**3GPP TSG-WG SA2 Meeting #142E *S2-2008479***

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**Title: KI#7, updates to conclusions**

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**Agenda Item: 8.4**

**Work Item / Release: FS\_eNS\_Ph2 / Rel-17**

*Abstract: This paper provides further updates to the conclusion for KI#7.*

# Introduction

This pCR provides further updates of the conclusion for Key Issue #7, titled, “Support of 5GC assisted cell selection to access network slice”.

# Discussion

Regarding the open issue on "Whether different cells within a tracking area can support different S-NSSAIs is based on RAN WGs feedback" (see SA2 LS [**S2-2006526**](https://www.3gpp.org/ftp/tsg_sa/WG2_Arch/TSGS2_140e_Electronic/Docs/S2-2006526.zip) regarding "LS on Cell Configuration within TA/RA to Support Allowed NSSAI"), RAN WGs have not replied to the SA2 LS, but CT1 replied in [C1-206760](http://www.3gpp.org/ftp/tsg_ct/WG1_mm-cc-sm_ex-CN1/TSGC1_126e/Docs/C1-206760.zip):

"CT1 has assumed that all S-NSSAIs in the allowed NSSAI are supported in all tracking areas of the registration area even if the registration area includes tracking areas belonging to multiple PLMNs (that are equivalent to each other)"

However, the RAN3 report to TSG RAN, see RP-201401, states the following:

"*Status Quo in Rel-16 is that the slices included in an Allowed NSSAI are available anywhere (i.e. in any cell) within the UE’s Registration Area*"

Therefore we can already now *finally* agree on what Rel-15/16 assumes i.e. that all cells of a TA support the network slices that NG-RAN indicated as supported during NG SETUP, and as per SA2 specifications, therefore all cells of the derived RA also supports the network slices provided in the Allowed NSSAI.

**OBSERVATION 1:** In Rel-16 all cells of the RA support the network slices provided in the Allowed NSSAI.

The solutions in TR 23.700-40 addressing KI#7 are Solution #17, #29, #30, #31, #44, #45 and #46.

The solutions provide different means to address the KI, while all solutions, except solution #45, maintain the principle of uniform support of S-NSSAIs within a TA and the RA.

**PROPOSAL 1:** Unless major limitations/issues are identified with the current logic that all cells of a TA supports the same set of S-NSSAIs and all TAs of the RA supports the S-NSSAIs of the Allowed NSSAI, and to avoid backwards compatibility issues, the logic should be kept in later releases. Therefore solution #45 is proposed to not be progressed to normative phase.

The KI#7 description copies some of the content of the GST that specifically states:

"*One of the attributes in the GST documented in GSMA 5GJA NG.116 [3] is the following:*

***Radio spectrum***

*This attribute defines the radio spectrum supported by the network slice. This is important information,* ***as some terminals might be restricted in terms of frequencies to be used****.*"

The text on bold has been debated a couple of times and can mean different things e.g. that UEs cannot support all frequencies and therefore the UE itself may support only a limited set of frequencies. Or that a network slice is better, preferably, served by certain frequencies as to achieve a better performance for the services using the network slice. Or that some frequencies are dedicated for some specific network slices.

If the objective is to ensure that network slices support the frequencies that the UE supports, then it seems the best option is to support all frequencies available for the operator as to enable access by as many kind of UEs as possible.

The conclusion includes the following EN:

Editor's note: As per the statement GSMA statement "some terminals might be restricted in terms of frequencies to be used", the attribute may instead be understood as the vertical's terminal radio frequency support. It is FFS to clarify the GSMA's intention.

If the attribute is used to ensure the network slice supports at least the frequencies supported by the verticals' UEs, then there is nothing more for SA2 to specify as then existing slice selection mechanisms can be used as is.

If the objective is to restrict the used frequencies due to the best or required service quality is obtained at some specific frequencies, then such restriction can be enforced when the services using the network slice are to be used as such (e.g. uses CA/DC or redirection when activating the UP for a PDU Session) which can be achieved with current 5GS functionality.

