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

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

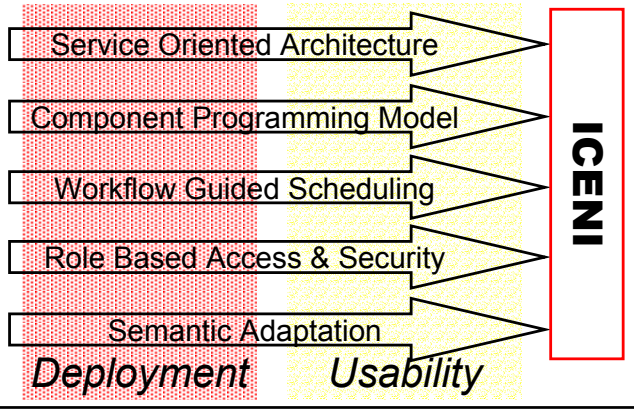
ICENI: Imperial College e-Science Network Infrastructure

- **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)**

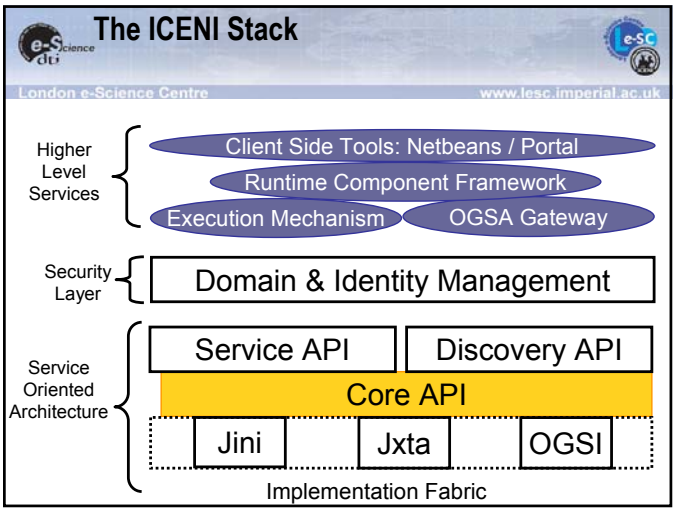
http://www.lesc.ic.ac.uk/iceni/

ICENI Release 1.0 available for download

ICENI Strands



The ICENI Stack



Focus on *Deployment:* Installation Mechanism and Control Centre

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

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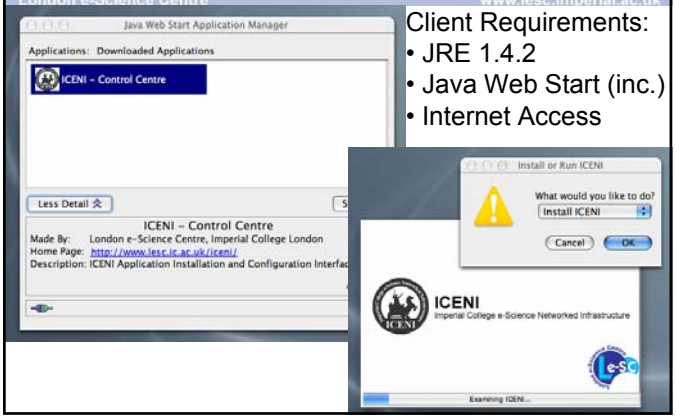

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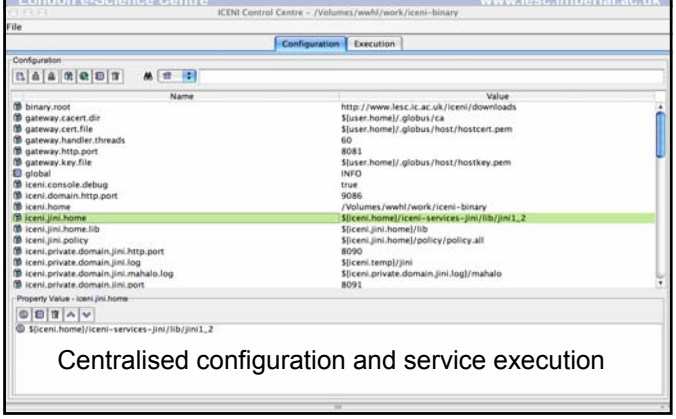

