An Introduction to OpenNebula Technical Workshop

OpenNebula Techday – Afternoon Session
Madrid, 8 May 2023
Module Structure

1. The Architecture of the Cloud
2. Virtual Lab
3. OpenNebula Interfaces
4. Virtualization Host Management
5. Basic Datastore Configuration
6. Basic Virtual Network Creation
7. VM Template Creation & Instantiation
8. Users and Groups Management
9. OpenNebula Views
The Architecture of the Cloud
1. The Architecture of the Cloud

A Typical OpenNebula Environment

- Repository of VM images
- Multiple Backends (LVM, Ceph)

Monitoring, Virtualization, Storage and Network

Frontend
ONED
Drivers Images

SSH Images
Hypervisor
Worker Node 1

SSH Images
Hypervisor
Worker Node 2

- Provides physical resources for the VMs
- Must have a hypervisor installed

OpenNebula Course: An Introduction to OpenNebula
2. Virtual Lab

Accessing the Environment

The instance lab_x is currently running. Please see attached details in order to connect to the instance.

Frontend connection details

- **SSH**: ssh gateway@3.127.36.156
- **Sunstone**: [Login to Sunstone](https://lab-X-node1.opennebula.cloud)
  - User credentials: root, oneadmin & gateway users with password <the password!>

Associated nodes

- 3.127.66.152
- 18.195.51.115

Note your lab number

Note your password

This is the IP of the front-end

These are the rest of servers in your lab
2. Virtual Lab

Accessing the Environment

- **User accounts** (UNIX) are created in your lab
  - gateway, use to ssh any server in the lab from outside.
  - oneadmin, use to interact with OpenNebula and ssh the nodes from the lab.
  - root, super-user you can sudo into it but not needed.

- To login in the environment use a SSH client

**Hands on! [laptop]** Login in the front-end machine

```bash
$ ssh gateway@<IP address in email>
gateway@<IP address>'s password: <password in email>
```
Accessing the Environment

**Hands on!** Login in the other servers in the lab

- Change to oneadmin account
- Watch out for the server names lab-\textbf{X}-node2

```
gateway@\textbf{lab-X-node1}:\sim$ sudo -i -u oneadmin
[sudo] password for gateway:

\textbf{oneadmin}@\textbf{lab-X-node1}:\sim$ ssh \textbf{lab-1-node2}
Welcome to Ubuntu 20.04.4 LTS (GNU/Linux 5.13.0-10-aws x86_64)
...
\textbf{oneadmin}@\textbf{lab-1-node2}:\sim$ exit
```

It is **necessary** to be able to ssh from any node to any other node without password as oneadmin
2. Virtual Lab

Accessing the Environment

- OpenNebula 6.4.0 is installed
- Lab is pre-configured with hypervisors installed and ready to use
- **User accounts** (OpenNebula):
  - oneadmin (password in email). Default account created in any OpenNebula installation
  - Use to login in the GUI services
- **OpenNebula GUI** (available in your laptop at):
  - Sunstone: https://<IP address in email>
  - Fireedge: https://<IP address in email>/fireedge
2. Virtual Lab

Accessing the Environment

Hands on! [node1] Let's see what packages have been installed:

```
oneadmin@lab-X-node1:$ dpkg -l | grep opennebula
```

These packages have already been installed from the repo located in `/etc/apt/sources.list.d/opennebula.list`. They have been installed with `apt install` (you don't need to do this).

Hands on! [node2, node3] Check the packages installed in node2 or node3, they're not the same!
2. Virtual Lab

Accessing the Environment

Hands on! [node1] Let's see what services are running:

```
oneadmin@lab-X-node1:~$ systemctl | grep opennebula
```

These services have been enabled to start automatically when the VM boots ($ systemctl enable <service>).

lab-X-node2 and lab-X-node3 have libvirt running.
### 2. Virtual Lab

#### Inspecting the environment - OpenNebula Configuration

**Configuration changes:**

**/etc/one/oned.conf**

```ini
#DB = [ BACKEND = "sqlite" ]
DB = [ BACKEND="mysql", SERVER="localhost", PORT=3306, USER="oneadmin", PASSWD="<randomize password>", DB_NAME="opennebula" ]
```

