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

Peer ID

Firewall

TCP/IP

HTTP

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-BFEFDEDFBABAFFFFRUDBACE00000001
  </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
JXTA Protocol Stack

PeerGroup

Peer Membership Protocol

Peer Information Protocol

Pipe Binding Protocol

Peer Discovery Protocol

Peer Resolver Protocol

Peer Endpoint Protocol

Transport

PeerGroup

Peer Membership Protocol

Peer Information Protocol

Pipe Binding Protocol

Peer Discovery Protocol

Peer Resolver Protocol

Peer Endpoint Protocol

Transport
Peer Discovery Protocol (JXTA 1.0)
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 through 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 peergroup 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
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