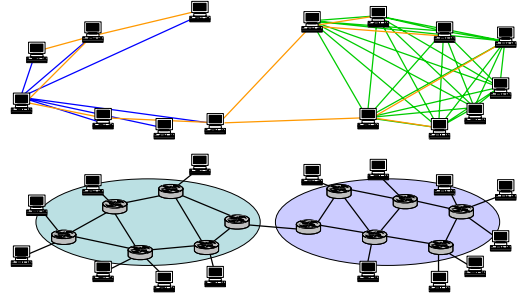


Toward Overlay Network Symbiosis

Naoki Wakamiya
 wakamiya@ist.osaka-u.ac.jp
 Osaka University, Japan

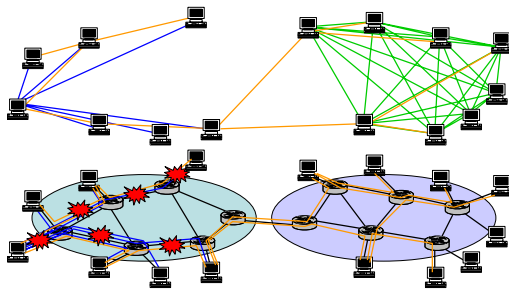
Overlay Network

- Variety of overlay networks are constructed on physical IP networks to satisfy their application-level QoS.



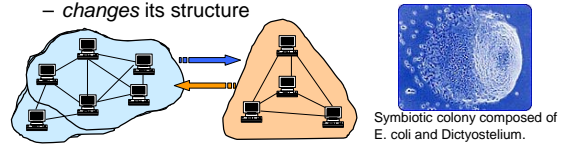
Competition of Selfish Overlay Networks

- Selfish overlay networks compete for physical network resources and disrupt each other.



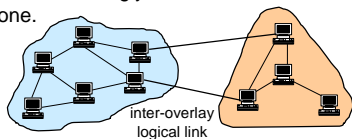
Symbiotic Overlay Networks

- Through cooperation among overlay networks, their collective performance can be enhanced.
- Overlay network = organism
 - evolves and expands when a new node joins
 - shrinks when a node leaves
 - interacts with each other through direct and/or indirect communications
 - changes its structure



Inter-overlay Communications

- Each node autonomously connect / disconnect logical links to
 - nodes in the same network, and
 - nodes in other networks
- When pathway nodes consider it beneficial, it is kept.
- Otherwise, it is disconnected.
- Overlay networks which benefit very much from each other will be strongly connected... and finally be merged into one.

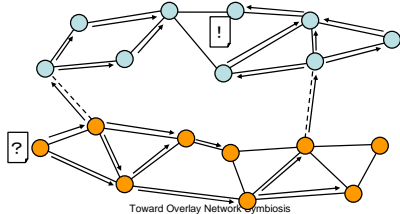


Mutualism

- By exchanging control information, overlay networks can
 - avoid flapping of paths.
 - construct better topology
- By exchanging application-level messages, they can
 - enhance application-level QoS
 - P2P file-sharing application
 - higher probability of successful search
 - more candidate peers for a better provider peer
 - enhance system-level QoS
 - faster and more reliable message forwarding
 - higher rate of message dissemination
 - higher resilience against network failures

Cooperative P2P File-sharing Networks

1. P2P file-sharing network discovers each other.
2. A logical link is established among networks.
3. Decide whether to start cooperation or not.
4. Relay query / response messages from one network to the other on inter-overlay logical link.
5. Those networks with much inter-flow will be merged.



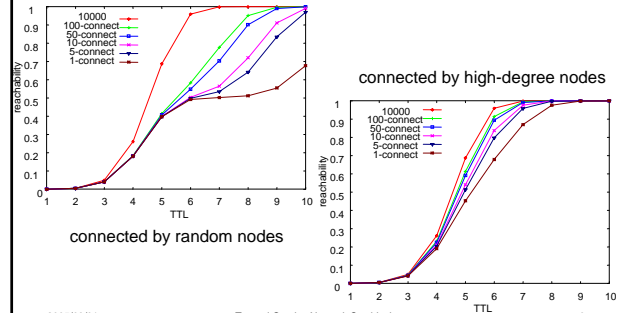
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Reachability

- Maximum interconnection leads to higher reachability.



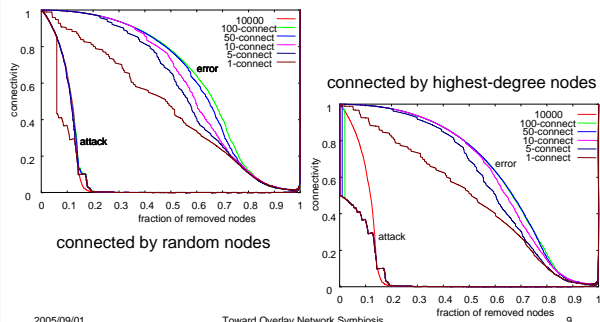
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Connectivity

- Maximum interconnection is more robust against random removal, but it is fragile under intentional attacks.



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Conclusion

- The model of symbiotic overlay networks is proposed.
- Currently, we consider mechanisms and algorithms for pure- / hybrid-P2P file-sharing networks to cooperate with each other.
- As future research topics, we will consider details of the symbiotic model and analyze its effect from the viewpoint of application-level performance and system-level performance.

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