

## Telecom Cloud Standards Information Day

Hyatt Regency, Santa Clara, CA, USA

6-7 December, 2010

# OpenNebula

## *Cloud Innovation and Case Studies for Telecom*

**Constantino Vázquez Blanco**

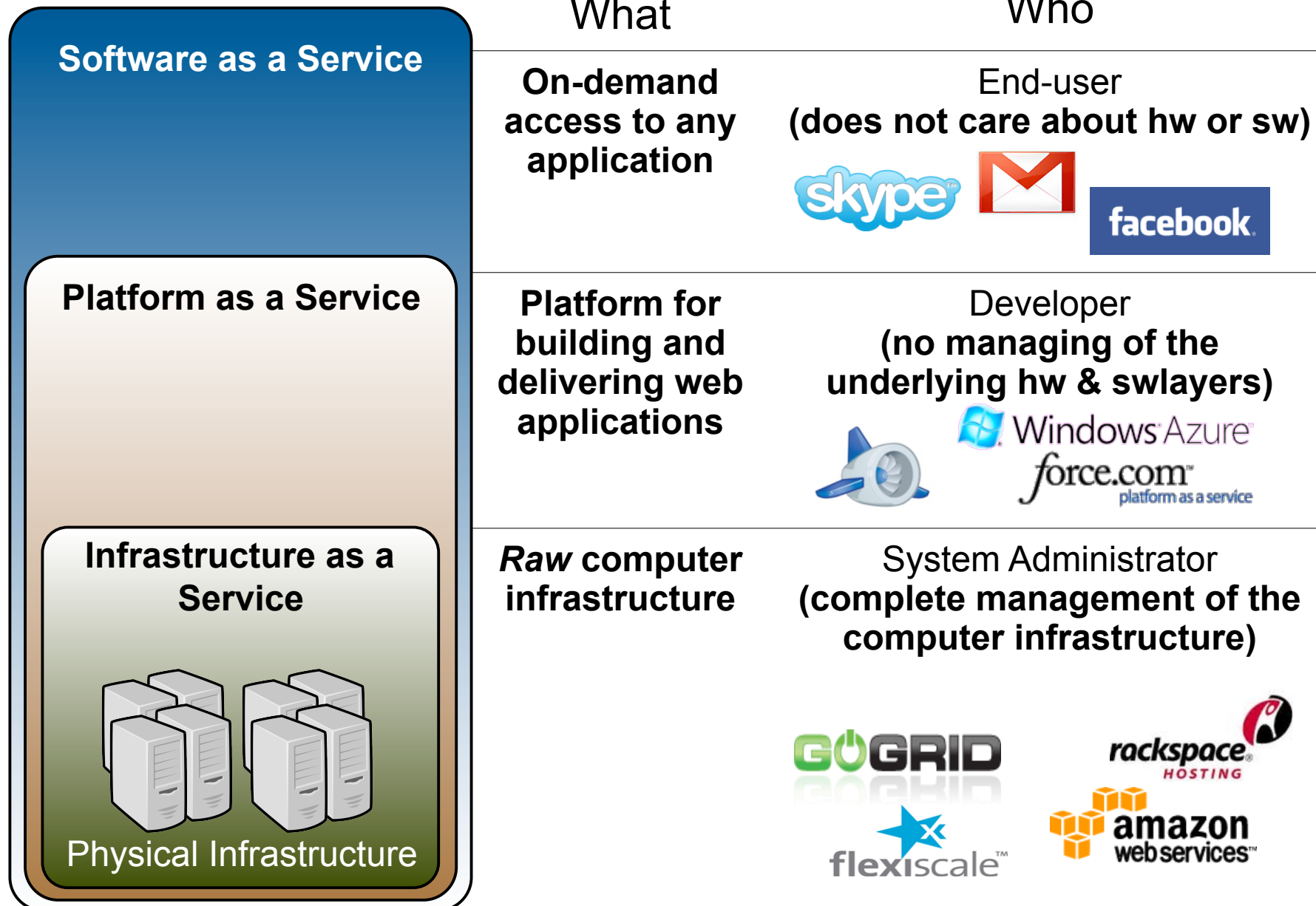
DSA-Research.org

Distributed Systems Architecture Research Group  
Universidad Complutense de Madrid

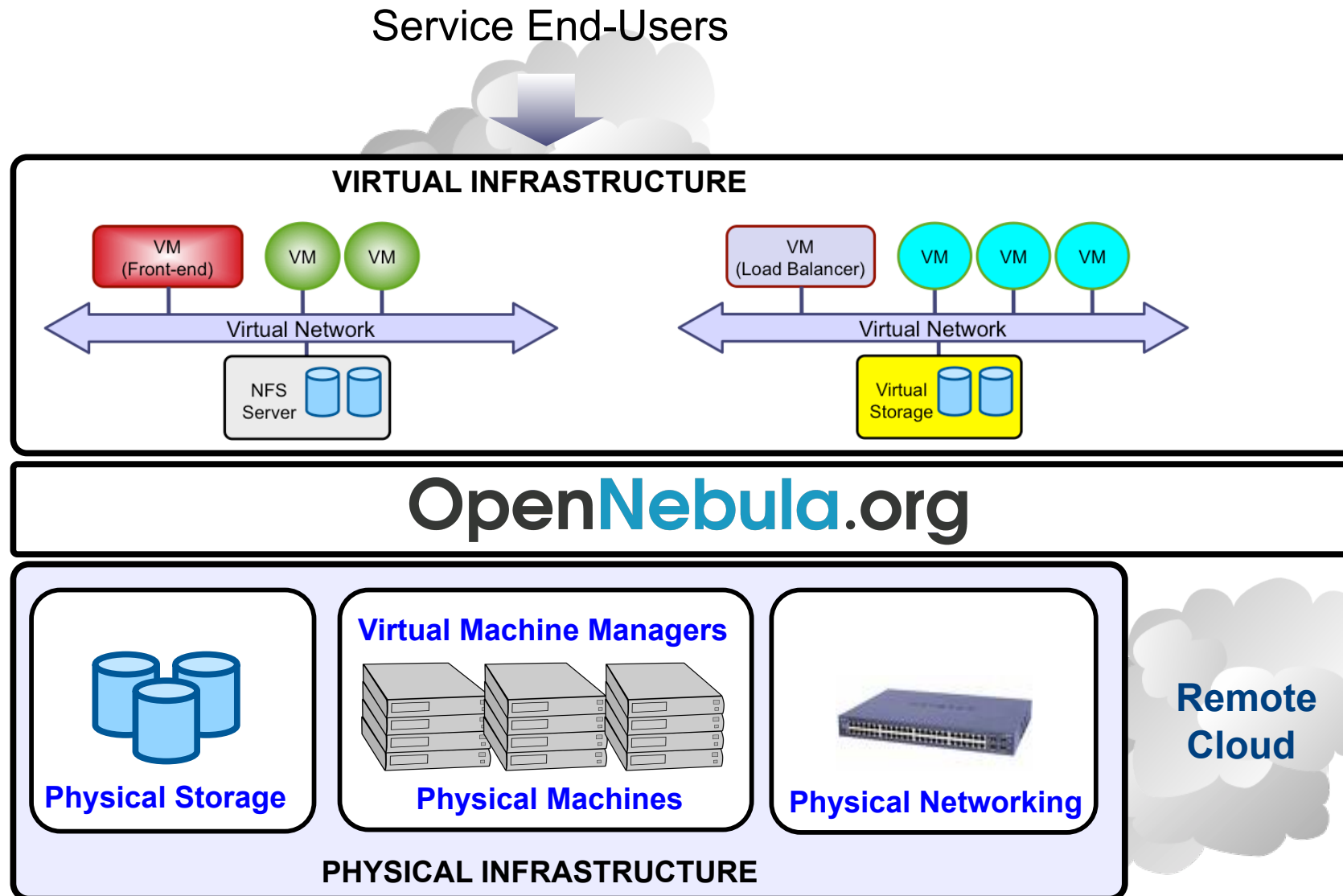
### Acknowledgments



*The research leading to these results has received funding from the European Union's Seventh Framework Programme ([FP7/2007-2013] ) under grant agreement n° 215605 (RESERVOIR Project)*

