Source: Samsung Electronics Co. Ltd

**Title: [FS\_MS\_NS\_Ph2] Use cases for Network Slicing and Architecture Assumptions**

**Agenda Item: 8.10**

**Document for: Discussion and Agreement**

# **Introduction**

During the last Post 121 MBS adhoc telco on Feb 9, 2023, there were questions from SA4 colleagues about the applications and use cases for network slicing. This contribution attempts to address these questions. Specifically:

* Clause 2 describes media specific use cases
* Clause 3 describes some observations from use cases described in clause 2
* Clause 4 provides an answer to an email question during Post 121 MBS adhoc telco (Feb 9) on the motivation for using multiple network slices
* Clause 6 proposes adding some use cases described in clause 2 to TR 26941, along with adding some architectural assumptions for progress of our study

# **Use cases and architectural assumptions**

Over the course of our study on the topic of network slicing, and the impact of 3GPP SA2 defined network slicing architecture on SA4 defined media streaming architecture, we’ve attempted to find use cases that could be basis of specification in SA4 MBS group. Towards this, we’ve discussed and presented, during the course of our study, following use cases that are of interest:

**2.1 Multiple network slices for uplink and downlink streaming**: [1] is a document that describes a number of media and content use cases that cover most of the common media and content situations from production to consumption. In this document, the two technology groups (New European Media and Networld2020) present 9 use cases and have identified 12 parameters to adapt the network to application requirements. Following is the set of 9 use cases, along with a mention of those use cases having strict QoS requirements for uplink and downlink direction.

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

The two groups 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***

**2.2 Network slice service continuity**: Contribution S4-230249 submitted to this meeting SA4#122 describes a use case on network slice service continuity that proposes migration of application flows to a PDU Session in a different slice in case of overloaded and underperforming network slices.

**2.3 Network slices and different operation points**: Clause 5.12 of TR 26.804 describes in detail a solution for streaming of different operation points in dedicated multiple network slices.

**2.4 Premium gaming slice**: [2] 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****”*.

**2.5 Tactile and multi-modal communication services**: TR 22.847, an SA1 TR, discusses potential 5G requirements on supporting tactile and multi-modal communication services. In this TR, use cases 5.1 (Immersive multi-modal Virtual Reality (VR) application) and 5.3 (Immersive VR games) described aspects of multiple media streams with different QoS requirements. An excerpt from clause 5.1.6 for this use case specifying two requirements:

“*[PR 5.1.6-3] The 5G network shall support a mechanism to allow an authorized 3rd party to provide QoS policy for multiple flows (e.g., haptic, audio and video) of multiple UEs associated with a multi-modal application. The policy may contain e.g. coordination information.*

*[PR 5.1.6-4] The 5G system shall support a mechanism to apply 3rd party provided policy for flows associated with an application. The policy may contain e.g. coordination information.*

*NOTE: The policy can be used by a 3rd party application for coordination of the transmission of multiple UEs’ flows (e.g., haptic, audio and video) of a multi-modal communication session*.”

An excerpt from clause 5.3.6 (potential requirements) is as follows:

“*[PR 5.3.6-2] The 5G system shall support a mechanism to allow an authorized 3rd party to provide QoS policy for coordination between flows of multiple UEs associated with an application. The policy may contain e.g. the set of UEs and data flows, the expected 5GS QoS handling(s) and associated triggering events, expected coordination assistance provided by 5G system between those multiple flows for different traffic types (e.g., haptic, audio and video).*”

**2.6 Our opinion of above use cases**:

1. On use case for multiple network slices for uplink and downlink streaming (clause 2.1 above): One way to realize the use cases referenced in clause 2.1 above, that require 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
2. On use case for premium gaming slice (clause 2.3 above): The use case for premium gaming slice described in clause 2.3 above requires a user subscription that triggers switching of slice that can be addressed using an URSP update. However, a similar use case can be imagined where the application provider can provision an alternate gaming slice that the UE can move to in case the current slice cannot provide required experience to the users.
3. On use cases for tactile and multi-modal communication services (clause 2.5 above): One way to realize service requirements for the use cases described in clause 2.5 above is using network slicing where flows of different modalities are streamed in different network slices, thus allowing for differentiated QoS for the constituent modality streams as specified in the requirements for the use case.

