Towards a French Academic Cloud

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Outline

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Past
► Then, there was the Grid
► Some personal assessments

Present
► Now, there is the Cloud
► Several views of the same concept

Future
► A French Academic Cloud
► First Step and Next Move

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- ▶ A wonderful promise!
  - ▶ Access to an unprecedented amount of computing and storage resources by just plugging your laptop
 - ▶ Analogy with the power grid

- ▶ Also a crucial need
  - ▶ LHC expected to produce Peta-Bytes of data per year

The (European) Grid Key Points

- Users
  - Mostly from the HEP community
  - Also from the Biomed community
- Jobs
  - Mostly long and sequential
  - Tightly linked to (huge) data
- Technology
  - Globus first . . .
  - then gLite
  - Scientific Linux
- Organization
  - Centralized (around the CERN)
  - Funded through DataGrid, E-GEE I, II, and III
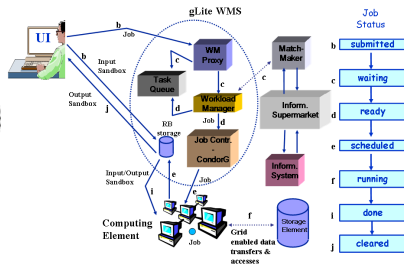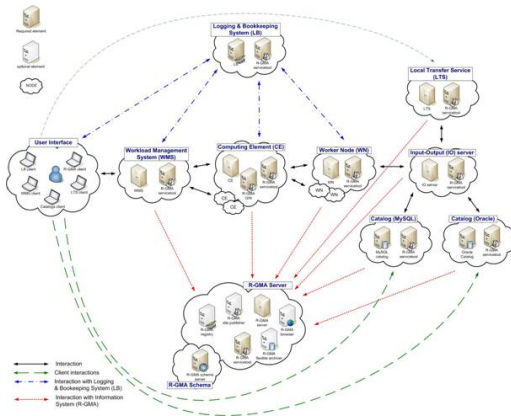
Assessment[*] after 10 years – Successes

- The distributed infrastructure is up and running
  - At a European scale
  - With a 90+% availability
- Tons of jobs running, with tons of data stored and moved!
- VOs are well structured
- Strong authentication and accounting mechanisms
  - X509 Certificates and Nagios
- Successful transition towards a distributed organization
  - From E-GEE to EGI and its federation of NGIs

(*) This is a totally personal assessment.

Assessment[(*)] after 10 years – Fails

- Software infrastructure far too complex and constrained
  - Discourage many new potential users
  - More and more VOs are bypassing the job management chain
    - Generalization of pilot jobs (DIRAC, Diane, Glide-ins, . . .)
- Part of the success is due to the specific of the main target community
  - Physicists are not afraid of computing and coding
- Bad support of HPC jobs
  - Running an MPI job on the Grid is a hassle
- Performance quite impossible to model
  - Too variable
  - Also prevents reproducibility
- In France: too scarce fostering between Research in CS and Production (admin and users)
  - since the DataGrid project!

(*) This is a totally personal assessment.

Past

- ▶ Then, there was the Grid
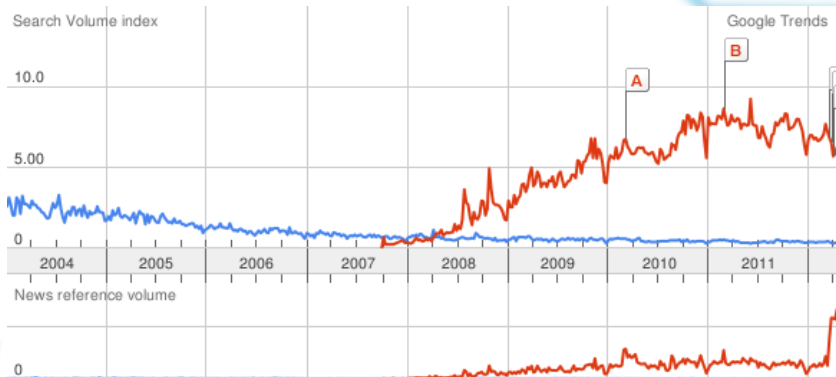- ▶ Some personal assessments

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- ▶ Replaced Grid (as a buzzword at least) in less than 5 years!
- ▶ Most CS conferences are now rather on Clouds than Grids

But, What is the Cloud?

