



ONEedge.io

A Software-defined Edge Computing Solution

---

# D4.5. Deployment of Validation Cases and Demonstrations - b

Deployment of Validation Cases and Demonstrations Report

Version 1.0

10 March 2021

## Abstract

This report, delivered at the end of the Second Innovation Cycle (M10-M16) summarizes the work done to generate actual demonstrations of the project's capabilities in real life situations and to deploy validation cases for different scenarios.



Copyright © 2021 OpenNebula Systems SL. All rights reserved.



This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No 880412.



This work is licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License.



## Deliverable Metadata

<b>Project Title:</b>	A Software-defined Edge Computing Solution
<b>Project Acronym:</b>	ONEedge
<b>Call:</b>	H2020-SMEInst-2018-2020-2
<b>Grant Agreement:</b>	880412
<b>WP number and Title:</b>	WP4. Demo and Operational Infrastructure
<b>Nature:</b>	R: Report
<b>Dissemination Level:</b>	PU: Public
<b>Version:</b>	1.0
<b>Contractual Date of Delivery:</b>	28/2/2021
<b>Actual Date of Delivery:</b>	10/3/2021
<b>Lead Authors:</b>	Michael Abdou, Vlastimil Holer and Alberto P. Martí
<b>Authors:</b>	Sergio Betanzos, Ricardo Díaz, Jim Freeman, Christian González, Alejandro Huertas, Shivang Kapoor, Jorge M. Lobo, Jan Orel and Petr Ospaly
<b>Status:</b>	Submitted

## Document History

Version	Issue Date	Status <sup>1</sup>	Content and changes
1.0	10/3/2021	Submitted	First final version of the D4.5 report

<sup>1</sup> A deliverable can be in one of these stages: Draft, Peer-Reviewed, Submitted and Approved.



---

## Executive Summary

A lot of the work carried out within the last several months has been focused, not only on developing a sophisticated edge computing software solution to innovatively address the needs for lower latency and provide a simple, distributed infrastructure management, but also to generate actual demonstrations of its capabilities in real life situations, as well as to get some of these capabilities in the hands of users to put them to the test on their own.

These exercises are the continuation of our getting validation and confirmation of the utility and usefulness of our product. As this is an open source project, a great deal of our work managing the project is not simply producing code, deliverables, and informational material, but also coordinating the creation of these items and publishing them to the broader public. Since a good portion of the content material is publicly available, we decided to include easily referenced links to the pertinent material, as opposed to recopying all of the text.



---

## Table of Contents

<b>1. Sandboxed Environments</b>	<b>5</b>
1.1 Updating MiniONE for OpenNebula 6.0	5
1.2. Extending MiniONE to deploy QEMU/KVM environments on AWS	5
<b>2. Demonstrations</b>	<b>7</b>
2.1. Container Orchestration with OpenNebula	7
2.2. Docker Hub images running at the Edge as Firecracker microVMs	8
2.3. Gaming on the Edge with OpenNebula and K3s	9
2.4. Using OpenNebula and AWS Wavelength to build a 5G Edge Cloud	10
2.5. Serverless Computing at the Edge	10
2.6. OpenNebula for Container-as-a-Service	11



## 1. Sandboxed Environments

The effort to build out functional Sandbox environments is directly dependent on the release of our OpenNebula version 6.0 with the enhancements developed in the Second Innovation Cycle, which at the time of writing has been recently released as a beta version. Once OpenNebula 6.0 stable is released and made publicly available, we will also make public the new version of the sandboxed environments to showcase the various capabilities of the software release and the use cases to which it can be applied.

### 1.1 Updating MiniONE for OpenNebula 6.0

The evaluation tool MiniONE has been updated to keep track of new features from OpenNebula 6.0, including specialized storage drivers for edge locations and the new ONEedge provision WebUI. MiniONE 6.0 has been updated to install these new components as well as the need runtime dependencies while still keeping the maximum simplicity by creating the deployments by single command run.

