Edge Clouds with OpenNebula
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OpenNebula
Edge Cloud Provisioning Demo
What’s OpenNebula?

- framework to build **IaaS cloud** (private / public)
- **virtual machines** (KVM, vCenter), **system containers** (LXD)
- various **cloud deployment architectures** (on-premises, hybrid, ...)
- **light** and **simple**, **extensible**
- easily **upgradable**
- support for **popular distributions** (CentOS/RHEL, Ubuntu, Debian)
- **open-source software** (Apache) + commercial services
- since 2008
OpenNebula
Web Management Interface Sunstone
Try Out

OpenNebula Project Page

Discover features, supported private cloud models, learn about existing users.

https://opennebula.org/discover/

miniONE

Simple deployment script which setups the all-in-one single node evaluation environment with OpenNebula (KVM, LXD, and edge cluster on Packet).

https://github.com/OpenNebula/minione

[root@centos7 ~]# ./minione

### Checks & detection
Checking augeas is installed  SKIP will try to install
Checking bridge-utils are installed  SKIP will try to install
Checking SELinux  SKIP will try to disable

### Main deployment steps:
Install OpenNebula frontend version 5.10
Configure bridge minionebr with IP 172.16.100.1/24
Enable NAT over eth0
Install OpenNebula KVM node
Export appliance and update VM template
Disable SELinux
Install augeas bridge-utils

Do you agree? [yes/no]: yes
OpenNebula Conference
9th edition
1 – 2 October 2020
In BRUSSELS
OpenNebula
Edge Cloud
Provisioning Demo
Cloud-like capabilities located at the infrastructure edge ... Often operated as a seamless extension of a centralized public or private cloud, constructed from micro data centers deployed at the infrastructure edge.

— Open Glossary of Edge Computing, v2.0
Why Edge Cloud?

- lower latencies
- real-time processing (AI, VR, video)
- lower transfers to central cloud
- comply w/ privacy and security requirements
- limitations (HW, SW, features)
- potential data loss
- maintenance overhead
Cloud Deployment Architecture

(Distributed) Edge Cloud

- Boston DC
- Brussels Hosted Edge
- Gent Hosted Edge
- Bruggae Hosted Edge
- Antwerpen Hosted Edge
Edge Clouds with OpenNebula

Features
- many locations
- small size
- created on-demand, dynamic
- ephemeral
- limited, restricted
- uniform view

Implementation
- on infrastructure edge
- proved technology from on-premises cloud (KVM, LXD, VXLAN, …)
- specialized integration drivers
- predefined reference edge cloud architecture
Edge Clouds with **OpenNebula**

**Key Building Blocks**

1. **Bare-Metal Cloud**
   - Cloud-like service model to provide and control physical servers. **Provides resources for OpenNebula Edge Clouds.**

2. **Automation**
   - Host configuration automation from base OS to ready-to-use virtualization node.

3. **OSS**
   - All the great open source stuff - Linux distributions, hypervisors, tools …..
   - **THANK YOU!!! ❤️**
Edge Clouds with **OpenNebula**

**OpenNebula Edge Clouds are ...**

- limited OpenNebula virtualization clusters
- deployed on infrastructure of bare-metal providers
- managed fully automatically
- “IaaS-in-IaaS”
## Infrastructure Limitations

<table>
<thead>
<tr>
<th></th>
<th>On-Premise</th>
<th>Bare-Metal Cloud</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hosts</strong></td>
<td>OK</td>
<td>OK</td>
</tr>
<tr>
<td><strong>Storage</strong></td>
<td>OK</td>
<td>OK</td>
</tr>
<tr>
<td><strong>Network</strong></td>
<td>OK</td>
<td>restricted?</td>
</tr>
<tr>
<td><strong>IP Addressing</strong></td>
<td>OK</td>
<td>restricted!</td>
</tr>
</tbody>
</table>
Infrastructure Limitations

Challenges in Bare-Metal Cloud

Network
- environment specific
- features (dedicated VLAN)
- limitations (no multicast)
- **solution** = common virt. net. model
  - overlay network
  - for unicast-only env.
  - provider independent

IP Addressing
- **private**
- **public**
  - provider assigned
- **solution** = IP management drivers
  - allocate from prov.
  - associate with hosts
  - release
  - provider dependent
Edge Clouds with OpenNebula

Conclusion

Run **IaaS** (OpenNebula w/ KVM) within **IaaS** (bare-metal cloud) might require **deeper integrations** with each target environment.
OpenNebula
Edge Cloud
Provisioning
Demo
Cloud Provision

Set of specialized tool, drivers and configurations for automated build and management of OpenNebula Edge Clouds.

