3GPP TSG RAN WG1 #106bis-e R1-210xxxx

**e-Meeting, October 11th – 19th, 2021**

**Agenda item: 5**

**Title: [106bis-e-NR-R17-CovEnh-07] Discuss incoming LS on Msg3 repetition in coverage enhancement**

**Source: Moderator (ZTE Corporation)**

**Document for:** **Discussion and Decision**

# Background

In [1], RAN2 sends one LS about Msg3 repetition, which is copied below.

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During RAN2#115\_e meeting, RAN2 discussed the potential impact of supporting Msg3 repetition and achieved the following agreements:

Agreements

1. Msg3 repetition is applicable to all cases that trigger 4-step CBRA procedure (can come back if we identify that some specific case should not be covered)
2. A separate RSRP threshold is introduced for requesting Msg3 repetition
3. Extension of ra-ResponseWindow and ra-ContentionResolutionTimer are not needed for Msg3 repetition.
4. RAN2 confirms enhancing MAC RAR for indicating MSG3 repetition is not supported.
5. Postpone the discussion on UE capability (i.e. whether explicit UE capability is needed for indicating the support of Msg3 repetition).

In addition, RAN2 would like to check the following with RAN1:

From RAN2 perspective, RAN2 observed that it is feasible to support Msg3 repetition on both NUL and SUL, and would like to ask if RAN1 has any concern on this. If RAN1 confirms the feasibility, then RAN2 would like to know whether different RSRP thresholds for requesting Msg3 repetition are needed for NUL and SUL?

RAN2 also observed that it is feasible to configure random access preamble Group B together with Msg3 repetition, in which case a separate set of Group B related parameters such as *ra-Msg3SizeGroupA*, *messagePowerOffsetGroupB*, *numberOfRA-PreamblesGroupA* may be configured for request of Msg3 repetition. RAN2 would like to ask if RAN1 has any concern on this.

In addition, RAN2 has been discussing parameters for the Msg1 transmission used to request Msg3 repetition. The question is whether RAN1 see any issue and benefit to optionally configuring a separate set of RACH parameters for the UE (The RACH parameters may include e.g. *preambleReceivedTargetPower, powerRampingStep, preambleTransMax*)?

**2. Actions:**

**To RAN1**

**ACTION:**  RAN2 respectfully asks RAN1 to answer the following questions.

* Question 1: Does RAN1 think it is feasible to support Msg3 repetition on both NUL and SUL? If it is feasible, whether different RSRP thresholds for requesting Msg3 repetition are needed for NUL and SUL?
* Question 2: Does RAN1 think it is feasible to configure random access preamble Group B together with Msg3 repetition?
* Question 3: For Msg1 transmission used to request Msg3 repetition, does RAN1 see any issue and benefit of optionally configuring a separate set of RACH parameters?

# Summary of Tdocs

## Answer to Q1

* Question 1: Does RAN1 think it is feasible to support Msg3 repetition on both NUL and SUL? If it is feasible, whether different RSRP thresholds for requesting Msg3 repetition are needed for NUL and SUL?
  + Support Msg3 repetition for both NUL and SUL, and different RSRP thresholds for requesting Msg3 repetition are needed for NUL and SUL
    - [3, Huawei, HiSilicon], [4, ZTE], [5, vivo], [6, Intel], [9, InterDigital]
  + Support Msg3 repetition for both NUL and SUL, while the same RSRP threshold for requesting Msg3 repetition for NUL and SUL
    - [7, Qualcomm], [8, Ericsson]
  + Support Msg3 repetition only for NUL
    - [2, LG]

**Summary from moderator:** Only one company prefers not to support Msg3 repetition for SUL. The main argument is about the necessity while RAN2 is asking RAN1 about feasibility and whether have concerns on. Regarding whether to configure different RSRP thresholds, FL understanding is that this is similar as the configuration of *rsrp-ThresholdSS*B in legacy, which is configured separately in NUL and SUL due to different coverage for different carriers. The same should be applied here.

