.Energy efficiency in HPC :

A new trend ?

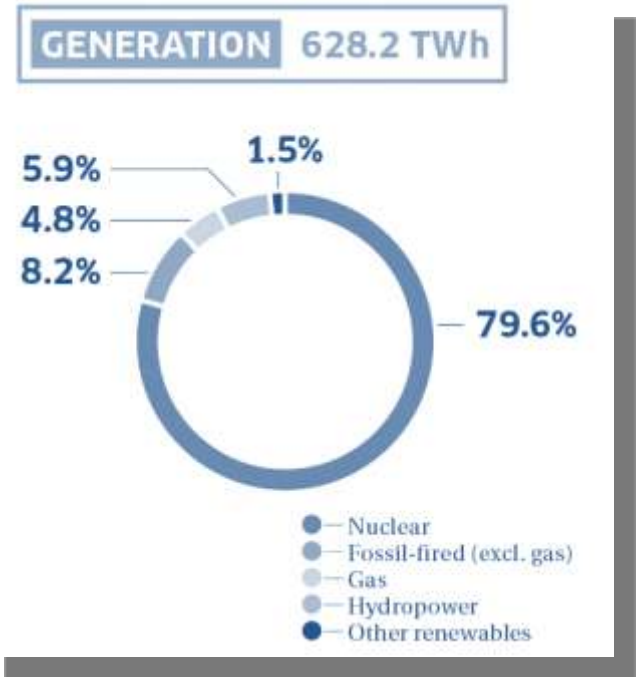
A software approach to save power but still increase the number or the size of scientific studies !

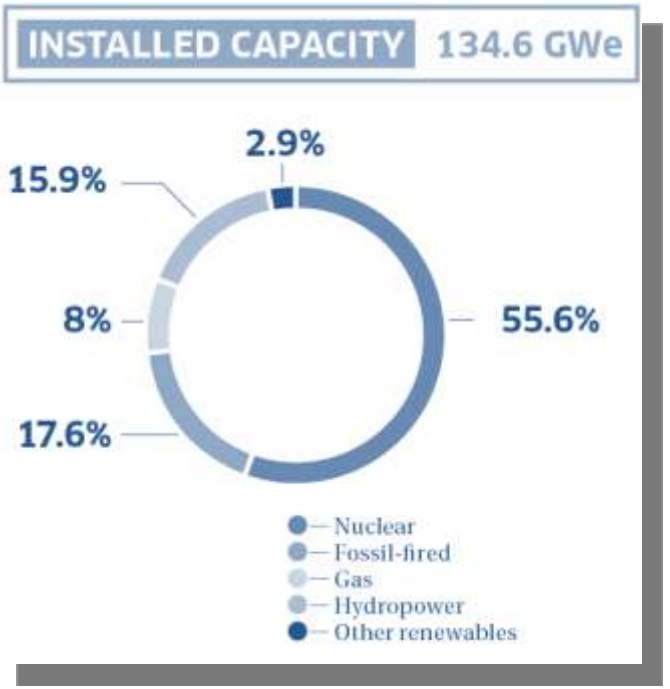
19 Novembre 2012

The EDF Group in brief

A GLOBAL LEADER IN ELECTRICITY

- **37.7 million** customers
- **156,168** employees worldwide





- **€65.3 billion** in sales
- **87% carbon-free** generation

EDF R&D, key figures

2 000 people

370 doctors

220 doctoral students

200 research fellows from Universities and other higher education establishments

€ 518 M

2011 budget

90 %

Success rate

For annuel contacts signed with EDF Group entities and business units

15 departments

12 common laboratories

7 Research centers

of which

3 in France

1 in Germany

1 in the UK

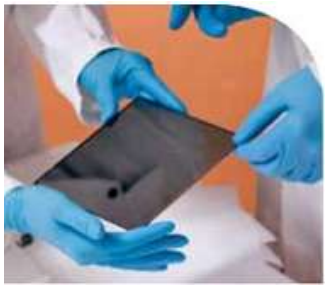
1 in Poland

1 in China

500

Major research projects

per year



RESEARCH PROGRAMMES

A BIG USE OF COMPUTING RESSOURCES

Specific R&D for all Group activities

- Generation
- Energy management
- Sales
- Electrical grids
- Renewable energies

Covering all programmes:

