**3GPP TSG-RAN WG2 Meeting #124 draft-R2-2313571**

**Chicago, USA, 13-17 Nov 2023**

**Source: Session chair (ZTE)**

**Title: Report from Further NR coverage enhancements session**

**Status of At-Meeting Email Discussions**

* [AT124][850][CE\_enh] Organisational (Session chair: ZTE)

 Scope:

* Share plans and list ongoing email discussions and their status
* Share meeting notes for any comments

Status: Ongoing

* [AT124][851][CE\_enh] MAC CR updates (ZTE)

 Scope:

* + F2F offline discussion to discuss the Editor’s notes and any other issues in the MAC CR implementation

Intended outcome:

* + Set of agreeable proposals for MAC CR updates

Deadline: Wednesday 15-11-2023

Status: Ongoing

**Summary of Post-Meeting Email Discussions**

**TBD**

## 7.21 Further NR coverage enhancements

(NR\_cov\_enh2-Core; leading WG: RAN1; REL-18; WID: [RP-221858](file:///C%3A%5Cevutukuri%5Cwork%5C5G%5CRANPlenary%5Cdocs%5CRP-221858.zip))

Time budget: 0.5 TU

Tdoc Limitation: 2 tdoc

### 7.21.1 Organizational

Incoming LSs, Rapporteur input etc, including reports from [Post123bis][851] and [Post123bis][853].

*Incoming LSs:*

[R2-2311710](file:///C%3A%5Cevutukuri%5Cwork%5C5G%5CRAN2%5Cdocs%5CR2-2311710.zip) Reply LS on RAN1 impacts regarding enhancements to realize increasing UE power high limit for CA and DC (R1-2310518; contact: Nokia) RAN1 LS in Rel-18 NR\_cov\_enh2-Core To:RAN4 Cc:RAN2

* + Noted

[R2-2311757](file:///C%3A%5Cevutukuri%5Cwork%5C5G%5CRAN2%5Cdocs%5CR2-2311757.zip) LS reply on further clarifications on enhancements to realize increasing UE power high limit for CA and DC (R4-2317768; contact: Huawei) RAN4 LS in Rel-18 NR\_cov\_enh2 To:RAN1, RAN2

* Huawei indicate that there could be some dependency between the DPC and ul-FullPowerTransmission and may have some impact on the UE capability discussion.
	+ Noted

*Endorsement of Running CRs*

[R2-2312732](file:///C%3A%5Cevutukuri%5Cwork%5C5G%5CRAN2%5Cdocs%5CR2-2312732.zip) Introduction of Further NR coverage enhancements to 38.300 China Telecom CR Rel-18 38.300 17.6.0 0733 - B NR\_cov\_enh2-Core

* + Update the WI code to NR\_cov\_enh2-Core
	+ Endorsed as baseline

[R2-2312573](file:///C%3A%5Cevutukuri%5Cwork%5C5G%5CRAN2%5Cdocs%5CR2-2312573.zip) Introduction of Further NR coverage enhancements in RRC Huawei, HiSilicon CR Rel-18 38.331 17.6.0 4433 - B NR\_cov\_enh2-Core [R2-2310197](file:///C%3A%5Cevutukuri%5Cwork%5C5G%5CRAN2%5Cdocs%5CR2-2310197.zip)

* + Endorsed as baseline

[R2-2312772](file:///C%3A%5Cevutukuri%5Cwork%5C5G%5CRAN2%5Cdocs%5CR2-2312772.zip) Introduction of Further NR Coverage Enhancements in MAC spec ZTE Corporation, Sanechips CR Rel-18 38.321 17.6.0 1711 - B NR\_cov\_enh2-Core

* + Endorsed as baseline
* [AT124][851][CE\_enh] MAC CR updates (ZTE)

 Scope:

* + F2F offline discussion to discuss the Editor’s notes and any other issues in the MAC CR implementation

Intended outcome:

* + Set of agreeable proposals for MAC CR updates

Deadline: Wednesday 15-11-2023

Status: Ongoing

*Open issues and rapporteur proposals*

[R2-2312572](file:///C%3A%5Cevutukuri%5Cwork%5C5G%5CRAN2%5Cdocs%5CR2-2312572.zip) Summary of [POST123bis][851][CE\_enh] CP running CR and open issues (Huawei) Huawei, HiSilicon discussion NR\_cov\_enh2-Core

Easy proposals:

Proposal 2 (9/10): The value of rsrp-ThresholdSSB for MSG1 repetition is common to different repetition number.

