Grid Operations

John Gordon
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Overview

- more on security
- see daves GDB slides
- more on fault handling.
- remote fixing
Outline

- The monitoring tools
- How we use them
- What is still to be done
Grid Operations

• Once middleware has been developed, tested and deployed, **grid operations** are the set of actions and procedures to keep a grid running for the users.
• GOC Processes and Activities
  – Coordinating Grid Operations
  – Defining Service Level Parameters
  – Monitoring Service Performance Levels
  – First-Level Fault Analysis
  – Interacting with Local Support Groups
  – Coordinating Security Activities
  – Operations Development
Have we delivered?

- Coordinating Grid Operations
- Defining Service Level Parameters
- Monitoring Service Performance Levels
- First-Level Fault Analysis
- Interacting with Local Support Groups
- Coordinating Security Activities
- Operations Development

- Yes, RAL & Taipei
- No
- up or down
- Yes
- Yes
- Policies, not operation
- Monitoring and accounting
The LHC Computing Grid, LCG, which was launched in September 2003 with 12 sites contributing, has been growing very rapidly. A snapshot of the 64 sites that were actively contributing to the LCG by mid-July is shown in the map above, which also provides a dynamic view of ongoing activity on the LCG. This map can be accessed at http://goc.grid-support.ac.uk/log2
Monitoring Overview

- **Why We Monitor**
  - Keep systems up and running
  - Notice failures; grid-wide services MDS;
  - Knowing what services a site should be running
    - No point raising an alert if the site isn’t meant to run it!
    - Definition of services and which sites run them (SLA)

- **What Tools Do We Use**
  - Job Submission; GridIce; Nagios; GIIS Monitor
  - How – Database
  - Developments Planned nagios
Monitoring Challenges

- We have only fragmentary information about the services that sites are running.
- We don’t know what RBs/SEs/Sites the VOs are using for data challenges.
- We don’t know what the core services are and who is running them.
- We don’t have a toolkit to test specific core services.
- We have to concentrate on functional behaviour of services e.g. If an RB sends your job to a CE, then we must assume the RB is working fine. Is this the only test of a RB?
- Not all the tests that we perform are effective at finding problems so we must take tests written by the experts and integrate them into GOC monitoring.
- We must develop tests which simulate the life cycle of real applications in a Grid environment.
- There are lots of monitoring tools available, so we need to bring them together.
- Do we spend time investigating new tools, or make the ones which we already have better?
- …and probably lots more!
Monitoring Services

- There are many frameworks which can be used to monitor distributed environments
  - MAPCENTRE  http://mapcenter.in2p3.fr/
  - GPPMON     http://goc.grid-support.ac.uk/
  - GRIDICE    http://grid-ice.esc.rl.ac.uk
  - NAGIOS     http://www.nagios.org/
  - MONALISA   http://monalisa.cacr.caltech.edu/
  - GIIS Monitor http://goc.grid.sinica.edu.tw/gstat/
  - Ganglia

  - Example: Mapcentre 30 sites ~ 500 lines in config file (static version)
  - Example: Nagios    30 sites, 12 individual config files with dependencies

  - Developed Tools to Configure these services to make the job easier
    NAGIOS, MAPCENTER and GPPMON
GOC Configuration Database

Secure Database Management via HTTPS / X.509
People, Contact Information, Resources
Scheduled Maintenance

Resource Centre
Resources & Site Information
EDG, LCG-1, LCG-2, …

GOC GridSite
MySQL

https
SQL

Monitoring

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GOC Job Submission Flow Diagram

1. SQL Query
2. Build List of CE, RB Resources
3. Sent acknowledge
4. GLOBUS.CE create
5. wget http://goc_ui/ack.cgi?GLOBUS.CE

Received acknowledgement

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Simple job through local jobmanager on CE via Resource Broker Job MatchMaking

wget http://goc_ui/ack.cgi?RB.CE

received acknowledgement

Build List of CE, RB Resources

JOB Script RB.CE

edg-job-submit

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LCG2 Site Status: 21 July 2004 10.00am
Nagios Monitoring - 1

Nagios is a powerful monitoring service that supports notifications, and the execution of remote agents to correct problems when faults are discovered.

