3GPP TSG-RAN WG4 Meeting #111 R4-2408613

Fukuoka, Japan, May 20th – 24th, 2024

**Agenda item:** 10.10.3

**Source:** Moderator (Intel Corporation)

**Title:** Topic summary for [111][132] NR\_FR1\_5MHz\_BW\_Ph2

**Document for:** Information

# Introduction

Rel-19 WI on **NR channel BW less than 5MHz for FR1 evolution** (RP-240832) was approved in RAN#103 with the following objectives:

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| --- |
| 4 Objective4.1 Objective of SI or Core part WI or Testing part WI  * Define common co-located and non-co-located inter-band NR CA/DC UE RF requirements with 3MHz CBW in the one band and 5MHz or 10MHz CBW in the other band   + Example band combination: CA/DC of 3MHz in band n100 and 5MHz or 10MHz in band n101 * Define RRM requirements for inter-band CA and DC for combinations introduced in RF part   Note: other band combinations than example band combinations can be specified in basket WIs after the above generic requirements are specified. 4.2 Objective of Performance part WI NOTE: Leave empty if the WI proposal does not contain a RAN performance part.   * Specify necessary performance requirements (RAN4) |

The discussion took place in the previous meetings with the following approved documents:

* **RAN4 #110bis (April 2024)**
  + R4-2406623 WF on RF requirements for less than 5MHz band combinations
  + R4-2406624 WF on clarification of multiple carrier operation for n100/n101

This summary handles the tdoc submitted for AI 10.10 for the Rel-19 NR\_FR1\_5MHz\_BW\_Ph2 WI and addresses the following Topics:

* **Topic #1: UE RF requirements for inter-band NR CA/DC with 3MHz CBW**

The following tdocs are handled in this summary document:

|  |  |  |  |
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| **TDoc** | **Title** | **Source** | **Agenda item** |
| [**R4-2407028**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2407028.zip) | Clarification of WID RP-240832 - NR\_FR1\_5MHz\_BW\_Ph2 | Union Inter. Chemins de Fer | 10.10.1 |
| [**R4-2407439**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2407439.zip) | UE RF requirements for inter-band NR CA/DC with 3MHz CBW | Nokia | 10.10.2 |
| [**R4-2407548**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2407548.zip) | Further discussion on UE RF requirements for inter-band NR CA/DC with 3MHz CBW | CATT | 10.10.2 |
| [**R4-2407549**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2407549.zip) | draftCR for inter-band NR CA&DC with 3MHz CBW (System parameter part) | CATT | 10.10.2 |
| [**R4-2407991**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2407991.zip) | Discussion for UE RF requirements for inter-band NR CA/DC with 3MHz CBW | LG Electronics France | 10.10.2 |
| [**R4-2408480**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2408480.zip) | Discussion on the RF requirements for Rel-19 less than 5MHz work item for TN phase 2 | Intel Corporation | 10.10.2 |
| [**R4-2408797**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2408797.zip) | Discussion on UE RF requirements for inter-band NR CADC with 3MHz CBW | ZTE Corporation, Sanechips | 10.10.2 |
| [**R4-2408798**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2408798.zip) | draftCR for TS 38.101-1: Introduction of inter-band NR CA/DC with less than 5MHz CBW | ZTE Corporation, Sanechips | 10.10.2 |
| [**R4-2408814**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2408814.zip) | draft CR to TS 38.101-1: Introduction of CA\_n100-n101 | Qualcomm Inc. | 10.10.2 |
| [**R4-2408815**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2408815.zip) | Scell bandwidth and sync raster | Qualcomm Inc. | 10.10.2 |
| [**R4-2409153**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2409153.zip) | Remaining RF requirements for CA\_n100-n101 and DC\_n100-n101 with 3MHz CBW | Huawei, HiSilicon | 10.10.2 |

