

Des grilles aux Clouds

Ecole Normale Supérieure de Lyon

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OpenNebula

Cloud Case Studies for Research and Industry

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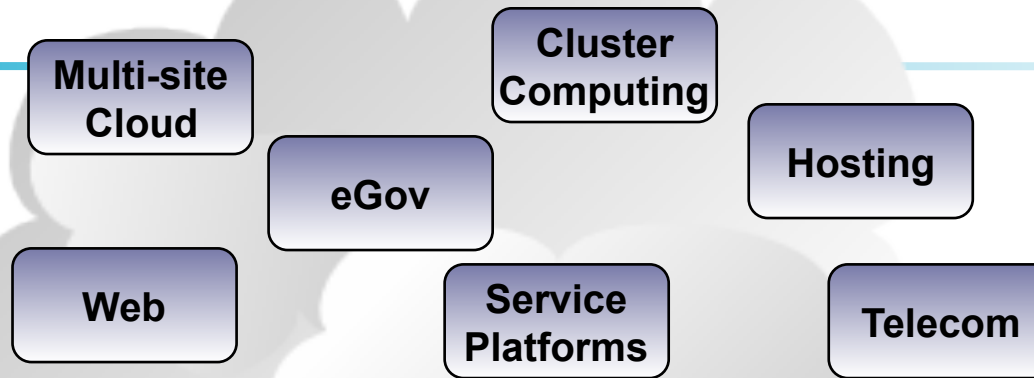
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Acknowledgments



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 as an Evolution of the Data Center

Addressing the constraints of your infrastructure environment and the requirements of your business use cases



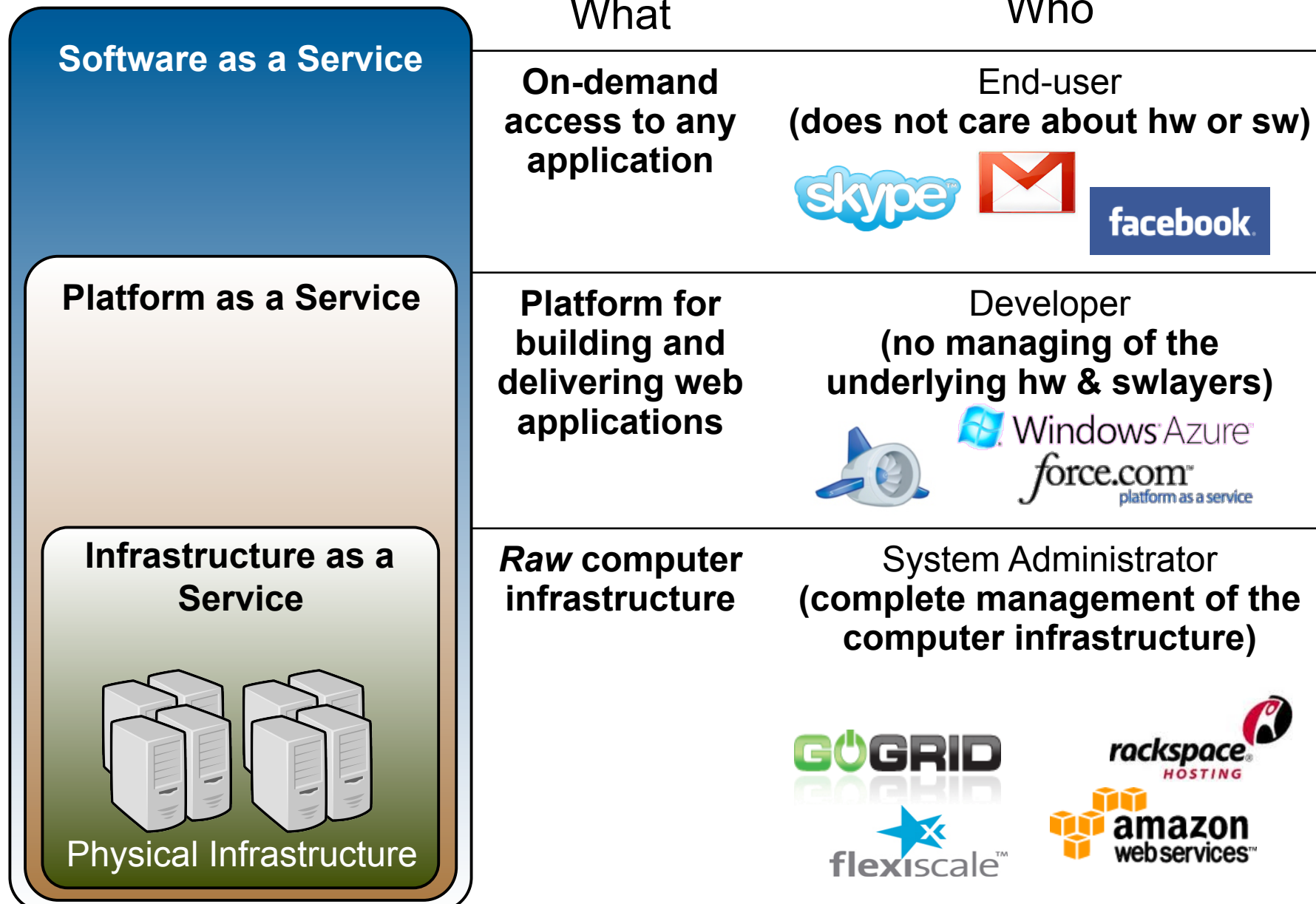
OpenNebula Toolkit

Fully open source, thoroughly tested, flexible, extensible and with excellent performance and scalability to manage tens of thousands of VMs



