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TECHNICAL SPECIFICATION

5G;
Management and orchestration;
Concepts, use cases and requirements
(3GPP TS 28.530 version 16.5.0 Release 16)

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Contents

Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

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y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

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Introduction

Network slicing is a key feature for 5G. Network slicing is a paradigm where logical networks/partitions are created, with appropriate isolation, resources and optimized topology to serve a purpose or service category (e.g. use case/traffic category, or for MNO internal reasons) or customers (logical system created "on demand").

1 Scope

The present document specifies the concepts, use cases and requirements for management of network slicing in mobile networks. The 3GPP management system directly manages only the parts of the network that consist of network functions specified in 3GPP (e.g. 5G RAN, 5G CN and IMS). For the network functions specified by other SDOs, the management impact of network slicing is addressed as required. For example, regarding the Transport Network (TN) part supporting connectivity within and between CN and RAN parts, 3GPP management system may provide link requirements (e.g. topology, QOS parameters) to the TN management system.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1]   3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2]   3GPP TS 22.261 "Service requirements for next generation new services and markets".

[3]   3GPP TS 23.501: " System Architecture for the 5G system".

[4]   3GPP TS 38.401 "NG-RAN; Architecture description".

[5]   3GPP TS 28.531: "Management and orchestration; Provisioning".

[6]   3GPP TS 28.541: "Management and orchestration ; 5G Network Resource Model (NRM); Stage 2 and stage3".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in 3GPP TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in 3GPP TR 21.905 [1].

network slice: a logical network that provides specific network capabilities and network characteristics, supporting various service properties for network slice customers.

NOTE 1: NetworkSlice Information Object Class (IOC) (refer to TS 28.541 [6]) is used to model network slice.

NOTE 2: Represent network slice defined in TS 23.501 [3] with added service properties.

NetworkSlice instance: A Managed Object Instance (MOI) of NetworkSlice IOC.

NOTE 3: NetworkSlice instance represents service view of a network slice which exposes the root NetworkSliceSubnet instance .

network slice subnet: a representation of a set of network functions and the associated resources (e.g. compute, storage and networking resources) supporting network slice.

NOTE 4: NetworkSliceSubnet IOC (refer to TS 28.541 [x]) is used to model network slice subnet which may include core network functions and/or RAN network functions and/or other network slice subnets. The network slice instance defined in TS 23.501 [3] can be reflected via the NetworkSliceSubnet IOC and the allocated resources.

NetworkSliceSubnet instance: A Managed Object Instance (MOI) of NetworkSliceSubnet IOC.

Service Level Specification (SLS) : a set of service level requirements associated with a Service Level Agreement (SLA) to be satisfied by a network slice.

NOTE: Void

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in 3GPP TR 21.905 [1].

CSC	Communication Service Customer
CSMF	Communication Service Management Function
CSP	Communication Service Provider
DN	Data Network
MNO	Mobile Network Operator
NOP	Network Operator
NSaaS	Network Slice as a Service
NSaasC	Network Slice as a Service Customer
NSaaSP	Network Slice as a Service Provider
NSMF	Network Slice Management Function
NSC	Network Slice Customer
NSSMF	Network Slice Subnet Management Function
NSP	Network Slice Provider
SLA	Service Level Agreement
SLS	Service Level Specification
TN	Transport Network

4 Concepts and background

4.1 General concepts

4.1.1 Management of 5G networks and network slicing

5G system consists of 5G Access Network (AN), 5G Core Network and UE, see TS 23.501 [3].

5G system is expected to be able to provide optimized support for a variety of different communication services, different traffic loads, and different end user communities, see clause 4 of TS 22.261 [2]. For example, the communication services using network slicing may include:

- V2X services

  The 5G system aims to enhance its capability to meet KPIs that emerging V2X applications require. For these advanced applications, the requirements, such as data rate, reliability, latency, communication range and speed, are made more stringent, see clause 4 of TS 22.261 [2].

- 5G seamless eMBB service with FMC

  As one of the key technologies to enable network slicing, fixed mobile convergence (FMC) which includes wireless-to-the-everything (WTTx) and fibre-to-the-everything (FTTx), is expected to provide native support for network slicing. For optimization and resource efficiency, the 5G system will select the most appropriate 3GPP

or non-3GPP access technology for a communication service, potentially allowing multiple access technologies to be used simultaneously for one or more services active on a UE, see clause 6.3 of TS 22.261 [2].

- massive IoT connections

    Support for massive Internet of Things (mIoT) brings many new requirements in addition to MBB enhancements, see clause 4 of TS 22.261 [2]. Communication services with massive IoT connections such as smart households, smart grid, smart agriculture and smart meter will require the support of a large number and high density IoT devices to be efficient and cost effective, see TS 23.501 [3]. Operators can use one or more network slices to provide these communication services, which require similar network characteristics, to different vertical industries.

The next generation 3GPP management system is expected to support the management of 3GPP 5G system and 3GPP legacy systems.

3GPP management system directly manages 3GPP managed network components (e.g. 5G RAN, 5G CN). For non-3GPP domains (e.g. DCN, TN), 3GPP management system needs to coordinate with the corresponding management systems of the non-3GPP domains.

4.1.2 Types of communication services

Communication services offered by Communication Service Providers (CSPs) to Communication Service Customers (CSCs) are of various categories, among which:

- Business to consumer (B2C) services, e.g. mobile web browsing, 5G voice, Rich Communication Services, etc.

- Business to business (B2B) services, e.g. Internet access, LAN interconnection, etc.

- Business to household (B2H) services, e.g. Internet access, MBMS, VOIP, VPN, etc.

- Business to business to everything (B2B2X) services: e.g. services offered to other CSPs (e.g. international roaming, RAN sharing, etc.) offering themselves communication services to their own customers. B2B2X service type includes B2B2 applied recursively, i.e. B2B2B, B2B2B2B, etc.

    NOTE: How to derive different network slice related requirements from different categories of communication services is not in the scope of the present document.

A communication service offered by CSPs can include a bundle of specific B2C, B2B, B2H or B2B2X type of services. Taking as an example the B2C type of services, a bundle could include: data (for mobile web browsing), voice (through 5G voice), and messaging (via Rich Communication Services). In this case, each one of the individual B2C may be fulfilled by different PDU connectivity services provided via corresponding PDU sessions.

4.1.3 Communication services using network slices

As an example, a variety of communication services provided by multiple network slice(s) are illustrated in the figure 4.1.3.1. Figure 4.1.3.1 is only for illustrative purposes to highlight the combination and relationship of communication services to network slices without depicting any UE. An actual network slice deployment offering communication services to UEs will need to comply with the 5G system architecture defined in TS 23.501 [3] and TS 38.401 [4].
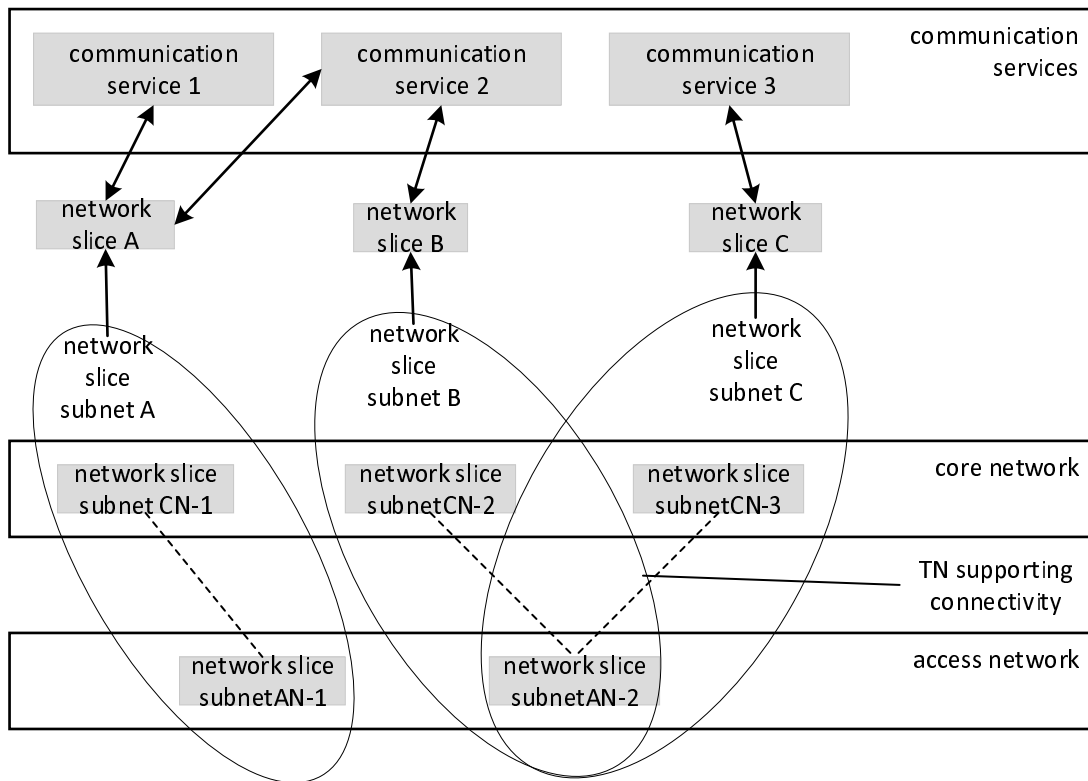
Figure 4.1.3.1: A variety of communication services provided by multiple network slices

