3GPP TSG RAN WG2 Meeting #123 R2-230xxxx

Toulouse, France, 21th– 25th August, 2023

Agenda Item: 8.x.x

Source: ZTE Corporation (Rapporteur)

Title: Summary of [Post122][802][R18CEenh-UP] UP open issues (ZTE)

Document for: Discussion and Decision

# Introduction

This is the summary of post email discussion:

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| [Post122][802][R18CEenh-UP] UP open issues (ZTE) Scope: If we should enable any fallback(s) and if so how to do this. Can identify impacts to both MAC procedure but also any implications on the signalling. Any other UP open issues for RACH procedure.  Intended outcome: Agreeable proposals  Deadline: Long, until next meeting (August 10 1000 UTC) |

In this document, we focus on the remaining user plan open issues for Msg1 repetition. The outcome of this discussion will be captured into MAC running CR after the proposals are agreed in RAN2#123.

Please companies provide your inputs before 4th Aug

Rapporteur will provide summary with proposals before 10th Aug.

# Contact information

Companies providing input to this email discussion are invited to leave contact information below.

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| --- | --- | --- |
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# Discussion

## Support of RACH fallback

In previous RAN2 meetings, companies discussed the support of RA fallback cases for Msg1-based repetitions and made below agreements:

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| RAN2#121bis-e Agreements:RAN2 will not support the fallback from legacy RA to Msg1 repetition and vice versa; Other fall back scenarios are FFSRAN2#122 AgreementsRAN2 to further discuss fallback from lower number of MSG1 repetition to higher number which is also FFS for now. We need to understand how to signal this and how this impacts MAC procedure. |

In short, for below fallback cases, RAN2 already concluded that Case1 is not supported in Rel-18, Case 2 can be prioritized because several companies showed interests in last RAN2 meeting.

* Case 1: Fallback from legacy 4-step RA to 4-step RA with Msg1 repetition; ----Not supported
* Case 2: Fallback from Msg1 repetition with lower number to Msg1 repetition with higher number; ----FFS, Supported by multiple companies
* Case 3: Fallback from 2-step RA to 4-step RA with Msg1 repetition; ----FFS, low priority (not much support)
* Case 4: Fallback from CFRA to CBRA with Msg1 repetition. ----FFS, low priority (not much support)

In this document, we will first further discuss the Case 2 and possible solutions if supported for this. For case 3 and case 4, we will discuss if there is support.

### Background

Before discussing RACH fallback for Msg1 repetitions, in this section, the existing RACH procedure specified in TS 38.321 is provided, so it is easy to understand the potential RRC or MAC impact if any RACH fallback scenario is supported.

By introducing RACH partitioning, the Rel-17 general RACH procedure is shown in below figure:



Figure 1 Rel-17 Random Access procedure

Highlights:

RACH partition (RACH resource set) is selected based on applicable features for this RACH procedure (e.g. RedCap, SDT, slice, Msg3 repetition, etc);

Once a RACH partition is selected, the RACH resources of this RACH partition can be used for this RACH procedure until RACH failure, the UE won’t select other RACH partition during the RACH procedure;

RACH resources of different RACH partitions can be configured with sharedROs or separateROs;

More than one RACH partitions associated with the same feature combinations per RA-type is not supported.

### Fallback options overview

So, there are two main options i.e. whether to support fallback or not. Then if we support fallback, then we need to discuss how to do this. So, the rapporteur would like to first discuss the following main options:

**Option 1: No fallback**

* In this option, there is no fallback between different Msg1 repetition numbers and this means each Msg1 repetition number can be treated as a separate feature
* This is aligned with the current agreements in RAN2

**Option 2: Allow fallback**

In this option, there may be 3 sub-options as below

***Option 2.1:*** *Each repetition number is treated as a separate RACH type*

* In this case Msg1 repetition is NOT considered as a feature;
* In this option, the fallback back can be supported within the RACH partition and the different Msg1 repetitions are treated as different RACH types (i.e. similar to 2-step and 4-step RACH today, where we allow fallback from 2-step to 4-step RACH);
* Requires big RRC spec change, e.g. to introduce multiple preamble index ranges (and/or RO mask indexes) within FeatureCombinationPreambles-r17, each one associated with a specific repetition number

***Option 2.2:*** *All repetitions are treated as a single feature, but within the feature, different repetition numbers are treated as different RACH type*

* In this case Msg1 repetition is considered as a feature;
* But, RACH resources for all repetitions are considered as RACH type within the same feature;
* In this option, the fallback can be supported within the RACH partition and the different Msg1 repetitions are treated as different RACH types within the same feature (i.e. similar to 2-step and 4-step RACH today, where we allow fallback from 2-step to 4-step RACH);
* Requires big RRC spec change, e.g. to introduce msg1-Repetition-r18 in FeatureCombination-r17, and to introduce multiple preamble index ranges (and/or RO mask indexes) within FeatureCombinationPreambles-r17, each one associated with a specific repetition number;

***Option 2.3:*** *Each repetition number is treated as a separate feature and we define fallback between features*

* In this case each Msg1 repetition number is considered as a separate feature;
* In this option we need to define fallback between different RACH partitions. This is currently not supported in MAC
* Less RRC spec change, but requires huge MAC spec impact, e.g. to allow switching between RACH partitions;

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| **Option 1** | **Option 2.1** |
| **Option 2.2** | **Option 2.3** |

Figure 2 Illustration of the 4 options

For above options, the supported RACH fallback cases are summarized in below table.

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|  | Supported RACH fallback cases |
| from lower repetition number to higher repetition number | from 2-step RACH to 4-step RACH with Msg1 repetition  | from CFRA to 4-step CBRA with Msg1 repetition |
| Option 2.1 | Support | Support | This is different from other fallback cases, see details in 3.1.3 |
| Option 2.2 | Support | Not support[Rapp’s note] Because this partition only has 4-step RACH resources and switching between partitions is not supported in this option. |
| Option 2.3 | Support | Can support but with complexity[Rapp’s note] This means switching from 2-step in another partition to a partition associated with Msg1 repetition. Currently, UE will fallback to 4-step that within the same partition, so allowing switching directly to different partition needs additional specification efforts. |

**Open issues for each option:**

For option1 there are no real open issues, basically, the existing framework in RRC and MAC can simply be reused.

