



## The LSST Data management and French computing activities

Dominique Fouchez on behalf of the IN2P3 Computing Team

### LSST France – April 8<sup>th</sup>,2015







- Introduction to the LSST Data Management
- The french contributions to LSST computing
  - Data Challenge 2013
  - CFHTLS reprocessing
  - Qserv
  - CC IN2P3
- Toward a deeper France USA collaboration
- Conclusion

## The big data issues



LSST Data Management System must deal with an unprecedented data volume.

- one 6.4-gigabyte image every 17 seconds
- 15 terabytes of raw scientif c image data / night
- 60-petabyte final image data archive
- 20-petabyte final database catalog
- 2 million real time events per night every night for 10 years
- Provide a highly reliable open source system to provide:
  - Real time alerts,
  - catalog data products,
  - image data.

Provides the infrastructure to transport, process, and serve the data.











#### Application Layer (LDM-151)

- Scientif c Layer
- Pipelines constructed from reusable, standard "parts", i.e. Application Framework
- Data Products representations standardized
- Metadata extendable without schema change
- Object-oriented, python, C++ Custom Software

#### Middleware Layer (LDM-152)

- Portability to clusters, grid, other
- Provide standard services so applications behave consistently (e.g. provenance)
- Preserve performance (<1% overhead)
- Custom Software on top of Open Source,
- Off-the-shelf Software

### Infrastructure Layer (LDM-129)

- Distributed Platform
- Different sites specialized for real-time alerting vs peta-scale data access
- Off-the-shelf, Commercial Hardware & Software, Custom Integration

Science User Interface and Analysis Tools

Science Data Archive (Images, Alerts, Catalogs) Alert, Calibration, Data Release Productions/Pipelines

**Application Framework** 

Data Access Services   Processing I	j Middlewar
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System Administration, Operations, Security



Data Management System Design LDM-1





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First large scale Data Challenge in summer 2013 **Goals :** 

- SDSS Stripe 82 reprocessing with LSST Stack
- Test the Satellite (a.k.a. Split) Data Release Processing together with NCSA

### **Processing**:

- Calibrated images from SDSS in 5 bands (u, g, r, i, z)
- Individual image processing and photometric calibration
- Co-addition
- Forced photometry

### Coordination with NCSA and DM team

- File transfer between the 2 sites using the CC-IN2P3 iRODS system
- Output cross validation on a predefined overlapping region

### Coordination of 5 french lab around CC-IN2P3





### At IN2P3 only :

- 10<sup>5</sup> CPU hours 700 CPU cores in // during 2.5 months
- Input data : 4.8 TB in 4.4 million files
- Output data : ~100 TB in 21 million files stored in GPFS
- Data exchanged between NCSA and CC-IN2P3 through the network
- Output products stored in a large MySQL database
- Test of the Dirac middleware system at CC-IN2P3

### Some issues :

- > Database issue completely underestimated
- Lack of production control tools (book-keeping, etc...)

### But very successful :

- Validated the Satellite DRP concept
  - Demonstrating that a coordinated production between both sites was achievable with reasonable efforts





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## Ideal use case to learn and understand the LSST stack in details

- Start from an initial work from Simon Krughoff (UW)
- Excellent collaboration with the DM team

## **Contributions from :**

- DB : Development and test of the obs\_cfht package
- LPNHE : Image reduction Algorithms Camera
- CPPM : Transient detection (comp. science PhD student from Bogota)
- LAL : Data analysis / validation
- LPC : Data analysis / validation code development data production
- LUPM : Joining the effort









### Avoid doing "DC for the sake of DC" but would rather try to make them scientifically useful

- A lot of expertise at IN2P3 on CFHT / Megacam with the SNLS group (LPNHE + CPPM)
- CFHT / Megacam much closer to LSST than SDSS (drift scan)
- All the data are already at CC-IN2P3
- Number of scientific results and technical procedures has been published
  - First and only Weak Lensing dataset publicly available















## Some issues with coadd





Partial images seem to trigger problems in processCoadd (Philippe)

Cannot compute CoaddPsf at point (39677, 5312) !

