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TECHNICAL REPORT

**Universal Mobile Telecommunications System (UMTS);  
LTE;  
5G;  
Network Slicing Extensions for 5G media services  
(3GPP TR 26.941 version 19.0.1 Release 19)**



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# Foreword

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

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- cannot** indicates that something is impossible

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- 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

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**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.

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## 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.

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# 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.

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# 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".
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- [36] [Jose Ordóñez-Lucena](#), [Pablo Ameigeiras](#), [Luis M. Contreras](#), [Jesús Folgueira](#) and [Diego R. López](#): "On the Rollout of Network Slicing in Carrier Networks: A Technology Radar", National Library of Medicine, Sensors, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8659767/>, December 2021.

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- [38] 5G Network Slicing: Android documentation, <https://source.android.com/docs/core/connect/5g-slicing>.
- [39] Apple device support for private 5G and LTE networks: <https://support.apple.com/guide/deployment/support-for-private-5g-and-lte-networks-depac6747317/web>.
- [40] GSM Association: "Network Slicing: North America's Perspective (Current) Version 1.0", <https://www.gsma.com/newsroom/wp-content/uploads//NG.130-White-Paper-Network-Slicing-NA-Perspective.pdf>, August 2021.
- [41] 3GPP TS 24.526: "User Equipment (UE) policies for 5G System (5GS); Stage 3".
- [42] 3GPP TS 26.510: "Media delivery; interactions and APIs for provisioning and media session handling".

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## 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

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## 4 Overview

### 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.

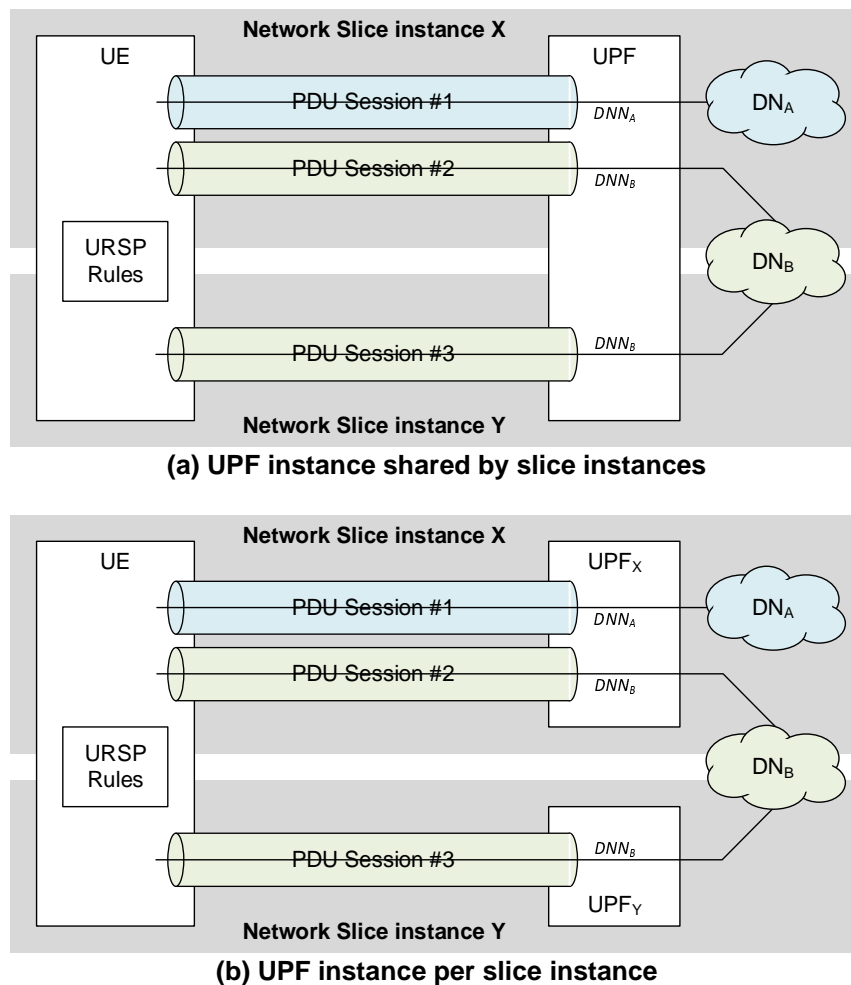
A Network Slice instance is a set of Network Function instances and the required resources (e.g. compute, storage and networking resources) which form a deployed Network Slice. A slice instance includes both core network control plane and user plane network functions as defined in clause 4.15.1 of [7].

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.



**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 tuple 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.

When the AMF is notified that the replaced network slice has become available again (e.g., congestion has been mitigated), the AMF reconfigures the UE (e.g., by using the UE Configuration Update procedure or else as a matter of course when the UE next registers with the network) to use the replaced S-NSSAI if it has already configured the UE to use the Alternative S-NSSAI when the S-NSSAI became unavailable. Furthermore, if a PDU Session was established in

the Alternative S-NSSAI when the replaced S-NSSAI became unavailable, the AMF triggers transfer of that PDU Session to the replaced S-NSSAI when the S-NSSAI becomes available again by updating the SMF(s) of the PDU Session using the *Nsmf\_PDUSession\_UpdateSMContext* service operation described in clause 5.2.8.2.6 of TS 26.502 [15].

## 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.

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# 5 Relevant scenarios and use cases

## 5.1 General

## 5.2 Types of network slicing

### 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. 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 requests that the operator provisions a network slice based on certain requirements. The operator provisions a network slice and hands it over to the third party. This mode of operation is specified in TS 28.530 [3] and is referred to as Network Slice-as-a-Service (NSaaS). Once the slice is handed over, the third party may 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 in GSMA NG.116 [5]. In addition to the performance-related characteristics, a number of scalability-related attributes may be used to describe the requirements of the slice to be provisioned in the 5G System.

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

An Application Service Provider may function as the third party in this scenario in which case it receives a provisioned network slice as a service from the Mobile Network Operator. In this case, in addition to the capabilities described in TS 26.501 [20] and TS 26.512 [21] a 5GMS Application Provider in the role of Application Service Provider may have additional facilities to control and manage the resources of the network slice.

A 5GMS Application Provider with the additional role of Network Slice Capability Exposure (NSCE) service provider may provide Network Slice Capability Exposure services to its users for Application Layer Enablement using the procedures and information flows specified in TS 23.435 [9]. Following are some of the network slice capability enablement features, a 5GMS Application Provider may benefit from:

1. Receive application layer network slice life-cycle management information based on network slice status collected from the 5G System (clause 9.4 of [9]). The 5GMS Application Provider may use this information to potentially activate feature such as metrics reporting (clause 7.8 of TS 26.512 [21]) and consumption reporting (clause 7.7 of TS 26.512 [21]), and update Policy Templates using Policy Template Provisioning API (clause 7.9 of TS 26.512 [21])
2. Network slice optimization based on customer application policy (clause 9.5 of [9]). The 5GMS Application Provider may use the policy information to potentially update Policy Templates for 5G Media Streaming using Policy Template Provisioning API (clause 7.9 of TS 26.512 [21])
3. For a given slice, discovery of management service capabilities and related permissions, and exposure of new or modified management service capabilities based on changes at OAM (clause 9.6 of [9]). The 5GMS Application Provider may use this information to potentially activate edge resource provisioning for 5G Media Streaming (clause 7.10 of TS 26.512 [21])
4. End-to-end network slice performance and analytics monitoring information based on data collected by the NSCE server from OAM, 5G Network etc. (clause 9.7 of [9]). The 5GMS Application Provider may use this information to potentially activate feature such as metrics reporting (clause 7.8 of TS 26.512 [21]) and consumption reporting (clause 7.7 of TS 26.512), and update Policy Templates using Policy Template Provisioning API (clause 7.9 of TS 26.512 [21])
5. Coordinated resource optimization across multiple slices to realize optimized and efficient resource usage among multiple slices sharing common network resources (clause 9.10 of [9]). The 5GMS Application Provider may potentially update Policy Templates for one or more network slices using Policy Template Provisioning API (clause 7.9 of TS 26.512 [21])
6. Network slice adaptation for customer application (clause 9.11 of [9]). Using this capability, the 5GMS Application Provider may potentially activate feature such as metrics reporting (clause 7.8 of TS 26.512 [21]) and consumption reporting (clause 7.7 of TS 26.512), and update Policy Templates using Policy Template Provisioning API (clause 7.9 of TS 26.512 [21])
7. Communication service life-cycle management to realize allocation of proper network slice resources to support customer application requirements (clause 9.12 of [9]). The 5GMS Application Provider may use this information to potentially negotiate requirements with the MNO as described in clause 4.3 of present document.

