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

Xiamen, China, 9th– 13th October, 2023

Agenda Item: 8.x.x

Source: ZTE Corporation (Rapporteur)

Title: Summary of [Post123][801][CE\_enh] UP running CR and open issue discussion

Document for: Discussion and Decision

# Introduction

This is the summary of post email discussion:

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| **[Post123][801][CE\_enh] UP running CR and open issue discussion (ZTE)**  Scope:  - Update the running CR and get feedback on the CR so that an updated version can be submitted to next meeting  - Identify any open issues and solutions for these for UP (including finalisation of the details of fallback)  Intended outcome: Running UP CR and list of proposals to agree  Deadline: Long |

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 22th Sep

Rapporteur will provide summary with proposals and updated running CR before 27th Sep.

# Contact information

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

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| --- | --- | --- |
| Company | Name | Email Address |
| Samsung | Anil Agiwal | anilag@samsung.coom |
| Huawei, Hisilicon | Lou Chong | louchong@huawei.com |
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# RAN2 agreements

The agreements made in RAN2#123 meeting are shown below:

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| **RAN2#123 agreements:**  *RACH configuration framework:*  **=> Regarding the framework for Msg1 repetition and whether to support fallback from lower number to higher number, Fallback is supported. All repetitions are treated as a single feature, but within the feature, different repetition numbers are treated as different RACH type.**  **=> For a RACH partition associated with multiple Msg1 repetition numbers, the parameters defined in RACH-ConfigGeneric IE (except preambleReceiveTargetPower and powerRampingStep) are common for those repetition numbers. This will reuse existing IE. We will allow different ROs to be used for different repetitions in the signalling. If this complicates the RRC with option 2.2 too much we can revisit that agreement**  **=> Each RSRP threshold is configured separately by RRC, which is associated with a repetition number if configured (for each carrier).**  **=> A single feature priority for MSG1 repetition is configured by RRC, i.e. all the MSG1 repetition numbers use the same feature priority.**  *Fallback from lower number to higher number:*  **=> UE selects higher repetition number upon Msg1 retransmission when the number of Msg1 retransmission reaches a configured value. FFS whether we need to also check DL RSRP at the time of switching (can ask RAN1) discuss as part of offline 801.**  **=> Upon fallback from lower number to higher number, SCALING\_FACTOR\_BI is not reinitialized. PREAMBLE\_POWER\_RAMPING\_STEP is not reinitialized if the preambleRampingStep parameter is common for different repetition numbers.**  **=> UE does not reset counters: PREAMBLE\_TRANSMISSION\_COUNTER and PREAMBLE\_POWER\_RAMPING\_COUNTER upon fallback from lower number to higher number.**  **=> Introduce a RRC configured threshold (e.g. TransMax-Msg1RepNum), the field is used for deciding whether to trigger fallback from with lower number to higher number when the number of Msg1 transmission exceeds this threshold. This parameter is common for different repetition numbers configured in one RACH partition.**  *CFRA and fallback from CFRA with Msg1 repetition to CBRA with Msg1 repetition:*  **=> NW indicates ONE MSG1 repetition number applicable for CFRA MSG1 repetition by RRC for Reconfiguration with sync.**  **=> support fallback from CFRA with Msg1 repetition to 4-step CBRA with Msg1 repetition. Details are FFS.**  **=> CFRA with Msg1 repetition for BFR and with PDCCH order are not supported (can be revisited if there is consensus to support this)**  *CE only BWP:*  **=> CE only BWP for msg1 repetition is supported. Details are FFS** |

# Discussion

In this document, we mainly discuss the following open issues:

* Issue 1: RACH configuration framework. Although the RACH configuration framework Option 2.2 (in [1]) has been agreed in RAN2, companies seems to have different understandings on Option 2.2, so, further clarification and confirmation is needed;
* Issue 2: How to perform RACH partition selection?
* Issue 3: Remaining issues on fallback from lower number to higher number.
* Issue 4: How to support fallback from CFRA with Msg1 repetition to CBRA with Msg1 repetition?
* Issue 5: How to support CE-only BWP and potential MAC spec impact;

## RACH configuration framework

### Background (Rel-17 RACH partitioning)

Before discussing the RRC configuration framework for Rel-18 Msg1 repetition, it is better to clarify the existing framework and principles that defined in Rel-17 for RACH partitioning.

A general RRC configuration structure is shown in below figure. In Rel-17, the spec supports configuring multiple sets of RACH resources, each set of RACH resources can be treated as one RACH partition. One RACH partition can be associated with one feature or a feature combination. The RACH resources that not associated with any feature are used for legacy RACH procedure.

From RRC signalling point of view, the network has two ways to configure the RACH partition:

* Option 1: SharedRO
  + It means the RACH resources for this partition applies the same RACH configuration (i.e. rach-ConfigGeneric) which used for legacy RACH;
  + It is configured via BWP-UplinkCommon-> rach-ConfigCommon->featureCombinationPreamblesList;
* Option 2: SeparateRO
  + It means the RACH resources for this partition applies different RACH configuration (i.e. rach-ConfigGeneric) from which used for legacy RACH;
  + It is configured via BWP-UplinkCommon->AdditionalRACH-ConfigList->rach-ConfigCommon-> featureCombinationPreambleList;



Figure 1 Signalling structure of Rel-17 RACH parititoning

For Rel-17 RACH procedure, we have the following rules:

* Rule-1: The RACH partition is selected upon the initialization of RACH procedure.
* Rule-2: Once a RACH partition is selected, the UE cannot reselect other RACH partition during the entire RACH procedure.

