UK e-Science Grid and EGEE

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The Primary Requirement ...

Enabling People to Work Together on Challenging Projects: Science, Engineering & Medicine
UK e-Science Budget (2001-2006)

Total: £213M

EPSRC Breakdown

- Applied (£35M) 45%
- Core (£31.2M) 40%
- HPC (£11.5M) 15%

+ Industrial Contributions

Source: Science Budget 2003/4 – 2005/6, DTI(OST)
The e-Science Centres

- Globus Alliance
- e-Science Institute
- Digital Curation Centre
- Open Middleware Infrastructure Institute
- EGEE
- Grid Operations Centre

EGEE
- NeSC (Glasgow)
- Edinburgh
- Newcastle
- Leeds
- Sheffield
- York
- Oxford
- London
- Cambridge
- Manchester
- Dundee
- Edinburgh
- Glasgow
- Leeds
- Sheffield
- York
- Oxford
- London
- Cambridge
- Manchester
- Dundee
- Edinburgh
- Glasgow

The Globus Alliance

CeSC (Cambridge)

Digital Curation Centre

Open Middleware Infrastructure Institute

Grid Operations Centre

The e-Science Centres
The e-Science Grid: National Grid Service

- Engineering Task Force (Contributions from e-Science Centres)
- Grid Support Centre / Grid Operations Centre
- OGSA Test Grid projects

- 1600 x CPU AIX
- 512 x CPU Irix
- 20 x CPU 18TB Disk Linux
- 64 x CPU 4TB Disk Linux

- HPC(x)
- 1600 x CPU AIX
- 512 x CPU Irix
- 20 x CPU 18TB Disk Linux
- 64 x CPU 4TB Disk Linux

OGSA Test Grid projects:
UK e-Science Grid Status - Q3 2003

- Operational and heterogeneous Level-2 Grid based on Globus Toolkit 2
- Demonstrated broad set of applications running across it
  - Monte Carlo simulations of ionic diffusion through radiation damaged crystal structures
  - Integrated Earth system modelling
  - BLAST on the Grid
  - Nimrod/G
  - DL_POLY and Portals
  - Grid Enabled Optimisation: Vibrations in Space Application to Satellite Truss Design
  - RealityGrid-Lite
  - Grid Integration Test Script Suite- from WP7
UK Level 2 Grid Project
The Engineering Task Force
They made it work

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UK e-Science Grids - the next steps

- Prototype status ...
  - Fragility?
  - Security?
  - Reliability?
  - Predictability?
  - Dynamicity?
  - Maintainability?

- Explore Research Grids based on OGSA
- Deliver production service – GT2 & LCG2
  - NGS – initially a subset of sites
  - Grid Operations Centre – Director Neil Geddes
- Many projects continue with GT2

The future is based on WSRF – Converge by mid 2005
Projects achieve results

- Across all disciplines
- More than 100 projects
  - Applications 70% core M/W 30%
  - Approximately $50 million from Industry collaboration
    - >70 companies
- Using UK e-Science Grid / NGS or Local Grids
- Or using their own “grids”
- The Grid idea is thriving
- It is still hard work to get started
- It is still very hard to push the technical limits
  - E.g. Teragyroid

Success depended on a strong rallying cry
EGEE & LCG2 Experience

Malcolm Atkinson & Ian Bird
EGEE manifesto:
Enabling Grids for E-science in Europe

• **Goal**
  - Create a wide European Grid production quality infrastructure on top of present and future EU RN infrastructure

• **Build On:**
  - EUEU and EU member states major investments in Grid Technology
  - International connections (US and AP)
  - Several pioneering prototype results
  - Large Grid development teams in EU require major EU funding effort

• **Approach**
  - Leverage current and planned national and regional Grid programmes
  - Work closely with relevant industrial Grid developers, NRENs and US-AP projects
EGEE: Partners

• Leverage national resources in a more effective way for broader European benefit
• 70 leading institutions in 27 countries, federated in regional Grids
EGEE Activities