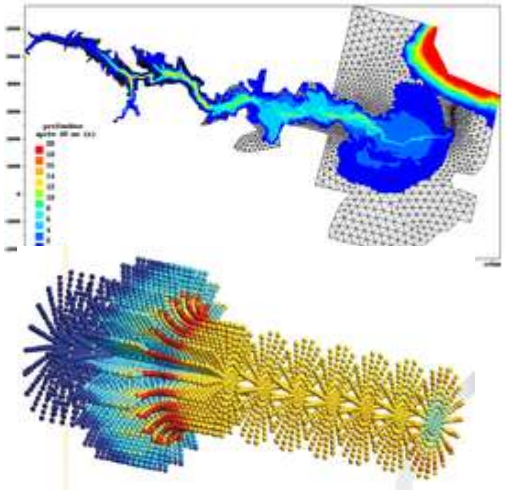
- Information technology

INFORMATION TECHNOLOGIES

- Improving the performance of operations throught advanced simulation technologies
- Coming up with new business opportunities through innovative uses of new ICTs

Simulate — Compute — Test

600 people working on numerical simulation



Ivanoé , a HPC cluster :
200,000 billion operations per second

Augmented reality

Computing Power for EDF R&D

In 8 years, the computing power at EDF R&D was multiplied by 2000

2002
Sinetics
100 Gflops

2011 : Ivanoe 200 Tflops

- 3 computers in the last TOP 500 (nov. 2012)
  - Frontier2 (IBM Blue Gene P) : 328th with 100 teraflops
  - Ivanoé, a conventional cluster : 149th with 200 teraflops
  - Zumbrota (IBM BG Q) : 32nd with 690 teraflops

Performance ! What is that ?

- To reduce the computing time
- To obtain more precise results
- To increase the size of the field of study or to increase the number of simulations
- To allow the multi-physics coupling

The Project : écoGrappe

Agence Nationale de la Recherche ANR

- Founded by ANR

- It involves 3 partners :
  - Kerlabs
  - INRIA
  - EDF

- Aim of the project :
  - Design & implement a cluster management system
  - Take into account energy consumption

EDF

EDF's role

- Experimentally validate SNOOZE
- Open source framework developped by Eugen Feller at INRIA
- It manages virtual machines in private clouds
- It is energy efficient

- Provide Hardware Infrastructure
- HPSLab : High Performance Simulation Laboratory

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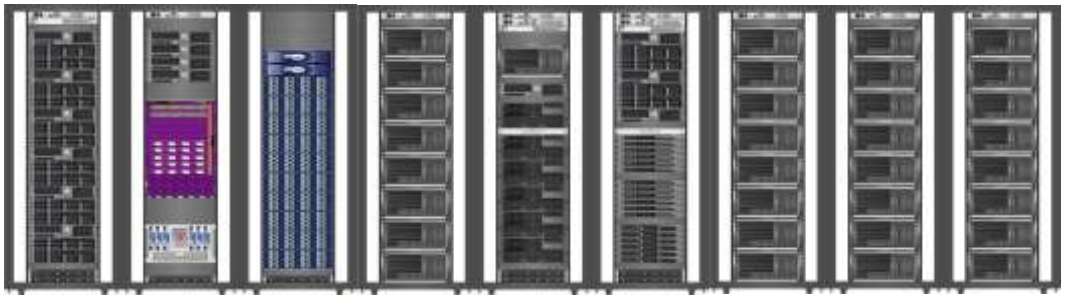

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HPSLAB ? What do you speak about ?

- An experimental platform…
  …or a platform for experiments !