### RRC framework

In last RAN2 meeting, RAN2 agreed that “**All repetitions are treated as a single feature, but within the feature, different repetition numbers are treated as different RACH type.**”

Based on the existing signalling structure of RACH partitioning, “Msg1-repeittion” is treated as a feature, the possible RRC change is shown below:

*FeatureCombination* information element

-- ASN1START

-- TAG-FEATURECOMBINATION-START

FeatureCombination-r17 ::= SEQUENCE {

redCap-r17 ENUMERATED {true} OPTIONAL, -- Need R

smallData-r17 ENUMERATED {true} OPTIONAL, -- Need R

nsag-r17 NSAG-List-r17 OPTIONAL, -- Need R

msg3-Repetitions-r17 ENUMERATED {true} OPTIONAL, -- Need R

msg1-Repetitions-r18 ENUMERATED {true} OPTIONAL, -- Need R

spare3 ENUMERATED {true} OPTIONAL, -- Need R

spare2 ENUMERATED {true} OPTIONAL, -- Need R

spare1 ENUMERATED {true} OPTIONAL -- Need R

}

NSAG-List-r17 ::= SEQUENCE (SIZE (1.. maxSliceInfo-r17)) OF NSAG-ID-r17

-- TAG-FEATURECOMBINATION-STOP

-- ASN1STOP

While different repetition numbers are treated as different RACH types, so, within one RACH partition (i.e. a featureCombinationPreambles), different repetition numbers can be associated with different RACH resources. On how to configure the RACH resources for different repetition numbers within the RACH partition, RAN2 made below agreement last meeting:

|  |
| --- |
| **=> For a RACH partition associated with multiple Msg1 repetition numbers, the parameters defined in RACH-ConfigGeneric IE (except preambleReceiveTargetPower and powerRampingStep) are common for those repetition numbers. This will reuse existing IE. We will allow different ROs to be used for different repetitions in the signalling. If this complicates the RRC with option 2.2 too much we can revisit that agreement** |

The green sentence is aligned with current RACH partitioning framework, that all the RACH resources within one RACH partition are linked to the same RACH configuration, i.e. rach-ConfigGeneric. While the yellow sentence was added because company commented that “separate ROs for different repetition numbers should be considered”, so RAN2 needs to further investigate the possible signalling impact.

* **Alt 1: If “separate RO” for different repetition numbers is not supported:**

Based on the existing RRC signalling structure, within a RACH partition, network can configure (at least) separate preamble indexes for different repetition numbers. If network configures more than one ROs per SSB and the network wants to indicate different ROs for different repetition numbers, then we can introduce separate ssb-SharedRO-MaskIndex configurations for different repetition numbers. The possible signalling structure is shown in below figure:

(Note: ASN.1 detail will be discussed in [Post123][802][CE\_enh] CP running CR and open issue discussion)



Figure 2 Signalling structure if “separate RO” for different repetitions is not supported

Remarks:

* For “configuration Option 1”, the RO for Msg1 repetition is shared with single PRACH transmission; For “configuration Option 2”, the ROs for Msg1 repetition is separate from single PRACH transmission; For a specific feature combination, whether to use Option 1 or Option 2 is up to network configuration.
* Fallback from lower number to higher number is performed within the selected RACH partition.
* **Alt 2: If “separate RO” for different repetition numbers has to be supported:**

The existing RACH partition signalling framework does not support separate ROs within a partition (because rach-ConfigGeneric IE is outside the featureCombinationPreambles), so, in order to support separate ROs for different repetition numbers, there are two options:

**Alt 2.1 Introduce separate RACH generic configuration (or essential child IEs) in featureCombinationPreambles**

For this Option, in order to avoid reselection of RACH partition during RACH procedure, we can introduce separate RACH configuration featureCombinationPreambles, so different repetition number can be associated with different RO configurations. Regarding which parameters should be introduced per repetition number, at least the following IEs are needed (FFS on other parameters):

* rach-ConfigGeneric->prach-ConfigurationIndex
* rach-ConfigGeneric->msg1-FDM
* rach-ConfigGeneric->msg1-FrequencyStart
* ssb-perRACH-OccasionAndCB-PeamblesPerSSB

The possible signalling structure of Alt 2.1 is shown in below figure:

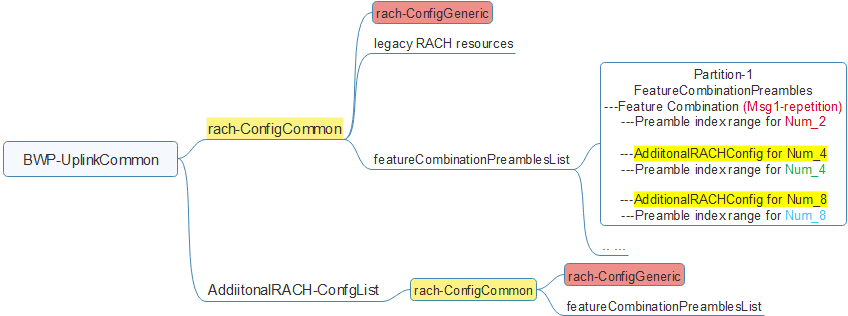


Figure 3 Signalling structure of Alt 2.1 if “separate RO” for different repetitions is supported

Remarks:

* The AdditionalRACHConfig structure includes a set of above listed parameters.
* The parameters configured in legacy rach-ConfigGeneric can be associated with repetition Num\_2 (or the lowest number configured in this partition). Within the partition, at most two additionalRACHConfig can be provided, one associated with Num\_4, the other associated with Num\_8.
* Fallback from lower number to higher number is still performed within the selected RACH partition.

**Alt 2.2 (Revert RAN2 agreement made last meeting), different repetition numbers are treated as separate features.**

For this option, it means we have to revert below agreement made in last RAN2 meeting:

**=> Regarding the framework for Msg1 repetition and whether to support fallback from lower number to higher number, Fallback is supported. All repetitions are treated as a single feature, but within the feature, different repetition numbers are treated as different RACH type.**

In addition, we need to support fallback between RACH partitions. The possible signalling structure of Alt 2.2 is shown in below figure:

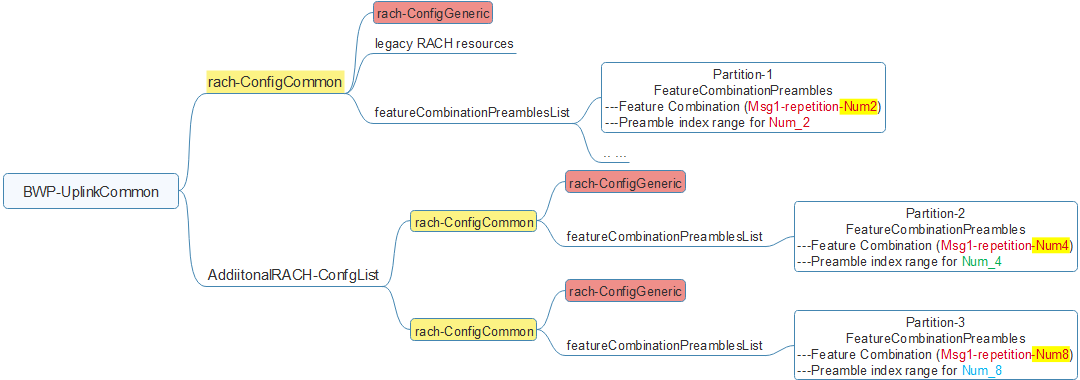


Figure 4 Signalling structure of Alt 2.2 if “separate RO” for different repetitions is supported

Remarks:

* Different repetition numbers are treated as separate feature, so one RACH partition is only applicable to a specific number.
* Fallback from lower number to higher number requires reselection of RACH partitions. This is currently not supported in MAC spec (note: RAN2 discussed RACH partition reselection in Rel-17 but not agreed in the end).
* If Alt 2.2 is adopted, then several agreements made last meeting are not applicable anymore and we have to re-discuss them in RAN2.

