Source: Samsung Electronics Co. Ltd

**Title: [FS\_MS\_NS\_Ph2] Collaboration Options and Network Slicing Scenarios**

**Agenda Item: 8.9**

**Document for: Discussion and Agreement**

# **Introduction**

3GPP TS 26501 describes collaboration scenarios for downlink streaming and uplink streaming. This contribution presents collaboration scenarios for downlink streaming using network slicing. In addition, this contribution also discusses some network slicing scenarios dependent on type of network slicing.

In specific, the contribution discusses the following:

* Collaboration scenarios with network slicing based on existing collaboration scenarios specified in TS 26501
* Collaboration scenarios with network slicing based on network slicing architecture described in clause 4.2 of TR 26941
* Discussion on network slicing scenarios, and collaboration options based on these network slicing scenarios.

# **Collaboration scenarios for network slicing**

2.1 Scenarios based on existing downlink streaming scenarios described in TS 26501

TS 26501 presents a number of collaboration scenarios for downlink and uplink streaming. In this contribution, we focus on downlink streaming scenarios and extend them to use network slicing. The uplink streaming scenarios described in TS 26501 could be similarly extended, but not presented in this contribution.

Following are the downlink streaming scenarios described in TS 26501:

|  |  |  |
| --- | --- | --- |
| No | Collaboration scenario | Clause in TS 26501 |
| 1 | Downlink media streaming with AS deployed in an external Data Network (OTT) | A.1 |
| 2 | Downlink media streaming with both AF and AS deployed in the trusted Data Network | A.2 |
| 3 | Downlink media streaming with both AF and AS deployed in an external Data Network (OTT) | A.3 |
| 4 | Downlink media streaming with AF deployed in the trusted Data Network and AS deployed in an external Data Network | A.4 |
| 5 | Downlink media streaming with AS deployed in an external Data Network, provisioned by AF deployed in the trusted Data Network | A.5 |
| 6 | Downlink media streaming with AS deployed in the trusted Data Network, provisioned by AF deployed in an external Data Network | A.6 |
| 7 | Downlink media streaming with both AF and AS deployed in the trusted Data Network and AF interaction with PCF | A.7 |
| 8 | Downlink media streaming with AFs deployed in two separate trusted Data Networks sharing AS in an external Data Network | A.8 |
| 9 | Downlink media streaming with both AF and AS deployed in external Data Network and AS delivering content through two trusted Data Networks (OTT) | A.9 |

Collaboration scenarios 1–7 in above table differ with respect to deployment of 5GMS AF and 5GMS AS instances in trusted vs external data network. The last two scenarios describe collaboration in lieu of multiple trusted data networks.

In clause 3.1 of this contribution, we show two example collaboration scenarios – MNO CDN and OTT collaboration (clauses A.2 and A.3 of TS 26501 respectively) enhanced with network slicing. Other MNO CDN and OTT collaboration scenarios (clauses A.1, A.4, A.5, A.6, A.7) can be similarly enhanced, and therefore not presented in this document. However, the accompanying document have all the collaboration scenarios in clauses A.1 – A.9 of TS 26501 enhanced with network slicing. The two multi-MNO distribution scenarios (A.8 and A.9 of TS 26501) are different than the rest of scenarios. So, in this document, we present these two scenarios enhanced with network slicing.

2.2 Scenarios based on network slicing architecture

Clause 4.2 of TR 26.941 describes network slicing architecture based on specification in TS 23.501. In this clause of TR 26.941, presented is the below figure that describes the relationship between network slice instances, PDU Sessions, and DNNs.

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

Figure 1: Mapping of PDU Sessions to Data Network Names and Network Slice instances (Figure 4.2.1-1 of TR 26941)

From Figure 1 above, following are some of the aspects that can be inferred:

1. A UPF instance may be shared between multiple network slices.
2. Multiple PDU Sessions terminating at different DNN may share the same slice.
3. PDU Sessions in different network slice instances may be associated with the same DNN.

From the above architecture figure, following two collaboration options are possible, that are not specified in TS 26.501:

* Downlink media streaming where in an AS delivers content through two different network slices
* Downlink media streaming where in AS instances deployed in different Trusted DNs are accessed by the 5GMSd client in the same network slice.

Clause 3.2 of this contribution specifies collaboration options based on the above two possibilities.

2.3 Network slicing scenarios

There is some literature on the web about 5G network slicing [2][6][7][8][9][10]. Some of these [6][7][8] have information about possible ways network slicing could be used. Based on literature study, and related standard specification in 3GPP and other SDOs, we can discuss network slicing scenarios from the following perspective.