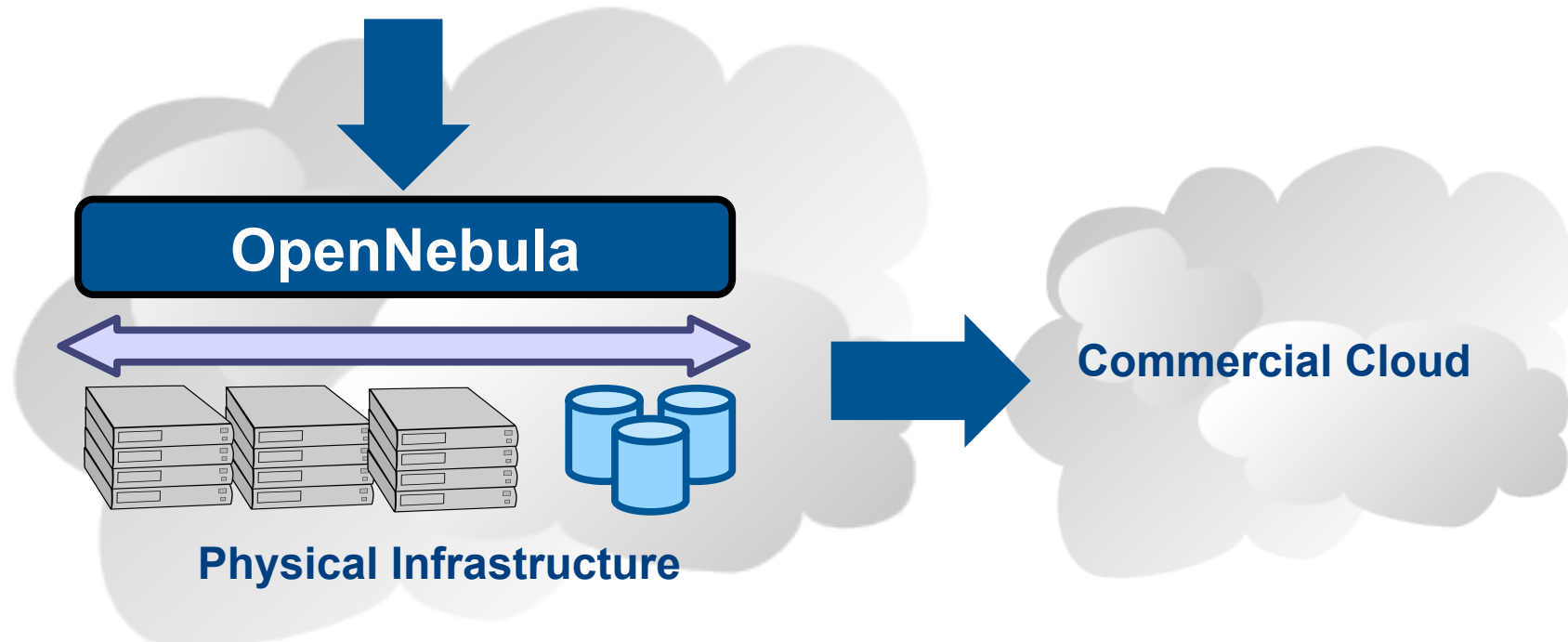


## Cloud Manager to Orchestrate the Complexity of a Datacenter



**Private Cloud Computing => A “Public Cloud behind the firewall”**

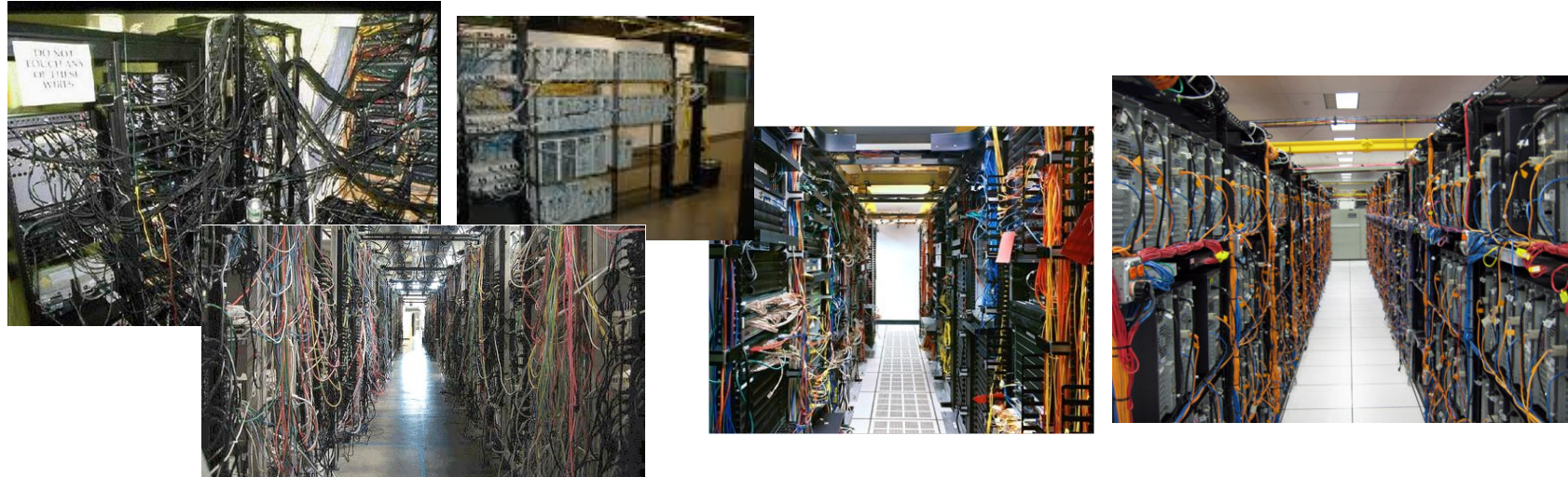
- Simplify and optimize internal operations
- Service flexibility and elasticity
- Higher utilization & operational savings