If the objective is to define network slices to support only a limited set of frequencies and the verticals' UEs may support more frequencies that are supported by the network (i.e. PLMN or SNPN), then some mechanism is required to direct the UE to the frequencies that the network slices support.

**OBSERVATION 2:** The GST attribute is not fully clear on the objective, but if the objective is to restrict the used frequencies or the network slice supports at least the frequencies supported by the verticals' UEs, this can be achieved with current 5GS functionality.

**OBSERVATION 3:** If the objective is to define network slices to support only a limited set of frequencies and the verticals' UEs may support more frequencies that are also supported by the network (i.e. PLMN or SNPN), then some mechanism is required to direct the UE to the frequencies that the network slices support.

The existing 5GS supports the ability to steer the UE to certain frequencies that is preferred for the UE and the ability to allocate dedicated resources to specific network slices while other resources are shared between the network slices.

Figure 1 shows a possible partitioning of the resources of a cell as to enable steering of UEs to preferred cells/frequencies while also ensuring that the cell is capable of handling network slices that require to use the specific cell/frequency.



Figure 1: Partitioning of resources of a cell

Principles – when a cell/frequency band preferred for a slice:

1. Dedicated resource partition allocated for a set of network slices e.g. a demanding slice (S-NSSAI=x)

2. Shared resources for all other network slices, including capability to perform CA/DC or to handle redirection of access attempts for UEs not using the dedicated S-NSSAI=x

The principle for resource partitioning above together with existing mechanisms to steer the UEs to other frequencies can be used to support the GSMA GST attribute and to avoid the need to define new logic if shared resources can be defined large enough for handling redirection.

**OBSERVATION 4a:** The existing capabilities to perform resource partitioning of a cell enables the network to both steer UEs to other frequencies as well as keep dedicated resources for network slices that require the specific frequency of the cell.

The steering of the UE can be done based on that the UE registers the network slices with the network (i.e. the 5GC then provides Allowed NSSAI and RFSP to RAN for subsequent mobility handling) or at the time when the UE make use of the UP resources i.e. at the time of UP activation as shown e.g. in solution #44.

**OBSERVATION 4b:** The existing capabilities can be used to steer/re-direct the UE to use preferred frequencies based on the registered network slices or based on the required UP resources when the UE uses services requiring UP resources from specific network slices.

**PROPOSAL 2:** As long as the network slices are defined to be available in all cells, the existing 5GS supports steering/re-direction of the UE to certain preferred frequencies based on used network slices i.e. S-NSSAIs in Allowed NSSAI and/or S-NSSAIs of activated UP.

However, the conclusion also includes the statement that "Existing capabilities of the 5GS do not fully support the case where certain frequencies **cannot** be used to access a slice" i.e. in such scenario the shared resources in figure 1 would not be defined and a cell would only have resources dedicated to some network slices. If that is a wanted network setup, then some mechanism would be required to move the UE to a cell supporting the network slices the UE wants to access.

**OBSERVATION 5:** if certain frequencies **cannot** be used to access a network slice, then some new mechanism is needed such that the UE is moved to the frequencies supporting the network slice

If the solution to address KI#7 impacts the UE, it seems to defeat the purpose of enabling functionality that can address all scenarios. Among the solutions in the TR that addresses the KI#7, the solution #29, and #30 impacts the UE and solution #31 and #46 optionally impacts the UE.

Solution #31 allows the UE to be registered in the frequency that is not supporting the services of the network slice, while it moves the UE when UP is to be activated.

Solution #46, besides the information impacting the UE, in a similar way as solution #17 providing information to RAN for redirecting the UE to a cell supporting the network slices requested by the UE.

**OBSERVATION 6:** Solutions that rely upon UE support would not be able to address scenarios with UEs that does not support the proposed additions e.g. pre-Rel-17 UEs.

