CloudCamp – Campus Party
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Open Source Cloud Computing Management with OpenNebula

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StratusLab
EU
CAPACITIES
# Cloud Computing Disciplines

## An Introduction to Cloud Computing

<table>
<thead>
<tr>
<th>What</th>
<th>Who</th>
</tr>
</thead>
<tbody>
<tr>
<td>On-demand access to any application</td>
<td><strong>End-user</strong> (does not care about hw or sw)</td>
</tr>
<tr>
<td></td>
<td><img src="skype.png" alt="skype" /> <img src="gmail.png" alt="gmail" /> <img src="facebook.png" alt="facebook" /></td>
</tr>
<tr>
<td>Platform for building and delivering web applications</td>
<td><strong>Developer</strong> (no managing of the underlying hw &amp; sw layers)</td>
</tr>
<tr>
<td></td>
<td><img src="windows-azure.png" alt="windows-azure" /> <img src="force.com.png" alt="force.com" /></td>
</tr>
<tr>
<td>Delivery of a <em>raw</em> computer infrastructure</td>
<td><strong>System Administrator</strong> (complete management of the computer infrastructure)</td>
</tr>
<tr>
<td></td>
<td><img src="grid.png" alt="grid" /> <img src="flexiscale.png" alt="flexiscale" /> <img src="amazon-web-services.png" alt="amazon web services" /></td>
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</tbody>
</table>
Infrastructure as a Service (IaaS)

An Introduction to Cloud Computing

**Public Cloud**

- Simple Web Interface
- Raw *Infrastructure* Resources
- Pay-as-you-go (On-demand access)
- Elastic & “infinite” Capacity
Infrastructure as a Service (IaaS)

An Introduction to Cloud Computing

Public Cloud
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• Elastic & “infinite” Capacity

Private Cloud
A “Public Cloud behind the firewall”
• Simplify internal operations
• Dynamic allocation of resources
• Higher utilization & operational savings
• Security concerns
Infrastructure as a Service (IaaS)

An Introduction to Cloud Computing

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**Hybrid Cloud**
- Supplement the capacity of the Private Cloud
- Utility Computing dream made a reality!
Infrastructure as a Service (IaaS)

An Introduction to Cloud Computing

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Challenges of an IaaS Cloud

An Introduction to Cloud Computing

I’m using virtualization/cloud, and plan a private Cloud (BUT’s)

Where do/did I put my web server VM?

Monitoring & Scheduling

Who have access to cloud (and What)?

User & Role Management

How do I provision a new VM?

Image Management & Context

How do I create a new disk?

Storage

How do I set up networking for a multitier service?

Network & VLANs

Can I use hypervisor X?

Virtualization

How can I manage the distributed infrastructure?

Interfaces & APIs

Uniform management layer that orchestrates multiple technologies

OpenNebula.org
History of OpenNebula.org

An Introduction to Cloud Computing

OpenNebula.org

- Develop & innovate
- Support the community
- Collaborate

Third party scalability tests: 16000 VMs

European Funding

Commercial Support

C12G LABS

4000 downloads/month

dsa group doing research…


TP v1.0 v1.2 v1.4 v2.0 v2.2 v2.4

Ubuntu Debian OpenSUSE

OpenNebula.org
History of OpenNebula.org: Sample Users

An Introduction to Cloud Computing

Organizations Building Clouds for Development, Testing and Production

Projects Building an Open Cloud Ecosystem Around OpenNebula

OpenNebula.org
Technical Overview of OpenNebula: Vision & Design Philosophy

An Introduction to Cloud Computing

• **One solution can not fit all** data-center, requirements and constraints

• **Open, flexible and extensible** architecture that allows multiple components to be orchestrated

• **Ready for production**

• **Massively scalable** deployments

• **Open Source** – Apache License v2.0

• Provide basic components, but allow them to be **easily replaceable**
Technical Overview of OpenNebula: Key Components

An Introduction to Cloud Computing

VM Networking
- VLANs
- Firewall hooks
- User defined

Interfaces & API
- CLI (local/remote)
- API (java, ruby bindings)
- Sunstone
- Cloud (EC2, OCCI)

User & Roles

OpenNebula

Hosts: Cluster workknoes to run VMs
- Multiple hypervisors defined per host
- Grouped in logical clusters
- Custom monitoring probes and technologies

Image Repository of VM disks
- ACLs (public + private)
- OS and Data types (persistent)
- Multiple storage backends

Storage
- NAS
- SAN
- Custom (bittorrent, ssh...)

