3GPP TSG-RAN WG4 Meeting #112 R4-2412825

Maastricht, Netherlands, August 19th – 23rd, 2024

**Agenda item:** 8.4.4

**Source:** Moderator (Intel Corporation)

**Title:** Topic summary for [112][123] NR\_FR1\_5MHz\_BW\_Ph2

**Document for:** Information

# Introduction

This topic summary document handles RF aspects of Rel-18 NR\_FR1\_lessthan\_5MHz\_BW and Rel-19 NR\_FR1\_5MHz\_BW\_Ph2 WIs with the following topics:

* Topic #1: Rel-18 NR\_FR1\_lessthan\_5MHz\_BW (AI 5.11, 5.11.1)
* Topic #2: Rel-19 NR\_FR1\_5MHz\_BW\_Ph2 (AI 8.4, 8.4.1, 8.4.2)

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| **Topic title** | **WI** | **Topic areas** | **AI covered in the topic thread** |
| [112][123] NR\_FR1\_5MHz\_BW\_Ph2 | NR\_FR1\_lessthan\_5MHz\_BW-Core NR\_FR1\_lessthan\_5MHz\_BW\_Ph2 | 5.11 NR support for dedicated spectrum less than 5MHz for FR1 5.11.1 System parameter and UE RF requirements 8.4 NR channel BW less than 5MHz for FR1 Phase 2 8.4.1 General aspects 8.4.2 UE RF requirements for inter-band NR CA/DC with 3MHz CBW | 5.11.1 8.4 8.4.1 8.4.2 |

# Topic #1: Rel-18 NR\_FR1\_lessthan\_5MHz\_BW

## Tdoc list

The following tdocs are handled in this summary document submitted under AIs 5.11, 5.11.1:

|  |  |  |  |
| --- | --- | --- | --- |
| **TDoc** | **Title** | **Source** | **Agenda item** |
| [**R4-2411186**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411186.zip) | (NR\_FR1\_lessthan\_5MHz\_BW) – CR to TS 38.101-5 : Reserved GSCN requested by RAN2 | Ericsson | 5.11.1 |
| [**R4-2411187**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411187.zip) | (NR\_FR1\_lessthan\_5MHz\_BW) – CR to TS 38.108 : Reserved GSCN requested by RAN2 | Ericsson | 5.11.1 |
| [**R4-2412426**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412426.zip) | (NR\_FR1\_lessthan\_5MHz\_BW-Core) CR on 38.307 Release independent reserved operating bands | Huawei, HiSilicon | 5.11.1 |

## Companies’ contributions summary

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| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2411186**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411186.zip) | Ericsson | **CR to TS 38.101-5: Reserved GSCN requested by RAN2**  **Reason for change:**  RAN4 agreed to reserve NR band n200 and GSCN=2 values to address RAN2 issue on backward compatibility for legacy TN UEs not supporting less than 5 MHz channel bandwidth. Those reserved values shall also be indicated in NTN specifications to avoid any problem.  Background: To solve backward compatibility issue for legacy TN UEs not supporting less than 5MHz but provided with a neighbour cell with SSB on the new GSCN value, RAN2 introduces new signallings of dl-CarrierFreq-r18 and frequencyBandList-r18 in SIB4 for the cells with <5MHz BW. However, legacy signallings are mandatory, RAN2 proposes to set legacy fields as reserved values, which will be ignored by the new UE, when the new fields are indicated. From RAN4 perspective, we can define NR band n200 and GSCN=2 (corresponding to ARFCN-ValueNR = 250) as reserved values.  **Summary of change:** Introduce band n200 and GSCN=2 (corresponding to ARFCN-ValueNR = 250) as reserved values.  **Consequences if not approved**: The band n200 might be allocated to NTN in the future, which would conflict with the reservation made for TN. Lack of consistency between TN and NTN specifications. |
| [**R4-2411187**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411187.zip) | Ericsson | **CR to TS 38.108: Reserved GSCN requested by RAN2**  Aligned with R4-2411186 |
| [**R4-2412426**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412426.zip) | Huawei, HiSilicon | **CR to TS 38.307: Release independent reserved operating bands**  **Reason for change:** Per CRs R4-2410599 and R4-2410598, n200 is considered as reserved NR operating band. On the other hand, NR operating bands are release independent from Rel-15, based on TS 38.307. Therefore, n200 needs to be introduced as release independent from Rel-15 onward.  **Summary of change:** Reserved operating bands need to release independent from Rel-15 onward.  **Consequences if not approved:** Reserved operating bands such as n200 will not be release independent |

