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The OpenNebula Standard-based Open -source Toolkit to Build Cloud Infrastructures

Ignacio M. Llorente

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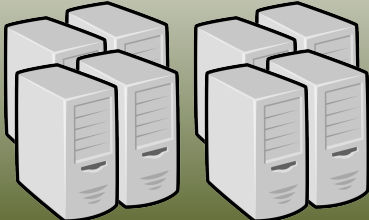
Distributed Systems Architecture Research Group
Universidad Complutense de Madrid





Cloud Computing in a Nutshell

The OpenNebula Standard-based Open-source Toolkit to Build Cloud Infrastructures

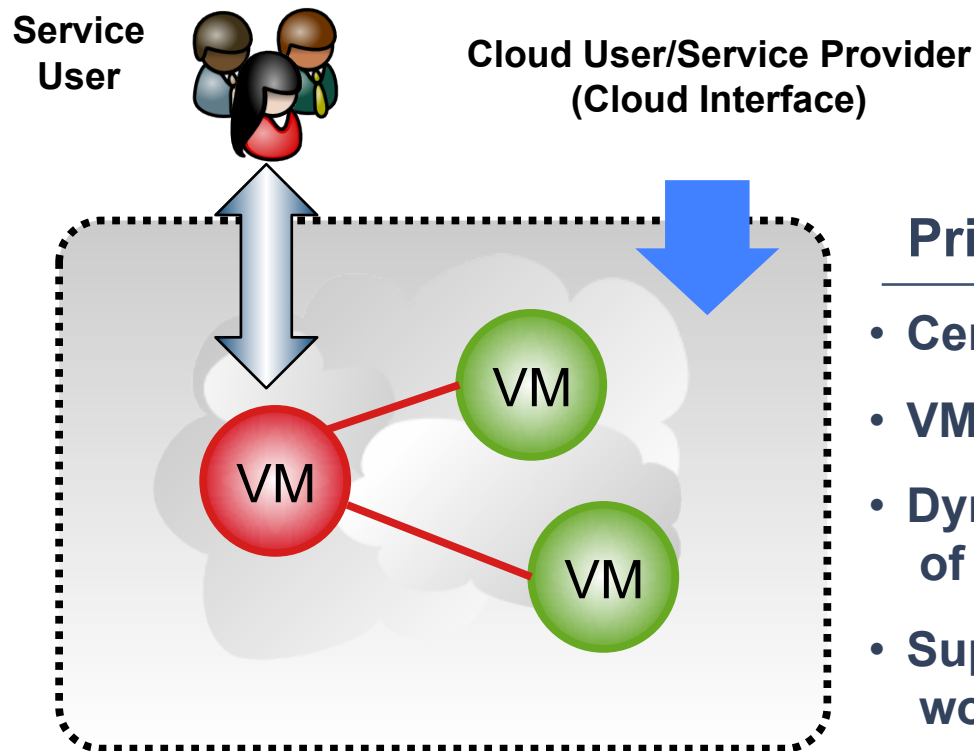
	What	Who
<div> <p>Software as a Service</p> </div>	<p>On-demand access to any application</p>	<p>End-user (does not care about hw or sw)</p> 
<div> <p>Platform as a Service</p> </div>	<p>Platform for building and delivering web applications</p>	<p>Developer (no managing of the underlying hw & swlayers)</p> 
<div> <p>Infrastructure as a Service</p>  <p>Physical Infrastructure</p> </div>	<div> <h2>OpenNebula.org</h2> <p>Innovative open, flexible and scalable technology to build IaaS clouds</p> </div>	

From Public to Private Cloud Computing

The OpenNebula Standard-based Open-source Toolkit to Build Cloud Infrastructures

Public Cloud

- Flexible and elastic capacity
- Ubiquitous network access
- On-demand access
- Pay per use



Private Cloud

- Centralized management
- VM placement optimization
- Dynamic resizing and partitioning of the infrastructure
- Support for heterogeneous workloads