Then back to RAN1’s requirement on separateRO for different repetition numbers. Rapporteur found this issue was discussed in RAN1 May meeting(RAN1#113):

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| Extracted from R1-2306039 FL Summary #4 on PRACH coverage enhancements Moderator (China Telecom) Proposal 2-1 If multiple values for the number of multiple PRACH transmissions are configured, support both options to differentiate between multiple PRACH transmissions with different numbers.   * Option 1: Multiple PRACH transmissions with different numbers are transmitted on separate ROs. * Option 2: Multiple PRACH transmissions with different numbers are transmitted with separate preamble on shared ROs.   Note: Shared or separate RO/preamble means that the RO/preamble is shared or separated between multiple PRACH transmissions with different numbers.   |  |  | | --- | --- | | **Companies** | **Comments** | | New H3C | Support | | LG | Support. Here, the framework of feature combination (*FeatureCombination-r17*) and additional RACH configuration (*AdditionalRACH-Config-r17*) can be reused. | | Vivo | According to RAN2 agreement, PRACH resources with different numbers would be treated as separate features which can be separated via either separate RO or separate preambles. | | Nokia/NSB | Support. | | Sharp | Support | | Ericsson | Support. To be clear, gNB can use either of the two options. | | Lenovo | Support | | DOCOMO | Support | | Panasonic | Support. | | ZTE | Support. It is up to gNB configurations. | | Xiaomi | Support. We recommend to reuse the R17 feature combination framework. We can’t see the necessary to introduce any new additional signalling. | | MediaTek | Support. | | Sony | Support. | | CMCC | Fine. | | CATT | Support | | Spreadtrum | Support | | Qualcomm | Support |   **Proposal 2-1**  Offline conclusion:  If multiple values for the number of multiple PRACH transmissions are configured, support both options to differentiate between multiple PRACH transmissions with different numbers.   * Option 1: Multiple PRACH transmissions with different numbers are transmitted on separate ROs. * Option 2: Multiple PRACH transmissions with different numbers are transmitted with separate preamble on shared ROs.   Note: Shared or separate RO/preamble means that the RO/preamble is shared or separated between multiple PRACH transmissions with different numbers.  Support: New H3C, LG, Nokia/NSB, Sharp, Ericsson, Lenovo, DOCOMO, Panasonic, ZTE, Xiaomi, MediaTek, Sony, CMCC, CATT, Spreadtrum, Qualcomm, Apple, TCL  **FL comments:** Is it common understanding that both options are already supported based on RAN2 agreements and no further agreement is necessary in RAN1? |

As we can see, RAN1 discussed the issue and made the conclusion based on the old RAN2 agreement. In May, RAN2 agreed that different repetition numbers are treated as separate features, so naturally shared RO and separate RO can be supported. However, after RAN2 discussed the “fallback” scenario in August meeting, RAN2 revert that agreement and decide to treat different repetition numbers are different RA types.

Based on the internal check with RAN1, from technical point of view, companies in RAN1 haven’t discussed the motivation/benefit for supporting separate RO for different numbers, thus the trade-off should be carefully investigated. In addition, based on some offline checking, no matter “separate RO” for different numbers is supported or not, this will not impact the on-going “RO group” and other discussions in RAN1.

**Rapp’s observation 1: Although RAN1 made conclusion on separate RO for different numbers, that conclusion was made based on the old RAN2 agreement (i.e. different repetition number are treated as separate features).**

Here are the options:

**- Alt 1: Different repetition numbers are treated as different RA types, no need to support separateRO for different numbers (see figure 2);**

**- Alt 2.1: Different repetition numbers are treated as different RA types, separate RO for different numbers is supported by introducing separate RACH configuration in featureCombinationPreamble (see figure 3);**

**- Alt 2.2: (revert RAN2 agreement) different repetition numbers are treated as different features, fallback from lower number to higher number is done by reselecting RACH partition during RACH procedure (FFS on how to support it in MAC spec, see figure 4).**

If Alt 1 is adopted, we can inform RAN1 about our conclusion.

Companies are encouraged to discuss this issue with your RAN1 colleagues and provide your answer to below question.

**Q1. Regarding the RRC framework, which option do you prefer (Alt 1, Alt 2.1, Alt 2.2), and which option is unacceptable to you?**

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| --- | --- | --- | --- |
| Company | Preferred Option  (Alt1, 2.1, 2.2) | unacceptable Option  (Alt 1, 2.1, 2.2) | Comments  (If Alt2.2 is preferred, please provide your suggestion on the MAC spec for supporting fallback) |
| Samsung | Alt 2.2 | Alt 1, 2.1 | Indicating a specific feature/subfeature using unique set of preambles or unique RO configuration is supported so far. Changing this principle specifically for Msg1 repetition number is not motivated enough. Also RAN1 has already agreed this way before RAN2 discussed this. So Alt 1 is not acceptable.  Alt 2.1 changes the basic design of RA partition where one RA partition has one set of RO configuration. It basically is trying to create a sub partition within a partition. Its not a clean design from our point of view.  Alt 2.2 is simple from RRC point of view (not need of introducing new parameters/IEs) and follows legacy design and also aligned with RAN1 agreements. |
| Huawei, Hisilicon | Alt 1 | Alt 2.1, 2.2 | 1) From the perspective of RRC rapporteur, Alt 1 is the only feasible solution in our mind considering the manageable spec impact, since only Alt 1 fits the current RA partitioning framework. The similar discussion already happened in R17 RA partitioning, the reason to introduce the mask index is to align with 2-step RA. Now we are in the similar situation and we fail to see a reason to overturn the existing framework.  2) From the perspective of resource utilization, we have concerns to reserve more RACH resources for CE feature, i.e. Alt 2.1 and 2.2, which would impact the network throughput. |
| vivo | Comments | Alt 2.1 | Alt 2.2 is generally aligned with the current RAN1/2 agreements and R17 partitioning framework. But in such case, we think different repetition number partitions are still regarded as the same feature/feature combination but different types. Using different ROs does not mean different features, instead, they can be considered as the same feature (Note that in Rel-16, 2-step RA resources and 4-step resources can be configured on different ROs while they are associated with initial access.  Alt 2.1 is contradictory with the Rel-17 partitioning structure. We should avoid this. Alt 1 is acceptable if it is the majority view.  So we suggest that:  **Fallback is supported. All repetitions are treated as a single feature, but within the feature, different repetition numbers are treated as different RACH type. (i.e. existing agreement)**  **separate RO for different numbers can be supported by providing separate RACH configurations via different entries of additionalRACH-Config.** |
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### Power related parameter