## Open issues summary

### Issue 1-1: Definition of reserved bands and GSCN for NTN specifications

* Proposals
  + Proposal #1: Introduce band n200 and GSCN=2 (corresponding to ARFCN-ValueNR = 250) as reserved values in TS 38.101-5 and TS 38.108 (Ericsson)
* CR list

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| **TDoc** | **Title** | **Source** |
| [**R4-2411186**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411186.zip) | (NR\_FR1\_lessthan\_5MHz\_BW) – CR to TS 38.101-5 : Reserved GSCN requested by RAN2 | Ericsson |
| [**R4-2411187**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411187.zip) | (NR\_FR1\_lessthan\_5MHz\_BW) – CR to TS 38.108 : Reserved GSCN requested by RAN2 | Ericsson |

* Recommended WF
  + Further discuss CRs

### Issue 1-2: Release independence of reserved operating bands

* Proposals
  + Proposal #1: Introduce reserved operating bands in a release independent manner from Rel-15 onward. (Huawei)
* CR list

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| --- | --- | --- |
| **TDoc** | **Title** | **Source** |
| [**R4-2412426**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412426.zip) | (NR\_FR1\_lessthan\_5MHz\_BW-Core) CR on 38.307 Release independent reserved operating bands | Huawei, HiSilicon |

* Recommended WF
  + Further discuss CRs

# Topic #2: Rel-19 NR\_FR1\_5MHz\_BW\_Ph2

## Tdoc list

The following tdocs are handled in this summary document submitted under AIs 8.4.1 and 8.4.2:

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| **TDoc** | **Title** | **Source** | **Agenda item** |
| [**R4-2412272**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412272.zip) | CA/DC using PC1 in bands n100 and n101 | Union Inter. Chemins de Fer | 8.4.1 |
| [**R4-2411096**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411096.zip) | Further discussion on UE RF requirements for Rel-19 NR channel BW less than 5MHz for FR1 Phase 2 | CATT | 8.4.2 |
| [**R4-2411097**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411097.zip) | draftCR on CA configuration for less than 5MHz UE RF requirements in Rel-19 | CATT | 8.4.2 |
| [**R4-2411854**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411854.zip) | Discussion on UE RF requirements for inter-band NR CADC with 3MHz CBW | ZTE Corporation, Sanechips | 8.4.2 |
| [**R4-2412411**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412411.zip) | Remaining open issues for NR CA\_DC with 3MHz CBW | Huawei, HiSilicon | 8.4.2 |
| [**R4-2412413**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412413.zip) | Discussion on the remaining issues for Rel-19 less than 5MHz work item for TN phase 2 | Intel Corporation | 8.4.2 |
| [**R4-2412414**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412414.zip) | Big draftCR for less than 5MHz UE RF requirements in Rel-19 | Intel Corporation | 8.4.2 |
| [**R4-2412429**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412429.zip) | LS on inclusion of 3MHz CBW in inter band NR CA\_DC applications | Huawei, HiSilicon | 8.4.2 |
| [**R4-2412594**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412594.zip) | UE RF requirements for inter-band NR CA/DC with 3MHz CBW | Nokia | 8.4.2 |
| [**R4-2413148**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2413148.zip) | Scell bandwidth and sync raster | Qualcomm Incorporated | 8.4.2 |

