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ICENI: A Next Generation Grid Middleware

Delivering e-Science

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London e-Science Centre,
Imperial College London, UK

SC2003, Phoenix AZ, November 2003

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London e-Science Centre 'Enabling the e-Scientist'

- Industrial Collaborations:
 - Sun Centre of Excellence in e-Science
 - Intel Virtual European Centre of Grid Computing
- Cross-campus collaborations:
 - Bioinformatics
 - High Energy Physics
 - Computational Engineering
- Projects:
 - e-Science Portal, Markets for Computational Services
 - OGSA UK Grid, Climate Modelling, Protein Annotation
 - Workflow for Grid Services, Materials Modelling, ...
- Specialisation: Next Generation Grid Middleware

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ICENI: Imperial College e-Science Network Infrastructure

- Integrated Grid Middleware Solution
- Interoperability between architectures, APIs
- Added value layer to other middleware
- Usability: Interactive Grid Workflows
- Deployment: Complete Install from Webstart
- Role and policy driven security
- Foundation for higher-level Services and Autonomous Composition
- ICENI Open Source licence (extended SISSL)

<http://www.lesc.ic.ac.uk/iceni/>
ICENI Release 1.0 available for download

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ICENI Strands

Service Oriented Architecture

Component Programming Model

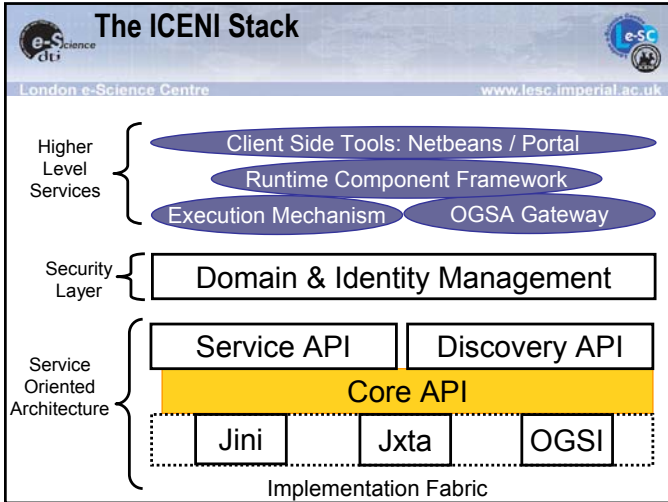
Workflow Guided Scheduling

Role Based Access & Security

Semantic Adaptation

Deployment Usability

ICENI



Focus on Deployment: Installation Mechanism and Control Centre

Client Requirements:

- JRE 1.4.2
- Java Web Start (inc.)
- Internet Access

Focus on Deployment: Installation Mechanism and Control Centre

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- JRE 1.4.2
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- Internet Access

Focus on Deployment: Installation Mechanism and Control Centre



Centralised configuration and service execution

Name	Value
binary.root	http://www.lesc.ic.ac.uk/iceni/downloads
gateway.cert.dir	\$(user.home)/globus/ica
gateway.cert.file	\$(user.home)/globus/host/hostcert.pem
gateway.handler.threads	60
gateway.http.port	8081
gateway.key.file	\$(user.home)/globus/host/hostkey.pem
global	INFO
iceni.console.debug	true
iceni.domain.http.port	9086
iceni.home	/Volumes/wahl/work/iceni-binary
iceni.jini.home	\$(iceni.home)/iceni-services-jini/lib/jini1_2
iceni.jini.policy	\$(iceni.jini.home)/policy/policy.all
iceni.private.domain.jini.http.port	8090
iceni.private.domain.jini.log	\$(iceni.temp)/jini
iceni.private.domain.jini.mahalo.log	\$(iceni.private.domain.jini.log)/mahalo
iceni.private.domain.jini.oort	8091



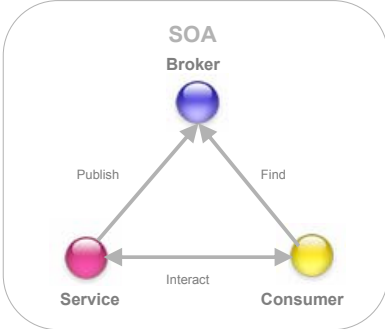

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Architecture Independent Service-Oriented Architecture