- Advantages => proactively monitor grid (NRPE daemon)
- Automatic Configuration of Nagios based on Database
- Developed a set of plugins which focus on service behaviour and data consistency
  - Do RBs find resources?
  - Does Site GIIS’s publish hostname?
  - Is the site running the latest stable software release?
  - Does the Gatekeeper authentication service work?
  - Are the host certificates valid e.g Issued by Trusted CA
  - Are essential services running e.g GridFTP?
Service Summary for Nodes:

Certificate Lifetime Check, GridFTP, GRAM Authentication

<table>
<thead>
<tr>
<th>HOST</th>
<th>PLUGIN</th>
<th>STATUS</th>
<th>Last Check</th>
<th>Duration</th>
<th>Attempt</th>
<th>Status Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>adc0015.cern.ch</td>
<td>Certificate Lifetime</td>
<td>OK</td>
<td>03-02-2004 13:27:59</td>
<td>7d 21h 49m 45s</td>
<td>1/3</td>
<td>Certificate expires: (36)wks,(0)days,(0)hrs,(21)min,(34)sec</td>
</tr>
<tr>
<td></td>
<td>GlueCEInfoHostName</td>
<td>OK</td>
<td>03-02-2004 12:41:39</td>
<td>7d 21h 11m 39s</td>
<td>1/3</td>
<td>GlueCEInfoHostName attribute is adc0015.cern.ch</td>
</tr>
<tr>
<td></td>
<td>siteName</td>
<td>OK</td>
<td>03-02-2004 12:54:40</td>
<td>7d 20h 58m 7s</td>
<td>1/3</td>
<td>siteName is CERN-LCG01 dataGridVersion is LCG01-1_1_3</td>
</tr>
<tr>
<td></td>
<td>GateKeeper Authentication Test</td>
<td>OK</td>
<td>03-02-2004 13:07:49</td>
<td>7d 21h 49m 29s</td>
<td>1/3</td>
<td>GRAM Authentication test successful</td>
</tr>
<tr>
<td></td>
<td>GridFTP</td>
<td>OK</td>
<td>03-02-2004 13:28:00</td>
<td>7d 21h 31m 7s</td>
<td>1/3</td>
<td>GRIDFTP Test Pass</td>
</tr>
<tr>
<td>atlasgrid06.usatlas.bnl.gov</td>
<td>Certificate Lifetime</td>
<td>OK</td>
<td>03-02-2004 13:26:00</td>
<td>7d 21h 30m 25s</td>
<td>1/3</td>
<td>Certificate expires: (46)wks,(0)days,(0)hrs,(42)min,(29)sec</td>
</tr>
<tr>
<td></td>
<td>GlueCEInfoHostName</td>
<td>CRITICAL</td>
<td>03-02-2004 12:43:00</td>
<td>7d 21h 48m 20s</td>
<td>1/3</td>
<td>IO::Socket::INET: connect: Connection refused</td>
</tr>
<tr>
<td></td>
<td>siteName</td>
<td>CRITICAL</td>
<td>03-02-2004 12:55:32</td>
<td>7d 20h 57m 13s</td>
<td>1/3</td>
<td>IO::Socket::INET: connect: Connection refused</td>
</tr>
<tr>
<td></td>
<td>GateKeeper Authentication Test</td>
<td>OK</td>
<td>03-02-2004 13:08:30</td>
<td>7d 20h 43m 43s</td>
<td>1/3</td>
<td>GRAM Authentication test successful</td>
</tr>
<tr>
<td></td>
<td>GridFTP</td>
<td>OK</td>
<td>03-02-2004 13:26:20</td>
<td>7d 21h 48m 9s</td>
<td>1/3</td>
<td>GRIDFTP Test Pass</td>
</tr>
<tr>
<td></td>
<td>RRDtool</td>
<td>OK</td>
<td>03-02-2004 13:34:17</td>
<td>7d 21h 9m 3s</td>
<td>1/1</td>
<td>GRAM Authentication test successful</td>
</tr>
</tbody>
</table>
# GRIDICE - 1

[Image of GridICE logo]

