Campus grids: e-Infrastructure within a University

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- Mark Calleja, Cambridge
- David Wallom, Oxford
- David McBride, Imperial College

for descriptions of their campus initiatives.

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Current campus grids

- Present focus is on enhanced use of resources
  - e.g. to save purchasing new clusters
- Cambridge, Bristol, UCL, Imperial, Oxford, Cardiff, Glasgow *and others*

Two classes:

- Within an administration domain: processors on a LAN… (e-infrastructure, but not a grid!!)
- Across administrative domains
  - E.g. Multiple institutes, each with own systems management, authorisation, authentication

Pooling processors on a LAN

- Teaching lab machines lie idle for most of the time
  - Use the processing power!
- Harvest spare compute cycles to create a low-cost "high throughput computing" platform
- Create a pool of processors as a batch processing resource
- Submit jobs that run when a machine is free
- Condor most common approach
 - http://www.cs.wisc.edu/condor/

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Condor

- **Converts collections of distributed workstations and dedicated clusters into a high-throughput computing (HTC) facility, a Condor Pool**
  - **HTC concerned with harvesting maximum compute time for many jobs... e.g. months CPU time in days elapsed**

- **Manages both resources (machines) and resource requests (jobs)**

- **Includes :**
  - **ClassAd Matchmaking**
  - **Process checkpoint / restart / migration**

Terminology

- **Machines**
  - **Pool — a collection of computers used by Condor**
  - **Central manager — one per pool**
    - ▶ **matchmaking**
    - ▶ **pool management**
- **functionalities**
  - **user submit -> schedd with queue of jobs**
  - **job execute -> startd**
  - **matchmaking ->**
  - **collector & negotiator**
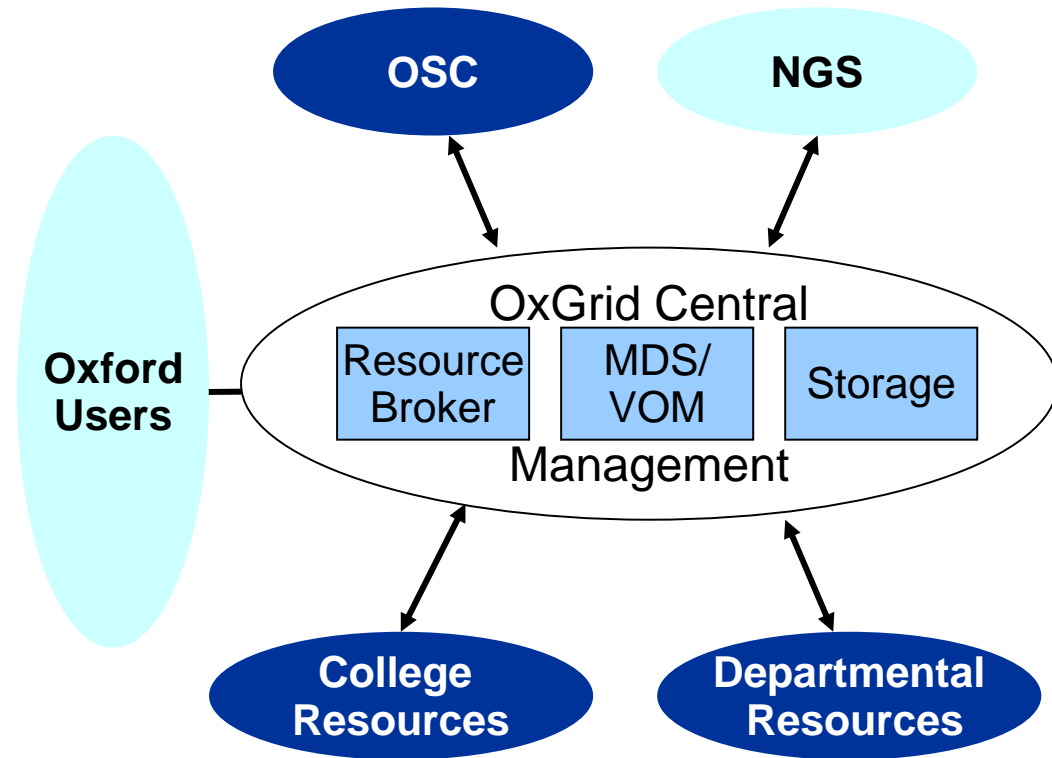 - **control of a node -> master**

