Lyon Analysis Facility
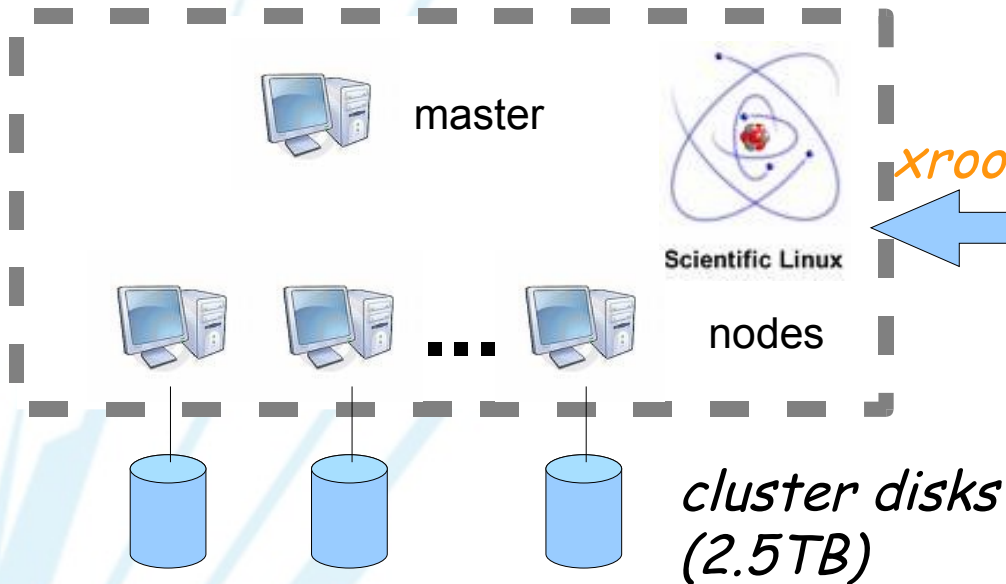## - *status & evolution* -

Renaud Vernet
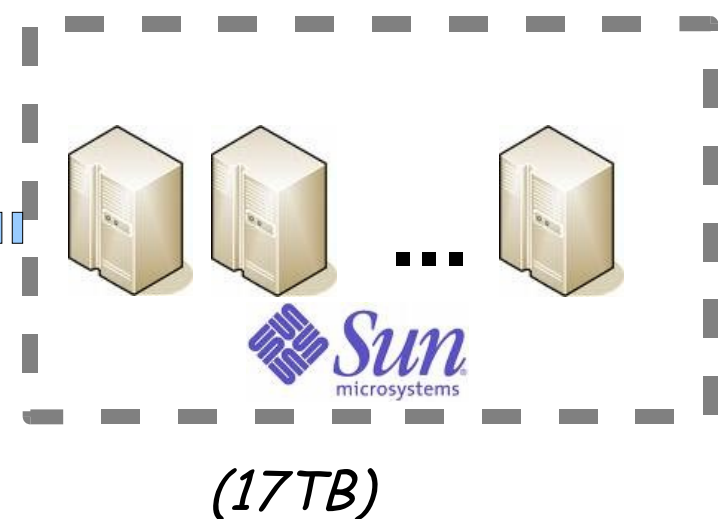
What is PROOF?

- Parallel ROOT Facility
  - Designed to be an alternative to GRID for data analysis
    - CPU power can be large + results are obtained quickly
  - Code is submitted by the master and balances the load between the slaves (available CPUs)

PROOF

xrootd SE

master

xrootd

Scientific Linux

nodes

...

Sun
microsystems

*cluster disks
(2.5TB)*

(17TB)

(this is our current setup)

PROOF and LAF

- Pros:
  - ROOT = analysis software common to all HEP experiments (C++ based)
  - Few requirements on OS and system
  - Experiment-specific libraries are compiled on proof using PAR files (tar archives)
  - ⇒ can be shared between several experiments/VOs
  - Priorities can be defined
- Cons:
  - Main contraint is on analysis code design : code must inherit from ROOT's **TSelector**
  - Not fully "interactive" … but monitoring possible on each worker
  - Can communicate with only 1 datafile manager : **xrootd**