For option 2.1, there is no open issue and we can follow the same framework as switching between 2-step RACH and 4-step RACH.

For option 2.2, the following option issues need to be addressed:

When triggering RACH fallback, which parameters need to be initialized?

For the same feature combination (RedCap+Msg1 repetition), whether the network can configure more than one RACH partitions associated with different repetition numbers. For example, for below RACH configuration, whether RACH partition 2 can also be configured? If allowed, how to select between RACH partition1 and RACH partition 2?

Partition 1: RedCap + Msg1 repetition (number\_2 + number\_4 + number\_8);

Partition 2: RedCap + Msg1 repetition (number\_4);

For option 2.3, the following option issues need to be addressed:

When triggering RACH fallback, which parameters need to be initialized?

Whether fallback is only allowed between two RACH partitions that configured with the same feature combination except Msg1 repetition? For example, for below RACH Configuration, whether only fallback from Partition 1 to Partition 2 is allowed?

Partition 1: RedCap + Msg1 repetition number\_2;

Partition 2: RedCap + Msg1 repetition number\_4;

Partition 3: RedCap + Slice 1+ Msg1 repetition number\_4;

(Note, if fallback from Partition 1 to Partition 3 is supported, it means the UE needs to evaluate all applicable features upon each Msg1 retransmission)

If switching between partitions is supported, how to restrict other fallback cases which are considered as “not supported”? e.g. fallback from legacy RA to RACH with Msg3 repetition, fallback from Msg1 repetition with higher number to lower number; fallback from legacy 4-step RA to 4-step RA with Msg1 repetition.

**Q1. Do companies agree with the above options and do you have any other options in mind?**

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| --- | --- | --- |
| Company | Agree/Disagree | Comments |
| Huawei, HiSilicon | See comments | We understand that the fallback should comply with the existing RA partitioning framework where the UE first select the feature(s). So we fail to see how Option 2.1 where Msg1 rep is not considered as a feature can fit in the current RA partition framework. It seems also contradictory with the previous RAN2 agreements to support various feature combination as follows: **Agreements**General assumption is that various feature combinations can be configured (which is up to network implementation), unless explicitly specified otherwise  |
| ZTE | Agree | Regarding the comment from Huawei, we would like to point out that both Option 2.1 and Option 2.2 conflict with the previous RAN2 agreements: **RAN2#121bis-e Agreements:*** Msg1 repetition with different repetition number {2, 4, 8} are treated a separate feature, and a RACH partition is associated with a specific repetition number (Stage 3 details are FFS, e.g. we should not use all the spare values in the current IE)

Only Option 1 and Option 2.2 can well fit the previous RAN2 agreements. But if RAN2 confirms to support fallback cases, we understand the previous agreements can be reverted as long as the specification efforts for supporting fallback can be minimized. Huawei: indeed option 2.2 needs to revert the Ran2#121bis agreement but this solution can still fill well in RA partitioning framework. Option 2.1 is an exceptional case for MSG1 repetition only and not future-proved if more new features are introduced in the future. We think option 2.2 is a compromised solution in case that fallback is supported.  |
| vivo | Comments | Firstly, we are confused about the intention of Q1. Does it mean that companies agree with these solutions (thus RAN2 will specify them)? Or does it mean that companies agree with the analysis above?Anyway, we generally agree with the motivation and intention of the above nice analysis from the rapporteur. But for some technical details, we have different views. For example, regarding Option 2.1, we don’t think this should be an option as it reverts the previous agreement. For another example, for option 2.2, no matter whether supporting fallback or not, we have to introduce the Msg1-repetition feature in *FeatureCombination-r17* and configure multiple RA partitions for different repetition numbers. We fail to figure out why this makes a huge RRC spec change (i.e. we think the configuration for multiple repetition numbers is basically independent of RRC signaling structure, but slightly impacts the MAC behavior regarding fallback and parameter re-initialization).  |
| Qualcomm | Agree | Agree with HW that option 2.1 seems a little bit out of the scope companies had in mind, but we can keep all options and down select in this discussion. |
| CATT | Agree | We think all the options listed above can be studied as start point. And we may need to check whether to revert the previous RAN2 agreement based on the details for option selection, e.g, whether different repetition number is treated as different feature.  |
| Apple | Agree | This is a nice analysis and can be used as a starting point for convergence.In addition, we agree with Huawei that Option 2.1 can support the fallback between legacy RA and Msg1 repetition, which is contradict with the RAN2121bis-e agreement:*RAN2#121bis-e Agreements:**RAN2 will not support the fallback from legacy RA to Msg1 repetition and vice versa;* |
| LGE | Agree | We also agree with Huawei that option 2.1 is not aligned with the discussion in past meetings, since it defines RACH resource separation without using the RACH partitioning framework. |

**Q2. Which option do companies prefer and why?**

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| Company | Option 1/Option 2.1/2.2/2.3 | Comments |
| Huawei, HiSilicon | Option 2.2  | CBRA from lower MSG1 repetition number to high MSG1 repetition number is useful in case that UE is moved to a worse coverage or wireless channel becomes worse during RA procedure.We do not think that there is a need to support it if fallback between 4-step RA without MSG1 repetition and 4-step RA with MSG1 repetition was excluded. |
| ZTE | Option 1 | We do not think fallback from lower number to higher number is so critical, same reason for not supporting the following fallback cases:* Rel-17 fallback from legacy RACH to 4-step RA with Msg3 repetition;
* Rel-18 fallback from legacy RACH to 4-step RA with Msg1 repetition;

If most companies have strong willingness to support fallback cases, then our preference is Option 2.1, in which Msg1 repetition is considered purely as RA-type:RA types:* 2-step RA;
* 4-step RA without Msg3 repetition;
* 4-step RA with Msg1 repetition number 2;
* 4-step RA with Msg1 repetition number 4;
* 4-step RA with Msg1 repetition number 8;