8. Receive network slice diagnostics information about specific event(s) related to service experience (clause 9.14 of [9]). The 5GMS Application Provider may use this information to potentially activate feature such as metrics reporting (clause 7.8 of TS 26.512 [21]) and consumption reporting (clause 7.7 of TS 26.512), and update Policy Templates using Policy Template Provisioning API (clause 7.9 of TS 26.512 [21])
9. Receive fault management information gathered from different data sources to identify problems relating to network connectivity and network performance (clause 9.15 of [9]). The 5GMS Application Provider may use this information to potentially activate feature such as metrics reporting (clause 7.8 of TS 26.512 [21]) and consumption reporting (clause 7.7 of TS 26.512), and update Policy Templates using Policy Template Provisioning API (clause 7.9 of TS 26.512 [21])
10. Verification of slice requirements and alignment capability based on QoS achievement status together with OAM QoS data versus the real customer QoS data collected from end users of customers (clause 9.16 of [9]). The 5GMS Application Provider may use this information to potentially activate feature such as metrics reporting (clause 7.8 of TS 26.512 [21]) and consumption reporting (clause 7.7 of TS 26.512), and update Policy Templates using Policy Template Provisioning API (clause 7.9 of TS 26.512 [21])
11. Receive network slice information e.g., retrieval and conversion of Network Slice Service Profile in 5GS as specified in TS 28.532 [12] (clause 9.17 of [9]). The 5GMS Application Provider may use this information to potentially negotiate requirements with the MNO as described in clause 4.3 of present document.
12. Perform network slice allocation if it cannot access 5G management system directly (clause 9.18 of [9]). The 5GMS Application Provider may use this information to potentially negotiate requirements with the MNO as described in clause 4.3 of present document.

## 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 Network2020) 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 Education

For 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.**

## 5.4 Collaboration scenarios for network slicing

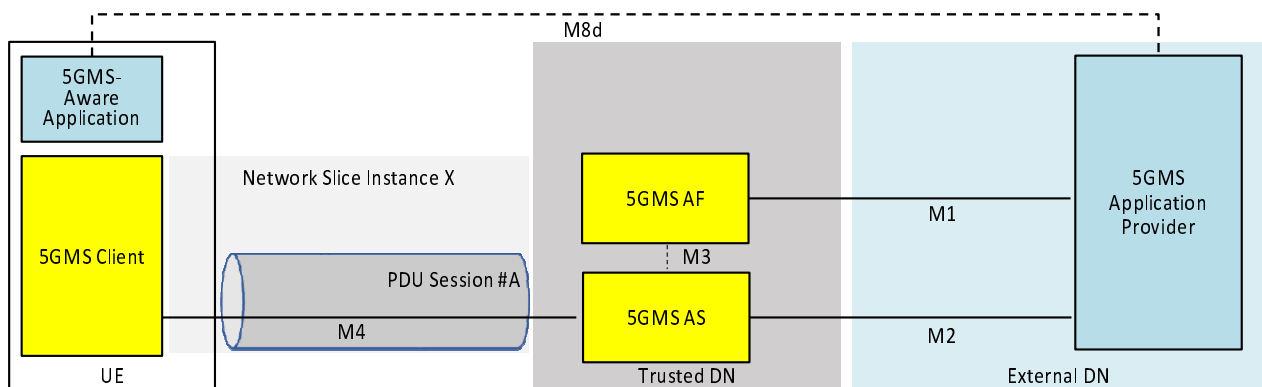
### 5.4.1 Collaboration scenarios for network slicing based on 5G Media Streaming scenarios

#### 5.4.1.0 Introduction

This clause presents the MNO CDN, OTT, and multi-MNO distribution collaboration scenarios corresponding to those described in clauses A.2, A.3, A.8, A.11, and A.14 of TS 26.501 [20] enhanced with network slicing. Other MNO CDN and OTT collaboration scenarios (clauses A.1, A.4, A.5, A.6, A.7, A.10, A.12, and A.13 of TS 26.501 [20]) can be similarly enhanced, and are therefore not presented here.

#### 5.4.1.1 Media streaming with both AF and AS deployed in the trusted Data Network

The collaboration scenario shown in figure 5.4.1.1-1 corresponds to the MNO CDN collaboration scenario described in clause A.2 and A.11 of TS 26.501 [20] delivered using a network slice.



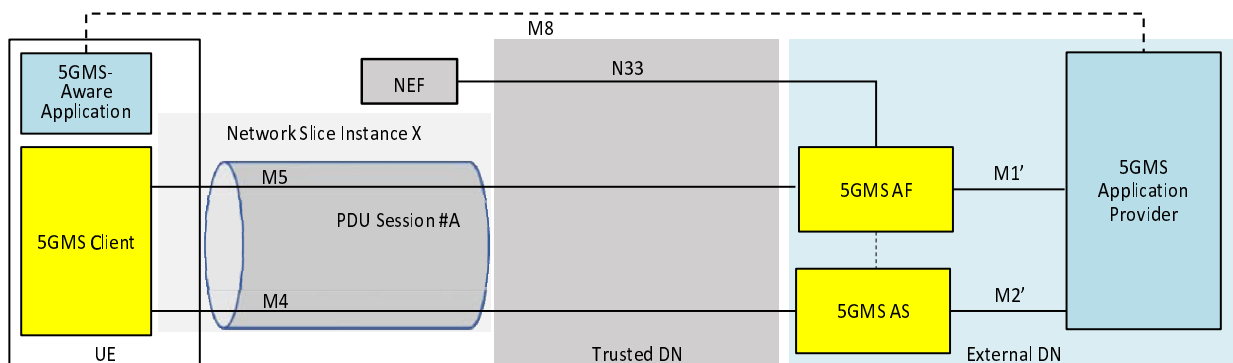
**Figure 5.4.1.1-1: Media streaming with AF and AS in the trusted Data Network with Network Slicing**

The 5GMS Application Provider may negotiate with the MNO for creation of a network slice as described in clause 4.2.2. The network slice is provisioned by the network operator as described in clause 4.3.

All the interactions between the participating entities (5GMS Application Provider, 5GMS-Aware Application, 5GMS Client, 5GMS AF, and 5GMS AS) for the 5G Media Streaming session described in clause A.2 and A.11 of TS 26.501 [20] apply in this scenario. All M4 interactions happen through a PDU Session established within the provisioned network slice.

### 5.4.1.2 Media streaming with both AF and AS deployed in an external Data Network (OTT)

This collaboration scenario shown in figure 5.4.1.2-1 corresponds to the OTT collaboration scenario described in clause A.3 and A.14 of TS 26.501 [20] delivered using a network slice.