**Hybrid Cloud Computing => Utility Computing dream made a reality!**

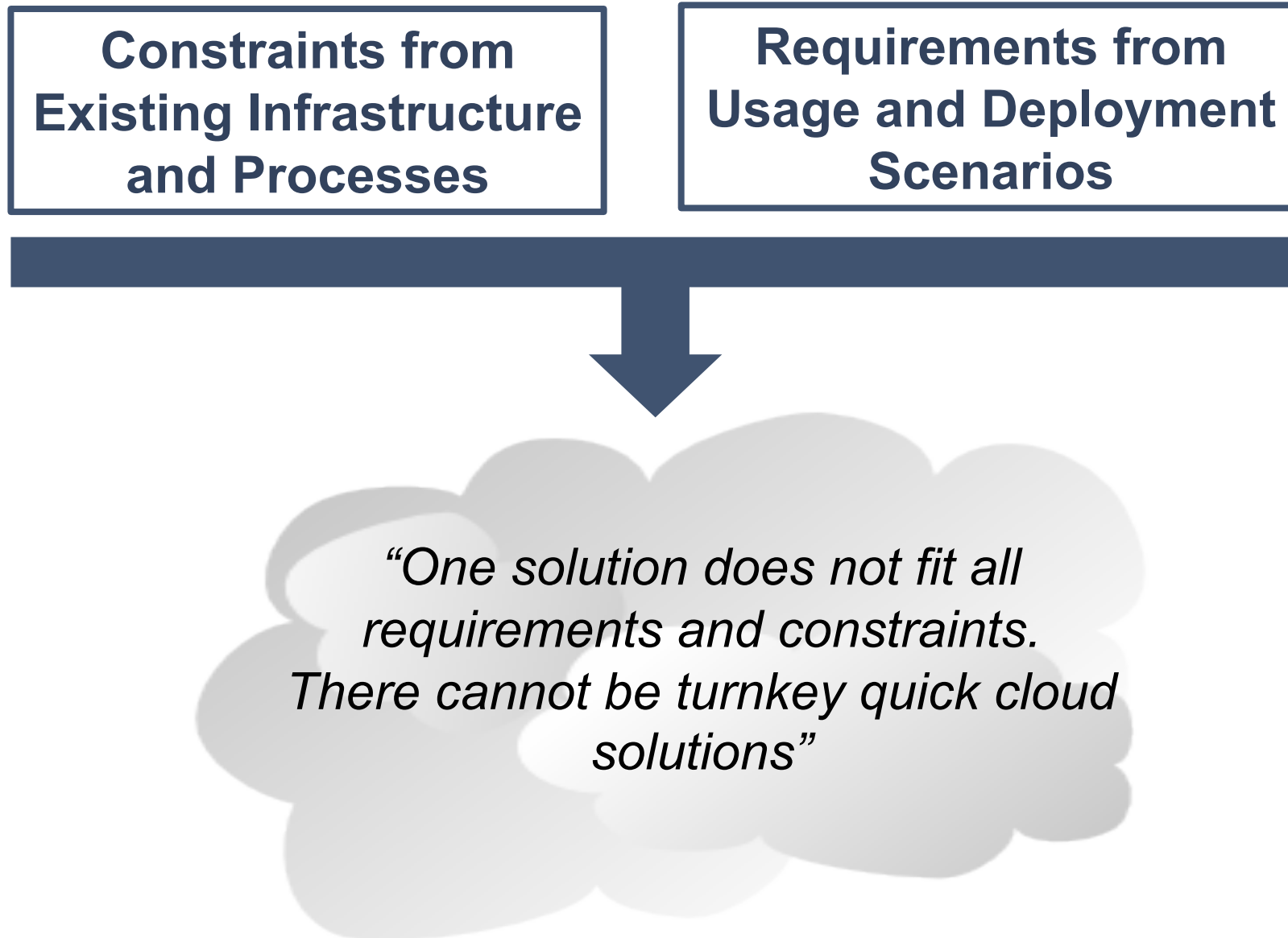
- Supplement the capacity of the Private Cloud

From Heterogeneous and Ugly Data Centers...



... To Homogenous, Modular and Beautiful Data Center





## Flagship International Projects in Cloud Computing

Result of many years of research and development in efficient and scalable management of virtual machines on large-scale distributed infrastructures.



## Open-source Toolkit

Open platform for innovation to research the challenges that arise in cloud management, and production-ready tool in both academia and industry

- **Started in 2005, first release in march 2008, and ONE 2.0 just released**
- **Open-source** released under Apache v2.0, packaged for main Linux distributions
- Mailing lists for **best-effort support** and **open development framework**
- Development and roadmap definition **driven by the community and projects**
- Active and engaged **open community and ecosystem**
- **> 3,000 downloads/month** (not including code repository and Ubuntu)
- Used in many **production environments**, distributed in **commercial solutions** and availability of **commercial professional support by C12G Labs**
- **Long-term sustainability** ensured by project funding and commercial sponsors

## Capabilities for Cloud Management

Most advanced open-source toolkit offering unique features to administer the complexity of large-scale distributed infrastructures

## Capabilities for Integration

Open, flexible and extensible architecture, interfaces and components that fit into any existing data center

## Capabilities for Production Environments

Scalability and performance tested on very large-scale infrastructures consisting of thousands of cores, with the security and fault tolerance levels required in production

## Leverage the Vibrant Cloud Ecosystems

Leverage the ecosystems being built around OpenNebula and the most common cloud interfaces, Amazon AWS, OGC OCCl and VMware vCloud

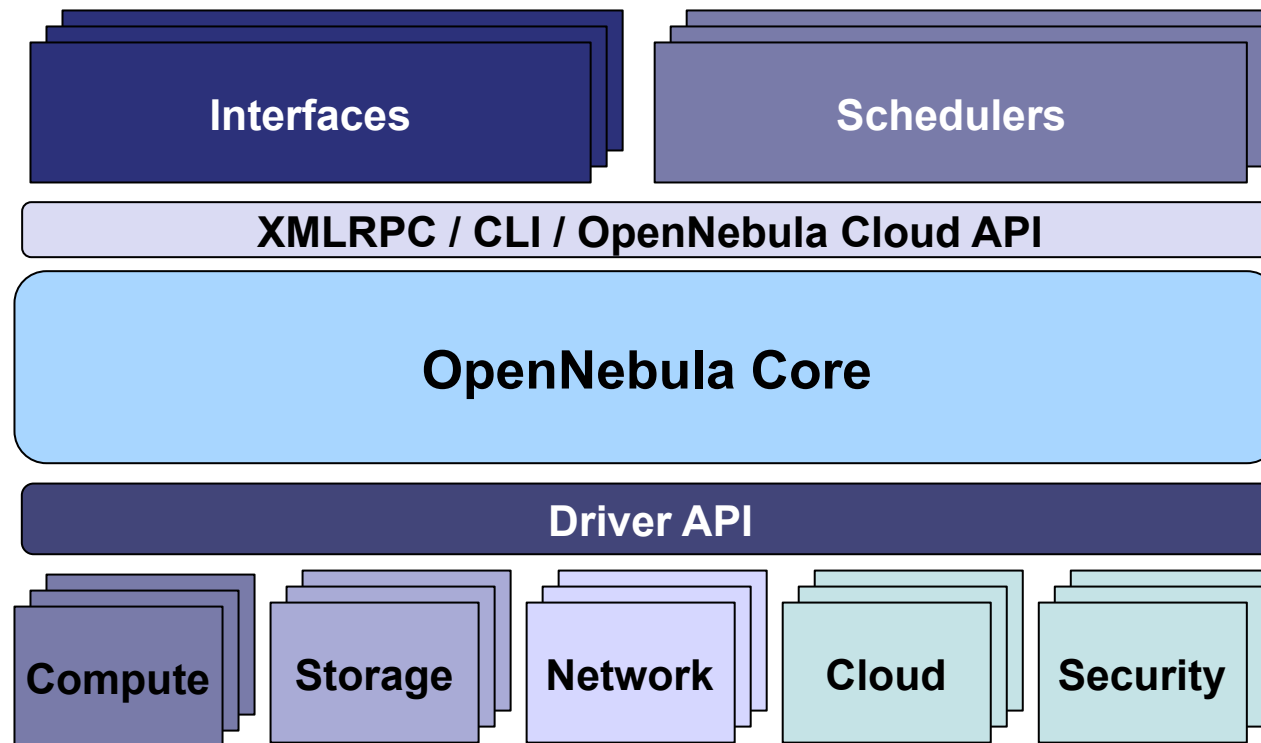
## Fully Open Source Cloud Software

OpenNebula is NOT a feature or performance limited edition of an Enterprise version.  
OpenNebula is truly open, and not open core.

