Some thoughts on the evolution of Grid and Cloud computing

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1. Distributed computing in scientific areas

2. Integration of access interfaces to computing resources

3. Summary
Outline

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By the name **Grid**, we understand a *widely distributed computing infrastructure*, including hardware resources and the corresponding software tools and services, which allow *optimal execution of computational tasks*, with appropriate access to the distributed data. The implementation of such an infrastructure is beyond the scope of this document. The Grid is assumed to provide proper authentication and authorisation, transparent access to resources, and overall management of the necessary databases. (HEPCAL, 2002)

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**Five attributes** that define **Cloud Computing** (Gartner Group, 2009):

- Service-Based
- Scalable and Elastic
- Shared
- Metered by Use
- Uses Internet Technologies
January 27, 2010: The UK government has unveiled a sweeping strategy to create its own internal "cloud computing" system – such as that used by Google, Microsoft and Amazon – as part of a radical plan that it claims could save up to £3.2bn a year from an annual bill of at least £16bn.

The key part of the new strategy [...] will be the concentration of government computing power into a series of about a dozen highly secure data centres, each costing up to £250m to build, which will replace more than 500 presently used by central government, police forces and local authorities.

By 2015, the strategy suggests, 80% of central government desktops could be supplied through a "shared utility service".

The new "cloud" system will not include the security services such as MI5 or MI6, which have their own, separate systems.
New requirements to existing Grid infrastructures

While Grid interfaces are widely used esp. by large user communities, Cloud computing offers significant advantages for many uses (among them, pay-as-you-go models, simplified access).

Ideally, though, one would like to adopt Cloud services so that:

- Resources are shared between access interfaces (Grid, Cloud, or else).
- Scalability is ensured.
- Existing services and agreements are not required to change.
- Resource center policies and know-how are honored.
- New services can attract both existing and new customers.

These are both key challenges and opportunities for existing Grid infrastructures.
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Distributed computing in scientific areas

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Some of the typical new service requests:

- **Customer-definable** software environments. This is actually a feature that finds several uses in "traditional" Grids as well.

- Setting up dynamic pools of virtual servers (e.g., user interfaces, or worker nodes for parallel interactive analysis). More generally, flexibly allocating hardware resources through complex advance-reservation requests.

- Instantiating pre-packaged, ready-to-go services.

- Truly distributed, on-demand, **Cloud storage**.

- Not everybody "speaks Grid": providing access to distributed, traditional Grid infrastructures as if they were not Grids, also to non-traditional users, like Public Administrations, or to the private sector.

The key problem is one of integration between several access interfaces (Grid, Cloud, or else).
Examples of currently requested services

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- Unstructured Data Storage (e.g., a cloud drive – think Dropbox)
- Backup to the Cloud
- Archive and Preservation to the Cloud
- Databases in the Cloud (e.g. Google Bigtable)
- Storage for Cloud Computing (e.g. VM images, Application images, Amazon S3)
- Content distribution, i.e. distributing data geographically
- "Intercloud" storage (e.g. federated cloud storage, cloud bursting, hybrid public/private clouds)

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A practical Grid/Cloud integration example: WNoDeS

The **Worker Nodes on Demands Service** (WNoDeS) is a software INFN is developing. It is built around a tight integration with a LRMS (a "batch system") and is running in production at the INFN Tier-1 Computing Center. Its main characteristics are:

- Full integration with existing computing resource scheduling, policing, monitoring and accounting workflows.
- On-demand virtual resource provisioning and VLAN support to dynamically isolate Virtual Machines depending on service type / customer requests.
- Support for users to select and access WNoDeS-based resources through Grid, Cloud interfaces, or also through direct job submissions.

The WNoDeS focus is on *Everything as a Service*, where *Everything* may be hardware, software, data, platform, infrastructure.
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Access to Cloud services happens in WNoDeS through the Open Grid Forum Open Cloud Computing Interface (OCCI). WNoDeS implements a subset of the OCCI API, using X.509 authentication and exposing a REST interface.