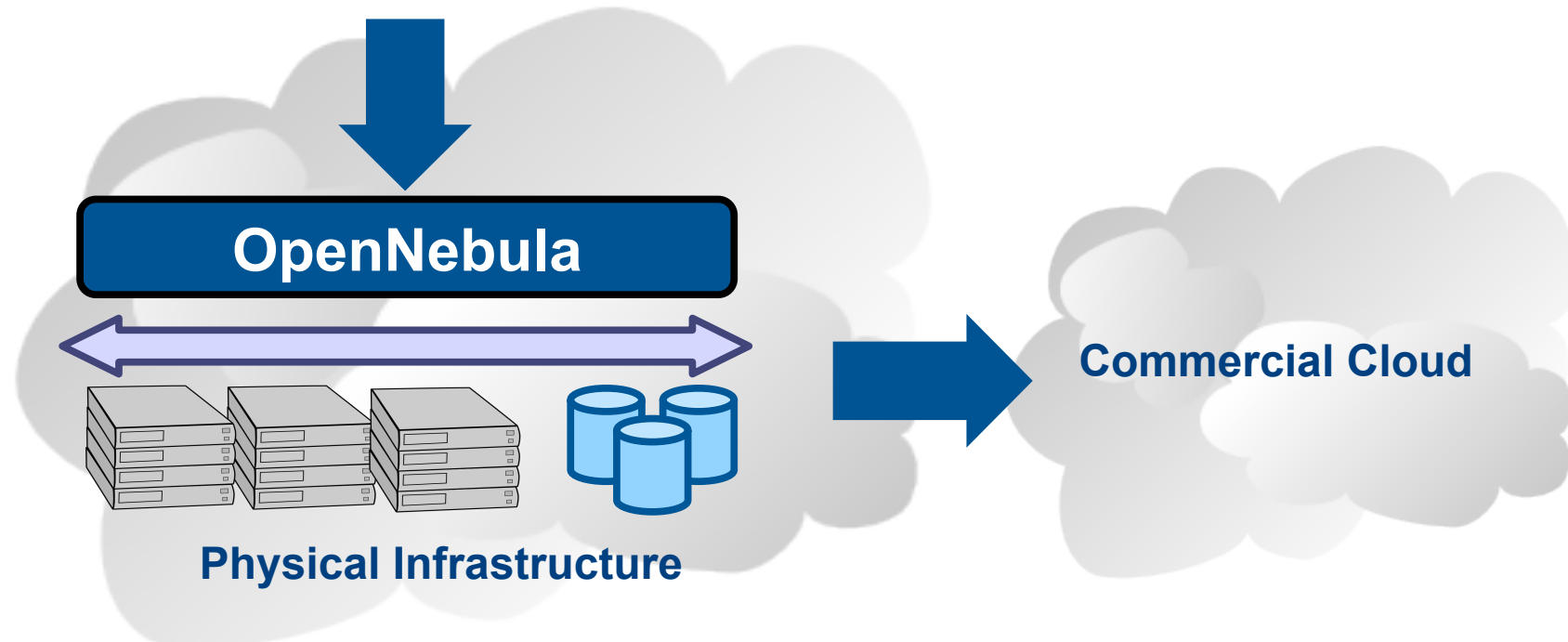
Cloud Computing Case Studies

Examples of cloud infrastructures and large projects using OpenNebula as cloud management tool



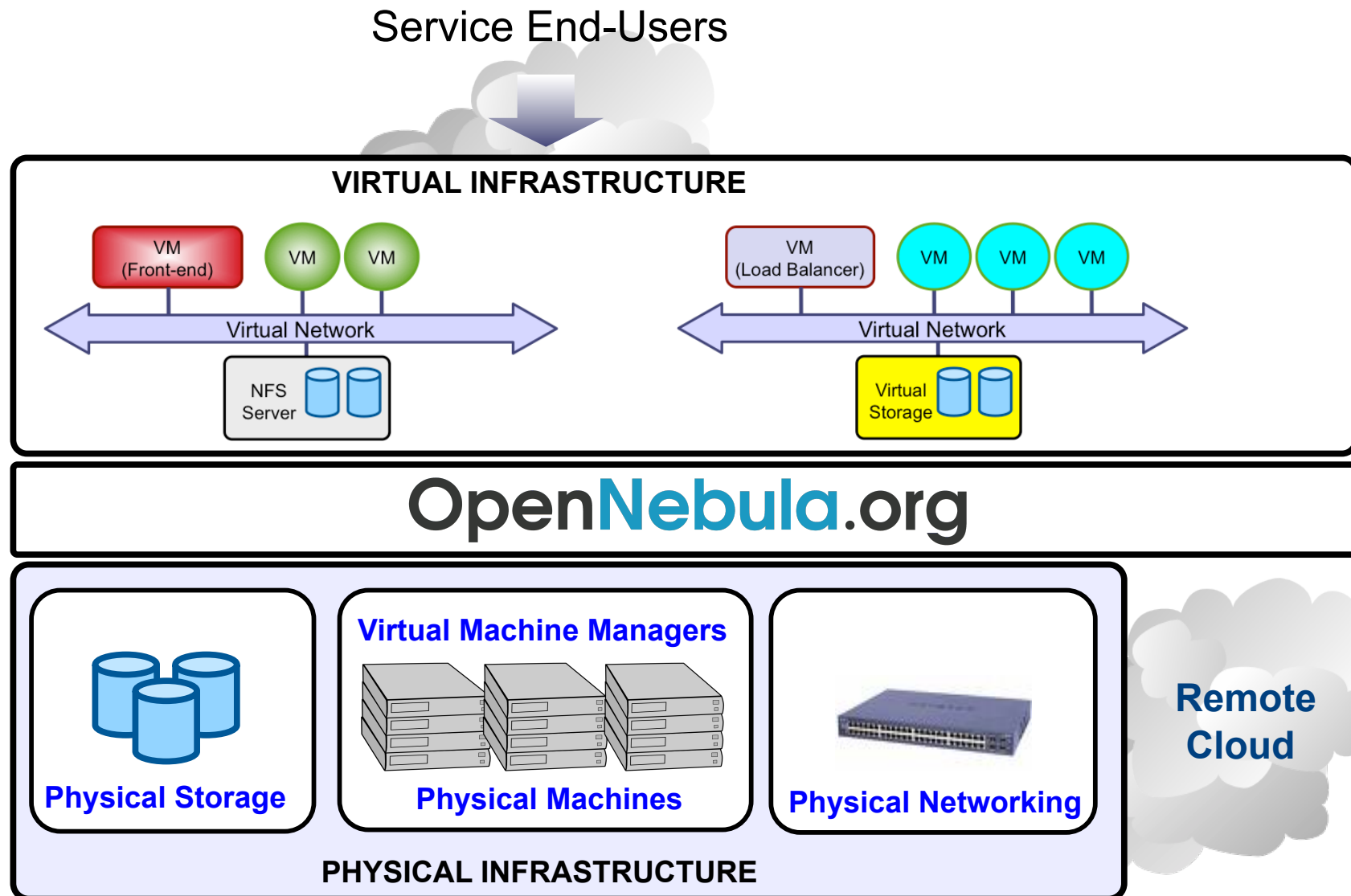
Private Cloud Computing => A “Public Cloud behind the firewall”

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



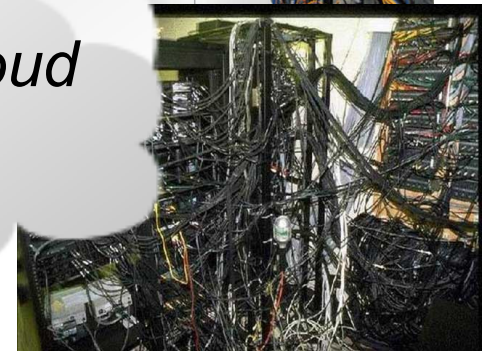
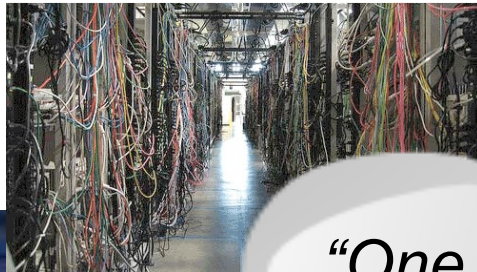
Hybrid Cloud Computing => Utility Computing dream made a reality!

