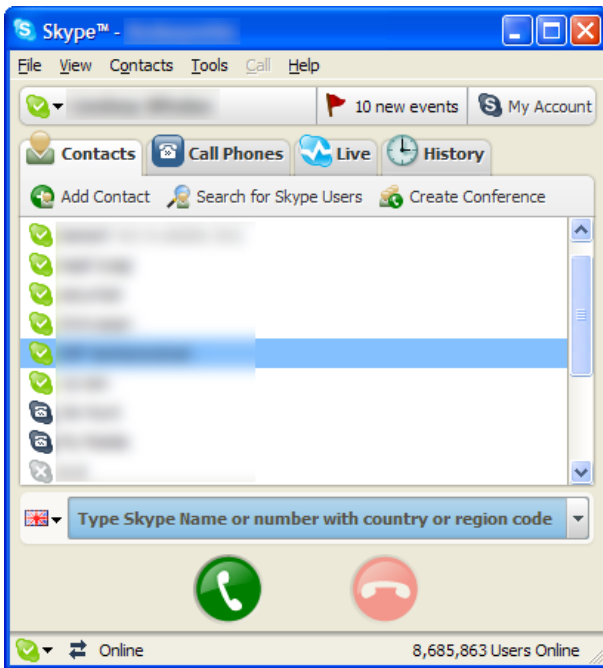


Designing a P2P Dictionary for Groupware Systems

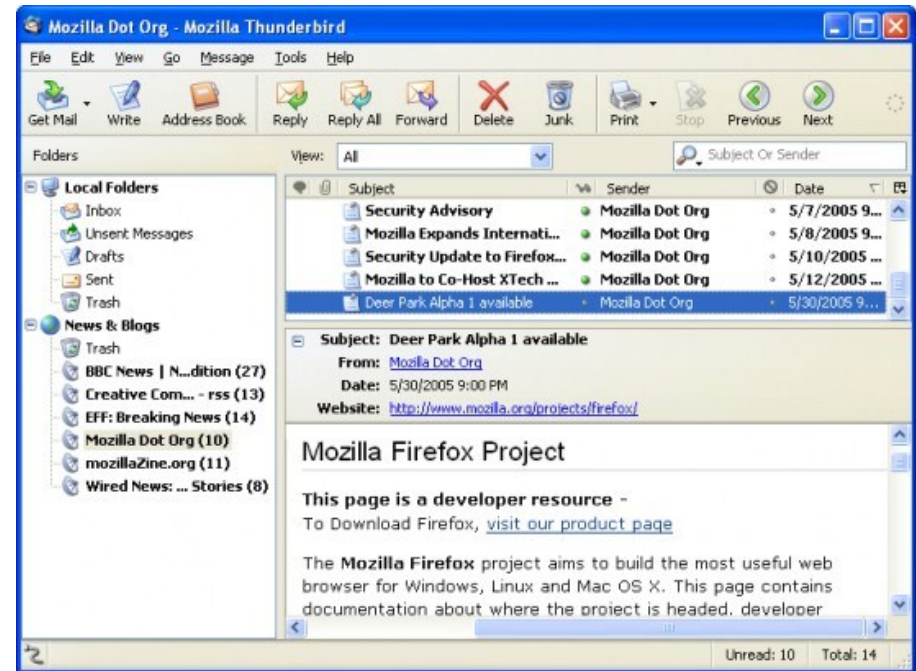
Richard Fung
CPSC 601.46

April 11, 2011

Groupware System



Voice/video chat



E-mail

Objective

Target

Interactive groupware

Content

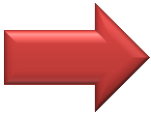
Shared memory

System

P2P protocol

Evaluation

Star, ring, line, mesh



Target

Interactive groupware

Content

Shared memory

System

P2P protocol

Evaluation

Star, ring, line, mesh

Target

Interactive groupware

- Goal:
 - Interactive responsiveness
- Assumptions:
 - Limited memory
 - Limited network bandwidth
 - 10s – 100s of users
 - Ad-hoc networks

