

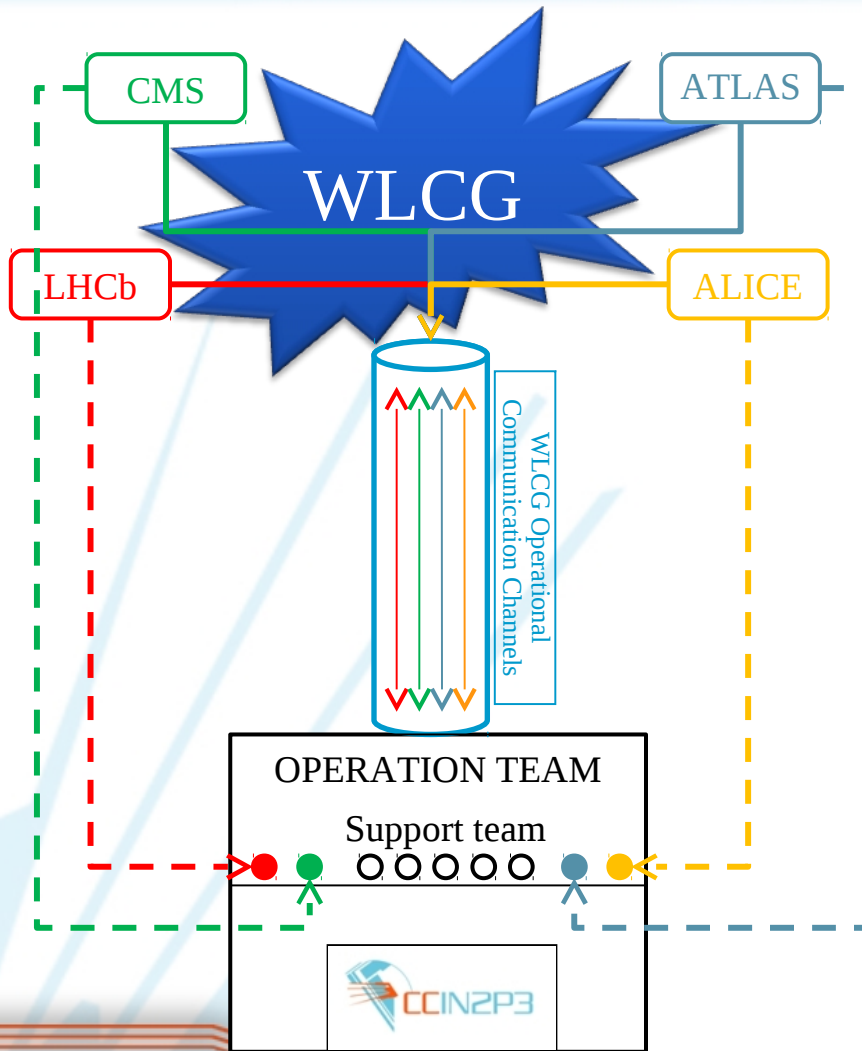


Status of LHC computing activities at CCIN2P3

Renaud Vernet – Jun. 2014

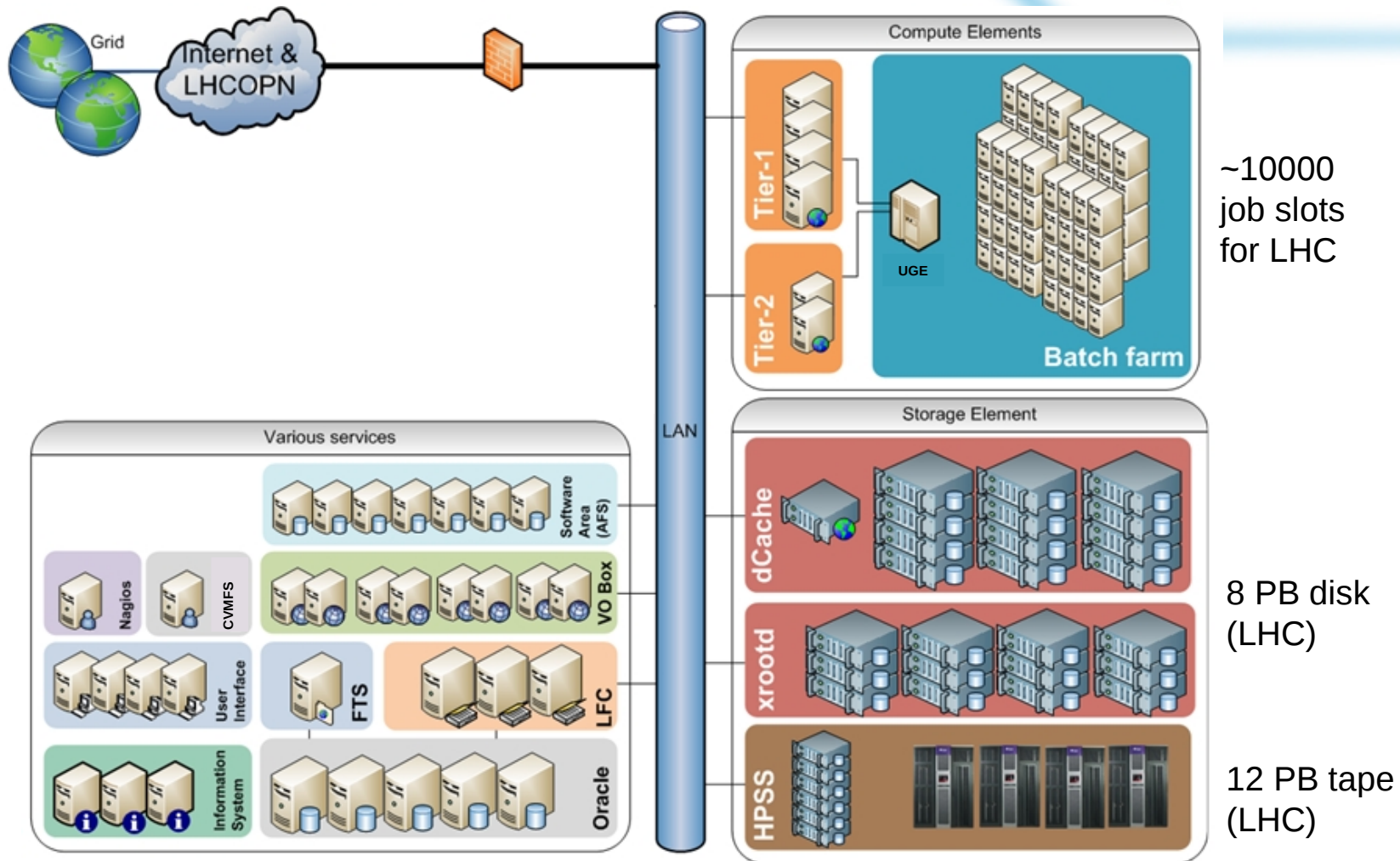
- Organization and setup
- Resource usage
- Performance (view from the outside)
- New concepts
- Conclusion

