Project JXTA:
An Open P2P Applications Platform

Introduction and Update

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www.jxta.org

Sun microsystems
We make the net work.

The time is right for P2P and Project JXTA

Peer to Peer (P2P) is not new. However, the time is *now* right for the broad P2P applications deployment.

The Project JXTA technology lets developers build and deploy P2P solutions more quickly.

Topics

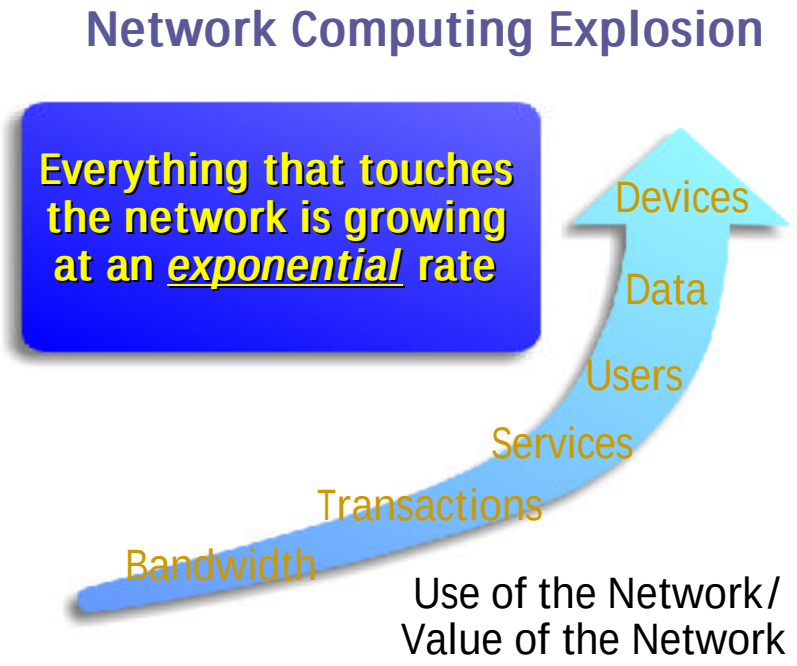
- Peer-to-Peer Computing
- JXTA Technology
  - Virtual network
  - Architecture
  - Concepts & components
- JXTA Today
- Future Directions

What is Peer-to-Peer (P2P)?

- P2P covers a wide range of applications...
  - Sharing files, distributed search and indexing
  - Sharing CPU and storage resources
  - Instant messaging & devices communicating together
  - Collaborative work (and games)
  - Web services
  - New forms of content distribution, sharing, and delivery
- P2P is not...
  - New or a specific architecture or technology
  - A business model or a market
  - About eliminating servers or centralized services
- P2P is about any device easily connecting “directly” to other devices to enable a more cooperative, or social, style of computing.

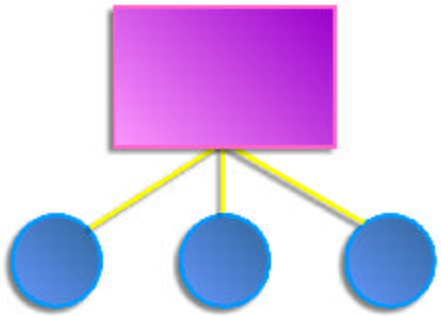
P2P Makes Sense Now

- More people connected, more data generated
- More nodes on the Internet and wireless Web
- More bandwidth available
- More computing power available (disk, memory, CPU)
- More interesting applications, content, and services
- Edge devices are increasingly providers of resources



JXTA Technology Objectives

- Interoperability
  - Across different P2P systems and communities
- Platform independence
  - Programming languages, system platforms, and networking platforms
- Ubiquity
  - Every device with a digital heartbeat
- Security and Monitoring
  - For commercial and enterprise deployment



What is JXTA?

An open set of XML-based protocols for creating peer-to-peer network computing applications and services.

- Language, OS, network, and service agnostic
- Virtual network overlay
- Mechanisms, not policies
- Open Source project: www.jxta.org