**Recommendation for reply:** Yes. From RAN1 perspective, it is feasible to support Msg3 repetition on both NUL and SUL, and different RSRP thresholds for requesting Msg3 repetition are needed for NUL and SUL.

### First round

**What’s your views on Question 1 in RAN2 LS, and do you have any concerns on the recommended reply from moderator?**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Huawei, HiSilicon | Support.  As a response to LG contribution paper, according to TS 38.321, the only difference of RACH procedure between SUL carrier and FDD carrier is the threshold-based uplink carrier selection before preamble transmission. Once SUL uplink carrier is selected, the remaining RACH procedure on SUL carrier is the same as that on FDD carrier. Therefore, the feasibility of Msg3 repetition on SUL carrier is no difference from that on FDD carrier. It is feasible to support Msg3 repetition on both NUL and SUL.  As a response to Qualcomm and Ericsson, for a UE to request Msg3 repetition, different RSRP thresholds between a FDD carrier and a TDD/FDD carrier should be allowed because different required SINRs for Msg3 reception on two carrier frequencies are possible. Similarly, different RSRP thresholds between SUL and NUL are needed. |
| Intel | We are fine with the recommended reply |
| Ericsson1 | It seems FL misunderstood our intention of our proposal.  Without the new RSRP threshold parameter, the RSRP threshold for SUL will still be separately configured in an initial UL BWP specific for SUL:  For SpCell:  ServingCellConfigCommonSIB-->UplinkConfigCommonSIB (supplementaryUplink) --> initialUplinkBWP  For SCell:  ServingCellConfigCommon->UplinkConfigCommon (supplementaryUplinkConfig for SUL)--> initialUplinkBWP   |  | | --- | | ServingCellConfigCommon ::= SEQUENCE {  physCellId PhysCellId OPTIONAL, -- Cond HOAndServCellAdd,  downlinkConfigCommon DownlinkConfigCommon OPTIONAL, -- Cond HOAndServCellAdd  uplinkConfigCommon UplinkConfigCommon OPTIONAL, -- Need M  supplementaryUplinkConfig UplinkConfigCommon OPTIONAL, -- Need S |   So there’s no need to introduce another RSRP threshold field for SUL, once the BWP for SUL is separately configured, the RSRP for SUL will be different from the one for NUL. |
| Sharp | We found no concern on configuring separate parameters for NUL/SUL. As indicated by Ericsson, a new RRC parameter may not be necessary to be introduced, which we think is up to RAN2. |
| Panasonic | We support the proposal. The actual signaling would be up to RAN2. |
| CATT | We think Msg3 repetition can be used in both NUL and SUL.  According to the current RRC IE structure, we think it seems natural to have separate RSRP thresholds, if the parameters are separately configured in each *UplinkConfigCommon*. |
| vivo | Support the recommended reply, and agree with Ericsson’s analysis. |
| Xiaomi | Support the recommended reply. |
| Nokia/NSB | Agree with Ericsson. |
| LG | We don’t have strong concern about introducing msg3 repetition on SUL, but we are still doubting whether it is necessary. Also we think that introducing msg3 repetition on SUL would make coverage mismatch between NUL and SUL worse. Hope this question could be resolved in the following discussion. |
| InterDigital | Agree with the recommended reply from the FL. As explained in our contribution, R1-2110236, if a common threshold is used for msg3 repetition on both SUL and NUL, the msg3 repetition is only usable on either NUL or SUL. |
| ZTE | Support the recommended reply. As for the signaling, there is no need to touch in the reply LS. |
| Qualcomm | Agree with Ericsson. |
| Apple | In our view, it is feasible to have Msg3 repetition for SUL, but technically speaking, SUL is already designed to enhance coverage and no need to have repetition in SUL. So once UE checks to select SUL (based on configured RSRP threshold) the threshold should be set without repetition in SUL. And consequently, no need to introduce new RSRP threshold for repetition request in SUL. |
| OPPO | Support the recommended reply. |
| Huawei, HiSilicon | Based on Ericsson and Qualcomm’s replies, the discussion point seems about threshold IE v.s. threshold value. The consensus is that different threshold values are needed between SUL and NUL. So the proposed answer could be revised as  **Proposal-rev1:**  Support Msg3 repetition for both NUL and SUL, and ~~different~~ RSRP threshold~~s~~ for requesting Msg3 repetition ~~are~~ is configured per uplink carrier and different threshold values between ~~needed~~ ~~for~~ NUL and SUL can be configured.  In response to Apple, a SUL has better UL coverage than NUL because it has lower carrier frequency and more available uplink slots than NUL. But better coverage for SUL does not mean that SUL is excluded from Msg3 repetition feature. The reason is similar to that no applicability restriction for FDD is introduced just because FDD carrier has better UL coverage than TDD carrier. |