UE will first select RACH partition (without considering the need of Msg1 repetition), and then select suitable RA-type (2-step, 4-step w/o rep, 4-step with rep2, 4-step with rep4, 4-step with rep8) within the partition based on DL RSRP. Any fallback is performed within the partition, similar to fallback from 2-step to 4-step.  |
| vivo | Option 2.2 or Option 2.3 | Considering that UE has to use multiple ROs across multiple associate periods to finish the preamble repetition (leading to large access latency). We think it is beneficial to allow repetition number switching during the RA procedure so that the UE could select the most appropriate repetition number in each RA attempt. Either Option 2.2 and 2.3 work.  |
| Qualcomm | 2.2 | Firstly, we agree with the intention of fallback between Msg1 repetition numbers (case 2) as a baseline. To the details on how to do that, this would be the simplest way to incorporate the fallback. It also makes sense from a capability standpoint to model repetition numbers as a single fearture like that and introduce fallbacks between them.This should allow the NW to configure the fewest number of RACH repetitions according to RSRP then rely on the RACH type fallbacks to fix RACH failures.  |
| CATT | Option 2.2 | We think fallback from lower repetition number to higher repetition number is helpful to the UEs to access the network, especially the UE which has reached its power limitation at the cell edge. And the option 2.2 is the preferred one considering the MAC specification impacts. |
| Samsung | Option 1 | Fallback from no repetition to repetition is not supported in R17 (for msg3 repetition) and in R18 (for Msg1 repetition). So we do not see any critical need to support other fallback cases.  |
| Apple | Option 1 (if not support fallback);Or Option 2.2 (if support fallback) |  |
| LGE | Option 1 as first priority,Option 2.2 as a second priority | Option 1 is clear and no issue to reuse the existing RACH partitioning framework. If the fallback operation is defined, additional work is required in order to define re-initializing the RA parameters when the fallback occurs from one repetition number to another repetition number.However, if the companies want to support the fallback operation from low repetition number to high repetition number, the only option to compromise is Option 2.2, i.e., define Msg1 repetition as a feature and configure separated RACH resource for each repetition number within the RACH partition for Msg1 repetition. For other option, the modification on RACH partition framework is expected to support the fallback procedure from one partition to another partition, which is not aligned with the Rel-17 principle and causes more complexity. |

**Q3. For your preferred option, please explain how to address the open issues mentioned above.**

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| Company | Option | Comments on how to address the open issues for this option |
| Huawei, HiSilicon | comment | We think the main issue for Option 2.2 is which parameters are configured per repetition number, and which parameters are common to repetition numbers. Only parameters configured per repetition number need to be re-initialized at fallback. So we should first figure out which parameters are per repetition number, and it may need RAN1 input. From RAN2 perspective, we think that variable initialization at fallback from 2-step RA to 4-step RA can be used as a baseline.[Rapp-ZTE] Seems issue 2 was not answered? The answer to issue 2 impacts the RACH partition selection procedure, rapporteur thinks it is better to disallow such configuration, but it is better to align the understanding with Option 2.2 supporters. ; )Huawei: we doubt that issue 2 does not exist. We understand that the sensible configuration should be an RACH partition is mapped to one of 2, 4 and 8. Separate RACH partitions are configured for 2, 4 and 8 even for the same feature combination (i.e. MSG1 repetition + Redcap). |
| ZTE | Option 1 | No open issue.  |
| vivo  |  | For issues 1 of Option 2.2 or 2.3, we share a similar view with Huawei (the mentioned solution is similar to the switching from 2-step to 4-step). We can further discuss which parameter can be separately configured for different “type/feature” of repetition number. For issue 2 of Option 2.2, we fail to see why the network needs to configure partition 2. Take one step back, in this case, the UE can never select a set of RA resources as it can never only identify one single RA resource (i.e. it is not aligned with the Rel-17 RACH partitioning framework, based on section 5.1.1d in 38.321). Thus, in revert, the network should guarantee such configuration will not exist. For issue 2 of Option 2.3, we think fallback is only allowed between two RACH partitions that are configured with the same feature combination except Msg1 repetition. Regarding the spec impact, we may have a note saying that allowed fallback case. 5.1.1d Selection of the set of Random Access resources based on feature prioritizationThe MAC entity shall:1> among the available sets of Random Access resources for this Random Access procedure (as specified in clause 5.1.1c), identify those configured with a feature which has the highest priority assigned in *featurePriorities* among all the features applicable to this Random Access procedure as specified in TS 38.331 [5].1> if a single set of Random Access resources is identified:2> select this set of Random Access resources.1> else if more than one set of Random Access resources is identified:2> repeat the procedure taking as an input the identified sets of Random Access resources and the feature applicable to the current Random Access procedure with the highest priority assigned in *featurePriorities* among all the features applicable to this Random Access procedure, except the features considered already.1> else (i.e. no set of Random Access resources is identified):2> repeat the procedure taking as an input the previous identified available sets of Random Access resources and the feature applicable to the current Random Access procedure with the highest priority assigned in *featurePriorities* among all the features applicable to this Random Access procedure, except the features considered already.  |
| Qualcomm | 2.2 | Issue 1: We agree with HW & vivo, that already existing 2-step to 4-step fallback is the baseline. We can take the MAC operation of this fallback as a starting point then address any issues that may need changing for the repetition number specific case.Issue 2: We also do not see the use case of this example, why would the NW configure two partitions for the same feature combination. So we can also say that for this issue, the NW implementation can ensure that proper resource selection happens at the UE. No enhancements needed. |
| CATT | Option 2.2 | For option 2.2, the following option issues need to be addressed: When triggering RACH fallback, which parameters need to be initialized?[CATT]We think the parameters specific to repetition number need to be initialized, e.g. RACH resources. Other parameters can be studied based on the progress on RAN1 and RAN2.For the same feature combination (RedCap+Msg1 repetition), whether the network can configure more than one RACH partitions associated with different repetition numbers. For example, for below RACH configuration, whether RACH partition 2 can also be configured? If allowed, how to select between RACH partition1 and RACH partition 2?Partition 1: RedCap + Msg1 repetition (number\_2 + number\_4 + number\_8);Partition 2: RedCap + Msg1 repetition (number\_4);[CATT]We think it is strange that different repetition numbers are configured for one Partition. This brings complexity to the UE behaviour on how to select the RACH resource for the particular repetition number. |
| Samsung | Option 1 |  |
| Apple | Option 1 (if not support fallback);Or Option 2.2 (if support fallback) | For Option 2.2:Issue 1: We share Huawei’s understanding.Issue 2: Issue does not exist as network does not need to configure two partitions. |
| LGE | Comment | Option 1: no open issueOption 2.2:* For issue 1, the RA parameter specific to each repetition number would be re-initialized, when the fallback is occurred.
* For issue 2, given that only one RACH partition can be defined for each feature combination, there would be no such configuration. Instead, if the network need to configure the RA resource for Msg1 repetition (number\_2) and Msg1 repetition number 4, the RACH partition would be configured as follows
	+ Partition 1: RedCap + Msg1 repetition (number\_2, number\_4);
 |