- A wonderful promise!
  - Access to an unprecedented amount of computing and storage resources by just plugging your laptop
  - Everything is hidden by a cloud
- Also a crucial need
  - Most sciences are now data-intensive

LET THE CLOUDS MAKE YOUR LIFE EASIER
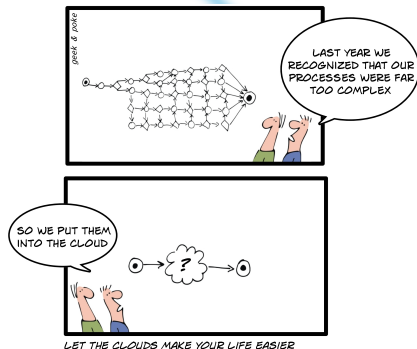
Still a large scale distributed computing and storage infrastructure

► But not the only motivation ...
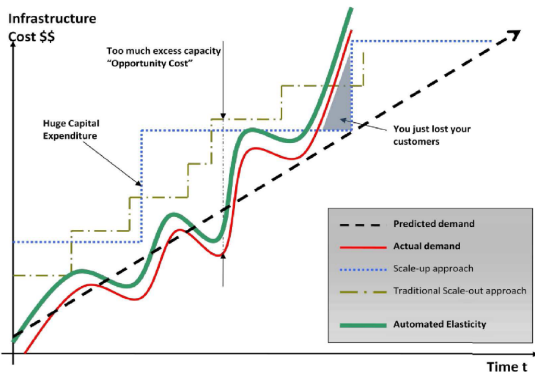
Source : http://media.amazonwebservices.com/AWS_Cloud_Best_Practices.pdf

A Commercial View

Amazon Web Services

- ▶ Commercial web site amazon.com (1995)
  - ▶ Fluctuating traffic (Christmas burst), 24/7 availability
  - ▶ Strong expertise on data analysis and stock management
- ▶ How to maximize the outcome of underused servers?
  - ▶ Rent them to individuals!

AWS is THE reference

- ▶ pay-as-you-go model and EC2/S3 interfaces
- ▶ More than 20 products
  - ▶ Dropbox, Slideshare, Netflix, Zinga, . . .
- ▶ 5 data centers scattered across the world
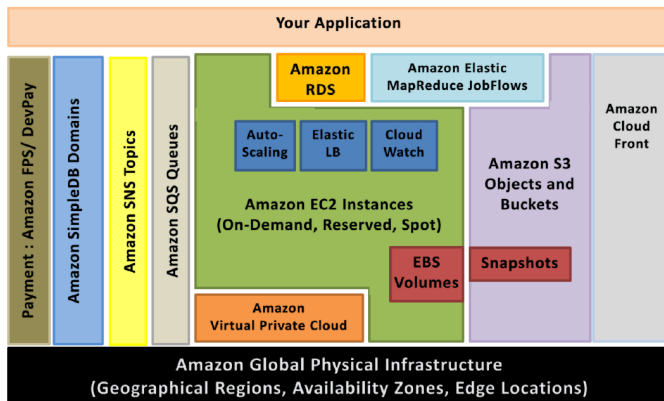
Source : http://media.amazonwebservices.com/AWS_Cloud_Best_Practices.pdf

What Shall We Keep From This View?

