



# Edge Clouds with OpenNebula

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# ONEedge.io

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# OpenNebula

## Edge Cloud Provisioning Demo

# OpenNebula

## 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

admin OpenNebula

Dashboard

Instances

- VMs
- infra
- Services
- Virtual Routers

Templates

Storage

Network

Infrastructure

System

Settings

Officially supported

Not connected

Sign in

OpenNebula 5.10.2  
by OpenNebula Systems.

### VMs

+
↺
🔒
▶
🔒
⏸
🔌
↻
☰
🔗

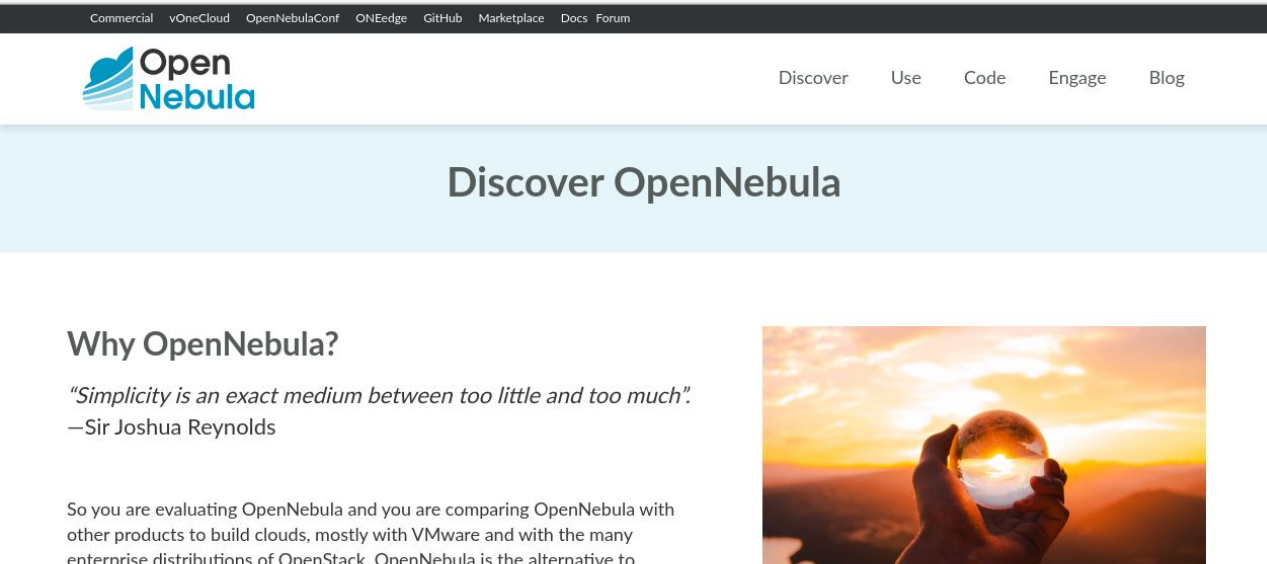
<input type="checkbox"/>	ID	Name	Owner	Group	Status	Host	IPs
<input type="checkbox"/>	279292	debian9-kvm-ssh-upgrade-v56-5-10-2-	jenkins	jenkins	PENDING	--	10.10.3.243 192.168.150.3
<input type="checkbox"/>	279291	debian9-kvm-ssh-upgrade-v56-5-10-2-126d1-1.test	jenkins	jenkins	BOOT	omega	10.10.3.242 192.168.150.2
<input type="checkbox"/>	279290	debian9-kvm-ssh-upgrade-v56-5-10-2-126d1-0.test	jenkins	jenkins	BOOT	omega	10.10.3.241 192.168.150.1
<input type="checkbox"/>	279289	ubuntu1604-minione-v58-5-10-2-126d1-0.test	jenkins	jenkins	RUNNING	omega	10.10.3.240 192.168.150.1
<input checked="" type="checkbox"/>	279288	ubuntu1804-lxd-nfs-5-10-2-126d1-2.test	jenkins	jenkins	RUNNING	omega	10.10.3.239 192.168.150.3
<input type="checkbox"/>	279287	ubuntu1804-lxd-nfs-5-10-2-126d1-1.test	jenkins	jenkins	RUNNING	omega	10.10.3.238 192.168.150.2
<input type="checkbox"/>	279286	ubuntu1804-lxd-nfs-5-10-2-126d1-0.test	jenkins	jenkins	RUNNING	omega	10.10.3.237 192.168.150.1
<input type="checkbox"/>	279285	ubuntu1604-kvm-ceph-ec-luminous-5-10-2-126d1-2.test	jenkins	jenkins	RUNNING	omega	10.10.3.236 192.168.150.3
<input type="checkbox"/>	279284	ubuntu1604-kvm-ceph-ec-luminous-5-10-2-126d1-1.test	jenkins	jenkins	RUNNING	omega	10.10.3.235 192.168.150.2
<input type="checkbox"/>	279283	ubuntu1604-kvm-ceph-ec-luminous-5-10-2-126d1-0.test	jenkins	jenkins	RUNNING	omega	10.10.3.234 192.168.150.1