If RACH fallback is supported, we also need to discuss the triggering conditions. For fallback from 2-step to 4-step, rapporteur thinks it makes sense to reuse the existing triggering condition: “when reaches MsgA-TransMax”, but for fallback from lower number to higher number, considering these are all 4-step RACH, so in which condition the UE can trigger fallback should be discussed. Following alternatives can be considered:

Alt 1: Based on DL RSRP evaluation upon each Msg1 retransmission;

Alt 2: UE autonomously selects higher repetition number upon Msg1 retransmission when the number of Msg1 retransmission reaches a configured value;

Alt 3: UE autonomously selects higher repetition number upon Msg1 retransmission when the UE reaches maximum transmission power;

other

**Q4. If fallback from repetition with lower number to higher number is supported, which option do companies prefer regarding the triggering condition?**

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| Company | Alt | Comments on how to address the open issues for this option |
| Huawei, HiSilicon | Alt 3 | Alt 1 may cause UE to fallback from higher number to lower number if DL RSRP becomes good. On the other hand, DL RSRP evaluation period may be longer enough than RA period and the RA problem may have been declared when new evaluated value is available.Alt 2 may increase the RA collision at RO of higher repetition number with the other UEs who initially selects higher repetition number. Keeping selecting the lower number would help for collision reduction if UE does not reach the maximum transmission power. |
| ZTE | Alt 2 | We prefer to not support any fallback cases, but if fallback from lower number to higher number is supported, then we slightly prefer Alt2 (similar to fallback from 2-step to 4-step).  |
| vivo | Alt 1 | Based on RAN1 input, RSRP should be the impacted factor of repetition number selection. |
| Qualcomm | Alt 1/2 | Alt 1 as a baseline: The fallback behaviour to be configured by the NW. We think this should be a part of DL RSRP evaluation. Simply, UE would suffer a RACH failure then compare the DL-RSRP to a fallback threshold to see if it should trigger the fallback behaviour. Open to Alt 2 as well by allowing some autonomous fallback by the UE if there is enough support by companies. |
| CATT | Alt2 and/or Alt3 | For initial feature selection, we think we can follow the legacy behaviour that the UE choose one feature, e.g. MSG1 repetition number 4. And we define the fallback procedure that when the RACH fails reaching one counter which may be preconfigured by the network, the UE falls to higher repetition number. This is similar to the UE behaviour in LTE:

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| - if PREAMBLE\_TRANSMISSION\_COUNTER\_CE = *maxNumPreambleAttemptCE* for the corresponding enhanced coverage level+ 1:- reset PREAMBLE\_TRANSMISSION\_COUNTER\_CE;- consider to be in the next enhanced coverage level, if it is supported by the Serving Cell and the UE, otherwise stay in the current enhanced coverage level; |

Or like Alt 3, allow the UE autonomously to select higher repetition number upon Msg1 retransmission when the UE reaches maximum transmission power.We think the Alt2+Alt3 can also be considered, that is, either Alt2 or Alt3 is matched, the UE can switch higher repetition number autonomously. |
| Apple | Alt 1/2 | For Alt 1, in order to address concern where UE may fallback from a higher repetition number to a lower repetition number, we can specify explicitly to avoid it.  |
| LGE | Alt 2 with comment | Alt 2 is preferred, similar to the CE procedure defined in LTE. However, when the contention resolution is failed, i.e., collision is occurred, fallback procedure from low repetition number to high repetition number is not needed, since it is not due to the channel condition. Therefore, new counter should be introduced(as PREAMBLE\_TRANSMISSION\_COUNTER\_CE defined in LTE CE), which is increased only if the RAR reception is failed (i.e., not increased when the contention resolution is failed). |

### Fallback from CFRA to 4-step CBRA with Msg1 repetition

Fallback from CFRA to 4-step CBRA with Msg1 repetition (Case 4) is different from other fallback cases because contention-free based RACH resources are configured independently, not within a RACH partition, in RAN2#122 meeting, companies discussed CFRA with Msg1 repetition and agreed that RAN2 intends to support CFRA for Msg 1 repetition for *ReconfigurationWithSync* case.

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| Agreements1. RAN2 intends to support CFRA for msg1 repetition for ReconfigurationWithSync case, FFS for other cases.
 |

Therefore, for RA fallback Case 4, there are two sub cases:

* Case 4-1: fallback from legacy CFRA to 4-step CBRA with Msg1 repetition;
* Case 4-2: fallback from CFRA with Msg1 repetition to 4-step CBRA with Msg1 repetition.

As mentioned in previous sections, no matter different repetition numbers are modelled not as a feature or as one feature or separate features, the RACH resources for Msg1 repetition must be configured via RACH partition (i.e. *FeatureCombinationPreambles-r17*). Based on current MAC spec, once CFRA resources are provided, the legacy CBRA resources will be selected as the fallback resource pool. The only exceptional case is RedCap, for which a RACH partition may be selected as the fallback resource pool if there is only one RACH partition that associated with RedCap feature only.