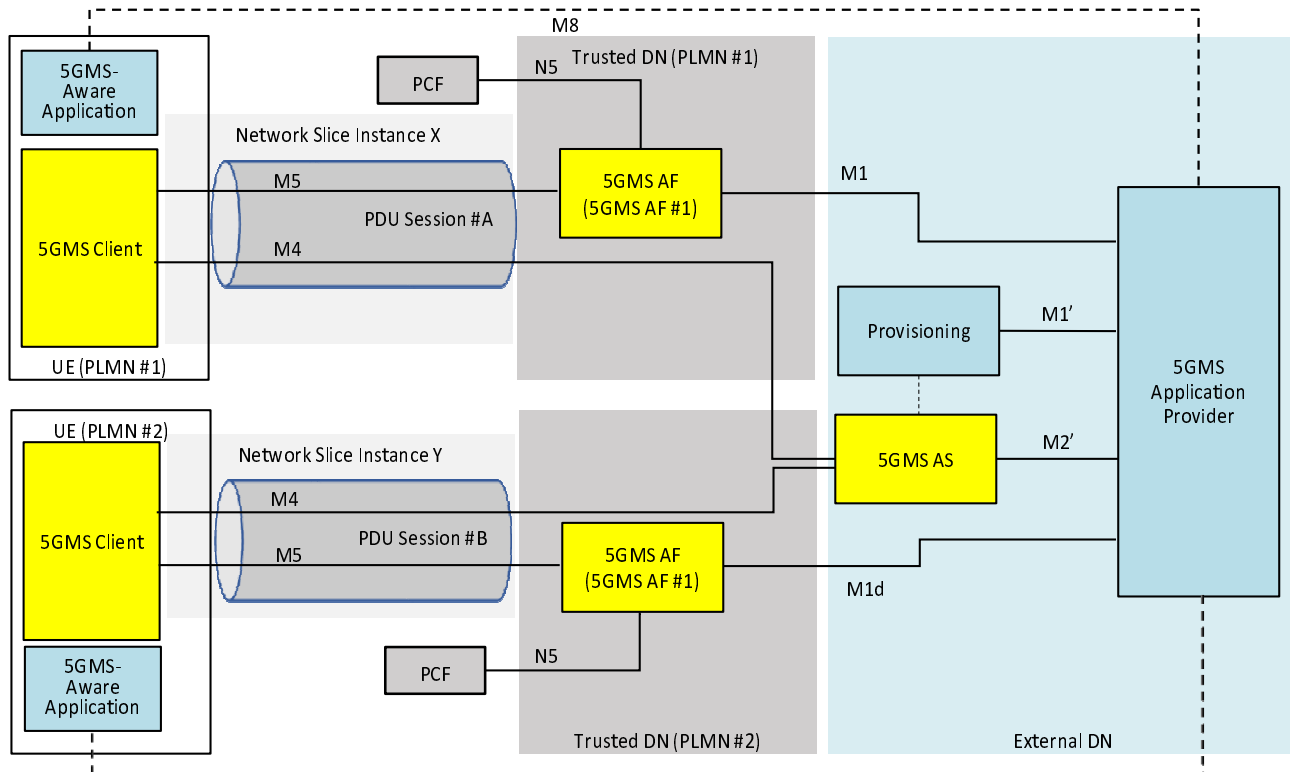
**Figure 5.4.1.2-1: Media streaming with AF and AS in an external Data Network (OTT) with Network Slicing**

The 5GMSd Application Provider may negotiate with the MNO for the creation of a network slice as described in clause 4.2.2. The network slice is provisioned by the network operator as described in clause 4.3.

All the interactions between all the participating entities (5GMS Application Provider, 5GMS-Aware Application, 5GMS Client, 5GMS AF, and 5GMS AS) described in clause A.3 of TS 26.501 [20] apply in this scenario. All M4 and M5 interactions happen through a PDU Session established within the provisioned network slice.

### 5.4.1.3 Media streaming with AFs deployed in two separate trusted Data Networks sharing AS in an external Data Network

This collaboration scenario shown in figure 5.4.1.3-1 represents a multi-MNO distribution scenario where an external CDN (5GMS AS) is used to deliver content to multiple UEs connected to different 5GMS-capable PLMNs, as described in clause A.8 of TS 26.501 [20], but delivered using network slices on those PLMNs.



**Figure 5.4.1.3-1: Media streaming with AFs in two trusted Data Networks sharing AS in external Data Network with Network Slicing**

The 5GMS Application Provider may negotiate with each of the PLMNs for creation of network sliced as described in clause 4.2.2 of the present document. The network slice for each PLMN is provisioned by the PLMN operator as described in clause 4.3.

All the interactions between all the participating entities (5GMS Application Provider, 5GMS-Aware Application, 5GMS Client, 5GMS AF, and 5GMS AS, PCF) described in clause A.8 of TS 26.501 [20] apply in this scenario. All M4 and M5 interactions happen through PDU Sessions established within the provisioned network slices. Each UE in a different PLMN may use the provisioned network slice in that PLMN for all the 5G Media Streaming operations. The same external CDN (5GMS AS) serves the users of both the PLMNs, and all the signaling and media traffic is sent through PSU Sessions in respective network slices.

## 5.4.2 Collaboration scenarios for network slicing with multiple slices or Data Networks

### 5.4.2.0 Introduction

From figure 4.2.1-1, the following is inferred:

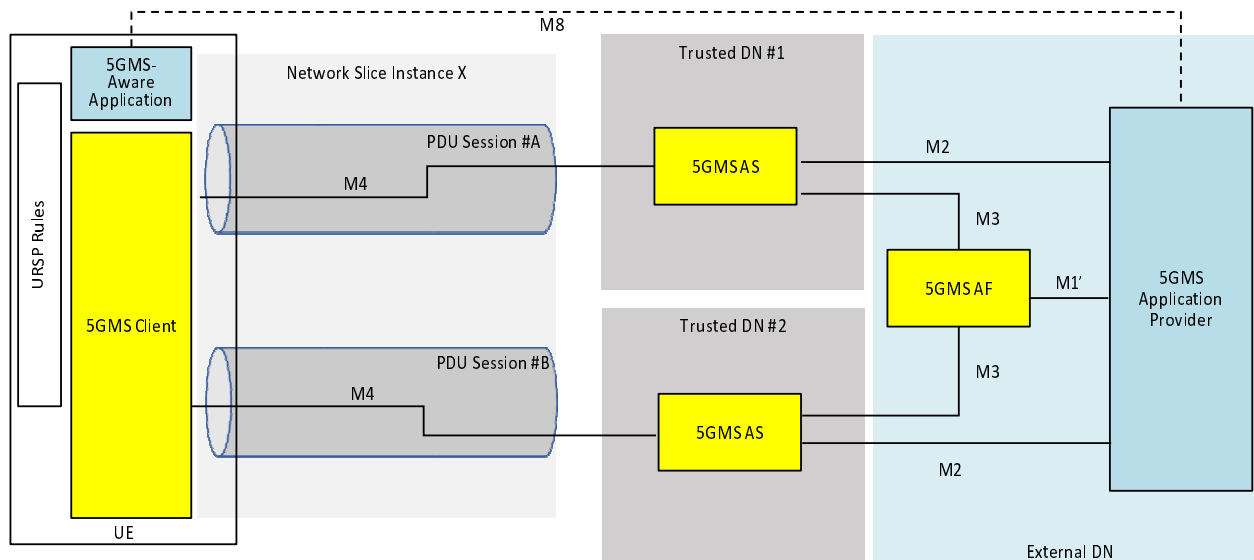
1. A UPF instance may be shared between multiple network slices.
2. Multiple PDU Sessions terminating in different Data Networks may share the same slice.
3. PDU Sessions in different network slice instances may terminate in the same Data Network.

Based on this, the following two collaborations are possible:



### 5.4.2.2 Media streaming with AS deployed in multiple trusted Data Networks

This collaboration scenario shown in figure 5.4.2.2-1 represents the case of accessing two different Data Networks using the same network slice as shown in figure 4.2.1-1. A CDN server (5GMS AS) is either deployed in each of the trusted Data Networks, or presents a multi-homed interface at reference point M4 through each of the trusted DNs.



