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Network Slicing Management and Orchestration
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Abstract

Network Slicing is worked in multiple SDOs from different view points. As network slicing is an end-to-end topic, this draft proposes that network slices architecture [[NS-Framework](#)] aligns with the work done in NGMN, 3GPP and ETSI with relation to management and orchestration. The key aspect that this draft makes is the rational for role and need for Network Slice Management Function (NSMF) entity that operates above Network Virtualization Function Orchestrator and PNFs Management Functions. NSMF needs to support different abstractions of resources and to offer access to different management entities.

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[1.](#) Introduction

The purpose of this draft is to highlight the essential aspects of network slice management from 3GPP, NGMN and ETSI relevant for the network slices architecture as described in [[NS-Framework](#)] and to propose a minimal alignment between these works to ensure compatibility between them. NGMN documents "161010_NGMN_Network_Slicing_framework_v1.0.8" [[NGMN_NS](#)] and "5G Network and Service Management including Orchestration" [[NGMN_NSMN](#)] define Network Slicing and how it relates to overall Service and Network Management architecture. The NGMN documents define as well the terminology adopted later by 3GPP and reflected in 3GPP [[TR28.801](#)]. In this paper, for sake of simplicity, only an "executive summary" of network slicing is given, while relying on both terminology and complete descriptions on the above mentioned documents.

Network Slicing provides multiple logical networks on top of a partially shared network infrastructure as described in [[NS-Framework](#)]. Each instance of a network slice represents an independent end-to-end network that allows deployment of different architectural flavors in parallel slices. These slices may be deployed and/or operated by the slice provider, or by the tenant who requested the slice.

A network slice can span across different administrative domains. NGMN Network slicing white paper [[NS-Framework](#)] defines various forward-looking business models engaging multiple administrative domains that may be envisioned in the industry. An administrative domain refers to the scope of jurisdiction of a provider. A provider may obtain services from 3rd parties (i.e. sub-providers) to enrich the services it provides to its end customers. A provider could also benefit from offering its spare capabilities or resources to other providers becoming itself a sub-provider. A network service can be a single user connectivity service, NaaS (Network as a Service) such as a service instance, a network slice instance or a subnetwork slice (note NGMN and 3GPP use a different terminology for what IETF netslices drafts call for "network slice segment") instance offering for a business vertical that utilizes forward-looking business models, or IaaS (Infra structure as a Service).

Depending on the use cases and type of services for which the end-to-end slice has been instantiated multiple levels of control may be exposed to the tenants by the slice provider. On the lowest level of the exposed control the network slice provider grants only access to use the slice and means to monitor its performance. At second level a control exposure is to allow tenants to change the configuration of the network functions associated to the tenant's network slice. At the highest level of control tenants can compose network slices and manage them with their own management system. These different levels of control exposure require that the network slice management must work on multiple levels of abstractions where highest level is at the Service Management & Orchestration (M&O) and lowest level at the network functions. The slice provider must be able to isolate these control functions of different tenants to match the "Slice Provider" - "Slice Consumer" -relationship.

A network slice instance can contain virtualized network functions as well as physical network functions. Virtualized network functions (VNF) are decoupled from physical network equipment by a virtualization layer. Both the lifecycle of the types of the network functions can span beyond the lifecycle of a Network Slice and they need their own life cycle management functions. The life cycle management of these two types of network functions differ. The environment in which VNFs are deployed is called Network Functions Virtualisation Infrastructure (NFVI) and is managed by Virtualised Infrastructure Manager (VIM) according to ETSI NFV-MANO [[MANO](#)] reference architecture. VNFs are instantiated by requests of NFV Orchestrator (NFVO). In the MANO architecture NFV Orchestrator (NFVO) uses VNF Managers for the lifecycle management of VNF instances and the VIM allocates the needed virtualized resources as requested by the NFVO into the NFVI. However, the same approach cannot be applied to network functions of dedicated hardware

(Physical Network Functions, PNF) as their resources are not controlled by NFVO nor VIMs. Network Functions (whether PNF or VNF) require their function specific management, as well as their resource management.

When adding support for the virtualized version of the PNFs their management systems will evolve to either extend their capability with an embedded VNF management functionality or will delegate their virtual resource management to an external VNF manager. In either case, the VNF management function interacts with the NFVO and the VIM through the MANO defined interfaces and provides the cloud resource FCAPS management for the network functions. Another key issue for provisioning of network slices is the identification, design, and management of network functions which can be shared by multiple end-to-end slices [[Rost](#)].