- various technologies
  - processors
  - Networks
  - …

- Easy administration
  - most maintenance actions are made through web interfaces

- Fully equipped for electricity consumption measurements

Internship's Objective

- Implement a test protocol
- Compare different use cases
- Analyse diverse execution conditions

- How ?
- Refining the data collected
- Choising the right execution parameters
- Monitoring the plateforme
- Having a user-friendly interface

- Also
- Analyse VM impact with SNOOZE
- Compare to other monitoring projects

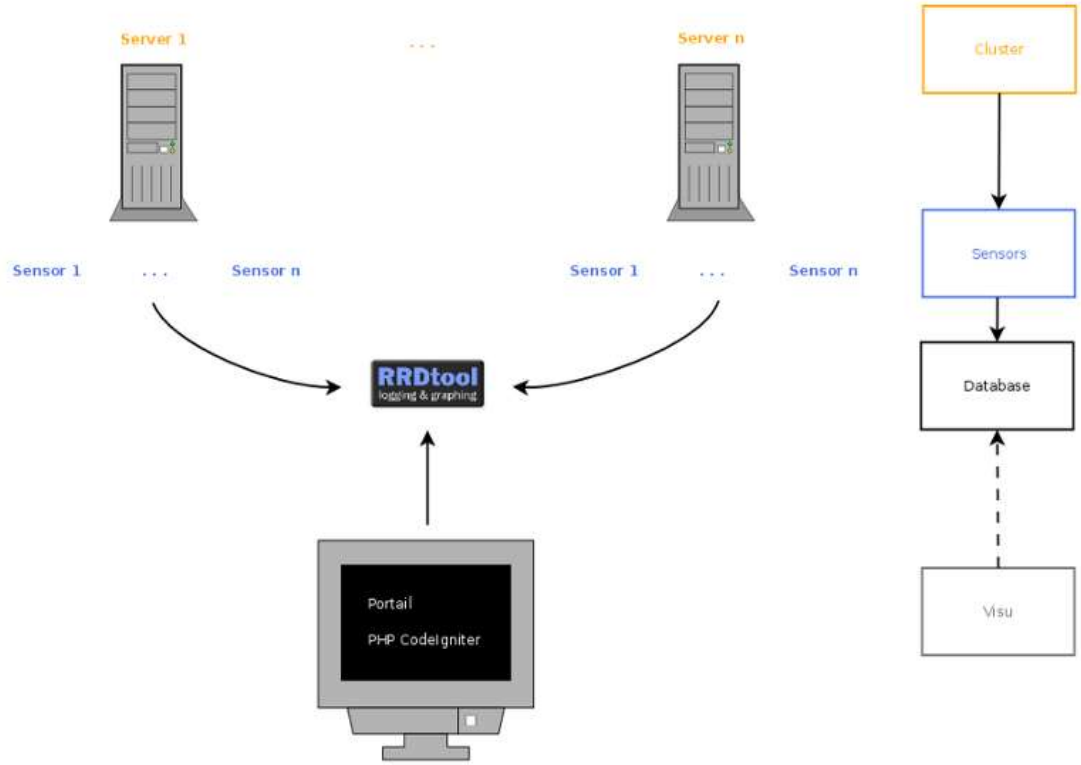
What has been done so far ?

- State of the art in cluster
  - Type of servers
  - Type of sensors
  - Network interfaces