10 Showing 1 to 10 of 497 entries

Previous 1 2 3 4 5 ... 50 Next

497 TOTAL 95 ACTIVE 400 OFF 1 PENDING 1 FAILED

# Try Out



## OpenNebula Project Page

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

<https://openebula.org/discover/>

### Why OpenNebula?

*"Simplicity is an exact medium between too little and too much".*  
—Sir Joshua Reynolds



So you are evaluating OpenNebula and you are comparing OpenNebula with other products to build clouds, mostly with VMware and with the many enterprise distributions of OpenStack. OpenNebula is the alternative to

## 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

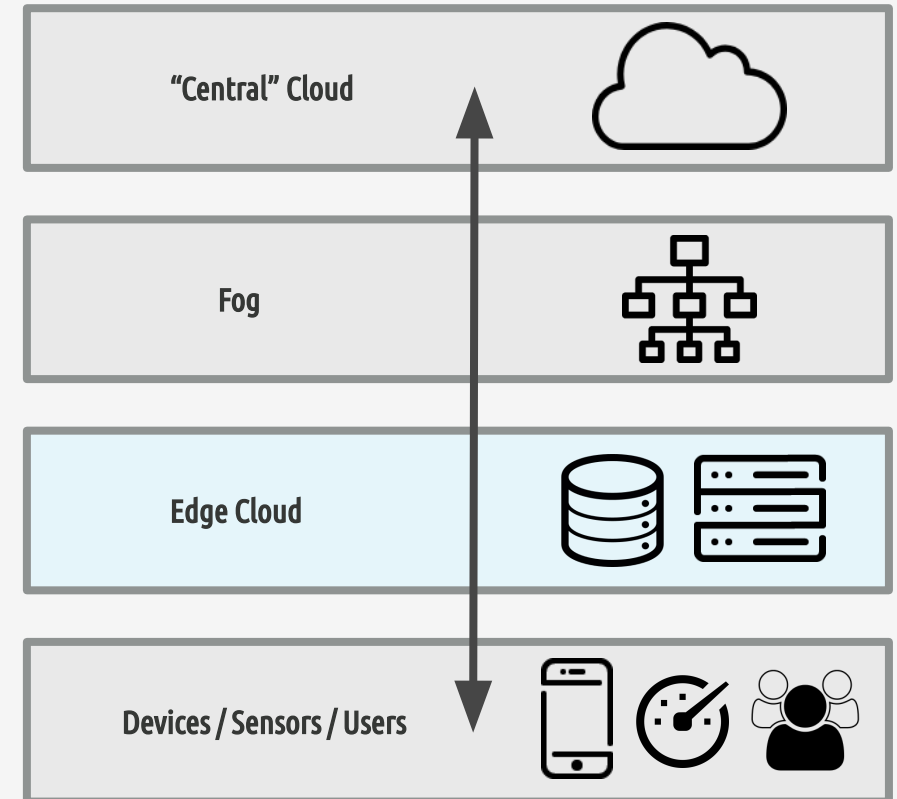