Target

Interactive groupware

Network
Type

Data
Interest

Consistency

Caching
Strategy

Target

Interactive groupware

Network
Type

Data
Interest

Consistency

Caching
Strategy

Single server

Top-tier servers

Directory server

Self-organized

Target

Interactive groupware

Network
Type

Data
Interest

Consistency

Caching
Strategy

Single server

Everywhere

Top-tier servers

Hash function

Directory server

Nearby peers

Self-organized

Primary/secondary
replicas

Subscription

Target

Interactive groupware

Network
Type

Data
Interest

Consistency

Caching
Strategy

Single server

Everywhere

Primary/secondary
replicas

Top-tier servers

Hash function

Timestamp logs

Directory server

Nearby peers

Change logs

Self-organized

Primary/secondary
replicas

Locking

Subscription

Thomas write rule

Target

Interactive groupware

Network
Type

Data
Interest

Consistency

Caching
Strategy

Single server

Everywhere

Primary/secondary
replicas

Pull when needed

Top-tier servers

Hash function

Timestamp logs

Push immediately

Directory server

Nearby peers

Change logs

Poll periodically

Self-organized

Primary/secondary
replicas

Locking

Subscription

Thomas write rule

Target

Interactive groupware

Network
Type

Data
Interest

Consistency

Caching
Strategy

Single server

Everywhere

Primary/secondary
replicas

Pull when needed

Top-tier servers

Hash function

Timestamp logs

Push immediately

Directory server

Nearby peers

Change logs

Poll periodically

Self-organized

Primary/secondary
replicas

Locking

Subscription

Thomas write rule

Target

Interactive groupware



Content

Shared memory

System

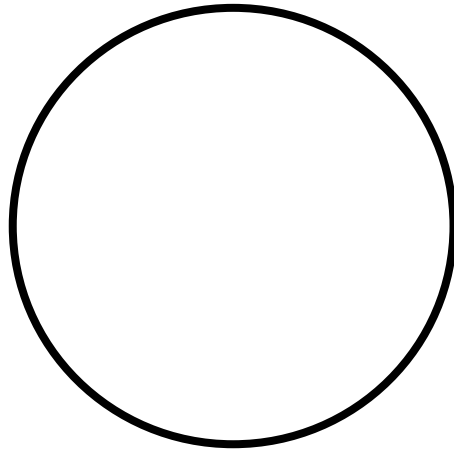
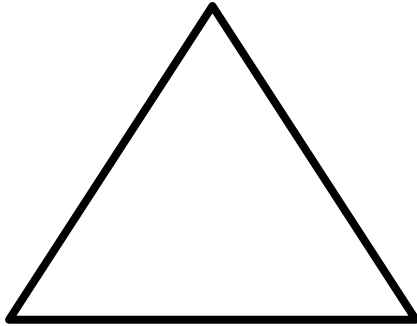
P2P protocol

Evaluation

Star, ring, line, mesh

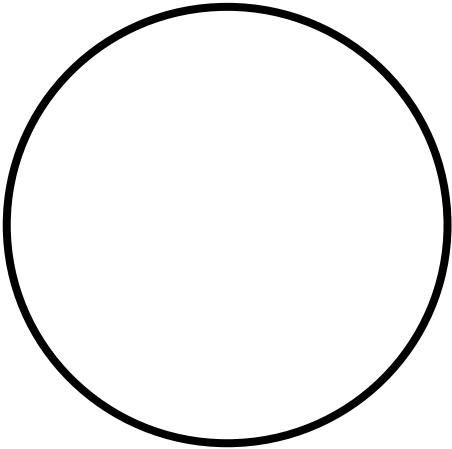
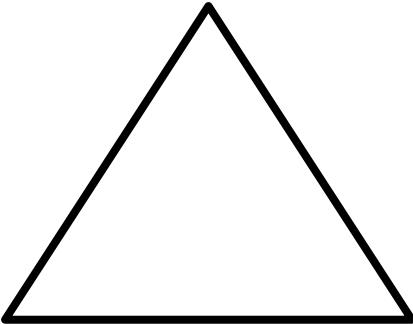
Content