CCIN2P3 and WLCG



- CCIN2P3 ensures the deployment of services required by WLCG
- GGUS interfaced with our ticketing system
- LCG and NGI representatives at CCIN2P3 attend WLCG meetings
- Direct communication between site and experiments is essential
- LHC support at CCIN2P3 is the front line for LHC computing-related issues

Farm setup

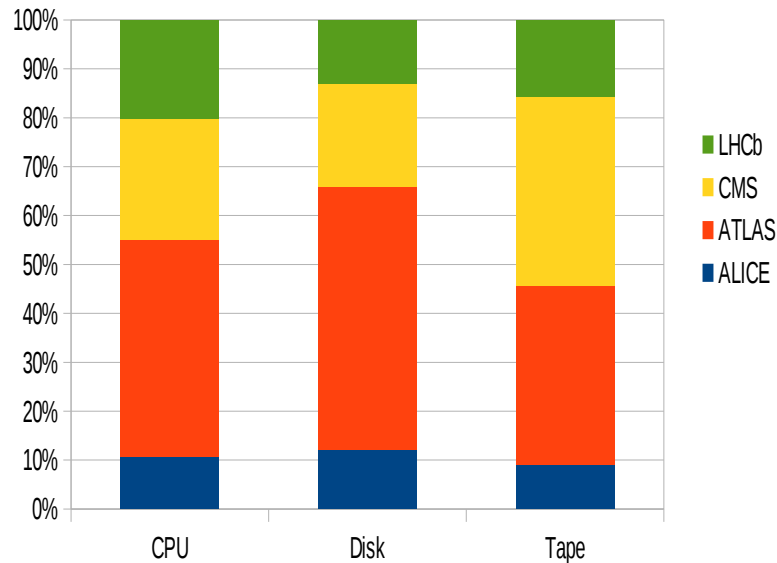


LHC experiments at CCIN2P3



VO shares at CCIN2P3

2014



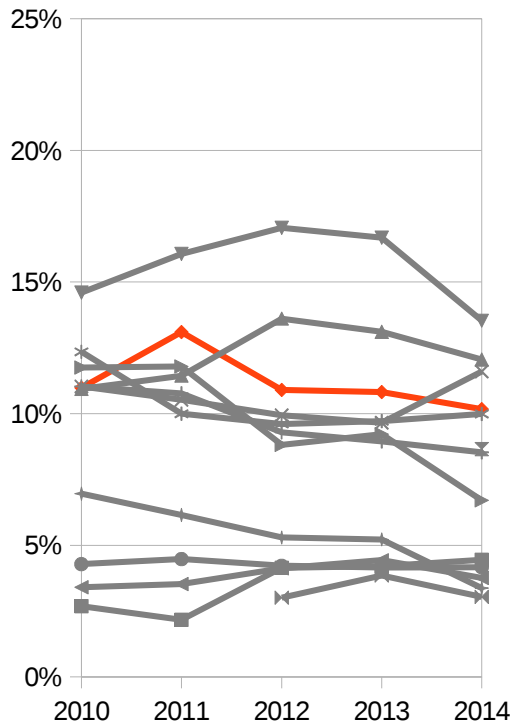
- T1 & T2 resources
 - + T3 resources (ATLAS & CMS)