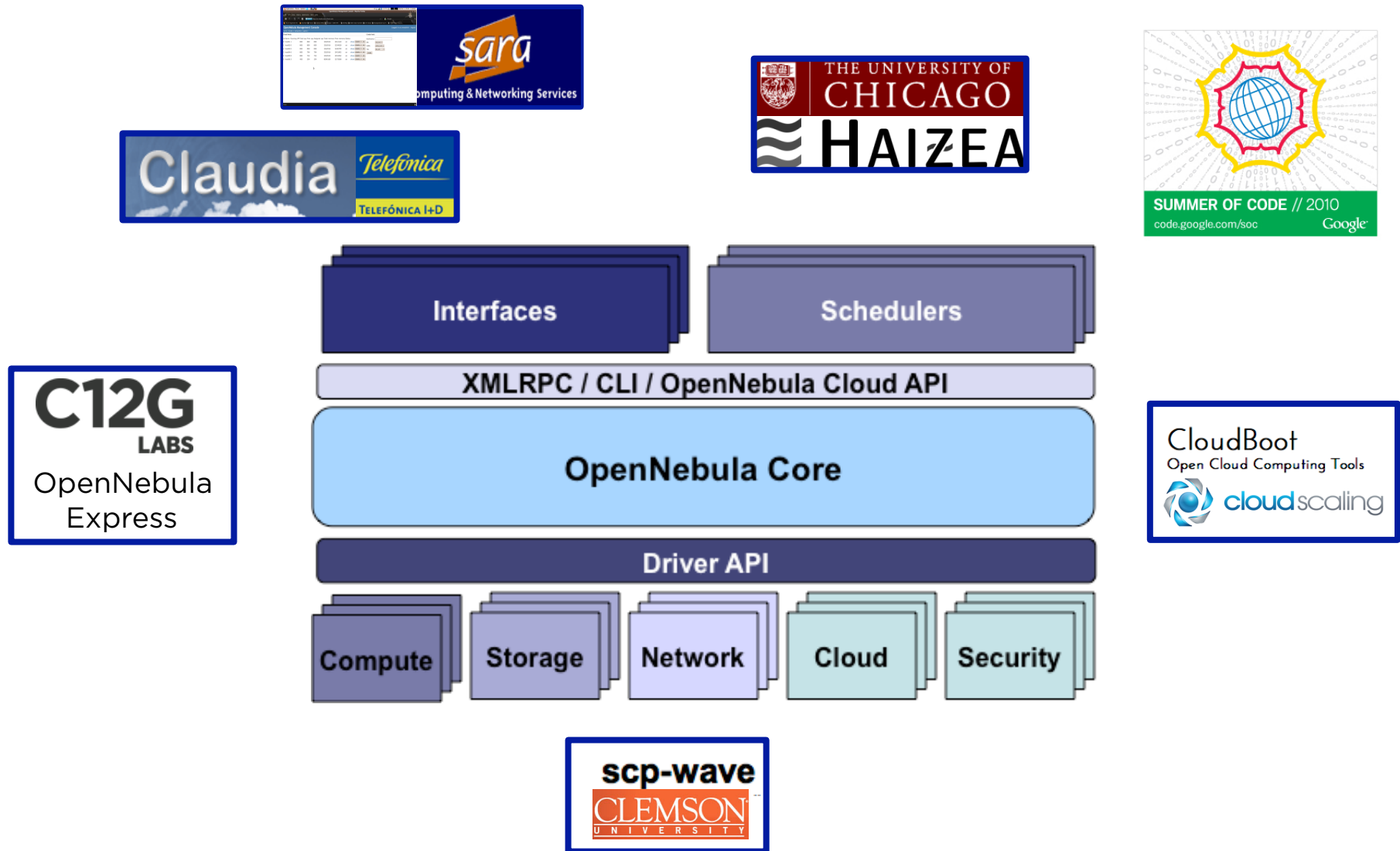


## A Highly Modular Architecture to Fit into any Existing Datacenter

- Cloud Computing is an **evolution of existing data centers**
- One solution can not fit all data-center and user requirements and constraints
- Open, flexible and extensible architecture
- Provide basic components, but allow them to be easily replaceable by others



## Examples of Components in the Ecosystem



## Openness

- Open architectures
- Open interfaces
- Open code

## Adaptability

- Modular architectures

The logo for OpenNebula.org is a stylized, multi-colored cloud shape. It features several overlapping circles in shades of blue, grey, and white, creating a soft, nebula-like appearance. The text "OpenNebula.org" is centered within the cloud, with "Open" in black, "Nebula" in blue, and ".org" in black.

