

SliceNet: E2E Cognitive Network Slicing and Slice Management in 5G Networks

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Abstract—Network slicing is a concept recently introduced in 5G networks. The EU 5G PPP SliceNet project focuses on network slicing and addresses the associated challenges in managing, controlling and orchestrating services for customers in the vertical industry sectors. It maximizes the potential of 5G networks by leveraging advanced software networking and cognitive network management. This poster presents the goals, initial achievements and expected innovations of the project.

I. INTRODUCTION

Network slicing is acknowledged as a fundamental architectural pattern and basic enabler of 5G networks. Network slicing has a number of benefits, in terms of reduction of capital expenditure (CAPEX) and operational expenditure (OPEX), increased flexibility and faster service delivery, efficient sharing of network infrastructure and spectrum, and customized network service provisioning for diverging requirements from verticals [1]. A number of gaps need to be filled to fully realize the envisioned benefits of network slicing.

II. GOALS OF THE PROJECT

Firstly, end-to-end (E2E) slicing must be conceived as an E2E concept. Currently, there is a gap on the extension of network slicing beyond a single administrative domain to a scenario where multiple providers are cooperating to achieve E2E network slicing across multiple administrative domains. Due to technical challenges, multi-domain slicing has yet to be fully achieved. Secondly, efforts so far have focused on the control plane. E2E network slicing must also consider the technical viability of a network slicing capability of the data plane. Thirdly, the 5G network infrastructure can only be successful in close cooperation among 5G technology/service provider industry and vertical business sectors. It is essential to demonstrate a cost-effective migration path for verticals to adopt slice-based/enabled services. Finally, and upon achieving slicing, the next critical step is to maintain and improve the application-level quality through dynamic optimization of the perceived quality of the running slices. Resource over-provisioning for achieving Quality of Experience (QoE) is expensive and not scalable.

Motivated by the above context, SliceNet takes 5G network slicing to the next level, by pushing

the boundaries significantly in meeting the challenging requirements from the management and control planes of network slicing across multiple administrative domains, facilitating early and smooth adoption of slices for verticals to achieve their demanding use cases, and managing the QoE for slice services. To realize this vision, an integrated network management, control and orchestration framework is entailed for realizing 5G network slicing and slice-based enabled services.

III. MAJOR ACHIEVEMENTS

A. Vertical Sector Requirements and Use Cases

SliceNet supports use cases of diverging requirements for vertical businesses. It delivers solutions for use cases in the verticals Energy, eHealth and Smart Cities. Three representative use cases are analyzed and requirements derived. For each use case, the implementation and evaluation considerations are described, and the functional, operational and interface requirements are assessed and specified.

B. Overall Architecture and Interfaces Definition

The approach to the overall architecture is rooted in the identification of the main stakeholders and actors of the SliceNet system, as well as the main principles – Network Slicing, Plug & Play, One-Stop API, Cognition, Cross-Plane Orchestration and Multi-Domain – that guide the architecture design. The overall architecture includes a logical and a functional view covering the relevant use-cases related with network slicing, cognition and multi-domain aspects.

IV. INNOVATIONS

SliceNet takes the following technical approaches and will deliver innovations in the following areas, meeting the project goals.

In the data plane, SliceNet explores the programmability of the data paths across the network segments in the E2E network slice, and investigates virtualized slicing-friendly infrastructure.

In the control plane, SliceNet targets to achieve truly multiple domain cooperation for multiple network operators, vendors and service providers, leading to new large-scale 5G services and new federation business models. The experiences learnt from Phase I project 5Gex [2] will be exploited

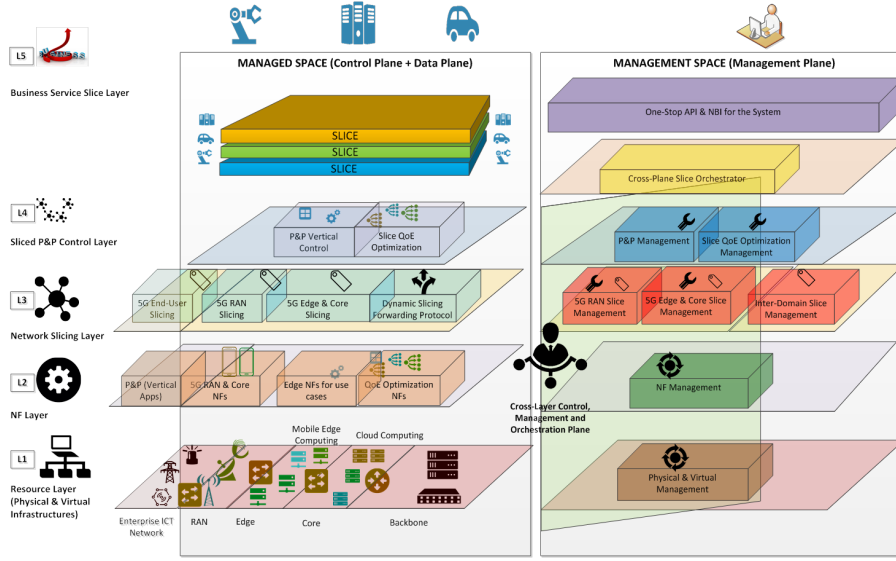


Figure 1. SliceNet Overall Architecture.

to advance this ambitious multi-domain slicing vision.

In the management plane, it plans to deliver a new set of integrated FCAPS slice management functionalities, leading to new FCAPS products for slices management. On top of this, SliceNet proposes a novel cognition-based QoE management approach, and will deliver new QoE sensors and actuators, leading to potentially new products. The cognitive network management approach will leverage related results from Phase I projects especially SELFNET [3] and CogNet [4].

In the orchestration plane, SliceNet takes a novel cross-plane coordination approach, and will deliver a novel cross-plane orchestrator that also preserves the boundaries among the planes, leading to potentially new orchestrator product to be integrated by the network operators, in line with their exploitation plans.

SliceNet takes a novel ‘Verticals in the loop’ design approach for the entire SliceNet framework (not just the use cases but also Plug & Play control, FCAPS etc.), and will deliver the innovative ‘one-stop-shop’ slice-based/enabled service solution for verticals to efficiently upgrade existing or creating new use cases the SliceNet northbound interface. The customization of slices featured with the novel Plug & Play control plane is a new service, leading to new business models between the verticals and the slice service provider.

V. PERFORMANCE KPIS

With respect to the 5G-PPP [5] programme KPIS, SliceNet contributes to (i) reducing the average service creation time cycle from 90 hours to 90 minutes; (ii) providing increased network coverage and more varied service capabilities, and helping create novel business models through innovative sharing of network resources across mul-

tipale actors; (iii) improvements in autonomic network management and automated network control, leading to reduced network OPEX; (iv) employing network function implementation on commodity equipment rather than on non-programmable specific firmware, leading to reduced network CAPEX, through maturation of NFV concepts and increased number of SDN controllable resources; and (v) improved architectural support for diverse types of terminals, traffic, network operators and Radio Access Networks.

VI. DEMONSTRATIONS

SliceNet will demonstrate 5G-enabled use cases on 5G Smart Grid Self-Healing, 5G eHealth Connected Ambulance and 5G Smart City Smart Lighting, in the verticals, Energy, eHealth and Smart Cities, among the top vertical industries identified as the most promising/influential 5G customers. These use cases exhibit ambitious performance requirements, among others, ultra-high reliability, quality of information and experience, and ultra-low latency.

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