**3GPP TSG-RAN WG4 Meeting # 111 R4-2408915**

Fukuoka City, Fukuoka, Japan, 20th May 2024 - 24th May 2024

**Agenda item:** 5.4

**Source:** Moderator (Huawei)

**Title:** Topic summary for [111][104] R18\_UERF\_maintenance\_Part2

**Document for:** Information

# Introduction

This agenda item (AI 5.2.8.1 and 5.3) will handle all contributions for Rel-18 TEI with the following sub-topics.

1. Further improvements to Harmonic MSD tables
2. Discussion on extension FR2 UE power class 7 to non-RedCap UE

The comments related to CRs and draft CRs can be collected in NMW (), and the final decision will be made online.

Based on Chairman’s guidelines, the following contributions/proposals are moved and treated in this thread.

In AI 5.3, the following tdocs will be treated in the main session:

R4-2407164, R4-2407298, R4-2408426, R4-2408440, R4-2408479, R4-2408695, R4-2408708, R4-2408710, R4-2408997, R4-2408998, R4-2408999, R4-2409657

Move R4-2408036, R4-2408304 from AI 4.1 to AI 5.3 and treat them in [104]

# Topic #1: Rel-18 TEI

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2407533**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2407533.zip) | CATT | draftCR to TS 38.101-2 for subclause 6.2K.4  **Summary of Change: Correct ΔTSTxMP and remove the unnecessary comma signs in the equation and correct other editorial errors.** |
| [**R4-2408230**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2408230.zip) | Anritsu Limited | (NR\_CA\_R16\_intra-Core, , ) CR to add notes for SCS restrictions on CBWs in CA configurations - TS38.101-1, Rel-18  **Summary of Change:**  The following notes  - NOTE 1 in Table 5.5A.1-1  - NOTE 8 in Table 5.5A.2-1  - NOTE 5 in Table 5.5A.2-2  - NOTE 3 in Table 5.5A.3.1-1a to Table 5.5A.3.1-1n  - NOTE 3 in Table 5.5A.3.2-1a to Table 5.5A.3.2-1c  - NOTE 3 in Table 5.5A.3.3-1a to Table 5.5A.3.3-1b  are updated with the text “For each channel bandwidth of each component carrier, refer to Table 5.3.5-1 for the applicable SCSs. For a given band, not all UE channel bandwidths support the same SCSs.”  The following notes  - NOTE 1 in Table 5.5A.3.4-1  - NOTE 1 in Table 5.5A.3.5-1  are updated with the text “For each channel bandwidth of each component carrier, refer to Table 5.3.5-1 of TS 38.101-1 and TS 38.101-2 for the applicable SCSs for NR FR1 and NR FR2 bands respectively. For a given band, not all UE channel bandwidths support the same SCSs.” |
| [**R4-2407164**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2407164.zip) | Skyworks Solutions Inc. | Further improvements to Harmonic MSD tables  **Proposal 1: Consider removing the RBstart from all UL harmonic and Rx harmonic mixing MSD tables. It is proposed to add a sentence in the core requirements to clarify to RAN5 that the RAN4 harmonic MSD requirements assume the UL RBs are centered on the UL channel carrier frequency.**  **Proposal 2: For UL harmonic MSD test points, consider adopting the following RB allocation configurations:**   * **Lcrb=12RB for UL2/DLx;** * **Lcrb=8RB for UL3/DLx;** * **Lcrb=6RB for UL4/DLx;** * **Lcrb=5RB for UL5/DLx.**   **Proposal 3: Interested companies are invited to cross-align the EN-DC UL and Rx mixing harmonic MSD test points with their NR-CA counterparts.** |
| [**R4-2407298**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2407298.zip) | Apple | CR on updating UE capability name for 2Rx XR UEs [2Rx\_XR\_Device]  **Summary of Change:**  **To replace the capability placeholder “[2Rx XR]” with the capability name “supportOf2RxXR-r18”** |
| [**R4-2408695**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2408695.zip) **Revised to R4-2409657** | Inmarsat, Viasat, Omnispace, Terrestar Solutions, Thuraya, Ligado Networks, EchoStar, Thales, Skyworks | (TEI) CR to 38.101-5 Flexible TX-RX Separation for NR NTN Bands from Rel-18 [TEI\_NTN]  *Reason for change:*  Currently NR NTN Bands n256, n255 are specified with fixed TX-RX separation based on initial Rel-17 work. However, this is already supported in other NR NTN bands specified later, such as n254.  This aspect was overlooked during the initial n256 and n255 specifications due to limited alignment with satellite deployments, which typically do not use fixed separation for MSS bands, and thus resulted in a misalignment in the expected operation of the system.  The correction must be implemented before the systems are deployed and devices reach the market. |
| [**R4-2408708**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2408708.zip) | (TEI18) CR to 36.102 In-band NB-IoT NTN deployment with NR from Rel-18 [TEI\_NTN] | Inmarsat, Viasat, Omnispace, Terrestar Solutions, Thuraya, Ligado Networks, EchoStar, Thales, Skyworks, Apple  **Reason for change:**  **NB-IoT supports In-band and guard-band deployments with LTE carriers since Rel-13 and in-band with NR carriers since Rel-15. Based on the conclusions of TR 37.824 and of the approved TP in R4- 2220812, the current channel arrangement and offset values can already support in-band deployment with NR. However, clarification is required in the spec.** |
