Demo Abstract: Assessing MANO Performance based on VIM Platforms within MEC Context

Nina Slamnik-Kriještorac and Johann M. Marquez-Barja

University of Antwerp - imec, IDLab research group, Sint-Pietersvliet, 2000 Antwerp, Belgium.
E-mail: {name.surname}@uantwerpen.be

***Abstract*—The network edge presses an urgent need for efficient network management and orchestration (MANO), in order to efficiently cope with the wide heterogeneity in services and resources, while providing a low-latency for the hosted services. Based on ETSI standardization, the MEC platform can be managed and orchestrated by NFV MANO components. In this demo, we show how to measure the impact of the Virtualized Infrastructure Manager (VIM), which is a component of the NFV MANO, on the performance of the MANO system. In our testbed-based experimentation, we evaluated the performance in terms of time needed for a MANO system to instantiate/terminate a network service on top of the MEC platform. Open Source MANO (OSM) and Open Baton are used as MANO entities, while for the VIM environments we investigated the impact of OpenStack and Amazon Web Services (AWS) on the above-mentioned OSM, and the impact of OpenStack and Docker on Open Baton.**

I. Introduction

For the emerging use cases of the network services, such as those illustrated in Fig. 1 (e.g., autonomous driving, video streaming, etc.), achieving low-latency is of high importance in order to increase Quality of Service (QoS) and Quality of Experience (QoE). To address the latency constraints, Mobile Edge Computing (MEC) offers moving cloud computing capabilities closer to the end-users, i.e., at the network edge. However, MEC platforms usually suffer from wide heterogeneity in resources and services, while being resource constrained at the same time. To make MEC platform able to cope with such constraints, the efforts to standardize the management and orchestration (MANO) resulted in a consolidated ETSI NFV MANO architectural framework [1], allowing various MANO components to manage and to orchestrate resources, and services that run within MEC. Therefore, in this demo we show our testbed-based experimental setup that enables measuring the impact of particular MANO component, i.e. Virtualized Infrastructure Manager (VIM) (shown in black rectangle in Fig. 1), on the performance of the whole MANO system. The demo setup includes two research MANO platforms – Open Source MANO (OSM), and Open Baton, which are suitable for deployment at the network edge due to their full compliance to the ETSI standardized framework, and their lightweight installation [2]. The Key Performance Indicators (KPIs) that we measured are: *overall instantiation delay*, and *overall termination delay* of a network service, as the time needed for a service to be instantiated/terminated on top of the MEC. Both KPIs are essential to be considered as they

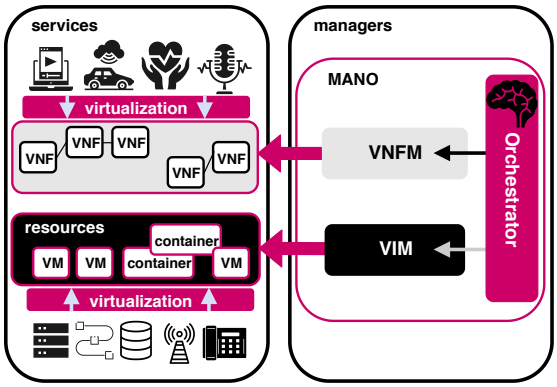

Fig. 1: ETSI NFV MANO components used to manage and orchestrate a MEC platform.

reflect how fast a particular MANO solution can perform the tasks of instantiation/termination, directly contributing to the overall delay in service operation. In the first experiment, we evaluate the impact of OpenStack VIM, which is installed on the testbed mimicking the realistic features of edge computing, and Amazon Web Services (AWS) VIM as a *public cloud*, on the performance of OSM. The second experiment included OpenStack and Docker as VIMs supported by Open Baton, and their impact on the Open Baton's performance. As it can be seen in Fig. 2, both MANO platforms as well as OpenStack and Docker machines are configured on the Virtual Wall[1] testbed, located in Gent, Belgium. With more than 400 bare metal and GPU servers, Virtual Wall is a high-performance large-scale generic testbed for advanced networking, distributed software, cloud, big data, and scalability research and testing.

