JINI: A Technology for 21st Century
Is it Ready for Prime Time?

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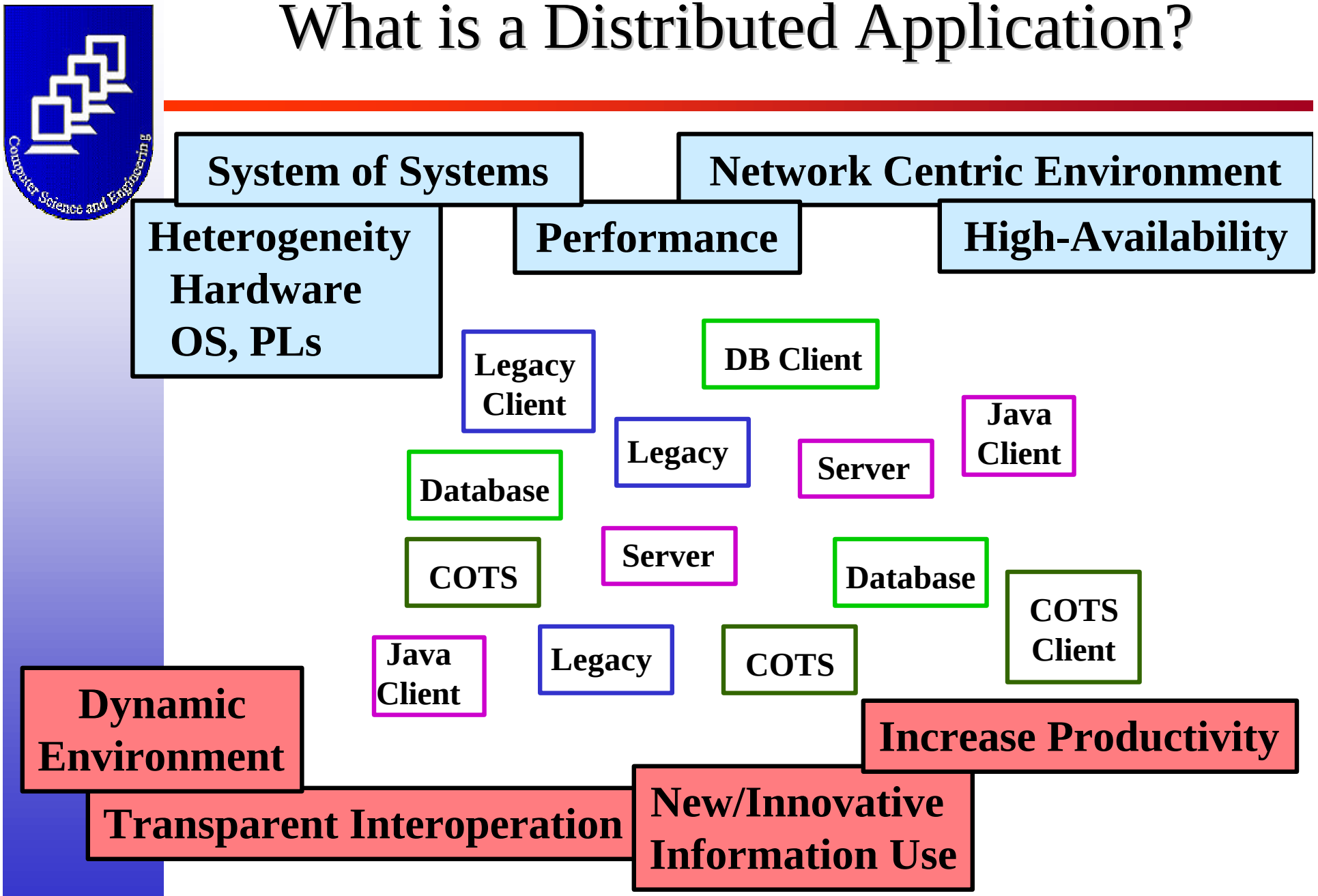
What is a Distributed Application?



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Goals of Research Effort

- Can JINI Support **Highly-Available Distributed Applications**?
- Can JINI Support a Network-Centric Environment with **Dynamic Clients and Services**?
- Will Clients Continue to Operate Effectively if **Replicated Databases Services Fail**?
- Can JINI be Utilized to **Maintain "minutes-off" Data Consistency** of Replicas?
- Is JINI Easy to Learn and Use?
- What is Maturity Level of JINI Technology?
- **Is JINI Ready for Prime Time???**

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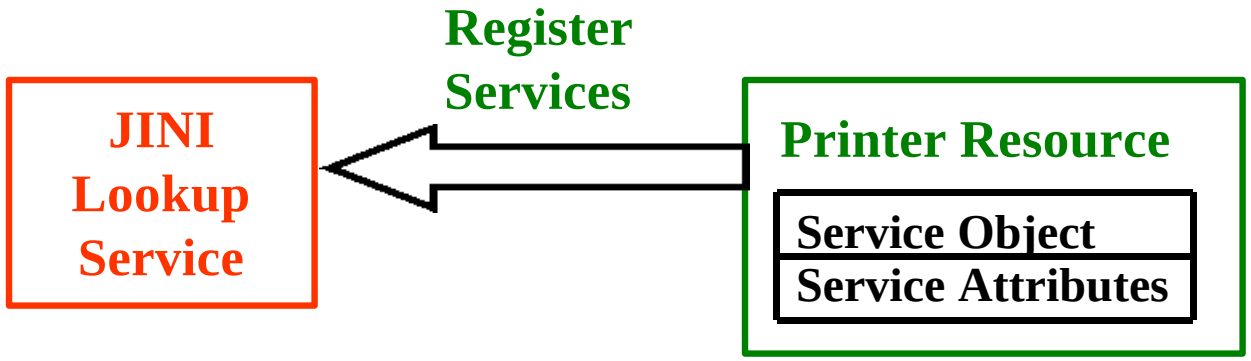
Sun's JINI Technology
Key JINI Concepts and Terms

- A ***Resource*** Provides a Set of Services for Use by Clients (Users) and Other Resources (Services)
- A ***Service*** is Similar to a Public Method
  - Exportable - Analogous to API
  - Any Entity Utilized by Person or Program
  - Samples Include:
    - Computation, Persistent Store, Comm. Channel
    - Software Filter, Real-Time Data Source
    - Sensor or Probe, Hardware (Printer, Display, etc.)
    - **Anything that is Relevant for Your Domain!**
- Services Register with ***Lookup Service***
  - **Clearinghouse** for Resources to Register Services and Clients to Locate Services

Sun's JINI Technology Resources & Services



- Sun's Initial Perspective
  - JINI for Hardware
  - Printers, Digital Cameras, etc.
  - Plug-and-Play on Network
- Services Registered
  - Class by Class Basis
  - Granularity up to SWE

Class and Methods Define Services to be Registered

PrinterActions Class
- **enqueuePrintJob**
- **dequeuePrintJob**
- **getPrinterStatus**
- **getPrinterType**
- **installPrinter**
- **removePrinter**
- **startJob**
- **cancelJob**

