The *Jini* System Architecture

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Presentation Outline

- Introduction/Overview
- Architecture
- Infrastructure
- Programmatic Interface
- JavaSpaces
- Summary

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What is Jini ?

- New distributed system architecture
- Sun R&D project inspired by Bill Joy
- Goal to simplify interaction with networks
- Built around model of clients looking for services
- Plug-and-participate (spontaneous networking)
- New class of network services

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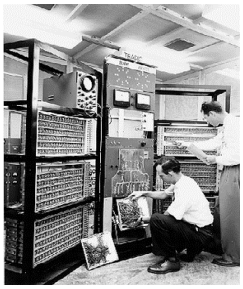
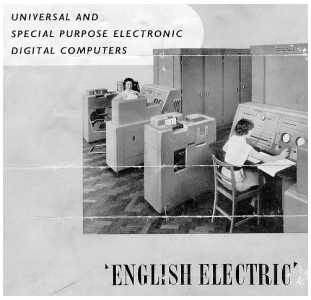
Why Change ?

Jini Evangelism Section



What has changed in the picture ?



"Windows NT is 16.5 million lines of code that will never be debugged"
-- Bill Joy

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Why Jini ?

Jini Evangelism Section

- You are the new system administrator,
- Computers are nowhere,
- The one computer is everywhere !

- Networks are becoming ubiquitous
- Consumer electronics devices are getting smarter
- Current networks rely on static configuration and are hard to administer

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Jini thinks "*Services*"

- Jini members **federate** to share access to services
- A **service** is an entity that may be used by a *person*, a *program* or *another service*
- A **service** may be a *computation*, *storage*, a *communication* channel, a software *filter*, a hardware *device*, or another *user*
- Services are **composed** for performance of a particular task

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Key Concepts

- **Federating** groups of devices and software components into single distributed system
- Single Jini system targeted to **workgroup**
- **Members** of federation agree on basic notions of trust, administration, identification and policy
- It is possible to **federate Jini systems** for larger organizations

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Jini Environment

- Entertainment devices will continue to increase their "**digital component**"
- Existence of **network** of reasonable speed (>=10mbps)
- Devices have some **memory & processing** power.
  - *Proxies* provided for "dumb" devices
- **Java**-technology centered : bytecode everywhere

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Base Java Features

- Java **byte-code** is platform independent
  - Other languages may be compiled to byte-code (Ada)
- Java objects may be ***serialized*** into stream of bytes
  - Lack of pointers & strong typing allows for deep-copy
  - Mobile objects : code + data saved as a byte-stream
- Java **RMI** (Remote Method Invocation)
- Java **security** model - beyond the sandbox
  - Signed applications + domain-based access control

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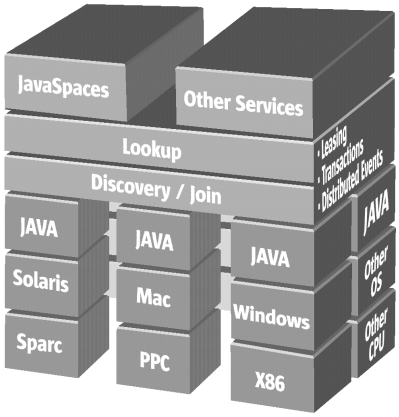
Architecture

- Jini *infrastructure* :
  - Discovery and Join
  - Lookup
- Jini *services* :
  - JavaSpaces
- *Programming model* :
  - Leasing, Transactions, Distributed Events



Extremely light-weight : Jini classes take 48Kb

Jini Infrastructure

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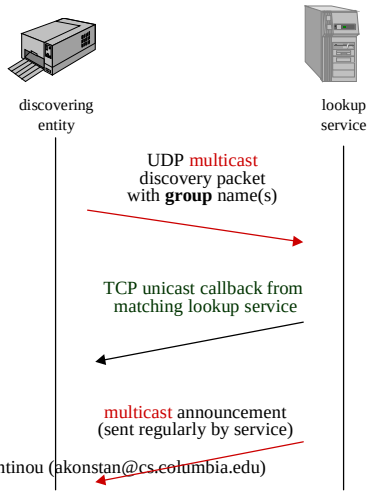
Discovery

- Host requirements :
  - functioning JVM
  - configured network stack
- IP stack requirements :
  - IP address
  - unicast TCP, multicast UDP
  - RMI stub export mechanism (e.g. HTTP)
- **Group** : an arbitrary string that acts as a name (recommend DNS names `eng.sun.com`)
  - initially empty (new service)



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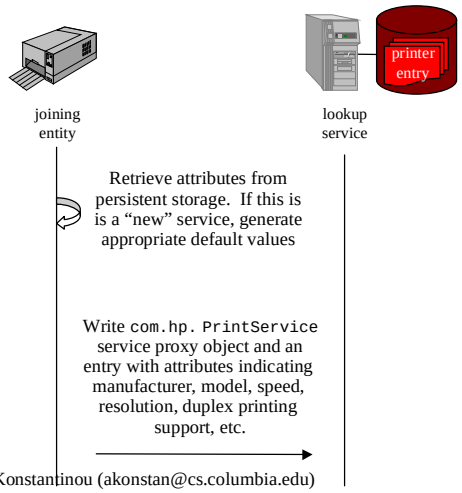
Join