(possibly not only “edge”)
Provision Components

Components

- execution tool **oneprovision**
  - manages full life-cycle of entities
  - CLI only
- per provider **integration drivers**
  - hosts management
  - IP address management and assignment
- **configuration** playbooks / roles
  - reference architectures
Provision Descriptor

- provision descriptor
  - YAML file w/ deployment specification
  - covers all aspects of all new cloud provision process
    - What **hosts allocate** and where? (provides, DC, HW, OS)
    - How **configure** hosts inside? (KVM, bridges, …)
    - What to **add** into OpenNebula for users? (clusters, vnets, datastores)
  - created by Infrastructure Administrator
  - required by **oneprovision** to create new cloud
Each provision run creates a new fully functional independent OpenNebula Edge Cloud.
Provision Process

0. Create Descriptor
   Infr. Administrator prepares provision descriptor (template).

1. Add
   Add data into OpenNebula (cluster, datastores, virtual networks, stub hosts)

2. Provision
   Allocate hosts from remote bare-metal cloud provider.

3. Configure
   Run Ansible to configure hosts (system, network, software).

4. Enable
   Enable for Cloud Users.

Run oneprovision
Provision Management

Cloud Management
- create: oneprovision create [TEMPLATE]
- delete: oneprovision delete [ID]
- (re)configure: oneprovision configure [ID]

Host Management
- power-off / resume: oneprovision host [poweroff|resume] [ID]
- reboot / reset: oneprovision host reboot [--hard] [ID]
- (re)configure: oneprovision host configure [ID]
- ssh: oneprovision host ssh [ID]
Current State

- available providers
  - **Packet**
  - **EC2** (partial)
- tool for cloud administrators
- executed on ONE frontend
- no edge cluster update
- simple deployment architecture
  - preconfigured static networks

Future Plans

- **H2020 ONEedge.io EU funding**
  - build easy to use edge cloud solution
  - catalog of edge providers
  - marketplace of edge apps.
- new integration drivers
- cluster scaling
- support for lightweight VMM
- caching datastores
- cross-locations networking ...
Try Out Edge

Documentation

Related chapter “Disaggregated Data Centers” in within comprehensive OpenNebula documentation.

http://docs.opennebula.org/

miniONE with Edge

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Use-Case Validation Demos

**Video Gaming**

Fully automated demo deployment on 17 edge locations (KVM clusters), 1 VM with Wolfenstein Enemy Territory public server in 25 minutes.


**AWS IoT Greengrass**

Application demo of distributed monitoring system across 15 edge locations (KVM clusters) with deployed AWS IoT Greengrass core and Lambda function in 23 minutes.

OpenNebula
Edge Cloud
Provisioning
Demo
name: fosdem

playbook: static_vxlan

defaults:
  provision:
    driver: packet
    packet_token: ******************************
    packet_project: ******************************
    facility: ams1
    plan: baremetal_0
    os: centos_7
  configuration:
    opennebula_node_kvm_param_nested: True
    iptables_masquerade_enabled: False
hosts:
- im_mad: kvm
  vm_mad: kvm
  provision:
    hostname: "<%= @name %>-%node1-c7"
- im_mad: kvm
  vm_mad: kvm
  provision:
    hostname: "<%= @name %>-%node2-u1804"
  os: ubuntu_18_04

datastores:
- name: "<%= @name %>-%default"
  ds_mad: fs
  tm_mad: ssh
- name: "<%= @name %>-%system"
  type: system_ds
  tm_mad: ssh
  safe_dirs: '/var/tmp /tmp'
networks:
  - name: "<%= @name %>-public"
    vn_mad: alias_sdnat
    external: yes
    description: "Packet Public IP Networking"
    ar:
      - size: 2
        type: IP4
        ipam_mad: packet
        packet_ip_type: public_ipv4
        packet_token: ***********************
        packet_project: ***********************
        facility: ams1
- name: "<%= @name %>-private-host-only"
  vn_mad: "dummy"
  bridge: "br0"
  dns: "8.8.8.8 8.8.4.4"
  gateway: "192.168.150.1"
  description: "Host-only networking"
  ar:
    - ip: "192.168.150.2"
      size: "253"
      type: "IP4"
- name: "<%= @name %>-private"
  vn_mad: "dummy"
  bridge: "vxbr100"
  mtu: "1450"
  description: "Private networking"
  ar:
    - ip: "192.168.160.2"
      size: "253"
      type: "IP4"
**Demo**

