

University of Tokyo Java Class

September 22-26, 2003

JXTA P2P Coding

Marc Hamilton

Director of Technology

Global Education and Research

Sun Microsystems, Inc



We make the net work.

Goal of Presentation

- Learn about project JXTA technology
- What is project JXTA technology?
- What problems does project JXTA technology address
- Get an update on project JXTA technology
- How can you participate in project JXTA technology

Learning Objectives

- Understand project JXTA technology
 - See the benefits of Peer-to-Peer computing
 - Get an update on the latest project JXTA technology
- Feel the momentum behind project JXTA technology

Project JXTA Technology

Technical Goal

Build a generic, secure, peer-to-peer virtual network as the foundation for the next generation of internet applications

jux.ta.pose

v.tr. jux.ta.posed, jux.ta.posing,

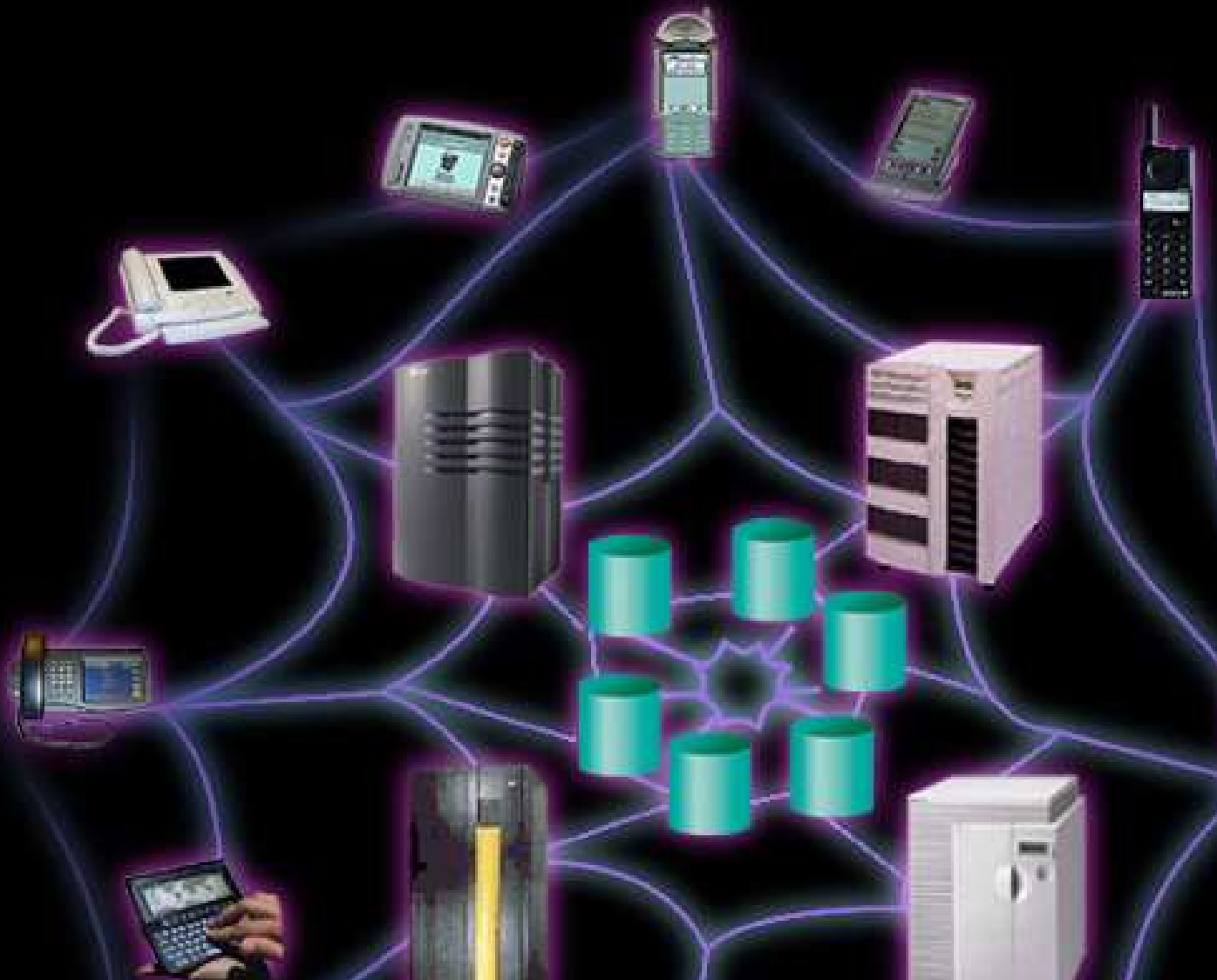
jux.ta.pos.es

To place side by side, especially for comparison or contrast

Presentation Outline

- **Benefits of Peer-to-Peer networking**
- What is project JXTA Technology
- Project JXTA technology momentum
- Project JXTA network abstractions
- Project JXTA technology implementations update
- How to participate in project JXTA technology

“Project JXTA will expand the accessibility of the Web and the depth of the content that’s available.”
— Bill Joy



