

Analysis the Architecture of VNFM (Virtual Network Function Manager)

Byung Yun Lee*, Bhum Cheol Lee*

* ETRI(Electronics and Telecommunications Research Institute), Korea

bylee@etri.re.kr, bcleee@etri.re.kr

Abstract— Network function virtualization is quickly gaining acceptance as the new approach to delivering communication services. The promises of greater flexibility and dramatically reduced time to introduce new services coupled with the cost advantages, are driving communications service providers(CSP) around the world to begin deploying NFV-based services. ETSI ISG has created the industry standards required in a short time to target specific technology areas that industry requires, and many global vendors are developing VNFs for managing VNF. In this paper, we examine the standardization trends and areas of development trends, and presents the most basic operation of the initialization procedure for performing the steps of VNF.

Keywords— NFV(Network Function Virtualization), VNF(Virtual Network Function), VNFM(Virtual Network Function Manager)

I. INTRODUCTION

Cloud-based NFV platform is a dynamic pool of virtualized computing resources and offers an elastic scheme matching the user demand, so that allocated resources can be scaled up or down on a per-use basis. To make the most of its advantages, distributed cloud-based NFV platform offers its high quality & proximity services to the end user from the closest cloud platform so called NFV HW platform.

Therefore orchestration and management of distributed computing & networking resources and virtualized network functions are necessarily needed with open interface for the various service providers to build and manage their cloud service environments where multiple services are running independently.

II. NFV MANAGEMENT FRAMEWORK

ETSI ISG has created the industry standards required in a short time to target specific technology areas that industry requires, for NFV management framework [1].

NFV management framework consists of three functional entities including NFV Orchestrator, VNF Manager and Virtualized Infrastructure Manager.

The NFVO(NFV Orchestrator) is responsible for the lifecycle management of Network Services across the entire Operator's domain (e.g. multiple VIMs: Virtualized Infrastructure Manager) and the orchestration of NFVI(Network Function Virtualization Infrastructure)

resources across multiple VIMs fulfilling the Resource Orchestration functions.

The VNF Manager is responsible for the lifecycle management of VNF instances. Each VNF instance is assumed to have an associated VNF Manager. A VNF manager may be assigned the management of a single VNF instance, or the management of multiple VNF instances of the same type or of different types.

The Virtualized Infrastructure Manager is responsible for controlling and managing the NFVI compute, storage and network resources, usually within one operator's infrastructure domain. A VIM may be specialized in handling a certain type of infrastructure resource (e.g., compute-only, storage-only, networking-only), or may be capable of managing multiple types of infrastructure resources.

NFV framework provides a virtual container interface in order to provide independent execution environment, and required resources (network, compute, storage, accelerator) rely on NFVI. Each VNF is given all the necessary resources through a virtual container interface.

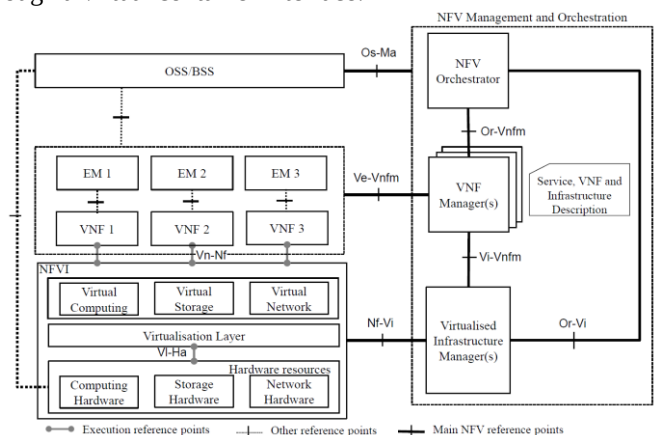


Figure 1. NFV MANAGEMENT FRAMEWORK(ETSI ISG)

III.NFV FRAMEWORK AND RESPONSIBILITIES

VIM exposes virtualised resources management, but does not know about VNFs or NSs(Network Services) [2]. VNFM manages the VNF lifecycle and maps the resources to the VNF, but it does not know about NSs.

