Cloud Computing: Interoperability and Data Portability Issues
Microsoft, Brussels
1st December 2009

Cloud Interoperability with the OpenNebula Toolkit

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Cloud Computing in a Nutshell

Cloud Interoperability with the OpenNebula Toolkit

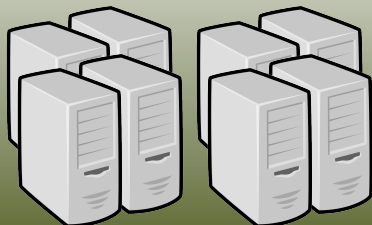|	What	Who
Software as a Service	**On-demand access to any application**	End-user **(does not care about hw or sw)**
Platform as a Service	**Platform for building and delivering web applications**	Developer **(no managing of the underlying hw & swlayers)**
Infrastructure as a Service		
Physical Infrastructure		

OpenNebula.org

Innovative open, flexible and scalable technology to build IaaS clouds

dsa-research.org

What is OpenNebula?

Cloud Interoperability with the OpenNebula Toolkit
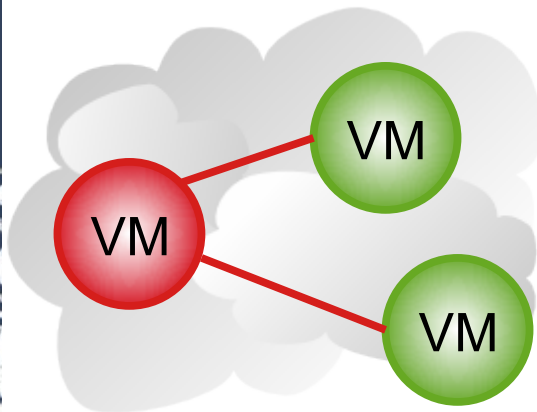
Innovations
Designed to address the technology challenges in cloud computing management

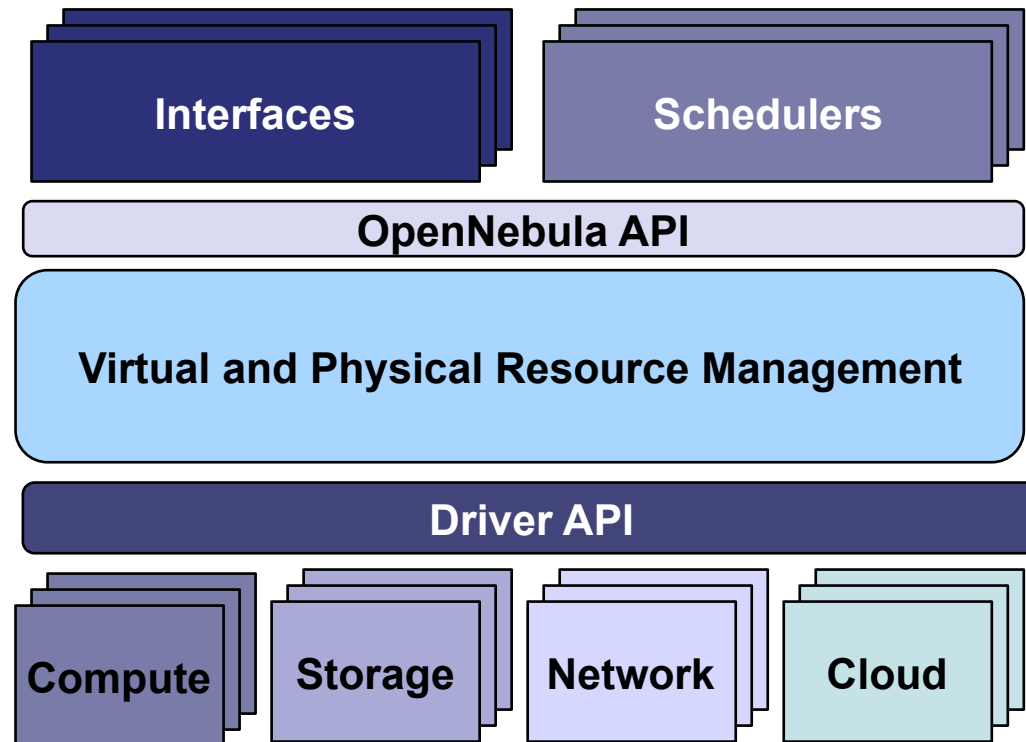## Open-source Toolkit
OpenNebula v1.4

- Support to build **new cloud interfaces**
- **Open and flexible tool** to fit into any datacenter and integrate with any ecosystem component
- **Private, public and hybrid clouds**
- Based on **standards**
- Support **federation** of infrastructures
- **Efficient and scalable management** of the cloud

