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| Technical Report |
| 3rd Generation Partnership Project;Technical Specification Group Services and System Aspects;Network Slicing Extensions for 5G media services;(Release 18) |
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# Foreword

This Technical Report 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:

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

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

z the third digit is incremented when editorial only changes have been incorporated in the document.

In the present document, modal verbs have the following meanings:

**shall** indicates a mandatory requirement to do something

**shall not** indicates an interdiction (prohibition) to do something

The constructions "shall" and "shall not" are confined to the context of normative provisions, and do not appear in Technical Reports.

The constructions "must" and "must not" are not used as substitutes for "shall" and "shall not". Their use is avoided insofar as possible, and they are not used in a normative context except in a direct citation from an external, referenced, non-3GPP document, or so as to maintain continuity of style when extending or modifying the provisions of such a referenced document.

**should** indicates a recommendation to do something

**should not** indicates a recommendation not to do something

**may** indicates permission to do something

**need not** indicates permission not to do something

The construction "may not" is ambiguous and is not used in normative elements. The unambiguous constructions "might not" or "shall not" are used instead, depending upon the meaning intended.

**can** indicates that something is possible

**cannot** indicates that something is impossible

The constructions "can" and "cannot" are not substitutes for "may" and "need not".

**will** indicates that something is certain or expected to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

**will not** indicates that something is certain or expected not to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

**might** indicates a likelihood that something will happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

**might not** indicates a likelihood that something will not happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

In addition:

**is** (or any other verb in the indicative mood) indicates a statement of fact

**is not** (or any other negative verb in the indicative mood) indicates a statement of fact

The constructions "is" and "is not" do not indicate requirements.

# Introduction

This document covers key issues, candidate solutions and potential requirements for supporting network slicing with 5GMS architecture. Aspects related to provisioning of media services, dynamic policy, and resolution of slice-specific AS instances while using network slicing for media streaming use cases are covered in this document.

# 1 Scope

The present document identifies standardization needs and potential standards gaps relevant to media streaming while using 5G network slicing. In specific, the following aspects are addressed in this document:

- To identify relevant use cases that can be addressed using network slicing, and study collaboration scenarios and deployment architectures to support network slicing for media services

- To identify any missing provisioning aspects for configuring media services with one or more network slices including QoS configuration, reporting and dynamic policy

- To identify impact of network slicing on dynamic policy invocation APIs, including selection of appropriate network slices for dynamic policy requests, possible migration of UE application traffic flows between network slices due to dynamic policy procedures, discovery of dynamic policy AF, and necessary routing considerations

- To determine the need and describe methods for AF-to-AF communication to support interoperability if 5GMS AF instances from different vendors are deployed in the same 5GMS System

- To identify methods for deploying, supporting, and resolving slice-specific 5GMS AS instances

- To identify potential areas for normative work and communicate/align with SA2 as well as other potential 3GPP WGs (SA5, SA6) on relevant aspects related to the study.

# 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 TR 26.804: “Study on 5G media streaming extensions”

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

[4] 3GPP TS 28.531: "Management and orchestration; Provisioning".

[5] GSM Association NG.116, “Generic Network Slice Template”, <https://www.gsma.com/newsroom/wp-content/uploads//NG.116-v6.0.pdf>

[6] 3GPP TR 23.700-40: “Study on enhancement of network slicing; Phase 2”

[7] 3GPP TS 23.501: "System architecture for the 5G System (5GS)".

[8] 3GPP TS 23.700‑99: " Study in Network slice capability exposure for application layer enablement (NSCALE)".

[9] 3GPP TS 23.435: “Procedures for Network Slice Capability Exposure for Application Layer Enablement Service”

[10] 3GPP TS 28.541: "Management and orchestration; 5G Network Resource Model (NRM); Stage 2 and stage 3".

[11] 3GPP TS 28.542: "Management and orchestration of networks and network slicing; 5G Core Network (5GC) Network Resource Model (NRM); Stage 1".

[12] 3GPP TS 28.532: "Management and orchestration; Generic management services".

[13] 3GPP TS 28.545: "Management and orchestration; Fault Supervision (FS)".

[14] 3GPP TS 28.546: "Management and orchestration of networks and network slicing; Fault Supervision (FS); Stage 2 and stage 3".

[15] 3GPP TS 23.502: "Procedures for the 5G System (5GS)".

[16] 3GPP TS 23.503: "Policy and charging control framework for the 5G System (5GS); Stage 2".

