**3GPP T****SG-RAN WG4 Meeting#110bis Draft\_R4-2405256**

**Changsha, China, 15th April – 19th April, 2024**

**Agenda item:** 5.1.2

**Source:** Moderator (Skyworks Solution Inc.)

**Title:** Topic summary for [110bis][103] NR\_Baskets\_Part\_1

**Document for:** Information

# Introduction

Topic 1: Band combination with intra-band ULCA

Topic 2: Band combination with close proximity issues

Topic 3: Band combination within 3.3-7.125GHz range

Topic 4: CRs requiring expert review.

Topic 5: Others: NR-U (R4-2405959), DC\_18\_n77 (R4-2404937), NE-DC & EN-DC Notations (R4-2405061), n71 SCC PC3 MSD for CA\_n71B BCS4/5 (R4-2405449)

Topic 6: Rules and guidelines TP/TR MSD analysis.

**Notifications on AI changes**:

* R4-2404937 was moved from AI 4 to AI 5.1.1.1 and treat it in [103] topic 5.
* R4-2404176 was moved to AI 5.19 and treat it in [111]
* Recommend moving R4-2405451 to AI 5.19 and treat it in [111]
* R4-2404180 to be treated in Topic 6 (AI 11.3) within [103] topic 6.
* R4-2405449 was moved from AI 5.9.2 to AI 5.1.1.1 and treat it in [103] topic 5.
* R4-2404614 was moved from AI 5.10.2 to AI 5.1.1.1 and treat it in [103] topic 2.

**Note on Tdoc handling via ad-hoc session(s)**: Considering the large number of documents proposed in this thread, not all Tdocs can be treated in a single ad-hoc session. It is proposed to initiate e-mail threads on Topic 4, 5 and 6 to ensure each company’s views are captured.

# Topic #1: Band combination with intra-band ULCA

## Companies’ contributions summary

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| **TDoc** | **Title** | **Source** | **Proposals / Observations** |
| [**R4-2405677**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110bis/Docs/R4-2405677.zip) | CA\_n3B BCS1 | Murata Manufacturing Co Ltd. | MSD is proposed for UL CA\_n3B 20MHz+20MHz with:* PCC MSD: [22] dB, SCC MSD [11.1]dB for 25(RBstart=0)+25(Rbstart=81).
 |
| [**R4-2405446**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110bis/Docs/R4-2405446.zip) | MSD for UL CA\_n3B | Qualcomm France | Two test points are analysed for UL CA\_n3B 20MHz+20MHz MSD :* 1st: PCC MSD: [28.1] dB, SCC MSD [13.6] for 25(RBstart=0)+25(Rbstart=81).
* 2nd: PCC MSD: [28.0] dB, SCC MSD [15.2] for 25(RBstart=0)+25(Rbstart=73).

**Proposal 1**: RAN4 should consider which of the two points to use in specification and to use the respective MSD numbers in averaging process. |
| [**R4-2405963**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110bis/Docs/R4-2405963.zip) | CA\_n3B REFSENS | Skyworks Solutions Inc. | Two test points are analysed. One MSD test point is proposed for UL CA\_n3B 20MHz+20MHz with:* PCC MSD: [22] dB, SCC MSD [11.1]dB for 25(RBstart=0)+25(Rbstart=81).
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| [**R4-2404172**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110bis/Docs/R4-2404172.zip) | MSD Analysis for PC3 CA\_n40A-n41C with UL CA\_n41C | Apple | **Proposes** 20.8dB MSD for IMD3 of n41C falling into n40. |
| [**R4-2405444**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110bis/Docs/R4-2405444.zip) | Considerations on CA\_n40A-n41C | Qualcomm France | **Observation 1**: MSD for CA\_n40A-n41C is well above 50dB**Proposal 1**: RAN4 should consider whether MSD number is captured, or if other ways could be introduced for this kind of combinations were the theoretical worst-case scenario is not pragmatic.Moderator: Qualcomm corrects the band n40 Fc to 2358MHz |
| [**R4-2405955**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110bis/Docs/R4-2405955.zip) | CA\_n40A-n41C MSD | Skyworks Solutions Inc., ZTE Corporation | Observes that the measured dual-UL IMD3 of +0.7dBm at MPR0 fails the -13dBm/MHz emission limits.**Proposes** 42.5dB MSD for IMD3 of n41C falling into n40 assuming the UE uses the allowed MPR to meet -13dBm/MHz requirements. |
| [**R4-2405240**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110bis/Docs/R4-2405240.zip) | TP for TR38.718-02-01\_CA\_n40A-n41C | ZTE Corporation, Skyworks Solutions, Inc. | **Proposes** 42.5dB MSD for IMD3 of n41C falling into n40 assuming based on [**R4-2405955**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110bis/Docs/R4-2405955.zip)MSD analysis.Moderator: It is proposed to correct the band n40 Fc to 2358.5MHz |
| [**R4-2405445**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110bis/Docs/R4-2405445.zip) | Considerations on CA\_n41C-n79A | Qualcomm France | **Proposes** 17.4dB MSD for IMD4 of n41C falling into n79 |
| [**R4-2405241**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110bis/Docs/R4-2405241.zip) | TP for TR38.718-02-01\_CA\_n41A-n79C and CA\_n41C-n79A | ZTE Corporation, Mediatek | **Proposes** 3.1dB MSD for IMD4 of n41C falling into n79 |
|  |  |  |  |
| [**R4-2401274**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110/Docs/R4-2401274.zip) | TP for TR38.718-02-01\_CA\_n41A-n79C and CA\_n41C-n79A | ZTE Corporation, Mediatek | Proposes 3.1dB MSD for IMD4 of n41C falling into n79 |

