**3GPP T****SG-RAN WG3 Meeting #116-e R3-223792**

***Is revision of R3-223724***

**Online, 9th – 19th May 2022**

Agenda Item: 17.2

Source: CMCC (Moderator)

Title: Summary of offline discussion on slicing grouping and priority

Document for: Discussion and Decision

# Introduction

**CB: # Slice1\_Group\_Priority**

**- Check the LS from SA2 and RAN2**

**- Whether and how to support of NSAG in NG, F1, Xn interfaces?**

**- Whether and how to make the RAN aware of the slice/slice group priorities signalled to the UE via NAS?**

**- Whether stage 2 CR on the NG-RAN providing the NSAG information to the AMF is needed?**

**- Send LS to SA2, RAN2, CT1, CT4?**

**-Capture agreements, provide CRs if agreeable**

(CMCC - moderator)

Summary of offline disc [R3-223724](file:///C:\\Users\\pgodin\\Desktop\\philipDocuments\\a_ran3new2\\ran3116\\meeting\\CB%20%23%20Slice1_Group_Priority\\Round%201\\Inbox\\R3-223724.zip) rev in [R3-223792](file:///C:\\Users\\pgodin\\Desktop\\philipDocuments\\a_ran3new2\\ran3116\\meeting\\CB%20%23%20Slice1_Group_Priority\\Round%202\\Inbox\\R3-223792.zip)

# For the Chairman’s Notes

## Phase 2

To be determined.

## Phase 1

**The following proposals can be agreed:**

**Proposal 1: RAN provides the AMF the slice group and associated S-NSSAIs per TA using NG Setup and RAN Configuration Update procedures.**

**Proposal 2: Introduce the NSAG information in the *Served Cell Information* IE of the F1 Setup and F1 Configuration Update messages.**

**Proposal 3: RAN3 should first work on a basic solution to support slicing grouping, other enhancements can be discussed later.**

**Proposal 4: The stage 2 text for supporting NSAG is not needed at the current stage.**

**Proposal 5: Whether to send a reply LS can be checked in phase II according to the progress and potential agreements achieved.**

**To discuss online the following open issues:**

* **RAN node needs to know the NSAGs information per TAI supported by neighboring node via Signaling or by OAM configuration?**
* **Stage 3 details to support slicing grouping in NG/F1/Xn online.**
  + **Option 1: add the NSAG ID in the *TAI Slice Support List/Extended TAI Slice Support List* for each S-NSSAI;**
  + **Option 2: introduce a new *Network Slice AS Groups (NSAGs) related IE*, at the same level as TAI Slice Support List/Extended TAI Slice Support List;**
* **Whether the slice group for cell reselection and for RACH should be clearly differentiated and indicated in the network signaling.**

# Discussion - Phase 2

## Work Split

In Wednesday online session, we achieved the following agreements:

**RAN provides the AMF the slice group and associated S-NSSAIs per TA using NG Setup and RAN Configuration Update procedures.**

**Introduce the NSAG information in the *Served Cell Information* IE of the F1 Setup and F1 Configuration Update messages.**

**RAN3 should first work on a basic solution to support slicing grouping, other enhancements e.g., slice/slice group priority per UE awareness can be discussed later.**

**The stage 2 text for supporting NSAG is not needed at the current stage.**

**Whether to send a reply LS can be checked in phase II according to the progress and potential agreements achieved.**

**Introduce a new Network Slice AS Groups (NSAGs) related IE, at the same level as TAI Slice Support List/Extended TAI Slice Support List.**

**The slice group for cell reselection and for RACH does not need to be differentiated and indicated in the network signaling.**

Based on the agreements, the CRs for NGAP and F1AP can be prepared for further check. And whether the CR for XnAP is needed depends on the process of phase 2. The moderator suggests the following work split:

* CR for TS 38.413: Nokia
* CR for TS 38.473: Huawei
* CR for TS 38.423: ZTE (if impacts on XnAP signaling are agreed)

The companies who are responsible for the CRs, please prepare the draft Tdoc based on the agreements and upload the draft CRs in the corresponding folder for second phase. The draft CRs should contain ASN.1.

It is suggested that companies to make comments/revisions on the draft CRs directly.

## Slice group info of neighboring cells to be transferred to AMF?

SA2 agreed CR (S2-2203618) indicated that *“The configuration the AMF provides includes at least the NSAGs for the UE for the TAs of the Registration Area.”*.

During the online session, companies discussed how the AMF configures the NSAG information to the UE, and this is associated with the issue whether the slice group info of neighboring cell should be transferred to AMF. Some companies support this because the slice group info (including neighbor TAs) should be sent from AMF to UE, and the AMF would need to know which TAs are neighboring TA. But some companies disagree with this because RAN node only reports its own slice info to AMF since Rel-15, and the CN can have the full picture of TAs by receiving all slice info from different RAN nodes.

**Q1: Do you agree that the slice group info of neighboring cells should be transferred to AMF? Please provide your view in the table below.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes or No** | **Comments** |
| Huawei | No | We agree with moderator analysis.  In 2G/3G/4G, the CN shall determine UE’s tracking area list and send to the UE, so that the UE can determine whether to perform tracking area update. This somehow proves the CN should at least be aware which TAs should be allocated to the UE.  In 5G R15, the same is true, additionally taken each RAN node reported OWN slice information per TA into account.  Then for NSAG, the AMF can just determines to how to determine the NSAG for the UE, after it determines UE’s registration area. So we don’t see any need for one NG-RAN node to report the NSAG of neighbor nodes to the CN. |
| Nokia | No but | What we commented during the online is that the AMF needs also to send the SGM (Slice Group Mapping) information for TAs neighboring the RA to the UE.  We can think of 3 solutions for this:  1/ basic solution: as mentioned by Huawei, each gNB reports to AMF the SGM information for its own TAs. AMF knows itself when building the UE’s RA which are the neighbouring TAs of the RA and AMF can build the appropriate info to the UE.  2/ possible improvement: each gNB reports to AMF the SGM information for its own TAs + for each TA which TAs are neighbouring the TA. AMF can build the appropriate info to the UE.  3/ each gNB reports to AMF the SGM information for its own TAs and also for the SGM info for neighbour cells , or neighbour TAs. AMF can build the appropriate info to the UE.  We think that the moderator through Q1 ask about solution 3 above.  We think solution 3 is probably too much. Solution 1 is the default of today. We can further think to enhance with solution 2. |
| CATT | No | The AMF obtains the NSAG mapping from all connected RAN nodes and provide to the UE. The NSAG mapping is not only including the serving node and neighbour node but also maybe the whole PLMN. |
| Ericsson | No | We do not believe that the RAN should signal to the AMF about information revealing the RAN topology. Namely, the RAN should not signal to the AMF which TAs/cells are neighbouring its own cells. The RAN should report to the AMF the NSAGs for which the RAN has been configured. Based on this information the AMF should determine the NSAGs to signal to the UE. |
| ZTE | No | There is no requirement from AMF for RAN to provide neighbor configuration. By provide RAN node itself ‘s configuration is enough for AMF. |
|  |  |  |
|  |  |  |
|  |  |  |

