3GPP TSG-RAN WG2 Meeting #117-e R2-22xxxxx

Electronic Meeting, 21 February – 3 March, 2022

**Agenda item: 8.8.3**

**Source: OPPO**

**Title: Report of [AT117-e][242][Slicing] Slice-specific RACH prioritization (OPPO)**

**WID/SID: FS\_NR\_slice**

**Document for: Discussion and Decision**

# Introduction

This document is for the following email discussion:

* [AT117-e][242][Slicing] Slice-specific RACH prioritization (OPPO)

 Scope: Discuss RAN slicing-specific RACH prioritization aspects from selected contributions indicated in the minutes.

 Intended outcome: Discussion report in [R2-2203636](file:///C%3A%5CUsers%5Cterhentt%5CDocuments%5CTdocs%5CRAN2%5CRAN2_117-e%5CR2-220xxxx.zip).

 Deadline: Deadline 2

**Contact List**

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| --- | --- | --- |
| Company | Name | Email |
| Qualcomm | Peng Cheng | chengp@qti.qualcomm.com |
| Huawei, HiSilicon | Jun Chen | jun.chen@huawei.com |
| LGE | Hanseul Hong | hanseul.hong@lge.com |
| Xiaomi | Xiaofei Liu | liuxiaofei@xiaomi.com |
| Intel Corporation | Seau Sian Lim | Seau.s.lim@intel.com |
| Spreadtrum | Xiaoyu Chen | xiaoyu.chen@unisoc.com |
| Apple | Yuqin Chen | yuqin\_chen@apple.com |
| OPPO | Zhe Fu | fuzhe@OPPO.com |

# Discussion

The discussions and questions are set up based on the selected contributions indicated in the minutes.

## Support for RA prioritization and RA partitioning via dedicated signalling

In RAN2#113bis-e, RAN2 has achieved the following agreements and leaves one open issue, i.e. whether the RACH prioritization parameters can be configured in dedicated RRC signalling.

* scalingFactorBI and powerRampingStepHighPriority can be configured at least in SIB (FFS for dedicated RRC signalling).
* RAN2 will prioritize the discussion for slice specific RACH for IDLE and INACTIVE mode. And CONNECTED mode is down prioritized and can be considered if time allows.
* Slice specific RACH (including RACH isolation and RACH prioritization) is only applied for CBRA but not for CFRA.

Another similar issue is whether to support dedicated RACH resources in the dedicated signalling. In [1], the above issues are categorized as OI 1.5, i.e. whether to support dedicated RACH resources and RACH prioritization parameters in the dedicated signalling. Several companies provide their views to this meeting and the majorities propose not to indicate the slice-based RACH configuration in the dedicated RRC signalling, considering 1) the current SIB has agreed to include slice-specific RACH configuration, 2) the CONNECTED mode is down prioritized. Proposal 1 of [6] is an example.

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| **R2-2202618** | CMCC | Proposal 1: For OI 1.5, R17 will not support dedicated slice based RACH resources and RACH prioritization parameters in RRC signalling for CONNECTED mode. |

Thus, the rapporteur would like to propose the following and check the companies' view.

**Q1) Do companies agree not to support the dedicated RACH resources and RACH prioritization parameters in the dedicated signalling?**

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| **Company** | **Yes/No** | **Comment** |
| Qualcomm | Yes | We agree with Rapporteur. |
| Huawei, HiSilicon | Yes |  |
| LGE | Yes |  |
| Xiaomi | Yes |  |
| Intel | Yes |  |
| Spreadtrum | Yes | We can accept, if it’s the majority view. |
| Apple | Can accept to go with majority view | Though we think the RRC reestablishment procedure is a good use case to also benefit from slice based RACH design, we can accept to go with majority view for the sake of progress. |
| OPPO | Yes |  |

## Confirming SI assumptions on RA prioritization and RA partitioning

One remaining issue in the Running MAC CR for Slicing is whether RA prioritization and RA partitioning will work independently, which is also categorized as OI 2.1 in [1]. In [2, 3, 4, 7, 8, 9], several companies provide their views. For example, [2] confirms that RA prioritization and RA partitioning work independently. They indicate that RAN2 has already agreed with this working assumption in the SI phase and understand that the common RACH session didn’t specify any restriction on the simultaneous configuration of two or more than two RACH features. While, [3, 8, 9] provide the opposite views.

