3GPP TSG-RAN WG2 Meeting #113bis-e R2-2104322

Electronic Meeting, April 12 – 20, 2021

**Agenda item: 8.8.3**

**Source: CMCC**

**Title: Summary for [AT113bis-e][252][NR] Slice-specific RACH**

**WID/SID: NR\_slice**

**Document for: Discussion and Decision**

# 1 Introduction

This contribution is the summary for the following email discussion during RAN2#113bis-e meeting.

Email discussions ([252]) - not kicked off before online session

* [AT113bis-e][252][NR] Slice-specific RACH (CMCC)

Scope:

* + - Summarize main open issues based on contributions and online agreements.
    - Highlight if there are topics that clearly require online discussion.
    - Identify topics that might benefit from email discussions.

Intended outcome:

* + - Discussion summary in [R2-2104322](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_113bis-e/Docs/R2-2104322.zip) (by email rapporteur)

Deadline for providing comments and for rapporteur inputs:

* + - Initial deadline (for companies' feedback): 1st week Fri, UTC 0900
    - Initial deadline (for rapporteur's summary): 2nd week Mon, UTC 1200

**Company Context**

|  |  |
| --- | --- |
| **Company** | **Contact** |
| CMCC Ningyu | chenningyu@chinamobile.com |
| Huawei, HiSilicon Jun Chen | jun.chen@huawei.com |
| Xiaomi, Xiaofei Liu | liuxiaofei@xiaomi.com |
| OPPO, Zhe Fu | fuzhe@OPPO.com |
| Perspecta Labs, Achilles Kogiantis | [akogiantis@perspectalabs.com](mailto:akogiantis@perspectalabs.com) |
| Qualcomm, Peng Cheng | chengp@qti.qualcomm.com |
| BT, Salva Diaz | salva.diazsendra@bt.com |
| Nokia, Nokia Shanghai Bell | malgorzata.tomala@nokia.com |
| Intel Corporation, Seau Sian Lim | seau.s.lim@intel.com |
| Lenovo | hchoi5@lenovo.com |
|  |  |
|  |  |

# 2 Discussion

This email mainly discusses on the following topics: basic solutions, co-existence with legacy UE and legacy MPS/MCS, RA selection and fallback cases. Some proposals in contributions [1-4] that covers above topics are copied below for discussion.

## 2.1 Basic solutions

In WID RP-210921, it limits that only MO cases should be considered for RACH. It needs to be clarified firstly what is “MO case”, i.e., does it include MO signaling or data traffic?

Proposal: Only MO data arrival triggered RACH can apply slice specific RACH. MO signaling (e.g. mo-Signalling and mo-SMS) triggered RACH is not applied to slice-specific RACH. [1]

**Q1: Do you agree with above proposal?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| CMCC | Yes | MO signaling should use the common RACH resources. |
| Huawei, HiSilicon | Yes |  |
| Xiaomi | Yes |  |
| OPPO | Yes | Sometimes, there is no valid S-NSSAI information in NAS layer when it is mo-Signalling or mo-SMS. |
| Qualcomm | Yes | Agree with the point raised by OPPO. If we allow MO signaling, we may need to consider more issues. It seems the main intention of slice-based RACH is for access attempt caused by arriving MO data. |
| Nokia | No | We are not convinced it make sense to differentiate between RACH for data and signalling. From the NW side the gNB would provide RACH configuration in System Information, and when UE needs to start RA procedure then it read slice-specific RACH configuration from broadcast and uses the configured RACH resources. The split of configuration for MO signallign and MO data may bring more complexity than necessary. Further the distinction (between MO data and signalling) requires input from NAS layer, thus require more scattered UE operations. |
| Intel | Yes |  |
| Lenovo | Yes |  |

In TR 38.832, it captured IDLE/INACTIVE UE can apply slice specific RACH. Companies are invited to share views on whether slice specific RACH can be applied to CONNECTED UE in below 3 highlighted cases in TS 38.300:

The random access procedure is triggered by a number of events:

- Initial access from RRC\_IDLE;

- RRC Connection Re-establishment procedure;

- DL or UL data arrival during RRC\_CONNECTED when UL synchronisation status is "non-synchronised";

- UL data arrival during RRC\_CONNECTED when there are no PUCCH resources for SR available;

- SR failure;

- Request by RRC upon synchronous reconfiguration (e.g. handover);

- Transition from RRC\_INACTIVE;

- To establish time alignment for a secondary TAG;

- Request for Other SI (see clause 7.3);

- Beam failure recovery;

- Consistent UL LBT failure on SpCell.

**Q2: Whether CONNECTED UE can also apply slice specific RACH when RACH is triggered by MO data arrival (i.e. when UL synchronisation status is "non-synchronised", or there are no PUCCH resources for SR available, or SR failure)?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| CMCC | Yes | We don’t have strong preference, ok to consider CONNECTED UE. |
| Huawei, HiSilicon | Neutral | On one hand, it may be some benefits for applying slice based RACH for connected Ues. On the other hand, we are concerned about the TUs as such discussions may consume Tus and then other discussions may be impacted. |
| Xiaomi | Yes | Share the same view with QC that slice-specific RACH configuration can also be applied to CONNECTED UE. |
| OPPO | No | It is already agreed that RRC connected mode is with a low priority. We should settle down other issues firstly. |
| Perspecta Labs | Yes | RA prioritization is useful in all RA attempts since low latency is the objective. Share the view that this will consume more TUs. |
| Qualcomm | Yes, but.. | These 3 RACH cases for CONNECTED UE may be triggered with arriving MO data, similar to our agreed slice RACH scenario (for IDLE/INACTIVE UE). Because the target scenario is similar, we thought current agreed slice based RACH can be easily extended to the 3 RACH cases for CONNECTED UE, without much spec work. However, if people have workload concern, we can follow majority. |
| Nokia | Yes | We support unified behaviour |
| Intel | No | In our view, if UE is configured with any critical slice, the UE will be configured with dedicated SR and will not be allowed to go UL out of sync. |
| Lenovo | No | We should stick to the RAN2 conclusion. Furthermore, it is not clear to us why slice-specific RACH needs to be supported in connected. |

Proposal: Slice specific RACH (including RACH isolation and RACH prioritization) is only applied to CBRA rather than CFRA. [1]

**Q3: Do you agree with above proposal?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| CMCC | Yes | Dedicated RACH resource is applied for CFRA. |
| Huawei, HiSilicon | Yes | Reasonable proposal as CFRA uses dedicated RACH resources so that it is no need to consider slice based RACH sources. |
| Xiaomi | Yes |  |
| OPPO | No | Even if it is CFRA, there is some benefits for applying slice-specific RACH. For example, slice-specific RACH prioritization can help the UE with a specific slice re-send MAG1/MSGA with a larger ramping power value than legacy UE does, which assures fast cell accessing for the UE with specific slice. |
| Qualcomm | Yes | For CFRA, NW assigns dedicated preamble for the CONNECTED UE, to reduce collision. It serves the similar intention of slice RACH. Considering the redundancy, we prefer to make this clarification. Otherwise, we will have more spec work for co-existence between slice RACH and CFRA.  @OPPO, it seems your comment here is conflicted with your comment in Q2. CFRA works for CONNECTED UE. |
| BT | Yes | NW assigns dedicate resources for CFRA therefore the collision probability is reduced. If at some point a company can justify the need, we can always add CFRA Slice specific RACH. |
| Nokia | Yes, but | It may depend on how CFRA resources are assigned |
| Intel | Yes | Our understanding of the proposal is that the network will not assign CFRA resources for the UE to perform slice specific RACH. The UE will just use the CFRA resource assigned by the network to perform PRACH transmission. Whether the CFRA resources are associated with the slice specific RACH resource or the common RACH resource is not something of concern to the UE. |
| Lenovo | Yes |  |