| [**R4-2408710**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2408710.zip) | (TEI18) CR to 36.108 In-band NB-IoT NTN deployment with NR from Rel-18 [TEI\_NTN] | Inmarsat, Viasat, Omnispace, Terrestar Solutions, Thuraya, Ligado Networks, EchoStar, Thales, Skyworks, Apple  **Reason for change:**  **NB-IoT supports In-band and guard-band deployments with LTE carriers since Rel-13 and in-band with NR carriers since Rel-15. Based on the conclusions of TR 37.824 and of the approved TP in R4- 2220812, the current channel arrangement and offset values can already support in-band deployment with NR. However, clarification is required in the spec.** |
| [**R4-2408997**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2408997.zip) | Discussion on extension FR2 UE power class 7 to non-RedCap UE | Huawei,HiSilicon  Observation 1: The UE power class definition for FR2 is based on certain assumed UE device architecture, the applicable UE types are not limited to those listed UE types in Table 6.2.1.0-1 of TS 38.101-2 which are only example UE types.  Observation 2: PC1 ~ PC6 are also applicable for RedCap UE.  Observation 3: The existing transmitter and receiver requirements defined for PC7 are only applicable for RedCap UE.  Observation 4: Extension PC7 to non-RedCap UE has no impact to RedCap UE. RedCap UE can decide to pass which transmitter and receiver requirements of PC7 by reporting UE capabilities of *supportOfRedCap-r17*, the supported UL and DL bandwidth and not report CA and UL-MIMO capabilities.  Proposal 1: Extend PC7 to be applicable for non-RedCap UE.  **Proposal 2: Agree the updates to requirements for PC7 in CR R4-2408998.**  Proposal 3: Send LS to RAN2 to remove the limitation of PC5 only applicable to RedCap UE in FR2. |
| [**R4-2408998**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2408998.zip) | [TEI18] CR on updates to PC7 requirements for non-RedCap UE (TS38.101-2, Rel-18) | Huawei,HiSilicon  ***Summary of change:***  Added related requirements for PC7 that are applicable for non-RedCap that has the similar device architecture as RedCap but with larger channel bandwidth. |
| [**R4-2408999**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2408999.zip) | Draft LS to RAN2 on removal limitation about PC7 only applicable to RedCap UE | Huawei,HiSilicon  To keep UE power class capability definition consistence between specifications of TS 38.306 and TS 38.101-2, the updates to RAN2 specification TS 38.306 as shown below is need. RAN4 kindly ask RAN2 to consider such updates:   | ***ue-PowerClass, ue-PowerClass-v1610, ue-PowerClass-v1700***  For FR1, if the UE supports the different UE power class than the default UE power class as defined in clause 6.2 of TS 38.101-1 [2], or in clause 6.2 of TS 38.101-5 [34], the UE shall report the supported UE power class in this field. For FR2, UE shall report the supported UE power class as defined in clause 6 and 7 of TS 38.101-2 [3] in this field. UE indicating support for *pc6* supports the enhanced intra-NR RRM and demodulation processing requirements for FR2 to support high speed up to 350 km/h as specified in TS 38.133 [5]. This capability is not applicable to IAB-MT. This capability is not applicable for UEs indicating support of *maxOutputPowerATG-r18*. | Band | Yes | N/A | N/A | | --- | --- | --- | --- | --- | |
| R4-2408036 | Qualcomm, Sony | On enabling a non-Redcap FR2 PC7 UE  **Observation 1: Removing the RedCap restriction on PC7 will serve to create a lower tier of handheld UEs, and this is not justified in a network that is often coverage limited**  **Observation 2: There is no justification to remove the RedCap-only restriction on PC7.**  **Proposal 1: Retain the RedCap-only restriction on PC7. A new UE power class shall be investigated if a new use case is identified.**  **Proposal 2: RAN4 to consider clarifying the note in table 6.2.1.0-1 of 38.101-2, for example:** ‘any power class in FR2 can be used for Redcap type devices as long as the device can meet the core requirements defined for that power class’ |
| [**R4-2408304**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2408304.zip)  (R17 Cat F)  [**R4-240830**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2408304.zip)**5** (R18 Cat A) | Sony, Qualcomm Incorporated | CR for TS 38.101-2 Rel-17 clarification on Redcap Applicability in FR2 power classes  ***Reason for change:***  The note in Table 6.2.1.0-1 “RedCap variants of non-RedCap UEs are not precluded” is intend to enble Redcap variants of power class 1-6 if they can fullfil the corresponding RF requirements defined for each power class. However, the current wording in the note brings some ambiguity on this aspect  ***Summary of change:***  Changing wording of the note in Table 6.2.1.0-1 to “any power classes in FR2 can be used for Redcap type devices as long as the device can meet the core requirements defined for the corresponding power class” |