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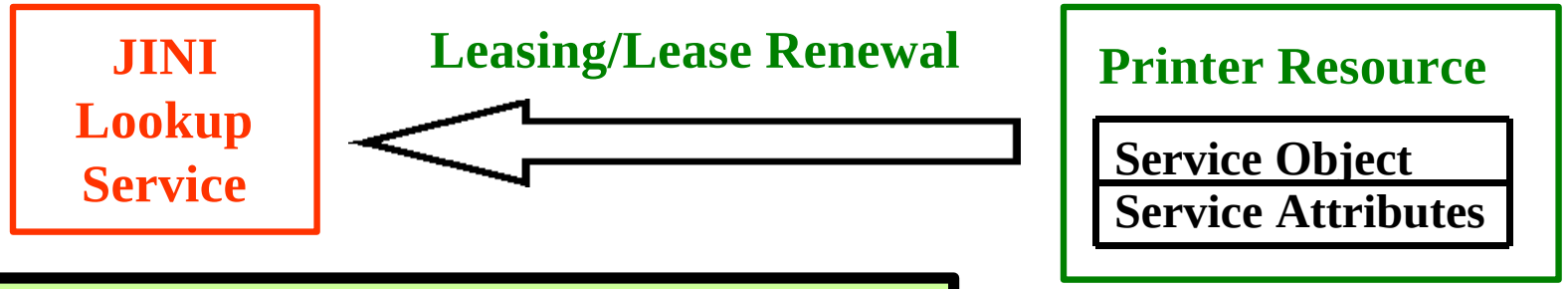
Sun's JINI Technology Registration & Leasing

- FOREVER or EXPIRATION DATE (millisecs)
- Renewal Must Occur Prior to Expiration
- JINI Provides Lease Renewal Manager to Allow Resource to Delegate Renewal Responsibility

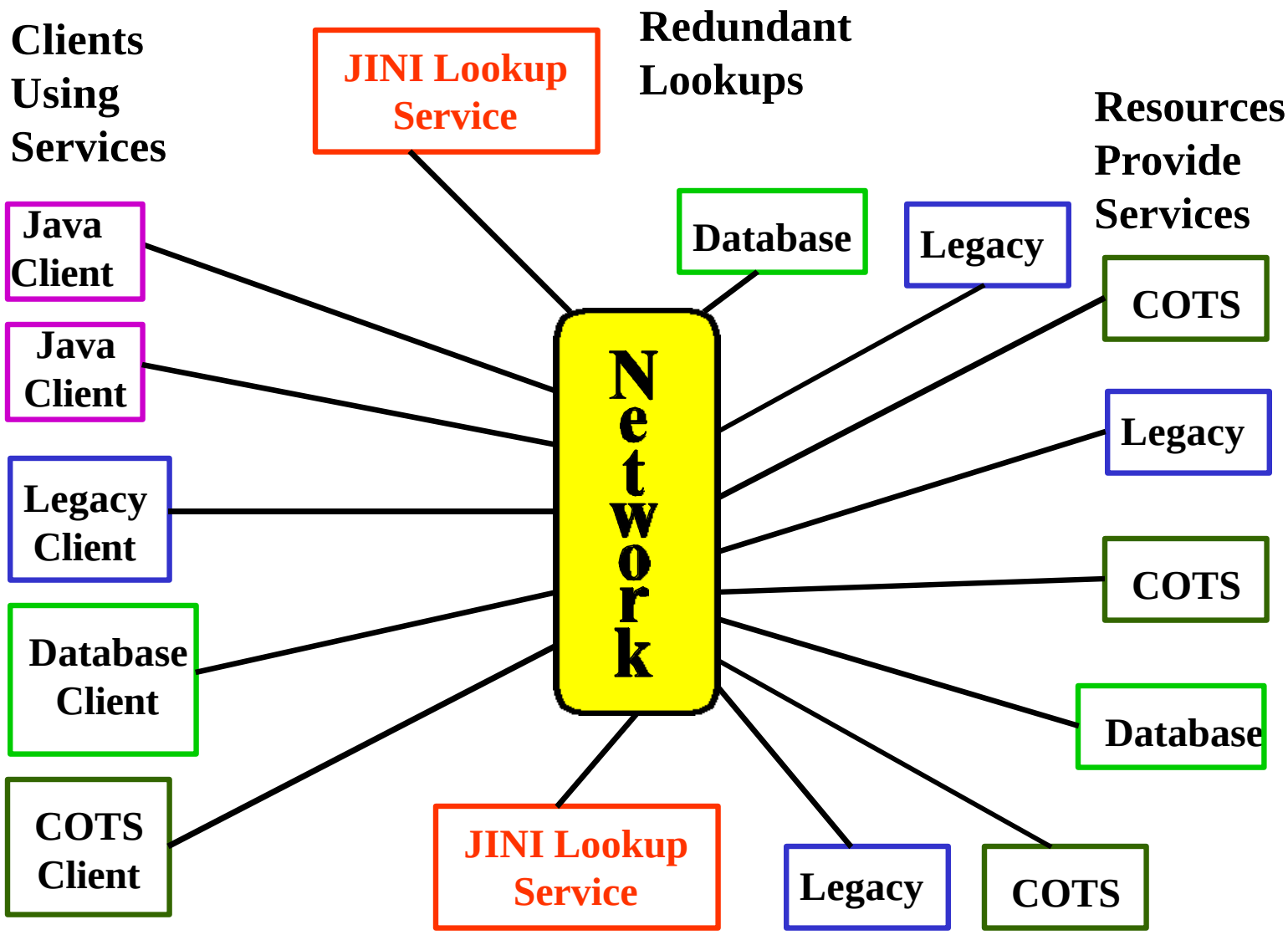


Lease for 5 minutes (3000000 msec)
Must Renew Before 5 Minutes Expire
If Not Renewed, Lookup Removes
If Failure, Lookup May Still Supply Service Until Expiration (5 mins)
Client MUST be SMART!

Class and Methods Define Services to be Registered

- PrinterActions Class
  - enqueuePrintJob
  - dequeuePrintJob
  - getPrinterStatus
  - getPrinterType
  - installPrinter
  - removePrinter
  - startJob
  - cancelJob

