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# Extended abstract: On the Need of MANO Evolution in the Context of Network Slicing

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**Abstract**—The ETSI MANO framework has been under development since November 2012. It is a widely accepted solution for network virtualization. Despite its already long life the framework is still not only undergoing considerable changes such as extending support to containerized environments, but also lacks several features that are crucial for management and orchestration of network slices. The paper outlines the current issues of ETSI MANO in the context of generic network slicing, i.e. not limited to 5G networks only. The analysis covers the technical and business oriented issues. On the basis of the analysis we will propose the future evolution of the framework.

**Index Terms**—5G, 6G, MANO, network slicing, network virtualization, orchestration

## I. INTRODUCTION

The ETSI NFV framework is one of the base solutions for building software-defined 5G networks. Adopted by 3GPP as the key mechanism for network slicing, it enables the dynamic deployment of network functions as software-only entities (termed as virtualized network functions, VNFs), abstracted from the underlying hardware.

The life cycle management together with dynamic resource allocation to Network Services (i.e. network slices according to 3GPP terminology), implemented as a set of interconnected VNFs, are performed by the ETSI NFV Management and Orchestration (MANO) [1].

As the NFV framework is agnostic to VNF functionalities, the specific support provided solely for the purpose of network slicing is very limited and includes only the “priority” parameter of Network Service Deployment Flavour, used for resolution of resource shortage conflicts [2]. The Operation/Business Support System (OSS/BSS) that is placed on top of the MANO stack thus plays a key role in the whole ETSI NFV picture. It is mainly responsible for the run-time slice management. At the time of writing of the paper, there was no large scale commercial deployment of the concept. Primarily, because the standardization of slicing in 3GPP is not completed yet, so there are no mobile 5G networks in the form of service-optimized subnets federation with multi-attach enabled for users, and distinct communication networks can already be implemented as separate NFV Network Services on the same shared resource pool. The already defined 3GPP approach to 5G System (5GS) orchestration and management [3]–[5] supports network slicing (at the level of network function, sub-network slice, network slice and communication service management), referring to ETSI NFV mechanisms, with the

exception of slice selection and authentication mechanisms. The 3GPP management system architecture is complementary to ETSI NFV MANO stack [6].

The paper describes the current issues and deficiencies of the ETSI NFV MANO approach as well as the evolution steps that we perceive as mandatory to enable the framework exploitation in network slicing-enabled 5G networks. Although some of the required features could be implemented in future ETSI NFV MANO releases, a re-design of the approach might be necessary to fully address the presented issues.

## II. MANO ISSUES

Having performed the deep analysis of MANO specifications as well as participating in research projects that involve MANO as a core solution for management and orchestration, we have noticed several issues with the current ETSI approach. The observed problems include:

### A. Lack of detailed specification of OSS/BSS functions in the MANO framework

The functionality of the OSS/BSS had not been defined by ETSI till NFV Release 3. The mentioned release [7] has introduced slice-related management functions of the OSS/BSS (at the levels of communication service, network and sub-network slice) identically to the 3GPP vision [6]. Moreover, in general, the OSS/BSS has to handle user subscriptions, performs policy-based management of slices and services, provides Key Performance Indicators (KPIs) monitoring for Service Level Agreement (SLA) fulfillment, collects accounting data, etc. The functions, however, are not sufficient for more advanced templates, i.e. beyond the 3GPP network.

In case of slicing, the gaps include mechanisms for slice description and slice selection: matching several of the mentioned issues have been solved by 3GPP, others are being handled by the ITU-T Study Group 13, which has already published some recommendations [8]–[10]. There is still an open issue where such functions should be placed in the framework.

### B. Performance of OSS/BSS

The OSS/BSS centralization raises scalability issues related to handling a large number of operations for each slice (management and run-time orchestration). The round-trip time (RTT) related to distance between network nodes and OSS/BSS cannot be neglected in some cases.

### C. Limited capability of management delegation to verticals

The 3GPP management system architecture [6] allows the slice operator (tenant) to obtain selected management data and to subscribe to slice management operations [3]. The tenant cannot have its private management system.

### D. Lack of slices management plane isolation

The fundamental principle of slice isolation should also include its management plane, as described in [11]. A common OSS/BSS (i.e. according to the current ETSI and 3GPP approaches) provides weak slice management plane isolation and raises serious security concerns. The access of slice tenants to the operator's OSS/BSS also creates many issues in terms of security, reliability and management performance.

### E. Dynamic modification of OSS/BSS

It has to be noted that in the 3GPP approach, each deployed network slice requires dedicated counterparts in the OSS/BSS (slice-specific run-time management plane) that are dynamically deployed in the OSS/BSS. The dynamic modification of the OSS/BSS is a new idea that may impact the performance as well as the security of the OSS/BSS. Additionally, such an operation is rather complicated since it has to be synchronized with slice deployment. This issue is currently ignored by 3GPP specifications.

### F. Lack of business interfaces

The MANO model has been created for a single operator. It does not support business interactions between multiple business players (infrastructure providers, orchestrator operators, template providers, VNF providers) through business interfaces. In the 3GPP approach, a definition of the Tenants Portal is also missing. Such an entity is present in many research works and serves for interactions between tenants and the system operator for the purpose of network slice service exposure, negotiation, ordering, and life cycle management [14]. It plays a crucial role in multi-tenant network slicing frameworks.

### G. MANO and MEC integration

A list of issues related to the integration of MEC and network slices can be found in [12], [13]. This topic is still a subject of discussion in standardization bodies. In fact, in most cases, adding services to service-oriented slices during their run-time (i.e. one of MEC functionalities) is not needed if the service oriented functions are already included in the slice template. Moreover, in such a case the MEAO orchestrator in most cases is not needed.

### H. Wrong separation of concerns

Separation of resource and service orchestration and management is needed in order to make the orchestrator slice agnostic.

### I. CI/CD limitations

So far, no interface is defined for the interactions between the VNF providers and the VNF operators. Moreover, there is a lack of procedures that enable validation of the VNFs (in terms of security, 3GPP compliance etc.) created as the result of CI/CD processes. This issue is currently under study by ETSI and is further described in [15].

## III. CONCLUSIONS

In the paper, we will describe the current issues and deficiencies of the ETSI NFV MANO approach as well as the evolution steps that we perceive as mandatory to enable the framework exploitation in network slicing-enabled 5G networks. Some of the required features could be implemented in future ETSI NFV MANO releases, but a deeper re-design of the approach might be necessary to fully address the presented issues.

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