Why Peer-to-Peer Computing

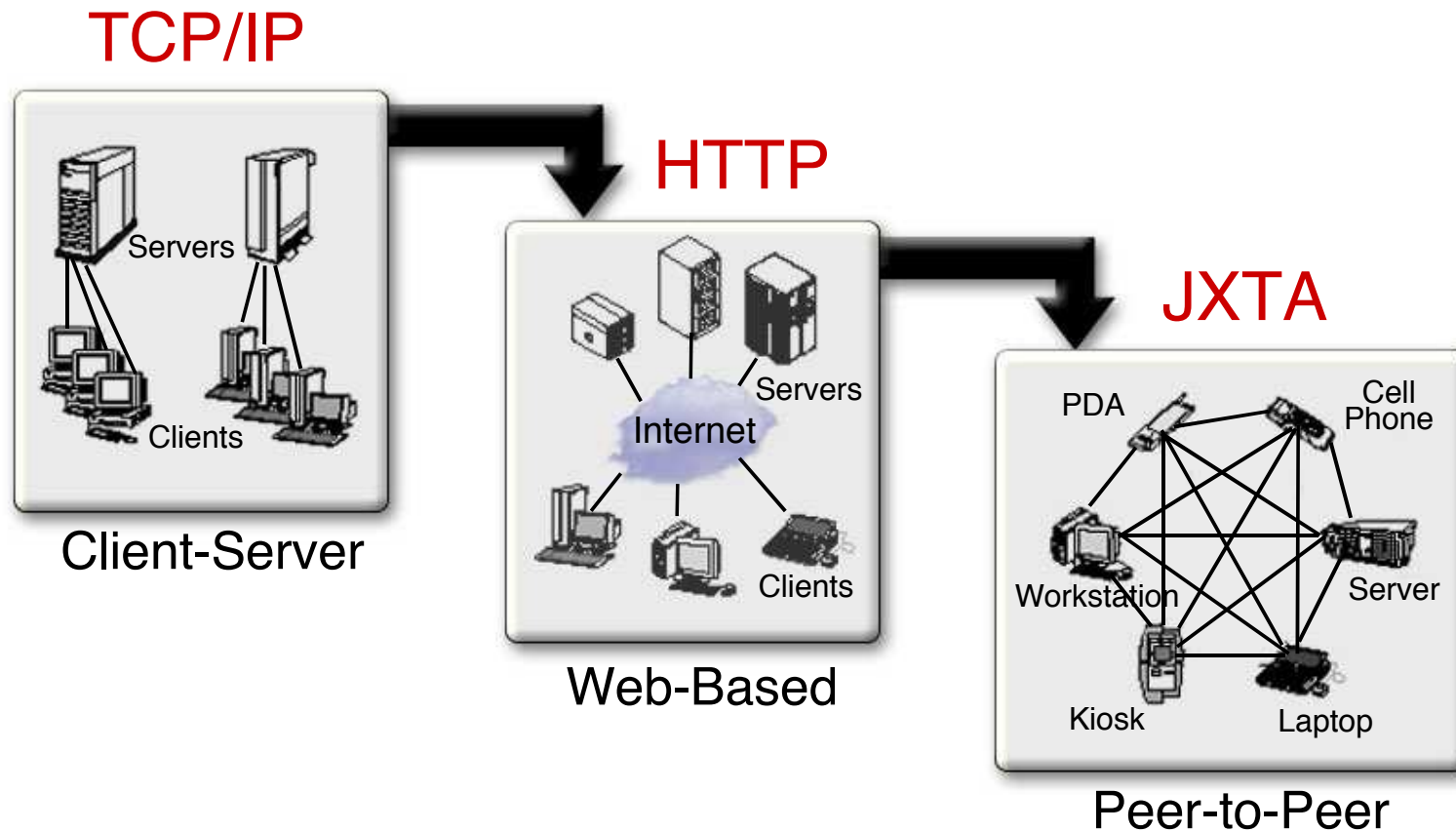
- Build complex behaviors by juxtaposing elementary ones
- Massive scalability
- Resilience
- Maximize localize peer interactions
- Self-organized network domains
- Decentralized and ad hoc resource discovery
- Increase performance as more peers participate
- Edge computing
- Share infrastructure cost

Presentation Outline

- Benefits of Peer-to-Peer networking
- **What is project JXTA technology**
- Project JXTA technology momentum
- Project JXTA network abstractions
- Project JXTA technology implementations update
- How to participate in project JXTA technology

Network Organization Is Driven by Internet “Core” Protocols

Define the minimum required network semantic (network DNA)



What Is Project JXTA ?

- An **open** set of XML **protocols** for developing peer-to-peer applications
 - Focus on network organization and connectivity
 - Service agnostic technology
(Web services, ORB, etc.)
 - A virtual network overlay
 - Defines mechanisms, not policies
 - Open source project: www.jxta.org

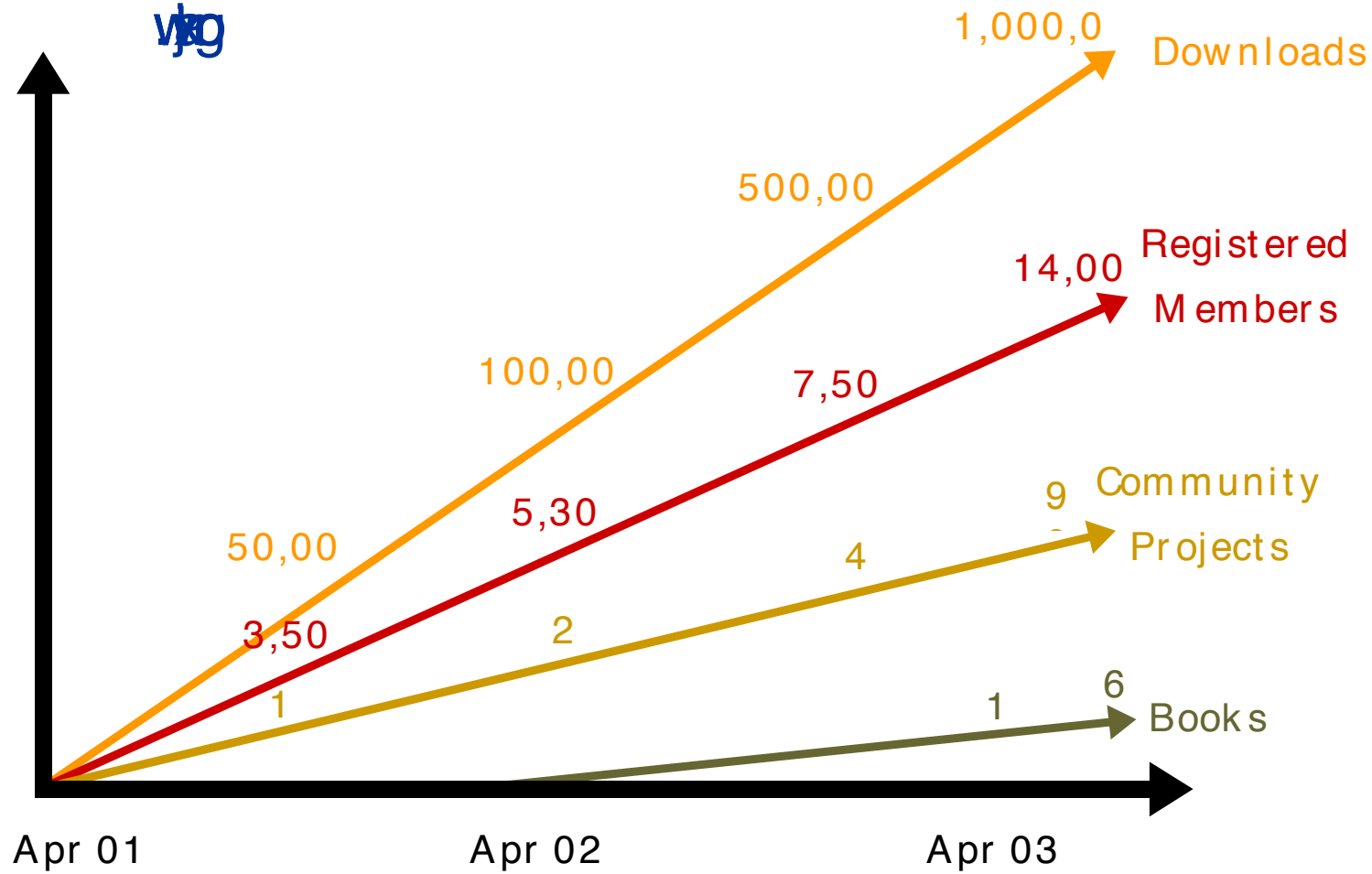
Project JXTA Technology Objectives

- **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

Presentation Outline

- Benefits of Peer-to-Peer networking
- What is project JXTA technology
- **Project JXTA technology momentum**
- Project JXTA network abstractions
- Project JXTA technology implementations update
- How to participate in project JXTA technology

