3GPP TSG-RAN WG2 #123 draft R2-22xxxxx

Toulouse, FR, 21 Aug – 25 Aug 2023

Agenda Item: x.x.x.x

Source: Huawei, HiSilicon

Title: Summary of [Post122][801][R18CEenh-CP] CP open issues (Huawei)

Document for: Decision

# 1 Introduction

This document aims at discussing the following RAN2#122 Post discussion.

* [Post122][801][R18CEenh-CP] CP open issues (Huawei)

Scope: Discuss the CP open issues (apart from any issue overlapping with the fallbacks), including open issues for SI request, details of CFRA for reconfigurationWithSync, Configuration of RSRP thresholds, any other CP open issues.

Intended outcome: Agreeable proposals

Deadline: Long, until next meeting (August 10 1000 UTC)

In this document we will have two phases discussion: **phase 1 and phase 2**. Phase 1 aims to collect the views and comments on the initial open issues and phase 2 aims to further collect views and comments to the further issues based on the outcome of phase 1 and UP open issues discussion and possibly to produce a TP for an early review.

Contact person(s) for each participating company:

|  |  |  |
| --- | --- | --- |
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# 2 CP open issues - Phase 1

2.1 Stage-2 level discussion

2.1.1. MSG1-based SI request

In the last RAN2 meeting, SI request support was discussed with the following conclusion that it is FFS for MSG1 repetition can be applicable to the 4-step CBRA procedure initiated by MSG1-based SI request [1].

|  |
| --- |
| Agreements   1. MSG1 repetition can be applicable to the 4-step CBRA procedure initiated by Msg3-based SI request 2. FFS for MSG1 repetition can be applicable to the 4-step CBRA procedure initiated by Msg1-based SI request. |

The proponent companies see the benefit to support MSG1 repetition for MSG1-based SI request, and additionally think it is feasible to configure separate RA resources for MSG1 repetition by extending the existing IE *SI-RequestConfg* [2]. However, the opponent companies think it adds significant complexity for configuration and also see some parameters have dependency with RAN1 [3] [4].

Note that the current RA resource configuration for MSG1 based SI request is shown below:

|  |
| --- |
| SI-RequestConfig ::= SEQUENCE {  rach-OccasionsSI SEQUENCE {  rach-ConfigSI RACH-ConfigGeneric,  ssb-perRACH-Occasion ENUMERATED {oneEighth, oneFourth, oneHalf, one, two, four, eight, sixteen}  } OPTIONAL, -- Need R  si-RequestPeriod ENUMERATED {one, two, four, six, eight, ten, twelve, sixteen} OPTIONAL, -- Need R  si-RequestResources SEQUENCE (SIZE (1..maxSI-Message)) OF SI-RequestResources  }  SI-RequestResources ::= SEQUENCE {  ra-PreambleStartIndex INTEGER (0..63),  ra-AssociationPeriodIndex INTEGER (0..15) OPTIONAL, -- Need R  ra-ssb-OccasionMaskIndex INTEGER (0..15) OPTIONAL -- Need R  } |

From the RRC CR rapporteur point of view, the moderator would like to remind the potential RRC procedural impact, provided that it is RRC layer who determines whether to initiate MSG1 or MSG3-based SI request and indicates the outcome to MAC layer. Thus, obviously the RRC specification impact is not small. Based on the above analysis, the moderator suggest not to support MSG1-based SI request in R18, companies are encouraged to provide your views by indicating support or not, and detailed comments.

**Question 1: Do you agree that MSG1 repetition cannot be applicable to MSG1-based SI request?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes or not** | **Comments** |
| Samsung | No | Configuration Aspect:   * In our view since RACH configuration/partition for 2/4/8 repetitions is different, Msg1 based SI request can be easily supported by configuring si-RequestConfigRepetitionNum2/ si-RequestConfigRepetitionNum4/ si-RequestConfigRepetitionNum8 in addition to si-RequestConfig. Each of these are of type SI-RequestConfig * No need to modify SI-RequestConfig   Procedure Aspect:   * Agree that change is needed in RRC but we do not think it is complex to extend the current procedure |
| Ericsson | No | We think it is applicable, but the impact, and whether or not it should be worth the effort could be discussed. |
| Huawei, Hisilicon | Yes | For Samsung’s approach, the RACH resource overhead/fragmentation should not be ignored since each on-demand SI needs to associate with separate RACH partitions for 2/4/8 repetitions.  One the other hand, even if UE is in a bad coverage, we think that MSG3 based SI request with MSG1 repetition can be alternative to SI request, so we don't see any urgency with it. |
| vivo | No | In our understanding, the configuration method for Msg1-based SI request with preamble repetition can be reused from that for preambles for initial access with preamble repetition, e.g. we will introduce multiple partitions for CBRA preambles for different repetition numbers via setting the preamble starting index and number of preambles, which can be reused for setting the preambles for Msg1-based SI request (also similarly to the configuration of 2-step CFRA). So, from the signaling point of view, we are not convinced that the complexity of the Msg1-based SI request is unacceptable (as long as we support repetition for CBRA preambles, then we should also support the Msg1-based SI request case).  From the MAC perspective, we assume the UE behavior is common in the case of triggering Msg1 repetition, e.g. as long as RA resources for both repetition and non-repetition are configured, then the UE can determine whether to do the Msg1 repetition based on RSRP threshold.  Based on the above, we fail to see any essential technical challenges to give up preamble repetition support for Msg1-based SI request. |
| Qualcomm | No strong view | On one hand it helps deployment and helps the UE enhancing coverage with manageable RRC impact, on the other hand there is a MSG3 based SI request alternative that can utilize PRACH repetition so we can follow majority. |
| CATT | Prefer to No | We prefer to supporting MSG1 repetition for MSG1-based SI request.  According to 5.2.2.3.3 of 38.331, if SIB1 includes si-SchedulingInfo containing si-RequestConfig, the UE will use the MSG1-based solution for SI request. So if SIB1 includes si-SchedulingInfo containing si-RequestConfig, the UE with bad coverage has no chance to use MSG3-based solution for SI request.  And in this case, if MSG1 repetition cannot be used for MSG1-based SI request, maybe the UE with bad coverage cannot access the network successfully, even the UE supports MSG1 repetition. Because the UE cannot obtain the necessary SIB the broad status of which is notBroadcasting. This will impose restriction on network implementation, because the network will not set the broadcast status of some SIB to notBroadcasting, if it wants to guarantee the UE need MSG1 repetition can also access the network. |
| ZTE | No strong view | Same view as Qualcomm, we think it is not a big problem if Msg1 repetition is not supported for Msg1-based SI request, anyway, the UE can trigger Msg3-based SI request and Msg3 repetition can be used if the UE is in bad coverage. |
| Apple | No strong view |  |
| LGE | Yes with comment | Samsung’s approach is possible if RAN2 agrees that Msg1 repetition is applicable to Msg1-based SI request, i.e*., si-RequestConfigRepetitionNum2*, *si-RequestConfigRepetitionNum4*, *si-RequestConfigRepetitionNum8* for different repetition number.  However, it causes impacts in configuration and RA procedure (or RRC procedure), including:   * Additional RACH resource for SI request should be reserved, which causes the RACH resource fragmentation (as in Huawei’s comment) * Whether the selection of RACH resource for SI request is based on the RSRP of pathloss measurement, e.g.,   + RACH resource for SI request with different repetition number may be configured with the separated RSRP threshold, i.e., UE only uses the SI request with different repetition number only if the channel condition is bad.   + RACH resource for SI request with highest repetition number is always used by UE, if the UE can perform the PRACH repetition. This avoids the multiple CFRA resource reservation for same RA purpose.   Given that Msg1-based SI request can be performed by any UE in the cell and RACH resource fragmentation is expected, further discussion is required whether it is really needed.  We are okay to discuss on Huawei’s approach to perform Msg3-based SI request in bad coverage. However, note that another RSRP threshold is needed to determine whether to perform Msg1-based SI request or Msg3-based SI request, since UE always perform Msg1-based SI request when the Random Access resource for Msg1-based SI request is configured (regardless of channel condition) |