- Supplement the capacity of the Private Cloud



**Constraints from
Existing Infrastructure
and Processes**

**Requirements from
Usage and Deployment
Scenarios**



“One solution does not fit all requirements and constraints. There cannot be turnkey quick cloud solutions”

Open Architecture, Interfaces and Code

- **Integration** with existing **processes** and **management tools** in the data center
- Support any **security, monitoring, storage, networking and virtualization infrastructure service**
- **Integration with any product and service** in the virtualization/cloud ecosystem such as cloud providers, hypervisors, virtual image managers, service managers, management tools, schedulers...
- Support to **build any type of deployment**: private, public, hybrid and community clouds
- **Easy to extend** to support new functionality and **to embed** into other Cloud applications and platforms
- Based on **standards** to avoid vendor lock-in and to enable interoperability
- **Truly open-source**, not open core
- **Liberal open-source license**

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

Feature	Requirements of Enterprise Clouds
Workload Profile	Management of multi-tier services with security levels, placement constraints and automatic configuration
Administration Interface	Complete CLI to manage VMs, images, users, accounting, clusters, virtual networks, physical resources...
Cloud Interfaces	Support standard and most popular cloud interfaces
Cloudbursting	Combine local capacity with remote cloud resources
Adaptability	APIs and modular architecture to integrate with existing processes and management tools in the data center
Scalability	Efficient Management of hundreds of thousands of VMs and multiple physical clusters
Stability & Robustness	Production-ready thoroughly tested and mature technology
Security	Multi-tenancy, isolation and integration with security mechanisms and policies
Openness and Standards	Open interfaces and architecture, fully open-source code, and adopt and implement standards
Interoperability and Portability	Provide with choice across most popular cloud interfaces, hypervisors and public clouds and with a flexible software that can be installed in any hardware and software combination
Cloud Administration	Monitoring, accounting and logging
Site Policy Enforcement	Scheduling and user quota management

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.

Openness

- Open architectures
- Open interfaces
- Open code

Adaptability

- Modular architectures

The logo for OpenNebula.org is a stylized, multi-colored cloud shape. It features various shades of blue, green, and yellow, with a white center. The text "OpenNebula.org" is written across the middle of the cloud in a bold, sans-serif font. The "Open" and ".org" are in black, while "Nebula" is in a vibrant blue.