**/etc/one/sched.conf**

```ini
SCHED_INTERVAL = 30
SCHED_INTERVAL = 10
```

**/etc/one/vmm_exec/vmm_exec_kvm.conf**

```ini
DISK = [ driver = "raw" , cache = "none" ]
DISK = [ driver = "qcow2", cache = "unsafe" ]
```
2. Virtual Lab

Inspecting the environment - OpenNebula Password

- The oneadmin password is located here:

   $ cat /var/lib/one/.one/one_auth
   oneadmin:<password in email>

The first time OpenNebula starts, it sets the password from the contents of this file.
2. Virtual Lab

Installation

Summary of the installation:

- Add repo: /etc/apt/sources.list.d/opennebula.list
- Install packages: `apt install opennebula` ...
- Enable OpenNebula services
- Configure Storage (to be discussed later)
- Configure Network (to be discussed later)
- Configure passwordless ssh access
- OpenNebula configuration files
OpenNebula Interfaces
3. OpenNebula Interfaces

Command Line Interface

- **Hands on! [node1]** Overview of the CLI (as oneadmin):

  ```
  # sudo -i -u oneadmin
  $ oneuser show
  $ oneuser -h
  $ one[TAB][TAB]
  ```

  All the CLI commands should be executed as the oneadmin user. **Remember** to switch to the oneadmin user always!
# 3. OpenNebula Interfaces

<table>
<thead>
<tr>
<th>Command Line Interface</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>oneuser</code></td>
<td>Manage Users</td>
</tr>
<tr>
<td><code>onelogin</code></td>
<td>Manage Groups</td>
</tr>
<tr>
<td><code>oneacl</code></td>
<td>Manage ACLs</td>
</tr>
<tr>
<td><code>onehost</code></td>
<td>Manage Hosts</td>
</tr>
<tr>
<td><code>onecluster</code></td>
<td>Manage Clusters</td>
</tr>
<tr>
<td><code>onevnet</code></td>
<td>Manage Networks</td>
</tr>
<tr>
<td><code>onedatastore</code></td>
<td>Manage Datastores</td>
</tr>
<tr>
<td><code>oneshowback</code></td>
<td>Showback</td>
</tr>
<tr>
<td><code>onevdc</code></td>
<td>Manage VDCs</td>
</tr>
<tr>
<td><code>onevcenter</code></td>
<td>Import vCenter resources</td>
</tr>
<tr>
<td><code>onecfg</code></td>
<td>Manage configuration files</td>
</tr>
<tr>
<td><code>onezone</code></td>
<td>Manage zones</td>
</tr>
<tr>
<td><code>oneimage</code></td>
<td>Manage Images</td>
</tr>
<tr>
<td><code>onetimeplate</code></td>
<td>Manage Templates</td>
</tr>
<tr>
<td><code>oneacct</code></td>
<td>Accounting Tool</td>
</tr>
<tr>
<td><code>onemarket</code></td>
<td>Marketplace Tool</td>
</tr>
<tr>
<td><code>onedb</code></td>
<td>DB Tool</td>
</tr>
<tr>
<td><code>oneflow</code></td>
<td>Manage flows (services)</td>
</tr>
<tr>
<td><code>onemarketapp</code></td>
<td>Import marketapps</td>
</tr>
<tr>
<td><code>onevrouter</code></td>
<td>Manage virtual routers</td>
</tr>
<tr>
<td><code>onesecgroup</code></td>
<td>Manage sec. groups</td>
</tr>
<tr>
<td><code>oneprovision</code></td>
<td>Manage provisions</td>
</tr>
<tr>
<td><code>oneprovider</code></td>
<td>Manage providers</td>
</tr>
<tr>
<td><code>onehook</code></td>
<td>Manage hooks</td>
</tr>
</tbody>
</table>
3. OpenNebula Interfaces

Graphical User Interface

**Hands on!**
[laptop/Sunstone]
Try Sunstone:

[Image showing a login page for OpenNebula]

**OpenNebula Course:** An Introduction to OpenNebula
3. OpenNebula Interfaces

OpenNebula Views - The Admin View

Admin

Group Admin

Cloud User

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4

Hosts
4. Virtualization Hosts Management

Adding Hosts

Hands on! [laptop/Sunstone] Add a new host:

- **Create** one host in Sunstone:
  - Type: QEMU
  - Cluster: Default
  - Hostname: lab-X-node2