- Register with each lookup service discovered
- Persistent state :
  - Service ID
  - Lookup entry
  - Groups
  - Lookup services



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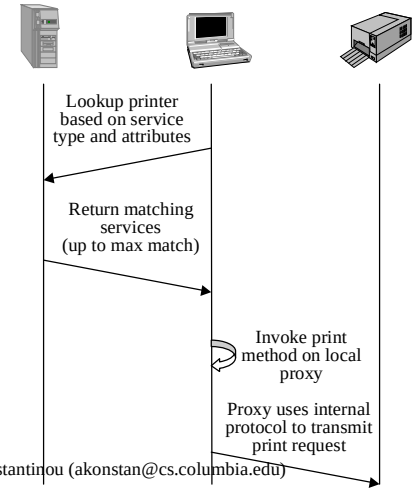
Lookup

- Lookup service maintains flat collection of *service items*
- Items contain the RMI stub or proxy object used to access the service + an extensible collection of descriptive **attributes**
- Entries may be manipulated graphically by administrator (JavaBeans)



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Entry

- An **entry** is a class containing a number of public fields of object type
- Service may provide **multiple** entries (set of sets)
- **Exact** lookup semantics
- Design issues :
  - matching cannot always be *automated* (reduce)
  - attributes are mostly *static* (order of minutes)
  - *humans* need to understand most attributes
  - attributes can be changed by services or humans, but *not both*
  - attributes must interoperate with *JavaBeans* components

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Programmatic Interface

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Distributed Leasing

- **Failures** in distributed systems result in unbounded resource consumption growth
- Services in Jini are **leased** based on time
- Jini provides a simple **interface** for requesting, renewing, and canceling a lease
- Lease time may be **absolute** or **durational**

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Distributed Events

- Remote events contain : *source*, *event ID*, *sequence number*, and *hand-back object*
- Notification of remote event may **fail** (Exception)
- Remote event registration is **leased**
- **Third party objects** may act as filters/proxies :
  - Store-and-forward agents (offload generator object)
  - Notification Filters (offload receivers)
  - Notification Mailboxes (offline receipt)

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Transactions

- Provides **coordination mechanism** (API) for performing a distributed two-phase commit
- No monitors: **objects responsible** for correct implementation
- Transaction created and overseen by *manager*
- Semantics represented by *semantic objects*
- Default action semantics preserve *atomicity, consistency, isolation, and durability*

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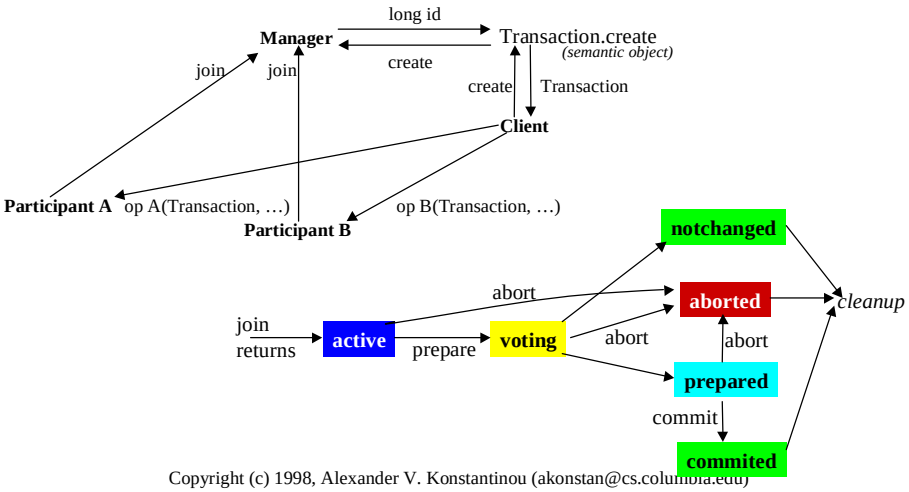
Transactions (cont.)



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JavaSpaces

- Distributed algorithms as **flows of objects**
- JavaSpaces implementations provide reliable distributed **storage** for objects
- JavaSpaces store **Entries** with public fields
- Field **lookup** is exact match or don't care
- Operations : *write*, *read*, *take*, *notify*
- Entries written into JavaSpace are leased
- Operations may be part of distributed transaction

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Open Issues

- Network infrastructure : DHCP, Multicast
- Schema standardization/evolution
- Embedded Java future
- Adoption by device manufacturers
- Jini v.s. directory-based approaches

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Summary

- Jini challenges the predominant (PC) network and computer architecture.
- Killer App ?
  - Home network
  - Mobile computing : navigating both local & home-base environment
  - Robust computing : service (object) redundancy
- Programming model may survive independently
- Mirror worlds ?

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Companies & References

Aplix, Axis, Canon, Computer Associates, Datek, Encanto, Epson, Ericsson, FedEx, Mitsubishi, Network Objects, Norwest Mortgae, Novell, Object Design, Oki, Quantum, Salomon Brothers, Seagate, Siemens, Toshiba.

http://java.sun.com/products/jini

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