ICENI: A Jini based Grid Middleware for Exploiting federated resources

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Building Computational Communities

• Need to federate resources from real organisations
  – Express ownership and retain control
  – Grid resources are ‘not’ free – accountability / payment!
  – Manage the resources as a single unit
• Computational Communities (a.k.a. Virtual Organisations)
  – Share and combine heterogeneous resources
  – Ensure transparency by hiding complexity from the user
  – Optimise resource utilisation for all jobs and users
  – Easy to contribute (and withdraw) resources
Need Higher Level Knowledge

- **Resources**
  - Availability, capability, environment, access

- **Application**
  - Composition, behaviour, performance

- **User**
  - Who, what, when, where

ICENI

*The Iceni, under Queen Boudicca, united the tribes of South-East England in a revolt against the occupying Roman forces in AD60.*

- IC E-Science Networked Infrastructure
- Developed by Grid Middleware Group
- Collect and provide relevant Grid meta-data
- Use to define and develop higher-level services
Open Extensible Technologies

- XML used to define:
  - Resource, application, user meta-data
  - Protocol between different services in the system
- Java used to construct the framework, run-time representation and interfaces to the assembled components
- Jini used to provide a wide-area transport layer that supports dynamic discovery and join
- Examining SOAP, WSDL, UDDI, .NET etc.

ICENI Architecture
Managing Internal Resources

- The resources advertise their capabilities to a private domain
- Three type of resources:
  - Computational resources
  - Storage resources
  - Software resources
- Annotate using XML

What is a resource?

- Provides a service (i.e. interface) towards the users in the computational community
  - Allows them to connect to it
  - Executes their applications (for the computational resources)
- Set of static and dynamic attributes
ResourceService: basic service

// Defines the interface for a basic resource
public interface ResourceService extends java.rmi.Remote,
   IpcTraceableService {

   // Gets the representation of the resource.
   public ResourceInfo getInfo();

   // Modifies the resource.
   public void modify(ResourceElement oldValue,
                       ResourceElement newValue);

} // end interface ResourceService

ComputationalResourceService

// Defines the interface for a computational resource
public interface ComputationalResourceService extends ResourceService {

   // Executes a job on this resource
   public boolean execute(String plan)
       throws RemoteException;

} // end interface ComputationalResourceService
The service ResourceAP3000

// Implementation of the resource AP3000
public class ResourceAP3000 extends Resource implements ComputationalResourceService {

    public ResourceAP3000() throws RemoteException {
        super();
    } // end ResourceAP3000

    public boolean execute(String plan) throws RemoteException {
        return true;
    } // end execute

} // end class ResourceAP3000

Definition of the resource

<resource name="ap3000"
type="icpc.grid.resources.computational.ResourceAP3000"
publish="jini://ariane.doc.ic.ac.uk/">
    <staticAttribute name="OS" value="Solaris" public="TRUE"
classURL="…" />
    <staticAttribute …/>
    <dynamicAttribute name="queueStatus" public="TRUE"
serviceURL="rmi://cnet0076.doc.ic.ac.uk/getAP3000NQSStatus"
classURL="…" interval="5" property="data/xml/grid/private/queueStatus.prp" />
    <dynamicAttribute …/>
    <connection
        login="data/xml/grid/private/resourceAP3000_login.xml.enc" />
</resource>
The Domain Manager

**Sole route between the private and the public areas of the infrastructure**

- **Private ➔ Public**
  - Imposes local usage requirements and access
  - and publicly advertises its resources

- **Public ➔ Private**
  - Authenticates requests to use the local resources (through the Identity Manager)

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Access to resources

- Recognise three entities: individuals, groups and organisations (or domains)
- Entities verified through public key architecture (Identity Manager)
- Locally managed access control list determine which entities have access to local resources
Who can access the resources and when?

```xml
<domainManager manage="jini://jini.doc.ic.ac.uk/" name="icpc">
  <promote domain="jini://trident.doc.ic.ac.uk/">
    <deny startDay="friday"> <entity type="group" name="ra"/> </deny>
    <allow> <entity type="organisation" name="ICPC"/> </allow>
    <resource name="ap3000">
      <allow> <entity type="person" name="nfurSigned"/> </allow>
    </resource>
  </promote>
  <resource name="atlas"/>
</domainManager>
```

Individuals, Groups & Organisations

```xml
<identificationOrganisation publish="jini://jini.doc.ic.ac.uk/"
  name="ICPC" keystore="/data/security/keystore/keystore.ICPC">
  <group name="ala">
    <user name="aem3Signed"/>
    <user name="asm100Signed"/>
    <user name="nfurSigned"/>
  </group>
  <group name="ra">
    <user name="asm100Signed"/>
    <user name="nfurSigned"/>
  </group>
  <knownOrganisation name="inria"/>
</identificationOrganisation>
```
Interaction with the Computational Community

The Computational Community allows Users & Domain Managers to advertise their capabilities and requirements.

Resources in a Computational Community

- When a resource is available, it is shown with all its public attributes and access policies.
  - It’s possible to get the values of the dynamic attribute(s)
  - It’s possible to connect to the resource (if there is an available connection)
  - The resource can be selected for the execution of an application.
ICENI Architecture

Higher-level Grid Services

- **Application Mapper**
  - Uses resource and application information to optimise resource selection for an application (e.g. are 16 PC processors better than 8 Alpha processors?)

- **Resource Broker**
  - Uses computational economics to balance priorities (e.g. 16 underused PC processors may cost less for longer than 8 over subscribed Alpha processors)
  - Factor queue length into resource selection (e.g. Will a slow unloaded resource provide shorter job turnaround time than a faster but heavily loaded resource?)
Integration with the Grid

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- Further information: http://www.lesc.ic.ac.uk/iceni/
- Contact: lesc@ic.ac.uk
- Slides available at
  http://www.doc.ic.ac.uk/~nfur/GGF4_Iceni.ppt
The PolicyManager GUI

- Marketplace jini://trident.doc
  - Resource ap3000 of type http://jini.doc.ic.ac.uk/icpc.grid.resources.com
  - allow from monday at 00:00 to sunday at 23:59
  - deny from saturday at 00:00 to sunday at 23:59
  - organisation: ICPC
- Marketplace jini://ariane.doc

The Resource Browser GUI

- List of public resources
  - Resource ap3000 in the marketPlace jini://trident.doc ...
  - Resource ap3000 of type http://jini.doc.ic.ac.uk/icpc.grid.resources.com
  - Connection login="data/xml/grid/private/resourceAP3000_login.xml"