## 2.2 Co-existence with legacy UE and non-urgent slice

It is important that the introduction of slice specific RACH resource shall not prevent from accessibility for Rel-15 / Rel-16 legacy UEs. In addition, Rel-17 UEs supporting RACH isolation should also have non-urgent slice, i.e. the Rel-17 should not switch to another BWP to trigger common RACH when non-urgent slice traffic arrival. [1]

Proposal: To support legacy UE and non-urgent slice, if slice specific RACH resource is configured in one BWP, common RACH resource (i.e. legacy CBRA resource) is required to be configured in the same BWP. [1]

**Q4: Do you agree with above proposal?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| CMCC | Yes | To support legacy UEs, the common RACH resource need always be configured. |
| Huawei, HiSilicon |  | For initial BWP, we think it may required to differentiate between common RACH reosurces and slice based RACH resources.  For dediated BWP, it is allocated by the network for RRC connected mode Ues. Based on Q2, if CONNECTED UE can’t apply slice specific RACH, there will be no slice based RACH resources in dedicated BWP, and then Q4 may not exist. |
| Xiaomi | Yes |  |
| OPPO |  | It may happen only for initial BWP if slice-specific RACH is not supported by RRC connected mode UE. Whether common RACH resource is restricted to legacy CBRA resource depends on the conclusion for Q3. |
| Qualcomm | Yes | We agree with Huawei’s comments: this proposal works only for IDLE/INACTIVE under initial BWP. If CONNECTED UE can also use slice RACH (Q2), we agree that this proposal is not necessary.  So, maybe in proposal, we can add “in initial BWP” or “for IDLE/INACTIVE UE” |
| BT |  | Yes for initial BWP as common RACH resources need to be always configured.  Depends for dedicated BWP. The answer depends on Q2. |
| Nokia | No | RACH prioritization with new parameters can be supported in backward compatible manner. Any possible methods for legacy UEs do not require dedicated proposal or agreement in Rel-17. There is also no definition of non-urgent slice |
| Intel | Yes for initial BWP. For non-initial BWP, see comments | For initial BWP, common RACH resource needs to be configured to support legacy UE and for slices that are not enabled to use sliced specific RACH.  For non-initial BWP and if slice specific RACH is to be supported for connected mode, common RACH resource needs to be configured for slices that are not enabled to use slice specific RACH. However, if UE does not have allowed slices that are not enabled to use slice specific RACH, then common RACH resource may not be needed for the BWP. |
| Lenovo | Yes but | So far, we can assume to have only one initial UL BWP for initial RACH. Whether to support additional initial UL BWP for RACH configuration due to other features (Redcap, coverage enhancement, SDT) is FFS.  Furthermore, we dislike the term “non-urgent” slice and suggest not to use it. RAN2 agreed to support RACH resource isolation for slices in order to provide guaranteed RACH resources to meet certain market needs. Such slices can be of type URLLC, eMBB, MIOT or non-standardized types. Therefore, saying slices for which specific RACH resources have not been configured are non-urgent is not appropriate and misleading. |