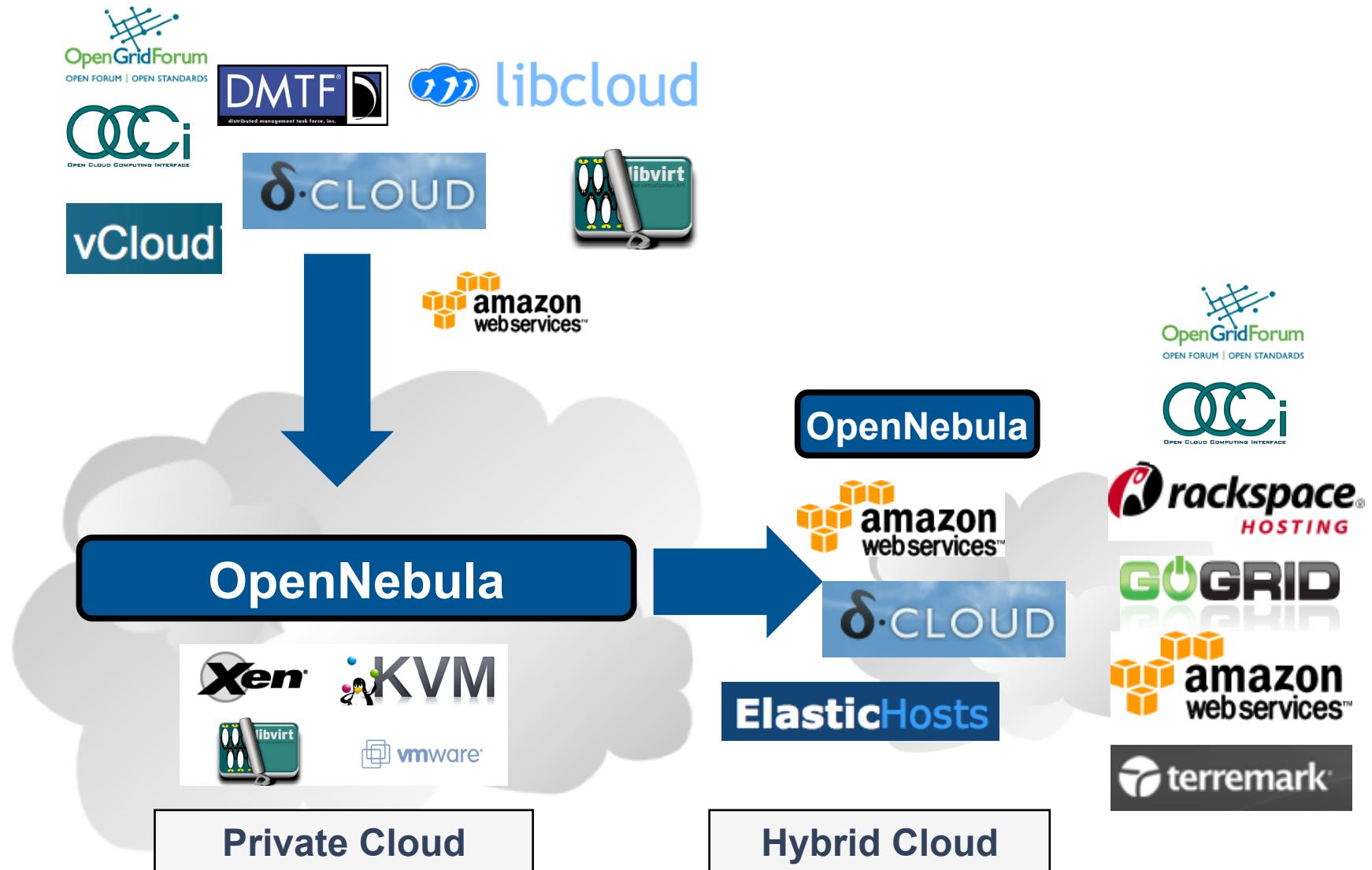
OpenNebula.org

Standardization

- Use standards
- Implement standards

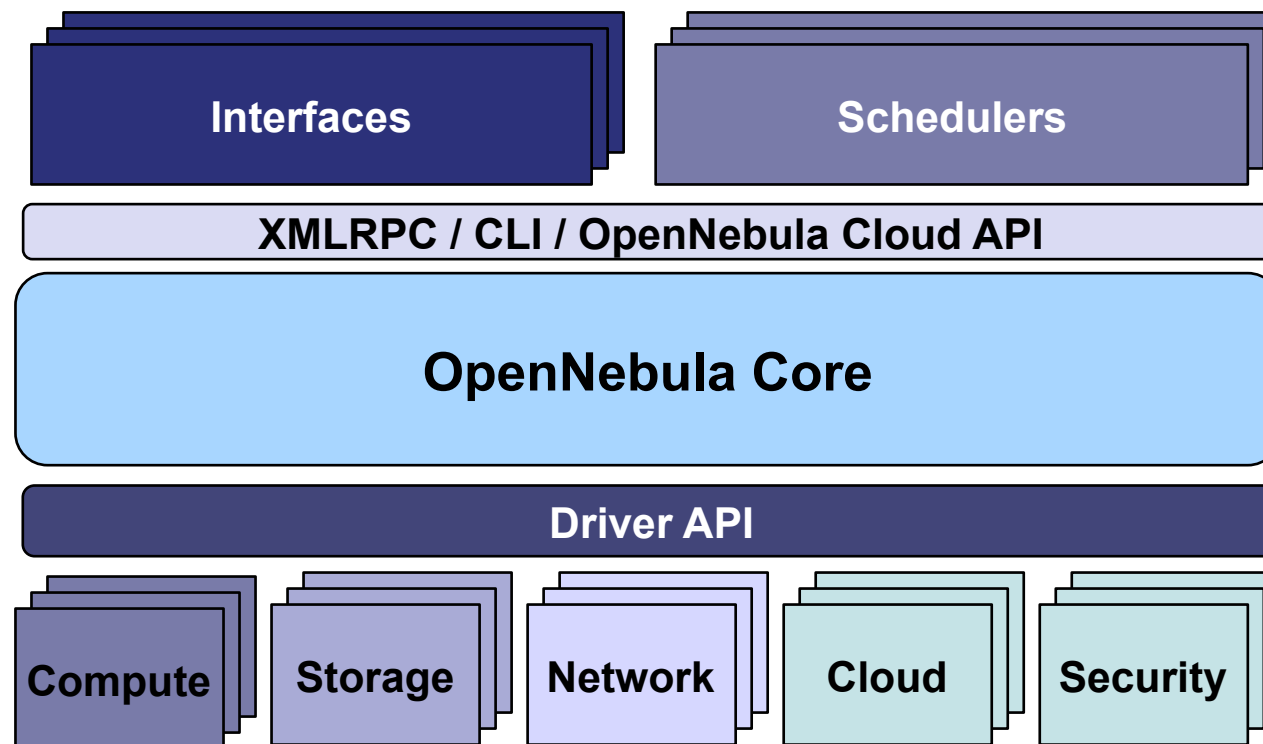
Portability

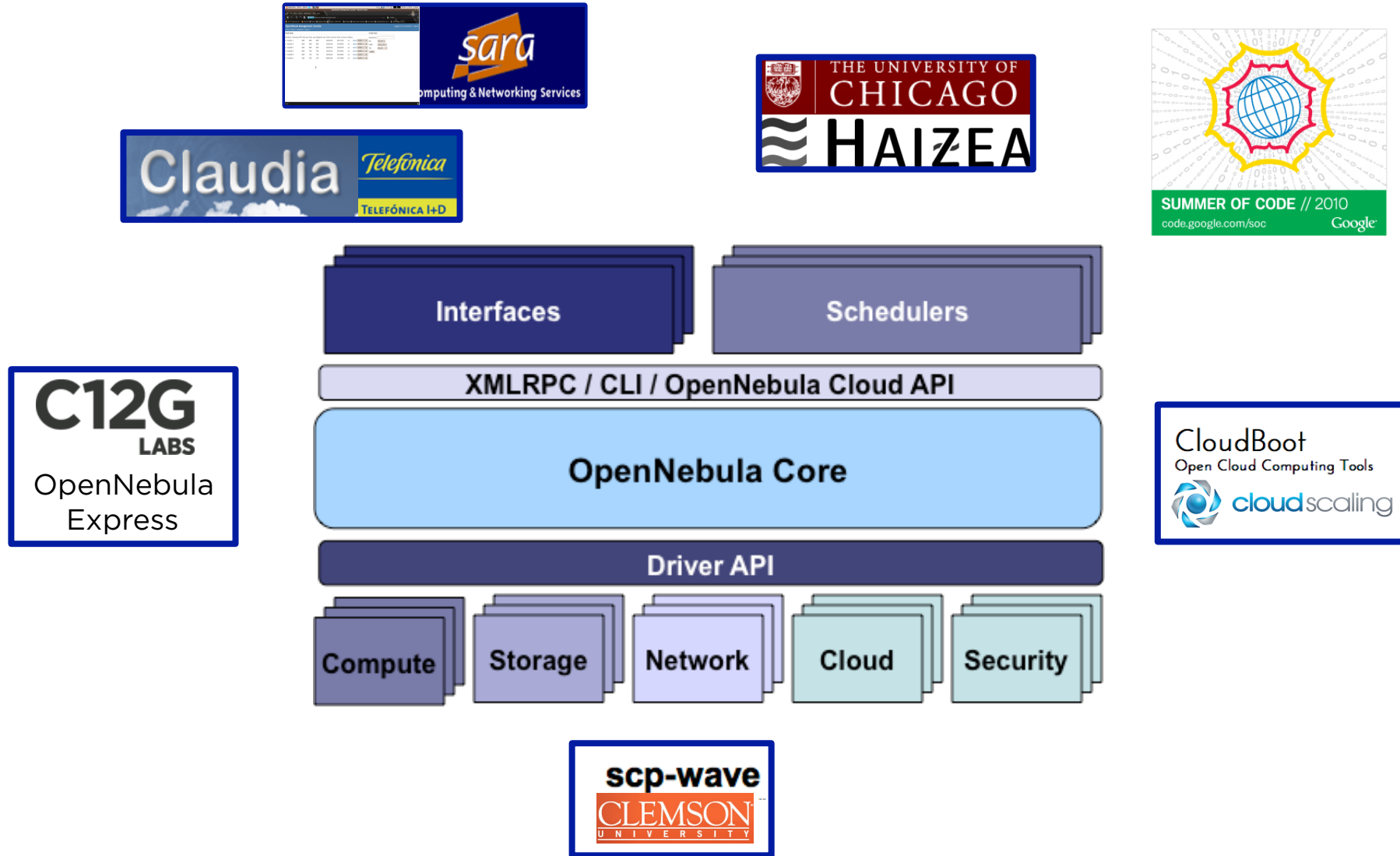
- It can be installed in any hardware and software