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2412272**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412272.zip) | Union Inter. Chemins de Fer | **Observation 1:** For railways it is essential to use PC1 UEs for CA/DC to enable high throughput while limiting the number of basestations and, as a result, reducing the network implementation cost.  **Observation 2**: PC1 support in band n100 and band n101 is supported by ECC and EC regulation as well as 3GPP technical specification.  **Observation 3**: Simultaneous transmission in bands n100 and n101 is not considered to be multiple carrier.  **Observation 4**: There are no harmonics nor IMD issues foreseen between using n100 and n101 in CA/DC.  **Observation 4**: There are no physical implementation limitations for FRMCS cabradios in bands n100 and n101.  **Observation 5**: TS38.101-1 [5] section 6.2A.1.3 should not be applicable to FRMCS cabradio HPUE in bands n100 and n101.  **Proposal 1**: The European spectrum regulation allows simultaneous transmission of 31dBm in bands n100 and n101. There are no technical nor implementation related reasons that should block simultaneous transmission with 31dBm per component carrier in 5G NR CA/DC.  RAN4 should discuss how to include in the 3GPP specifications inter-band CA/DC in bands n100 and n101 using 31dBm component carriers for FRMCS cabradios. |
| [**R4-2411096**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411096.zip) | CATT | **Proposal 1:** RAN4 not to consider PC1 support for band combination CA\_n100A-n101A by December 2024.  **Proposal 2:** With the introduction of supported BCS for band combination CA\_n100A-n101A, there is no need to update Rel-18 UE signaling to enable less than 5MHz CBW operation for CA/DC.  **Proposal 3:** There is no need for UE to be informed that SCell has 12 PRB or 20 PRB transmission bandwidth for 3MHz or 5MHz CBW, respectively.  **Proposal 4:** Less than 5 MHz SCell in CA/DC operation should be associated with the new sync raster points for less than 5MHz, similar as PCell.  **Proposal 5:** Considering that the required extra work is almost neglegible in RAN4 and at the same time RAN plenary guideline must be followed, RAN4 could have 5MHz channel bandwidth in band n100 included in CRs but with square brackets, and just remove square brackets in CRs after the update is approved in the revised WID. |
| [**R4-2411097**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411097.zip) | CATT | **draftCR on CA configuration for less than 5MHz UE RF requirements in Rel-19**  **Reason for change:** 5MHz channel bandwidth in band n100 was not approved in RAN#104, however, its required RAN4 work is almost negligible. By adding square brackets at this stage and removing the brackets when the demand is agreed, RAN plenary guidelines are followed and RAN4 efforts can be saved.  **Summary of change**: Add square brackets around 5MHz channel bandwidth for band n100 in CA configuration |
| [**R4-2411854**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411854.zip) | ZTE Corporation, Sanechips | **Proposal 1:** It is necessary to update Rel-18 UE capability signalling to enable less than 5 MHz CBW operation for CA/DC.  **Observation 1:** *CarrierBandwidth* means the width of carrier can be any number of PRBs, and 12 PRB or 20 PRB transmission bandwidth for 3MHz or 5MHz CBW will be indicated by carrierBandwidth for SCell.  **Proposal 2:** It’s proposed to require less than 5 MHz SCell to be associated with the new sync raster points for less than 5MHz, similar as PCell. |
| [**R4-2412411**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412411.zip) | Huawei, HiSilicon | **Proposal 1:** a UE can be aware of the *carrierBandwidth* of the other Scells and, using Table 1, the SSB bandwidth (and even their exact ARFCN values in case of 15 and 12 PRB) via Pcell and there is no need to add more requirements to associate Scell with the new sync raster points.  Table 1 Mapping between transmission BW and the SSB BW    **Proposal2:** To enable NR CA/DC with 3MHz CBW, in Rel-19, either *support3MHz-ChannelBW-Symmetric-r18* or/and *support3MHz-ChannelBW-Asymmetric-r18* need to be updated or new Rel-19 UE capabilities need to be defined. RAN2 should decide on which path to take.  **Proposal 3:** Send an LS to RAN2 to inform them of the Rel-19 UE capabilities that RAN4 needs. |
| [**R4-2412429**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412429.zip) | Huawei, HiSilicon | **Draft LS to RAN2**  **ACTION:** RAN4 respectfully requests RAN2 to specify the Rel-19 UE capabilities to include 3MHz CBW to inter band NR CA/DC operations. |
| [**R4-2412413**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412413.zip) | Intel Corporation | **Proposal 1:** 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 2:** No new signalling indication is required in the RF scope of this item.  **Observation:** potential enhancements on the network signalling for better UE mobility performance in SCell addition or other related operations can be discussed in RRM room.  **Proposal 3:** Send an LS to RAN2 about removing the descriptions against non-single-carrier deployments in the Rel-18 UE capability elements in the Rel-19 specs.  **Proposal 4:** Use the approved basket item [3] to accommodate new requests from interested parties and specify the combo-specific requirements. |
| [**R4-2412414**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412414.zip) | Intel Corporation | **Big draftCR for less than 5MHz UE RF requirements in Rel-19** |
| [**R4-2412594**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412594.zip) | Nokia | **Proposal 1:** UE capability signalling for less than 5 MHz CBW operation for CA/DC need to be defined in TS 38.306.  **Proposal 2:** No need to inform the UE that SCell has 12 PRB or 20 PRB transmission bandwidth for 3MHz or 5MHz CBW.  **Proposal 3:** Require less than 5 MHz SCell to be associated with the new sync raster points for less than 5MHz, similar as PCell. |
| [**R4-2413148**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2413148.zip) | Qualcomm Incorporated | **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. |