### Bad registration



## A lot of cross checks still to be performed





# Many improvement on CFHT software implementation, (Dominique Boutigny), where key for success are :

- Queries to experts : hipchat, mailling list, next office (!)
- Use of github, tickets and branch
- Trello and ipython notebook for documentation and sharing of information





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# Technical work on LSST software (Fabio Hernandez) (Christian's talk)

- Binary distribution of official LSST software releases through CernVM FS, available worldwide
- Analysis of I/O activity during data processing
  - Could serve as input data for another comp. science PhD : simulation of large scale computing infrastructure (SimGrid)

### **Satellite Data Release Processing**

- Requires a plan to ramp up the CC-IN2P3 infrastructure
- Periodic Data Challenges
  - > To stress and validate the infrastructure
  - > To test middleware and tools
  - > To explore possible alternative strategies, hardware and software





### CFHT reprocessing is a central point for a lots of our activities :

Work on the stack software : gain in expertise, contribution to the algorithms

Use the produced real data as a benchmark for the Qserv deployment and performances. Use of real request, develop end user tools etc ...

Real data prototype for testing and sizing the infrastructure at CC-IN2P3 : CPU, IO : tracking of activity with synthetic files (fabio), production framework ...

Science : A lot of improvement are needed : (Pierre's talk) But many potential outcomes

- work on transients (preparation for SN science) (Juan Pablo's talk)
- weak lensing systematics (Dominique Boutigny and David Kirkby)
- strong interest from DESC members in general
- work on calibration (Fabrice's talk)
- photo z (discussion in computing parallel session)

Last but not Least : A genuine processing lead by France/CC-IN2P3





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### The Computing MOA :

• March 5<sup>th</sup>, the LSST heads went to sign the MOA





#### Parties :

• IN2P3 – LSSTC – LSSTPO – NCSA

### **Purpose :**

- Establish a partnership to enable participation by French scientists in the scientific exploitation of the LSST database
- Specify the terms of an IN2P3 contribution to the LSST Data Release Processing during the survey operations

### Agreement :

- NCSA is the lead production data processing center, i.e. the Archive Center for LSST and the Data Access Center for the US
- CC-IN2P3 is a satellite data processing Center
- NCSA and CC-IN2P3 will process 50% of the data (level 2)
- A full dataset will be available in both sites





### Agreement (cont.):

- IN2P3 will coordinate with RENATER to establish the necessary bandwidth between CC-IN2P3 and Chicago StarLight POP
- CC-IN2P3 and NCSA : reciprocal disaster recovery centers for LSST
- Joint Coordination Council (JCC) to collaborate in the planning, technical and operational constraints ==> Implementation plan
  - NCSA has the lead responsibility for defining the constraints
  - Guarantee that IN2P3 contributions are consistent with the LSST Data Management
  - Joint tests of Satellite DRP no later than the start of Commissioning (October 2019)
- CC-IN2P3 contribution valuated to 900 k\$/year in operation cost
  - Data rights for 45 new PI on top of the data right granted from the Camera MOA





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## The CC-IN2P3 and NCSA:

- March 6<sup>th</sup> : visit of the CC infrastructure
- Agreements for a collaboration on LSST and beyond
- CC-IN2P3 is setting up a specific internal organization to prepare its official involvement in LSST computing operation

## A CFHTLS data challenge at CC-IN2P3 ?

- Test of the stack and of the CC infrastructure
- Share results with the LSST full collaboration



## Conclusions



### French contribution to LSST data management software :

- A first successful data challenge
- Adaptation of the software to process CFHTLS images
- Work on Qserv
- Technical development at CCIN2P3, distribution, IO ...
- First comparison of LSST processing with SNLS processing
- New contribution to image subtraction starting
- Link with camera software starting

The MoA signature will allow us to pursue thoses effort and go beyond : Many new opportunities may and should arise from this strong effort :

New collaborations,

fund raising,

international visibility ...