Service-orientation and Jini

Strengths and Obstacles

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Motivation

- The JGrid project
  - Investigate whether Jini could help Grid Computing
  - Produced interesting results and services
- Not much interest within the grid community
  - Why?
  - Have we got something wrong?
  - Is it to do with service-orientation?
  - Is it about Jini?
Central problems

- Large-scale computations
- Heterogeneous platform
- Faults -> reliability, availability
- Security
- Assumptions
  - New problems require new techniques
  - Service-oriented approach

<table>
<thead>
<tr>
<th>availability</th>
<th>downtime a year</th>
</tr>
</thead>
<tbody>
<tr>
<td>99%</td>
<td>3.65 days</td>
</tr>
<tr>
<td>99.9%</td>
<td>8.76 hours</td>
</tr>
<tr>
<td>99.99%</td>
<td>52.56 minutes</td>
</tr>
<tr>
<td>99.999%</td>
<td>5.256 minutes</td>
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</tbody>
</table>
Service-orientation

- Perhaps Jini is not the “right” type of service orientation?
- What is a service? Sample definitions:
  - “A service is a unit of work done by a service provider to achieve desired end results for a service consumer.” [http://webservices.xml.com]
  - “A computing service specifies a collection of operations whose execution can be triggered by inputs from service users or the passage of time.” [F. Cristian, Understanding Fault-Tolerant Distributed Systems]
  - “Services are what you connect together using Web Services. A service is the endpoint of a connection.” [http://www.service-architecture.com]
Service-orientation cont’d

- “A service is a set of actions that form a coherent whole from the point of view of service providers and service requesters.” [http://www.w3.org/TR/2003/WD-ws-arch-20030808/]
- “A service is functionality that must be specified in the business context and in terms of contracts between the provider [...] and its consumers. Implementation details should not be revealed. [...] A software service is a type of service that is implemented by software and that offers one or more operations.” [Paul Allen, Service Orientation, Cambridge Univ. Press]
- “A service is an entity that can be used by a person, a program, or another service. A service may be a computation, storage, a communication channel to another user, a software filter, a hardware device, or another user.” [The Jini Architecture Specification]
- **Conclusion:** a service is functionality, behaviour
Web Services

- Let there be XML and SOAP
- In search of standards and protocols
  - Solving the heterogeneity, coupling, scalability, etc., etc. problems!?
- RPC style invocation in the beginning
- Move towards document-oriented (?) model
  - Passing of XML-encoded messages (documents)
  - RPC is not suited to data streaming, group communication; blocking, tightly coupled, etc
- Where and what is the service interface then?
Document-oriented Web services

- **Processes**
  - need minimal interfaces: “send”
  - must know messages *a priori*
    - Ontologies, agreed schemas -> protocols
  - Must have **command interpreters**

- **Orchestration, workflow**
  - Very much in fashion
  - But how to provide reliable operation?
    - Deadlocks, message delivery, detection, fault handling, etc.
Distributed System Models

- **Object and Action model**
  - aka: object-oriented systems
  - Objects represent processes, communication via RPC
- **Process and Conversation model**
  - aka: message-oriented systems
  - Communicating sequential processes
  - Communication via message passing
- **Theory tells us they are equivalent (duals)**
  - Lauer and Needham, On the Duality of Operating System Structures
  - Shrivastava, Mancini and Randell, The Duality of Fault-tolerant System Structures
- **We can map from one to the other!**
Common SOA (WS) buzzwords

- Asynchronous
  - No notion of time?
  - Blocking vs non-blocking calls?
- Loosely coupled
  - Blocking vs non-blocking calls?
  - Interface based?
  - Message passing?
- Industry standards based
  - Standards or protocols based?
- Platform and vendor neutral
  - Might be…
Distributed systems issues

- Back to basics
  - Resource sharing
  - Reliability
  - Privacy and security
  - Design tools and techniques (programming model)
  - Distribution and sharing (partitioning system and data)
  - User environment
- Is there a technology that really helps?
Fault tolerance

- Distributed systems are more complex
- Fault tolerance is an issue
- Redundancy is a necessary condition for fault tolerance
- Faults need to be detected -> not always possible
- Masking faults
  - Relies on Exceptions
  - Hierarchical masking
  - Group masking
  - Restart/activation
- Jini gives you
  - Java Exceptions, events, leasing, the LUS and activation
The Big Misunderstanding

- Jini is not RMI!
  - Java supports mobile code
  - Client interacts with smart proxies
  - Using proxies is (almost) local Java
    - Interact locally, transfer control and/or as needed
- Rich choice of implementation and system partitioning options
- Data streaming, more complex communication IS possible
- Not to mention JavaSpaces for coordination, asynchronous messaging, workflow, etc.
Other features

- Security
- Programming model
  - Language and infrastructure support
- Configuration
  - Wide range of deployment, system partitioning options
- User experience
  - Rich clients
  - Alternative user interfaces
Data streaming

- Can represent instruments, data feed
- Weather service
Instant Sharing

- Peer-to-Peer teleconferencing
Other examples

- Media delivery
- Control over remote jobs
- Remote file space
Potential problems

- Technical problems
  - Firewalls, port usage
  - Class versioning
  - Class loading and the required infrastructure
  - Discovery (description, proxies, ServiceUI)
  - Service handles
  - Restricted devices
- Social and business issues
  - Strong technological competition
  - Lack of in-depth knowledge
  - Interoperability requirements, integration
  - Assessing risks
  - Following the crowd effect
- Others?
Conclusions

- Distributed systems is hard, do not pretend it isn’t
- Jini is still misunderstood by many
- Jini is a technology that
  - focuses on the real problems of distributed systems
  - helps creating reliable distributed system by giving the right tools
  - increases our knowledge and understanding of distributed systems
- Other technologies may look more successful but how will they compare?
- These benefits will not be visible until we start building and using **large-scale** service-based environments
- The role of the Community
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