Innovation for Cloud Infrastructure Management in OpenNebula/RESERVOIR

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Cloud Computing in a Nutshell

**Innovation for Cloud Infrastructure Management in OpenNebula/RESERVOIR**

<table>
<thead>
<tr>
<th>What</th>
<th>Who</th>
</tr>
</thead>
<tbody>
<tr>
<td>On-demand access to any application</td>
<td>End-user (does not care about hw or sw)</td>
</tr>
<tr>
<td>Platform for building and delivering web applications</td>
<td>Developer (no managing of the underlying hw &amp; sw layers)</td>
</tr>
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OpenNebula.org
Innovative open, flexible and scalable technology to build IaaS clouds
Innovation for Cloud Infrastructure Management in OpenNebula/RESERVOIR

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Innovations
Designed to address the technology challenges in cloud computing management

Standard-based Toolkit
OpenNebula v1.4

Community
Users, projects and ecosystem
The Innovations: Infrastructure User View

**Innovation for Cloud Infrastructure Management in OpenNebula/RESERVOIR**

**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)

Service as Groups of VMs

- Service **components** in VMs
- **Inter-connection** relationship
- **Placement** constraints
The Innovations: Infrastructure Manager View

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

Scalable back-end
- Virtualization
- Storage
- Networking
The Innovations: Infrastructure Manager View

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

Innovation for Cloud Infrastructure Management in OpenNebula/RESERVOIR

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
- Minimum installation requirements (distributed in Ubuntu)
- Open Source – Apache 2
# The Toolkit: Building a Private Cloud

**Innovation for Cloud Infrastructure Management in OpenNebula/RESERVOIR**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Function</th>
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</thead>
<tbody>
<tr>
<td><strong>Internal Interface</strong></td>
<td>• Unix-like CLI for fully management of VM life-cycle and resources</td>
</tr>
<tr>
<td></td>
<td>• XML-RPC API and libvirt virtualization API</td>
</tr>
<tr>
<td><strong>Scheduler</strong></td>
<td>• Requirement/rank matchmaker allowing the definition of workload</td>
</tr>
<tr>
<td></td>
<td>and resource-aware allocation policies</td>
</tr>
<tr>
<td></td>
<td>• Support for advance reservation of capacity through Haizea</td>
</tr>
<tr>
<td><strong>Virtualization Management</strong></td>
<td>• Xen, KVM, and VMware</td>
</tr>
<tr>
<td><strong>Image Management</strong></td>
<td>• General mechanisms to transfer and clone VM images</td>
</tr>
<tr>
<td><strong>Network Management</strong></td>
<td>• Definition of isolated virtual networks to interconnect VMs</td>
</tr>
<tr>
<td><strong>Service Management and</strong></td>
<td>• Support for multi-tier services consisting of groups of inter-</td>
</tr>
<tr>
<td><strong>Contextualization</strong></td>
<td>connected VMs, and their auto-configuration at boot time</td>
</tr>
</tbody>
</table>

Physical Infrastructure

Admin

Scheduler

OpenNebula

[Diagram showing cloud infrastructure and integration with OpenNebula and physical infrastructure]
The Toolkit: Building a Public Cloud

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<tr>
<td>Cloud Interfaces for Users</td>
<td>• Implementation of a subset of the EC2 Query API and OGF - OCCI</td>
</tr>
<tr>
<td>Flexibility</td>
<td>• The Cloud Service allows the implementation of new Cloud interfaces</td>
</tr>
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</table>
The Toolkit: Building a Hybrid Cloud

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<th>Feature</th>
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<tr>
<td>Cloud Plugins</td>
<td>• Amazon EC2 and ElasticHosts connectors</td>
</tr>
<tr>
<td>Federation</td>
<td>• Support for simultaneous access to several remote clouds</td>
</tr>
<tr>
<td>Flexibility</td>
<td>• Modular approach to develop new connectors</td>
</tr>
</tbody>
</table>
The Community: Users

Innovation for Cloud Infrastructure Management in OpenNebula/RESERVOIR

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

Projects
The Community: Active Ecosystem

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 (Telefónica 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,…

• …
Haizea Lease Manager

- 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)

[Haizea Website](http://haizea.cs.uchicago.edu/)
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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www.reservoir-fp7.eu/

References


• 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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