Sun's JINI Technology Support for Distributed Computing



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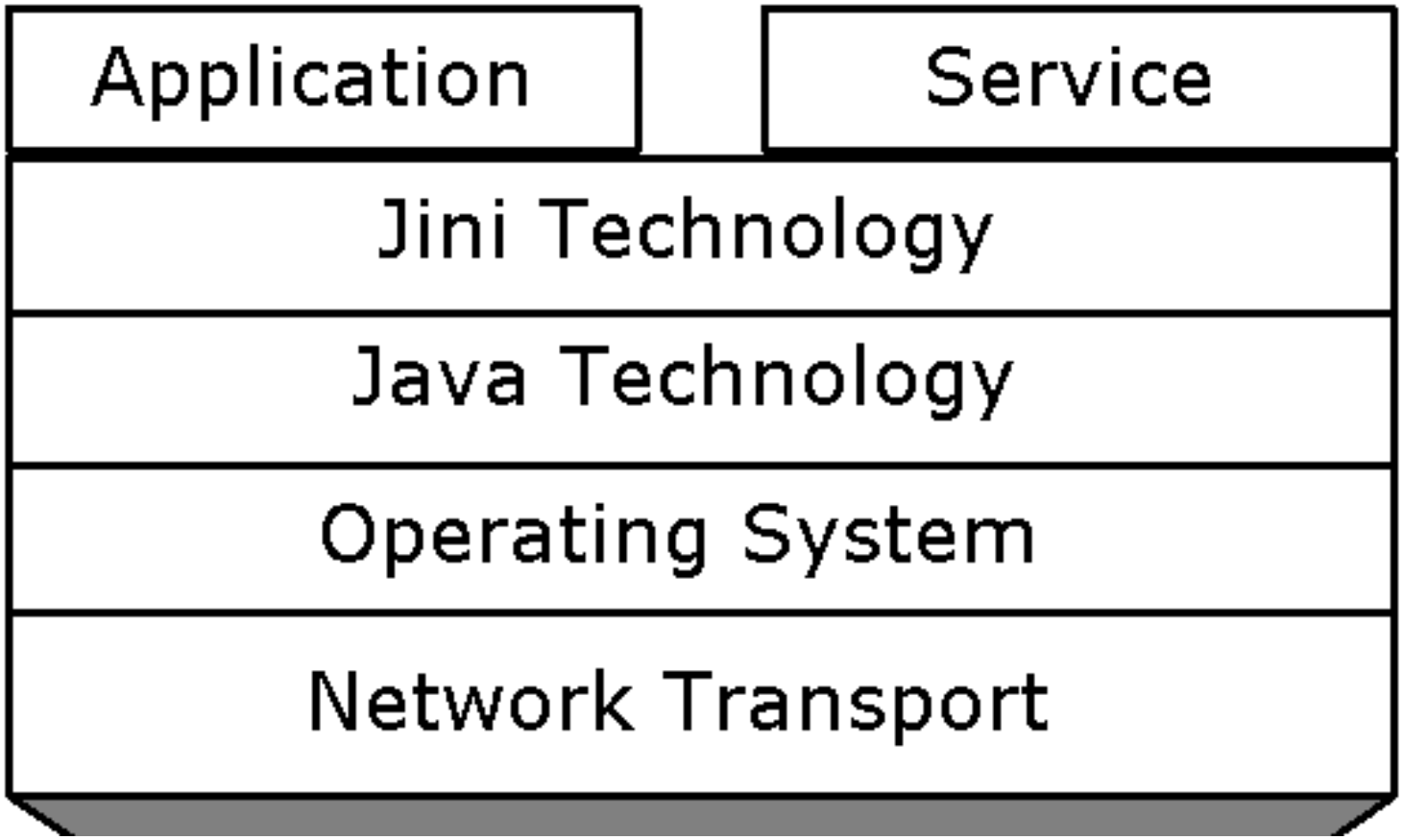
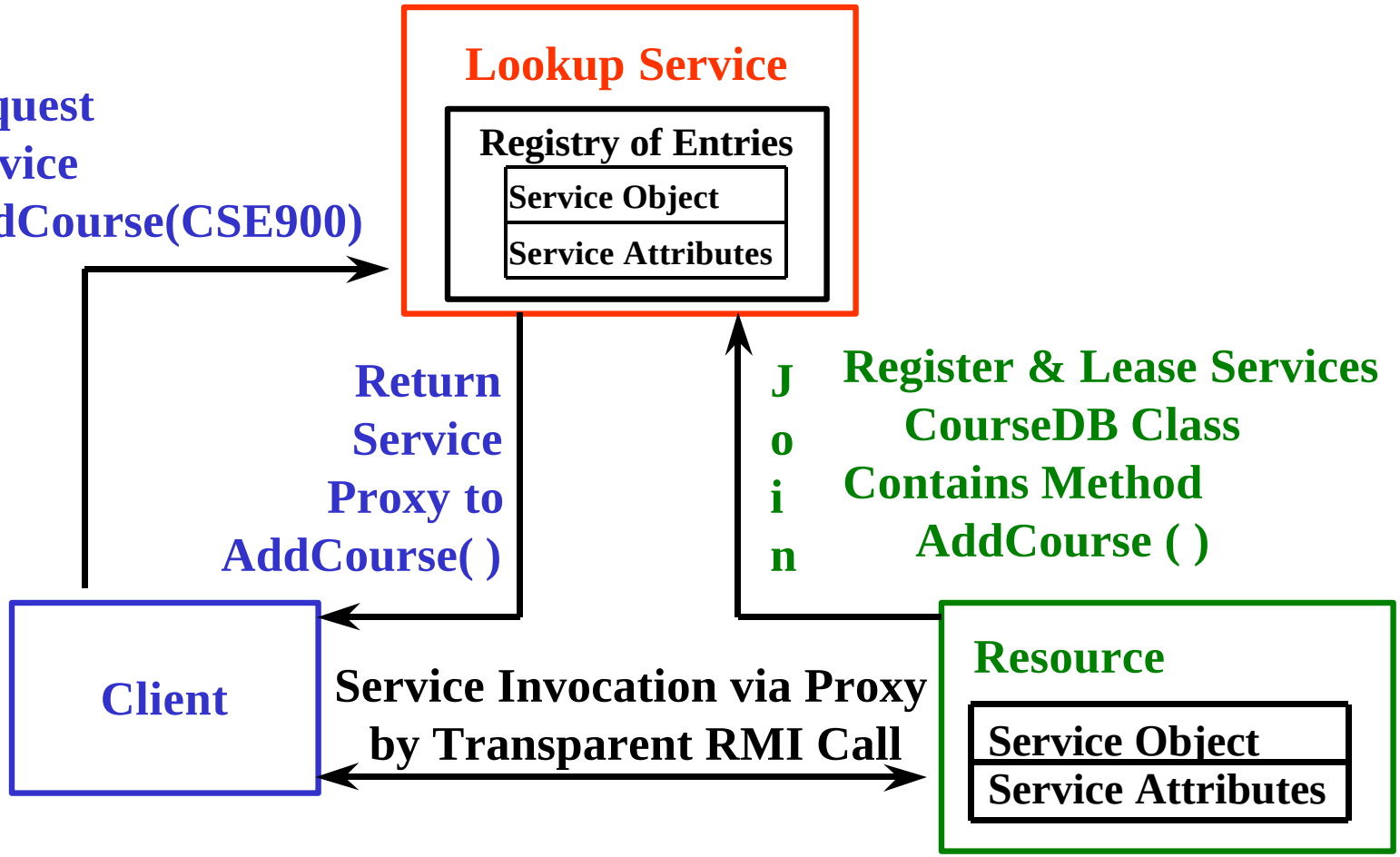
Sun's JINI Technology Overall Computing Architecture and JINI.