## 2.3 RACH type selection and fallback

During the online session, RAN2 agreed to support configuring 2-step RA resources or 4-step RA resources or both for slices, as well as the legacy fallback mechanism. Several contributions [1,2,3,6,7] are supportive to have RA type fallback for slice based RACH. In Qualcomm’s contribution [1], the following 5 cases for RACH type configuration, selection and fallback are proposed. Companies are invited to share views on whether these 5 cases should be supported.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Cases | RACH resource configuration in one BWP | RACH type selection | Fallback after MSGA attempt number beyond threshold | Notes |
| Case 1 | 2-step slice specific RACH  4-step common RACH | Always perform 2-step slice specific RACH | UE switch to MSG1 of 4-step common RACH | Via only configuring 2-step slice RACH resource, high priority slice may only trigger 2-step RACH to reduce latency |
| Case 2 | 2-step slice specific RACH  4-step slice specific RACH  4-step common RACH | RACH type selection based on RSRP threshold | UE can switch to MSG1 of 4-step slice specific RACH | No fallback from 4-step slice specific RACH to 4-step common RACH |
| Case 3 | 4-step slice specific RACH  2-step common RACH | Always perform 4-step slice specific RACH | No fallback |  |
| Case 4 | 4-step slice specific RACH  4-step common RACH | Always perform 4-step slice specific RACH | No fallback |  |
| Case 5 | 2-step slice specific RACH  2-step common RACH  4-step slice specific RACH  4-step common RACH | RACH type selection based on RSRP threshold | UE can switch to MSG1 of 4-step slice specific RACH | No fallback from 4-step slice specific RACH to 4-step common RACH. Not preferred due to large RACH resource usage |

**Q5: Do you support above 5 cases for RA configuration, selection and fallback?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No/Part of them** | **Comments** |
| CMCC | Yes | We support to have flexible RA configuration for slices. And we are also ok with the RA selection and fallback in the table. |
| Huawei, HiSilicon | Yes | We think the above table is very good and it includes almost all cases for RACH type selection and fallback. We understand that it follows the concept of legacy fallback mechanisms, so we support the above table. |
| Xiaomi | Part of them | For the fallback mechanism of case2/4/5, in our view, the fundamental intention to support slice-specific RACH configuration is to gurantee UE fast access, thus, we think if UE failed on 4-step slice-specific RACH resource, it should be allowed to use 4-step common RACH resource to initiate access attemp other than just wait. |
| OPPO | Yes | It can be the baseline. |
| Qualcomm | Yes | For the fallback from 4-step slice RACH to 4-step common RACH mentioned by Xiaomi, we are not convinced with its benefit, unless UE can know heavier congestion on slice specific RACH resource than common RACH. However, the UE doesn’t know the load difference from common RACH. We tend to simplify the procedure. |
| BT | Yes | A flexible RA configuration is required so we support the table above. |
| Nokia | Limited | 2-step RACH is to reduce the RA latency, thus we are wondering if it make sense to use 2-step RACH as fallback after the first one already failed?  To avoid too much resource segregation, maybe fallback should be limited to common RACH only as 4-step. It will offer some form of fallback (assuming RACH prioritization for dedicated resources did not work), and would help to identify the problems with the slice specific configurations |
| Intel | Yes but | As one of the objectives of the WI is for fast access, case 3 seems a bit counter-intuitive to not support 2-step slice specific RACH. But we are OK to support it in specifications. We also wonder if this covers all cases – for example is it possible to have 2-step slice specific and 2-step common RACH configured? The fallback for MsgA attempts and the RACH type selection look logical to us. |
| Lenovo | No | Case 1 looks ok.  Case 2: We wonder about the use-case to specify different RA types for slices as it is resource-consuming.  Case 3: This case looks really odd. Why should the slower 4-step RA type be configured for slices? We thought the intention is to speed-up the RACH access for slices.  Case 4: Configuration is ok but wonder why a fallback from 4-step slice RACH to 4-step common RACH should not be supported. In case of congestion of 4-step RACH resources a fallback to common RACH may be beneficial.  Case 5: same comment as for case 2. The benefit to specify different RA types for slices is not clear to us.  A case 6 with “2-step slice specific RACH and 2-step common RACH” is missing. |

## 2.4 co-existence with MPS/MCS

**For the topic of prioritization parameter collision with MPS/MCS, here are the candidate approaches:**

Option 1: It should be clearly specified in the specification.

