**3GPP TSG-RAN WG4 Meeting #109 R4-232xxxx**

**Chicago, USA, November 13th – 17th, 2023**

**Agenda item: 7.14, 7.15, 7.23, 7.24, 7.25, 7.26, 7.27, 9.2**

**Source:** Moderator (Huawei)

**Title:** Topic summary for [109][113] LTE\_NR\_Other\_WI

**Document for:** Information

# Introduction

*Briefly introduce background, the scope of this summary (e.g. list of treated agenda items).*

The contributions for the following agenda items are summarised in this document:

7.14 NR CA band combinations with two SUL cells in Rel-18 (2)
7.15 Rel-18 band combinations for concurrent operation of NR/LTE Uu bands/band combinations and one NR/LTE V2X PC5 band (1)
7.23 Rel-18 downlink interruption for NR and EN-DC band combinations at dynamic Tx switching (2)
7.24 Additional NR bands for UL-MIMO in Rel-18 (3)
7.25 Adding new NR FDD bands for RedCap in Rel-18 (1)
7.26 Adding new channel bandwidth(s) support to existing NR bands (4)
7.27 Simultaneous Rx/Tx inter-band combinations for NR CA/DC, NR SUL and LTE/NR DC in Rel-18 (5)
9.2 Additional LTE bands for UE categories M1/M2/NB1/NB2 in Rel-18 (0)

# Topic #1: NR CA band combinations with two SUL cells in Rel-18

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2318928 | CMCC | CR for 38.101-1: Add delta RIB requirements for CA\_n78C\_n84A-n89A |
| R4-2319617 | ZTE | Draft CR for TS 38.101-1 to correct SUL band combination with inter-band CA for two SUL cells |

*The moderator can suggest a limited number of papers which could be presented.*

## Open issues summary

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

No open issues for the topic.

# Topic #2: Rel-18 band combinations for concurrent operation of NR/LTE Uu bands/band combinations and one NR/LTE V2X PC5 band

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2318329 | CATT | CR on release independent for concurrent operation of NR/LTE Uu bands/band combinations and one NR/LTE V2X PC5 band<Moderator: Current version is shown as: 17.10.0, but Release is: Rel-18. Typo?> |

*The moderator can suggest a limited number of papers which could be presented.*

## Open issues summary

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

No open issues for the topic.

# Topic #3: Rel-18 downlink interruption for NR and EN-DC band combinations at dynamic Tx switching

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2320248 | China Telecom | CR to R16 38.307 Release independent requirements for 2CC 1Tx-2Tx switching |
| R4-2320249 | China Telecom | CR to R17 38.307 Release independent requirements for 3CC 1Tx-2Tx switching and 2CC or 3CC 2Tx-2Tx switching<Moderator: Should B.14-1 be B.4.14-1? B.15-1 be B.4.15-1? Typo?> |

*The moderator can suggest a limited number of papers which could be presented.*

## Open issues summary

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

No open issues for the topic.

# Topic #4: Additional NR bands for UL-MIMO in Rel-18

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2320072 | Huawei, HiSilicon | TS 38.101-1 big CR for NR\_bands\_UL\_MIMO\_R18 |
| R4-2320073 | Huawei, HiSilicon | Revised WID: Additional NR bands for UL-MIMO in Rel-18 |
| R4-2320074 | Huawei, HiSilicon, Bell Mobility, TELUS | Draft CR for 38.101-1 PC2 and PC3 UL-MIMO configurations for SUL band n86 |

*The moderator can suggest a limited number of papers which could be presented.*

## Open issues summary

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

No open issues for the topic.

# Topic #5: Adding new NR FDD bands for RedCap in Rel-18

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2320550 | Ericsson | CR for adding RedCap UE for release independent feature |

*The moderator can suggest a limited number of papers which could be presented.*

## Open issues summary

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

No open issues for the topic.