- Our current setup
  - all nodes = Intel(R) Xeon(R) CPU / 8 cores [2.66GHz] / 16GB RAM / SL4
  - 1 master (ccapl0001) + 20 slaves (ccapl00[02-21]) = 160 workers
  - SE (xrootd) : 17TB
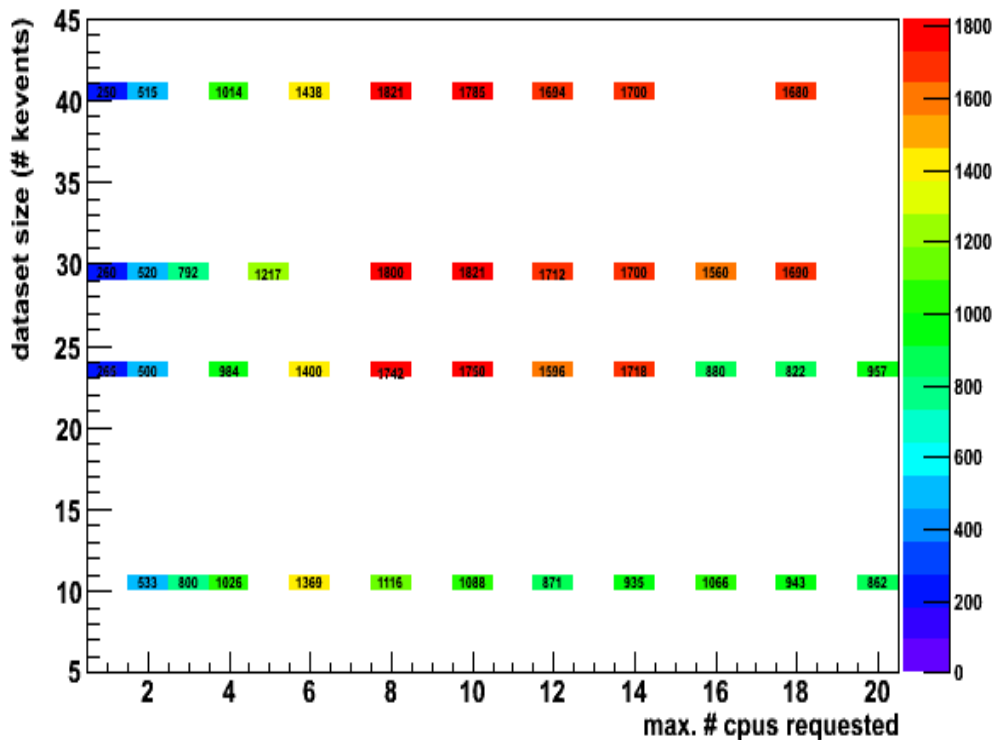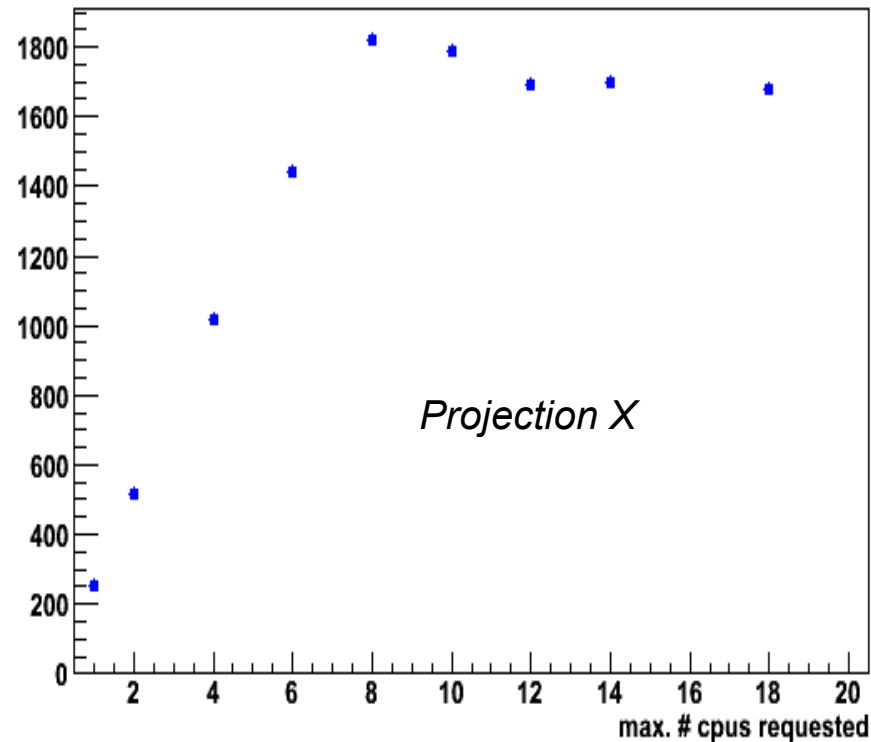 - Identification to PROOF based on certificate

Live demo...