[Website URL: http://grid-ice.esc.rl.ac.uk/gridice]

## GridICE: The Eyes of the Grid

### Site and Storage Resources Overview

<table>
<thead>
<tr>
<th>Site</th>
<th>Slot#</th>
<th>SlotFree</th>
<th>SlotLoad%</th>
<th>RunJob</th>
<th>WaitJob</th>
<th>Power</th>
<th>CPU#</th>
<th>CPULoad</th>
<th>Available</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>cern.ch</td>
<td>408</td>
<td>180</td>
<td>90%</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>67.5 Gb</td>
<td>69.1 Gb</td>
<td>2%</td>
</tr>
<tr>
<td>cnaf.infn.it</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>cr.cnaf.infn.it</td>
<td>2154</td>
<td>1036</td>
<td>33%</td>
<td>253</td>
<td>0</td>
<td>762647</td>
<td>387</td>
<td>5%</td>
<td>868.0 Gb</td>
<td>999.7 Gb</td>
<td>13%</td>
</tr>
<tr>
<td>fnal.gov</td>
<td>12</td>
<td>12</td>
<td>4%</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>fzk.de</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<td>-</td>
<td></td>
</tr>
<tr>
<td>gridka.de</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>gridpp.rl.ac.uk</td>
<td>458</td>
<td>273</td>
<td>57%</td>
<td>55</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>59.8 Gb</td>
<td>69.0 Gb</td>
<td>13%</td>
</tr>
<tr>
<td>grid.sinica.tw</td>
<td>294</td>
<td>294</td>
<td>99%</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>hep.ph.ic.ac.uk</td>
<td>126</td>
<td>126</td>
<td>99%</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>9.2 Gb</td>
<td>16.5 Gb</td>
<td>5%</td>
</tr>
<tr>
<td>ifae.es</td>
<td>460</td>
<td>400</td>
<td>86%</td>
<td>0</td>
<td>0</td>
<td>433978</td>
<td>160</td>
<td>9%</td>
<td>5.6 Tb</td>
<td>22.4 Tb</td>
<td>25%</td>
</tr>
<tr>
<td>nikhef.nl</td>
<td>500</td>
<td>230</td>
<td>46%</td>
<td>137</td>
<td>13</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.4 Tb</td>
<td>1.7 Tb</td>
<td>24%</td>
</tr>
<tr>
<td>triumf.ca</td>
<td>4490</td>
<td>30</td>
<td>96%</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>729.1 Tb</td>
<td>731.1 Gb</td>
<td>6%</td>
</tr>
</tbody>
</table>

**TOTAL**: 8902 | 2711 | 53% | 445 | 13 | 1196525 | 547 | 26% | 8.6 Tb | 25.9 Tb | 17% |

*Generated: Mon, 22 Mar 2004 15:50:30 +0000*
<table>
<thead>
<tr>
<th>Process Name</th>
<th>Status</th>
<th>Inst#</th>
<th>Instances</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>condor-scheduler</td>
<td>S</td>
<td>1</td>
<td>1-3:15</td>
<td>0-0:0</td>
</tr>
<tr>
<td>condor-master</td>
<td>S</td>
<td>1</td>
<td>1-3:15</td>
<td>0-0:0</td>
</tr>
<tr>
<td>tmon-agent</td>
<td>S</td>
<td>1</td>
<td>1-3:16</td>
<td>0-0:0</td>
</tr>
<tr>
<td>ftp-server</td>
<td>S</td>
<td>1</td>
<td>1-2:16</td>
<td>0-0:0</td>
</tr>
<tr>
<td>job-controller</td>
<td>S</td>
<td>1</td>
<td>1-3:15</td>
<td>0-0:0</td>
</tr>
<tr>
<td>local-logger</td>
<td>S</td>
<td>1</td>
<td>1-2:1</td>
<td>0-0:0</td>
</tr>
<tr>
<td>local-logger-interlog</td>
<td>S</td>
<td>1</td>
<td>1-4:1</td>
<td>0-0:3</td>
</tr>
<tr>
<td>logging-and-bookkeeping</td>
<td>S</td>
<td>11</td>
<td>1-2:55</td>
<td>0-0:0</td>
</tr>
<tr>
<td>log-monitor</td>
<td>S</td>
<td>1</td>
<td>1-3:11</td>
<td>0-0:0</td>
</tr>
<tr>
<td>network-server</td>
<td>S</td>
<td>1</td>
<td>1-3:13</td>
<td>0-0:0</td>
</tr>
<tr>
<td>proxy-renewal</td>
<td>S</td>
<td>4</td>
<td>1-3:16</td>
<td>0-0:0</td>
</tr>
<tr>
<td>workload-manager</td>
<td>S</td>
<td>4</td>
<td>1-3:16</td>
<td>0-0:0</td>
</tr>
</tbody>
</table>