## Answer to Q2

* Question 2: Does RAN1 think it is feasible to configure random access preamble Group B together with Msg3 repetition?
  + Yes: [2, LG], [5, vivo], [7, Qualcomm], [8, Ericsson], [9, InterDigital], [10, Sharp]
  + No: [3, Huawei, HiSilicon], [6, Intel]

**Summary from moderator:** Majority companies think it is feasible while two companies think otherwise. One company concerns that it needs further PRACH partitioning. However, PRACH partitioning for Group A/B is within RAN2 scope, and it has been considered as feasible in RAN2 based on the LS. Another company mainly concerns on the necessity while RAN2 is asking about the feasibility from RAN1 perspective.

**Recommendation for reply:** Yes. From RAN1 perspective, it is feasible to support both Group A with or without Msg3 repetition and Group B with or without repetition. RAN1 doesn’t identify any concerns on introducing a separate set of Group B related parameters including *ra-Msg3SizeGroupA, messagePowerOffsetGroupB* and *numberOfRA-PreamblesGroupA* for request of Msg3 repetition.

### First round

**What’s your views on Question 2 in RAN2 LS, and do you have any concerns on the recommended reply from moderator?**

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| --- | --- |
| **Company** | **Comments** |
| Intel | We do not think it is necessary/feasible to support group B with repetition. This is for coverage enhancement, where we do not think large payload size is needed for Msg3 transmission. It is not clear to us why we even need such feasibility for group B with repetition for cell edge UEs.  We do not support this. |
| Ericsson1 | Fine with the proposal.  Repetition of Msg3 when preamble groupB is selected is still necessary in our understanding as the TBS is expected to be larger than a normal msg3 TBS even if the UE may not near the cell edge according the pathloss requirement for selecting the groupB preambles. Repetition can mitigate the loss of performance due to payload size increase.  From RAN1 perspective, we do not see the reason to preclude group B preambles specifically for coverage enhancement feature.  Furthermore, without groupB for msg3 repetition feature, this will be different from other features introduced in Rel-17, which may be bad for finding a unified solution for PRACH partitioning for all new features in Rel17. |
| Sharp | Group B may be selected even if the UE is in cell-edge, at least for UL CCCH. At least from RAN1 perspective, no concern found since the preamble group A/B is not visible in RA procedure from RAN1 perspective. |
| Panasonic | Although we have concern on the further PRACH partitioning, it is the matter of the network decision. Then, we can agree the recommendation. |
| CATT | We are generally OK with the recommendation. Typically, RAN1 spec is agnostic to Group A and Group B preambles. It will be strange (or almost impossible) if RAN1 spec introduce the concept of Group B preambles just to preclude using Msg3 repetition for it. |
| vivo | Agree with the recommended reply.  It should be noted that PHY is agnostic to the concept of Preamble Group A/B, the preamble is selected by MAC layer. Hence, it is feasible from RAN1 perspective.  As for the necessity and PRACH partitioning issue, we can leave these aspects to RAN2 discussion. |
| Xiaomi | Fine with the recommended reply. PUSCH repetition type A can be applied for both mg3 group A and group B. |
| Nokia/NSB | The structure of the reply looks good to us, but incomplete. We understand that the question is about feasibly and not about relevance. On the other hand, we think that observations about the relevance of the use case should be provided to RAN2, given that the latter is not directly exposed to RAN1 considerations about the relationship between measured RSRP and coverage conditions (which is what justifies the introduction of Msg3 repetitions in the first place). Giving RAN2 all the tools to decide what is the best course of action from RAN2’s perspective is important from our perspective, to void further iterations and issues.  Suggest the following modification:  Yes. From RAN1 perspective, it is feasible to support both Group A with or without Msg3 repetition and Group B with or without repetition. RAN1 doesn’t identify any concerns on introducing a separate set of Group B related parameters including *ra-Msg3SizeGroupA, messagePowerOffsetGroupB* and *numberOfRA-PreamblesGroupA* for request of Msg3 repetition. Consensus on the relevance of this use case cannot be achieved in RAN1, since selection of groupB preambles is subject to conditions on *messagePowerOffsetGroupB* which seem hardly satisfied when coverage shortage occurs. |
| LG | We are fine with the proposal. We have same view with Ericsson and CATT. |
| InterDigital | We agree with the reply draft proposed by the FL. Preamble group B is used to indicate the desired msg3 size, which should help the scheduler in providing a bigger grant with better reliability. It can beneficial to support this, e.g. especially for RA initiated for data transmission purposes (e.g. small data transmission) with improved coverage, as the payload size can vary. It can be up to the network whether to configure Group B preambles together with Msg3 repetition. |
| ZTE | Fine with the proposal. The larger Msg3 payload size, the more coverage enhancement is needed. It is more desirable to configure Group B together with Msg3 repetition to ensure the performance of Msg3 transmission with large payload size. |
| Qualcomm | Agree with recommended reply. |
| Apple | We share similar view as Intel. Use-case in not clear. |
| OPPO | Fine with recommended reply. |