During the offline discussion in RAN2#123, companies discussed whether separate parameters of rach-ConfigGeneric are needed for different repetition numbers, however, due to limited time, the below proposal was not treated:

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| from offline report R2-2309081  Proposal 2    From RAN2 perspective, for a RACH partition associated with multiple Msg1 repetition numbers, the preambleReceiveTargetPower and powerRampingStep parameters defined in RACH-ConfigGeneric IE are common for those repetition numbers. |

Based on the offline discussion in RAN2, several companies commented that we need to ask RAN1 about the power related parameters. However, in RAN1 last meeting, they also discussed this issue and all the companies in RAN1 think this can be decided by RAN2. So, rapporteur suggests to continue discuss this issue in RAN2, no need to send LS to RAN1.

From RAN2 perspective, unless there is strong motivation, it seems not necessary to define separate preabmleReceiveTargetPower and powerRampingStep for different repetition numbers. Companies are invited to provide your views if any.

**Q2.** **From RAN2 perspective, for a RACH partition associated with multiple Msg1 repetition numbers, the preambleReceiveTargetPower and powerRampingStep parameters defined in RACH-ConfigGeneric IE are common for those repetition numbers?**

(If Alt2.2 in Q1 is selected, then this question means the same value should be configured for different repetition numbers)

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| --- | --- | --- |
| Company | Yes/No | Comments  (If answers “disagree”, please elaborate the technical reason, please do not simply say “up to RAN1 because RAN1 thinks this is up to RAN2”) |
| Samsung | yes |  |
| Huawei, HiSilicon | Yes | We found that RAN1 has recently made the following agreements relevant to power control of PRACH, where preambleReceiveTargetPower and powerRampingStep are common to different rep number, so we don't see a need to further check with RAN1.   |  | | --- | | **For reference:**  The power control formula of **NR PRACH** consists of the following two steps:  **Step 1**: Calculate the receive target power of one single transmission.  PREAMBLE\_RECEIVED\_TARGET\_POWER=preambleInitialReceivedTargetPower+DELTA\_PREAMBLE + (PREAMBLE\_TRANSMISSION\_COUNTER – 1) \* powerRampingStep (1)  **Step 2**: Calculate the transmission power of single transmission.  P\_PRACH = min{P\_CMAX(i), PREAMBLE\_RECEIVED\_TARGET\_POWER + PL\_c} [dBm] (2) | |
| vivo | No | Even for shared RO case, separately configuring *powerRampingStep* may help to achieve higher transmission power for the high times of repetition (when the radio condition is poor).  By the way, the RAN1 agreement mentioned by HW just tells the existing NR preamble PC formula is reused, rather than using the LTE CE preamble one. There is no information abouth the power parameter configuration.   * For multiple PRACH transmissions with the same Tx beam, the two transmission power determination equations (just for reference: equation (1) and (2) as shown in the reference) of Rel-17 NR PRACH are reused for calculating the transmission power of each PRACH transmission, i.e.,  |  | | --- | | **For reference:**  The power control formula of **NR PRACH** consists of the following two steps:  **Step 1**: Calculate the receive target power of one single transmission.  PREAMBLE\_RECEIVED\_TARGET\_POWER=preambleInitialReceivedTargetPower+DELTA\_PREAMBLE + (PREAMBLE\_TRANSMISSION\_COUNTER – 1) \* powerRampingStep (1)  **Step 2**: Calculate the transmission power of single transmission.  P\_PRACH = min{P\_CMAX(i), PREAMBLE\_RECEIVED\_TARGET\_POWER + PL\_c} [dBm] (2) | |
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RAN2 already agreed that UE variable PREAMBLE\_POWER\_RAMPING\_STEP is not reinitialized upon fallback:

**=> Upon fallback from lower number to higher number, SCALING\_FACTOR\_BI is not reinitialized. PREAMBLE\_POWER\_RAMPING\_STEP is not reinitialized if the preambleRampingStep parameter is common for different repetition numbers.**

So, if answers “No” to Q2, we need to further discuss how to calculate the new power if the values of power parameters are configured differently for different repetition numbers.

**Q3.** **If answers “No” to Q2, then upon fallback from lower number to higher number, how to calculate the new power (e.g. if powerRampingStep configured for Num\_8 is smaller than the one configured for Num\_4)?**

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| --- | --- |
| Company | Comments |
| vivo | UE can calculate the delta power ramping value and calculate the actual transmit power based on the delta value, similar to 2-step to 4-step. |
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## RACH partition selection

**Q4.** **Similar to legacy, do companies agree that RACH partition (i.e. set of RACH resources) is only selected at the initialization of RACH procedure ?**

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| --- | --- | --- |
| Company | Yes/No | Comments |
| Samsung | - | It depends on conclusion of Q1. |
| Huawei | Yes |  |
| vivo | Yes | We prefer not to revet the agreement:  **Fallback is supported. All repetitions are treated as a single feature, but within the feature, different repetition numbers are treated as different RACH type. (i.e. existing agreement)**  Then, the answer is clearly Yes. |
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Based on MAC spec, RACH partition and RACH resource selection includes three steps:

* Step 1: Determine the applicable feature(s) for current RACH procedure;
* Step 2: Select a RACH partition based on the identified applicable features. (described in clause 5.1.1b)
* Step 3: Select RACH resource. (described in clause 5.1.2)

For step 1 of Msg3 repetition, the MAC spec has defined how to evaluate the applicability of Msg3 repetition for current RA procedure, see below text:

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| --- |
| TS 38.321 v17.5.0  5.1.1b Selection of the set of Random Access resources for the Random Access procedure  The MAC entity shall:  1> if the BWP selected for Random Access procedure is configured with both set(s) of Random Access resources with *msg3-Repetitions* set to *true* and set(s) of Random Access resources without *msg3-Repetitions* set to *true* and the RSRP of the downlink pathloss reference is less than *rsrp-ThresholdMsg3*; or  1> if the BWP selected for Random Access procedure is only configured with the set(s) of Random Access resources with *msg3-Repetitions* set to *true*:  2> assume Msg3 repetition is applicable for the current Random Access procedure.  1> else:  2> assume Msg3 repetition is not applicable for the current Random Access procedure. |

Generally, there are two scenarios, either the UE fulfils the Msg3 repetition RSRP threshold or the select BWP is CE-only BWP. Different from Msg3 repetition, for Msg1 repetition, RAN2 has agreed that multiple RSRP thresholds can be configured and each associated with a Msg1 repetition number, so how to evaluate the Msg1 repetition RSRP thresholds need to be discussed.

