DevOps based service orchestration in 5G virtualised Networks.

SONATA Project Demo

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***Abstract*— Research in 5G architectures is focused on exploring ways to leverage the use of virtualisation offered by cloud infrastructures and network programmability to provide flexibility and agility in the development and deployment of Network Services and virtual network functions. In this context, this paper presents the description of SONATA project demonstrator. SONATA supports agile development and orchestration of network services in 5G networks.**

Keywords—NFV, SDN, 5G, DevOps, programmable networks, pilots

I. INTRODUCTION

In today's classical networks, service creation can often take several hours or even days, lowering the quality of experience of customers and therefore affecting the revenue of the Service Providers (SP). However, data centres can currently set up compute services within minutes, if not seconds. The convergence of the two worlds, namely the network and the IT, has raised a lot of interest recently. Technologies such as network softwarisation and Network Function Virtualization (NFV), which try and leverage virtualization and cloudification to execute (virtualized) network functions as software on cloud infrastructures, are being optimized under the control of a single orchestrating entity.

To this extent, NFV creates new challenges with respect to service orchestration and service management. In this frame, the European Telecommunications Standards Institute (ETSI) NFV group has defined a standardized Management and Orchestration (MANO) reference architecture [1] that aims at the feasibility of cloud deployments of typical network functions.

In this context, SONATA Project addresses the technological challenges of developing and orchestrating complex user-facing applications and services perceived for 5G networks, by proposing a customised SDK developed to boost the efficiency of developers of network functions and composed services, and a novel service platform to manage service deployment and execution. SONATA functionality covers (i) the multi-service control layer; (ii) partially the integrated management and operation layer and (iii) the application and business services layer. SONATA is also capable of incorporating widely heterogeneous physical resources: various access networksin, aggregation and core networks, software networks, data-centre networks and mobile edge computing clouds.

In this demo paper the anticipated pilot of SONATA projects are described and detailed operation scenarios are presented. The SONATA pilots will be executed over a distributed infrastructure hosted in various testbeds offered by the consortium partners. The intention of SONATA pilots is to validate the functional and non-functional requirements of SONATA and highlight the added value of its framework in the development, deployment and operation of novel, agile network services.

The document structure is as follows: section II provides a summary of the SONATA architecture and its main components; section III provides the description of the demos; section IV gives information of the technical requirements for the demonstration.

II. SONATA ARCHITECTURE

SONATA architecture extents the ETSI MANO specifications by introducing flexibility and agility by the exploitation of a pluggable architecture for both the NFVO and the VNFM (see Fig.1). At the NFVO level, the component introduced is the Service Specific Manager (SSM) that empowers third-party service developers with control over specific orchestration and management functionalities pertaining to their own service. At the VNFM level, the introduced component is the Function Specific Manager (FSM)