A Toolkit for System Integrators

Cloud Interoperability with the OpenNebula Toolkit

## One Size does not Fit All: Tailoring the Tool to Fit your Needs

- Open, modular and extensible architecture
- Easy to enhance and embed
- Minimal installation requirements (distributed in Ubuntu)
- Open Source – Apache 2

Interfaces	Schedulers

OpenNebula API

Virtual and Physical Resource Management

Driver API

Compute	Storage	Network	Cloud

Interoperability in the OpenNebula Toolkit

Cloud Interoperability with the OpenNebula Toolkit

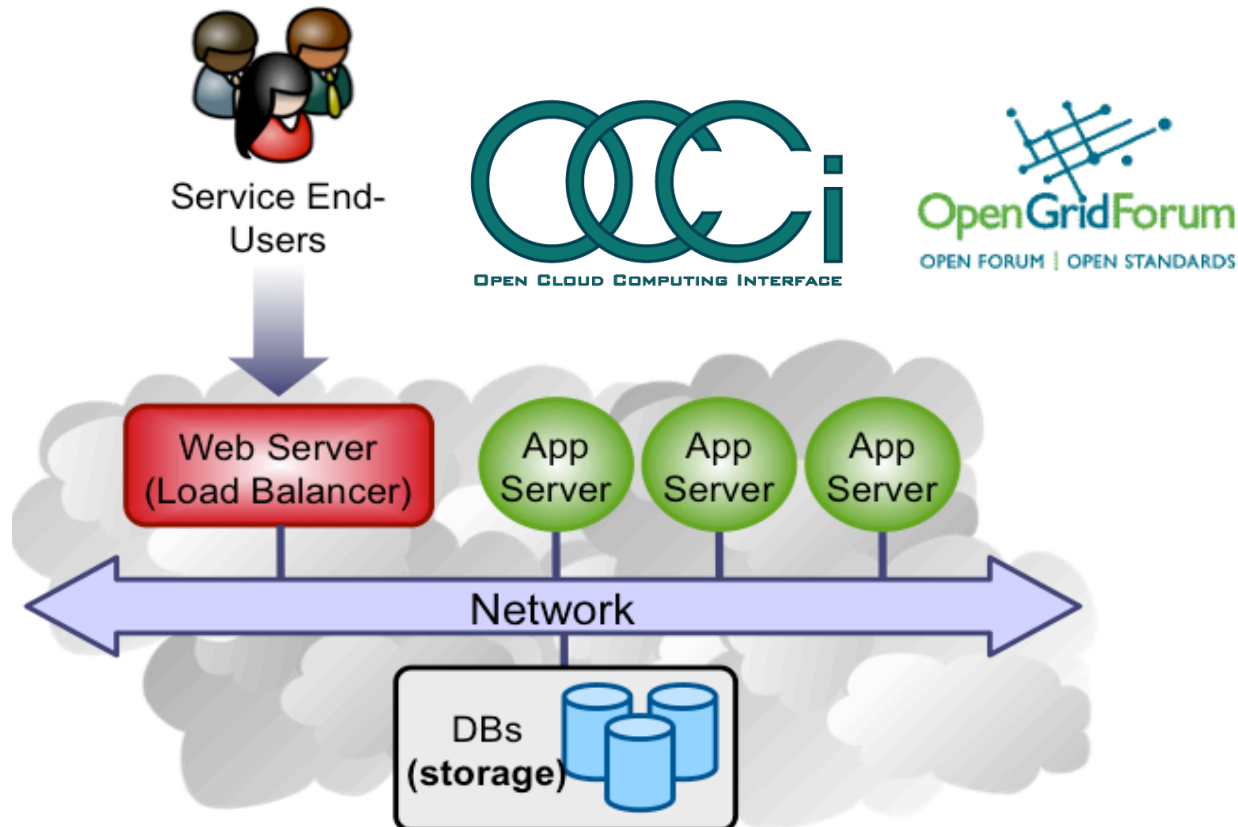## Interoperation from Different Perspectives
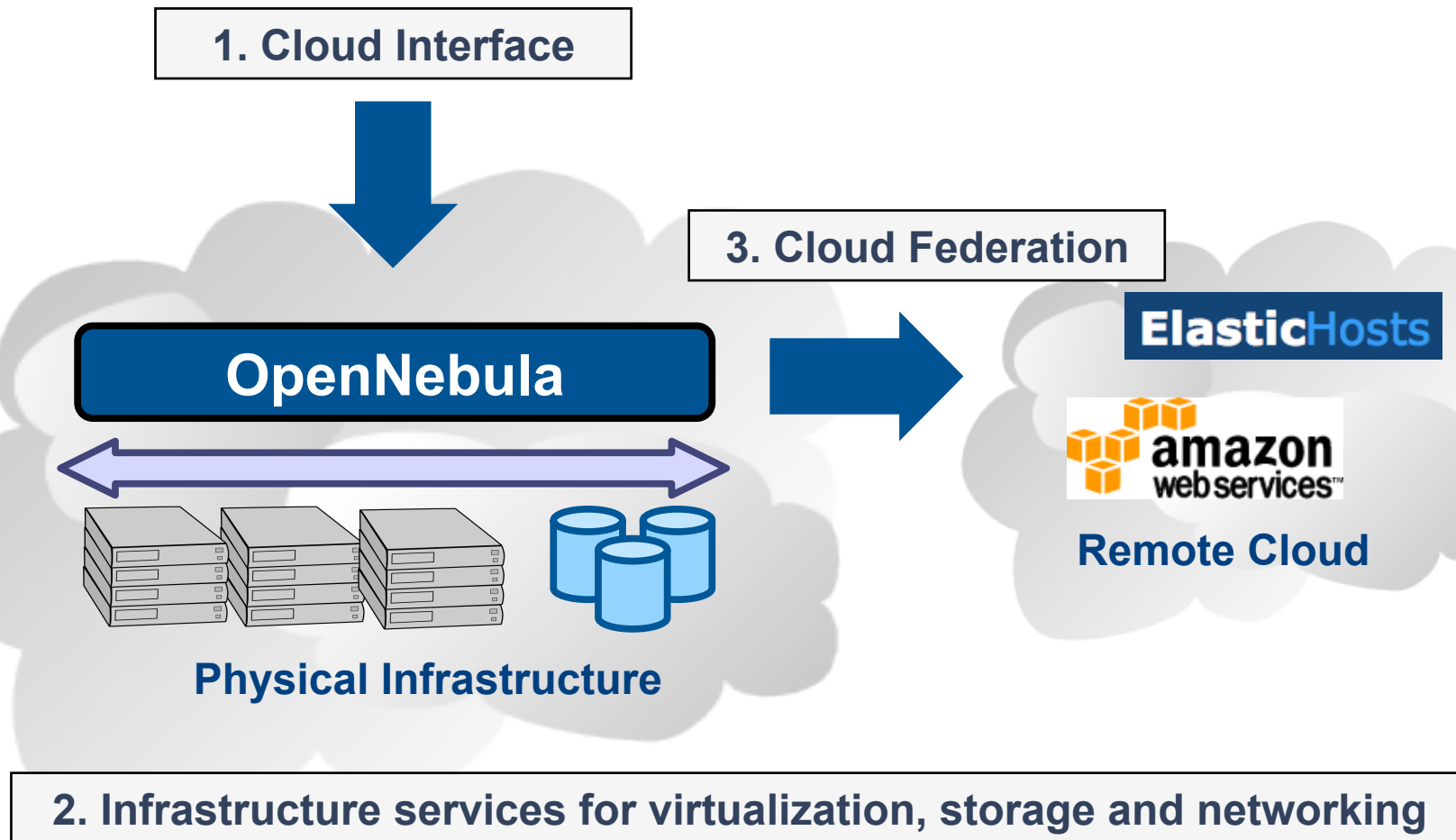
Interoperability: Infrastructure Use

