RHIC Computing Facility

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DOE RHIC Program Review
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RHIC Computing Facility (RCF) Mission

- Formally Initiated In 1997
- Supply Computing Infrastructure for RHIC Exper.
  - Including code development, repository, & distribution
- Supply resources & systems for the production processing of RHIC data
  - Raw data recording
  - Reconstruction
  - Data mining
  - Analysis
- Production simulation *not* part of the RCF mission
Context

The RHIC & ATLAS Computing Facilities (RCF & ACF) are currently co-located and co-operated on the raised floor area of Bldg 515, ITD.

Fully integrated support staff of 25.5 FTE’s
- 20 FTE’s from RHIC
- 4.5 FTE’s from ATLAS
- 1 FTE’s DOE MICS/Data Grid

ACF is US Tier 1 Regional Center for ATLAS

Emphasis here will be RCF, mission as described

Strong synergy between RCF & ACF in the form of
- Shared expertise and operational support
- Shared infrastructure components
Summary For Past Year

- RCF in a Production Mode
- Provided Storage and Processing for RHIC Run-3
- Implemented RCF Upgrades
Mass Storage Subsystem

- Hierarchical Storage Management by HPSS
- 4 StorageTek robotic tape silos
  - ~24,000 tape cartridges
  - 4.5 PBytes
- Tape drives
  - 1000 MB/sec
Mass Storage (cont.)

RHIC Run-3

- Raw data recording at rates up to 120 MByte/sec
- RAW data volume was 180 TB
- Total of ~236 TB to date including derived data, but still in the early stages of reconstruction and analysis.
- System ran well
Mass Storage (cont.)

PHENIX Data Sinking – May 7 to May 14

STAR Data Sinking – March 5 to March 12
Processor Farms Subsystem

- Hardware is soft partitioned by experiment according to allocation
- CRS Farms have restricted access and locally produced control software
- CAS Farms have interactive access and batch queues managed by LSF

Hardware
- ~2050 CPU’s
  - … total capacity ~100 kSPECint95 (2+ TFLOPS)
Processor Farms (cont.)

For Run-3

- Approximately 335,000 jobs processed in CRS Farm to date
- Approximately 3,353,000 jobs processed through LSF in the CAS Farm.
RAID Disk Subsystem

FibreChannel Storage Area Network
- Brocade Switches 1x64 + 2x16
- ~30 RAID controllers 2-3 GBytes/sec
118 TBytes of RAID 5 storage
Capital Procurement Plan

- Majority of FY’03 funds committed at the beginning of the year to prepare for Run-3
- Example rate plots show we could have sustained substantially higher rates expected during the run
- Detailed plan for FY’04 not yet available – we will begin next round of “requirements” meetings soon
- FY’04 will see significant fraction of funds going into replacing old equipment
Computing Capacity Comparisons (Apr ’03)

- CPU (kSPECint2000)/10
- Centrally Served Disk (TBytes)/2
- Other Disk (TBytes)
- Mass Storage (TBytes)/40
- Mass Storage I/O (MBytes/sec)/10

BNL
Fermilab
JLAB
SLAC
Computing Capacity Comparisons (Jul ’02)

- CPU (kSPECint2000)/10
- Centrally Served Disk (TBytes)/2
- Other Disk (TBytes)
- Mass Storage (TBytes)/40
- Mass Storage I/O (MBytes/sec)/10

Graph showing comparisons of computing capacity among BNL, Fermilab, JLab, and SLAC.
Staffing

 сравнивается количество сотрудников в различных организациях (Fermilab имеет сопоставимую миссию):

Fermilab('02) SLAC('02) RHIC('03)
70 16.5 20.0

отчет о ревизии DOE Facility Operations Review of RHIC, февраль 2002:"

The RHIC computing facility is the one area that does immediately need increased resources. We recommend the addition of ~3 FTE to ensure that the ever-growing analysis and logging capacities are available to the users in a timely fashion.”

RCF/US ATLAS Computing Facilities Effort By Funding Source

<table>
<thead>
<tr>
<th>Funding Source</th>
<th>Initial RCF Plan</th>
<th>FY 2002 Actual</th>
<th>FY 2003 Actual</th>
<th>FY 2004 Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>NP Operating *</td>
<td>18</td>
<td>19.5</td>
<td>20</td>
<td>22</td>
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<tr>
<td>ITD/BNL Contrib.</td>
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<td>0</td>
<td>0</td>
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<td>RHIC Experiment Contrib.</td>
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<td>Δ</td>
<td>Δ</td>
<td>Δ</td>
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<tr>
<td>TOTAL RHIC</td>
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<td>20</td>
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<tr>
<td>HEP/US ATLAS</td>
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<td>6.5</td>
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<tr>
<td>MICS/Data Grid</td>
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<td>1</td>
<td>0.5</td>
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<tr>
<td>TOTAL</td>
<td>34</td>
<td>24.5</td>
<td>25.5</td>
<td>29</td>
</tr>
</tbody>
</table>

Δ Not well defined, probably of order 2 FTE’s

* Includes 1 FTE of hardware support from ITD
RCF Staffing Issues

- RCF staff still lean
- While so far RCF has functioned well,
  - Availability and reliability … has been good
  - Capacities … have been more than adequate
- …once again, lower than anticipated demands during Run-3 resulted in less stress on the facility
- There have been, and continue to be, significant areas receiving inadequate attention
Where Staffing is Needed

- Large Scale Online Storage (RAID Disk)
  - Performance/reliability tuning of existing systems
  - Integration of new acquisitions
  - Technology tracking (NAS, IDE RAID)

- CPU Farms
  - Increased 3rd party product support
  - Evolution of cluster management to increase flexibility
  - OS & Kernel evolution
  - System image export to desk tops etc.

- Wide Area Data Distribution
  - Tape copy
  - WAN tuning
  - Direct secure remote HPSS access
  - Data Grid deployment

- Facility Cyber Security
  - ITD, peer site, and Data Grid compatibility
RHIC Computing Facility Summary

RCF has performed well during past runs
It is in position to effectively support analysis of data in hand
Success to date is, in part, a result of moderate data pressure & judicious application of very dedicated but limited personnel
February 2002 DOE Operations Review of RHIC recommended an increase of three FTE’s, which should help in a major way, but will still fall short by 1.5 FTE of the 24 FTE’s we estimated the facility requires