- Balance in agreement with exp. computing models / requirements

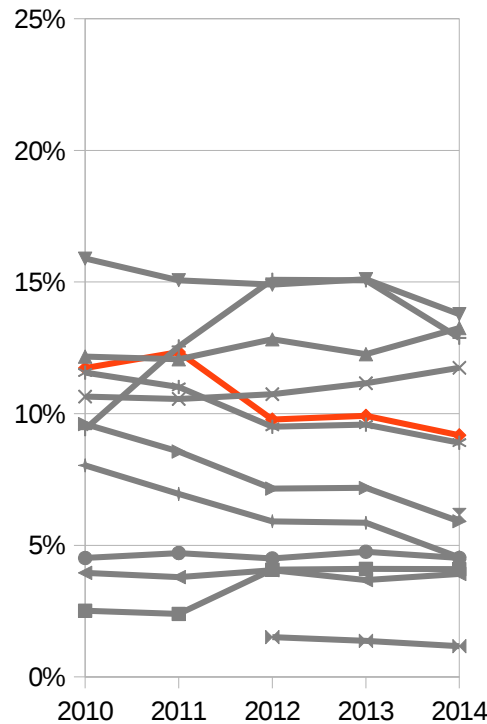
Our weight among the T1's



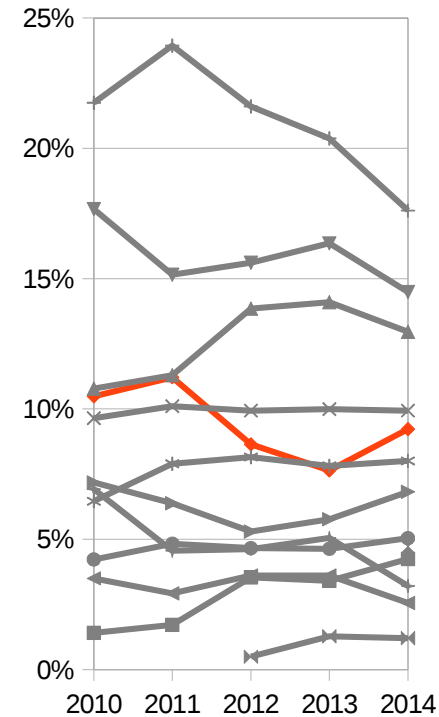
T1 shares (CPU)



T1 shares (Dis)

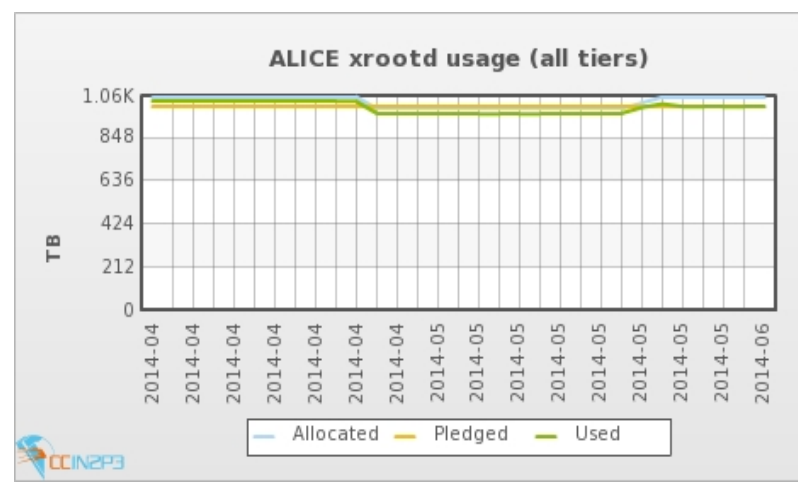
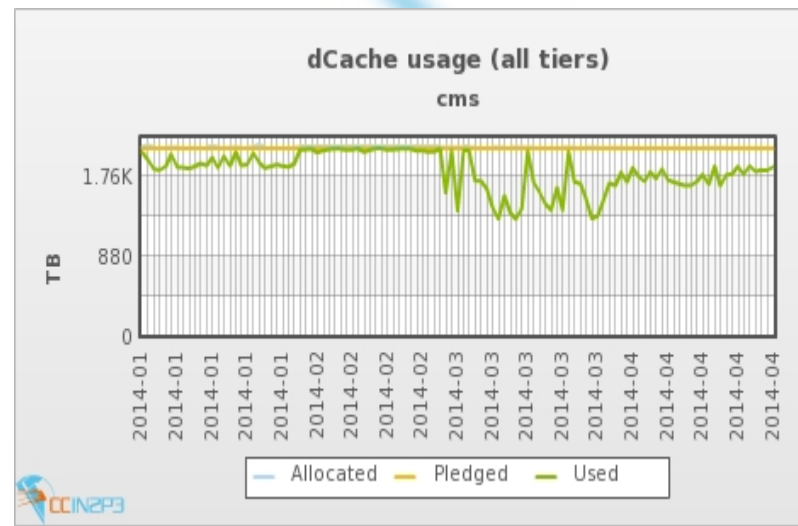
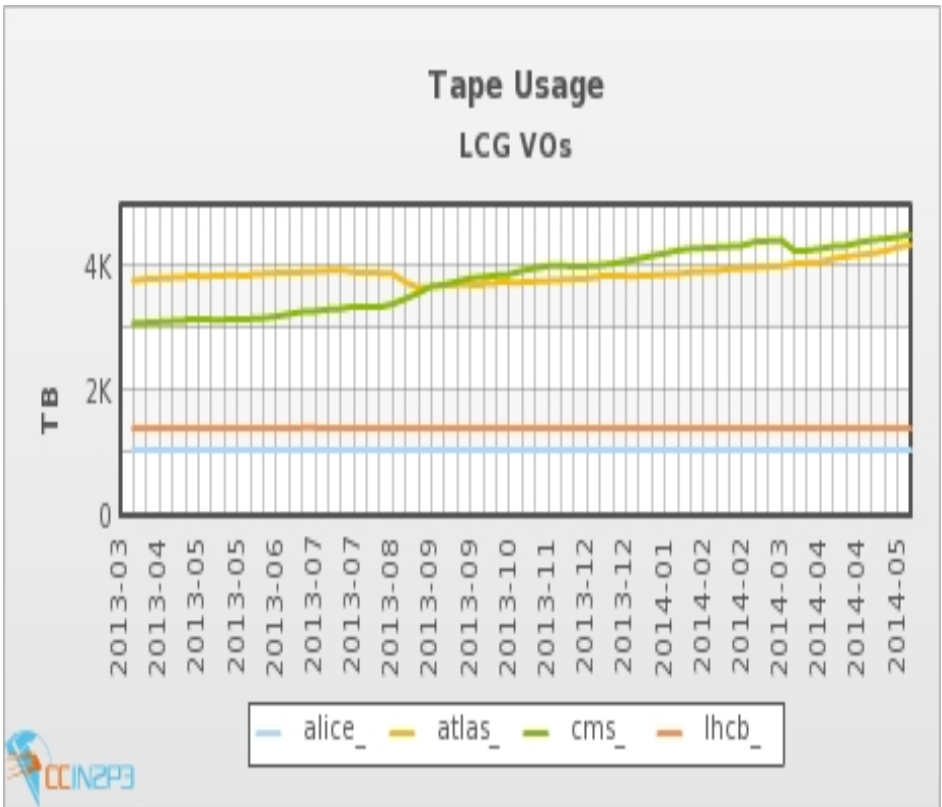