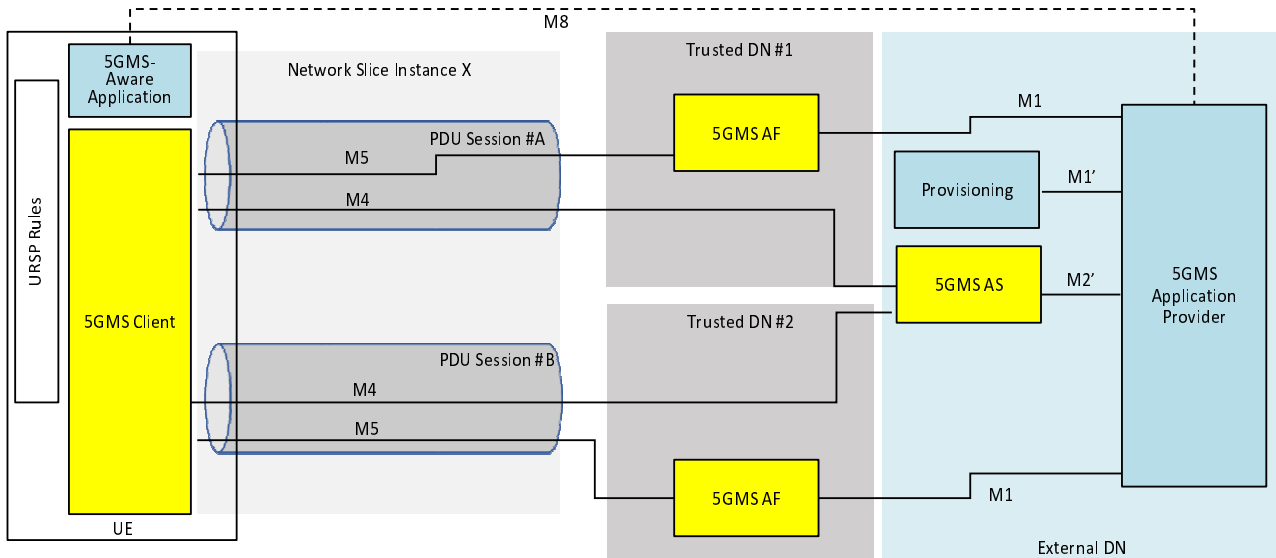
**Figure 5.4.2.2-1: Media streaming with AS deployed in multiple trusted Data Networks**

The 5GMS Application Provider may negotiate with the MNO to provision a network slice as described in clause 4.3. The operator provisions the network slice, and provides connectivity services to both the DNs through the slice.

The 5GMS Application Provider may deliver Service Access Information through reference point M8. The Service Access Information delivered to the 5GMS-Aware Application may have information about different Service Operation Points accessible through each of the DNs. For example, an enterprise may utilize an enterprise-specific CDN (e.g., hosting enterprise-related video tutorials). 5G Media Streaming sessions for enterprise-related video tutorials use the PDU Session terminating in the enterprise-specific CDN, while some other video tutorial requests are sent through PDU Sessions terminating in a different CDN. Alternatively, a DN may act as a back-up CDN, utilized by the 5GMS Client if the primary CDN is inaccessible or unavailable for any reason.

In a variant of this scenario, the second CDN may be a CDN edge with optional media processing.

In another variation of the above scenario shown in figure 5.4.2.2-1, a common 5GMS AS may serve traffic via two trusted Data Networks down the separate PDU Sessions, as shown in figure 5.4.2.2-2.



**Figure 5.4.2.2-2: Media streaming with single AS serving traffic through multiple Data Networks**

## 5.4.3 Collaboration options based on network slicing scenarios

### 5.4.3.0 Introduction

Clause 5.15.2 of TS 23.501 [7] describes the identification of network slice using NSSAI, and specifies the following:

*An S-NSSAI identifies a Network Slice.*

*An S-NSSAI is comprised of:*

- A Slice/Service type (SST), which refers to the expected Network Slice behaviour in terms of features and services;
- A Slice Differentiator (SD), which is optional information that complements the Slice/Service type(s) to differentiate amongst multiple Network Slices of the same Slice/Service type.

Based on the above NSSAI identification, different network slicing scenarios are possible:

1. *A slice allocated for a specific customer/tenant.* For example, a network slice allocated by the MNO for a specific enterprise. In this scenario, all applications of every UE in the enterprise use the allocated network slice. The SD field of the S-NSSAI is used to indicate the customer/tenant.
  - Both the Android [38] and iOS [39] mobile Operating Systems have recently started supporting 5G network slicing in mobile devices for enterprise users. Android 12 onwards supports network slicing with a separate enterprise slice and slicing based on user profiles, while Android 13 onwards supports network slicing with multiple enterprise slices [38].
2. *A slice allocated for a specific customer/tenant for a specific service/application.* For example, a network slice allocated by the MNO for a specific enterprise and application. In this scenario, the application in every UE in the enterprise uses the allocated enterprise network slice; all other applications in enterprise UEs use a different (possibly default) network slice. The SD field of the S-NSSAI is used to indicate the customer/tenant and the service information.
3. *A slice allocated for a specific service/application:* For example, a slice optimized for 5G Media Streaming. In this scenario, the optimized slice is shared between all UEs, specifically for 5G Media Streaming application; the

UEs use a different (possibly default) slice for other applications/services. The SD field of the S-NSSAI is used to indicate the service/application.

- The GSM Association specifies application-based network slicing [35], in which different network slices are provisioned for different applications.
4. *A slice leased by MNO to a virtual operator.* In this scenario, the virtual operator leases a network slice from the MNO, and in turn, can offer any of the above three network slicing scenarios to its customers over the leased network slice.

This clause describes collaboration options based on the above network slicing scenarios by presenting MNO CDN collaboration scenario described in clause A.7 of TS 26.501 [20] wherein both the 5GMS AF and 5GMS AS are deployed in the Trusted DN, and the 5GMS Application Provider uses reference points M1 and M2 respectively to interact with them.

NOTE: All the collaboration scenarios described in clause A of TS 26.501 [20] can be similarly shown with each of the network slicing scenarios described in this clause.

### 5.4.3.1 Scenario #1: Slice serving a set of enterprise services/applications

This is a network slicing scenario wherein the MNO, upon a request from an enterprise, allocates one or more network slices exclusively for enterprise users.

Figure 5.4.3.1-1 shows the case of an enterprise network slice for all applications in the enterprise UE. Every application on the enterprise UE, including the 5GMSd-Aware Application, uses the allocated network slice for communication with the DN entities.

NOTE: Android 12 onwards supports network slicing with a separate enterprise network slice allocated by the MNO.