## Support of NSAG in Xn signaling or OAM configuration?

During the online session, there is no consensus on how the RAN node knows the NSAG information per TAI supported by neighboring node, via Xn signaling or by OAM configuration. The moderator suggests that the companies can provide the pros and/or cons for each option, and expects that we can have a better discussion and progress based on these pros and/or cons.

* Option 1: via Xn signaling;
* Option 2: by OAM configuration;

**Q2: Which option do you prefer? please provide the pros and cons in the table below.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Option 1 or option 2** | **Comments (including pros and/or cons)** |
| Huawei | Option 1 | for option 1: it is aligned with S-NSSAIs exchange over Xn, and the self-configuration/self-optimization mechanism could be in place.  For option 2, we may ask why to exchange S-NSSAI over Xn at the beginning of R15. Now the logic is suddenly different about the NSAG. Also this option will lead to heavy OAM burden, especially in multi-vendor cases. |
| Nokia | Option 1 | Agree with Huawei.  In addition, only the NSAG information (i.e. SGM per TA) needs to be sent over Xn, not the NSAG priority as was commented by Ericsson. Whenever the NSAG information is updated in a neighbour node, the serving RAN node gets automatically informed. Because the NSAG information can change and is not static, it is good to avoid O&M burden for these updates to the operators as we usually do.  Another argument provided by the one company proposing to use O&M is that this could avoid broadcasting the TAC. This argument is completely unclear. We note that the use case provided by this company in tdoc 3409 shown in figure 2 in support of their argumentation is very strange and actually doesn’t seem to work. |
| CATT | Option 1 | Share with HW and Nokia, we should follow the same principle for the slice information exchange between nodes. No reason let OAM handle NSAG but RAN node handle the TAI support slice list . |
| Ericsson | Option 2 | As we commented online, we need to distinguish signalling of S-NSSAIs over Xn and signalling of NSAGs.  S-NSSAIs are signalled over Xn in order to allow appropriate mobility to target cells that support the slices the UE is using.  NSAGs are not used for mobility. Therefore there is no link between the two information and there should be no deduction that NSAGs needs to be signalled over Xn just because S-NSSAIs are signalled over Xn.  As already mentioned, one of the major issues of signalling over Xn is that it is not possible to configure an appropriate Cell Reselection Priority per Slice GroupID.  SIB16 includes the following information:  ***FreqPriorityListNRSlicing* information element**  -- ASN1START  -- TAG-FREQPRIORITYLISTNRSLICING-START  FreqPriorityListNRSlicing-r17 ::= SEQUENCE (SIZE (0..maxFreq)) OF FreqPriorityNRSlicing-r17  FreqPriorityNRSlicing-r17 ::= SEQUENCE {  sliceInfoList-r17 SliceInfoList-r17 OPTIONAL, -- Need R  ...  }  SliceInfoList-r17 ::= SEQUENCE (SIZE (1..maxSliceInfo-r17)) OF SliceInfo-r17  SliceInfo-r17 ::= SEQUENCE {  sliceGroupID-r17 SliceGroupID-r17,  cellReselectionPriority-r17 CellReselectionPriority OPTIONAL, -- Need R  cellReselectionSubPriority-r17 CellReselectionSubPriority OPTIONAL, -- Need R  sliceCellListNR-r17 CHOICE {  sliceAllowCellListNR-r17 SliceCellListNR-r17,  sliceExcludeCellListNR-r17 SliceCellListNR-r17  } OPTIONAL, -- Need R  ...  }  SliceGroupID-r17 ::= BIT STRING (SIZE(8)) -- The size is FFS, depends on slice group granulartiy  SliceCellListNR-r17 ::= SEQUENCE (SIZE (1..maxCellSlice-r17)) OF PCI-Range  -- TAG-FREQPRIORITYLISTNRSLICING-STOP  -- ASN1STOP   | ***FreqPriorityListNRSlicing* field descriptions** | | --- | | ***FreqPriorityListNRSlicing***  Indicates the list of frequency priority information for frequencies. The 1st entry in the list corresponds to the current frequency (referring SIB2), the 2nd entry in the list corresponds to the first frequency indicated by the InterFreqCarrierFreqList in SIB4, and the 3rd entry in the list corresponds to the second frequency indicated by the InterFreqCarrierFreqList in SIB4, and so on. | | ***sliceAllowCellListNR***  Indicates the list of allow-listed neighbouring cells for slicing. If present, cells not listed in this list do not support the corresponding sliceGroup-frequency pair. | | ***sliceCellListNR***  Indicates the list of allow-list or exclude-listed neighbour cells for slicing. If *sliceInfo-r17* corresponds to the current frequency, this field should be absent. FFS if the field can be provided in *RRCRelease*. | | ***sliceExcludeCellListNR***  Indicates the list of exclude-listed neighbouring cells for slicing. If present, cells not listed in this list support the corresponding slice sliceGroup-frequency pair. |   The information above provides a mapping of this kind (for simplicity we do not mention the information in the sliceCellListNR-r17)   |  |  | | --- | --- | | Frequency | Slice Group ID to priority mapping | | Frequency 1 (referring SIB2) | Slice Group ID 1 – Priority 1  Slice Group ID 4 – Priority 3 | | Frequency 2 (first frequency of SIB4) | Slice Group ID 2 – Priority 5  Slice Group ID 5 – Priority 3 | | … |  |   As it can be seen, the priority levels broadcast in SIB16 are associated to a Slice Group ID.  If a RAN node receives NSAGs from its neighbour RAN nodes and uses them to broadcast them, how would that RAN node broadcast the required CellReselectionPriority for the neighbour´s Slice Group ID?  