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Service Oriented Architecture



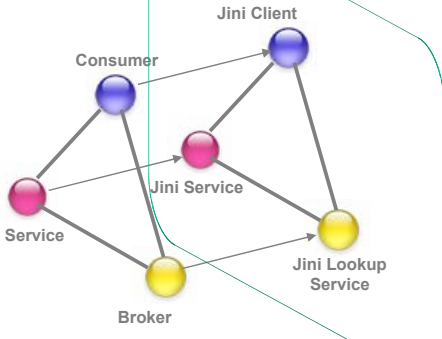
```

graph TD
    S((Service)) -- Publish --> B((SOA Broker))
    B -- Find --> C((Consumer))
    C -- Interact --> S
  
```



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Realisation of the Service Oriented Architecture with JINI



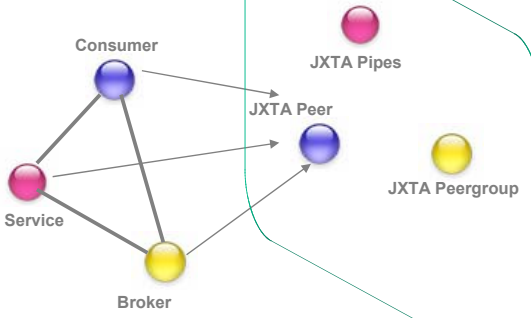
```

graph LR
    subgraph SOA
        C((Consumer))
        S((Service))
        B((Broker))
    end
    subgraph JINI
        JC((Jini Client))
        JS((Jini Service))
        JLS((Jini Lookup Service))
    end
    C --> JC
    S --> JS
    B --> JLS
    JC --> JS
    JS --> JLS
  