# Topic #6: Adding new channel bandwidths support to existing NR bands

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2318433 | Apple | n8 30MHz DL REFSENS and PC2 RSD***Proposal****: RAN4 to take the n8 DL 30MHz PC3 REFSENS and PC2 RSD values in the table below into consideration for the corresponding specifications development.*

|  |  |  |  |
| --- | --- | --- | --- |
| n8 | PC3 REFSENS (dBm) | 1Tx | -81.2 |
| PC2 RSD (dB) | 1Tx | 2.3 |
| 2Tx | 5.1 |

 |
| R4-2320996 | Skyworks Solutions Inc. | n8 PC3 30MHz REFSENS**Observation 1:** * **In Figure 4, the measured PA noise (plain blue line) does not rise linearly (dashed blue line) between DL n8 25MHz and n8 DL35MHz CBW,**
* **the measured MSD leads to lower REFSENS than the legacy agreements,**
* **the band n8 30MHz CBW MSD is approximately 0.6dB higher than the MSD for 25MHz CBW.**

**Proposal 1: Consider adopting the following band n8 REFSENS requirements and uplink configuration of** Table 1, Table 2**, changes highlighted in green.**Table 1 band n8 REFSENS requirements

| **Operating band / SCS / Channel bandwidth** |
| --- |
| **Operating Band** | **SCS kHz** | **5****MHz(dBm)** | **10****MHz(dBm)** | **15****MHz(dBm)** | **20****MHz(dBm)** | **25****MHz(dBm)** | **30 MHz (dBm)** | **35 MHz (dBm)** | **40****MHz(dBm)** | **45 MHz (dBm)** | **50****MHz(dBm)** |
| n8 | 15 | -97.0 | -93.8 | -91.4 | -85.8 | -83.6 | -82.2 | -78.4 |  |  |  |
| 30 |  | -94.1 | -91.7 | -87.2 | -84.7 | -82.8 | -78.5 |  |  |  |

Table 2 band n8 REFSENS uplink configuration

| **Operating band / SCS (kHz) / Channel bandwidth (MHz) / Duplex mode** |
| --- |
| **Operating Band** | **SCS** | **5** | **10** | **15** | **20** | **25** | **30** | **35** | **40** | **45** | **50** | **60** | **70** | **80** | **90** | **100** | **Duplex Mode** |
| n8 | 15 | 25 | 251 | 201 | 201 | Note 5 | Note 5 | Note 5 |  |  |  |  |  |  |  |  | FDD |
|  | 30 |  | 121 | 101 | 101 | Note 5 | Note 5 | Note 5 |  |  |  |  |  |  |  |  |  |
| Note 5: For this DL channel bandwidth, the UL configuration of the highest UL channel bandwidth specified in Table 5.3.6-1 and the default Tx-Rx frequency separation specified in Table 5.4.4-1 shall be used. |

**Observation 2: If not already captured in a draft CR, consider bringing the changes highlighted in yellow to Table 5.3.6-1 – to be confirmed with proponent CBW request.****Table 5.3.6-1: FDD asymmetric UL and DL channel bandwidth combinations**

|  |  |  |  |
| --- | --- | --- | --- |
| **NR Band** | **Channel bandwidths for UL (MHz)** | **Channel bandwidths for DL (MHz)** | **Asymmetric channel bandwidth combination set** |
| n5 | 20 | 25 | 0 |
| n8 | 20 | 35 | 0 |
|  | 10, 15, 20 | 25, 35 | 1 |
|  | [10, 15, 20] | [25, 30, 35] | [2] |
| n24 | 10 | 5 | 0 |
| n25 | 40 | 45 | 0 |
| n26 | 20 | 25, 30 | 0 |
| n66 | 5, 10 | 20, 40 | 0 |
|  | 20 | 40 |  |
|  | 5, 10 | 20, 25, 30, 40 | 1 |
|  | 20, 25, 30 | 40 |  |
|  | 5, 10, 15 | 20, 25, 30, 35, 40 | 2 |
|  | 20, 25, 30 | 40 |  |
| n70 | 5, 10 | 15 | 0 |
|  | 5, 10, 15 | 20, 25 |  |
| n71 | 5 | 10 | 0 |
|  | 10 | 15 |  |
|  | 15 | 20 |  |
|  | 5 | 10 | 1 |
|  | 10 | 15 |  |
|  | 15 | 20 |  |
|  | 20 | 35 |  |
|  | 20 | 25, 30, 35 | 2 |
| n911 | 10 | 5 | 0 |
| n921 | 5 | 10, 15, 20 | 0 |
|  | 10 | 15, 20 |  |
| n931 | 10 | 5 | 0 |
| n941 | 5 | 10, 15, 20 | 0 |
|  | 10 | 15, 20 |  |
| n105 | 20 | 25, 30, 35 | 0 |
| NOTE 1: The assignment of the paired UL and DL channels are subject to a TX-RX separation as specified in clause 5.4.4.NOTE 2: As indicated in TS38.306 [15], it is mandatory for UEs to support asymmetric channel BCS0 if there is an asymmetric BCS0 defined for the band. |