*Discussion*

* LG are okay with the proposal but the current CR supports different values to be configured. So, what is the impact to the running CR?
* HW explain that some restriction in field description may be needed if we agree this.
* Samsung why this restriction is needed.
* ZTE and Ericsson also think this is not needed

Proposal 3(9/10): Separate MSG3 repetition parameter (e.g. numberOfMsg3-RepetitionsList and mcs-Msg3-Repetitions) when MSG1 repetition is applicable is not supported.

*Discussion*

* + Separate MSG3 repetition parameter (e.g. numberOfMsg3-RepetitionsList and mcs-Msg3-Repetitions) when MSG1 repetition is applicable is not supported as implemented in the current running CR

Proposal 4(10/10): The values of preambleTransMax-Msg1Repetition are { n1, n2, n4, n6, n8, n10, n20, n50, n100, n200}.

*Discussion*

* + The values of preambleTransMax-Msg1Repetition are { n1, n2, n4, n6, n8, n10, n20, n50, n100, n200}

Proposal 6(9/10): CFRA configured with one MSG1 repetition number can be applied to CHO. No further optimization of CFRA is needed in this case.

*Discussion*

* ZTE wonder if this means that for fallback case we will still use the same repetition number, companes seem to agree with this understanding.
	+ CFRA configured with one MSG1 repetition number can be applied to CHO. No further optimization of CFRA is needed in this case (and in this case the same repetition will be used upon fallback to CBRA as already agreed in the past)

May need online discussion:

Proposal 1(7/10): RAN2 to discuss if numberOfRA-PreamblesGroupA can be configured separately for different repetition number.

*Discussion*

* LG think that there is no need to have any restriction for this either (similar to the RSRP threshold). Ericsson, ZTE also support,
* HW indicate that the issue is if there is a different configuration for different repetition number then there may be issues in case of fallback.
* Samsung think if we agree that it is up to the network configuration to allow that there is no need for preamble group reselection. Especially there should be no need to specify rebuilding.
	+ numberOfRA-PreamblesGroupA can be configured separately for different repetition number.

Proposal 5(6/10): From RAN2 CE perspective, the maximum number of RACH configuration that the network is allowed to configure can be extended. To decide the maximum value between 32 and 64.

* Huawei highlight that the current restriction is for maximum of 16.
* Samsung think 16 is already too many even considering MSG1 repetition. Nokia and CATT agrees.
* ZTE think 64 will be preferable. There will be other features requiring eREDCAP also.
* LG agree that some extension may be needed but can be discussed further.
* Huawei think that even without considering eREDCAP we need to extend this.
	+ From CE perspective, the maximum number of RACH configurations that the network is allowed to configure may need to be extended to 32. Can be revisited if other features need other number

[R2-2312771](file:///C%3A%5Cevutukuri%5Cwork%5C5G%5CRAN2%5Cdocs%5CR2-2312771.zip) UP open issue list for R18 CE ZTE Corporation, Sanechips Work Plan Rel-18 NR\_cov\_enh2-Core

### 7.21.2 Control plane issues

Details of RACH configuration and RACH partitioning signalling and any other impacts to CP from RAN1 agreements.

*SI request period/RA association period index with repetition*

[R2-2311830](file:///C%3A%5Cevutukuri%5Cwork%5C5G%5CRAN2%5Cdocs%5CR2-2311830.zip) SI request and CFRA Aspects Samsung Electronics Co., Ltd discussion Rel-18 NR\_cov\_enh2-Core



Proposal 1: Adopt the SI-RequestConfigRepetition structure above in the RRC CR.