A few results (with ALICE software)

Saturation a 1800 events/s for typically 8-10 workers
Data rate ~ 130 MB/s ~ bandwidth between data and workers
→ only limiting factor ? No other effect behind ?
→ answer will be given with a larger bandwith
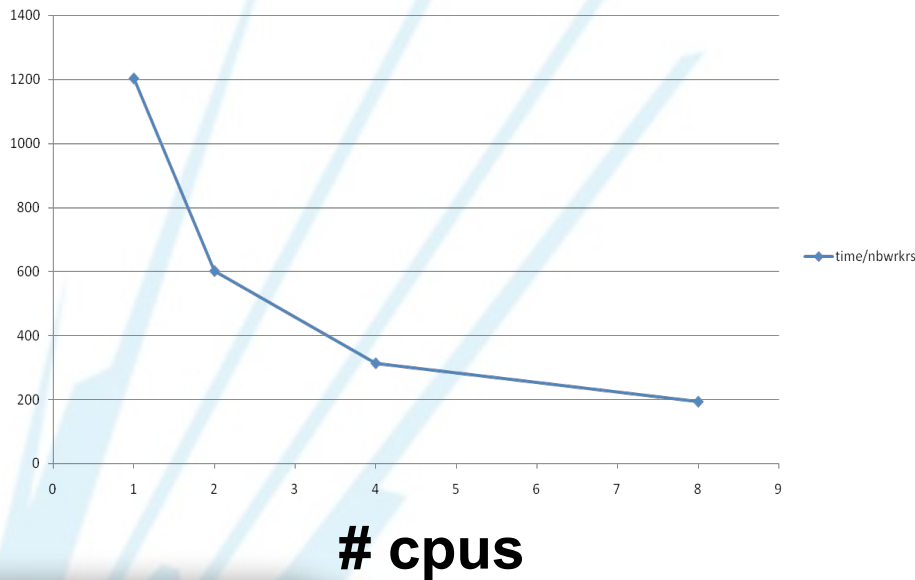
Situation for experiments : ALICE

- **PROOF** already part of the computing model
- Extensively tested and used for several years
- Analysis tasks belonging to AliRoot run on both GRID and PROOF
- Unique issue :
  - Direct access to data on GRID and staging
    - AliEn services must run on Solaris, which is not the case yet
    - Work ongoing, hopefully completed soon
  - Other experiments may face that problem too (?)

Situation for experiments : ATLAS
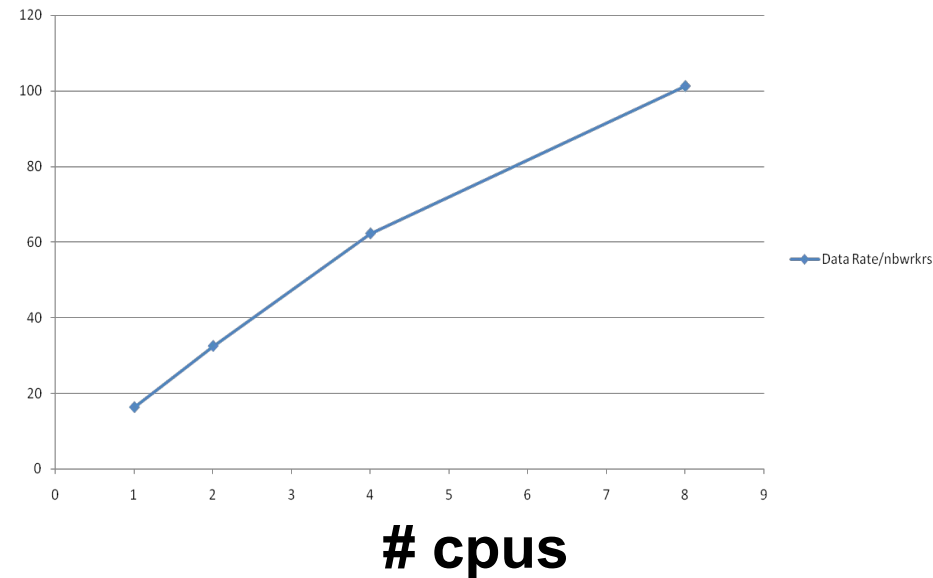
- Contact person: M. Airaj @ CEA saclay
- Tests successful
  - Library compilation OK
  - Access to data OK
- Analysis code run on 500k events stored on the xrootdSE