- Cloud computing is a way to maximize the outcome of a distributed infrastructure
- Diversity of service offers is a key to success
- Viable economic model
- Importance of user interfaces
- Elasticity is an interesting new concept
  - Offer great production opportunities and research topics

A Governmental View

- Objective
  - Build a trusted data center to store French strategic data
  - Namecode Andromede
  - IaaS Cloud
  - Computing, storage, and network offer
  - Development of an Open Source software stack
- Who is it for?
  - French administration and companies
- Budget and Operation
  - 225 millions euros (75 millions through the FSN)
  - Operated by Orange and Thales

A Governmental View

- A concurrent project: Nuage
    - Operated by a consortium of 7 French SME
    - Including two research teams on distributed systems
- Budget
    - 10 millions euros (5 millions through the FSN)
- Focus on Green Data Centers
    - Original design
    - Reduced energy consumption and low PUE
- Claimed strength
    - Smaller project but easier and faster to set up!

What Shall We Keep From This View?

- Cloud computing is strategic for the French government
  - At least until May, 6th . . .
- A lot of invested money
- Strong incentive to not depend on non-French companies
  - Keep a total control on where data are stored and analyzed
- Energetic concerns
  - Through workload consolidation

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- ▶ The CAPRI project
  - ▶ Answer to the EquipEx call for proposal
- ▶ Objectives
  - ▶ Provide an innovative Data-Scope instrument of unprecedented capabilities
  - ▶ Cover IaaS, PaaS, and SaaS views of a cloud.
- ▶ Approach
  - ▶ User-centric
  - ▶ Build upon some well identified pilot use cases
  - ▶ Close collaboration Applications–Research–Industry
 - ▶ Intrinsically multidisciplinary project

A Production View – CERN

- The LX Cloud initiative
  - Migrate the CERN IT to the Cloud
- Objectives
  - Service consolidation
  - Virtualization of batch resources
  - Both should ease the management
- 90% of resources to be virtualized by the end of next year

A Production View – EGI

- **EGI Federated Cloud Task Force**
  - Led by Matteo Turilli, Oxford e-Research Centre, University of Oxford
- **Objectives**
  - Write a blueprint document
  - Deploy a test bed
    - Integration of virtualised resources, monitoring and accounting
  - Investigate requirements
  - Provide feedback
  - Identify user communities willing to be early adopters
  - Identify indirect issues
- **Mandate**: from September 2011 to March 2013

EGI TF Investigated Scenarios

- Scenario 1: VM Management
  - *"I want to start a single existing VM image on a remote cloud"*
- Scenario 2: Managing my own data
  - *"I want to start a VM instance from an image that I have created"*
  - *"I want to associate my running VM with a data set in the Cloud"*
  - *"I want to take snapshots of my running VM for restart purposes"*
- Scenario 3: Integrating multiple resource providers
  - *"I want to choose on which resource provider I want to start my single VM"*
  - *"I need to know about the VMM capabilities the provider offers"*
- Scenario 4: Accounting across Resource Providers
  - *"My usage across different resource providers needs to be recorded and reported to multiple aggregators"*
- Scenario 5: Reliability/Availability of Resource Providers
  - *"Give me info on the reliability/availability and status of the remote VMs"*
- Scenario 6: VM/Resource state change notification
  - *"Told me when the status of the [VM] instance I am running changes"*
- Scenario 7: AA across Resource Providers
  - *"I want to use my existing identity, and not re-apply for new credentials"*

Roadmap Mar/Sep '12
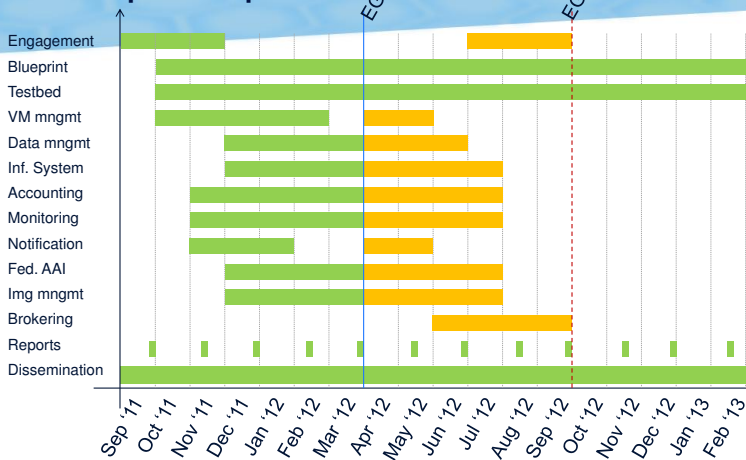
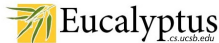# What Shall We Keep From This View?