JXTA Technology Momentum



JXTA Technology Samples Applications



Project JXTA Technology: Shell

JXTA Shell modeled after the Unix Shell

Interactive commands executed
within the JXTA network

JXTA> whoami

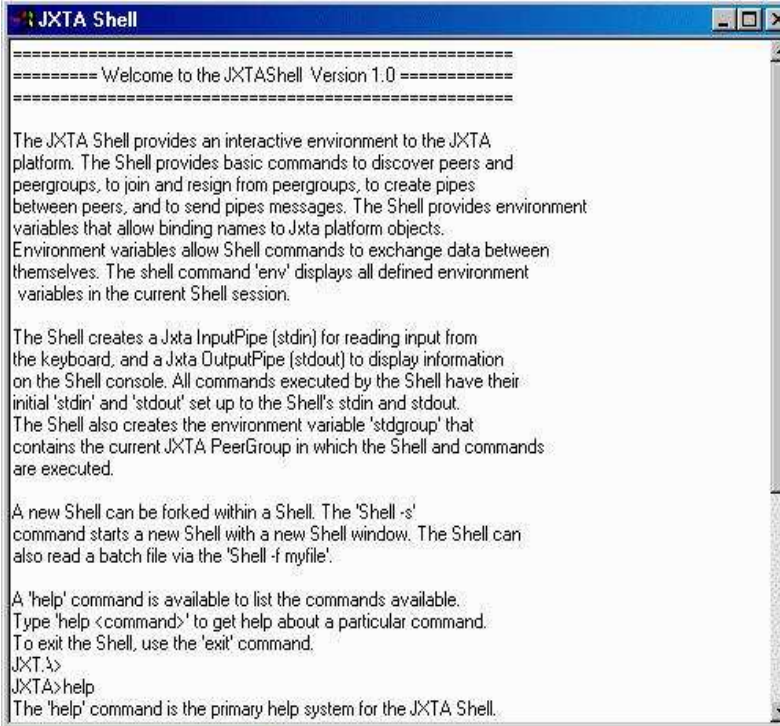
JXTA> peers

JXTA> groups | grep SUNW

JXTA> join SUNW

JXTA> peers | wc

JXTA> talk tra



```
JXTA Shell
=====
Welcome to the JXTAShell Version 1.0
=====

The JXTA Shell provides an interactive environment to the JXTA
platform. The Shell provides basic commands to discover peers and
peer groups, to join and resign from peer groups, to create pipes
between peers, and to send pipes messages. The Shell provides environment
variables that allow binding names to Jxta platform objects.
Environment variables allow Shell commands to exchange data between
themselves. The shell command 'env' displays all defined environment
variables in the current Shell session.

The Shell creates a Jxta InputPipe (stdin) for reading input from
the keyboard, and a Jxta OutputPipe (stdout) to display information
on the Shell console. All commands executed by the Shell have their
initial 'stdin' and 'stdout' set up to the Shell's stdin and stdout.
The Shell also creates the environment variable 'stdgroup' that
contains the current JXTA PeerGroup in which the Shell and commands
are executed.

A new Shell can be forked within a Shell. The 'Shell -s'
command starts a new Shell with a new Shell window. The Shell can
also read a batch file via the 'Shell -f myfile'.

A 'help' command is available to list the commands available.
Type 'help <command>' to get help about a particular command.
To exit the Shell, use the 'exit' command.
JXT.>
JXTA.>help
The 'help' command is the primary help system for the JXTA Shell.
```

