**3GPP TSG-RAN WG2 Meeting #113 electronic R2-2101975**

**Online, Jan 25th – Feb 5th, 2021**

**Agenda Item:**  **8.8.3** **Slice based RACH configuration**

**Source: CMCC**

**Title:** **Report of [AT113-e][252][Slicing] Conclusions on slice-based RACH configuration**

**Document for: Discussion and Decision**

## 1 Introduction

At RAN2#113-e meeting, the following email discussion is allocated after the 1st week web conference and to be reported to the 2nd week web conference.

* **[AT113-e][252][Slicing] Conclusions on slice-based RACH configuration (CMCC)**

Scope:

* + - Determine agreeable additional conclusions on slice-based RACH configuration for the SI, including technical justification of each and open issues not handled during the SI.

 Intended outcome:

* + - Discussion summary in [R2-2101975](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_113-e/Docs/R2-2101975.zip) (by email rapporteur).

 Deadline for providing comments, for rapporteur inputs, conclusions and CR finalization:

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

## 2 Slice based RACH configuration

### 2.1 Previous agreements

Here are the relevant agreements made at RAN2#112-e meeting [2]:

Agreements

* 10: The intentions and use cases for slice-based RACH configuration are as follows:
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.
* 11: The following solutions will be studied and captured in the TR 38.832:
Solution 1: Slice-specific separate RACH resources pool can be configured per slice or per slice group, in addition to the existing common RACH resources.
Solution 2: Slice-specific RACH parameters prioritization can be configured per slice or per slice group.
Neither solution may not be applicable to all possible slices.

Agreements made at RAN2#113-e during 1st week web conference:

**Agreements**

3 Slice based RACH configuration can be applied to idle/inactive UE.

4 The association between slices and slice-specific RACH resources can be configured and provided to UE in SIB and dedicated signalling.

### 2.2 Discussions on open issues

Here are some open issues and the corresponding proposals from companies’ contributions [3~16].

#### Q1: RACH resource isolation

Proposal 8 in [5]: Separated PRACH transmission occasions of time-frequency domain and preambles can be configured for slice or slice group. [5]

**Question 1: Do you agree with the above proposal? Please provide comments if any.**

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| --- | --- | --- |
| **Company** | **Agree or not (Yes/No)** | **Comments** |
| **Qualcomm** | **Yes for RO** | **We prefer to use RO for slice specific RACH resource isolation. It is simple and has good backward compatibility for further RACH features. Meanwhile, Rel-16 adopted separate RO for 2-step RACH resource.** **For preamble, we think it needs further study. Preamble number is limited (up to 64), and some may be reserved for CFRA and some maybe reserved for on-demand SIB. We think it may bring more complexity for NW operation and spec work than RO approach. Considering RO approach can already work, we suggest to first agree to use RO. If majority prefer to study preamble, we can accept to study it in WI phase.** |
| **ZTE** | **Yes** | **We understand the intention of this proposal is to introduce ROs and preambles not overlapped/shared with the existing RACH-ConfigCommon and RACH-ConfigCommonTwoStepRA and we think this is one potential option.****Another option is to map the slice(s) to ROs and preambles configured by RACH-ConfigCommon and RACH-ConfigCommonTwoStepRA.****We understand both options can be considered in the WI phase.****Also to clarify it is possible for 2-step and 4-step RACH to share ROs, in which case the preambles will be differentiated.** |
| **CATT** | **Yes** | **We can consider these solutions independently or mixed for the RACH resource isolation.**  |
| **CMCC** | **Yes** | **We support the proposal.****We prefer to leave the flexibility for network to configure either separate RO or separate preamble for the specific slice or slice group.** |
| **Huawei, HiSilicon** | **Yes** | **We see the benefits of the proposal, so we support it.** |
| **Xiaomi** | **Yes**  | **Slice specific RACH resource can be differentiated via RO or preamble.** **However, for preamble, the number of preambles can be used by slices is limited. And for RO, it can be used by all preambles but can introduce extra access.****Therefore, we prefer to configure both preambles and PRACH transmission occasions of time-frequency domain to slices to** **balance the access delay and preamble collision and** **provide flexible configuration to more slices.****Furthermore, as we states in[5], if slice based RACH resource are configured in addition to the existing common RACH resource, we should consider to resolve the collision of the RA-RNTI, otherwise, UE will be confused about which is the RACH resource pool the RAR is associated.**  |
| **Intel** | **Yes** | **But further details need to be worked out on how this separation can be done, whether it will just follow the existing PRACH configuration or this is separately defined.** |
| **OPPO** | **Yes** | **Separate RACH resource can make gNB knows the intended slice as quickly as possible, it is good for some urgent/specific slice.** |
| **Lenovo** | **Yes but** | **Depending on cell deployment (e.g. size of initial UL BWP, frequency ranges and duplexing modes) both separate and shared RA resources (i.e. shared with legacy RACH config) in time/frequency domain can be considered, same as it was done for 2-step and 4-step RA.** |