Cloud Interoperability with the OpenNebula Toolkit

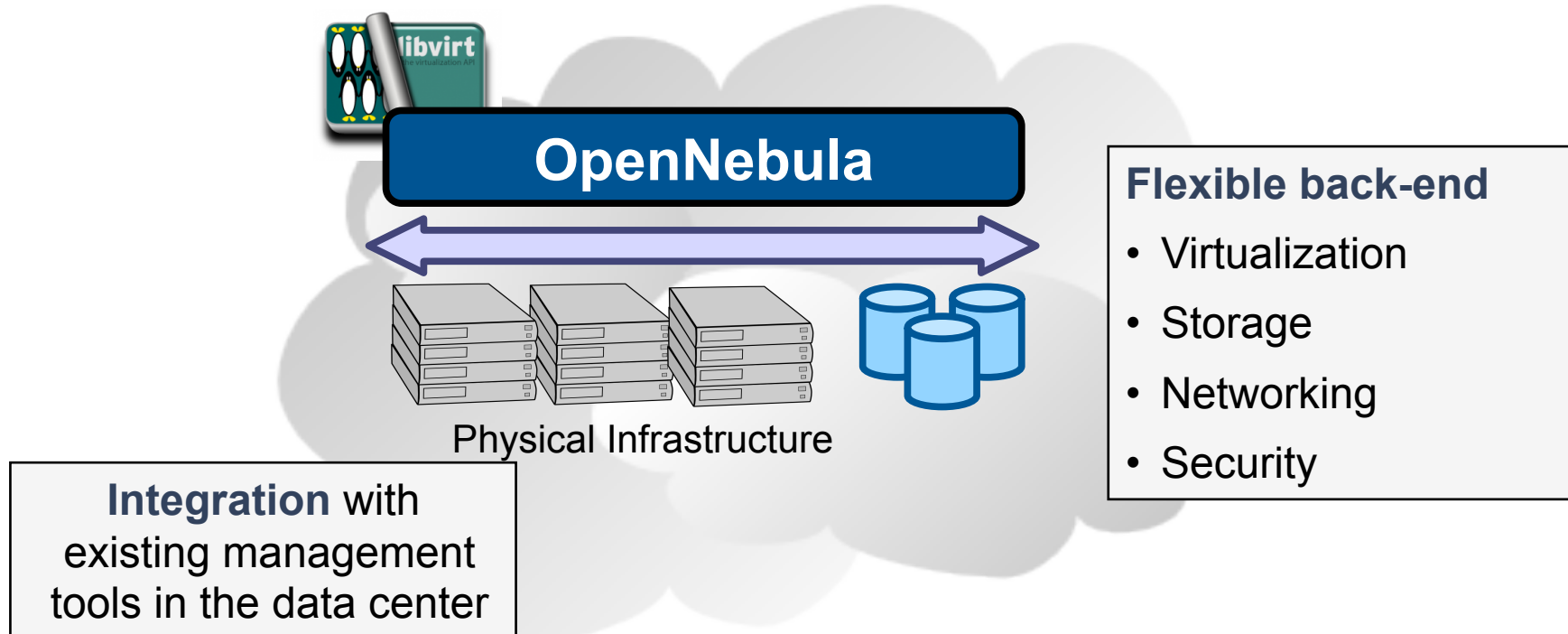## Cloud Interface for the Management of Virtualized Services

- Cloud Restful interface and CLI to manage virtual machines, network and storage **(OGF OCCI API)**

- Implementation of other popular interfaces (**Amazon EC2**)

- Support to build **any other cloud interface** (vCloud API, Sun Cloud API…)

Interoperability: Infrastructure Management

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Integration with Infrastructure and Management Services