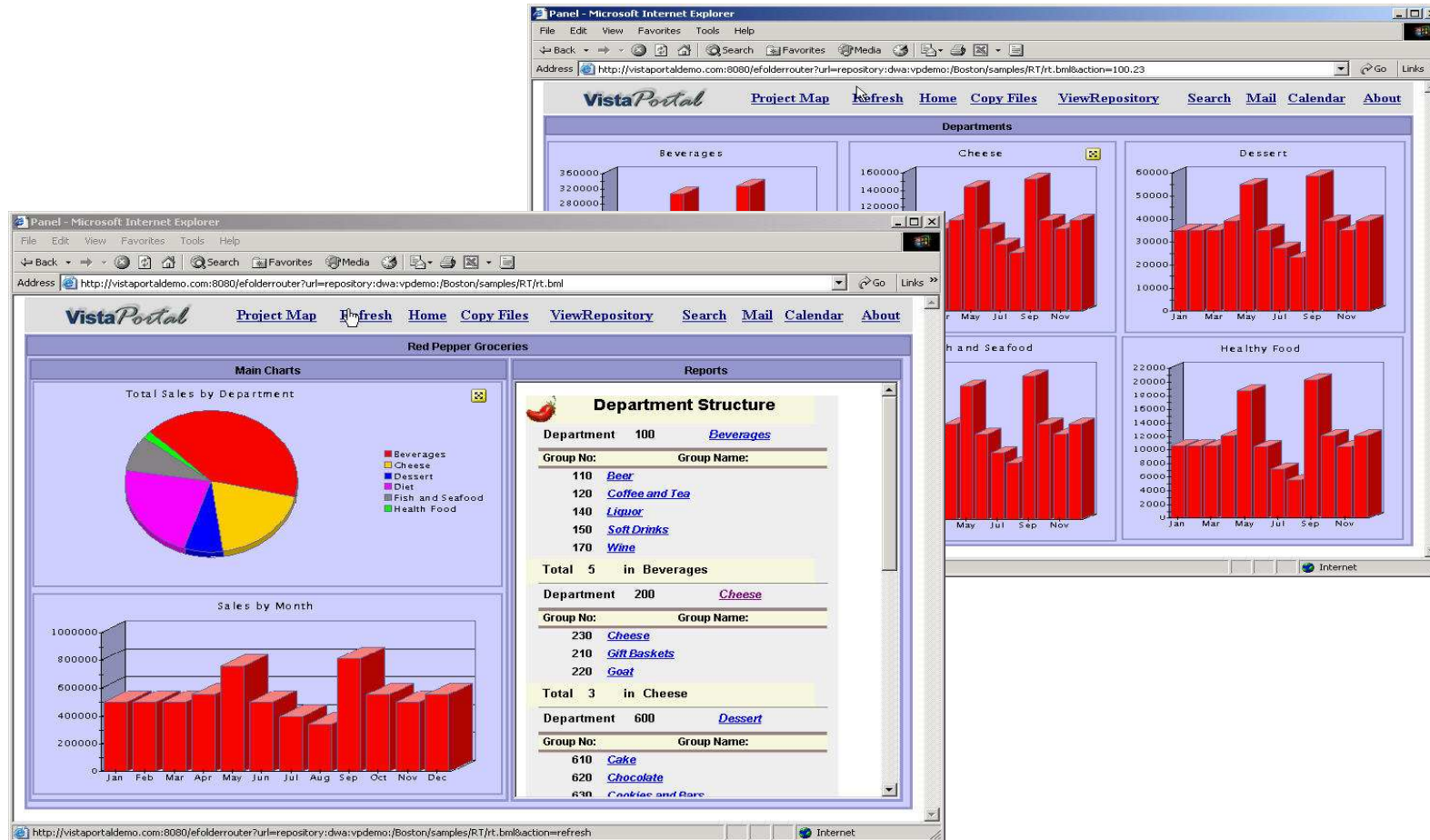

JXTA Commercial Applications



The screenshot displays the Momentum software interface, which is used for managing JXTA commercial applications. The main window is titled "Momentum - artw" and features a menu bar (File, Edit, View, Tools, Window, Help) and a toolbar. The interface is divided into several panes:

- Shortcuts:** A vertical list of icons for "Inbox", "Local Network Users", "My Personal Workspace", "Personal Contacts", and "Sent Items".
- Navigation:** A tree view showing a hierarchy of folders and items, including "Contacts", "Local Network Users", "Personal Contacts", "Messages and Notifications", "My Personal Workspace", "My Shared Workspaces", "The Orion Product", "Budget", "Critical Milestones", "Kickoff Presentation", "Product Plan", "Product Team", "Members", "Other Shared Workspaces", and "Shape Palettes".
- General Properties:** A pane showing details for "The Orion Product", including the owner (Art Whitten) and creation date (10/16/02 1:33 PM).
- Proposal Block Diagram:** A diagram titled "Controller Schematic" showing a central "JTAG/BUS" component connected to various hardware modules. The modules include:
 - 8 MHz Basic
 - RISC CPU 16-bit
 - FLASH 4/8 KB ISP
 - RAM 256 KB
 - Power-on reset with Brown-out Protection
 - Port 1 with IRQ
 - Port 3
 - Watchdog 15-bit
 - Timer A3 16-bit
 - ADC10 DTC
 - Port 2 with IRQ
 - USART0 UART/SP1
- Chat Window:** A window at the bottom right showing a chat message from Art Whitten: "This looks good for our response to Solarion's Request for Proposal. I think we'll just be able to meet the RFP deadline of October 23rd." The chat window also lists other participants: Tom Brubaker, Art Whitten, Ken Sigel, and Pete Crouch.

JXTA Commercial Applications



JXTA on J2ME™ Wireless Devices



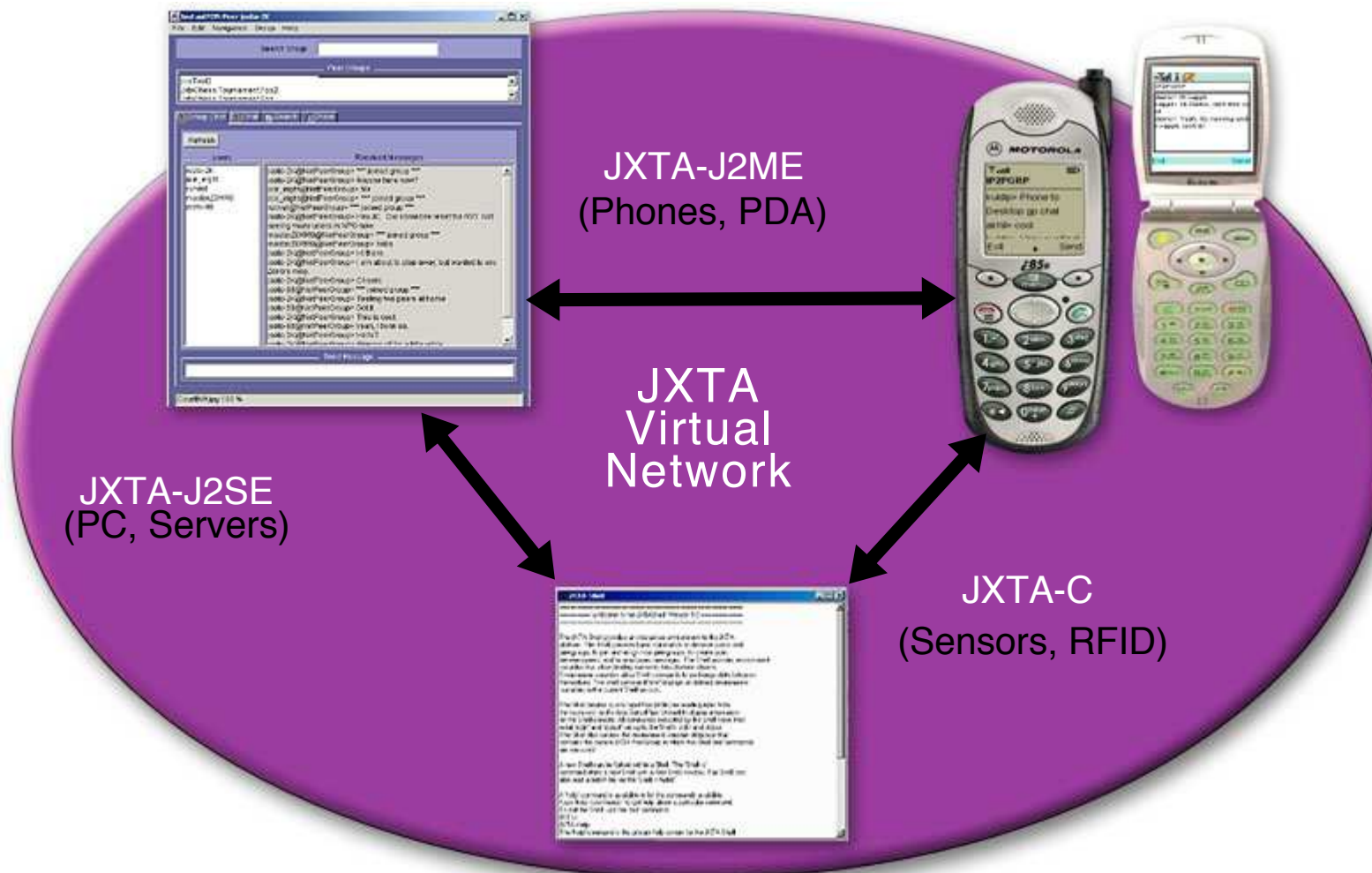
P2P Messaging
Group and 1:1



P2P
Collaboration



Everything Connected to the Network!