T1 shares (Tape)



- CA-TRIUMF
- ◆ FR-CCIN2P3
- ▼ DE-KIT
- ▲ IT-INFN-CNAF
- ▶ NL-T1
- ◀ NDGF
- ✕ GSDC-KISTI
- ✕ RRC-KI-T1
- ES-PIC
- ◀ TW-ASGC
- ✕ UK-T1-RAL
- ◀ US-FNAL-CMS
- ✕ US-T1-BNL

Storage usage

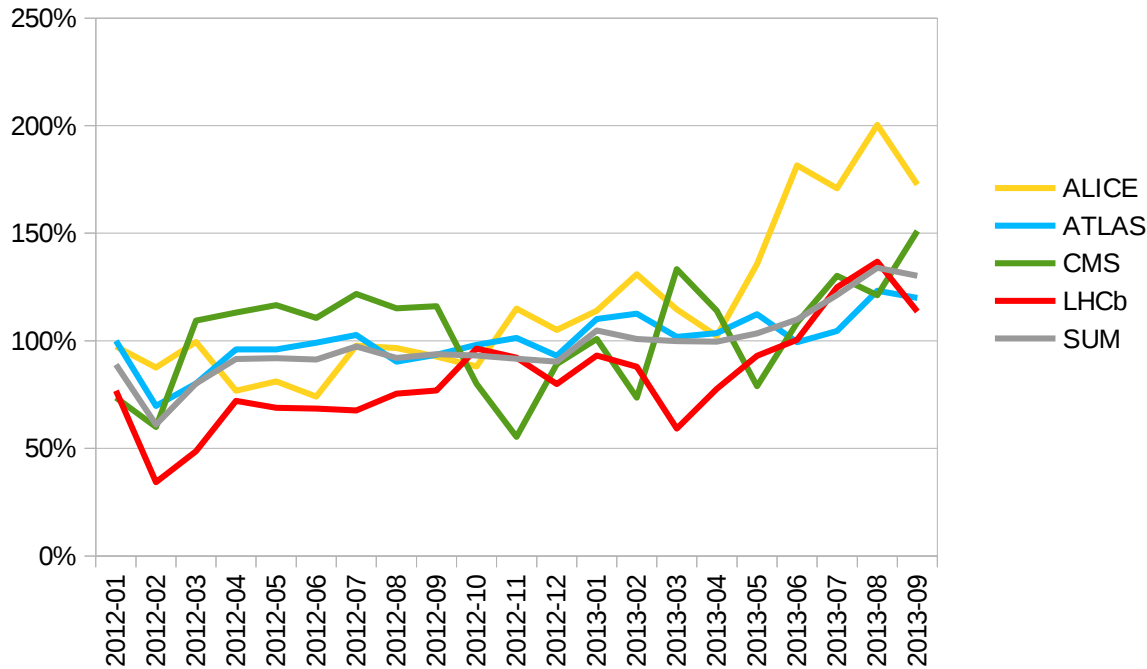


CPU usage



Wall / pledged

all jobs



We manage to provide more jobs than we pledge

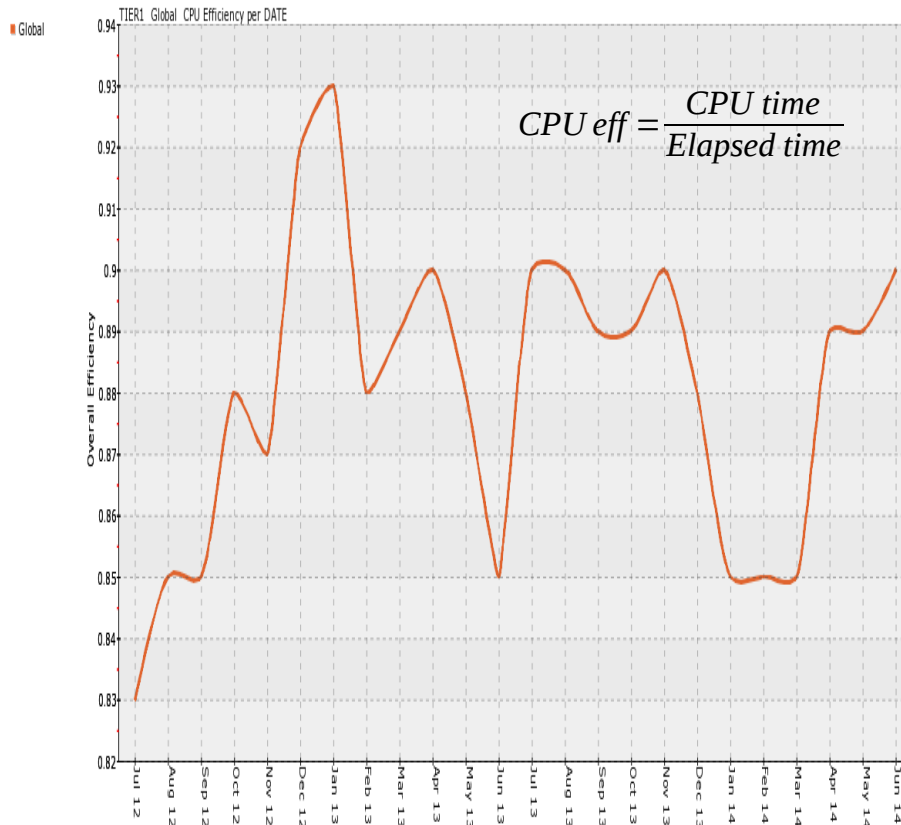
ALICE	ATLAS	CMS	LHCb	AVG
136 %	107 %	103 %	96 %	107 %