Note that the CellReselectionPriority signalled in SIB2, SIB4 etc (which have been configured by OAM) have nothing to do with the CellReselectionPriority per Slice Group ID. The CellReselectionPriority per Slice Group ID is specific to a Slice Group ID and cannot be derived from the CellReselectionPriority signalled in SIB2, SIB4 etc.  For this reason, the OAM needs to anyhow configure the RAN with the CellReselectionPriority per Slice Group ID of neighbour cells.  If one assumes that CellReselectionPriority per Slice Group ID is signalled over Xn, one ends up with inconsistent priorities for the same S-NSSAI.  To explain this example, let´s assume that, from the table above, Slice Group ID 1 maps to S-NSSAI1 and Slice Group ID 2 maps to S-NSSAI1, S-NSSAI3.  Let´s also assume that the RAN node received information concerning Slice Group ID 2 over the XN (i.e. it received the mapping Slice Group ID2 -> S-NSSAI 1, S-NSSAI3 -> Priority 5).  As it can be seen, an indiscriminate broadcast of Slice Group ID and priority received over Xn leads to errors, i.e. for S-NSSAI1 the UE will see two different priorities (Priority 1 and Priority 5)  The above should let understand that an OAM configuration is unavoidable.  The configuration effort is limited to configuration of the NSAGs in neighbour TAIs. Namely, if a Cell1 is in TA1, and if TA1 has 4 neighbour TAs (TA2 to TA5), then OAM needs to configure Cell 1 with the NSAGs supported in TA2 to TA4. In other words, the configuration is not done on a neighbour cell basis but on a neighbour TA basis and for that it is rather simple and straightforward.  It should also be noted that, although RAN2 agreed that a TAC can be broadcast in SIB16, it is undoubtable that avoiding to broadcast a TAC is beneficial as it reduces broadcast information. Appropriate OAM configuration enables to avoid or at least reducing TAC broadcasts, as explained in R3-223409 |
| ZTE | Option 1 | Response to Ericsson:  Instead of neighbor cell, the priority for S-NSSAI broadcast in the SIB is for the serving cell.  The cellReselectionPriority-r17 for each slicegroup is only for the serving cell not for the neighbor cell. Then the configured example related to priority of neighbor NSAGs as deliberated by Ericsson is not used by RAN2.  The excerpt as following from RAN2#116:  For slice-specific cell re-selection, cell reselection priorities for one or multiple slice group for the serving frequency are indicated in SIB of the serving cell.  Then the intention to provide relationship of NSAGs/S-NSSAIs via XnAP is aiming for slice allowedcell list/slice ExcludeCelllist.  SliceInfoList-r17 ::= SEQUENCE (SIZE (1..maxSliceInfo-r17)) OF SliceInfo-r17  SliceInfo-r17 ::= SEQUENCE {  sliceGroupID-r17 SliceGroupID-r17,  cellReselectionPriority-r17 CellReselectionPriority OPTIONAL, -- Need R  cellReselectionSubPriority-r17 CellReselectionSubPriority OPTIONAL, -- Need R  sliceCellListNR-r17 CHOICE {  sliceAllowCellListNR-r17 SliceCellListNR-r17,  sliceExcludeCellListNR-r17 SliceCellListNR-r17  } OPTIONAL, -- Need R  ...  }  As can be seen from the RAN2#117 Chair minutes ([R2-2203509](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_117-e/Docs/R2-2203509.zip)), the gNB needs to provide two cell lists(one is for allowed , one is for excluded) to the UE via SIB. The cell list contain the neighbor cells. Without XnAP or OAM , the information can not provided by serving cell.   * 15.1: Network can indicate whether the PCI list is block-list (“cells not supporting the corresponding slice group”) or allow-list (“cells supporting the corresponding slice group”).   The reason why RAN2 need neighbor’s information raised from one contribution in R2-2203071. If based on the priority broad cast in the serving cell, the UE can decide the higher priority slice group to cell reselection. For UE power saving, it is straightforward for gNB to provide such cell list for UE, then UE will not need to consider many cells which definitely not support the desired slice group.  Excerpt from R2-2203071:  Providing PCI lists for cell reselection is already part of the specifications. Using them is efficient as PCI is broadcast within the MIB. Extending this concept with slice-group specific PCI lists for slice-based cell reselection is straight-forward. It is useful to cover the case when there are cells of different TAs on a band, and it also covers the case when cells from different TAs support a given slice group. Whether using a list of allowed or forbidden cells is more efficient depends on the deployment, thus both should be enabled. In a similar way as in case of PCI lists provided in legacy cell reselection process providing any of the lists should be optional, but if a list is provided then the UE shall use it. It can also be assumed that when a list is provided then it is a full list in the sense that no further checking is needed whether a cell supports the selected slice group.  We share views from companies support option 1, in addition we thinks OAM is hard to achieve co-ordinate. It is because in case of split architecture, the NSAGs are configured in many DUs. Coordinate OAMs from serving CU,neighbor CU and neighbour DUs is challenge and introduce unnecessary burden. |
|  |  |  |
|  |  |  |
|  |  |  |

## Others

**If you have other questions, please indicate it in the table below.**

|  |  |
| --- | --- |
| **Company** | **Other Questions** |
|  |  |
|  |  |
|  |  |
|  |  |