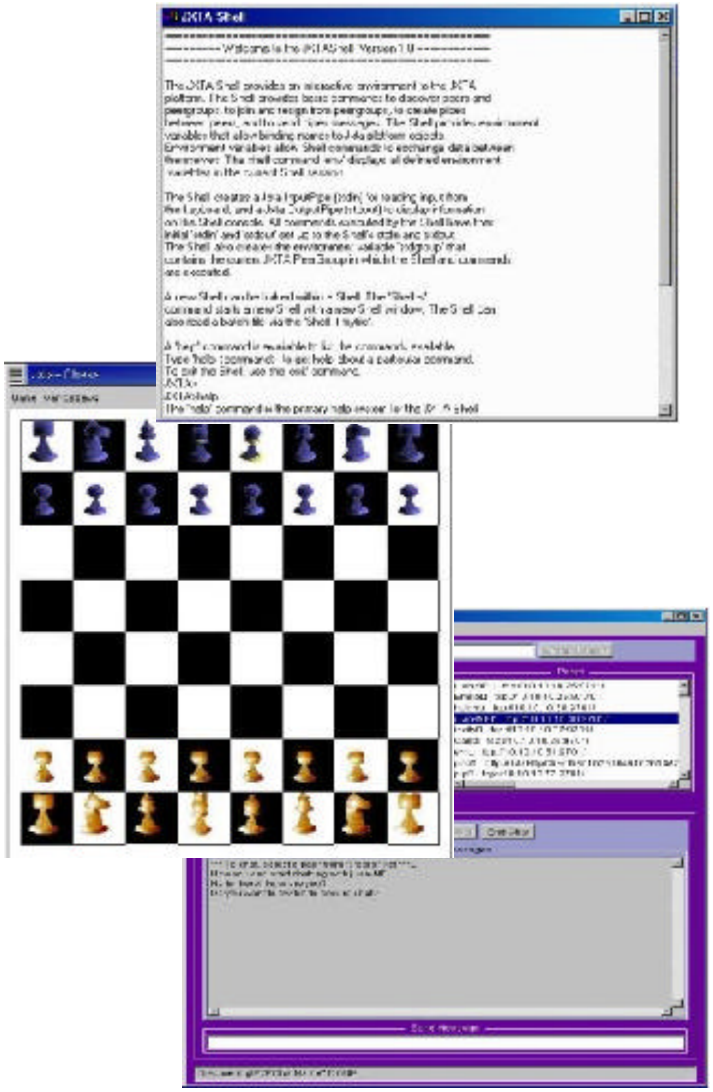
What JXTA Technology Does

Creating Connected Communities

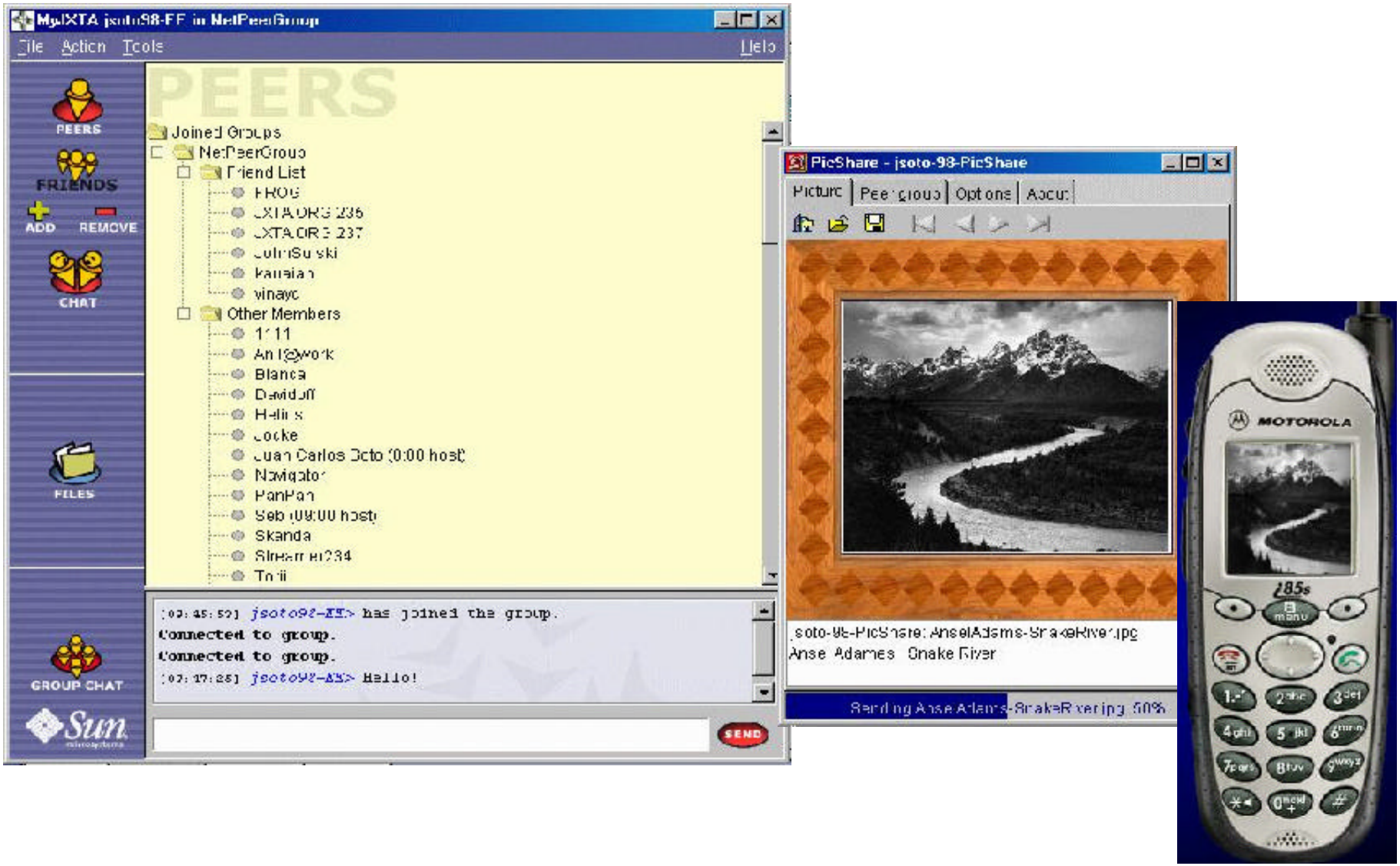
- Brings devices, services, and networks together
- Takes the complexity out of the network and operating environments
- Users have better access to content across multiple devices, regardless of location
- Enables a more cooperative or social style of computing to occur (e.g. people-to-people)
  - Search and share with yourself, your friends, and your community

JXTA Enables Classic P2P Applications

- Communications, collaboration, gaming
- Content delivery and sharing networks
- Transactional web services
- Resource sharing



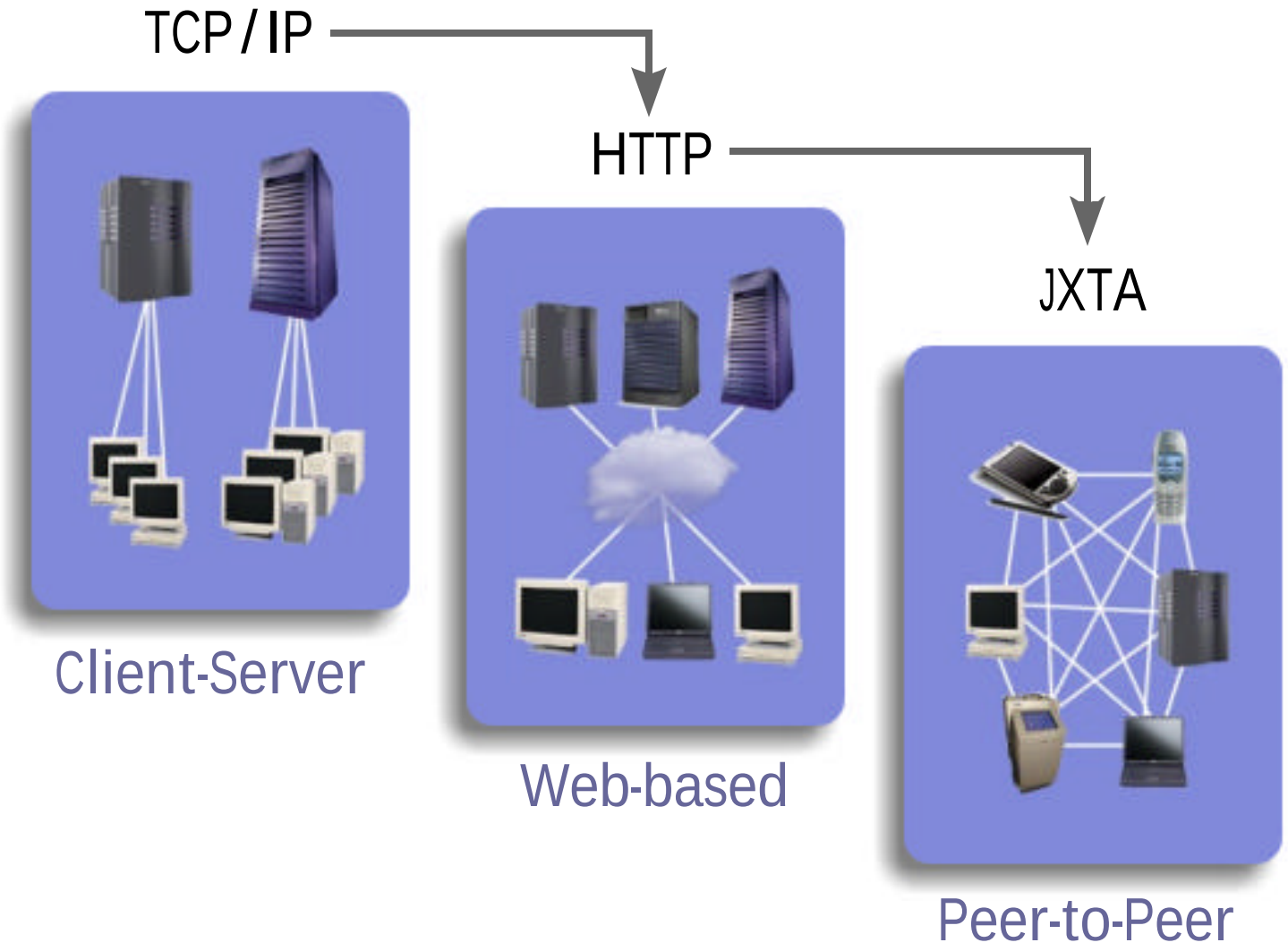
JXTA Sample Applications -- myJXTA2 and PicShare



