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650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00   Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - APE 7112B
Association à but non lucratif enregistrée à la
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Contents

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Foreword

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

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

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1 Scope

The present document specifies use cases, requirements, management services and procedures for provisioning of 5G networks.

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 28.525: "Telecommunication management; Life Cycle Management (LCM) for mobile networks that include virtualized network functions; Requirements".

[3]   ETSI GS NFV-IFA 013 (V2.4.1) (2018-02): "Network Function Virtualisation (NFV); Release 2; Management and Orchestration; Os-Ma-nfvo reference point - Interface and Information Model Specification".

[4]   3GPP TS 28.530: "Management and orchestration; Concepts, use cases and requirements".

[5]   3GPP TS 22.261 "Service requirements for next generation new services and markets".

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

[7]   3GPP TS 28.526: "Life Cycle Management (LCM) for mobile networks that include virtualized network functions; Procedures".

[8]   3GPP TS 28.532: "Management and orchestration; Generic management services".

[9]   GSMA NG.116 Generic Network Slice Template v1.0 (2019-05-23) - https://www.gsma.com/newsroom/wp-content/uploads//NG.116-v1.0-4.pdf.

[10]   3GPP TS 23.501: "Technical Specification Group Services and System Aspects;System Architecture for the 5G System;Stage 2".

[11]   3GPP TS 38.300: "Technical Specification Group Radio Access Network;NR; NR and NG-RAN Overall Description;Stage 2".

[12]   ETSI GS NFV-IFA 014 (V4.2.1) (2021-05): "Network Function Virtualisation (NFV); Release 4; Management and Orchestration; Network Service Templates Specification".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [1], TS 28.530 [4] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [1] and TS 28.530 [4].

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1], TS 28.530 [4] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1].

5GAA	5G Automative Association
5G-ACIA	5G Association for Connected Industries and Automation
5GC	5G Core Network
AMF	Access and Mobility Management Function
CSC	Communication Service Customer
CSP	Communication Service Provider
CP	Control Plane
GST	Generic Slice Template
IOC	Information Object Class
MANO	Management and Orchestration
MnS	Management Service
NEST	Network Slice Type
NF	Network Function
NFV	Network Functions Virtualisation
NRM	Network Resource Model
NSaaS	Network Slice as a Service
NSC	Network Slice Customer
NSI	Network Slice Instance
NSP	Network Slice Provider
NSSI	Network Slice Subnet Instance
P-NEST	Private NEST
S-NEST	Standardized NEST
TN	Transport Network
VNF	Virtualized Network Function
UP	User Plane

4 General

4.1 Overview

A 5G system consists of a 5G Access Network (AN), and a 5G Core Network (5GC). Network slicing is one of the key 5G features.

The management aspects of a Network Slice Instance (NSI) are described by the four phases shown in Figure 4.3.1.1 of TS 28.530 [4].

The provisioning of network slicing includes the four phases which are preparation, commissioning, operation and decommissioning:

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

- During the NSI lifecycle stage which include commissioning phase, operation phase and decommissioning phase, the NSI provisioning operations include:

  - Create an NSI;

  - Activate an NSI;

  - Deactivate an NSI;

- Modify an NSI;

- Terminate an NSI.

The operations of the provisioning of an NSI occurs during different phases of a NSI:

a) During the commissioning phase:

- Create an NSI.

During NSI creation all resources to the NSI have been created and configured to satisfy the network slice requirements. NSI creation may trigger NSSI(s) creation or using existing NSSI(s) and setting up the corresponding associations.

b) During the operation phase:

- Activate an NSI;

- Modify an NSI;

- Deactivate an NSI.

NSI activation includes any actions that make the NSI active to provide communication services. NSI activation may trigger NSSI activation.

NSI modification in operation phase could map to several workflows, e.g. changes of NSI capacity, changes of NSI topology, NSI reconfiguration. NSI modification can be triggered by receiving new network slice related requirements, new communication service requirements, or the result of NSI supervision automatically. NSI modification may trigger NSSI modification.

The NSI deactivation operation may be needed before NSI modification operation and the NSI activation operation may be needed after the NSI modification operation. NSI deactivation includes any actions that make the NSI inactive and not providing any communication services. NSI deactivation trigger NSSI deactivation to deactivate constituent NSSI(s) which is not used by other NSI(s). Operator may decide to keep the NSI without termination after deactivation and reactivate it when receives new communication service request.

c) During the decommissioning phase:

- Terminate an NSI.