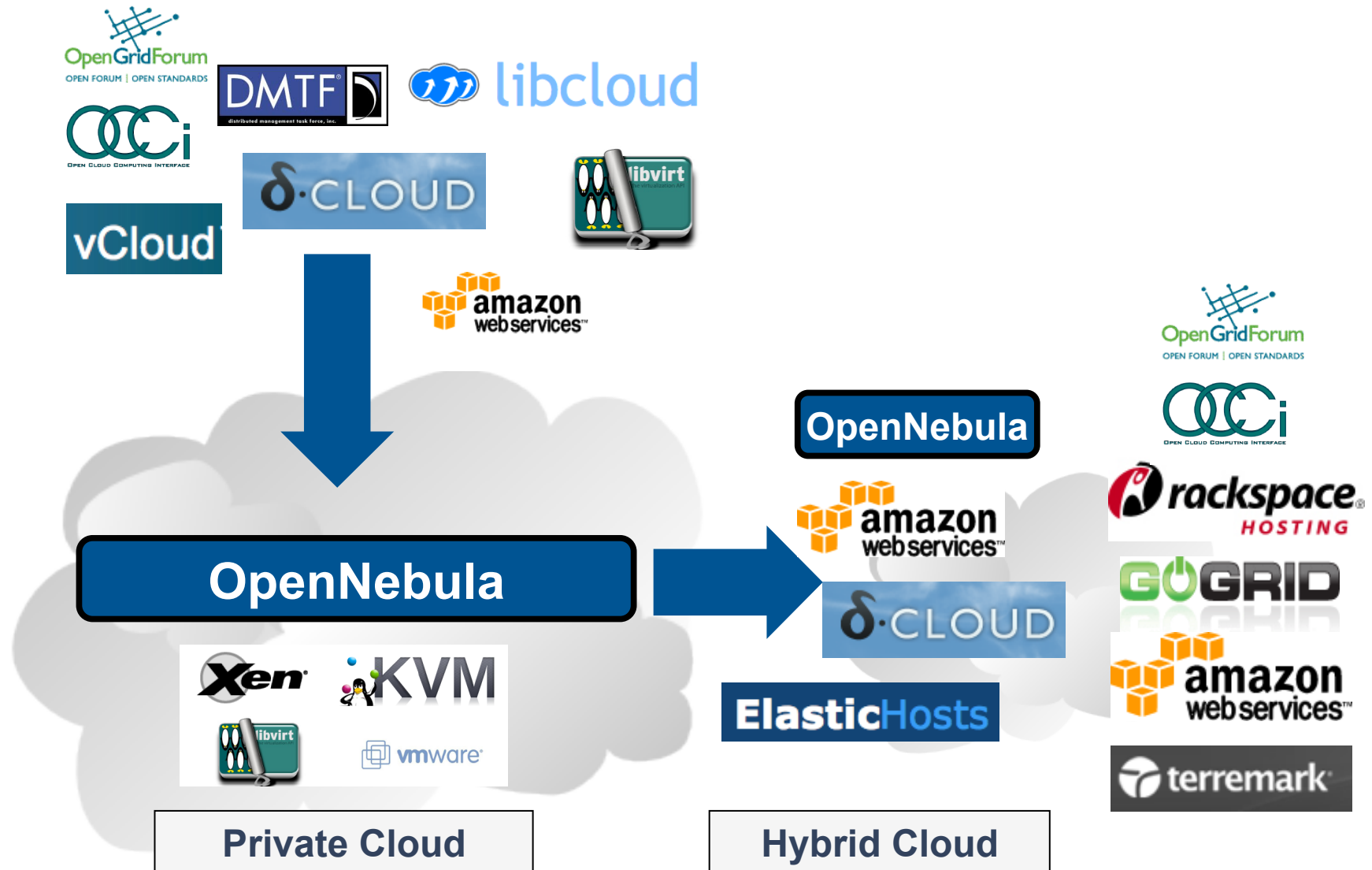
OpenNebula.org

## Standardization

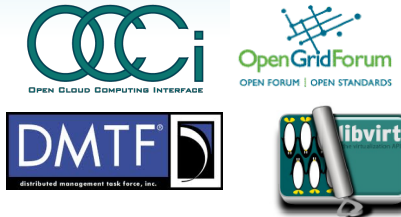
- Use standards
- Implement standards

## Portability

- It can be installed in various hardware and software



## Adopt Standards



## Open Source Community

- Open architecture and interfaces
- Open code and liberal license
- Open community and ecosystem

OpenNebula.org

## Management Tool



## Innovation Tool



Model	Definition	Cloud Cases
<b>Private</b>	Infrastructure is owned by a single organization and made available only to the organization	<ul style="list-style-type: none"><li>• Optimize and simplify <b>internal operation</b></li><li>• <b>SaaS/PaaS</b> support</li><li>• IT consolidation within <b>large organizations</b> (Government Clouds, University Clouds...)</li></ul>
<b>Public</b>	Infrastructure is owned by a single organization and made available to other organizations	<ul style="list-style-type: none"><li>• <b>Commercial cloud providers</b></li><li>• <b>Science public clouds</b> by ICT service centers to enable scientific and educational projects to experiment with cloud computing</li><li>• <b>Special purpose clouds</b> with dedicated capabilities (HPC Clouds..)</li></ul>
<b>Hybrid</b>	Infrastructure is a composition of two or more clouds	<ul style="list-style-type: none"><li>• <b>Cloudbursting</b> to address peak demands</li><li>• <b>Cloud Federation</b> to share infrastructure with partners</li><li>• <b>Cloud Aggregation</b> to provide a larger resource infrastructure</li></ul>

## Private Cloud to Support Grid Site



- **Goal:** Execution of a virtualized Grid site in D-Grid and EGEE
- **Details:** The D-Grid Resource Center Ruhr (DGRZR) runs an OpenNebula private cloud on 248 blades and 1,984 cores with Xen

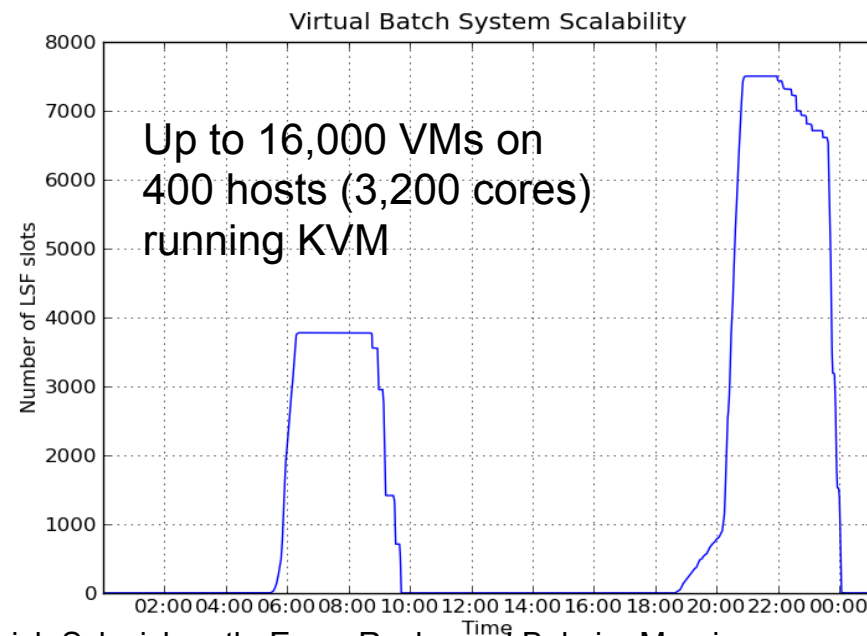
## Public HPC Cloud



- **Goal:** OpenNebula is used to support the execution of virtual clusters and HPC applications
- **Details:** SARA High Performance Computing Center uses OpenNebula in its new HPC Cloud service



- **Goal:** Easier management and new computing models in the batch farm
- **Example of Integration with Existing Infrastructure Environment**
  - **Configuration Management:** Quattor with lifecycle management and “self - notification” in OpenNebula
  - **Network Management:** Adapted to address network infrastructure requirements regarding fixed IP/MAC leases in each box
  - **Storage Management:** New LVM transfer scripts and a very fast parallel scp to push images to all the hosts