**Summary:**

9 companies participated in the discussion.

* Yes: 2
* No: 4
* Neutral: 3

The slight majority prefer that the MSG1 repetition can be applicable. Hence the modorater suggest to follow the majority and would like to have the following proposal.

**Proposal 1: MSG1 repetition can be applicable to 4-step CBRA procedure initiated by Msg1-based SI request (4/2).**

For the issues in bad coverage (e.g. whether to make sure UE is able to select MSG1 repetitions for SI request) as mentioned by Huawei, CATT and LGE, the moderator think this can be further discussed in the phase 2. Companies are invited to share your view there.

Companies also mentioned configuration details on how to configure the RACH resources and the moderator thinks this can be further discussed in the phase 2.

The TP can be made after phase 2 discussion.

2.2 Stage-3 level discussion

2.2.1 RSRP threshold configuration details

At RAN2#122 meeting, the following agreement are made for RSRP threshold(s).

|  |
| --- |
| Agreements   1. RAN2 to agree to configure multiple RSRP thresholds for different repetition numbers 2. The RSRP threshold(s) for triggering Msg1 repetition are configured per-BWP |

Based on the above agreement, the new RSRP threshold(s) parameter for MSG1 repetition numbers (2, 4 and 8) should be included under *BWP-UplinkCommon* IE, similar as R17 CE. Regarding the configuration details, moderator think that we could discuss the details on how to configure the RSRP threshold(s) by ASN.1, and there can be two following options to choose.

* **Option 1: use SEQUENCE structure like:**

rsrp-ThresholdMsg1-r18 SEQUENCE (SIZE (1..3)) OF RSRP-Range OPTIONAL, -- Cond Msg1Rep

With this option, all the RSRP thresholds, if configured, are configured in one list with simplicity, but it needs additional efforts to explain the association between the particular RSRP thresholds and the repetition number.

* **Option 2: use separate parameters like:**

rsrp-ThresholdMsg-RepetitionNum2-r18 RSRP-Range OPTIONAL, -- Cond Msg1Rep

rsrp-ThresholdMsg1-RepetitionNum4-r18 RSRP-Range OPTIONAL, -- Cond Msg1Rep

rsrp-ThresholdMsg1-RepetitionNum8-r18 RSRP-Range OPTIONAL, -- Cond Msg1Rep

With this option, the RSRP threshold is configured separately corresponding to the repetition number. This structure has the advantages of self-explanation but has higher overhead from ASN.1 coding.

**Question 2: Which option is preferred for configuring RSRP threshold(s) of MSG1 repetition in ASN.1?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Option 1 or option 2** | **Comments** |
| Samsung | Option 1 |  |
| Ericsson | Option 1 |  |
| Huawei, Hisilicon | Option 2 | Option 2 has better readability |
| vivo | Option 1 | It is aligned with LTE CE configuration and it helps to reduce signaling overhead. |
| Qualcomm | Option 2 | Easier if not all repetitions are configured. This can be revisited once fallbacks are agreed on in UP discussion. |
| CATT | Option 1 | The signaling overhead is lower in Option 1. |
| ZTE | Option 2 | It is possible the network only configures RACH resources for repetition Num2 and Num8 (not Num4), in this case, Option 2 is better for indicating corresponding RSRP thresholds.  We also agree with Qualcomm that this can be revisited after the fallback discussions. |
| Apple | Option 2 | Both options can work but Option 2 is more readable. |
| LGE | Option 2 | Option 2 looks better considering the case that network may not configure the RACH partition for all repetition number. In other words, each RSRP threshold should be associated with the repetition number, e.g., to differentiate Case 1 and Case 2:   * Case 1: RACH partition for repetition 2 and RACH partition for repetition 4 is configured in the BWP * Case 2: RACH partition for repetition 4 and RACH partition for repetition 8 is configured in the BWP |

**Summary:**

9 companies participated in the discussion.