 |
| R4-2320677 | Huawei, HiSilicon, China Unicom | DraftCR for Adding 30MHz BW for band n8 |
| R4-2320321 | Ericsson | draft CR 38.101-1 corrections table 5.3.5-1 |
| R4-2319584 | Ericsson | Revised Basket WID on adding channel bandwidth support to existing NR bands<Moderator: reserved for email approval> |
| R4-2319585 | Ericsson | Big CR to TS 38.104: Adding channel BW support in existing NR bands<Moderator: reserved for email approval> |
| R4-2319586 | Ericsson | Big CR to TS 38.101-1: Adding channel BW support in existing NR bands<Moderator: reserved for email approval> |

*The moderator can suggest a limited number of papers which could be presented.*

## Open issues summary

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

### Sub-topic 6-1 Additional CBWs for band n8

*Sub-topic description:*

For 30MHz channel bandwidth, the PC3 REFSENS and PC2 RSD were agreed in RAN4#108bis based on contribution from Murata and Huawei. Two companies provided additional contribution to this meeting.

*Open issues and candidate options:*

**Issue 6-1-1: PC3 REFSENS for 30MHz DL CBW**

 UL RB allocation: 20 RBs at the bottom of the channel for 20 MHz CBW.

* Proposals

Table 6-1-1-1: Two antenna port QPSK PREFSENS for n8

| Source | SCS / Channel bandwidth  |
| --- | --- |
| SCS kHz | 30MHz (dBm) |
| R4-2318433 (Apple) | 15 | -81.2 |
| 30 | - |
| R4-2320996 (Skyworks) | 15 | -82.6 |
| 30 | -82.8 |
| R4-2315442 (Murata) | 15 | -81.3 |
| 30 |  |
| R4-2316774 (Huawei, HiSilicon) | 15 | -80.6 |
| 30 | -80.7 |
| Average | 15 | **-81.4** |
| 30 | **[-81.5]** |

* Recommended WF
	+ Take the average values as REFSENS

**Issue 6-1-2: PC2 REFSENS Degradation (RSD)**

* Proposals

Table 6-1-2-1: PC2 RSD for n8

| Source | Tx arch / Channel bandwidth | Remark |
| --- | --- | --- |
| Tx  | 30MHz (dB) | REFSENS+RSD (dBm) |
| R4-2318433 (Apple) | 1Tx | 2.3 | -78.9 |
| 2Tx | 5.1 | -76.1 |
| R4-2315442 (Murata) | 1Tx | 2.9 | -78.4 |
| 2Tx | 6.6 | -74.7 |
| R4-2316774 (Huawei, HiSilicon) | 1Tx | 3.6 | -77 |
| 2Tx | 6.8 | -73.8 |
| Average | 1Tx | **3.3** | **-78.1** |
| 2Tx | **6.5** | **-74.9** |

Note 1: REFSENS + RSD = PC2 Sensitivity (based on individual contribution)

Note 2: Average RSD = Average PC2 Sensitivity – Average REFSENS

* Recommended WF
	+ Take the average values as PC2 RSD

**Issue 6-1-3: Asymmetric channel bandwidth combination set**

Rel-18 spec:

**Table 5.3.6-1: FDD asymmetric UL and DL channel bandwidth combinations**

|  |  |  |  |
| --- | --- | --- | --- |
| **NR Band** | **Channel bandwidths for UL (MHz)** | **Channel bandwidths for DL (MHz)** | **Asymmetric channel bandwidth combination set** |
| n5 | 20 | 25 | 0 |
| n8 | 20 | 35 | 0 |
|  | 10, 15, 20 | 25, 35 | 1 |

* Proposals
	+ Option 1 (Skyworks): define new BCS2 with UL [10, 15, 20], DL [25, 30, 35]
	+ Option 2 (Huawei): add 30MHz to existing BCS0 and BCS1
	+ Option 3: others
* Recommended WF
	+ TBA