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| **R2-2202188** | Qualcomm Incorporated | Proposal 2: RA prioritization and RA partitioning work independently. |

**Q2) Do companies agree that RA prioritization and RA partitioning work independently?**

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| **Company** | **Yes/No** | **Comment** |
| Qualcomm | Yes | Proponent.1. In SI phase, it was agreed that they work independently in a complementary way and it was captured in TR 38.832. We think RAN2 should stick to SI conclusionSlice based RACH configuration can be applied to idle and inactive UE. Solution 1 and Solution 2 can work independently in a complementary way. Neither solution 1 nor solution 2 may not be applicable to all possible slices.2. From technique perspective, RA prioritization and RA partitioning are different and independent to each other. For example, it should be common understanding that RA prioritization can be configured in whole RA resource (i.e., no RA resource partitioning) |
| Huawei, HiSilicon | Can be Yes | In our paper, we think that it may be good to discuss them together, and the reason is that other features may also introduce RA prioritization so that common RACH session may be a good place for such discussions. However, if majority of companies say Yes to Q2, we can be ok. |
| LGE | No | We support to configure the RA prioritization and RA partitioning simultaneously with following reasons:1. In common RACH session, it is agreed that RACH parameters are configured per RACH partition rather than per feature within the partition. For slicing, it is a baseline to configure the slice-specific RA prioritization parameter per feature combination (i.e., per RACH partition). Therefore, we prefer to align with the common RACH discussion for the unified RA framework of feature/feature combinations.
2. Since there are the multiple cases of feature combinations, the RA procedure for slicing should be defined as simple as possible, rather than allowing slice-specific operation.
3. Considering that there are multiple RACH configurations for feature combinations, independent configuration of RA prioritization would cause significant signalling overhead in SIB1, which should be avoided.
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| Xiaomi  | Yes | According to current RACH partition selection rule decided by common session, even though there is a slice specific RACH partition configured, it may not be selected. In this case, if the slice specific RA prioritization parameters are configured only in slice specific RACH partition, it will also lead the specific RA prioritization parameters not applied. In addition, if slicing UE can get access based on any dedicate RACH partitions, there seems not much benefits to configure the prioritization still. Thus, compared with including that parameters in all RACH partitions, only configuring that for legacy RACH resource (i.e. RACH resource that are feature combination agnostic) seems better and reasonable. |
| Intel | See comments | It depends on how the signalling structure works. If it follows the legacy structure, the ra-prioritisation will be part of the RACH partition. If it needs to be independent, then the ra-prioritisation has to be pulled out from the RACH partition. |
| Spreadtrum | No, but no strong views | The common RACH part has agreed the followings:

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| 6 RACH parameters (e.g. power ramping step, max RACH transmissions etc) are **configured per RACH partition** rather than per feature within the partition. 7 RA-type selection can happen like today based on the RACH parameters **signalled in the selected RACH partition** |

In our understanding, common RACH has agreed that RACH prioritization and RACH partition are configured together and work simultaneously. Although RAN2 agreed that RACH prioritization and RACH resources can be configured independently in SI phase, but more factors should be considered in WI phase, such as the alignment with other topics or signalling overhead (extra signalling to configure RACH prioritization for the slices that are not configured with specific RACH resources.)We prefer to follow the common RACH agreements. However, we have no strong views. If the majority view is to support independent configuration for slice, we can also accept it.  |
| Apple | Tend to Yes | If the ASN.1 is not too complex because of supporting independent configuration, we don’t see problem with doing it. |
| OPPO | Yes | We understand that the logic should be: slicing session decides whether RA prioritization and RA partitioning work independently, then the common session considers the impact, e.g. whether to put ra-prioritisation will be part of the RACH partition.In our understanding, there is no restriction on the simultaneous configuration, and we prefer to confirm the WA in the SI phase.  |

## RRC re-establishment and RACH prioritization

As agreed, the slice-based RACH in connected mode is down prioritized. While, [5] would like RAN2 to consider a special case in slice-based RACH design, i.e. the RRC re-establishment procedure triggered RACH. They indicate that the RRC re-establishment procedure is very time-critical to recover the RRC connection while at that time point UE can only use the RACH resource configured in SIB.

