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Multi-access Edge Computing (MEC); Support for network slicing

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Foreword

This Group Report (GR) has been produced by ETSI Industry Specification Group (ISG) Multi-access Edge Computing (MEC).

Modal verbs terminology

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1 Scope

The present document focuses on identifying the MEC functionalities to support network slicing. It first analyses the relevant network slicing concepts as defined by external organizations. Next, it collects relevant use cases based on the identified network slicing concepts when applied in the context of MEC and it evaluates the gaps from the defined MEC functional elements. When necessary, the present document identifies new MEC functionalities or interfaces as well as changes to existing MEC functional elements, interfaces and requirements. It will also recommend the necessary normative work to close these gaps if identified.

2 References

2.1 Normative references

Normative references are not applicable in the present document.

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] ETSI GS MEC 001: "Multi-access Edge Computing (MEC); Terminology".

[i.2] NGMN Alliance: "5G White Paper", February 2015.

[i.3] NGMN Alliance: "Description of Network Slicing Concept", January 2016.

[i.4] Open Networking Foundation: "Applying SDN Architecture to 5G slicing", ONF TR-526, April 2016.

[i.5] ETSI TS 123 501: "5G; System architecture for the 5G System (5GS) (3GPP TS 23.501)".

[i.6] 3GPP TR 28.801: "Telecommunication management; Study on management and orchestration of network slicing for next generation network".

[i.7] ETSI TS 128 530: "5G; Management and orchestration; Concepts, use cases and requirements (3GPP TS 28.530)".

[i.8] ETSI GS NFV-MAN 001: "Network Functions Virtualisation (NFV); Management and Orchestration".

[i.9] ETSI GS NFV-IFA 013: "Network Function Virtualization (NFV); Management and Orchestration; Os-Ma-Nfvo reference point - Interface and Information Model Specification".

[i.10] ETSI GR MEC 017: "Mobile Edge Computing (MEC); Deployment of Mobile Edge Computing in an NFV environment".

[i.11] ETSI GS MEC 010-2: "Multi-access Edge Computing (MEC); MEC Management; Part 2: Application lifecycle, rules and requirements management".

[i.12] ETSI GS MEC 003: "Multi-access Edge Computing (MEC); Framework and Reference Architecture".

[i.13] ETSI GS MEC 002: "Multi-access Edge Computing (MEC); Phase 2: Use Cases and Requirements".

[i.14] ETSI GS MEC 010-1: "Mobile Edge Computing (MEC); Mobile Edge Management; Part 1: System, host and platform management".

[i.15] ETSI White Paper No. 28: "MEC in 5G networks"; First edition - June 2018; ISBN No. 979-10-92620-22-1.

[i.16] ETSI GR NFV-EVE 012: "Network Functions Virtualisation (NFV) Release 3; Evolution and Ecosystem; Report on Network Slicing Support with ETSI NFV Architecture Framework".

[i.17] ETSI GR NFV 001: "Network Functions Virtualisation (NFV); Use Cases".

[i.18] ETSI GR NFV-IFA 028: "Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; Report on architecture options to support multiple administrative domains".

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the terms given in ETSI GS MEC 001 [i.1] apply.

3.2 Symbols

Void.

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in ETSI GS MEC 001 [i.1] and the following apply:

3GPP	3rd Generation Partnership Project
5G	Fifth Generation
5QI	5G QoS Class Identifier
AMF	Access and Mobility Management Function
AN	Access Network
API	Application Programming Interface
CN	Core Network
CSMF	Communication Service Management Function
DN	Data Network
E2E	End-to-End
eMBB	enhanced Mobile Broadband
IoT	Internet of Things
MEAO	Multi-access Edge Application Orchestrator
MEC	Multi-access Edge Computing
MEP	Multi-access Edge Platform
MEPM	Multi-access Edge Platform Manager
MEPM-V	Multi-access Edge Platform Manager - NFV
MIoT	Massive Internet of Things
NF	Network Function
NFV	Network Function Virtualisation
NFVI	NFV Infrastructure
NFVO	NFV Orchestrator
NFV-SCF	NFV-Slice Control Function
NGMN	Next Generation Mobile Networks
NRF	NF Repository Function
NS	Network Service
NSD	Network Service Descriptor