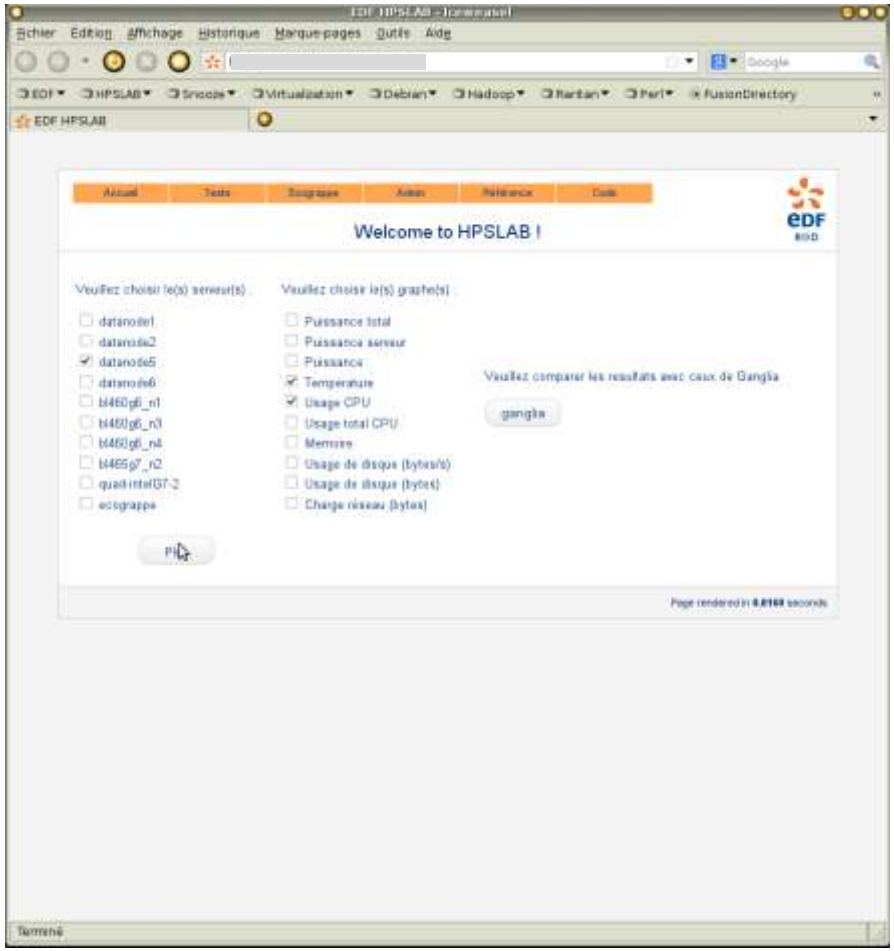
- Monitoring system
  - Scripts to get the data & plot it
  - Web interface
  - Comparaison to Ganglia

