Network Slicing Over A Packet/Optical Network For Vertical Applications Applied To Multimedia Real-Time Communications

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***Abstract*— This demo presents the deployment of two network slices with different QoS using a packet and optical networks for the deployment of multiple real-time communication suites. Two novel features of SONATA Service Platform are demonstrated: QoS-based network slices and WIM support through ONF Transport API.**

Keywords*— *Optical networks control, orchestration and management; Optical transmission and networks with higher layer network services integration

I. Introduction

Network Slicing allows the deployment of multiple services that require different network requirements on top of the same network infrastructure [1]. Network Slices are typically deployed on top of virtualized network infrastructure that is located in multiple NFV infrastructure Points of Presence (NFVI-PoP). These NFVI-PoP are interconnected using multiple Transport Networks. In order to interconnect the deployed network services, a WAN Infrastructure Manager (WIM) is proposed.

The aim of this demo is to present the experience achieved with the usage of the Network Slice Manager developed in SONATA Service Platform (SP) [2] to deploy multiple real-time communications (RTC) suites with different QoS. The key innovations of this demo are: a) Network Slicing with control of Network Services QoS; and b) The WIM plugin allows the interaction to Transport SDN controllers using ONF Transport API (T-API). It allows to control the resources of different VIMs placed in multiple Points of Presence (PoP) of the network, another component being developed in the SONATA SP.

II. Proposed Architecture

A. Overall Architecture

The presented demo runs over full network structure (from edge to core and back) with two network types; on one side a packet-based network and on the other side, an optical based network.

On top of the architecture (Fig. 1), there is the SONATA Service Platform (SP), the responsible to deploy (among other actions) Network Slices and Network Services (NSs) in any Data Centre (DC) or VIM registered in the SONATA SP [2] . Under the SP, there is the WIM TAPI component in charge of managing the resources of each WIM in order to create and control any transport connection, such as DC interconnection or ingress/egress port connectivity to DC.

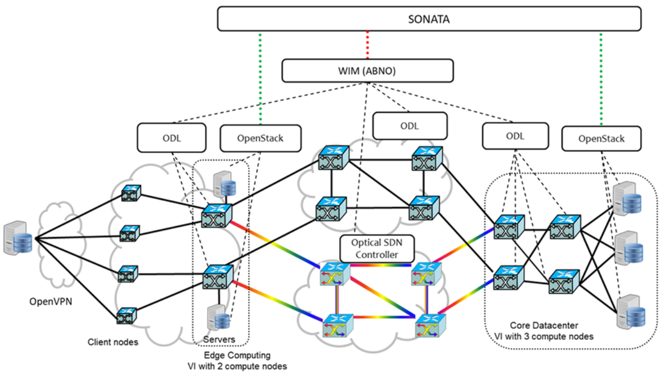

Fig. 1 Proposed architecture

B. Network Slice Manager

The SONATA Network Slice Manager is based on the 3GPP technical specification [1] and, it aims to allow the management of multiple interconnected Network Services (NS) as one single unit called Network Slice. Even though this component has new features since its first version [3]; "Network Service Composition", to link all the multiple NS within a network slice among them, or, "Network Service Sharing", to share an equal NS among multiple network slices allowing to be resource efficient.

The current demonstration aims to show a possible way to introduce Quality of Service (QoS) within a Network Slice. The idea is, based on the network slice type; Ultra-Reliable Low-Latency Communication (URLLC), Enhanced Mobile Broadband (eMBB) or Massive Machine Type Communication (mMTC), to assign one Service Level Agreement (SLA) to each one of the NSs composing the Network Slice Template descriptor (NSTd) before this is uploaded to the SP. When a new NSTd is being created, the NSTd developer must know which SLA Templates are available for each NS in the SONATA SP. So, for each NS, the right SLA Template is assigned and at the network slice level, all the assigned SLAs will fulfil the requirements of the selected type. When the NSTd is instantiated, then for each NS instantiation the corresponding SLA Template is enforced and promoted into an Agreement between the customer and the SP owner.

C. WIM TAPI Wrapper

As previously described, the SONATA SP interacts with Virtualized Infrastructure Managers (VIMs) and WAN Infrastructure Managers (WIMs) in order to request and manage infrastructure resources. In the SONATA SP lower layer architecture, there is the Infrastructure Abstraction (IA) module with a southbound interface implementing the APIs needed to communicate with the registered VIMs and WIMs.