For Network slice management function (NSMF), which is a slice-dedicated function with slice-specific view on any FCAPS data and management procedures, such sharing or common usage should be transparent, i.e., the multiplexing of multiple network slices to a commonly used function/element is done by EMS/NMS. NSMF operates above NFVO and PNFs Management Functions in the Service M&O. In view of 3GPP as well as ETSI NFV, NSMF belongs to OSS/BSS. When a network slice contains PNFs the NSMF instructs the PNFs Management Functions to configure the physical network components to deliver the required slice characteristics.

This draft introduces the role of NSMF in the context of 3GPP [[TR28.801](#)], [[TS28.530](#)] and ETSI [[MANO](#)] work and reflects that back to netslices-architecture presented in [[NS-Framework](#)]. We argue that the NSMF is at the Service M&O level, even at a tenant. This is because of several reasons:

- o Need for exposing different levels of network slice control to the tenants.
- o Different life cycle management approaches for PNFs and VNFs. NSMF must have interfaces both to NFVO and to PNFs Management and is therefore above of the NFVO and PNF management and it should support service level abstractions.

Network slicing is end-to-end concept, thus including several network components, (Network Slice Subnetwork Functions according to 3GPP terminology). Often those components belong to different administrative domains (e.g. RAN, Core Network, Transport) and therefore the need for a higher level of abstraction. Transport network [[ACTN](#)] is a subnetwork slice in the 3GPP model and recursion can be applied to slices as well as to subnetwork slices.

1.1. Acronyms and Abbreviations

This document uses the following acronyms:

3GPP	3rd Generation Partnership Project
BSS/OSS	Business Support Systems/Operations Support Systems
EMS	Element Management System
ETSI	European Telecommunications Standards Institute
FCAPS	Fault, Configuration, Accounting, Performance, Security
IaaS	Infra structure as a Service
KPI	Key Performance Indicator
MANO	ETSI Management and Orchestration
LCM	Life Cycle Management
MNO	Mobile Network Operator
M&O	Management & Orchestration
NaaS	Network as a Service
NGMN	Next Generation Mobile Networks
NMS	Network Management System
NSMF	Network Slice Subnet Management Functions
NSSMF	Network Slice Management Function
NFVI	Network Functions Virtualisation Infrastructure
NVFO	Network Virtualization Function Orchestrator
PNF	Physical Network Function
RAN	Radio Access Network
SLA	Service Level Agreement
VIM	Virtualised Infrastructure Manager
VNF	Virtualised Network Function

2. Different levels of Network Slice Control exposure

Depending on the "Slice Provider" - "Slice Consumer" -relationship the Slice Provider can offer various levels of control to the Slice Consumers. Roughly speaking levels of control can be categorized onto follow cases:

1. Monitoring only. The Slice Provider offers only means to monitor the slice KPIs as agreed in the contract. Network slice configuration is chosen from a catalogue of readymade slice templates. Accesses via dashboard-like web service and/or north bound interfaces provided by the Slice Provider.
2. Limited control to Slice Consumer to perform design and composition of network slice. Slice Consumer can change configuration of deployed network functions and /or onboard own certified network functions into Slice Provider's repository using interfaces provided by the Slice Provider.

3. **Extended Control.** In this case the Slice Consumer deploys and operates the network slice using its own MANO stack and NMS. The Slice consumer has tight control over its own network functions and services while has limited control over MNO network functions.

Because of these varying levels of network slice control, the NSMF needs to support different abstractions of resources and to offer access to different management entities (e.g. PNFs management functions, NFV-MANO). Consequently, the logical place for NSMF function in the network slice management architecture is at the Service Management & Orchestration (M&O).

