Track 4

Middleware,
software development and tools,
experiment frameworks,
tools for distributed computing

Marco Clemencic
on behalf of the conveners of Track 4
I tried to summarize all oral contributions and give a view of all the great work done. I apologize if I have missed something.

I'm very sorry that I did not manage to cover the posters.
Overview of Track 4

• 42 orals + 48 posters
• Heterogeneous contributions
• Roughly grouped in categories:
  − Middleware
  − Framework
  − Application
  − Software
• Boundaries often fuzzy, so I reorganized them
Overview of Track 4

• LHC experiments dominating the scene
• Very valuable contributions from
  - Non-LHC/HEP experiments
  - Service providers
  - Computing centers
  - Etc.
Overview of Track 4

- We discussed mainly about middleware
- But also about frameworks and tools
- A lot of work has been done on improvements
  - “rewrite” is not a bad word, don't be afraid
- Sharing efforts seems the key to success
Middleware

• Contributions on
  – Job Management/Pilots
  – Data Management
  – Network Awareness
  – Multicore
Middleware

Job Management / Pilots

- CMS and LHCb showed how pilots can bring uniformity to the Grid
Middleware

Job Management / Pilots

- CMS commissioned CRAB3

- Complete re-implementation
- Integrates with CMS new developments
  - GlideInWMS Global Pool
  - Asynchronous Stage-Out
Middleware

Job Management / Pilots

• ATLAS presented an overview of the evolution of PanDA in preparation for RUN2

The Future of PanDA in ATLAS Distributed Computing


University of Texas at Arlington, USA
Brookhaven National Laboratory, USA
Joint Inst. for Nuclear Research, RU
Argonne National Laboratory, USA

CHEP2015, Okinawa, Japan, April 13-17 2015

• Dynamic Jobs
• Network Awareness
• Event Service
• New Pilot
• Support for HPC
• New Monitoring
Middleware

Job Management / Pilots

- We have seen how MIRA became the primary Alpgen event generation site for ATLAS via integration with PanDA
Middleware

Job Management / Pilots

- Many contributions on ARC Control Tower
  - Job Management Layer in front of ARC-CE

**Push vs Pull Model**

![Diagram showing Push vs Pull Model](image)

**Example 3: Connecting Norwegian HPC sites for Life Sciences**

- Problem: Galaxy only supports one cluster per instance -> no load balancing between clusters
- Solution:
  - Each site installs ARC CE
  - Galaxy pushes jobs to aCT
  - aCT takes care of load balancing as part of job management
- Requires developing an aCT plugin in Galaxy
Middleware
Job Management / Pilots

• HTCondor-CE
  - use HTCondor to provide a CE interface

• It's a special configuration of HTCondor
• Choice strategic and technical
Middleware

Job Management / Pilots

- BelleII adopted DIRAC for their Production System

![Production system diagram]

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**Middleware**

**Job Management / Pilots**

- IHEP and GridPP extended DIRAC to support their many (small) VOs
Fermilab combined existing tools to provide a new Distributed Computing system: FIFE

FIFE Architecture: Job Management & Software Distribution

- Job Submission Tools
  - JobSub
    - Suite of tools to simplify & manage job submission
    - Provides scalable & Highly Available job submission service
- Resource Provisioning
  - GlideinWMS
    - Pilot-based WMS that creates on demand a dynamically-sized overlay condor batch system on Grid & Cloud resources to address the complex needs of VOs in running application workflows
- Software Distribution
  - CVMFS
    - Network file system based on HTTP
    - Optimized for software distribution in a fast, scalable and reliable way
- Data Transfer Client
  - ifdh
    - FIFE Data handling tool
    - Provides common interface for transferring data to/from different storage services like file systems, SAMWeb, dCache, Amazon S3
LHCb can gracefully stop simulation jobs just before the allocated time is over.
Middleware

Job Management / Pilots

- LHCb showed how to predict required resources
- ALICE studied how to increase security on the Grid

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**Project main goals**

- Improve computer security in the GRID by:
  - Intrusion prevention
  - Security by isolation
  - Intrusion detection
  - Analysis of Job behavior
  - Machine learning
Middleware

