

Experimental Validation of a SDN Orchestrator for the Automatic Provisioning of Fixed and Mobile Services

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Abstract *We design, implement and experimentally validate an SDN orchestrator for the automatic provisioning and seamless transport of fixed and mobile services over a multi-layer aggregation network. The proposed solution aims at fostering fixed mobile convergence solutions for future 5G networks.*

Introduction

Bandwidth usage at both fixed and mobile access networks is continuously growing and this trend will continue in coming years. Despite this, the revenues for service operators do not increase proportionally¹. Aiming at keeping the competitiveness, operators are seeking for scalable, energy-efficient and optimized network solutions that besides coping with the increasing traffic do minimize both CapEx and OpEx. To this end, an appealing solution fosters the fixed mobile convergence (FMC) concept which is seen as crucial for future 5G networks².

Traditionally FMC is attained at the service level (IP and IP Multimedia Subsystems) where fixed and mobile networks were designed and evolve independently. However, a more effective and efficient FMC strategy aims at deploying solutions at the network level from a twofold perspective²: structural and functional. The former focuses on sharing and unifying equipment/technologies to transport both fixed and mobile traffic flows over the same network. The later, functional convergence, explores common entities and functions (e.g., unified control and management, AAA operations, etc.) that are applied regardless of the service type.

Herein both structural and functional convergence are achieved over a multi-layer (packet and optical) aggregation network controlled by a unified Software Defined Network (SDN) orchestration system. The multi-layer aggregation network (structural convergence) leverages the benefits of both packet (i.e., granularity, statistical multiplexing) and optical (huge capacity) switching to seamlessly transport QoS-enabled packet flows¹. Hence, multiple mobile and/or fixed services are grouped and carried over the same infrastructure³. The automatic provisioning of such flows is handled by the SDN orchestration. The considered SDN orchestrator follows the architecture defined on the Application-Based Network Operations (ABNO)³. This provides achieving the targeted functional convergence.

We present the implemented ABNO orchestrator wherein both fixed and mobile client applications running on top of it automatically instantiate connections within the aggregation network. Then, the experimental validation is carried out through the setting up of mobile LTE services (Evolve Packet System –EPS- Bearers) between cell stations (eNBs) and the Evolved Packet Core (EPC), responsible for the Internet access for the mobile users. The validation is shown from a twofold perspective: i) at the control plane level, it is detailed the ABNO building blocks interactions and exchanged heterogeneous control messages, including OpenFlow extensions; ii) at the data plane level, the traffic flow adaptation to actually transport EPS Bearers over the multi-layer (MPLS and optical) network infrastructure.

Architecture of the ABNO for functional FMC

The considered SDN-based ABNO orchestrator is depicted in Fig.1. The Service Controller handles incoming service requests from both fixed and mobile service applications. These applications trigger the service demands (via REST API) specifying the type of transport service (e.g., MPLS), endpoints (e.g., for mobile connections the eNBs and EPC Serving Gateway - SGW), the requested bandwidth and other QoS requirements (e.g., maximum latency). The PCE computes a multi-layer path including both packet and optical infrastructure. The objective function besides dealing with the QoS requirements is to attain the most efficient use of network resources at both layers fostering the packet grooming into established optical circuits⁵. The topology server is a database where full (or partial/abstracted) network connectivity and resource attributes at both layers are gathered. This is the input for the PCE computations. The provisioning manager function coordinates the corresponding SDN controllers to actually conduct the network elements configuration along the computed paths. As shown in the Fig.1, in the aggregation