# Topic #7: Simultaneous Rx/Tx inter-band combinations in Rel-18

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2319510 | Huawei, HiSilicon | draft CR to 38.101-1: Removal of the non-simultaneous Note for CA\_n40-n41 |
| R4-2318424 | Apple | CR on Simultaneous RXTX 38101-3-i30\_s00-05 |
| R4-2319761 | Samsung | Discussion on Simultaneous RxTx Note handling for 38.101-3***Observation 1: Mandatory simultaneous Rx/Tx notes are added into Clause 5.2 of TS 38.101-1 for CA and Clause 5.5 of 38.101-3 for EN-DC.******Observation 2: If CA\_nXA-nYA is required to support mandatory simultaneous Rx/Tx, mandatory simultaneous Rx/Tx is supposed to apply to all NR-CA band combinations of the same band pair (band X and band Y). Similarly, If DC\_XA-nYA is required to support mandatory simultaneous Rx/Tx, mandatory simultaneous Rx/Tx is supposed to apply to all EN-DC band combinations of the same band pair (band X and band Y).******Observation 3: Mandatory simultaneous Rx/Tx notes are missing for some higher order EN-DC, such as DC\_XA\_nYC, DC\_XC\_nYA, DC\_XA\_nY(2A), and so on, which may cause confusion to vendors for implementation and RAN5 for conformance test.****Proposal 1: It is proposed to only add the general Note X to each configuration tables, but do not remove the mandatory simultaneous Rx/Tx note for the higher order EN-DC combos for which the note is already added.***Note X: If the mandatory simultaneous Rx/Tx capability is applied to an EN-DC configuration, the mandatory simultaneous Rx/Tx capability is also applied to other higher order configurations sharing the same band pair, without additional indication of NOTE Y (Note Y corresponds to the mandatory simultaneous Rx/Tx note in each configuration table).***Proposal 2: It is proposed to implement above method from Rel-15, and maintenance corrections CRs for 38.101-3 are provided [3][4][5][6] in this meeting.* |
| R4-2320020 | Nokia, Nokia Shanghai Bell | Discussion on Simultaneous Rx/Tx[**Observation 1:** The Simultaneous Rx/Tx UE capability is conditional mandatory and therefore it needs to be accurately noted in the RAN4 specification whether it is expected supported by the UE for a given band combination.](#_Toc149912997)[**Observation 2:** There is a large number of Notes within TS 38.101-1 related to simultaneous Rx/Tx, it is not always clear which mandates the simultaneous Rx/Tx capability and which doesn’t.](#_Toc149912998)[**Observation 3:** If a lower order band combination (CA or DC) is mandated to support the simultaneous Rx/Tx capability, then all higher order band combinations also is mandated to support simultaneous Rx/Tx capability.](#_Toc149912999)[**Observation 4:** It seems at least some combination of CA TDD-TDD has associated a wrong use and purpose of the notes related to Simultaneous Rx/Tx.](#_Toc149913000)[**Proposal 1: RAN4 shall review combinations with simultaneous Rx/Tx currently in the specifications to assess whether all needed requirements are captured as expected.**](#_Toc149913001)[**Proposal 2: RAN4 shall discuss whether or not all of the notes, as listed in Table 1, are needed or these can be simplified/merged.**](#_Toc149913002)[**Observation 5:** Note 13 and Note 15 in Table 5.2A.2.1-1 seems redundant.](#_Toc149913003)[**Proposal 3: Void Note 13 and Note 15 in Table 5.2A.2.1-1 and apply Note 9 were used in the Table.**](#_Toc149913004)[**Proposal 4: RAN4 shall remove notes related to simultaneous Rx/Tx in all band combination tables except for the two band CA and DC combinations.**](#_Toc149913005)[**Observation 6:** Current band combinations in the specification with no Notes related to simultaneous Rx/Tx seems to indicate operation both with and without simultaneous Rx/Tx.](#_Toc149913006) |
| R4-2320758 | Apple | Simultaneous RxTx and missing MSD test points**Observation:** With the introduction of simultaneous Rx/Tx requirements for CA\_n40A-n41A higher order combinations may require relaxation due to harmonic or IMD impact. At least CA\_n8A-n40A-n41A, CA\_n28A-n40A-n41A and CA\_n40A-n41A-n79A seem to require MSD. Similar cases could be present for the other combinations where simultaneous Rx/Tx requirements were added.**Proposal:** Use maintenance phase to identify combinations with missing requirements and introduce MSD where required. |
| R4-2319508 | Huawei, HiSilicon | Revised WID on Simultaneous Rx-Tx basket<Moderator: reserved for email approval> |
| R4-2319509 | Huawei, HiSilicon | Big CR to 38.101-1 on simultaneous Rx-Tx basket<Moderator: reserved for email approval> |
| R4-2319553 | Huawei Device Co., Ltd | Draft TR 38.894<Moderator: reserved for email approval> |

*The moderator can suggest a limited number of papers which could be presented.*

## Open issues summary

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

### Sub-topic 7-1 simultaneous Rx-Tx requirements in TS 38.101-1

**Issue 7-1-1: Further clarification on the simultaneous Rx-Tx requirements**

*Background: in the approved WF R4-2317576*

**<Way forward>:** RAN4 shall review the use of notes related to simultaneous Rx/Tx currently used in the specifications and whether all potential needed requirements are captured as expected. Companies are asked to provide proposals for simplification and increasing consistency.