Sun's JINI Technology
Join, Lookup, and Service Invocation



1. Client Invokes AddCourse(CSE900) on Resource
2. Resource Returns Status of Invocation

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Experimental Prototyping Effort Goals and Objectives

- High Availability of Services and Data
- Volatility of Resources, Clients, and Network
- Clients Rely on Lookup Service to Locate and Execute Services Against Replicated Resources
  - Databases Replicated in Multiple Workstations
  - Redundant Services Available if Failure
  - “Minutes-Off” Allowed - Sync Over Time
  - No Lost Updates During Modification Process
- **Characteristics of Enterprise Applications**
  - **Movement of Clients/Reconfigure Networks**
  - **Need for Data Availability on Demand**
  - **Receive “Current” Data if Client/Resource Plugs Back In**

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Experimental Prototypes Rapid, Incremental Design/Development

- First Prototype: Explore JINI and Develop Baseline University Application: Single Computer
- Second Prototype:Client and Services Spread to Two Computers: Lookup with Database Services
- Third Prototype: Extend Second to Multiple Clients and Three Computers
- Fourth and Fifth Prototypes
  - Single Client, Three Replicated Databases
  - **Testing of Replica Failures on Application**
  - Fifth: Multiple Clients/**Simultaneous Updates**
- **Sixth Prototype: Extends Fifth PT with Pre-Lookup Services for Locking During Updates**
- Six Prototypes in Six Weeks by 2 Grad Students

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Prototype Six

- Functionality:
  - Incorporate Pre-Lookup Service that Insures Only One Client Updates Replicas
  - Use a Exclusive Write/Simultaneous Reads Protocol
  - Client Interacts with Pre-Lookup Service to “Request” Locks
  - Client Then Asks Lookup Service for Services
  - Client Receives and Updates All Replicas
- Purpose:
  - Bootstrap: Use JINI to Solve Update Problem
  - Eliminate Consistency Problems Across Replicas by Locking Databases During Update

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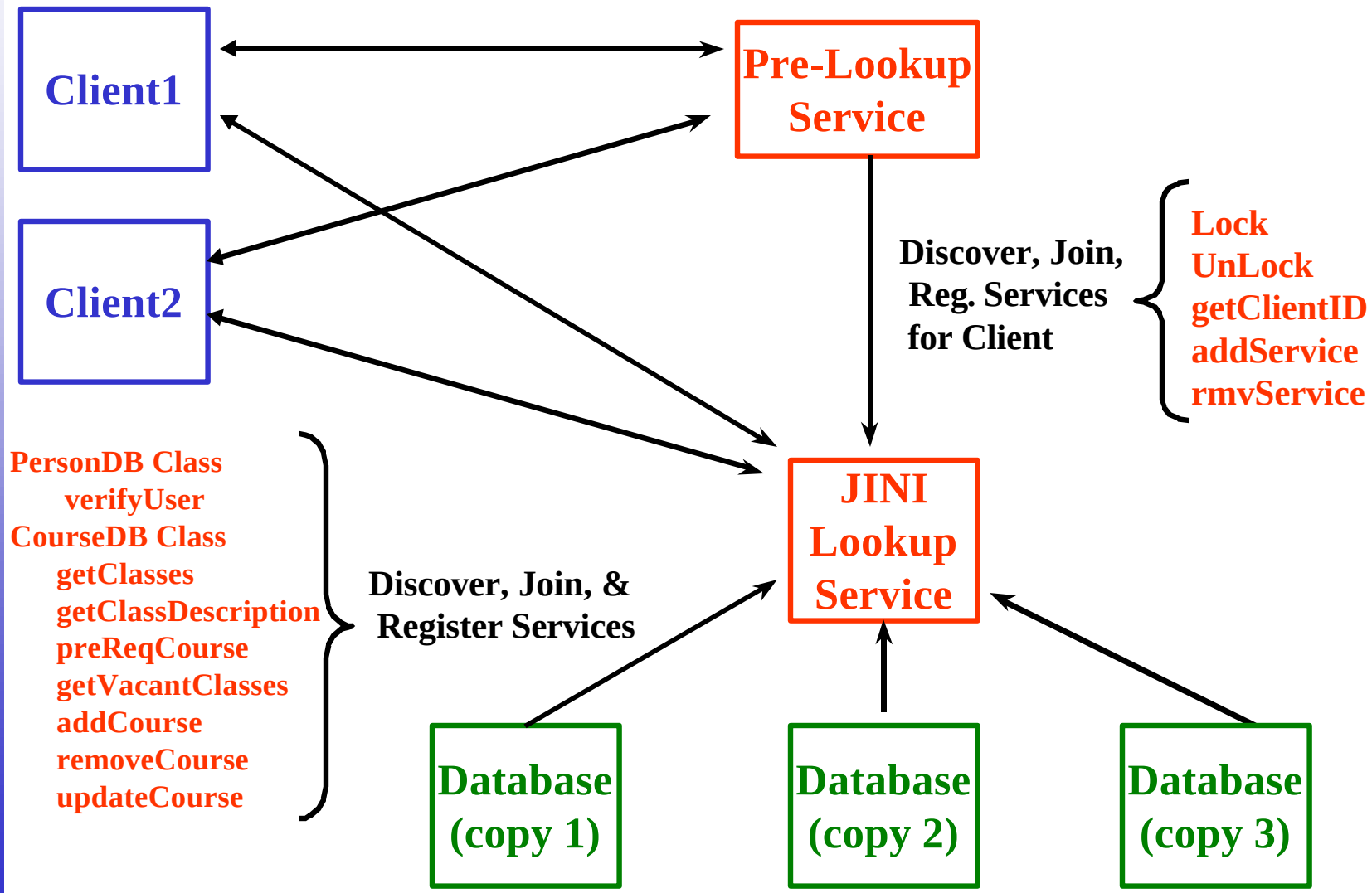
Services in Prototype Six