Data Management

- ATLAS implemented Rucio, a new Distributed Data Management tool

Replacement for DQ2

Flexible Quotas and Accounting

Workflow

Figure: Rule creation

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**Middleware**

**Data Management**

- CMS implemented Asynchronous stage-out to avoid that jobs fail during data transfer
Middleware

Data Management

- Fermilab re-engineered SAM with new interface while maintaining operations
Middleware

Network Awareness

- CMS and ATLAS showed uses of Network Awareness

**CMS improves data transfers**

**ATLAS improves job submission**

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**Results using the prototype**

- Seamless path switch
  - Per job link rates with PhEDEx traffic
    - ~620MB/sec -> 1060 to 1250MB/sec
  - Average link rates with PhEDEx traffic
    - ~570MB/sec -> ~1050MB/sec

**Jobs Using FAX for Remote Access**

- Completed jobs (Sum: 14,559,951)
  - About 4% of jobs access data remotely
  - Through federated XRootD

**Remote site is selected based on network performance**

Data for October 2014

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Middleware

Multicore

- Report from WLCG Multicore Task Force
  - ATLAS and CMS cases

- Good progress
- It works already
- Fine tuning needed
• CMS reported on their successful use of multicore jobs on the Grid
• Ready for RUN2
Middleware

Multicore

• Interesting report of the importance of multicore awareness in data transfers

MDTM Early Test Evaluation

• Wide-area network links, end-to-end tests
• Performance comparison with GridFTP, bandwidth captured at ESnet’s edge router

Parallel large file transfers (16 streams, 2TB, 8MB blocks), from SSDs to /dev/null, with 40Gbps links and 50Gbps aggregate disk bandwidth
Frameworks

- Contributions on
  - Experiment frameworks
  - Monitoring frameworks
  - Validation frameworks
  - Analysis frameworks
Experiment Frameworks

- IceCube presented their new IceProd2

- Complete rewrite on
  - Python
  - SQLite
  - CVMFS
  - Web API
  - Pilot jobs
  - User permissions
Experiment Frameworks

- Reports on ROOT 6 and beyond
  - Impossible to summarize all the changes, see #441
  - Impressive work on optimization and validation

**Conclusion**

- **ROOT** Modernization underway
  - Starting to add **new** API that will overtime replace then deprecated historical API
  - Making writing [physics [analysis]] code even simpler, more intuitive and more robust

- Main Driving Principles
  - Simplicity
  - Robustness
  - Performance
    - Embrace multi-tasking and vectorization
    - Provide even better features
    - Continue our many collaborations (e.g. **Python, R, I/O**)

**Start up Time**

- Very first feature seen by the user
  - Baseline: ROOT5, ~100 ms (Python 2.7 ~20 ms)

**Solution:**

- Leverage PCH to store I/O information of ROOT most used classes (Hist, RooFit, …)
- Optimise data structures and algorithms holding/manipulating autoloading info: e.g. use STL!
- Optimise reading of ROOTmap files

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Monitoring Frameworks

- From DESY we saw how to display dCache accounting informations.

Outline

The Flow

- Collector
- Parser
- Processor
- Selector
- Visualizer

logstash

elasticsearch

kibana
Monitoring Frameworks

- The quantitative monitoring of FTS3 has been crucial for commissioning and production.
Validation Frameworks

- Geant4 has been used as a test bench to study
  - Testability
  - Statistical analysis of software quality
Validation Frameworks

- Validate Puppet configuration in Jenkins-CI
- Validate ATLAS Shifter Assistant directives
LHCb showed that it is possible to apply the SCRUM agile methodology to physics analysis.
Tools
Tools

- ATLAS presented the new incarnation of their Software Installation System
Tools

- ATLAS decided to leverage on standard Message Queue technologies to synchronize Data Quality Monitoring tasks.
Tools

• From ATLAS we saw an interesting new way of developing web interfaces

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Tools

- From SLAC a great contribution for debugging Grid jobs
Tools

- Deep insight on the features of IgProf
  - a feature rich profiler for HEP
  - including power monitoring for energy efficient code
Tools

- CERN developed an EOS-based Dropbox alternative: CERNBox
Conclusions

- We are working for a better (computing) world
  - Continuous efforts towards improvements
  - Sometimes “rewrite” is good
- Common solutions are beneficial to many
- Many are beneficial to common solutions
I want to thank the organizers for the great work they have done to make CHEP 2015 a success

Thank you!