#### Q2: RACH Prioritization

Proposal 10 in [5]: Existing RACH parameters prioritization (i.e. *scalingFactorBI* and *powerRampingStepHighPriority* ) can be supported as baseline for slices.

**Question 2: Do you agree with the above proposal? Please provide comments if any.**

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| --- | --- | --- |
| **Company** | **Agree or not (Yes/No)** | **Comments** |
| **Qualcomm** | **Yes** | **It is straight forward. Other parameters can be discussed in WI phase.** |
| **ZTE** | **Yes** |  |
| **CATT** | **Yes** |  |
| **CMCC** | **Yes** |  |
| **Huawei, HiSilicon** | **Yes** | Additional RACH parameters, e.g., preambleTransMax, ra-ResponseWindow, etc. may also be considered. |
| **Xiaomi** | **Yes** |  |
| **Intel** | **Yes** |  |
| **OPPO** | **Yes** |  |
| **Lenovo** | **Yes** | For the time being we see no need to consider additional parameters such as preambleTransMax or ra-ResponseWindow. For instance, powerRampingStepHighPriority already implies a low preambleTransMax value. |

#### Q3: Slicing Grouping

Proposal 2 in [3]: RAN2 is kindly suggested to discuss how to configure slice group(s).

Proposal 2 in [6]: For slice-based RACH isolation and prioritisation, the gNB provides RACH configuration for one or more Access Categories from the set of Operator-defined Access Categories.

From rapporteur point of view, access category is to allocate 1 or several slices into 1 group i.e. 1 Access Category.

**Question 3: Do you agree to using slice group? Whether to define a new grouping mechanism or reusing UAC access category is left to WI phase.**

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| --- | --- | --- |
| **Company** | **Agree or not (Yes/No)** | **Comments** |
| **Qualcomm**  | **Yes** | **When slice number is large, it will cause issues for both Solution 1 and Solution 2, i.e. resource fragment for RACH resource isolation and too many prioritized parameters for the UE. Therefore, slice grouping is necessary to be introduced.** **We assume that the same grouping approach and signaling can be used for slice specific cell reselection. Thus, there is no extra spec work.****With regarding to specific signaling, we prefer NAS signaling to configure UE specific slice group(s), instead of reusing access category because it is a clean solution. But we agree with Rapporteur that it is left to WI phase.** |
| **ZTE** | **Yes** | **We understand 1:1 and 1:N mapping between access category and slices have already been supported and the mapping is assigned and updated via NAS signaling.** **Reusing this structure will have less impact in RAN2, CT1 and SA2 and produce a unified control for access via slices with the barring factor/time and RACH isolation/prioritization broadcasted.** |
| **CATT** | **Yes**  | **We agree to group the slice for the slice information transfer and resource management in the solution in our study. So far the SA2 does not have the definition for slice group concept. They don’t manage the slice as group. We need consider how to define and use the slice group. Whether other groups need to be involved.**  |
| **CMCC** | **Yes** | **Several slices may share the same cell reselection priority or RACH configuration. By categorizing the slices into a few groups, the SI load can be saved.** |
| **Huawei, HiSilicon** | **Yes** | Considering the possible large amount of slices supported by the Network, slice grouping is necessary.While according to the analysis in R2-2101699, the operator defined access category is not suitable for indicating the slices. And we agree with Rapp that to define a new grouping mechanism can be left to WI phase. |
| **Xiaomi** | **Yes** | **Network can support hundreds of slices but RACH resource can be configured to slices is limited, it is obviously that the slice group need to be used and defined. The details can be left to WI phase.** |
| **Intel** | **Yes with comments** | For slice based RACH, we think that user defined access category is sufficient to provide one to one and one to many mapping between access category and slice. There is no need for new slice grouping. |
| **OPPO** | **Yes** | **Considering slice number is large, we agree to using slice group.** **We also think access category can not work well, considering the reasons we provided in R2-2100894. But we agree with rapporteur to discuss the details in WI phase.** |
| **Lenovo** | **No** | **It is not clear to us how slice group or AC can achieve the target of fast access to the intended slice. We think the mapping should be 1:1 and not 1:N.** |