```

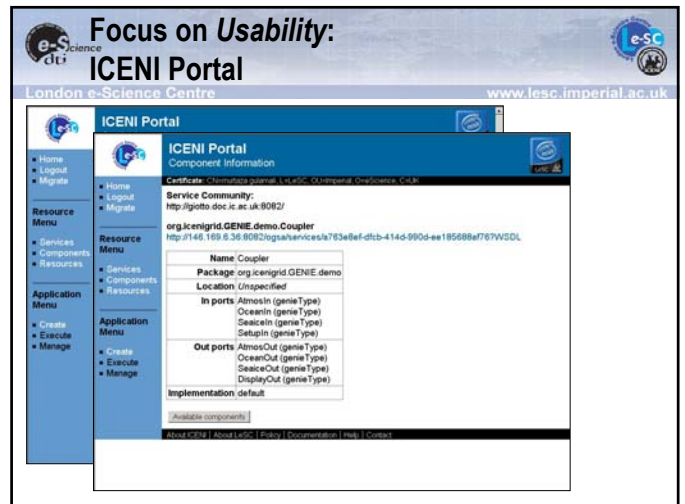
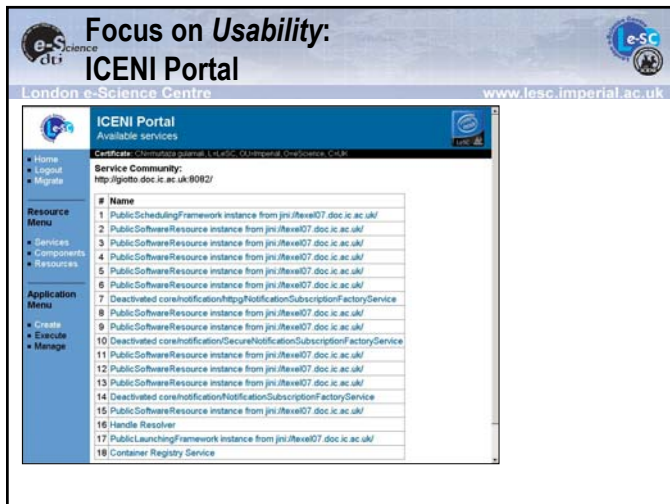
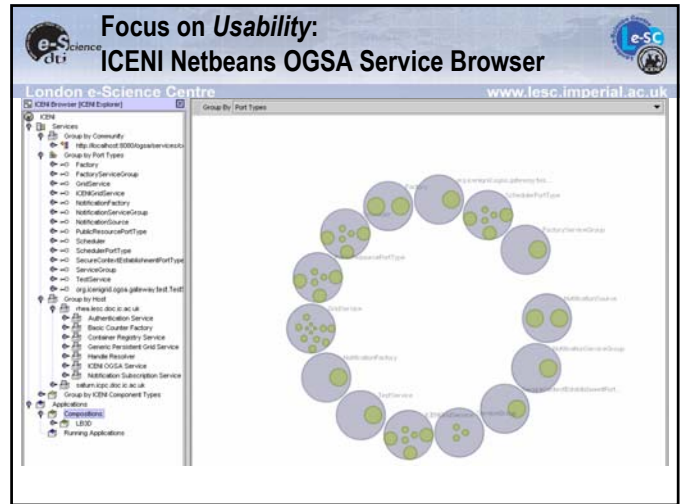
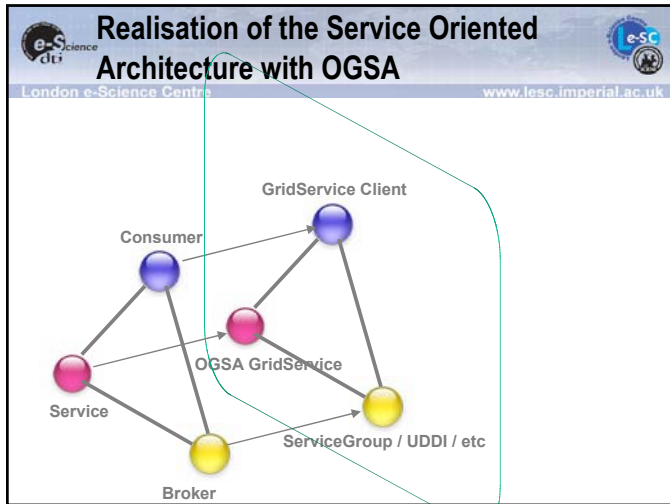
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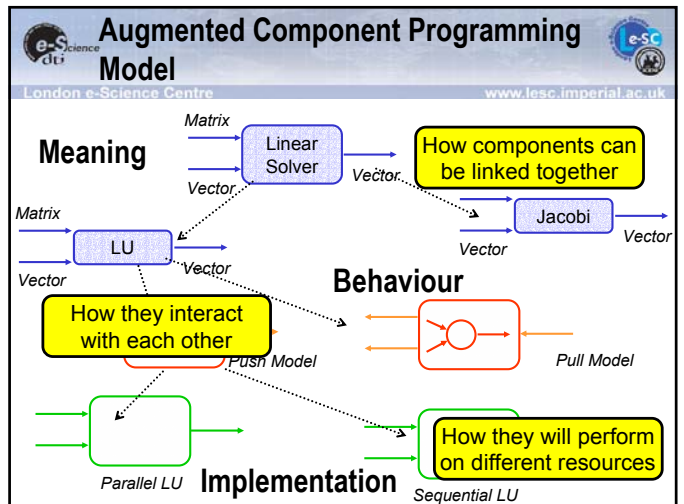
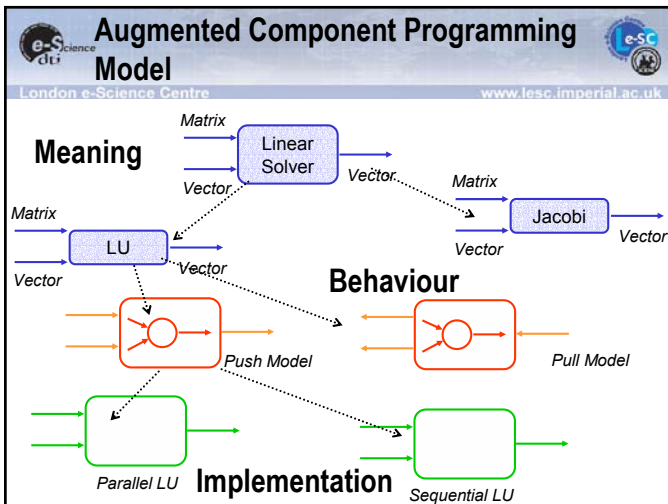
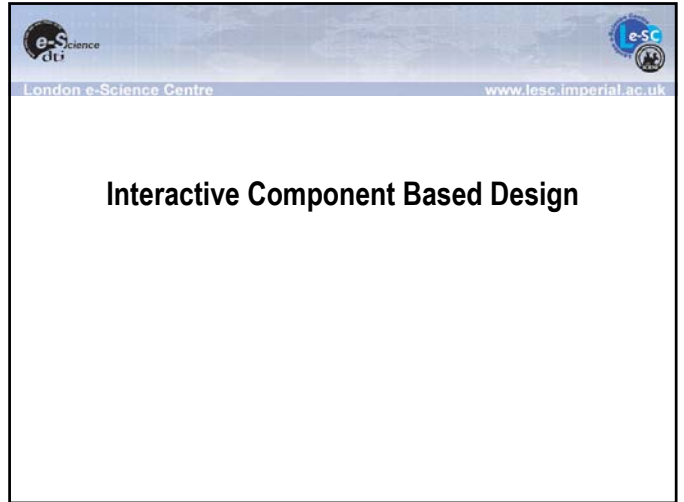
