**3GPP TSG-RAN WG2 Meeting #112 electronic R2-20xxxxx**

**Online, Nov 2nd – 13th, 2020**

**Agenda Item:**  **RAN Slicing SI**

**Source: CMCC**

**Title:** **Email discussion on open issues for RAN slicing SI**

**Document for: Discussion and Decision**

## 1 Introduction

At RAN2#111-e meeting, the following email discussion was agreed:

Post-meeting email discussion

* **[Post111-e][916][NR RAN slicing] RAN slicing study questions (CMCC)**

Scope: Based on online agreements. Discuss issues to address in the SI and in which deployment scenarios, meaning of “intended slice”. Can also discuss candidate solutions (including whether Rel-15 mechanisms can work), e.g. slice-based reselection or slice-based RACH.

Phase 1(From 14 Sep to 25 Sep): Discuss on scenarios and issues, i.e. section 2, 3.1, 4.1, 5.1

Phase 2(From 28 Sep to 15 Oct): Discuss on the solutions, i.e. section 3.2, 4.2, 5.2

Intended outcome: Email discussion summary + TP

Deadline: Thursday 15 OCT, 0700 UTC

Regarding the scope, there were some agreements as below:

*[Cat a] Proposal 3: The scope for the long term email discussion is:*

*- Discuss the issue that RAN2 needs to address in this SI for the agreed scenario, and whether to add new scenarios can be also discussed.*

*- Discuss the meaning of the intended slice, and how or whether the UE knows the intended slice for MO and/or MT services. In addition, discuss whether the intended slice can always be obtained by UE.*

*- Discuss the candidate solutions which can address the above issues, and the solutions in the contributions in RAN2-111-e meeting will be summarized by rapporteur.*

*- Discuss whether the R15 mechanism (e.g. dedicated priority mechanism) can solve the above issues.*

*- Discuss the use cases or intentions for slice-based RACH configuration or RACH parameters prioritization, and discuss whether identified issues can be solved by legacy mechanisms.*

*The above discussions are the priority for this SI, and other aspects may be also considered if there are enough supports to be studied.*

* P1 and P2 are noted
* Post-meeting email scope according to P3. Can use phases in discussion to help not having too huge discussion at once.

The structure of this email discussion is showed in section 2, 3, 4 and 5. For efficient and constructive email discussions, it is proposed to have two phases:

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| **Phases** | **Scope** | **Time plan** |
| Phase 1 | Section 2  *Aim at scenarios*  Section 3.1, 4.1 and 5.1  *Aim at issues including whether existing solutions could solve the issues or not* | From 14 Sep to 25 Sep |
| Phase 2 | Section 3.2, 4.2 and 5.2  *Aim at candidate solutions to address the issues* | From 28 Sep to 15 Oct  And then rapporteur will prepare the summary and TP.  Note: submission deadline of RAN2-112-e meeting may be 22 Oct, 2020. |

**In addition, the following principles are suggested:**

* For scenarios, issues, existing solutions, and candidate solutions, the contributions at RAN2#111-e are to be used for inputs, and the intention is to avoid diverse discussions
* For solutions mentioned in this email discussion, only concept and key designs are mentioned, i.e. avoid too much details. In addition, if there are some impacts related to other WGs, it should limit the discussions, e.g. from RAN2 point of view, these impacts can be recorded in an efficient way

## 2 Scenarios for RAN slicing

### 2.1 Scenarios

***[RAN2 agreements on the scope]*** *Discuss the issue that RAN2 needs to address in this SI for the agreed scenario, and whether to add new scenarios can be also discussed.*

In RAN2#111-e meeting, the draft TR 38.832 v0.1.0 was endorsed in R2-2008549 which captured the scenarios to be studied in this SI. The general description for the scenario is copied here:

**• Multiple and different slices can be supported on different frequencies**

**• Multiple and different slices can be supported on the same frequency in different regions**



**Figure 5.1.1-1: An example for slice deployment scenario**

**[Phase 1] Q1: Is there any additional scenario that companies propose to study?**

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| **Company** | **Comments** |
| Qualcomm | Yes.  During RAN2#111-e, we agreed two scenarios. However, in our understanding, figure 5.1.1-1 in current TR only captured 2nd scenario (i.e. Multiple and different slices can be supported on the same frequency in different regions). The 1st scenario is still missing now (i.e. Multiple and different slices can be supported on different frequencies). We think it should also be captured in TR. An example can be illustrated below:    It is worth noting that this scenario needs to consider the following 2 different cases:   1. Case 1: DC/CA is available and thereby both Slice 1 and Slice 2 can be available and active at the same time. 2. Case 2: DC/CA is not available. So, Slice 1 and Slice 2 cannot be active at the same time. |
| CMCC | We see the agreed scenarios are the most widely deployed scenarios and need to be emphasized in this SI.  We also open to see companies views. |
| CATT | We think both agreed two scenarios are already reflected in Figure 5.1.1-1, from our side, no more scenarios are identified in phase 1 before discussing detail solutions. |
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### 2.2 Slicing handling in UE side

***[RAN2 agreements on the scope]*** *Discuss the meaning of the intended slice, and how or whether the UE knows the intended slice for MO and/or MT services. In addition, discuss whether the intended slice can always be obtained by UE.*

In the objective of SID, intended slice is mentioned. As companies commented during the short email discussion, it would be good to achieve common understanding on the meaning of intended slice.

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| 1. Study mechanisms to enable UE fast access to the cell supporting the intended slice, including [RAN2] 2. Slice based cell reselection under network control 3. Slice based RACH configuration or access barring   Note: whether the existing mechanism can meet this scenario or requirement can be studied. |

**[Phase 1] Q2: What’s the meaning of the intended slice, and how or whether the UE knows the intended slice for MO and/or MT services?**

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| **Company** | **Comments** |
| Qualcomm | In our understanding, “intended slice” means the UE is able to distinguish the slice type (e.g. S-NSSAI) associated with the coming MO and/or MT traffics, and thereby can perform different behaviors (e.g. cell reselection and RACH parameters) depending on the slice type associated with the coming traffics.  For MO service, we think it is more or less already available in NR Rel-15 via traffic indication from NAS to AS, i.e. the access category provided by NAS can be mapped to different slice type.  For MT service, we think it is not available in current NR spec. One simple way is to include intended slice information in paging message for the UE. The signaling details can be discussed further. |
| CMCC | There maybe two different understandings of the intended slice:   * Option 1: Intended slices = all the slices supported by UE   Which traffic the UE is going to launch in the near future is actually unpredictable. So one understanding is to consider all the supported slices as intended slices. And study how to let UE always reselect to the cells that supporting most of the supported slices.   * Option 2: Intended slices = the slices that triggering MO or MT paging   For MO service, both IDLE and INACTIVE mode UEs are aware of the slice triggering state transition.  For MT service, since the paging message doesn’t contain any slice info, neither IDLE nor INACTIVE UE has any idea on which slice the UE is being paged, before the UE turns to CONNECTED mode.  We don’t have strong view between the two options. |
| CATT | We think the meaning of the intended slice is different if we discuss different use cases:  Case1: During cell selection/reselection  If no preferred slices info is provided by NAS, based on R15 spec, UE will always select a best cell or highest ranked cell according to the cell signal quality during cell selection/reselection. The drawback for R15 mechanism is that UE may do cell reselection again or the UE wanted slice service may be barred if the wanted slice service UE triggered in the near future is not supported in the current selected cell, which is not friendly for user experience.  If some slice assisted info can be get by UE AS, like the allowed CAG list info in NPN WI, UE AS can have a more efficient and accurate cell reselection based on slice assisted info along with cell quality info.  In this case, the meaning of the intended slice is the slice assisted info, like UE allowed/configured slice.  Case2: During transition from idle/inactive to connected mode  In this case, the intended slice is the slice which triggers the RACH procedure including both MO and MT service.  As mentioned by Qualcomm, for MO service, UE AS can implicitly get the intended slice info from the operator defined access category as we think there is a mapping rule between slice and operator defined access category.  As for MT service, we’re open to discuss whether/how the UE AS will get the intended slice info. |
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**[Phase 1] Q3: Whether the intended slice can always be obtained by UE.**