# Edge Cloud

## What's Edge Cloud?

**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



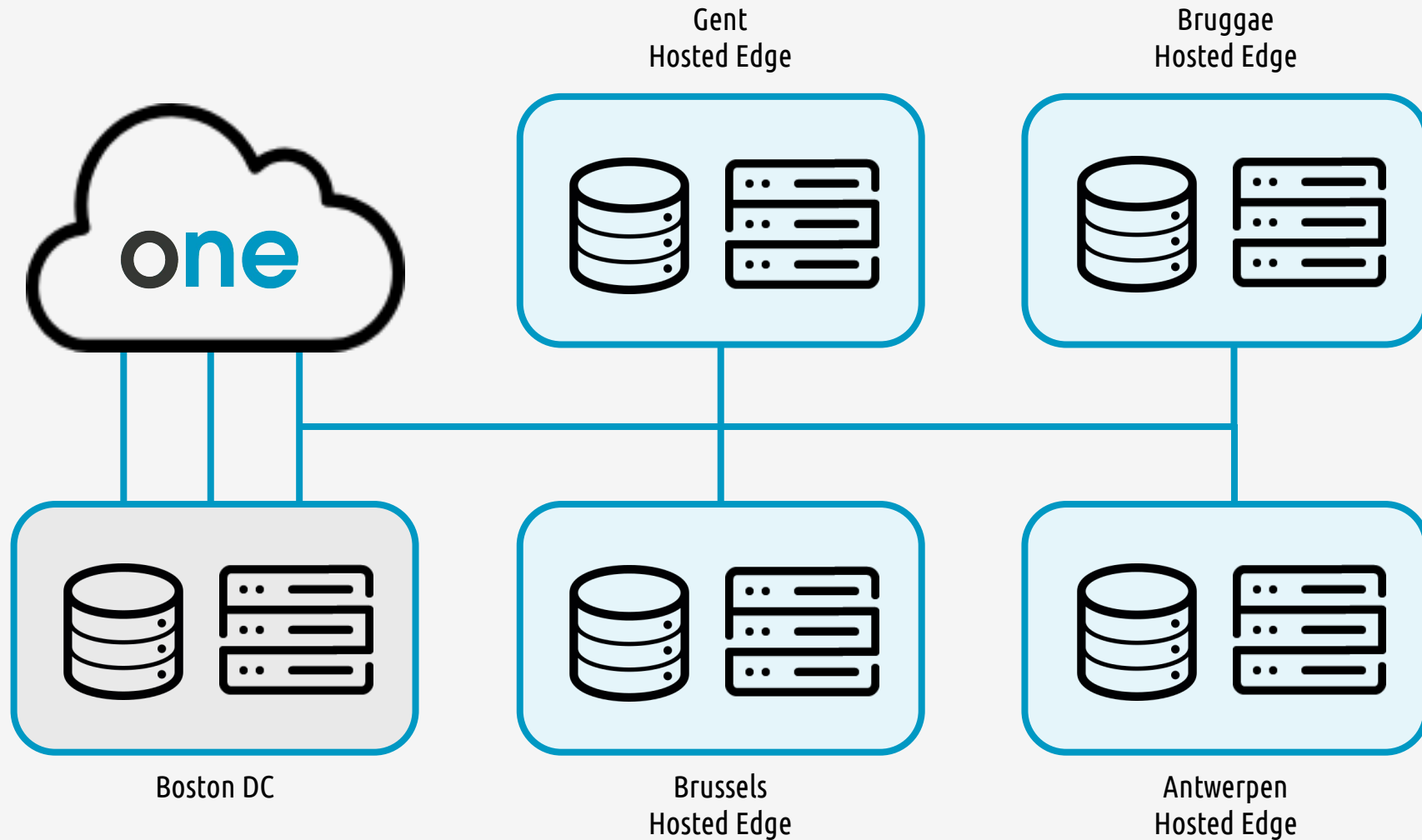
# Edge Cloud

## 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



# Edge Clouds with OpenNebula

## Features

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

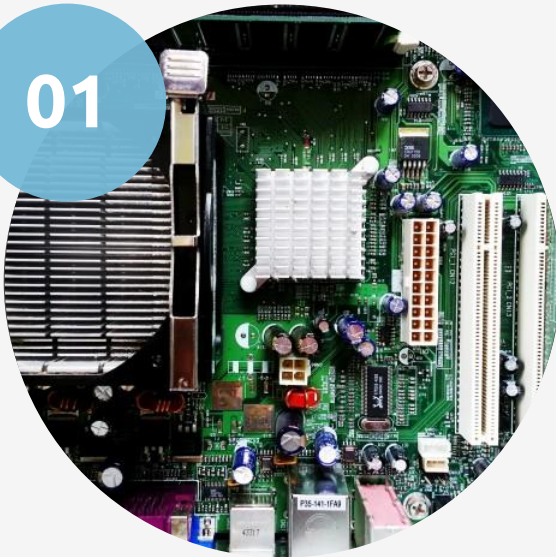
## Implementation

- 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

01



## Bare-Metal Cloud

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

02



## Automation


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

03



## 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

	On-Premise	Bare-Metal Cloud
Hosts	OK	OK
Storage	OK	OK
Network	OK	restricted?
IP Addressing	OK	restricted!