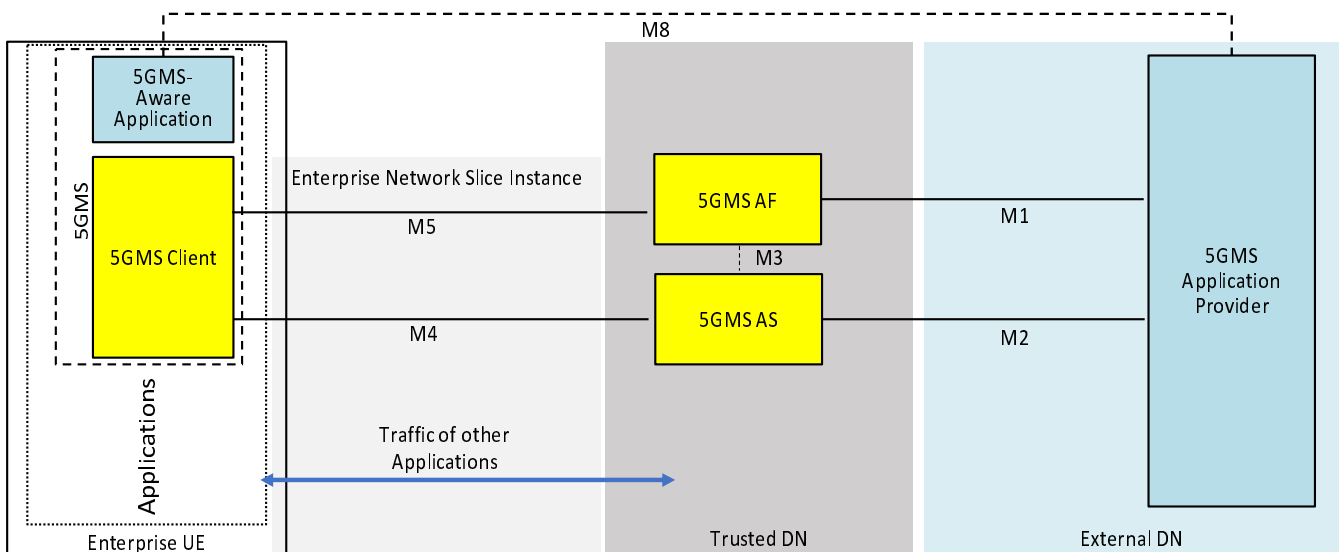
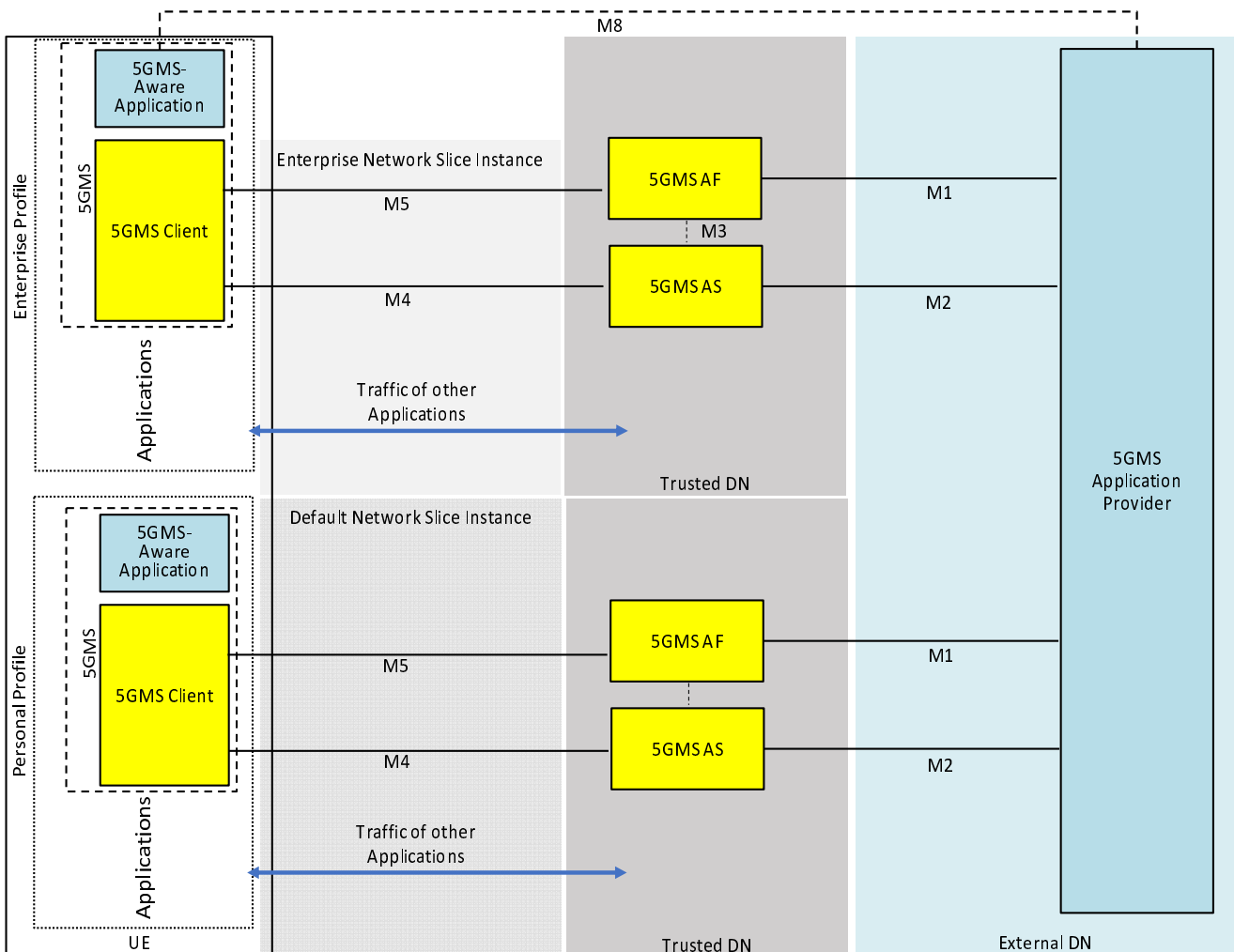


Figure 5.4.3.1-1: Network slice for all applications in the enterprise UE

Figure 5.4.3.1-2 shows the case of an enterprise network slice for applications in the enterprise profile of the UE.



**Figure 5.4.3.1-2: Network slice for enterprise profile applications**

In this scenario:

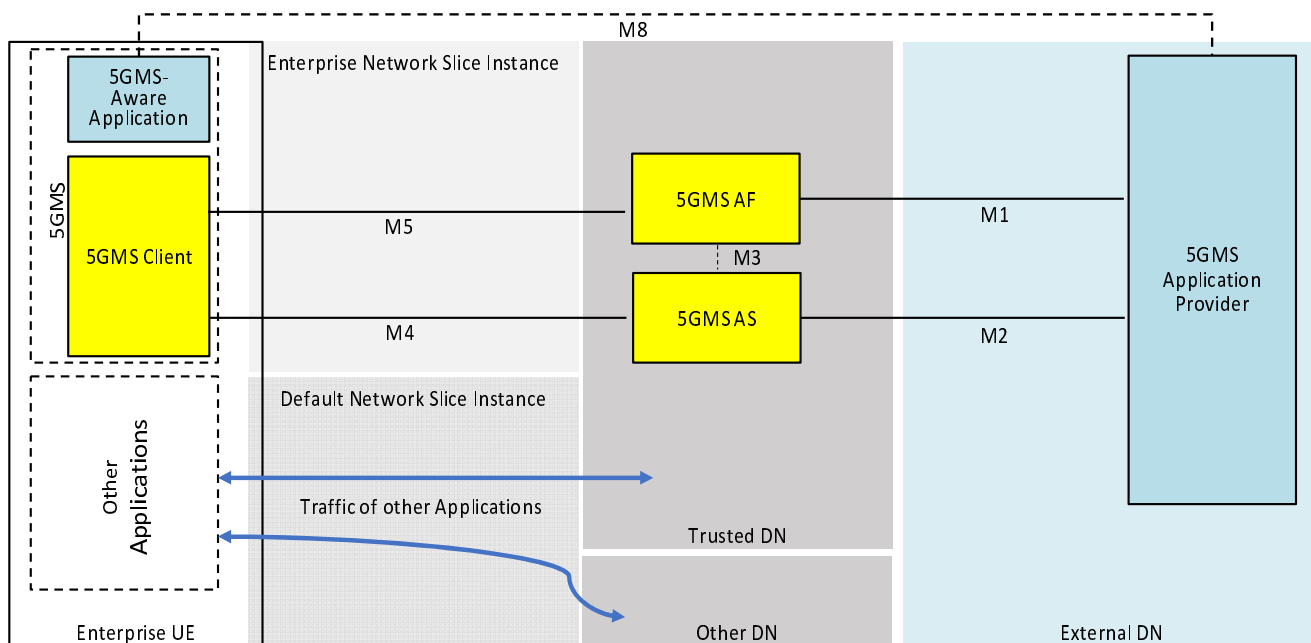
- Every application in the enterprise/work profile of the UE, including the 5GMS-Aware Application, uses the allocated enterprise network slice for communication with DN entities accessible from that slice.
- Every application in the non-enterprise profile of the UE (e.g., personal profile), including the 5GMS-Aware application, uses the default (e.g., eMBB) network slice for communication with DN entities accessible from that slice.

NOTE: Android 13 onwards supports network slicing with multiple enterprise slices, and slicing based on user profiles.

### 5.4.3.2 Scenario #2: Slice serving a specific application of an enterprise

This is a network slicing scenario wherein the MNO, upon a request from an enterprise, allocates a specific network slice for a specific service/application for enterprise users.

Figure 5.4.3.2-1 shows the case of an enterprise network slice for a specific application (e.g., 5GMS-Aware Application) for enterprise UEs. The media streaming traffic belonging to the 5GMS-Aware application is sent through the enterprise network slice, while traffic for all other applications is sent through a default network slice (e.g. eMBB).



**Figure 5.4.3.2-1: Network slice for specific application for enterprise users**

URSP rules, provisioned by the PCF, as described in clause 6.6.2.2 of TS 23.503 [16], assist in traffic detection and route selection of appropriate network slice for application traffic in the UE.