Clause 5.15.2 of TS 23.501 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.* |

Table 5.15.2.2-1 of TS 23.501 specifies standardized SST values. [1][2][3] shed light on usage of the Slice Differentiator value as a way to describe services, customer information and slice priority. Of particular interest amongst these three types of information is the customer information (or the tenancy information) which indicates the slice allocated to a specific customer/tenant, and the service information (to identify a service/application).

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

* A slice allocated for a specific customer/tenant: Example a network slice allocated by the MNO for a specific enterprise. 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.
	+ Android [4] and IOS [5] have recently started supporting 5G network slicing in mobile devices for enterprise users. Android 12+ supports network slicing with a separate enterprise slice and slicing based on user profiles, while Android 13+ supports network slicing with multiple enterprise slices [4].
* A slice allocated for a specific customer/tenant for a specific service/application. Example a network slice allocated by the MNO for a specific enterprise and application. 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.
* A slice allocated for a specific service/application: Example a slice optimized for 5G Media Streaming. This slice is shared between all UEs, specifically for 5G Media Streaming application. For other applications/services, the UEs use a different (possibly default) slice. The SD field of the S-NSSAI is used to indicate the service/application.
	+ GSMA [10] specifies application-based network slicing, where different network slices are provisioned for different applications.
* A slice leased by MNO to a virtual operator. In this case, the virtual operator leases 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.

Clause 3.3 of this contribution describes collaboration options based on the above network slicing scenarios.

# **Collaboration Scenarios for network slicing**

## 3.1 Collaboration scenarios for network slicing based on download streaming scenarios described in TS 26.501

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 and A.9 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 of TS 26.501 [20]) can be similarly enhanced, and are therefore not presented here. [However, the accompanying document have all the collaboration scenarios in clauses A.1 – A.9 of TS 26501 enhanced with network slicing.]

### 3.1.1 Downlink media streaming with both AF and AS deployed in the trusted Data Network

The collaboration scenario shown in figure 3.1.1-1 corresponds to the MNO CDN collaboration scenario described in clause A.2 of TS 26.501 [20] delivered using a network slice.



Figure 3.1.1-1: Downlink media streaming with AF and AS in the trusted Data Network
with Network Slicing

The 5GMSd Application Provider may negotiate with the MNO for creation of a network slice as described in clause 4.2.2 of TR 26941. The network slice is provisioned by the network operator as described in clause 4.3 of TR 26.941.

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

### 3.1.2 Downlink media streaming with both AF and AS deployed in an external Data Network (OTT)

This collaboration scenario shown in figure 3.1.2-1 corresponds to the OTT collaboration scenario described in clause A.3 of TS 26501 delivered using a network slice.



Figure 3.1.2-1: Downlink 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 creation of a network slice as described in clause 4.2.2 of TR 26941. The network slice is provisioned by the network operator as described in clause 4.3 of TR 26.941.

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

### 3.1.3 Downlink media streaming with AFs deployed in two separate trusted Data Networks sharing AS in an external Data Network

This collaboration scenario shown in figure 3.1.3-1 represents a multi-MNO distribution scenario where an external CDN (5GMSd AS) is used to deliver content to multiple UEs connected to different 5GMSd-capable PLMNs, as described in clause A.8 of TS 26.501 [20], but delivered using a network slices on those PLMNs.



Figure 3.1.3-1: Downlink media streaming with AFs in two trusted Data Networks sharing AS in external Data Network with Network Slicing

The 5GMSd Application Provider may negotiate with each of the PLMNs for creation of network sliced as described in clause 4.2.2 of TR 26941. The network slice for each PLMN is provisioned by the PLMN operator as described in clause 4.3 of TR 26.941.

All the interactions between all the participating entities (5GMSd Application Provider, 5GMSd-Aware Application, 5GMSd Client, 5GMSd AF, and 5GMSd AS, PCF) described in clause A.8 of TS 26.501 [20] apply in this scenario. All such 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 (5GMSd AS) serves the users of both the PLMNs, and all the signaling and media traffic is sent through PSU Sessions in respective network slices.

### 3.1.4 Downlink media streaming with both AF and AS deployed in external Data Network and AS delivering content through two trusted Data Networks (OTT)

This collaboration scenario shown in figure 3.1.4-1 represents a multi-MNO distribution scenario where an external CDN (5GMSd AS) is used to deliver content through multiple 5GMSd-capable PLMNs, as described in clause A.9 of TS 26.501 [20], but delivered using network slicing.