Figure 4.1.3.1 illustrates the relationship between communication services, network slices, and network slice subnets:

- network slice subnet AN-1 and network slice subnet AN-2 each contain distinct sets of AN NFs. network slice subnet CN-1, network slice subnet CN-2 and network slice subnet CN-3 each contain distinct sets of CN NFs. The TN supporting connectivity facilitates the communication between CN and AN NFs. network slice subnet A combines network slice subnet AN-1 with network slice subnet CN-1 and corresponding TN connectivity. network slice subnet B combines network slice subnet AN-2 and network slice subnet CN-2 and corresponding TN connectivity. network slice subnet C combines network slice subnet AN-2 with network slice subnet CN-3 and corresponding TN connectivity. The network slice subnet AN-2 is shared between network slice subnet B and network slice subnet C, while network slice subnet AN-1 is dedicated to network slice subnet A.

- NOP offers network slice subnet A as a network slice A, in this relationship network slice A represents network slice subnet A with associated Service Level Specification (SLS). NOP also offers network slice subnet B as network slice B and network slice subnet C as network slice C. The SLS of network slice A satisfies the service requirements of communication service 1 and communication service 2. The SLS of network slice B satisfies the service requirements of communication service 2. The SLS of network slice C satisfies the service requirements of communication service 3.

- The communication service 1 is supported by network slice A. The communication service 2 may be supported by either network slice A or network slice B. The communication service 3 is supported by network slice C.

4.1.4   Communication services requirements

eMBB service type aims at supporting high data rates and high traffic densities as outlined in TS 22.261 [2], Table 7.1-1 "Performance requirements for high data rate and traffic density scenarios". URLLC service type aims at supporting the requirements in TS 22.261 [2], Table 7.2.2-1 "Performance requirements for low-latency and high-reliability services." related to high reliability and low latency scenarios. mIoT service type aims at supporting a large number and high density of IoT devices efficiently and cost effectively, see TS 23.501 [3].

Depending on the service type (eMBB, URLLC, mIoT), different service types may include different network slice related requirements, for example:

- Area traffic capacity requirement

- Charging requirement

- Coverage area requirement

- Degree of isolation requirement

- End-to-end latency requirement

- Mobility requirement

- Overall user density requirement

- Priority requirement

- Service availability requirement

- Service reliability requirement

- UE speed requirement

4.1.5 NetworkSlice instance Lifecycle and relationship to service instances

An NetworkSlice instance may support multiple service instances if it satisfies their service level requirements or has been modified to support these requirements. When a service instance is to be supported, it may trigger an operation phase of the NetworkSlice instance lifecycle for activation or modification(s) of an existing NetworkSlice instance, or it may trigger a commissioning phase of the NetworkSlice instance lifecycle for creation of a new NetworkSlice instance. When a service instance no longer needs to be supported by an NetworkSlice instance, it may trigger an operation phase of the NetworkSlice instance lifecycle for de-activation or modification(s) of an existing NetworkSlice instance, or it may trigger a decommissioning phase of the NetworkSlice instance lifecycle for termination of an existing NetworkSlice instance.

4.1.6 Network Slice as a Service (NSaaS)

Network Slice as a Service (NSaaS) can be offered by a CSP to its CSC in the form of a service. This service allows CSC to use the network slice as the end user or optionally allows CSC to manage the network slice as manager via management interface exposed by the CSP. In turn, these CSC can play the role of CSP and offer their own services (e.g. communication services) on top of the network slice obtained from the CSP. For example, a network slice customer can also play the role of NOP and could build their own network containing the network slice obtained from the CSP as a "building block". In this model, both CSP offering NSaaS and CSC consuming NSaaS have the knowledge of the existence of network slices. Depending on service offering, CSP offering NSaaS may impose limits on the NSaaS management capabilities exposure to the CSC, and the CSC can manage the network slice according to NSaaS management capabilities exposed and agreed upon limited level of management by the CSP.

The NSaaS offered by the CSP could be characterized by certain properties (capabilities to satisfy service level requirements), e.g.

- radio access technology,

- bandwidth,

- end-to-end latency,

- reliability,

- guaranteed / non-guaranteed QoS,

- security level, etc.

Figure 4.1.6.1 illustrates some examples on how network slices can be utilized to deliver communication services, including network slice as a Service. For simplicity this figure omits the details of how NFs are being managed and does not show their groupings into network slice subnet:

a) A Network Slice as a Service (NSaaS) is provided to CSC-A by CSP-A. Unlike the communication service delivered to end customers, in NSaaS, the offered service is the actual network slice.

b) CSC-A can use the network slice obtained from CSP-A to support own Communication Services or may add additional network functions to the obtained NSaaS and offer the resulting combination as a new network slice to CSP-B. In this case, CSC-A plays the role of NOP-B and builds his own network. The network slice obtained by CSC-A from CSP-A becomes a "building block" or a network slice subnet of CSC-A in its role of NOP-B. The NOP-B (a.k.a. CSC-A) combines this network slice subnet with other network slice subnets and offers the new network slice subnet as network slice to CSP-B.

c) CSP-B can use the network slice obtained from CSC-A / NOP-B to deliver communication services to its end customers (as CSC-B).
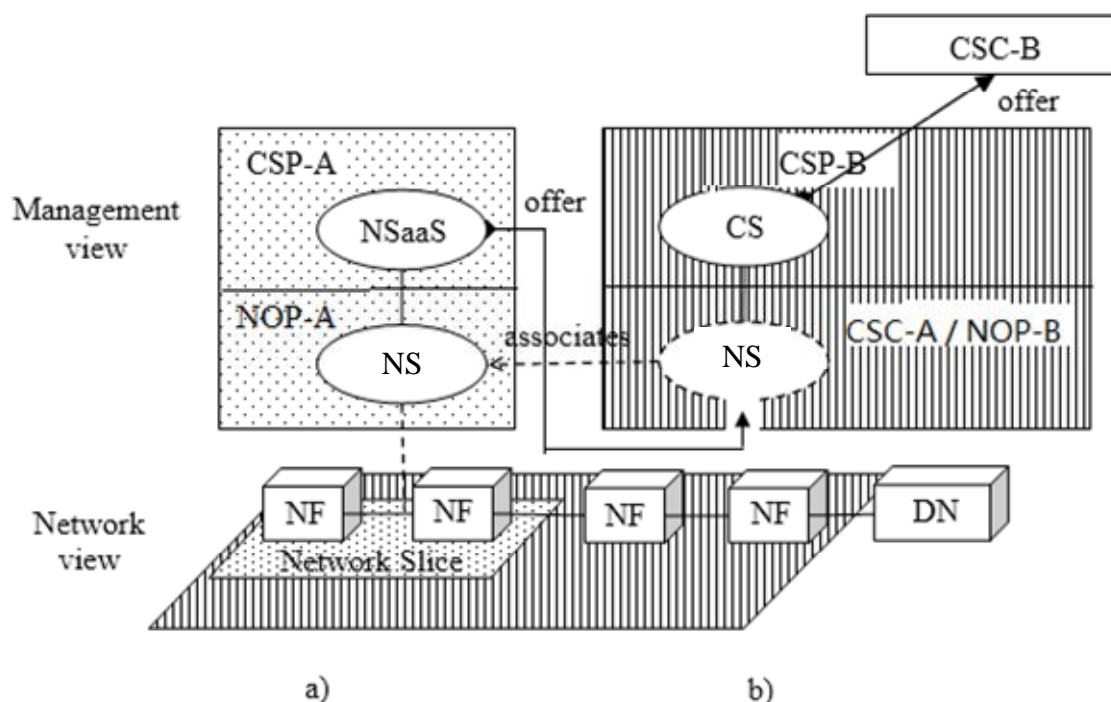
Figure 4.1.6.1: Examples of Network Slice as a Service (NSaaS) being utilized to deliver communication services to end customers

NOTE: In Figure 4.1.6.1, NS represents network slice, CS represents communication service

4.1.7 Network slices as NOP internals

In the "network slices as NOP internals" model, network slices are not part of the NOP service offering and hence are not visible to its customers. However, the NOP, to provide support to communication services, may decide to deploy network slices, e.g. for internal network optimization purposes. This model allows CSC to use the network as the end user or optionally allows CSC to monitor the service status (assurance of the SLA associated with the internally offered network slice).