Contents

The OpenNebula Standard-based Open-source Toolkit to Build Cloud Infrastructures



Innovations

Designed to address the technology challenges in cloud computing management



Toolkit

OpenNebula v1.4



Community

Users, projects and ecosystem



Open-source and Standardization

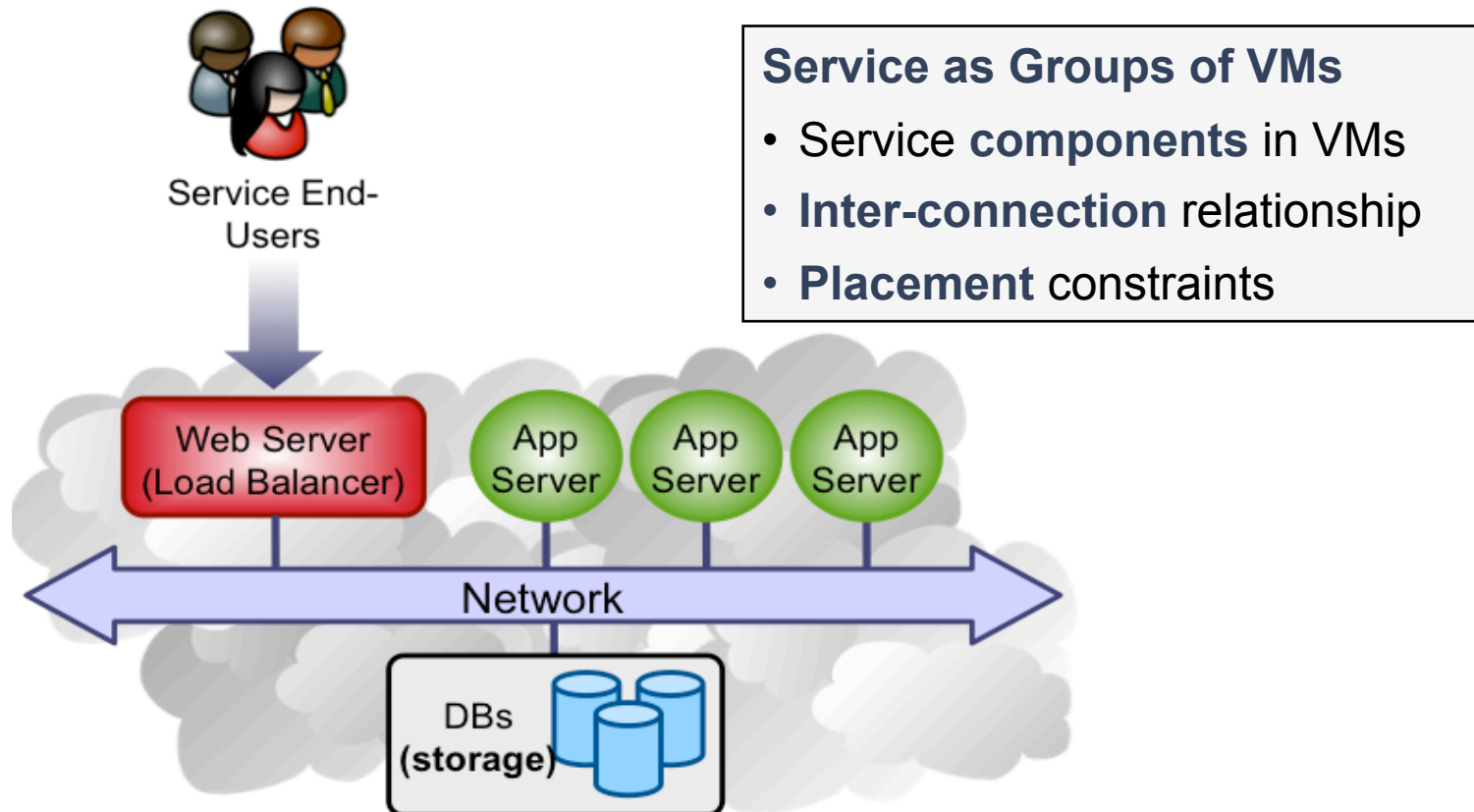
Ongoing efforts

The Innovations: Infrastructure User View

The OpenNebula Standard-based Open-source Toolkit to Build Cloud Infrastructures

Elastic Multi-tier Services

- Service as **basic management entity**
- Cloud Restful interface and CLI to **manage virtual machines, network and storage => Based on an open standard**
- **Concurrent support** for other popular interfaces (Amazon EC2)