**GridCE**

**Site view**

**Select Site**

**Role**

**Show**

**Full View**

---

**Generated:** Tue, 23 Mar 2004 15:12:58 +0000

**GridICE Homepage**
Ganglia Monitoring - 1

- [http://gridpp.ac.uk/ganglia](http://gridpp.ac.uk/ganglia)
- Can use Ganglia to monitor a cluster

RAL Tier-1 Centre
LCG PBS Server displays Job status for each VO
Ganglia Monitoring - 2

- Can also use Ganglia to monitor clusters of clusters

**GridPP Grid (2 sources) (tree view)**

- CPUs Total: 1036
- Hosts up: 437
- Hosts down: 9
- Avg Load (15, 5, 1m): 20%, 24%, 24%
- Localtime: 2004-07-22 18:26

**DZeroFarm ManHEP (physical view)**

- CPUs Total: 47
- Hosts up: 24
- Hosts down: 2
- Avg Load (15, 5, 1m): 44%, 45%, 44%
- Localtime: 2004-07-22 18:26

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Provide ROCs with a package to monitor the resources in the region
  - Tailored Monitoring
  - ROCs may upload their own maps
  - JAVA GUI to automate site locations on the map

Hierarchical view of Resources
  - Example GridPP made up of virtual T2 centres

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Regional Monitoring - 2

- [Link](http://goc.grid-support.ac.uk/roc_map/map.php)
- Active map to select individual regions
Regional Monitoring - 3

UK/I Monitoring displays GRIDPP and NGS resources.

- No information
- Scheduled Maintenance
- Timeout
- Globus OK
- RB OK

Map of the UK showing various locations and markers for monitoring sites.
Replica Manager Tests - 1

• GOC to take over site certification testing which is done by CERN deployment team on a daily basis (e.g reports by Piotr Nyczwyk)

• First step toward this involves running a series of replica manager tests which register files onto the grid, move them around, delete them; and 3rd party copies from remote SE e.g Castorgrid

• **Demonstrates that we can integrate other peoples tools into GPPMON**

• Development of a portal which will:
  – Make it easy to retrieve debug information from the job output.
  – Connect with information provided by other monitoring tools e.g Taipei GIIS Monitor.
  – Provide testing “on-demand” to site administrators through a secure interface.
Replica Manager Tests - 2

http://goc.grid-support.ac.uk/gridsite/status/rmtest.php?action=table

Results of each test are shown as a coloured index on the map.

Distinguish between jobs that have completed, or have failed or still running.
### GIIS Monitor Information