Centralised configuration and service execution

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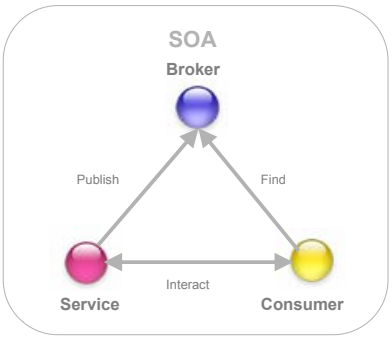
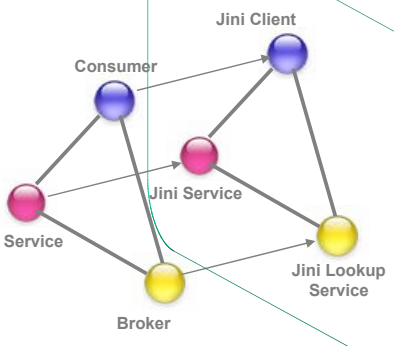
Architecture Independent Service-Oriented Architecture

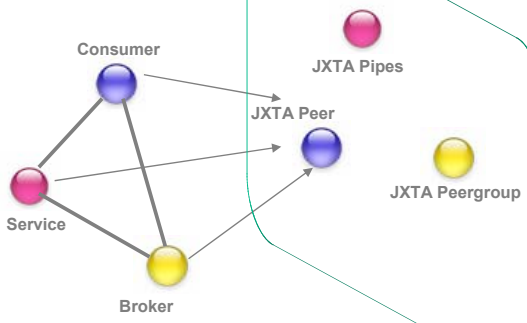
Service Oriented Architecture



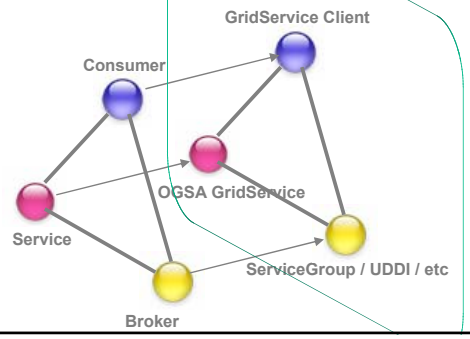
Realisation of the Service Oriented Architecture with JINI



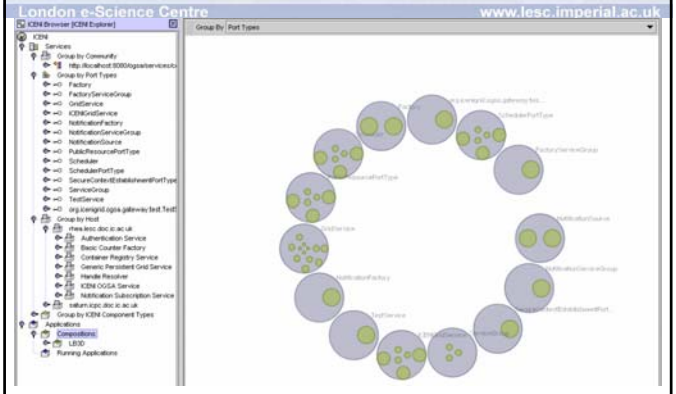
Realisation of the Service Oriented Architecture with JXTA



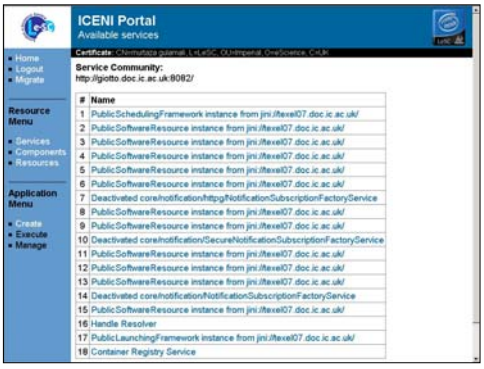
Realisation of the Service Oriented Architecture with OGSA



