A Cooperation Mechanism for Pure P2P File-Sharing Networks to Improve Application-Level QoS

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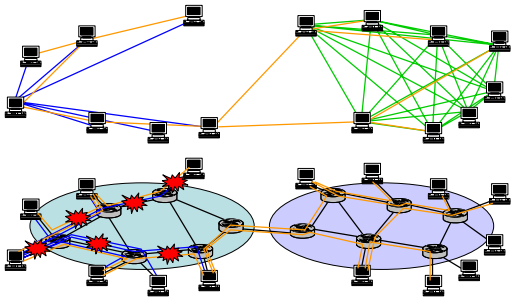
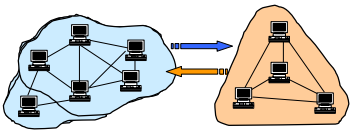
Competing Overlay Networks

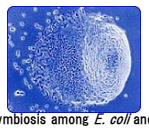
- Overlay networks competing underlying physical network resources disrupt each other



Overlay Network Symbiosis

- Collective performance of overlay networks can be improved by cooperation of them
- Overlay network = organism
  - **Emerges** as a new node joins
  - **Shrinks** as a node leaves
  - Direct and/or indirect **interactions**
  - **Changes in internal structure**





Symbiosis among *E. coli* and Dictyostelium

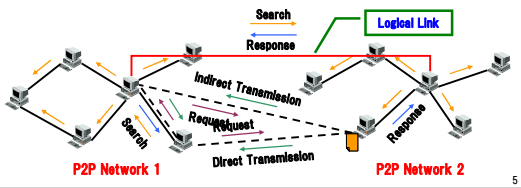
Cooperation of P2P File-sharing Networks

- Independent(Selfish)
  Performance and topology dynamically change as a result of dynamic behavior (search, response, retrieval, topology change) of others
- Cooperation through sharing control information
  Share control information such as measurement and topology and organize less-influential networks
- Cooperation through relaying messages
  Relaying search/response messages leads to higher hit rate and higher robustness
- Aggregation and re-organization of P2P networks
  Reduces the load on physical networks and attains higher performance by avoiding competition

Cooperation Mechanism

1. P2P networks find each other
2. Decide whether to cooperate or not
3. Establish a logical link between peers
4. Exchange query/response message
5. Actively cooperating P2P networks are finally merged

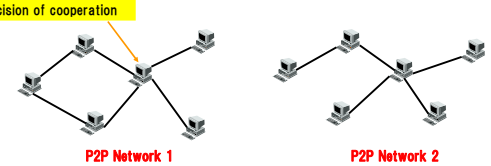
How should two overlay networks be connected?



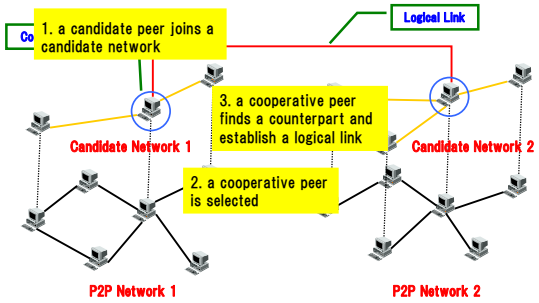
Cooperation Mechanism: candidate peer

- A peer introduces a cooperation program on its own decision and becomes a candidate peer
  - cannot find a desired file
  - cannot find the enough number of file holders
  - cannot obtain a file fast enough

Cooperation program
- protocol conversion
- meta-information cache
- decision of cooperation



Cooperation Mechanism: logical link



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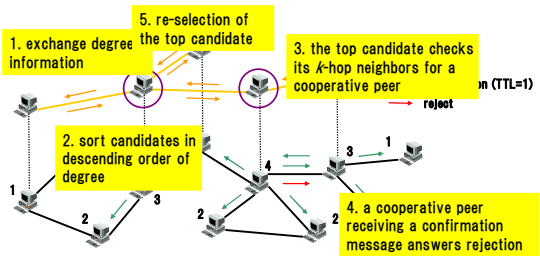
Cooperation Mechanism: cooperative peer

- A candidate peer with a higher degree becomes a cooperative peer -> higher search efficiency
- Distribute cooperative peers to avoid the load concentration



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Simulation Experiments

- Measures
  - The number of discovered file-holders
  - Search latency
  - Rate of load increase (duplicated search messages, number of messages)
- Two scale-free networks of 10,000 peers
  - 10 cooperative peers in a network
  - 93,668 files of 10,000 kinds
  - File-popularity follows Zipf distribution
  - Averaged over 20,000 search messages (TTL=7)
  - File to find is determined following Zipf distribution

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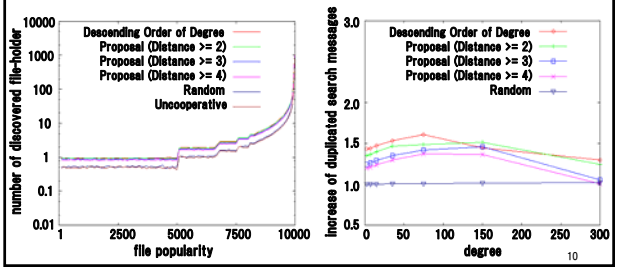
Simulation Results

- Degree-dependent selection leads to higher search efficiency
- Load is decreased by putting cooperative peers apart from each other



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Conclusion and Future Works

- We propose a mechanism for P2P file-sharing networks to effectively and efficiently cooperate with each other to enhance their application-level QoS
- We need to investigate cooperation among dynamic P2P networks
- We plan to implement our mechanism in an actual P2P file-sharing system

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