**<Way forward>:**

* Companies are asked to identify missing requirements for existing band combinations without note of mandatory simultaneous Rx/Tx
	+ Handling the missing requirement of the band combinations in simultaneous Rx-Tx WI instead of Maintenance session

It is observed that the following statements have been specified, but further clarification might be needed.

5.2A.2 Inter-band CA – TS 38.101-1:

|  |
| --- |
| If the mandatory simultaneous Rx/Tx capability applies for a lower order band combination, when the applicable lower order band combination is a band pair in a higher order band combination, the mandatory simultaneous Rx/Tx capability also applies for the band pair in the higher order band combination. |

5.2B Operating bands for DC – TS 38.101-1:

|  |
| --- |
| If the mandatory simultaneous Rx/Tx capability applies for a band combination, the mandatory simultaneous Rx/Tx capability also applies for the band combination when the applicable band combination is a subset of a higher order band combination. |

* Proposals:
	+ - Proposal 1 (Nokia): Void Note 13 and Note 15 in Table 5.2A.2.1-1 and apply Note 9 were used in the Table.
		- Proposal 2 (Nokia): RAN4 shall remove notes related to simultaneous Rx/Tx in all band combination tables except for the two band CA and DC combinations.
* Recommended WF
	+ TBA

### Sub-topic 7-2 simultaneous Rx-Tx requirements in TS 38.101-3

***Background****: For the simultaneous Rx/Tx capability for a lower order DC configuration, it has been specified in TS 38.101-3 sub-clause 5.5B.1 General*

|  |
| --- |
| If the mandatory simultaneous Rx/Tx capability applies for a lower order DC configuration, when the applicable lower order DC configuration is a band pair in a higher order DC configuration, the mandatory simultaneous Rx/Tx capability also applies for the band pair in the higher order DC configuration. |

**Issue 7-2-1: Further clarification on the simultaneous Rx-Tx requirements**

Observation 3: Mandatory simultaneous Rx/Tx notes are missing for some higher order EN-DC, such as DC\_XA\_nYC, DC\_XC\_nYA, DC\_XA\_nY(2A), and so on, which may cause confusion to vendors for implementation and RAN5 for conformance test. (R4-2319761)

* Proposals:
	+ Proposal 1 (Samsung): It is proposed to only add the general Note X to each configuration tables, but do not remove the mandatory simultaneous Rx/Tx note for the higher order EN-DC combos for which the note is already added.
		- Note X: If the mandatory simultaneous Rx/Tx capability is applied to an EN-DC configuration, the mandatory simultaneous Rx/Tx capability is also applied to other higher order configurations sharing the same band pair, without additional indication of NOTE Y (Note Y corresponds to the mandatory simultaneous Rx/Tx note in each configuration table).
	+ Proposal 2 (Samsung): It is proposed to implement above method from Rel-15, and maintenance corrections CRs for 38.101-3 are provided [3][4][5][6] in this meeting.
* Recommended WF
	+ TBA

### Sub-topic 7-3 simultaneous Rx-Tx requirements for higher order combinations containing CA\_n40A-n41A

**Issue 7-2-1: Further clarification on the simultaneous Rx-Tx requirements**

**Observation:** With the introduction of simultaneous Rx/Tx requirements for CA\_n40A-n41A higher order combinations may require relaxation due to harmonic or IMD impact. At least CA\_n8A-n40A-n41A, CA\_n28A-n40A-n41A and CA\_n40A-n41A-n79A seem to require MSD. Similar cases could be present for the other combinations where simultaneous Rx/Tx requirements were added. (R4-2320758)

* Proposals:
	+ Proposal 1 (Apple): Use maintenance phase to identify combinations with missing requirements and introduce MSD where required.
* Recommended WF
	+ TBA

# Topic #8: Additional LTE bands for UE categories M1/M2/NB1/NB2 in Rel-18

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| N/A |  |  |

*The moderator can suggest a limited number of papers which could be presented.*

## Open issues summary

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

No open issues for this topic.