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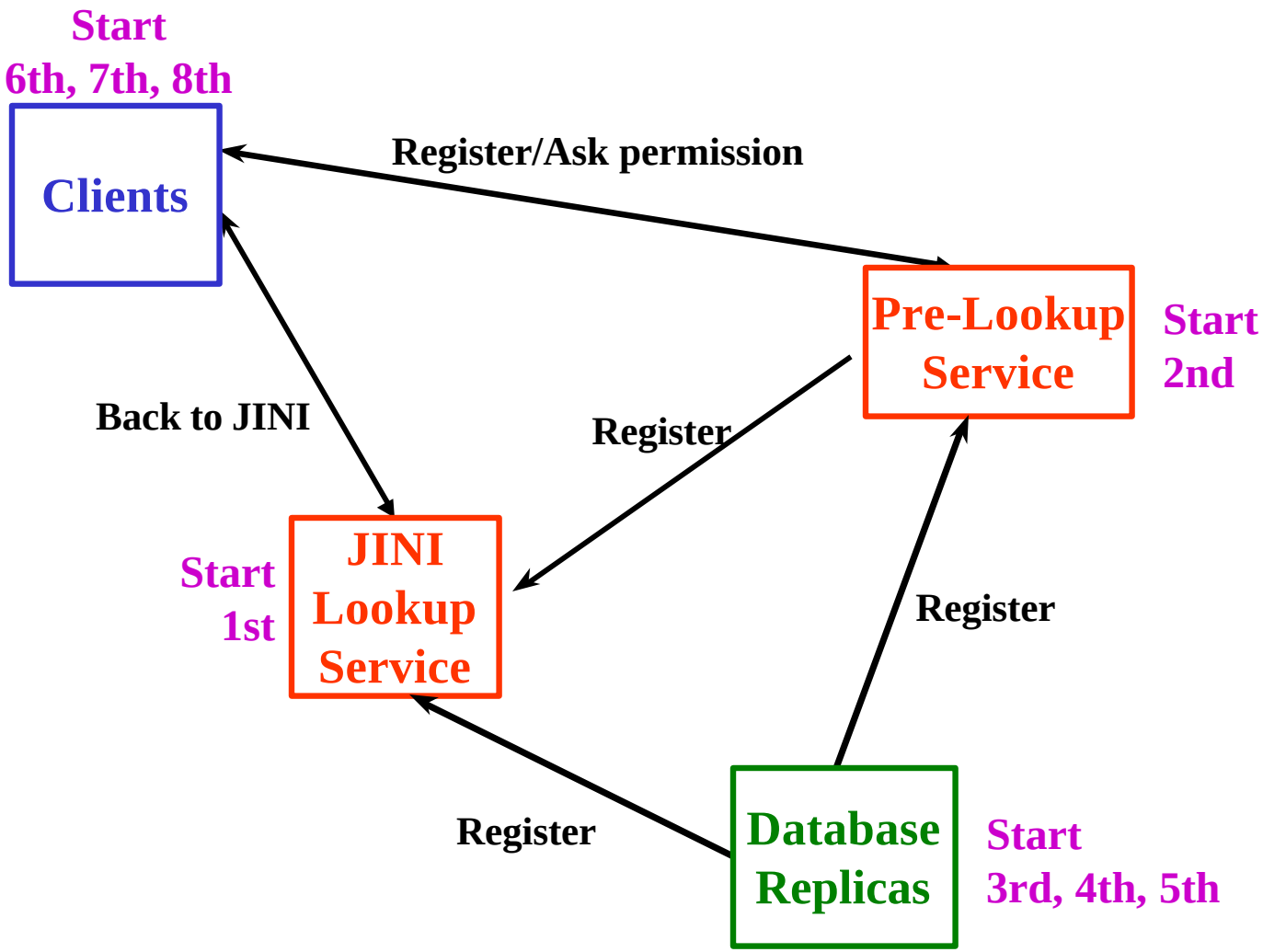
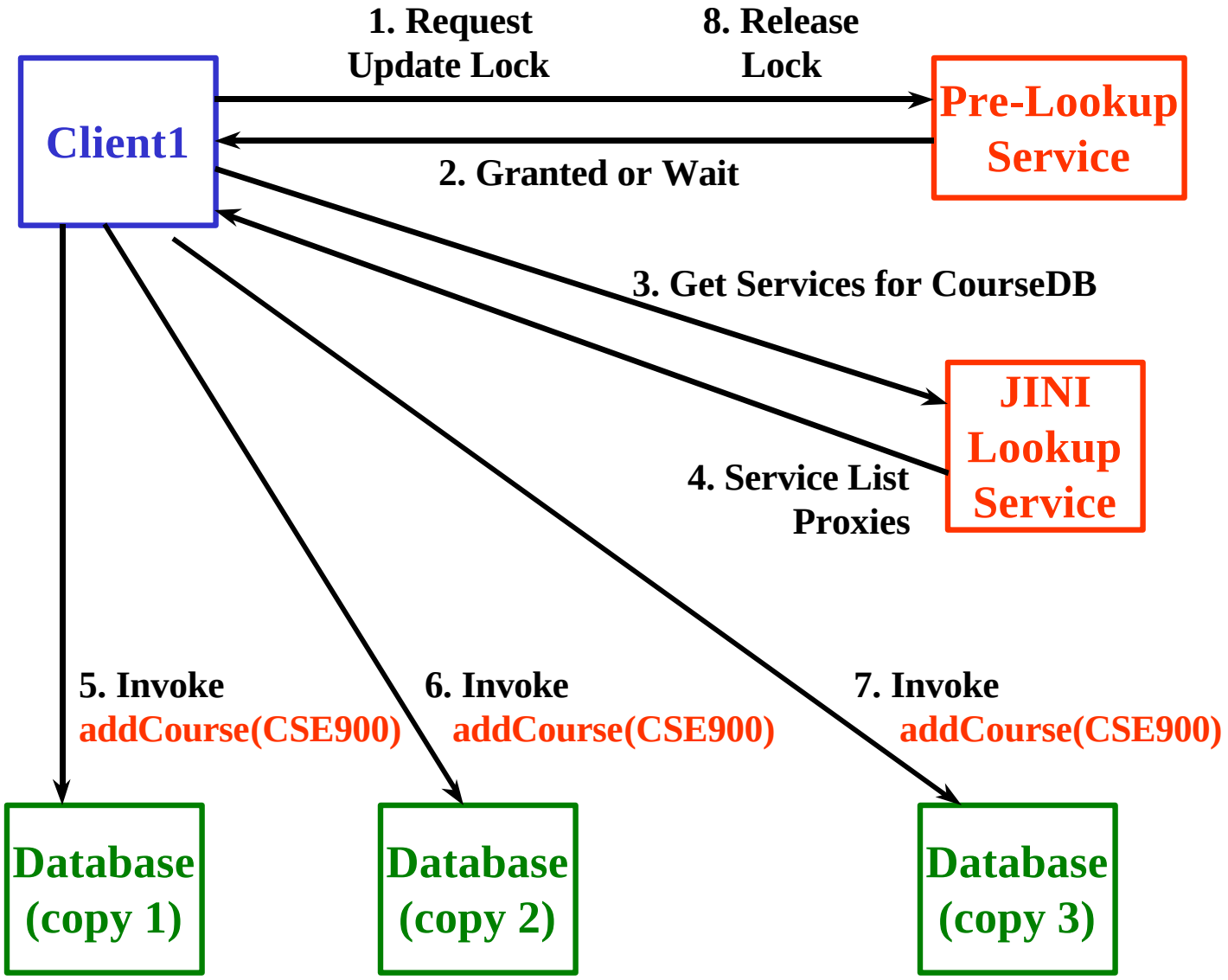
Order to Start Application