Focus on *Usability*: ICENI Netbeans OGSA Service Browser



Focus on *Usability*: ICENI Portal



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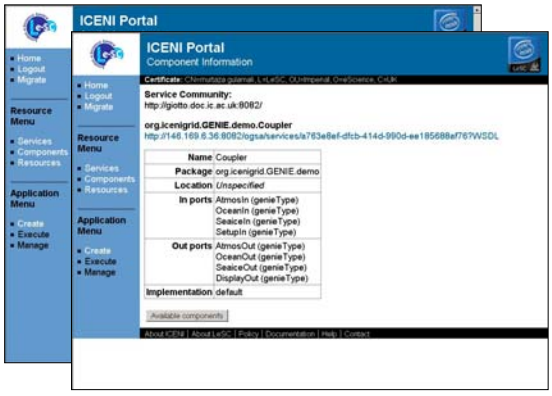

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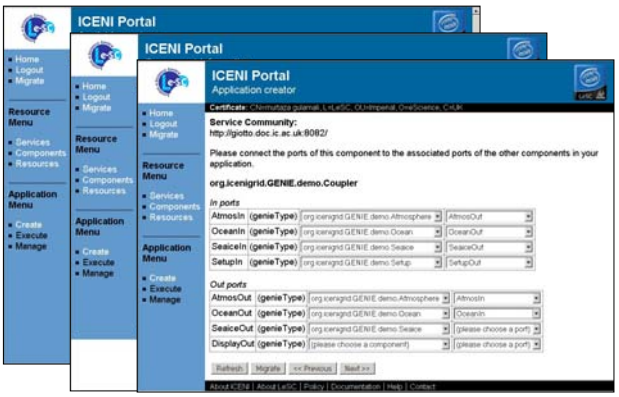
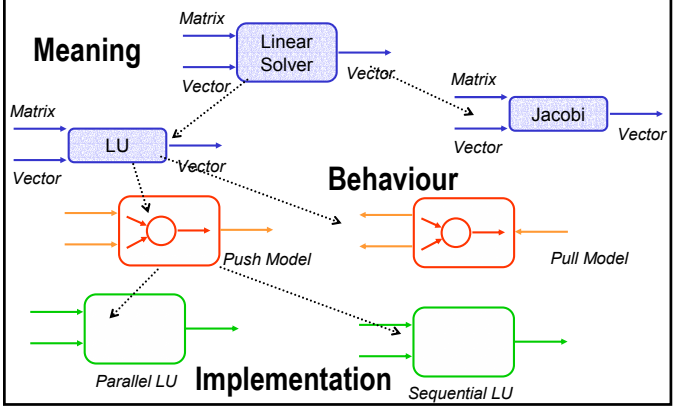


Interactive Component Based Design

Augmented Component Programming Model



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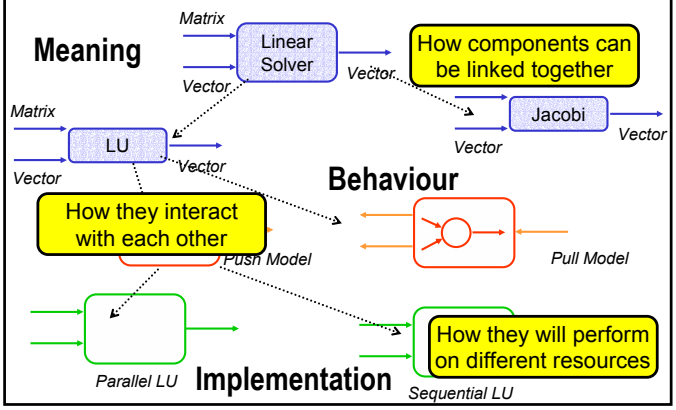