Presentation Outline

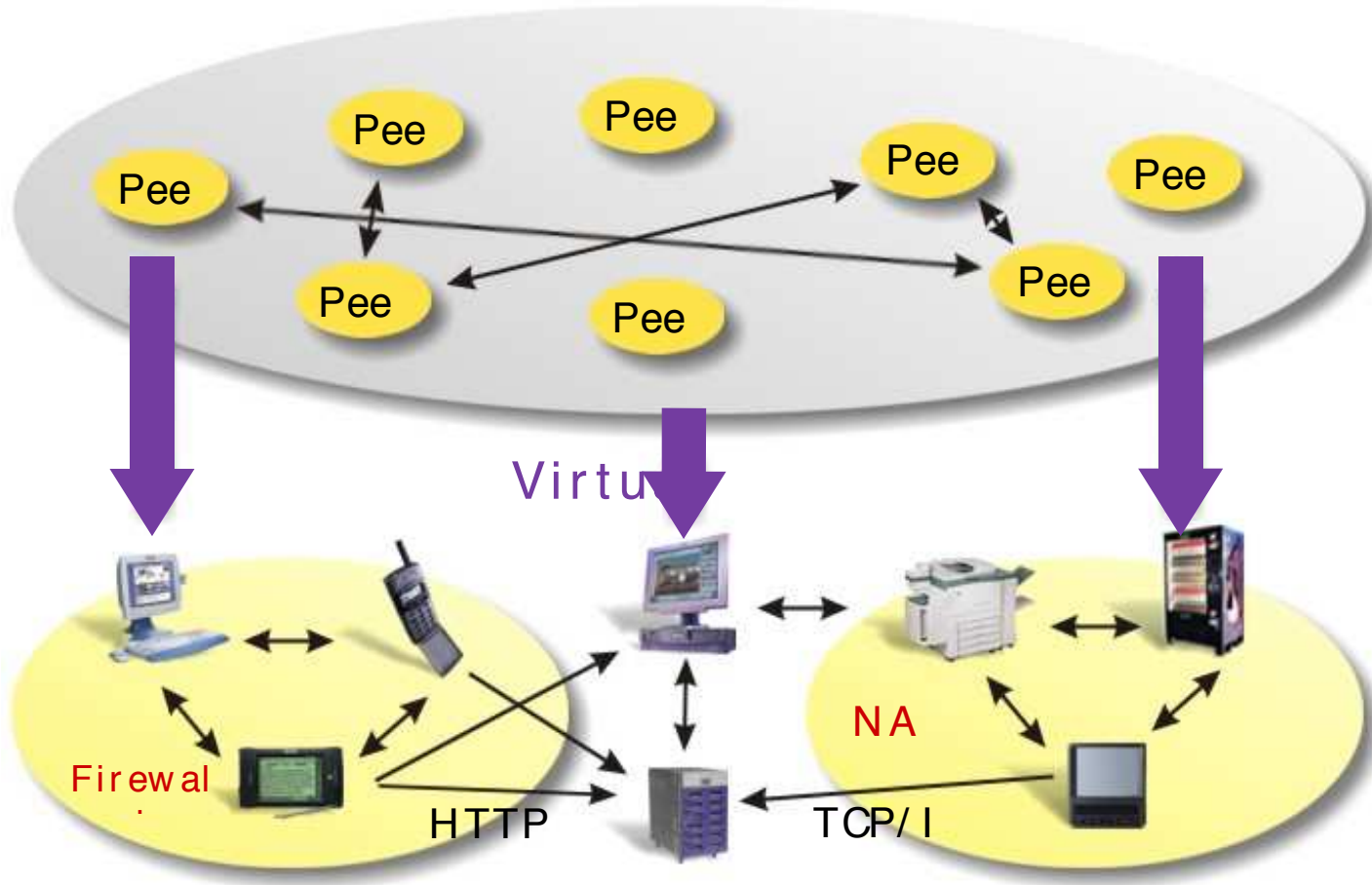
- Benefits of Peer-to-Peer networking
- What is project JXTA technology
- Project JXTA technology momentum
- **Project JXTA network abstractions**
- Project JXTA technology implementations update
- How to participate in project JXTA

JXTA Virtual Network Abstractions

- Virtual addressing (dynamic mapping between virtual and physical network)
- Advertisements as platform-neutral (XML) network resource descriptors
- Decentralized resource discovery (rendezvous network)
- Ad hoc peer groups (virtual secure domains)
- Pipes (virtual communication channels)

JXTA Virtual Network

☐
☐

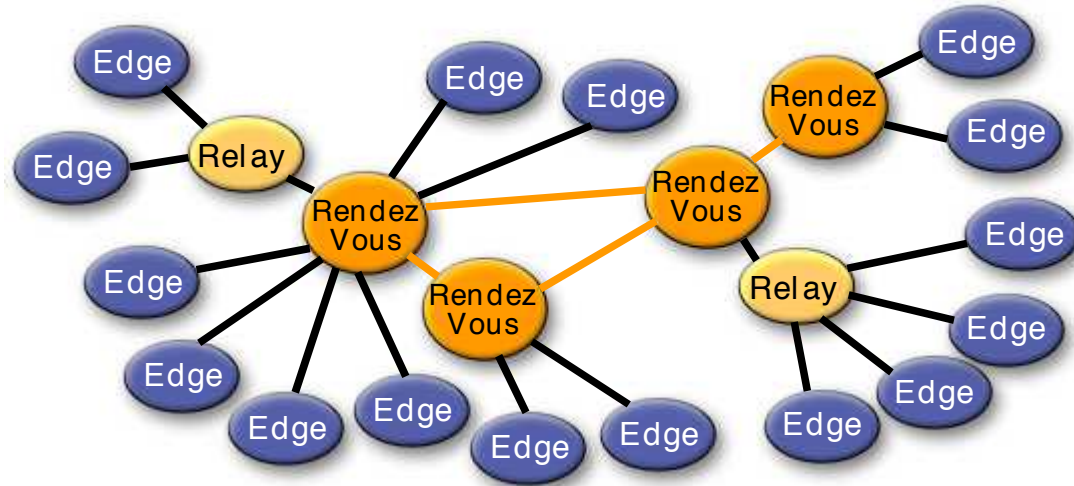


☐
☐

JXTA Advertisements

- Language-neutral meta-data resource descriptors
- Can be used to describe virtually anything (data, code, classes, JIT code, Web service, java object, etc.)
- Developers can create their own advertisements
- Peers publish, cache and discover advertisements
- Every advertisement is assigned a lifetime (self-healing resource presence)