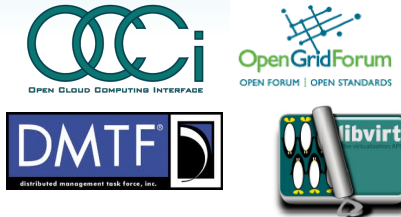
A Highly Modular Architecture to Fit into any Existing Datacenter

- Open, flexible and extensible architecture
- Provide basic components, but allow them to be easily replaceable by others





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

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

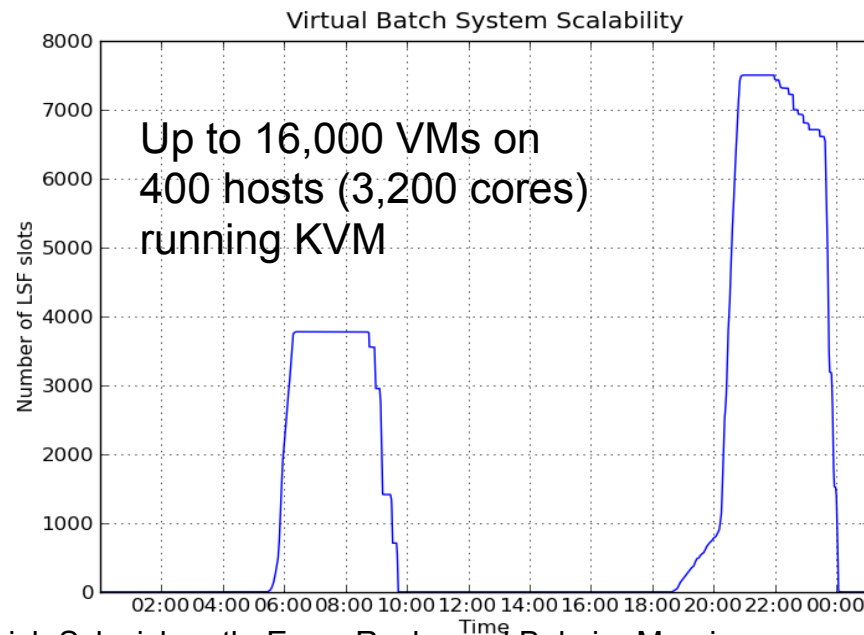
Public HPC Cloud



- **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

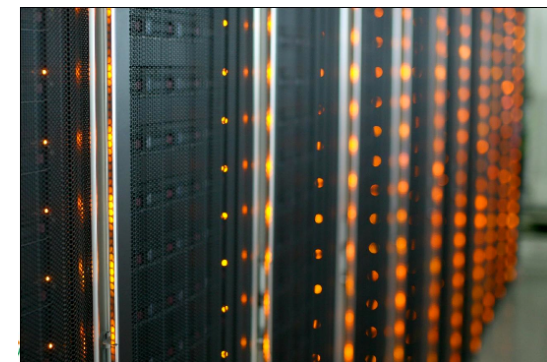
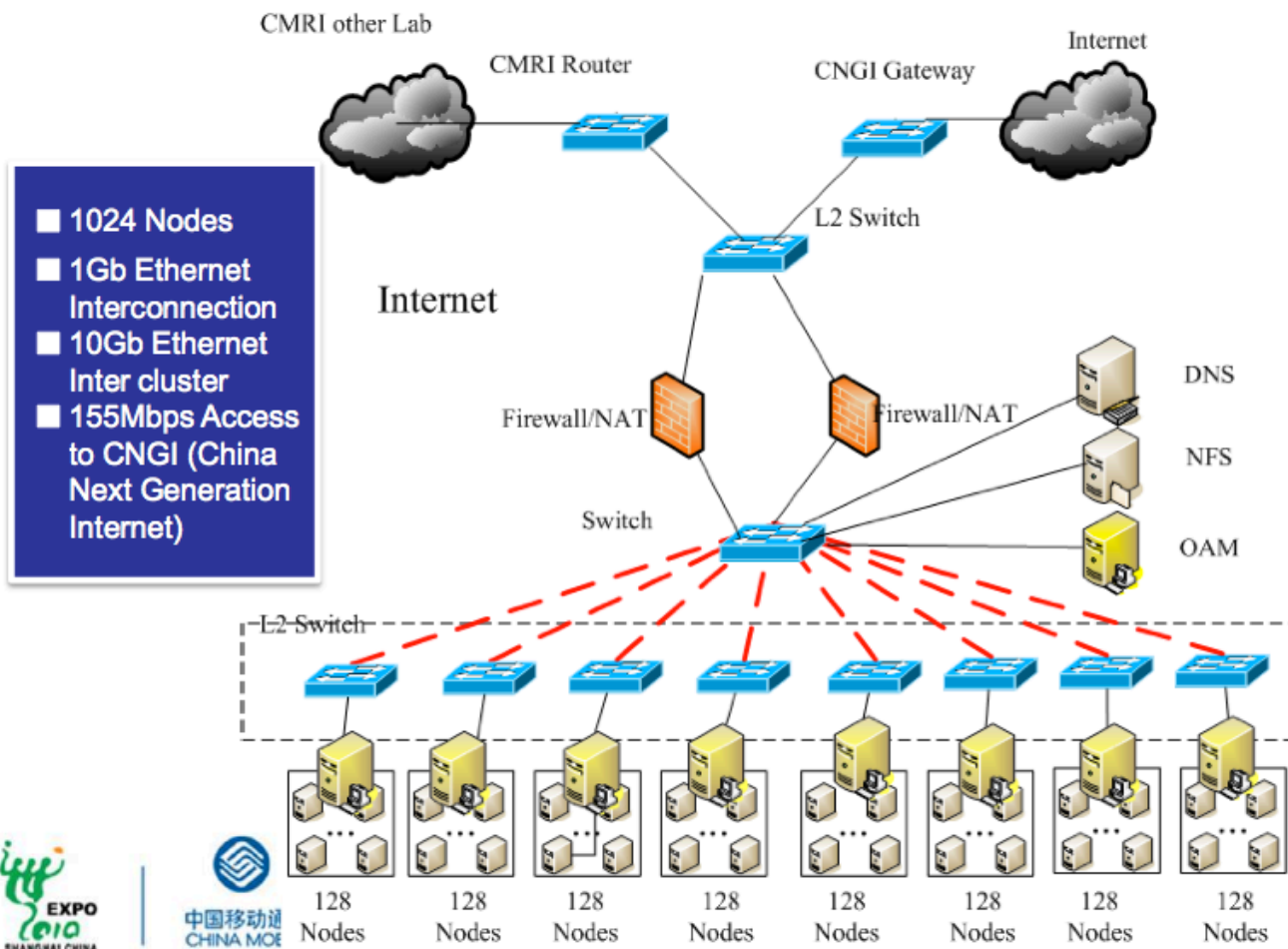