# Discussion - Phase 1

RAN2 sends a LS [1] on Slice list and priority information for cell reselection as follows:

|  |
| --- |
| RAN2 has re-discussed the mapping of slice to the slice groups based on the latest SA2 LS.  RAN2 understands whether per TA or per PLMN granularity has no major RAN2 impacts. However, RAN2 assumes (based on majority views in RAN2) that the mapping of slice to the slice groups for cell reselection is per TA.  RAN2 also assumes that the NAS layer in the UE is able to provide slice group priorities to AS layer in the UE.  RAN2 considers the WI is completed from RAN2 specification perspective based on the above assumptions. RAN2 expects other WGs to finalize their relevant specifications and indicate if RAN2 assumptions are not valid before RAN2#118.  RAN2 has achieved the following agreements.   1. A slice is not associated with multiple slice groups for the same purpose within a slice to slice group mapping “granularity”. A slice can be associated at most with one slice group for RACH and with one slice group for reselection, within the same granularity. 2. Both for RACH and for cell reselection, the UE NAS needs to provide the slice information to the UE AS. The UE AS is aware of the slice group ID (s) based on such slice information provided by the UE NAS. |

And SA2 sends reply LS [2] and agreed CRs [3,4,5] to RAN2, RAN3, CT1, CT4 about SA2 progress of supporting slice groups and slice priorities as follows:

|  |
| --- |
| SA2 would like to inform RAN2, RAN3, CT1, CT4 about SA2 progress of supporting Slice Groups and Network Slice priorities required for enabling RAN Slicing as per Work Item NR\_Slice-Core.  SA2 confirms that the mapping of slice to the slice group is per TA, and slice group priority is sent to the UE over NAS message by the AMF. SA2 approved the attached CRs.  SA2 would like to emphasize that the support of network sharing is required for all features unless agreed otherwise so an optional PLMN index indication or a similar concept should be considered to be added as part of the slice group format in SIB.  For your information in SA2 the slice group is referred as NSAG (Network Slice AS Group). |

This summary is to discuss RAN3 specification impacts based on the LS from RAN2 and SA2.

## Whether and how to support NSAG in NG, F1, Xn interfaces?

### Support of NSAG in NG

According to the SA2 reply LS and agreed CRs, SA2 has agreed that the mapping of slice to the slice group is per TA, and RAN provides the AMF the slice group and associated S-NSSAI within a TA using NG Set up and RAN Configuration Update procedures, and AMF configures the UE with NSAG information.

All the references papers [3,5,8,9,12,13,16,17,20,21,23,24,27,28,31,32] propose that RAN provides the AMF the slice group and associated S-NSSAI within a TA using NG Set up and RAN Configuration Update procedures.

**Proposal 1: RAN provides the AMF the slice group and associated S-NSSAIs per TA using NG Setup and RAN Configuration Update procedures.**

**Q1: If you have different views, please indicate in the table below, otherwise, no feedback is needed.**

|  |  |
| --- | --- |
| **Company** | **Comments** |
|  |  |
|  |  |
|  |  |

**Summary of Q1:**

There is no different view, so the following proposal can be agreed:

**RAN provides the AMF the slice group and associated S-NSSAIs per TA using NG Setup and RAN Configuration Update procedures.**

### Support of NSAG in F1

In order for the gNB-CU to send the slice group mapping information to the AMF, the information must first be sent from the gNB-DU to the gNB-CU.

Almost all the reference papers propose to introduce of the NSAG information in the Served Cell Information IE of the F1 Setup and F1 Configuration Update messages.

**Proposal 2: Introduce the NSAG information in the *Served Cell Information* IE of the F1 Setup and F1 Configuration Update messages.**

**Q2: If you have different views, please indicate in the table below, otherwise, no feedback is needed.**

|  |  |
| --- | --- |
| **Company** | **Comments** |
|  |  |
|  |  |
|  |  |

**Summary of Q2:**

There is no different view, so the following proposal can be agreed:

**Introduce the NSAG information in the *Served Cell Information* IE of the F1 Setup and F1 Configuration Update messages.**

### Support of NSAG in Xn

Large majority views of the reference papers [4,6,16,18,23,26,27,29,31,33] propose that the RAN node needs to know the NSAGs information per TA supported by neighboring nodes in the XnAP Setup and RAN Configuration Update messages.

One company [8] has a difference view and thinks OAM should configure to the RAN NSAG information for all NSAGs used in a cell, including NSAG’s mapping to S-NSSAIs only supported in neighbor cells. Therefore, XnAP signaling is not needed.

Following the majority views, the moderator made the following proposals.

**Proposal 3: RAN node needs to know the NSAGs information per TAI supported by neighboring node via the Xn Setup and RAN Configuration Update procedures.**

**Q3: If you have different views on this proposal, please indicate in the table below, otherwise, no feedback is needed.**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Signalling of NSAGs supported by neighbour cells/TAs is not needed. Signalling of neighbour NSAGs over Xn has negative implications, some of which are described below:   1. Frequency priorities for neighbour NSAGs received over Xn is not known to the receiving RAN. Even if this is received over Xn, the receiving RAN cannot use the information consistently. As an example, Neighbour NSAG X has freq priority 1 and it includes S-NSSAI1 while receiving RAN supports NSAG Y with frequency priority 2 and it also includes S-NSSAI1. If neighbour NSAG X freq priority is received over Xn and broadcast by receiving RAN, there will be different frequency priorities for the same S-NSSAI1. This leads to unpredictable UE behaviours. The result is that OAM needs anyhow to configure the frequency priority of NSAGs including neighbor slices, hence an OAM configuration and coordination is needed, which can be extended to neighbour NSAG configuration. 2. Broadcast of NSAGs received over Xn implies the broadcast of TAIs for those neighbour NSAGs. This has negative impacts due to the larger amount of data to be broadcast. Besides, RAN2 has not added TAIs in SIB16 so far, so it cannot be assumed that TAI is broadcast. Instead, OAM can configure NSAGs that include neighbour S-NSSAIs. If OAM configures such NSAGs properly, no TAI needs to be broadcast. 3. Receiving neighbour NSAGs over Xn and broadcast them, without signalling them to the AMF, implies knowledge of the RAN topology at the AMF. In fact, the AMF would need to know which cells are neighbouring a RAN node in order to configure a UE with the NSAGs of the serving and neighbour RAN nodes. So far, 3GPP has followed the principle that an AMF does not need to know the RAN topology, e.g. it does not need to know neighbour relations between RAN nodes.   Note that OAM configuration is not complex in this case because a RAN node needs to be configured only with the NSAGs of neighbour TAs (and not with NSAGs supported by neighbour cells).  The advantages of relying on OAM configuration are:   * Coordinated and consistent frequency priority per NSAG * Avoiding broadcasting of TAI per NSAG * Avoiding that the AMF needs to know the RAN topology, e.g. neighbour relations between RAN nodes. |
| Deutsche Telekom | We share Ericsson’s view that RAN should rely on OAM configuration for NASG. |
| CMCC | We support this proposal and we just would like to share the latest agreements from RAN2.  Regarding Ericsson’s comment 2), RAN2 agreed to introduce an optional TAI in SIB16 during online discussion on Monday as follows:   * 1: Introduce an optional trackingAreaIdentity-r17 IE within SliceInfo-r17 to indicate the associated TAI for the slice group. The TAI should present if the sliceGroupID-r17 is used in different TAs with a different association with NSSAIs according to TS 23.501. |

**Summary of Q3:**

Majority companies support this proposal. Ericsson and DT propose to rely on OAM configuration for NSAG information.