**PROPOSAL 3:** The conclusion of the KI should not rely upon UE impacts.

Among the solutions that does not impact the UE, the solutions can be categorized as follows:

1. 5GC provides information to RAN as to enable RAN to steer the UE to a cell supporting the network slices requested by the UE (solutions #17 and #46), or

2. UE is allowed to be registered to network slices also with frequencies not supported by the network slice, and the UE is moved dependent on the UP activated (solutions #31, #44).

The category 2 (solutions #31 and #44) have been debated to not be following the principle of all network slices in Allowed NSSAI are available for the UE. As #44 does not impact the specifications, it seems to be up to deployments whether to enable such behavior.

The category 1 solutions rely upon sending information to the RAN as to possibly move the UE. The solution #17 provides a 5GC created Target NSSAI and an additional RFSP, while solution #46 provides Rejected S-NSSAI. As a rejected S-NSSAI does not necessarily consist of all the network slices that can be supported by a target cell it is proposed to use the principles with a Target NSSAI and RFSP.

**PROPOSAL 4:** It is proposed to conclude to normative phase the principles of 5GC deriving and providing to RAN a Target NSSAI and RFSP for allowing RAN to redirect the UE to a cell supporting the network slices not available in a current cell.

The solutions that impacts the UE mainly do it by signaling of frequencies per slice to the UE, but there has not been any evidence that such logic would considerably enhance the performance e.g. reducing the delay for access to the slice. Also, the UE may change its Requested NSSAI also in CM-CONNECTED mode and in CM-CONNECTED the network anyway steers the mobility of the UE, i.e. it needs to be clarified if UE is to be kept in CM-CONNECTED or the UE should go to CM-IDLE before changing the set of network slices. The existing principles of idle and connected mode mobility should be kept, i.e. UE performs cell re-selection in CM-IDLE whereas the network controls the UE mobility in CM-CONNECTED.

**PROPOSAL 5:** Signaling of prefered frequencies per slice/prioritized slices per cell, to the UE, should only be considered if significant enhancements on signaling load and/or delay can be shown.

**PROPOSAL 6:** The existing principles of idle and connected mode mobility should be kept, i.e. UE performs cell re-selection in CM-IDLE whereas the network controls the UE mobility in CM-CONNECTED.

# Conclusion

The following observations have been made:

**OBSERVATION 1:** In Rel-16 all cells of the RA supports the network slices provided in the Allowed NSSAI.

**OBSERVATION 2:** The GST attribute is not fully clear on the objective, but if the objective is to restrict the used frequencies or the network slice supports at least the frequencies supported by the verticals' UEs, this can be achieved with current 5GS functionality.

**OBSERVATION 3:** If the objective is to define network slices to support only a limited set of frequencies and the verticals' UEs may support more frequencies that are also supported by the network (i.e. PLMN or SNPN), then some mechanism is required to direct the UE to the frequencies that the network slices support.

**OBSERVATION 4a:** The existing capabilities to perform resource partitioning of a cell enables the network to both steer UEs to other frequencies as well as keep dedicated resources for network slices that require the specific frequency of the cell.

**OBSERVATION 4b:** The existing capabilities can be used to steer/re-direct the UE to use preferred frequencies based on the registered network slices or based on the required UP resources when the UE uses services requiring UP resources from specific network slices.

**OBSERVATION 5:** if certain frequencies **cannot** be used to access a network slice, then some new mechanism is needed such that the UE is moved to the frequencies supporting the network slice

**OBSERVATION 6:** Solutions that rely upon UE support would not be able to address scenarios with UEs that does not support the proposed additions e.g. pre-Rel-17 UEs.

The following proposals have been made:

**PROPOSAL 1:** Unless major limitations/issues are identified with the current logic that all cells of a TA supports the same set of S-NSSAIs and all TAs of the RA supports the S-NSSAIs of the Allowed NSSAI, and to avoid backwards compatibility issues, the logic should be kept in later releases. Therefore solution #45 is proposed to not be progressed to normative phase.

