|  |
| --- |
| 3GPP TR 26.941 V0.4.0 (2023-02) |
| Technical Report |
| 3rd Generation Partnership Project;Technical Specification Group Services and System Aspects;Network Slicing Extensions for 5G media services;(Release 18) |
|   |
|  |  |
|  |
| The present document has been developed within the 3rd Generation Partnership Project (3GPP TM) and may be further elaborated for the purposes of 3GPP.The present document has not been subject to any approval process by the 3GPPOrganizational Partners and shall not be implemented.This Specification is provided for future development work within 3GPPonly. The Organizational Partners accept no liability for any use of this Specification.Specifications and Reports for implementation of the 3GPP TM system should be obtained via the 3GPP Organizational Partners' Publications Offices. |

|  |
| --- |
|  |
| ***3GPP***Postal address3GPP support office address650 Route des Lucioles - Sophia AntipolisValbonne - FRANCETel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16Internethttp://www.3gpp.org |
| ***Copyright Notification***No part may be reproduced except as authorized by written permission.The copyright and the foregoing restriction extend to reproduction in all media.© 2022, 3GPP Organizational Partners (ARIB, ATIS, CCSA, ETSI, TSDSI, TTA, TTC).All rights reserved.UMTS™ is a Trade Mark of ETSI registered for the benefit of its members3GPP™ is a Trade Mark of ETSI registered for the benefit of its Members and of the 3GPP Organizational PartnersLTE™ is a Trade Mark of ETSI registered for the benefit of its Members and of the 3GPP Organizational PartnersGSM® and the GSM logo are registered and owned by the GSM Association |

Contents

Foreword 5

Introduction 6

1 Scope 7

2 References 7

3 Definitions of terms, symbols and abbreviations 8

3.1 Terms 8

3.2 Symbols 8

3.3 Abbreviations 9

4 Overview 9

4.0 Assumptions 9

4.1 General 9

4.2 Network slicing architecture 10

4.2.1 General 10

4.2.2 Network slicing for specific applications 11

4.2.3 Service continuity for media streaming sessions migrated between Network Slices 13

4.2.3.1 Background 13

4.2.3.2 Moving application flows to different Network Slices 13

4.3 Slice orchestration and management 13

4.4 Network slice capability exposure 14

5 Relevant scenarios and use cases 15

5.1 General 15

5.2 Scenarios 15

5.2.1 Scenario 1: Operator-managed network slicing 15

5.2.2 Scenario 2: Third-party-managed network slicing 15

5.3 Use cases 16

5.3.1 Multiple network slices for uplink and downlink streaming 16

5.3.2 Premium gaming slice 17

6 Key issues and candidate solutions 17

6.1 Key Issue #1: Service Provisioning 17

6.1.1 Description 17

6.1.1.1 Provisioning multiple Network Slices for media streaming 17

6.1.2 Candidate solutions 18

6.1.2.1 Candidate solution #1 18

6.2 Key Issue #2: Realising dynamic policies using different slices 18

6.2.1 Description 18

6.2.1.1 Slice selection for M5 dynamic policy requests 18

6.2.2 Candidate solutions 18

6.2.2.1 Candidate solution #1 18

6.3 Key Issue #3: Moving media flows to other Network Slices 18

6.3.1 Description 18

6.3.1.1 Migration of media streaming application flows between Network Slices 18

6.3.2 Candidate solutions 19

6.3.2.1 Candidate solution #1 19

6.4 Key Issue #4: AF discovery for dynamic policy 19

6.4.1 Description 19

6.4.1.1 Discovery of 5GMS AF instance for dynamic policy 19

6.4.2 Candidate solutions 19

6.4.2.1 Candidate solution #1 19

6.5 Key Issue #5: Interoperability considerations 19

6.5.1 Description 19

6.5.1.1 Communication between AF instances to support interoperability 19

6.5.2 Candidate solutions 19

6.5.2.1 Candidate solution #1 19

6.6 Key Issue #6: Slice resource resolution 20

6.6.1 Description 20

6.6.1.1 Resolve slice-specific application instances 20

6.6.2 Candidate solutions 20

6.6.2.1 Candidate solution #1 20

7 Potential requirements 20

8 Conclusions and recommendations 20

Annex A (informative): Change history 21

# 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".

[25] 3GPP TR 28.809: "Study on enhancement of management data analytics".

[26] 3GPP TR 23700-41: "Enhancement of Network Slicing Phase 3".

[27] 3GPP TS 22.261: "Service requirements for the 5G system".