[17] 3GPP TS 23.434: " Service Enabler Architecture Layer for Verticals (SEAL); Functional architecture and information flows ".

[18] 3GPP TS 27.007: “AT command set for User Equipment (UE)”

[19] 3GPP TS 29.520: “5G System; Network Data Analytics Services; Stage 3”

[20] 3GPP TS 26501: "5G Media Streaming (5GMS); General description and architecture".

[21] 3GPP TS 26512: "5G Media Streaming (5GMS); Protocols".

[22] 3GPP TS 28.552: "Management and orchestration; 5G performance measurements".

[23] 3GPP TS 28.554: "Management and orchestration; 5G end to end Key Performance Indicators (KPI)"

[24] 3GPP TS 23.558: "Architecture for enabling Edge Applications".

# 3 Definitions of terms, symbols and abbreviations

## 3.1 Terms

For the purposes of the present document, the terms given in 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 TR 21.905 [1].

**example:** text used to clarify abstract rules by applying them literally.

## 3.2 Symbols

For the purposes of the present document, the following symbols apply:

<symbol> <Explanation>

## 3.3 Abbreviations

For the purposes of the present document, the abbreviations given in 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 TR 21.905 [1].

CSC Communication Service Customer

CSP Communication Service Provider

DN Data Network

DNN Data Network Name

ECS Edge Configuration Server

EEC Edge Enabler Client

eMBB Enhanced Mobile Broadband

EPC Evolved Packet Core

GST Generic Network Slice Template

MIoT Massive Internet of Things

MPS Multimedia Priority Service

MNO Mobile Network Operator

MVNO Mobile Virtual Network Operator

NEST Network Slice Type

NOP Network Operator

NRM Network Resource Model

NSaaS Network Slice as a Service

NSC Network Slice Customer

NSCE Network Slice Capability Enablement

NSI Network Slice Instance

NSP Network Slice Provider

NSSI Network Slice Subnet Instance

NSSP Network Slice Selection Policy

NWDAF Network Data Analytics Function

PDU Protocol Data Unit

URSP UE Route Selection Policy

V2X Vehicle-to-Everything

# 4 Overview

Editor’s Note: This clause to describe network slicing features and capabilities, and existing network slicing related support in different 3GPP groups. In particular, different slice management procedures that are relevant for specifying media streaming aspects of network slicing are described in this clause.

## 4.1 General

Clause 5.12 of 3GPP TR 26.804 [2] provides a brief overview of network slicing feature standardization in different 3GPP groups. This clause describes different slice management processes in a little more detail that are relevant for specifying the media streaming aspects of network slicing.

## 4.2 Slice Orchestration and Management

3GPP TS 28.530 [3] and TS 28.531 [4] specify general concepts related to network slicing and slice life cycle management including specification of roles related to network slicing such as the CSC, CSP, NOP, NSC, and NSP. A network operator can perform both the roles of a CSP and NSP. A request from a CSC or NSC to the CSP or the NSP respectively for setting up a network slice is in the form of a set of slice attributes that represents the service requirements for the service that the customer intends to provide to its users.

The GSM Association describes a GST template [5] which specifies a set of attributes that characterize a given type of network slice/service. The slice customer prepares a NEST based on GST attributes and forwards it to the NSP for slice orchestration. A NEST is a GST filled with values. A study on GST attributes is specified in TR 23.700-40 [6], and a reference to GST attributes is included in clause 5.15.2.2 of TS 23.501 [7]. GST attributes and NEST are also discussed in study on network slice capability exposure for application enablement (NSCALE) in TR 23700-99 [8]. The normative specification for this work is being specified in 3GPP TS 23.435 [9].

GST attributes, as defined in [5], are categorized into two types:

- Character attributes: These attributes typically characterize a slice (e.g., throughput, latency, APIs etc.). The character attributes can be further classified as relating to performance, function, or control and management

- Scalability attributes: These attributes provide information about the scalability of a slice (e.g., number of UEs)

The CSP/NSP translates the NEST to service requirements for a set of subnets (e.g., core, transport network, RAN) using the slice NRM as described in 3GPP TS 28.530 [3], TS 28.541 [10], TS 28.542 [11]. Based on individual slice subnet requirements, slice subnet resources are provisioned using slice orchestration operations for creating and managing NSI and NSSI resources as defined in 3GPP TS 28.531 [4]. Such operations include:

- Creation/modification/termination of NSI instances

- Creation/modification/termination of NSSI instances

- Creation/modification/termination of 3GPP NF instances

Management and orchestration concepts such as provisioning management services, fault supervision management services, and performance assurance management services in addition to management service specification on the above slice resources are specified in TS 28.532 [12]. TS 28.545 [13] and TS 28.546 [14] describe fault supervision aspects of management and orchestration of networks and network slicing.