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| TS 38.321 5.1.1b Selection of the set of Random Access resources for the Random Access procedure…1> if contention-free Random Access Resources have not been provided for this Random Access procedure and one or more of the features including RedCap and/or Slicing and/or SDT and/or MSG3 repetition is applicable for this Random Access procedure:NOTE 2: The applicability of SDT is determined by MAC entity according to clause 5.27. The applicability of *NSAG-ID* is determined by upper layers when the Random Access procedure is initiated. The applicability of RedCap is also determined by upper layers when Random Access procedure is initiated and it is applicable to the Random Access procedures initiated by PDCCH orders and any Random Access procedure initiated by the MAC entity.2> if none of the sets of Random Access resources are available for any feature applicable to the current Random Access procedure (as specified in clause 5.1.1c):3> select the set(s) of Random Access resources that are not associated with any feature indication (as specified in clause 5.1.1c) for this Random Access procedure.2> else if there is one set of Random Access resources available which can be used for indicating all features triggering this Random Access procedure:3> select this set of Random Access resources for this Random Access procedure.2> else (i.e. there are one or more sets of Random Access resources available that are configured with indication(s) for a subset of all features triggering this Random Access procedure):3> select a set of Random Access resources from the available set(s) of Random Access resources based on the priority order indicated by upper layers as specified in clause 5.1.1d for this Random Access Procedure.1> else if contention-free Random Access Resources have been provided for this Random Access procedure and RedCap is applicable for the current Random Access procedure and there is one set of Random Access resources available that is only configured with RedCap indication:2> select this set of Random Access resources for this Random Access procedure.1> else:2> select the set of Random Access resources that are not associated with any feature indication (as specified in clause 5.1.1c) for the current Random Access procedure. |

Technically, rapporteur thinks the motivation for supporting Case 4 is unclear, because:

* In current spec, except RedCap UE, the legacy RACH resources will be selected as CBRA fallback pool. If we change this principle, it means the UE can select a RACH partition that only associated with Msg1 repetition as the CBRA fallback pool. However, RACH partition selection is performed before triggering CFRA, after CFRA fails, it is possible the selected RACH partition pool is not applicable any more due to not fulfilment of the Msg1 repetition threshold. And it is possible the UE will not select the Msg1 repetition RACH partition because the UE does not fulfil the threshold when triggering CFRA.
* RAN2 already agreed to support CFRA with Msg1 repetition for *ReconfigurationWithSync* case, and this is applicable to RRC\_CONNECTED UEs, so the network is already possible to enhance Msg1 transmission by enabling CFRA with Msg1 repetition;
* CFRA is only applicable to RRC\_CONNECTED UEs, thus fallback from CFRA to legacy 4-step CBRA is sufficient.
* If “CE only BWP” is supported for Msg1 repetition, then once CFRA fails, the UE will autonomously select the RACH resource that associated with Msg1 repetition for CBRA.

In Rel-17 CE discussion, companies discussed similar issue and concluded that fallback from CFRA to CBRA with Msg3 repetition is not supported. For Msg1 repetition, do companies .

**Q5. Do companies agree that there is no need to support fallback from CFRA to CBRA with Msg1 repetition? (If answers No, please elaborate which case (4-1, 4-2) you want to support and how to support?)**

|  |  |  |
| --- | --- | --- |
| Company | Not support /Support (Case4-1/ 4-2) | Comments |
| Huawei, HiSilicon | Support Case 4-2 | **Case 4-1**We think this is excluded based on the previous agreement.**Case 4-2**For ReconfiguationWithSync case, we cannot assume that the network always have enough CFRA resource for associating with all SSBs (e.g. 64 SSBs). In some case, network needs to provide CFRA resource for partial SSB. However UE may move out of those partial SSB after receiving ReconfigurationWithSync unfortunately, how UE can do? Fallback to CBRA with MSG1 repetition would avoid HO failure.In legacy, we already support the fallback between CFRA without MSG1 repetition and CBRA without MSG1 repetition based on SSB selected (see the clause 5.1.2). We do not see any issue to reuse the similar behaviours as in clause 5.1.2 for CFRA with MSG1 repetition. |
| ZTE | Not support | Same argument as mentioned by rapporteur above.Regarding the comments from Huawei, we have different views: For reconfigurationWithSync, usually, the CFRA resources are provided based on measurement results received from the UE, so the network is not required to associate all SSBs, even if no suitable CFRA resource can be found by the UE, the UE can fallback to legacy CBRA resource pool, based on current specification. Clause 5.1.2 describes RACH resource selection after a set of RACH resources (partition) was selected. How the partition is selected is described in clause 5.1.1b. If we intend to support Case 4-1 or Case 4-2, we must ensure the RACH partition associated with Msg1 repetition can be selected during RACH initialization. Based on current specification, only legacy RACH resources will be considered for CFRA->CBRA fallback unless the UE is RedCap. If we want to change this principle, then we need to further discuss multiple things:During RACH initialization and CFRA resources are provided, if we allow the UE to select a RACH partition associated with Msg1 repetition based on its DL RSRP. What should the UE do if the RSRP changes after CFRA fails? Can UE reselect another partition?During RACH initialization and CFRA resources are provided, whether the non-RedCap UE can only select the RACH partition when it is ONLY associated with Msg1 repetition?We need to consider the combination between RedCap and Msg1 repetition. E.g. whether the RedCap UE can select a partition associated with both RedCap and Msg1 repetition during RACH initialization? and whether the RedCap UE can reselect the partition only associated with RedCap after CFRA fails and its DL RSRP does not fulfil Msg1 repetition anymore?In short, it is not easy to modify MAC spec to support such fallback, and the benefit of supporting such fallback is unclear, in our view, fallback to legacy CBRA is enough in Rel-18.  |
| vivo | Case 4-2 | We agree with Huawei’s comments regarding the necessity of supporting fallback from CFRA repetition to CBRA repetition. Regarding the feasibility, we think the UE configured with CFRA resource for preamble repetition can first check whether Msg1 repetition is applicable or not. And secondly, determine whether the CFRA resources for preamble repetition can be used or not (similar to legacy CFRA). If not, then the UE would select the CBRA preamble for preamble repetition if applicable. Otherwise, follow the legacy behavior (i.e. legacy CFRA v.s. legacy CBRA). Meanwhile, partition fallback from different features except Msg1 repetition is not allowed.  |
| Qualcomm | Case 4-2 | If we agree on option 2.2 we think the UE can select the CBRA resource partition including repetition number and CFRA including repetition number and establish the fallback relationship between thenm (similar to legacy CFRA to legacy CBRA). We did not identify new issues specifically here between CFRA and CBRA once repetition is introduced. Case 4-1 is a little bit more complicated since it involves fallback from legacy so would need further thinking. |
| CATT | Yes | We share the same understanding that the network is aware of the channel of the UE via measurement report. Hence, it can configure one proper repetition number. Considering the spec complexity as well as the limitation we prefer not to support the fallback from CFRA to CBRA with Msg1 repetition. |
| Samsung | Case 4-2 | Fallback from CFRA to CBRA should be supported. If repetition is supported for CFRA, same repeition number is applied for CBRA. |
| Apple | Case 4-2 | Same view as QC. |
| LGE | Case 4-2 | For Case 4-1, agree with other companies that is already excluded since it requires fallback procedure from common RACH partition to RACH partition for Msg1 repetition.However, when the RA fallback is occurred from CFRA with repetition to CBRA procedure, Case 4-2 should be the baseline.If the CFRA with Msg1 repetition is supported, the RACH partition for Msg1 repetition would be selected after the BWP operation and prior to the RA type selection. Therefore, according to the current RA procedure, the selected RACH partition is remained when the fallback procedure from CFRA to CBRA, which is occurred after the RACH partition selection.As in the legacy operation, for CFRA cases (e.g., for HO cases), if the RACH partition for Msg1 repetition is selected, the corresponding RA procedure should be operated within the selected RACH partition even though fallback procedure to CBRA is performed, in order to align with the current RACH partitioning framework.Note that in relase 17, the common CBRA resource is selected for the fallback case from CFRA to CBRA procedure, since CFRA is not supported in any RACH partitioning feature. Therefore, for CFRA case, common RACH partition is selected, and the fallback procedure is performed within the same RACH partition (i.e., common RACH partition). |