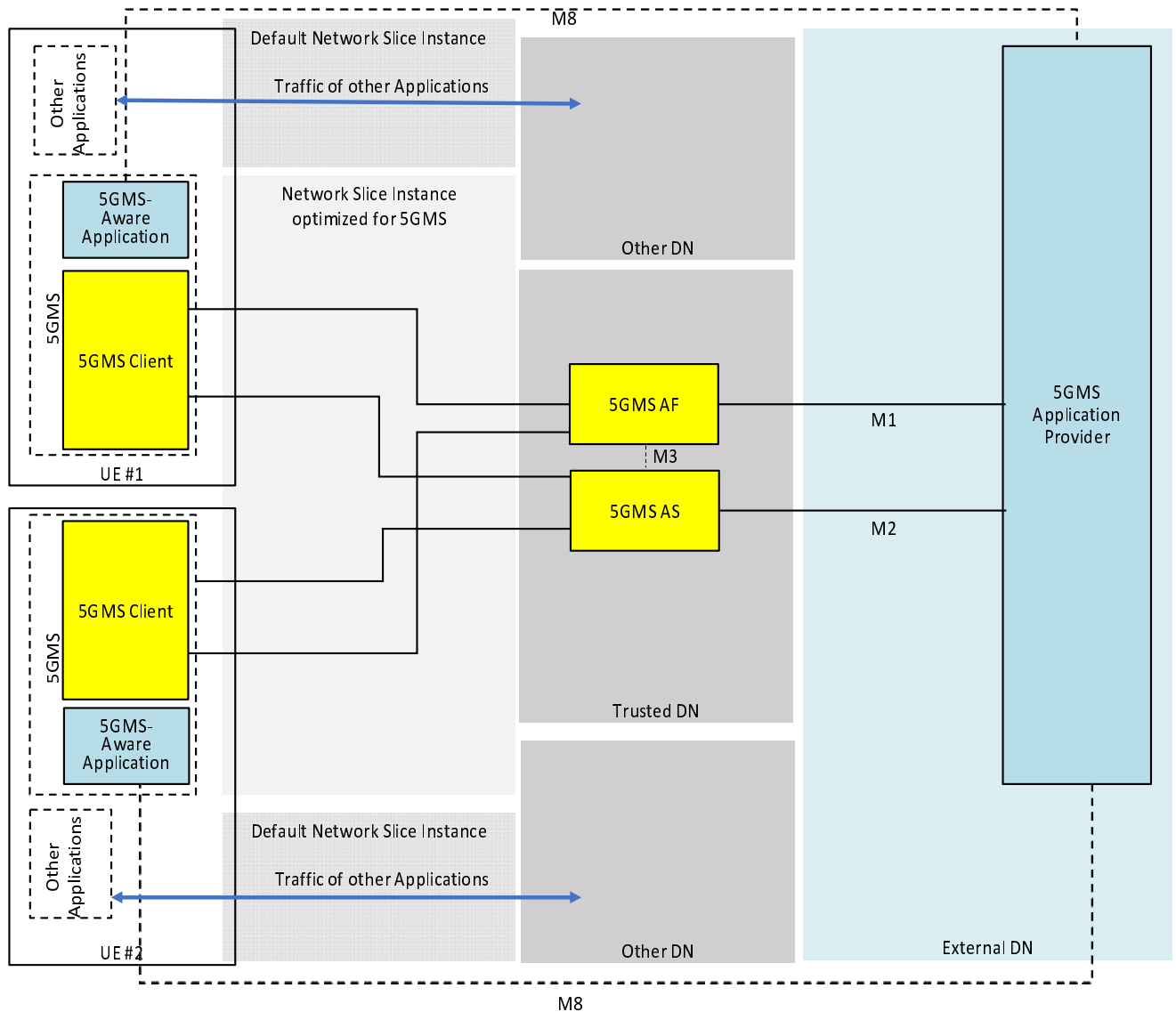
### 5.4.3.3 Scenario #3: Slice optimised for a specific service/application

This is a network slicing scenario wherein the MNO allocates a specific network slice for a specific service/application for use by multiple users. (The MNO may also provision additional network slices for carrying traffic of other specific applications.)

NOTE 1: The GSM Association specifies application-based network slicing [40], in which different network slices are provisioned for different applications.

NOTE 2: Unlike Scenario#1 and Scenario#2, the users in this scenario need not belong to the same enterprise.

Figure 5.4.3.3-1 shows the case of a slice optimized for 5G Media Streaming. The traffic belonging to the 5GMS-Aware Applications of all users is sent through this network slice, while the traffic of other applications is sent through a default network slice (e.g., eMBB).



**Figure 5.4.3.3-1: Network slice for specific application for all users**

URSP rules, provisioned by the PCF, as described in clause 6.6.2.2 of TS 23.503 [16], assist in traffic detection and route selection of the appropriate network slice for application traffic in the UE.

**5.4.3.4 Scenario #4: Slice serving a virtual operator**

This is a network slicing scenario where in virtual operator leases network slice from the MNO, and uses it to provide service to its customers as described in clause 5.2.2 of present document. The virtual operator may, in turn, offer any of the above three slicing scenarios on the leased network slice.

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## 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: Policy template provisioning for a plurality of Network Slices and/or DNNs

Pre-requisites and assumptions:

- A single 5GMS Application Provider (with identity *aspId*) intends to provision a Policy Template for a plurality of Network Slices.
- The one or more Network Slices are already provisioned and activated. Appropriate Slice and DNN identifiers are known to the 5GMS Application Provider.
- The 5GMS AF is preconfigured by the 5G System operator with a mapping from IP subnet range(s) to S-NSSAI/DNN tuples so that it can select an appropriate Network Slice and/or Data Network when manipulating the network QoS of the application flows described by a Network Assistance session or Dynamic Policy invocation.

To enable a Policy Template to be valid for more than one Network Slice and/or DNN, in this candidate solution the Policy Template resource specified in clause 7.9.3.1 of TS 26.512 [21] is modified as follows:

1. Add an array of *networkContexts* as a child under the *applicationSessionContext* parent. For backwards compatibility with the existing syntax, this array may be omitted, or present but empty.
2. Each Network Context object includes the existing *sliceInfo* and *dnn* properties. Both properties remain optional, so it is syntactically valid for the *networkContexts* array to contain empty objects (although this is meaningless semantically).

## 7.9.3 Data model

### 7.9.3.1 PolicyTemplate resource

The data model for the PolicyTemplate resource is specified in table 7.9.3-1 below:

**Table 7.9.3-1: Definition of PolicyTemplate resource**

Property	Type	Cardinality	Usage	Visibility	Description
policyTemplateId	ResourceId	1..1	C: RO R: RO U: RO		Unique identifier of this Policy Template within the scope of the Provisioning Session.
state	Enumeration of Strings	1..1	C: RO R: RO U: RO		A Policy Template may be in the PENDING, INVALID, READY, or SUSPENDED state. Only a Policy Template in the READY state may be instantiated as a Dynamic Policy Instance and applied to media streaming sessions.
apiEndPoint	String	1..1	C: RW R: RO U: RW	MNO Admin	The API endpoint that should be invoked when activating a Dynamic Policy Instance based on this Policy Template.
apiType	Enumeration of Strings	1..1	C: RW R: RO U: RW	MNO Admin	N5: Npcf_PolicyAuthorization Service. N33: AsSessionWithQoS or ChargableParty.
externalReference	String	1..1	C: RW R: RO U: RW		Additional identifier for this Policy Template, unique within the scope of its Provisioning Session, that can be cross-referenced with external metadata about the media streaming session.
qoSSpecification	M1QoS Specification	0..1	C: RW R: RO U: RW		Specifies the network quality of service to be applied to media streaming sessions at this Policy Template.
applicationSession Context	Object	1..1			Specifies information about the application session context to which this Policy Template can be applied.
afApplId	AfApplId	0..1	C: RW R: RW U: RW		As defined in clause 5.6.2.3 of TS 29.514 [34] and clause 5.3.2 of TS 29.571 [12].
networkContexts	array(object)	0..1			
sliceInfo	Snssai	0..1	C: RW R: RW U: RW		
dnn	Dnn	0..1	C: RW R: RW U: RW		
aspld	Aspld	1..1	C: RW R: RW U: RW		
chargingSpecification	Charging Specification	0..1	C: RW R: RW U: RW		Provides information about the charging policy to be used for this Policy Template.

NOTE: The cardinality relationship between *aspld* and *sliceInfo* is for future study.

### 6.1.3 Conclusions

The study of the key issue involved looking into use cases for running 5G Media Streaming services in one or more Network Slices, and the current stage-3 support for provisioning those slices. The stage-3 API for Policy Template provisioning supports one Network Slice and/or Data Network per Provisioning Session. As described by the candidate solution in clause 6.1.2.1, it is useful for the 5G Application Service Provider to provision multiple Network Slices and/or Data Networks at once if the same Policy Template may be applied to one or more Network Slices and/or Data Networks.