Shared memory



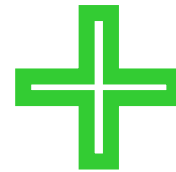
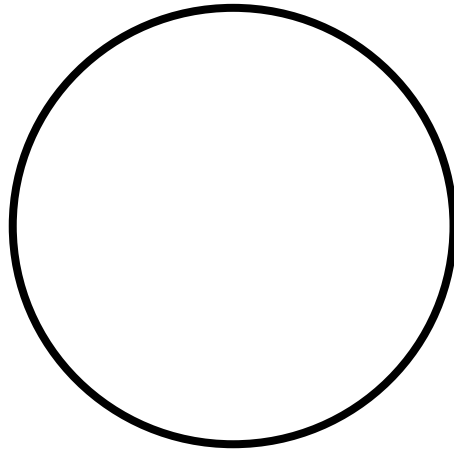
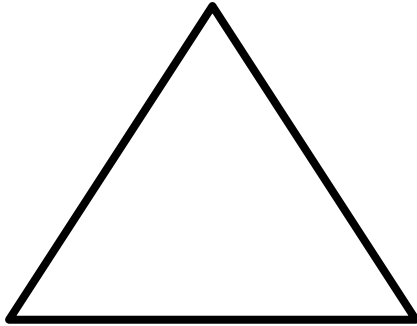
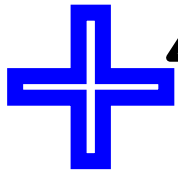
Content

Shared memory



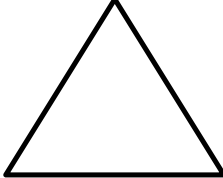
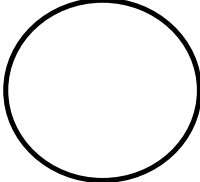

Content

Shared memory



Content

Shared memory

Key	Value	Stored at	
		Client 1	Client 2
Canvas.Object1		•	•
Canvas.Object2		•	•
Canvas.Object3		•	•
Client1.MousePosition	(20,40)	•	
Client1.DrawingColour	Blue	•	
Client2.MousePosition	(60,90)		•
Client2.DrawingColour	Green		•

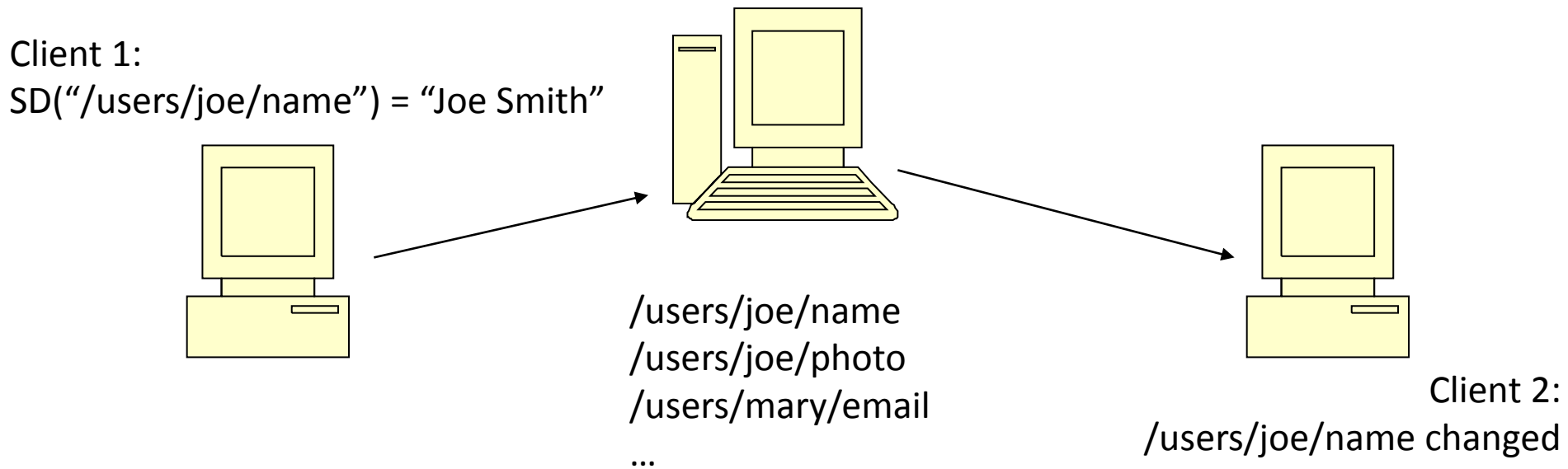
Content

Shared memory

Boyle, M. and Greenberg, S. (2002)

GroupLab Collabratory: A Toolkit for Multimedia Groupware.

In Workshop on Network Services for Groupware, ACM Conference on Computer Supported Cooperative Work.



