A Multi-Operator Network Service Orchestration Prototype: The 5G Exchange

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Abstract: In the context of the 5GEx Project, a Multi-domain Orchestrator is in charge of creating, deploying, and terminating Network Services spanning across multiple-operators. This live demo showcases the main functionalities of the 5GEx system.

1. Overview section

There is general consensus around the concept that 5G networks will have to rely on the coordinated allocation of IT (e.g., compute, storage) and networking resources. This to guarantee that, on one hand, service performance and functional requirements are met, and, on the other, the network infrastructure is used efficiently. For this reason there is an ongoing debate on how to design future 5G systems able to incorporate flexibility and (re)configurability features in their network architectures. Another aspect to tackle is market and technology fragmentation, i.e., the ability to flexibly provision a service should not be hindered by technology/vendor specific solutions, and by administrative domain boundaries. In other words, a 5G service provisioning paradigm will also require a unified infrastructure service market, integrating multiple operators and technologies. In this context, Software-Defined Network (SDN) and Network Function Virtualization (NFV) are very promising tools able to provide high programmability and great elasticity while deploying network services (NSs).

The 5G Exchange (5GEx) project [1] builds heavily on the SDN/NVF functionalities and tries to overcome the aforementioned market fragmentation by designing, implementing, and testing a multi-domain orchestrator (MdO) prototype for fast and automated NS provisioning over multiple-technologies also spanning across multiple-operators. The main features of the 5GEx MdO are: *(i)* a 5GEx interface to the customers for both the purchase and the management of NSs, *(ii)* a 5GEx interface to the operators for the creation and the publishing of NSs, *(iii)* a resource slice composition process to dynamically extend the controlled domains across other operators, *(iv)* a multi-operators NS orchestration both at the resource and the service orchestration level, and *(v)* the automatic discovery of other MdOs. The MdO prototype design is presented in Figure 1, highlighting the main functional blocks and the related communication interfaces. This design is compliant with the paradigm of the ETSI NFV group. In particular, Interface1 (I1) is a North Bound Interface to both the 5GEx customers and the 5GEx administrators. Interface2 (I2) refers to the interaction among MdOs. Then, Interface3 (I3) considers the communication between the MdO and the underlying Domain Orchestrators (DOs). More details on the 5GEx architecture are available in the public deliverables [2] and [3].

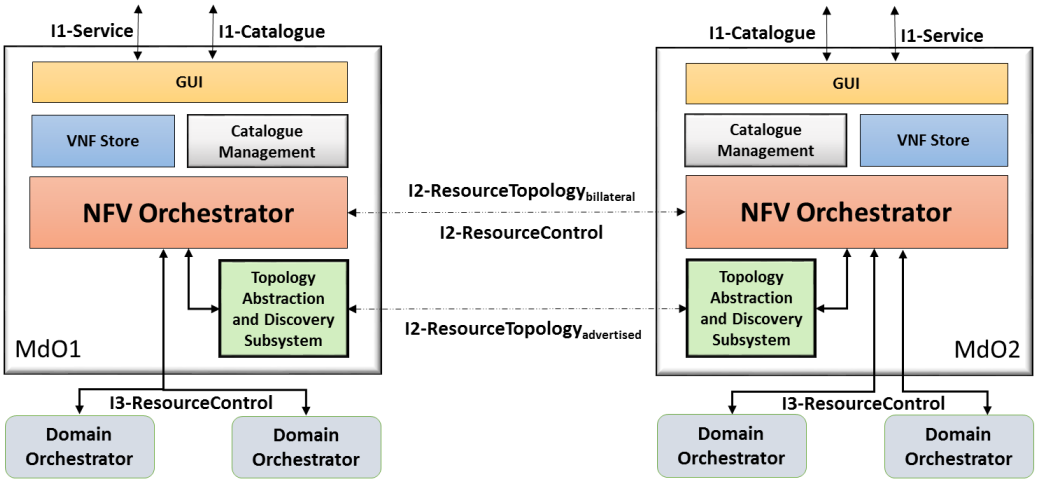

Figure 1. Design of the 5GEx Multi-domain Orchestrator.