Focus on Usability: Netbeans Component Application Builder

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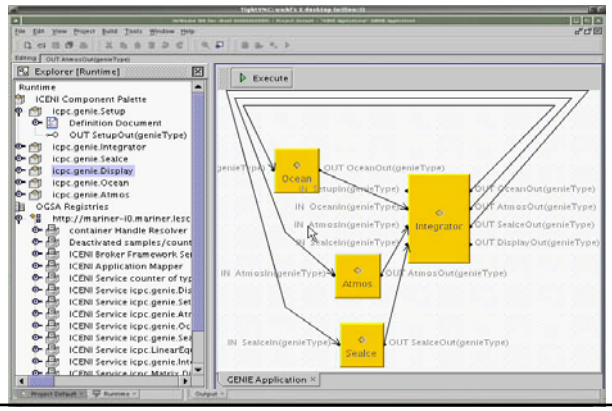

Added Value: Dynamic Discovery & Composition

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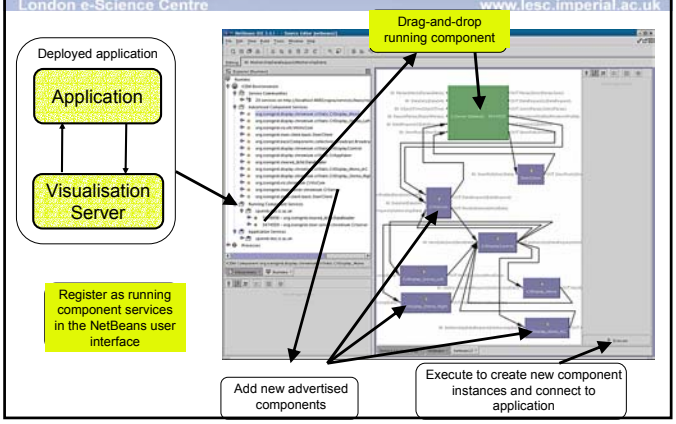

Collaborative Visualisation & Steering integrated with ICENI driven Access Grid!

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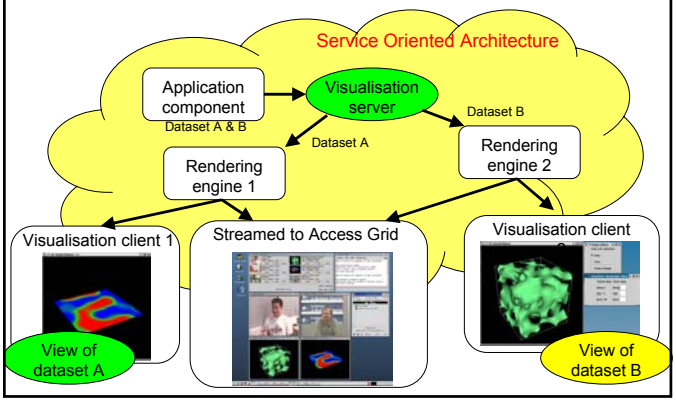

Workflow Guided Scheduling

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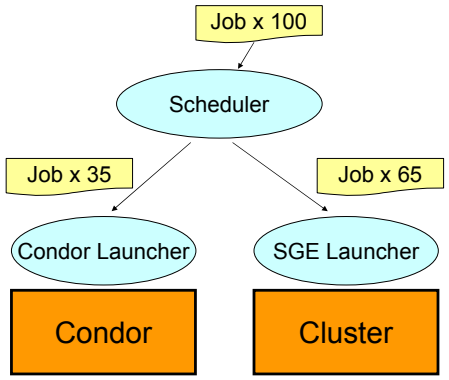
Targeting Multiple Architectures