Characteristics of Ideal P2P Applications

- Applications best suited for P2P implementation are those where:
  - Centralization is not possible or desired
  - Massive scalability is desired
  - Relationships are transient or ad-hoc
  - Resources are highly distributed
  - Its value or performance *increases* as more nodes participate in the network

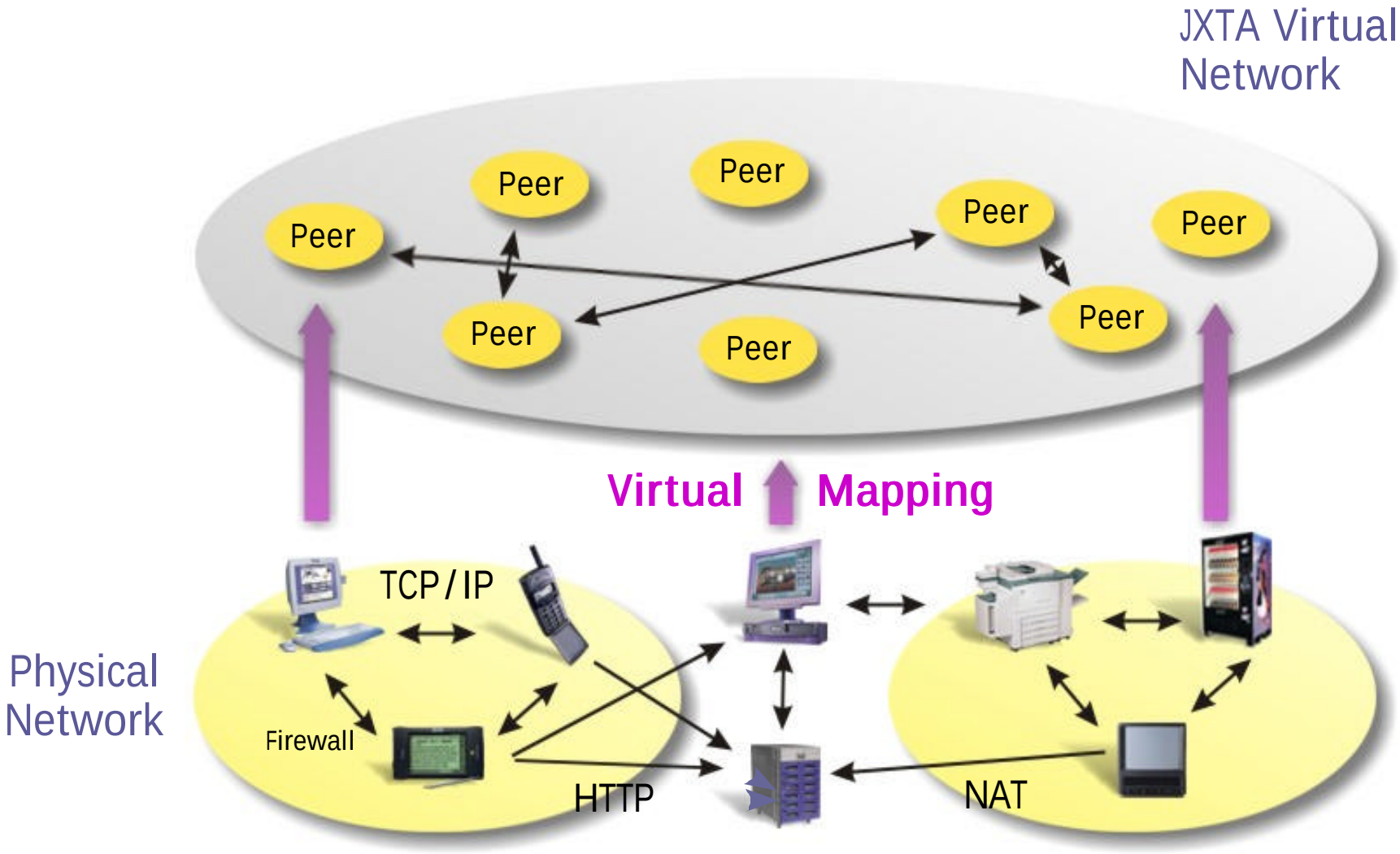
Evolution of Distributed Computing



JXTA defines a set of Protocols

- JXTA defines XML message formats, or *protocols*, for communication between peers
- Protocols used to discover peers, advertise and discover resources, communicate and route messages, and provide monitoring
- Asynchronous; based on query/response model
- Can be implemented in any language and sent across different networks

