Service Description in the NFV Revolution:Trends, Challenges and a Way Forward

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Abstract

This paper briefs about challenges and suggestions put forward by different bodies in network service description related to Network Function Virtualization (NFV).

1 Introduction

Technological advancement in recent years demands more flexible and efficient service delivery so that Network Functions (NFs) like routing, load balancing, firewalls, etc. can be scaled up or down, taken in and out of service whenever required. Earlier NFs were tightly coupled with hardware appliances. As an alternative to the traditional approach, NFV suggests virtualizing the NFs and running them on a general-purpose hardware which can be dynamically deployed. One of the starting points is the description of network service to be provided which will be a key factor for integration and interoperability between different ways of the service description[2]. This paper gives a brief overview of alternatives from the European Telecommunications Standards Institute (ETSI), Internet Engineering Task Force (IETF), OpenStack, Organization for the Advancement of Structured Information Standards (OASIS). [2]:

2 ETSI Network Functions Virtualization

ETSI NFV Industry Specification Group (ISG) has issued an architecture defining the main components of NFV [1] and published Management and Orchestration (MANO) framework for NFV [6]. As per ETSI [2]

- **Network Service:** NS is a set of Virtual Network Functions (VNFs) and/ or Physical Network Functions (PNFs).
- **Virtual Links (VLs):** VLs are used for interconnections between VNFs/ PNFs.

- **Virtualized Network Function Forwarding Graphs (VNFFGs):** Defines the topology of NS.
- **Network Forwarding Paths (NFPs):** VNFFGs contains different paths which define the traffic flow for the network service.

3 IETF Service Function Chaining

The IETF workgroup gives an abstract view of the Service Functions (SFs), it also defines the sequence of SFs in Service Function Chaining (SFC) [2]. Both architecture and the problem statement are published by IEFT in RFCs [5, 3]. As per IETF, the architecture can be described around following major components [2]

- **Network Services (NSs):** Network service is a service provided by an operator which is composed of one or more SFs.
- **Service Functions (SFs):** SFs are something which is responsible for the handling of the received packets. [5].
- **Service Classification Functions (SCFs):** Used to classify the network traffic[2].

4 OpenStack

This section references [2]. OpenStack is an open source software platform for cloud computing. In the field of NFV, OpenStack focuses on orchestration and advanced network capabilities along with other challenges. It defines the Heat orchestration template to describe the infrastructure for a service. Following are the three important components of Heat template

- **Input Parameters:** Information that is used to instantiate and for customization of the instances of the template.
- **Resources:** Describes the resources that must be instantiated, also describes the interconnection between them so that the deployment sequence can be controlled.
- **Output Parameters:** Determines which information gathered as a result of the instantiation process will be provided to the requester of deployment.

5 OASIS TOSCA

TOSCA stands for Topology and Orchestration Specification for Cloud Applications. It is a standard which is inclined towards interoperability between parts of the services and the operational behavior of these services (e.g., deploy, patch, shutdown) –independent of the supplier creating the service, and any cloud provider or hosting technology [4]. Following are the main elements defining a service [2]:

- **Topology Template:** Topology template includes Node and Relationship template which in combination define the topology model as a direct graph.

- **Node and Relationship Template:** Describes properties and operations to modify the components. Relationship connects different nodes of the system.

- **Plans:** It describes the life cycle of a service.

6 Challenges

This section references [2].

- **Hierarchical orchestration:** The first challenge is to consider the fact that in real use cases the geographical region over which infrastructure will be deployed is going to be significantly huge. Counting on a global orchestrator to manage different resources managed by different parties will eventually affect the scalability.

- **Multidomain nature of service deployment:** Need to maintain interconnection between the segments of service deployed across multiple domains.

- **Variability of the service:** Another challenge is to consider the dynamicity of the service. Adding new functions to the existing service consisting of different network functions will require updating (e.g. internal re-optimization) of the service itself.

7 Straw-Man Service and Resource Graph Models

This section references [2]. To address the above discussed challenges the paper suggests Straw man model of service and resource description according to which their structure should be closely aligned. The model proposes a Service Graph (SG) and closely aligned Resource Graph (RG) which is designed to provide support for resource orchestration, scalability, dynamicity etc.

Service Graph (SG): Its a directed graph illustrating the service. In SG Network Functions are represented by nodes of the graph. Service access points (SAPs) are nodes representing the connection between the SG with another component outside the domain. Service Links (SLs) are represented by edges of the directed graph which depicts logical connectivity.

Resource Graph (RG): Its a directed graph representing the resources that will be used to deploy the requested services. In RG, Infrastructure Nodes (Ins) on which NFs are deployed and provide functionalities like network connectivity and traffic processing. End Points (EPs) are the nodes represent the points through which RG can be connected to external elements of another domain. Infrastructure Links (ILs) which represents the edges of RG, in other words, connectivity between Infrastructure nodes.

8 Deployment Process

This section references [2]. Service graph elements store the mapping between SG and RG elements. The Mapping between SG and RG is done with the following considerations:

- Network Functions of SG are mapped to Infrastructure nodes of RG
- Service access points of SG are mapped to one or more End points of RG
- Service Links representing edges in SG are mapped to the internal connection of the Infrastructure nodes

9 Conclusion

To utilize the benefits of NFV, network service description is one of the key things to consider which eventually helps in interoperability of different components. The paper discussed major challenges to be addressed and proposed a straw-man model for service description.

References

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