NSI	Network Slice Instance
NSMF	Network Slice Management Function
NSSAI	Network Slice Selection Assistance Information
NSSF	Network Slice Selection Function
NSSI	Network Slice Subnet Instance
NSSMF	Network Slice Subnet Management Function
NSSP	Network Slice Selection Policy
NST	Network Slice Template
ONF	Open Networking Foundation
OSS	Operations Support System
PCC	Policy & Charging Control
PCF	Policy Control Function
PDB	Packet Delay Budget
PDU	Protocol Data Unit
PLMN	Public Land Mobile Network
PNF	Physical Network Function
QoS	Quality of Service
RAN	Radio Access Network
RAT	Radio Access Technology
RNI	Radio Network Information
RRC	Radio Resource Connection
RTT	Round Trip Time
SD	Slice Differentiator
SDN	Software Defined Networking
SDO	Standards Development Organization
SI	Service Instance
SLA	Service Level Agreement
SMF	Session Management Function
S-NSSAI	Single NSSAI
SST	Slice/Service Type
TN	Transport Network
UE	User Equipment
UPF	User Plane Function
URLLC	Ultra-Reliable Low Latency Communications
V2X	Vehicle-to-everything
VIM	Virtualised Infrastructure Manager
VNF	Virtual Network Function
VNFFG	VNF Forwarding Graph
VNFM	VNF Manager

4 Overview

4.1 Introduction

The following clauses 4.2 to 4.5 provide an overview of network slicing concept as it has been defined in different SDOs and Fora. In particular, the following clauses refer to the most relevant external body's documents which introduce and define network slicing, and describe related specifications provided in NGMN, ONF, 3GPP and ETSI ISG NFV.

4.2 NGMN

According to NGMN "5G White Paper" [i.2], a network slice (i.e. "5G slice") supports the communication service of a particular connection type with a specific way of handling the C- and U-plane for this service. To this end, a 5G slice is composed of a collection of 5G network functions and specific Radio Access Technology (RAT) settings that are combined for the specific use case or business model while leveraging NFV and SDN concepts. Thus, a 5G slice can span all domains of the network: software modules running on cloud nodes, specific configurations of the transport network supporting flexible location of functions, a dedicated radio configuration or even a specific RAT, as well as configuration of the 5G device.

More specifically, the NGMN white paper "Description of Network Slicing Concept" [i.3] provides a detailed description of terminology and network slicing related concepts that are organized according to a three-layer architecture, as shown in Figure 4.2-1:

- **Service Instance Layer:** the end-user or business services, provided by a network operator or a 3rd party, which should be supported by the slice. Each service is represented by a Service Instance (SI).
- **Network Slice Instance Layer:** Network Slice Instances are sets of functions, each forming a complete instantiated logical network to meet certain network characteristics (e.g. ultra-low latency, ultra-reliability) required by the Service Instance(s). They are created based on Network Slice Blueprints, which provide a complete description of the network slice structure, lifecycle workflow and configuration options. A Network Slice Instance can be shared among multiple Service Instances, at least when the Service Instances are provided by network operators. Each Network Slice Instance may include one or more Sub-Network Instances to form a set of Network Functions running in physical or logical resources.
- **Resource Layer:** Resources are distinguished in "physical resources" and "logical resources". A physical resource is a physical asset for computation, storage or transport, including radio access. Logical resources are partitions of physical resources or grouping of multiple physical resources dedicated to a Network Function or shared between a group of Network Functions.

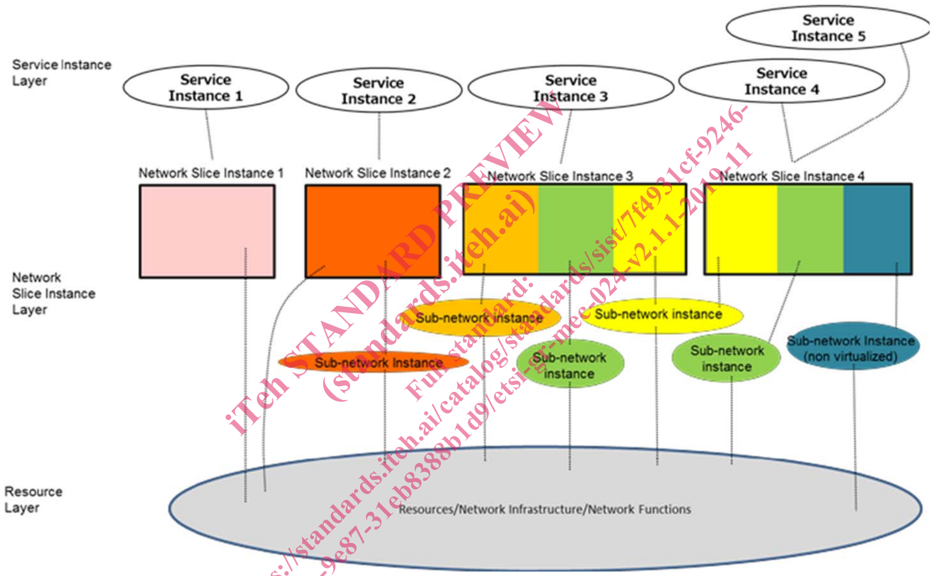

Figure 4.2-1: NGMN Network Slice Concept (Figure 1 in NGMN White Paper "Description of Network Slicing Concept" [i.3])

The mapping between the NGMN layers and the ETSI NFV architectural framework is illustrated in Figure 4.2-2 and can be summarized as follows:

- the Service Instance layer plays the role of an OSS functional block with regards to the NFVO;
- the Network Slice Instance layer maps to the collection of Network Services handled by NFV Management & Orchestration functions. The network service can be described by a VNF Forwarding Graph (VNFFG), typically defined by a Network Service Descriptor (NSD) using a specific deployment flavour;
- the Resource layer maps to the NFVI and the VIM(s).

