

Network Slice Management on top of ONAP

Veronica Quintuna Rodriguez, Fabrice Guillemin, Amina Boubendir
Orange Labs, 2 Avenue Pierre Marzin, 22300 Lannion, France
{veronica.quintunarodriguez, fabrice.guillemin, amina.boubendir}@orange.com

Abstract—We develop and demonstrate a network slice management architecture on top of the so-called Open Network Automation Platform (ONAP). A slice manager is introduced to allow a client to describe the desired slice along with the associated Service Level Agreement (SLA), and to interface with ONAP in order to deploy and maintain the negotiated slice. This approach is illustrated by considering a private mobile network based on open source software components orchestrated by ONAP.

Keywords: Network Slicing, Management, Automation, ONAP, NFV, On-demand, SLA-compliance.

I. INTRODUCTION

Network slicing has been introduced by standardization bodies under the impetus of vertical markets (entertainment, automotive, health, etc.) with the development of 5G networks to meet their specific needs in terms of data rate, resilience, latency, etc. This has led to the definition of QoS-based slice families: enhanced Mobile BroadBand (eMBB), Ultra-Reliable Low-Latency Communications (uRLLC), and massive Machine Type Communications (mMTC) [1]. In turn, network operators have recognized network slicing as an opportunity of developing new businesses by progressively extending the concept.

A network slice appears today as a bundle of logical subnetworks following a negotiated SLA. To manage such a bundle when offering communication services on the basis of slices, 3GPP notably considers three management levels: Communication Service Management Function (CSMF), Network Slice Management Function (NSMF), Network Slice Subnet Management Function (NSSMF). These three levels consider communication services, network slices, and network slice subnets, respectively. Communication Services are provided through one or several slices.

To make the concept of slicing concrete, we consider in the present demo the use-case consisting in the deployment of a private mobile network for a given company in the form of a slice. The end-to-end customized slice involves two subnets: a virtual core and an emulated Radio Access Network (RAN), both are based on Open Air Interface (OAI). The core network particularly implements the separation of control and user planes developed by 3GPP.

The various Virtualized Network Functions (VNFs) belonging to the slice subnets are orchestrated by ONAP. The end-to-end management is performed by means of an upper layer, namely the slice manager, deployed on

the basis of an open source solution referred to as *Service Resolver* [2].

The organization of this paper is as follows: In Section II, we review the existing means of slice management: 3GPP, ETSI and ONAP. We describe the network slice management architecture in Section III and the testbed in Section IV. Concluding remarks are presented in Section V.

II. NETWORK SLICE MODEL

Offering customized end-to-end communication services requires various management levels. The goal is to provide logical dedicated and customized networks via a negotiation between the client and the network operator. The outstanding point adopted by 3GPP [3] is that the various subnets involved in a slice need to be related to an upper subnet entity. For instance, when considering a given *Slice A* composed of two subnets (e.g., the core and access networks), three subnet instances are required, say, referred to as Network Slice Subnet Instance (NSSI) CN-1, NSSI-AN-1 and a global subnet so-called NSSI-A. This latter subnet functionally embeds the two others. According to ETSI [4], a subnet represents a single or multiple networks under the control of an agent. An agent refers to a logical entity that has complete control of its network infrastructure.

It follows that a slice is composed of a single subnet which in turn can be formed by the interconnection of various slice subnets. A slice subnet can be seen as the network view of a network slice by a client. From a management point of view, a slice subnet is the interconnection of various managed network functions either physical or virtual. Similarly, one or various subnets are related to a single network service.

While network services can be orchestrated by ONAP, the end-to-end management of network slices requires an upper level, which shall account of the client requirements (namely, Service Resolver). The objective of the proposed demo is to illustrate the various management levels and to show that CSMF and NSMF can be outside of ONAP.

III. NETWORK SLICING MANAGEMENT ARCHITECTURE

For managing an end-to-end slice, we specifically propose a slice manager placed on the top of the service orchestration architecture (namely, ONAP); see Figure 1. The role of the slice manager is to guarantee the end-to-end SLA signed between a customer and a slice provider, while ONAP is in charge of managing the lifecycle of network services or subnets (See [5] for details).