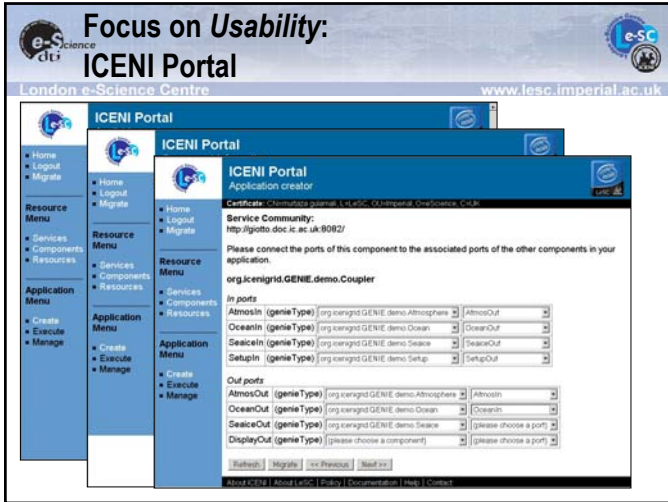
Realisation of the Service Oriented Architecture with JXTA



```

graph LR
    subgraph SOA
        C((Consumer))
        S((Service))
        B((Broker))
    end
    subgraph JXTA
        JP((JXTA Peer))
        JXP((JXTA Pipes))
        JXPG((JXTA Peergroup))
    end
    C --> JP
    S --> JP
    B --> JP
    JP --> JXP
    JP --> JXPG
  