3GPP TS 23.501 [7] and TS 23.502 [15] specify control plane architecture and procedures on enabling the connection of the UE to the above provisioned network slices including establishment of PDU sessions through those slices to the intended DNN. TS 23.503 [16] describes the data model for URSP rules and NSSP policies that enable UE application traffic to be routed through the provisioned network slices to the respective DNNs.

In addition, a study on network slice capability exposure for application layer enablement is described in 3GPP TR 23700-99 [8]. The application layer enablement architecture in [8] is based on the Service Enabler Architecture Layer for Verticals (SEAL) whose functional architecture and information flows are specified in TS 23.434 [17].

One of the key issues under study in [8] is whether a more concise approach to managing the lifecycle of network slices exposed to the application layer with additional functionality for verticals can be defined. One of the solutions being studied in clause 6.1.1 of [8] is to interface the network slice capability enablement server with the 5G system in order to perform all the network slice lifecycle management operations defined in [3] and [4]. With this capability, applications of different verticals can interface with the network slice capability enablement server for all network slice related operations.

3GPP TS 27.007 [18], in clause 10.1, describes how via AT commands the UE is able to set network slice preferences.

## 4.3 Network Slice Capability Exposure

In 23700-99 [8], documented are several key issues and candidate solutions in addition to enabling network slice lifecycle management operations using the network slice capability enablement server. Some of the key issues relevant to that study are the following:

- Discovery and registration aspects for management service exposure

- Network slice fault management capability

- Communication service management exposure

- Application layer QoS verification capability enablement

- Network slice related performance and analytics exposure

- Network slice capability exposure in the edge data network

- Delivery of existing network slice information to the trusted-third party

- Network slice creation to the third party and UE

In addition to the above information available at the network slice capability enablement server, TS 29.520 [19] specifies the stage-3 definition of NWDAF Services of the 5G System and provides a data model for network slice information that NWDAF can provide to authorized customers. Such information can also be used as network slice capability information.

## 4.4 Network slicing in SA2

### 4.4.1 General

A Network Slice is a logical network with specific capabilities and characteristics as defined in clause 3.1 of [7]. According to the supported features, functionalities and different groups of UEs, the multiple Network Slices can be deployed by the operator. More specifically, the network slice can support different functionality (e.g., priority, policy control), different performance requirements (e.g., latency, data rates), or different targeted users (e.g., MPS users, Public Safety users, corporate customers, roamers, or MVNO hosting users). For example, based on the operator’s needs, there can be one network slice for MIoT services, one for supporting eMBB UEs and another one for V2X services.

A Network Slice instance is a set of Network Function instances and the required resources (e.g. compute, storage and networking resources) which form a deployed Network Slice. A slice instance includes both core network control plane and user plane network functions as defined in clause 4.15.1 of [7].

A UE can access multiple Network Slices simultaneously. The occurrence of PDU Session Establishment in a Network Slice instance to a DN allows data transmission in that Network Slice instance. The Network Slice Selection policies in the UE are used to associate an application with a specific network slice during PDU Session Establishment. A PDU Session belongs to one and only one specific Network Slice instance per PLMN. Therefore, different Network Slice instances do not share a PDU Session. But multiple PDU Sessions in different Network Slice instances may be associated with the same Data Network, identified by the same DNN.

In addition, enhancements to interworking between the EPC and the 5GC have been made to the 5G System, and network slice-specific authentication and authorization are also supported. For each network slice that is subject to Network Slice Admission Control, the monitoring and control of the number of registered UEs, the number of PDU Sessions and the slice-maximum bit rate are defined in order to ensure that the maximum resource of the network slice is not exceeded.

### 4.4.2 Network slicing for specific applications

Before application services are allowed to access specific network slices, a third-party Application Service Provider can negotiate with the MNO and the MNO may create or allocate the network slices based on the service requirements. For example, a cloud gaming service provider may interact with the MNO to reserve specific network slices supporting low latency, and high computing resources.

Afterwards, the Application Function, on behalf of the Application Service Provider, informs the 5GC that the target application service can use the specific network slices, i.e., by providing application guidance for UE Route Selection Policy (URSP) determination as defined in clause 4.15.6.10 of TS 23.502 [15]. Depending on the nature of the application guidance, the operator may update the Network Slice Selection policies in the URSP accordingly.