Target

Interactive groupware

Content

Shared memory

 System

P2P protocol

Evaluation

Star, ring, line, mesh

System

P2P protocol

Metadata

Subscribed
Keys

Proxy Paths

Concurrency

Substrate

Join/Depart

Queues

System

P2P protocol

Metadata

Subscribed
Keys

Proxy Paths

Concurrency

System

P2P protocol

Metadata

Subscribed
Keys

Proxy Paths

Concurrency

Replicate all

Push immediately

List of senders

System

P2P protocol

Metadata

Subscribed
Keys

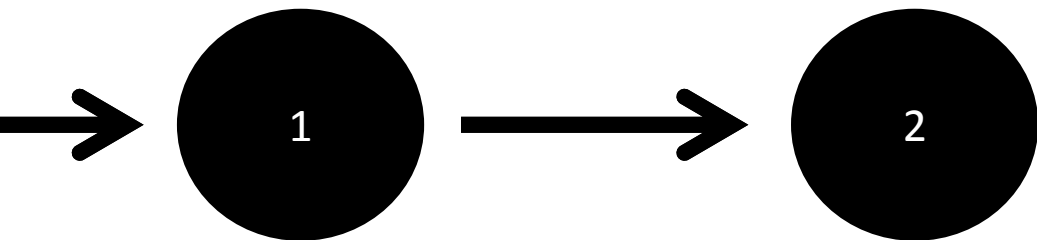
Proxy Paths

Concurrency

Replicate all

Push immediately

List of senders



System

P2P protocol

```
HTTP/1.1 200 OK
P2P-Dictionary: 12345
Content-Location: /data/key
E-Tag: "12345.67"
Content-Type: application/octet-stream
Content-Length: <length of data>
P2P-Sender-List: 12345
Response-To: HEAD
```

System

P2P protocol

HTTP/1.1 200 OK

P2P-Dictionary: 12345

Content-Location: /data/key

E-Tag: "12345.67"