Source: CERN IT-PES/PS Group: Sebastien Goasguen, Ulrich Schwickerath, Ewan Roche and Belmiro Moreira



- **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

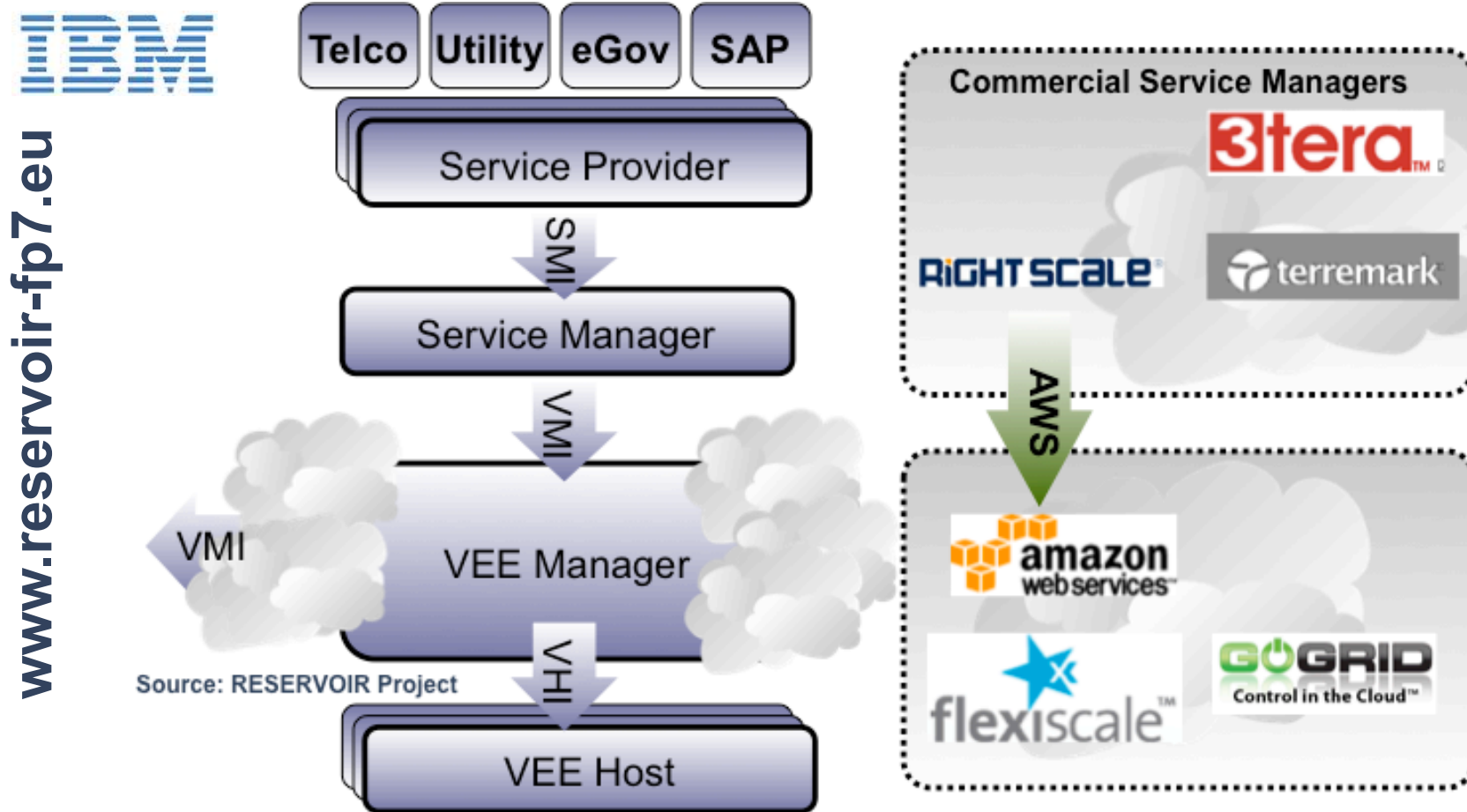
OpenNebula: Cloud Case Studies for Research and Industry



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





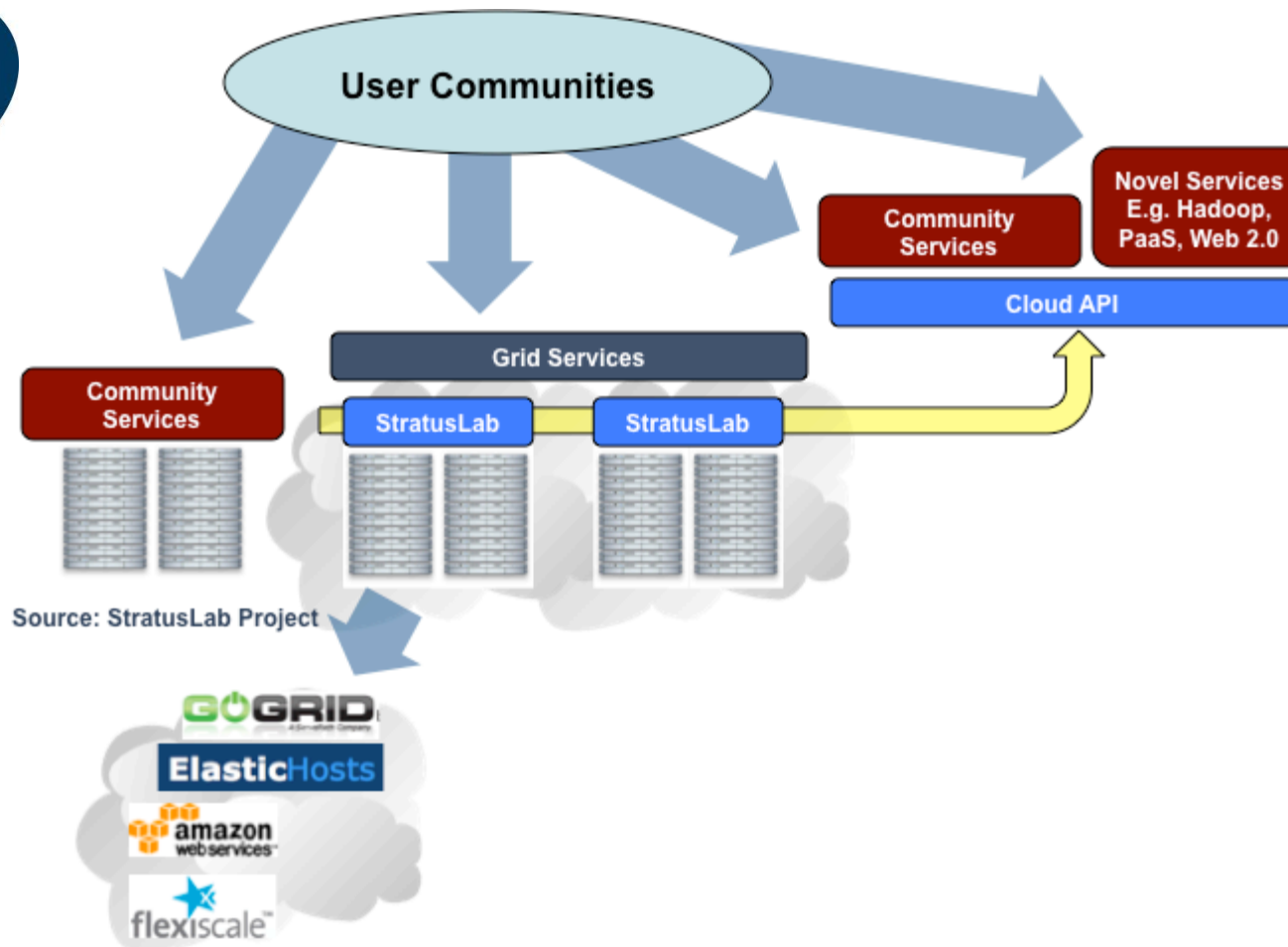
EU grant agreement RI-261552
e-Infrastructure
(2010-2012)