# Topic #1: UE RF requirements for inter-band NR CA/DC with 3MHz CBW

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2407028**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2407028.zip) | Union Inter. Chemins de Fer | **Observation 1**: The support of 5MHz CBW (5MHz n100: 20 and 25RB cases) in bands n100 and n101 has been left out of the current WID.  **Observation 2**: UIC – Railways have a clear need for the support of CA/DC in both less than 5MHz CBW and 5MHz CBW.  **Proposal 1**: Agree to include in WID RP-240832 CA/DC support for 5MHz CBW (both 20RB and 25RB). |
| [**R4-2407439**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2407439.zip) | Nokia | **Proposal 1:** To specify ΔTIB,c for CA\_n100-n101 and NR DC\_n100-n101 as 0.3 dB for both bands.  **Proposal 2:** Not to specify MSD for CA\_n100-n101 and NR DC\_n100-n101. |
| [**R4-2407548**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2407548.zip) | CATT | **Proposal 1:** RAN4 not to define PC1 inter-band CA/DC for the band combination CA\_n100A-n101A until receiving approval from RAN plenary.  **Proposal 2:** RAN4 not to introduce a new UE capability to support NR CA/DC with less than 5MHz CBW and support of 12/20 RB transmission bandwidth.  **Proposal 3:** RAN4 to specify the requirement ΔTIB,c according to sufficient inputs and evaluation from vendors.  **Proposal 4:** RAN4 not to specify the requirement MSD for the band combination CA\_n100A-n101A. |
| [**R4-2407549**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2407549.zip) | CATT | Draft CR to TS 38.101-1 (Clause 5). |
| [**R4-2407991**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2407991.zip) | LG Electronics France | **Proposal 1**: Revisit the PC1 issue pending RAN decision.  **Proposal 2**: No need to specify the MSD requirements for CA n100-n101, but if other band combinations for BW less than 5 MHz have the MSD issues, it can be discussed in the future basket WI. |
| [**R4-2408480**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2408480.zip) | Intel Corporation | **Observation 1:** 5MHz is supported together with 3MHz as channel bandwidth for band n100 for single carrier operations and requirements.  **Proposal 1:** Send an LS to RANP to clarify in the WID that 5MHz support needs to be included together with 3MHz for CA/DC\_n100-n101 for band n100.  **Proposal 2:** Specify support of 5MHz channel bandwidth together with 3MHz for band n100 in CA\_n100-n101 and DC\_n100-n101 in the UE RF specifications.  **Proposal 3:** No new signalling indication is required in the RF scope of this item.  **Observation 2:** potential enhancements on the network signalling for better UE mobility performance in SCell addition or other related operations can be discussed in RRM room starting from August 2024.  **Proposal 4:** Use the basket items to be approved in June RANP to accommodate new requests from interested parties and specify the combo-specific requirements.  **Proposal 5:** Work item rapporteur is to provide a Big Draft CR for all the UE RF requirements and the group tries to endorse the Big Draft CR in every WG meeting in Q3-Q4 2024. |
| [**R4-2408797**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2408797.zip) | ZTE Corporation, Sanechips | **Proposal 1:** Whether to support PC1 inter-band CA/DC combinations needs input from operators.  **Proposal 2:** Whether to introduce new UE capability and/or other RRC signalling to support NR CA/DC with less than 5MHz CBW and support of 12 or 20 RB transmission bandwidth needs to wait for RRM requirements for CA.  **Proposal 3:** For inter-band CA\_n100-n101, no MSD issue needs to be discussed. |
| [**R4-2408798**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2408798.zip) | ZTE Corporation, Sanechips | Draft CR to TS 38.101-1 (Clauses 5 and 6). |
| [**R4-2408814**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2408814.zip) | Qualcomm Inc. | Draft CR to TS 38.101-1 (Clauses 5 and 6). |
| [**R4-2408815**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2408815.zip) | Qualcomm Inc. | **Observation 1:** Current RAN1 specifications specify a cell with SSB/CORESET0 for less than 5MHz are associated with the new sync raster points.  **Observation 2:** If SCell with less than 5MHz is not required to be in the new sync raster points, current specification is unclear on the transmission bandwidths when the cell is not a Pcell.  **Proposal 1:** Require less than 5 MHz SCell to be associated with the new sync raster points for less than 5MHz, similar as PCell. |
| [**R4-2409153**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2409153.zip) | Huawei, HiSilicon | **Proposal 1:** As ECC considered PC1 on n100 and n101, it is better to ask RANP to include PC1 Cab-radio UE NR CA/DC communications with the following configurations, in the WID.   |  |  | | --- | --- | | PC1 NR CA/DC TX output power | | | PC1 on FDD band n100 | PC3 on TDD band n101 | | 31 dBm | 23 dBm | | Note: the maximum output power on the two bands are limited to 31dBm. | |   **Proposal 2:** No UE capability of signaling is needed, as non-colocated inter-band CA is supported since Rel 15 and it was agreed to specify RF requirements agnostic of transmission bandwidth configurations for 3 MHz.  **Proposal 3:** ΔTIB,c of CA\_n100-n101:    **Proposal 4:** Spurious emissions for UE co-existence for CA\_n100-n101    **Proposal 5:** No IMD or harmonic related MSD is needed. Moreover as the two bands are 1 GHZ away from each other no MSD for cross band leakage is needed, neither. |