CPU efficiency



Developed by CESGA 'EG1 View': / cpueff / 2012:7-2014:6 / VO-DATE / lhc (x) / LINES-LIN / i

2014-06-03 19:29



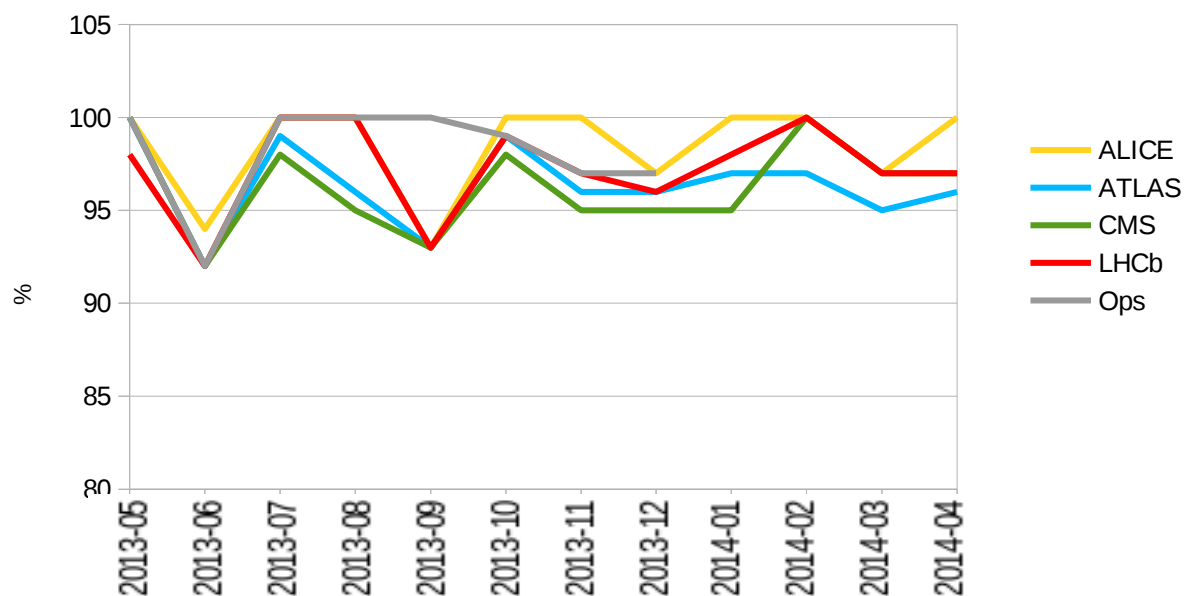
- Overall >85 %
 - Including analysis
- → very satisfactory
- Resources are fit to the needs
 - Storage IO speed
 - Network performance

Site availability



T1 availability
CC-IN2P3

$$a = \frac{T(up)}{T(up) + T(down)}$$



Average % on the last 12 months :