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





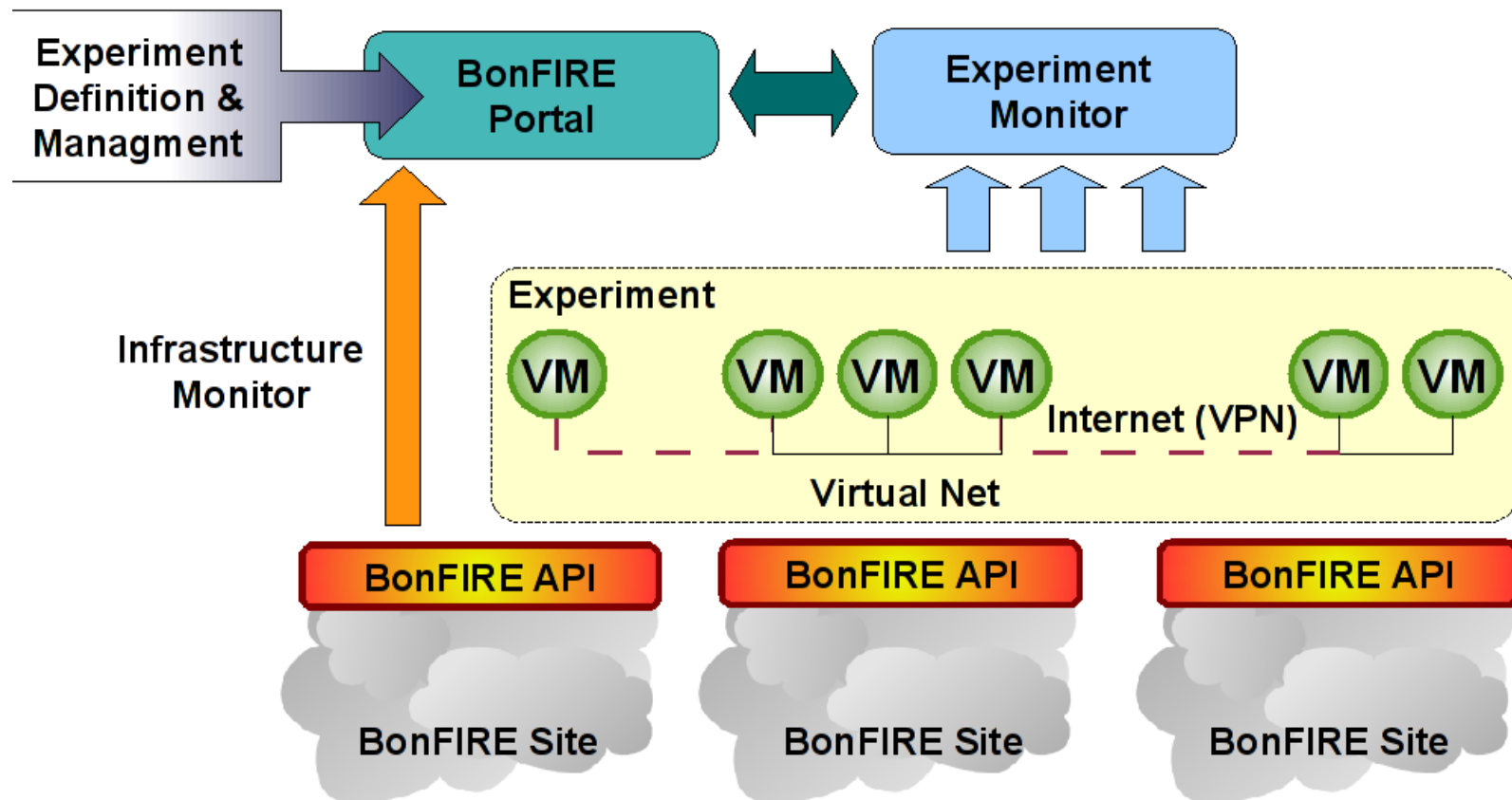
Agreement 257386 (2010-2013)
**New Infrastructure Paradigms
and Experimental Facilities**