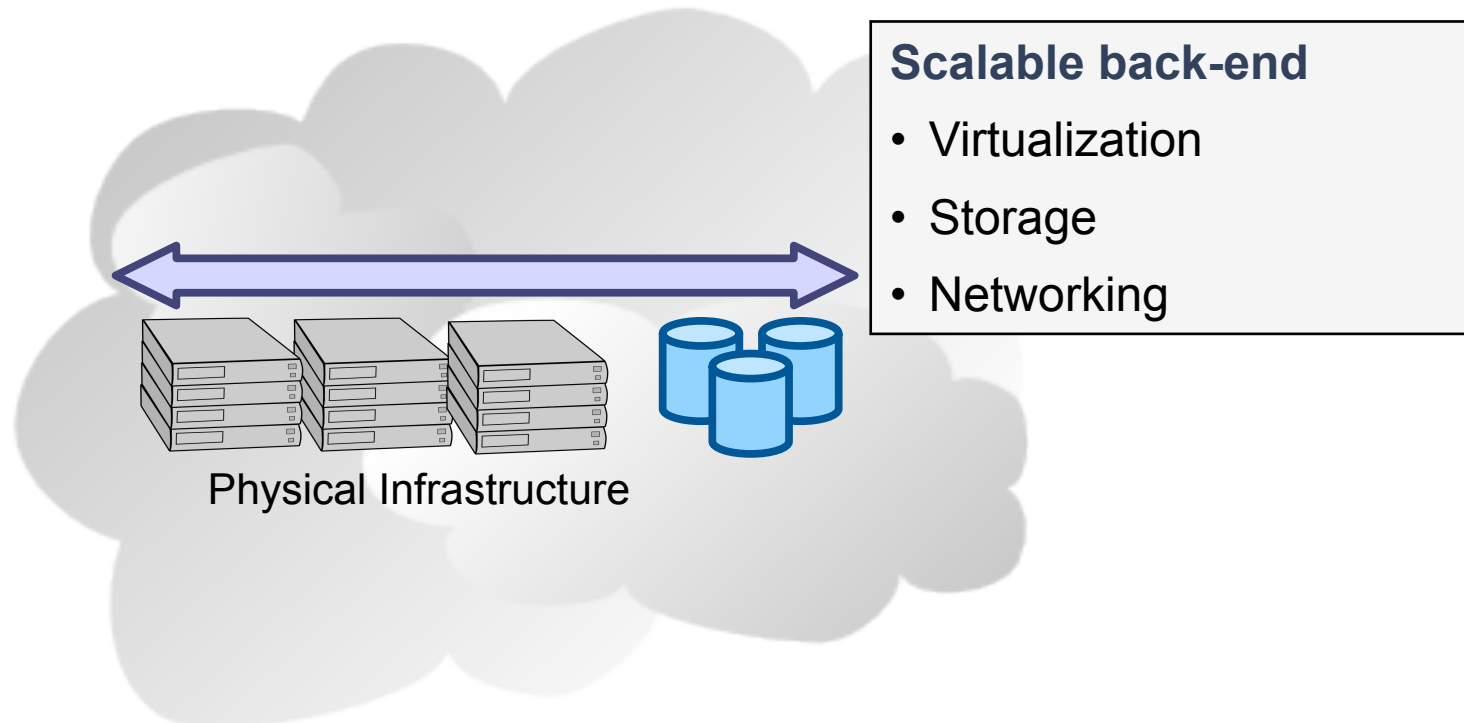


The Innovations: Infrastructure Manager View

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Flexible, Efficient and Scalable Management of the Cloud

- **Administration interface** for the centralized monitoring and management of the infrastructure
- Support for the definition of workload and resource-aware **allocation policies** such as consolidation (energy efficiency) , load balancing, affinity-aware, capacity reservation...
- **Integration** with existing management tools in the data center

