



# An NFV system to support service provisioning on UAV networks

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## I. ABSTRACT

In this presentation, we will first describe the design and implementation of an NFV system capable of deploying moderately complex network services over a wireless ad-hoc network of resource-constrained compute nodes. The system design targets aerial networks built by Unmanned Aerial Vehicles (UAVs), and it relies on container virtualization to support the execution of network functions within constrained environments, as well as on mobile ad-hoc networking to support the underlying end-to-end network communications [1]. The presentation will also cover the implementation experience from developing this NFV system, which is based on relevant and widely-adopted open-source technologies in the NFV arena such as ETSI Open-Source MANO (OSM) and OpenStack.

In addition, we will present the details concerning the integration of this system into a distributed NFV testbed spanning three different remote sites in Spain, i.e., Universidad Carlos III de Madrid (UC3M), Universidad Politécnica de Cataluña (UPC), and Universidad del País Vasco (UPV-EHU). The goal of this testbed is to explore synergies among NFV, UAVs, and 5G vertical services, following a practical approach primarily governed by experimentation. To showcase the potential of this testbed to support vertical services, we will present three different use cases that have been realized as part of our prior research work: *i)* the automated deployment of an IP telephony service on a delimited geographic area, using a network of interconnected UAVs [2] (noteworthy, this work was awarded by ETSI as the best proof-of-concept demonstration with OSM during the OSM Release Eight cycle [3]); *ii)* the realization of a smart farming vertical service [4]; and *iii)* a public-safety vertical use case, which uses aerial and vehicular NFV infrastructures to monitor traffic conditions and handle emergency situations [5]. This latter involves an international collaboration with the Instituto de Telecomunicações of Aveiro, which operates a vehicular NFV infrastructure.

Finally, the presentation will tackle the standardization challenges related with the future view of a decentralized

and flexible MANO framework, capable of supporting the operation of cost-effective, reliable services beyond the edge of the telecommunication operator infrastructures. In this view, multiple stakeholders would collaboratively provide a wide range of heterogeneous compute-connect devices (e.g., end-user terminals, CPEs, or UAV swarms). These devices might exist and be opportunistically used, or they could otherwise be deployed on-demand by those stakeholders, contributing to the availability of a potentially unlimited pool of network, computing, and storage resources beyond the network edge. This view introduces several standardization challenges to the NFV MANO framework in terms of interoperation, flexibility, robustness, and security. These challenges have been presented at the *NFV Evolution*<sup>1</sup> event organized by ETSI, and will build the basis of our future work in this research line.

## II. ACKNOWLEDGMENT

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<sup>1</sup> ETSI *NFV Evolution* event. All details included in: <https://www.etsi.org/events/1892-nfvevolution>