* Option 1: 4
* Option 2: 5

The slight majority prefer option 2. The moderator thinks this issue is not critical but from the perspective of CE RRC CR rapporteur, it seems that option 2 would be more readable considering if not all repetitions are configured as many companies mentioned.

**Proposal 2: Each RSRP threshold is configured separately by RRC, which is associated with a repetition number if configured (5/4).**

No needed for phase 2 discussion on this issue and companies can review the CR with option 2.

2.2.2 Feature priority configuration details

In the existing RA partitioning framework, feature priorities are used to determine which *FeatureCombinationPreambles* the UE shall use when a feature maps to more than one *FeatureCombinationPreambles*. And SIB1 or *ServingCellConfigCommon* shall always provide a feature priority (as shown below) for a feature if a RA resource set associated with the feature are provided in the *RACH-ConfigCommon*.

|  |
| --- |
| featurePriorities-r17 SEQUENCE {  redCapPriority-r17 FeaturePriority-r17 OPTIONAL, -- Need R  slicingPriority-r17 FeaturePriority-r17 OPTIONAL, -- Need R  msg3-Repetitions-Priority-r17 FeaturePriority-r17 OPTIONAL, -- Need R  sdt-Priority-r17 FeaturePriority-r17 OPTIONAL -- Need R  } OPTIONAL -- Need R  ]], |

However, the moderator finds company’s views are diverging on how to configure the feature priority for different repetition number. Some company thinks that the UE can prioritize the feature combination with higher repetition number when multiple feature combinations with different repetition number are met, and thus a single priority is sufficient [5]. However, [4] thinks that RAN2 agreed to re-use the RA partitioning framework for MSG1 repetition in R18 CE and further to treat each MSG1 repetition number (e.g. 2, 4 and 8) as separate feature, and in some sense, the network is allowed to configure the equal priority that can cover the single priority case. Therefore, it is straightforward to introduce new feature priority (ies) for different repetition number, similarly as R17 features.

Given the situation, the moderator would like companies to pick one between the following two options:

* **Option 1**: a single feature priority, i.e. all the MSG1 repetition numbers use the same feature priority.
* **Option 2:** separate feature priorities, i.e. each MSG1 repetition number has separate feature priority.

**Question 3: Which option is preferred for configuring feature priority of MSG1 repetition?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Option 1 or option 2** | **Comments** |
| Samsung | Option 1 |  |
| Ericsson | Option 1 |  |
| Huawei, Hisilicon | Option 2 | Option 1 may need a fixed priority/rule captured in MAC for selecting between different repetitions numbers which makes the procedure of selection more complicated.  Moreover, if a fixed priority is introduced, RAN2 may need to re-discuss the priority if a new repetition number is introduced in the future. To avoid any re-discussion in the future, we choose to have a configurable feature priority as in R17 for future proof. |
| vivo | Option 1 | We think the motivation for selecting an appropriate repetition number should only be based on radio conditions. We fail to see the necessity of using separate priority configurations. |
| Qualcomm | Option 1 | No good reason to have different prioritization between repetition numbers. |
| CATT | Option 1 | We can accept Option 1, for simplification. And we see no obvious benefits for introducing separate feature priorities.  Furthermore, we also think that, maybe we need not to introduce priority to Msg1 repetition, the UE just select the RACH resource based on its channel quality, and the priority of other/existing feature.  Actually, the repetition number is more related with the channel quality, even we may define it as a feature. For example, we confige Redcap with higher priority, and configure Msg1 repetition with lower priority, if a Redcap with bad coverage triggers a RACH procedure, the Redcap UE should use the configuration for Msg1 repetition, otherwise, the preamble from the Redcap UE will not be detected by network. |
| ZTE | Option1 | In our view, Option 2 is only useful if network wants to configure the priority of other feature to be in the middle of different repetition numbers, for example:   * Msg1 repetition Num8 > Slice/RedCap/Msg3\_rep > Msg1 repetition Num2   If we don’t have such requirements, then Option 1 is sufficient.  We think Option 1 does not mean we need to define a fixed priority for Msg1 repetition, the configured priority for Msg1 repetition is used to compare with features other than Msg1 repetition. Among different Msg1 repetition numbers, we always assume that Num8 > Num4 > Num2. This can be captured as a general principle in MAC spec. Even if new repetition number is introduced in the future, the same principle is applied (i.e. higher repetition number has higher priority). |
| Apple | Option 1 | We actually don’t see the motivation to assign different priorities to different repetitions. UE should use RSRP threshold rather than priority to determine the repetition number. Thus how does the different priority values kick in here? |
| LGE | Option 1 | Given that the feature priority value is defined between 0 to 7 (i.e., 4 spaces left to define new feature priorities), defining separated feature priority for each repetition number (i.e., Option 2) is risky considering the potential new RACH partitioning feature(s) in other WIs and future releases. Since it is natural that the high repetition number has higher priority than low repetition number within the PRACH repetition feature, a single feature priority (i.e., Option 1) seems enough which is commonly applied to all repetition number. |

**Summary:**

9 companies participated in the discussion.

* Option 1: 8
* Option 2: 1

The companies are converaging in this question. The overwhelming majority prefer option 1. Hence the moderator suggests to follow the majority, and would like to have the following proposal.

**Proposal 3: A single feature priority for MSG1 repetition is configured by RRC, i.e. all the MSG1 repetition numbers use the same feature priority (8/1).**

No needed for phase 2 discussion on this issue and companies can review the CR based on the above proposal.

2.2.3 CFRA details

In last RAN2 meeting, RAN2 discussed the support of CFRA for MSG1 repetition and the following WA was reached that for *ReconfigurationWithSync* the CFRA for MSG1 repetition is intended to support for RAN2. For other case, RAN2 leaved it as FFS as show below:

|  |
| --- |
| Agreements   1. RAN2 intends to support CFRA for msg1 repetition for ReconfigurationWithSync case, FFS for other cases. |

The moderator understands that the above WA is based on the common assumption that there is no RAN1 impact for CFRA support. Since there is only one RAN1 meeting left for R18 CE, any case with clearly RAN1 impact is not desirable and should not be considered.

a) PDCCH order based CFRA with MSG1 repetition

The moderator thinks it certainly has RAN1 impact, e.g. new parameter (i.e. repetition number) shall be added to PDCCH order for indicating the repetition number to be used.