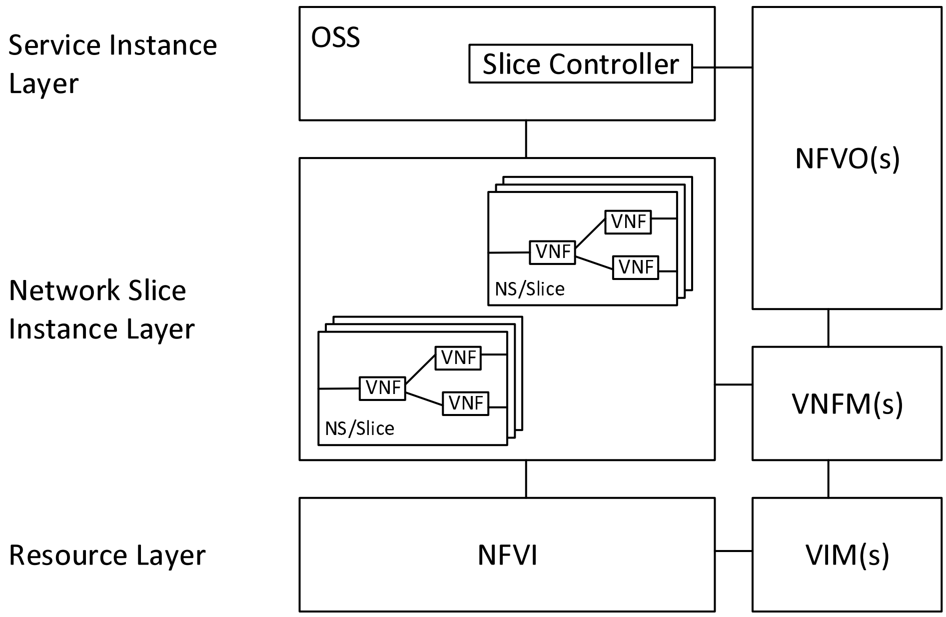

Figure 4.2-2: Mapping of the NGMN layers onto the ETSI NFV architectural framework

Based on the NGMN white papers [i.2], [i.3], the NGMN focus is mainly given to communications services and to traffic treatment into the 5G slice across both mobile and core networks while providing the network capacity when and where needed and according to the use case requirements. Moreover, although cloud nodes are considered as possible substrate to host the 5G network functions, not any reference is provided to the specific location of cloud resources used to allocate the 5G slice, whether at the edge or in the centralized cloud. Finally, although the deployment of application functions is considered as an option to address specific use cases (e.g. 5G slice for smartphone use), the on-boarding of vertical application on a cloud node is not specifically addressed except in terms of just promoting the definition of open interfaces.

4.3 ONF

The SDN architecture defined by ONF TR-526 [i.4] allows multiple client network instances to share the common underlying infrastructure in a technology-independent fashion, thus enabling the orchestration of any type of resources, such as storage, computing, and heterogeneous network resources (i.e. wired, wireless, and mobile) that may be available at any location of the network including the edge. At that end, the ONF architecture comprises three main components (see Figure 4.3-1), namely applications, SDN controller, and resources. A client-server relationship is established through the interfaces between the applications and SDN controller and between the SDN controller and the underlying resources.

The SDN controller is in charge of mapping the service requirements to the underlying resources according to policies defined by the administrator of the network and of dynamically optimizing the use of such resources. The SDN controller provides two types of resource views: one offered to the application on top, through a client context, which is specific to a given client, and a second one enabling the interaction with the underlying resources, through a server context, which is specific to a given group of underlying resources. The client context is created by the administrator after a business agreement is reached between the client organization and the serving organization. Through orchestration, the SDN controller dynamically handles the contention of multiple services for the resources of a common infrastructure and it offers a homogeneous end-to-end handling of the underlying resources, even if belonging to different technical and/or administrative domains. Through virtualisation instead, the SDN controller creates the client context by allocating (part of) the underlying resources to that client. Additionally, the client context also includes the actions by the client that are allowed over those resources. As part of the client context, resource groups determine how virtual resources are exposed to the client.