

# Peer-to-Peer Group Communication

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# Outline

- Introduction
- Group communication
- Related works
- The proposed system
- Comparison
- Discussion
- Existing products

# Introduction

- P2P applications beyond file sharing are still rare due to the lack of P2P enabling technologies.
- Specially designed middleware would release the advantages of P2P networks and help on the development and quality of P2P applications.

# Introduction

- This paper proposed a self-organizing publish/subscribe middleware for group communication in dynamic P2P networks.
- A group comprises peers with a specific common interest within the network.

# P2P Topology vs. Group Communication

- ex.
  - There may be a group participating in a videoconference, while another logically independent group is interested in chatting with each other. They share the P2P network.
  - Each node forwards all messages, but listens to only the messages belonging to its group.

# P2P Topology vs. Group Communication

- P2P topology is not an ideal choice for group communication:
  - First, latency is usually high because messages have to traverse a large number of peers that also may not be members of the group to which the message belongs.
  - Second, performance is degraded by slow peers on the route.
  - Third, the bandwidth of each peer is partially consumed by traffic caused by other peers.

# Challenges

- Shared environment
- Scalability
- Dynamic network
- Dynamic node characteristics
- Network heterogeneity
- Quality of service

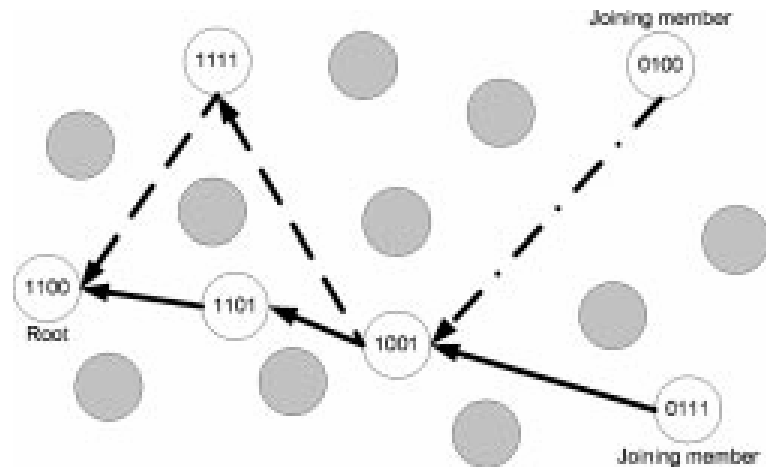
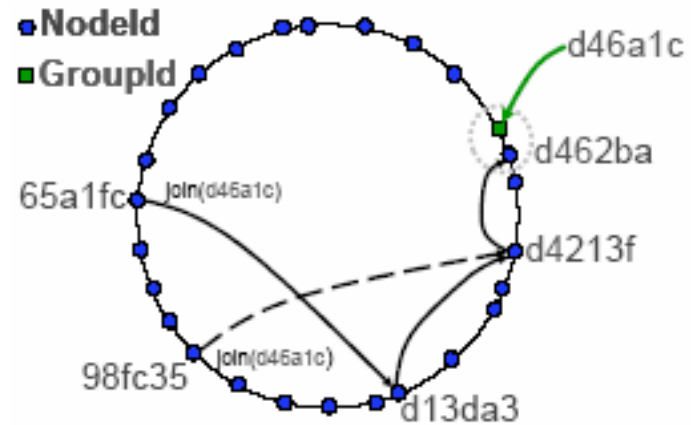
# Related Works

- Scribe/Pastry [Microsoft Research]
  - SCRIBE is a generic, scalable and efficient group communication and event notification system. It provides application level multicast and anycast. Scribe is efficient, self-organizing, flexible, highly scalable and supports highly dynamic groups.
- JXTA [Sun Microsystems]
  - JXTA™ technology is a set of open protocols that allow any connected device on the network ranging from cell phones and wireless PDAs to PCs and servers to communicate and collaborate in a P2P manner.