**Question 4: Do you agree that CFRA with MSG1 repetition for PDCCH order has RAN1 impact and should not be considered in RAN2?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes or No** | **Comments** |
| Samsung | - | Agree that it has RAN1 impact. However, the impact seems small. New parameter (i.e. repetition number) is sufficient. |
| Ericsson |  | Some RAN1 impact might be acceptable |
| Huawei, Hisilicon | Yes | In general, we agree with the moderator that any functionality with RAN1 impact should not be considered by RAN2 at this stage.  In addition to the repetition number indicator as mentioned by the moderator, we think the RO mask for PDCCH order based CFRA also needs some updates in RAN1 spec. |
| vivo | No | It depends on the detailed solution. For example, if the CFRA resources can be delivered via RRC configuration, then UE could select the preamble based on the selected repetition number (ignoring the indicated preamble in PDCCH order). If so, there might be no RAN1 impact (DCI format is not impacted and all the UE procedure is defined in RAN2). |
| Qualcomm |  | We see some benefits to support from RAN2 standpoint. Since there may be RAN1 impact, perhaps RAN2 can agree to support and leave it for RAN1 to decide on support next meeting |
| CATT | Comments | We share the same view that CFRA has RAN1 impacts. We are wondering whether we can send LS to RAN1 to ask whether CFRA with MSG1 repetition for PDCCH order can be considered in RAN1 considering RAN1 may have no time to discuss this. And in LTE, “Starting CE level” in DCI has be supported for eMTC, and “Starting number of NPRACH repetitions” in DCI has been supported for NB-IoT. The impact on RAN1 is not so big. |
| ZTE |  | We agree that it has RAN1 impact, but from RAN2 perspective, we also see benefit of supporting it. We think RAN2 cannot conclude this is not supported just because of the concern on RAN1 impact.  We suggest to send LS to RAN1, to indicate that RAN2 see benefits of supporting this and ask RAN1 to further evaluate the spec impact and make final decision. |
| Apple |  | We agree it may impact RAN1 if PDCCH order based CFRA is supported for MSG1 repetition.  RAN1 discussed this but has no conclusion. We think if RAN2 sees the benefits then we can send a LS to RAN1. |
| LGE | - | Agree that RAN1 impact is expected to design the PDCCH order format with the repetition number.  However, as other companies’ comment, we are okay to discuss on benefits to support the PRACH repetition for PDCCH order, and send an LS to leave the final dicision in RAN1, if RAN2 agrees on the benefits. |

**Summary:**

9 companies participated in the discussion.

The most majority agree CFRA has RAN1 impact, only 1 company think it may not have RAN1 impact. 4 companies are mentioned to send RAN1 LS on the feasibility or necessity. For the progress, the modorater woud suggest that RAN2 sends a LS to RAN1 asking the feasibility and necessity on the support of PDCCH order based CFRA with MSG1 repetition. The moderator plans to submit a LS to RAN1 on this.

**Proposal 4: Send LS to RAN1 to ask the feasibility and necessity on the support of PDCCH order based CFRA with MSG1 repetition.**

No needed for phase 2 discussion on this issue.

b) BFR based CFRA

BFR procedure is also well-designed in RAN1 spec and it may also have RAN1 impact then if supported. In addition, BFR is initiated by the UE after beam failure is detected based on the threshold(s) while HO is by the network, so BFR support may require a different solution which introduce considerable spec complexity. Considering only one RAN1 meeting left, the moderator suggest not to consider BFR based CFRA for MSG1 repetition.

**Question 5: Do you agree that CFRA with MSG1 repetition for BFR should not be considered in RAN2?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes or No** | **Comments** |
| Samsung | - | No strong view. Ok to follow majority view. |
| Ericsson | No | I think RAN2 should act to support this, and if RAN1 can’t accept then it will be the case. Should be discussed in RAN2#123. |
| Huawei, Hisilicon | Yes | We agree with the moderator that any functionality with RAN1 impact should not be considered by RAN2 at this stage. At least, it needs double check with RAN1 but it seems not feasible to settle the feature down in one RAN1 meeting. |
| vivo | Comments | Agree with the analysis from the rapporteur. Maybe we should ask RAN1 about the feasibility and necessity via LS. |
| Qualcomm | No | Agree with Ericsson |
| CATT | Yes | We think supporting CFRA with MSG1 repetition for BFR will introduce great burden on PRACH resource fragmentation considering BFR is configured per UE which is not per cell configured. |
| ZTE | No | We do not have strong view in supporting this, but if this is going to be supported, we need to further discuss the fallback from “BFR CFRA with Msg1 repetition” to “BFR CBRA with Msg1 repetition” which is not preferred by us. |
| Apple | No strong view | We are open to discuss it. |
| LGE | No strong view | We are open to discuss the benefits of CFRA support for BFR case in RAN2, but it should be informed to RAN1 if RAN2 aims to support the CFRA for BFR case. |

**Summary:**

9 companies participated in the discussion.

* Yes: 2
* No: 3
* Neutral: 4

The view seems diveraging. 1 company shares concern on PRACH resource fragmentation for BFR and 4 companies mentioned to ask RAN1. The modorater would suggest to send a LS to RAN1 asking the feasibility and necessity on support CFRA with MSG1 repetition for BFR for the progress. We can check with RAN1 on both PDCCH order based CFRA and BFR CFRA. The moderator plans to submit a LS to RAN1 on this.

**Proposal 5: Send LS to RAN1 to ask the feasibility and necessity on the support of CFRA with MSG1 repetition for BFR.**

No needed for phase 2 discussion on this issue.

If companies answered **NO** the Question 5, i.e. BFR based CFRA should be supported for MSG1 repetition, you are encouraged to further elaborate the procedure/framework how to enable it in the following Question 6, from RRC and MAC perspective.