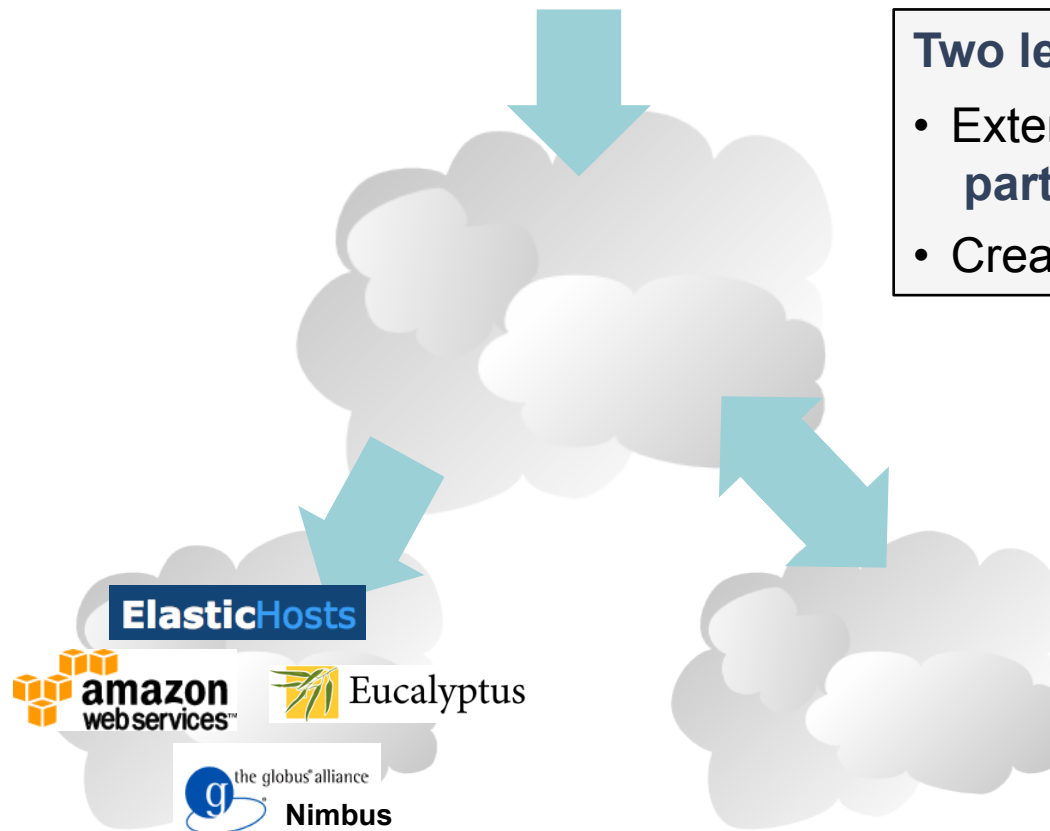


The Innovations: Infrastructure Manager View

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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



Two levels of Collaboration

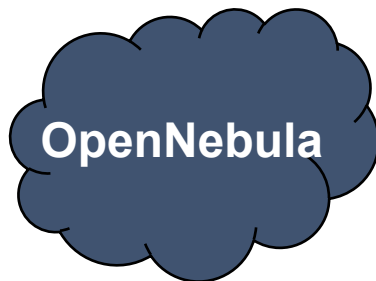
- Extend the private cloud using both **partner and commercial clouds**
- Create a **federation of clouds**

The Innovations: System Integrator View

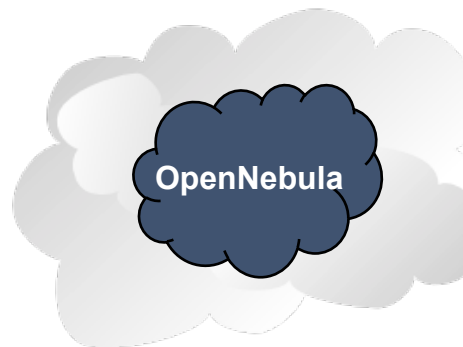
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Open Architecture, Interfaces and Code

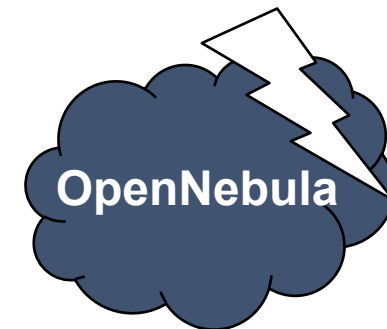
- **Integration with any product and service** in the virtualization/cloud ecosystem such as cloud providers, hypervisors, virtual image managers, service managers, management tools, schedulers...
- Support to **build any type of deployment**: private, public, hybrid and community clouds
- **Easy to enhance** to support new functionality
- **Easy to embed** into other Cloud applications and platforms
- **Liberal open-source license**