<table>
<thead>
<tr>
<th>Site CE</th>
<th>GIIS Monitor</th>
<th>PrintInfo</th>
<th>CopyAndReg. WN &gt; defaultSE</th>
<th>Copy defaultSE &gt; WN</th>
<th>Replicate defaultSE to castorgrid</th>
<th>3rd Party Rep. castorgrid to defaultSE</th>
<th>Copy replica to WN</th>
<th>Delete Replica from defaultSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>atlas-hep-INFN</td>
<td>ldap://ibm140.cern.ch:2170</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
</tr>
<tr>
<td>atlassc.fis.infn.it</td>
<td>ldap://ibm140.cern.ch:2173</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
</tr>
<tr>
<td>biomac-lpc-INFN</td>
<td>ldap://ibn1183.cern.ch:2170</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
</tr>
<tr>
<td>cern-0001.desy.mp-mppc.ac.uk</td>
<td>ldap://ibn1183.cern.ch:2170</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
</tr>
<tr>
<td>ce01.in2p3.fr</td>
<td>ldap://ibn1183.cern.ch:2170</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
</tr>
<tr>
<td>ca01.lip.pt</td>
<td>ldap://ibn1183.cern.ch:2170</td>
<td>OK</td>
<td>FAILED</td>
<td>FAILED</td>
<td>FAILED</td>
<td>FAILED</td>
<td>FAILED</td>
<td>FAILED</td>
</tr>
<tr>
<td>ca01.ph-gmu.ac.uk</td>
<td>ldap://ibn1183.cern.ch:2170</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
</tr>
<tr>
<td>ca1.co.rhu.ac.uk</td>
<td>ldap://ibn1183.cern.ch:2170</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
</tr>
<tr>
<td>ce.qrdpp.hef.ac.uk</td>
<td>ldap://ibn1183.cern.ch:2170</td>
<td>OK</td>
<td>FAILED</td>
<td>FAILED</td>
<td>FAILED</td>
<td>FAILED</td>
<td>FAILED</td>
<td>FAILED</td>
</tr>
<tr>
<td>ceitep.itp.ac.cn</td>
<td>ldap://ibn1183.cern.ch:2170</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
</tr>
<tr>
<td>ce-prd.hp.com</td>
<td>ldap://bdii.prd.hp.com:2170</td>
<td>OK</td>
<td>FAILED</td>
<td>FAILED</td>
<td>FAILED</td>
<td>FAILED</td>
<td>FAILED</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Description of the tests

- **PrintInfo**: Status of print information.
- **CopyAndReg. WN > defaultSE**: Status of copying and registering from WN to defaultSE.
- **Copy defaultSE > WN**: Status of copying from defaultSE to WN.
- **Replicate defaultSE to castorgrid**: Status of replicating from defaultSE to castorgrid.
- **3rd Party Rep. castorgrid to defaultSE**: Status of third-party replication from castorgrid to defaultSE.
- **Copy replica to WN**: Status of copying replica to WN.
- **Delete Replica from defaultSE**: Status of deleting replica from defaultSE.

---

**Job Outputs**

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GIIS Monitor

- Developed by MinTsai (GOC Taipei)
- Tool to display and check information published by the site GIIS
Job Accounting -1

http://goc.grid-support.ac.uk/ROC/docs/accounting/accounting.php
Program publishes PBS log file information through RGMA to the GOC

LCG Accounting Flow

GOC aggregates data across all sites.

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Job Accounting - 2

- Offline testing of program using data from the CORE sites completed.
- Development of an accounting portal underway to provide accounting on-demand for each site, and aggregated for each EGEE region.
- Challenge! Deal with large database 1 ROW per LCGPBS Job per Site!
- [http://goc-dev.esc.rl.ac.uk/jpg/goc_demo.php](http://goc-dev.esc.rl.ac.uk/jpg/goc_demo.php)
- [http://goc-dev.esc.rl.ac.uk/jpg/goc_demo3.php](http://goc-dev.esc.rl.ac.uk/jpg/goc_demo3.php)
EDG-network monitoring
Security

- Worked with Security Group
- Defined a Security Policy
  - and auditing procedures
- Have a list for security contacts
  - but not really exercised it yet
  - still need to define procedures in the event of security incidents
Keeping the Work Flowing

• Regular monitoring of job submission
  – shows sites that have problems running jobs
• Nagios tracks individual services
  – plus certificate lifetime
• RM tests show whether data can be moved
• GridICE and Ganglia show what is running

• Limited by RB behaviour
  – we can see that jobs are not getting to sites but not why.
What we have delivered?

- A set of monitoring tools
- A monitoring regime
- Two GOCs (RAL and Taipei)
- Security Policy
Still to do

• Effective problem tracking
  – we see site problems and get them fixed
  – but don’t manage long-term problems

• Integration with User Support
  – we track problems we see
  – but problems users notice not effectively dealt with

• Automatic alerts
  – Nagios does but EMS from Taipei looks promising

• Remote repair
  – agents until middleware can support this directly

• Security
• Deploy accounting
• Distribute monitoring to EGEE ROCs and others