Not All Peers Are Equals

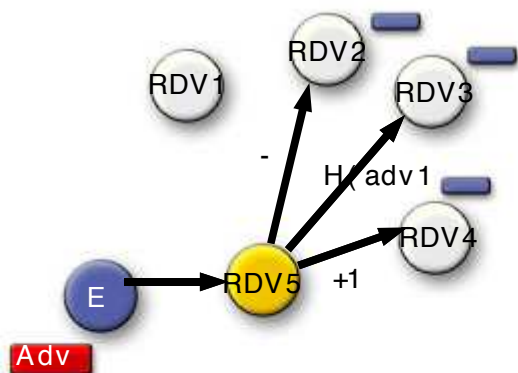


- **Edge Peer**
Publish, discover share resources and communicate)
- **Relay Peer (connectivity network)**
Store and forward messages across NAT and Firewall domains
Virtual router (logical multicast)
Landmark routing access point
- **Rendezvous Peer (advertisement discovery network)**
Index edge peer advertisements
Route discovery queries

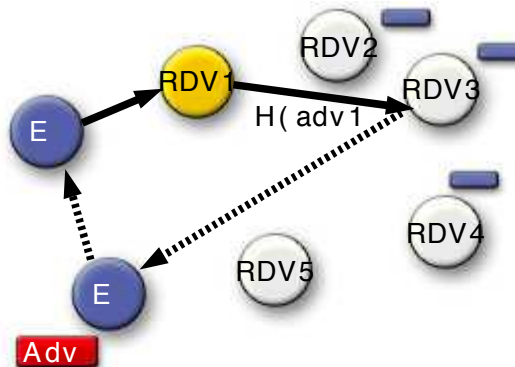
Decentralized RendezVous Discovery

- Route queries within RDV network (no centralized registry mandated)
- Loosely-consistent Distributed Hash Table (DHT) to index advertisements ($\log(n)$)
- Replicate indexes in the proximity of the target RDV
- Rendezvous **walkers** to garbage collect inconsistent indexes
- Provide a default RDV walker policy, but walkers are pluggable!
- Ad hoc RDV network organization and failover

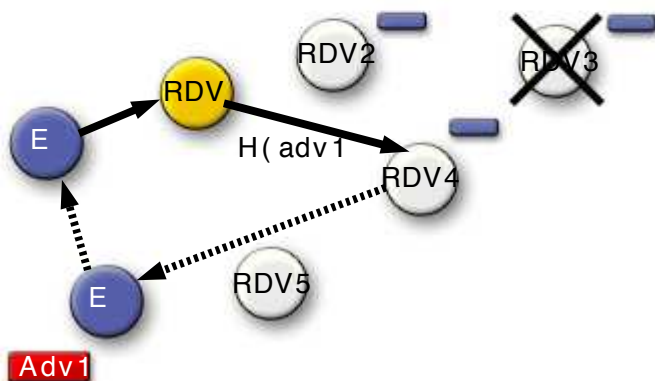
RendezVous Network Discovery



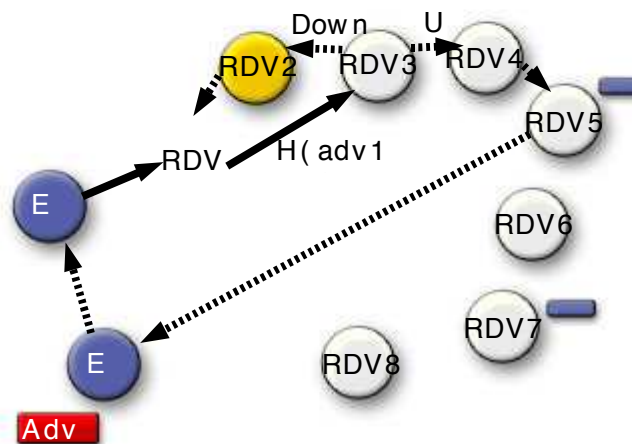
1) E1 publish



2) E2 search Adv1
(Consistent RDV view)



3) E2 search Adv1
(Shift (+1 -1) RDV)