The CSP should be able to provide the service status information (e.g. service performance, fault information, traffic data, etc) to CSC via the management exposure interface.

Figure 4.1.7.1 illustrates an example on how network slices can be utilized to deliver communication services:

a) A network slice is used as NOP internal, and CSP delivers communication services to end customers (CSC).

b) The CSC should be able to monitor the network and service status information (e.g. service performance, fault information, traffic data, etc.) provided by CSP.
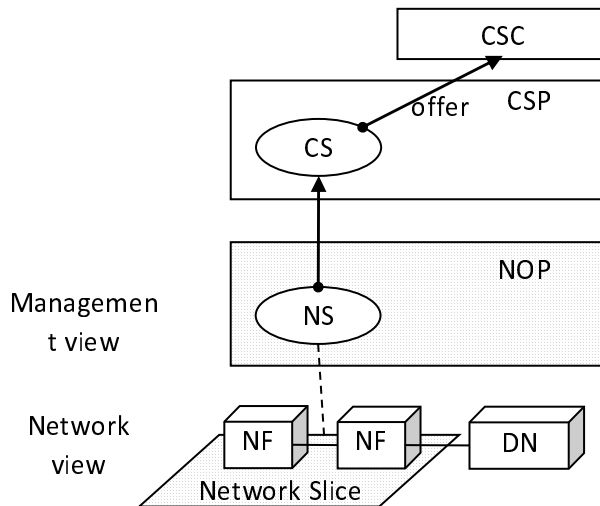
Figure 4.1.7.1: Examples of network slice as NOP internals

NOTE: In Figure 4.1.7.1, NS represents network slice, CS represents communication service

4.1.8 Network slice delivery concepts

Network slices are provided in different compositions to the customer which may include access to different management capabilities and network slice provisioning procedures for the customer.

For example, a network slice may be delivered

a) to meet customer's communication service requirements without any exposure of internal network slice structures (applicable to both individual subscribers and NSaaS); or

b) to meet the network slice requirements, with some exposure of the internal network slice structures (e.g. NFs, topology, etc.) and with some network monitoring capability as enabled by the provider; or

c) to meet the network slice requirements with some exposure of the internal network slice structures (e.g. NFs) with some management capabilities as enabled by the provider.

4.1.9 Tenant information concept

The purpose of tenant information concept is to support multiple tenant environment in 5G network management. The 3GPP management system may use tenant information for the following:

- Associating communication services with the tenant.

- Controlling access of the tenant in relation to management capabilities.

4.2 Principles

4.2.1 General Principles

The 5G network management framework is built upon the following principles:

a. Support management of 5G networks with or without network slicing features.

b. Support management across multiple operator's scenario.

   c. Support interaction with non-3GPP management system.

   d. Support service-based management.

4.2.2 Principles of network slicing management framework

The 5G network slicing management framework is built upon the following principles:

1. Standardized management service interfaces of the network slicing management services.

2. Standardized management service interfaces of network function management services.

3. Multi-vendor interaction utilizing the standardized management service interfaces of the network slicing management services, as well as the standardized management service interfaces of the network function related management functions.

4. A simple network slicing set of management functions to simplify the management of network function(s) from the slicing management point-of-view.

5. Network slicing management services are capable to support various Network Operator deployment options to support diverse use cases, and a set of generic management services applicable to all kinds of network functions.

Figure 4.2.2.1 illustrates the basic principle of standardized management services for network slicing management related capabilities.
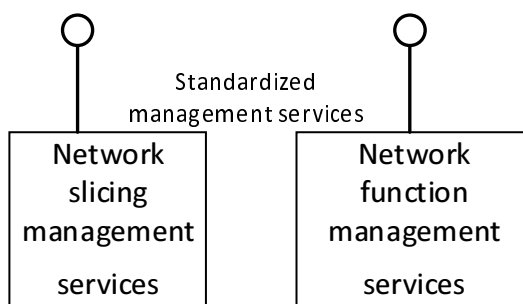

Figure 4.2.2.1: Standardized network slicing management services and network function management services

4.3 Management aspects of network slicing

4.3.1 Introduction

This clause describes management aspects of network slicing, which can be described by the four phases shown in Figure 4.3.1.1, the phases are:

- Preparation

- Commissioning

- Operation

- Decommissioning
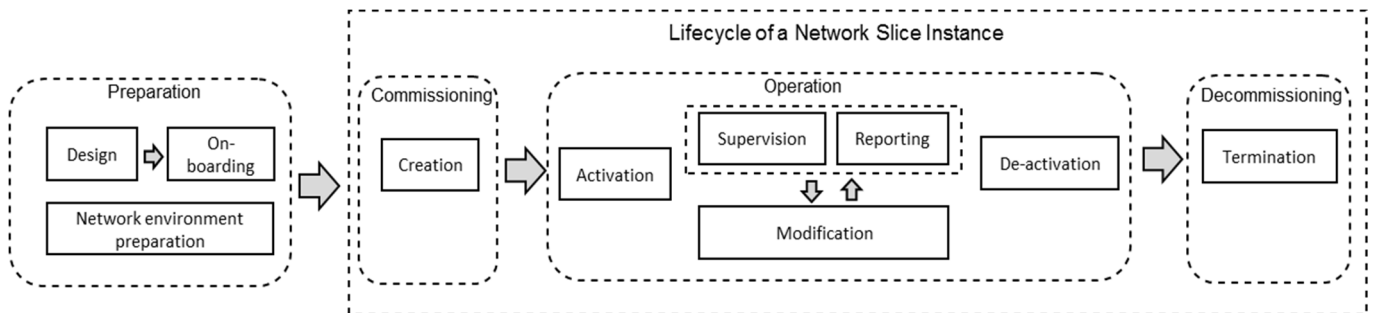
Figure 4.3.1.1: Management aspects of network slicing

Each phase, described in subsequent clauses, defines high level tasks and should include appropriate verification of the output of each task.

4.3.2 Preparation

In the preparation phase the NetworkSlice instance does not exist. The preparation phase includes network slice design, network slice capacity planning, on-boarding and evaluation of the network functions, preparing the network environment and other necessary preparations required to be done before the creation of an NetworkSlice instance.

4.3.3 Commissioning

NetworkSlice instance provisioning in the commissioning phase includes creation of the NetworkSlice instance. During NetworkSlice instance creation all needed resources are allocated and configured to satisfy the network slice requirements. The creation of an NetworkSlice instance can include creation and/or modification of the NetworkSlice instance constituents.

4.3.4 Operation

The Operation phase includes the activation, supervision, performance reporting (e.g. for KPI monitoring), resource capacity planning, modification, and de-activation of an NetworkSlice instance.

Activation makes the NetworkSlice instance ready to support communication services.

Resource capacity planning includes any actions that calculates resource usage based on an NetworkSlice instance provisioning, and performance monitoring and generates modification polices as a result of the calculation.

NOTE: Automation of resource capacity planning is out of scope of the present document.

NetworkSlice instance modification could be including e.g. capacity or topology changes. The modification can include creation or modification of NetworkSlice instance constituents. NetworkSlice instance modification can be triggered by receiving new network slice requirements or as the result of supervision/reporting

The deactivation includes actions that make the NetworkSlice instance inactive and stops the communication services.

Network slice provisioning actions in the operation phase involves activation, modification and de-activation of an NetworkSlice instance.

4.3.5 Decommissioning

NetworkSlice instance provisioning in the decommissioning phase includes decommissioning of non-shared constituents if required and removing the NetworkSlice instance specific configuration from the shared constituents. After the decommissioning phase, the NetworkSlice instance is terminated and does not exist anymore.

4.4   Managed network slice concepts

4.4.1   General

From a management point of view a network slice is complete in the sense that it includes all the network function instances, with their supporting resources, to provide service for certain business purpose (e.g. to support a certain set of communication services, provide PNI-NPNs, etc. in NSaaS model) or operational efficiencies purpose (e.g. to optimize operator internal O&M procedures in network slice as NOP internals model). In other words, the network slice is complete because it completely satisfies the associated SLS.

