

Summary of UK e-Science Campus Grid Workshop, 16/17th June 2005

David Wallom

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Framework within which Campus Grids will develop in the UK

- Funding
 - Spending Review 2004, Spending Review 2006
 - full Economic Costing of University Research and Teaching
- **Extract from Science & innovation investment framework 2004 - 2014**
 - *2.25 The Government will therefore work with interested funders and stakeholders to consider the national e-infrastructure (hardware, networks, communications technology) necessary to deliver an effective system.*
 - *Due to the potential importance of a national e-infrastructure to the needs of the research base and its supporting infrastructure in meeting the Government's broader science and innovation goals, as a first step OST will take a lead in taking forward discussion and development of proposals for action and funding, drawing in other funders and stakeholders as necessary.*
 - OST e-Infrastructure Group formed for SR2006

e-Infrastructure Components

- Activity: National Grid Service and Operational Support
 - Deployed National Grid Service (NGS) and established Grid Operation Support Centre (GOSC)
 - Need to extend funding for this activity beyond present 2 years
 - Core Programme should provide funding for hardware renewal: JISC should fund support services
 - Scale of funding required **£8m**

National Grid Service

- Hardware
 - 4 separate clusters, located in physically disparate locations (Oxford, Manchester, Leeds & Rutherford Labs)
 - 2 x Compute clusters, 120 processors
 - 2 x Data Nodes, 40 CPU & 4TB Disk
 - Uniform software and user interface.
 - Software
 - Globus Toolkit version 2.4.3 (VDT)
 - Job submission, File transfer, Shell
 - Storage Resource Broker
 - OGSA-DAI (Oracle (9i))
 - Information Services (MDS/BDII)
 - Certification Authority
 - MyProxy server
 - Integration tests and database
 - Cluster monitoring
 - EDG VO management tools
- In testing:
- VOMS
 - EDG Resource Broker
 - Portal(s)

A Personal View of Campus Grids

- Campus Grids are where e-Science meets University
- Essential component of University Computing Services...
 - as is e-Infrastructure in general
- Reach point where will be asked why we are not running Campus Grid?
- But precisely what a Campus Grid actually is, and the best way to provide the service needs:
 - refinement of ideas
 - technology development
 - costs analyses
 - security clarification
 - development of best practice

Campus Grid Workshop at NeSC

- Advertised on NeSc web site..

<http://www.nesc.ac.uk/esi/events/556/>

“Meeting to explore the use of Campus Grids and to inform sites how to set up such Campus Grids for the first time.

The aims of the meeting are: to find out which centres are working in this area, the technologies that are being used, what might be done to share best practice, to look for commonality where appropriate, to help new sites create their own Campus grids, and to consider how the centres may be interconnected to each other and to the UK National Grid Service

The target audience will be mainly computing service departments and e-Scientists directly involved in the development and operation of Campus Grids”

Objectives

- Part 1

- Overview of existing CampusGrid activities
- determine best practice, understand security issues, explore full economic costing
- outline challenges in setting up a CampusGrid, connection to the National Grid Service

- Part 2

- Data issues within Campus Grids
- Determine consensus on definition of a Campus Grid
- Review exciting new technologies for second generation Campus Grids.

Condor(-G)/Globus/SRB

- Condor:
 - High throughput computing system
 - Class Ads - core to operations
 - Condor-G: allows use of Condor commands in Globus environment
 - Can be used to perform matchmaking \Rightarrow resource broker
- Globus: Offers applications, protocols and APIs and GSI - certificates
- SRB: Interface to heterogeneous data storage resources

Campus Grids across UK..

- Universities of Bristol & Oxford:
 - Centralised access to disparate resources (including wider than Campus!)
 - Bristol, departmental clusters but no Windows as not user requested.
 - Oxford, restarting central Windows systems overnight into Linux for Condor pools
 - Clusters within single firewall
 - Virtual Data Toolkit – bundles tools
 - Self developed Virtual Organisation Manager and Resource Usage Service
 - Use SGE and PBS as schedulers on clusters
 - Resource Broker has access to campus systems and NGS
- Cambridge University Grid (Env 2):
 - Condor & Condor-G
 - 125 nodes (desktops and farms); each CUDN-only routable address
 - Authentication not strong; handled at submit machine
 - Vanilla and standard universe jobs; also cluster for MPI universe jobs

Campus Grids across UK..