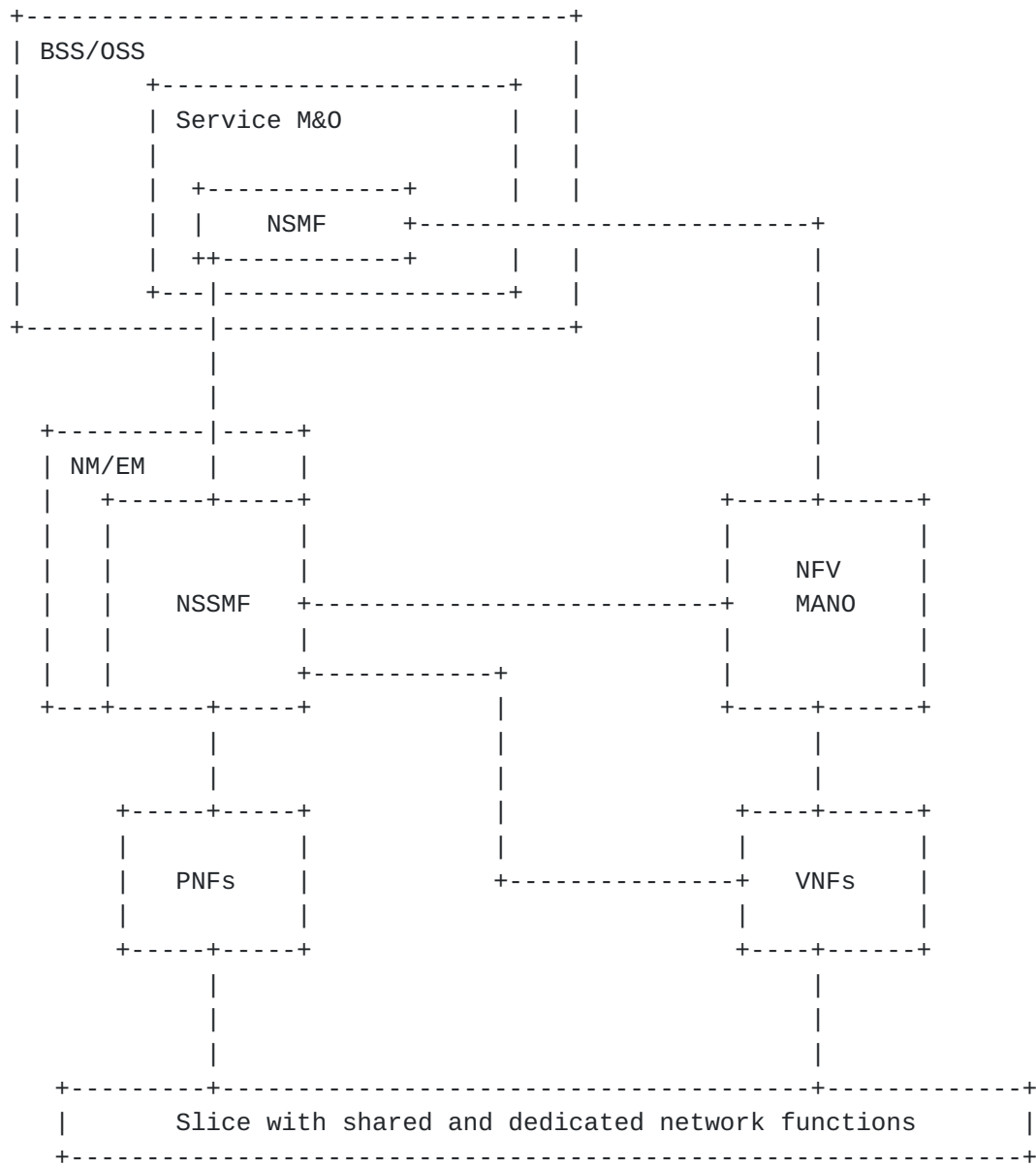
3. Network Slice Management Function (NSMF)

Network slicing concept of NGMN consists of 3 layers: Service Instance Layer, Network Slice Instance Layer, and Resource layer [[NGMN_NS](#)]. The Service Instance Layer is managed by service orchestrator that is considered to be part of BSS/OSS according to the 3GPP view [[TR28.801](#)]. Network Slicing Instance Layer is a Business to Business service and may pass across multiple administrative domains. Network Slice Management Function resides at this layer and is consequently part of Service Orchestration and BSS/OSS.

The end-to-end network slice management (NSMF) can use different technology domains and their segments to create an end-to-end slice. It has full visibility and control to the end-to-end slice and its performance. It resides above the Network Slice Subnet Management Functions (NSSMF). It monitors slice specific FCAPS to maintain and to expose the overall SLAs of the end-to-end slices to the tenant.

NSMF interfaces domain specific Network Management and Element Management Systems through Network Slice Subnet Management Functions (NSSMF). In addition, NSMF also interfaces NFV-MANO to manage virtualization aspects (through "OS-Ma-nfvo"-interface).