- 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

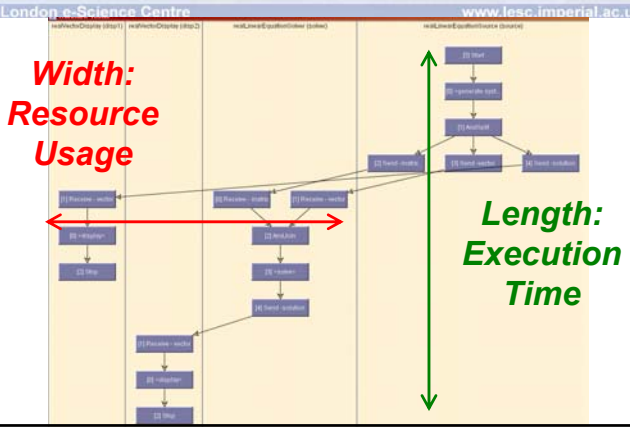
Scheduling job over Resources



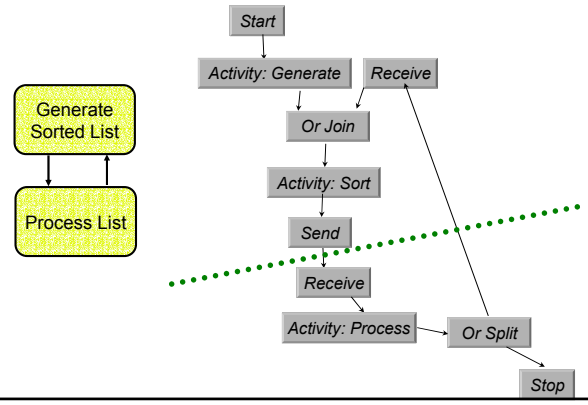
Scheduling within ICENI

- 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

Inferred temporal view of workflow



Loops!



Useful information despite loops

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

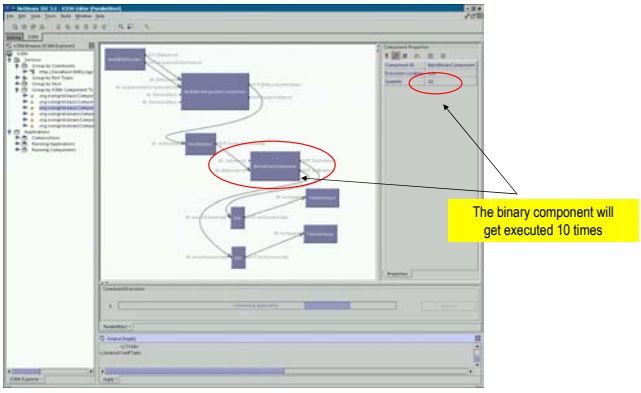
  T(Generate) + *y*. (T(Sort) + T(Process))

thus we can order implementations on

  (T(Sort) + T(Process))

- Surprisingly common!

Case Study: Parameter Sweep



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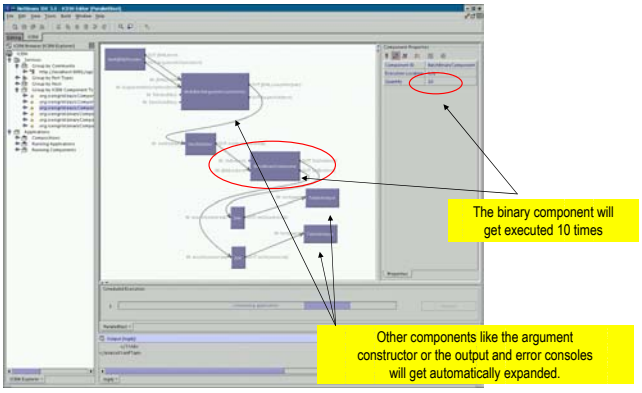
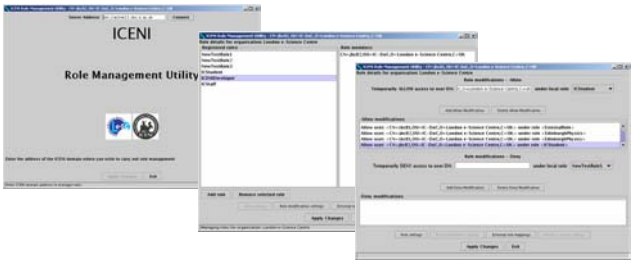