```





**Focus on Usability:
Netbeans Component Application Builder**

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The screenshot shows the NetBeans IDE interface. On the left is the 'ICENI Component Palette' with various components like 'Ocean', 'Atmos', and 'Sealce'. The main window displays a 'GENIE Application' runtime diagram with nodes for 'Ocean', 'Atmos', and 'Sealce' connected by arrows representing data flow. The 'Execute' button is visible at the bottom of the diagram.

**Added Value:
Dynamic Discovery & Composition**

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The diagram shows a 'Deployed application' containing an 'Application' and a 'Visualisation Server'. A 'Drag-and-drop running component' is shown being added to the application. A 'Register as running component services in the NetBeans user interface' box points to the application. A 'NetBeans' screenshot shows a component being added to a diagram. Labels include 'Add new advertised components' and 'Execute to create new component instances and connect to application'.

**Collaborative Visualisation & Steering
integrated with ICENI driven Access Grid!**

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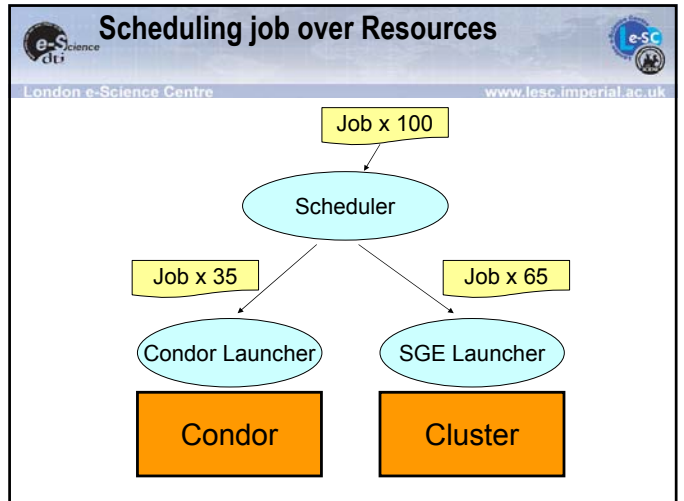
The diagram illustrates a 'Service Oriented Architecture' cloud. Inside the cloud are 'Application component (Dataset A & B)', 'Visualisation server', 'Rendering engine 1', and 'Rendering engine 2'. 'Dataset A' and 'Dataset B' are shown as data flows. 'Streamed to Access Grid' is shown as a central hub. Below the cloud are 'Visualisation client 1' (View of dataset A) and 'Visualisation client' (View of dataset B).

Workflow Guided Scheduling

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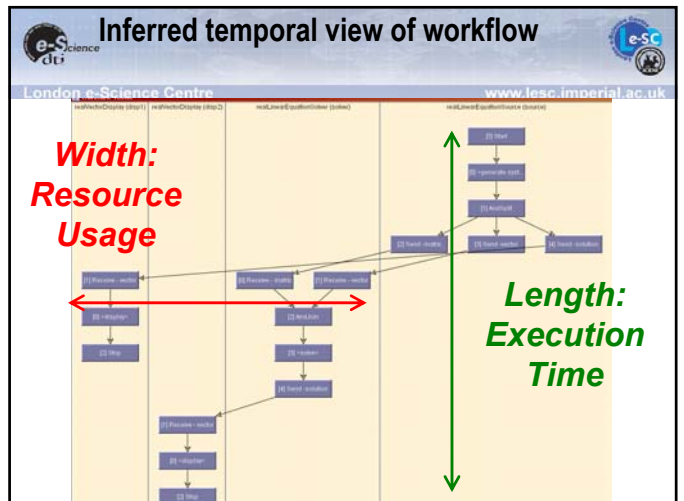
Targeting Multiple Architectures

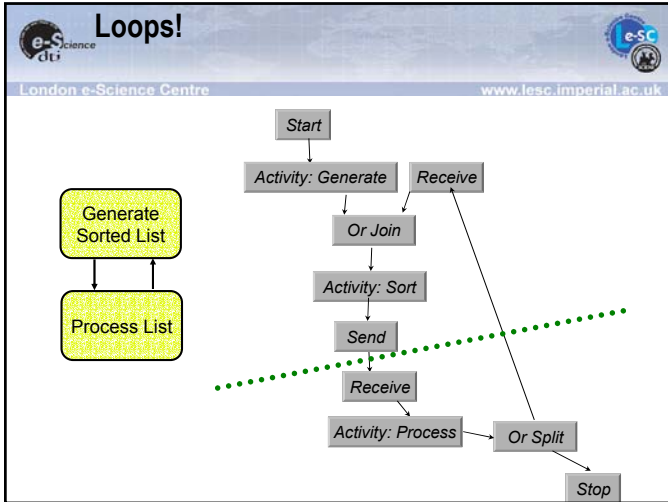
- DRMs and machines run a *launcher* service:
 - Presents a uniform interface to ICENI
 - Provides resource meta-data to scheduler
 - Allows discovery, access & policy control etc
- Currently supported launchers:
 - Windows
 - Bash
 - SGE
 - Condor
 - Globus 2



Scheduling within ICENI

- Exploit common meta-data within SOA
 - Resource description
 - Component workflow
 - Application structure
 - User specified policy
 - Access & control at service & method level
- Extensible Scheduling framework & simulator
 - Random
 - Round Robin
 - Game Theory
 - Simulated Annealing





Useful information despite loops

- Performance models used for comparison
 - implementation selection
 - resource selection
- So in our example:

$$T(\text{Generate}) + y \cdot (T(\text{Sort}) + T(\text{Process}))$$
 thus we can order implementations on $(T(\text{Sort}) + T(\text{Process}))$
- Surprisingly common!