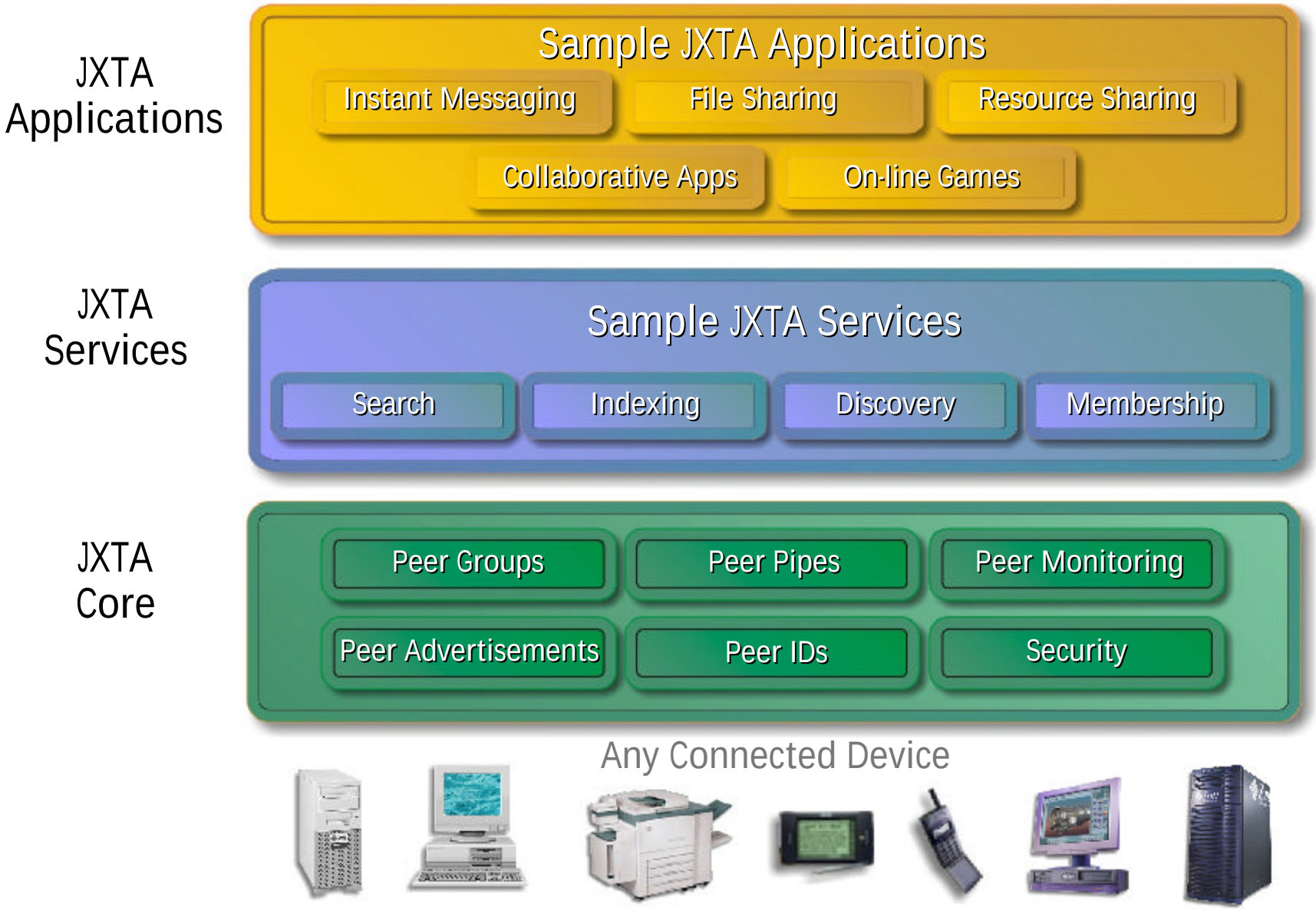
JXTA Virtual Network



JXTA Virtual Network Building Blocks

- Uniform peer addressing
  - Peer IDs
- Dynamically configurable peer domains
  - Peer groups
- Uniform resource representation
  - Advertisements
- Virtual communication channels
  - Pipes
- Security and Monitoring

JXTA Software Architecture



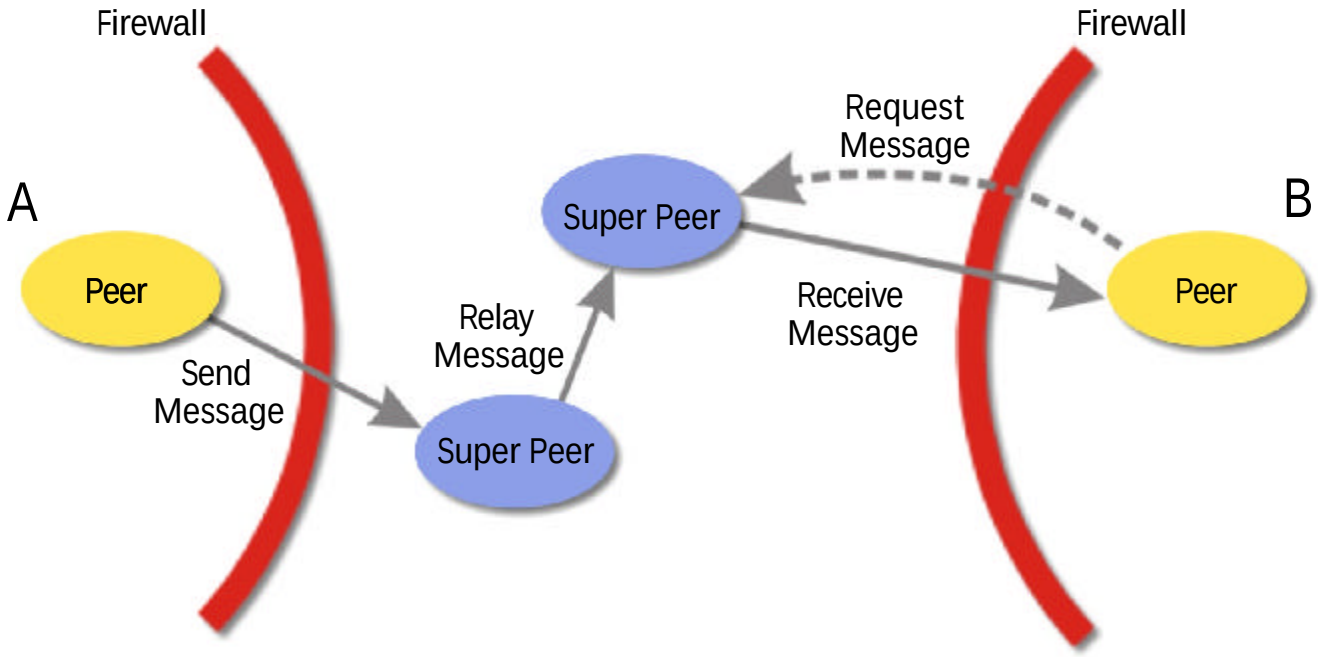
Peers

- Any networked device that implements one or more JXTA protocols
  - PC, server, PDA, cell phone, etc.
- Operate independently, asynchronously
- Spontaneously discover each other on the network
  - Transient relationships
  - Persistent relationships (peer groups)