The following concepts are related to network slicing management:

a.   Services which are supported by network slices (services whose service level requirements are satisfied by the SLS associated with the network slices).

b.   Network slice subnet instances and networks composed of PNF, VNF or both and offered as network slices.

c.   Network function (PNFs, VNFs) grouped into network slice subnets.

d.   Resources which support the network (e.g. virtualized resource, non-virtualized resource)

The management aspects of the network slice are represented by management of the CN part, and AN part which are directly managed by the 3GPP management system, and management of non-3GPP part which is not directly managed by the 3GPP management system. The non-3GPP part includes TN parts. The 3GPP management system provides the network slice requirements to the corresponding management systems of those non-3GPP parts, e.g. the TN part supports connectivity within and between CN and AN parts. For the TN part, the 3GPP management system provides the TN topology requirements and individual TN links' QoS attributes requirements to the TN management system.

The 3GPP management system maintains the network topology and the related QOS requirements.
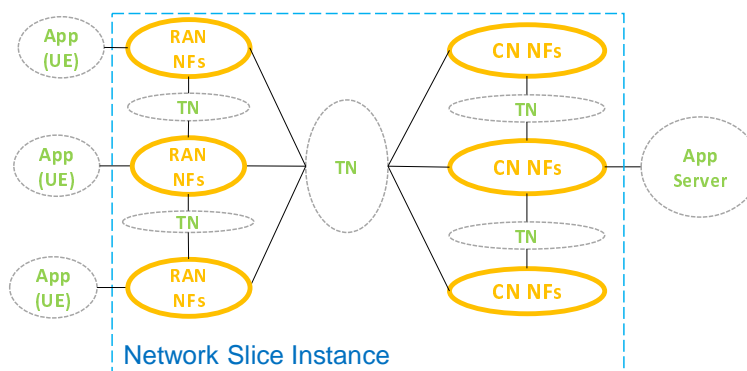
Figure 4.4.1.1: Example of a network slice

4.5   Network slice subnet concepts

The network slice subnet represents a group of network functions (including their corresponding resources) that form part or complete constituents of a network slice. The grouping of the network functions allows the management of each group of network functions to be conducted independently of the network slice.

The network slice subnet concepts include the following aspects:

-   A network slice subnet constituent may include network function(s) and other constituent network slice subnet(s).

-   A network slice subnet may be shared by two or more network slices, this is called a shared constituent of network slice. This sharing may be direct or indirect. The direct sharing implies that the network slice subnet is offered as network slice multiple times. The indirect sharing implies that the network slice subnet is either a constituent of a network slice subnet shared by two or more network slices, or is shared by two or more network slice subnet(s) which are in turn offered as different network slices.

- A network slice subnet may be shared by two or more network slice subnet(s), this is also called a shared constituent of network slice subnet. The sharing may be direct or indirect. The direct sharing implies that network slice subnet is a constituent of two or more network slice subnets. The indirect sharing implies that network slice subnet is a constituent of a shared network slice subnet.

- A network slice subnet that is dedicated to one network slice and is not shared as a constituent by two or more network slice subnet(s) is called a non-shared network slice subnet.

- A network slice subnet may contain instances of CN network functions only, or instances of AN network functions only, or any combination thereof.

- A network slice subnet may additionally have information representing a set of links with capacities to provide connection between network functions. This information is also known as TN requirements of the network slice subnet.

- The resources used, and whose management aspects are represented by a network slice subnet comprise physical and logical resources. In case of virtualization, virtualized resources may be used.

4.6 Slice profile and service profile concepts

4.6.1 Slice profile

The network slice subnet has an associated set of requirements (e.g. those derived from service level requirements) that are applicable to the network slice subnet constituents, such set is called slice profile. TN requirements (e.g. set of QoS attributes for the links interconnecting network slice subnet constituent network functions) is an example of requirements that may be included in the slice profile. The slice profile may be common (applicable to all network slice subnet constituents, regardless of their types) or specific (applicable to only AN network function or only to CN network function network slice subnet constituents).

4.6.2 Service profile

Depending on industry requirements and operator's requirements, different service profiles may be used to represent SLS associated with network slices.

The following are examples for service profiles:

- A service profile is used to capture a set of requirements for the new network slice such as (eMBB, MIoT, URLLC).

- A service profile is used to capture a set of specific industry requirements for creation of network slice such as V2X, smart grid, Remote Healthcare.

4.7 Coordination with management systems of non-3GPP parts

When providing an end to end communication service, the network may use non-3GPP parts (e.g. Data centre network (DCN), Transport network (TN)) in addition to the network components defined in 3GPP. Therefore, in order to ensure the performance of a communication service according to the business requirements, the 3GPP management system has to coordinate with the management systems of the non-3GPP parts (e.g., MANO system) when preparing a network slice for this service. This coordination may include obtaining capabilities of the non-3GPP parts and providing the slice specific requirements and other requirements on the non-3GPP parts. Figure 4.7.1 illustrates an example for the coordination with management of TN part (e.g., directly or via MANO system).

The 3GPP management system identifies the requirements on involved network domains, such as RAN, CN and non-3GPP parts of a slice by deriving them from the customer requirements to the services supported by the network slice. The derived requirements are sent to the corresponding management systems. The coordination may also include related management data exchange between those management systems and the 3GPP management system.
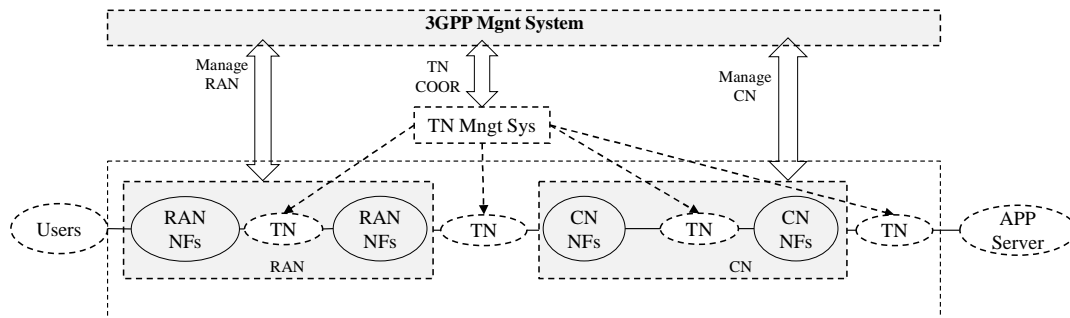
Figure 4.7.1: Example of coordination between 3GPP and TN management systems

4.8 Roles related to 5G networks and network slicing management

In the context of next generation networks, responsibilities regarding operations have to be clearly defined and assigned to roles. The roles related to 5G networks and network slicing management include:

- Communication Service Customer (CSC): Uses communication services.

- Communication Service Provider (CSP): Provides communication services. Designs, builds and operates its communication services. The CSP provided communication service can be built with or without network slice.

- Network Operator (NOP): Designs, builds and operates networks and provides related services, including network services and network slices.

- Network Equipment Provider (NEP): Supplies network equipment to network. For sake of simplicity, VNF Supplier is considered here as a type of Network Equipment Provider. This can be provided also in the form of one or more appropriate VNF(s).

- Virtualization Infrastructure Service Provider (VISP): Provides virtualized infrastructure services. Designs, builds and operates its virtualization infrastructure(s). Virtualization Infrastructure Service Providers may also offer their virtualized infrastructure services to other types of customers including to Communication Service Providers directly, i.e. without going through the Network Operator.

- Data Centre Service Provider (DCSP): Provides data centre services. Designs, builds and operates its data centres.

- NFVI Supplier: Supplies network function virtualization infrastructure to its customers.

- Hardware Supplier: Supplies hardware.

Depending on actual scenarios:

- each role can be played by one or more organizations simultaneously;