- Watch transition INIT => ON

- **Click on the row** for more information
  - Automatic gathering of monitoring data
  - Take a look at the graphs
Adding Hosts

**Hands on! [node1]** Add a new host with the CLI:

```bash
# Execute these commands as oneadmin

$ onehost -h
$ onehost create -h

$ onehost create lab-X-node3 -i qemu -v qemu
$ onehost list
$ onehost top

# Wait for ON ... and then CTRL-C

$ onehost show lab-X-node3
$ onehost show 1
$ onehost show -x 1
```
Datastores
5. Basic Datastore Configuration

Adding Images

**Hands on! [laptop/Sunstone]**

Download a new Image (Storage > Apps)

Search for Alpine Linux 3.15
Select *default* datastore
# 5. Basic Datastore Configuration

## Datastores

<table>
<thead>
<tr>
<th>ID</th>
<th>Name</th>
<th>Owner</th>
<th>Group</th>
<th>Capacity</th>
<th>Cluster</th>
<th>Type</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>files</td>
<td>oneadmin</td>
<td>oneadmin</td>
<td>97GB / 224.8GB (43%)</td>
<td>0</td>
<td>FILE</td>
<td>ON</td>
</tr>
<tr>
<td>1</td>
<td>default</td>
<td>oneadmin</td>
<td>oneadmin</td>
<td>97GB / 224.8GB (43%)</td>
<td>0</td>
<td>IMAGE</td>
<td>ON</td>
</tr>
<tr>
<td>0</td>
<td>system</td>
<td>oneadmin</td>
<td>oneadmin</td>
<td>-/-</td>
<td>0</td>
<td>SYSTEM</td>
<td>ON</td>
</tr>
</tbody>
</table>

10 entries are shown from 1 to 3 of 3 entries.
Virtual Networks
6. Basic Virtual Network Creation

Adding Networks

**Hands on! [laptop/Sunstone]** Create a Network

Create a Network in Sunstone and assign it the name "private".
6. Basic Virtual Network Creation

Adding Networks

Hands on! [laptop/Sunstone]
Network parameters:

General
- Name: private

Configuration
- Network mode: VXLAN
- VLAN ID: Manual VLAN ID 15
- Physical device: eth0

Addresses
- IP start: 192.168.0.100
- Size: 100

Context
- Gateway: 192.168.0.1
- DNS: 1.1.1.1
Virtual Machines
7. VM Template Creation & Instantiation

Adding Templates

- A VM Template is a Virtual Machine definition ready to be **instantiated**.
- It has all the server configuration parameters like CPU, Memory, Disks, NIC, Graphical Ports, etc…

**Hands on! [laptop/Sunstone]** Update the template that has been created when downloading the app.

- **VM Server Tabs: General / Storage /…**
  - Take a look to the predefined configuration and attributes.

- **Network**
  - Click **private** (to add a NIC to the virtual network **private**).

- **Input/Output**
  - Enter your keymap. Leave as is if using a US keyboard.
7. VM Template Creation & Instantiation

Adding Templates

**Hands on! [laptop/Sunstone]** Update the template that has been created when downloading the app

**Context**
- Check 'Add OneGate token'
- In the Start script text area type:
  ```
  touch /tmp/tutorial-test
  ```
- Custom vars. Add a new one
  - Name: PASSWORD
  - Value: opennebula

Click **Update**
7. VM Template Creation & Instantiation

Adding SSH Contextualization

**Hands on! [node1]** Prepare the VM users can SSH to the VM using pub keys

- Copy the SSH from here (in lab-X-node1, from oneadmin account):

```bash
$ cat /var/lib/one/.ssh/id_rsa.pub
ssh-rsa
AAAAB3NzaC1yc2EAAAADAQABAAABAQ9nzF1cl1aAji5k6eh+3W5GEopFKfuwSWm88mASTNTX31rnqJeGCqSkw5VwgSdGaaPzPVC3jNvB31... one
```
7. VM Template Creation & Instantiation

Adding SSH Contextualization

- Paste the SSH public key into oneadmin account data
Instantiating VMs

**Hands on! [laptop/Sunstone]**

- **Instantiate** the template
- Deploy 2 VMs
- Leave the name blank
- Open **Instances > VMs**
- Watch Status transition **PENDING** => **RUNNING**
- Check **Host**