## Open issues summary

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

### Issue 1-1: Support of 5MHz CBW in band n100

* RAN4 #110bis agreements
  + 5MHz bandwidth can be added for n100 in the band combination after RAN plenary agrees to add it in the WID
* Proposals
  + Proposal 1: Agree to include in WID RP-240832 CA/DC support for 5MHz CBW (both 20RB and 25RB). (UIC)
  + Proposal 2: Send an LS to RANP to clarify in the WID that 5MHz support needs to be included together with 3MHz for CA/DC\_n100-n101 for band n100. (Intel)
  + Proposal 3: Specify support of 5MHz channel bandwidth together with 3MHz for band n100 in CA\_n100-n101 and DC\_n100-n101 in the UE RF specifications. (Intel)
* Recommended WF
  + Further discuss in the meeting whether RAN4 shall agree and send LS to include in WID RP-240832 CA/DC support for 5MHz CBW (both 20RB and 25RB) for band n100.

### Issue 1-2: ΔTIB,c

* RAN4 #110bis agreements
  + ΔTIB,c is FFS
    - Option 1: ΔTIB,c = [0.3] dB
    - Other option are not precluded
* Candidate options
  + Option 1: ΔTIB,c = 0.3 dB for CA\_n100-n101 and NR DC\_n100-n101 (Nokia, Huawei, Qualcomm, ZTE)

|  |  |  |
| --- | --- | --- |
| Inter-band CA combination | ΔTIB,c for NR bands (dB) | |
| Component band in order of bands in configuration | |
| CA\_n100-n101 | 0.3 | 0.3 |

* + Option 2: RAN4 to specify the requirement ΔTIB,c according to sufficient inputs and evaluation from vendors. (CATT)
* Recommended WF
  + Option 1

### Issue 1-3: MSD requirements

* RAN4 #110bis agreements
  + FFS on MSD requirements
* Proposals
  + Proposal 1: Not to specify MSD for CA\_n100-n101 and NR DC\_n100-n101. (Nokia).
  + Proposal 2: RAN4 not to specify the requirement MSD for the band combination CA\_n100A-n101A. (CATT)
  + Proposal 3: No need to specify the MSD requirements for CA n100-n101, but if other band combinations for BW less than 5 MHz have the MSD issues, it can be discussed in the future basket WI. (LGE)
  + Proposal 4: For inter-band CA\_n100-n101, no MSD issue needs to be discussed. (ZTE)
  + Proposal 5: No IMD or harmonic related MSD is needed. Moreover as the two bands are 1 GHZ away from each other no MSD for cross band leakage is needed, neither. (Huawei)
* Candidate options
  + Option 1: Do not specify MSD requirements for CA\_n100-n101 and NR DC\_n100-n101
* Recommended WF
  + Do not specify MSD requirements for CA\_n100-n101 and NR DC\_n100-n101
  + MSD requirements for other band combinations for BW less than 5 MHz can be discussed in the basket WI(s)

### Issue 1-4: Spurious emissions for UE co-existence

* Candidate options
  + Option 1: Spurious emissions for UE co-existence for CA\_n100-n101 (Huawei, QC, ZTE)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| NR CA combination | Spurious emission | | | | | | |
|  | Protected Band | Frequency range (MHz) | | | Maximum Level (dBm) | MBW (MHz) | NOTE |
| CA\_n100-n101 | Frequency range | 758 | - | 788 | -50 | 1 |  |