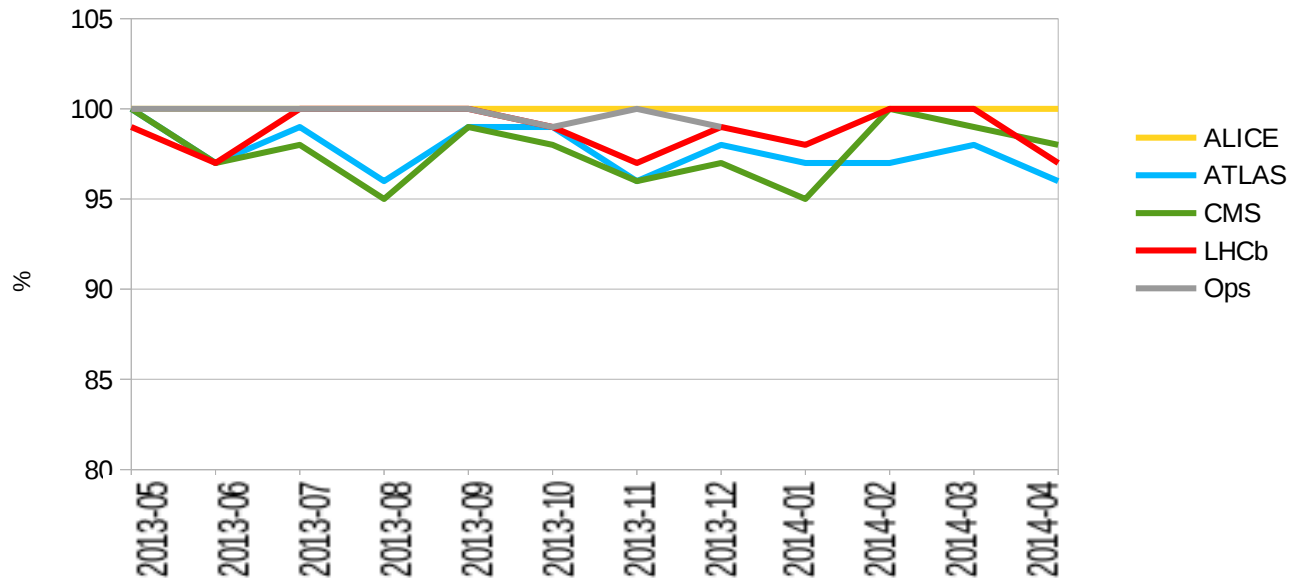
ALICE	ATLAS	CMS	LHCb	Ops
98	96	96	97	98

Site reliability



T1 reliability
CCIN2P3

$$r = \frac{T(up)}{T(up) + T(down) - T(sched. down)}$$



Average on the last 12 months :

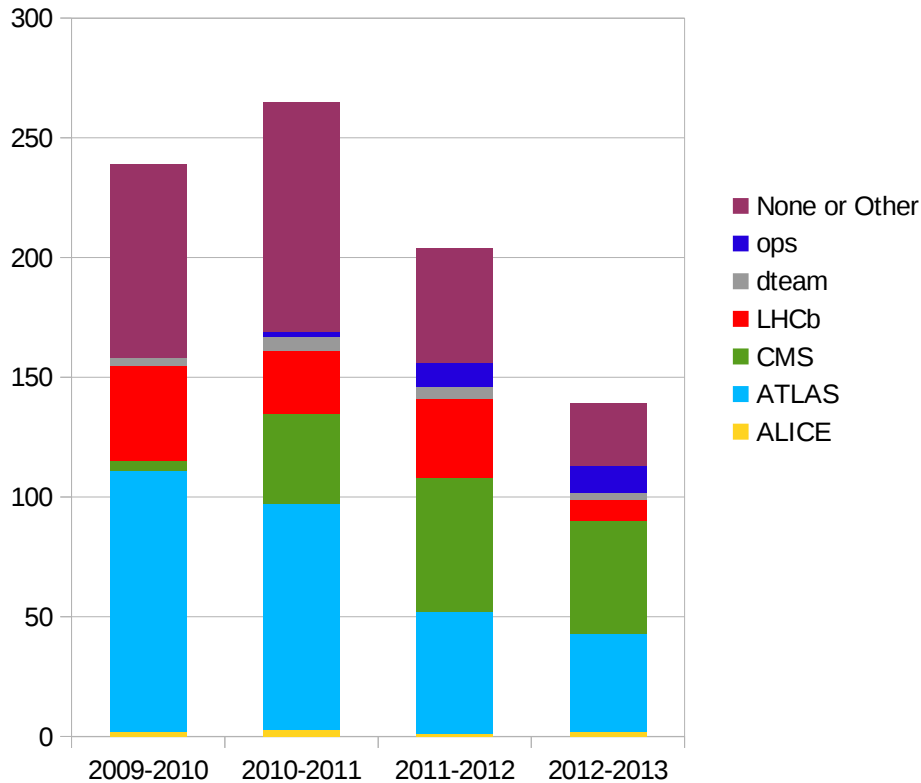
ALICE	ATLAS	CMS	LHCb	Ops
100	98	99	99	100