- an organization can play one or several roles simultaneously (for example, a company can play CSP and NOP roles simultaneously).
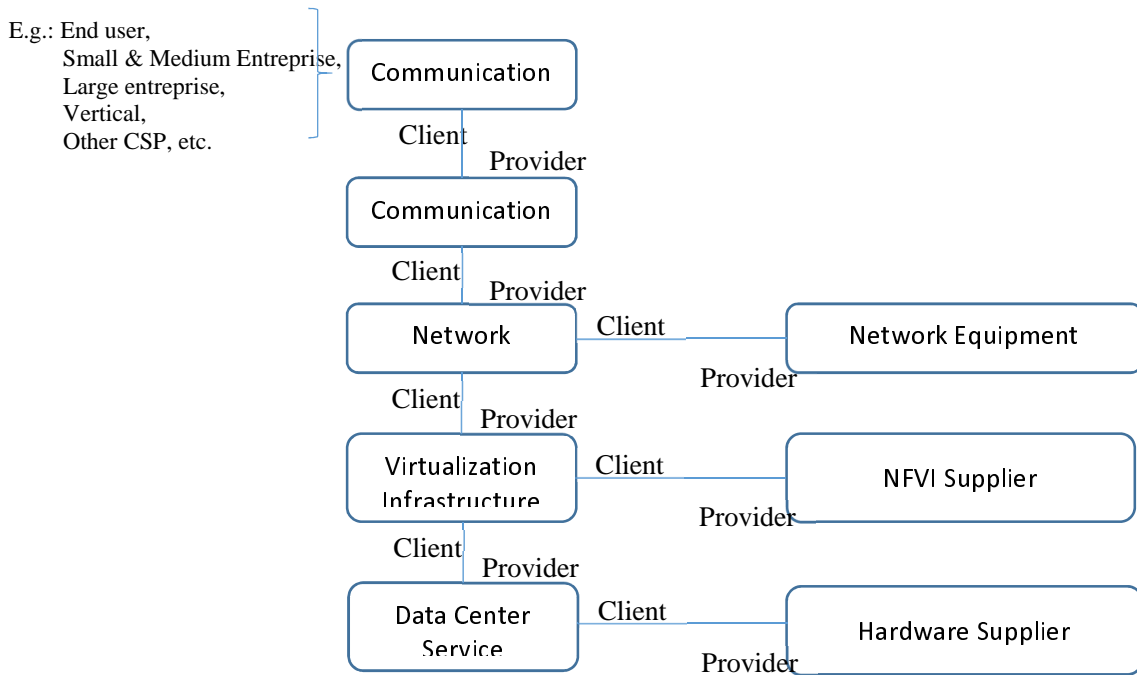
Figure 4.8.1: High-level model of roles

In case of Network Slice as a Service (NSaaS) (cf. clause 4.1.6), the Communication Service Provider (CSP) role can be refined into NSaaS Provider (NSaaSP) role – or, in short, Network Slice Provider (NSP) - and the Communication Service Customer (CSC) role can be refined into NSaaS Customer (NSaaSC) role – or, in short, Network Slice Customer (NSC). A NSC can, in turn, offer its own communication services to its own customers, being thus CSP at the same time. A tenant might take the role of a NSC.

4.9 Void

5 Business level requirements

5.1 Requirements

5.1.1 General requirements

REQ-5GNS-CON-01 The network slicing management architecture shall allow any deployment options within the Network Operator's domain.

REQ-5GNS-CON-02 The set of network slicing management functions shall be generic to all kinds of network function and network function provider.

REQ-5GNS-CON-05 The network slicing management architecture shall provide capabilities to manage the total view of all created slice instances.

REQ-5GNS-CON-06 The network slicing management architecture should provide management capabilities that are dedicated to each network slice. The management dedicated to a network slice shall work independently from the management dedicated to another network slice.

REQ-5GNS-CON-07 The network slicing management architecture shall allow managing multiple network slices simultaneously or independently along with their lifecycle.

REQ-5GNS-CON-08 The 3GPP management system shall have the capability to determine to use network with or without slicing based on network related requirements.

REQ-5GNS-CON-09 The 3GPP management system shall, when given the capacity increase or decrease of a network slice, be able to calculate the capacity increase or decrease of a RAN slice subnet, CN slice subnet and derive corresponding requirements for the TN part that support the network slice.

REQ-5GNS-CON-10 The 3GPP management system shall be able to modify the capacity of a RAN slice subnet to a given value.

REQ-5GNS-CON-11 The 3GPP management system shall be able to modify the capacity of a CN slice subnet to a given value.

REQ-5GNS-CON-12 The 3GPP management system shall be able to communicate the TN requirements corresponding to the network slice capacity change.

REQ-5GNS-CON-13 The 3GPP management system shall be able to provide management data analytics to authorized consumers.

REQ-5GNS-CON-14 The 3GPP management system shall be able to collect and analyse relevant management data.

REQ-MnSD-FUN-15 The MnS producer shall have the capability allowing its authorized consumer to obtain information about MnS capabilites.

5.1.2 Network slicing management

REQ-3GPPMS-CON-01 The 3GPP management system shall have the capability to create a new or use an existing NetworkSlice instance according to the communication service requirements.

REQ-3GPPMS-CON-02 The 3GPP management system shall have the capability to translate the communication service requirements to network slice related requirements.

REQ-3GPPMS-CON-03 The 3GPP management system shall have the capability to create a new or use an existing NetworkSlice instance according to the network slice related requirements

   NOTE: The network slice related requirements include requirements such as: area traffic capacity, charging, coverage area, degree of isolation, end-to-end latency, mobility, overall user density, priority, service availability, service reliability, UE speed.

REQ-3GPPMS -CON-04 The 3GPP management system shall be able to create a NetworkSlice instance.

REQ-3GPPMS -CON-05 The 3GPP management system shall have the capability to monitor the network slice related data and provide the agreed data to an authorized consumer.

REQ-3GPPMS -CON-06 The 3GPP management system shall be able to create a NetworkSliceSubnet instance.

REQ-3GPPMS-CON-07 The 3GPP management system shall be able to evaluate the feasibility of providing a new NetworkSlice instance which does not impact with the existing NetworkSlice instance(s).

REQ-3GPPMS-CON-07a The 3GPP management system should have the capability of allocating the resources of NetworkSlice instances according to the priority.

REQ-3GPPMS-CON-08 The 3GPP management system should have the capability of re-allocating the resources of NetworkSlice instances according to the priority.

REQ-3GPPMS-CON-09 The 3GPP management system shall be able to manage the NetworkSlice instance lifecycle.

REQ-3GPPMS-CON-10 The 3GPP management system shall be able to provide link requirements related to the network slice (e.g. topology, QOS parameters) to the appropriate management system that handles the TN part related to the slice (e.g. via NFV MANO).

REQ-3GPPMS-CON-11 The 3GPP management system shall be able to report performance measurement data of a NetworkSlice instance to the NOP.

REQ-3GPPMS-CON-12 The 3GPP management system shall be able to report performance measurement data of a NetworkSliceSubnet instance to the NOP.

REQ-3GPPMS-CON-13 The 3GPP management system shall be able to report fault management data of a NetworkSlice instance.

REQ-3GPPMS-CON-14 The 3GPP management system shall be able to report fault management data of a NetworkSliceSubnet instance.

REQ-3GPPMS-CON-15 The 3GPP management system shall be able to activate a NetworkSlice instance.

REQ-3GPPMS-CON-16 The 3GPP management system shall be able to de-activate a NetworkSlice instance.

REQ-3GPPMS-CON-17 The 3GPP management system shall be able to modify a NetworkSlice instance.

REQ-3GPPMS-CON-18 The 3GPP management system shall be able to terminate a NetworkSlice instance.

REQ-3GPPMS-CON-19 The 3GPP management system shall be able to activate a NetworkSliceSubnet instance.

REQ-3GPPMS-CON-20 The 3GPP management system shall be able to modify a NetworkSliceSubnet instance.

REQ-3GPPMS-CON-21 The 3GPP management system shall be able to de-activate a NetworkSliceSubnet instance.

REQ-3GPPMS-CON-22 The 3GPP management system shall be able to terminate a NetworkSliceSubnet instance.

REQ-3GPPMS-CON-23 The 3GPP management system shall support slice capacity management.

REQ-3GPPMS -CON-24 The 3GPP management system shall support inter-slice orchestration (e.g., orchestrated provisioning of multiple slices and resolving issues on quality, fault, and anomaly, among multiple slices).

REQ-3GPPMS -CON-25 The 3GPP management system shall support collection and analysis of the status and events of the NetworkSlice instance resources for the purpose of fault management.

REQ-3GPPMS -CON-26 The 3GPP management system shall support collection and analysis of the status and events of the NetworkSlice instance resources for the purpose of performance management.

REQ-3GPPMS-CON-27 The 3GPP management system shall have the capability of exposing network slice management data for Network Slice as a Service (NSaaS) to the authorized consumer.

REQ-3GPPMS -CON-28 The 3GPP management system shall have the capability to differentiate communication services provided by a single NetworkSlice instance when the NetworkSlice instance is used to support multiple communication services.

REQ-3GPPMS -CON-29 The 3GPP management system shall have the capability to perform network slice related operations (e.g., performance monitoring) considering requirements for each communication service when the network slice is used to support multiple communication services.

REQ-3GPPMS-CON-30 The 3GPP management system shall be able to expose the network slice management services such as performance management, fault supervision and provisioning management to the authorized consumer based on the mutual agreement between consumer and operator.

REQ-3GPPMS-CON-31 The 3GPP management system shall have the capability to expose, based on the mutual agreement between consumer and operator, the network slice assurance services to the authorized consumers.

REQ-3GPPMS-CON-32 The 3GPP management system shall have the capability to expose, based on the mutual agreement between consumer and operator, the network slice control and configuration services to the authorized consumers and to resolve potential conflicts

5.1.3 CM requirements

REQ-3GPPCM-CON-01 The 3GPP management system shall have a capability to configure NF instances.