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X.509-based access, widely adopted in Grids, is by no means the only authentication mechanism in use. Providing access to services for an expanded customer base means also the need to cater for several authentication methods.

The WNoDeS project is developing an authentication gateway to map several authentication mechanisms (Kerberos, Shibboleth) to a dynamically-assigned, short-lived X.509 personal certificate.

### Authentication gateway advantages

- Authentication for the WNoDeS software framework converges around a single method (X.509).
- X.509 is the authentication mechanism used to access the Grid. Being able to generate a dynamic X.509 certificate opens up the possibility for e.g. users of Cloud services to access Grid (e.g. EGEE) resources.
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The WNoDeS authentication gateway

D. Salomoni (INFN-CNAF)

Grid and Cloud Computing Evolution

SuperB Workshop
Integration of access interfaces to computing resources

WNoDeS: overall architectural framework

Key points
1. On-demand virtual service provisioning
2. Flexible, integrated scheduling policies
3. Multiple access interfaces
4. Multiple authentication methods
5. Integrated access to existing (e.g., Grid) infrastructures
6. Access to external resources
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The WNoDes framework is running at the INFN Tier-1

- It is **in production** with currently \( \sim 1400 \) on-demand Virtual Machines, \( O(10) \) supported Virtual Images, serving 20 different user communities; on average, more than 20,000 jobs are executed each day through WNoDeS.

- The plan is to have \( \sim 4000 \) Virtual Machines by April 2010 and progressively **integrate all Tier-1 resources**.

- **Distributed selection of VM images** works either statically (on a customer-community basis), or dynamically (per-user), through standard Grid job submission commands.

- A pilot **Cloud service** is in place to allocate on-demand resources through OCCI.
A few questions (1)

- Do we still need or want an e-Infrastructure for scientific computing? Do you care?

A recent poll by CommVault identified the following as the main obstacles or worries for cloud adoption:

- Security and privacy
- Reliability
- Cost
- Scalability (are there really infinite resources?)

Can we formalize what our difference is?
A few questions (2a)

Do we fully understand the economic implications of each choice? See the article by Folker Meyer of ANL, "Genome Sequencing vs. Moore’s Law: Cyber Challenges for the Next Decade" (2006).

**Bioinformatics Use Case**

**the “simple” problem: sequencing outpaces moore’s law**

Folker Meyer

- Values are for BLAST searches on Amazon EC2 (from Wilkening *et al.*, IEEE Cluster09)
- Acknowledged: BLAST is not the ideal tool for a lot of this, but...
A few questions (2b)

For example, **elasticity** is a great thing, but...

Cloud Elasticity Could Make You Go Broke

*March 11th, 2009 · 13 Comments*

Ever had a mobile phone and get a bill that was way, way more than you expected? You know what I mean. The day that bill for 700 dollars comes in and your eyes bug out of your head because you could swear (and in fact you do swear – at the customer service rep) that you could not possibly have exceeded your plan minutes? Or maybe you “pay as you

(Daryl Plummer, Gartner) – i.e., **On-Demand Overspending:**
What do we make of the **existing, considerable know-how** in middleware, software development, and in general of the investments made in developing and running the current production grid infrastructures? How could a new computing model **integrate into (and perhaps shape) projects** like EGI, or EMI, or the National Grid/Cloud Infrastructures?

Do we still **need or want** a multi-tiered computing model, with – say – N>1 or N>2 in Tier-N? Do we still need per-experiment, per-research, per-subgroup resources? Think also of overhead, critical mass, and expected availability/reliability of smaller sites.

The computing/business world is undoubtedly showing, like always, a changing (and cloudy) scenario, e.g. for what regards service provider offerings. Can we **start exploring or asking for or testing "novel" requirements now?**
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A few questions (3)

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That’s it – It’s Shoppable (although perhaps not yet shippable)

[Cloud computing is] nothing more than a faddish term for the established concept of computers linked by networks. A cloud is water vapor. (Larry Ellison, co-founder and CEO, Oracle Corporation, September 2009)

The truth is rarely pure and never simple. (Oscar Wilde, The Importance of Being Earnest, 1895)

Thanks!

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