This issue can be discussed online:

**To discuss RAN node needs to know the NSAGs information per TAI supported by neighboring node via Signaling or by OAM configuration.**

### Stage 3 details to support slicing grouping in NG/F1/Xn

Assuming support of slicing grouping in NG/F1/Xn is agreed, regarding the exact location of NSAG information, there are basically two options as listed in the references papers and both work.

* **Option 1**: add the NSAG ID in the *TAI Slice Support List/Extended TAI Slice Support List* for each S-NSSAI [17,19,21,22,24,25,32,33,34]
* **Option 2**: introduce a new *Network Slice AS Groups (NSAGs) related IE*, at the same level as TAI Slice Support List/Extended TAI Slice Support List [3,4,5,6,7,9,10,13,14,18,28,29,30]

**Q4: Please provide your preferred option and list possible reasons.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Options** | **Comments** |
| Huawei | Option 2 is preferred | Both could work.  For option 1, it has low signaling overhead, but for NG interface, the Slice Support List 9.3.1.17 can be used in both the setup/response messages. Then it should clarify further this is not needed in the AMF generated messages. |
| Nokia | Option 2 | Option 2 has several advantages:  1/ it allows same encoding across all NG, Xn, F1 interfaces i.e. option 1 cannot be encoded for XnAP. So selecting option 1 would actually mean having option 1 for NG, F1 and option 2 for Xn which is not nice.  2/ future-proof: today one slice can belong to 2 groups max, because we have only two features (RACH and cell reselection). But in the future we may add additional features which is more complicated to extend with option 1. In contrast, the encoding of option 2 doesn’t need any future need of extension to encode more than 2 features (i.e. a same slice can natively be in multiple groups). |
| ZTE | Option 1 is preferred | Both options feasible. Option 1 has less redundant of N-SSNAI information at least for NG/F1 interface. |
| Ericsson | Option 2 | The list of NSAGs and the list of supported S-NSSAIs are not necessarily related. For example, the list of supported slices may change, but the list of used NSAGs may not change. There is therefore no need to nest the list of NSAGs into the list of supported slices. |
| Samsung | Option1 | Option1 is the most straight-forward way.  As designed within many contributions, only Extended Slice Supported list IE is associated with NSAG ID, but we cannot find any reason why slices in Slice Supported list cannot be associated with NSAG ID.  Regarding HW’s comment, we acknowledge the concern but it can be easily solved by adding more descriptions in Semantics.  Regarding Nok’s comment 1), for Xn we can add similar NSAG IDs in Slice Support List/Extended Slice Support List IE in TAI Support List IE for Xn Setup and NG-RAN Node Configuration Update procedures, nothing different from NG and F1.  Regarding Nok’s comment 2), we should note that slice-based cell reselection and slice based RACH has different operations across RAN and CN, so CN needs to know which NSAGs are used for reselection and which ones are for RACH. One specific example is that CN needs to determine NSAG priority and send the priority via NAS message, so if CN cannot know which NSAGs are used for slice-based cell reselection as indicated by RAN, CN has no clue to associate NSAG priority to which NSAG. So we cannot just associate one specific slice with at most two NSAG ID without any information on the use. So in our understanding, when new sub-features are introduced, we always have high possibility that they have different operations across RAN and CN, so the future-proofness cannot always be foreseen.  Regarding E///’s comment, for the case that if the supported slice changes, then RAN-OAM will always need to configure the new NSAG IDs associated with the updated supported slice as long as this updated supported slice is used for slice-based reselection or RACH, so there’s no reason why NSAG ID is not changed under such case. Also note that even with Option2 we need to explicitly signal S-NSSAI + associated NSAG ID every time the S-NSSAI info is updated. |
| Qualcomm | Both can work | One comment to add to this discussion is that a S-NSSAI is supposed to map to one NSAG only. Option 1 effectively ensures this if a single NSAG is added per slice. In most codings of option 2, this is done on a per NSAG loop, so potentially error conditions are allowed. Of course one could still take option 2 and invert the loops; or simply ignore the possibility. |
| Deutsche Telekom | Option 2 (preferred) | We see both options as feasible, but see a slight advantage with option 2 on separation of the 2 issues addressed here (see Nokia’s and Ericsson’s statements). |
| LGE | Option 2 is preferred | Both options are feasible. We agree with Nokia’s comment. So, we slightly prefer Option 2. |
| Verizon | Option1 preferred | Both options can work but Option 1 is slightly preferred. Slices in Slice Supported list could be associated with NSAG ID and Option 2 seems to preclude this possibility. Option 2 also causes confusion as to which operation (re-selection or RACH) the NSAG is for. Further there could be error conditions with Option 2 as Qualcomm pointed out. Option 1 appears much simpler and could be implemented in a harmonized way across NG/Xn/F1 interfaces. |
| CATT | Option1 | Both solutions are feasible. But the option1 is less specification work. Share with Samsung on the explanation on the companies’ comments. For Nokia/s comments, the CN should be aware the slice group for each features, so it is not different between two options on the future proof. For e///’ comments, the scenario is not corrected. If slice update the NSAG should be updated.  Also in SA2 spec state “all the NSAGs configured in the RAN may be unique per PLMN” so both options should consider how to reflect this information in the NGAP |
| CMCC | Option 1 | We share the same view with Samsung. |

**Summary of Q4:**

**The opinions from the participants can be summarized as follows:**

* **Support option 1 (preferred):** 5 companies (ZTE, Samsung, Verizon, CATT, CMCC);
  + Proponent Companies’ view is that option 1 is the most straight-forward way and has less redundant of N-SSNAI information, and could be implemented in a harmonized way across NG/Xn/F1 interfaces.
* **Support option 2 (preferred):** 5 companies (Huawei, Nokia, Ericsson, DT, LGE);
  + Proponent Companies’ view is that option 2 allows same encoding across all NG/Xn/F1 interfaces and the encoding of option 2 doesn’t need any future need of extension to encode more than 2 features.
* **Both can work:** 1 company (QC), but QC indicated that there could be error conditions with Option 2.