NFVO manages the NS lifecycle and maps the VNFs, PNFs(Physical Network Functions), VLs(Virtual Links) to the

NS. There are two options for management of resource related to VNFs:

- (1) Performed by the NFVO, acting a global Resource Orchestrator. VNFM requests resources to NFVO that forwards the request for resources to the VIM
- (2) Performed by the VNFM. VNFM asks the NFVO for granting the VNF lifecycle management request and then directly requests resources to the VIMⁱ

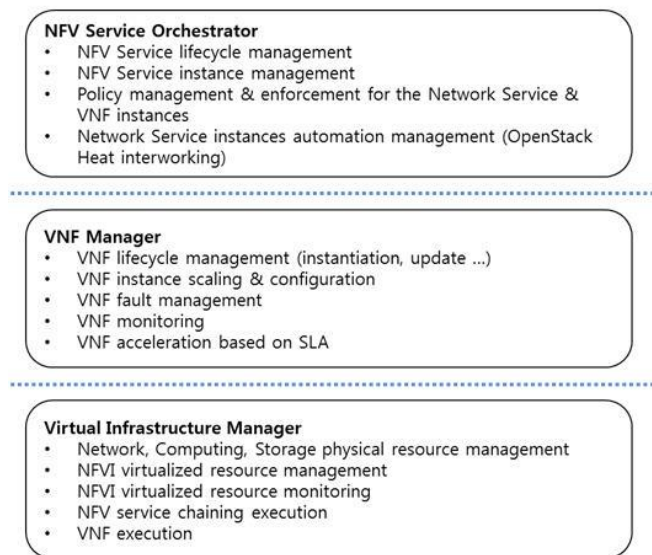


Figure 2. NFV Framework and Responsibilities

IV. TREND OF INDUSTRY ABOUT VNFM

There are three major building blocks in a MANO solution: the NFV orchestrator (NFVO), the virtual network function manager (VNFM) and the virtualized infrastructure manager (VIM) [3]. As the NFV initiative has developed over the past several years, the focus of attention in NFV management has shifted perceptibly. Initially, the VIM (e.g., OpenStack, VMware, etc.) at the bottom of the stack was the issue; then, the special requirements and complexities of telco network orchestration kicked in and attention shifted up to the NFVO at the top. Now, it's the turn of the VNFM, which – notwithstanding the awesome responsibilities of the NFVO.

The ETSI standards are not yet, so certainly a debate to be had.

- Is the mark of a good VNF supplier one that also provides its own VNFM?
- Is the mark of a good MANO supplier one that can accommodate a VNF without a VNFM?
- Is the mark of a good NFVI platform vendor one that takes away the need for a VNF supplier to even develop a VNFM?

There are likely many more angles to explore around the VNFM, but from an operator's perspective, they will certainly need to be harmonized or multi-vendor NFV implementations may well get “stuck in the MANO. VNFM is responsible for the lifecycle management of the VNF under the control of the NFVO, which it achieves by instructing the VIM. However,

this is the big question: who is best placed to supply the VNFM? As the ETSI architecture shows, the VNFM has strong “all-round” affinities, with the VNF itself, the VIM and the NFVO.

A. CloudBand Management System - Alcatel-Lucent

- Alcatel-Lucent CloudBand enables service providers to accelerate adoption of Network Functions Virtualization (NFV), providing a fully integrated solution that orchestrates infrastructure, applications, and network in a single virtualized NFV platform. The platform comprises two elements, the CloudBand Management System, and the CloudBand Node [5].
- They make the VNFM part and parcel of their overall solution