## Answer to Q3

* Question 3: For Msg1 transmission used to request Msg3 repetition, does RAN1 see any issue and benefit of optionally configuring a separate set of RACH parameters? (The RACH parameters may include e.g. *preambleReceivedTargetPower, powerRampingStep, preambleTransMax*)?
  + Not configure a separate set of RACH parameters for *preambleReceivedTargetPower, powerRampingStep, preambleTransMax* for requesting Msg3 repetition with shared RO.
    - [2, LG], [3, Huawei, HiSilicon], [5, vivo], [6, Intel]
  + Configure a separate set of RACH parameters for *preambleReceivedTargetPower, powerRampingStep, preambleTransMax* for requesting Msg3 repetition with shared RO.
    - [4, ZTE], [7, Qualcomm], [8, Ericsson], [9, InterDigital], [11, NTT DOCOMO]

**Summary from moderator:** Companies’ views are divergent. On one hand, some companies don’t see the necessity of separately configuring such parameters, and think it would cause near-far problem if configured. On the other hand, some companies think it is beneficial since in this case a larger power ramping step or larger preamble received target power or a larger number of PRACH attempts can be configured for UEs requesting Msg3 repetition targeting for UEs with bad link quality, and it could facilitate UE to decide whether to trigger Msg3 repetition.

**Recommendation for reply:** RAN1 has no consensus to optionally configure a separate set of RACH parameters for *preambleReceivedTargetPower, powerRampingStep, preambleTransMax* for requesting Msg3 repetition with shared RO. On one hand, RAN1 thinks it would cause near-far problem if such parameters are separately configured. On the other hand, it might be beneficial since in this case a larger power ramping step or larger preamble received target power or a larger number of PRACH attempts can be configured for UEs requesting Msg3 repetition targeting for UEs with bad link quality, and it could facilitate UE to decide whether to trigger Msg3 repetition.