OpenNebula

Physical Infrastructure

Flexible back-end

- Virtualization
- Storage
- Networking
- Security

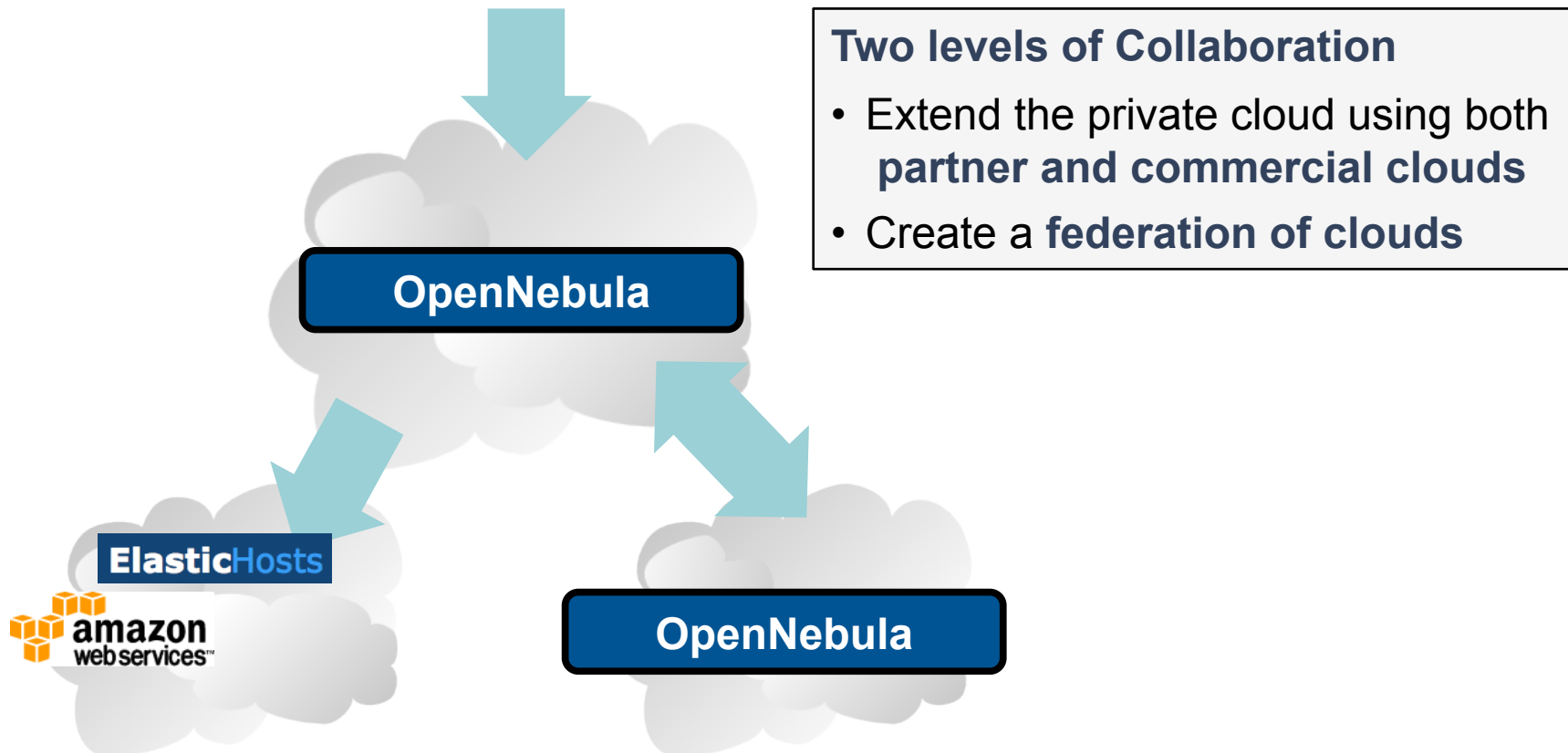**Integration** with existing management tools in the data center

- **Administration interface** for the centralized monitoring and management of the infrastructure (CLI, XML-RPC and **libvirt**)
- Support for the definition of workload and resource-aware **allocation policies** such as consolidation (energy efficiency) , load balancing, affinity-aware, capacity reservation…

Interoperability: Infrastructure Federation

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Hybrid Cloud Computing and Federation

- *Cloudbursting* **at infrastructure layer**, fully transparent to users
- **Scale-out decisions are taken by infrastructure administrators** according to business policies

OpenNebula

OpenNebula

ElasticHosts

amazon
web services™

Two levels of Collaboration

- Extend the private cloud using both **partner and commercial clouds**
- Create a **federation of clouds**

The Community: Users

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Users (Different Levels of Use: From Experimental to Production)
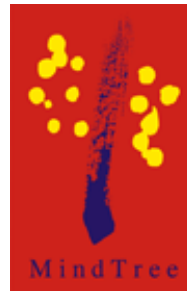
Projects

The Community: Active Ecosystem

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Components around OpenNebula

- **Haizea Lease Manager (University of Chicago):** Advance reservation of capacity and queuing of best effort requests

- **RESERVOIR Policy Engine (IBM Haifa/Elsag Datamat):** Policy-driven probabilistic admission control and dynamic placement optimization to satisfy site level management policies

- **VM Consolidation Scheduler (UCM):** Periodic re-placement of VMs for server consolidation and suspension/resume of physical resources

- **Virtual Cluster Tool (CRS4 Distributed Computing Group):** Atomic virtual cluster management with versioning and multiple transport protocols.

- **Nephele (Telefonica I+D):** SLA-driven automatic service management

- **Under Development:** SUN Cloud API, vCloud API, VirtualBox plugin, dashboard for infrastructure management, new schedulers, SLA and security framework, Grid service manager, LVM and SAN support,…

- …

Cloud Interoperability with the OpenNebula Toolkit

More info, downloads, mailing lists, and cloud at www.OpenNebula.org

www.reservoir-fp7.eu/

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)

The OpenNebula Team

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