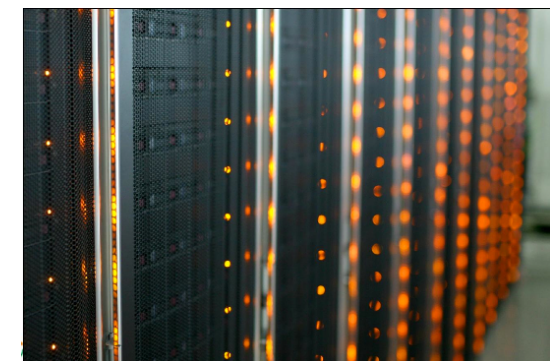
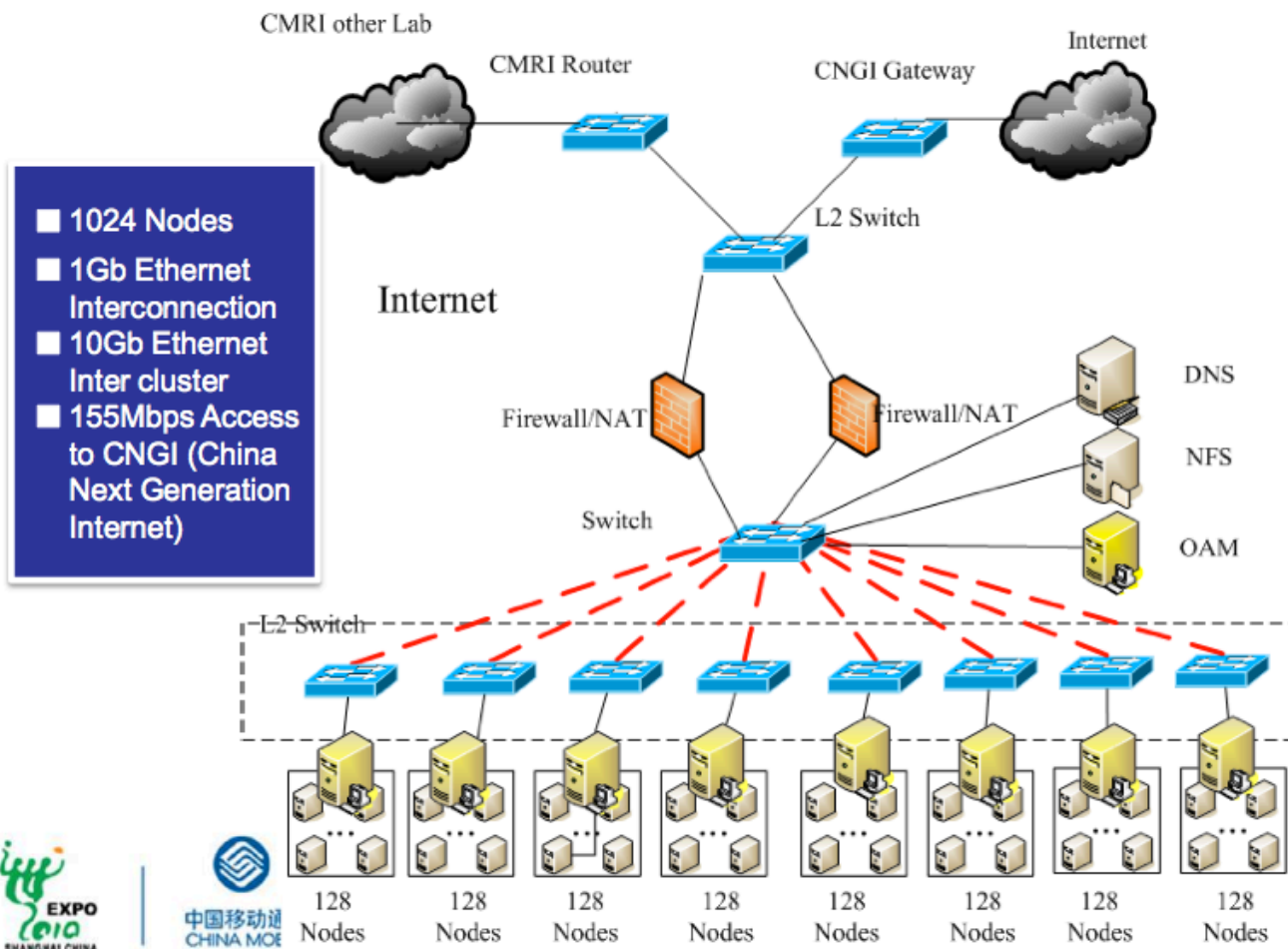
Source: CERN IT-PES/PS Group: Sebastien Goasguen, Ulrich Schwickerath, Ewan Roche and Belmiro Moreira





- **Goal:** Meet the growing demands for high performance, low cost, high scalability, high reliability of China Mobile IT Infrastructure (computing, storage); and the demands of China Mobile to deliver Internet business and services

- **Details:** 4,096 cores, Xen, Ganglia, and Hadoop



Source: China Mobile's Presentation at OpenCirrus Meeting

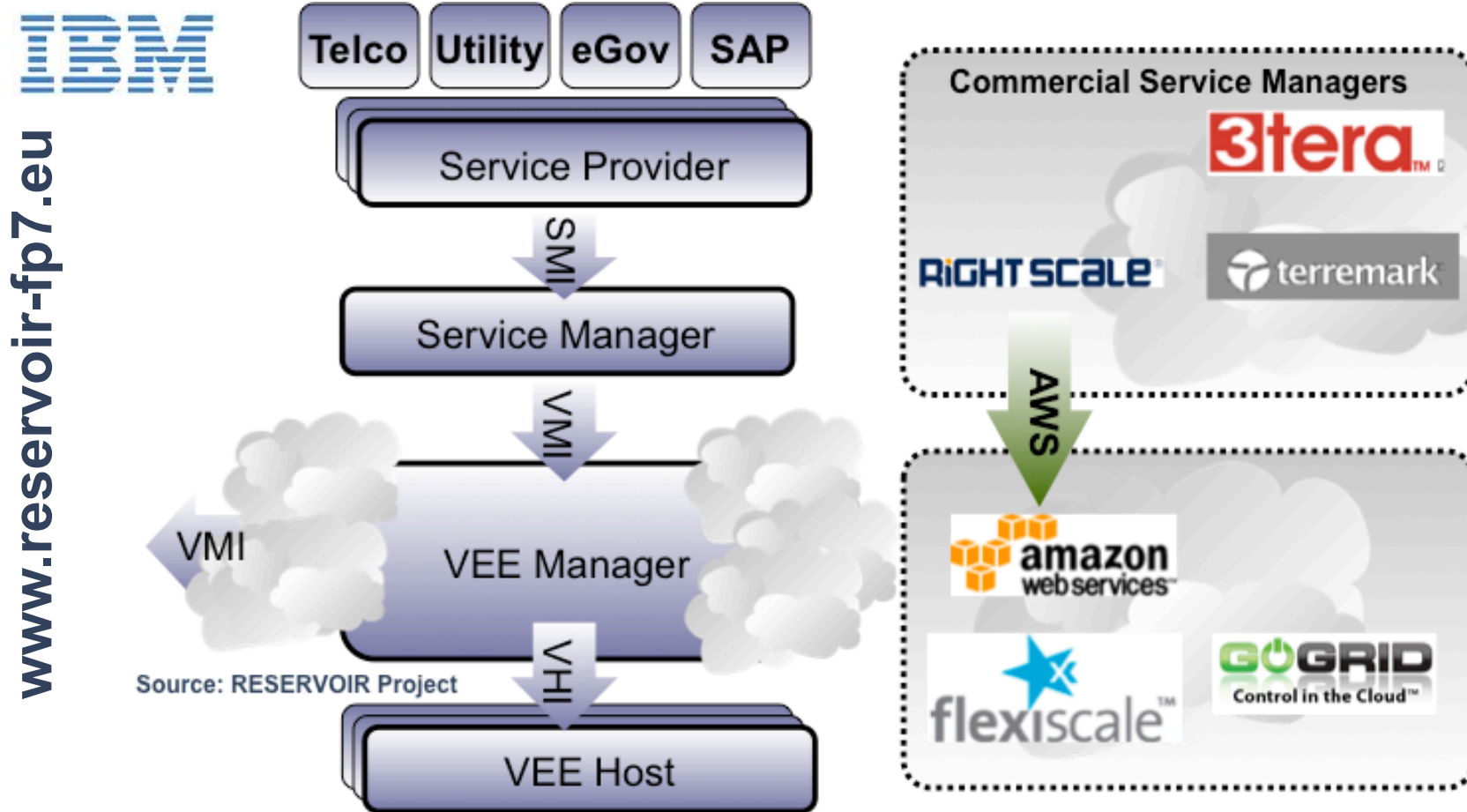
OpenNebula: *Cloud Innovation and Case Studies for Telecom*



Agreement 215605 (2008-2011)  
Service and Sw Architectures  
and Infrastructures

## Resources and Services Virtualization without Barriers

- Open source technology to enable deployment and management of complex IT services across different administrative domains