#### Q4: RA type selection for slicing

2-step RACH was introduced in NR Rel-16, which can send both msg1 and msg3 in msgA to reduce latency of RACH procedure. According to TS 38.321 [3], whether to select 2-step RACH or 4-step RACH only depends on RSRP measurement against configured threshold. However, for slice-specific RACH, some companies think it makes sense to introduce new approach to select 2-step RACH, e.g. 2 step RACH is preferred for URLLC related slice(s) to reduce RACH access latency.[3][10][12] proposed to discuss how to select RACH type.

Proposal 3 in [3]: RAN2 is kindly suggested to discuss how to select RACH type (i.e. 4-step slice-based RACH or 2-step slice-based RACH) in slice-based RACH.

**Question 4.1: Do you agree RACH type selection (between 4-step slice-based RACH and 2-step slice-based RACH) should be considered for slice-based RACH? Details left to WI phase.**

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| --- | --- | --- |
| **Company** | **Agree or not (Yes/No)** | **Comments** |
| **Qualcomm**  | **Yes** | **Proponent** **We think 2-step RACH is a useful feature to reduce access latency. Thus, it is important to support 2-step slice specific RACH.****2-step RACH has the similar intention of slice specific RACH (i.e. reduce access latency). Thus, we think it is necessary to study how 2-step RACH and slice specific RACH co-existence. However, only RSRP is considered in Rel-16 2-step RACH type selection, we think it should be further discussed for 2-step slice specific RACH.**  |
| **ZTE** | **See comments** | **We understand it is the co-existence of slice specific RACH resources and RACH type specific RACH resources that need to be considered.** **And the discussion should not be limited to the “selection”of the RACH type . Selection between RACH type for a certain slice only happens when both 2-step RACH and 4-step RACH resources are provided for the same slice.****One possible configuration is to provide 2-step RACH resources for some slices and 4-step RACH resources for the others, in which there is no need to consider the selection of the RACH type as once the intended slice is identified, the corresponding RACH type will be determined.****We suggest to change the proposal into the following:*****Co-existence of slice specific RACH resources and RACH type specific RACH resources should be considered in WI phase.*** |
| **CATT** | **Yes** | **The matrixed configuration may be configured for the slice and RACH type.** |
| **CMCC** | **Yes** | **Considering on the low latency for 2-step RACH, we think the RACH type selection between 2-step and 4-step RACH should take slice or slice group into consideration, as well as RSRP.** |
| **Huawei, HiSilicon** | **Yes** | **Slice-based RACH type selection can achieve slice access prioritization.** |
| **Xiaomi** | **Yes** | **As 2-step RACH can provide fast access for some slices, e.g. URLLC slice, we agree to support RACH type selection considering slices as well as RSRP.** |
| **Intel** | **Yes** | **UE can base it on the access category/slice of MO to decide whether 2-Step RACH can be used. If 2-step RACH can be applied for a slice, then RSRP based selection should then be used for the RACH type selection as per legacy. Otherwise, only 4-step RACH is applied.** |
| **OPPO** | **Yes** | **The combination of RACH type and slice info can be considered.** |
| **Lenovo** | **No** | **As addressed in our contribution R2-2101062, R16 specifications allow the following configuration options:**