**Question 6: If you think BFR based CFRA should be supported for MSG1 repetition, what would be the procedure/framework?**

|  |  |
| --- | --- |
| **Company** | **Solution** |
|  | Separate CFRA configuration for each of 2, 4, and 8 repetitions would be needed in BFR configuration. UE select one CFRA configuration based on the threshold at the time random access is initiated for BFR. |
| Samsung |  |
| Ericsson | Samsungs proposal above is one option that we agree on. |
| vivo | As mentioned above, we agree that separate CFRA configurations (e.g. CFRA preambles and RSRP threshold) for preamble repetition are needed in the RRC configuration. For MAC, similar to the CBRA case, the UE can select a preamble indicating an appropriate repetition number. |
| Qualcomm | Agree with Samsung |
| LGE | In CFRA resource configuration within BFR configuration, repetition number can be additionally configured, which is similar to option 1 in Question 7 |

No summary on this question.

c) CFRA procedure

For CBRA, CBRA resource for MSG1 repetition number 2, 4 and 8 are provided in SIB1 in advance for UE to choose since network has no clue on the UE’s channel condition when it is accessing to the network. UE chooses the CBRA resource associated with a suitable MSG1 repetition number based on the RSRP of current position. However for CFRA with MSG1 repetition, some company think that network can indicate whether 4 step CFRA resources corresponds to RACH attempt with 0/2/4/8 Msg1 repetitions in *ReconfigurationWithSync*[3][7].

Some company provided some more details for solutions about the selection of a number of MSG1 repetition.

In [3] it is mentioned that UE select the set of random access resources corresponding to the indicated number of Msg1 repetitions. In [5] it is mentioned to optionally configure a threshold for UE to select the number of MSG1 repetition for CFRA. In [6] the following approaches are proposed to be discussed.

|  |
| --- |
| * Option A) One set of Msg1 repetitions applicable for all SSBs. * Option B) One individual K factor for each SSB. * Option C) A set of repetition factors (denoted K) per SSB, which the UE can select between based on specified criteria. |

In a summary, the moderator think there can be several options for CFRA procedure

* **Option 1: NW indicates ONE MSG1 repetition number**

With this option, the number of MSG1 repetition and corresponding CFRA resources are configured by the network via dedicated RRC signaling, the UE shall follow the network instruction and select a suitable CFRA resource for the indicated repetition number. However, whether the number of MSG1 repetition is applicable for all SSBs/CFRA resources, or per SSB/CFRA resource needs further discussion as in [6]. The moderator thinks if it is per SSB, the repetition number may be changed for each RA attempt, which should be further discussed in the modeling of fallback in UP email discussion.

* **Option 2: NW indicates MULTIPLE MSG1 repetition numbers + UE selects the applicable repetition number**

With this option, network configures more than one number of MSG1 repetitions, where each number of MSG1 repetition is corresponding to separate CFRA resources. The UE shall determine the applicable number of MSG1 repetition among the configured values and select the corresponding CFRA resources for the determined repetition number. However, how to determine the applicable number of MSG1 repetition, e.g. based on a configured RSRP threshold, needs further discussion. Similar to Option 1, if the repetition number is per SSB, potential fallback should be further discussed in the UP email discussion.

From the RRC rapporteur point of view, Option 2 is similar to CBRA procedure with the cost of CFRA resources which would also complicate the RRC and MAC specifications, and the necessity is questionable given that NW has the full knowledge of the link quality of the connected UE through measurement.

**Question 7: Which option is preferred for CFRA procedure in support of MSG1 repetition for *ReconfigrationWithSync*?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Option 1 or option 2** | **Comments** |
| Samsung | Option 1 | Just indicating one repetition number in CFRA configuration is sufficient.  Option 2 is complex and would require separate CFRA configuration for each of 2, 4, and 8 repetitions and then UE select one based on the threshold. |
| Ericsson | Option 2 | We think option 2 have some advantages, but we are willing to discuss approach. |
| Huawei, Hisilicon | Option 1 | Agree with Samsung.  Target cell can infer which repetition number is used for ReconfigurationWithSync based on the measurement result provided from the source cell so that it can provide RA resource for one particular repetition number to the source cell. |
| vivo | Option 2 | With option 2 the UE can select the more appropriate RA partition with a given repetition number, considering the already reported cell quality may be largely different than the latest measured RSRP of the downlink pathloss during HO. What’s worse, option 1 is not suitable for the CHO case. |
| Qualcomm | Option 1 | NW has sufficient information to choose repetition number. If the fallbacks are agreed in UP we can further revisit if it extends to CFRA as rapporteur mentioned  Option 2 would need some work on RO resources/RO groupings differentiation. |
| CATT | Option 1 | For CFRA procedure of MSG1 repetition for *ReconfigrationWIthSync*, the target Cell is aware of the channel status of the UE and can estimate the repetition number for MSG1 repetition. Hence, option 1 is enough. |
| ZTE | Option 1 | Option 1 is sufficient. |
| Apple | Option 1 preferred and see comments | We also think Option 1 is sufficient. But if BFR based CFRA is decided to support, we are also fine to pursue a unified solution. |
| LGE | Option 1 | Agree with Samsung and Huawei. For Option 2, multiple CFRA RACH resource for single UE should be reserved, which causes RACH resource shortage. Given that measurement report is provided prior to the Reconfiguration with Sync procedure, the network would be able to configure one appropriate repetition number based on the RSRP in the measurement report and the latency of the service. |

**Summary:**

9 companies participated in the discussion.

* Option 1: 7
* Option 2: 2

The majority prefer option 1. Hence to follow majority the moderator would like to have the following proposal.

**Proposal 6: NW indicates ONE MSG1 repetition number applicable for CFRA MSG1 repetition by RRC for Reconfiguration with sync. (7/2)**

No needed for phase 2 discussion on this issue and companies can review the CR based on the above proposal.

**Question 8: If you indicate support of Option 2, how to select the applicable repetition number for the RA procedure?**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | UE select according to threshold. |
| vivo | We prefer to reuse the framework for CBRA with preamble repetition (i.e. based on the measured RSRP and the configured threshold). |
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No summary on this question.