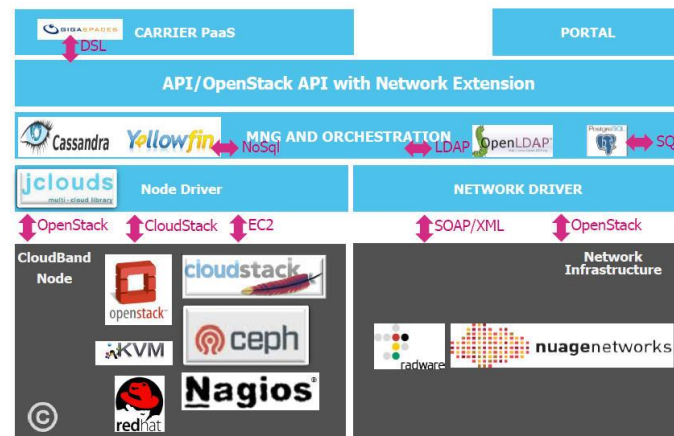


Figure 3. CloudBand Management System - Alcatel-Lucent

B. NFV Director – HP

- HP NFV Director provides a common point to ensure consistent management and behaviour of VNFs, regardless of vender, enabling each VNF to efficiently run on heterogeneous hardware platforms and virtualization environments. It takes responsibility for automatically managing the end-to-end service across VNF, VNF forwarding graph(VNF-FGs) and network services(NSs) [6].

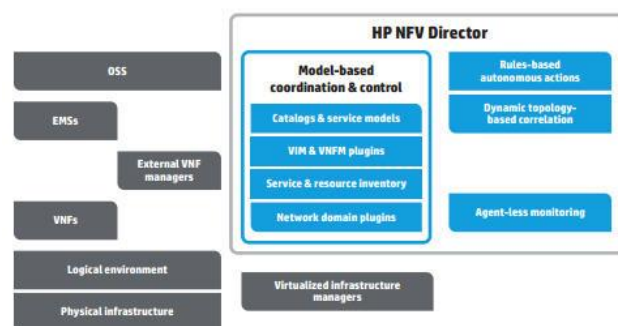


Figure 4. NFV Director – HP

- It is designed to meet the evolving ETSI specifications for the NFV orchestrator functionality. This includes the orchestration and management of virtual network functions and network services, providing the global

resource management, and consistently applying global, cross-VNF, and VNF-specific policies.

- It can work with external VNF managers, when supplied by the vendors. It also can provide the VNF manager functionality through its embedded functions, which compensate for completely or partially missing VNF manager functionality in the vendor solutions or in virtual network functions created from basics by carriers.

C. Cloud Manager-Ericsson

- Ericsson Cloud Manager enables the creation, orchestration, activation, and monitoring of services running on virtualized IT and programmable network resources at consistent levels of quality. With Ericsson Cloud Manager, cloud resources are no longer confined to a single data center, but rather are spread throughout the network, to help improve both internal operations and service quality [7].

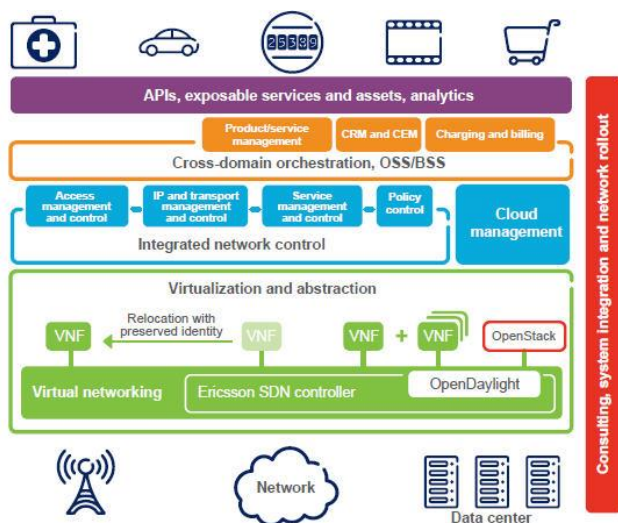


Figure 3: Combining Network-enabled Cloud, NFV and Service Provider SDN.