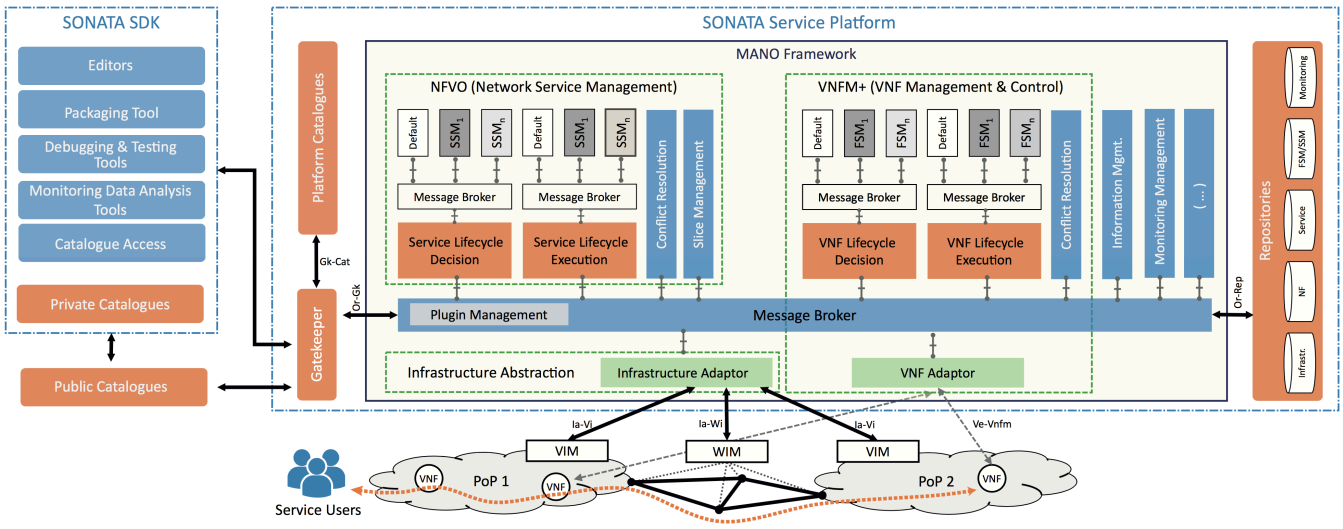

Fig. 1 SONATA Service Platform architecture

that provides flexibility to network operators via customizable platform functionality and ability to add new features via pug-ins. The above components enable the developer to alter the default lifecycle operations or trigger new algorithms that affect the way the service reacts to certain events observed by the monitoring system (i.e. placement, policies, scaling, etc.). The deployment of new functionalities as SSM or FSM plugins does not require always the re-deployment of the service functionality and ability to add new features via pug-ins. The above components allow the developer to alter the default lifecycle operations or trigger new algorithms that affect the way the service reacts to certain events observed by the monitoring system (i.e. placement, policies, scaling, etc.).

SONATA, via the SDK component, provides the required libraries and toolset for the development of composite VNFs and Network Services. The SDK allows the use of either public or private catalogues to be re-used during the network service or VNF development.

III. Demo Description

A. Overview

SONATA defines three pilots for demonstration and validation. These pilots are:

- Content Delivery Network (CDN) - targeted to Service Providers that want to deploy a vCDN (virtual CDN) for their end-users.
- Personal Security Application (PSA) – targeted to end-users that would like a personalised security service.
- Hierarchical Service Providers (HSP) – targeted to highlight recursive operation between two instances of SONATA platform.

The proposed demo will be based on the vCDN Pilot, that will be deployed over the SONATA demonstration infrastructure that spans across two testbeds, one located in Athens and the other in Aveiro (see Fig.2). The testbeds are interconnected via VPN links over the internet. As it can be observed, the Content Server lays at one and at the end users at the other. Of course, in the general case, multiple edge locations may exist with content consumers. Other components of the demo are:

- SONATA Service Platform (SP) is the orchestration entity that is responsible for the deployment and operation of the vCDN network service over the underlying infrastructure.
- WAN Infrastructure Management (WIM) is the component that is responsible for the slicing of WAN across the infrastructure and the enforcement of the VNF Forwarding Graph (VNFFG). In this example, the WIM, based on the information received by the SONATA SP, will enforce the traffic in both edges to go through the NFVI-PoPs.
- Virtualised Infrastructure Manager (VIM) is the component that (i) instantiates the requested VNFs in the cloud platform and (ii) enforces the VNFFG inside the NFVI-PoP.
- Virtual Transcoding Unit (vTU) is the VNF that allows the transcoding of DASH video content when the End-User is not capable of consuming the video due to incompatible video format. When the transcoded video is available (or part of it), the video chunks are made available to the Content Server and the video is served to the end-user.
- Virtual Traffic Classifier (vTC) is the VNF that is responsible of (i) traffic identification; (ii) enforcement of the service function chaining based on traffic identification and (iii) monitoring of traffic. The vTC acquires information on the traffic and sends this information to the Service Platform.

- Virtual Content Cache (vCC) is the VNF responsible for caching the content close to the End Users.
- WAN network is assumed that is created via the SDN based switches available at both ends of the infrastructure.