Since there is no consensus, this issue can be discussed online.

**To discuss stage 3 details to support slicing grouping in NG/F1/Xn online.**

* **Option 1: add the NSAG ID in the *TAI Slice Support List/Extended TAI Slice Support List* for each S-NSSAI;**
* **Option 2: introduce a new *Network Slice AS Groups (NSAGs) related IE*, at the same level as TAI Slice Support List/Extended TAI Slice Support List;**

RAN2 agreed that a slice can be associated at most with one slice group for RACH and with one slice group for reselection, within the same granularity. Accordingly, SA2 has specified that “A S-NSSAI can be associated with at most one NSAG values for RACH and at most one NSAG value for Cell Reselection within a Tracking Area”.

It is proposed in [17,19,21,22,32,34] that the slice group for slice-based cell reselection or RACH should be clearly differentiated in the network signaling.

**Q5: Do you think the slice group for cell reselection and for RACH should be clearly differentiated and indicated in the network signaling?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes or No** | **Comments** |
| Huawei | “Yes” is preferred | In our understanding, we need to consider the case that a single NSAG ID value is used both for RACH and cell reselection with different S-NSSAIs associations. E.g.,   * For RACH, **NSAG ID#1** – S-NSSAI1, S-NSSAI2 * For Cell reselection, **NSAG ID#1** – S-NSSAI 1, S-NSSAI3.   Then the RAN should indicate the two NSAG#1 to the AMF with the purpose, then the AMF provides them to the UE with the purpose.  We also understand further SA2/CT1 involvement is needed.  On the other hand, if a single NSAG ID value is not used for both, then there is no such need. |
| Nokia | No | We disagree to add this information over NG because:  1/ it not needed: RAN2 has designed that a UE will learn from the radio if a given group is to be used for RACH or for cell reselection. So AMF doesn’t need to relay it over NAS to the UE.  2/ the AMF doesn’t need it for itself. There is no such requirement. |
| ZTE | No | 1. SA2 does not show the requirement of the information 2. Based on NSAG from NAS and SIB information, the UE can correctly differentiate the group for RACH or cell reselection. |
| Ericsson | No | A UE learns from the SIBs which NSAGs are for reselection and which NSAGs are for RACH. Therefore, the UE NAS layer does not need to pass lists of NSAGs for RACH/reselection to the UE AS, because the UE learns this distinction by reading the SIBs. Consequently, the AMF does not need to signal different lists of NSAGs to the UE and therefore the RAN does not need to signal different NSAG lists over NG.  Making the AMF aware of different NSAG lists simply increases the solution complexity without any good reason. |
| Samsung | Yes | As we commented in Q4, the AMF may use it to determine NSAG priority information for slice-based cell reselection as indicated in S2-2203620 as the affiliated file with reply LS from SA2. So for the AMF, no matter a single NSAG ID is used for a single purpose or both purposes, it shall be informed of the purpose by RAN clearly. |
| Qualcomm | No | As per other’s arguments, we also think this information is not needed at the AMF as UE learns it from SIB (i.e. not used in NAS) |
| Deutsche Telekom | No | There is no need to pass any information for differentiation to the AMF (no requirement to do so, as not used in NAS signaling to UE). |
| LGE | No | We also think that this information can be provided to UE by SIB. Also, there is no such requirement on this information in RAN2 and SA2 specification. |
| Verizon | Yes preferred, but... | This may need clarification from SA2 since SA2 reply LS does not address this issue. We need to ask SA2 to clarify if this is a requirement. |
| CATT | Yes | Share with SS, the AMF use it for setting the cell reselection priority. Otherwise the AMF cannot know which slice group is for cell reselection |
| CMCC | Yes | We agree with Samsung that it is essential for determining NSAG priority information for slice-based cell reselection by AMF, and agree with Huawei that it is needed if a single NSAG ID value is used both for RACH and cell reselection associated with different S-NSSAIs.  In addition, according to SA2 agreed CR, “*A S-NSSAI can be associated with at most one NSAG values for RACH and at most one NSAG value for Cell Reselection within a Tracking Area.*”, we think this implies that AMF expects to be aware of it. Therefore, it should be differentiated clearly NSAG for cell reselection and for RACH in the network signaling. |

**Summary of Q5:**

**The opinions from the participants can be summarized as follows:**

* **Yes for Q5 (preferred):** 5 companies (Huawei, Samsung, Verizon, CATT, CMCC)
  + Proponent Companies’ view is that the AMF may use it to determine NSAG priority information for slice-based cell reselection as indicated in SA2 agreed CR (S2-2203620), and it is needed if a single NSAG ID value is used both for RACH and cell reselection associated with different S-NSSAIs.
* **No for Q5:** 6 companies (Nokia, ZTE, Ericsson, QC, DT, LGE)
  + Proponent Companies’ view is that the UE can differentiate the NSAG for reselection or RACH based on NSAG information from NAS and SIB, and SA2 doesn’t show the requirements for this in reply LS.

In addition, Verizon proposed to ask SA2 to clarify if this is a requirement.

Since there is no consensus on this issue, moderator suggests to continue to discuss online.