It is assumed that the M4 and M5 application flows are on the same PDU Session.

The following stage 2 normative specification work is recommended to support Policy Template provisioning for a plurality of Network Slices and/or Data Networks:

- Update the **media streaming features** introduced in clause 4.0 of TS 26.501 [20] as follows:
  1. Modify the domain model for dynamic policies (figure 4.0.6-2) to additionally illustrate the properties of Data Network Names and Network Slice identifiers as array elements in the Policy Template entity.
- Update the **procedures for downlink media streaming** defined in clause 5 of TS 26.501 [20] as follows:
  2. In the procedure for dynamic policy based on network slicing for download streaming (clause 5.8.1), add the following pre-requisites:
    - a. The 5GMSd Application Provider may identify Network Slice(s) and/or Data Network(s) applicable to each Policy Template. Add a note to the clause that the 5GMSd AF may map the external slice identifier and DNN to operator-internal identifiers.
    - b. The 5GMSd AF is preconfigured by the 5G System operator with a mapping from IP subnet range(s) to slice identifiers/DNN duples so that it can select an appropriate network slice and/or Data Network when manipulating the network QoS of the application flows described by a Network Assistance session or Dynamic Policy invocation. The 5GMSd AF may use information of the selected network slice and/or Data Network to filter viable Policy Templates before including them in Service Access Information provided to the 5GMSd Client described in clause 4.3.2 of TS 26.501 [20].
- Update the **procedures for uplink media streaming** defined in clause 6 of TS 26.501 [20] as follows:
  3. In the procedure for dynamic policy based on network slicing for uplink streaming (clause 6.9.6), add the following pre-requisites:
    - a. The 5GMSu Application Provider may identify Network Slice(s) and/or Data Network(s) applicable to each Policy Template. Add a note to the clause that the 5GMSu AF may map the external slice identifier and DNN to operator-internal identifiers.
    - b. The 5GMSu AF is preconfigured by the 5G System operator with a mapping from IP subnet range(s) to slice identifiers/DNN duples so that it can select an appropriate network slice and/or Data Network when manipulating the network QoS of the application flows described by a Network Assistance session or Dynamic Policy invocation. The 5GMSu AF may use information of the selected network slice and/or Data Network to filter viable Policy Templates before including them in Service Access Information provided to the 5GMSu Client described in clause 4.3.2 of TS 26.501 [20].

The following stage 3 normative specification work is recommended to support Policy Template provisioning for a plurality of Network Slices and/or Data Networks:

- The *PolicyTemplate* resource data model in TS 26.510 [42] is adjusted to permit the array of S-NSSAI and DNN duples to include more than one member.

## 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

### 6.2.3 Conclusions

No conclusion has been reached for this Key Issue.

## 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

### 6.3.3 Conclusions

This Key Issue studied the aspect of network slice replacement specified by 3GPP SA2 in TS 23.501 [7] and its impact on 5G Media Streaming procedures. The study found that:

- The network slice replacement procedure is transparent to the Application Function and the Application Service Provider.
- There is no guarantee that the Alternative S-NSSAI provides similar performance as that of the replaced S-NSSAI when a network slice replacement procedure is undertaken by the 5G System.

We conclude that:

- Per 3GPP SA2 guidance on the current support of network slice replacement in the 5G System, no normative work to enhance existing procedures in TS 26.501 [20] and data model definitions in TS 26.512 [21] is required at this time.
- Future work in 3GPP SA2 related to network slice replacement is to be monitored, and the data model definitions in TS 26.510 [42] enhanced, if necessary.

## 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

### 6.4.3 Conclusions

No conclusion has been reached for this Key Issue.

## 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

### 6.5.3 Conclusions

No conclusion has been reached for this Key Issue.

## 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

### 6.6.3 Conclusions

No conclusion has been reached for this Key Issue.

## 6.7 Key Issue #7: Bootstrapping application invocation on Network Slice

### 6.7.1 Description

#### 6.7.1.1 Discover appropriate Network Slice for 5GMS procedures

Clauses 5 and 6 of TS 26.501 [20] describe the high-level procedures for downlink and uplink media streaming respectively. As part of these procedures, the 5GMS Application Provider performs service provisioning at the 5GMS AF. The 5GMS-Aware Application subsequently receives Service Access Information from the 5GMS Application Provider over reference point M8 or else acquires it directly from the 5GMS AF over reference point M5. If the UE currently has access to more than one Network Slice, it is unclear how the 5GMS-Aware Application and the 5GMS Client on the UE discover the appropriate Network Slice to use to establish a new media streaming session.

Open issues:

- How the bootstrapping of the application invocation on a Network Slice happens before the 5GMS Client performs 5G Media Streaming operations.

### 6.7.2 Candidate solutions

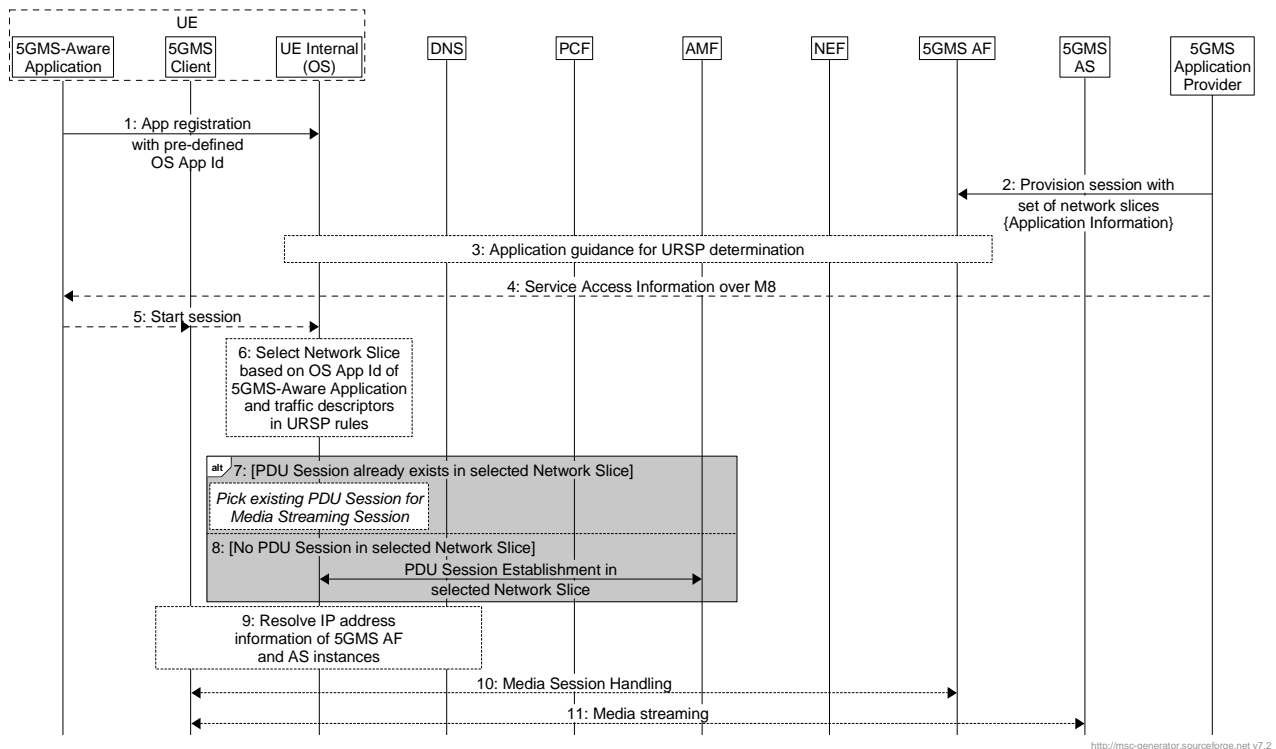
#### 6.7.2.1 Candidate solution #1: Network Slice selection based on Traffic Descriptor information in URSP rules

From clause 5.15.5.2.2 of TS 23.501 [7], the UE uses either the URSP rules (which includes the NSSP) or the UE local configuration to determine which PDU Sessions to use to route ongoing application traffic. Clause 6.6.2.1 of TS 23.503 [16] describes the structure of URSP rules. One of the components of a URSP rule is the *Traffic description information* that helps a UE to identify matching application traffic. Table 6.6.2.1-2 of TS 23.503 [16] specifies a number of Traffic descriptor options, one of which is the *Application descriptor* that identifies traffic of applications running on the UE. An Application descriptor consists of OS Id and OS App Id properties that are known to both the UE application and the 5GMS Application Service Provider.