## Open issues summary

*Before f2f meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 1-1 Further improvements to Harmonic MSD tables

*Sub-topic description:*

*Open issues and candidate options before f2f meeting:*

**Issue 1-1-1: On “RBstart” for harmonic MSD test point**

Observation 1: All UL harmonic and Rx harmonic MSD test point for all NR-CA power classes are specified using RBstart=0. This observation is also true for all EN-DC harmonic MSD test points.

Observation 2: While RBstart=0 may help for fully allocated UL configurations, it is difficult to understand the rationale of specifying RBstart=0 when the UL band is not fully allocated. For example, Lcrb = 8(RBstart=0) in a 5MHz UL CBW. For such cases, the UL harmonic affecting the DL band is asymmetric and it is not certain if the entire harmonic power spectral density that overlaps the DL band has been carefully accounted for in the MSD analysis. Such asymmetry in the harmonic spectrum is not desirable since the harmonic power spectral density is further spread due to the RB image. RBstart=0 does not seem to serve any particular goal.

Observation 3: One may consider two improvements regarding RBstart:

- Option 1: For non-fully allocated UL waveforms,the RBstart could be used to center the UL RB in the center of the UL Channel, thereby also condensing the UL harmonic power spectral density. All test points would need to be revisited.

- Option 2: Since the RBstart does not seem to serve any particular goal, consider removing RBstart from the UL harmonic MSD tables and add a core requirement text that explains to RAN5 that RAN4 assumes the UL RB allocations are centered on the UL channel carrier frequency.

* **Proposal: Consider removing the RBstart from all UL harmonic and Rx harmonic mixing MSD tables. It is proposed to add a sentence in the core requirements to clarify to RAN5 that the RAN4 harmonic MSD requirements assume the UL RBs are centered on the UL channel carrier frequency.**
* Recommended WF
  + If RAN4 can approve this proposal, the specific sentence can be discussed in detail and avoid any confusion in RAN5.

**Issue 1-1-2: On RB Allocation “Lcrb” for harmonic MSD test point**

Observation 4: The specified RB allocation Lcrb is inconsistent from band combinations to band combinations. The choice of Lcrb does not seem to follow any logic or guidelines. In the Rx harmonic clean-up CRs presented this week, the concept of scaling Lcrb with the UL harmonic order is implemented.

Observation 5: Scaling Lcrb with the harmonic order has several benefits including:

- Introducing a clear and consistent set of rules for all band combinations;

- Potentially ensuring that the harmonic BW is always fully overlapped by the smallest DL CBW, hence maximizing the harmonic interference level that affects the DL band.