**To discuss online whether the slice group for cell reselection and for RACH should be clearly differentiated and indicated in the network signaling.**

## Whether and how to make the RAN aware of the slice/slice group priorities signalled to the UE via NAS？

In [8], one aspect raised is the RAN is unaware of the slice/slice group priorities assigned to a UE via NAS. It is pointed out that not knowing slice/slice group priorities assigned to a UE would cause the following drawbacks:

* For UEs in RRC\_INACTIVE, the RAN is not able to optimize RAN paging and page the UE over the frequencies/TAs with highest priority
* The RAN is not able to estimate how load will be affected by UEs moving from RRC\_IDLE/INACTIVE to RRC\_CONNECTED
* In case the RAN signals to the UE frequency priorities per slice group in RRC Release, the RAN is not able to adjust such information to the UE

It is proposed to further discuss the issue of how to make the RAN aware of the slice/slice group priorities signalled to the UE via NAS. And it is suggested that RAN3 should acknowledge the issue and make sure that a discussion may take place in the coming meetings on how to fix this problem.

The moderator holds the opinion that we should first work on a basic solution to support slicing grouping, then discuss this issue and potential solutions if the issue is acknowledged.

**Q6: Do you acknowledge the issue above, or any further views?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes or No** | **Comments** |
| Huawei | Can be discussed later | There may be some benefits for the NG-RAN to be aware of the UE-specific NSAGs/associated priority. But we think this can be considered as an optimization. And without it, the NSAG feature/slice-specific cell reselection can work. So this can be further considered in TEI 18, to further consider the deficiencies of the existing tools (e.g. the Assistance information for RRC\_inactive, the RFSP, the allowed/target NSSAI etc). |
| Nokia | Yes but | We share the moderator’s view that we should concentrate in this meeting on the solution for slice group mapping. We can study whether any priority need to be sent in following meetings. |
| ZTE | Can be discussed later | Share the view the we should focus on basic function to in line with RAN2/SA2. The enhancement can be discussed later. |
| Ericsson | Yes | We acknowledge the moderator´s view that our first priority is to converge on a basic working solution. However, we would like to at least mark this problem as to be continued and to inform SA2 about the fact that RAN3 identified this problem and that it needs further discussions. In the end the problem involves SA2 as well, so informing them will speed up progress. |
| Samsung | Can be discussed in future |  |
| Qualcomm | Can be discussed later | We think this topic should be taken up for discussion once the slice grouping is completed (i.e. basic functionality). |
| Deutsche Telekom | Yes but | We share the view of other companies that current focus should be on slice grouping first, but similar to Ericsson we see that this topic of slice priority awareness should be marked as “To be continued” by RAN3. |
| LGE | Can be discussed later |  |
| Verizon | Yes | Can be discussed after agreeing on basic solution |
| CATT | Can be discussed later |  |
| CMCC | Can be discussed later |  |

**Summary of Q6:**

All companies support that we should first work on a basic solution to support slicing grouping. 7 companies (Huawei, ZTE, Samsung, QC, LGE, CATT, CMCC) think this issue can be discussed later as an optimization. 4 companies (Nokia, Ericsson, DT, Verizon) propose to mark this problem as “to be continued” by RAN3.

Therefore, the moderator suggests to agree the following proposal:

**RAN3 should first work on a basic solution to support slicing grouping, other enhancements can be discussed later.**

## Whether stage 2 CR on the NG-RAN providing the NSAG information to the AMF is needed?

In [15], stage 2 text is proposed to support NSAG as below,

### *16.3.3 Resource Isolation and Management*

#### *16.3.3.1 General*

*Resource isolation enables specialized customization and avoids one slice affecting another slice.*

*Hardware/software resource isolation is up to implementation. Each slice may be assigned with either shared, prioritized or dedicated radio resource up to RRM implementation and SLA as in TS 28.541 [49].*

*To enable differentiated handling of traffic for network slices with different SLA:*

*- NG-RAN is configured with a set of different configurations for different network slices by OAM;*

*- To select the appropriate configuration for the traffic for each network slice, NG-RAN receives relevant information indicating which of the configurations applies for this specific network slice.*

*Slice specific RACH configuration for RA isolation and prioritization can be included in SIB1 messages. The slice specific RACH configurations are associated to specific slice groups, and if not provided for a slice or slice group that UE considers for selecting the RACH configuration, then the UE does not consider the slice(s) for selecting the slice specific RACH configuration, i.e., the UE uses the common RACH configuration. In the UE, NAS provides the slice group to be considered during RA to AS.*

*In order to support the network slice AS groups (NSAGs), the NG-RAN informs the AMF with the NSAG information per TA in the appropriate NG interface management procedures, as specified in TS 23.501 [3].*

*Editor’s Note: Details of slice grouping and how it is provided to the UE are FFS, depends on SA2.*

Q7: **Do you think the stage 2 text is needed and agreeable?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes or No** | **Comments** |
| Huawei | Yes | Nice to have |
| Nokia | No | No need to duplicate TS 23.501. No duplication is an old and good principle in 3GPP. |
| ZTE | No | The description actually can be covered by SA2 ‘s CR. In addition, RAN2 is the leading group can decide whether anything missing in stage 2. |
| Ericsson | No | Stage 2 is already available in 23.501. Besides, RAN2 is also working on stage 2 descriptions. At this point in time it is better if RAN3 focusses on stage 3. |
| Samsung | No | Agree with Nokia. |
| Qualcomm | Not now | Seems not needed, but this can be double checked once we have a full round including stage 2 changes in RAN2. |
| Deutsche Telekom | Not now | We share Qualcomm’s view with respect to waiting for possible RAN2 St2 inputs. |
| LGE | No | This text is already captured in 23.501. |
| Verizon | Not now | Wait for stage 2 inputs from RAN2 |
| CATT | Not now |  |
| CMCC | No | Agree with Nokia. |

**Summary of Q7:**

6 companies (Nokia, ZTE, Ericsson, Samsung, LGE, CMCC) think the stage 2 text is not needed because it is already captured in TS 23.501. 4 companies (QC, DT, Verizon, CATT) think we can wait for stage 2 inputs from RAN2. 1 company (Huawei) supports this modification.

Thus, the following proposal can be agreed to follow the majority views:

**The stage 2 text for supporting NSAG is not needed at the current stage.**

## LS to SA2, RAN2, CT1, CT4

In [11], a reply LS is provided to inform our agreements on NSAG, and RAN awareness of the slice/slice group priorities which is signalled to the UE via NAS. It depends on the discussion and decision in Section 3.2.