Role Based Access & Security

Focus on *Deployment:* ICENI Role Management Utility

- Managing role details
  - Use ICENI Role Management Utility



  - Remote access through ICENI SOA

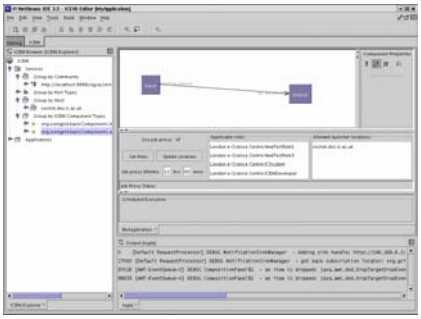
Job Proxies

- **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**

Job Proxy Certificate
Version: 3
S/N: XX-XX-XX-XX
Issuer: /C=UK/O=CA/OU=CA1/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>

Focus on *Usability*: Job Proxies in ICENI

- **Job Proxy use configured in Netbeans**



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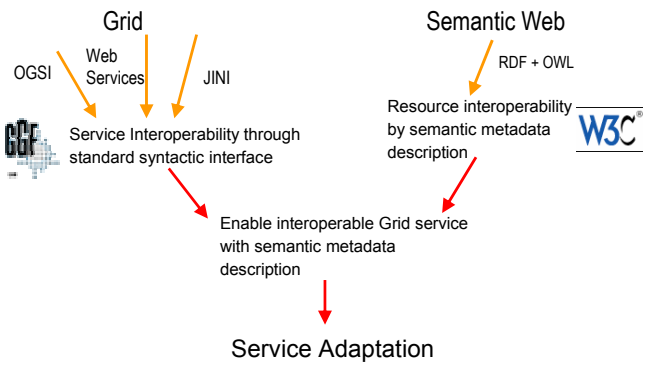
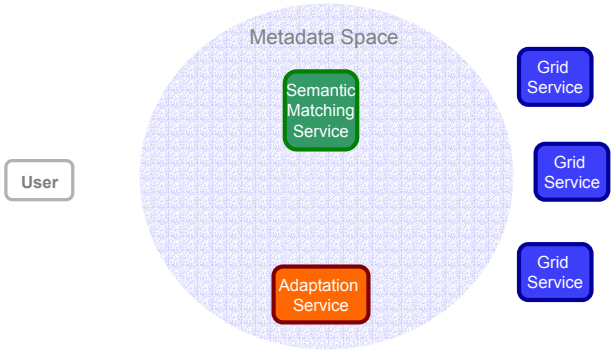
Semantic Adaptation

Grid and Semantic Web



Overview of ICENI Semantic Adaptation Framework



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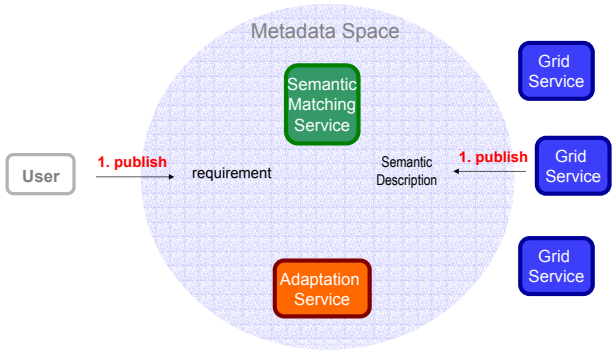

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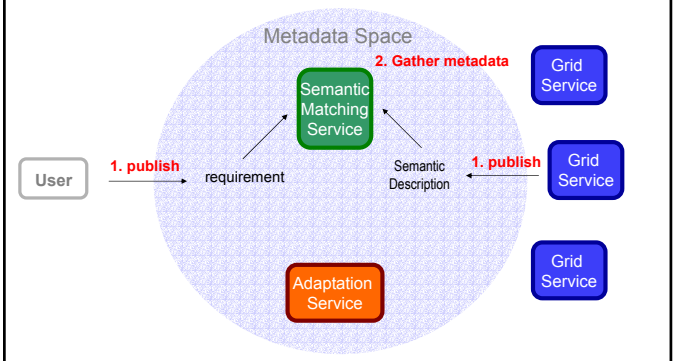