5.2 Actor roles

Consumers of a network management service. A consumer can be a Network Operator (NOP) or Communication Service Provider (CSP).

5.3 Telecommunication resources

The Telecommunication resources include network management functions and/or the managed network functions/resources.

5.4 High-level use cases

5.4.1 Network slicing supporting communication services

Use case stage	Evolution/Specification	<<Uses>> Related use
Goal	A communication service provider (CSP) uses the network slicing service provided by operator to offer communication services to end users.	
Actors and Roles	A CSP request a NOP to provide a network slice	
Telecom resources	3GPP management system	
Assumptions	N/A	
Pre-conditions	The CSP and the operator negotiate and sign the communication service requirements contract a.k.a. Service Level Agreement (SLA).	
Begins when	The CSP declares communication service(s) requirements to the operator. These requirements are called Service Level Specification (SLS). The operator triggers the NetworkSlice instance preparation phase which includes the on-boarding and verification of network function products, feasibility check, preparing the necessary network environment, which are used to support the lifecycle of NetworkSlice instances and any other preparations that are needed in the network.	
Step 1 (M)	Based on the SLS (e.g. coverage area, number and distribution of users, traffic demand, mobility, latency, etc.) , the operator prepares the corresponding NetworkSlice instance.	
Step 2 (M)	After the NetworkSlice instance preparation phase, the operator triggers the deployment of an NetworkSlice instance. 1) If the CSP plans to operate services across multiple operators' administrative domains, this may require cross-country operations. The operator management system will perform cross-domain collaboration with the management systems from other administrative domains for NetworkSlice instance deployment. 2) If customization of TN is required, the operator management system and TN management system will first cooperate on network planning of TN. 3) The operator management system performs overall mapping and coordination among different technical domains in order to provide the end-to-end services via the NetworkSlice instance. If CSP uses the NSaaS provided by operator to offer multiple communication services to end users, related operations (e.g., performance monitoring) are performed considering requirements for each communication service.	
Step 3 (O)	If requested, the operator provides management data of the NetworkSlice instance to the authorized CSP according to the communication service requirements. Examples of management data that could be provided to CSP include service availability and reliability, UE traffic information, etc.	
Ends when	The operator maintains the NetworkSlice instance during the lifecycle of the NetworkSlice instance.	
Exceptions	One of the steps identified above fails.	
Post-conditions	The NetworkSlice instance(s) is provided by the operator to the CSP to support one or more communication services.	
Traceability	REQ-3GPPMS-CON-01, REQ-3GPPMS-CON-02, REQ-3GPPMS-CON-03, REQ-3GPPMS-CON-04, REQ-3GPPMS-CON-05, REQ-3GPPMS-CON-07, REQ-3GPPMS-CON-08, REQ-3GPPMS-CON-09, REQ-3GPPMS-CON-10, REQ-3GPPMS -CON-28, REQ-3GPPMS -CON-29	

5.4.2 Provisioning of a network slice instance

Use case stage	Evolution/Specification	<<Uses>> Related use
Goal	To perform operations of the provisioning of a NetworkSlice instance.	
Actors and Roles	A Network Operator (NOP) plays the role of a Network Slice Provider.	
Telecom resources	3GPP management system	
Assumptions	None	
Pre-conditions	Preparation for the NetworkSlice instance is done. For creation, NetworkSlice instance is not existing. For activation, modification, de-activation or termination, the NSI is existing.	
Begins when	The 3GPP management system has received a request from the Network Operator.	
Step 1 (M)	The 3GPP management system assesses the feasibility of executing the request, e.g., checks the inventory and the required NetworkSlice instance constituents, and reserves available resources.	
Step 2 (M)	The 3GPP management system performs the LCM operations required according to the request (create, activate, modify, de-activate, or terminate) on one or more NetworkSliceSubnet instance(s). For shared NetworkSliceSubnet(s), the 3GPP management system performs required actions.	5.4.3 Provisioning of a NetworkSliceSubnet instance
Step 3 (M)	The 3GPP management system replies to the Network Operator that the requested operation is completed.	
Ends when	All the mandatory steps have passed.	
Exceptions	In case the feasibility check fails, the use case fails and the 3GPP management system rejects the request with the reason included in the reply. In case any of the LCM operations fail, the use case fails and the 3GPP management system replies to the Network Operator that the requested operation is failed with the reason included in the reply.	
Post-conditions	A NetworkSlice instance has been provisioned.	
Traceability	REQ-3GPPMS-CON-04, REQ-3GPPMS-CON-15, REQ-3GPPMS-CON-16, REQ-3GPPMS-CON-17, REQ-3GPPMS-CON-18.	

5.4.3 Provisioning of a NetworkSliceSubnet instance

Use case stage	Evolution/Specification	<<Uses>> Related use
Goal	To perform operations of the provisioning of a NetworkSliceSubnet instance.	
Actors and Roles	A Network Operator (NOP) plays the role of a Network Slice Provider (NSP) responsible for the network slice subnet.	
Telecom resources	3GPP management system	
Assumptions	None	
Pre-conditions	Preparation for the NetworkSliceSubnet instance is completed. For the creation use case an NetworkSliceSubnet instance does not exist. For activation, modification, de-activation or termination use cases, the NetworkSliceSubnet instance exists.	
Begins when	The 3GPP management system has received a request from the Network Operator.	
Step 1 (M)	The 3GPP management system assesses the feasibility of executing the request, e.g., checks the inventory and the required NetworkSliceSubnet instance constituents, and reserves available resources.	
Step 2 (M)	The 3GPP management system performs the LCM operations required according to the request (activate, modify, de-activate, or terminate) on one or more NetworkSliceSubnet instance(s) constituents. In case the required LCM operation is create a new NetworkSliceSubnet instance constituent is created.	
Step 3 (M)	The 3GPP management system replies to the Network Operator that the requested operation is completed.	
Ends when	All the mandatory steps have passed.	
Exceptions	In case the feasibility check fail, the use case fails and the 3GPP management system rejects the request with the reason included in the reply. In case any of the LCM operations fail, the use case fails and the 3GPP management system replies to the Network Operator that the requested operation has failed with the reason included in the reply.	
Post-conditions	A NetworkSliceSubnet instance has been provisioned.	
Traceability	REQ-3GPPMS-CON-06, REQ-3GPPMS-19, REQ-3GPPMS-CON-20, REQ-3GPPMS-CON-21, REQ-3GPPMS-CON-22	

5.4.4 Performance management of a NetworkSlice instance

Use case stage	Evolution/Specification	<<Uses>> Related use
Goal	To report performance measurement data of a NetworkSlice iInstance to the NOP.	
Actors and Roles	A Network Operator (NOP) plays the role of a Network Slice Provider (NSP)	
Telecom resources	3GPP management system	
Assumptions	N/A	
Pre-conditions	An NetworkSlice instance has been activated.	
Begins when	The NOP requests performance measurement and monitoring on the NetworkSlice instance.	
Step 1 (M)	For each NetworkSliceSubnet instance associated with the NetworkSlice instance the 3GPP management system fetches NetworkSliceSubnet instance-level performance measurement data.	Performance management of a NetworkSliceSubnet instance
Step 2 (M)	The 3GPP management system generates the network slice-level performance measurement data and sends the network slice-level performance measurement data to the NOP.	
Ends when	The performance measurement and monitoring ends as scheduled or when requested by the NOP.	
Exceptions	One of the steps identified above fails.	
Post-conditions	The NOP receives the network slice-level performance measurement data from the 3GPP management system.	
Traceability	REQ-3GPPMS-CON-11	

NOTE: Steps 1 and 2 may be executed on demand, or repeatedly according to a schedule.

5.4.5 Performance management of a NetworkSliceSubnet instance

Use case stage	Evolution/Specification	<<Uses>> Related use
Goal	To report performance measurement data of a NetworkSliceSubnet instance to the NOP.	
Actors and Roles	A Network Operator (NOP) plays the role of a Network Slice Provider responsible for the network slice subnet.	
Telecom resources	3GPP management system	
Assumptions	N/A	
Pre-conditions	An NetworkSliceSubnet instance has been activated.	
Begins when	The NOP requests performance measurement and monitoring on the NetworkSliceSubnet instance.	
Step 1 (M)	For each component of the NetworkSliceSubnet instance the 3GPP management system fetches performance measurement data on the components of the NetworkSliceSubnet instance.	
Step 2 (M)	The 3GPP management system generates the network slice subnet-level performance measurement data and sends the network slice subnet-level performance measurement data to the NOP.	
Ends when	The performance measurement and monitoring ends as scheduled or when requested by the NOP.	
Exceptions	One of the steps identified above fails.	
Post-conditions	The NOP receives the network slice subnet-level performance measurement data from the 3GPP management system.	
Traceability	REQ-3GPPMS-CON-12	

NOTE: Steps 1 and 2 may be executed on demand, or repeatedly according to a schedule.