[28] "5G Media Slice Definition", version 1.2, Joint outcome between New European Media and Networld2020 technology platforms, <https://5genesis.eu/wp-content/uploads/2019/10/NEM_Networld2020-5GPPP-5G-Media-Slice-White-Paper-V1.pdf>

[29] "Commercializing 5G Network Slicing", 5G Americas White Paper, https://www.5gamericas.org/wp-content/uploads/2022/07/Commercializing-5G-Network-Slicing-Jul-2022.pdf, July 2022.

# 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].

ANDSP Access Network Discovery & Selection Policy

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

ProSe Proximity based Services

ProSeP ProSe Policy

URSP UE Route Selection Policy

V2X Vehicle-to-Everything

V2XP V2X Policy

# 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.

## 4.0 Assumptions

The following assumptions apply to the present document:

1. Possible and efficient solutions based on network slicing are sought to support the use cases listed in clause 5 and many others that also require differentiated QoS for their application streams. Network slicing may not be the only solution to support these use cases, but is one possible solution.

2. Service requirements relating to network slicing specified in TS 22.261 [27] and TR 23700-99 [8] are considered for studying possible issues in relation to 5G Media Streaming.

## 4.1 General

Clause 5.12 of TR 26.804 [2] provides a brief overview of network slicing feature standardization in different 3GPP groups, areas of study related to 5G Media Streaming for specifying network slicing extensions, and potential open issues. 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 Network slicing architecture

### 4.2.1 General

A Network Slice is a logical network with specific capabilities and characteristics as defined in clause 3.1 of TS 23.501 [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. Figure 4.2.1‑1 below shows some illustrative scenarios. The occurrence of PDU Session Establishment in a Network Slice instance to a DN allows data transmission in that Network Slice instance.

NOTE: In the context of 5G Media Streaming, PDU Sessions of type IPv4 or IPv6 are the primary focus.

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.

|  |
| --- |
| (a) UPF instance shared by slice instances |
| (b) UPF instance per slice instance |

Figure 4.2.1‑1: Mapping of PDU Sessions to Data Network Names and Network Slice instances

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.

### 4.2.2 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. As a consequence, the application service may be migrated to the new network slice/DNN duple based on the updated URSP rule.

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.

2. If there is no matching URSP rule (except the “match all” rule), the UE uses 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].

3. 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.

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

In the case where a network slice becomes unavailable (e.g. due to overload), the AMF is triggered, either by local configuration (e.g. trigger from OAM) or by a notification from the Access and Mobility Management PCF (AM PCF) or by the NSSF [26], to replace the current S‑NSSAI with a previously chosen Alternative S-NSSAI. Using a suitable NAS procedure (e.g. UE Configuration Update) the AMF informs the UE about the Alternative S-NSSAI as well as providing the mapping between S-NSSAI(s) and Alternative S-NSSAI(s) in the Allowed NSSAI and/or in the Configured NSSAI.

1. In the case where there is no existing PDU Session in the unavailable slice and the UE is trying to establish a new one to support a 5G Media Streaming session, the UE may provide both the Alternative S-NSSAI and the current S-NSSAI in the PDU Session Establishment message, in which case the AMF provides both S-NSSAI values to the SMF for the PDU Session establishment. The SMF proceeds with the PDU Session Establishment using the Alternative S-NSSAI. As a result, the new PDU Session is established over the Alternative S-NSSAI with a new IP address.

2. In the case where an ongoing 5G Media Streaming session is already being carried over the PDU Session associated with the unavailable slice, the AMF informs the SMF responsible for the PDU Session that it is to be transferred to the Alternative S-NSSAI. Then, depending on the Session and Service Continuity (SSC) mode of the existing PDU Session, either:

- *SSC mode 1:* The SMF further updates the network slices in the UE/RAN/UPF via the PDU Session Modification procedure. In this case, the IP address of the PDU Session remains the same.

- *SSC mode 2 or 3:* The SMF triggers the modification/release of the PDU Session and re-establishment of the PDU Session in the Alternative S-NSSAI. In this case, a new IP address is allocated during the PDU Session re-establishment procedure and the ongoing 5G Media Streaming session at reference point M4 and M5 needs to be migrated to the new PDU Session.

Editor’s note: the above descriptions of Network Slice Replacement will be updated to aligned with SA2’s conclusion.

### 4.2.3 Service continuity for media streaming sessions migrated between Network Slices

#### 4.2.3.1 Background

TR 28.809 [25] is the result of a feasibility study that looked into aspects of management data analytics. Clause 6 of [25] specifies use cases, potential requirements and possible solutions for management data analytics. One of the issues relating to service-level specifications documented in clause 6.3.2 of [25] is the issue of network slice load analysis, described as follows:

|  |
| --- |
| Network slice load may vary over time. Therefore, network resources allocated initially could not always satisfy the traffic requirements, for example, the network slice may be overloaded or underutilized. Various factors may impact the network slice load, e.g. number of UEs accessing the network, number of PDU sessions, service types and the end users distribution. Overload of signalling in control plane and/or user data congestion in user plane will lead underperforming network. Besides, allocating excessive resources for network slice with light load will decrease resource efficiency. |

From the above, it is understood that a Network Slice can become overloaded from time to time, and that consequently the slice cannot satisfy the traffic requirements, and therefore may fail to meet its SLA.