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Case Study: Parameter Sweep

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The binary component will get executed 10 times

Case Study: Parameter Sweep

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The binary component will get executed 10 times

Other components like the argument constructor or the output and error consoles will get automatically expanded.

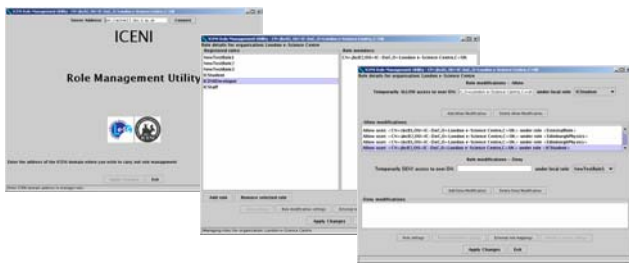
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Role Based Access & Security

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Focus on *Deployment*: ICENI Role Management Utility

- Managing role details
 - Use ICENI Role Management Utility



- Remote access through ICENI SOA

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Job Proxies

- Job Proxy Certificates
 - Valid only for the duration of a single job
 - X.509 based: signed by user's master cert.
 - Increased security & flexibility
 - Embedded policies

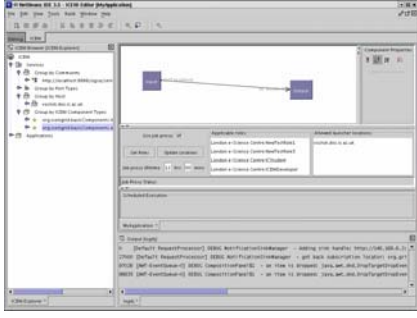
```



Version: 3
S/N: XX-XX-XX-XX
Issuer: C=UK,O=CA/OU=CA/L=London/CN=jhc02
Issuer Signature: .....
Validity Period: From: 00.01.01/01/00
To: 00.00.01/01/01
Subject DN: /C=UK,O=Org/OU=A/L=London/CN=jhc02,CN=34534534
Subject Public Key: .....
Embedded Access Policy:
<policy>
<allow> <location name="vostock.doc.ic.ac.uk"/></allow>
</policy>
  
```

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Focus on *Usability*: Job Proxies in ICENI