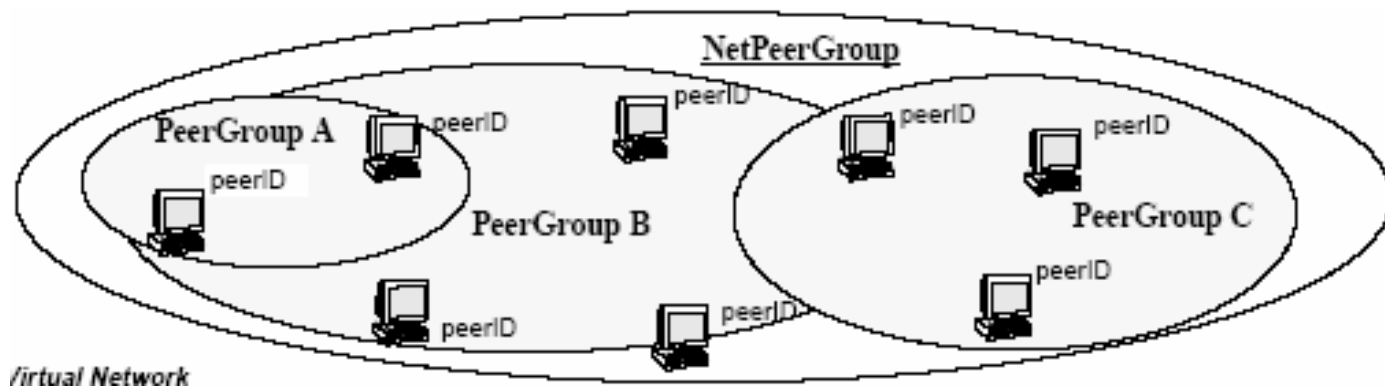
# Scribe

- Pastry
- Topic-centric
- Publish/subscribe
- Multicast tree



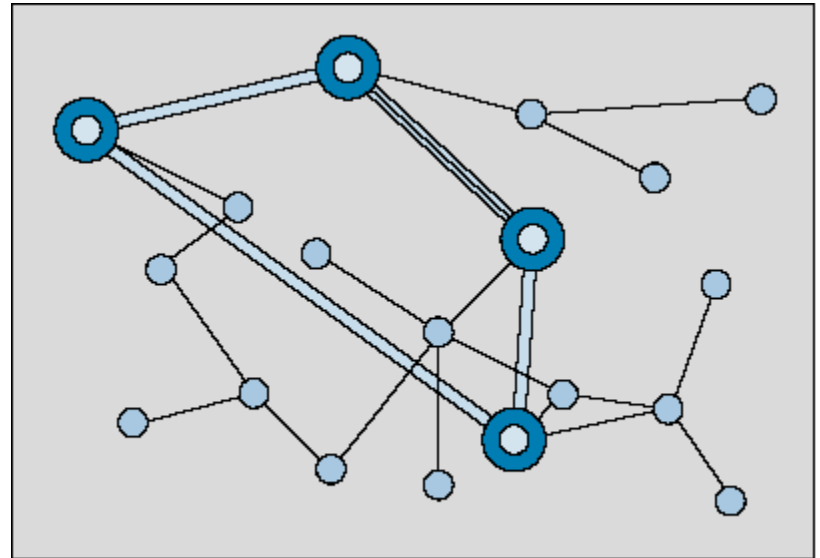
# JXTA

- Rendezvous peer
- Relay peer
- Resource advertisement
- Propagate pipe



# The P2P Messaging System

- Group-based overlays
- Multi-ring topology
- Backup link
- Implicit routing
- Node swapping



■ Figure 1. Peer-to-peer and peer group layers.