Delete si-RequestResourcesRepetition-r18

Add si-RequestResourcesRepetitionTwo-r18, si-RequestResourcesRepetitionFour-r18 and si-RequestResourcesRepetitionEight-r18, optionally, where each is SEQUENCE (SIZE (1..maxSI-Message)) OF SI-RequestResources

*Focus on P1*

* LG support the new structure as it reduces the overhead.
* HW clarify that there is no functionality change and agree that this is the simplest one.
	+ Delete si-RequestResourcesRepetition-r18
	+ Add si-RequestResourcesRepetitionTwo-r18, si-RequestResourcesRepetitionFour-r18 and si-RequestResourcesRepetitionEight-r18, optionally, where each is SEQUENCE (SIZE (1..maxSI-Message)) OF SI-RequestResources

[R2-2311816](file:///C%3A%5Cevutukuri%5Cwork%5C5G%5CRAN2%5Cdocs%5CR2-2311816.zip) Discussion on Remaining Issues for PRACH Repetition vivo discussion Rel-18 NR\_cov\_enh2-Core

Proposal 2: SI request period is not applicable for Msg-1 based SI request with Msg1 repetition.

*Focus on P2*

[R2-2313163](file:///C%3A%5Cevutukuri%5Cwork%5C5G%5CRAN2%5Cdocs%5CR2-2313163.zip) Discussion on Coverage Enhancements CP Ericsson discussion NR\_cov\_enh2-Core

Proposal 5: RAN2 to discuss the alternatives described and the impact on RAN1/RAN2 specifications.

Opt A) Collision handling in RAN1 specification handles this with a restriction that multiple PRACH transmissions are restrained in the indicated association period in one si-RequestPeriod.

Opt B) The ra-AssociationPeriodIndex denotes the first association period in every si-RequestPeriod, and the UE implicitly determines a number of association periods starting from the indicated association period within si-RequestPeriod for the multiple PRACH transmissions.

Opt C) Multiple PRACH transmissions can be performed in ROs in the indicated association period in more than one si-RequestPeriod.

Opt D) a UE doesn't expect a configured PRACH repetition factor for SI request to be larger than the number of ROs permitted by ra-ssb-OccasionMaskIndex in an association period.

*Focus on P5*

*Combined discussion on P12 and P5 above*

* Huawei think another alternative is to highlight that in this case the RA association period is associated with a set of RACH occasions. This can be clarified in field description.
* Samsung agree with the proposal and think that solving this issue might be too late for this issue.
* LG think one option is to apply the SI request occasion only for the first period and rest can be in RAN1 specifications.
* Ericsson and Chinatelecom indicate that they prefer option D
* Samsung indicate that it is still not clear how the options A – D in [R2-2313163](file:///C%3A%5Cevutukuri%5Cwork%5C5G%5CRAN2%5Cdocs%5CR2-2313163.zip) work.
	+ SI request period is not applicable for Msg-1 based SI request with Msg1 repetition (can comeback if there is a critical issue with this agreement)

*LTM applicability*

[R2-2311830](file:///C%3A%5Cevutukuri%5Cwork%5C5G%5CRAN2%5Cdocs%5CR2-2311830.zip) SI request and CFRA Aspects Samsung Electronics Co., Ltd discussion Rel-18 NR\_cov\_enh2-Core

Proposal 3: Msg1 repetition is supported for both CBRA and CFRA based LTM cell switch. Msg1 repetition number can be signalled in cell switch command MAC CE.

*Focus on P3*

[R2-2312574](file:///C%3A%5Cevutukuri%5Cwork%5C5G%5CRAN2%5Cdocs%5CR2-2312574.zip) Remaining issues of CP aspects for CE Huawei, HiSilicon discussion NR\_cov\_enh2-Core

Proposal 2: CFRA with repetition is applicable to LTM with no additional change.

*Focus on P2*

*Combined discussion on P3 and P2 above*

* Vivo, LG think this discussion should happen in LTM session.
* ZTE indicate that the dedicated configuration for LTM can also be provided in RRC signalling. And some companies in LTM session think this should be discussed in CE.
* Nokia think we can indicate this is feasible from CE point of view and leave the MAC CE design to LTM session.
* Samsung indicate that they are fine to discuss it in LTM session.
* Huawei don’t support the proposal.
	+ From CE perspective, Msg1 repetition is feasible for both CBRA and CFRA based LTM cell switch assuming the MSG1 repetition configuration is in the RACHConfigDedicated.