Execution Process in Prototype Six



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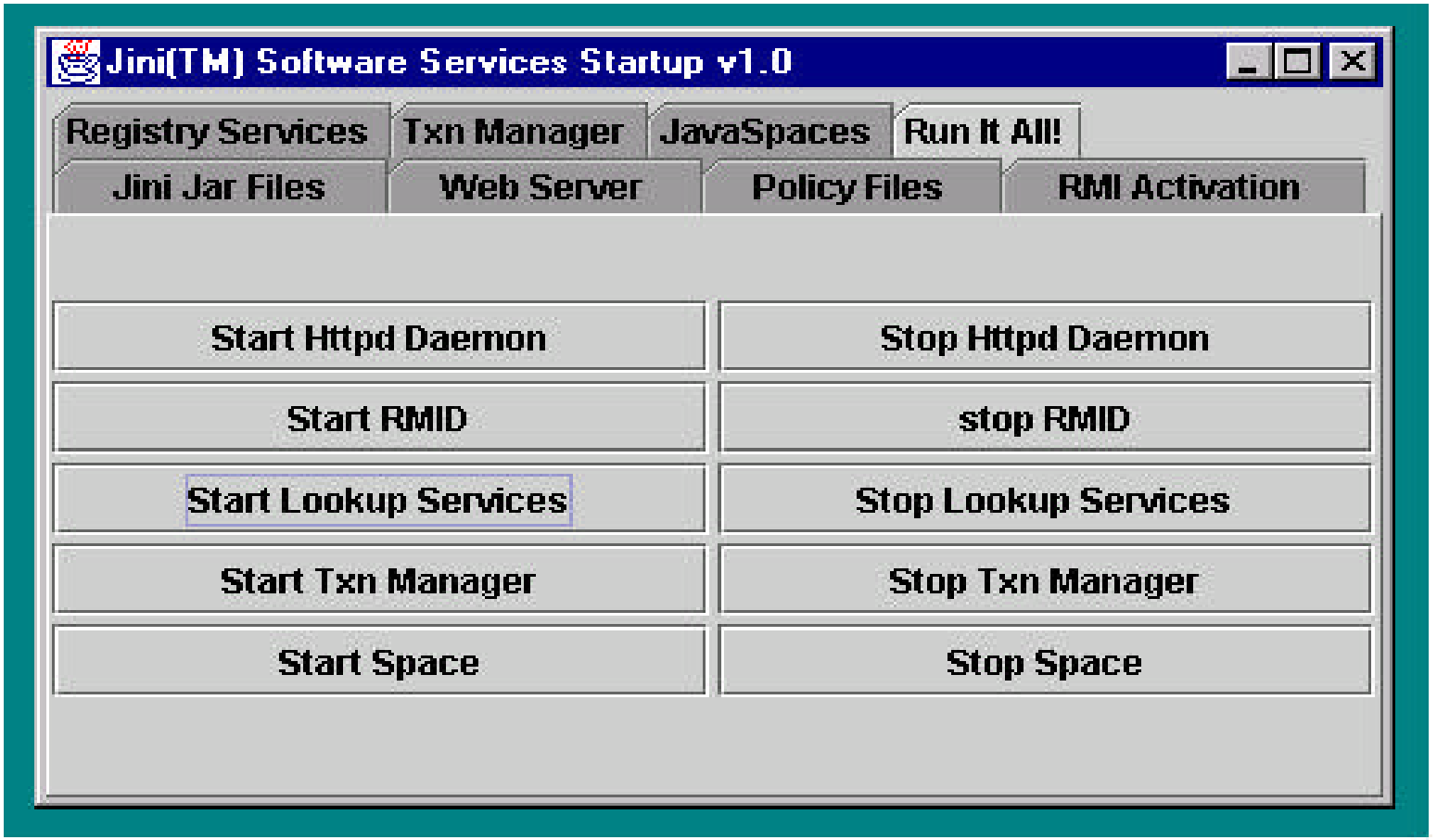
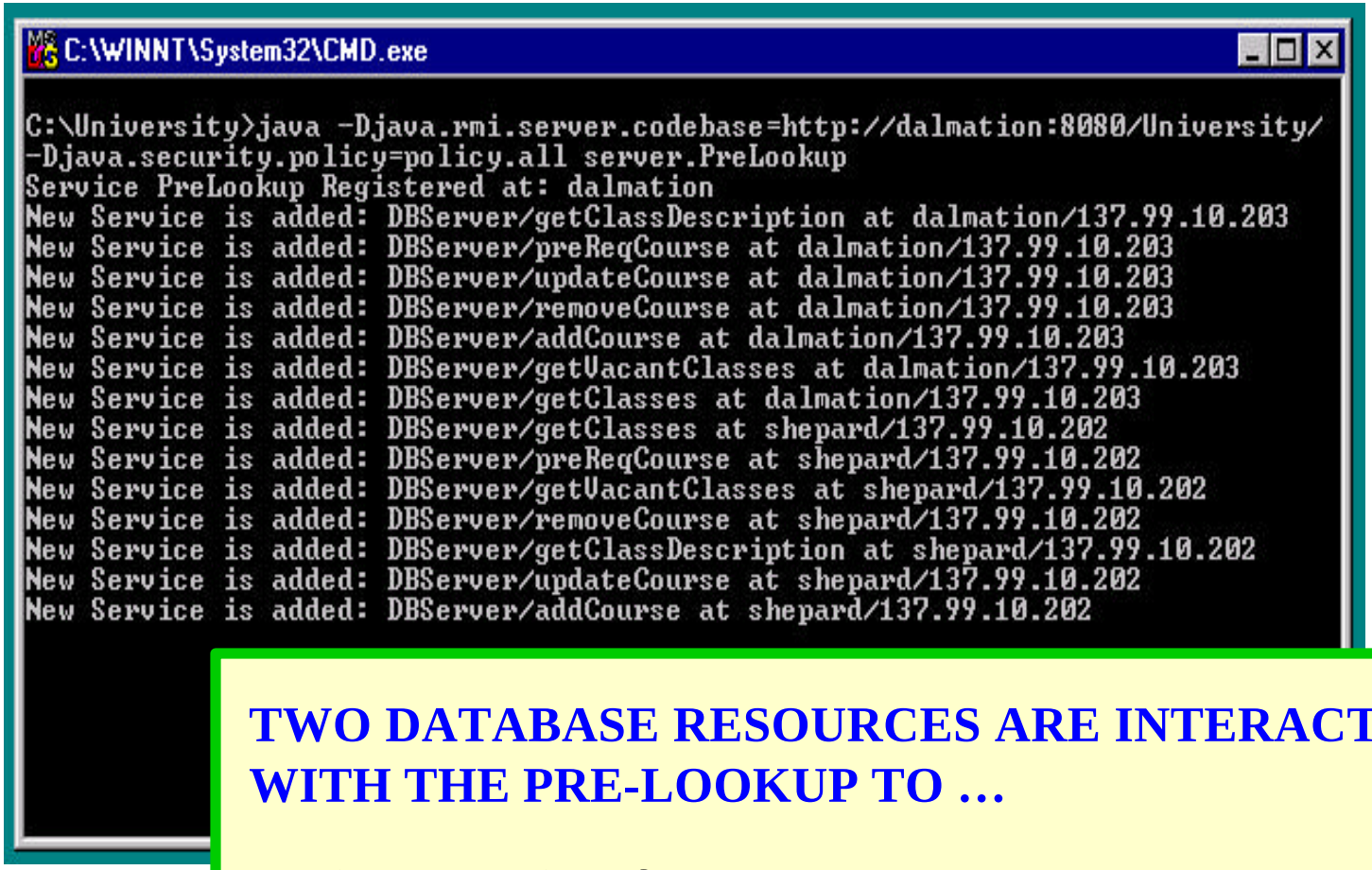
Services GUI



