Demonstration of NFV Content Delivery using SDN-enabled virtual infrastructures

Ali Hammad[1], Alejandro Aguado[1, 2], Koteswararao Kondepu[1], Yue Zong[1], Shuangyi Yan[1], Reza Nejabati[1], Dimitra Simeonidou[1]

(1) High Performance Networks Group, University of Bristol, UK
(2) Center for Computational Simulation - UPM, Madrid, Spain
Email: ali.hammad@bristol.ac.uk

Abstract: We will demonstrate the composition and operation of a virtual infrastructure (VI) for NFV content delivery. The demonstrated VI will be controlled through SDN controller. Furthermore, an infrastructure replanning mechanism will be also demonstrated.

1. Overview

Software defined networking (SDN) and network functions virtualization (NFV) are key enablers for the evolution in the design, management and operation of network infrastructure and the service delivery. Software Defined Networks (SDN) reduces the complexity of the network, and provides new methods of automation and flexibility. NFV has been proposed to use computing virtualization mechanisms in standard commodity hardware to provide virtualized network functions (VNFs) for the virtualization of network service delivery. The dynamic management of VNFs across the network, such as migration of VNFs, service chaining and the dynamic composition of services require an automated and flexible network infrastructure. Therefore, SDN and NFV are considered complementary to improve the flexibility and simplicity of networks and service delivery [1].

The existing multi-domain multi-technology transport network scenario raises the challenges for efficient network control and operation [2]. End-to-end service provisioning through SDN-enabled virtualization is promising for efficient abstraction, virtualization and control over the heterogeneous resources. This virtualization will enable the rapid deployment of multi-tenant, application-specific and customized virtual infrastructures (VIs). Each VI will have its own control plane to enable the provisioning of dynamic, adaptive and fault-tolerant network services [3]. VNFs can be deployed on top of VIs to take advantage of the flexible and simplified composition and management of VNFs.

2. Innovation

In this demonstration, we are going to demonstrate a SDN-enabled virtual infrastructure (VI) that will be used for content delivery taking advantage of NFV. This will include the demonstration of a virtualization and orchestration platform (as shown in Figure 1) that is proposed for multi-domain multi-technology network transport scenario including optical transport network [4]. The multi-domain SDN orchestrator (MSO) and the multi-domain network hypervisor (MNH) have been introduced in [2][5][6]. The MSO has been proposed as a solution for end-to-end network orchestration. The MNH runs on top of the MSO architecture and provides abstracted VIs that can be controlled through SDN controllers.

The virtualization planner is responsible to run virtualization algorithms in order to provide the required intelligence for composing VIs over multi-domain multi-technology network infrastructures. This includes a VI composition algorithm that is able to select the physical resources in the different domains and layers (i.e. computing, L2 and optical resources) to provide the required end-to-end IT and network services through virtualization services. Furthermore, a real-time replanning mechanism can also be used for the goal to optimise the usage of physical resources.

Network operator can use the orchestration and virtualization platform to compose VIs. A service provider uses a VI to deliver a service to end users. The VI comprises of virtual machines (VMs) to host the VNFs and virtual network resources such as virtual switches. Virtual links are used to connect the VMs and the virtual switches. Service provider can view/configure his virtual resources which are abstracted set of resources using SDN controller. For instance, service provider can configure virtual flows (vflows) in the virtual switches, and these vflows are translated by the MNH into a set of real flows which are then directed by the MSO to the controller of the physical switches. The demonstrated VI will have virtual links that are mapped onto end-to-end physical paths that span SDN-enabled packet and optical domains.

Furthermore, we will demonstrate the impact of a hitless infrastructure replanning that can be done by network operator to improve service delivery to end-users. Infrastructure replanning will be used to replan the optical lightpaths using SDN technology based on the status of the optical network. We will demonstrate how replanning

can change the mapping of virtual links in a VI onto shorter and less congested lightpaths using SDN controller over the optical network. This will lead to better connectivity service over the VI and better performance observed by end-users.