Figure 5. Cloud Manager - Ericsson

D. Application Orchestrator – Oracle

- Oracle Communication Application Orchestrator support NFV architecture standards from the European Telecommunication Standards Institute (ETSI) and is designed to fulfil the role of Virtual Network Function Manager in the ETSI architecture.
- Oracle Communication Application Orchestrator is designed to work with multiple virtualization infrastructure managers to support a flexible, multi-cloud environment [8].

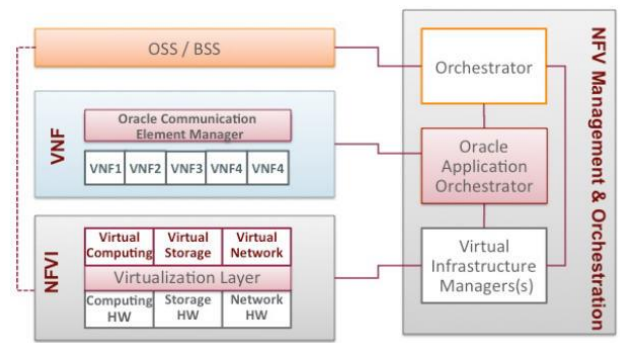


Figure 6. Application Orchestrator – Oracle

V. VNF INSTANTIATION

In order to use virtual network function efficiently by creating a VNF, the initialization procedure is required by the interaction among NFV Orchestrator, VNF Manager, VIM, OSS(Operation Support System), EM(Element Manager). They have basic roles as follow.

- Any authorized consumer can use it
- VIM exposes virtualised resources management, but does not know about VNFs or Network Services
- VNFM manages the VNF lifecycle and maps the resources to the VNF. VNFM does not know about Network Services.
- NFVO manages the NS lifecycle and maps the VNFs, PNFs, VLs to the NS.
- NFVO also re-exposes the VNF Lifecycle Management interface and the Virtualised Resource Management interface

There are 2 kinds of resource management processes, deployment specific configuration, and application specific configuration. Deployment specific configuration is done by the VNFM, it configure the VNF with parameters specific for VNF instantiation. It uses the VNF Configuration interface exposed by VNF [4].

Application specific configuration done by the EM and it configure the VNF with application specific parameters. EM must subscribe to VNF life cycle management change notifications. The VNF Instantiated notification is used as a trigger by EM to start the application specific configuration.

The Instantiate VNF operation returns after the notification VNF Instantiated has been sent. No synchronization between end of VNF instantiation and end of application specific configuration by EM.

Configuration is done after the end of the resource allocation, deployment specific configuration first

E. VNF Instantiation flow (Resource Management performed by NFVO)

It performed by the NFVO, acting a global Resource Orchestrator. VNFM requests resources to NFVO that forwards the request for resources to the VIM

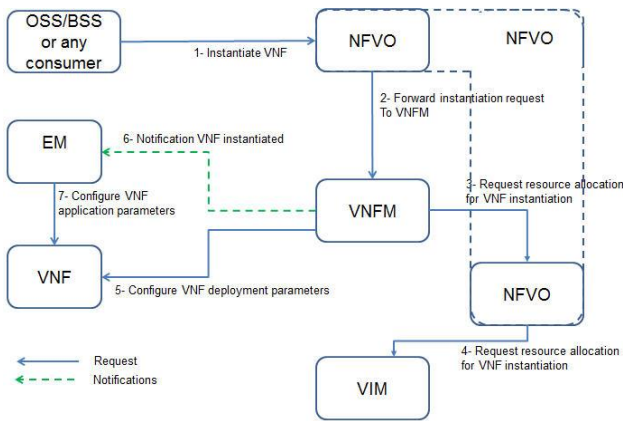


Figure 7. VNF Instantiation flow (Resource Management performed by NFVO)

NFVO identifies the target VIM and uses the Virtual Resource Management interface of the target VIM to do the resource allocation.