Processing time (s)

cpus

Data rate (MB/s)

cpus

Situation for experiments : CMS
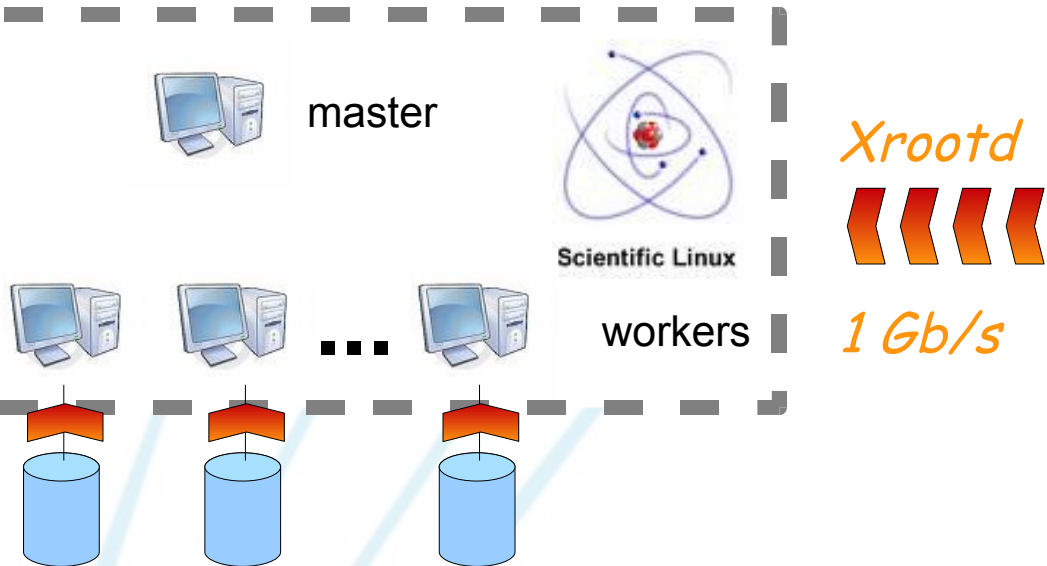
- Contact persons: M. Bluj, A. Kalinowski @ LLR
- No real tests performed yet
  - Not all CMS libraries can be loaded
  - Probable mismatch between ROOT CMS flavour and bare ROOT used by PROOF … under investigation

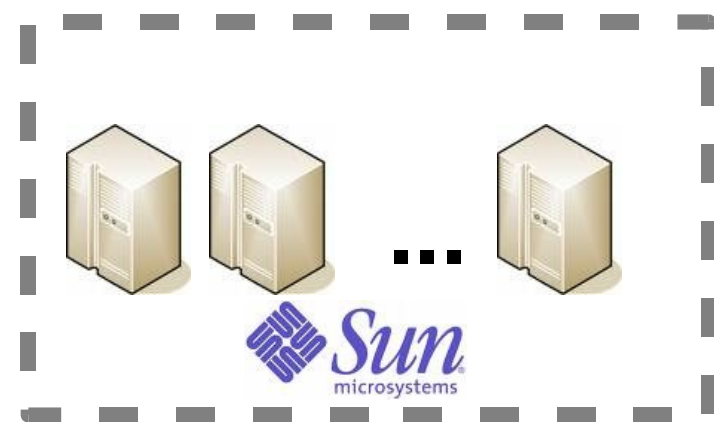# Evaluation of different storage possibilities