II. Management and Orchestration in MEC

The components of ETSI NFV MEC architecture [1] that represent a so-called ETSI NFV MANO (Fig. 1) perform the orchestration functions for network services and resources, and lifecycle management of Virtual Network Functions (VNFs). In particular, the left side of the Fig. 1 shows services and resources available in a MEC platform. By utilizing virtualization techniques, both services and resources can be virtualized, and thus managed and orchestrated by MANO. The MANO

[1]Virtual Wall testbed: https://doc.ilabt.imec.be/ilabt/virtualwall/index.html

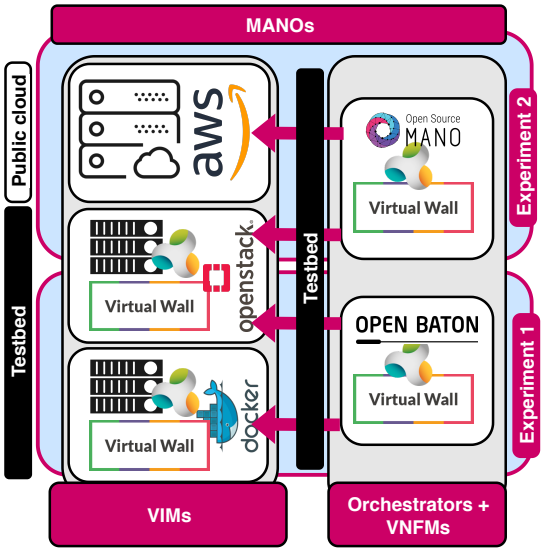

Fig. 2: Experimentation setup on the testbed and the public cloud.

is presented on the right side of the Fig. 1, embedding the following components: orchestrator, VNF manager (VNFM), and VIM. Based on the orchestration decisions and instructions delegated from orchestrator, VNFM manages all network service instance (i.e., VNFs) running in MEC, while VIM: a) manages NFVI consisted of virtualized resources, b) allocates these resources to instantiate a network service as a Virtual Machine (VM), or a container, and c) releases resources when terminating the service instance.

III. Demo

To evaluate the impact of VIM on the performance of MANO systems, we created the experimental setup that is illustrated in Fig. 2, showing all the constituent elements that allowed us to measure the network service instantiation and termination delays. In particular, on the left side of the Fig. 2 there are the bare metal machines as part of the testbed, hosting OpenStack, and Docker, and mimicking the realistic edge environment. Furthermore, the Fig. 2 also shows the public AWS cloud that was used as a VIM. The right side of the Fig. 2 illustrates the set of different testbed machines, hosting the MANO systems, i.e. OSM and Open Baton. The arrows indicate to which VIMs are the MANO systems connected. The experimentation procedure consists of the two following segments (Fig. 2), both measuring the instantiation and termination delays for MANO systems:

- Experiment 1: MANO system - OSM, VIMs: OpenStack, and AWS
- Experiment 2: MANO system - Open Baton, VIMs - OpenStack, and Docker

As a showcase of what we will visualize as a result of our demo, accessing our Virtual Wall testbed remotely, in Fig. 3 we present the overall instantiation delay as a KPI for MANOs in Experiments 1 and 2.

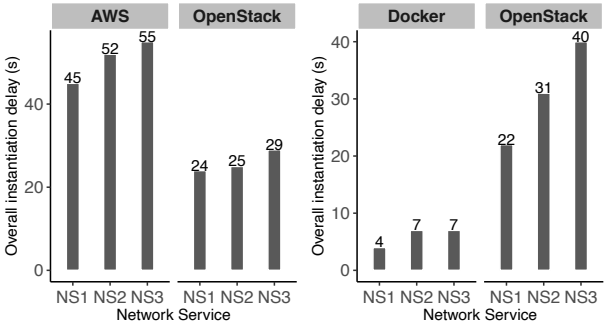

Fig. 3: The overall service instantiation delay

The results for instantiation and termination delays that we plan to show, will serve as a common denominator to compare OpenStack and AWS, and their impact on the performance of OSM. Taking into account their fundamental differences, as AWS is a public cloud, and OpenStack is used as a dedicated platform which provides NFVI, such performance evaluation is important when considering which VIM driver is suitable for MANO implementation. In particular, this evaluation enables extracting the essential information of how fast a particular MANO solution can be, depending on the VIM that is connected to it. In Experiment 2, as Docker containers are a lightweight solution in comparison to VMs instantiated on top of the OpenStack, the live results will illustrate the level of suitability for a virtualization technology to the deployment on the resource-constrained network edge.

IV. Conclusion

In this demo, we measure the impact of VIM environment on the performance of MANO systems used within MEC. To mimic the resource-constrained network edge, we utilized the Virtual Wall, the high-performance testbed, and evaluated the overall instantiation and termination delays, as indicators of the performance of OSM and Open Baton. Our interesting results show how different VIM platforms influence the performance of MANO systems, used for management and orchestration of MEC services and resources.

Acknowledgment

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