2.2.4 Other issue

There are some other issues mentioned by contributions in the last meeting, e.g. Group B with MSG1 repetition, the number of Additional RACH configurations, Msg3 repetition parameters with Msg1 repetition. However, the moderator think they are either pending to RAN1 or are too early to decide. So the moderator would suggest not to include them but companies are welcomed to propose in the next RAN2 meeting. But in case if any company see some issue worthy to be discussed in this email discussion, please provide it by below.

|  |  |  |
| --- | --- | --- |
| **Company** | **Issue** | **Comments** |
| Qualcomm | Discuss separate PRACH repetition thresholds depending on UE power class | We think that different UE power classes should be able to assess different RSRP thresholds in order to determine whether to use PRACH repetions/the PRACH repetition number |
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Since not many companies have provided inputs, so moderator encourages the proponent companies to bring contributions to discuss in the next RAN2 meeting.

# 3 CP open issues - Phase 2

3.1 Configuration for MSG1-based SI request with MSG1 repetition

If MSG1 repetition is applicable for MSG1 based SI request, how to configure the MSG1 repetition resource in RRC layer. As mentioned by Samsung, separate SI-RequestConfig parameters can be introduced for each MSG1 repetition number. The moderator think this is a good start and invites company to share your view on the following question.

**Question 1: Do companies agree that separate SI-RequestConfig IE is introduced for repetition number 2, 4 and 8?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes or No** | **Comments** |
| Huawei, Hisilicon | Yes | There is no extension bit inside SI-RequestConfig IE.  Furthermore, RAN2 should discuss whether or not separate SI-RequestConfig with MSG1 repetition numbers can be applicable for RedCap and Positioning.  posSI-RequestConfig-r16 SI-RequestConfig OPTIONAL, -- Cond MSG-1  posSI-RequestConfigSUL-r16 SI-RequestConfig OPTIONAL, -- Cond SUL-MSG-1  ...,  [[  posSI-RequestConfigRedCap-r17 SI-RequestConfig OPTIONAL -- Cond REDCAP-MSG-1 |
| Samsung | Yes | Since RACH configuration is separate for 2/4/8 repetitions,SI request configuration needs to be sepereately signaled for 2/4/8 repetitions for each BWP on which Msg1 based SI request is allowed. |
| LGE | Yes |  |
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3.2 Selection for MSG1-based SI request and MSG3-based SI request

Currently RRC specifies whether MSG1 based SI request or MSG3 based request is used, e.g. UE always selects MSG1 based SI request if MSG1 based SI request resource is configured as below:

|  |
| --- |
| 5.2.2.3.3 Request for on demand system information  The UE shall, while SDT procedure is not ongoing:  1> if *SIB1* includes *si-SchedulingInfo* containing *si-RequestConfigSUL* and criteria to select supplementary uplink as defined in TS 38.321[3], clause 5.1.1 is met:  2> trigger the lower layer to initiate the Random Access procedure on supplementary uplink in accordance with TS 38.321 [3] using the PRACH preamble(s) and PRACH resource(s) in *si-RequestConfigSUL* corresponding to the SI message(s) that the UE requires to operate within the cell, and for which *si-BroadcastStatus* is set to *notBroadcasting*;  2> if acknowledgement for SI request is received from lower layers:  3> acquire the requested SI message(s) as defined in clause 5.2.2.3.2, immediately;  1> else if the UE is a RedCap UE and if *initialUplinkBWP-RedCap* is configured in *UplinkConfigCommonSIB* and if *SIB1* includes *si-SchedulingInfo* containing *si-RequestConfigRedCap* and criteria to select normal uplink as defined in TS 38.321[3], clause 5.1.1 is met:  2> trigger the lower layer to initiate the Random Access procedure on normal uplink in accordance with TS 38.321 [3] using the PRACH preamble(s) and PRACH resource(s) in *si-RequestConfigRedcap* corresponding to the SI message(s) that the UE requires to operate within the cell, and for which *si-BroadcastStatus* is set to *notBroadcasting*;  2> if acknowledgement for SI request is received from lower layers:  3> acquire the requested SI message(s) as defined in clause 5.2.2.3.2, immediately;  1> else:  2> if the UE is not a RedCap UE and if *SIB1* includes *si-SchedulingInfo* containing *si-RequestConfig* and criteria to select normal uplink as defined in TS 38.321[3], clause 5.1.1 is met; or  2> if the UE is a RedCap UE and if *initialUplinkBWP-RedCap* is not configured in *UplinkConfigCommonSIB* and if *SIB1* includes *si-SchedulingInfo* containing *si-RequestConfig* and criteria to select normal uplink as defined in TS 38.321[3], clause 5.1.1 is met:  3> trigger the lower layer to initiate the Random Access procedure on normal uplink in accordance with TS 38.321 [3] using the PRACH preamble(s) and PRACH resource(s) in *si-RequestConfig* corresponding to the SI message(s) that the UE requires to operate within the cell, and for which *si-BroadcastStatus* is set to *notBroadcasting*;  3> if acknowledgement for SI request is received from lower layers:  4> acquire the requested SI message(s) as defined in clause 5.2.2.3.2, immediately;  2> else:  […]  3> initiate transmission of the *RRCSystemInfoRequest* message with *rrcSystemInfoRequest* in accordance with 5.2.2.3.4;  3> if acknowledgement for *RRCSystemInfoRequest* message with *rrcSystemInfoRequest* is received from lower layers:  4> acquire the requested SI message(s) as defined in clause 5.2.2.3.2, immediately; |

Based on the phase 1 discussion, the companies mentioned the repetition selection procedure needs to be revisited if the existing spec is reused, i.e. UE may not be able to select repetition resource for SI request **in some configuration** when UE in a bad coverage according to the existing RRC procedure.