Content-Type: application/octet-stream

Content-Length: <length of data>

P2P-Sender-List: 12345

Response-To: HEAD

System

P2P protocol

Metadata

Subscribed
Keys

Proxy Paths

Concurrency

Replicate all

Replicate subscribed

Push immediately

Pull after metadata
is received

List of senders

System

P2P protocol

Metadata

Subscribed
Keys

Proxy Paths

Concurrency

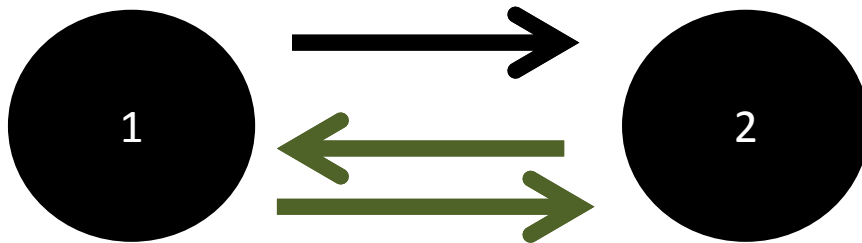
Replicate all

Replicate subscribed

Push immediately

Pull after metadata
is received

List of senders



System

P2P protocol

Metadata

Subscribed
Keys

Proxy Paths

Concurrency

Replicate all

Replicate subscribed

Path along senders

subscribe to the key

Push immediately

Pull after metadata

is received

List of senders

System

P2P protocol

Metadata

Subscribed Keys

Proxy Paths

Concurrency

Replicate all

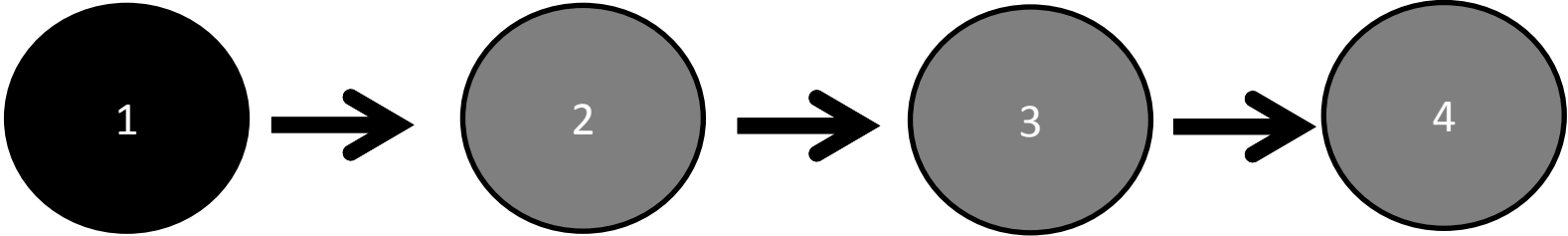
Replicate subscribed

Path along senders
subscribe to the key

Push immediately

Pull after metadata
is received

List of senders



System

P2P protocol

Metadata

Subscribed Keys

Proxy Paths

Concurrency

Replicate all

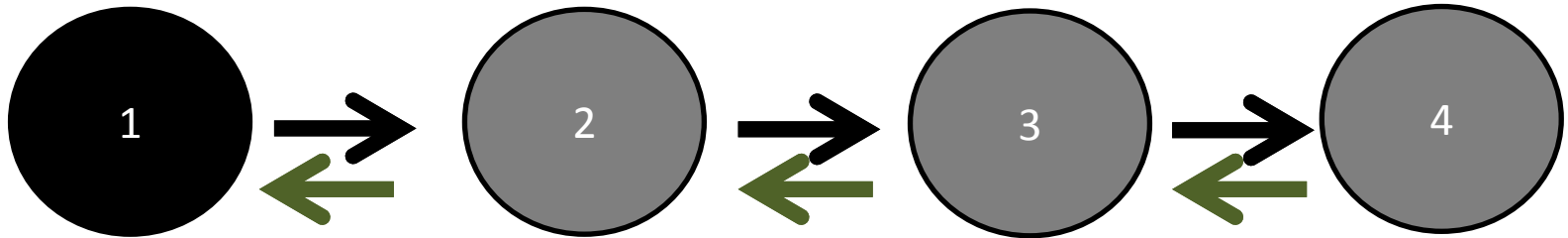
Replicate subscribed

Path along senders
subscribe to the key

Push immediately

Pull after metadata
is received

List of senders



System

P2P protocol

Metadata

Subscribed Keys

Proxy Paths

Concurrency

Replicate all

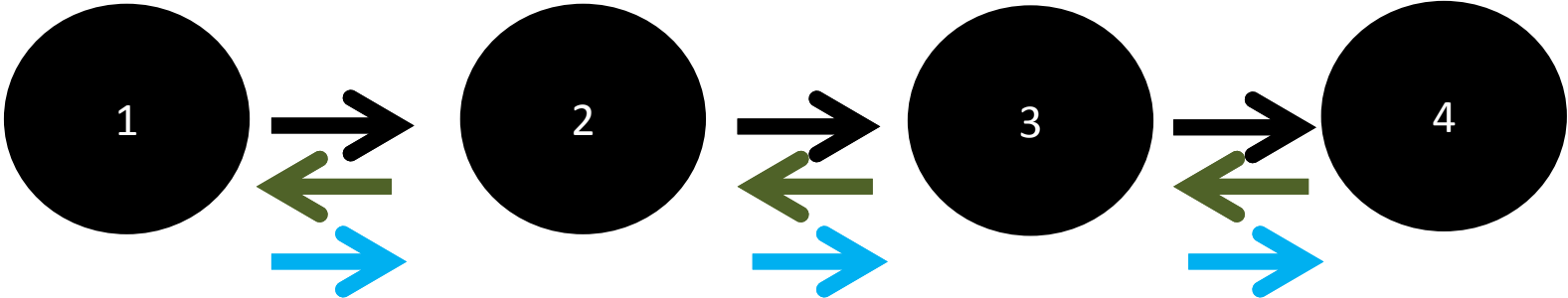
Replicate subscribed

Path along senders
subscribe to the key

Push immediately

Pull after metadata
is received

List of senders



System

P2P protocol

Metadata

Subscribed
Keys

Proxy Paths

Concurrency

Replicate all

Replicate subscribed

Path along senders
subscribe to the key

Owner ID

Push immediately

Pull after metadata
is received

Revision number

List of senders

Democratic vote

Frequent changes

System

P2P protocol

Substrate

Join/Depart

Queues

System

P2P protocol

Substrate

Join/Depart

Queues

Unique IDs for all

Structured ring

Add random edge

System

P2P protocol

Substrate

Unique IDs for all

Structured ring

Add random edge

Join/Depart

Joining:

Exchange entries

Departure:

Run away

Queues

System

P2P protocol

Substrate

Unique IDs for all

Structured ring

Add random edge

Join/Depart

Joining:

Exchange entries

Departure:

Run away

Queues

Reader threads
for each client

3 writer threads
for all clients,
round robin

Target

Interactive groupware

Content

Shared memory

System

P2P protocol

 Evaluation

Star, ring, line, mesh

Evaluation

Star, ring, line, mesh

Network
Topology

Number of
Nodes

Subscription
Size

Network
Load

Evaluation

Star, ring, line, mesh

Network
Topology

Number of
Nodes

Subscription
Size

Network
Load

Star

Ring

Line

Mesh

Evaluation

Star, ring, line, mesh

Network
Topology

Number of
Nodes

Subscription
Size

Network
Load

Star

6-50

Ring

Line

Mesh

Evaluation

Star, ring, line, mesh

Network
Topology

Number of
Nodes

Subscription
Size

Network
Load

Star

6-50

2-pair

Ring

Everything

Line

Mesh

Evaluation

Star, ring, line, mesh

Network
Topology

Number of
Nodes

Subscription
Size

Network
Load

Star

6-50

2-pair

% peers w/ load

Ring

Everything

Traffic size

Line

Mesh

Evaluation

Star, ring, line, mesh

Network
Topology

Number of
Nodes

Subscription
Size

Network
Load

Star

6-50

Ring

Line

Mesh

Evaluation

Star, ring, line, mesh

Network
Topology

Number of
Nodes

Subscription
Size

Network
Load

Star

6-50

Ring

Line

Mesh

Nodes	Star (su)	Line (su)	Circle(su)	Random
6	109-124	31-390	15-218	31-31
8	109-124	15-592	15-218	15-31
10	93-124	31-780	31-390	15-124
20	78-124	15-1606	15-733	15-265
50	62-124	15-4570	15-1840	15-405

Arrival Time

Evaluation

Star, ring, line, mesh

Network
Topology

Number of
Nodes

Subscription
Size

Network
Load

Star

6-50

Ring

Line

Mesh

Nodes	Star	Line	Circle	Random
6	2	1,3,4,5	1,3	1
8	2	1,3,5,7	1,3	1
10	2	1,3,5,7,9	1,3,5	1,2
20	2	1-19	1-9	1-4
50	2	1-49	1-25	1-6

Number of Hops

Evaluation

Star, ring, line, mesh

Network
Topology

Number of
Nodes

Subscription
Size

Network
Load

2-pair

Everything

Evaluation

Star, ring, line, mesh

Network
Topology

Number of
Nodes

Subscription
Size

Network
Load

Star Topology

# of Nodes	2-pair (su)	Full (su)
6	109-124	93-124
10	93-124	78-124
20	78-124	62-109
50	62-124	62-124

Arrival Time

Random Topology

# of Nodes	2-pair (su)	Full (su)
6	31-31	15-31
10	15-124	15-93
20	15-265	15-171
50	15-405	15-280

Arrival Time

Evaluation

Star, ring, line, mesh

Network
Topology

Number of
Nodes

Subscription
Size

Network
Load

% peers w/ load

Traffic size

Evaluation

Star, ring, line, mesh

Network
Topology

Number of
Nodes

Subscription
Size

Network
Load

Load Factor	Star (su)	Line (su)	Circle (su)	Random (su)
20%	31-83	12-307	4-162	12-111
40%	40-67	2-381	7-163	15-93
60%	33-131	10-408	12-292	7-76
80%	71-4049	13-2565	10-2689	10-126
100%	47-3413	67-2550	8-2380	9-1575

Arrival Time

Target

Interactive groupware

Content

Shared memory

System

P2P protocol

Evaluation

Star, ring, line, mesh

Target

Interactive groupware

- Network Type
- Data Interest
- Consistency
- Caching Strategy

Content

Shared memory

- Dictionary

System

P2P protocol

- Metadata
- Subscribed Keys
- Proxy Paths
- Concurrency
- Substrate
- Join/Depart
- Queues

Evaluation

Star, ring, line, mesh

- Network Topology
- Number of Nodes
- Subscription Size
- Network Load