Out-of-the-box
Cloud Solution



Embedded VM
Orchestrator in PaaS
and SaaS Solution



Platform for Innovative
Projects

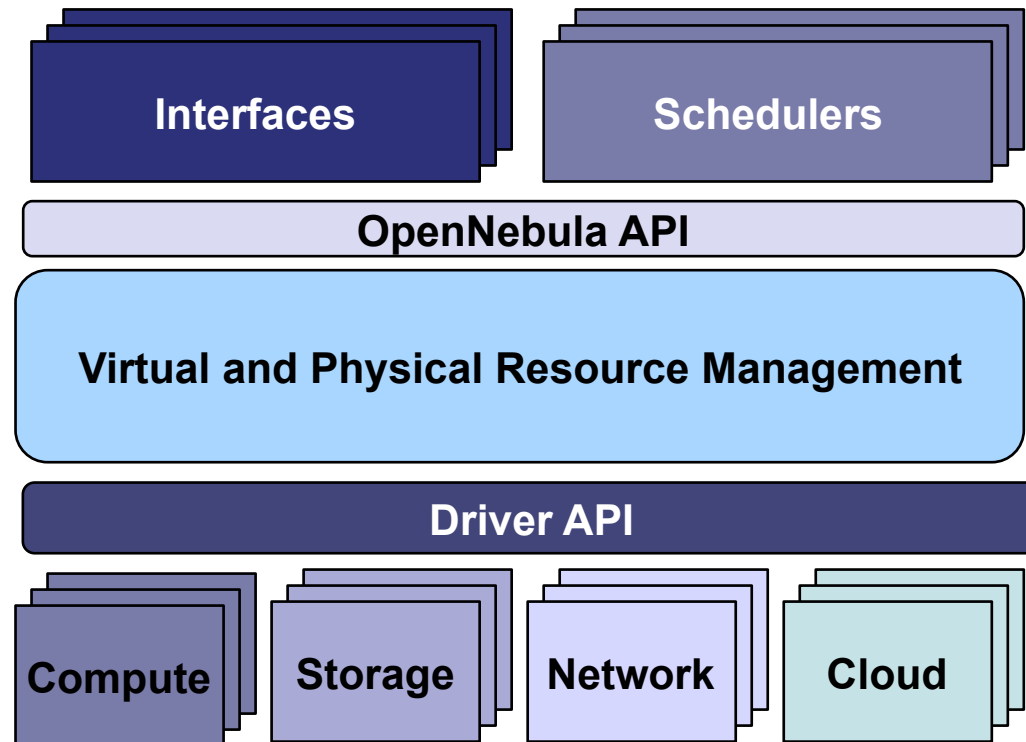


The Toolkit: OpenNebula 1.4

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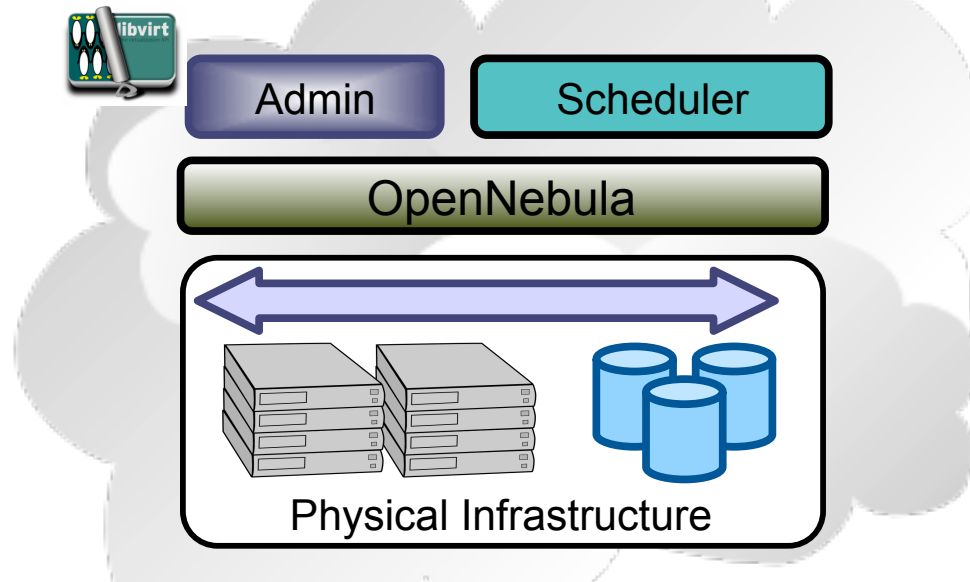
One Size does not Fit All: Tailoring the Tool to Fit your Needs

- Open, modular and extensible architecture
- Minium installation requirements (distributed in Ubuntu)
- Open Source – Apache 2



The Toolkit: Building a Private Cloud

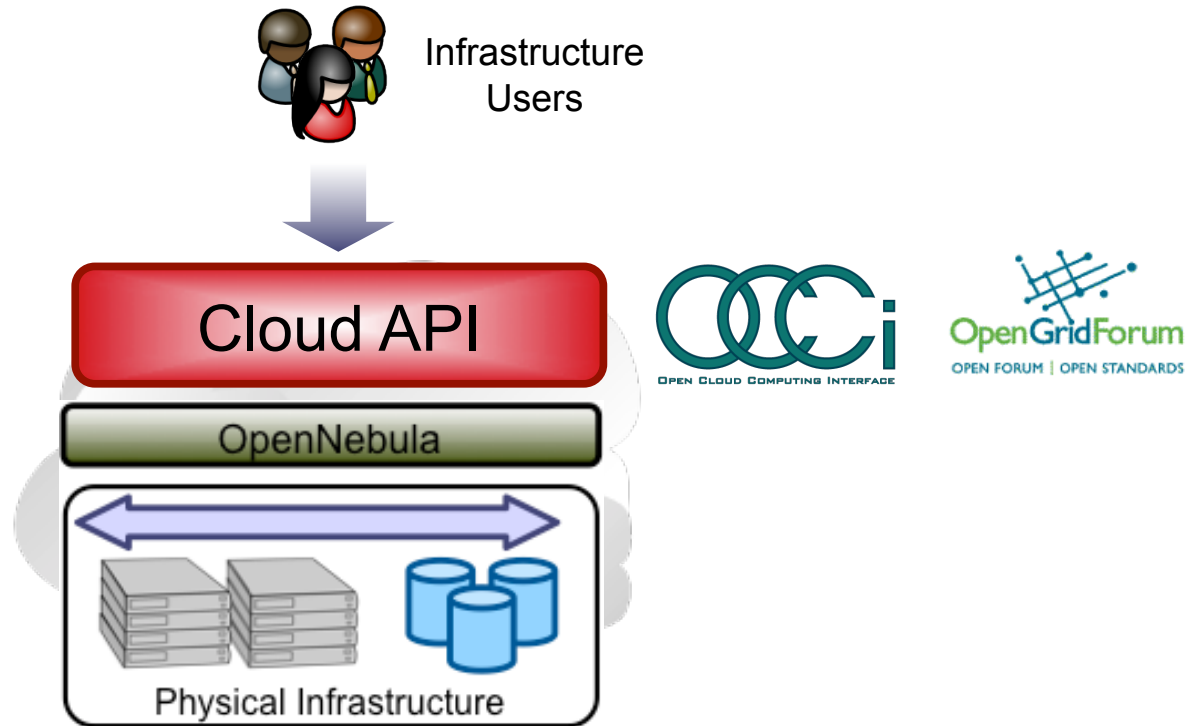
The OpenNebula Standard-based Open-source Toolkit to Build Cloud Infrastructures