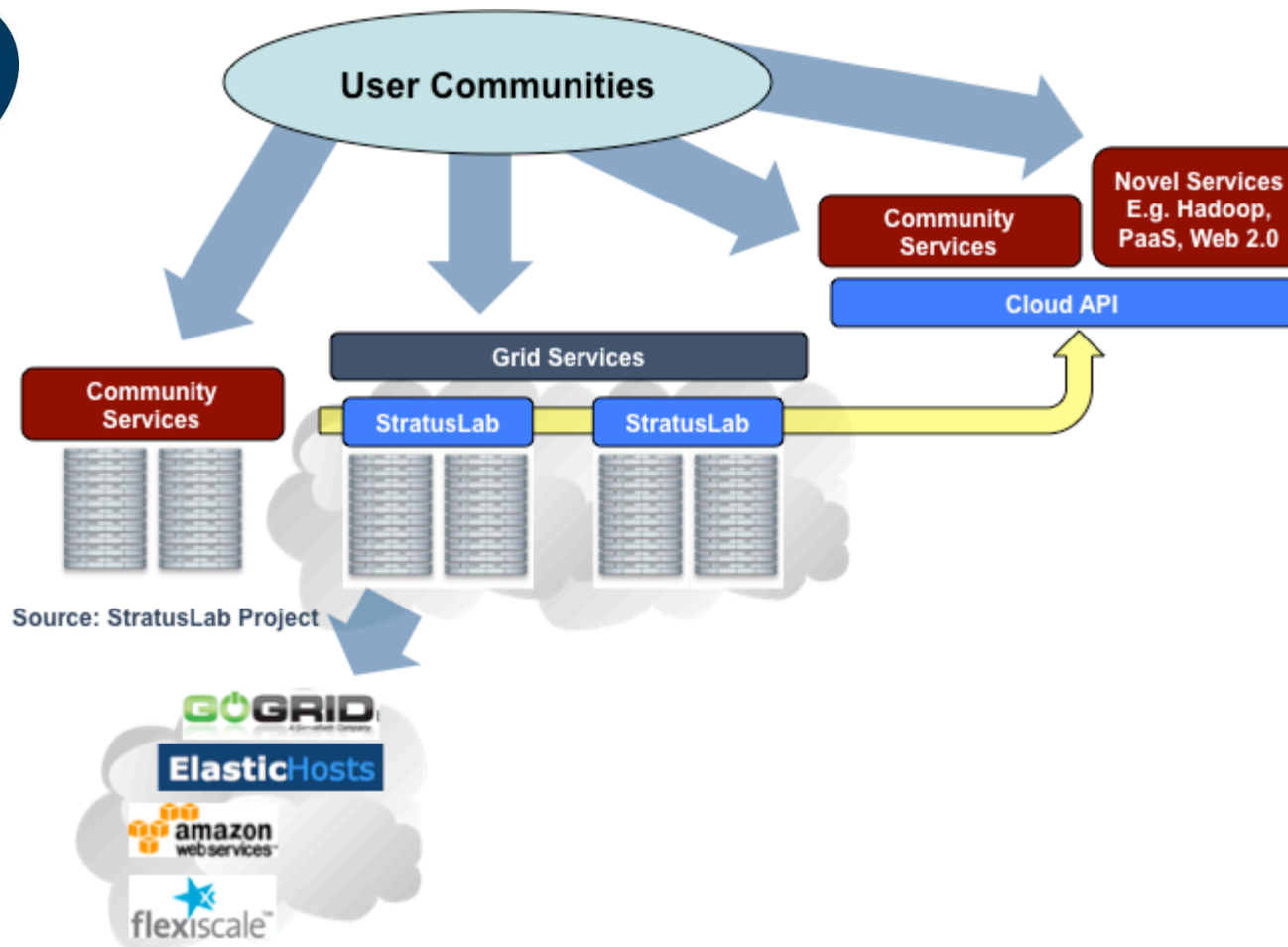
EU grant agreement RI-261552  
**e-Infrastructure**  
(2010-2012)

## Enhancing Grid Infrastructures with Cloud Computing

- Simplify and optimize its use and operation, providing a more flexible, dynamic computing environment for scientists; and enhance existing computing infrastructures with “IaaS” paradigms



www.StratusLab.eu





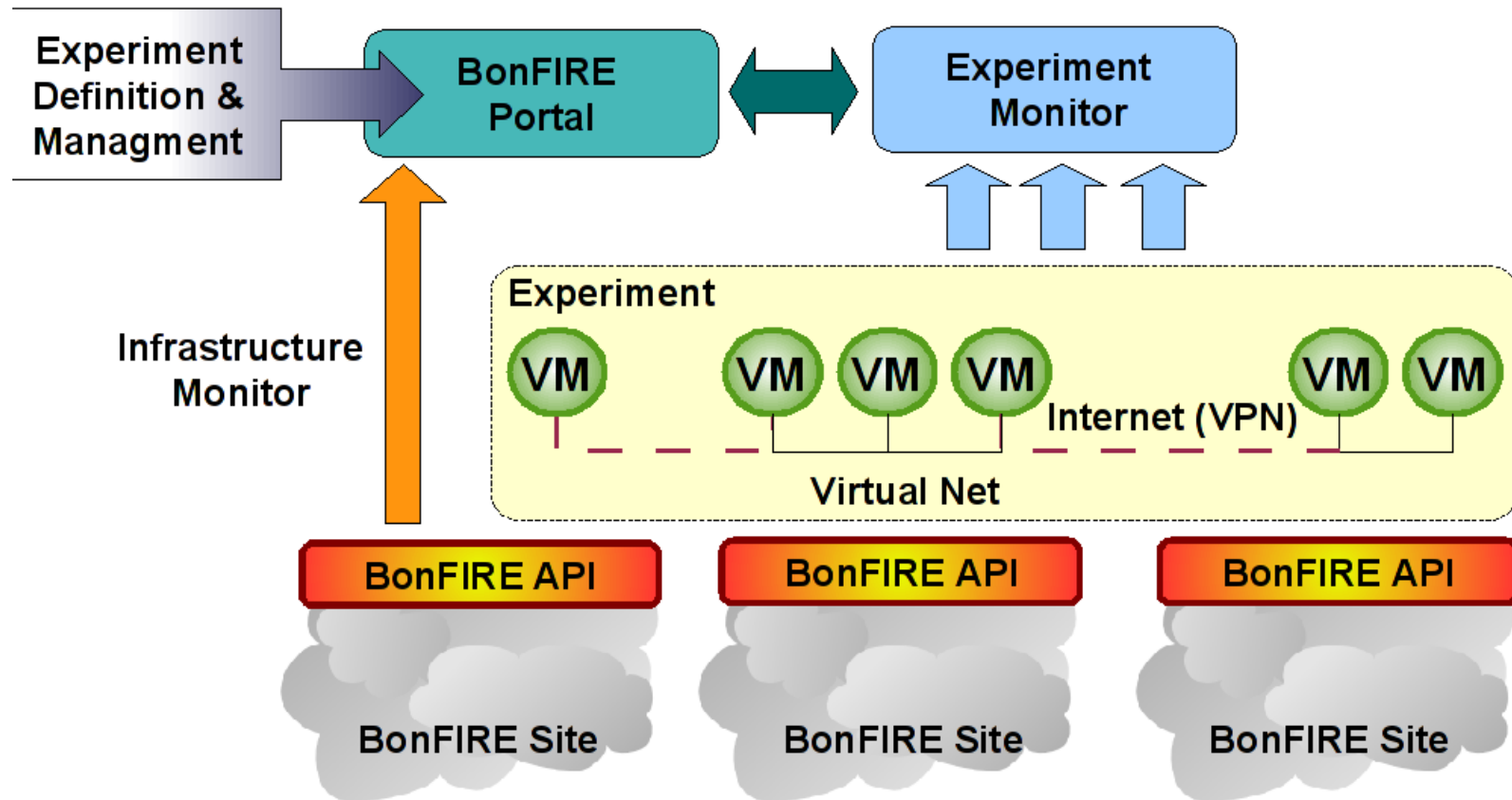
Agreement 257386 (2010-2013)  
**New Infrastructure Paradigms  
and Experimental Facilities**