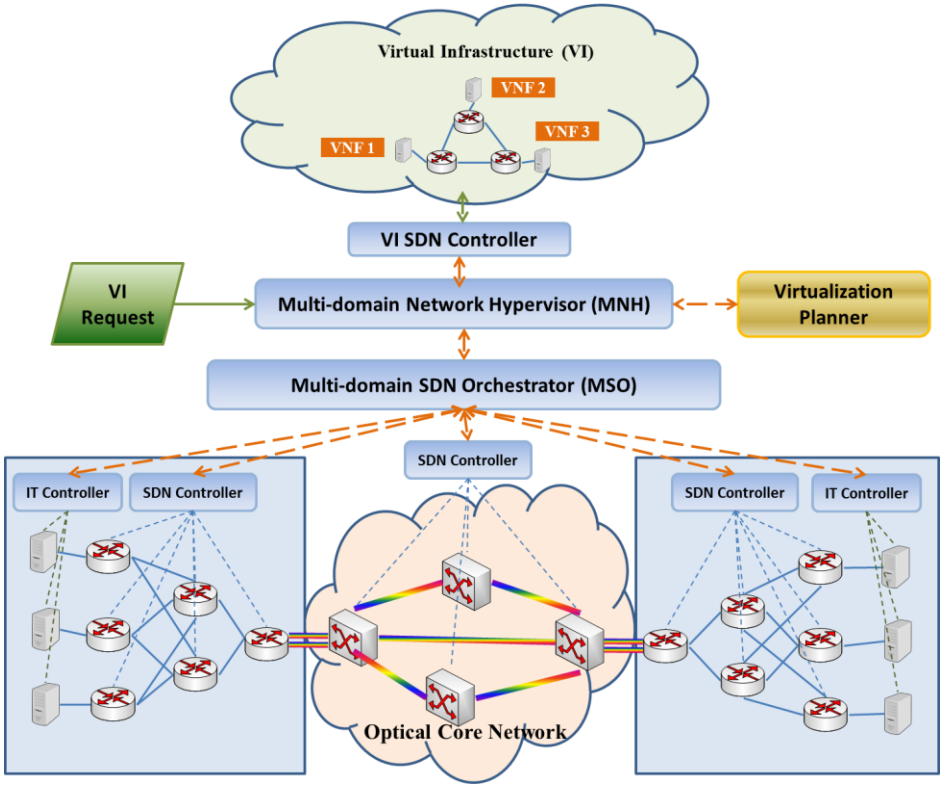

Figure 1: Virtualization and Orchestration Platform for SDN-enabled VIs and NFV services

The proposed demonstration will be done live on the optical and layer 2 test-bed of High Performance Networks Group in University of Bristol, and using the following equipments:

- 3 x ADVA FSP 3000 DWDM ROADM nodes (OpenFlow-enabled).
- 4 x Campus Grade Ethernet switches (also OpenFlow-enabled) (NEC IP8800).
- 1 Polatis Fibre switch 192 x 192.
- Physical servers for running MSO, MNH and virtualization planner.
- Physical servers for running virtual machines, video VNFs e.g. video caching, streaming application and a VI SDN controller.

3. OFC Relevance

The proposed demonstration is relevant to OFC since it handles solutions and approaches for SDN control, orchestration and virtualization over optical and L2 networks. It also addresses NFV by demonstrating VNFs and service delivery on top of controlled and virtualized infrastructure that is mapped onto L2, optical and computing resources.

4. Acknowledgements

This work is supported by the EU-Brazil Horizon 2020 FUTEBOL project, and the EU FP7 Fed4FIRE project.

5. References

[1] J. Matias, J. Garay, N. Toledo, J. Unzilla and E. Jacob, "Toward an SDN-enabled NFV architecture," in IEEE Communications Magazine, vol. 53, no. 4, pp. 187-193, April 2015.
[2] R. Munoz, etc, “Transport network orchestration for end-to-end multi-layer provisioning across heterogeneous sdn/openflow and gmpls/pce control domains,” Journal of Lightwave Technology, vol. 33, no. 8, pp. 1540 – 1548, 2015.
[3] W. Xia, etc, "A Survey on Software-Defined Networking," in IEEE Communications Surveys & Tutorials, vol.17, no.1, pp.27-51, 2015.
[4] A. Hammad et al., "On-demand virtual infrastructure composition over multi-domain and multi-technology networks," 2016 Optical Fiber Communications Conference and Exhibition (OFC), Anaheim, CA, 2016, pp. 1-3.
[5] R. Vilalta, etc, “Network virtualization controller for abstraction and control of OpenFlow-enabled multi-tenant multi-technology transport networks”, in Proc. Optical Fiber Conference (OFC), Mar 2015.
[6] A. Aguado, etc, “Dynamic Virtual Network Reconfiguration over SDN Orchestrated Multi-Technology Optical Transport Domains”, accepted for publication in Proc. of ECOC 2015.