## CE only BWP

In Rel-17 CE discussion, RAN2 agreed to support CE only BWP for Msg3 repetition, so for RRC\_CONNECTED UEs, the network can configure a dedicated BWP that only with RACH resources for Msg3 repetition, in this case, the UE is not required to evaluate the DL RSRP during RACH initialization.

For Rel-18 Msg1 repetition, we also need to discuss whether the network can configure a dedicated BWP in which all RACH resources are associated with Msg1 repetition. Technically, this may be useful during handover procedure, e.g. network may want the UE to directly trigger Msg1 repetition if the target cell is not so good.

However, by considering we have multiple Msg1 repetition numbers, the solution specified for Rel-17 CE may not applicable for Rel-18 CE. For discussion, rapporteur provides the following options:

* Alt 1: CE only BWP for Msg1 repetition is supported in Rel-18
	+ Alt 1.1: Network can configure a dedicated BWP in which all configured RACH resources are associated with a specific Msg1 repetition number, when RACH is triggered, the UE is not required to perform RSRP evaluation.
	+ Alt 1.2: Network can configure a dedicated BWP in which all configured RACH resources are associated with Msg1 repetition but can be configured with more than one repetition numbers, when RACH is triggered, the UE selects the applicable repetition number and corresponding RACH resource based on the DL RSRP.
* Alt 2: CE only BWP for Msg1 repetition is NOT supported in Rel-18;

**Q6. Which option do you prefer regarding the support of “CE only BWP” for Msg1 repetition?**

|  |  |  |
| --- | --- | --- |
| Company | Preferred Alternative | Comments |
| Huawei, Hisilicon | Alt 1 | In general, Alt 1 is beneficial on signalling overhead reduction for static UE or low mobility UE in bad coverage, similarly as R17. We think both alt 1.1 and alt 1.2 can be supported for different use cases and is up to network implementation to choose one of them. |
| ZTE | Alt 1.1 | CE only BWP only works in dedicated BWP which is full of network’s control. So for simplicity, we think Alt1.1 is enough.  |
| vivo | Comments | We should ask RAN1 about the necessity.  |
| Qualcomm | Alt 1 | Agree with HW. R17 already supports a CE BWP, so the same principle can be followed here. Alt 1.1 and Alt 1.2 can both be accomodated |
| CATT | Alt 1 | We think Alt 1.1 is helpful to the network to figure out the repetition number for Msg1. |
| Samsung | Alt 1 | Support both Alt 1.1 and Alt 1.2.  |
| Apple | Alt 1 |  |
| LGE | Alt 1 | We also think that both Alt 1.1 and Alt 1.2 can be supported based on the network configuration. |

## Power ramping

For Msg1 power ramping, RAN1 made the following agreement:

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| --- |
| **RAN1#112 Agreement:**For multiple PRACH transmissions with same Tx beam in one RACH attempt, transmission power ramping is not applied within one RACH attempt. |

Based on above agreement, the UE should use the same power for Msg1 repetitions within one RACH attempt, so the MAC spec can be updated accordingly, see below example:

|  |
| --- |
| 5.1.3 Random Access Preamble transmissionThe MAC entity shall, for each Random Access Preamble:1> if *PREAMBLE\_TRANSMISSION\_COUNTER* is greater than one; and1> if the notification of suspending power ramping counter has not been received from lower layers; and1> if LBT failure indication was not received from lower layers for the last Random Access Preamble transmission; and1> if the current Random Access preamble is not part of a preamble transmission with Msg1 preamble repetition and SSB or CSI-RS selected is not changed from the selection in the last Random Access Preamble transmission:2> increment *PREAMBLE\_POWER\_RAMPING\_COUNTER* by 1.1> select the value of *DELTA\_PREAMBLE* according to clause 7.3;1> set *PREAMBLE\_RECEIVED\_TARGET\_POWER* to *preambleReceivedTargetPower* + *DELTA\_PREAMBLE* + (*PREAMBLE\_POWER\_RAMPING\_COUNTER* – 1) × *PREAMBLE\_POWER\_RAMPING\_STEP* *+* *POWER\_OFFSET\_2STEP\_RA*; |