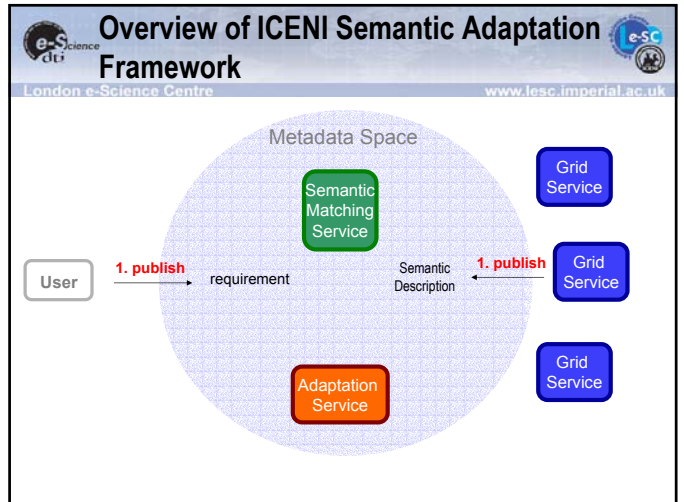
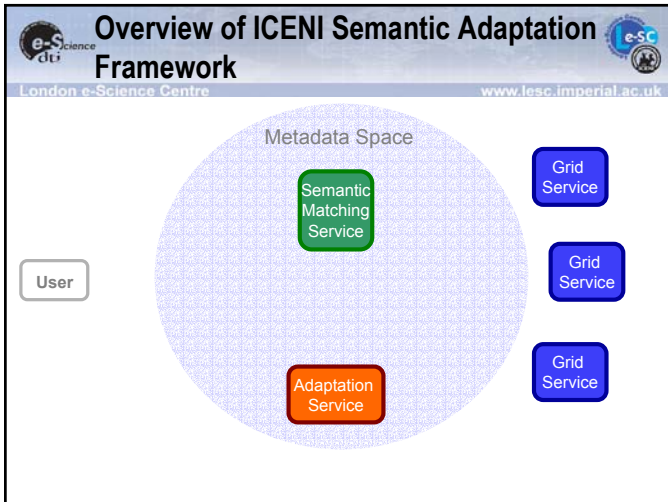
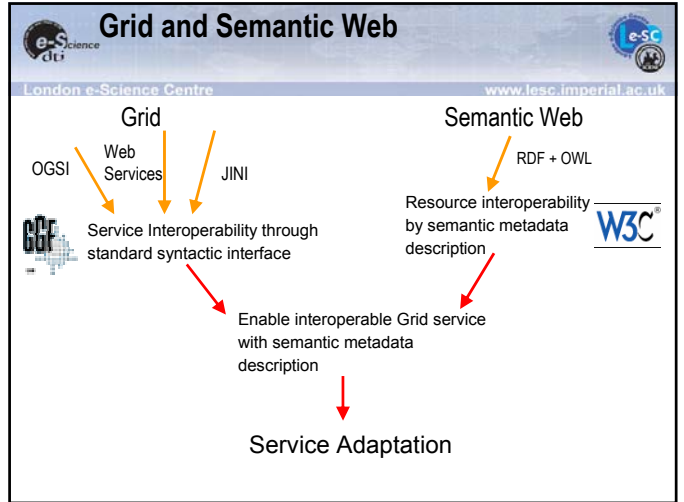
- Job Proxy use configured in Netbeans

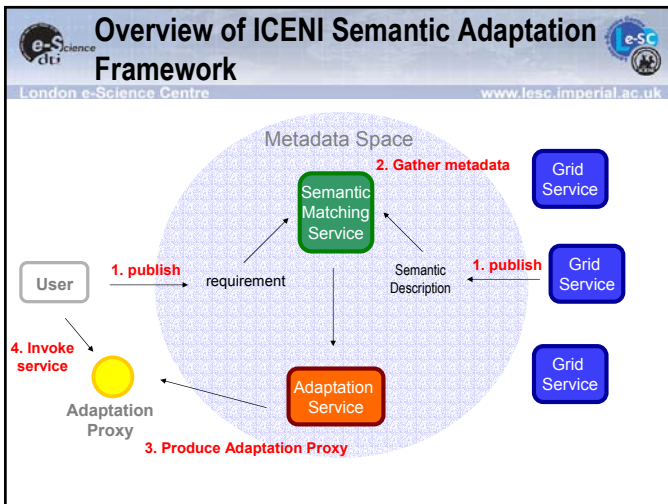
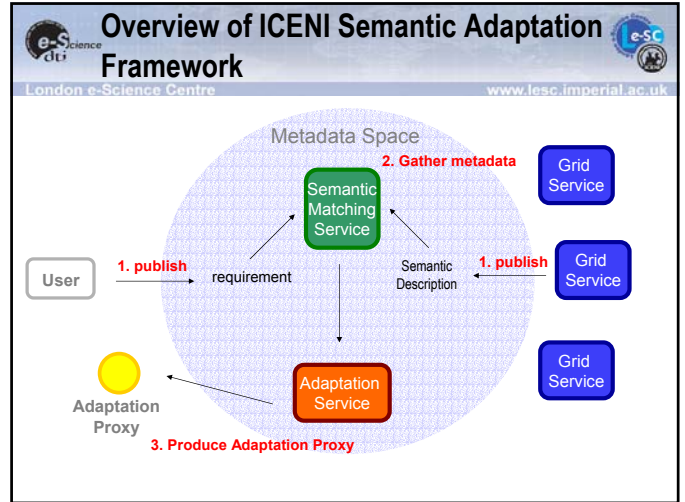
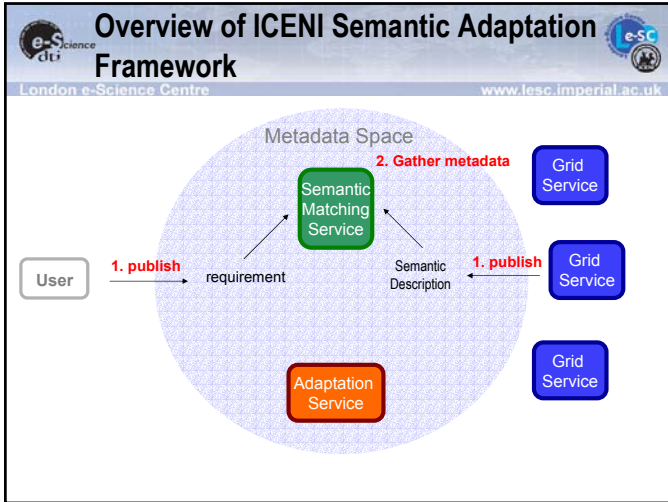


