RAL Tier-1

Meeting national aspirations and international obligations for UK particle physics

Tier-1 Opening
30th March 2010

Prof. David Britton
GridPP Project leader
University of Glasgow
The LHC and Experiments

Mont Blanc
Geneva
Airport
Switzerland
France

CMS
ATLAS
http://atlas.web.cern.ch/Atlas/public/EVTDISPLAY/MovieSmall.mp4
The CMS Detector

Iron yoke

ECAL
Crystals $\eta < 3.0$

Brass/scintillator tiles $\eta < 5.0$

HCAL

4T solenoid

Tracker

Si Microstrips
Pixels $\eta < 2.5$

Barrel Muon

Drift tube chambers + RPC

Endcap Muon

Cathode strip chambers + RPC

Total weight: 12,500 t
Overall diameter: 15 m
Overall length: 21.6 m
Magnetic field: 4 T

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- **Iron yoke**
- **ECAL**: Crystals $\eta < 3.0$
- **Brass/scintillator tiles**: $\eta < 5.0$
- **HCAL**
- **4T solenoid**
- **Tracker**
- **Si Microstrips**: Pixels $\eta < 2.5$
- **Barrel Muon**
- **Drift tube chambers + RPC**
- **Endcap Muon**: Cathode strip chambers + RPC
- **Total weight**: 12,500 t
- **Overall diameter**: 15 m
- **Overall length**: 21.6 m
- **Magnetic field**: 4 T
A national and international role:

Useful model for Particle Physics but not necessary for others
A suitable Tier-1 god? Janus, the Roman god of gates/doorways
The Data Deluge

- ~100 million electronic channels
- 600 million p-p collision/sec

- 10-15 PB of data/year
- In 2010, requires 1100 KHSO6 (130,000 modern cores) and 200 PB of storage (disk + tape) globally
- In 2011 these increase by 30% and 50% respectively
## Tier-1 Role

<table>
<thead>
<tr>
<th></th>
<th>Tier-0</th>
<th>Tier-1</th>
<th>Tier-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALICE</td>
<td>First-pass scheduled reconstruction</td>
<td>Reconstruction On-demand analysis</td>
<td>Central simulation On-demand analysis</td>
</tr>
<tr>
<td>ATLAS</td>
<td></td>
<td>Reconstruction Scheduled analysis/skimming Calibration</td>
<td>Simulation Group and User analysis Calibration</td>
</tr>
<tr>
<td>CMS</td>
<td></td>
<td>Reconstruction Scheduled analysis/skimming</td>
<td>Simulation Group and User analysis Calibration</td>
</tr>
<tr>
<td>LHCb</td>
<td></td>
<td>Reconstruction On-demand analysis Scheduled skimming</td>
<td>Simulation</td>
</tr>
</tbody>
</table>
A Little History

From http://www.gridpp.ac.uk/news

Feb 2000:  *RAL was chosen as the location of the prototype Tier-1 centre because it already hosted the UK BaBar computing centre and had a long history of delivering large scale computing and data storage...*

Mar 2002:  *RAL included in successful deployment of DataGrid*  
For the EU Review of DataGrid on 1st March a testbed Grid of five sites was successfully deployed at CERN, RAL, IN2P3-Lyon, CNAF-Bologna and NIKHEF. Demonstrations included jobs running at all sites and the movement of data between them.

Mar 2002:  *First TierA/Prototype Tier1 Hardware delivered*  
Three racks holding 156 dual CPU PCs arrived, a total of 312 1.4GHz Pentium III CPUs. This is a big increase in power as the existing 250 CPUs range from 450MHz to 1GHz. Each box has 1GB of memory, a 30GB internal disk and 100Mb ethernet.