JXTA Peer Types

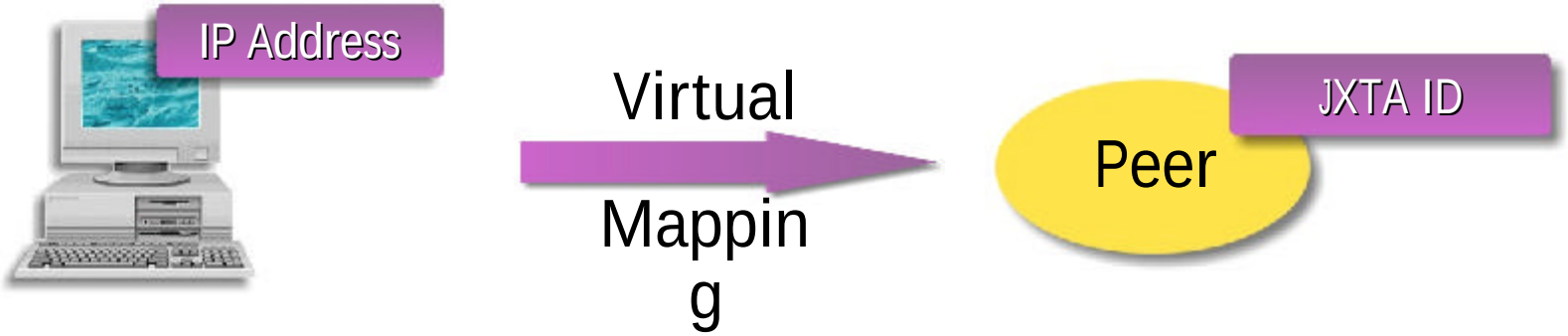
- Micro peers
- Simple peers
- Super peers:
  - Rendezvous peer
  - Relay peer
  - Proxy peer

Message Routing Via Relay Peers



Identifiers

- JXTA IDs uniquely identify resources: peers, peer group, pipes, etc.
- Uniform peer addressing scheme
  - Unique Peer IDs enable peers to be addressed independently of their physical network location
  - Example Peer ID:
    Urn:jxta:uuid-59616261646162614E5047205032
    50338E3E786229EA460DADC1A176B69B731504



Peer Endpoints

- Network interface(s) published by peer
- Example:
  - TCP/IP (tcp://129.127.29.65:9700)
  - HTTP (http://JxtaHttpClientuuid-...)
- Used to establish point-to-point connections between two peers
- Direct connections not required; intermediary peers can route messages

Protocols

- JXTA defines XML message formats, or *protocols*, for communication between peers
- Protocols used to discover peers, advertise and discover resources, communicate and route messages, and provide monitoring
- Asynchronous; based on query/response model
- Can be implemented in any language