# Multi-Ring Topology

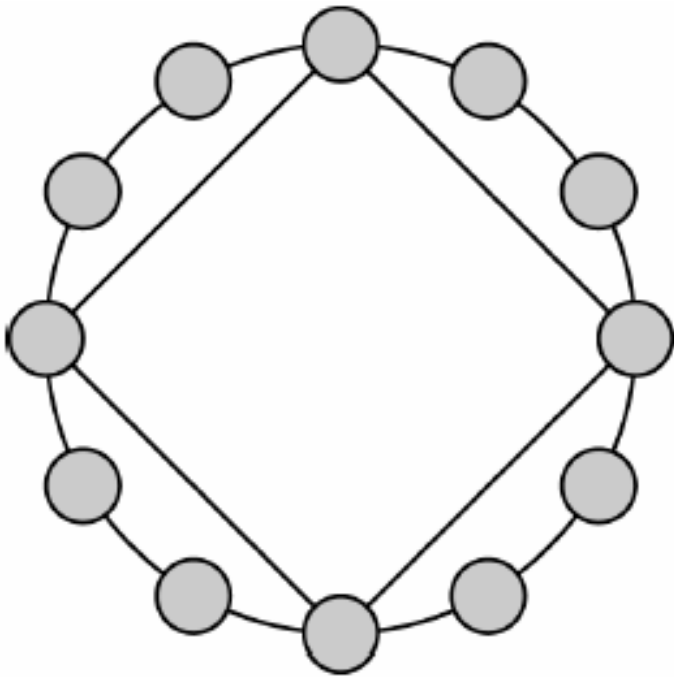


Figure 24. Outer and Inner Ring

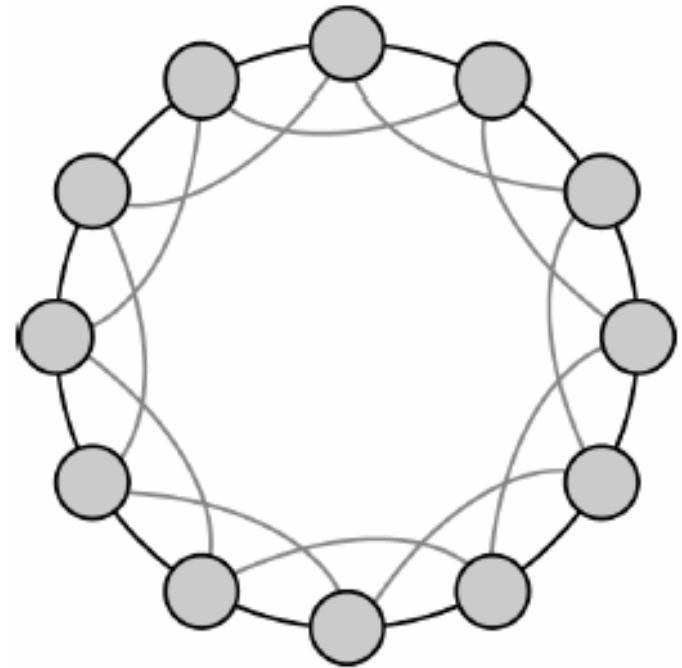


Figure 26. Ring with Backup Links

# Why Rings?

- The work load of any node is independent of the total number of nodes.
- A node depends only on its neighbors.
- Rings can be made robust easily because of their manageability.

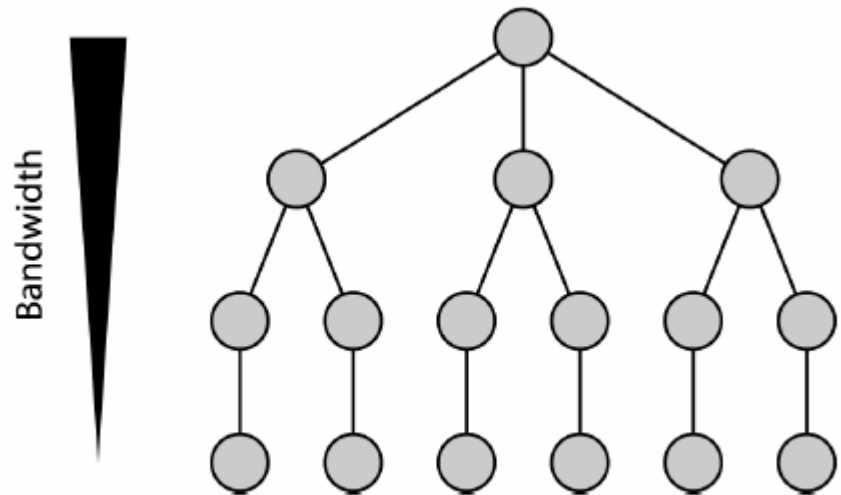


Figure 23. Tree topology: can utilize individual node bandwidth capabilities

# Implicit Dynamic Routing

- Dual mode links
  - Primary links allow immediate sending of messages.
  - Secondary links must first announce the availability of messages. Only if the receiving side needs the announced message are they actually sent.