## Open issues summary

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

### Issue 2-1: Support of 5MHz CBW in band n100

* Background
  + RAN4 #111 agreement: In RAN4 common understanding, the support of 5MHz CBW on band n100 and 5MHz/10MHz on n101 in the band combination with band n100 and n101 can be included in Rel-19 WID
  + No agreement to update WID was made in RAN #104
* Proposals
  + Proposal 1: Considering that the required extra work is almost negligible in RAN4 and at the same time RAN plenary guideline must be followed, RAN4 could have 5MHz channel bandwidth in band n100 included in CRs but with square brackets, and just remove square brackets in CRs after the update is approved in the revised WID. (CATT)
  + 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. (Intel)
* Recommended WF
  + 5MHz channel bandwidth in band n100 included in CRs but with square brackets, and brackets can be removed after the update is approved in the revised WID

### Issue 2-2: UE capability signaling

* RAN4 #111 agreement
  + FFS whether any updates to Rel-18 UE capability signalling are needed to enable less than 5 MHz CBW operation for CA/DC.
* Proposals
  + Proposal 1: With the introduction of supported BCS for band combination CA\_n100A-n101A, there is no need to update Rel-18 UE signaling to enable less than 5MHz CBW operation for CA/DC (CATT)
  + Proposal 2: It is necessary to update Rel-18 UE capability signalling to enable less than 5 MHz CBW operation for CA/DC (ZTE)
  + Proposal 3: To enable NR CA/DC with 3MHz CBW, in Rel-19, either support3MHz-ChannelBW-Symmetric-r18 or/and support3MHz-ChannelBW-Asymmetric-r18 need to be updated or new Rel-19 UE capabilities need to be defined. RAN2 should decide on which path to take. Send an LS to RAN2 to inform them of the Rel-19 UE capabilities that RAN4 needs. (Huawei)
  + Proposal 4: Send an LS to RAN2 about removing the descriptions against non-single-carrier deployments in the Rel-18 UE capability elements in the Rel-19 specs. (Intel)
  + Proposal 5: UE capability signalling for less than 5 MHz CBW operation for CA/DC need to be defined in TS 38.306. (Nokia)
* Candidate options
  + Option 1: Do not update UE capability signalling and reuse Rel-18 signalling for less than 5MHz CBW operation for CA/DC (CATT)
  + Option 2: Introduce UE capability signaling to enable less than 5MHz CBW operation for CA/DC (ZTE, Huawei, Intel, Nokia)
    - Option 2a: Update Rel-18 UE capability signaling
    - Option 2b: Introduce Rel-19 UE capability signaling
    - Option 2c: The details including whether to update existing capabilities or introduce new capabilities are up to RAN2.
* Recommended WF
  + Option 2
  + Further discuss on the preferable approach to remove “single carrier” constraint in the capability signalling
  + Further discuss applicable release for new capabilities