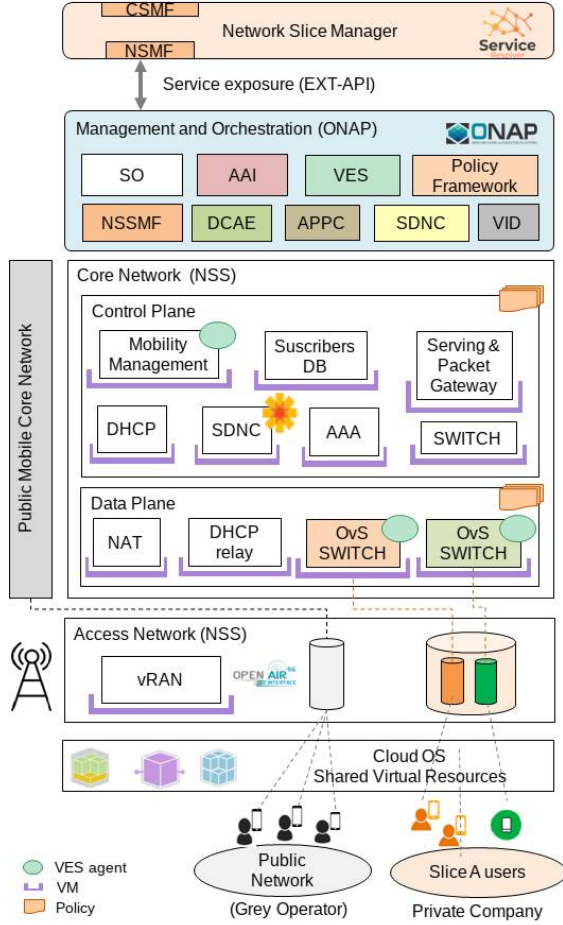


Fig. 1. Testbed architecture, E2E Network Slice Management.

The proposed architecture is motivated by the need of developing a global view of a network slice. The slice manager interfaces with the service orchestrator to retrieve Key Performance Indicators (KPIs) reflecting the slice behavior. The end-to-end slice performance is then given by the combination of individual performances of the various network services composing a slice. Maintaining a negotiated SLA is possible via an enforcement infrastructure (implying policies and constraints) based on monitoring, analytics and actions. This requires a monitoring entity for collecting and reporting the performance information of the various VNFs of the slice, and an analytic entity capable of evaluating the reported information. This information is translated into policies to prevent any SLA degradation. Collection of analytics and policy enforcement are natively supported by ONAP without any additional modules.

IV. TESTBED DESCRIPTION

We consider, as a slicing use case, the deployment of a private mobile network for a given customer. The private mobile network involves both the core and access network modules as illustrated in Figure 1. In our testbed, the

access network slice subnet is emulated by using a virtual RAN and virtual UEs. OpenStack is used as Virtualized Infrastructure Manager (VIM). The orchestration of network services (namely, Core CP, Core DP, vRAN) is performed by ONAP and the management of the end-to-end slice is carried out by Service Resolver. The onboarding of the three network services into ONAP has been totally automated by using the *onap-tests* [6] tools. The service resolver handles service orders, which are defined as Customer Facing Services (CFSs). A CFS contains the slice definition (i.e., the various network services or subnets composing the slice) and the instantiation rules (e.g., service version, sharing principles). The service resolver maintains a catalog of network services, where each of them is defined as a Resource Facing Service (RFS). The slice composition is given in Figure 2, which shows the result provided in the Service Resolver GUI. The service order triggers the instantiation of the required services by means of external northbound ONAP APIs, which notably interact with the ONAP orchestrator.

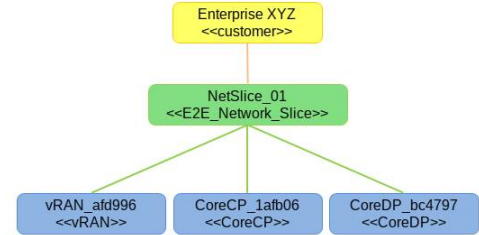


Fig. 2. Network slice composition illustration.

V. CONCLUSION

We have proposed in this demo paper a method for designing and deploying a network slice via a management module on top of ONAP which in turns deals with network services (or slice subnets). This module referred to as slice manager is the interface between the client and the network. The slice manager notably traduces service orders coming from clients (e.g. a low latency slice) in technical orders (e.g., a list of RFSs to be instantiated) to be performed by the network orchestrator. The presented management layer particularly interfaces with ONAP for deploying and maintaining the slice.

REFERENCES

- [1] 3GPP TS 23.501 V16.0.2, "System Architecture for the 5G System (Release 16)," 2019.
- [2] SRP, "Service Order Management," <https://gitlab.com/Orange-OpenSource/lfm/onap/service-resolver>, 2019.
- [3] 3GPP TS 28.541 V15.1.0, "Management and orchestration 5G Network Resource Model (NRM) Release 15," 2018.
- [4] ETSI, "Next Generation Protocols (NGP) E2E Network Slicing Reference Framework and Information Model," 2018, Report ETSI GR NGP 011 V1.1.1.
- [5] Quintana Rodriguez V. et al., "5G E2E Network Slicing Management with ONAP," in *ICIN*, 2020.
- [6] Onap-tests Project, "Automation of VNF onboarding and instantiation," <https://gitlab.com/Orange-OpenSource/lfm/onap/onap-tests>, 2019.