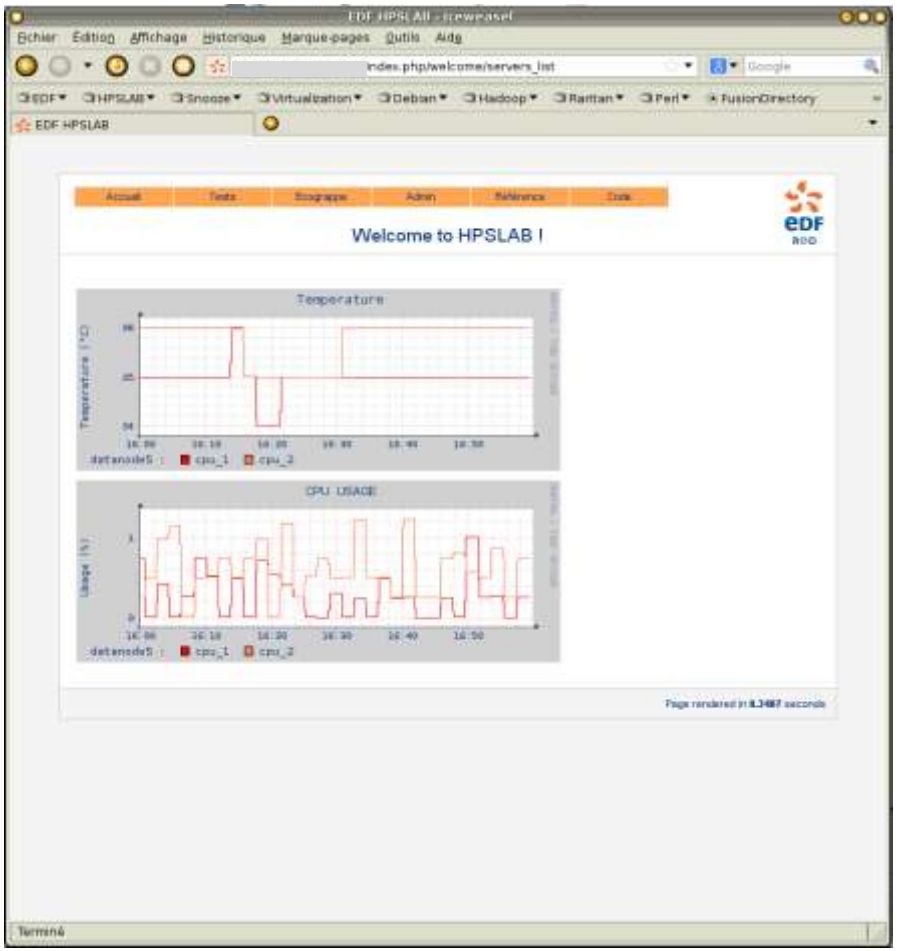
- First tests with Hadoop

Monitoring system architecture



Web Interface





Hadoop

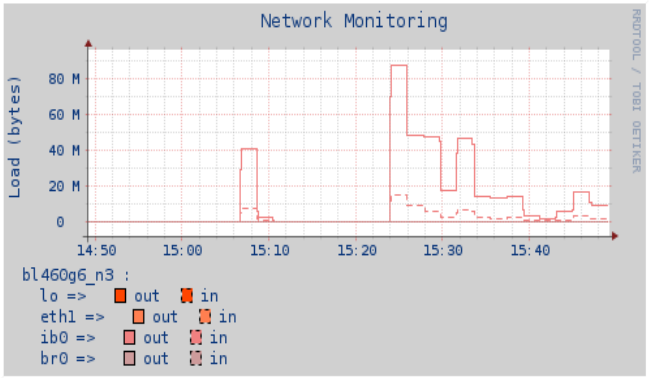
- What is it ?
  - Open source framework
  - Written in Java
  - Under Apache license

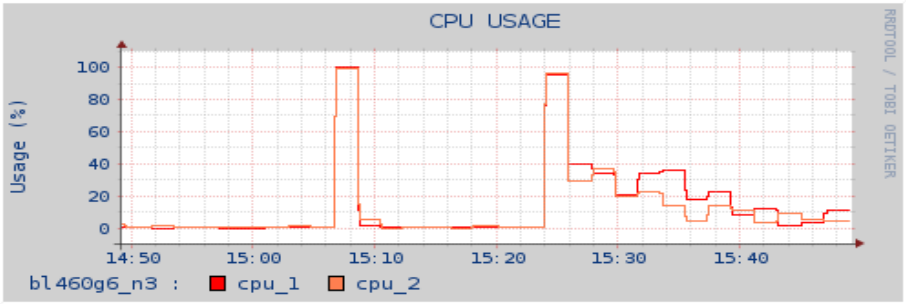
- Store & process large amounts of data

- How does it work ?
  - MapReduce : the programming model
  - HDFS : the distributed File System