# 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

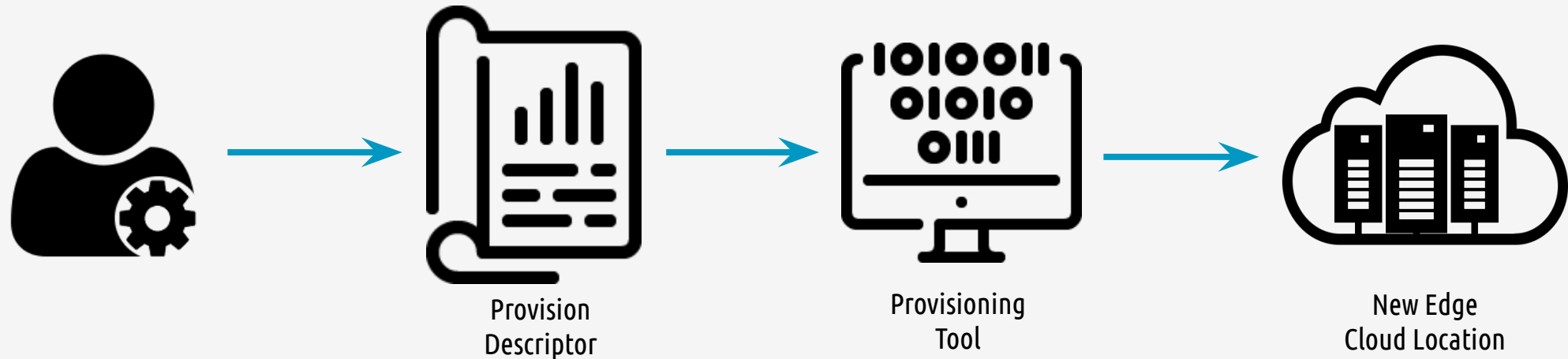
- execution tool **oneprovision**
  - manages full life-cycle of entities
  - CLI only
- per provider **integration drivers**
  - hosts management
  - IP address management and assignment
- **configuration** playbooks / roles
  - reference architectures