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| --- | --- | --- |
| **Option**  | **4-step CBRA****(Type-1)** | **2-step CBRA****(Type-2)** |
| 1 | x |  |
| 2 | x | x |
| 3 | x | x |
| 4 |  | x |

**In case of option 1 and 4, slice-specific RA type can be either 4-step or 2-step RA.****In case of option 2 and 3, we wonder why a RA type selection is needed. In general, we think that 2-step RA should be used for slice-specific RA to achieve the target of fast access. Otherwise, it may result in a longer delay for UEs which want to access a slice for which 4-step RA resources have been configured compared to legacy UEs which use common 2-step RA resources.**  |

If you agree to discuss 2-step slice-based RACH, there is another issue on fallback mechanism. Fallback mechanism to 4-step RACH was specified for 2-step RACH in NR Rel-16: when the number of msgA transmission failure is beyond the configured threshold, the UE will use 4-step RACH instead. If you agree to discuss 2-step slice-based RACH, [3] proposed that there may have below 4 type of RACH:

1. 2-step slice-based RACH
2. 4-step slice-based RACH
3. 2-step common RACH
4. 4-step common RACH

**Question 4.2: If you agree Question 4.1, do you agree fallback mechanism (e.g. 2 step slice-based RACH fallback to 4-step slice-based/common RACH) should be considered for slice-based RACH? Details left to WI phase.**

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| --- | --- | --- |
| **Company** | **Agree or not (Yes/No)** | **Comments** |
| **Qualcomm**  | **Yes** | **Proponent** **Fallback mechanism is necessary for 2-step RACH. As long as we support 2-step slice specific RACH, we need to study its fallback mechanism in WI phase (e.g. whether to fallback to 4-step slice specific RACH or 4-step common RACH).**  |
| **ZTE** | **See comments** | **We understand the UE behavior in initiating random access should be discussed and clarified in stage 3 if the slice specific RACH resources (can either be 4-step RACH resources or 2-step RACH resources) is provided and it seems too early to call it a “fallback” mechanism.****As mentioned under Question 4.1, there would be no fallback from 2 step slice-based RACH fallback to 4-step slice-based if 2-step RACH resources are provided for some slices and 4-step RACH resources are provided for the others.****We suggest to change the proposal into the following:*****The UE behavior in initiating random access should be discussed and clarified in WI phase if the slice specific RACH resources are provided.*** |
| **CATT** | **Yes**  | **The fallback for 2 step RACH should be supported when slice specific RACH configured. How to fallback can be study in WI phase** |
| **CMCC** | **Yes** | **This is kind of stage 3 details. If 2-step slice-based RACH is supported, we agree the fallback should be considered in WI phase.** |
| **Huawei, HiSilicon** |  | **On one hand, we see some benefits for doing fall back solutions, and on the other hand, we think the proposal in Q4.1 is more important so that maybe Q4.2 is lower priority (or may be further considered in WI phase).** |
| **Xiaomi** | **Yes** | **We agree with QC that if slice based RACH type selection is supported, the fallback mechanism is necessary, but the details of how to fallback need further study in stage-3.** |
| **Intel** | **Yes** | **Fallback mechanism should be used if 2-step RACH attempt fails (e.g. Only MsgA PRACH is received and not the MsgA PUSCH).**  |
| **OPPO** | **Yes** | **The fallback mechanism should be considered if we support 2-step slice-specific RACH. The details can be discussed and resolved in WI phase.** |
| **Lenovo** |  | **Currently, it is not clear what is better in terms of performance: 1) fallback to 4-step RA or 2) no fallback and after “N” msgA retransmission (preamble and PUSCH) the UE retries on 2-step RA in accordance with scalingFactorBI.** |

Tdoc [10] also discussed that, in legacy, RA prioritization for several scenarios, i.e. HO, beamFailureRecovery and special UE (i.e. MPS and MCS UE) is already supported. If multiple sets of RA parameters are configured, i.e. slice-specific RA prioritization is configured together with legacy RA prioritization, one left issue is which set of RACH parameters to be chosen. For example, in case that UE is in idle/inactive mode and both slice-specific RA prioritization and access identity-specific RA prioritization are configured, UE behaviour should be specified on which set of RACH parameters to be prioritized.