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



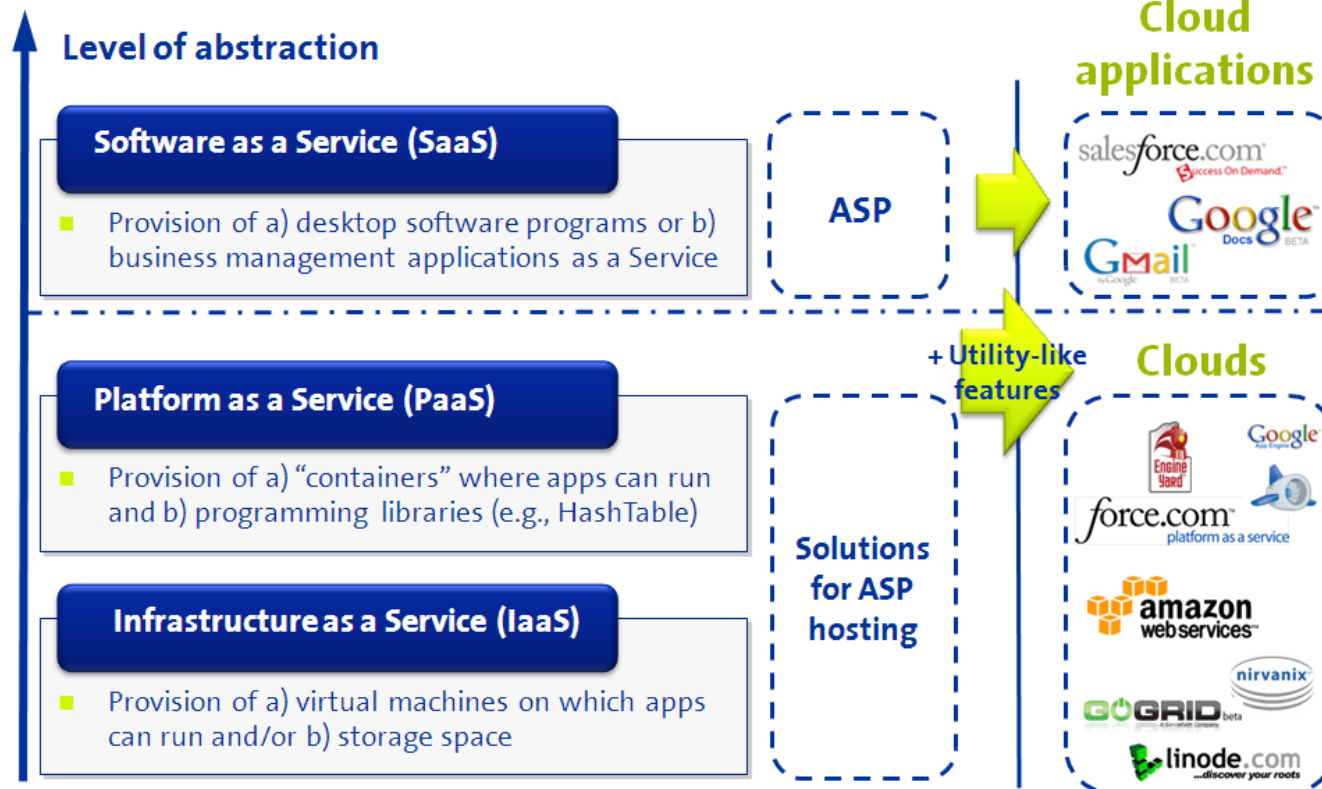
Agreement 258862 (2010-2013)
**Service and Sw Architectures
 and Infrastructures**

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

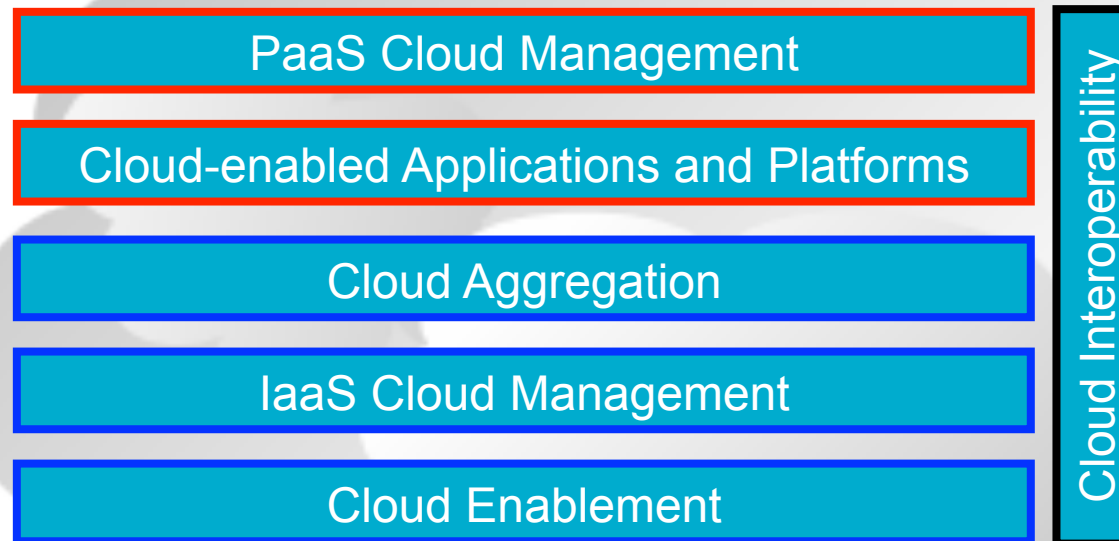


4caast.morfeo-project.org



Source: 4CaaS Project

- **Future enterprise datacenters will operate like hybrid Clouds** combining local with public Cloud-based infrastructure to enable highly scalable hosting environments
 - **Public Clouds will be supported by a network of geographically distributed datacenters** for high availability, end-user service proximity, data regulatory issues...
 - Growing number of **domain specific Cloud providers**
 - Grid will operate like a **federation of cloud infrastructures**
- ... and we are at the beginning of the road, significant research is needed



Use the Technology and Give us Feedback

- Support through several mailing lists or describe your use case in our blog
- Report bugs and make feature requests

Spread our Word

- Spread the word about OpenNebula and open source cloud computing

Contribute to the Development

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

Contribute to the Quickly Growing Ecosystem

- Submit a new tool or extension to the OpenNebula ecosystem

Sponsor the Community

- Provide funds or resources to support development or to organize events

Innovation Alliance

- Collaboration in open-source and innovation in cloud computing management

The screenshot shows the OpenNebula.org website. At the top, it says "OpenNebula.org The Open Source Toolkit for Cloud Computing". Below this is a navigation menu with links for Home, About, Documentation, Software, Support, Community, Cloud, Dev, and Blog. The main content area is divided into two columns. The left column is titled "The Truly Open-Source, Leading and Most Advanced Cloud Software" and lists features like Scalability, Openness, Robustness, Security, Community, and Flexibility. It also includes a "Getting Started" section with three steps: 1. Download OpenNebula, 2. Read the Documentation, and 3. Engage the Community. The right column is titled "OpenNebula 2.0 RC1" and features a "Try it now!" button. Below this is a "Featured Quotes" section with a quote from Sebastian Goasguen, CERN, and an "Announcements" section with several news items.

The screenshot shows the RESERVOIR website. At the top, it says "RESERVOIR Resources and Services Virtualization without Barriers". Below this 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 is divided into two columns. The left column is titled "RESERVOIR: Business Driven Research" and features a "How the Research Community is facilitating on-demand services for business" section. The right column is titled "RESERVOIR Framework Downloads" and features a "RESERVOIR Demos & Videos" section. Below these are four smaller sections: Business Driven Research, Technical Information, RESERVOIR Framework Downloads, and RESERVOIR Demos & Videos.

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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Sponsors

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- **European Commission:** RESERVOIR (EU agreement 215605), StratusLab (EU agreement 261552), BonFIRE (EU agreement 257386) and 4CaaS (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

- **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!