### First round

**What’s your views on Question 3 in RAN2 LS, and do you have any concerns on the recommended reply from moderator?**

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| --- | --- |
| **Company** | **Comments** |
| Huawei, HiSilicon | We don’t see any benefit to have larger preamble received target power. Because the power control for preamble is per slot regardless repetition and its per-slot transmission power has been limited by UE power for the scenario of Msg3 repetition, increasing received target power does not increase UE transmission power.  Similarly, in a power-limited scheme like Msg3 repetition, we are not sure how a larger power ramping step is effective and has any benefit, since the UE has already tried its maximum UL power anyway.  Regarding a larger number of PRACH attempts, it causes longer channel occupation by the UE with worse channel quality, resulting in more collision with those UEs of better channel quality. Considering its side effect, it seems too early to claim larger number of PRACH attempts is beneficial to Msg3 repetition.  Therefore, we suggest to remove the text about benefit at least for power ramping step and target power. |
| Intel | For shared RO cases, we do not think we need to configure separate RACH power setting parameters, which would lead to undesirable impact on the legacy system. The same design principle was agreed for 2-step RACH and 4-step RACH, where in the shared RO case, same power control setting parameters are reused.  In the reply, we would like to mention that RAN1 has not agreed on the support of separate ROs for requesting Msg3 PUSCH repetition. If this is agreed, in our view, a separate set of RACH parameters can be configured, which can help improve the performance for initial access. |
| Ericsson1 | We were assuming this proposal is relate to separate RO case in which separate PRACH configurations are useful without affecting legacy RA.  For shared RO, to avoid impact to legacy RA, we also think that separate power ramping related parameters should be precluded.  Regarding whether separate RO should be supported for msg3 repetition, we think this is necessary so that independent PRACH configurations for msg3 can be supported especially when the system load is high, similar to the discussions we had in Rel-16 when we introduce 2-step RACH. And I guess RAN2 was assuming separate RO case as well when discussing these separate parameters. |
| NTT DOCOMO | We believe that the separate number of PRACH attempts *preambleTransMax* is beneficial.  It is difficult to estimate the uplink channel quality based on only RSRP of the downlink pathloss reference. If perfect RSRP target power and threshold for all UEs within a cell can be configured, power ramping of PRACH is not necessary from the beginning. Anyway, given that downlink pathloss-based uplink estimation is not impeccable, some UE do not request Msg3 repetitions even though uplink channel is poor. To save that UE, it is beneficial to separate the number of PRACH attempts to facilitate UEs to decide whether to trigger Msg3.  Also, the separate number of PRACH attempts was introduced for MsgA. It just follows the same structure.  Channel occupation is picked up as a side effect form other company. However, *preambleTransMax* is configured parameter. If channel occupation is concerned, why not to configure a small value as *preambleTransMax*? We could not find any side effect of having this feature. |
| Sharp | For shared RO, power control related parameters *preambleReceivedTargetPower, powerRampingStep,* may lead to an issue of larger interference to legacy PRACH transmission. On the other hand, for *preambleTransMax*, we don’t see any concern from RAN1 perspective.  For separate RO, we found no concern for all the 3 parameters from RAN1 perspective. |
| Panasonic | For shared RO, in order to have similar received power at gNB for the orthogonality of the preamble, we don’t support the proposal.  For separate RO, we agree to have separate power setting possibility. |
| CATT | We do not think it essential to support separate set of RACH parameters. We are fine to have such conclusion. |
| vivo | For shared RO, we do not see necessity for separated *preambleReceivedTargetPower, powerRampingStep, preambleTransMax* configurations.  For preambleReceivedTargetPower, it is a broadcast parameter to all UEs in the cell. NW need to consider the poor coverage UEs when providing this parameter. Hence, NW has no intention to configure a low target receive power for PRACH. Furthermore, poor coverage UE which request Msg3 repetition may have already reached the Max Tx power if the RSRP threshold is properly configured, which makes it meaningless to configure a different preambleReceivedTargetPower.  The difference between Rel-17 UEs which request Msg3 repetitions and those do not request Msg3 repetitions is pathloss, which have been taken into account in RAN1 power control mechanism. Furthermore, a different power ramping step also seems meaningless if UE has already reached the Max Tx power. We can not see the benefit to configure a separate power ramping step either.  Besides, a Rel-17 PRACH procedure with Msg3 repetition with same number of attempts according to preambleTransMax can provide higher accessibility compared with that in Rel-16. The benefit of configuring a different configuration for preambleTransMax is also not clear. |
| Xiaomi | We share the same vies as Sharp. For shared RO, a larger received target power or a larger power ramping step will have impact on the legacy RACH procedure. While, a larger maximum number of preamble transmission is beneficial to the success of RACH procedure of CE UEs at cell edge.  So, we suggest separate *premableTransMax* can be configured. |
| Nokia/NSB | Agree with vivo. The supposed beneficial impact of a change of *preambleTransMax* has never been studied and should not be advocated so light-heartedly. This can have a detrimental impact on all other transmissions making use of PRACH resources in Rel-17. Please also note that PRACH enhancements are being currently discussed as a candidate for Rel-18 content. Further enhancements in this sense could also be achieved, without touching important cell-specific parameters like *preambleTransMax*, or *preambleReceivedTargetPowe.* Concerning *powerRampingStep*, we fully agree with Huawei.  Proposed reply is not suitable in our view. We know at the last the following three effects would be observed, for sure:   * Near-far problem; * Channel accessibility issues compared to Rel-16; * Longer channel occupation by the UE with worse channel quality, resulting in more collision with those UEs of better channel quality.   We cannot agree on the extent of these issues as a group, and their impact, we acknowledge this. However, the fact that they **will be** present is rather obvious.  Conversely, the supposed advantages are simply general statements which do not account for the fact that a UE in coverage shortage is already transmitting at max power and that power control is performed over the slot anyway. Indeed, what is proposed is to say that configuring a separate set of RACH parameters for *preambleReceivedTargetPower, powerRampingStep, preambleTransMax* for requesting Msg3 repetition with shared RO **might be** beneficial. |
| LG | We don’t see any benefit of configuring a separate set of RACH parameter for msg3 repetition in terms of coverage enhancement. So we are agree on RAN1 has no consensus to this subject. |
| InterDigital | Our view is to support configuring a separate set of RACH parameters for Msg1 transmission used to request Msg3 repetition.  If the UE is in bad coverage for msg3, it is also likely in bad coverage for Msg1 detection. These parameters (*preambleReceivedTargetPower*, *power ramping step*, *preambleTransMax*) can be configured differently for prioritized RACH in TS 38.321, so this type of RA procedure with Msg3 repetition can be considered part of it. |
| ZTE | We prefer to separately configure the three RRC parameters. It could provide more flexibility for NW and could be potentially beneficial. For instance, NW can configure a larger ramping step to quickly boost up the power in case the UE is in cell edge using Msg3 repetition, or configure a larger value of *preambleTransMax* to increase the chance to successfully detect PRACH transmission. |
| Qualcomm | Agree with recommended reply. |
| Apple | We support moderator’s recommendation (have similar view as LG) |
| OPPO | Agree with recommended reply. |