To facilitate the discussion, here are some examples:

# Example 1:

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

Partition 2: RedCap + Msg1 repetition (Num\_2);

Feature priority: RedCap > Msg1 repetition;

In example 1, in addition to legacy RACH resources, the network configures two RACH partitions, one is only associated with Msg1 repetition, the other is associated with RedCap and Msg1 repetition, but Partition 2 only provides RACH resources for repetition Num\_2.

When UE evaluates the DL RSRP thresholds for Num2, 4 and 8, and finds its DL RSRP is lower than the RSRP threshold for repetition Num\_8. If the UE only considers RACH resources that associated with Num8 as available, the UE has to select Partition 1. However, if the UE is a RedCap UE, then Partition 2 should be selected because RedCap feature has higher priority. So, when the UE fulfils the RSRP thresholds for higher repetition number, the UE should consider the lower repetition numbers are also applicable. The UE should take all applicable features into account when selecting the suitable RACH partition.

**Rapp’s observation 5: When UE’s DL RSRP is less than the RSRP thresholds for higher repetition number, the UE should consider Msg1 repetition with lower repetition numbers are also applicable.**

Companies may argue that UE only needs to consider “Msg1 repetition” feature as applicable without considering the applicable number. Here is another example:

# Example 2:

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

Partition 2: RedCap + Msg1 repetition (Num\_8);

Feature priority: RedCap > Msg1 repetition;

In example 2, the partition 2 only provides RACH resources associated with RedCap and Msg1 repetition number 8, if the UE’s DL RSRP is only lower than the RSRP threshold for repetition Num\_2, then the UE should consider that only RACH resources associated with Num\_2 are applicable and select Partition 1. If the UE simply considers “Msg1 repetition” feature as applicable, then it is possible the UE will select Partition 2 upon RACH initialization, and finally fails in Step 3 (RACH resource selection).

**Rapp’s observation 6: When selecting the RACH partition, the UE needs to consider both Msg1 repetition feature and UE’s applicable repetition number(s).**

Once a RACH partition is selected and this RACH partition includes RACH resources for multiple repetition numbers, for initial RACH, the UE should select the RACH resource that associated with the highest applicable repetition number.

**Q5. Regarding RACH partition selection, do companies agree with above Observation 5 and 6?**

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| --- | --- | --- |
| Company | Yes/No | Comments  (If answers “disagree”, please indicate your concerned observation and elaborate your comments/proposals) |
| Samsung | Yes |  |
| Huawei, Hisilicion | comment | We understand the agreed threshold for different repetition number is used to select the RA type and think RAN2 should first discuss how to select feature for MSG1 repetition, whether separate feature specific threshold is needed or the agreed threshold is reused.  On the other hand, if DL RSRP is below the threshold for highest repetition number, it is also below the threshold for lower number. UE will consider lower number as applicable naturally. |
| vivo | Comments | As per the agreement,  **Fallback is supported. All repetitions are treated as a single feature, but within the feature, different repetition numbers are treated as different RACH type. (i.e. existing agreement)**  The UE only considers Msg1 repetition feature is applicable as long as RSRP is lower than one threshold configured. Then the UE will further select the repetition number during RA repetition type selection. If only one specified repetition number is configured while the RSRP threshold condition is not fulfilled, then the UE selected the configured repetition number (e.g. similar to the case using 2-step RA where only 2-step RA is configured for a specified feature in Rel-17, regardless of RSRP check). For example, if the RedCap UE’s DL RSRP is only lower than the RSRP threshold for repetition Num\_2, then the UE should use RedCap + Msg1 repetition (Num\_8). |
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For Observation 5, the possible MAC spec change can be:

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| TS 38.321 v17.5.0  Part 1: For determining the applicable feature(s) for current RACH procedure  5.1.1b Selection of the set of Random Access resources for the Random Access procedure  The MAC entity shall:  1> if the BWP selected for Random Access procedure is configured with both set(s) of Random Access resources with *msg3-Repetitions* set to *true* and set(s) of Random Access resources without *msg3-Repetitions* set to *true* and the RSRP of the downlink pathloss reference is less than *rsrp-ThresholdMsg3*; or  1> if the BWP selected for Random Access procedure is only configured with the set(s) of Random Access resources with *msg3-Repetitions* set to *true*:  2> assume Msg3 repetition is applicable for the current Random Access procedure.  1> else:  2> assume Msg3 repetition is not applicable for the current Random Access procedure.  1> if the BWP selected for Random Access procedure is configured with both set(s) of Random Access resources with *msg1-Repetitions* set to *true* and set(s) of Random Access resources without *msg1-Repetitions* set to *true* and the RSRP of the downlink pathloss reference is less than [*rsrp-ThresholdMsg1-Num8*];  2> assume Msg1 repetition with repetition number 8, 4 and 2 are applicable for the current Random Access procedure.  1> else if the BWP selected for Random Access procedure is configured with both set(s) of Random Access resources with *msg1-Repetitions* set to *true* and set(s) of Random Access resources without *msg1-Repetitions* set to *true* and the RSRP of the downlink pathloss reference is less than [*rsrp-ThresholdMsg1-Num4*];  2> assume Msg1 repetition with repetition number 4 and 2 are applicable for the current Random Access procedure.  1> else if the BWP selected for Random Access procedure is configured with both set(s) of Random Access resources with *msg1-Repetitions* set to *true* and set(s) of Random Access resources without *msg1-Repetitions* set to *true* and the RSRP of the downlink pathloss reference is less than [*rsrp-ThresholdMsg1-Num2*];  2> assume Msg1 repetition with repetition number 2 is applicable for the current Random Access procedure.  1> else if the BWP selected for Random Access procedure is only configured with the set(s) of Random Access resources with *msg1-Repetitions* set to *true*:  2> assume Msg1 repetition is applicable for the current Random Access procedure.  1> else:  2> assume Msg1 repetition is not applicable for the current Random Access procedure. |