*Next procurement will deliver 45x this computing power in 2011*
Hardware requirements have increased exponentially - fortunately Moore’s Law has held true with about the same time constant.
Tier-1 Connectivity

To/from the UK Tier-2s

To/from CERN and the other Tier-1s
Receiving Data - OPN Network

10Gb optical link to CERN with backup link being installed

STEP09 full-scale exercise in June 2009
### T0-T1 Data Rates

<table>
<thead>
<tr>
<th>Link</th>
<th>In</th>
<th>Out</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average</td>
<td>Maximum</td>
</tr>
<tr>
<td>ASCG</td>
<td>553Mbps</td>
<td>1.71Gbps</td>
</tr>
<tr>
<td>BNL Primary</td>
<td>681Mbps</td>
<td>2.67Gbps</td>
</tr>
<tr>
<td>BNL Backup</td>
<td>74Mbps</td>
<td>837Mbps</td>
</tr>
<tr>
<td>CNAF</td>
<td>193Mbps</td>
<td>1.33Gbps</td>
</tr>
<tr>
<td>FNAL Primary</td>
<td>713Mbps</td>
<td>2.02Gbps</td>
</tr>
<tr>
<td>FNAL Backup</td>
<td>1Mbps</td>
<td>21Mbps</td>
</tr>
<tr>
<td>IN2P3</td>
<td>797Mbps</td>
<td>2.31Gbps</td>
</tr>
<tr>
<td>KIT</td>
<td>689Mbps</td>
<td>2.23Gbps</td>
</tr>
<tr>
<td>NDGF</td>
<td>24.8Mbps</td>
<td>161Mbps</td>
</tr>
<tr>
<td>NLT1</td>
<td>266Mbps</td>
<td>1.57Gbps</td>
</tr>
<tr>
<td>PIC</td>
<td>1.07Gbps</td>
<td>3.81Gbps</td>
</tr>
<tr>
<td><strong>RAL</strong></td>
<td><strong>1.10Gbps</strong></td>
<td><strong>3.46Gbps</strong></td>
</tr>
<tr>
<td>TRIUMF Primary</td>
<td>190Mbps</td>
<td>923Mbps</td>
</tr>
<tr>
<td>TRIUMF Backup</td>
<td>5Mbps</td>
<td>263Mbps</td>
</tr>
</tbody>
</table>
- RAL was the best ATLAS Tier-1 after the BNL ATLAS-only Tier-1

- Glasgow ran more jobs then any of the 50-60 ATLAS Tier-2 sites throughout the world.

- Most Tier-2 sites made good contributions and many gained valuable insight into tuning issues during STEP09 and subsequent testing.

- “The responsiveness of RAL to CMS during STEP09 was in stark-contrast to many other Tier-1s.”

- CMS noted the tape performance at RAL was very good as was the CPU efficiency.

- Many (if not all) the metrics for the experiments were met, and in some cases, significantly exceeded at RAL during STEP09.
Resources in 2009

Delivering Resources...

... to the LHC experiments and beyond

An essential part of GridPP

David Britton, University of Glasgow

RAL Tier-1
GridPP supports around 40 Virtual Organisations (VOs) beyond the LHC experiments who harvest unused cycles in an opportunistic mode.
Report explicitly mentions:

- GridPP’s expertise in large-scale distributed data management and analysis.
- Our work with start-up companies.
- The substantial secondary economic benefit arising from the ability to rapidly screen drugs "in-silico". GridPP resources were used in this way to screen potential agents in the fight against bird-flu and malaria.

“NGS and GridPP have been highly successful, providing many users with access to more computing power than they could otherwise easily obtain. Looking forward, we recommend that these efforts, including enhanced capacity and function of distributed storage, be sustained and expanded.”

David Britton, University of Glasgow
The LHC has started and is likely to run throughout 2010 and 2011 before a significant break. This covers GridPP3 → GridPP4.

Computing is required, as much as the detectors and the machine, in order to extract the physics. Collaborative and Competitive environment.

GridPP has a responsibility and an obligation to deliver to the UK and an international community.

The EU backdrop is complex; but is now starting to come into focus with the development of the EGI.