*Open if time allows (after all other discussions)*

R2-2311816 Discussion on Remaining Issues for PRACH Repetition vivo discussion Rel-18 NR\_cov\_enh2-Core

R2-2311830 SI request and CFRA Aspects Samsung Electronics Co., Ltd discussion Rel-18 NR\_cov\_enh2-Core

R2-2312511 Discussion on the remaining CP issues NEC Corporation. discussion Rel-18 NR\_cov\_enh2-Core

R2-2312574 Remaining issues of CP aspects for CE Huawei, HiSilicon discussion NR\_cov\_enh2-Core

R2-2312750 Discussion on numberOfRA-PreamblesGroupA for Msg1 repetition CATT discussion Rel-18 NR\_cov\_enh2-Core

R2-2312773 Remaining CP issues for CE ZTE Corporation, Sanechips discussion Rel-18 NR\_cov\_enh2-Core

R2-2313163 Discussion on Coverage Enhancements CP Ericsson discussion NR\_cov\_enh2-Core

R2-2313462 Remaining CP issues on Msg1 repetition LG Electronics Inc. discussion Rel-18 NR\_cov\_enh2-Core

### 7.21.3 User plane issues

Overall RACH procedure and any other MAC impacts

*Open issues for RA procedure*

*CFRA fallback*

[R2-2313164](file:///C%3A%5Cevutukuri%5Cwork%5C5G%5CRAN2%5Cdocs%5CR2-2313164.zip) Discussion on Coverage Enhancements UP Ericsson discussion NR\_cov\_enh2-Core

Proposal 2 RAN2 does not support the fallback from lower to higher number of multiple PRACH Transmissions if UE has performed fallback from CFRA to CBRA.

*Focus on P2*

[R2-2312575](file:///C%3A%5Cevutukuri%5Cwork%5C5G%5CRAN2%5Cdocs%5CR2-2312575.zip) Remaining issues of UP aspects for CE Huawei, HiSilicon discussion NR\_cov\_enh2-Core

Proposal 1: Fallback from lower repetition number to higher repetition is also applicable when CFRA with repetition is configured.

*Focus on P1*

*Combined discussion on P2 and P1 above*

* Huawei indicate that they are also fine with Proposal from Ericsson.
	+ Fallback from lower to higher number of multiple PRACH Transmissions is not supported if UE has performed fallback from CFRA to CBRA

*Fallback for SI request*

[R2-2312774](file:///C%3A%5Cevutukuri%5Cwork%5C5G%5CRAN2%5Cdocs%5CR2-2312774.zip) Remaining UP issues for CE ZTE Corporation, Sanechips discussion Rel-18 NR\_cov\_enh2-Core

Proposal 1 Fallback from lower number to higher number is not supported for Msg1-based SI request with Msg1 repetition.

*Focus on P1*

* + Fallback from lower number to higher number is not supported for Msg1-based SI request with Msg1 repetition.

*DWS open issues*

[R2-2312725](file:///C%3A%5Cevutukuri%5Cwork%5C5G%5CRAN2%5Cdocs%5CR2-2312725.zip) Discussion on PHR for dynamic waveform switching Xiaomi discussion Rel-18

Proposal 1: RAN2 agree to introduce Ei field for each serving cell to indicate the existence of PH information for assumed PUSCH in multiple entry PHR with assumed PUSCH MAC CE.

*Focus on P1*

[R2-2313018](file:///C%3A%5Cevutukuri%5Cwork%5C5G%5CRAN2%5Cdocs%5CR2-2313018.zip) PHR for assumed PUSCH InterDigital discussion Rel-18 NR\_cov\_enh2-Core

Proposal 2: If a value for Pcmax for assumed PUSCH is not available from lower layers for an NR cell or for any LTE cell, UE reports “R” bits instead of Pcmax.