5.4.6   Report fault management data of a NetworkSlice instance

Use case stage	Evolution/Specification	<<Uses>> Related use
Goal	To report fault management data of a NetworkSlice instance to the NOP.	
Actors and Roles	Network Operator (NOP)	
Telecom resources	3GPP management system	
Assumptions	N/A	
Pre-conditions	An NetworkSlice instance is created.	
Begins when	The 3GPP management system detects a fault on the NetworkSlice instance that needs NOP intervention.	
Step 1 (M)	The 3GPP management system generates fault management data of the NetworkSlice instance and reports the fault management data to the NOP.	
Step 2 (M)	When the fault is recovered, the 3GPP management system updates the fault management data of the NetworkSlice instance to the NOP.	
Ends when	The NOP has the fault management data of NetworkSlice instance.	
Exceptions	In case any of the mandatory steps fail, the use case fails.	
Post-conditions	N/A	
Traceability	REQ-3GPPMS-CON-13	

5.4.7   Report fault management data of a NetworkSliceSubnet instance

Use case stage	Evolution/Specification	<<Uses>> Related use
Goal	To report fault management data of a NetworkSliceSubnet instance to the NOP.	
Actors and Roles	Network Operator (NOP)	
Telecom resources	3GPP management system	
Assumptions	N/A	
Pre-conditions	An NetworkSliceSubnet instance is created.	
Begins when	The 3GPP management system detects a fault on the NetworkSliceSubnet instance that needs operator intervention.	
Step 1 (M)	The 3GPP management system generates fault management data of the NetworkSliceSubnet instance and reports to the NOP.	
Step 2 (M)	When the fault is recovered, the 3GPP management system updates the fault management data of the NetworkSliceSubnet instance to the NOP.	
Ends when	The NOP has the fault management data of NetworkSliceSubnet instance.	
Exceptions	In case any of the mandatory steps fail, the use case fails.	
Post-conditions	N/A	
Traceability	REQ-3GPPMS-CON-14	

5.4.8 Multiple operator support for network slicing

Use Case	Evolution/Specification	<<Uses>> Related use
Goal	Create a communication service spanning multiple NetworkSlice instance hosted across multiple operators	
Actors and Roles	Communication service provider (CSP) Network Operator (NOP) A, Network Operator (NOP) B	
Telecom resources	3GPP management system	
Assumptions	The business level agreement(s) between CSP and NOPs to support the management system interaction is done	
Pre-conditions	None	
Begins when	Communication service provider receives a request to deploy a 5G Communication service	
Step 1 (M)	The CSP requests NOP A to create the NetworkSlice instance and NOP B to create another NetworkSlice instance to support the communication service	
Step 2 (M)	NOP A and NOP B's 3GPP management system evaluates if they can support the respective NetworkSlice instances, and, if they can, the 3GPP management systems create the corresponding NetworkSlice instance and respond positively to the CSP	
Step 3 (M)	The communication services provider instantiates the service over the multiple NetworkSlice instances	
Ends when	Ends when all mandatory steps identified above are successfully completed or when an exception occurs.	
Exceptions	One of the steps identified above fails.	
Post-conditions	A communication service across multiple operators is created	
Traceability	REQ-3GPPMS-CON-01, REQ-3GPPMS-CON-02	

5.4.9 Manage network slice with agreed performance

Use case stage	Evolution/Specification	<<Uses>> Related use
Goal	To manage network slice with agreed performance to CSP	
Actors and Roles	A Communication Service Provider (CSP) requests the Network Operator (NOP) to provide a NetworkSlice instance	
Telecom resources	3GPP management system	
Assumptions		
Pre-conditions	The NOP has the capability to manage network slices.	
Begins when	A set of service requirements (e.g. business scenario, isolation, throughput, latency, coverage, etc.) have been provided by the CSP.	
Step 1 (M)	NOP creates a customized NetworkSlice instance with performance that meet CSP's requirements.	
Step 2 (M)	NOP make use of 3GPP management system to monitor the NetworkSlice instance performance.	
Step 3 (M)	When NOP detects that the monitored NetworkSlice instance performance does not meet the agreed performance requirement, the NOP requests the 3GPP management system to executes some actions (e.g. scale in/out, modification, etc.), so that the NetworkSlice instance performance requirements are fulfilled. NOTE: The step 2 and 3 are executed continuously until the "ends when".	
Ends when	The NetworkSlice instance is terminated.	
Exceptions	One of the steps identified above fails.	
Post-conditions	The NetworkSlice instance performance requirements requested by CSP are fulfilled.	
Traceability		

5.4.10 Communication services using network with or without slicing

Use case stage	Evolution/Specification	<<Uses>> Related use
Goal	A communication service provider (CSP) uses the 5G network and network slicing service provided by operator to offer communication services to end users.	
Actors and Roles	Communication Service Provider (CSP) requests the Network Operator (NOP) to support its network requirements	
Telecom resources	3GPP management system	
Assumptions	N/A	
Pre-conditions	CSP derives the network related requirements (e.g. isolation, latency, coverage) from the communication service related requirements.	
Begins when	CSP provides the network related requirements to the NOP.	
Step 1 (M)	NOP decides to use network with or without slicing based on the network related requirements received and/or pre-configured network planning or optimization policies. For example, If CSP requires an isolated network, NOP may decide to use a network slice.	
Step 2 (M)	In case of using network with slicing, NOP create a NetworkSlice instance or reuse an existing NetworkSlice instance to satisfy the network related requirements. Otherwise, NOP deploys a new network without slicing or utilize the existing network without slicing to satisfy the network related requirements.	
Step 3 (M)	NOP notifies CSP that the network is ready.	
Ends when	Ends when all mandatory steps identified above are successfully completed or when an exception occurs.	
Exceptions	One of the steps identified above fails.	
Post-conditions	Network with or without slicing can be utilized to provide communication service.	
Traceability	REQ-5GNS-CON-08	

5.4.11 Exposure of network slice management data for Network Slice as a Service (NSaaS) case

Use case stage	Evolution/Specification	<<Uses>> Related use
Goal	To expose network slice management data to a Communication Service Provider (CSP) consuming Network Slice as a Service (NSaaS) based on mutual agreement.	
Actors and Roles	A Communication Service Provider (CSP) provides limited management data to a Communication Service Customer (CSC)	
Telecom resources	3GPP management system	
Assumptions	Network slice management data of network slice can be exposed to the CSP consuming NSaaS according to the pre-defined agreements.	
Pre-conditions	1. NSaaS level exposure has been agreed upon and the CSP offering the NSaaS is aware of it. 2. An NetworkSlice instance used for NSaaS is created.	
Begins when	The CSP consuming NSaaS wants to get the management data of the NetworkSlice instance.	
Step 1 (M)	The CSP consuming NSaaS sends requests to the 3GPP management system for the exposure management data of NetworkSlice instance.	
Step 2 (M)	The 3GPP management system provides the CSP consuming NSaaS of exposed management data for the NSaaS scenario.	
Ends when	The network slice management data is provided.	
Exceptions	One of the steps identified above fails.	
Post-conditions	The CSP consuming NSaaS is aware of the management data of the NetworkSlice instance.	
Traceability	REQ-3GPPMS-CON-27	

5.4.12   Exposure of network slice management capability

Use case stage	Evolution/Specification	<<Uses>> Related use
Goal	To expose limited network slice management capability to a Communication Service Customer (CSC) consuming Network Slice as a Service (NSaaS) based on mutual agreement.	
Actors and Roles	A Communication Service Provider (CSP) provides limited management capability to a Communication Service Customer (CSC)	
Telecom resources	3GPP management system	
Assumptions	Network slice management capability of 3GPP management system can be partially exposed to the CSC consuming NSaaS according to the pre-defined agreements.	
Pre-conditions	Level of management exposure has been agreed upon and the CSP offering the NSaaS service is aware of it.	
Begins when	The CSC consuming NSaaS wants to get certain management capability to manage the NetworkSlice instance, e.g., PM, FM, CM, based on the mutual agreement between CSC and CSP.	
Step 1 (M)	The CSC consuming NSaaS sends requests to the 3GPP management system for the exposure of management capability of NetworkSlice instance.	
Step 2 (M)	The 3GPP management system provides the CSC consuming NSaaS with the requested capability via appropriate methods, e.g., exposing network slice management service to the CSC.	
Ends when	The network slice management capability is provided.	
Exceptions	One of the steps identified above fails.	
Post-conditions	The limited network slice management capability has been exposed to the CSC consuming NSaaS.	
Traceability	REQ-3GPPMS -CON-30, REQ-3GPPMS -CON-31, REQ-3GPPMS -CON-32	