MiniONE handles all the differences in the installation on:

1. Supported operating systems:

- |            |             |                |
|------------|-------------|----------------|
| ✓ Centos 7 | ✓ Debian 9  | ✓ Ubuntu 16.04 |
| ✓ Centos 8 | ✓ Debian 10 | ✓ Ubuntu 18.04 |
|            |             | ✓ Ubuntu 20.04 |

2. Supported OpenNebula versions:

- ✓ 5.10 "Boomerang"
- ✓ 5.12 "Firework"
- ✓ 6.0 "Mutara"

3. Different hypervisors:

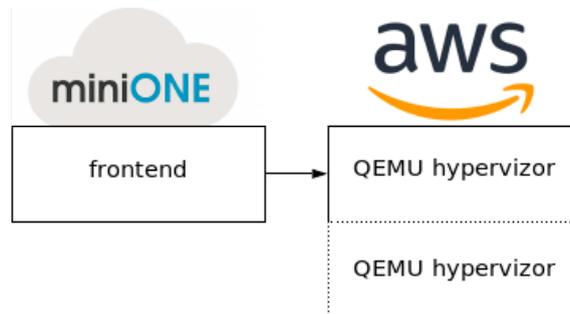
- ✓ KVM
- ✓ LXD
- ✓ Firecracker

This way it provides a single interface as an entry point for installing the evaluation deployment.

### 1.2. Extending MiniONE to deploy QEMU/KVM environments on AWS

Apart from on-premise deployments, MiniONE previously allowed easy deployment of functional sandbox environments on Packet/Equinix. In order to maximize the showcase potential of the appliance we have developed an emulated provision type based on nested

virtualization for AWS EC2. The goal of this simple and cheap provision type is to simplify the evaluation process of ONEedge features.



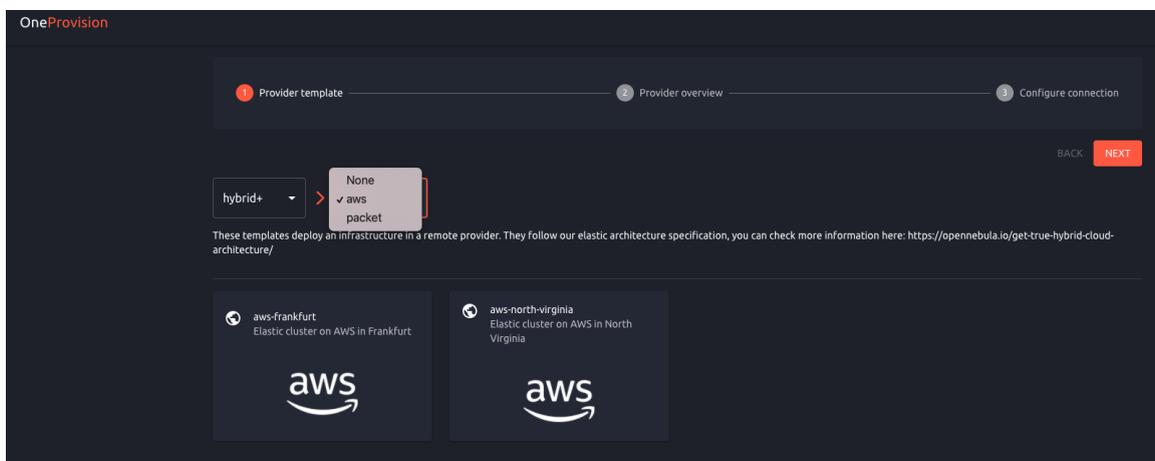
Basic example of complete deployment of AWS QEMU evaluation environment is following command:

```
# bash minione --edge aws --edge-aws-access-code [access-code] --edge-aws-secret-code [secret-code]
```

Similarly to the Packet/Equinix deployment, also the AWS could be parametrized using following options:

```
# bash minione --help
...
--edge [aws|packet]           Edge provider
--edge-aws-access-code [access-code] AWS access code
--edge-aws-secret-code [secret-code] AWS secret code
--edge-host-num [1]          Number of edge hosts
--edge-aws-region [us-east-1] AWS region
--edge-aws-instance-type [t2.small] AWS instance type
--edge-aws-ami [centos 8 ami] AWS image
--edge-marketapp-name [Service WordPress - KVM]
                             Market app name for Edge deployment
```

The provision can be created from the new FireEdge OneProvision web interface:



## 2. Demonstrations

This section describes the main actions that we have taken for demonstrating the new features developed in ONEedge. We make sure that all these actions acknowledge the support received from the European Commission, i.e. by incorporating a standard slide on ONEedge:

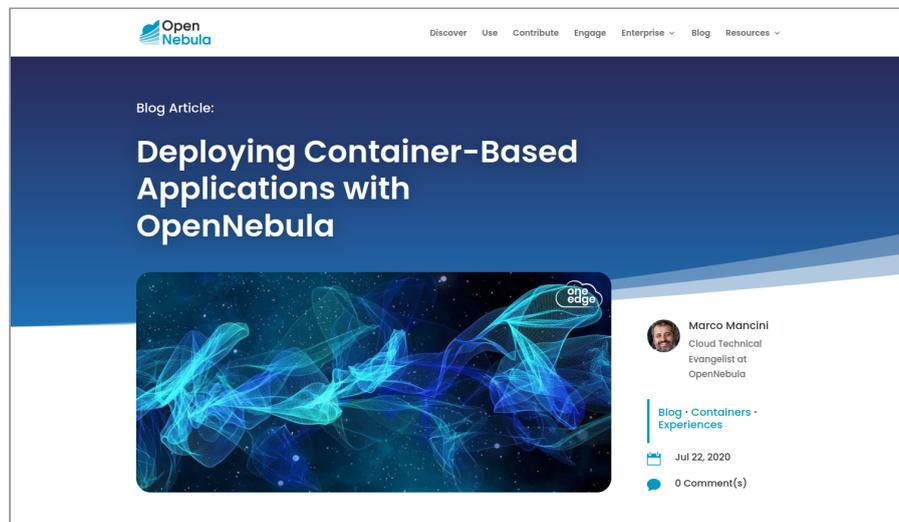


### 2.1. Container Orchestration with OpenNebula

Here we took the opportunity to review and explain in some detail OpenNebula's evolution and innovative focus around container orchestration. Apart from outlining our approach of running microservices based on containerized applications, we laid the groundwork for users to see just how simple and powerful it is to manage containerized applications with OpenNebula.

#### Deploying Container-Based Applications with OpenNebula

Blog Post <https://opennebula.io/deploying-container-based-applications-with-opennebula/> (July 22, 2020)

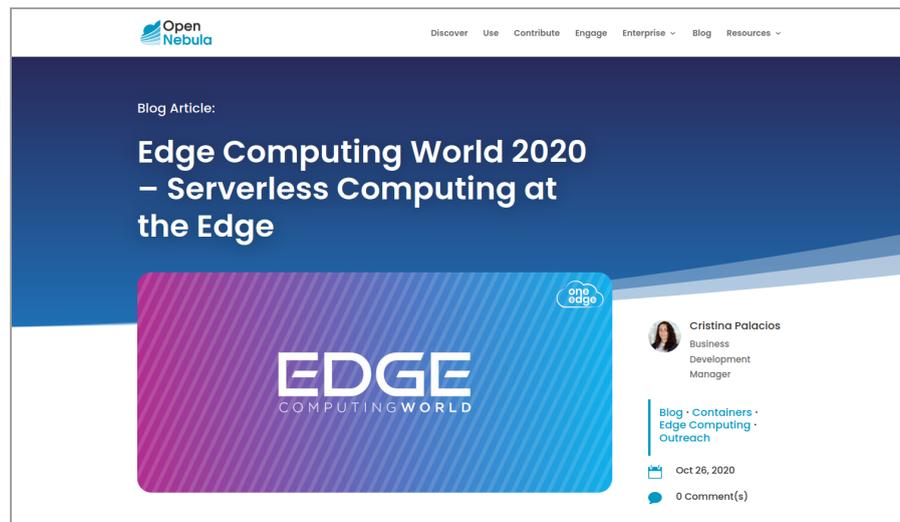


## 2.2. Docker Hub images running at the Edge as Firecracker microVMs

We joined other leading technology innovators like Toyota, Rakuten Mobile, Boeing, and the US Air Force at the Edge Computing World Conference in October 2020, where we took the opportunity to demonstrate the latest developments of ONEedge, in this occasion showing how to easily deploy and manage a composition of Docker Hub images running as Firecracker microVMs within an OpenNebula cloud on a distributed bare-metal edge infrastructure.

### Edge Computing World 2020 – Serverless Computing at the Edge

Blog Post <https://opennebula.io/edge-computing-world-2020/> (October 26, 2020)



Demonstration <https://www.youtube.com/watch?v=kD7mEdOASFQ> (October 26, 2020)