1. OSS request the instantiating the VNF to NFVO
2. NFVO forward the instantiation request the VNFM
3. VNFM request resource allocation to NFVO for VNF instantiation
4. NFVO Request resource allocation to VIM for VNF instantiation
5. VNFM Configure VNF deployment parameters
6. VNFM notify to EM about VNF instantiated successfully.
7. EM Configure VNF application parameters

F. VNF Instantiation flow (Resource Management performed by NFVM)

It is performed by the VNFM. VNFM asks the NFVO for granting the VNF LCM request and then directly requests resources to the VIM. VNFM asks NFVO for grant request and uses the Virtual Resource Management interface of the target VIM to do the resource allocation.

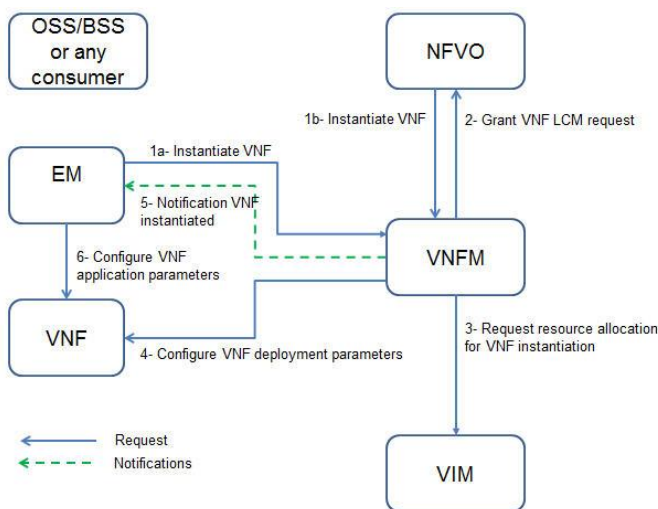


Figure 8. VNF Instantiation flow (Resource Management performed by NFVM)

1. NFVO or EM request to Instantiate VNF to VNFM
2. VNFM request NFVO to grant VNF lifecycle management
3. VNFM request VIM to allocate resource for VNF instantiation
4. VNFM Configure VNF deployment parameters
5. VNFM notify to EM about VNF instantiated successfully.
6. EM Configure VNF application parameters

VI.CONCLUSION

Network function virtualization is quickly gaining acceptance as the new approach to delivering communication services. The promises of greater flexibility and dramatically reduced time to introduce new services coupled with the cost advantages, are driving communications service providers(CSP) around the world to begin deploying NFV-based services. ETSI ISG has created the industry standards required in a short time to target specific technology areas that industry requires, and many global vendors are developing VNFM for managing VNF. In this paper, we examine the standardization trends and development architecture of VNFM, and presents the most basic operation of the initialization procedure for performing the steps of VNFM.

ACKNOWLEDGMENT

This work was supported by Institute for Information & communications Technology Promotion(IITP) grant funded by the Korea government(MSIP) (B0101-15-233, Smart Networking Core Technology Development)

REFERENCES

- [1] ETSI GS NFV-MAN 001, NFV Management & Orchestration
- [2] ETSI GS NFV 002, NFV Architectural Framework, 2014-12
- [3] ETSI GS NFV 003, Terminology for Main Concept, 2014-12
- [4] ETSI GS NFV-INF 001, NFV Infrastructure Overview, 2015-01
- [5] <http://www.alcatel-lucent.com/>, CloudBand Management System
- [6] <http://www.hp.com/>, NFV Director
- [7] <http://www.ericsson.com/>, Cloud Manager
- [8] <http://www.oracle.com/>, Application Orchestrator



Byung Yun Lee is currently a Principal Member of Telecommunication Internet Research Division at Electronics and Telecommunication Research Institute (ETRI), Korea. He received the PhD degree in computer engineering from Chungnam National University, Korea, in 2003. Since joining ETRI in 1992, his work has focused on SDN/NFV technology, and network management.



Bhum Cheol Lee received M.S. and Ph.D. degree in Electric Engineering from Yonsei University, Korea in 1983 and 1997, respectively. He is currently Manager of Networking Computing Convergence Lab. in Electronics and Telecommunications Research Institute (ETRI), Korea. His research interests are Smart Network, Parallel Flow Processing and Network Virtualization