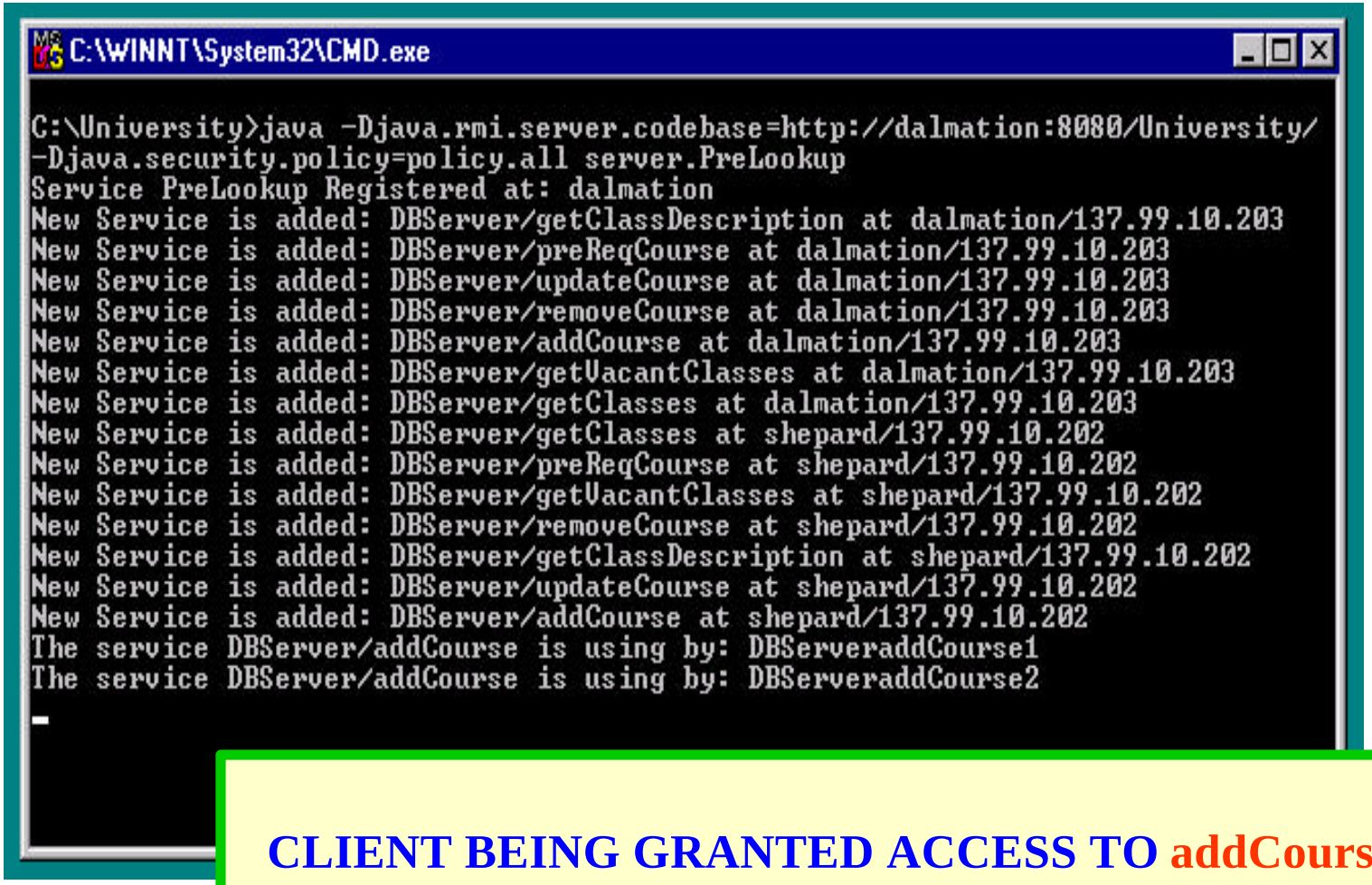
Pre-Lookup when Two Replicated Database Resources Register



TWO DATABASE RESOURCES ARE INTERACTING WITH THE PRE-LOOKUP TO …

Register Services from DALMATION & SHEPARD:
getClassDescription, preReqCourse, updateCourse, removeCourse, addCourse, getVacantClasses, getClasses

Pre-Lookup when Client Invokes "addCourse" Service



CLIENT BEING GRANTED ACCESS TO addCourse SERVICE ON DALMATION & SHEPARD

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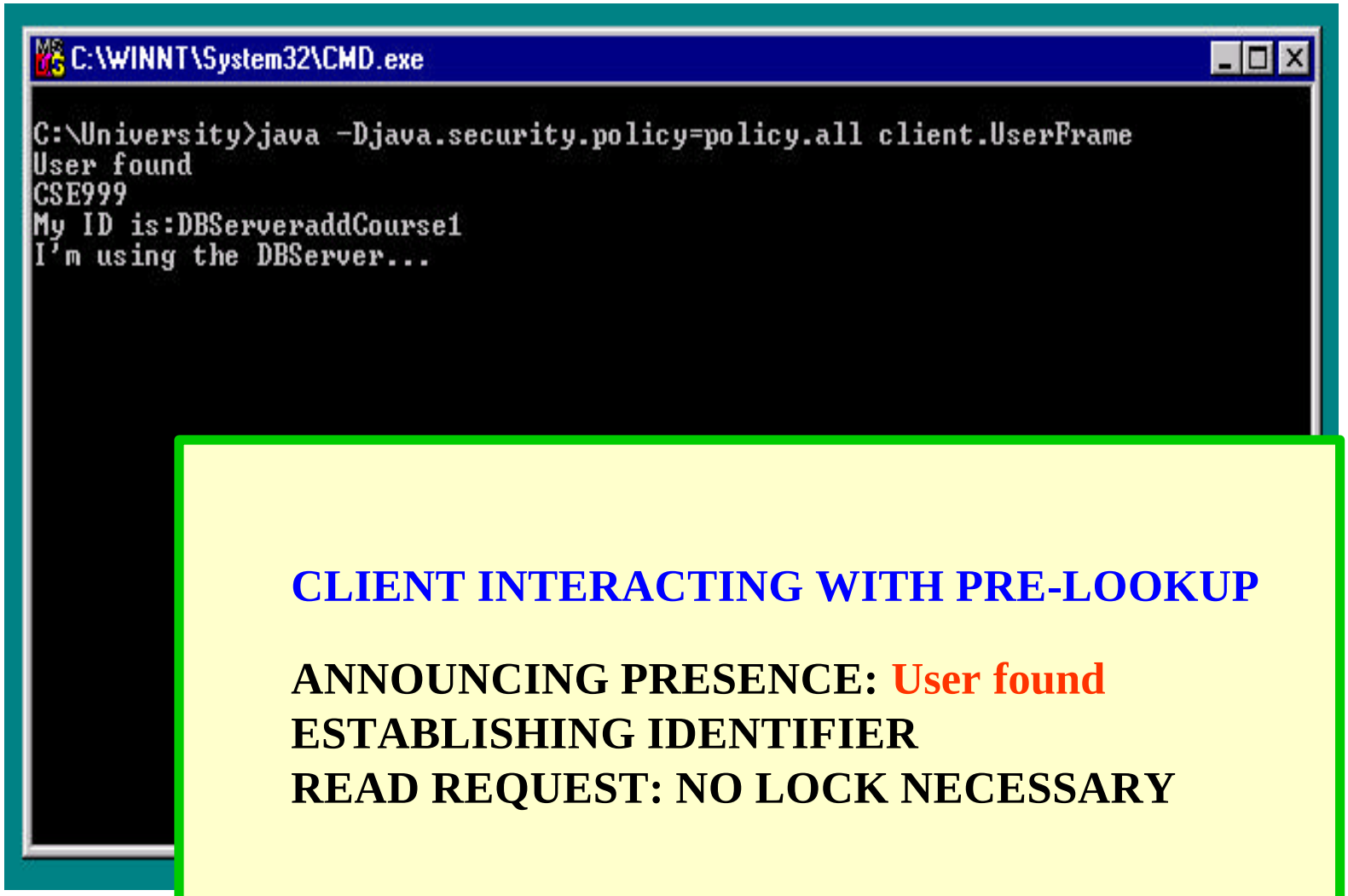
Client Passed Through Pre-Lookup