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| **R2-2202515** | Apple | Proposal 3: RAN2 to discuss if RRC re-establishment triggered RACH should be considered in slice based RACH design. |

**Q3) Do companies agree that the RRC re-establishment triggered RACH should be considered in slice-based RACH design?**

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| **Company** | **Yes/No** | **Comment** |
| Qualcomm | Deprioritize | We agree there is some benefit to allow it. However, as rapporteur mentioned, RACH in CONNECTED was agreed to be de-prioritized and we still have a lot of remaining issues in this meeting. Thus, we prefer to still de-prioritize this topic.  |
| Huawei, HiSilicon | Deprioritize | Agree with Rapporteur. |
| LGE | Deprioritize | Considering the Rel-17 timeline, we prefer not to support the slice-specific RACH in connected mode. The discussion on slice-specific RACH in RRC\_IDLE and RRC\_INACTIVE should be completed first. |
| Xiaomi | Deprioritize |  |
| Intel | Deprioritise | We also agree that there is some benefit with the proposal. But we prefer to not change the previous agreement not to consider RACH in connected mode. |
| Spreadtrum | Deprioritize | Prefer to focus on the identified open issues firstly. The RACH in connected should be deprioritized. |
| Apple | Can accept to go with majority view | For the sake of making progress, we can accept to go with majority view. |
| OPPO | Deprioritize |  |

## Preamble Group selection

In legacy, if the UE performs the contention-based RA and if the preamble group has been selected during the RA procedure, the UE shall select the same preamble group for each RACH attempt, no matter this RA attempt is for RA fallback or not. If the preamble group was not selected during the RA procedure, the UE shall select the preamble group based on e.g. potential Msg3 size, RA resource configuration, etc. For simplicity, [4] proposes to reuse this existing rule in preamble group selection for slice-based RACH procedure.

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| **R2-2202440** | OPPO | Proposal 3 In slice-specific RACH, RAN2 considers to reuse the same rule as the legacy in preamble group selection, i.e. if the preamble group has been selected during the RA procedure, the UE shall select the same preamble group for each RACH attempt. |

**Q4-1) Do companies agree to reuse the same rule as the legacy in preamble group selection for slice-based RACH, i.e. if the preamble group has been selected during the RA procedure, the UE shall select the same preamble group for each RACH attempt?**

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| **Company** | **Yes/No** | **Comment** |
| Qualcomm  | Yes, but prefer to handle it in common session | We think it seems to be straight forward. However, since it is the same issue caused by fallback for all RACH features, we prefer to handle it in common RACH session.  |
| Huawei, HiSilicon | Yes, but to be discussed in common session |  |
| LGE | Yes | It is same as the legacy RA procedure. |
| Xiaomi | Yes | Legacy RA procedure can be reused and we are fine to discuss it in common session. |
| Intel | Yes | We think it can be decided here  |
| Spreadtrum | Yes | Legacy procedure can be further discussed in common RACH part. |
| Apple | Yes |  |
| OPPO | Yes | No matter the RA attempt is for RA fallback or not, we understand that the UE selects the same preamble group for each RACH attempt. It is aligned with the legacy RA procedure. |

Assuming Q4-1 is agreed (depending on the company inputs), a follow-up question is to confirm the configuration restriction of RA preamble group B in the case of slice-based RA fallback enabled. In detail,

* In the case that 2-step and 4-step slice-specific RA resources are configured for a specific slice and RA preambles group B is configured for 2-step slice-specific RA, preambles group B should be configured for 4-step slice-specific RA.
* In the case that 4-step slice-specific RA resource is not configured for a specific slice and RA preambles group B is configured for 2-step slice-specific RA, preambles group B should be configured for 4-step common RA.

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| **R2-2202440** | OPPO | Proposal 4 In the case that slice-specific RA fallback is enabled and 2-step slice-specific RA is configured with preambles group B, RA preambles group B should be configured for 4-step slice-specific RA or 4-step common RA. |

[4] understands that the proposed solution is to follow the working assumption in the legacy 2-step RA switch.