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| **Company** | **Comments** |
| Qualcomm | Yes (although we don’t fully understand the intention of this question)    In our understanding, the intention of this study item is for enhancement of either cell reselection or RACH depending on different slice type associated with the coming traffics to UE. Then for either slice based cell reselection and RACH, we don’t understand how they can be achieved if the UE is not aware the intended slice of coming traffic. |
| CMCC | For option 1 in our comment for Q2, YES.  For option 2 in our comment for Q2, YES for MO. For MT, slice info may need to be added to the paging message. |
| CATT | We’re a little bit confused by the question, so try to clarify and share our understanding.  In our view, two use cases may be identified in Q2 for intended slice:  Case1: During cell selection/reselection  Case2: During transition from idle/inactive to connected mode due to MO/MT service.  For Case1, UE allowed/configured slice info is not available by UE AS, e.g. only maintain in NAS layer. If the UE AS would like to use allowed/configured slice info to assist cell reselection procedure, UE NAS should inform AS of the allowed/configured slice info. But in current spec, this behavior is not specified. we think this SI can discuss how to achieve slice aware cell reselection.  For Case2, if this requirement is confirmed by RAN2, for MO service case, the current spec may still work as mentioned in Q2, but for MT service, some spec enhancement can be further studied, anyway, the current spec is not sufficient. |
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## 3 Slice based cell selection and reselection under network control

### 3.1 Issue discussions

***[RAN2 agreements on the scope]*** *Discuss the issue that RAN2 needs to address in this SI for the agreed scenario, and whether to add new scenarios can be also discussed.*

In the contributions in RAN2#111-e, here are the issues raised by companies to be studied in this SI:

**Issue 1**: The UE is unaware of the slices supported on different cells or frequencies, which prevents UE from (re)select to the cell or frequency supporting the intended slice.

**Issue 2:** Dedicated priorities would not be available to the UE prior to first RRC connection establishment and only remain valid before T320 expires upon entering IDLE mode. In addition, dedicated priorities are discarded each time when UE entering CONNECTED mode and need to be configured again before UE leaving CONNECTED mode.

**Issue 3**: Operator may require different frequency priority configurations for the specific slice in different areas, however the dedicated priority always overwrites the broadcast priorities if configured.

**Issue 4:** If the serving cell is unable to support the requested slices for the subsequent access of the UE, the serving cell may bring on handover or rejection of access request. That may increase control plane signalling overhead as well as long control plan latency for the UE to access the network.

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**[Phase 1] Q4: Do you agree that the above issues should be addressed? And any additional issues can be added.**

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| **Company** | **Which ones?** | **Comments** |
| Qualcomm | All |  |
| CMCC | All | All of the issue 1/2/3/4 need to be addressed in Rel-17.  We would like to emphasize the Issue3. As shown in Figure 5.1.1-1, in Area 1, F2 is primarily to provide service for Slice2 UEs. So, the Slice2 UEs need to prior to camp on F2, and Slice1 UEs prior to camp on F1 to avoid occupying too much resources for Slice2 on F2.  While in Area 2, both F2 and F1 only serve Slice1 service, and F2 with wider bandwidth is deployed as hotspot for Slice1, which means Slice1 UEs should prior to camp on F2. So, in Area1, the frequency priority for Slice1 UE is F1<F2. But in Area2, the priority for Slice1 is F2>F1.  The use case for Issue3 is that operator may require different frequency priority configurations for the specific slice in different areas. If the UE is configured with dedicated priority F1<F2 in Area1, that dedicated priority will still working when UE moving to Area2. |
| CATT | All | For issue3, we agree with CMCC that the requirement is reasonable and valid, but the current dedicated priority can’t cover this new requirement.  For issue4, in last RAN2 meeting, we agree that connected mode issues should have second priority, so we agree to study issue4, but with low priority. |
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***[RAN2 agreements on the scope]*** *Discuss whether the R15 mechanism (e.g. dedicated priority mechanism) can solve the above issues*