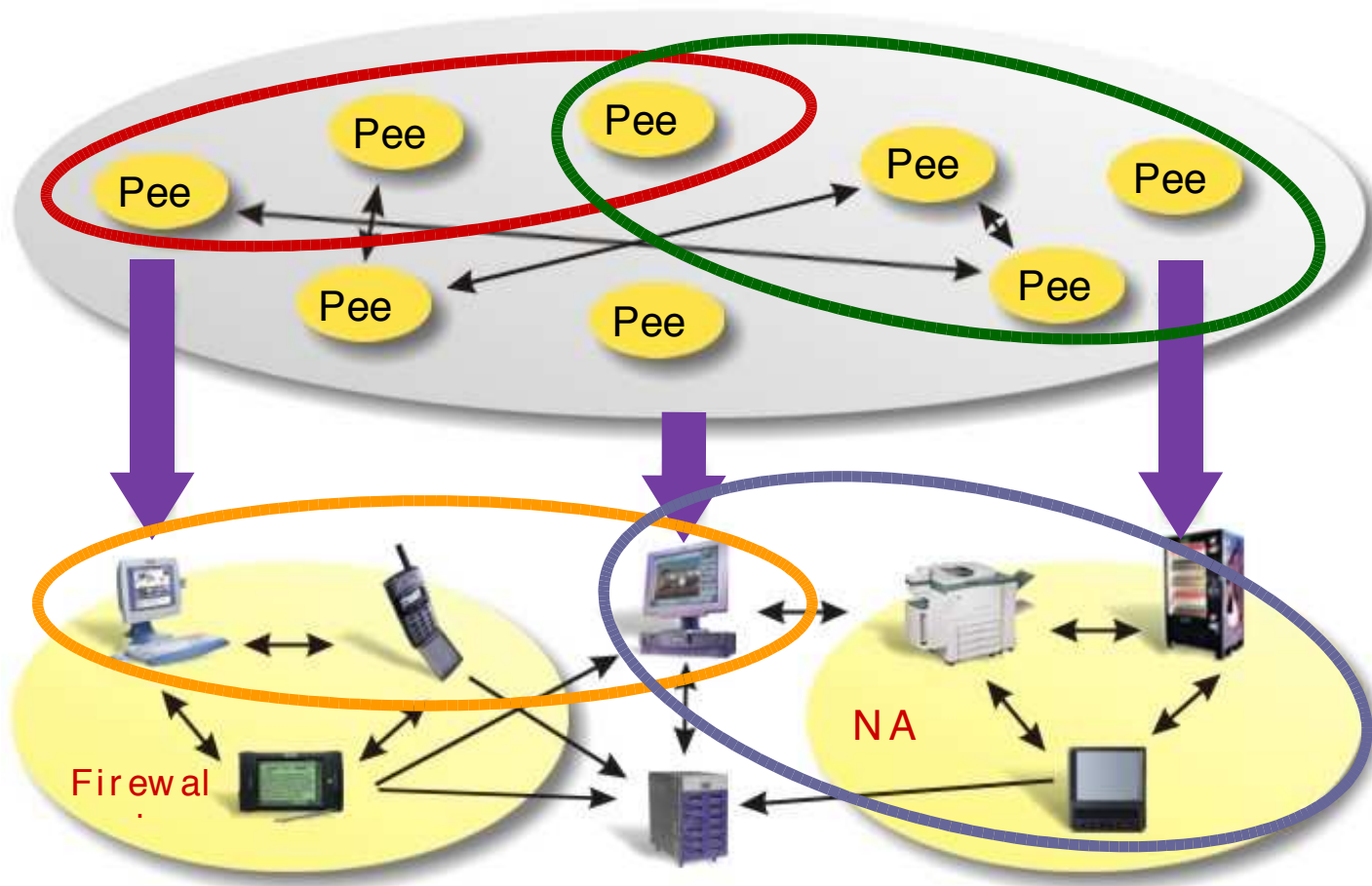


4) E2 search Adv1
(Limited-Range Walker)

Virtual PeerGroup Domains



Virtual PeerGroup Domains



Virtual PeerGroup Domains

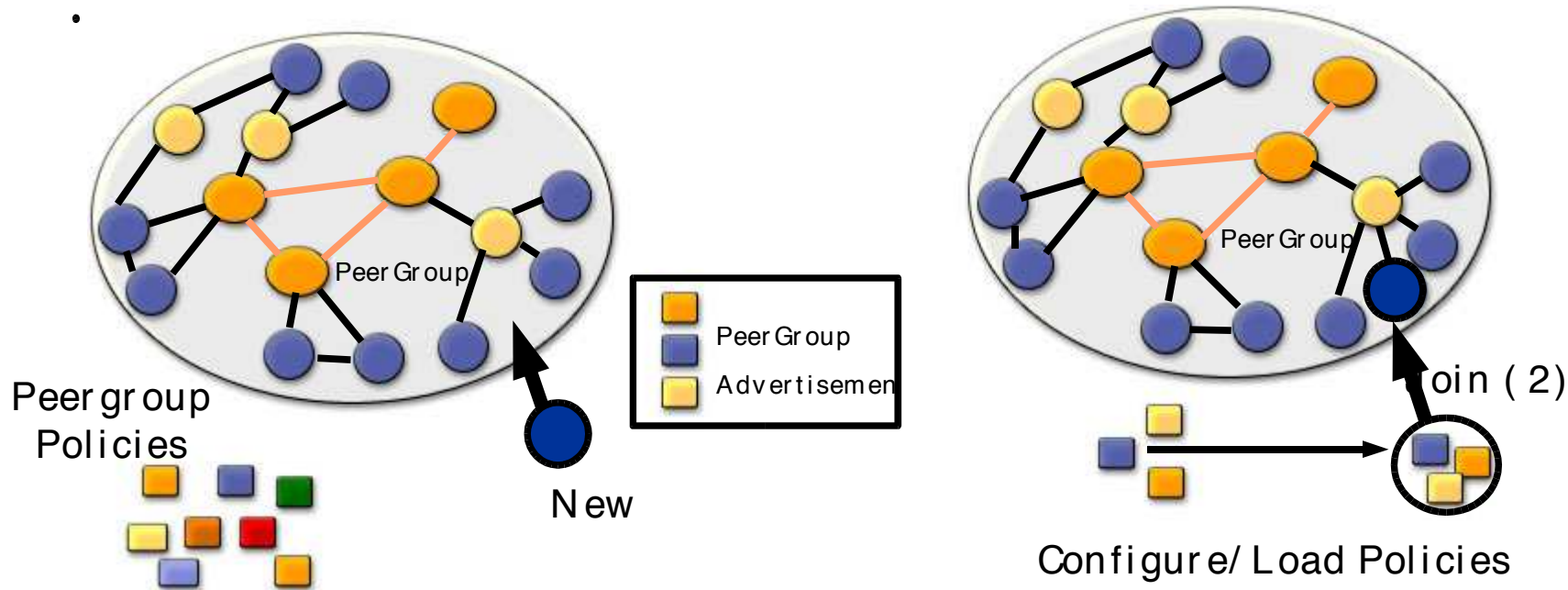
Peergroups

- Define by developers, NOT ONLY by network administrators
- Enable self-organization of peers
- Pluggable membership and access control policy
- Create secure and protected domains (virtual firewalls)
- Scope peer interactions (discovery)
- Create an identity for peers sharing a “common” interest (baseball, storage or cpu-sharing peer groups)