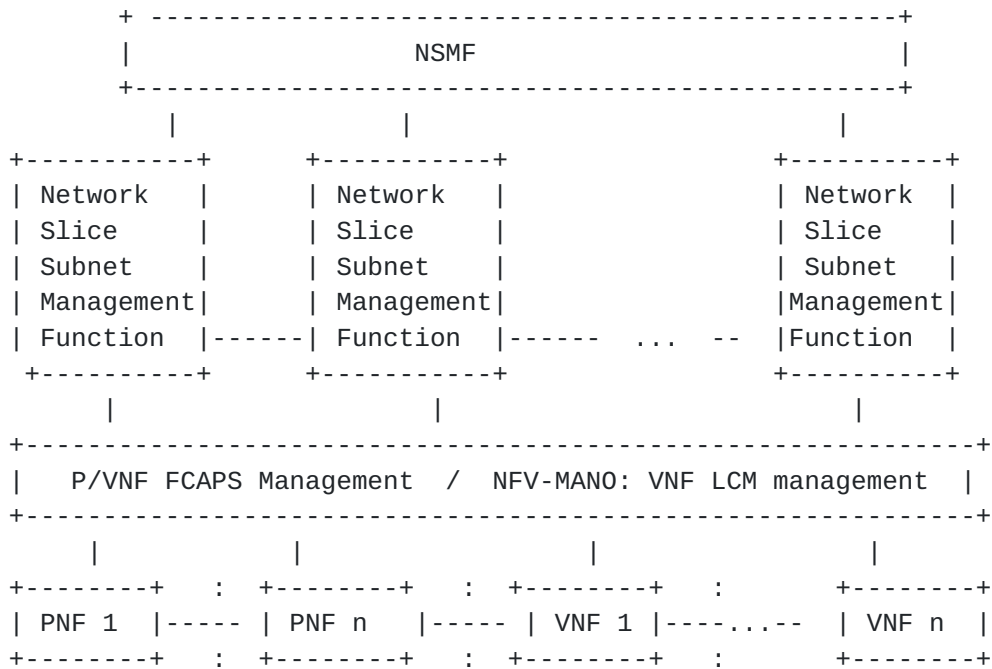
NSSMF manages Network Slice Subnet (3GPP defined management abstraction) composed of Network Functions (virtualized or not) and other Network Slice Subnets (recursion principle). NM/EM could play the role of NSSMF. For management of virtualization aspects (such as NS and VNF LCM) and TN, NSSMF interacts with NFV-MANO (through "Os-Ma-nfvo"-interface). The 3GPP defined Network Slice Subnets correspond to ETSI NFV defined NSs composed from either network functions and/or nested network slices (recursion principle).



Network Slice Management functional architecture.

Figure 1

Based on the above reasoning we propose to replace the "Figure 2: E2E Slice Orchestration"-figure of the section of Management and Orchestration of Network Slicing in [NS-Framework] with the following figure with the above stated reasoning.



Network Slice Management Function (Network Slice segment term corresponds roughly to Network Slice subnetwork term used by 3GPP/NGMN)

Figure 2

4. IANA considerations

This document makes no request of IANA.

5. Security considerations

Each element and their interface of the proposed management architecture needs to address their security requirements.

6. Acknowledgements

7. Informative References

[ACTN] Ceccarelli, D. and Lee, Y., "Framework for Abstraction and Control of Traffic Engineered Networks", [draft-ietf-teas-actn-framework-06](#) (work in progress), June 2017.

[MANO] ETSI, "ETSI GS NFV-MAN 001: Network Functions Virtualization (NFV); Management and Orchestration", 2014.

- [NGMN_NS] NGMN Alliance, "Description of Network Slicing Concept", https://www.ngmn.org/uploads/media/161010_NGMN_Network_Slicing_framework_v1.0.8.pdf , 2016.
- [NGMN_NSMN] NGMN Alliance, "5G Network and Service Management including Orchestration", <https://www.ngmn.org/publications/all-downloads/article/5g-network-and-service-management-including-orchestration.html> , 2017.
- [NS-Framework] Geng, L., Dong, J., Bryant, S., Makhijani, K., Galis, A., De Foy, X., and Kuklinsk, S., "Network Slicing Architecture", [draft-geng-netslices-architecture-01](#) (work in progress), June 2017.
- [Rost] Rost, P., Mannweiler, C., Diomidis, M., Sartori, C., Sciancalepore, V., Sastry, N., Holland, O., Tayade, S., Han, B., Bega, D., Aziz, D., Bakker, H., and IEEE Communications Magazine, Volume: 55 Issue: 5,, "Network Slicing to Enable Scalability and Flexibility in 5G Mobile Networks", May 2017.
- [TR28.801] 3GPP, "Study on management and orchestration of network slicing for next generation network, Release 14)3GPP TR 28.801 V1.2.0", <https://portal.3gpp.org/desktopmodules/Specifications/SpecificationDetails.aspx?specificationId=3091> , 2017.
- [TS28.530] 3GPP, "Management of network slicing in mobile networks; Concepts, use cases and requirements. Technical specification. Release 15. 3GPP TR 28.530.", <https://portal.3gpp.org/desktopmodules/Specifications/SpecificationDetails.aspx?specificationId=3091> , 2017.

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