Proposal 4 in [10]: RAN2 considers to solve the collision in case that slice-specific RA prioritization is configured with legacy RA prioritization, i.e. it should be specified that which set of RA parameters to be prioritized.

Email rapporteur tend to think this is kind of issue to be solved in WI phase, and would like to check with companies’ views.

**Question 4.3: Do you agree that the collision in case that slice-specific RA prioritization is configured together with legacy RA prioritization (e.g. MPS & MCS UEs) need to be solved in WI phase, i.e. to specify which set of RA parameters to be prioritized?**

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| **Company** | **Agree or not (Yes/No)** | **Comments** |
| **Qualcomm**  |  | **We tend to think it is a kind of legacy issue which has to be resolved in stage 3 if slice-specific RA prioritization is finally agreed in normative phase. But if majority think we should make conclusion right now, we are also fine.**  |
| **ZTE** |  | **We understand the UE behavior will anyway be discussed and clarified in stage 3 if slice specific RACH prioritization is provided.** **If companies insist, we can have a proposal with something like:*****The UE behavior in initiating random access should be discussed and clarified in WI phase if the slice specific RACH prioritization is provided.*** |
| **Perspecta Labs** |  | **We think this can be resolved in stage 3 during normative text development. We think that MPS RA prioritization would typically override the slice-specific RA prioritization but there could be corner use cases where it does not make sense to do so. Some programmability to whether override is implemented in the slice would cover all use cases.**  |
| **CATT** |  | **We would like to suggest we discuss it in stage 3, WI phase** |
| **CMCC** | **Yes** | **This is kind of stage 3 details and will be addressed in WI phase.** |
| **Huawei, HiSilicon** |  | **Can be handled in stage-3 in WI phase.** |
| **Xiaomi** |  | **We agree with above comments that the issue can be considered and solved in stage-3.** |
| **Intel** |  | **Agree with others that this can be further studied in Stage-3 of the WI phase** |
| **OPPO** | **Yes** | **In our understanding, it is an issue which has to be resolved if we support slice-specific RACH prioritization. It is also confirmed by some companies provided comments above.** **We think we can confirm the issue, then discuss it in WI phase.**  |
| **Lenovo** |  | **We wonder whether the scenario is real an issue. But we are ok to clarify it in the WI phase.** |

**Note: To avoid duplicate discussion, “Q5 Slice info for MT” is moved to #251 email discussion.**

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| **Qualcomm** | **Yes** | We think including intended slice info for MT service is useful for slice specific RACH. If the upcoming MT service is associated with urgent slice (URLLC), the UE should be allowed to use prioritized RACH resource or parameters to reduce collision and latency. Meanwhile, please note in SA2, MU-SIM has agreed to include some indication for voice traffic in paging. We think slicing can reuse the similar way. But the signalling details can be discussed in WI phase |
| **ZTE** | **See comments** | **Response to paging has been assigned with a specific access category 0. If some RACH resources or prioritization are associated with access category 0, UE can apply the corresponding configuration, which provides a unified handling for the MT access.****Inserting too much information in the paging message would impact the paging capacity, which is not preferred from our perspective.** |
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#### Q6: Co-existence for solution 1 & 2

It seems solution 1 & 2 are not conflict with each other and both can be specified. Companies are invited to confirm with this understanding.

