 26, 2006 Bio-ADIT 2006 10

3. Finding Other P2P Networks

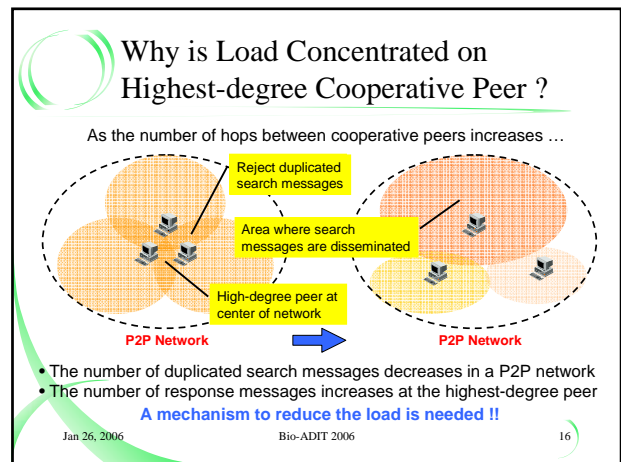
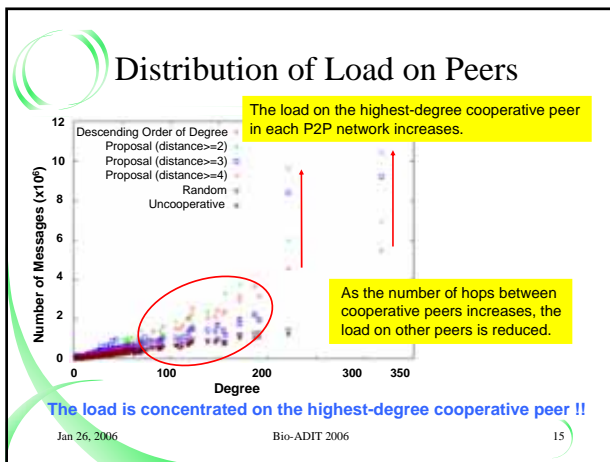
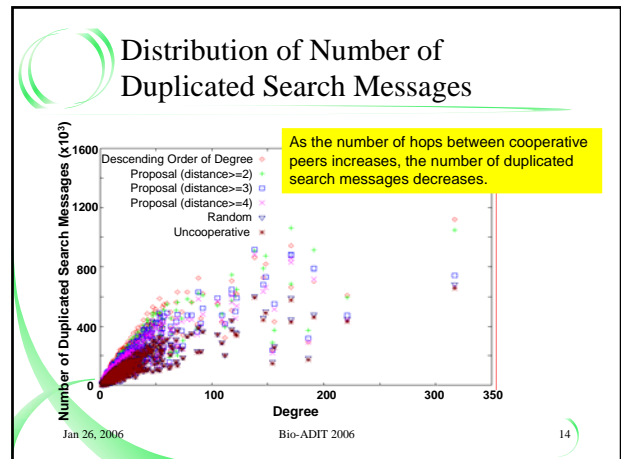
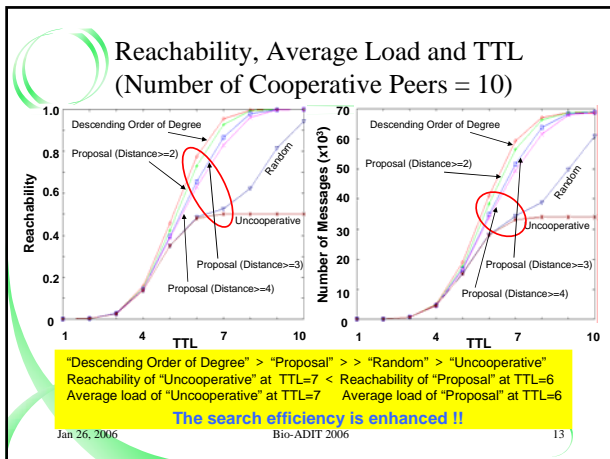
- A cooperative peer finds another cooperative peer in another P2P network, and connects to it.
 - By using the i3 network

Jan 26, 2006 Bio-ADIT 2006 11

Simulation Experiments

- Metrics**
 - The reachability of search messages
 - The average fraction of the number of peers which a search message reaches over all peers
 - The load on peers
 - The number of messages which a peer sends, relays, and receives
- Conditions**
 - Two power-law networks of 10,000 based on the BA model
 - 5,000 types of 45,473 files in each P2P network
 - Their popularity is determined by a Zipf distribution with $\alpha = 1.0$.
 - 20,000 search messages are generated at randomly chosen peers
 - The popularity of desired files is also determined by a Zipf distribution.

Jan 26, 2006 Bio-ADIT 2006 12



Conclusions and Future Topics

- We proposed a cooperative mechanism for pure P2P file sharing networks
- Through simulation experiments, we showed that
 - our proposed mechanism improves the search efficiency
 - our proposed mechanism causes a heavy load on the highest-degree cooperative peer
- Future topics
 - Introduction of a caching mechanism at cooperative peers
 - Proposal of a rule to judge whether P2P networks cooperate with each other or not
 - Investigation of the cooperation among P2P networks changing topologies dynamically

Jan 26, 2006 Bio-ADIT 2006 17

- Thank you.

Jan 26, 2006 Bio-ADIT 2006 18