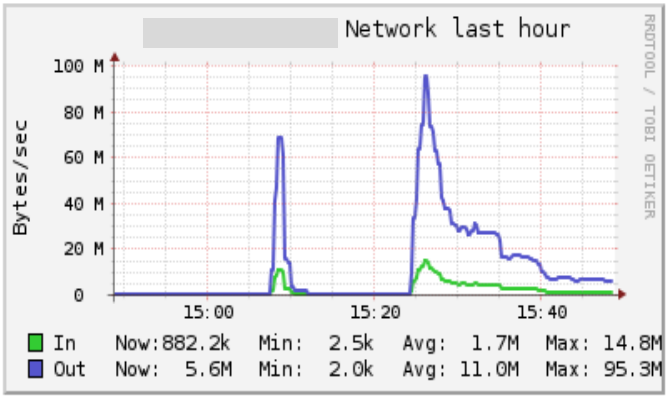
Test with Hadoop

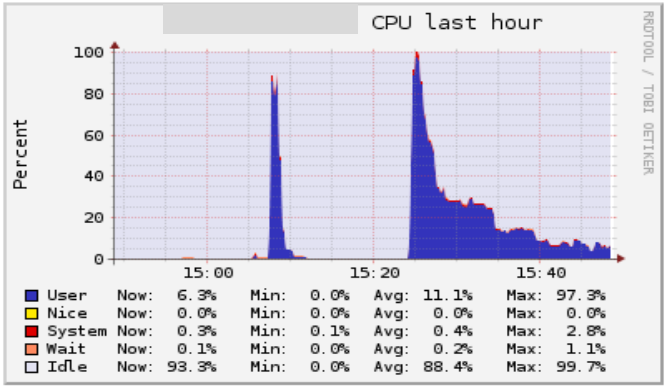
EDF's results





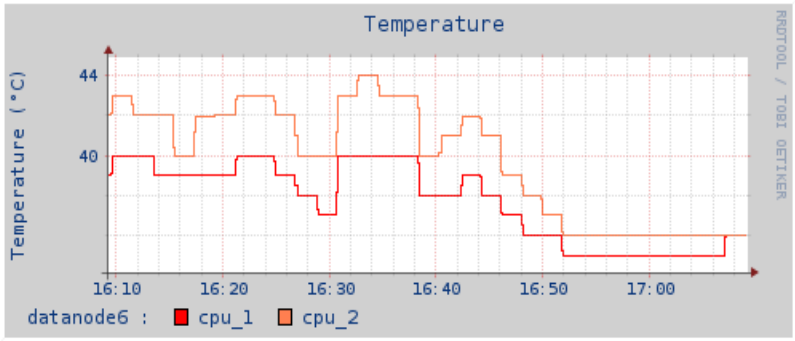
Ganglia's results

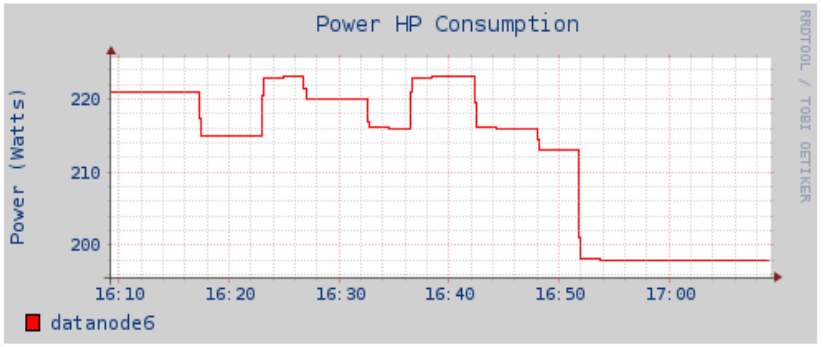




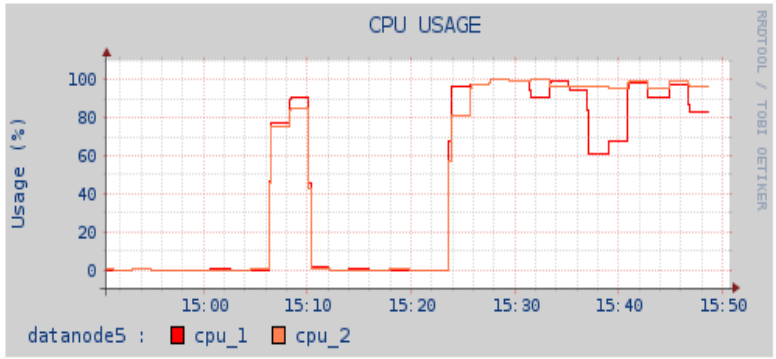
Test with Hadoop

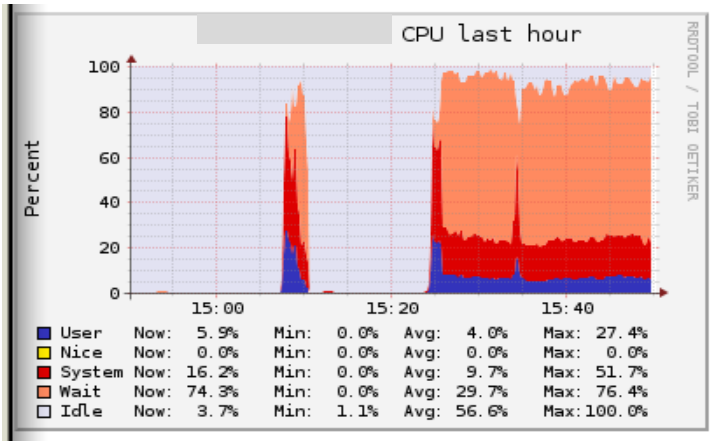
EDF's results