Below the moderator provides a summary table for all configuration cases with MSG1 repetition for MSG1 based SI request and MSG3 based SI request.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| case | MSG1 repetition for MSG1 based SI request | MSG1 repetition for MSG3 based SI request | MSG1 based SI request without MSG1 reqetition | MSG3 based SI request without MSG1 reqetition | UE behavious if following the existing spec and/or CE agreement so far. |
| 1 | Configured | Not configured | Not configured | Configured | UE will always perform RA with MSG1 repetition even in a good coverage, where the RSRP is above the thresholds for all MSG1 repetition number. |
| 2 | Not configured | Configured | Not configured | Configured | MAC layer will check the RSRP threshold for selecting the repetition number after it is indicated to perform MSG3 based SI request.  No issue. |
| 3 | Not configured | Not configured | Configured | Configured | Legacy behavior |
| 4 | Configured | Configured | Not configured | Configured | Same as case 1, UE will always perform RA with MSG1 repetition even in a good coverage, where the RSRP is above the thresholds for all repetition number. |
| 5 | Not configured | Configured | Configured | Configured | UE will always perform MSG1 based SI request without MSG1 repetition even in a bad coverage, where the RSRP is below the thresholds for all repetition number.  Access Problem: The UE may not be able to access the network. |
| 6 | Configured | Not configured | Configured | Configured | MAC layer will check the RSRP threshold for selecting the repetition number or selecting without repetition number after it is indicated to perform MSG1 based SI request from RRC.  No issue. |
| 7 | Configured | Configured | Configured | Configured | Same as case 6, MAC layer will check the RSRP threshold for selecting the repetition number or selecting without repetition number after it is indicated to perform MSG1 based SI request from RRC.  No issue. |

The modorater invite company to share the view on whether to consider the issue in case 1/4/5.

**Question 2: Do companies think whether or not the issue in case 1/4/5 should be considered and provide comments if any?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes or NO** | **Comments** |
| Huawei, Hisilicon | Yes |  |
| Samsung |  | In general,  UE should apply Msg1 based SI request with repetitions (on an UL carrier/BWP)   * if criteria for N (N equals 2 or 4 or 8) message 1 repetitions is met and if *SIB1* includes SI request configuration for N Msg1 repetitions (for that UL carrier/BWP)   For criteria of repetitions our understanding is as follows:  If set of random access resources for 8 Msg1 repetitions is configured in the BWP and if RSRP of the downlink pathloss reference < *rsrp-ThresholdPRACHRepetitons* for 8 Msg1 repetitions; or If BWP is configured only with set of random access resources for 8 Msg1 repetitions:   * Criteria for 8 msg1 repetitions is met   Else If set of random access resources for 4 Msg1 repetitions is configured in the BWP and if RSRP of the downlink pathloss reference < *rsrp-ThresholdPRACHRepetitons* for4 Msg1 repetitions; or If BWP is configured only with set of random access resources for 4 Msg1 repetitions:   * Criteria for 4 msg1 repetitions is met   Else If set of random access resources for 2 Msg1 repetitions is configured in the BWP and if RSRP of the downlink pathloss reference < *rsrp-ThresholdPRACHRepetitons* for2 Msg1 repetitions; or If BWP is configured only with set of random access resources for 2 Msg1 repetitions:   * Criteria for 2 msg1 repetitions is met   Else   * Criteria for no repetitions is met. |
| LGE | Comments | Case 1 and Case 4 are not usual cases since the legacy UE cannot perform Msg1-based SI request, i.e., Msg1-based SI request is allowed only for Rel-18 UE supporting Msg1 repetition. However, if Case 1/4 are supported, there is no issue to perform Msg1-based SI request with Msg1 repetition, since the Msg1-based SI request works anyway in any channel condition.  For Case 5, it depends on whether the Proposa 1 in Phase 1 is agreed:   * if Proposal 1 in Phase 1 (i.e., support Msg1 repetition for Msg1-based SI request) is agreed, it seems that this case is bad network configuration. However, it can be left to network implementation, i.e., no restriction nor additional procedure is needed. * If Proposal 1 in Phase 1 is not agreed, option 1 in Question 3 can be considered if the companies see benefits to perform the Msg1 repetition for SI request. |
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If companies think the issues are considered, the following options are available to address the issues in case 1/4/5.

* **Option 1: modify the existing procedure**, e.g. MSG1 repetition is selected (e.g. based on the criteria to select MSG1 repetition as captured in MAC layer) before selecting between the MSG1 based SI request and MSG3 based SI request in RRC layer. If a MSG1 repetition number is selected by MAC layer, RRC layer will select the MSG1 or MSG3 based SI request with this repetition number configured. If both MSG1 and MSG3 based SI request is configured with this MSG1 repetition number, the UE prioritise to choose the MSG1 based SI request with this MSG1 repetition number.
* **Option 2: reuse the existing procedure with network configuration restriction**. network cannot configure the case 1/4/5.

The modorater thinks the option 1 may introduce some procedure modification in RRC and interaction between RRC and MAC. The option 2 only impacts the configuration part which looks simple. Companies are invited to share your view on following question.

**Question 3: Do companies think which option is preferred to address issue in case 1/4/5?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Option 1 or option 2** | **Comments** |
| Huawei, Hisilicon | Option 2 | Agree with the moderator. Option 1 is simpler. |
| Samsung | - | Modifying the existing procedure is simple. No explicit interaction is needed between MAC and RRC. We can model is similar manner as we have done for SUL/NUL carrier selection.  We need to add condition for selecting Msg1 based SI request with repetitions before the condition for selecting Msg1 based SI request without repetitions in current spec. Example   * if criteria (as specified in TS 38.321) for N message 1 repetitions is met and if *SIB1* includes SI request configuration for N Msg1 repetitions for SUL and criteria (as specified in TS 38.321) to select SUL is met   + trigger the lower layer (i.e. MAC) to initiate the Random Access procedure on supplementary uplink using the PRACH preamble(s) and PRACH resource(s) in SI request configuration for N Msg1 repetitions corresponding to the SI message(s) that the UE requires to operate within the cell, and for which *si-BroadcastStatus* is set to *notBroadcasting*; |
| LGE | Comments | See our response in Question 2 |
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3.3 RA partitioning configuration details (pending to UP open issue discussion)

Based on the UP email discussion, the following option are mentioned for indicating the MSG1 repetition number.