Edge Cluster Provision on Packet provider

<table>
<thead>
<tr>
<th>ID</th>
<th>NAME</th>
<th>HOSTS</th>
<th>VNETS</th>
<th>DATASTORES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>default</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

```bash
[oneadmin@fosdem ~]$ onehost list
```

```bash
[oneadmin@fosdem ~]$ onedatatstore list
```

```bash
[oneadmin@fosdem ~]$ onedatatstore list
```

```bash
[oneadmin@fosdem ~]$ onevnet list
```

```bash
[oneadmin@fosdem ~]$ time oneprovision create demo/demol1.yaml -d
```

```
2020-01-30 18:19:04 INFO : Creating provision objects
WARNING: This operation can take tens of minutes. Please be patient.
2020-01-30 18:19:06 INFO : Deploying
2020-01-30 18:22:49 INFO : Monitoring hosts
2020-01-30 18:22:53 INFO : Checking working SSH connection
2020-01-30 18:22:55 INFO : Configuring hosts
ID: bf991fc4-4615-40b0-af8a-8b2dad2e9d98
```

```
real 15m36.599s
user 1m27.531s
sys 0m21.688s
```

```bash
[oneadmin@fosdem ~]$
```
Demo

State after provision

<table>
<thead>
<tr>
<th>ID</th>
<th>NAME</th>
<th>HOSTS</th>
<th>VNETS</th>
<th>DATASTORES</th>
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</thead>
<tbody>
<tr>
<td>108</td>
<td>fosdem</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>0</td>
<td>default</td>
<td>0</td>
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<table>
<thead>
<tr>
<th>ID</th>
<th>NAME</th>
<th>CLUSTER</th>
<th>TVM</th>
<th>ALLOCATED_CPU</th>
<th>ALLOCATED_MEM</th>
<th>STAT</th>
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<tbody>
<tr>
<td>9</td>
<td>147.75.100.201</td>
<td>fosdem</td>
<td>0</td>
<td>0 / 400 (0%)</td>
<td>0K / 7.8G (0%)</td>
<td>on</td>
</tr>
<tr>
<td>8</td>
<td>147.75.101.53</td>
<td>fosdem</td>
<td>0</td>
<td>0 / 400 (0%)</td>
<td>0K / 7.8G (0%)</td>
<td>on</td>
</tr>
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</table>

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<thead>
<tr>
<th>ID</th>
<th>NAME</th>
<th>SIZE</th>
<th>AVA</th>
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<th>IMAGES</th>
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<th>TM</th>
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<tr>
<td>117</td>
<td>fosdem-system</td>
<td>- -</td>
<td>108</td>
<td>0 sys</td>
<td>-</td>
<td>ssh</td>
<td>-</td>
<td>-</td>
<td>on</td>
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<tr>
<td>116</td>
<td>fosdem-default</td>
<td>12.9G</td>
<td>85%</td>
<td>108</td>
<td>0 img</td>
<td>fs</td>
<td>ssh</td>
<td>on</td>
<td></td>
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<tr>
<td></td>
<td>2 files</td>
<td>12.9G</td>
<td>85%</td>
<td>0</td>
<td>0 fil</td>
<td>fs</td>
<td>ssh</td>
<td>on</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 default</td>
<td>12.9G</td>
<td>85%</td>
<td>0</td>
<td>1 img</td>
<td>fs</td>
<td>ssh</td>
<td>on</td>
<td></td>
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<tr>
<td></td>
<td>0 system</td>
<td>- -</td>
<td>0</td>
<td>0 sys</td>
<td>-</td>
<td>ssh</td>
<td>-</td>
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<tr>
<th>ID</th>
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<th>GROUP</th>
<th>NAME</th>
<th>CLUSTERS</th>
<th>BRIDGE</th>
<th>LEASES</th>
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<tbody>
<tr>
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<td>oneadmin</td>
<td>fosdem-private</td>
<td>108</td>
<td>vxbr100</td>
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<tr>
<td>14</td>
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<td>oneadmin</td>
<td>fosdem-private-host-only</td>
<td>108</td>
<td>br0</td>
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<tr>
<td>13</td>
<td>oneadmin</td>
<td>oneadmin</td>
<td>fosdem-public</td>
<td>108</td>
<td>onebr13</td>
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</tr>
</tbody>
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<tr>
<td>bf991fc4-4615-40b0-af8a-8b2dad2e9d98</td>
<td>fosdem</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>configured</td>
</tr>
</tbody>
</table>
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