Feature	Function
Internal Interface	<ul style="list-style-type: none"> • Unix-like CLI for fully management of VM life-cycle and resources • XML-RPC API and libvirt virtualization API
Scheduler	<ul style="list-style-type: none"> • Requirement/rank matchmaker allowing the definition of workload and resource-aware allocation policies • Support for advance reservation of capacity through Haizea
Virtualization Management	<ul style="list-style-type: none"> • Xen, KVM, and VMware
Image Management	<ul style="list-style-type: none"> • General mechanisms to transfer and clone VM images
Network Management	<ul style="list-style-type: none"> • Definition of isolated virtual networks to interconnect VMs
Service Management and Contextualization	<ul style="list-style-type: none"> • Support for multi-tier services consisting of groups of inter-connected VMs, and their auto-configuration at boot time

The Toolkit: Building a Public Cloud

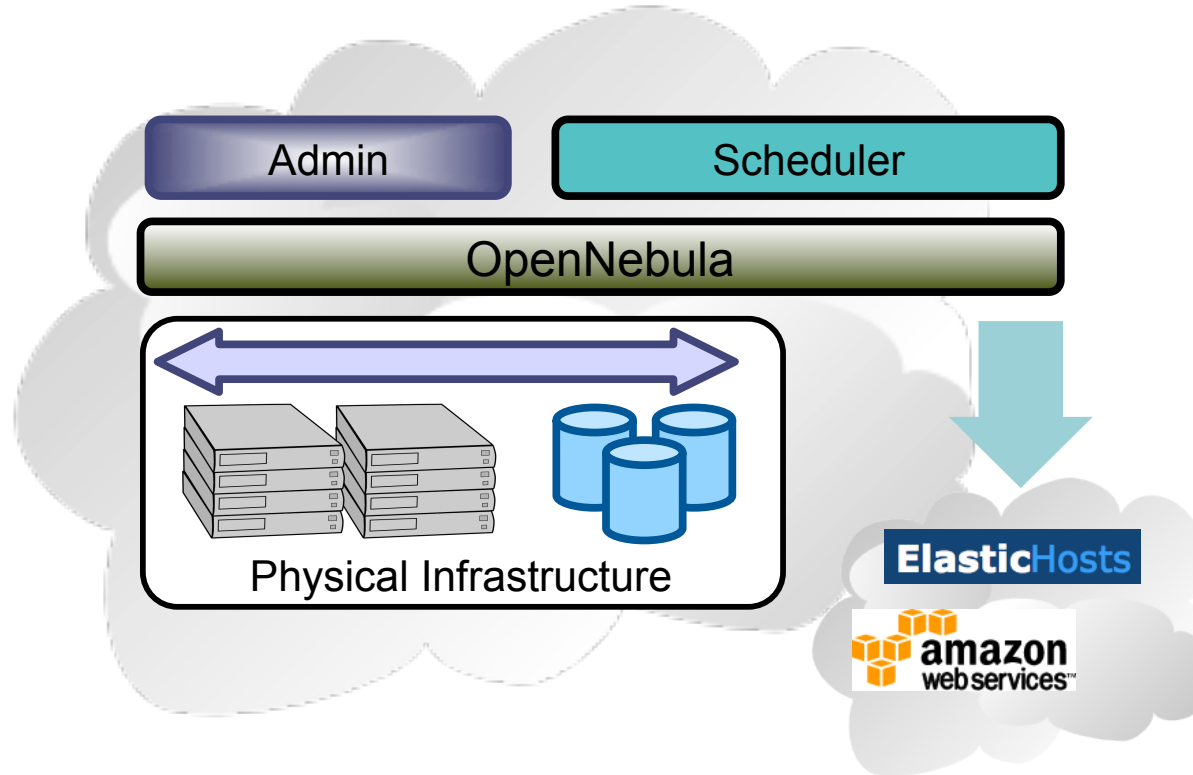
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Feature	Function
Cloud Interfaces for Users	<ul style="list-style-type: none"> • Implementation of a subset of the EC2 Query API and OGF - OCCi
Flexibility	<ul style="list-style-type: none"> • The Cloud Service allows the implementation of new Cloud interfaces