**Q7. Do companies agree with above spec change regarding the conclusion on power ramping (any wording suggestion is welcome)?**

|  |  |  |
| --- | --- | --- |
| Company | Yes or No | Comments |
| Huawei, HiSilicon | NO | We think the above modelling is complicated in MAC and prefer to simplify the modelling as it was agreed in RAN1 that MSG1 repetition always use the same preamble. The MAC entity selects the preamble for MSG1 repetition **only one time which would be sufficient.** In respect to RAN1 agreement, we think the “each Random Access Preamble” should also hold for all MSG1 repetitions in a RA attempt, therefore we understand that, the MAC entity executes the above procedure (i.e. clause 5.1.3) only once, i.e. RA resource selection will not be performed for subsequent repetitions and there is no power ramping for the following preamble repetitions at all, naturally. However the MAC entity should additionally indicate to the physical layer a RO group for the selected repetition number. We prefer the following wording.The MAC entity shall, for each Random Access Preamble:1> if PREAMBLE\_TRANSMISSION\_COUNTER is greater than one; and1> if the notification of suspending power ramping counter has not been received from lower layers; and1> if LBT failure indication was not received from lower layers for the last Random Access Preamble transmission; and1> if SSB or CSI-RS selected is not changed from the selection in the last Random Access Preamble transmission:2> increment PREAMBLE\_POWER\_RAMPING\_COUNTER by 1.1> select the value of DELTA\_PREAMBLE according to clause 7.3;1> set PREAMBLE\_RECEIVED\_TARGET\_POWER to preambleReceivedTargetPower + DELTA\_PREAMBLE + (PREAMBLE\_POWER\_RAMPING\_COUNTER – 1) × PREAMBLE\_POWER\_RAMPING\_STEP + POWER\_OFFSET\_2STEP\_RA;1> except for contention-free Random Access Preamble for beam failure recovery request, compute the RA-RNTI associated with the PRACH occasion in which the Random Access Preamble is transmitted;1> instruct the physical layer to transmit the Random Access Preamble using the selected PRACH occasion or PRACH occasions associated with the selected repetition number, corresponding RA-RNTI (if available), PREAMBLE\_INDEX, and PREAMBLE\_RECEIVED\_TARGET\_POWER. |
| ZTE | Yes with comments | We think the proposal does not imply different preambles can be used for Msg1 repetitions. The title of 5.1.3 is “Random Access Preamble transmission”, and multiple repetitions referring to multiple preamble transmissions, so modifying the condition looks more straightforward, otherwise, the last part may cause confusion.1> if the current Random Access preamble is not part of a preamble transmission with Msg1 preamble repetition and SSB or CSI-RS selected is not changed from the selection in the last Random Access Preamble transmission:However, we agree the proposal from HW is another way to go, but, how PRACH occasion(s) is selected is described in 5.1.2, so in 5.1.3, we would suggest the below rewording. We can modify 5.1.2 to capture RACH occasions selection for Msg1 repetition.1> instruct the physical layer to transmit the Random Access Preamble using the selected PRACH occasion or selected PRACH occasions when Msg1 repetition is applicable, corresponding RA-RNTI (if available), PREAMBLE\_INDEX, and PREAMBLE\_RECEIVED\_TARGET\_POWER. |
| vivo | No | We fail to see the motivation of spec changes as all the preamble repetition can be regarded as one preamble transmission in MAC. Once the initial RO is indicated by MAC, the PHY can know the associated subsequent RO based on the RO group mapping rule. So the MAC does not need to indicate all the ROs to PHY.  |
| Qualcomm | No | Agree with vivo. If all Msg1 repetitions are considered a single RACH attempt, then the preamble power ramping text would not go into effect? Thus, the MAC does not need to have a special rule for handling ramping between PRACH repetitions, ramping should not go into effect anyway.  |
| CATT | No | We agree to introduce some modification regarding the RAN1 agreement, but maybe the following change is sufficient:1> instruct the physical layer to transmit the Random Access Preamble using the selected PRACH occasion(s), corresponding RA-RNTI (if available), PREAMBLE\_INDEX, and PREAMBLE\_RECEIVED\_TARGET\_POWER. |
| Samsung | No | ‘Random Access Preamble transmission’ can be with or without repetitions. So we do not see need of modification suggested by rapporteur.Agree with change suggested by CATT. |
| Apple | No | CATT’s version looks fine. |
| LGE | No | Agree with other companies that the increasing the counters is required only once in one RACH attempt and current text is sufficient.Regarding issues on whether the MAC layer should indicate multiple PRACH occasions within the RO group to PHY layer, slightly prefer vivo’s approach, i.e., indicate only the initial RO and leave RAN1 to determine the subsequent ROs within the RO group. Meanwhile, if multiple PRACH occasions are indicated(as in HW, ZTE, or CATT’s text), text modification in clause 5.1.2 may also be needed to determine multiple PRACH occasions. However, Editor’s note may be enough for now since the details in clause 5.1.2 should be implemented after the RAN1 discussion on RO group design. |

## RAR window

For the start of RAR window in case of Msg1 repetition, RAN1 made the following agreements:

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| **RAN1#112bis Agreement:**The starting point of RAR window is after the last symbol of the last valid RO in the RO group corresponding to the multiple PRACH transmissions.Note: Valid RO(s) refers to what is defined in existing specification, i.e., Section 8.1 in TS 38.213.Note: The last valid RO is irrespective of whether the PRACH transmission on the last valid RO in the RO group is dropped or not.**RAN1#112 Agreement:**For multiple PRACH transmissions with same Tx beam, only one RAR window is supported for RAR monitoring for one RACH attempt. |

Based on above agreements, in case of Msg1 repetition, the RAR window starts after the last symbol of the last Msg1 repetition, so the MAC spec needs to be clarified, see below example:

|  |
| --- |
| 5.1.4 Random Access Response receptionOnce the Random Access Preamble is transmitted and regardless of the possible occurrence of a measurement gap, the MAC entity shall:1> if the contention-free Random Access Preamble for beam failure recovery request was transmitted by the MAC entity:…omitted…1> else:2> if the Random Access Preamble was transmitted on a non-terrestrial network:3> start the *ra-ResponseWindow* configured in *RACH-ConfigCommon* at the PDCCH occasion as specified in TS 38.213 [6].2> else:3> if Msg1 repetition is not applicable:4> start the *ra-ResponseWindow* configured in *RACH-ConfigCommon* at the first PDCCH occasion as specified in TS 38.213 [6] from the end of the Random Access Preamble transmission.3> if Msg1 repetition is applicable:4> start the *ra-ResponseWindow* configured in *RACH-ConfigCommon* at the first PDCCH occasion as specified in TS 38.213 [6] from the end of the last Random Access Preamble of the multiple preamble transmissions in one Msg1 repetition. |