Clause 5.1 of TR 23700-41 [26] describes a related key issue "Key Issue#1: Support of Network Slice Service Continuity" in terms similar to the issue described above in [25] above. Specifically, aspects related to service continuity are being studied for two scenarios – a "no mobility" scenario and an "inter-RA mobility" scenario – in the case when a Network Slice or Network Slice instance in the Core Network (CN) or target CN is overloaded or undergoing planned maintenance (e.g., Network Slice termination), and the network performance of the Network Slice cannot meet the SLA.

As described in clause 4.2.2 of the present document, SA2 is in the process of specifying a method where an alternative slice is identified in advance, with the aim of migrating application traffic from the PDU Session in the current slice to the existing PDU Session or a new one in that alternative slice.

#### 4.2.3.2 Moving application flows to different Network Slices

The 5G System provides generic support for moving application flows to different slices. As described in clause 5.15.5.2.2 of TS 23.501 [7] on determining whether ongoing traffic can be routed over existing PDU Sessions in other Network Slices:

|  |
| --- |
| The UE uses either the URSP rules (which includes the NSSP) or the UE Local Configuration as defined in clause 6.1.2.2.1 of TS 23.503 [16] to determine whether ongoing traffic can be routed over existing PDU Sessions belonging to other Network Slices or establish new PDU Session(s) associated with same/other Network Slice. |

From the above, it is clear that either the URSP rules delivered to the UE or the UE local configuration determine how ongoing application traffic can be routed over existing PDU Sessions belonging to other Network Slices.

Clause 4.2.2 of the present document describes how the URSP rules are used to route application traffic through appropriate network slices.

For UE Local Configuration, clause 6.1.2.2.1 of [16] describes UE policy control, and specifies that among the four policy objects – Access Network Discovery & Selection Policy (ANDSP), UE Route Selection Policy (URSP), V2X Policy (V2XP), and ProSe Policy (ProSeP) – only ANDSP and URSP may be pre-configured in the UE.

## 4.3 Slice orchestration and management

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 23.700-99 [8]. The normative specification for this work is being specified in 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 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 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.

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 TR 23.700-99 [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.

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

## 4.4 Network slice capability exposure

TR 23.700-99 [8] documents 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.

# 5 Relevant scenarios and use cases

## 5.1 General

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

## 5.2 Scenarios

### 5.2.1 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.

### 5.2.2 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.

## 5.3 Use cases

### 5.3.1 Multiple network slices for uplink and downlink streaming

[28] describes a number of media and content use cases that cover most of the common media and content situations from production to consumption. The two technology groups that co-authored [28] (New European Media and Networld2020) present nine use cases and have identified twelve parameters to adapt the network to application requirements. The following table lists the nine use cases, along with a mention of those use cases having strict QoS requirements in the uplink and/or downlink direction.

|  |  |  |
| --- | --- | --- |
| Use Case | Uplink Slice | Downlink Slice |
| Ultra-high fidelity imaging for medical applications | ✓ |  |
| Immersive and Interactive Media | ✓ | ✓ |
| Audio Streaming in Live Productions | ✓ | ✓ |
| Remote, Co-operative and Smart Media Production incorporating User-Generated Content | ✓ |  |
| Professional Content Production | ✓ |  |
| Machine generated content | ✓ |  |
| Collaborative design including immersive communication | ✓ | ✓ |
| Dynamic and Flexible UHD Content Distribution over 5G CDNs |  | ✓ |
| Smart Education | ✓ | ✓ |

The authors make a case for different design choices using number of slices for media use cases. An extract from the document:

|  |
| --- |
| Other use cases, identified in Chapter 2, requiring a combination of both uplink and downlink traffic, often with strong latency requirements, are the following:- Immersive and Interactive media- Audio Streaming in Live productions- Collaborative Design including Immersive Communication- Smart EducationFor these use cases the uplink traffic needs to be synchronised or correlated to the downlink traffic. In order to support these use cases, the 5G system should provide one of the following: - a new type of slice with support for downlink and uplink at the same time**- the ability to link an uplink slice to a downlink slice in order to synchronise or correlate the uplink traffic and the downlink traffic running through them, respectively.** |

One way to realize the use cases referenced above requiring a combination of uplink and downlink traffic is to run them in different network slices. By doing so, QoS requirements for uplink traffic and downlink traffic can be provided using differentiated QoS possible because of network slicing.