The Toolkit: Building a Hybrid Cloud

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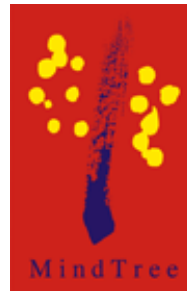
Feature	Function
Cloud Plugins	<ul style="list-style-type: none"> • Amazon EC2 and ElasticHosts connectors
Federation	<ul style="list-style-type: none"> • Support for simultaneous access to several remote clouds
Flexibility	<ul style="list-style-type: none"> • Modular approach to develop new connectors



The Community: Users

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



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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,...
- ...



The Community: Ecosystem

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Haizea Lease Manager

 **HAIZEA** <http://haizea.cs.uchicago.edu/>

- Haizea is a lease manager that can act as a **scheduling backend for OpenNebula**, providing advanced functionality such as:
 - Advance reservation of capacity
 - Best-effort scheduling with backfilling
 - Resource preemption (using VM suspend/resume/migrate)
 - Policy engine, allowing developers to write pluggable scheduling policies in Python
- Includes a simulation mode (useful for researchers testing scheduling algorithms)
- Open source (Apache 2)

Open-source and Standardization: Other Technologies

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Other Open-Source Technologies



Eucalyptus

- Compatible with **Amazon EC2 interfaces** and designed to support additional client-side interfaces



the globus[®] alliance

Nimbus

- **Exposes EC2 and WSRF interfaces and offers self-configuring virtual cluster support**



enomaly
elastic computing

- Management of clusters and virtual machines through a single **easy to use interface**