**Q6: Do you agree the solution 1 & 2 can work together?**

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| --- | --- | --- |
| **Company** | **Agree or not (Yes/No)** | **Comments** |
| **Qualcomm**  | **Yes** | **We don’t see any confliction of these two solutions. One solution can be another solution’s supplement. For example, a group of slices with latency requirement can be configured with a set of prioritized RACH parameters. Within the group the slice with highest latency requirement (e.g. URLLC) can be allocated with an isolated RACH resource.**  |
| **ZTE** | **Yes** | **No confliction of the two solutions.** |
| **CATT** | **Yes** |  |
| **Huawei, HiSilicon** | **Yes** |  |
| **Xiaomi** | **Yes** | **We agree that there is no collision between two solutions.****Solution1 means slice has dedicated RACH resource and solution2 means multiple slices sharing the same RACH resource but have different RACH prioritization.****As we analyzed in [5], considering that solution1 can provide guaranteed RACH isolation while solution2 can not, we think the solution 1 can be considered as baseline, and limited by the RACH resource, the slice specific RACH resource may be configured per slice group, then the solution2 can be considered as supplemental solution of solution1 to provide more flexible and differential RACH configuration.** |
| **Intel** | **Yes** |  |
| **OPPO** | **Yes** |  |
| **Lenovo** | **No** | **If solution 1 is configured in the cell, then there is no need for solution 2.****Solution 2 makes sense if there are no sufficient resources in the initial UL BWP to configure slice-specific RA resources.** |

#### Q7: Conclusion for slice-based RACH configuration

Proposal 1 in [16]: Both solution 1 and solution 2 for slice-based RACH configuration are recommended for normative work. (And the details are depending on the summary of the above questions.)

**Q7: Do you agree the above conclusion? If not, please also provide the suggested conclusion.**

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| **Company** | **Agree or not (Yes/No)** | **Comments** |
| **Qualcomm** | **Yes** | **We see majority companies support these two solutions. And these two solutions are not mutual-exclusive. So, both can be recommended for normative work.** |
| **ZTE** | **Yes** | **Both recommended for normative work.** |
| **CATT** | **Yes** | **Both recommended for normative work** |
| **Huawei, HiSIlicon** | **Yes** | **Based on the report R2-2101802, we think majority companies are ok with these two solution, so we agree that both are recommended for normative work.** |
| **Xiaomi** | **Yes** | **Both recommended for normative work.** |
| **Intel** | **Yes** |  |
| **OPPO** | **Yes** |  |
| **Lenovo** | **Yes but** | **We are concerned about the number of open issues and details which need to be clarified in the WI phase. Further issues/details include, e.g. max number of slice configurations, support of RAN sharing.** |

## 3 Conclusion

Here are the summarized proposals for this email discussion.

## 4 Reference

Session Chairman notes:

1. RAN2-112e LTE DCCA Mobility RAN slicing and Multi-SIM (Tero)\_2020-11-13-eom UTC
2. RAN2-113e LTE DCCA Mobility RAN slicing and Multi-SIM (Tero)\_2021\_01\_26\_1900

Contributions for slice based RACH configuration

1. R2-2100129 Discussion on candidate solutions of slice-based RACH Qualcomm Incorporated
2. R2-2100363 Consideration of slice based RACH Intel Corporation
3. R2-2100424 Considerations on the solutions of slice based RACH configuration Beijing Xiaomi Software Tech
4. R2-2100599 RACH prioritisation for slices Nokia, Nokia Shanghai Bell
5. R2-2100662 Consideration on slice based RACH configuration Spreadtrum Communications
6. R2-2100705 Remaining issues on RACH configuration vivo
7. R2-2100878 Discussion on slice based RACH and cell barring Apple
8. R2-2100895 Consideration on slice-specific RACH OPPO
9. R2-2100929 Consideration on slice-specific separate RACH resources pool Samsung Electronics
10. R2-2101062 Considerations on solutions for slice-specific RACH configuration Lenovo, Motorola Mobility
11. R2-2101195 Consideration on the slice specific RACH configuration ZTE corporation, Sanechips
12. R2-2101405 RSRP Thresholds for RACH separation and prioritisation for numerous slice configurations NEC Telecom MODUS Ltd.
13. R2-2101701 Slice based RACH configuration Huawei, HiSilicon
14. R2-2101805 Solutions analysis and draft TP for slice-based RACH configuration CMCC

## 5 Contact

Since upload announcement is not mandatory required, indicating contact person is helpful in case companies would like to offline. The same list as last email discussion is copied here, please correct the list if contact person is changed.

|  |  |  |
| --- | --- | --- |
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