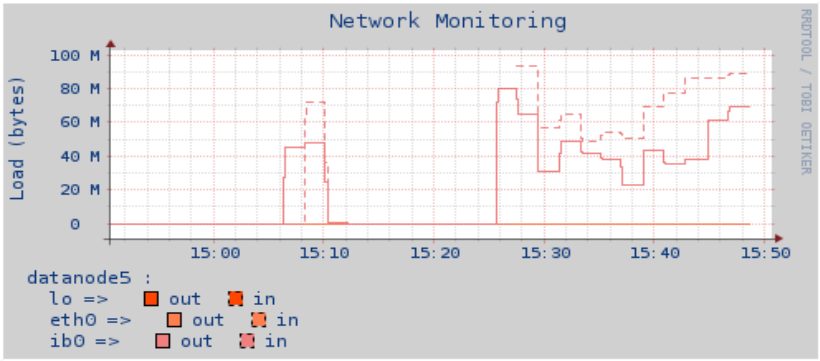
Ganglia's results

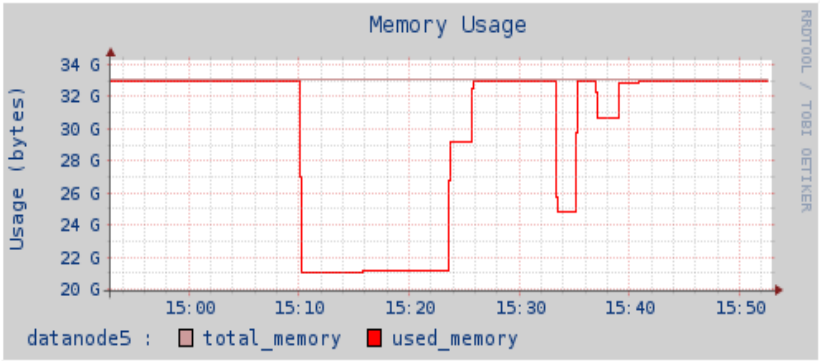




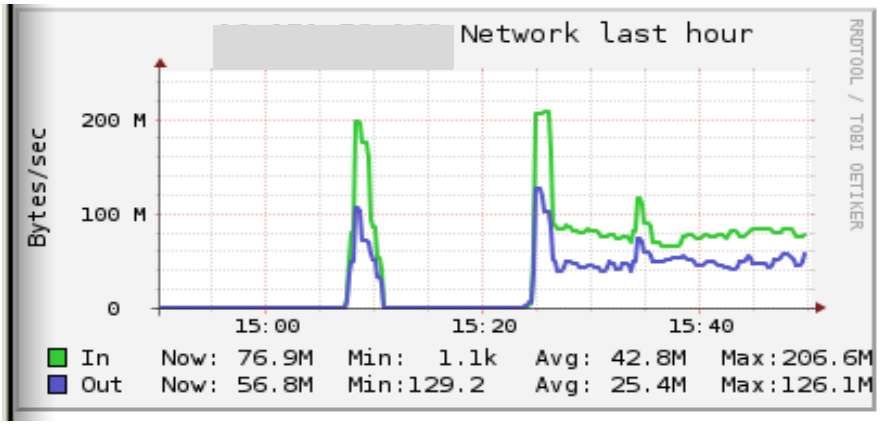
Test with Hadoop

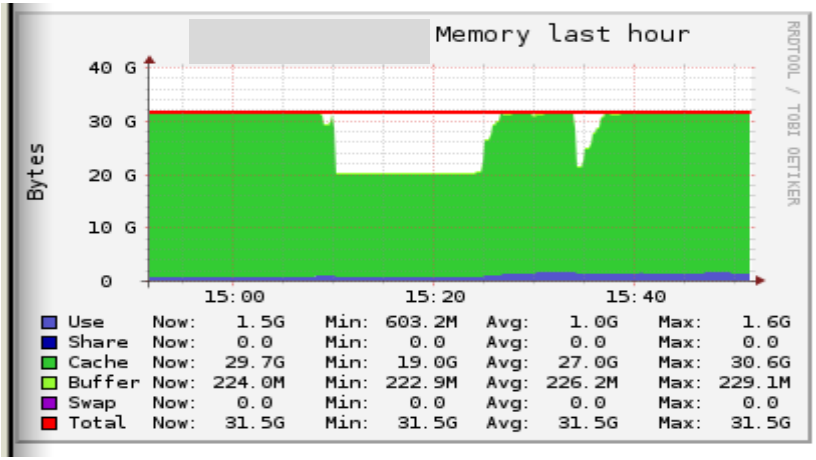
EDF's results





Ganglia's results

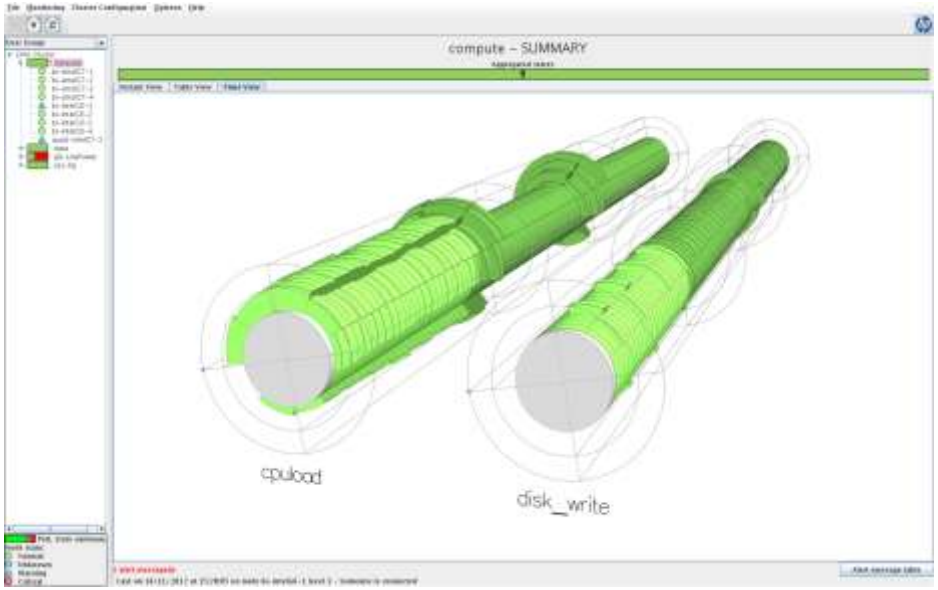




What is left to do ?

- Experimentally validate SNOOZE
- Use the framework in the HPSLab cluster
- Test it with multiple use cases

- Analyse the results



Aims for the future

- Become an EDF's researchers work tool

- Integrate this project to futur production clusters

.Links

- http://www.edf.com
- http://ecograppe.inria.fr
- http://snooze.inria.fr
- http://hadoop.apache.org
- http://ganglia.sourceforge.net/