**PROPOSAL 2:** As long as the network slices are defined to be available in all cells, the existing 5GS supports steering/re-direction of the UE to certain preferred frequencies based on used network slices i.e. S-NSSAIs in Allowed NSSAI and/or S-NSSAIs of activated UP.

**PROPOSAL 3:** The conclusion of the KI should not rely upon UE impacts.

**PROPOSAL 4:** It is proposed to conclude to normative phase the principles of 5GC deriving and providing to RAN a Target NSSAI and RFSP for allowing RAN to redirect the UE to a cell supporting the network slices not available in a current cell.

**PROPOSAL 5:** Signaling of prefered frequencies per slice/prioritized slices per cell, to the UE, should only be considered if significant enhancements on signaling load and/or delay can be shown.

**PROPOSAL 6:** The existing principles of idle and connected mode mobility should be kept, i.e. UE performs cell re-selection in CM-IDLE whereas the network controls the UE mobility in CM-CONNECTED.

# Proposal

Based on the above observations and proposals, it is proposed to add the following in the TR 23.700-40.

\*\*\* Start of Changes \*\*\*

## 8.7 Conclusion for Key Issue #7

Editor's note: The following is an interim conclusion for the KI#7 and are subject to change dependent on RAN WGs feedback, and on evaluation of the new solutions agreed in SA2#141e..

The existing capabilities of the 5GS, e.g. the ability to steer UEs to certain frequencies based on RFSP, Allowed NSSAI and activated UP, together with a suitable resource partitioning of the NG-RAN resources, enable the 5GS to support the case where the network operator **prefers** that certain network slices use certain frequencies (certain network slices may get dedicated resources by NG-RAN resource partitioning in preferred frequencies). That is, the existing 5GS supports steering/re-directing the UE to appropriately preferred frequencies based on the S-NSSAIs in Allowed NSSAI or when the UP resources are activated for the S-NSSAIs.

Existing capabilities of the 5GS do not fully support the case where certain frequencies **cannot** be used to access a slice, in particular as described in clause 5.7 "how to select a particular cell that can be used to access the network slice(s) when the operator manages a different range of radio spectrums per network slice".

- Existing (Rel-15/16) 5GS behaviour is that when the UE attempts to simultaneously register with slices that are not available in a common operating band, it is assumed that the some requested slices will be not allowed based on the network policies. The UE then can retry with a different Requested NSSAI if the current Allowed NSSAI is not suitable for its needs. This can result in several trials and errors till a stable state between UE and network is achieved. Or, if the S-NSSAI not allowed is provided as a Rejected S-NSSAI for the RA, the UE may wait to request the S-NSSAI until the UE moves out of the RA.

The existing network slice selection mechanisms supports the case when the network slices the UE is allowed to access are defined to support all the frequencies supported by the UE.

The following **interim** conclusions are agreed:

- The following existing assumptions are kept:

- all cells of a tracking area supports the same S-NSSAI(s); and

- the S-NSSAI(s) of the Allowed NSSAI are supported by all tracking areas in a registration area.

- To enable the possibility where certain frequencies, supported by the network i.e. PLMN or SNPN, **cannot** be used to access a network slice, a solution without UE impacts is required as to ensure any UE can be directed towards a frequency/cell from which the UE can access the network slice.

- The principles (see solution #17) of 5GC deriving and providing to RAN a Target NSSAI and RFSP for allowing RAN to redirect the UE to a cell supporting the network slices not available in a current cell is proposed to be progressed to normative work.

Editor's note: It is FFS whether further enhancements are required beyond what is supported by existing capabilities and solution principles from solution #17.

Editor's note: It will be determined based on RAN WGs feedback whether a deployment scenario where all cells of a TA don’t necessarily support the same S-NSSAIs needs to be considered.

\*\*\* End of Changes \*\*\*