On the VIMs side, the IA generates HEAT templates to orchestrate the resources, uses Neutron to handle the DC networking and Keystone for authentication among other OpenStack APIs. On the WIMs side, the IA implements an interface (WIM TAPI) in order to deploy a service across the network. The WIM TAPI is in charge of enforcing the end-to-end service connectivity between PoPs. So as to reach its objective, the WIM TAPI makes uses of ONF Transport API to build any WAN connection.

The workflow for deployment of a Network Slice is as follows. A new Network Slice Instance request is received at SONATA SP. This request refers to NSTd and includes ingress/egress connections, QoS and necessary NS (depicted in Fig.2). The SP deploys NS, and once the VNFs are deployed, there is the necessity to create the connectivity service request from ingress/egress network ports. This action is executed by SONATA WIM plugin towards WIM, using a ONF Transport API connectivity service request. Once the link is deployed, the network slice creation is notified to the user.

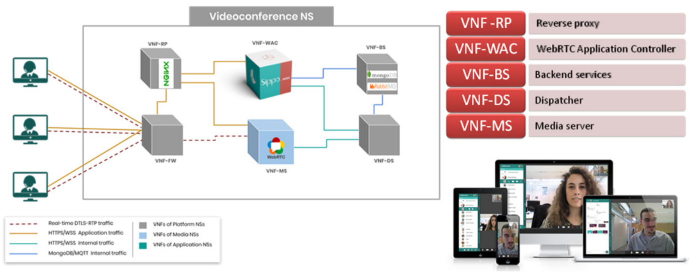

Fig. 2 Proposed workflow for RTC Network Service deployment

D. *Real-Time Communication Network Service*

The demonstration selected NS is a videoconference service and it designed with five VNFs: a) Reverse Proxy (VNF-RP) composed by an Nginx to receive all the HTTP and WebSocket traffic; b) WebRTC Application Controller (VNF-WAC), which is a Sippo Server and a Signalling Server (QSS) in charge of the WebRTC communication; c) Backend Services (VNF-BS), that includes a MongoDB to safe information and a RabbitMQ for the communication among VNFs; d) Media Server (VNF-MS) composed by a Janus and a Wrapper in charge of receiving and relaying the media during the videoconferences and also in charge of measuring the QoS achieved in the media flows of each video-conference; and e) Dispatcher (VNF-DS), which is used to ask for media rooms and create/manage the multimedia sessions. Any Media Server must register itself to the Dispatcher.

Moreover, to the previous VNFs, the NS has two more components; Function Specific Manager (FSM) and Service Specific Manager (SSM). These two managers allow the option to configure any of the VNFs (FSM) and also the overall configuration of the NS (SSM).

III. Multiple Network Slices For RTC Demonstration

The demonstration provides multiple real-time communications suites using multiple network slices with the aim to provide flexibility when deploying different Quality of Services (QoSs) over the same physical network. The idea is to create two network slices, both using the same exact NSs but each network slice with a different QoS. By doing this, the physical resources operator is able to create and manage multiple network slices by fulfilling QoS requirements requested by the different users.

The network slices used were composed by the NS previously described in section II.D, each one of them with a different QoS levels defined by two SLA descriptors; called GOLD (high performance) and SILVER (low performance). It should be mentioned that a set of specific Service Level Objectives (SLOs) is considered for each SLA level, by specifying the maximum values and thresholds allowed for a set of service specific parameters (i.e. audio and video bitrate).

When instantiating any of the two Network Slices, the first step to verify is that the NS deployment follows all the steps defined in II.C. Initially the user must pass a token to be verified (by the SP) and then, it can request the deployment of the network slice. Once deployed (with its NSs and VNFs), then, the WAN connection creation starts; the SONATA SP requests to the WIM the “service-interface-points” so as to know where to connect the VNFs connection points and finally, requests to the WIM the end-to-end connection between VIMs creation.

Once both Network Slices were deployed, it was possible to carry on tests to validate the complete NSs functionality. Fig.3 shows the bitrate of the audio stream (a), which was stable at 25Kbps. Meanwhile, the video stream (b) had a mean value of 300Kbps.

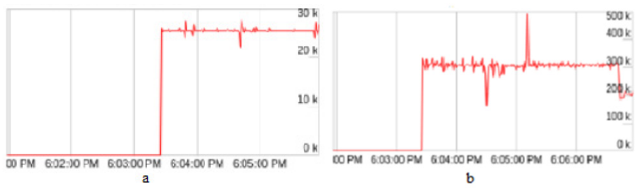

Fig. 3 (a) Audio bitrate, (b) Video bitrate

IV. Conclusion

On this demo we present the SONATA SP that is able to deploy multiple Real-Time Communication Services within Network Slices through an end-to-end transport link.

Acknowledgment

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