- **VNC** (	exttt{root/opennebula})
- Network configured using **context**
  ip address
- **ping** the other machine
- **migrate** the other machine (watch ping)
- **live-migrate** the other machine (watch ping)
Instantiating VMs

**Hands on! [node1]** SSH the VM through node1 (oneadmin account)

```bash
#Grab the ID or name of the VM you want to log into

oneadmin@lab-1-node1:~$ onevm list

```

<table>
<thead>
<tr>
<th>ID</th>
<th>USER</th>
<th>GROUP</th>
<th>NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>oneadmin</td>
<td>oneadmin</td>
<td>Alpine Linux 3.15-3</td>
</tr>
<tr>
<td>2</td>
<td>oneadmin</td>
<td>oneadmin</td>
<td>Alpine Linux 3.15-2</td>
</tr>
</tbody>
</table>

```

oneadmin@lab-1-node1:~$ onevm ssh 2

Warning: Permanently added '192.168.0.100' (ECDSA) to the ...

localhost:~#

**Hands on! [node1]** SSH the VM using the ssh command and VM IP (look for it in Sunstone or CLI)
7. VM Template Creation & Instantiation

Contextualization

Hands on! [node1 or VNC - Sunstone] Login to the first VM and look at contextualization

```
localhost:~# head -n 11 /var/run/one-context/context.sh.local
# Context variables generated by OpenNebula
DISK_ID='1'
ETH0_DNS='1.1.1.1'
ETH0_EXTERNAL=''
ETH0_GATEWAY='192.168.0.1'
ETH0_GATEWAY6=''
ETH0_IP='192.168.0.100'
...
```
7. VM Template Creation & Instantiation

Contextualization

**Hands on! [node1 or VNC - Sunstone]** Take a look to context files:

```
localhost:~# ls /etc/one-context.d/
loc-04-run-dir            loc-14-mount-swapp
net-15-hostname
loc-05-grow-rootfs        loc-16-gen-env
...
```

**Hands on! [node1 or VNC - Sunstone]** The file /tmp/tutorial-test has been created thanks to the START SCRIPT text area:

```
localhost:~# ls -la /tmp/tutorial-test
-rw-r--r--   1 root      root       0 Jun
30 14:41 /tmp/tutorial-test
```
## 7. VM Template Creation & Instantiation

### Main VM Actions

<table>
<thead>
<tr>
<th>Action</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>suspend</td>
<td>VM state saved. Kept in the host.</td>
</tr>
<tr>
<td>power off (--hard)</td>
<td>Powers off a VM. Kept in the host.</td>
</tr>
<tr>
<td>stop</td>
<td>VM state saved. Taken to the system datastore.</td>
</tr>
<tr>
<td>undeploy (--hard)</td>
<td>Powers off a VM. Taken to the system datastore.</td>
</tr>
<tr>
<td>reboot (--hard)</td>
<td>Reboots the VM.</td>
</tr>
<tr>
<td>recover --recreate</td>
<td>Cleans the VM and moves it to PENDING.</td>
</tr>
<tr>
<td>terminate (--hard)</td>
<td>Shuts down a VM, cleans host and VM is removed from OpenNebula.</td>
</tr>
<tr>
<td>recover --delete</td>
<td>VM is immediately destroyed regardless of state. Recommended only for oneadmin.</td>
</tr>
</tbody>
</table>
Main VM Actions

**Hands on! [laptop - Sunstone]**
Create an empty disk image:

**Generic storage datablock**

- **data-100**
- **100 MB**
- **Virtio**
- **qcow2**
Main VM Actions

Hands on! [laptop - Sunstone] Attach the disk to a running VM

![Attach disk](Attach disk)

Select data-100 image

Hands on! [node1 / Sunstone] Check the result in the guest (VNC or SSH)