* **Proposal: For UL harmonic MSD test points, consider adopting the following RB allocation configurations:**
  + **Lcrb=12RB for UL2/DLx;**
  + **Lcrb=8RB for UL3/DLx;**
  + **Lcrb=6RB for UL4/DLx;**
  + **Lcrb=5RB for UL5/DLx.**
* Recommended WF
  + TBA

**Issue 1-1-3: Necessity to cross-align NR-CA and EN-DC MSD test points**

Observation 6: For the same pair of constituent bands, there are important discrepancies in UL Lcrb and MSD levels between the NR-CA MSD test point and its EN-DC counterpart.

* **Proposal: Interested companies are invited to cross-align the EN-DC UL and Rx mixing harmonic MSD test points with their NR-CA counterparts.**
* Recommended WF
  + TBA

### Sub-topic 1-2 Discussion on extension FR2 UE power class 7 to non-RedCap UE

*Sub-topic description:*

*Open issues and candidate options before f2f meeting:*

**Issue 1-2-1: Discussion on extension FR2 UE power class 7 to non-RedCap UE**

Observation 1: The UE power class definition for FR2 is based on certain assumed UE device architecture, the applicable UE types are not limited to those listed UE types in Table 6.2.1.0-1 of TS 38.101-2 which are only example UE types.

Observation 2: PC1 ~ PC6 are also applicable for RedCap UE.

Observation 3: The existing transmitter and receiver requirements defined for PC7 are only applicable for RedCap UE.

Observation 4: Extension PC7 to non-RedCap UE has no impact to RedCap UE. RedCap UE can decide to pass which transmitter and receiver requirements of PC7 by reporting UE capabilities of *supportOfRedCap-r17*, the supported UL and DL bandwidth and not report CA and UL-MIMO capabilities.

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| 6.2.1 UE maximum output power6.2.1.0 General NOTE: Power classes are specified based on the assumption of certain UE types with specific device architectures. The UE types can be found in Table 6.2.1.0-1.  Table 6.2.1.0-1: Assumption of UE Types   |  |  | | --- | --- | | UE Power class | UE type | | 1 | Fixed wireless access (FWA) UE | | 2 | Vehicular UE | | 3 | Handheld UE | | 4 | High power non-handheld UE | | 5 | Fixed wireless access (FWA) UE | | 6 | High Speed Train Roof-Mounted UE | | 7 | RedCap UE | | Note: RedCap variants of non-RedCap UEs are not precluded | | |

* **Proposal:** 
  + **Option 1: Extend PC7 to be applicable for non-RedCap UE**
  + **Option 2: Retain the RedCap-only restriction on PC7. A new UE power class shall be investigated if a new use case is identified.**
    - **Observation 1: Removing the RedCap restriction on PC7 will serve to create a lower tier of handheld UEs, and this is not justified in a network that is often coverage limited**
    - **Observation 2: There is no justification to remove the RedCap-only restriction on PC7.**
* Recommended WF
  + RAN4 can discuss these two options.

Qualcomm: In general we support it. We need more study on the use case including deployment scenarios.

OPPO: we also support this study.

Ericsson: PC7 has been studied targeting at sensor and wearable. Whether to extend it to other use case needs more discussions. It is outside TEI.

Verizon: Generally support this one. We are OK that some companies need more time.

AT&T: challenge is to use device type of redcap for justification. If we decide the type beyond redcap, we need define the new scenario and do not mix with redcap application. No objection to add new device and power class for this case.

CHTTL: Proposal new UE power class can be considered. Do not consider PC7. If we extend beyond, the smartphone can use it. We are OK to new power class.

Sony: General OK. Define the new power class.

Samsung: In general, it is helpful to encourage all UE types for industry. There are two aspects: 1) whether PC2 is limited to redcap 2) how to handle the new UE types. Now RAN2 limit the PC2 to redcap. Not sure if the limitation is the RAN4 intention. If such limitation made by misunderstanding by RAN2, one solution is to extend PC7, and other is to consider the new power class. Open to these two solutions based on operator demand.

Vivo: as long as the new power class is OK, we supportive. Whether duplicate the indication of PC7 and other capability. For scenario, we need study.

Xiaomi: Based on part of evaluation of UE type, we are interested in it. For general requirement, such UE can use PC7 requriement for single carrier. But new CA requirement needs be defined.

China telecom: Support the way forward. Different devices have different capability. New power class.

Qualcomm: we want to ensure if we go down this power class, we should take it to RAN as a WID.