24% Joint Research
JRA1: Middleware Engineering and Integration
JRA2: Quality Assurance
JRA3: Security
JRA4: Network Services Development

28% Networking
NA1: Management
NA2: Dissemination and Outreach
NA3: User Training and Education
NA4: Application Identification and Support
NA5: Policy and International Cooperation

48% Services
SA1: Grid Operations, Support and Management
SA2: Network Resource Provision

Emphasis in EGEE is on operating a production grid and supporting the end-users

31 million Euros over 2 years
EGEE Implementation

• From day 1 (1\textsuperscript{st} April 2004)

  Production grid service based on the LCG infrastructure running LCG-2 grid middleware (SA)

  LCG-2 will be maintained until the new generation has proven itself (fallback solution)

• In parallel develop a “next generation” grid facility (JRA)

  Produce a new set of grid services according to evolving standards (Web Services)
  Run a development service providing early access for evaluation purposes
Some observations - middleware

- LCG took close to 1 year to make existing middleware into something close to production quality
- Found existing middleware:
  - Was not well tested
  - Did not handle exceptions
  - Assumed that networks, other services would always work
    - This is a distributed system!
  - Did not address reliability
  - Did not address scalability
  - Did not address application required functionality
    - Use-cases often do not describe exactly how a service will be used → underlying architecture sometimes not appropriate
  - Could not easily be integrated into existing computing infrastructures
    - Often assumed full control of dedicated test-beds – this is not the real situation
Certification, Testing and Release Cycle

CERTIFICATION TESTING
- Integrate
  - Basic Functionality Tests
  - Run Certification Matrix
  - Run tests C&T suites Site suites
- Release candidate tag
- Release tag

APP INTEGR
- HEP EXPTS
- BIO-MED
- OTHER TBD
- APPS SW Installation

DEPLOY
- Certified release tag
- Deployment release tag

SERVICE
- Production tag

DEVELOPMENT & INTEGRATION UNIT & FUNCTIONAL TESTING
- Dev Tag

PRE-PRODUCTION

PRODUCTION
LCG Certification

- Significant investment in certification and testing process and team
  - Skilled people capable of system-level debugging, tightly coupled to VDT, Globus, and EDG teams
  - Needs significant hardware resources
  - This was essential in achieving a robust service
- Making production quality software is
  - Expensive
  - Time consuming
  - Not glamorous!
  - … and takes very skilled people with a lot of experience
- Message for developers
  - One good idea at a time – test, test, test
  - Exception handling is not the exception – it is the normal mode of operation in a distributed system!
  - Reference implementations are (by definition) NOT production quality
    - Expect components to be replaced by the deployers!
Experiences in deployment

- LCG covers many sites (~60) now – both large and small
  - Large sites – existing infrastructures – need to add-on grid interfaces etc.
  - Small sites want a completely packaged, push-button, out-of-the-box installation (including batch system, etc)
  - Satisfying both simultaneously is hard – requires very flexible packaging, installation, and configuration tools and procedures
    - A lot of effort had to be invested in this area
- Richness of batch systems does not match simple gatekeeper model
  - Many queues, heterogeneous clusters, hierarchical “fair-share” scheduling and polices versus simple assumptions at gatekeeper
- Current model of Information system with unique schema does not scale
  - Does not allow for differences between sites and full richness of available resources
- Data management systems still have a long way to go
Summary

• This was a list of problems – but in the end we are quite successful
  ▪ System is stable and reliable
  ▪ System is used in production
  ▪ System is reasonably easy to install now – 60 sites
  ▪ Now have a basis on which to incrementally build essential functionality

• This infrastructure forms the basis of the initial EGEE production service
Sites in LCG-2/EGEE-0: June 4 2004

- 22 Countries
- 58 Sites (45 Europe, 2 US, 5 Canada, 5 Asia, 1 HP)
  - Coming: New Zealand, China, other HP (Brazil, Singapore)
- 3800 cpu