NSI termination step includes any action that make the NSI does not exist anymore and release resources that are not used by other NSI(s). NSI termination may trigger NSSI termination to terminate constituent NSSI(s) which is not used by other NSI(s).

Similarly, provisioning for network slice subnet instance includes the following operations:

- Create an NSSI;

- Activate an NSSI and associate it with certain NSI to be used by the NSI;

- Disassociate the NSSI with certain NSI and deactivate the NSSI if it's not associated with any NSI;

- Modify an NSSI;

- Terminate an NSSI.

4.2   Configuration information for the constituents of an NSI

To use network slice to support communication service or deliver a network slice as a service, the 3GPP defined constituents of the NSI should be configured by 3GPP management system according to the types and requirements of the network slice so that the NSI can be operated and maintained.

The configuration information of these components may include:

- *Information on the requirements to be applied to every NSI constituent to satisfy the requirements of multiple NSIs* if the constituent is shared by multiple NSIs;

- *Network function selection information:* Information on the selection of the NFs (e.g., AMF) according to the requirements of this NSI;

- *Connection information*: The information of the logical links to carry the NSI's CP and UP data between the component and other NFs and NSSIs belonging to the NSI.

NOTE 1: The list of information above is not exhaustive.

NOTE 2: The list of information above is not all necessary for an NSI.

4.3 General information for network slice instance

The general information used to describe a network slice instance may include:

- Resource model information, which describes the static parameters and functional components of network slice, includes service profile, network slice type (e.g. eMBB), additional system feature (e.g. multicast, Edge Computing), priority.

- Management model information, which describes the information model that is used for network slice lifecycle management, includes configuration profile (e.g. application configuration parameters).

- Capability model information, which describes the capability including supported communication service characteristic information (e.g. service type, UE mobility level, density of users, traffic density), QoS attributes (e.g. bandwidth, latency, throughput and so on) and capacity (e.g. maximum number of UEs), can be exposed to CSC .

4.4 General information for network slice subnet instance

The general information used to describe a network slice subnet instance may include:

- Resource model information, which describes the static parameters and functional component of network slice subnet, includes slice profile, network slice subnet type (e.g. RAN eMBB, CN eMBB), additional system feature (e.g. multicast, Edge Computing), priority, QoS attributes (e.g. bandwidth, latency, number of subscribers and so on), NSD ID.

- Management model information, which describes the information model that is used for network slice subnet lifecycle management, includes configuration profile (e.g. application configuration parameters).

- Capability model information, which describes the capability including supported communication service characteristic information (e.g. service type, UE mobility level, density of users, traffic density), QoS attributes (e.g. bandwidth, latency, throughput and so on) and capacity (e.g. maximum number of UEs).