* **Option 1:** use three reserved bits in *featureCombiantion* IE for indicating the MSG1 repetition number 2, 4 and 8.
* **Option 2:** use one reserved bit in *featureCombiantion* IE for indicating MSG1 repeititon as a feature and introduce a **new** paratmer in *featureCombinationPreamble* IE for indicating the associated MSG1 repetition number 2, 4 or 8.
* **Option 3:** introduce a **new** paratmer outside *featureCombiantion* IE for indicating the associated MSG1 repetition number 2, 4 or 8. No change to *featureCombiantion* IE.

Regarding the fallback issue in UP email discussion is ongoing, the moderator does not provide question here.

3.4 CR TP

TP is provided based on the phase 1 discussion. Companies are invited to comment there.

***SIB1* message**

-- ASN1START

-- TAG-SIB1-START

SIB1 ::= SEQUENCE {

…

SIB1-v1800-IEs ::= SEQUENCE {

msg1-RepetitionPriority-r18 FeaturePriority-r17 OPTIONAL, -- Need R

nonCriticalExtension SEQUENCE {} OPTIONAL

}

-- TAG-SIB1-STOP

-- ASN1STOP

|  |
| --- |
| ***msg1-RepetitionPriority***  Indicates a feature priority for MSG1-Repetition number 2, 4 and 8 for coverage enhancements. |

***ServingCellConfigCommon* information element**

-- ASN1START

-- TAG-SERVINGCELLCONFIGCOMMON-START

ServingCellConfigCommon ::= SEQUENCE {

…

[[

msg1-RepetitionsPriority-r18 FeaturePriority-r17 OPTIONAL, -- Need R

]]

}

***BWP-UplinkCommon* information element**

-- ASN1START

-- TAG-BWP-UPLINKCOMMON-START

BWP-UplinkCommon ::= SEQUENCE {

…

[[

rsrp-ThresholdMsg1-RepetitionNum2-r18 RSRP-Range OPTIONAL, -- Need R

rsrp-ThresholdMsg1-RepetitionNum4-r18 RSRP-Range OPTIONAL, -- Need R

rsrp-ThresholdMsg1-RepetitionNum8-r18 RSRP-Range OPTIONAL, -- Need R

]]

}

-- TAG-BWP-UPLINKCOMMON-STOP

-- ASN1STOP

|  |
| --- |
| ***rsrp-ThresholdMsg1-RepetitionNum2***  Threshold used by the UE for determining whether to select resources indicating Msg1 repetition number 2 in this BWP, as specified in TS 38.321 [3]. |
| ***rsrp-ThresholdMsg1-RepetitionNum4***  Threshold used by the UE for determining whether to select resources indicating Msg1 repetition number 4 in this BWP, as specified in TS 38.321 [3]. |
| ***rsrp-ThresholdMsg1-RepetitionNum8***  Threshold used by the UE for determining whether to select resources indicating Msg1 repetition number 8 in this BWP, as specified in TS 38.321 [3]. |

***RACH-ConfigDedicated* information element**

-- ASN1START

-- TAG-RACH-CONFIGDEDICATED-START

RACH-ConfigDedicated ::= SEQUENCE {

cfra CFRA OPTIONAL, -- Need S

ra-Prioritization RA-Prioritization OPTIONAL, -- Need N

...,

[[

ra-PrioritizationTwoStep-r16 RA-Prioritization OPTIONAL, -- Need N

cfra-TwoStep-r16 CFRA-TwoStep-r16 OPTIONAL -- Need S

]]

}

CFRA ::= SEQUENCE {

occasions SEQUENCE {

rach-ConfigGeneric RACH-ConfigGeneric,

ssb-perRACH-Occasion ENUMERATED {oneEighth, oneFourth, oneHalf, one, two, four, eight, sixteen}

OPTIONAL -- Cond Mandatory

} OPTIONAL, -- Need S

resources CHOICE {

ssb SEQUENCE {

ssb-ResourceList SEQUENCE (SIZE(1..maxRA-SSB-Resources)) OF CFRA-SSB-Resource,

ra-ssb-OccasionMaskIndex INTEGER (0..15)

},

csirs SEQUENCE {

csirs-ResourceList SEQUENCE (SIZE(1..maxRA-CSIRS-Resources)) OF CFRA-CSIRS-Resource,

rsrp-ThresholdCSI-RS RSRP-Range

}

},

...,

[[

totalNumberOfRA-Preambles INTEGER (1..63) OPTIONAL -- Cond Occasions

]],

[[

cfra-RepetitionNum-r18 ENUMERATED {2, 4, 8} OPTIONAL, -- Need S

]]

}

-- TAG-RACH-CONFIGDEDICATED-STOP

-- ASN1STOP

|  |
| --- |
| ***CFRA* field descriptions** |
| ***cfra-RepetitionNum***  Indicates the MSG1-repetition number used for contention free 4-step random access type in TS 38.321 [3]. |

# 4 Conclusions

# References

1. RAN2-122 Chairnotes
2. R2-2304702 RAN2 Impacts of Multiple PRACH Transmissions from CP vivo Mobile Com. (Chongqing)
3. R2-2304723 Control plane aspects of further NR Coverage Enhancements Samsung Electronics Co., Ltd
4. R2-2306231 RRC aspects for Msg1 repetition Huawei, HiSilicon
5. R2-2305403 CP issues for PRACH coverage enhancement ZTE Corporation, Sanechips
6. R2-2305354 Discussion on Multiple PRACH Transmission Procedures Ericsson
7. [R2-2304703](file:///D:\Tdoc%20review\RAN2%23122\word\R2-2304703%20RAN2%20Impacts%20of%20Multiple%20PRACH%20Transmissions%20from%20UP.docx) RAN2 Impacts of Multiple PRACH Transmissions from UP vivo Mobile Com. (Chongqing) discussion Rel-18 NR\_cov\_enh2-Core