NOTE: Uplink and downlink traffic carried over different network slices should have different Traffic descriptors (containing one or more components, as described in table 6.6.2.1-2 of TS 23.503 [16]).

### 5.3.2 Premium gaming slice

[29] discusses aspects related to commercializing 5G network slicing. The white paper discusses network slicing use cases and path to initial commercialization, and evolution of network slicing technology. The white paper discusses gaming slice scenarios, and talks of two use-cases:

|  |
| --- |
| **- Premium service use-case**: where the user pays in a subscription model and will be able to use such premium treatment whenever it needs [**provided using a separate dedicated premium network slice**]**- Upsell use-case**: where the user pays a one-time fee for a premium slice-enabled treatment, such as in the previously mentioned example of a temporary boost in performance for video or gaming |

The white paper states the following:

|  |
| --- |
| One aspect we have hinted at but not discussed in detail is the on-demand enablement of slicing in the upsell scenario. While the Premium use case approach can be implemented by configuring the network with allowed NSSAI-s and modifying the user profile to use specific NSSAI when accessing the network, the Upsell approach requires communication between subscriber’s app, or the OS in case it intermediates the payment, and the Core for the purpose of dynamically managing the slicing activation/deactivation, as well as the monetization aspect. **An example of upsell in our gaming slice scenario involves asking the user to purchase the gaming slice treatment for a desired duration at a premium slice, at which point a network API would be accessed to enable the user to access the gaming slice. In this example, it would trigger the sending of a new URSP table that contains the rule and route for the gaming NSSAI**. |

# 6 Key issues and candidate solutions

## 6.1 Key Issue #1: Service Provisioning

### 6.1.1 Description

#### 6.1.1.1 Provisioning multiple Network Slices for media streaming

Clause 5.3.2 of the present document describes a use case for premium gaming where two network slices are provisioned by the 5GMS Application Provider for users with different subscription levels. Clauses 7 and 11 of TS 26.512 [21] describe 5G Media Streaming APIs for (respectively) M1 Provisioning and M5 Media Session Handling. However, the present APIs support only one Network Slice per Provisioning Session. Furthermore, it is not clear from [21] whether the same Service Operation Points and Policy Templates are available in different slices when they are provisioned in this way.

Open issues:

- Whether and how the 5GMS Provisioning (M1) APIs and corresponding data model definitions in [21] need to be enhanced to support the use case referenced by this Key Issue.

- Whether and how the Media Session Handline (M5) APIs and corresponding data model definitions in [21] need to be enhanced to support the use case referenced by this Key Issue.

NOTE: Migration of media flows to different Network Slice is studied separately in clause 6.3

Assumptions:

- Slice creation and activation are out of scope of this Key Issue. The 5GMS Application Provider may perform offline negotiation with MNO OAM for slice creation and activation as described in clause 4.3.

### 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 Network Slices

### 6.3.1 Description

#### 6.3.1.1 Migration of media streaming application flows between Network Slices

As introduced in clause 4.2.3 of the present document, clause 5.1 of TR 23700-41 [26] studies a Key Issue on network slice service continuity. According to this, a Network Slice or Network Slice instance can become overloaded or the performance of the Network Slice may fall below the requirements of its SLA.

The recommendation in clause 8.1 of [26] is for the 5G System to identify an alternative slice to migrate application flows from the PDU Session of the current slice to the existing PDU Session or a new one in the chosen alternative slice. When 5G Media Streaming sessions are carried over a PDU Sessions that cannot be migrated transparently to the application layer with the support of the service continuity procedure, the impacts on ongoing 5G Media Streaming sessions needs to be studied.

Open issues:

- Whether the service continuity procedure is transparent to 5G Media Streaming or requires enhancement of existing procedures and data model definitions in TS 26.501 [20] and TS 26.512 [21].

### 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

|  |
| --- |
| 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 | S4-221173 |  |  |  | S4-221132: Overview of Network slicing feature and capabilities S4-221133: Collaboration Scenarios with Network SlicingS4-221139: Network Slicing in SA2 | 0.2.0 |
| 2022-11 | SA4-e (AH) MBS SWG post 120-e | S4-221601 |  |  |  | S4aI221381: [FS\_MS\_NS\_Ph2] Architecture sketches | 0.3.0 |
| 2023-02 | SA4#122 | S4-230339 |  |  |  | S4-230333: Clarification on traffic migration to different network slices.S4-230336: [FS\_MS\_NS\_Ph2] Network Slice Service ContinuityS4-230337: [FS\_MS\_NS\_Ph2] Use cases for Network Slicing and Architecture AssumptionsS4-230338: [FS\_MS\_NS\_Ph2] Key Issues on service provisioning and dynamic policy | 0.4.0 |