Campus grids

- Single sign-on to virtualised resources in multiple administrative domains
- Need AA mechanisms
  - X 509 certificates
  - For users that only wish to access internal (university) resources, a Kerberos CA (e.g. Oxford, Imperial College)
- Need brokering – where should a job be run?
- Needs information systems – what are the options?!
- Scalability requires each VO or institute contributes its average requirement
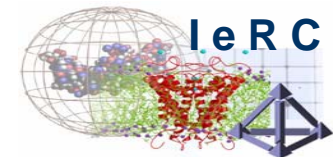
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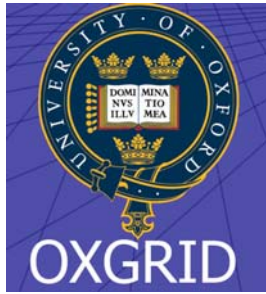
Example: OxGrid, a University Campus Grid

- Single entry point for Oxford users to shared and dedicated resources
- Seamless access to National Grid Service and OSC for registered users
- Single sign-on using PKI technology integrated with current methods

OSC

NGS

Oxford Users

OxGrid Central

| Resource Broker | MDS/ VOM | Storage |

Management

College Resources

Departmental Resources

David Wallom

Oxford Interdisciplinary e-Research Centre

I e R C

Middleware for campus grids

- ## Globus toolkit
  - Tools built on Grid Security Infrastructure to include:
    - Job submission (GRAM) : run a job on a remote computer
    - Information services: So I know which computer to use
    - File transfer: so large data files can be transferred
    - Replica management: so I can have multiple versions of a file "close" to the computers where I want to run jobs

- ## Storage Resource Broker
  - Virtual filesystem: for files held in multiple locations

- ## Condor "flocking"
  - Allow access to multiple Condor pools

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Globus

- A software toolkit: a modular "bag of technologies"
  - Made available under liberal open source license
- *Not* turnkey solutions, but *building blocks* and *tools* for application developers and system integrators
- International production grids are (currently) based on the Globus Toolkit release 2
- Globus Alliance: http://www.globus.org/

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Running a job with GT2

- GT2 *Toolkit* commands: an example
  - Job submission – need to know UNIX and name of a CE to use
  - Higher tools allow jobs to be submitted to "the grid" – to a resource broker

```
globus-job-submit grid-data.rl.ac.uk/jobmanager-pbs /bin/hostname -f

https://grid-data.rl.ac.uk:64001/1415/1110129853/

globus-job-status https://grid-data.rl.ac.uk:64001/1415/1110129853/

DONE

globus-job-get-output https://grid-data.rl.ac.uk:64001/1415/1110129853/

grid-data12.rl.ac.uk
```
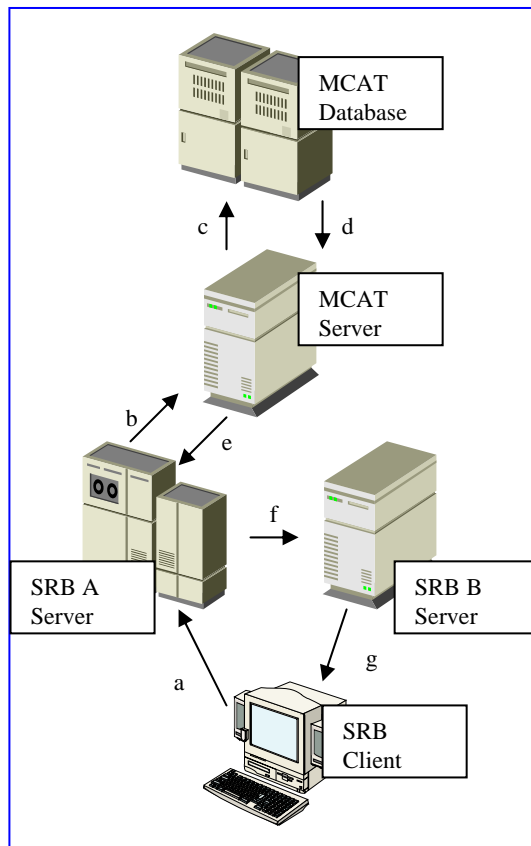
How SRB Works

- 4 major components:
  - The Metadata Catalogue (MCAT)
  - The MCAT-Enabled SRB Server
  - The SRB Storage Server
  - The SRB Client

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Obvious issues

- Need specific initial user communities
  >> vague sense this is a good idea!

- Engage with systems managers from first thoughts

- Operations effort must be factored in and justifiable! Researcher enthusiasm is not enough!

Platform for interdisciplinary research??

- Campus grid gives an infrastructure spanning multiple institutes
- Potential for VOs spanning those institutes also
    - Doing more than sharing spare compute cycles
- Enabling easier access / reuse of research data

- Higher level services + ontologies/semantics + workflow

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