**Q8. Do companies agree with above spec change regarding the conclusion on RAR window (any wording suggestion is welcome)?**

|  |  |  |
| --- | --- | --- |
| Company | Yes or No | Comments |
| Huawei, HiSilicon | No | 1. The above change is for BFR. We do not yet agree to support CFRA with MSG1 repetition for BFR. [Rapp-ZTE] Sorry for the mistake, now it is fixed.2. For the wording, we think it is a bit lengthy where “last Random Access Preamble”, “multiple preamble transmission” and “one Msg1 repetition” are redundant. Thus we prefer to align with *ra-ContentionResolutionTimer* for Msg3 repetition, which is like as follows,For Msg3 repetition 2> start or restart the *ra-ContentionResolutionTimer* in the first symbol after the end of all repetitions of the Msg3 transmission.For Msg1 repetition3> start the *ra-ResponseWindow* configured in *RACH-ConfigCommon* at the first PDCCH occasion as specified in TS 38.213 [6] from the end of all repetitions of the Random Access Preamble transmission. |
| ZTE | Yes | We can also accept Huawei’s proposal. |
| vivo | Comments | We agree with the intention. But we prefer not to add condition for the legacy text, i.e.,2> else:3> if Msg1 repetition is applicable:4> start the *ra-ResponseWindow* configured in *RACH-ConfigCommon* at the first PDCCH occasion as specified in TS 38.213 [6] from the end of the last Random Access Preamble of the multiple preamble transmissions in one Msg1 repetition.4> else:4> start the *ra-ResponseWindow* configured in *RACH-ConfigCommon* at the first PDCCH occasion as specified in TS 38.213 [6] from the end of the Random Access Preamble transmission. |
| Qualcomm |  | Agree with HW |
| CATT |  | Prefer the version of Huawei, which is simpler.  |
| Samsung |  | Reference to RAN1 spec may be enough. However we are ok with text suggested by HW. |
| Apple |  | Agree with HW |
| LGE |  | Agree with HW. |

## RA-RNTI

For the calculation of RA-RNTI in case of Msg1 repetition, RAN1 made the following agreements:

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| **RAN1#113 Agreement:**RA-RNTI is calculated based on the last valid RO in the RO group corresponding to the multiple PRACH transmissions. Note 1: Valid RO(s) refers to what is defined in existing specification, i.e., Section 8.1 in TS 38.213.Note 2: The last valid RO is irrespective of whether the PRACH transmission on the last valid RO in the RO group is dropped or not. |

Based on above agreements, in case of Msg1 repetition, the RA-RNTI is calculated based on the last valid RO no matter the PRACH transmission on the last valid RO in the RO group is dropped or not, so the MAC spec needs to be clarified, see below example:

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| --- |
| 5.1.3 Random Access Preamble transmissionThe RA-RNTI associated with the PRACH occasion (i.e. the PRACH occasion associated with the transmitted Random Access Preamble when Msg1 repetition is not applicable, and the PRACH occasion associated with the last Random Access Preamble within one Msg1 repetition transmission, regardless of whether the last preamble is transmitted or not, when Msg1 repetition is applicable) 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 |

**Q9. Do companies agree with above spec change regarding the conclusion on RA-RNTI calculation (any wording suggestion is welcome)?**

|  |  |  |
| --- | --- | --- |
| Company | Yes or No | Comments |
| Huawei, HiSilicon | NO | We prefer to simplify as: The RA-RNTI associated with the last PRACH occasion in which the Random Access Preamble is transmitted, is computed as: |
| ZTE | Yes | We have concern on Huawei’s proposal because the sentence says “in which the …preamble is transmitted”, according to RAN1 agreements, even if the last preamble is not transmitted, the calculation should base on the RO associated with the last preamble, so simply adding “last” is incomplete. Huawei: In our memories, NR-U has discussed the similar modelling issue and agreed the MAC layer can still consider the transmission as performed even though physical layer does not transmit due to LBT failure as below from TS 38.321:When lower layer performs an LBT procedure before a transmission and the transmission is not performed, an LBT failure indication is sent to the MAC entity from lower layers. Unless otherwise specified, when LBT procedure is performed for a transmission, actions as specified in this specification are performed regardless of if an LBT failure indication is received from lower layers. |
| vivo | No  | We can add a NOTE that:RA-RNTI is calculated based on the last valid RO in the RO group corresponding to the multiple PRACH transmissions if Msg1 repetition is applicable. |
| Qualcomm | No | Prefer taking RAN1 agreement language  |
| CATT | No | Agree with QC, and prefer taking RAN1 agreement language. We suggest the following version:The RA-RNTI associated with the last valid (as specified in TS 38.213 [6]) PRACH occasion in which the Random Access Preamble is transmitted, is computed as:We can use the wording “valid”, but leave the definition to 38.213.  |
| Samsung | No | Prefer to not modify legacy text. Suggested TP:The RA-RNTI associated with the PRACH occasion in which the Random Access Preamble is transmitted or the RA-RNTI associated with the the last valid RO in the RO group (as specified in TS 38.213 [6]) for Msg1 repetition, is computed as: |
| Apple | No | CATT’s version is OK. |
| LGE | No | Agree with the ZTE that RA-RNTI is determined based on last valid RO irrespective of whether the PRACH is transmitted or not.However, the word “if Msg1 repetition is applicable” may cause confusion considering the feature applicablility used in clause 5.1.1b to 5.1.1d. According to the current RACH partitioning framework, even though the Msg1 repetition feature is applicable, the Msg1 repetition would not be performed if the RACH partition for Msg1 repetition is not selected. In addition, we also agree with QC to use RAN1 agreement language, in order to implement the intention of RAN1 agreement accurately. We are okay with the Samsung’s text or following TP:

|  |
| --- |
| The RA-RNTI associated with the PRACH occasion in which the Random Access Preamble is transmitted or the last valid PRACH occasion in the RO group corresponding to the multiple PRACH transmissions (as specified in TS 38.213 [6]) if the set of Random Access resource for Msg1 repetition is selected, is computed as: |

 |

## Other

Besides above questions, companies are welcome to provide your comments if other issues are identified.

Q10. Any other MAC open issues that need to be discussed in RAN2?

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| Company | Comments |
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# Conclusion

To be updated

# References

[1] RAN2#122 Chairman notes