The MdO prototype has been implemented extending already existing open source software tools at the disposal of the 5GEx partners. In particular, the T-NOVA Marketplace [4] has been used for implementing the *GUI*, the *NF Store*, and the *Catalogue Management*. The Unify Orchestrator [5] is the main component of the *NFV Orchestrator* and it has been extended to support the 5GEx multi-providers orchestration functionalities. Moreover, the Unify virtualizer library [6] has been used to implement the following interfaces: *I2-ResourceTopology*$_{bilateral}$ to retrieve detailed information from other MdOs, in addition to *I2-ResourceControl* and *I3-ResourceControl* to perform the NS deployment. The topology library of the Netphony project [7] have been extended to implement the *Topology Abstraction and Distribution Subsystem*, where the BGP-LS is used for the *I2-ResourceTopology*$_{advertised}$ interface at the basis of discovery process of the MdOs of other operator.

The demonstration that we plan to present has been designed to showcase some of the main functionalities of the 5GEx MdO prototype. The demo will be based on a multi-operator scenario, where at least three partners of the 5GEx project will be involved. They will be acting as operators that can ask for the provisioning of multi domain NSs. Each partner will run its own instance of the 5GEx MdO in control of the partner's connectivity and IT resources. One partner will run the management and orchestration plane as well as its resource domains in-loco at the demo site, while the remaining partners will be connecting remotely from some selected nodes of the experimental Sandox built as part of the 5GEx project. The demo will show how it possible to create and the deploy NSs in the context of a Slice as a Service (SlaaS) use-case. The request of a NS will be triggered, using the 5GEx GUI, by a customer of one of the remote request-receiving-operators. A default set of NSs will be provided from which it is possible to choose. We will also show how, with the 5GEx MdO, new NSs can be created on-demand by composing the VNFs available in the store. Then, the requested NS will be deployed. More specifically, the remote request-receiving-operator will perform the resource slice composition to dynamically extend its controlled resource domains over the other operators. Then, the NFV Orchestrator will orchestrate the NS on the available resources, activating the deployment of VNF chain. In particular, we will show that, for NSs with specific requirements (i.e., low latency), the resource slice hosted by the operator at the demo site will be used by the remote operators for the placement of the required VNFs. At the end of the deployment process, we will check its overall consistency, verifying both the network reachability and the configuration/functionalities of the VNFs composing the NS.

2. Innovation section

This demo demonstrates the feasibility of the end-to end NS orchestration across multiple operators. The 5GEx MdO prototype represents a first step in that direction, and this demo will showcase some of its capabilities. The main innovation aspects of this demo are: (1) a new MdO prototype for a fully automated NS creation and deployment spanning across multiple technological domains and multiple operators; (2) the 5GEx GUI including I1-C and I1-S; (3) the process of resource slice composition between MdOs; (4) strategies for end-to-end NS orchestration across multiple providers integrating network and IT in order to perform VNFaaS and Resource Slice as a Service (SlaaS); (5) the automatic discovery of other MdOs; (6) the feasibility of new concepts such as infrastructures and services manufactured by software.

3. OFC relevance section

The 5GEx MdO prototype presented in this demo is the first open-source solution enabling automatic NS provision across multiple operator domains. NS orchestration considers both network (multi-technologies) and IT resources. The demo is specifically targeted to the OFC industrial audience and to operators in particular. They will be very interested in learning about the capabilities of the 5GEx MdO prototype and the new business opportunities that it might open up for them.

4. Acknowledgement

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5. Requirements

To better highlight both the main steps and the procedures of the demo, a large monitor can be useful; regarding the connectivity aspects to the remote sites, we will evaluate later if to consider a better network connectivity.

6. References

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