CLIENT INTERACTING WITH PRE-LOOKUP

ANNOUNCING PRESENCE: User found
ESTABLISHING IDENTIFIER
READ REQUEST: NO LOCK NECESSARY

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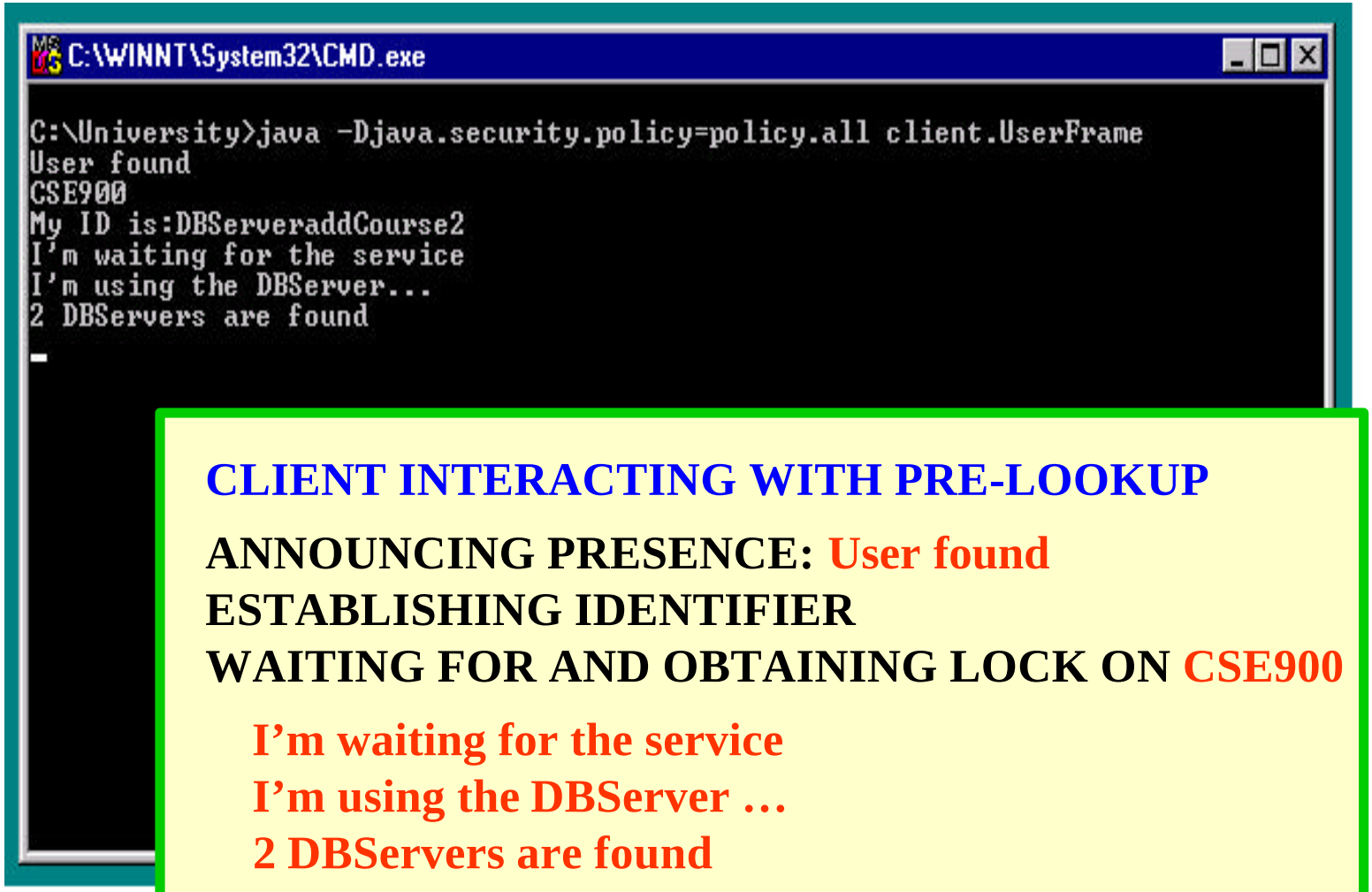
Client Locked by Pre-Lookup



CLIENT INTERACTING WITH PRE-LOOKUP

ANNOUNCING PRESENCE: User found
ESTABLISHING IDENTIFIER
WAITING FOR AND OBTAINING LOCK ON CSE900

I'm waiting for the service
I'm using the DBServer …
2 DBServers are found

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Results from Prototype Six

- Achievements:
  - **Any** Number of Clients Can Do the **Read** Operation on the Database
  - Only **One** Client Can **Modify** a Replicated Database Resource at a Given Point of Time
  - Pre-Lookup Service Can be Modified to Support other Locking Protocols
- Drawbacks:
  - **Can't Force Stakeholders to Consult Pre-Lookup Service - Rely on SW Practice**
  - No Redundant Lookup/Pre-Lookup Services
  - Failure of Lookup/Pre-Lookup - Total Restart
  - **No Logging and Recovery When Replicated Server Application Fails and is Restarted**

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Experimental Prototyping Effort Future Work Possibilities

- **Verification of Write-Once-Run Anywhere**
  - Extend to Win95, 98, NT, Solaris, and Other Databases (Sybase, Oracle, …)
  - **CRITICAL for Comprehensive Evaluation of JINI's Readiness for 21st Century!**
- **Explore Other JINI Capabilities**
  - Transactions/Two-Phase Commit and JINI Security Model for Granting/Denial of Services
  - **Response, Consistency, Authorization**
- **Software Agents and JINI**
  - Ongoing Project this Semester
  - **Can Technologies Work Together?**
- **Others Include (JavaSpaces, Performance, …)**

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Conclusions and Recommendations
Revisiting Goals of Research Effort

- Can JINI Support **Highly-Available Distributed Applications**?
  - PTs 4, 5 and 6 Demonstrate Ability to Architect Highly Available Solutions via JINI
- Can JINI Support an Environment with **Dynamic Clients and Replicated Services**?
  Will Clients Continue to Operate Effectively if **Replicated Databases Services Fail**?
  - Yes, PTs 4, 5, 6 All Support Starting and Stopping of Clients and Database Resources
- Can JINI be Utilized to **Maintain "minutes-off" Data Consistency** of Replicas?
  - PT 6 Superior Due to Pre-Lookup Service Guarantee of No Lost Updates

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Conclusions and Recommendations
Is JINI Ready for Prime Time???

- **Compatibility of JINI with Java**
  - Homogeneity of JINI and Java Unlike ORBs and IDL which are Heterogeneous
  - **But - Verify Across Heterogeneous HW/SW**
- **Track Record of Java and Sun**
  - Java's Increasing Dominance in Agents, E-Commerce, EJB, Data Mining, etc.
  - **But - Incompatibility of Java Releases and Danger of Evolving Technologies**
- **Understandability and Ease of Use of JINI**
  - 400 Hours Total for Obtaining Familiarity with JINI, Visual Café, JDBC/ODBC, 6 PTs, etc.
  - Faster Speed Up w.r.t. CORBA/ORB

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Conclusions and Recommendations
Important Caveats

- **Future Work Clearly Indicates that More Effort is Required to Tilt Scales Toward JINI**
  - Work Extensive w.r.t. JINI Technologies
  - Potential Role of JavaSpaces
- **Experiences on Whole Positive**
  - Leasing Issues Need to be Explored
  - Impact of Registry Currency on Clients
- **Continued Evolution of JINI Specification**
  - Will JINI 1.1 be Compatible with JINI 1.0?
  - Java has Had Compatibility Problems in Past (Deprecated APIs)
- **Conclusion: JINI Great Promise as a Successful Technology in 21st Century!**