# Provision Descriptor

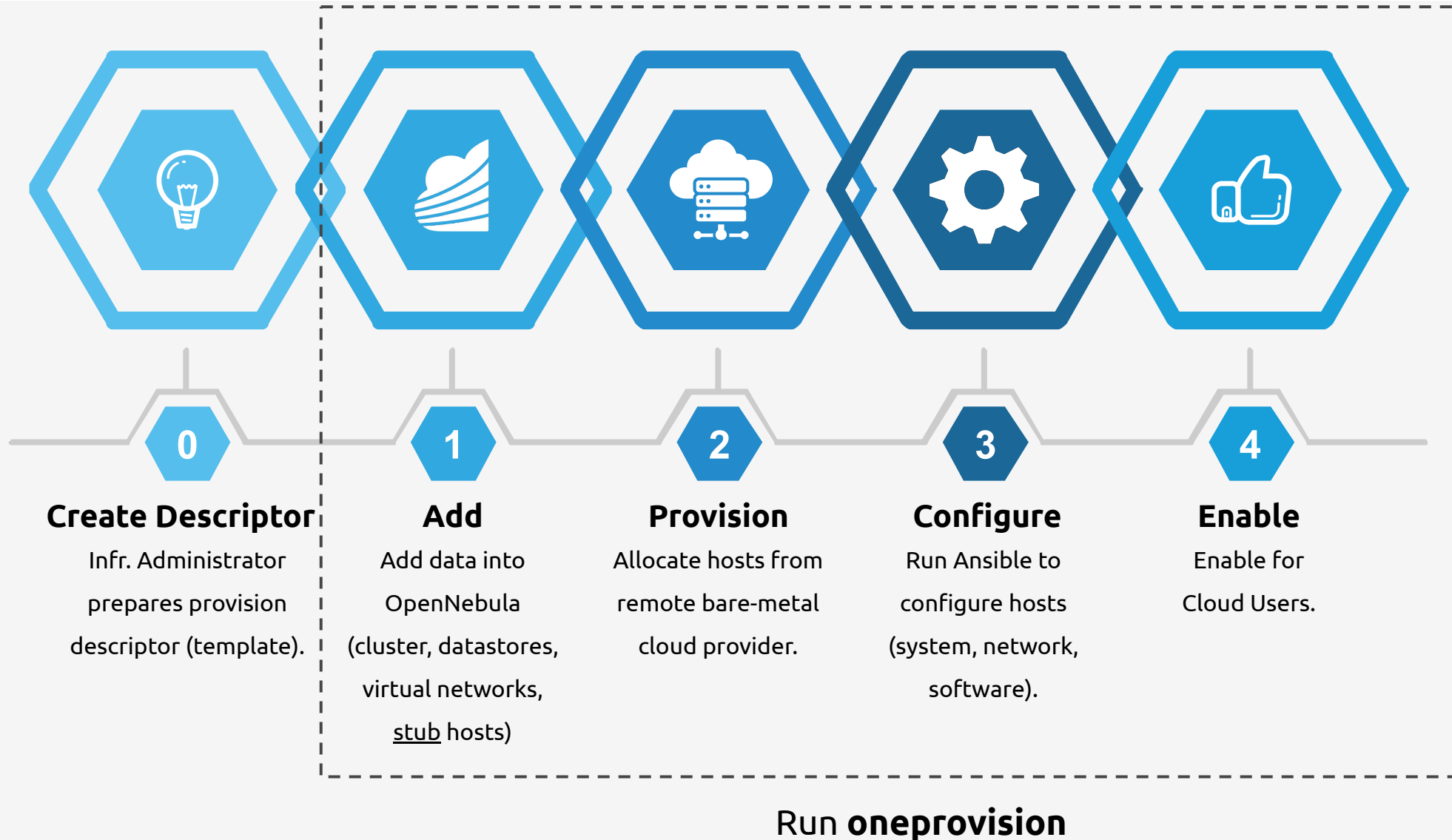
- **provision descriptor**
  - YAML file w/ deployment specification
  - covers all aspects of all new cloud provision process
    - What **hosts allocate** and where? (provides, DC, HW, OS)
    - How **configure** hosts inside? (KVM, bridges, ...)
    - What to **add** into OpenNebula for users? (clusters,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

# Provision Process

Each provision run creates a new fully functional independent OpenNebula Edge Cloud.



# Provision Process



# Provision Management

## Cloud Management

- **create**
- **delete**
- **(re)configure**

oneprovision create [TEMPLATE]

oneprovision delete [ID]

oneprovision configure [ID]

## Host Management

- **power-off / resume**
- **reboot / reset**
- **(re)configure**
- **ssh**

oneprovision host [poweroff|resume] [ID]

oneprovision host reboot [--hard] [ID]

oneprovision host configure [ID]

oneprovision host ssh [ID]