## Others

In addition, it’s better to explicitly inform RAN2 about RAN1 understanding on other RRC parameters for requesting Msg3 repetition. However, whether to include such information depends on the discussion in email thread [106bis-e-NR-R17-CovEnh-05].

Reference

1. R1-2108712 LS on Msg3 repetition in coverage enhancement RAN2, ZTE
2. R1-2110095 Draft Reply LS on Msg3 repetition in coverage enhancement LG Electronics
3. R1-2110362 Discussion on LS on Msg3 PUSH repetition Huawei, HiSilicon
4. R1-2108838 [DRAFT] Reply LS on Msg3 repetition in coverage enhancement ZTE
5. R1-2108942 Discussion on RAN2 LS on Msg3 repetition in coverage enhancement vivo
6. R1-2109588 Discussion on RAN2 LS on Msg3 repetition in coverage enhancement Intel Corporation
7. R1-2110160 Draft reply LS on Msg3 repetition in coverage enhancement Qualcomm Incorporated
8. R1-2110360 Draft Reply on Msg3 Repetition in Coverage Enhancement Ericsson
9. R1-2110236 Type A PUSCH repetitions for Msg3 InterDigital, Inc.
10. R1-2110004 Type-A PUSCH repetition for msg3 Sharp
11. R1-2109696 Type A PUSCH repetitions for Msg3 NTT DOCOMO, INC.