Q8: **Do you think a reply LS is needed?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes or No** | **Comments** |
| Huawei | It depends on 3.1.4 | If RAN3 agrees to signal the NSAG for RACH/Cell reselection, then the LS is needed. Otherwise, no LS is strongly needed. |
| Nokia | Peharps | Pending outcome of discussions. |
| ZTE | Depends on 3.2 | Agree the moderator the LS depends on the discussion in section 3.2 |
| Ericsson | Good to LS groups about RAN3´s progress | In order to make order in this multi WG topic, it would be beneficial that RAN3 LSs other groups with the achieved progress. |
| Samsung | Depends | If it needs, it should focus on potential agreements achieved. |
| Qualcomm | Depends | Agree with moderator, and probably should focus on agreements / results |
| Deutsche Telekom | Depends | Details depend on possible agreements in Sec. 3.1 and outcome of discussion in Sec. 3.2 on RAN awareness of priorities. |
| Verizon | Yes | LS would be helpful to update other groups on agreements reached in RAN3 and/or any clarifications needed from SA2 on Q4 and Q5 |
| CATT | Depends | Pending outcome of discussions |
| CMCC | Depends on 3.2 | We understand only section 3.2 has impacts on other WGs. |

**Summary of Q8:**

8 companies support that it depends on the progress and potential agreements achieved, and 2 companies support to send a reply LS.

Therefore, the following proposal can be provided:

**Whether to send a reply LS can be checked in phase II according to the progress and potential agreements achieved.**

# Conclusion, Recommendations

# Reference

1. R3-223011, Reply LS on Slice list and priority information for cell reselection (RAN2) LS in
2. R3-223035, Reply LS on Slice list and priority information for cell reselection (SA2) LS in
3. R3-223090, (TP for TS 38.413) Support slice grouping over NGAP (NTT DOCOMO INC.) discussion
4. R3-223091, (TP for TS 38.423) Support slice grouping over XnAP (NTT DOCOMO INC.) discussion
5. R3-223161, Correction of Slice Group Configuration (Nokia, Nokia Shanghai Bell) CR0785r, TS 38.413 v17.0.0, Rel-17, Cat. F
6. R3-223162, Correction of Slice Group Configuration (Nokia, Nokia Shanghai Bell) CR0784r, TS 38.423 v17.0.0, Rel-17, Cat. F
7. R3-223163, Correction of Slice Group Configuration (Nokia, Nokia Shanghai Bell) CR0875r, TS 38.473 v17.0.0, Rel-17, Cat. F
8. R3-223409, Discussion and way forward on Network Slice AS Groups (Ericsson) discussion
9. R3-223410, Support for slice grouping over NGAP (Ericsson) CR0802r, TS 38.413 v17.0.0, Rel-17, Cat. B
10. R3-223411, Support for slice grouping over F1AP (Ericsson) CR0917r, TS 38.473 v17.0.0, Rel-17, Cat. B
11. R3-223412, Reply LS to Reply LS on Slice list and priority information for cell reselection (Ericsson) LS out To: SA2, RAN2, CT1, CT4 CC:
12. R3-223465, Supporting network slice AS group (Huawei) discussion
13. R3-223466, Supporting network slice AS group (Huawei) CR0817r, TS 38.413 v17.0.0, Rel-17, Cat. F
14. R3-223467, Supporting network slice AS group (Huawei) CR0927r, TS 38.473 v17.0.0, Rel-17, Cat. F
15. R3-223468, Supporting network slice AS group (Huawei) draftCR
16. R3-223515, Discussion on Supporting for NSAG (CATT) discussion
17. R3-223516, CR to 38.413 for Supporting for NSAG (CATT) CR0823r, TS 38.413 v17.0.0, Rel-17, Cat. B
18. R3-223517, CR to 38.423 for Supporting for NSAG (CATT) CR0825r, TS 38.423 v17.0.0, Rel-17, Cat. B
19. R3-223518, CR to 38.473 for Supporting for NSAG (CATT) CR0937r, TS 38.473 v17.0.0, Rel-17, Cat. B
20. R3-223549, On support of slice grouping and slice priority (Samsung) discussion
21. R3-223550, Correction on the slice group mapping for RAN Slicing (NGAP) (Samsung) CR0830r, TS 38.413 v17.0.0, Rel-17, Cat. B
22. R3-223551, Correction on the slice group mapping for RAN Slicing (F1AP) (Samsung) CR0943r, TS 38.473 v17.0.0, Rel-17, Cat. B
23. R3-223581, Impact on Slice Grouping and Slice Priority (ZTE) discussion
24. R3-223582, Enable configuration of Network Slice Groups(NGAP) (ZTE) CR0835r, TS 38.413 v17.0.0, Rel-17, Cat. F
25. R3-223583, Enable configuration of Network Slice Groups(F1AP) (ZTE) CR0946r, TS 38.473 v17.0.0, Rel-17, Cat. F
26. R3-223584, Enable configuration of Network Slice Groups(XnAP) (ZTE) CR0833r, TS 38.423 v17.0.0, Rel-17, Cat. F
27. R3-223611, Discussion on NSAG information (LG Electronics) discussion
28. R3-223617, Support of NSAG in NG interface (LG Electronics) CR0840r, TS 38.413 v17.0.0, Rel-17, Cat. B
29. R3-223618, Support of NSAG in Xn interface (LG Electronics) CR0837r, TS 38.423 v17.0.0, Rel-17, Cat. B
30. R3-223620, Support of NSAG in F1 interface (LG Electronics) CR0956r, TS 38.473 v17.0.0, Rel-17, Cat. B
31. R3-223646, Discussion on slice grouping and slice priority (CMCC) discussion
32. R3-223647, Enabling configuration of Network Slice AS Group (CMCC) CR0848r, TS 38.413 v17.0.0, Rel-17, Cat. B
33. R3-223648, Enabling configuration of Network Slice AS Group (CMCC, Huawei) CR0844r, TS 38.423 v17.0.0, Rel-17, Cat. B
34. R3-223649, Enabling configuration of Network Slice AS Group (CMCC) CR0960r, TS 38.473 v17.0.0, Rel-17, Cat. B