# Quality of Service

- QoS parameters
  - Priority
  - Preservation priority
  - Expiration time

Bits	Field	Description
0..7	Message type	Identifies the message
8..11	Priority	QoS message priority
12..15	Preservation priority	QoS message preservation priority — determines messages to be dropped if queues are full
16..23	Options	Bits 0,1: Forwarding mode Bit 2: Extended length Bit 3: Sender ID and sequence Bit 4: Extended headers fields Bits 5–7: Future use
24..39	Length	Length of message including headers and application data

■ Table 1. *Header field descriptions.*

# Node Swapping

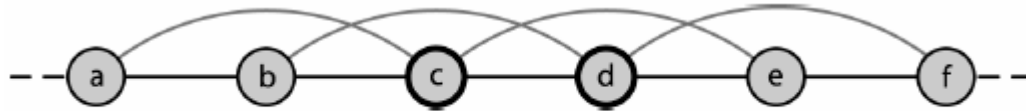


Figure 27. Nodes before Swapping

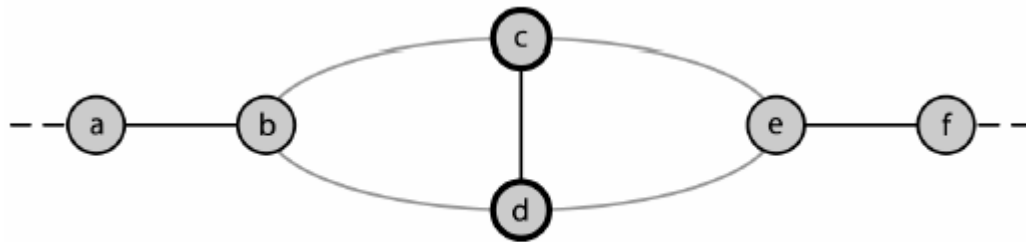


Figure 28. Temporary Situation during Swapping A

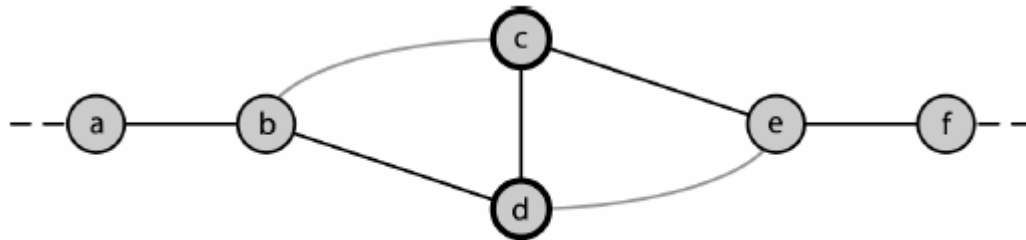


Figure 29. Temporary Situation during Swapping B



Figure 30. Situation after Swapping



# Comparison

	P2P Messaging System	Pastry/Scribe	JXTA propagate pipe
Group formation	Topic subscription	Topic subscription	Peer group membership, propagate pipe
Node roles	Peers	Peers	Peers, rendezvous peers
Topology	Multi-ring	Tree built on Peer-to-Peer network	Peer-to-peer with dedicated rendezvous peers
Scalability increasing measures	Topology, implicit routing, separation of groups	Topology, routing	Routing, separation of peer groups
Quality of service parameters	Priority, preservation priority, expiration time, delivery mode	None	None
Message filters	Yes	No	No
Multicast messages traverse only nodes in the group	Yes	No	No
Dynamic consideration of individual node characteristics and network heterogeneity	Yes	No	No
Message loss scenarios	Failure of multiple nodes	Failure of a single node	Failure of a single node
Adjustment to node failures	Activation of backup links, restoration of regular links	Local restoration of subscriptions necessary	(Insufficient information available)

■ Table 2. *System comparison.*

# Summary

- Concepts
  - Multi-ring topology
  - Backup link
  - Implicit routing
  - QoS support
- Limitations
  - Complexity
  - Maintenance overhead

# Discussion

- Explicit grouping
  - Interest-based
  - Publish/subscribe model
  - Users-involved
- Implicit grouping
  - Shortcuts
  - Ranking (subjective)
  - Reputation (objective)
  - Transparency

# P2P File-Sharing Products

- Napster
  - Centralized server
- Jigle, FileDonkey
  - Web-based
- eDonkey, eMule, EzPeer, Kuro
  - Explicit servers (peers)
- Kazaa, BearShare
  - Implicit super-nodes
- Overnet
  - DHT-based

# Features

- Friend list
- Multi-source download
- Professional content provider
- Firewall/NAT
- Reputation
- Streaming
- Private messaging
- Horde/Swarm