- ▶ Cloudification in on the move!
  - ▶ At least at the IaaS level
- ▶ Importance of federation aspects
  - ▶ Need to build upon standards (OCCI, CMDI)
  - ▶ Let the site decide of their own local policies
- ▶ Efforts driven by use cases/scenarios
  - ▶ Do what is needed only
- ▶ Keep the best features of the Grid
  - ▶ Single Sign-on, accounting and monitoring

An OSS View

- Many Open Source IaaS management systems
    - OpenStack, OpenNebula, Nimbus, Eucalyptus
    - Some come from research
    - Other from industry
- Two stacks emerge
    - OpenNebula
        - Deployed by early adopters
    - OpenStack
        - More promising for newcomers
        - A lot of developing force (a.k.a. money) behind
        - Strong support of industry
- All aim at interoperability
    - Through standardized (OCCI, CDMI) or *de facto* (EC2, S3) interfaces

NIMBUS

OpenNebula.org
The Open Source Toolkit for Cloud Computing

Eucalyptus
cs.ucsb.edu

openstack

What Shall We Keep From This View?

- Cloud will probably be Open Source
    - Coherent with governmental trends
- Open Stack is rising!
    - A feature is missing? Just ask, someone will add it soon!
- Every stack has its own strengths
    - Keep them in mind whatever the chosen one!

A Research View – Grid'5000

- The Grid'5000 platform
  - An infrastructure for research on Grid, Clouds and other DCI
  - Customize, deploy, test, and do over
- Towards virtualized environments
  - Historical bare metal IaaS mode
    - Since 2005!
    - using OAR (batch) and kaDeploy (system image deployment)
  - Network isolation (KaVLAN)
  - Virtual machine deployment (Xen, KVM)
  - Many supported Cloud stacks
    - OpenNebula, Nimbus, and Open Stack soon

- Many hot research topics investigated
    - Virtualized resource management
        - Including scheduling, mapping, and migration
    - Managing Big Data
        - Including MapReduce, storage resource management, application deployment
    - Energy consumption monitoring and resource management
    - Fault-tolerance and resilience
    - Sky computing
        - Using several IaaS management stacks as a single environment

What Shall We Keep From This View?

- A lot of top level CS research teams in France
  - Many of them involved on topics related to cloud and big data
- Will propose a platform dedicated to experiments involving big data
- Existing collaborations with production clouds
  - Technological and expertise transfers
  - Dimensioning experiments
  - Log analysis and injection in a simulation context
- Grid'5000 provides the perfect playground to test new solutions
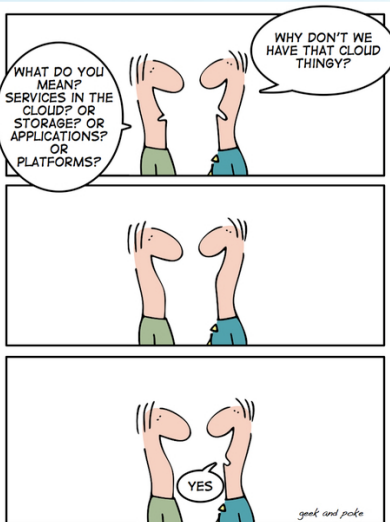
A User view – Some Use Cases