Commercial Software

VMware vSphere™

- **VMware** solution for private cloud computing

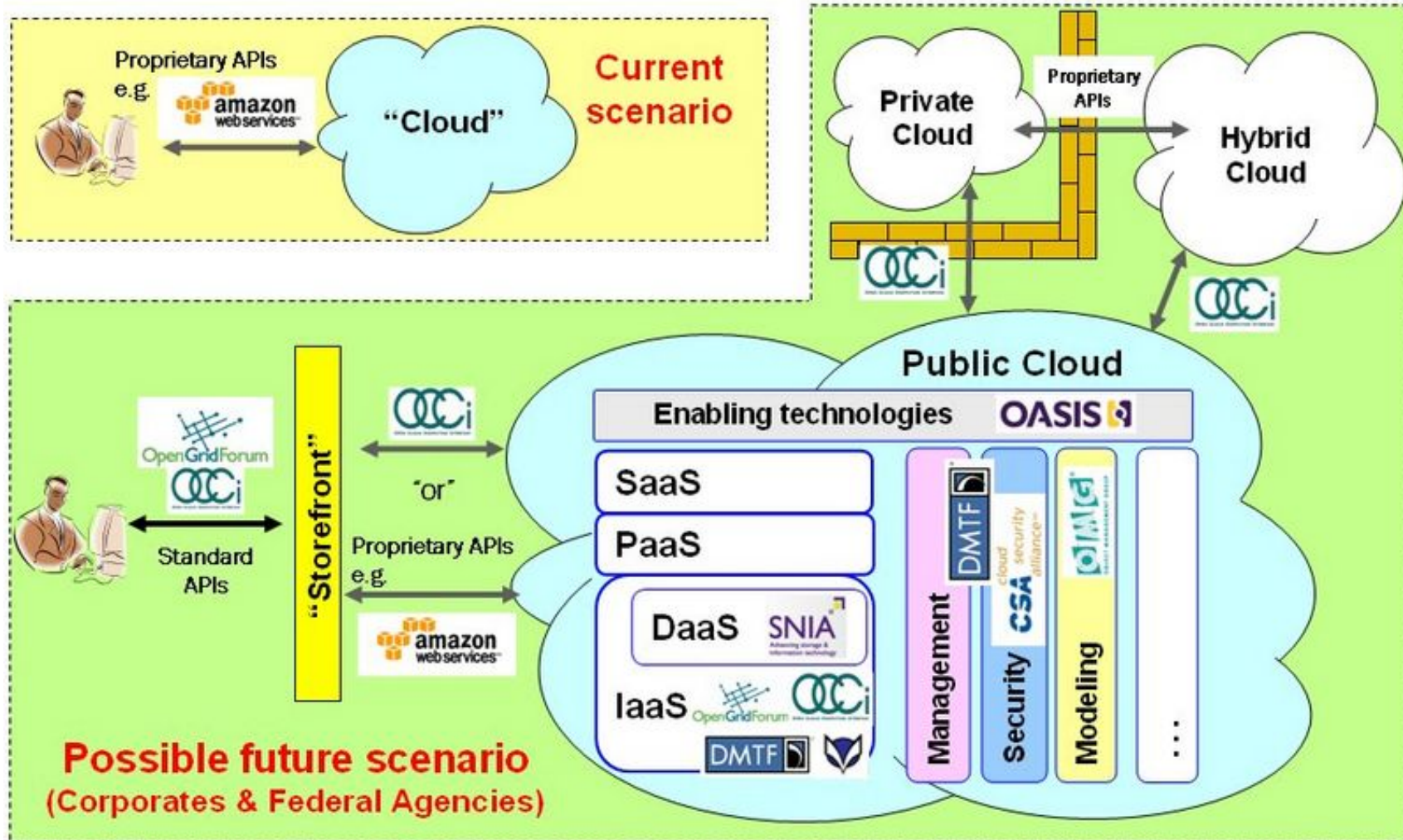
Platform ISF

- **Infrastructure sharing software** for physical and virtual resources

Open-source and Standardization: Existing Efforts

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A Positioning of Cloud Standards



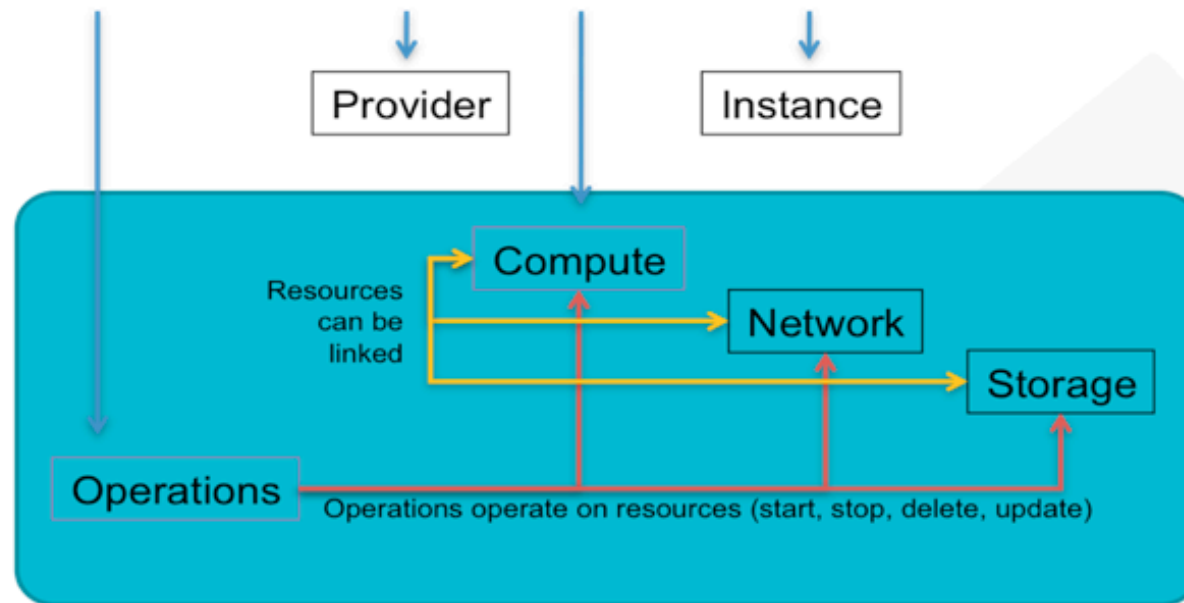
Open-source and Standardization: Interface Standard

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OGF OCCi Open Cloud Computing Interface



operation: `GET http://abc.com/compute/uid123foobar/`



Covered by OCCi



Vision on the Future of Cloud Computing

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IT Resources will be the Next Utility

- **Future enterprise datacenters will look like private Clouds** supporting a flexible and agile execution of virtualized services, and combining local with public Cloud-based infrastructure to enable highly scalable hosting environments
- **Growing number of domain specific and regional Cloud providers implementing a utility computing business model** by offering pay per use resources on-demand
- **Public Clouds will be supported by a network of geographically distributed datacenters** for high availability, end-user service proximity, legal and policy issues...
- **Public Clouds will be interconnected to meet fluctuating demands**
- **Grid sites will offer infrastructure cloud-like interfaces** to address the new resource access demands from the community



The Open Source Toolkit to Build Cloud Infrastructures

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

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References

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- 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

- Ruben S. Montero, Rafel Moreno, Tino Vazquez, Javier Fontan and Jaime Melis