* Recommended WF
  + Option 1

### Issue 1-5: Power class for UL inter-band CA

* Background
  + PC3 and PC1 have been specified for band n100 and n101
  + The WID does not explicitly provide information on target PC
  + RAN4 #110bis agreements
    - Define PC3 inter-band CA/DC combinations
    - FFS on whether to define PC1 inter-band CA/DC combinations
* Proposals
  + Proposal 1: RAN4 not to define PC1 inter-band CA/DC for the band combination CA\_n100A-n101A until receiving approval from RAN plenary (CATT)
  + Proposal 2: Revisit the PC1 issue pending RAN decision. (LGE)
  + Proposal 3: Whether to support PC1 inter-band CA/DC combinations needs input from operators. (ZTE)
  + Proposal 4: As ECC considered PC1 on n100 and n101, it is better to ask RANP to include PC1 Cab-radio UE NR CA/DC communications with the following configurations, in the WID (Huawei)

|  |  |
| --- | --- |
| PC1 NR CA/DC TX output power | |
| PC1 on FDD band n100 | PC3 on TDD band n101 |
| 31 dBm | 23 dBm |
| Note: the maximum output power on the two bands are limited to 31dBm. | |

* Candidate options
  + Option 1: Further discuss whether to define PC1 inter-band CA/DC for the band combination CA\_n100A-n101A in RANP.
  + Option 2: RAN4 to recommend RANP to include PC1 cab-radio UE NR CA/DC communications in the WI scope with the following configurations

|  |  |
| --- | --- |
| PC1 NR CA/DC TX output power | |
| PC1 on FDD band n100 | PC3 on TDD band n101 |
| 31 dBm | 23 dBm |
| Note: the maximum output power on the two bands are limited to 31dBm. | |

* Recommended WF
  + Further discuss in the meeting

### Issue 1-6: UE capability and network signalling

* RAN4 #110bis agreements
  + FFS whether to introduce new UE capability and/or other RRC signalling to support NR CA/DC with less than 5MHz CBW and support of 12 or 20 RB transmission bandwidth
* Proposals
  + Proposal 1: RAN4 not to introduce a new UE capability to support NR CA/DC with less than 5MHz CBW and support of 12/20 RB transmission bandwidth. (CATT)
  + Proposal 2: No new signalling indication is required in the RF scope of this item. (Intel)
  + Proposal 3: Potential enhancements on the network signalling for better UE mobility performance in SCell addition or other related operations can be discussed in RRM room starting from August 2024. (Intel)
  + Proposal 4: Whether to introduce new UE capability and/or other RRC signalling to support NR CA/DC with less than 5MHz CBW and support of 12 or 20 RB transmission bandwidth needs to wait for RRM requirements for CA. (ZTE)
  + Proposal 5: No UE capability of signaling is needed, as non-colocated inter-band CA is supported since Rel-15 and it was agreed to specify RF requirements agnostic of transmission bandwidth configurations for 3 MHz.
* Recommended WF
  + Do not to introduce a new UE capability signalling to support NR CA/DC with less than 5MHz CBW and support of 12/20 RB transmission bandwidth within RF work scope.
  + Further potential enhancements can be further discussed in the RRM session.

### Issue 1-7: Sync raster applicability for Scell with < 5MHz CBW

* Proposals
  + Proposal #1: Require less than 5 MHz SCell to be associated with the new sync raster points for less than 5MHz, similar as PCell. (QC)
* Recommended WF
  + Discuss in the meeting

### Issue 1-8: CR handling

* Proposals
  + Proposal 1: Work item rapporteur is to provide a Big Draft CR for all the UE RF requirements and the group tries to endorse the Big Draft CR in every WG meeting in Q3-Q4 2024. (Intel)
* Draft CR list

|  |  |  |
| --- | --- | --- |
| **TDoc** | **Title** | **Source** |
| [**R4-2407549**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2407549.zip) | draftCR for inter-band NR CA&DC with 3MHz CBW (System parameter part) | CATT |
| [**R4-2408798**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2408798.zip) | draftCR for TS 38.101-1: Introduction of inter-band NR CA/DC with less than 5MHz CBW | ZTE Corporation, Sanechips |
| [**R4-2408814**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2408814.zip) | draft CR to TS 38.101-1: Introduction of CA\_n100-n101 | Qualcomm Inc. |

* Recommended WF
  + Further discuss timelines to endorse draft CRs
  + If agreeable to endorse CRs in RAN4 #111, then discuss individual CRs