Figure 3.1.4-1: Downlink media streaming with AF and AS in external Data Network delivering through two trusted Data Networks (OTT) with Network Slicing

The 5GMSd Application Provider may negotiate with each of the PLMNs for creation of network sliced as described in clause 4.2.2 of TR 26941. The network slice for each PLMN is provisioned by the respective PLMN operator as described in clause 4.3 of TR 26.941.

All the interactions between the participating entities (5GMSd Application Provider, 5GMSd-Aware Application, 5GMSd Client, 5GMSd AF, and 5GMSd AS) described in clause A.9 of TS 26.501 apply in this scenario. All such 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 (5GMSd AS) and 5GMSd AF functions serve the users of both the PLMNs, and all the signaling and media traffic is sent through PDU Sessions in respective network slices.

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

### 3.2.1 Downlink media streaming with AS deployed in external Data Network and AS delivering content through two different network slices

This collaboration scenario shown in figure 3.2.1-1 represents the case of accessing the same external Data Network through two different network slices shown in figure 1. An external CDN (5GMSd AS) is accessed by the UE via this Data Network.



**Figure 3.2.1-1: Downlink media streaming with AS in external Data Network accessible through two different network slices**

The 5GMSd Application Provider may negotiate with the MNO to setup two different network slices with different SLAs as described in clause 4.3 of TR 26941. After the SLA negotiation, the operator may provision two network slices, and povide connectivity services to the external Data Network through both the slices.

The 5GMSd Application Provider may deliver Service Access Information through reference point M8d. The Service Access Information delivered to the 5GMSd-Aware Application may have information about different Service Operation Points accessible through each of the network slices. Upon receiving the Service Access Information, the 5GMSd-Aware Application passes this information to the 5GMSd Client. The 5GMSd Client selects the operating point of interest, and requests media streaming session establishment over the PDU Session in the network slice that provides the required Service Operation Point. Media streaming (M4d) thus happens through the selected network slice.

The other network slice may be used to fetch other media streaming assets (depending on criticality and SLA availability considerations), or serves as an alternate network slice in case the first slice becomes unavailable, as discussed in clause 6.3 of TR 26941.

### 3.2.2 Downlink media streaming with AS deployed in multiple trusted Data Networks

This collaboration scenario shown in figure 3.2.2-1 represents the case of accessing two different Data Networks using the same network slice as shown in figure 4.2.1-1 of TR 26941. A CDN server (5GMSd AS) is either deployed in each of the trusted Data Networks, or presents a multi-homed interface at reference point M4d through each of the trusted DNs.



**Figure 3.2.2-1: Downlink media streaming with AS deployed in multiple trusted Data Networks**

The 5GMSd Application Provider may negotiate with the MNO to provision a network slice as described in clause 4.3 of TR 26941. The operator provisions the network slice, and povides connectivity services to both the DNs through the slice.

The 5GMSd Application Provider may deliver Service Access Information through reference point M8d. The Service Access Information delivered to the 5GMSd-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 5GMSd 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.

## 3.3 Collaboration Options based on network slicing scenarios

## 3.3.0 General

Scenarios described in this clause are based on the MNO CDN collaboration scenario described in clause A.7 of TS 26.501 [20] wherein both the 5GMSd AF and 5GMSd AS are deployed in the Trusted DN, and the 5GMSd Application Provider uses reference points M1d and M2d 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.

## 3.3.1 Scenario #1: Slice serving an enterprise

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 3.3.1-1 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 version 12+ supports network slicing with a separate enterprise network slice allocated by the MNO.



**Figure 3.3.1-1: Network slice for all applications in the enterprise UE**

Figure 3.3.1-2 shows the case of an enterprise network slice for applications in the enterprise profile of the UE.



**Figure 3.3.1-2: Network slice for enterprise profile applications**

In this scenario:

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

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

## 3.3.2 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 3.3.2-1 shows the case of an enterprise network slice for a specific application (e.g., 5GMSd-Aware Application) for enterprise UEs. The media streaming traffic belonging to the 5GMSd-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 3.3.2-1: 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.

## 3.3.3 Scenario #3: Slice optimized for an 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: GSMA specifies application-based network slicing, where 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 3.3.3-1 shows the case of a slice optimized for downlink 5G Media Streaming. The traffic belonging to the 5GMSd-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 3.3.3-1: 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.

## 3.3.4 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 TR 26941. The virtual operator may, in turn, offer any of the above three slicing scenarios on the leased network slice.

# **References**

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# **Proposal**

We propose that the clause 3 of this contribution be included in clause 5 of TR 26941.