```bash
oneadmin@lab-1-node1:~$ onevm ssh 2
localhost:~# lsblk
NAME      MAJ:MIN  RM SIZE RO TYPE MOUNTPOINTS
sr0       11:0    1   366K 0  rom
vda       253:0    0  256M 0  disk
└─vda1 253:1    0  255M 0  part /
vdb       253:16   0  100M 0  disk
localhost:~#
```
7. VM Template Creation & Instantiation

Main VM Actions

**Hands on! [laptop - Sunstone] Test VM operations**

- **Capacity**: Power off first, then resize VM capacity (Memory 512) and resume. Check the effect in the guest with `free -m` command.

  ![Capacity Diagram]

- **Snapshot**: Take (system) snapshot. Then modify the VM (e.g. touch file). Revert the snapshot and check effect in the guest.

  ![Snapshot Diagram]
Users & Groups
8. Users and Groups Management

Permissions: Chmod and Chown, UNIX Style!

**Hands on! [laptop - Sunstone]** Make the all the resources previously created usable by everybody

- Apply to all the **images**, **networks** and **templates** (take a look at Template → Share)
- Owner could be changed too with **chown**, **chgrp** and **chmod**.

**OpenNebula Course**: An Introduction to OpenNebula
8. Users and Groups Management

Groups

Hands on! [laptop - Sunstone] Create a new group

General
- Name: students

Admin
- Enable administrator user
- Set password for students-admin

Check the Permissions and Views tab (no modifications)
### 8. Users and Groups Management

#### Groups

**Hands on! [laptop - Sunstone]** When a group is created, a new set of **ACLs** are introduced

<table>
<thead>
<tr>
<th>ID</th>
<th>Applies to</th>
<th>Affected resources</th>
<th>Resource ID / Owned by</th>
<th>Allowed operations</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>User 3</td>
<td>Virtual Machines, Virtual Networks, Images, VM Templates, Documents, Security Groups, Virtual Routers, VM Groups</td>
<td>Group students</td>
<td>use, manage</td>
</tr>
<tr>
<td>10</td>
<td>User 3</td>
<td>Users</td>
<td>Group students</td>
<td>use, manage, admin, create</td>
</tr>
<tr>
<td>9</td>
<td>Group students</td>
<td>Virtual Machines, Images, VM Templates, Documents, Security Groups, Virtual Routers</td>
<td>All</td>
<td>create</td>
</tr>
<tr>
<td>8</td>
<td>Group students</td>
<td>Datastores</td>
<td>All</td>
<td>use</td>
</tr>
<tr>
<td>7</td>
<td>Group students</td>
<td>Virtual Networks</td>
<td>All</td>
<td>use</td>
</tr>
<tr>
<td>6</td>
<td>Group students</td>
<td>Hosts</td>
<td>All</td>
<td>manage</td>
</tr>
</tbody>
</table>
8. Users and Groups Management

The Power of VDCs

Virtual Data Centers

<table>
<thead>
<tr>
<th>ID</th>
<th>Name</th>
<th>Groups</th>
<th>Clusters</th>
<th>Hosts</th>
<th>VNets</th>
<th>Datastores</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>default</td>
<td>1</td>
<td>All</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Showing 1 to 1 of 1 entries

Virtual Data Center: default

Information
- ID: 0
- Name: default

Attributes
Every new group added to this VDC use it to store default access rules for your groups. NOTE: you may need to remove a group from the default VDC before assigning it to other VDCs.

OpenNebula Course: An Introduction to OpenNebula
OpenNebula Views
9. OpenNebula Interfaces

Configure your Cloud from the Admin perspective

Admin

Group Admin

OpenNebula

Cloud User

OpenNebula Course: An Introduction to OpenNebula
9. OpenNebula Interfaces

Using Groups with the Group Admin View

Hands on! [laptop - Sunstone] Login as students-admin, create a new user (student) in the group, and set a quota to only allow the user to create 2 VMs.

OpenNebula Course: An Introduction to OpenNebula
9. OpenNebula Interfaces

Cloud Consumer View

Admin

Group Admin

OpenNebula

Cloud User

OpenNebula Course: An Introduction to OpenNebula
Hands on! [laptop - Sunstone] Login as student and create a new VM

- Select the Alpine Linux 3.15 template
- Network private

- Explore the VM actions. **Power Off** and **Save VM**
- With the oneadmin account see the new template and image
- Other options: SSH Key, Quotas, Settings
9. OpenNebula Interfaces

Cloud Admin View

**Hands on! [laptop - Sunstone]** Login as *students-admin*, Check the students Group (e.g. **Accounting**, Users, Group quotas and usage...)

---

**OpenNebula Course:** An Introduction to OpenNebula
Module Structure

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7. VM Template Creation & Instantiation
8. Users and Groups Management
9. OpenNebula Views
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