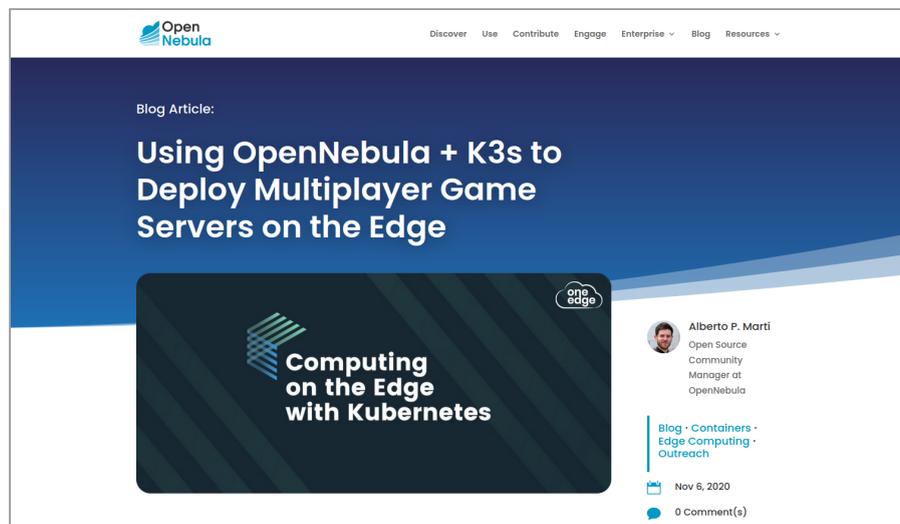


## 2.3. Gaming on the Edge with OpenNebula and K3s

As part of our participation in Rancher Labs' "Computing at the Edge with Kubernetes" virtual conference event, we showcased the OpenNebula integration with the Docker Hub marketplace and Firecracker, and demonstrated how to easily deploy multiple K3s clusters at the edge for multiplayer gaming deployments. Within the demonstration, we showed how to use Agones (a platform originally developed by Google and Ubisoft) to deploy at the edge dedicated gaming servers.

### Using OpenNebula + K3s to Deploy Multiplayer Game Servers on the Edge

Blog Post <https://opennebula.io/computing-on-the-edge-with-kubernetes/>  
(November 6, 2020)



Demonstration <https://www.youtube.com/watch?v=fOeasVHexs4> (November 4, 2020)

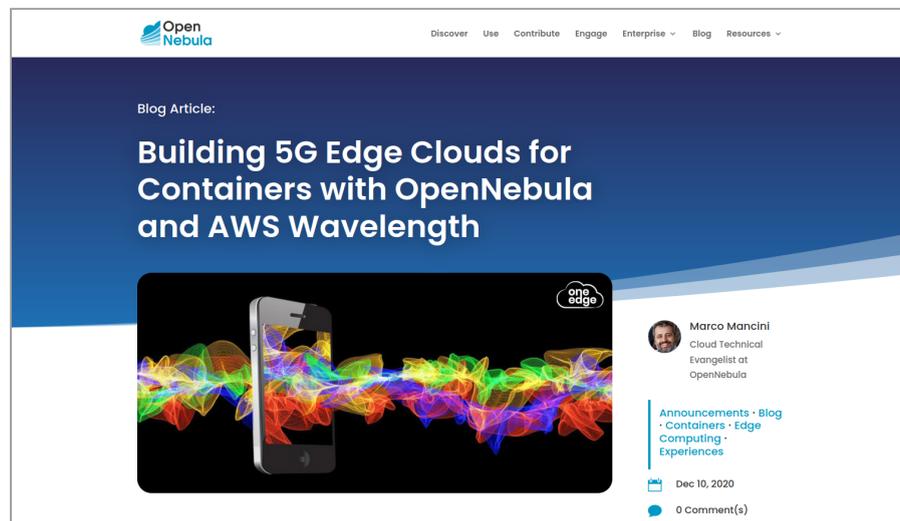


## 2.4. Using OpenNebula and AWS Wavelength to build a 5G Edge Cloud

This was a tightly-executed initiative to highlight the groundbreaking capabilities OpenNebula provides organizations to expand their private clouds utilizing the flexible resource offerings from third-party cloud providers like AWS and Equinix Metal. Not only did we outline the on-demand flexibility to grow one's private cloud to the edge, but in this case, we focus on demonstrating the added capability of expanding one's private cloud to utilize AWS Wavelength zones to take advantage of the high bandwidth and ultra-low latencies as offered by the growing 5G networks. In this case, we demonstrated how a company with an OpenNebula private cloud is able to deploy a multi-container application at the edge (i.e a Machine Learning solution) closer to the 5G devices of their end-users.