## Building Service Testbeds on FIRE

- Design, build and operate a multi-site cloud-based facility to support research across applications, services and systems targeting services research community on Future Internet



www.BonFIRE-Project.eu



Source: BonFIRE Project



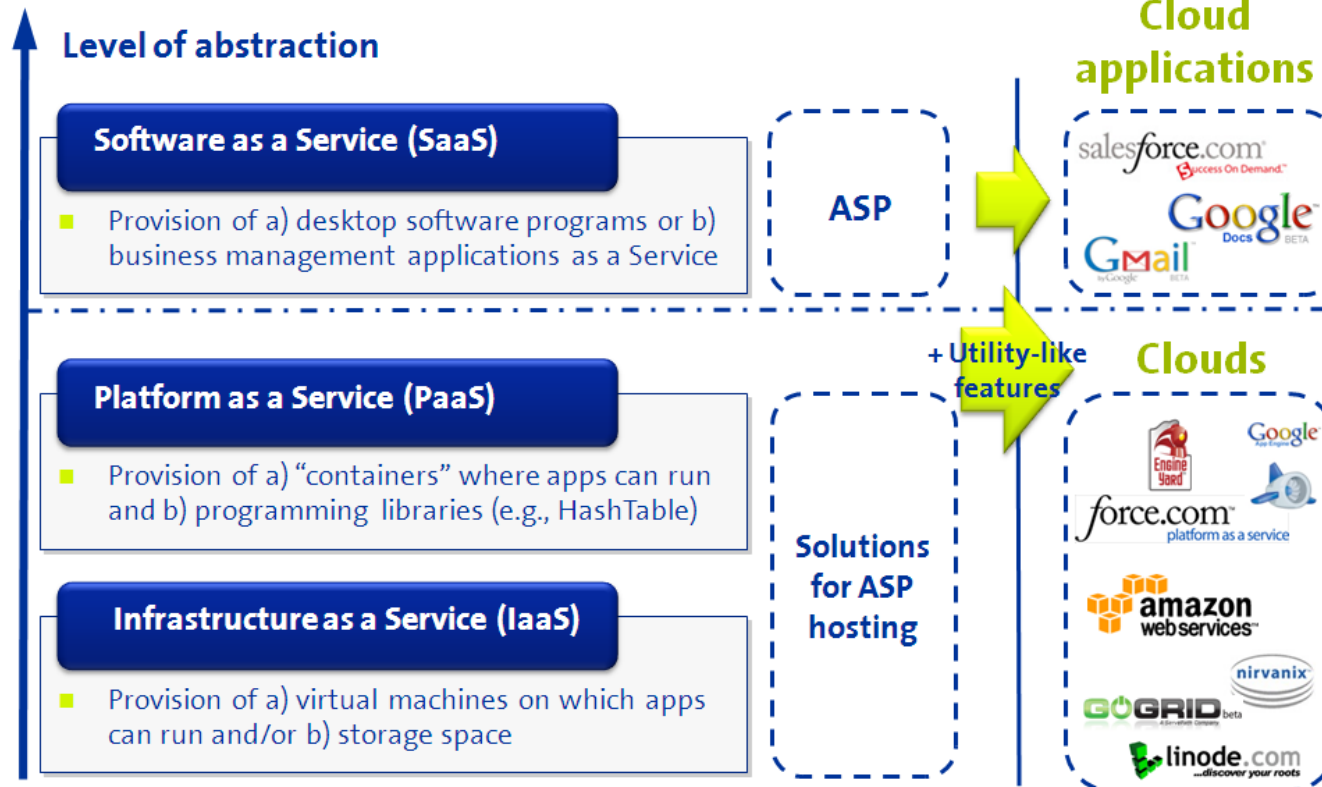
Agreement 258862 (2010-2013)  
Service and Sw Architectures  
and Infrastructures

## Building the PaaS Cloud of the Future

- Create an advanced PaaS Cloud platform which supports the optimized and elastic hosting of Internet-scale multi-tier applications



4caast.morfeo-project.org



Source: 4CaaS Project

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## Use the Technology and Give us Feedback

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- Support through several mailing lists
- Report bugs and make feature requests
- Describe your use case in our blog
- Participate in the OpenNebula Technology Days

## Spread our Word

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- Spread the word about OpenNebula and open source cloud computing

## Contribute to the Development

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- Open development infrastructure
- Provide patches for bug fixes or enhancements

## Contribute to the Quickly Growing Ecosystem

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- Submit a new tool or extension to the OpenNebula ecosystem

## Sponsor the Community

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- Provide funds or resources to support development or to organize workshops or tutorials

## Sponsors

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### dsa-research.org

- **European Commission:** RESERVOIR (EU agreement 215605), StratusLab (EU agreement 261552), BonFIRE (EU agreement 257386) and 4CaaSt (EU agreement 258862).
- **Ministry Science & Innovation:** HPCcloud 2010-2012, MICINN TIN2009-07146
- **Community of Madrid:** MEADIANET 2010-2013 CAM S2009/TIC-1468
- **C12G Labs** dedicates an amount of its own engineering resources to support and develop OpenNebula

## The OpenNebula Community

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- **The OpenNebula Team:** Ignacio M. Llorente, Ruben S. Montero, Tino Vazquez, Javier Fontan, Jaime Melis, Carlos Martín, Rafael Moreno, Daniel Molina, Borja Sotomayor...
- ... and many **value community contributors** from several organizations

**Your support and contribution are very much appreciated!**

## More info, downloads, mailing lists at

The screenshot shows the OpenNebula.org website. At the top, it says "OpenNebula.org" and "The Open Source Toolkit for Cloud Computing". Below that is a navigation menu with links for Home, About, Documentation, Software, Support, Community, Cloud, Dev, and Blog. The main content area features a "The Truly Open-Source, Leading and Most Advanced Cloud Software" section with a list of features: Private cloud with Xen, KVM and VMware; Hybrid cloud with Amazon EC2, and other providers through Deltacloud (from ecosystem); and Public cloud supporting EC2 Query, OGF OCCT and vCloud (from ecosystem) APIs, and much more. There is also a "Getting Started" section with three steps: 1. Download OpenNebula, 2. Read the Documentation, 3. Engage the Community. A "Try it now!" button is visible. On the right, there is a section for "OpenNebula 2.0 RC1" with a "Try it now!" button and "Featured Quotes" and "Announcements" sections.

The screenshot shows the RESERVOIR website. At the top, it says "RESERVOIR Resources and Services Virtualization without Barriers". Below that is a navigation menu with links for Home, What is Reservoir?, Technical Info, Downloads, Training, Demos & Videos, Media Centre, Events & Presentations, Blogs, and News. The main content area features a "RESERVOIR: Business Driven Research" section with a sub-heading "How the Research Community is facilitating on-demand services for business". Below this is a "RESERVOIR Framework Downloads" section with a large download icon and a "RESERVOIR Demos & Videos" section with a play button icon.

## Research References

- B. Rochwerger, J. Caceres, R.S. Montero, D. Breitgand, E. Elmroth, A. Galis, E. Levy, I.M. Llorente, K. Nagin, Y. Wolfsthal, "The RESERVOIR Model and Architecture for Open Federated Cloud Computing", **IBM Systems Journal**, Vol. 53, No. 4. (2009)
- B. Sotomayor, R. S. Montero, I. M. Llorente and I. Foster, "Virtual Infrastructure Management in Private and Hybrid Clouds", **IEEE Internet Computing**, September/October 2009 (vol. 13 no. 5)



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