Option 1a: slice specific RA prioritization parameter should override MPS/MCS specific RA prioritization parameter. [2][13]

Option 1b: MPS/MCS specific RA prioritization parameter should override slice specific RA prioritization parameter. [3][12]

Option 2: It should be configurable by network. [4]

**Q6: which option do you prefer**

|  |  |  |
| --- | --- | --- |
| **Company** | **Option** | **Comments** |
| CMCC | 1a | In order to guarantee the fairness among UEs initiating the same slice, we prefer the slice specific RA prioritization parameter should override MPS/MCS specific parameter |
| Huawei, HiSilicon | 1a | We share similar views as CMCC. |
| Xiaomi | Option 1b. and Option 2 | We think it should be configurable by network and if not, MPS/MCS specific RA prioritization should overrule slice specific RA prioritization because it is configured to specific UE and can provide more precise configuration. |
| OPPO | 1a | We share the similar view as CMCC. |
| Perspecta Labs | Prefer 2, 1b is ok | MPS/MCS RA prioritization configuration should at least be able to override the slice specific one since it matters only to those UEs with the special Access Identities. Also, MPS/MCS override (1b) covers the corner case where a slice has not configured its RA prioritization parameters, which would happen with 1a implementation. To address all use cases, configurability (Option 2) is preferred. Agree with Xiaomi. |
| Qualcomm | Option 1a and Option 2 | Considering RAN2 is introducing RACH prioritization for different scenarios / cases ever from Rel-15 to Rel-17, we tend to think specifying a flexible / configurable way is more forward compatible way. This priority can be configured by gNB or be pre-configured via UE’s subscription.  Default rule is also acceptable to us, especially if (pre)configuration on priority is not available. Then, we agree with CMCC and Huawei. |
| BT | Option 2 | We don’t see the need to agree on option 1a or 1b when option 2 offers the flexibility to choose among them.  It is important to note that different regions may have different requirements and only Option 2 offers the required flexibility. |
| Nokia | Option 2 | We believe it should dbe clear from procedures, but we are not convinced the conflict would appear. E.g. MCS as Access identity 2 may be not conficting with any Access Category if the NW configuration is set properly.  Our understanding is that it should be under NW control to prioritize one or the other type of access. This will be possible with barring configuration setup (no special prioritization rule on the UE side.) |
| Intel | See comments | We are not sure if this is a realistic use case where the access is for MPS/MCS and slice specific RACH priority at the same time and if so, whether we need to define a specific UE behaviour. |
| Lenovo | Option 1a | In general, we should follow the rule that if a NW configures a new feature then the UE that supports this new feature has to apply the configuration for that feature. Furthermore, we can assume that it’s up to NW implementation whether the RA prioritization parameters for slices and MPS/MCS can be same or different. |
|  |  |  |

## 2.5 Collision of slice based RA-RNTI and legacy RA-RNTI

As if slice-specific RACH resources are configured in addition to legacy common RACH resources, based on legacy RA-RNTI calculation formula, the value of RA-RNTI calculated for using existing common RACH resources and slice-specific RACH resources may be same. And then UE can not recognize which RACH resource pool the RAR is associated. [3]

Q7: Do you think there is the collision of slice-based RA-RNTI and legacy RATI if slice-based RACH resources are configured in addition to the existing common RACH resources, and RAN2 need to address it?