### Building 5G Edge Clouds for Containers with OpenNebula and AWS Wavelength

Blog Post <https://opennebula.io/building-5g-edge-clouds-for-containers-with-opennebula-and-aws-wavelength/> (December 10, 2020)

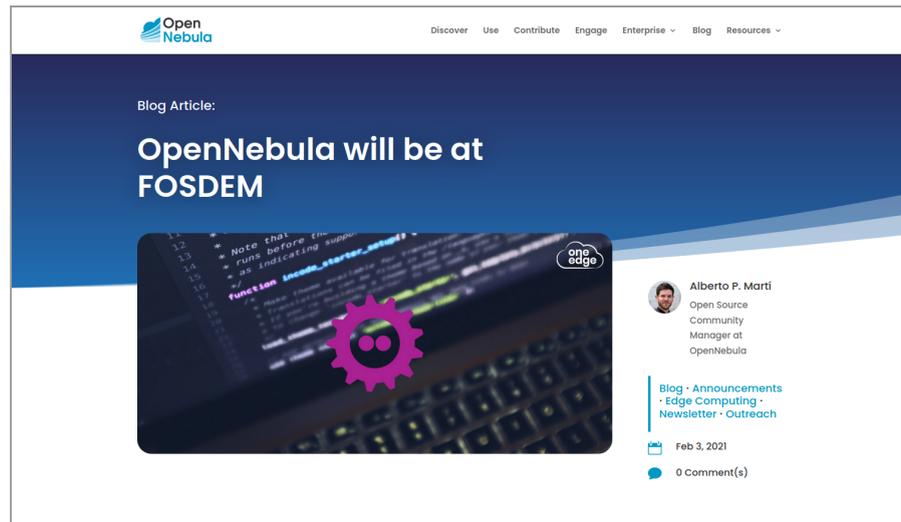


## 2.5. Serverless Computing at the Edge

This demonstration at the iconic Free and Open Source Software Developers' European Meeting (FOSDEM) was part of the "Virtualization and IaaS DevRoom". We used this occasion to explore our recent integration with Firecracker and showcase how to run containers as microVMs at the Edge. This use case demonstrates how the new edge computing features developed as part of the ONEedge project open up a whole new world of possibilities as the foundation for serverless offerings that need to deploy containerized critical applications nearly instantly while keeping them in isolation.

### FOSDEM 2021 – Serverless Computing at the Edge

Blog Post <https://opennebula.io/opennebula-will-be-at-fosdem/> (February 3, 2021)



Demonstration [https://fosdem.org/2021/schedule/event/vai\\_serverless\\_opennebula/](https://fosdem.org/2021/schedule/event/vai_serverless_opennebula/)  
(February 6, 2020)

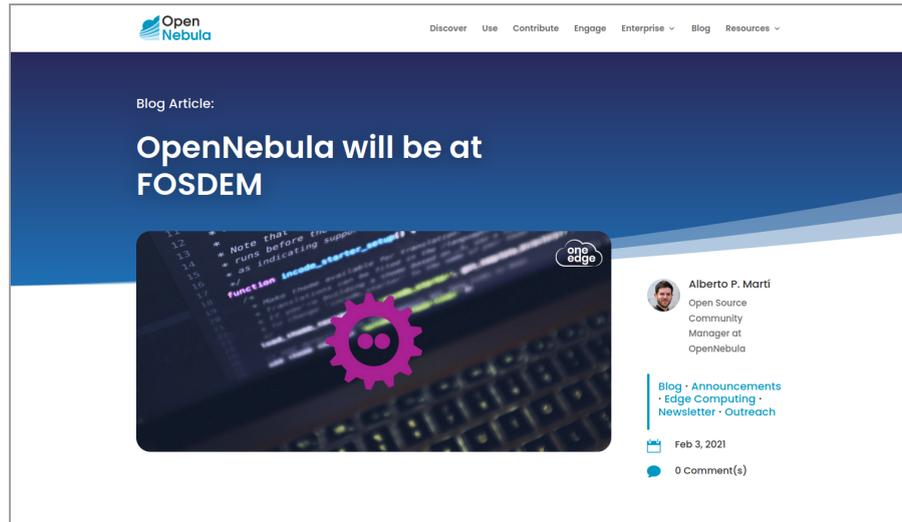


## 2.6. OpenNebula for Container-as-a-Service

This second demonstration at the Free and Open Source Software Developers' European Meeting (FOSDEM) was part of the "Containers DevRoom". We used this occasion to explain in detail how it is that OpenNebula, thanks to the ONEedge project, and after its new native integration with the Docker Hub marketplace, has actually become a very real, simpler, alternative to some Kubernetes use cases.

### FOSDEM 2021 – The OpenNebula alternative to Kubernetes for Container-as-a-Service

Blog Post <https://opennebula.io/opennebula-will-be-at-fosdem/> (February 3, 2021)



Demonstration [https://fosdem.org/2021/schedule/event/containers\\_opennebula\\_k8s/](https://fosdem.org/2021/schedule/event/containers_opennebula_k8s/) (February 7, 2020)