JXTA Protocols

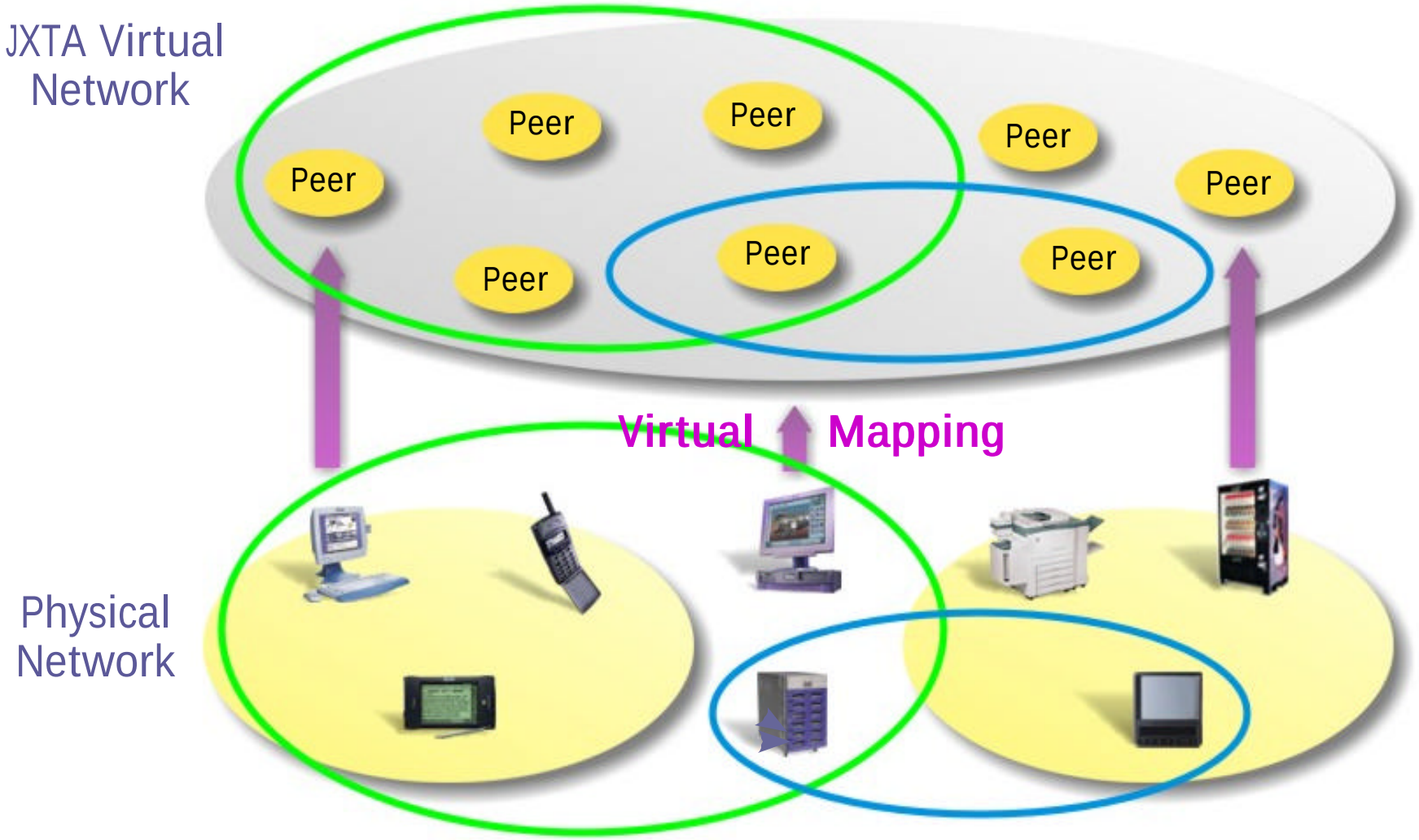
Super Peer

Simple Peer

Micro Peer

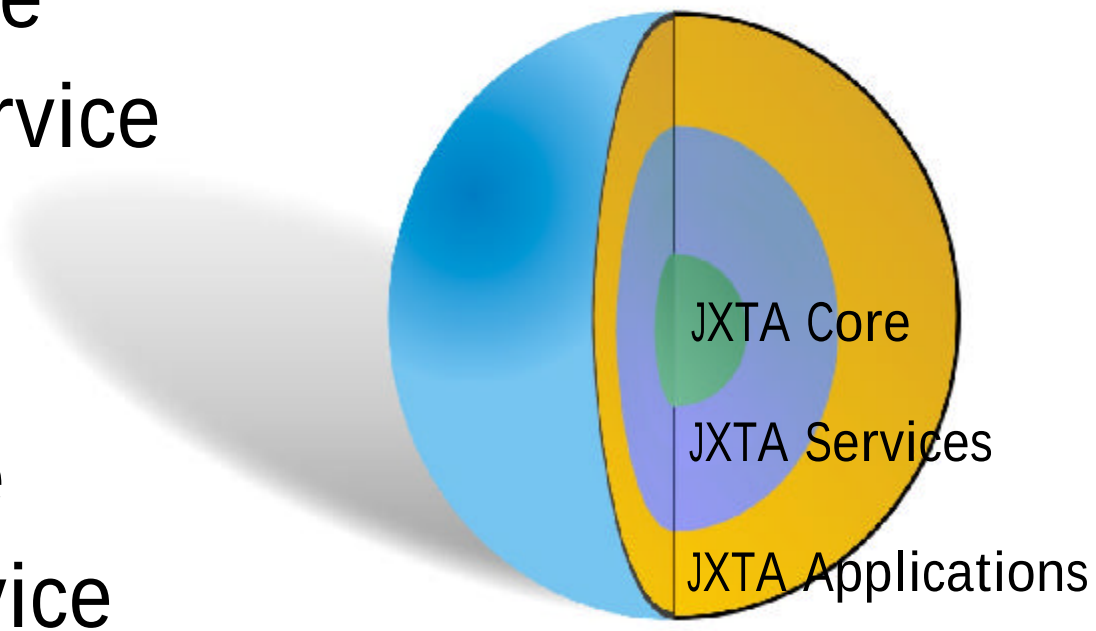
	Micro Peer	Simple Peer	Super Peer
			Peer Rendezvous Protocol
			Peer Discovery Protocol
		Peer Information Protocol	Peer Information Protocol
		Pipe Binding Protocol	Pipe Binding Protocol
Core Protocols	Peer Resolver Protocol	Peer Resolver Protocol	Peer Resolver Protocol
	Endpoint Routing Protocol	Endpoint Routing Protocol	Endpoint Routing Protocol

Peer Groups


JXTA Virtual Network
Peer
Peer
Peer
Peer
Peer
Peer
Peer
Peer
Virtual
Mapping
Physical Network

JXTA Core Peer Group Services

- Discovery Service
- Membership Service
- Access Service
- Pipe Service
- Resolver Service
- Monitoring Service



Peer Groups are not required to implement all services; can use default net peer group services.

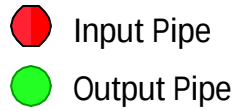
Why Use Peer Groups?

- Create secure and protected domains
- Scope peer operations
  - Discovery, search, communications
- Provide a “group” identity
  - Group peers sharing a common interest
- Enable monitoring

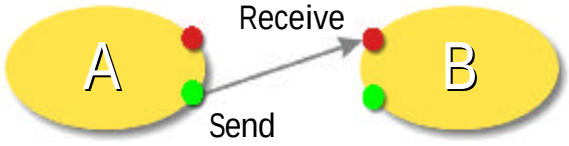
Pipes

- Used to send/receive messages
- Asynchronous and unidirectional
- Support the transfer of any object
  - Binary code, data strings, etc.
- Dynamically bound
- Virtual communication channels
  - May connect peers that do not have direct physical link
  - Can be bound to more than one peer endpoint

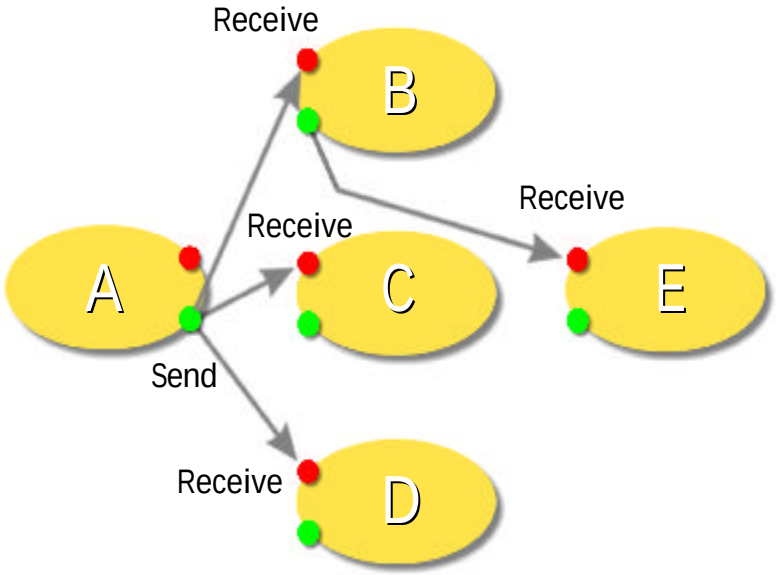
Pipe Types



- Point-to-Point Pipe
  - Connects exactly two peer endpoints together



- Propagate Pipe
  - Connects one output pipe to multiple input pipes



Additional pipe types can be created from the core types.

Services

- Set of functions that a provider offers
- Provider peer publishes service advertisement
- Pipes typically used to communicate with service
- Types of services:
  - Peer Services
  - Peer Group Services (discovery, membership, etc.)

Advertisements

- All JXTA resources represented by advertisements
- Language-neutral XML documents
- Peers cache, publish, and exchange advertisements
- Each advertisement published with a lifetime (time-to-live)
  - Enables deletion of obsolete resources without requiring centralized control

Example Pipe Advertisement

```
<?xml version="1.0"?>
<!DOCTYPE jxta:PipeAdvertisement>
<jxta:PipeAdvertisement xmlns:jxta="http://jxta.org">
   <Id>
      urn:jxta:uuid-59616261646162614E5047205032503 38E3E786229
      EA460DADC1A176B69B731504
   </Id>
   <Type>
      JxtaUnicast
   </Type>
   <Name>
      TestPipe.end1
   </Name>
</jxta:PipeAdvertisement>
```