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Semantic Adaptation





Delivering e-Science: Who is using ICENI?

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Early adopters through Pilot Projects:
 RealityGrid (LB3D)
 GENIE

A number of universities have downloaded 1.0.1 and are testing it for future projects.

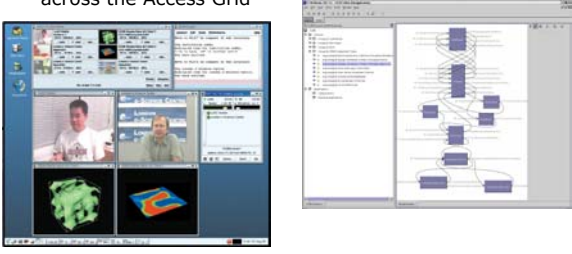
Still some development required to implement features.

**Delivering e-Science:
Who is using ICENI?**

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LB3D - (Lattice-Boltzmann 3D)

ICENI provides collaborative visualisation and steering across the Access Grid

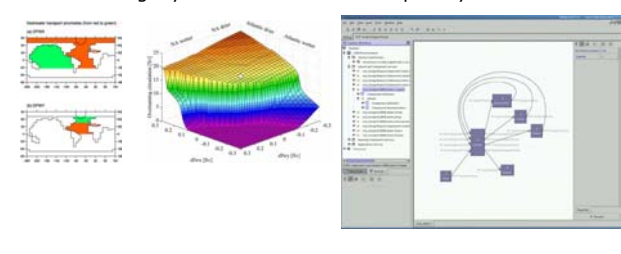


**Delivering e-Science:
Who is using ICENI?**

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GENIE - (Grid ENabled Integrated Earth system model)

Has already produced major scientific results, showing the fragility of the freshwater transport system.



ICENI: An integrated Grid Middleware

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<http://www.lesc.ic.ac.uk/iceni/>

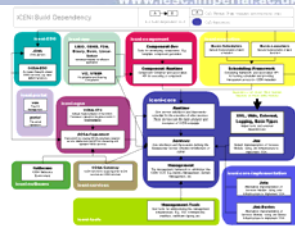
**ICENI Release 1.0
available !!!**

ICENI Open Source licence (extended SISSL)

Development Infrastructure

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- Project Website & mailing lists
- Daily build
 - Regression tests
 - On success binaries updated
 - Regenerated JavaDoc
 - Deployment tests
- CVS
 - Code split across multiple repositories & modules
- Documentation, manuals & user guides
- ICENI Open Source License (Extended SISSL)



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Bonus Demo at the London Demo Pod: A Market for Computational Services!

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A Market for Computational Services

- UK Core e-Science Programme project
- Interfaces & protocols to trade Grid Services
- Funded by Department of Trade & Industry
- Collaborators
 - London e-Science Centre (LeSC)
 - e-Science North West (ESNW)
 - Southampton e-Science Centre (SeSC)
 - UK Grid Support Centre









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 - [Asif Saleem](#), [Laurie Young](#), [Gary Kong](#), [Jeffrey Hau](#)
 - [Angela O'Brien](#), [Jeremy Cohen](#), [Ali Afzal](#)
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 - System:
 - [Keith Sephton](#), [David McBride](#)
 - Operations:
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