The URSP rules in the UE, which are used to associate applications with usage of particular network slices, may be pre-configured or provided by the PCF as defined in TS 23.503 [16]. Each URSP rule is expressed as a traffic descriptor for application detection, e.g. IP descriptors, application descriptors, domain descriptors.

NOTE: There is no restriction on which part of UE should (re-)evaluate the URSP rules. This may be done by either the Operating System or the modem layer.

Once an application is started or detected on the UE, the following procedure is followed:

1. The UE evaluates its URSP rules in the order of Rule Precedence and determines whether the application matches the Traffic descriptor of any URSP rule.

a. When a URSP rule is determined to be applicable for a given application, the UE derives the suitable network slices based on the applicable URSP rule.

b. If the UE determines that there is more than one existing PDU Session which matches a given URSP rule, it is up to UE implementation (Operating System or modem layer) to select one of them to use. Otherwise, the UE tries to establish a new PDU Session using the derived network slices.

4. If there is no matching URSP rule (except the “match all” rule), the UE shall use the its own local configuration (if any) to determine which PDU Session to use.

NOTE: The UE local configuration in this context is information about the associated application, such as application-specific parameters to set up a PDU Session or end user configuration for specific applications. This can be provisioned in the UE via the application layer, e.g. following interaction between the Edge Enabler Client (EEC) and the Edge Configuration Server (ECS), as defined in TS 23.558 [24].

5. When URSP rules are updated, or when a particular URSP rule’s validity changes, the association of existing applications to PDU Sessions may need to be re-evaluated.

6. Depending on UE implementation, the associations between applications and PDU Sessions may also be re-evaluation periodically, independent of any changes to USRP rules.

# 5 Relevant network slicing use cases

Editor’s Note: This clause to cover possible network slicing related use case collaboration scenarios and deployment architectures.

## 5.1 General

Editor’s Note: This clause to include text to describe the overview and relevance of below two scenarios

## 5.2 Scenario 1: Operator-managed network slicing

In the operator-managed network slice scenario, the operator instantiates, configures, and manages a network slice that can be used by one or more customers (e.g., third-party service providers). A customer intending to provide a service to its users with differentiated quality of service or experience, requests that the operator sets up communication services in a network slice through which its users can access the customer’s service. The customer does not have any information about the slice internals, and completely relies on the operator to set up the resources requested by the customer in a network slice and make the service accessible to that customer’s users in that slice.

The customer and the operator negotiate a set of service requirements based on the expectation of the service that the customer intends to provide to its users. One way of negotiating service requirements is the use of GST attributes specified by GSM Association in [5]. Some of the performance-related GST attributes resemble the QoS service requirements specified in TS 26.501 [20] and TS 26.512 [21] as part of the M1d reference point specification.

NOTE: A detailed mapping between the GST attributes and the QoS attributes specified in [20] and [21] is for future study.

In this scenario, an Application Service Provider, as a customer of the operator providing a network slice, can negotiate service parameters to be provided in a network slice. Based on the negotiated service requirements, the operator provisions necessary control and management functions to enable the setting up of an end-to-end network slice spanning different slice domains (e.g., RAN, Core, Transport etc.). The operator-provided management functions manage the end-to-end operation of the network slice and guarantee the availability of application functions that are deployed in that slice. 3GPP TS 28.545 [13], TS 28.546 [14], TS 28.552 [22], TS 28.554 [23] define fault management and performance management capabilities which can be used to measure and assure the health of different slice resources.

By delegating these functions to the Mobile Network Operator, a media Application Service Provider can focus on media service delivery, using the 5G Media Streaming capabilities defined in TS 26.501 [20] and TS 26.512 [21], by interacting with the application functions provisioned in the network slice.

## 5.3 Scenario 2: Third-party-managed network slicing

In this scenario, a third-party entity requests that the operator creates a network slice based on certain requirements. The operator creates a network slice and hands over the network slice to the third-party entity. This mode of operation is specified in [3] and is referred to as NSaaS. Once the slice is handed over, the third-party entity can enhance the network slice e.g., by adding custom network functions, modifying slice configuration etc.

A method for negotiating requirements for NSaaS service is the use of GST attributes specified by the GSM Association [5]. In addition to the performance-related character attributes, a number of scalability-related attributes can be used to describe the requirements of the slice to be provisioned in the 5G System.

