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Exploitation of heterogeneous resources for ATLAS Computing

Jiří Chudoba on behalf of the ATLAS collaboration

7. 7. 2018

Institute of Physics (FZU) of the Czech Academy of Sciences
ATLAS general introduction (number of collisions, data rates and volumes, CPU requirements)

Usage of Grid as the main resource
- geographic distribution of resources
- heterogeneity of resources

ATLAS Solutions for Grid
- PanDA, JEDI, Rucio

Newer types resources

HPC
- harvester, ARC cache, huge variations in number of cores

Clouds

ATLAS@Home
Collaboration of more than 3000 authors from 182 institutes – grant data access to all

Large number of channels + High trigger rates = Huge data volumes
Computing requirements

Still increasing:

LHC luminosity

ATLAS 2018 requirements
186 PB on disk
289 PB on tape
2520 kHS06 CPU years
Z -> μ⁺μ⁻ with additional 28 vertices
WLCG connects sites distributed across 5 continents

- “EGI” sites with various implementation of CEs and SEs
- OSG sites

<table>
<thead>
<tr>
<th>WLCG Capacities in 2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>cores</td>
</tr>
<tr>
<td>CPU capacity</td>
</tr>
<tr>
<td>disk</td>
</tr>
<tr>
<td>tape</td>
</tr>
</tbody>
</table>

US capacities not included
ATLAS Distributed Computing Solutions

Big effort to maximize resource usage and to automatize workflows

**PanDA workload management system**
- Used by ATLAS since 2008, now adopted also by other projects
- Pilot based
- Factorized code
Rucio

– Distributed Data Management System
– Developed for ATLAS, but now used and evaluated by other projects
– Handles 1 Billion ATLAS files, 365 PB
JEDI

– Job Execution and Definition Interface
– Dynamic job definition from tasks
Pilot

- Control and benchmark execution node
- Get jobs
- Monitor
- Stage-in, stage-out
- Cleanup
Differences between HPC and HTC

– Architecture
– Authentication
– Network access
– Access model
Harvester

- New component between Pilot and PanDA
- Running on site
- Stateless service plus DB
Event Service

- reduces lost CPU time in case of premature job termination
- important for backfilling HPC resources
- Successful business model
- Huge resources provided by commercial clouds
  - All LHC computing need covered by less than 1%
  - But significantly more expensive (apart from spot market)
  - Option for peak demands
- Private clouds enable better sharing with other groups
- Fully integrated in the ATLAS infrastructure
  - “Standard” CE exposed by clouds
  - Details hidden by local setup
    - HTCondor, ARC
- Cloud Data storage used mostly for log files
  - Not (yet) suitable for big volume data storage
- Open-source software for volunteer computing
- Uses the idle time of (personal) computers
- VirtualBox used for various platforms (Windows, Mac, Linux)
- Easy to use for laymen
- Also great for outreach
New use cases on clusters
- clusters not supporting ATLAS VO
- clusters supporting ATLAS VO

Example of Beijing Tier2 site
- Grid jobs walltime utilization 88%, cputime 66%
- additional 23% of cpu utilization

<table>
<thead>
<tr>
<th>Rank</th>
<th>Name</th>
<th>Recent average credit</th>
<th>Total credit</th>
<th>Country</th>
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</thead>
<tbody>
<tr>
<td>1</td>
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<td>1,172,053,424</td>
<td>Switzerland</td>
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<td>2</td>
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<td>LRZ-LMU</td>
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<td>10,176,386</td>
<td>Germany</td>
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</tbody>
</table>
ATLAS Offline Computing successfully uses various resources with still increasing automation of workflows.

But it remains a huge distributed effort in terms of manpower for development and operations.

We greatly appreciate also non-pledged resources.

Thank you for your attention!