PROOF

xrootd SE

master

Scientific Linux

Xrootd

1 Gb/s

workers

Sun microsystems

- Read data from
  - "External" storage : dedicated xrootd SE
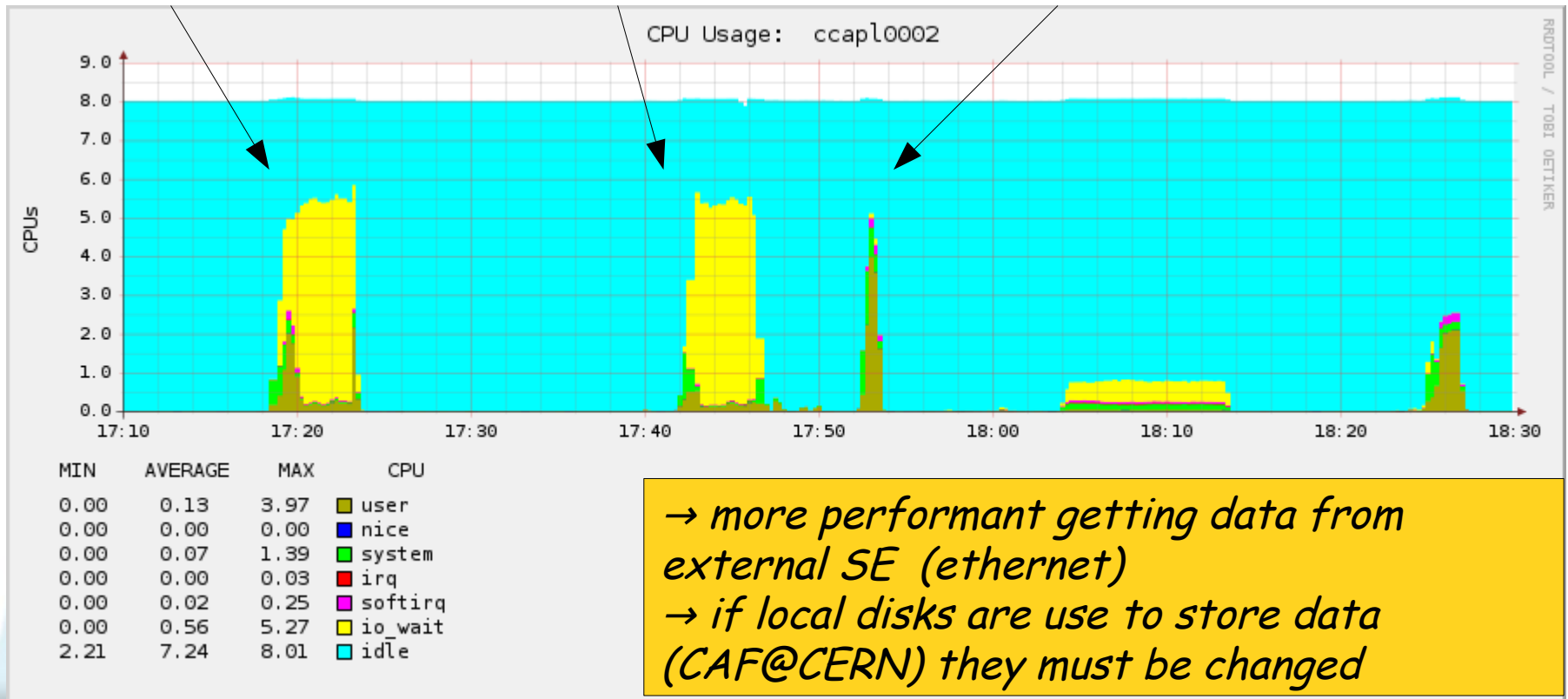 - "Internal" storage : hard disks of the cluster nodes

Performance benchmark (1 node only)

Analysis on
cluster disks :
Worker reads data on
another worker's disk

Analysis on
cluster disks :
Worker reads data on
its own disk

Analysis on
Xrootd storage :
Worker reads data
on SE

CPU Usage: ccapl0002

MIN	AVERAGE	MAX	CPU
0.00	0.13	3.97	user
0.00	0.00	0.00	nice
0.00	0.07	1.39	system
0.00	0.00	0.03	irq
0.00	0.02	0.25	softirq
0.00	0.56	5.27	io_wait
2.21	7.24	8.01	idle

→ more performant getting data from external SE (ethernet)
→ if local disks are use to store data (CAF@CERN) they must be changed

Summary

- LAF is working ...
  - Successful tests from ATLAS, ALICE
  - CMS feedback necessary
- … but can & must be improved
  - bandwidth between SE and nodes
  - interface with GRID services (data staging)
- Tests from several simultaneous users needed
  - → stress the system !
  - results will help defining future improvements
- Possibility of using SSD disks for fast access (cache)
  - can that be supported by PROOF/xrootd ?
  - to be investigated
- No constraint on design, open to all good solutions