Assumptions:

- The 5GMS-Aware Application developer is aware of different OS App Ids supported by the UE operating system.

Figure 6.7.2.1-1 below illustrates the procedure for bootstrapping application invocation on a Network Slice.



**Figure 6.7.2.1-1: Call flow for bootstrapping application invocation on a Network Slice**

The steps are as follows:

1. The 5GMS-Aware Application is installed on the UE, and is programmed to invoke an OS-specific network connection API using a pre-defined OS App Id supported by the UE operating system.
2. The 5GMS Application Provider provisions the media streaming session in the 5GMS AF with one or more network slices at reference point M1. The provisioning information may include application information such as the *ProvisioningSession.externalApplicationId* specified in clause 7.2.3.1 of TS 26.512 [21]. The 5GMS AF uses this information to synthesise application traffic descriptor information used for application guidance, as specified in clause 4.15.6.10 of TS 23.502 [15].
3. The 5GMS AF uses the *Nnef\_ServiceParameter* service defined in clause 5.2.6.1 of TS 23.502 [15] to provide application guidance for URSP determination via the NEF as described in clause 4.15.6.10 of TS 23.502 [15], which is eventually delivered to the UE as described in clause 4.15.6.7 of TS 23.502 [15]. The application guidance for URSP includes service parameters such as the application traffic descriptor information (synthesised in the previous step) and Route selection parameters (DNN and S-NSSAI) as specified in clause 4.15.6.10 of TS 23.502 [15].

NOTE 1: URSP rules may also be configured in the UE as described in clause 4.2.2 of this present document.

4. The 5GMS Application Provider may provide Service Access Information to the 5GMS-Aware Application at reference point M8. In the Service Access Information, the 5GMS Application Provider may include information related to Service Operation Points associated with different Network Slices.
5. The 5GMS-Aware Application initiates a media streaming session with the 5GMS Client at reference point M6. The 5GMS Client uses an OS-specific UE-internal API to request a network connection for use at reference points M5 (step 10) and M4 (step 11).

NOTE 2: If the 5GMS-Aware Application is aware about Network Slices, the 5GMS-Aware Application may explicitly indicate the Network Slice to use as part of its request for a network connection. In this case, the following step is skipped.

6. Based on the OS App Id configured for the 5GMS-Aware Application in step 1, the UE Operating System enables selection of the appropriate Network Slice using the traffic descriptor information inside the currently configured URSP rules.

NOTE 3: If multiple network slices are provided for the same traffic descriptor, the precedence information in the route selection descriptor is used to select the appropriate Network Slice.

NOTE 4: Whether the UE OS should evaluate the URSP rule is up to implementation.

7. The UE Operating System checks whether a PDU Session already exists in the selected Network Slice and, if so, selects this PDU Session for further interaction with the media streaming endpoints (steps 10 and 11).
8. Alternatively, if no PDU Session exists in the Network Slice, the UE Operating System creates a PDU Session using the UE-requested PDU Session establishment procedure specified in clause 4.3.2.2 of TS 23.502 [15].

NOTE 5: See table A-1 in TS 23.503 [16] for an example of this procedure.

NOTE 6: According to clause 4.2.2.2 of TS 24.526 [41], the mechanisms used by the UE Operating System to check for the existence of a PDU Session in the selected Network Slice and to establish a new PDU Session if needed are up to UE implementation.

9. Once the PDU Session is available, the 5GMS Client interacts with DNS system to resolve the IP address of the 5GMS AF and 5GMS AS instances.
10. The 5GMS Client interacts with the 5GMS AF for media session handling procedures as specified in clause 11 of TS 26.512 [21].
11. The 5GMS Client interacts with the 5GMS AS for media streaming as specified in clause 10 of TS 26.512 [21].

### 6.7.3 Conclusions

This Key Issue studied application bootstrapping onto a Network Slice based on application information provisioned by the 5GMS Application Provider and the configuration information in the 5GMS-Aware Application. The application information provisioned by the 5GMS Application Provider is used by the 5GMS AF to provide application guidance for URSP determination in the 5G System. The configuration in the 5GMS-Aware Application and the currently configured URSP rules help the UE Operating System select the appropriate Network Slice for routing application traffic.

The following is recommended for stage 2:

- The Key Issue description and candidate solution in clauses 6.7.1 and 6.7.2 respectively of the present document be included as an informative annex to TS 26.501 [20] as guidance for implementations.

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## 7 Potential requirements

The following topics for further study are identified:

1. Impact to 5G Media Streaming procedures and data model definitions in TS 26.510 [42] based on specification progress related to Network Slice replacement.

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## 8 Conclusions and recommendations

Network slicing is one of the key features of 5G which allows Mobile Network Operators to provision logical networks to serve a specific service or service category, or to serve customers with specific service requirements. Network slicing standardization has progressed in various different 3GPP Working Groups. Specification related to this feature includes architecture, orchestration and management, network resource models, capability management and exposure. The Key Issues studied in the present document point to a need to extend the 5GMS architecture in order to take advantage of network slicing when delivering 5G Media Streaming services.

The present document provides an overview of network slicing architecture and aspects related to slice orchestration and management as well as network slice capability exposure. It briefly describes different network slice management options such as operator-managed network slicing and third-party-managed network slicing. The present document also collects a set of use cases for running 5G Media Streaming services in one or more network slices, and describes a number of collaboration scenarios for exploiting network slicing capabilities within the 5GMS architecture. It also documents key issues and candidate solutions related to service provisioning, moving media flows to other network slices, and bootstrapping application invocation on a network slice.

It is recommended that:

1. The use cases and collaboration scenarios for network slicing documented in clauses 5.3 and 5.4 respectively be included in an informative annex to TS 26.501 [20].
2. The changes to the *PolicyTemplate* resource data model definition described in clause 6.1.2.1 be implemented in TS 26.510 [42] to support Policy Template provisioning for a plurality of Network Slices and/or Data Networks, and the corresponding alignment changes described in clause 6.1.3 be implemented in TS 26.501 [20].
3. The Key Issue description and corresponding candidate solution on bootstrapping application invocation on a Network Slice documented in clause 6.7 of the present document be included as an informative clause or annex to TS 26.501 [20] as guidance for implementations.

## 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 Slicing S4-221139: Network Slicing in SA2	0.2.0
2022-11	SA4-e (AH) MBS SWG post 120-e	S4-221601				S4a1221381: [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 Continuity S4-230337: [FS_MS_NS_Ph2] Use cases for Network Slicing and Architecture Assumptions S4-230338: [FS_MS_NS_Ph2] Key Issues on service provisioning and dynamic policy	0.4.0
2023-04	SA4#123-e	S4-230597				S4-230679: [FS_MS_NS_Ph2] Candidate Solution for Key Issue #1: Service Provisioning	0.5.0
2023-08	SA4#125	S4-231555				S4-231486: [FS_MS_NS_Ph2] Key Issue on Bootstrapping Application Invocation on a Network Slice S4-231487: [FS_MS_NS_Ph2] Collaboration Options and Network Slicing Scenarios	0.6.0
2023-09	SA#101					Version 1.0.0 created by MCC	1.0.0
2023-11	SA4#126	S4-231852				S4-232049: [FS_MS_NS_Ph2] pCR on Conclusions and recommendations S4-231851: [FS_MS_NS_Ph2] Way forward on network slice replacement	1.1.0
2023-12	SA#102	SP-231293				Version 2.0.0 created by MCC	2.0.0
2023-12	SA#102					Approved at TSG SA#102	18.0.0
2024-03	SA#103	SP-240050	0001	1	F	Addressing editor notes and missing details in TR 26.941	18.1.0
2024-06	SA#104	SP-240699	0002	1	C	Stage-2 Aspects of Network Slicing	19.0.0
2024-08						Restoring visibility of figures introduced in CR S4-241250	19.0.1

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# History

<b>Document history</b>		
V19.0.1	January 2026	Publication