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes or No** | **Comments** |
| Xiaomi | Yes | As we analyze in [3], we think this issue exists and need to be considered to resolve. |
| OPPO | Yes | The issue on RA-RNTI collision exists, and it can be addressed by using a new RNTI associated with slice-specific RO, as we mentioned in our paper [8]. |
| Qualcomm | No | In Tuesday’s online discussion, RAN2 has agreed to use separate RO and/or preamble for slice-based RACH. Then we don’t see RA-RNTI collision at least in separate RO case  For the shared RO case, we also don’t think this RA-RNTI collision exists. In Rel-16, 2-step RACH introduced a new RA-RNTI but the reason is that legacy 4-step UE may decode 2-step MsgB in shared RO. Because payload of msgB and msg2 are different, it may cause ambiguous issue if the legacy UE decodes the msgB RAR content and misunderstands the network’s response. However, in slice-based RACH, we don’t have MsgB/Msg2 enhancement. Thus, we don’t have such legacy UE ambiguous issue. Instead, it will waste RA-RNTI space, especially if we target for a unified RACH design. |
| Nokia | No | We are not convinced this is a problem. MSG2 is aware from which preamble the answer is going for, so this can be differentiated at MSG3 |
| Intel | See comment | For shared RO, we think that there is no issue as the preamble can be used as the differentiator.  For separate RO, it depends on whether the same PDCCH search space will be used. If it is the same, there may be possibility of RNTI collision |
| Lenovo | No | We wonder why there is an RA-RNTI issue. Common and slice-specific RACH are separated in time/frequency so there should be no issue acc. to the RA-RNTI computation as specified in TS 38.321:  The RA-RNTI associated with the PRACH occasion in which the Random Access Preamble is transmitted, is computed as:  RA-RNTI = 1 + s\_id + 14 × t\_id + 14 × 80 × f\_id + 14 × 80 × 8 × ul\_carrier\_id  where s\_id is the index of the first OFDM symbol of the PRACH occasion (0 ≤ s\_id < 14), t\_id is the index of the first slot of the PRACH occasion in a system frame (0 ≤ t\_id < 80), where the subcarrier spacing to determine t\_id is based on the value of μ specified in clause 5.3.2 in TS 38.211 [8], f\_id is the index of the PRACH occasion in the frequency domain (0 ≤ f\_id < 8), and ul\_carrier\_id is the UL carrier used for Random Access Preamble transmission (0 for NUL carrier, and 1 for SUL carrier). |

# 3 Conclusion

TBD

# 4 References

1. [R2-2102697](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_113bis-e/Docs/R2-2102697.zip) Slice specific RACH Qualcomm Incorporated discussion
2. [R2-2103696](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_113bis-e/Docs/R2-2103696.zip) Discussion on slice based RACH configuration CMCC discussion Rel-17
3. [R2-2102761](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_113bis-e/Docs/R2-2102761.zip) Considerations on slice based RACH configuration Beijing Xiaomi Software Tech discussion
4. [R2-2104019](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_113bis-e/Docs/R2-2104019.zip) Analysis on slice based RACH configuration CATT discussion
5. [R2-2102832](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_113bis-e/Docs/R2-2102832.zip) Considerations of slice based RACH Intel Corporation discussion Rel-17
6. [R2-2102989](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_113bis-e/Docs/R2-2102989.zip) Considerations on slice-based PRACH configuration Lenovo, Motorola Mobility discussion Rel-17
7. [R2-2103089](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_113bis-e/Docs/R2-2103089.zip) Slice based RACH configuration Samsung discussion Rel-17
8. [R2-2103214](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_113bis-e/Docs/R2-2103214.zip) Consideration on slice-specific RACH OPPO discussion Rel-17
9. [R2-2103240](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_113bis-e/Docs/R2-2103240.zip) Consideration on slice based RACH configuration Spreadtrum Communications discussion Rel-17
10. [R2-2103376](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_113bis-e/Docs/R2-2103376.zip) Slice based RACH configuration vivo discussion Rel-17
11. [R2-2103548](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_113bis-e/Docs/R2-2103548.zip) RACH prioritisation for slices Nokia, Nokia Shanghai Bell discussion Rel-17 FS\_NR\_slice

1. [R2-2103882](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_113bis-e/Docs/R2-2103882.zip) Discussion on slice based RACH Apple discussion Rel-17

1. [R2-2104005](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_113bis-e/Docs/R2-2104005.zip) Discussion on slice based RACH configuration Huawei, HiSilicon discussion Rel-17
2. [R2-2104064](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_113bis-e/Docs/R2-2104064.zip) Discussion on slice specific RACH resources and RACH prioritization ZTE corporation, Sanechips discussion Rel-17
3. [R2-2104099](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_113bis-e/Docs/R2-2104099.zip) Slice-specific RA procedure LG Electronics UK discussion