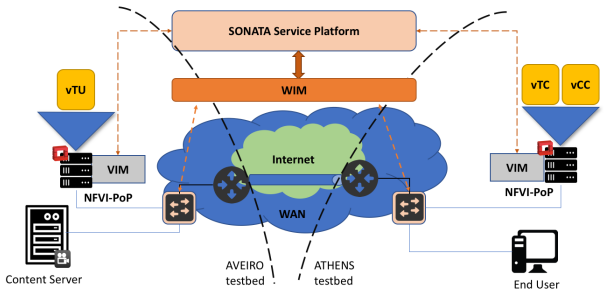

Fig. 2 Demo overview

B. *Objectives*

The objectives of the demo are:

- Demonstrate the Service Platform capabilities in orchestrating multi-pop environments.
- Demonstrate the WAN management capabilities for end-to-end connectivity and seamless network embedding.
- Demonstrate the flexibility offered by the SSM/FSM modular/pluggable service orchestration framework.

C. *Scenarios*

The SONATA framework is used for the development (i.e. VNFs, SSM, FSM) and instantiation of a vCDN Network Service (not part of the demo). The service is deployed over the Service Provider infrastructure , as requested by the customer (i.e. vCDN operator), and a slice is allocated for him.

Two scenarios are anticipated for this pilot, namely:

- Classic vCDN mode: Content originates from a single content provider or multiple ones distributed across the vCaches and eventually delivered to a huge number of subscribers. This scenario will be used to highlight placement and scaling functionalities of the SONATA SP.
- User Generated Content (UGC) based vCDN mode: Content also originates from the End-Users ,allowing various sub-cases of social networking content exchange. The twist of this scenario is that the UGC content is identified and cached at the edges, allowing resource optimisation in each location.

The following deployment scenarios will be demonstrated.

SCENARIO 1 - NETWORK SERVICE RECONFIGURATION

- The NS is instantiated by the SP on top of the already provisioned network slice.
- SSM and the FSMs are instantiated.
- SSM placement plugin is deciding on the proper placement of the VNFs to the available NFVI-PoPs, considering the explicit placement and resource availability.
- The VNFs are instantiated and monitoring is established to SONATA monitoring framework.
- The SFC is established and traffic from the content servers is now passing through the deployed VNFs.
- Content is now received on end users' terminals.
- Monitoring information is collected by the VNFs and the infrastructure elements.
- Alerts are issued by SONATA monitoring framework and collected by the SSM Monitoring plugin.
- In another end-point of the network service, End Users start to consume content however there is no vCache for them.
- Alerts are received by SSM Monitoring plugin (related to usage of the service on all branches towards the edge locations).
- ssm-place detects that at a edge new users are connected, thus increase of the aggregate traffic towards that particular edge is detected.
- ssm-place checks if that edge is served locally by a vCache.
- When alerts surpass the configured threshold, automatic placement of vCache is requested.
- The PoP in proximity to the edge location is identified (ssm-place).
- The SSM coordinated the required lifecycle operations to deploy the vCache and update the NS.

SCENARIO 2 - QOE ENHANCEMENT

This scenario is an extension of the vCDN service including a DASH transcoding unit. The transcoding functionality can produce new content per combination of elements (available bandwidth, terminal information, etc.). By choosing the best suitable transcoding and segmentation, it ensures the best Quality of Experience (QoE). The vTU will be exploited on-demand according to the situation and customer needs. The scenario storyline is as follows:

- Upon user request of a content format or quality that is not available.
- vTC forwards request to the vTU.
- vTU transcodes the content based on the user request.
- As soon as the initial segments are transcoded, they are made almost immediately available to the content server.
- Upon new request for the new content format, the content server streams the content to the user.

- vTC is monitoring the whole process.

IV. Technical Requirements

Most of the infrastructure that is required for the realisation of this demo will be already deployed in the SONATA testbeds. The demonstrators will need to access remotely the infrastructure and connect to the appropriate systems that will be used to execute the demo and visualise the result. At minimum the demo requires:

- One big screen.
- Ordinary power outlets (at least 4).
- Access to the internet (wired or wireless) for connections with CISCO anyconnect with the infrastructure.
- A panel for placing the demo poster.
- A table to deploy the rest of the equipment that will be brought by the demonstrators (i.e. laptops/pcs).

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