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Contents

Foreword

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

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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".

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: Defined in 3gpp TS 23.501 v1.4.0 [3].

network slice instance: Defined in 3GPP TS 23.501 V1.4.0 [3].

network slice subnet: a representation of the management aspects of a set of Managed Functions and the required resources (e.g. compute, storage and networking resources).

network slice subnet instance: an instance of Network Slice Subnet representing the management aspects of a set of Managed Function instances and the used resources (e.g. compute, storage and networking resources).

Service Level Specification: a set of service level requirements associated with a Service Level Agreement to be satisfied by a network slice instance

NOTE: Network Slice Subnet Information Object Class describes the structure (i.e. contained components and connectivity between them) and configuration of a network slice subnet, as well as network capability.

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
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
NSC	Network Slice Customer
NSI	Network Slice Instance
NSP	Network Slice Provider
NSS	Network Slice Subnet
NSSI	Network Slice Subnet Instance
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 slice instances 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 slice instances

As an example, a variety of communication services instances provided by multiple NSI(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].

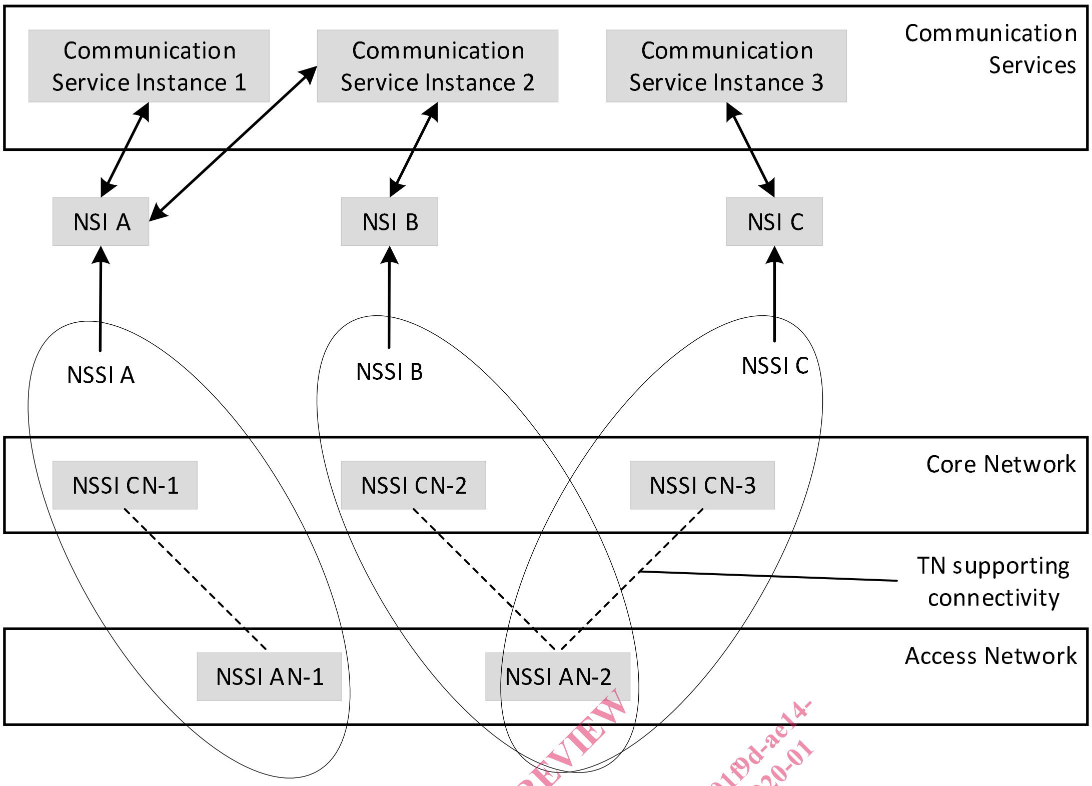

Figure 4.1.3.1: A variety of communication services instances provided by multiple NSIs

Figure 4.1.3.1 illustrates the relationship between instances of Communication Services, instances of Network Slices, and instances of Network Slice Subnets:

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

- NOP offers NSSI A as a Network Slice instance NSI A, in this relationship NSI A represents NSSI A with associated Service Level Specification (SLS). NOP also offers NSSI B as NSI B and NSSI C as NSI C. The SLS of NSI A satisfies the service requirements of Communication Service Instance 1 and Communication Service Instance 2. The SLS of NSI B satisfies the service requirements of Communication Service Instance 2. The SLS of NSI C satisfies the service requirements of Communication Service Instance 3.

- The Communication Service Instance 1 is supported by NSI A. The Communication Service Instance 2 may be supported by either NSI A or NSI B. The Communication Service Instance 3 is supported by NSI 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 NSI Lifecycle and relationship to service instances

An NSI 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 NSI lifecycle for activation or modification(s) of an existing NSI, or it may trigger a commissioning phase of the NSI lifecycle for creation of a new NSI. When a service instance no longer needs to be supported by an NSI, it may trigger an operation phase of the NSI lifecycle for de-activation or modification(s) of an existing NSI, or it may trigger a decommissioning phase of the NSI lifecycle for termination of an existing NSI.

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 instance as the end user or optionally allows CSC to manage the network slice instance 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 instance 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 slice instances. 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 instance 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 NSSI:

a) A Network Slice as a Service 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