OpenNebula.org
Component Overview

- Executes the OpenNebula Services
- *Usually* acts as a classical cluster front-end

- Repository of VM images
- Multiple backends (LVM, iSCSI..)
- Usually in a separate host

- Modular components to interact with the cluster services
- *Types:* storage, monitoring, virtualization and network

- Provides physical resources to VMs
- *Must have* a hypervisor installed

The same host can be a front-end and a node
Component Overview

Processes
Storage for the Private Cloud

Component Overview

- **Image Repository**: Any storage medium for the VM images (usually a high performing SAN).

- **Cluster Storage**
  - OpenNebula supports multiple back-ends (e.g. LVM for fast cloning)

- **VM Directory**: The home of the VM in the cluster node
  - Stores checkpoints, description files and VM disks
  - Actual operations over the VM directory depends on the storage medium
  - Should be shared for live-migrations
  - You can go on without a shared FS and use the SSH back-end
  - **Defaults to** $ONE_LOCATION/var/$VM_ID
Storage for the Private Cloud

Example, a shared FS architecture
Networking for the Private Cloud

Component Overview

- OpenNebula management operations uses a ssh connections, it does not require a performing NIC

- **Image traffic**, may require the movement of heavy files (VM images, checkpoints). Dedicated storage links may be a good idea

- **VM demands**, consider the typical requirements of your VMs. Several NICs to support the VM traffic may be a good idea

- OpenNebula relies on bridge networking for the VMs
Virtual Networks

Overview

- A **Virtual Network (vnet)** in OpenNebula
  - Defines a separated MAC/IP address space to be used by VMs
  - A vnet is associated with a physical network through a bridge
  - Virtual Networks can be isolated (at layer 2 level)

- Virtual Network *definition*
  - **Name**, of the network
  - **Type**
    - **Fixed**, a set of IP/MAC leases
    - **Ranged**, defines a network range
  - **Bridge**, name of the physical bridge in the physical host where the VM should connect its network interface.

- Virtual Networks are managed with the **onevnet** utility
Images

Overview

- An **Image** in OpenNebula’s repository
  - A virtual machine disk to be used as OS or DATA device.
  - Images can be **persistent** and/or **public**
  - Images modifications can be saved as another image

- **Image Types**:
  - **OS**: contains a working operative system
  - **CDROM**: readonly data
  - **DATABLOCK**: A storage for data. Can be created either from previous existing data, or as an empty drive.

- Images are **stored** in the repository
Automatic Disk Layout for Images

- **Prefix** (hd, sd): set as default in oned.conf
- **Can be set per image in its template**
- **Target** (hda...): can be set in the VM template for the DISK

- **OS**
  - hda
- **Context ISO**
  - hdb
- **CD-ROM**
  - hdc
- **swap**
  - hdd
- **Data 1**
  - hde
- **Data N**
  - hdn
Virtual Machines

Overview

- A **Virtual Machine** in OpenNebula
  - A **capacity** in terms memory and CPU
  - A set of **NICs** attached to one or more virtual networks
  - A set of **disk images**, to be “*transfered*” to/from the execution host.
  - A **state file** (optional) or recovery file, with the memory image of a running VM plus some hypervisor specific information.

- Virtual Machines are defined in a **VM template**

- Each VM has an unique ID in OpenNebula the **VMID**

- All the files (logs, images, state files...) are stored in **$ONE_LOCATION/var/<VMID>**
Overview

- VMs can be local or remote
- VM connectivity has to be configured, usually VPNs

External Clouds are like any other host
- Placement constraints
- OpenNebula distribution includes EC2 drivers
Public Cloud Computing with OpenNebula

Overview

- You can use multiple interfaces for the Cloud
- Transparent to your setup:
  - Hypervisor
  - Storage Model
  - Hybrid configuration

- Supports HTTP and HTTPS protocols
- *EC2 authentication* based on OpenNebula credentials
- Public Cloud users need an OpenNebula account

OpenNebula.org
StratusLab Project
Grid aware cloud stack

• MarketPlace with pregenerated Grid images
• Claudia service manager
• User friendly CLI to manage VMs and create new images
• Prepackaged software for common Linux distributions
• Quattor recipes to easily install and configure the software in a cluster
• X509/Grid credentials support
• VM management based on OpenNebula 2.2
StratusLab Project

Grid aware cloud stack

StratusLab

The version 0.4 of the software is available at http://stratuslab.eu

Version 1.0 is coming soon with utilities to upgrade previous installed versions.