Resolvers

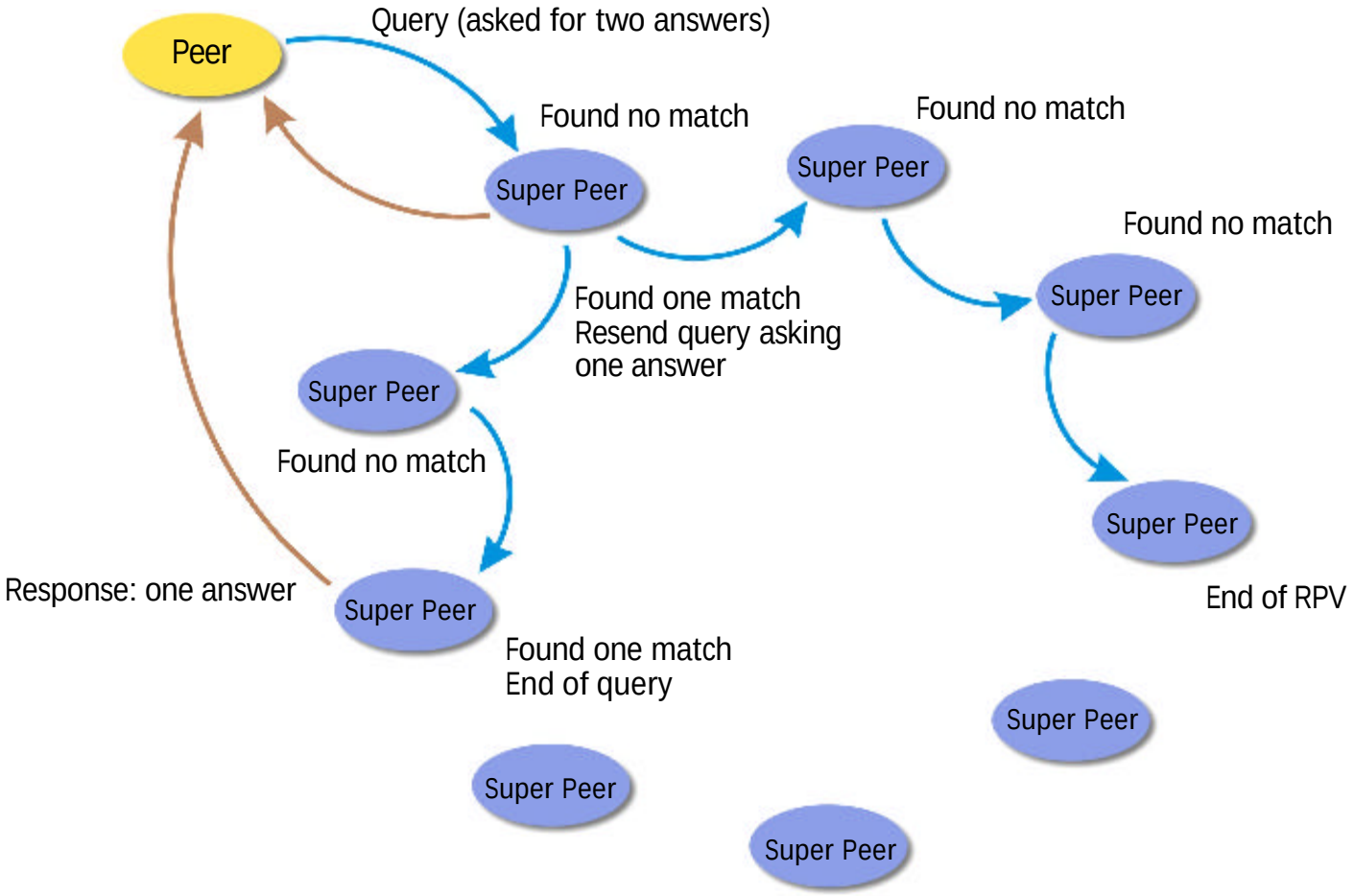
- In JXTA, all “binding” operations are simple discovery of advertisement(s)
- Example resolution operations
  - DNS (search for Peer or Peer Group advertisement)
  - Directory Service (search for a Peer adv.)
  - Socket Binding (search for a Pipe adv.)

Advertisement Discovery

- Local neighbor discovery
  - TCP/IP multicast
- Rendezvous peers
  - Discovery requests forwarded between rendezvous peers
  - Any peer may be a rendezvous peer
  - Cache a large number of advertisements
  - Each peer group has a set of rendezvous peers
- Out-of-band discovery

Request Propagation via Rendezvous Super Peers

Limited Range Walker



Security in JXTA

- TLS Endpoint Transport
- Simple cryptography library
- Peer security
  - Every peer has its own root certificate
  - Public key certificate part of peer advertisements
  - Credential certificate embedded in every JXTA protocol message
- Authentication framework
- Password-based login scheme

JXTA Implementation Platforms

- J2SE™ Implementation
  - Full implementation of JXTA protocols
  - APIs and functionality frozen
- JXTA-C
  - Full edge-peer functionality
  - Interoperates with J2SE relay and rendezvous peers
  - Runs on Linux, Solaris™ OE, and Windows
- JXTA for J2ME™
  - MIDP-1.0 compliant
  - (new) iAppli compliant

JXTA Wireless P2P on J2ME (MIDP)