**Q6. On determining whether Msg1 repetition is applicable for current RACH procedure, any comments to above TP?**

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| Company | Yes/No | Comments |
| Huawei, Hisilicon |  | See comment in Q5 |
| vivo | comments | As per the agreement,  **Fallback is supported. All repetitions are treated as a single feature, but within the feature, different repetition numbers are treated as different RACH type. (i.e. existing agreement)**  The UE only considers Msg1 repetition feature is applicable. No need to mention repetition types during feature selection. |
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For observation 6, the possible MAC spec change can be:

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| Part 2: For RACH partition selection based on identified features 5.1.1c Availability of the set of Random Access resources The MAC entity shall for each set of configured Random Access resources for 4-step RA type and for each set of configured Random Access resources for 2-step RA type:  1> if *redCap* is set to *true* for a set of Random Access resources:  2> consider the set of Random Access resources as not available for a Random Access procedure for which RedCap is not applicable.  1> if *smallData* is set to *true* for a set of Random Access resources:  2> consider the set of Random Access resources as not available for the Random Access procedure which is not triggered for RA-SDT.  1> if *NSAG-List* is configured for a set of Random Access resources:  2> consider the set of Random Access resources as not available for the Random Access procedure unless it is triggered for any one of the *NSAG-ID*(s) in the *NSAG-List*.  1> if *msg3-Repetitions* is set to *true* for a set of Random Access resources:  2> consider the set of Random Access resources as not available for the Random Access procedure if Msg3 repetition is not applicable.  1> if *msg1-Repetitions* is set to *true* for a set of Random Access resources and the set of Random Access resources includes Random Access resources for Msg1 repetition number 2:  2> consider the set of Random Access resources as not available for the Random Access procedure if Msg3 repetition with repetition number 2 is not applicable.  1> if *msg1-Repetitions* is set to *true* for a set of Random Access resources and the set of Random Access resources includes Random Access resources for Msg1 repetition number 4:  2> consider the set of Random Access resources as not available for the Random Access procedure if Msg3 repetition with repetition number 4 is not applicable.  1> if *msg1-Repetitions* is set to *true* for a set of Random Access resources and the set of Random Access resources includes Random Access resources for Msg1 repetition number 8:  2> consider the set of Random Access resources as not available for the Random Access procedure if Msg3 repetition with repetition number 8 is not applicable.  1> if a set of Random Access resources is not configured with *FeatureCombination*:  2> consider the set of Random Access resources to not associated with any feature. 5.1.1d Selection of the set of Random Access resources based on feature prioritization The 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. |

**Q7. On RACH partition selection, any comments to above TP?**

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| --- | --- | --- |
| Company | Yes/No | Comments |
| Huawei, Hisilicon | No | We understand the repetition number 2, 4 and 8 are associated with the same resource set. This resource set is excluded only when all repetition number is not applicable. Three bullets can be simplified as:  1> if *msg1-Repetitions* is set to *true* for a set of Random Access resources:  2> consider the set of Random Access resources as not available for the Random Access procedure unless any one (2, 4 or 8) of Msg1 repetition number is applicable. |
| vivo | Comments | Same comments to Q7. |
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## Fallback from lower number to higher number

In last RAN2 meeting, RAN2 agreed to support fallback from lower number to higher number and made following agreements:

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| **=> UE selects higher repetition number upon Msg1 retransmission when the number of Msg1 retransmission reaches a configured value. FFS whether we need to also check DL RSRP at the time of switching (can ask RAN1) discuss as part of offline 801.**  **=> Upon fallback from lower number to higher number, SCALING\_FACTOR\_BI is not reinitialized. PREAMBLE\_POWER\_RAMPING\_STEP is not reinitialized if the preambleRampingStep parameter is common for different repetition numbers.**  **=> UE does not reset counters: PREAMBLE\_TRANSMISSION\_COUNTER and PREAMBLE\_POWER\_RAMPING\_COUNTER upon fallback from lower number to higher number.**  **=> Introduce a RRC configured threshold (e.g. TransMax-Msg1RepNum), the field is used for deciding whether to trigger fallback from with lower number to higher number when the number of Msg1 transmission exceeds this threshold. This parameter is common for different repetition numbers configured in one RACH partition.** |

However, no conclusion was made on the following offline proposals due to limited time.

*Proposal 7    (8/11) DL RSRP threshold is not checked when determining whether to trigger fallback from lower number to higher number.*

*Proposal 8 (7/10) After UE fallbacks from repetition number 2 to repetition number 4, the UE can then fallback to repetition number 8 when the fallback condition is met.*

*Proposal 5.a If RAN2 agrees that fallback from lower number to higher number can be excuted only one time, the counter PREAMBLE\_TRANSMISSION\_COUNTER is reused (to compare with the configured maximum transmission threshold)*

*Proposal 5.b If RAN2 agrees that fallback from lower number to higher number can be excuted more than one times (i.e. 2->4->8), to introduce a new counter (e.g. PREAMBLE\_TRANSMISSION\_COUNTER\_MSG1REP) for deciding whether to trigger fallback, the counter is increased by 1 when RAR window of Msg1 reptition expires and the counter is reset to 0 upon fallback.*

On whether to check DL RSRP upon fallback from lower number to higher number, based on the offline discussion, majority companies think it is sufficient to trigger fallback when the number of Msg1 retransmission reaches a configured value. By checking the DL RSRP, it is possible to trigger fallback directly from num\_2 to num\_8, but on the other hand, it is questionable whether the UE should trigger fallback if the UE does not fulfil the RSRP threshold for higher number.

For fallback from 2-step to 4-step, it is triggered upon reaching the maximum configured Msg1 retransmission times. So, for simplicity, the same mechanism can also be applied here.

