**3GPP T****SG-RAN WG3 Meeting #116-e 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%3A%5CUsers%5Cpgodin%5CDesktop%5CphilipDocuments%5Ca_ran3new2%5Cran3116%5Cmeeting%5CCB%20%23%20Slice1_Group_Priority%5CRound%201%5CInbox%5CR3-223724.zip)

# For the Chairman’s Notes

**To be added**

# Discussion

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

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| 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.
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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:

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| 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.**

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| --- | --- |
| **Company** | **Comments** |
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### 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.**

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| **Company** | **Comments** |
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### 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.**

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| **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.
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### 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.**

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| **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. |

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?**

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| **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.
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| 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. |

## 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?**

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| **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 |  |

## 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?**

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| **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. |

## 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?**

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| **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. |

# 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