**Q4-2) If Q4-1 is supported, do companies agree that RA preambles group B should be configured for 4-step slice-specific RA or 4-step common RA in the case that slice-specific RA fallback is enabled and 2-step slice-specific RA is configured with preambles group B?**

* **Option1: Yes, without any spec impact**
* **Option2: Yes, with any spec impact**
* **Option3: No (Please elaborate in comments).**

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| **Company** | **Option** | **Comment** |
| Qualcomm | No strong view | If we understand correctly, it is proposed to address issue on rebuilding of msg3. From UE perspective, msg3 rebuilding is not an issue when it switches/fallbacks to a different RACH feature. So, we keep neutral. |
| Huawei, HiSilicon | FFS | We think that common RACH session will also have some discussions on fallback, so it may be good to firstly wait for their progress and then we can further check the above options. |
| LGE | See comments | Option 1 for the fallback case from 2-step slice-specific RA to 4-step slice-specific RA, which is same as the legacy procedure. Option 3 for the fallback case from 2-step slice-specific RA to 4-step common RA, since this fallback case should be discussed in the common RACH session. |
| Xiaomi | Option 1 | The same issue existed when 2-step RA was introduced in R16, and this is guaranteed by MAC procedure and there is no restriction on NW configuration in spec, thus we think it can also be resolved in the same way(i.e. without any spec impact). And if the Q4-1 is discussed in common session, this can be confirmed as well. |
| Intel | Option 1 or should be handled by common session | Since it discusses on the fallback from 2-step to 4-step RACH. If Option 1 is not agreed, we would prefer it to be decided in common session. |
| Spreadtrum | See comments | The above fallback case is common to other R17 features. It should be discussed in common RACH session.  |
| Apple | Option 1 | Agree with xiaomi. |
| OPPO | Option 1 | The intention is to assure that a proper MSG3 grant is selected and to avoid the MAC PDU rebuilding issue. In our understanding, the principle is the same as the legacy working assumption for the 2-step RA switch, which seems most straightforward to follow and can keep the spec simple. |

## Slice-specific RACH parameters for RA fallback

In legacy, *msgA-TransMax* is a switch enabler for 2-step RA and 4-step RA, i.e. if *msgA-TransMax* is absent, switching from 2-step RA type to 4-step RA type is not allowed.

 ***msgA-TransMax***

Max number of MsgA preamble transmissions performed before switching to 4-step random access (see TS 38.321 [3], clauses 5.1.1). This field is only applicable when 2-step and 4-step RA type are configured and switching to 4-step type RA is supported. If the field is absent, switching from 2-step RA type to 4-step RA type is not allowed.

Considering many kinds of RA fallback are introduced beyond the legacy RA fallback in Rel-17, [4] proposes to introduce a new parameter for the slice-specific RA fallback in order to 1) assure the network can enable/disable different kinds of RA fallback respectively, 2) reflect the feature-specific characteristics, 3) provide configuration flexibility.

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| **R2-2202440** | OPPO | Proposal 5 For the slice-specific RA fallback, RAN2 considers to introduce the slice-specific max number of MsgA preamble transmissions. |

**Q5) Do companies agree to introduce the slice-specific max number of MsgA preamble transmissions for the slice-based RA fallback?**

* **Option1: Yes**
* **Option2: No**
* **Option3: To discuss in the common session**

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| **Company** | **Option** | **Comment** |
| Qualcomm | Not Option 1 | We are not convinced how it can bring benefit. Even if majority agree it, we think it is necessary to check with common session, because the same intention can be applied to all RACH features in Rel-17.  |
| Huawei, HiSilicon | Not option 1 | Share similar views as Qualcomm. |
| LGE | Option 2 | We do not see clear benefit, but we can follow option 1 if majority supports. |
| Xiaomi | Not option 1 | Share similar views as Qualcomm. |
| Intel | Option 2 | It should be discussed in slicing whether there is any benefit. And we are also not convinced it needs to be slice specific. Anyway, such parameter is already RACH partition specific (i.e. feature combination specific) |
| Spreadtrum | Not option 1 | Share similar views as Qualcomm.  |
| Apple | Option 2 | We also don’t see the real need to introduce a slice specific configuration on this. |
| OPPO | Can accept to go with majority view | We understand that different slices with different requirements may use different max numbers of MsgA preamble transmissions. But, we are fine to follow the majority. |