# State

Current State and Next Plans

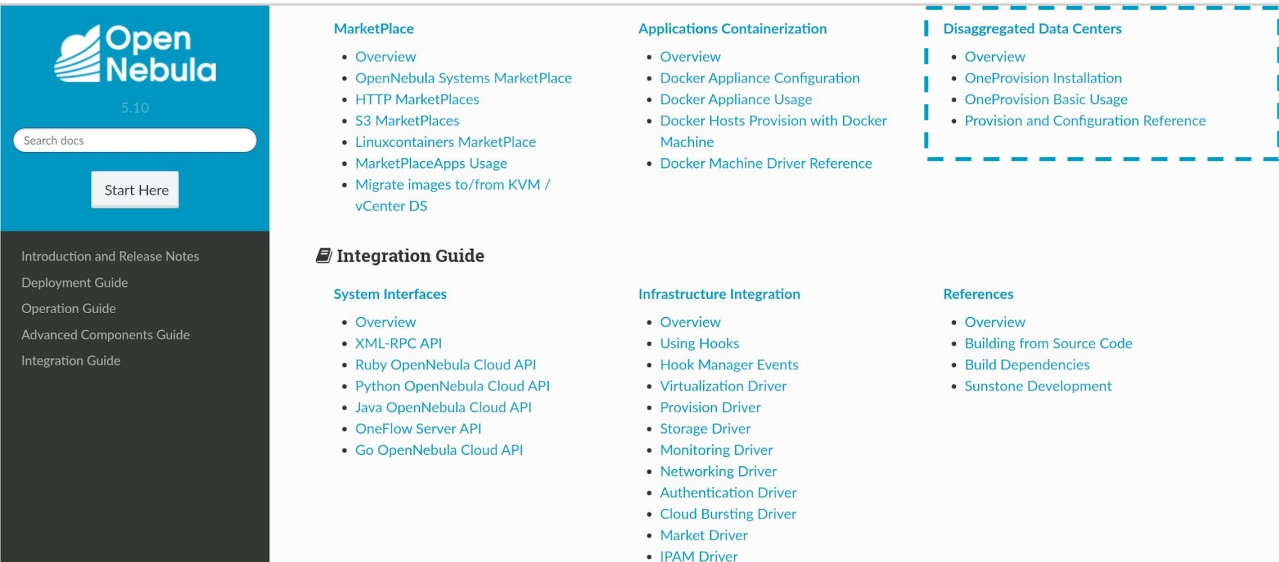
## Current State

- 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



The screenshot shows the Open Nebula documentation website. The top navigation bar includes the Open Nebula logo, version 5.10, a search bar, and a 'Start Here' button. The left sidebar contains a list of navigation links: Introduction and Release Notes, Deployment Guide, Operation Guide, Advanced Components Guide, and Integration Guide. The main content area is divided into several sections:

- MarketPlace**
  - Overview
  - OpenNebula Systems MarketPlace
  - HTTP MarketPlaces
  - 53 MarketPlaces
  - Linuxcontainers MarketPlace
  - MarketPlaceApps Usage
  - Migrate images to/from KVM / vCenter DS
- Applications Containerization**
  - Overview
  - Docker Appliance Configuration
  - Docker Appliance Usage
  - Docker Hosts Provision with Docker Machine
  - Docker Machine Driver Reference
- Disaggregated Data Centers** (highlighted with a dashed border)
  - Overview
  - OneProvision Installation
  - OneProvision Basic Usage
  - Provision and Configuration Reference
- Integration Guide**
  - System Interfaces**
    - Overview
    - XML-RPC API
    - Ruby OpenNebula Cloud API
    - Python OpenNebula Cloud API
    - Java OpenNebula Cloud API
    - OneFlow Server API
    - Go OpenNebula Cloud API
  - Infrastructure Integration**
    - Overview
    - Using Hooks
    - Hook Manager Events
    - Virtualization Driver
    - Provision Driver
    - Storage Driver
    - Monitoring Driver
    - Networking Driver
    - Authentication Driver
    - Cloud Bursting Driver
    - Market Driver
    - IPAM Driver
  - References**
    - Overview
    - Building from Source Code
    - Build Dependencies
    - Sunstone Development

## Documentation

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

<http://docs.opennebula.org/>

## miniONE with Edge

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 --edge packet --edge-packet-token *****
***** --edge-packet-project *****
```

```
### Checks & detection
```

```
Checking augeas is installed SKIP will try to install
Checking SELinux SKIP will try to disable
Checking python-pip is installed SKIP will try to install
Checking ansible SKIP will try to install
```

```
### Main deployment steps:
```

```
Install OpenNebula frontend version 5.10
Install ONEProvision
Configure IPAM Packet, alias IP mapping driver, VM hooks
Trigger oneprovision
Export appliance and update VM template
Disable SELinux
Install augeas python-pip
```