P2P Messaging
Group and 1:1 Chat

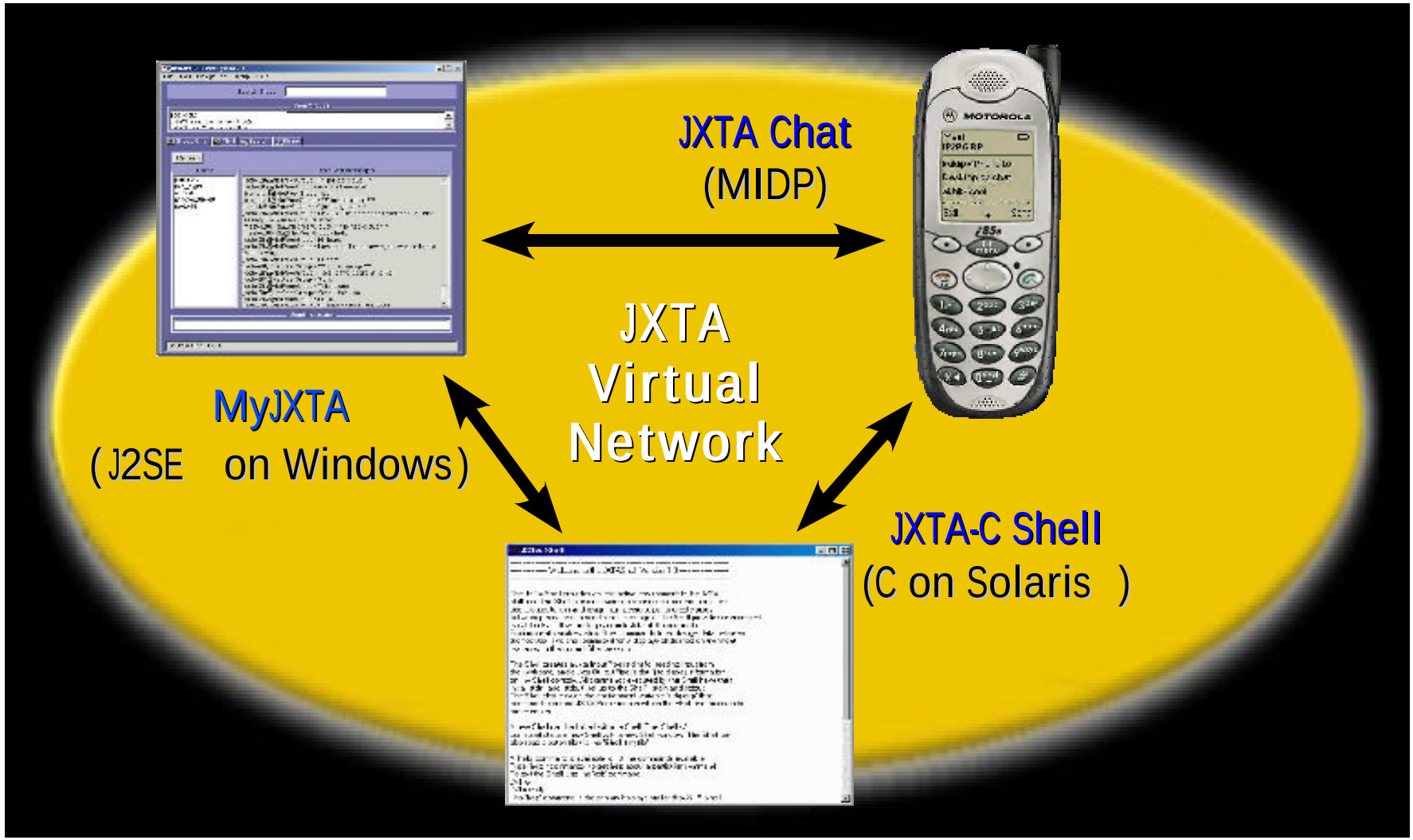
P2P Entertainment
TicTacToe Game

JXTA Wireless P2P on J2ME (iAppli)

P2P Messaging
Group and 1:1 Chat

P2P Image Sharing

Any Platform, Any Network



Current Platform Work – Scalability and Performance Enhancements

- Instrumentation & Benchmarks
- "Vertical" scalability
  - Optimize single platform instance (memory, thread, message queues, cpu, network, etc.)
- "Horizontal" scalability
  - Multi-peer platform optimization (discovery, resolver, propagation, Rendezvous, etc.)

Instrumentation and Benchmarking

- Adding instrumentation to the code and developing test suites
- Determining performance bottlenecks and tracking scalability improvements
- Measurements validate optimizations and changes
- Open community benchmark project (http://bench.jxta.org) serves as a repository of benchmarking tests and results

“Vertical” Scalability

- Optimize Resource Usage
  - Memory footprint usage
  - Endpoint thread and queue “fairness” management
- Enhance TCP/IP Transport
  - Bi-directional communications
- Reduce internal message copying

“Horizontal” Scalability

- Edge peers index their contents on Rendezvous peers
- Propagation limited to Rendezvous network
- Structure Rendezvous peers into a “semi-consistent” tree organization
- Add Resolver Access Point “hints” to speed resolution of resource endpoints (e.g. Pipes)

Community Projects

- Python
- Perl
- Objective-C
- Ruby
- SmallTalk
- TINI
- Services (e.g. JXTA-SOAP)
- *And many others…*

Looking Ahead

- New services and opportunities
  - E.g. content management, digital rights, presence, identity, integration with Web services

- Specification standardization through public organization – IETF (Internet Engineering Task Force)
  - See http://spec.jxta.org/v1.0/docbook/JXTAProtocols.txt

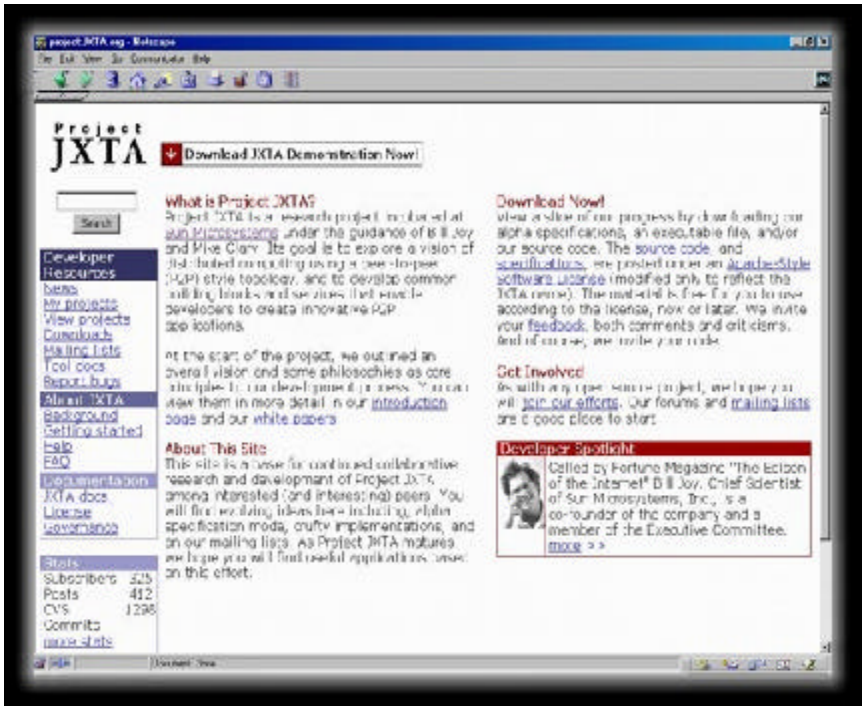
jxta.org Based on a Proven Open Source Model

- www.jxta.org
  - All source, projects, docs, examples on-line
- Apache–style software license
  - No barriers to getting started
  - No royalties, no fees, no registration
- Meritocracy
  - The more you've done, the more you can do

JXTA Community Momentum

www.jxta.org (4/25/2001 – 9/25/2002)

- 690,000 downloads
- 80+ projects
- 11,100+ members
- Active discussion groups
- Community actively contributing and integrating technology



Please join our efforts!

Project JXTA Resources

- Project home: http://www.jxta.org
- Downloads, tutorials, spec, documentation
  - http://platform.jxta.org
  - http://download.jxta.org
  - http://spec.jxta.org
- Mailing Lists and Active Community
  - Announce, Discuss, Dev, User @ jxta.org
  - Project-specific (e.g. http://jxme.jxta.org)
- Independent Software Vendors and Sun Microsystems Professional Services

JXTA Books

http://www.jxta.org/bookshelf.html

- *Early Adopter: JXTA*, Sing Li, 2001
- *JXTA*, Brendon J. Wilson, 2002
- *JXTA: Java P2P Programming*, Daniel Brookshire, et al, 2002
- *Mastering JXTA Development*, Joe Gradecki, August 2002
- *Java P2P Unleashed*, Robert Flenner, et al, 2002
- *JXTA in a Nutshell*, Scott Oaks, et al, 2002

Summary

- Project JXTA is an open source platform for P2P applications – it is free!
- Project JXTA technology is language, operating system, network, and service agnostic.
- Project JXTA works on any network device -- from cell phones to super servers
- Future Directions:
  - Massive Scaling, High Performance
  - Protocol Standardization with IETF
- Project JXTA resources and large, active community at http://www.jxta.org

If you only remember one thing...

Project JXTA lets you build and deploy enterprise and commercial P2P solutions more quickly.

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Sun microsystems
We make the net work.