Pipes

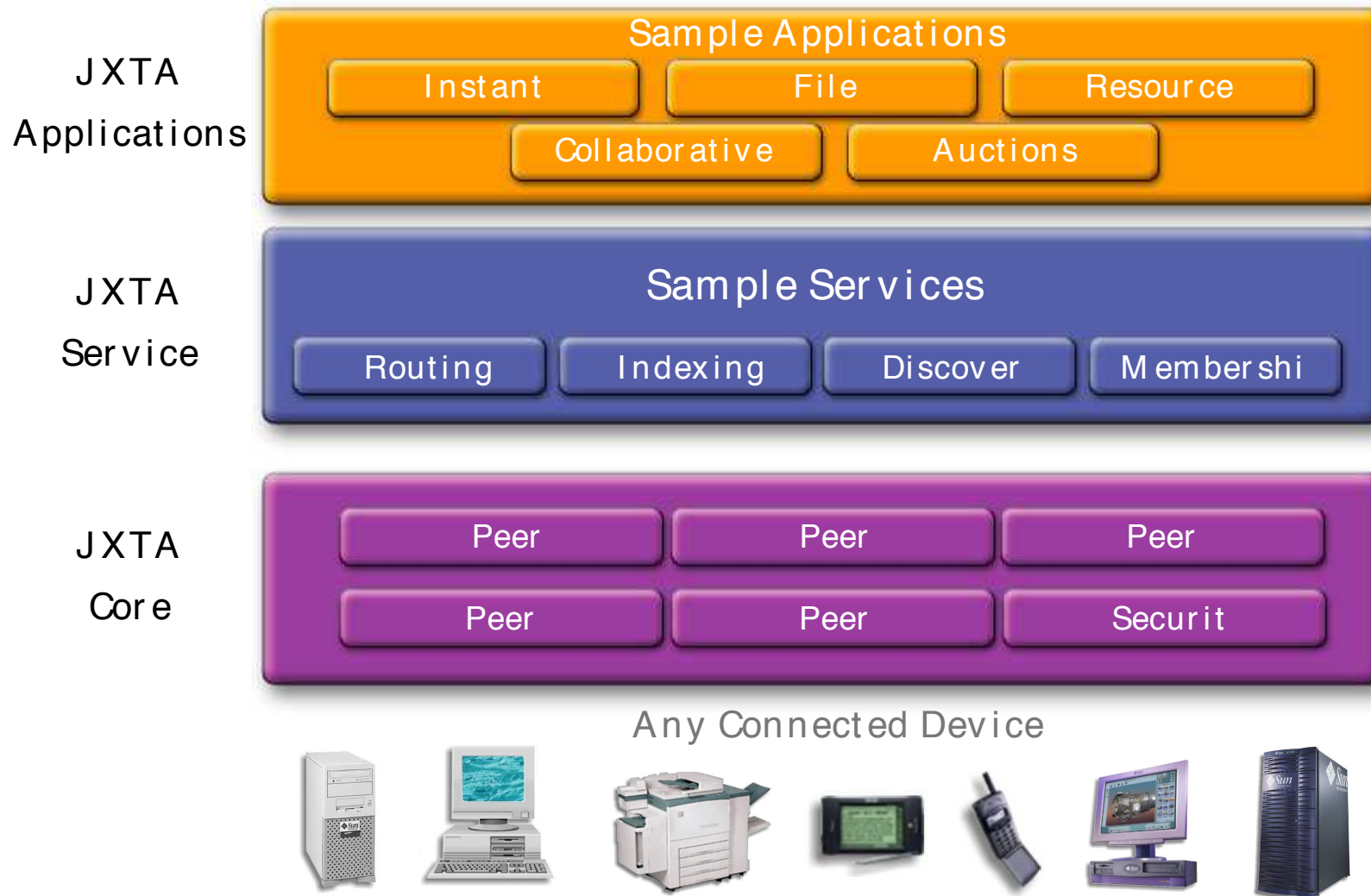
- Virtual communication channels (traverse NAT and firewall)
- Dynamic binding of pipe ends
- Can be used to transfer virtually anything (data, code, binary, XML, etc.)
- Core pipe services
 - Unicast (asynchronous and uni-directional)
 - Propagate (virtual multicast within peergroup)
- Can be extended (reliable and secure pipes)

Peergroups Enable Network Diversity



- Peergroup policies (membership, routing, searching, indexing, etc.)
- Policy represented by advertisements (Module advertisements)
- Loadable policies (mutation and learning)

JXTA Software Architecture



Presentation Outline

- Benefits of Peer-to-Peer networking
- What is project JXTA
- Project JXTA technology momentum
- Project JXTA network abstractions
- **Project JXTA implementations update**
- How to participate in project JXTA

JXTA Implementations Status

- J2SE™ Reference Implementation
 - Full implementation of JXTA 1.0-2.0 protocols
 - Edge, relay and rendezvous functionality
 - APIs and functionality frozen since Nov'02
 - Just released JXTA 2.1 for JavaOne!**
 - New metering and monitoring framework
 - Reliable JXTA socket
 - New Bi-directional pipes
 - Access peer group service
 - Relay and rendezvous dynamic failover

JXTA Implementations Status (2)

- JXTA for J2ME™ technology
 - Edge Peer JXTA 2.0 functionality only
 - MIDP — 1.0 compliant
- JXTA-C
 - Edge Peer JXTA 1.0 functionality only
 - Runs on Linux, Solaris™ OE, and Windows
- Community effort
 - Python, Perl
 - .Net

What's in It for Developers?

- Open Source Code and License friendly!
- Community of Open Source Developers
- Opportunity to “Steer the Boat”
- A “pluggable” infrastructure that provide a foundation for P2P applications
- Quick time to market for new products and services



Looking Ahead

- Better performance and scalability
- Continue improving Quality
 - Distributed Testing Framework (www.jdf.org)
- Security
 - crypto ID
 - advertisement signing
 - QoS pipes
- Better integration with Web services (JXTA socket, JXTA-SOAP, JXTA-RPC)
- Specification standardization through public organization (IRTF)

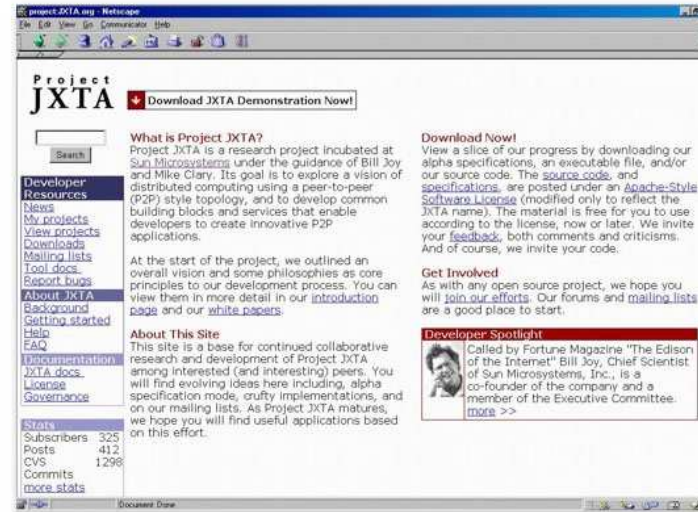
Presentation Outline

- Benefits of Peer-to-Peer networking
- What is project JXTA
- Project JXTA technology momentum
- Project JXTA network abstractions
- Project JXTA implementation update
- **How to participate in project JXTA**

JXTA Community (www.jxta.org)



- ~~1~~
- ~~2~~
- ~~3~~
- ~~4~~
- ~~5~~



Please join our efforts!



Marc Hamilton

marc.hamilton@sun.com

Sun Microsystems, Inc.



We make the net work.