



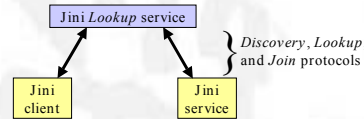
A Lightweight Proxy for Connecting Low-power and Legacy Devices to Jini Networks

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Jini overview

- Java-based *lingua franca* for composable network services
- Dynamically distributed system
- Common language and implementation
- Services register with *Lookup* service
- *Discovery* and *Join* protocols facilitate connections to lookup service

Jini communication



Jini limitations

- Jini requirements
 - TCP/IP, multicast, and Java RMI
 - Java2 virtual machine
- Precluded technologies
 - IEEE 1394, Bluetooth, USB, IrDA, X-10, Sony S-Link
 - PIC processor, Palm Pilot, Windows CE, embedded systems (e.g. JetDirect print servers)

Motivation

- Many legacy devices **can't** participate
 - Architectures without a JVM
 - Devices not connected to a TCP/IP network
- Other devices may **choose** not to participate
 - Devices with limited bandwidth
 - Low-power devices
 - Highly mobile devices

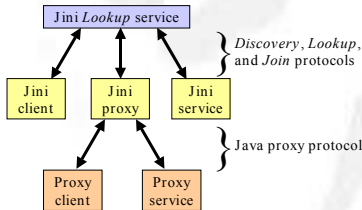
Proxy architecture

- Proxy server periodically announces its availability via multicast
- Soft-state: proxies are issued a lease which must be regularly renewed
- Disconnected operation: proxies request to run for an extended, non-renewable length of time

Proxy architecture continued

- Each proxy runs in a separate thread with a restricted class loader
- Proxy classes are loaded from a proxy-specified URL or an uploaded JAR file
- Restricted security permissions granted to remote objects

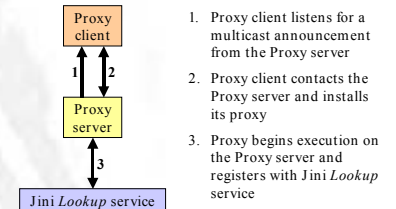
Jini proxy communication



Proxy protocol messages

- Multicast announcement
 - `jpp://ginkgo.cs.washington.edu:4550 1.0`
- Service installation requests
 - `JPP/1.0 INSTALL <CODE> INIT <STRING> FROM <URL>`
 - `JPP/1.0 INSTALL <CODE> FROM DATA LIMIT <TIME>`
 - `<SERVICE ID>` and response returned to client
- Service management requests
 - `JPP/1.0 RENEW <SERVICE ID>`
 - `JPP/1.0 RELEASE <SERVICE ID>`

Proxy Deployment



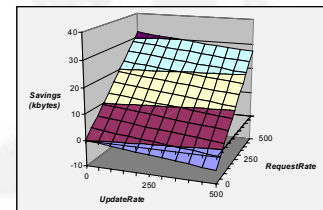
Application: Jini/X-10 bridge

- HTTP/CGI interface to X-10 devices via Hydra web server
- Proxy implements Jini **LampController** and X-10 CGI interfaces
- Proxy installed and managed by Hydra web server
- Client code less than 1,200 lines long
 - JVM + Jini code is more than 60,000 lines

Application: Load sensor

- Sensor installs proxy, which registers itself as a Jini service
- Changes in sensor values are pushed to the proxy
- Proxy could aggregate data from multiple sensors
- Bandwidth savings depend on the size of update and query messages

Bandwidth savings



Application: Publisher proxy

- Format and publish documents in a disconnected mode
- Clients upload a JAR file containing proxy code and unformatted document
- Reduced bandwidth
 - 120,000 bytes vs. 3,000 bytes
- Reduced computation
 - 1.8 sec vs. 0.7 sec of user + system time

Conclusions

- JPS effectively connects legacy architectures to Jini networks
 - Lightweight protocol
 - Low implementation overhead
- Potential benefits for low-power devices
 - Reduced bandwidth and computation
 - Must be considered on a case-by-case basis
- Potential applications beyond Jini