4.5 Void

4.6 Void

5 Specification level requirements

5.1 Use cases

5.1.1 Network slice instance allocation

Use case stage	Evolution/Specification	<<Uses>> Related use
Goal	To satisfy request for allocation of a network slice instance with certain characteristics, by creating a new or using an existing network slice instance; the request includes the network slice related requirements.	
Actors and Roles	A network slice provisioniong management service consumer.	
Telecom resources	Network slice instance Network slice subnet instance Transport network A network slice provisioning management service provider. A network slice subnet provisioning management service provider.	
Assumptions	N/A	
Pre-conditions	N/A	
Begins when	The network slice provisioning management service provider receives the request for allocation of the network slice instance with certain characteristics; the request contains network slice related requirements and the information indicating whether the requested NSI could be shared with other consumers. The network slice provisioning management service provider has the capability toprocess the network slice related requirements (e.g. SLA information from GSMA GST) which are represented by service profile parameters [6]. The service profile can be translated to the corresponding requirements for dedicated domains and NSSIs.	
Step 1 (M)	If the requested NSI can be shared and if an existing NSI can be used, the network slice provisioning management service provider decides to use the existing NSI. Modification of the existing NSI may be needed to satisfy the network slice instance related requirements. Use case is completed go to "Step 8". Otherwise, the network slice provisioning management service provider triggers to create a new NSI, for which the following steps 2 – 8 are needed.	
Step 2 (M)	The network slice provisioning management service provider decides on the constituent NSSIs and the topology of the NSI to be created using the information from service profile [6]. For the constituent NSSIs, the network slice provisioning management service provider derives network slice subnet related requirements from the network slice related requirements. If reconfiguration of the transport network is needed, the network slice provisioning management service provider derives transport network related requirements (e.g. latency, bandwidth) from the network slice related requirements.	
Step 3 (M)	For the required NSSI(s), the network slice provisioning management service provider sends network slice subnet related requirements to the network slice subnet provisioning management service provider to request allocation of the required NSSI(s).	Network slice subnet instance allocation use case
Step 4 (M)	The network slice provisioning management service provider receives the information of the allocated NSSI(s) (e.g. the management identifier of NSSI, service access point information of NSSI, external connection point information of NSSI) from NSSMF.	
Step 5 (M)	The network slice provisioning management service provider, via the network slice subnet provisioning management service provider, sends the transport network related requirements (e.g. external connection point, latency and bandwidth) to the TN Manager. The TN manager reconfigures the TN accordingly and responds to the network slice provisioning management service provider via the network slice subnet provisioning management service provider.	
Step 6 (M)	The network slice provisioning management service provider receives the response from TN Manager via the network slice subnet provisioning management service provider.	
Step 7 (M)	The network slice provisioning management service provider associates the NSSI(s) with the corresponding NSI (e.g. allocation of the management identifier of NSI and mapping the management identifier of NSI with the received management Identifier of NSSI(s)) and triggers to establish the links between the service access points of the NSSI(s).	
Step 8 (M)	The network slice provisioning management service provider notifies the network slice instance information of NSI (e.g., the management identifier of NSI).	
Ends when	All the steps identified above are successfully completed.	
Exceptions	One of the steps identified above fails.	
Post-conditions	An NSI is ready to satisfy the network slice related requirements.	
Traceability	REQ-PRO_NSSI-FUN-1, REQ-PRO_NSI-FUN-3.	

5.1.2 Network slice subnet instance allocation

Use case stage	Evolution/Specification	<<Uses>> Related use
Goal	Create a new network slice subnet instance or use an existing network slice subnet instance to satisfy the network slice subnet related requirements; provide the provisioning service consumer with identity of the NFVO which the consumer can use for further access to the information of the involved VNFs, PNFs and NSs.	
Actors and Roles	A network slice subnet provisioning management service consumer.	
Telecom resources	Network Slice Subnet instance Network Service instance A network slice subnet provisioning management service provider. The operator deployed NFVO to manage the lifecycle of VNFs and interconnection between the VNFs and PNFs in terms of the NS instances.	
Assumptions	Network slice subnet instance may include network functions which are virtualized.	
Pre-conditions	VNF Packages for virtualized network functions to be included in the network slice subnet instance have been already on-boarded.	
Begins when	The network slice subnet provisioning management service consumer sends to the network slice subnet provisioning management service provider a request for an NSSI to be associated with the NSI; the request contains network slice subnet related requirements including the SliceProfile [6]. The network slice subnet provisioning management service provider receives request for a network slice subnet instance. The request contains network slice subnet related requirements. The request may also include query of the identity of the NFVO to be used.	
Step 1 (M)	Based on the network slice subnet related requirements received, the network slice subnet provisioning management service provider decides to create a new NSSI or use an existing NSSI.	
Step 2 (M)	If an existing network slice subnet instance is decided to be used, the network slice subnet provisioning management service provider may trigger to modify the existing network slice subnet instance to satisfy the network slice subnet related requirements. Go to "Step 8". Otherwise, the network slice subnet provisioning management service provider triggers to create a new NSSI, the following steps are needed.	
Step 3 (O)	If the required NSSI contains constituent NSSI(s) managed by other network slice subnet provisioning management service provider (s), the first network slice subnet provisioning management service provider derives the requirements for the constituent NSSI(s) and sends those requirements to the corresponding network slice subnet provisioning management service provider (s) which manages the constituent NSSI(s). The first network slice subnet provisioning management service provider receives the constituent NSSI information from the other network slice subnet provisioning management service provider (s) and associates the constituent NSSI(s) with the required NSSI.	
Step 4 (M)	Based on the network slice subnet related requirements received and SliceProfile [6], the network slice subnet provisioning management service provider decides that to satisfy the NSSI requirements, the part of the network controlled by certain NFVO should be involved. The network slice subnet provisioning management service provider determines the NS related requirements (i.e. information about the target NSD and additional parameterization for the specific NS to instantiate, see clause 7.3.3 in ETSI GS NFV-IFA013 [3]).	
Step 5 (M)	Based on the NS related requirements, the network slice subnet provisioning management service provider triggers corresponding NS instantiation request to NFVO via Os-Ma-nfvo interface as described in clause 6.4.3 in TS 28.525 [2], and the NFVO performs NS instantiation. (see note)	TS 28.525 [2] Clause 6.4.3 NS instance use cases
Step 6 (M)	The network slice subnet provisioning management service provider associates the NS instance with corresponding network slice subnet instance (e.g. allocation of the management identifier of NSSI and mapping with the corresponding identifiers).	
Step 7 (M)	The network slice subnet provisioning management service provider is using the NF provisioning service to configure the NSSI constituents. In case of RAN NSSI, the configuration contains RRM policy information for individual Radio cells. In the cells shared by multiple NSSIs such policy includes guidance for split of Radio resources between the NSSIs.	NF provisioning service