**[Phase 1] Q5: Whether the R15 mechanism (e.g. dedicated priority mechanism) can solve the above issues?**

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| **Company** | **Comments** |
| Qualcomm | No.   1. It can’t resolve issue 2: The dedicated priorities are provided to the UE in RRC Release message. So, it means dedicated priorities would not be available to the UE prior to first RRC connection establishment and only remain valid before T320 expires upon entering IDLE mode. 2. It can’t resolve issue 1 and 4: we think there may be scenarios where no frequency may provide all the slices (i.e. the agreed 1st scenario: multiple and different slices can be supported on different frequencies). In such case the UE may camp on a frequency based on legacy reselection rules and chose to reselect to a frequency providing the intended slice prior to access. No matter NW uses HO or redirection, it will incur signaling overhead and latency, which is unnecessary 3. It can’t resolve issue 3 for agreed 2nd scenario (i.e. Figure 5.1.1-1 in current TR): The frequency priorities are different in different regions (i.e. different in area 1 and area 2). However, the dedicated priority always overwrites the broadcast priorities, which means the UE can’t switch frequency priority when moving across area 1 to area 2 if dedicated priority is configured. So, region-dependent frequency priorities can’t work in this scenario. |
| CMCC | No.  We don’t think the legacy mechanism can address any of the 4 issues listed in Q4. |
| CATT | Agree with Qualcomm |
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### 3.2 Candidate solutions

***[RAN2 agreements on the scope]*** *Discuss the candidate solutions which can address the above issues, and the solutions in the contributions in RAN2-111-e meeting will be summarized by rapporteur.*

In the contributions of RAN2#111-e, the following solutions are proposed:

**Solution 1**: Legacy dedicated priority via *RRCRelease* message.

**Solution 2**: Slice related cell (re)selection info, the slice info of serving cell and neighboring cells should be provided in the system information.

**Solution 3**: Cell reselection priority per slice should be provided in the system information or *RRCRelease* message.

**Solution 4**: UE preferred slice info can be considered for slice-based cell reselection design.

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**[Phase 2] Q6: How do you think about the solutions and do you agree to capture above solutions in the TR? Addition solution can also be added.**

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## 4 Slice based RACH configuration or RACH parameters prioritization

### 4.1 Issue discussions

***[RAN2 agreements on the scope]*** *Discuss the use cases or intentions for slice-based RACH configuration or RACH parameters prioritization, and discuss whether identified issues can be solved by legacy mechanisms.*

During the online session, chairman suggest we should first understand on the intention and use case for slice-based RACH configuration. Here are the intentions or use cases mentioned in the contributions in last meeting:

**Intention 1:** RA resource isolation. From marketing point of view, some of the industrial customers have the requirement for access resource isolation, in order to provide guaranteed RA resources for their sensitive slices.

**Intention 2**: Slice access prioritization. In R15/16, all slices are sharing the same RA resources and cannot be differentiated by network side. But some slices may need to be prioritized during the RA procedure.

**Intention 3**: MSG1 or MSGA access control. Separate RA resources for slices provides a simpler way for slicing access control comparing with UAC. Network can decide which MSG1 or MSGA to reply based on the corresponding slices.