### Issue 2-3: Network signaling on Scell transmission bandiwdth

* RAN4 #111 agreement
  + FFS whether UEs needs to be informed that SCell has 12 PRB or 20 PRB transmission bandwidth for 3MHz or 5MHz CBW, respectively
* Proposals
  + Proposal 1: There is no need for UE to be informed that SCell has 12 PRB or 20 PRB transmission bandwidth for 3MHz or 5MHz CBW, respectively (CATT)
  + Proposal 2: No new signalling indication is required in the RF scope of this item. (Intel)
  + Proposal 3: No need to inform the UE that SCell has 12 PRB or 20 PRB transmission bandwidth for 3MHz or 5MHz CBW. (Nokia)
* Candidate options
  + Option 1: There is no need for UE to be informed that SCell has 12 PRB or 20 PRB transmission bandwidth for 3MHz or 5MHz CBW, respectively
* Recommended WF
  + Option 1

### Issue 2-4: Sync raster applicability

* RAN4 #111 agreement
  + FFS whether any restrictions on ARFCN for SSB locations for SCell SSB need to be defined
    - Option 1: Require less than 5 MHz SCell to be associated with the new sync raster points for less than 5MHz, similar as PCell.
    - Other options are not precluded
* 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 (CATT, ZTE, Nokia, Qualcomm)
  + Proposal 2: UE can be aware of the carrierBandwidth of the other Scells and, using Table 1, the SSB bandwidth (and even their exact ARFCN values in case of 15 and 12 PRB) via Pcell and there is no need to add more requirements to associate Scell with the new sync raster points (Huawei)
* Candidate options
  + Option 1: Require less than 5 MHz PCell/SCell to be associated with the new sync raster points for less than 5MHz (CATT, ZTE, Nokia, Qualcomm)
  + Option 2: For CA case there is no need to add more requirements to associate Scell with the new sync raster point (Huawei)
* Recommended WF
  + Option 1

### Issue 2-5: Inter-band CA/DC in bands n100 and n101 using 31dBm component carriers

* RAN4 #111 agreement
  + Whether to define PC1 for UL inter-band CA for CA\_n100-n101 can be discussed in RANP.
* Proposals
  + Proposal 1: RAN4 should discuss how to include in the 3GPP specifications inter-band CA/DC in bands n100 and n101 using 31dBm component carriers for FRMCS cabradios. (UIC)
  + Proposal 2: RAN4 not to consider PC1 support for band combination CA\_n100A-**n101A by December 2024 (CATT)**
* **Recommended WF**
  + **Further discuss in the meeting**

### Issue 2-6: Big CR to TS 38.101-1

* RAN4 #111 agreement
  + Rapporteur (Intel) will prepare a single draft CR for RAN4 #112 covering the agreements in RAN4 #110bis and #111 and share before the RAN4 #112 with interested companies.
* Recommended WF
  + Further discuss and update as needed Draft Big CR R4-2412414
  + Moderator: Draft Big CR with necessary updates is recommended to be endorsed to complete the RF part of the WI. The formal CR can be brought in RAN4 #113 before official WI completion.