*Focus on P2*

*Discussion on P1 from* [R2-2312725](file:///C%3A%5Cevutukuri%5Cwork%5C5G%5CRAN2%5Cdocs%5CR2-2312725.zip) *and P2 from* [R2-2313018](file:///C%3A%5Cevutukuri%5Cwork%5C5G%5CRAN2%5Cdocs%5CR2-2313018.zip)

* Nokia think we don’t need either of these proposals and highlight that the alternative according to P9 in can be used [R2-2313431](file:///C%3A%5Cevutukuri%5Cwork%5C5G%5CRAN2%5Cdocs%5CR2-2313431.zip) instead. Nokia also indicate that there is this 1 byte overhead unnecessarily.
* HW think for CA case this may be unambiguous but for DC case there may be a problem.
* Interdigital think that Nokia proposal is acceptable assuming there is no ambiguity at network side. IDC indicate that the DC case can be also solved by network implementation.
	+ introduce Ei field for each serving cell to indicate the existence of PH information for assumed PUSCH in multiple entry PHR with assumed PUSCH MAC CE (can double check the implementation in MAC offline and comeback on Thursday if needed)

Proposal 1: If DWS is configured, the UE reports the new PHR format for assumed PUSCH for any triggered PHR.

Discussion on P1

* IDC highlight that this is needed as we already agreed no discussion on new triggers at last meeting.
* LG wonder how this can work if the gNB doesn’t support the DWS feature.
* IDC indicate that there is an RRC configure the transmission of assumed PUSCH.
* Vivo think that there is DCI indication that should enable this. Session chair indicate that the DCI only switches between the waveforms.
* LG wonder what “any triggered PHR means”. IDC explain that this refers to any PHR triggered by legacy triggers.
* LG ask how this is impacted if the 2 PHR mode is configured.
	+ If DWS is configured for the MAC entity transmitting PHR, the UE uses the new PHR format for PHR reporting (details on how to implement this in MAC CR is FFS can be discussed as part of 851 offline)

Proposal 3: The new PHR format for assumed PUSCH is not reported if twoPHRmode is configured.

* + The new PHR format for assumed PUSCH is not reported if twoPHRmode is configured unless RAN1 indicates us otherwise

*DPC open issues*

[R2-2313431](file:///C%3A%5Cevutukuri%5Cwork%5C5G%5CRAN2%5Cdocs%5CR2-2313431.zip) Delta Power Class and assumed PUSCH reporting Nokia, Nokia Shanghai Bell discussion Rel-18 NR\_cov\_enh2-Core

Proposal 1: ΔPPowerClass is reported in a PHR MAC CE upon a trigger to report ΔPPowerClass.

Discussion

* Ericsson support P1
* LG think the final decision depends on whether 2 bits are enough or not. Think that we can only agree this as a baseline.
* Qualcomm think 2 bits for DPC and 2 bits for change in full power MIMO transmission
* Ericsson highlight that even if we need more than 2 bits it will still be in the PHR MAC CE.
	+ As a baseline ΔPPowerClass is reported in a PHR MAC CE upon a trigger to report ΔPPowerClass. FFS on exact PHR format based on RAN4 input on how many bits are needed

Proposal 2: MAC entity triggers PHR upon ΔPPowerClass reporting is triggered based on the conditions specified by the RAN4 into RAN4 specifications.

* Ericsson think some triggering specification work is needed in MAC.
	+ RAN2 preference is that triggering of PHR for ΔPPowerClass reporting is based on the power class change conditions specified by RAN4 and we will add a reference to RAN4 specs in the MAC spec.

Proposal 3: ΔPPowerClass reporting is provided per Serving Cell.

* ZTE indicate that this is still being discussed in RAN4. So, we can wait. But we can still reuse the legacy MAC CE format regardless, but final discussion can wait until RAN4 conclusion.
* Nokia indicate that per serving cell is simpler but we can wait for RAN4 input.
	+ We will wait for RAN4 input on the granularity of the DPC report. Comeback on Thursday based on RAN4 input.

Observation 1: The two MPE bits used for reporting P-MPR could be used for reporting ΔPPowerClass given the MPE reporting is applicable only for FR2 while ΔPPowerClass reporting is relevant for FR1 only.

Proposal 4: If the reporting of full power MIMO transmission capability per ΔPPowerClass would be agreed to be supported, the UE can report the full power MIMO transmission capability per ΔPPowerClass in UE capabilities and it does not need to be included in the PHR MAC CE.