GGUS tickets



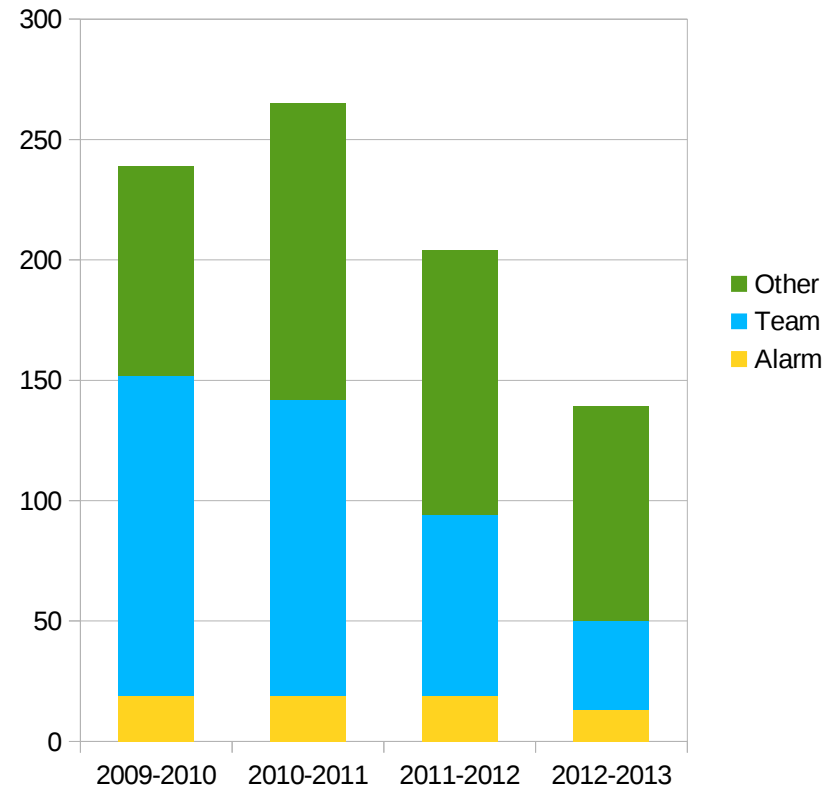
Number of GGUS tickets opened per VO

nov. 1st - oct. 31st



GGUS Ticket Type

nov. 1st - oct. 31 st



■ Federation

- Xrootd, webdav
- Failover and remote accesses

■ Cloud

- Optimisation of resources
- Simplification of computing models
- Use of opportunistic resources
- Less hard/software constraints on sites and VOs
- ATLAS has started using cloud at CCIN2P3



- Many services
 - Load shared between sysadmins, grid admins, batch, and dedicated support
 - Constant interaction between all those people
- Front-line dedicated support
 - ALICE, ATLAS, CMS, LHCb
 - All involved in additional activities as well



- And other activities...

The Nobel Prize in Physics 2013



Photo: Pnicolet via Wikimedia Commons

François Englert



Photo: G-M Greuel via Wikimedia Commons

Peter W. Higgs

The Nobel Prize in Physics 2013 was awarded jointly to François Englert and Peter W. Higgs *"for the theoretical discovery of a mechanism that contributes to our understanding of the origin of mass of subatomic particles, and which recently was confirmed through the discovery of the predicted fundamental particle, by the ATLAS and CMS experiments at CERN's Large Hadron Collider"*

CC-IN2P3, a French Computing Center
For Nuclear Physics and Particle Physics

We work for them



They send us their data

Who we are



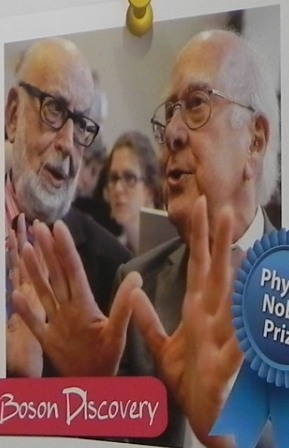
The IN2P3 Computing Center (CC-IN2P3), located in Lyon (France), is a service and research unit belonging to CNRS. A major French research infrastructure, it provides computing and data storage resources for researchers involved in cosmological physics experiments.

The main services offered by CC-IN2P3 are the storage and processing of large volumes of data and their transfer over very high-speed international networks.

Experiments in high-energy and astroparticle physics require the analysis of billions of interactions between particles. More than 50 international collaborations in physics use the resources of CC-IN2P3.



Our services



Higgs Boson Discovery

The Nobel Prize in Physics 2013 was awarded to F. Englert and P.W. Higgs for the discovery of an essential part of the Standard Model of particle physics: the Higgs Boson.

The search for the Higgs at the Large Hadron Collider was an international effort involving thousands of people. The Worldwide LHC Computing Grid gave a community of over 8000 researchers near real-time access to LHC data.

France played an active role in LHC data processing with the CC-IN2P3, one of the biggest computing centers on the WLCG.

OUR SECOND DATA CENTER

For Nuclear Physics and Particle Physics



First phase completed in April 2013

Modularity

- From rack to building
- Capacity planning up to 2019
- Multi-tier architecture
- Movable wall between computing and spare room

9 MW on site
3 phases
3.6 MW in room

Ease of deployment

- All distribution from ceiling
- 6 aisles of 2*20 racks
- Delivery and test room
- Preparation decreases deployment time

Confined hot aisle
15 kW mean per IT rack

Inflammable parts away

Secured power lines

- Dedicated and primary 9 MW
- 2 MW backup line
- First UPS chain capacity 2 MW
- Transparent switch to main power line
- Small battery capacity

no power generator

20 minutes full phase 1

Cooling system

- Resilient
- Backup for 20 minutes
- Capacity to provide 70 m³/hour at 50°C (122°F)
- PUE: 1,47

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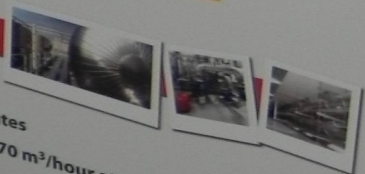
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LHC

The world's largest particle accelerator!



LHC main goals

Beyond revealing a new world of unknown particles, the LHC experiments could explain why those particles exist and behave as they do. With the discovery of the Higgs Boson, one of the main goals has been achieved. Until last year, the Higgs Boson mechanism was the last remaining piece of the physics standard model to be experimentally verified. But the LHC experiments could also shed light on dark matter, uncover hidden symmetries of the universe, and possibly find extra dimensions of space.