The UK context is responsive to the European developments with the formation of an NGI based on GridPP and the NGS.
GridPP operates the largest scientific Grid in the UK and has a vested interest in ensuring the UK NGI meets the needs of the large community we serve.

We have identified certain tasks that are absolutely required by GridPP and wLCG, which have wider UK applicability and would sensibly be done in close collaboration as part of a larger team within a UK NGI: Security, accounting, monitoring and some aspects of regional support.
A complex and evolving situation requiring constant management. Historically we have seen the integrated requirements are reasonably “good-and-improving” estimates of actual needs.
GridPP4 and the Tier-1

- Castor Team
- Database Team
- Grid Team
- Production Team
- Fabric Team
- Networking Support
- Machine room operations

Today’s talks!
## OPS SAM Tests

<table>
<thead>
<tr>
<th>Test Type</th>
<th>Date</th>
<th>Added by</th>
<th>Subject</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CREANCE</td>
<td>09/18/2010</td>
<td>Tiju Idicula</td>
<td>Status</td>
<td>No known operational issues.</td>
</tr>
<tr>
<td>SRMv2</td>
<td>09/18/2010</td>
<td>Tiju Idicula</td>
<td>Status</td>
<td>No known operational issues.</td>
</tr>
<tr>
<td>PFS</td>
<td>10/29/2010</td>
<td>John Kelly</td>
<td>Failed SAM test overnight</td>
<td>We failed one SAM test overnight for labdil, gridpp.rl.ac.uk. There are no other known issues.</td>
</tr>
<tr>
<td>LFC L</td>
<td>10/29/2010</td>
<td>John Kelly</td>
<td>Quiet night</td>
<td>No known problems. The scheduled LFC downtime may end early as the work is almost complete.</td>
</tr>
</tbody>
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## Atlas SAM Tests

<table>
<thead>
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<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE</td>
<td>10:45/2010</td>
<td>John Kelly</td>
<td>Quiet night</td>
<td>No known problems. The scheduled LFC downtime may end early as the work is almost complete.</td>
</tr>
<tr>
<td>SRMv2</td>
<td>10:45/2010</td>
<td>John Kelly</td>
<td>Quiet night</td>
<td>No known problems. The scheduled LFC downtime may end early as the work is almost complete.</td>
</tr>
<tr>
<td>PFS</td>
<td>09:17/2010</td>
<td>Catalin Conduruche</td>
<td>Quiet night</td>
<td>A quiet night with no callouts - no known operational issues.</td>
</tr>
</tbody>
</table>

## Alice SAM Tests

### Disk servers in Intervention

- No machines in intervention

## CMS SAM Tests

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<tr>
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<tr>
<td>CE</td>
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<td></td>
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</tr>
<tr>
<td>SRMv2</td>
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</table>

## LHCB SAM Tests

<table>
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<th>Subject</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>CREANCE</td>
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</tr>
<tr>
<td>CE</td>
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</tr>
<tr>
<td>SRMv2</td>
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<td></td>
</tr>
<tr>
<td>LFC L</td>
<td></td>
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</tbody>
</table>

## Downtimes

- No ongoing downtime
- Downtimes during next 2 weeks

<table>
<thead>
<tr>
<th>Downtime ID</th>
<th>Hosts</th>
<th>Start time</th>
<th>End time</th>
<th>Severity</th>
<th>Description</th>
</tr>
</thead>
</table>

### LHC Data!

- RAL Tier-1 Farm Capacity during last week
- RAL Tier-1 Farm Queued and Running
- RAL-LCG2 Tier-1 FTS Active Transfers (All Channels)

David Britton, University of Glasgow

RAL Tier-1
Latest SAM results, Site Status, for 'OPS' VO, 30 Mar 2010 10:26 GMT.
Size of site rectangles is number of CPUs from BDII.
Certified Production sites, grouped by regions.
"Janus was frequently used to symbolize change and transitions such as the progression of past to future, of one condition to another, of one vision to another, the growing up of young people, and of one universe to another." wikipaedia
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