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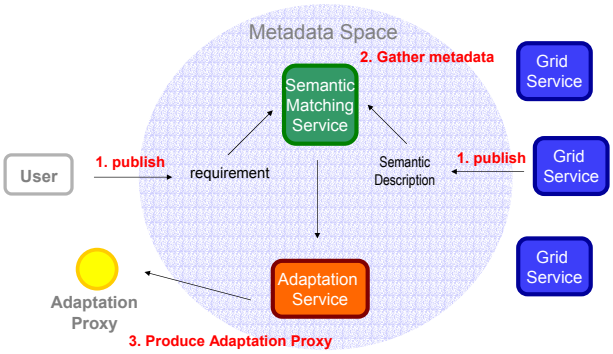

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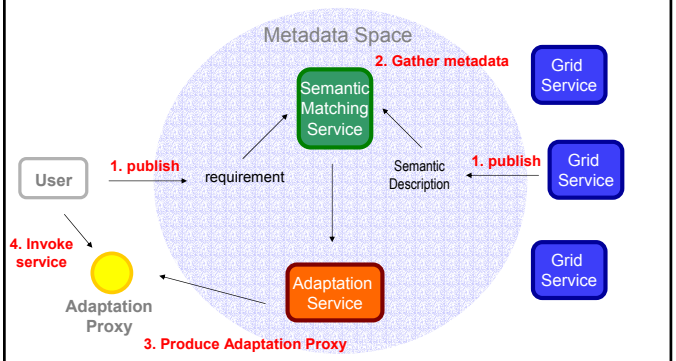

Delivering e-Science: Who is using ICENI?

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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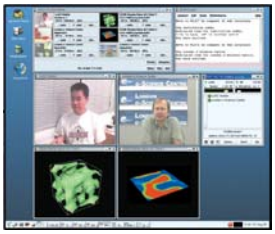
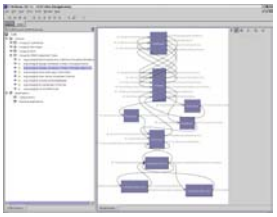
LB3D – (Lattice-Boltzmann 3D)

ICENI provides collaborative visualisation and steering across the Access Grid





Delivering e-Science: Who is using ICENI?

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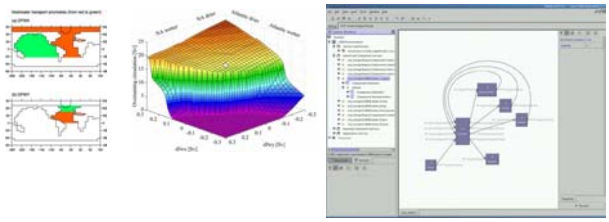
GENIE – (Grid ENabled Integrated Earth system model)

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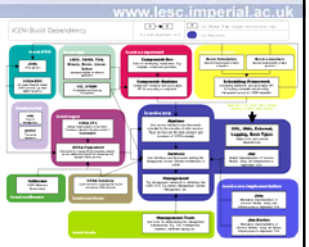
- Project Website & mailing lists
- Daily build
  - Regression tests
  - On success binaries updated
  - Regenerated JavaDoc
  - Deployment tests
- CVS
  - Code split across multiple repositories & modules
- Documentation, manuals & user guides
- ICENI Open Source License (Extended SISSL)



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

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

Acknowledgements

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- Technical Director: Dr Steven Newhouse
- Research Staff:
  - Anthony Mayer, Nathalie Furmento, Stephen McGough
  - William Lee, Marko Krznaric, Murtaza Gulamali
  - Asif Saleem, Laurie Young, Gary Kong, Jeffrey Hau
  - Angela O'Brien, Jeremy Cohen, Ali Afzal
- Support Staff:
  - System:
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  - Operations:
    - Susan Brookes, Oliver Jevons
- Contacts:
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  - Discovery Net (GR/R67750/01)
  - Effective Multi-user Multi-job Resource Utilisation (GR/R74505/01)
  - High Performance Software Components (GR/N13371)
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- Natural & Environmental Research Council
  - GENIE