LHC in numbers

- 27-kilometer ring of superconducting magnets
- Circular tunnel 100 meters beneath the Swiss/French border at Geneva
- Produces 15 Petabytes of data annually
- A community of more than 8,000 physicists around the world

Worldwide LHC Computing Grid

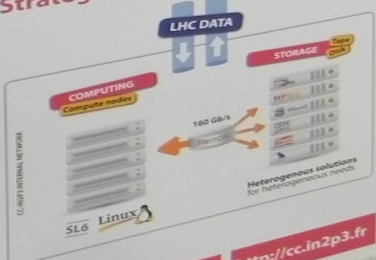
The WLCG project is a worldwide grid infrastructure that provides mutualized computing resources to store, distribute, and analyze LHC data. CC-IN2P3 is one of the biggest computing centers of the WLCG.



CC-IN2P3 Contribution

- 10,000 logical CPUs for LHC
- 20 PB storage capacity for LHC
- Fast access DAS for High-Troughput Computing (HTC)
- Heterogeneous solutions for heterogeneous needs
- Robust and performant networking solutions
- Hierarchical and strategic organization: data popularity vs. data custody level vs. data access speed

Strategic Storage Organization



<http://wlcg.web.cern.ch> <http://cc.in2p3.fr>

LSST

Large Synoptic Survey Telescope



LSST main goals

The LSST project aims at mapping the mysterious dark matter and characterizing the properties of the even more mysterious dark energy thanks to its large aperture and giant camera. With a light-gathering power among the largest in the world, it can detect faint objects with short exposures.

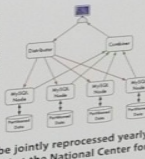
LSST in numbers

- 3.2 Gigapixels high sensitivity CCD camera
 - 15 TB of data per night
 - Entire sky covered twice a week
- Total dataset over the ten years of operation:
- 60 PB for the raw data
 - 34 PB for the catalog database
- Total data volume after processing:
- several hundreds PB
 - requires 500 TFlops for catalog generation

LSST Data Management

A set of production pipelines will process the images to produce a number of catalogs containing the detected astronomical sources and resolved astronomical objects.

These catalogs will be stored in a large scale database system distributed on thousands of nodes using a 'shared nothing' technology. This database system, named Oserv, is specifically developed within the LSST collaboration. The whole dataset will be jointly reprocessed yearly by CC-IN2P3 in France and at the National Center for Supercomputing Application (NCSA) in Illinois.

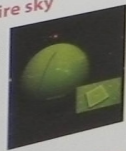


CC-IN2P3 Contribution

By 2022, the CC-IN2P3 will have deployed 15 PB of disk space, 8 PB of mass storage and 20,000 cores ready to process its share of the first data coming out from the telescope. This capacity will be pushed to more than 100,000 cores, 37 PB of disk and 82 PB of mass storage by the end of the project. CC-IN2P3 is also contributing to the Oserv LSST database development effort by providing a 300-node test platform.

Mapping the entire sky

Each region of the sky will correspond to an individual database in the Oserv database system. The regions are slightly overlapping to optimize the queries on objects located close to a boundary.



<http://www.lsst.org>

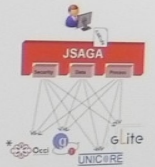
JSAGA

Simple API for Grid Applications



A Java implementation of the SAGA specification

JSAGA is developed at the CC-IN2P3 since 2008. It was initially funded by the IGTMD grant from the French National Research Agency.



SAGA: Simple API for Grid Applications

Specification defined by the Open Grid Forum. SAGA is a specification for uniform access to different grid infrastructures. This specification defines a middleware-independent and programming language-independent interface for submitting and monitoring jobs, and managing logical and physical files. SAGA is independent of existing middleware package and acts as a common interface.

Others major implementations worldwide:

- SAGAC++ (C++)
- SAGAPYTHON (PYTHON)

JSAGA

- is independent of operating system (Linux, Windows, MacOS)
- is extensible via plugins
- is designed for efficiency (plugins can implement core optional interfaces for optimization)
- offers uniform usage of middleware native features
- emulates unsupported features

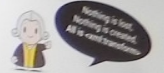
Applications

A Science Gateway has been built in the context of the EU CHAIN and CHAIN-RES projects to demonstrate how the Science Gateway paradigm and standard adoption can make e-infrastructure worldwide. Based on different middleware and architectures (Grid, HPC, Cloud or simply local clusters), interoperable among each other, at user application level.

<http://grid.in2p3.fr/jsaga>

LAVOISIER

Data aggregation framework

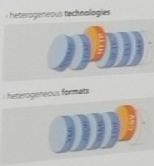


Lavoisier main goals

Lavoisier is a framework to retrieve, transform, merge and query heterogeneous data sources. Lavoisier can easily be extended through new plugins.

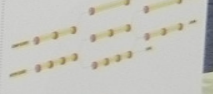


Plugins for input data



Workflow of plugins chain

A Lavoisier application is described as a workflow of plugins chains. Each plugin chain generates a stream of XML events from input data streams.



The stream of XML events is propagated through these plugins to generate the XML view without creating huge data structures.



<http://webteam.in2p3.fr/lavoisier>

H-TECH
Technology Consortium
of the Ohio Board of Regents

CC-IN2P3, a French Computing Center

For Nuclear Physics and Particle Physics

We work for them

Who we are



CCIN2P3 @ SC'13

- Storage and CPU resources largely used
 - CPU : experiments consume more than we pledge
- Quality of service
 - Continuous decrease of problems (GGUS tickets)
 - No 'Serious Incident' over the last year
 - Focus on availability and reliability improvement
- Manpower is essential
 - Constant interaction with experiments
- In spite of the LHC shutdown, we were kept very busy this year