* QC don’t think that from a UE implementation this proposal is acceptable. So we should wait for RAN4 feedback.
* Vivo clarify that this is not just for MAC signalling but any dynamic signalling is precluded. Nokia confirm this understanding.
	+ We will wait for RAN4 input on the full power MIMO transmission capability indication – comeback Thursday

Proposal 5: Use the two MPE bits for ΔPPowerClass reporting in the PHR MAC CE.

Focus on P1-5

[R2-2311817](file:///C%3A%5Cevutukuri%5Cwork%5C5G%5CRAN2%5Cdocs%5CR2-2311817.zip) Discussion on RAN2 Impacts of DWS and DPC Reporting vivo discussion Rel-18 NR\_cov\_enh2-Core

[R2-2311829](file:///C%3A%5Cevutukuri%5Cwork%5C5G%5CRAN2%5Cdocs%5CR2-2311829.zip) Fallback from lower repetition number to higher repetition number Samsung Electronics Co., Ltd discussion Rel-18 NR\_cov\_enh2-Core

[R2-2311993](file:///C%3A%5Cevutukuri%5Cwork%5C5G%5CRAN2%5Cdocs%5CR2-2311993.zip) Open issues of power domain enhancements for CE China Telecom discussion Rel-18 NR\_cov\_enh2-Core

[R2-2312575](file:///C%3A%5Cevutukuri%5Cwork%5C5G%5CRAN2%5Cdocs%5CR2-2312575.zip) Remaining issues of UP aspects for CE Huawei, HiSilicon discussion NR\_cov\_enh2-Core

[R2-2312725](file:///C%3A%5Cevutukuri%5Cwork%5C5G%5CRAN2%5Cdocs%5CR2-2312725.zip) Discussion on PHR for dynamic waveform switching Xiaomi discussion Rel-18

[R2-2312751](file:///C%3A%5Cevutukuri%5Cwork%5C5G%5CRAN2%5Cdocs%5CR2-2312751.zip) Discussion on remaining UP issues for Msg1 repetition CATT discussion Rel-18 NR\_cov\_enh2-Core

[R2-2312774](file:///C%3A%5Cevutukuri%5Cwork%5C5G%5CRAN2%5Cdocs%5CR2-2312774.zip) Remaining UP issues for CE ZTE Corporation, Sanechips discussion Rel-18 NR\_cov\_enh2-Core

[R2-2312954](file:///C%3A%5Cevutukuri%5Cwork%5C5G%5CRAN2%5Cdocs%5CR2-2312954.zip) Open Issues in PRACH Repetition Qualcomm Incorporated discussion

[R2-2312956](file:///C%3A%5Cevutukuri%5Cwork%5C5G%5CRAN2%5Cdocs%5CR2-2312956.zip) DPC and DWS UE reporting Qualcomm Incorporated discussion Rel-18

[R2-2313018](file:///C%3A%5Cevutukuri%5Cwork%5C5G%5CRAN2%5Cdocs%5CR2-2313018.zip) PHR for assumed PUSCH InterDigital discussion Rel-18 NR\_cov\_enh2-Core

[R2-2313164](file:///C%3A%5Cevutukuri%5Cwork%5C5G%5CRAN2%5Cdocs%5CR2-2313164.zip) Discussion on Coverage Enhancements UP Ericsson discussion NR\_cov\_enh2-Core

[R2-2313430](file:///C%3A%5Cevutukuri%5Cwork%5C5G%5CRAN2%5Cdocs%5CR2-2313430.zip) Miscellaneous issues with PRACH repetition Nokia, Nokia Shanghai Bell discussion Rel-18 NR\_cov\_enh2-Core

[R2-2313431](file:///C%3A%5Cevutukuri%5Cwork%5C5G%5CRAN2%5Cdocs%5CR2-2313431.zip) Delta Power Class and assumed PUSCH reporting Nokia, Nokia Shanghai Bell discussion Rel-18 NR\_cov\_enh2-Core

[R2-2313463](file:///C%3A%5Cevutukuri%5Cwork%5C5G%5CRAN2%5Cdocs%5CR2-2313463.zip) Remaining issues on Coverage Enhancement in UP aspects LG Electronics Inc. discussion Rel-18 NR\_cov\_enh2-Core