**Q8. Do companies agree that DL RSRP threshold is not checked when determining whether to trigger fallback from lower number to higher number?**

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| --- | --- | --- |
| Company | Yes/No | Comments |
| Samsung | No | Disagree. Rapporteur mention to reuse same mechanism as 2 step to 4 step. 2 step to 4 step fallback is completely different feature than Msg1 repetitions and fallback. There is no similarity except the usage of term ‘fallback’. Infact number of UL transmissions are reduced (PUSCH transmission are dropped) when UE fallback from 2 step to 4 step unlike fallback from lower to higher number of repetitions.  Blindly transmitting more Msg1 repetitions without the knowledge about the cause of failure is not useful. DL RSRP measurement is the basic criteria to determine specific repetition number, so both DL RSRP and TransMax-Msg1RepNum should be used. |
| Huawei, HiSilicon | Yes | No need to check for each fallback. |
| vivo | No | Regarding 2-step to 4-step, there are only two types, so the UE can directly choose the other type when encountering failure of 2-step. But for repetitions 2,4,8 are configured, the UE should anyway check the RSRP for an appropriate number (4 or 8) when encountering 2 repetition failure, for the sake of successful access and power saving. This is also aligned with the RSRP check principle when the UE firstly selects a repetition number. Why should we ignore the RSRP check when fallback? |
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On whether UE can trigger subsequent fallbacks (2-> 4 ->8), based on offline discussion, majority companies support such behaviour, from rapporteur perspective, it requires additional spec effort if we do not support subsequent fallback, because UE needs to remember whether current Msg1 transmission is triggered by fallback or not, and technically, there seems no clear benefit for disallowing it.

**Q9. Do companies agree that after UE fallbacks from repetition number 2 to repetition number 4, the UE can then fallback to repetition number 8 when the fallback condition is met?**

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| Company | Yes/No | Comments |
| Samsung | No | More transmissions will create more collisions in case the ROs are shared. So we would like to limit fallback to only one time. |
| Huawei, HiSilicon | Yes |  |
| vivo | No | As per the agreement,  **Introduce a RRC configured threshold (e.g. TransMax-Msg1RepNum), the field is used for deciding whether to trigger fallback from with lower number to higher number when the number of Msg1 transmission exceeds this threshold. This parameter is common for different repetition numbers configured in one RACH partition.**  we assume fallback can only be performed once as there is only one threshold and no new transmission counter, similar to 2-step to 4-step. |
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Regarding whether to introduce a new UE counter (e.g. PREAMBLE\_TRANSMISSION\_COUNTER\_MSG1REP) for deciding whether to trigger fallback. Considering RAN2 already agreed that the configured maximum transmission number(e.g. TransMax-Msg1RepNum) is common for different repetition numbers, then the simple approach is to reuse existing counter (i.e. PREAMBLE\_TRANSMISSION\_COUNTER), for instance:

* (existing) increment *PREAMBLE\_TRANSMISSION\_COUNTER* by 1;
* if *PREAMBLE\_TRANSMISSION\_COUNTER* = *TransMax-Msg1RepNum* + 1, or
* if *PREAMBLE\_TRANSMISSION\_COUNTER* = 2\**TransMax-Msg1RepNum* + 1
  + Triggers fallback from lower number to next higher number.

**Q10. Do companies agree the existing UE counter (PREAMBLE\_TRANSMISSION\_COUNTER) can be reused to trigger fallback from lower number to higher number?**

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| --- | --- | --- |
| Company | Yes/No | Comments |
| Samsung | Yes |  |
| Huawei, HiSilicon | Yes |  |
| vivo | Yes | One time of fallback is sufficient. If radio condition rapidly becomes poor, then cell reselection should be done. |
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(Note: the draft MAC CR will be updated based on the outcome of Q8~10)

## Fallback from CFRA with repetition to CBRA with repetition

In last RAN2 meeting, RAN2 agreed to support fallback from CFRA with repetition to CBRA with repetition. In addition, CFRA with Msg1 repetition is only supported for reconfigurationWithSync. However, the details are FFS.

Based on current MAC spec, no matter CFRA resources are provided or not, RACH partition selection is done at the initialization of RACH procedure. See corresponding MAC spec below:

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| TS 38.321 v17.5.0 5.1.1b Selection of the set of Random Access resources for the Random Access procedure The MAC entity shall:  …skip non-related part …  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. |

As we can see, for the fallback from CFRA to CBRA, only RedCap feature is considered. For fallback from CFRA with Msg1 repetition to CBRA with Msg1 repetition, the similar mechanism can be applied.

Below is the proposal provided in R2-2308067:

When CFRA RACH resources with Msg1 repetition have been provided:

* + If the UE is RedCap UE:
    - If there is one RACH partition available and associated with only RedCap feature and Msg1 repetition feature;
      * Select this RACH partition;
    - else if there is one RACH partition available and associated with only RedCap feature:
      * Select this RACH partition;
    - else:
      * Select the set of RACH resources that not associated with any feature;
  + else:
    - If there is one RACH partition available and associated with only Msg1 repetition feature:
      * Select this RACH partition;
    - else:
      * Select the set of RACH resources that not associated with any feature;

**Q11. To support fallback from CFRA with repetition to CBRA with repetition, do companies agree that the RACH partition is selected at RACH initialization as proposed above?**

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| Company | Yes/No | Comments  (Please elaborate your proposal if answers “no” ) |
| Samsung | - | Depends on conclusion to Q1 |
| Huawei, HiSilicon | Yes but | Yes if rach-ConfigGeneric is not provided in the CFRA IE. In case that rach-ConfigGeneric is provided, a special RACH partition is assigned for CFRA. We should make sure this set can be selected.  CFRA ::= SEQUENCE {  occasions SEQUENCE {  rach-ConfigGeneric RACH-ConfigGeneric,  ssb-perRACH-Occasion ENUMERATED {oneEighth, oneFourth, oneHalf, one, two, four, eight, sixteen}  OPTIONAL -- Cond Mandatory |
| vivo | Comments | Agree with intention. We would like to keep details FFS after the CBRA repetition framework is done. |
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In addition, we need to discuss whether the UE must select the same repetition number as indicated for CFRA upon fallback? Because the network cannot configure two RACH partitions that associated with the same feature or feature combination, and RACH-ConfigCommon is cell specific configuration. So from network perspective, when network configures a RACH partition that associated with Msg1 repetition, usually, this RACH partition includes RACH resources for all repetition numbers (2, 4 and 8). So, when triggering CFRA with Msg1 repetition in reconfigurationWithSync, there are expected UE behaviour:

After UE selects the RACH partition that associated with Msg1 repetition:

* Option 1: Upon fallback from CFRA with repetition to CBRA with repetition, the UE only selects the RACH resources that associated the same repetition number that indicated for CFRA;
* Option 2: Upon fallback from CFRA with repetition to CBRA with repetition, the UE determines the repetition number and corresponding RACH resource based on DL RSRP. (note: if the UE does not fulfill any Msg1 repetition RSRP threshold, the UE selects the RACH resources for repetition number 2)