**[Phase 1] Q7: Do you agree with the intention or use case for slice-based RACH configuration or RACH parameters prioritization? Any addition intention can also be added.**

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| **Company** | **Which ones?** | **Comments** |
| Qualcomm | Intention 1 and 2 | For intention 1, we agree the requirement is valid. However, it is worth noting that RACH resource partitioning may cause fragments of RACH resource, especially when the number of slices supported by one cell is large.  For intention 3, NR had spent a lot of efforts on UAC in Rel-15. We don’t think it can provide much benefit over UAC, and its functionality will be overlapped with UAC, which is not preferred |
| CMCC | All of the 3 intentions | The above intention 1&3 came from our contribution.  For intention 1, we see the requirement from the industrial customers.  For intention 3, the R15 UAC is perfect but a bit complex for us to deploy, which requires both RAN and CN configurations and impacting both AS and NAS layers. If the RA resource can be separately configured for different slices, the RAN node can directly perform access control for the slices, without impact on CN and NAS layer. |
| CATT | All |  |
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### 4.2 Candidate solutions

***[RAN2 agreements on the scope]*** *Discuss the use cases or intentions for slice-based RACH configuration or RACH parameters prioritization, and discuss whether identified issues can be solved by legacy mechanisms..*

In the contributions, following candidate solutions were proposed:

**Solution 1**: Separate RACH resources pool can be configured per slice or per slice group, in addition to the existing common RACH resources.

**Solution 2**: RACH parameters prioritization can be configured per slice.

**[Phase 2] Q8: How do you think about the solutions and do you agree to capture above solutions in the TR? Additional candidate solutions can also be provided.**

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## 5 Slice based access barring

### 5.1 Issue discussions

Since R15 UAC has already supported operator defined access category which can be mapped to slices, it would be good to understand first what’s the intention for the enhancement and the issues for R15/16 UAC.

**[Phase 1] Q9: What’s the intention to enhance slice-based access barring?**

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| **Company** | **Comments** |
| Qualcomm | We don’t see the need to enhance UAC.  In current spec, we support operator based access categories (based on e.g. DNN, slice etc.) can also be provided to UE in Registration Accept and Configuration Update Command. And we have 32-63 available. So, the space should be enough to support different slice. |
| CMCC | No strong view. Open to see companies’ views. |
| CATT | For MO service, in current spec, most of the MO service/slice will use the same cause value in MSG3, e.g. ‘MO data’, if this service attempt is rejected in MSG4, all the slice service will be barred during T302 running except AC ‘0’ and ‘2’. But this is not the intended network/UE behavior for slice based access control, the network may want to bar the service attempt per AC except all ACs. Even if the operator defined ACs are used to imply the triggered slice behind, this per slice rejection requirement by the network is still valid and should be considered in this SI. |
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### 5.2 Candidate solutions

**[Phase 2] Q10: What’s the candidate solutions for slice-based access barring?**

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## 6 Conclusion

[To be added]