▶ Have my own nice customized VM with all the software package I need
▶ Access to a virtually infinite pool of resources and manage it by myself
   ▶ Similar to the pilot job approach on the Grid
▶ Keep my old fashioned Grid stack on top an IaaS Cloud
   ▶ The StratusLab approach
▶ Do everything through a simple web portal
   ▶ Required by non-CS specialists
   ▶ as in the IRT BioAster and IMI eTRIKS projects
▶ Access to small subsets of huge data in a cloud fashion

- ▶ Most of new potential users of cloud
  - ▶ Do not know what they expect from the Cloud
  - ▶ Do not (sometimes) even know what they need
    - ▶ Glaring example of the IRT BioAster
- ▶ We cannot assume the same public as for the Grid
  - ▶ Users that see CS as a magical (but frightening) tool
  - ▶ No more skilled physicists
- ▶ Implies to start with some well defined use cases

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Towards an French Academic Cloud
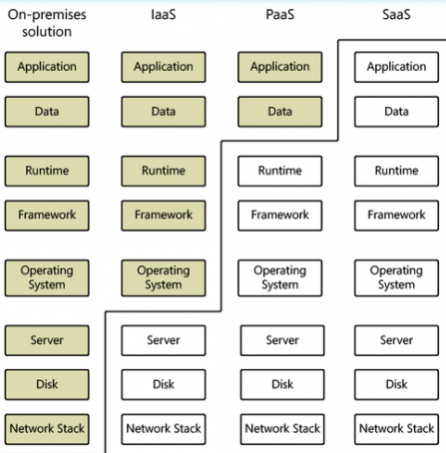
► **Definition**
  ► Deploy a Cloud infrastructure to serve the computing and storage needs of french academic institutes (universities, research institutes)

► **Expectations**
  ► Not miss the Cloud (r)evolution
  ► Control our technical and strategic decisions
  ► Answer to government expectations related to Big Data challenges
  ► Be coherent with strategies of partners (CERN, EGI, . . .)
    ► To what extent?
  ► Foster collaborations with research in CS and industry
    ► Not reproduce the same errors as for the Grid
  ► Benefit (and make users benefit) of the strong expertise on
    ► Data management
    ► Federated distributed computing infrastructures

- Initial test bed
  - Funded by France Grilles (cont'd in 2012)
  - Two sites: CC IN2P3 and IRIT, Toulouse
  - Other potential sites (LAL, LPHC)
- Technical choices
  - Thorough study conducted at CC IN2P3
  - Open Stack holds the rope
  - Be part of a federation is a main concern ($\Rightarrow$ standards)
- Use cases
  - Provided by IRT BioAster and eTRIKS projects
  - More to come with new projects (Mastodons, Big data, ...)
- Aims
  - Run jobs in production
  - Test solutions coming from research in CS

Which aaS do we target?

On-premises solution	IaaS	PaaS	SaaS
Application	Application	Application	Application
Data	Data	Data	Data
Runtime	Runtime	Runtime	Runtime
Framework	Framework	Framework	Framework
Operating System	Operating System	Operating System	Operating System
Server	Server	Server	Server
Disk	Disk	Disk	Disk
Network Stack	Network Stack	Network Stack	Network Stack

▶ IaaS is on the way
  ▶ Virtualized batch
▶ Most users would like SaaS
  ▶ Web portals mainly
▶ Will be driven by use cases

Source: "Windows Azure Step by Step" By Roberto Brunetti, Microsoft Press

What's next?

- ▶ Integrate the EGI task force test bed
  - ▶ Once the stack is up and running
- ▶ Keep an open eye on the choices made by other main partners
- ▶ Serve the applications of on-going projects
- ▶ Set up a group of reflexion with
  - ▶ People operating the production Grid
  - ▶ Researchers working on cloud and data management
  - ▶ Power users from various communities
- ⇒ Define a strategic roadmap for the next 5 years

I don't care if my cloud computing architecture is powered by a grid, a mainframe, my neigbour's desktop or an army of monkeys, so long as it's **fast, cheap and secure***.*

Sam Johnston (`http://samj.net/`)

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let's try to avoid the army of monkeys!