## The linkage between slice group and RACH configuration

In the previous RAN2 meetings, it is agreed,

* *Slice specific RACH is only applicable if there is slice information (e.g., slice group or slice related operator-defined access category) available for AS layer when access. FFS on details of slice group.*
* *A new slice grouping mechanism is introduced for RACH configuration. One slice belongs to one and only one slice group. Slice groups are assumed to be only updated when UE does Registration Update.*
* *In a cell, there may be multiple slice-specific RACH configurations.*
* *One or more of the slice groups are linked to a slice-specific RACH configuration.*
* *There may be slice groups that are not linked to a slice-specific RACH configuration (they use the common RACH configuration).*
* *All slices of a slice group use the slice-specific RACH configuration of the slice group.*

[4] would like to further confirm whether one slice group links to only one slice-specific RACH configuration.

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| **R2-2202440** | OPPO | Proposal 6 In slice-specific RACH, one slice group links to only one slice-specific RACH configuration. |

**Q6) Do companies agree that one slice group links to *only one* slice-specific RACH configuration in slice-based RACH?**

* **Option1: Yes**
* **Option2: No**
* **Option3: To discuss in the common session**

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| **Company** | **Option** | **Comment** |
| Qualcomm | Option 1 | We understand the only controversial part is on slice specific cell reselection. For slice RACH, we see no reason that one slice group can be linked to more than 1 RA resource. |
| Huawei, HiSilicon | Option 1 |  |
| LGE | Option 1 |  |
| Xiaomi | Option 1 |  |
| Intel | Option 1 | In one BWP |
| Spreadtrum | Option 1 |  |
| Apple | Option 1 |  |
| OPPO | Option 1 | Yes, in one BWP. |

## The cross-layer impacts of slice-based RACH

[8] describes a cross-layer interaction for slice-based RA procedure. They understand that the UE AS should be aware of the selected slice group ID (s). And, the selected slice group known by the UE AS can be received from the UE NAS directly or derived based on the information provided by the UE NAS indirectly.

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| **R2-2203019** | Huawei, HiSilicon | Proposal 2: It is proposed that the UE AS should be aware of the selected slice group ID (s), no matter received from the UE NAS directly or deriving based on the information provided by the UE NAS indirectly. |

The rapporteur would like to check the companies’ views on whether/how the UE AS is aware of the slice group.

**Q7) Which option do your company prefer for slice-based RACH?**

* **Option1: The UE AS should be aware of the selected slice group ID (s), no matter received from the UE NAS directly or derived based on the information provided by the UE NAS indirectly.**
* **Option2: The UE AS should be aware of the selected slice group ID (s), which is received from the UE NAS directly.**
* **Option3: The UE AS should be aware of the selected slice group ID (s), which is derived based on the information provided by the UE NAS indirectly.**
* **Option4: Others(Please elaborate in comments).**

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| **Company** | **Option** | **Comment** |
| Qualcomm | Option 1 |  |
| Huawei, HiSilicon | Option 1 |  |
| LGE | Option 1 |  |
| Xiaomi | Option 1 |  |
| Intel | Option 1 | For idle mode, the UE AS receives the slice group from the UE NAS directly, while for inactive mode, UE AS derives based on the information provided by the UE NAS indirectly  |
| Spreadtrum | Option 1 |  |
| Apple | Option 1 |  |
| OPPO | Option 2 | We understand that the UE AS can obtain the slice group directly from the UE NAS. But, we can accept Option 1 if it is the majority view. One additional question is whether/how to reflect it in the spec. |

## Slice setting in RACH prioritization

Given that RA prioritization parameters settings would aim at the association of selected slices with some priority, [11] arises an issue on how to adopt priorities in RA-prioritization and provides the following solutions.

* Option1: Left to the network implementation
* Option2: RA-prioritization parameters are set in the appropriate order reflecting the priority, i.e., *scalingFactorBI*, *powerRampingStepHighPriority* values are set in the appropriate order reflecting the priority.

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| **R2-2203401** | Nokia, Nokia Shanghai Bell | Proposal 2: RAN2 to discuss whether RA-prioritization parameters (scalingFactorBI and powerRampingStepHighPriority) are signalled according to a slice group priority. |

The rapporteur would like to check the companies’ views on the setting order for RA-prioritization parameters.