# **Observations from above use cases**

Based on our study of use cases and discussion with different stakeholders:

1. There is lot of work being done in 3GPP SA1, SA2, SA5, SA6, and other groups in the area of network slicing. The emphasis of these works is related to service continuity, services with multiple flows with different QoS requirements etc. Based on our study, we think SA4 related aspects such as dynamic policy, service provisioning etc. are some of the problems that can be studied in SA4 with respect to network slicing.
2. There are many use cases as described in clauses 2.1-2.4 above that requires us to develop specification to enable them. There are also use cases that are current under study in different groups (e.g., TR 22.287 as discussed in clause 2.5 above) that may be of interest.
	1. The promise of network slicing is that services can be provisioned in such a way that differentiated QoS is possible for different application streams.
	2. Network slicing may not be the only solution for the above use cases but one of the possible solutions, hence the merit in studying them.

# **Addressing a question from Post #121 MBS adhoc telco (Feb 9)**

Question : An email question for a contribution (S4aI230043) discussed during the call:

“It would be good to get understanding in the example, what for example a content provider such as Elbonia Broadcast Corporation (EBC) wants to do, when running a 5G Media Streaming service on the network work of Elbonia Mobile Network Operator (EMNO). Does it mean that the EMNO offers multiple slices, and EBC wants to use all of the slices or at least several ones? If this is the case, why? It would be just good to explain the whole scenario better, in order for us to also promote this to outside in case we agree.”

Answer: Couple of points to make here:

* Clause 2 of this contribution describes some use cases that require more than one slice for media services. In this context, it helps if we look at provisioning and other features currently supported by 5G Media Streaming (e.g., dynamic policy, reporting, network assistance) from this perspective.
* We are seeing that there is a move towards providing end-to-end service quality assurance with network slicing with enablers described in [3][4]. We think that looking at media services from a slice level will benefit our work in SA4. For example, this work can benefit our data reporting work in TS 26531 and TS 26.532

# **References**

1. “5G Media Slice Definition”, version 1.2, Joint outcome between New European Media and Networld2020 technology platforms, https://5genesis.eu/wp-content/uploads/2019/10/NEM\_Networld2020-5GPPP-5G-Media-Slice-White-Paper-V1.pdf
2. “Commercializing 5G Network Slicing”, 5G Americas White Paper, https://www.5gamericas.org/wp-content/uploads/2022/07/Commercializing-5G-Network-Slicing-Jul-2022.pdf, July 2022
3. 3GPP TS 28.535: “Management and orchestration; Management services for communication service assurance; Requirements”
4. GSM Association NG.116, “Generic Network Slice Template”,
<https://www.gsma.com/newsroom/wp-content/uploads//NG.116-v6.0.pdf>

# **Proposal**

We propose the following:

1. Add clauses 2.1, 2.3, and 2.4 to clause 5 to TR 26.941. Since clause 2.3 is still under progress in SA2, we do not add it to the TR. There is a separate contribution requesting to add more details about clause 2.2 into the TR.
	1. For proper organization, propose adding a section titled “Scenarios” and moving existing clauses 5.2 and 5.3 under it.
2. Propose adding the below changes to help progress on network slicing study.

**===== 1. CHANGE =====**

# 2 References

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

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

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

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

**===== 2. CHANGE =====**

## 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 [A] and TR 23700-99 [8] are considered for studying possible issues in relation to 5G Media Streaming.

**===== 3. CHANGE =====**

## 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. CHANGE =====**

# 5 Relevant scenarios and use cases

## 5.1 General

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

## 5.X Scenarios

## 5.X.1 Scenario 1: Operator-managed network slicing

[Existing text in clause 5.2]

5.X.2 Scenario 2: Third-party-managed network slicing

[Existing text in clause 5.3]

## 5.Y Use cases

### 5.Y.1 Multiple network slices for uplink and downlink streaming

[BA] 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 (New European Media and Networld2020) that co-authored [BA] 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.

|  |  |  |
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| Use Case | Uplink Slice | Downlink Slice |
| Ultrahigh fidelity imaging for medical applications | ✓ |  |
| Immersive and Interactive Media | ✓ | ✓ |
| Audio Streaming in Live Productions  | ✓ | ✓ |
| Remote, Cooperative and Smart Media Production incorporating UGC | ✓ |  |
| 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:

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

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

One way to realize the use cases referenced above that require 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.

### 5.Y.2 Premium gaming slice

[BB] 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:

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| 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**. |

**===== END CHANGES =====**