Plan

- Why peer-to-peer (P2P) ?
- Introduction to JXTA
  - Goals
  - Basic concepts
  - Protocols
- JXTA 2.0
  - Loosely-Consistent DHT
- Conclusion
Why peer-to-peer (P2P)?
P2P: a definition

- **Goal**: take advantage of resources available at the edges of Internet
  - Computing power, storage, content

- **Definition**
  - Larged distributed system
  - *Variable connectivity* and *temporary IP addresses*
  - Parity: each node can be client and server
P2P: features

- Dynamicity of the network
  - Composition and topology
- Dynamic discovery of peers and resources
- Scalability
  - More peers => more performance
- High availability
  - Interchangeable peers (replication)
JXTA: a Generic Framework for P2P Computing

- Open platform for P2P programming
- Common functionalities
- Language, OS, network agnostic
- Set of interoperable protocols (XML)
- Open source project: http://www.jxta.org
JXTA Services and Applications

- Distributed storage and data sharing
  - Search, indexing and file sharing
- Large scale distributed computing
- P2P messaging and collaboration tools
JXTA Virtual Network

Virtual Mapping

Physical Network
Peers

- A peer
  - Unique identifier (UUID)
  - Adressable independently of its location (firewalls, NAT)
  - Multiple Peer “endpoint” address (TCP, HTTP, etc.)

- Peer types
  - Minimal edge : send/receive
  - Full edge : + cache
  - Rendezvous : + fwd requests
  - Relay : +routing cache +firewall support
Peer Groups

- Why Peer Groups?
  - Provide a “group” identity (common interest)
  - Create secure & protected domains
  - Scope peer operations (discovery, search, communications)
  - Enable monitoring
Advertisements

- Every resource is represented by an advertisement
  - Peer
  - Peer group
  - Pipe
  - Service
  - Content
  - Peer status

PeerGroup Advertisement:

```xml
<?xml version="1.0"?>
<!DOCTYPE jxta:PGA>
<jxta:PGA>
  <GID>
    urn:jxta:uuid-BCBCDEABDBBBABEABBBABA000000
  </GID>
  <MSID>
    urn:jxta:uuid-BFEFDEDFBABAFRUDBACE000000
  </MSID>
  <Name>
    My Group
  </Name>
  <Desc>
    This group is to be used for my own testing
  </Desc>
</jxta:PGA>
```
Pipe: Virtual Communication Channel

- Non-localized communication channel between two or more peers
  - Uni-directional
  - Asynchronous
  - Unreliable
Pipe Communication Model

- Connect to services independently of their peer locations
- Dynamic binding
  - At pipe creation or for every message sent
- Build highly-available services
  - Transparent fail-over by reconnecting pipe endpoints
- Pipeline multiple services to form complex service
Network Services

- Peer Services
- PeerGroup Services
- Can be dynamically loaded
JXTA Protocol Stack

- Peer Discovery Protocol
- Pipe Binding Protocol
- Peer Info Protocol
- Peer Resolver Protocol
- Peer Endpoint Protocol
- Peer Rendezvous Protocol
Peer Discovery Protocol (JXTA 1.0)
JXTA: Architecture

Community JXTA Applications

Sun JXTA Applications

Sun JXTA Services
- Indexing
- Searching
- File sharing

JXTA Shell

Peer Commands

Peer Monitoring

Security

Peer Pipes

Peer Groups

Any Peer on the Expanded Web
JXTA: Core Services

- Discovery Service
- PeerInfo Service
- Pipe Service
- Resolver Service
- Membership Service
- Access Service
JXTA 2.0 J2SE Released

- Better performance
- Greater scalability
- More stable
- Wire protocol incompatible
- Mostly API compatible
New Rendezvous Network

- In JXTA 1.0, all peers were involved in the propagation of resolver, discovery, and propagate pipe messages within the PeerGroup.

- In JXTA 2.0, resolution and propagation are done via two new concepts:
  - Rendezvous super-peer network and Rendezvous Walker Service
  - Shared Resource Distributed Index (SRDI) Service to distribute advertisement indexes throughout the rendezvous network.
New Propagation

- Queries only propagated among rendezvous peers
- Edge peers only receive direct queries for their own advertisements
- Rendezvous peers self organize
- Pluggable frameworks used to walk the Rendezvous web
Shared Ressource Distributed Index

- Edge peers publish indices of advertisements across Rdv network using Distributed Hash Tables (DHT)
- DHTs are maintained by Rendezvous peers
- Queries are directed to appropriate Rdv
- If not found, a walk of the Rdv web is performed
- Hash functions are pluggable
Loosely-Consistent DHT

- Peers have high churn rate
- Maintaining a consistent distributed index outweighs the advantages of having one
- Network crawling is expensive but does not have any maintenance cost
Rendezvous Peer View (RPV)

- Each rendezvous peer maintains an ordered list of known rendezvous peer in the peer group by their peer IDs
- No strong consistency mechanism is used to enforce the consistency of the RPV across all rendezvous
- Rendezvous periodically select random number of rendezvous from their RPV, and send them a random list of their known rendezvous
Publish advertisement
Search advertisement

Diagram:

- P1 to P2: Response
- adv1 to R2: H(Adv1) to R5, R6
Inconsistent view
Limited-range walker
Finding Rendezvous Peers

- Edge peers maintain lists of rendezvous peers
- Dynamic fail-over when connection fails
- Edge peers discover and cache Rdv advertisements
- Seeding Rdvs are used to bootstrap
- Auto-promotion to Rdv if none can be found in PeerGroup
JXTA Implementation Platforms

- JXTA-J2SE Implementation (J2SE 1.3.1)
  - Full Implementation of JXTA Protocols
  - Tutorials and Programmer Guide

- JXTA-C
  - JXTA 1.0
  - Edge peer only

- Others: Objective-C, Perl, Ruby, .Net
Conclusion

- JXTA: open platform for P2P services and applications
- JXTA Concepts
  - Peers
  - PeerGroups
  - Advertisements
  - Pipe
  - JXTA protocol stack
- Loosely-Consistent DHT