```
Do you agree? [yes/no]:
```

# Use-Case Validation Demos



## Video Gaming

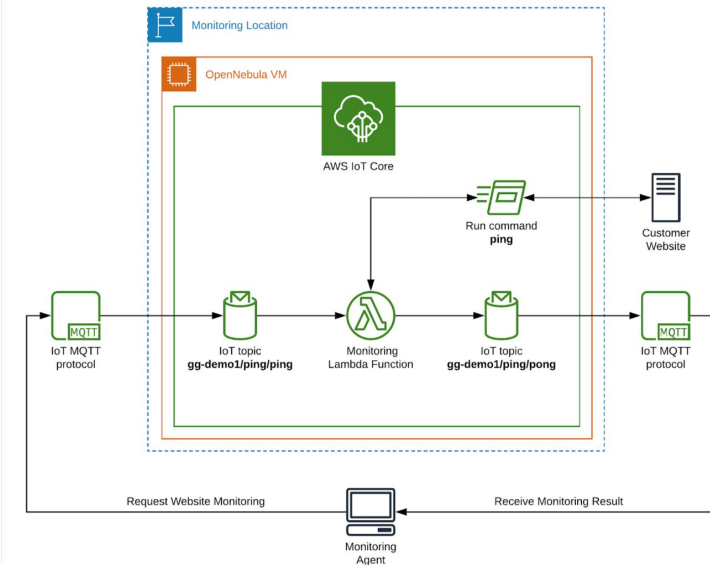
Fully automated demo deployment on 17 edge locations (KVM clusters), 1 VM with Wolfenstein Enemy Territory public server in 25 minutes.

<https://opennebula.org/opennebula-a-lightning-fast-video-gaming-edge-use-case-2/>

## 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.

<https://opennebula.org/automatic-deployment-of-aws-iot-greengrass-at-the-edge/>



# OpenNebula Edge Cloud Provisioning Demo

# Demo

Provision Descriptor

---

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

# Demo

## Provision Descriptor

### 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'

# Demo

## Provision Descriptor

### 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
```

# Demo

## Provision Descriptor

```
- 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

```
Terminal - oneadmin@fosdem:~
ID NAME                                HOSTS  VNETS  DATASTORES
0 default                                0      0      3
[oneadmin@fosdem ~]$ onehost list
ID NAME                                CLUSTER  TVM    ALLOCATED_CPU  ALLOCATED_MEM  STAT
[oneadmin@fosdem ~]$ onedatastore list
ID NAME                                SIZE AVA  CLUSTERS  IMAGES  TYPE  DS    TM    STAT
2 files                                12.9G 85% 0          0  fil  fs    ssh  on
1 default                                12.9G 85% 0          1  img  fs    ssh  on
0 system                                -    -    0          0  sys  -    ssh  on
[oneadmin@fosdem ~]$ onevnet list
ID USER    GROUP    NAME                                CLUSTERS  BRIDGE    LEASES
[oneadmin@fosdem ~]$ time oneprovision create demo/demo1.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
[oneadmin@fosdem ~]$
```

# Demo

State after provision

```
Terminal - oneadmin@fosdem:~
[oneadmin@fosdem ~]$ onecluster list
ID NAME                                HOSTS    VNETS  DATASTORES
108 fosdem                               2        3      2
  0 default                               0        0      3
[oneadmin@fosdem ~]$ onehost list
ID NAME                                CLUSTER  TVM    ALLOCATED_CPU  ALLOCATED_MEM  STAT
  9 147.75.100.201                       fosdem   0      0 / 400 (0%)   0K / 7.8G (0%) on
  8 147.75.101.53                         fosdem   0      0 / 400 (0%)   0K / 7.8G (0%) on
[oneadmin@fosdem ~]$ onedatastore list
ID NAME                                SIZE AVA  CLUSTERS  IMAGES  TYPE  DS    TM    STAT
117 fosdem-system                       - -    108      0      sys  -    ssh  on
116 fosdem-default                       12.9G 85%  108      0      img  fs    ssh  on
  2 files                                 12.9G 85%  0        0      fil  fs    ssh  on
  1 default                               12.9G 85%  0        1      img  fs    ssh  on
  0 system                                 - -    0        0      sys  -    ssh  on
[oneadmin@fosdem ~]$ onevnet list
ID USER    GROUP    NAME                                CLUSTERS  BRIDGE    LEASES
15 oneadmin oneadmin fosdem-private                       108      vxbr100   0
14 oneadmin oneadmin fosdem-private-host-only 108      br0       0
13 oneadmin oneadmin fosdem-public           108      onebr13   0
[oneadmin@fosdem ~]$ oneprovision list
ID NAME                                CLUSTERS  HOSTS  VNETS  DATASTORES  STAT
bf991fc4-4615-40b0-af8a-8b2dad2e9d98 fosdem     1      2      3      2            configured
[oneadmin@fosdem ~]$
```



# OUR CONTACT



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[OpenNebula.systems](https://OpenNebula.systems)  
[OpenNebula.org](https://OpenNebula.org)  
[OpenNebula.pro](https://OpenNebula.pro)