Use case stage	Evolution/Specification	<<Uses>> Related use
Step 8 (M)	The network slice subnet provisioning management service provider notifies the provisioning service consumer with the NSSI information (e.g. the management identifier of NSSI). The network slice provisioning management service provider associates the NSSI with the NSI.	
Ends when	All the steps identified above are successfully completed.	
Exceptions	One of the steps identified above fails.	
Post-conditions	A NSSI is ready to satisfy the network slice subnet related requirements.	
Traceability	REQ-PRO_NSSI-FUN-2, REQ-PRO_NSSI-FUN-3, REQ-PRO_NSSI-FUN-4, REQ-PRO_NSSI-FUN-5, REQ-PRO_NSSI-FUN-6, REQ-PRO_NSSI-FUN-14.	
NOTE:	According to the TS 28.525 [2], for the PNFs, NS instantiation includes only establishment of interconnection with other NFs.	

5.1.3   Network slice instance deallocation

Use case stage	Evolution/Specification	<<Uses>> Related use
Goal	To deallocate a network slice instance.	
Actors and Roles	A network slice provisioning management service consumer.	
Telecom resources	Network slice instance Network slice subnet instances A network slice provisioning management service provider. A network slice subnet provisioning management service provider.	
Assumptions	N/A	
Pre-conditions	N/A	
Begins when	The network slice provisioning management service provider receives the request indicating that an existing NSI is no longer needed to support a particular service (identified by service profile Id). The NSI identification is included in the request.	
Step 1 (M)	Based on the request, the network slice provisioning management service provider deletes the corresponding slice profile and checks if there are other services to be supported by the NSI. If there are none the network slice provisioning management service provider may decide to terminate the NSI; then proceed to Step 2. Otherwise, the network slice provisioning management service provider may decide to trigger to modify the NSI or to do nothing. The use case is completed; go to step 5.	NSI modification use case
Step 2 (M)	If the NSI to be terminated is active, the network slice provisioning management service provider de-activates the NSI. Then, the NSI to be terminated is inactive.	NSI de-activation use case
Step 3 (M)	The network slice provisioning management service provider identifies the network slice subnet instances used by the NSI, and for every such NSSI sends the request to the corresponding network slice subnet provisioning management service provider (s) indicating that the NSSI(s) are longer needed for the NSI. The network slice subnet provisioning management service provider (s) may decide to terminate or modify the NSSI(s) based on the request and disassociates them with the NSI.	
Step 4 (M)	The network slice provisioning management service provider receives the response from the network slice subnet provisioning management service provider (s) and terminates the NSI.	
Step 5 (M)	The network slice provisioning management service provider notifies its consumer of the deallocation.	
Ends when	All the steps identified above are successfully completed or skipped per condition in the Step 1.	
Exceptions	One of the steps identified above fails.	
Post-conditions	The NSI has been deallocated.	
Traceability	REQ-PRO_NSI-FUN-3	