The third-party entity can then provide the network slice resources to its customers. As described in the previous scenario, customers of the third-party entity can then negotiate with the third-party entity to set up communication services in that network slice. The users of the customers will then be able to access the customer’s service using the provisioned network slice.

An Application Service Provider can function as the third-party entity in this scenario and can receive a provisioned network slice as a service from the Mobile Network Operator. In this case, the Application Service Provider may, in addition to the capabilities described in [20] and [21], also have additional facilities to control and manage the resources of the network slice.

NOTE: It is for future study to identify how the capabilities available as a NSaaS consumer specified in [3] benefit an Application Service Provider whose role is specified in [20] and [21]. This scenario is therefore not considered further in the present document.

Editor’s Note: [8] and [9] are to be monitored for specification related to the interface capabilities between the third-party entity and the NSCE server for control of network slices.

# 6 Key issues and candidate solutions

## 6.1 Key Issue #1: Service Provisioning

### 6.1.1 Description

#### 6.1.1.1 Provisioning media services with network slicing

Editor’s Note: Key issue to cover study objective to describe provisioning aspects for configuring media services with one or more network slices including QoS configuration, reporting and dynamic policy.

### 6.1.2 Candidate solutions

#### 6.1.2.1 Candidate solution #1

## 6.2 Key Issue #2: Realising dynamic policies using different slices

### 6.2.1 Description

#### 6.2.1.1 Slice selection for M5 dynamic policy requests

Editor’s Note: Key issue to cover study objective of identifying the appropriate network slice for outbound M5 dynamic policy requests from UE to AF.

### 6.2.2 Candidate solutions

#### 6.2.2.1 Candidate solution #1

## 6.3 Key Issue #3: Moving media flows to other slices

### 6.3.1 Description

#### 6.3.1.1 Migration of UE flows between slices due to dynamic policy

Editor’s Note: Key issue to cover study objective of migrating/moving UE media flows between different network slices as a result of dynamic policy procedures

### 6.3.2 Candidate solutions

#### 6.3.2.1 Candidate solution #1

## 6.4 Key Issue #4: AF discovery for dynamic policy

### 6.4.1 Description

#### 6.4.1.1 Discovery of 5GMS AF instance for dynamic policy

Editor’s Note: Key issue to cover study objective of discovering dynamic policy AF that the UE sends the outbound M5 requests to.

### 6.4.2 Candidate solutions

#### 6.4.2.1 Candidate solution #1

## 6.5 Key Issue #5: Interoperability considerations

### 6.5.1 Description

#### 6.5.1.1 Communication between AF instances to support interoperability

Editor’s Note: Key issue to cover study objective of determining the need and describing methods for AF-to-AF communication to support interoperability if 5GMS instances from different vendors are deployed in the 5GMS system. Media services may have different types of AFs (provisioning AF, dynamic policy AF, DCAF etc.) due to slicing, edge service provisioning, reporting configuration etc., and this key issue will cover communication aspects between those AFs if the AFs are deployed by different vendors.

### 6.5.2 Candidate solutions

#### 6.5.2.1 Candidate solution #1

## 6.6 Key Issue #6: Slice resource resolution

### 6.6.1 Description

#### 6.6.1.1 Resolve slice-specific application instances

Editor’s Note: Key issue to cover study objective of identifying methods for deploying, supporting, and resolving slice-specific 5GMS AS instances. Solutions all levels – higher layer methods such as modification of media description documents to lower layer methods using networking protocols – can be included.

### 6.6.2 Candidate solutions

#### 6.6.2.1 Candidate solution #1

# 7 Potential requirements

Editor’s Note: This clause to cover and include any identified potential requirements for further study.

# 8 Conclusions and recommendations

Editor’s Note: This clause to cover conclusions and recommendations based on studied key issues and evaluation of their respective candidate solutions.

Annex A (informative):
Change history

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| --- |
| Change history |
| Date | Meeting | TDoc | CR | Rev | Cat | Subject/Comment | New version |
| 2022-07 | SA4#120e | S4-221055 |  |  |  | Initial version | 0.1.0 |
| 2022-08 | SA4#120e | S4-221132 |  |  |  | Overview of Network slicing feature and capabilities | 0.2.0 |
| 2022-08 | SA4#120e | S4-221133 |  |  |  | Collaboration Scenarios with Network Slicing | 0.2.0 |
| 2022-08 | SA4#12e | S4-221139 |  |  |  | Network Slicing in SA2 |  |