Huawei: For two candidate options, we are open. There is some gap between FR1 and FR2. We care about the UE experience like heavy BM and power consumption. It is good to have diverse UE type to fully utilize FR2 spectrum. For option 1 and 2, if we need power classes, we need the new WID. If all the companies are interested, we can work together to identify the use cases.

OPPO: This is non-spectrum WI. If we go with the new item, which time slot can we approve it. We can have more discussions.

Nokia: We also support to discuss it for new WI or SI.

Huawei: if all the companies observe the benefit, we can initial the study.

CATT: we also support the effort. We can discuss it in RAN.

**Issue 1-2-2: TEI18 CR** **for PC7 in R4-2408998**

* **Proposal:** 
  + **Option 1: Agree the updates to requirements for PC7 in CR R4-2408998.**
  + **Option 2: Revise CR R4-2408998**
  + **Option 3: Other**
* Recommended WF
  + If option 1 is agreeable in issue 1-2-1, RAN4 can further discuss whether to agree/revise R4-2408998.

**Issue 1-2-3: Send LS to RAN2 to remove the limitation of PC7**

* **Proposal:** 
  + **Option 1: Send LS to RAN2 to remove the limitation of PC7 only applicable to RedCap UE in FR2 as proposed in R4-2408999.**
  + **Option 2: Revise CR R4-2408999**
  + **Option 3: Other**
* Recommended WF
  + If option 1 is agreeable in issue 1-2-1, RAN4 can further discuss whether to approve/revise R4-2408999.

**Issue 1-2-4: The clarification on the note in table 6.2.1.0-1 of 38.101-2. And the accompanying CR can be found in R4-2408304/R4-2408305.**

* **Proposal:** 
  + **Option 1: ‘any power class can be used for Redcap type devices as long as the device can meet the core requirements defined for that power class’.**
  + **Option 2: ‘RedCap variants of PC1 through PC6 are not precluded’**
  + **Option 3: Other**
* Recommended WF
  + TBA.

### Sub-topic 1-3 CRs and TPs

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| **CR number** | **Comments collection** |
| [**R4-2407533**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2407533.zip) | draftCR to TS 38.101-2 for subclause 6.2K.4 (CATT) |
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| [**R4-2408230**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2408230.zip) | (NR\_CA\_R16\_intra-Core, , ) CR to add notes for SCS restrictions on CBWs in CA configurations - TS38.101-1, Rel-18 (Anritsu Limited) |
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| [**R4-2407298**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2407298.zip) | CR on updating UE capability name for 2Rx XR UEs [2Rx\_XR\_Device] (Apple)  (Moderator Note: this official CR is the resubmission of the endorsed CR R4-2404354) |
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| [**R4-2408695**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2408695.zip) **Revised to R4-2409657** | (TEI) CR to 38.101-5 Flexible TX-RX Separation for NR NTN Bands from Rel-18 [TEI\_NTN] (Inmarsat, Viasat, Omnispace, Terrestar Solutions, Thuraya, Ligado Networks, EchoStar, Thales, Skyworks) |
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| [**R4-2408708**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2408708.zip) | (TEI18) CR to 36.102 In-band NB-IoT NTN deployment with NR from Rel-18 [TEI\_NTN] (Inmarsat, Viasat, Omnispace, Terrestar Solutions, Thuraya, Ligado Networks, EchoStar, Thales, Skyworks, Apple) |
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| [**R4-2408710**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2408710.zip) | (TEI18) CR to 36.108 In-band NB-IoT NTN deployment with NR from Rel-18 [TEI\_NTN] (Inmarsat, Viasat, Omnispace, Terrestar Solutions, Thuraya, Ligado Networks, EchoStar, Thales, Skyworks, Apple) |
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| [**R4-2408998**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2408998.zip) | [TEI18] CR on updates to PC7 requirements for non-RedCap UE (TS38.101-2, Rel-18) (Huawei,HiSilicon) |
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| [**R4-2408999**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2408999.zip) | Draft LS to RAN2 on removal limitation about PC7 only applicable to RedCap UE (Huawei,HiSilicon) |
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| [**R4-2408304**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2408304.zip)  (R17 Cat F)  [**R4-240830**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2408304.zip)**5** (R18 Cat A) | CR for TS 38.101-2 Rel-17 clarification on Redcap Applicability in FR2 power classes (Sony, Qualcomm Incorporated) |
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