## 7 Tdocs under AI 8.8 RAN slicing SI

*Note: contributions highlighted in grey are LS related.*

1. R2-2006513 Response to 5GC assisted cell selection for accessing network slice (R3-202558; contact: ZTE) RAN3 LS in Rel-17 FS\_NR\_slice To:SA2 Cc:RAN,RAN2,SA1
2. R2-2006527 Reply LS on GSMA NG.116 Attribute Area of service and impact on PLMN (S1-202294; contact: Nokia) SA1 LS in Rel-17 FS\_eNS\_Ph2 To:SA2, CT1, RAN2, RAN3, GSMA 5GJA, GSMA WAS
3. R2-2006528 LS on 5GC assisted cell selection for accessing network slice (S1-202264; contact: ZTE) SA1 LS in Rel-17 FS\_eNS\_Ph2 To:SA2 Cc:RAN2, RAN3 Withdrawn
4. R2-2006529 LS on 5GC assisted cell selection for accessing network slice (S2-2001728; contact: ZTE) SA2 LS in Rel-17 FS\_eNS\_Ph2 To:SA1, RAN2, RAN3 Withdrawn
5. R2-2006534 LS on SA5 Rel-17 work on SLA (S5-203370; contact: CMCC) SA5 LS in Rel-17 EMA5SLA To:GSMA 5GJA, SA2, RAN3, IETF TEAS WG Cc:SA, SA1, SA6, RAN2, ETSI ISG ZSM
6. R2-2006632 Initial Discussion on the Scope and Requirements for Slicing CATT discussion Rel-17 FS\_NR\_slice
7. R2-2006655 LS on 5GC assisted cell selection for accessing network slice (S1-202264; contact: ZTE) SA1 LS in Rel-17 FS\_eNS\_Ph2 To:SA2 Cc:RAN2, RAN3
8. R2-2006656 LS on 5GC assisted cell selection for accessing network slice (S2-2001728; contact: ZTE) SA2 LS in Rel-17 FS\_eNS\_Ph2 To:SA1, RAN2, RAN3
9. R2-2006707 Considerations on slice aware cell selection KDDI Corporation discussion
10. R2-2006767 Discussion on RAN slicing enhancement Qualcomm Incorporated discussion Rel-17 FS\_NR\_slice
11. R2-2006854 Considerations on slice-based cell reselection Nokia, Nokia Shanghai Bell discussion Rel-17 FS\_NR\_slice
12. R2-2006871 Consideration on the scope and solutions for RAN slicing enhancement ZTE corporation, Sanechips discussion Rel-17 FS\_NR\_slice
13. R2-2006883 Considerations on scope of RAN slicing enhancements Lenovo, Motorola Mobility discussion Rel-17 FS\_NR\_slice
14. R2-2006887 5G RAN Slicing Framework During Cell Reselection MITRE Corporation discussion Late Withdrawn
15. R2-2006951 Slicing based cell (re)selection Intel Corporation discussion Rel-17 FS\_NR\_slice
16. R2-2006970 Considerations for RAN slicing Samsung Electronics Co., Ltd discussion Rel-17 FS\_NR\_slice
17. R2-2007051 Consideration on RAN slicing Spreadtrum Communications discussion
18. R2-2007088 Scoping of RAN Slicing Apple discussion Rel-17 FS\_NR\_slice
19. R2-2007140 Consideration on Rel-17 slicing OPPO discussion Rel-17 FS\_NR\_slice
20. R2-2007250 Assistant information to enable UE fast access network slice ITRI discussion FS\_NR\_slice
21. R2-2007302 Consideration on RAN slicing vivo discussion Rel-17 FS\_NR\_slice
22. R2-2007402 Discussion on RAN Slicing LG Electronics UK discussion Rel-17
23. R2-2007419 Skeleton for TR 38.832 CMCC draft TR Rel-17 38.832 0.0.0 FS\_NR\_slice
24. R2-2007420 Work Plan for RAN Slicing CMCC, ZTE discussion Rel-17 FS\_NR\_slice
25. R2-2007421 Discussion on support of RAN slicing CMCC discussion Rel-17 FS\_NR\_slice
26. R2-2007521 Enhancement on RAN support of network slicing Beijing Xiaomi Software Tech discussion Rel-17
27. R2-2007606 Considerations on Frequency Band Selection for RAN Slicing SHARP Corporation discussion Rel-17
28. R2-2007607 Basic requirements for RAN slicing Google Inc. discussion Rel-17 FS\_NR\_slice
29. R2-2007609 Discussion on Network Slicing’s Impact on Cell Reselection Convida Wireless discussion FS\_NR\_slice
30. R2-2007645 Methods for serving slices on different frequencies Ericsson discussion Rel-17 FS\_NR\_slice
31. R2-2007716 Scenarios and requirements for RAN slicing SoftBank Corp. discussion Rel-17 FS\_NR\_slice
32. R2-2007772 Considerations on enhancing the RAN support of network slicing Huawei, HiSilicon discussion Rel-17 FS\_NR\_slice
33. R2-2008071 Considerations scenarios on enhancing the RAN support of network slicing China Unicom discussion Rel-17 FS\_NR\_slice