**Q8) Which option do your company prefer to signal slice-based RA-prioritization parameters?**

* **Option1: Left to the network implementation.**
* **Option2: RA-prioritization parameters are set in the appropriate order reflecting the slice group priority.**
* **Option3: Others(Please elaborate in comments).**

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| **Company** | **Option** | **Comment** |
| Qualcomm | Option 1 | In our understanding, this proposal seems to restrict NW configuration, which is not aligned with 3GPP principle.  |
| Huawei, HiSilicon | Option 1 | No need to restrict NW configuration. |
| LGE | Option 1 | In our view, the order of RA-prioritization parameters does not depends on the slice group priority, so we prefer to leave as the network implementation. |
| Xiaomi | Option 1 |  |
| Intel | Option 1 | Not sure what is the motivation for Option 2 |
| Spreadtrum | Option 1 |  |
| Apple | Option 1 |  |
| OPPO  | Option 1 |  |

Furthermore, for the issue with System Information capacity and size, [11] proposes to restrict the maximum number of slice-based RA prioritization configurations to 3. No matter which option in Q8 is selected, the rapporteur would like to check the companies’ views on the maximum number of RA-prioritization configurations.

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| **R2-2203401** | Nokia, Nokia Shanghai Bell | Proposal 3: RA-prioritization supports at most 3 different configurations (i.e. maxSliceInfo-r17= 3)). |

**Q9) Do companies agree to support at most 3 different RA-prioritization configurations (i.e. maxSliceInfo-r17= 3)?**

* **Option1: Yes**
* **Option2: No**
* **Option3: To be decided later.**

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| **Company** | **Option** | **Comment** |
| Qualcomm | Option 3 | It can be left to ASN.1 review. |
| Huawei, HiSilicon | Option 3 | It can be put to running 38.331 CR discussion. |
| LGE | No strong view |  |
| Xiaomi | Option 3 |  |
| Intel | Option 3 | Agreed with the other that this can be decided later after Q2 is decided. If the signalling for ra-prioritisation is independent to RACH partitioning, then it makes sense to limit the number of different ra-prioritisation. |
| Spreadtrum | Option 3 |  |
| Apple | Option 3 |  |
| OPPO  | Option 3 |  |

## The override indication for RAN slicing and MCS/MPS

In [12], it was discussed whether the override indication can be put under the IE *BWP-UplinkCommon*. Based on the companies’ inputs, the following proposal was made.

***Proposal 2: The indication (i.e. whether slice override MCS, MPS or MPS override slice is common for all slice groups) is put under the IE BWP-UplinkCommon.***

As instructed in the chairman's notes, the above proposal can be discussed as part of [AT117-e][242]. Thus, the rapporteur would like to add one question to check the companies’ views.

**Q10) Do companies agree that the indication (i.e. whether slice override MCS, MPS or MPS override slice is common for all slice groups) is put under the IE *BWP-UplinkCommon*?**

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| **Company** | **Yes/No** | **Comment** |
| Spreadtrum | Yes |  |
| Qualcomm | Yes |  |
| Apple | Yes |  |
| OPPO | Yes |  |
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# Summary

[TBD]

# References

1. R2-2202616 List of open issues for RAN slicing WI, CMCC
2. R2-2202188 Remaining issues on slice specific RACH, Qualcomm Incorporated
3. R2-2202418 Consideration on remaining issues for slice specific RACH, Spreadtrum Communications
4. R2-2202440 Remaining issues on slice-specific RACH, OPPO
5. R2-2202515 Discussion on RACH in slicing, Apple
6. R2-2202618 Discussion on open issues for slice based RACH configuration, CMCC
7. R2-2202691 The remaining issues on slice specific random access, CATT
8. R2-2203019 Discussion on slice based RACH configuration, Huawei, HiSilicon
9. R2-2203064 Remaining issues on slice based RACH, LG Electronics Inc.
10. R2-2203388 Further consideration on slice specific RACH , ZTE corporation, Sanechips
11. R2-2203401 Detailed RRC signalling for RACH prioritization configuration, Nokia, Nokia Shanghai Bell
12. R2-2203021 Report of [Post116-e][243][Slicing] Running NR RRC CR for RAN slicing (Huawei), Huawei