5.4.13   To modify the network slice instance due to changed demand

Use case stage	Evolution/Specification	<<Uses>> Related use
Goal	To modify a NetworkSlice instance due to changed demand	
Actors and Roles	A Network Operator (NOP) plays the role of a Network Slice Provider (NSP).	
Telecom resources	3GPP management system	
Assumptions	None	
Pre-conditions	A network slice is activated	
Begins when	The NOP has received a request to modify the capacity of a NetworkSlice instance. For example, in case there is an increased demand in call capacity in specific geographical area, the request indicates the needed capacity increase amount in that specific geographical area	
Step 1 (M)	The NOP initiates the 3GPP management system to process the request	
Step 2 (M)	The 3GPP management system analyses the request and identifies that one or more supporting network slice subnets need to be modified with X1 amount, X2 amount, X3 amount etc.	
Step 3 (M)	3GPP system derives new TN requirements	
Step 4 (M)	The 3GPP management system initiates modification of the capacity of the identified supporting slice subnets with X1 amount, X2 amount, X3 amount etc	
Step 5 (M)	3GPP system communicates new TN requirements	
Ends when	All capacity modification activities (of step 3) have been completed.	
Exceptions	One of the steps identified above fails.	
Post-conditions	The NetworkSlice instance capacity is modified according to demand.	
Traceability	REQ-3GPPMS-CON-17, REQ-3GPPMS-CON-20, REQ-5GNS-CON-9, REQ-5GNS-CON-10, REQ-5GNS-CON-11, REQ-5GNS-CON-12	

5.4.14 Management data analytics for 5G networks

Use case stage	Evolution/Specification	<<Uses>> Related use
Goal	To provide management data analytics services to authorized customers (e.g., re-configuring for more efficient operation and maintenance)	
Actors and Roles	Network Operator (NOP)	
Telecom resources	NetworkSlice instance 3GPP management system	
Assumptions	N/A	
Pre-conditions	The 3GPP management system has the capability to collect the related network data for analysis.	
Begins when	The 3GPP management system receives network data analytics request.	
Step 1 (M)	The 3GPP management system checks if the existing management data is sufficient to generate the network data analytics information.3GPP management system may trigger to obtain more network data for analytics purpose, such as new measurement jobs, subscriptions to alarm notifications.	
Step 2 (M)	For management data analytics purposes, 3GPP management system may request services (e.g., management data analytics, PM, FM) from the related NetworkSlice instance constituents.	
Step 3 (M)	3GPP management system sends the analytics results to the NOP.	
Ends when	NOP has the required network data analytics information.	
Exceptions	One of the steps identified above fails.	
Post-conditions	The NOP receives network data analytics information from the 3GPP management system, the information could be utilized for optimizing the network.	
Traceability	**REQ-5GNS-CON-13,REQ-5GNS-CON-14**	

5.4.15 Capacity management of Network Slice Instances (NSIs) and Network Slice Subnet Instances (NSSIs)

Use case stage	Evolution/Specification	<<Uses>> Related use
Goal	To support capacity management of NetworkSlice instances and NetworkSliceSubnet instances.	
Actors and Roles	A Network Operator (NOP) plays the role of a Network Slice Provider responsible for the network slice capacity management.	
Telecom resources	3GPP management system	
Assumptions	N/A	
Pre-conditions	The capacity optimization objectives have been set by the NOP	
Begins when	The NOP requests capacity management process of the NetworkSlice instances and NetworkSliceSubnet instances when the pre-set resource optimization objectives need to be satisfied.	
Step 1 (M)	The 3GPP management system obtains information needed for the optimization process such as network slice provisioning requirements, existing active or non-active NetworkSlice instance and/or NetworkSliceSubnet instance resource information, and performance measurement data by requesting the feasibility check operation.	Feasibility check
Step 2 (M)	The 3GPP management system performs resource optimization process based on the information obtained in Step 1. The goal of the process is to find an optimal resource capacity availability against the target objective.	
Step 3 (M)	The 3GPP management system proceeds with network slice (NetworkSlice instance and/or NetworkSliceSubnet instance) provisioning or modification processes until it meets the resource capacity optimization objective.	
Step 4 (M)	The 3GPP management system updates capacity availability information after provisioning or modification processes.	
Ends when	The capacity management ends as it meets the optimization objective.	
Exceptions	One of the steps identified above fails.	
Post-conditions	The NOP receives the updated capacity management information from the 3GPP management system.	
Traceability	REQ-3GPPMS-CON-23	

6 High level features

6.1 General

The present clause describes the high level features of the 5G management system and network slicing.

6.2 Self-Organizing Networks (SON) for 5G networks

In order to reduce the operating expenses associated with the management of increasing number of nodes from more than one vendor the feature of the Self-Organizing Network (SON) was introduced. Automation of some network planning, configuration and optimisation processes via the use of SON functions can help the network operator to reduce operating expenses by reducing manual involvement in such tasks. Based on the location of the SON algorithm, SON is categorized into four different solutions: Cross Domain-Centralized SON, Domain-Centralized SON, Distributed SON and Hybrid SON.

6.3 Management data analytics for 5G networks

The 5G networks have capability to support a variety of communication services, such as IoT and eMBB. The increasing flexibility of the networks to support services with diverse requirements may present operational and management challenges. 5G networks management system can therefore benefit from management data analytics for improving networks performance and efficiency to accommodate and support the diversity of services and requirements. The management data analytics utilize the collection of network data (including e.g. service, slicing and/or network functions related data) to perform analytics in order to assist and complement management services for an optimum network performance and service assurance.

6.4 Closed loop SLS Assurance

Closed loop SLS Assurance relies on a set of management services in a control loop which consists of the steps of Monitoring, Analysis, Decision and Excution to assure the communication service. The adjustment of the resources used for the communication service is completed by the continuous iteration of the steps in the control loop with SLS assurance. Closed loop SLS assurance can be deployed at domain level or cross domain level.

6.5 Energy Efficiency(EE) for 5G networks

Operators are aiming at decreasing power consumption in 5G networks to lower their operational expense with energy saving management solutions. With the foreseen deployment of more NR base stations, e.g., small base stations with massive MIMO in high-band, energy saving becomes even more urgent and challenging. Management of 5G networks contributes to energy saving by reducing energy consumption of 5G networks, while maintaining coverage, capacity and quality of service.

Annex A (informative):
Change history

						Change history	
Date	Meeting	TDoc	CR	Rev	Cat	Subject/Comment	New version
2018-12	SA#82	SP-181041	0001	-	F	Align title with TS database	15.1.0
2018-12	SA#82	SP-181042	0002	1	F	Fix gap of requirement for Network Slicing priority	15.1.0
2018-12	SA#82	SP-181043	0003	1	F	Replace MF with managed function	15.1.0
2019-09	SA#85	SP-190742	0009	1	F	Fix inconsistencies related to service requirements	15.2.0
2019-09	SA#85	SP-190753	0007	2	B	Add MnS query related requirement	16.0.0
2019-12	SA#86	SP-191159	0010	1	F	Clean up for incosistence	16.1.0
2019-12	SA#86	SP-191171	0011	1	B	Add description for tenant information	16.1.0
2019-12	SA#86	SP-191173	0013	1	A	Fix inconsistencies in the usage of word instance	16.1.0
2020-07	SA#88E	SP-200497	0022	3	B	Extend roles related to 5G networks and network slicing management	16.2.0
2020-07	SA#88E	SP-200485	0025	2	F	Cleanup Network Slice related definitions in OAM space	16.2.0
2020-07	SA#88E	SP-200485	0027	1	F	update slice NRM to align with refined slice definitions	16.2.0
2020-09	SA#89e	SP-200724	0028	1	F	Replacement of instance of the term MF/managed function with network function	16.3.0
2020-09	SA#89e	SP-200724	0029	1	F	Corrections	16.3.0
2020-12	SA#90e	SP-201050	0032	-	F	Add abbreviation	16.4.0
2020-12	SA#90e	SP-201053	0033	1	F	Decouple communication service and network slice	16.4.0
2020-12	SA#90e	SP-201053	0034	1	F	Move service profile definition from 28531	16.4.0
2020-12	SA#90e	SP-201050	0035	-	F	Correction of missing Figure 4.1.7.1 Examples of network slice as NOP internals	16.4.0
2020-12	SA#90e	SP-201088	0036	-	F	Add the chapter of high level features	16.4.0
2021-12	SA#94e	SP-211464	0049	-	F	Correct tenant phrasing	16.5.0

History

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V16.2.0	August 2020	Publication
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