- Reading University:
 - Condor under Linux and Windows (50-100 processors); vanilla and MPI
 - Utilising dual boot workstations and 'diskless' clients (also CoLinux)
 - Investigating Inferno Grid
- Newcastle University:
 - Condor based as first step, 200 nodes – mainly Linux; running 4 months
 - Focus on student clusters with 1500 machines, and expand to 10,000 nodes
 - Aim to add database/filestores/workflow enactors
- University of Liverpool:
 - Prototype running for 18 months
 - 900 processors. Condor and Condor-G
- Cardiff University:
 - 900 processors, Condor
 - Few users
 - Greater aspirations

Supporting Campus Grids

- System support/application support staff
 - Oxford: dedicated Campus Grid Manager
 - Bristol: 1 member of the e-Science centre
 - Cambridge: 1 plus local support from departments
 - L'pool: 2 total
 - Newcastle: $2 \times 0.25\text{FTE}$ plus little support (3 for CCE)
 - Cardiff: 0.1FTE
- 75% of HPC resources run HTC
 - These have their own support arrangements

Data in a Campus Grid Environment

- Storage Resource Broker commonly used by existing Campus infrastructures.
- Other Projects outlined
 - eMinerals given as example
 - Scientist has common interface across resources in 6 institutions through *minigrid*
 - mySRB; need suitable metadata->
 - CCLRC Scientific Metadata Model (for general discovery):
 - Keywords/provenance/conditions/description/location (SRB)/references
 - Metadata editor as well
 - Data Portal
 - Enables scientist to search for studies and data from within metadata

Campus to National Resources

- Over the next 5 years it will be increasingly necessary to distribute the workload.
- NGS core nodes already full
- Need to distribute and connect campus grids with the NGS
- Are CGs cycle stealing?
- Are turn-key solutions possible – or desirable?
- How does a CampusGrid support a VLE/VRE

Campus Grid/Compute Pool

- CampusGrid
 - Heterogeneous dedicated and non-dedicated resources
 - Designed to enable resource sharing and (over time) cost saving
 - A system to federate compute and data resources across a campus, abstracting the interface to each from users
- Compute Pool
 - Dedicated resource with specific purpose
 - Single stakeholder allowing for closer control of resources
- What next?
 - Software must become easier to use for all
 - Smaller overhead to run securely (for admins and, especially – users)

Current Virtualisation Schemes

- Xen
 - Xen is a virtual machine manager;
 - an isolation kernel
 - Hardware virtualisation treats OS as a component
 - Offers: consolidation/avoids downtime/re-balance workload/enforces security
- Inferno
 - Inferno Grid – free to academia
 - Condor-like
 - Inferno Grid based on Inferno OS
 - Inferno OS – built for distributing computing, very lightweight
 - Runs as emulated application identically on multiple platforms
 - Not really used in anger yet, not let proper users loose!

Current commercial solutions

- United Devices GridMP
 - Very quick and easy to set up
 - 80 licences £15k
 - Applied for additional 400 licences (£60k)
 - Have to make some changes to the applications (wrap it; not change executable)
 - Investment worthwhile
 - Mercifully few problems encountered
- Sun Grid Engine Enterprise
 - Meta Scheduler sitting onto top or standard scheduler
 - No real advantage except commercial support.

New Technologies to solve Campus Grid Problems

- Virtualisation is the key to offering a CG which can be shared, simple to administrate, offers users absolute control of their environment, owners retain absolute control of their machines, and uses non-dedicated resources
- A virtual machine completely isolates the Grid Process from the underlying OS
- VMWare performance – 97% native performance
 - Not marketed as Grid technology 2006 will be released
 - Intel VTx (Vantepol) – HW support for virtualisation
- Comment: single node problem sorted; but not many-node issues:
 - DoS, nodes which die, etc need to be addressed

Conclusions

- Compute Pool is a resource, while a CG is a (centrally) managed service with various stakeholders throughout the organisation.
- Data storage, access, and retrieval integral parts of the service (i.e. not just cycle stealing)
- The cycles they provide are not free; policy for funding required
- Added value is given to the service with Portals or other user interface software
- CGs must be configured so as to avoid impinging on resources' original intended use
- The current commercial solutions are not significantly better than open source solutions.
- The future is with the application of virtualisation technologies.