**Q12. Which option do you prefer regarding the UE behaviour upon fallback?**

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| Company | Preferred option (1 or 2) | Comments |
| Samsung | Option 1 | Option 1 seems simple. Also note that CFRA vs CBRA selection is done every RA attempt. Option 2 may change repetition number every attempt. |
| Huawei, HiSilicon | Option 1 |  |
| vivo | Option 2 | The same principle should be applied for CBRA and CFRA->CBRA cases. This is also feasible as the repetition number is treated as RA type. |
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Another question is whether the UE can trigger further fallback from lower number to higher number,

**Q13. For your preferred Option (1 or 2), after fallback from CFRA to CBRA with Msg1 repetition, do you think the UE can trigger fallback further from CBRA with lower number to higher number when the fallback condition is met?**

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| --- | --- | --- |
| Company | Support/ not support | Comments |
| Samsung | Not support | CFRA vs CBRA selection is done every RA attempt. |
| Huawei, HiSilicon | Not support | Since it is for connected UE and NW is already aware of the link condition, we don't prefer to over-optimize for this case with such a complicated mechanism. |
| vivo | Yes | CFRA with repetition -> CBRA with repetition -> CBRA with higher repetition can be supported by using the fallback solution for lower repetition to higher repetition. No addition work is needed. No new limitation for fallback should added (i.e. there is no need to specifically exclude CFRA with repetition -> CBRA with repetition -> CBRA with higher repetition case). |
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(Note: the draft MAC CR will be updated based on the outcome of Q11~13)

## CE-only BWP

In last RAN2 meeting, RAN2 agreed that CE-only BWP can be supported for Msg1 repetition. In addition, in RAN2 main session, companies discussed how to configure Rel-17 CE-only BWP and reached below consensus:

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| Cov Enh  [R2-2308063](file:///C:\Users\mtk65284\Documents\3GPP\tsg_ran\WG2_RL2\RAN2\Docs\R2-2308063.zip) Clarification on CE-only BWP ZTE Corporation, Sanechips discussion Rel-17 NR\_cov\_enh-Core  - MTK wonder if 1.2 invovles TS change. ZTE think maybe, as this is largely unclear.   * Use featureCombinationPreamblesList-r17 in additionalRACH-ConfigList-r17 to configure CE-only BWP, and the legacy RACHConfigCommon is absent in such case. * Current spec doesn’t support CFRA for CE-only BWP |

**Q14. Similar to Rel-17 CE-only BWP, do companies agree below conclusions are also applicable to Rel-18 CE-only BWP?**

* + - * **Use featureCombinationPreamblesList-r17 in addiitonalRACH-ConfigList-r17 to configure Rel-18 CE-only BWP, and the legacy RACH-ConfigCommon is absent in such case;**
      * **CFRA is not supported in Rel-18 CE-only BWP**

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| Company | Support/ not support | Comments |
| Samsung | No | CFRA was not supported for Msg3 repetitions. So it was ok to not support CFRA of BSW supporting only Msg3 repetitions.  CFRA is supported for Msg1 repetitions. So CFRA should be supported for BWP only supporting Msg1 repetitions. |
| Huawei, HiSilicon | Support | Similar as legacy. |
| vivo | Yes | In our understanding, the situation for Rel-18 is the same as Rel-17. Specifically, if legacy CFRA is configured on a BWP, then there will always be legacy common RO and configuration for legacy CBRA. As a result, there is no way for Rel-18 CE only.  It is better to clarify that the CFRA mentioned is referred to R15/R16 CFRA (i.e. CFRA with repetition should be excluded) |
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Considering both Msg1 repetition and Msg3 repetition are enhancements for UL coverage, it is possible the network wants to enable both functions at the same time, so for “CE-only BWP”, we may have following types:

* Type 1: A dedicate BWP in which all the RACH resources are only associated with Msg3 repetition;
* Type 2: A dedicate BWP in which all the RACH resources are only associated with Msg1 repetition;
* Type 3: A dedicate BWP in which all the RACH resources are associated with both Msg1 repetition and Msg3 repetition (i.e. one RACH partition associated only with Msg1 repetition and Msg3 repetition).

**Q15. Except Type 1 and Type 2, do companies agree that Type 3 CE-only BWP can also be supported?**

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| --- | --- | --- |
| Company | Support/ not support | Comments |
| Samsung | Support |  |
| Huawei, HiSilicon | support |  |
| vivo | Support | It is up to NW configuration. |
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In addition, as discussed in [1], most companies think in CE-only BWP, the network is allowed to configure

*Proposal 6 CE only BWP for Msg1 repetition is supported, whether to use Alt1.1 or Alt.1.2 is up to network implementation. (10/12)*

* + *Alt 1.1: If the selected dedicated BWP is configured with set of RACH resources that all associated with Msg1 repetition and a specific repetition number, when RACH is triggered, the UE applies the Msg1 repetition number without evaluating the Msg1 repetition RSRP threshold.*
  + *Alt 1.2: If the selected dedicated BWP is configured with sets of RACH resources that all associated with Msg1 repetition but with different repetition numbers, when RACH is triggered, the UE selects the applicable repetition number and corresponding RACH resource based on the evaluation of Msg1 repetition RSRP threshold.*

**Q16. Do companies agree with above Proposal 6?**

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| --- | --- | --- |
| Company | Yes/ No | Comments |
| Samsung | Yes |  |
| Huawei, HiSilicon | Yes |  |
| vivo | Yes |  |
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(Note: the draft MAC CR will be updated based on the outcome of Q11~13)

## Other

**Q17. Any other MAC open issues that need to be discussed in RAN2?**

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| Company | Comments |
| vivo | Whether Group B, RO mask can be configured per repetition level? We assume Yes based on the Rel-17 partitioning signaling. |
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# Conclusion

To be updated

# References

[1] [R2-2308065](file:///C:\evutukuri\work\5G\RAN2\docs\R2-2308065.zip) Report of [Post122][802][R18CEenh-UP] UP open issues (ZTE) ZTE Corporation discussion Rel-18 NR\_cov\_enh2-Core

[2] [R2-2309081](file:///C:\evutukuri\work\5G\RAN2\docs\R2-2309081.zip) Report of [AT123][801][CE\_enh] Discussion on issues needing RAN1 input (ZTE) Rapporteur (ZTE)