## Open issues summary

### Sub-topic 1-1 CA\_n3B MSD

**Issue 1-1: CA\_n3B MSD test point and value**

* Proposals are summarized in the table below.
	+ Murata proposes one test point with footnote X to indicate that the MSD is applicable to BCS1 only.
	+ Qualcomm and Skyworks have analysed two test points. The 1st test point is identical to Murata’s proposal.
		- Qualcomm asks which test point should be captured in TS.
		- Skyworks proposes to adopt the 1st test point claiming that the 2nd test point is not compliant to the latest WF guidelines on MSD test points for intra-band CA.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **Test** **point #** | **CA configuration** | **SCS****(PCC/SCC)****(kHz)** | **Aggregated channel bandwidth (PCC+SCC)** | **UL PCC allocation****(LCRB)** | **UL SCC allocation****(LCRB)** | **PCC ΔRIBC (dB)** | **SCC ΔRIBC (dB)** |
| Murata | 1st | CA\_n3Bx | 15/15 | 20MHz + 20MHz | 25 (RBSTART = 0) | 25 (RBSTART = 81) | [22.0] | [11.1] |
| Qualcomm | CA\_n3B | 28.1 | 13.6 |
| Skyworks | 22.1 | 12.1 |
| Qualcomm | 2nd | CA\_n3B | 15/15 | 20MHz + 20MHz | 25(RBSTART = 0) | 25 (RBSTART = 73) | 28.0 | 15.2 |
| NOTE X: Applicable only to BCS1 |

* + UL configurations: same CBW, test point #2 aims at maximizing SCC MSD using same Lcrb values but different RB starts.
	+ MSD values:
		- 1st test point Murata/Skyworks: PCC/SCC MSD values are close 22dB/22.1dB. Qualcomm SCC MSD is close to Murata/Skyworks, PCC MSD is ~ 6dB higher (28.1dB).
		- 2nd test point: Qualcomm/Skyworks: SCC MSD are close: 15.2dB/15.5dB. Qualcomm PCC MSD is ~6.5dB higher (28dB). Skyworks considers that the 2nd MSD test point should not be considered because it does not comply to the latest guidelines on MSD test point selection for intra-band CA.
	+ Note: Murata proposes to add a note that this test point is applicable to BCS1 only.
* Recommended WF
	+ Test point selection: Moderator suggests that proponents discuss if the 2nd test point should be considered.
	+ MSD values: Moderator:
		- For 1st MSD test point, the SCC MSD values are similar enough that averaging may be used and proponents to discuss if averaging may be considered for PCC 1st test point.
		- 2nd test point MSD depends on outcome of discussions on the test point selection.
	+ Note: Since CA\_n3B is only BCS1 is there a need for a note?

### Sub-topic 1-2 CA\_n40A-n41C

* Band n40 MSD proposals are summarized in the table below.
	+ Apple proposes 20.8dB MSD.
	+ Qualcomm analysis indicates >50dB MSD and asks if such MSD should be captured.
	+ Skyworks/ZTE propose 42.5dB MSD by assuming the UE uses the MPR allowance to meet the -13dBm/MHz requirements. This MSD is proposed in TP for TR.
		- Moderator:
		- At MPR0, the IMD3 level measured in [R4-2405955](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110bis/Docs/R4-2405955.zip)would also lead to >50dB MSD,

|  |
| --- |
| **Band / Channel bandwidth / NRB / Duplex mode** |
| **NR CA band combination** | **NR band** | **UL Fc (MHz)** | **UL/DL BW (MHz)** | **UL LCRB** | **DL Fc (MHz)** | **MSD (dB)** | **Source** | **Source of IMD** |
| CA\_n40-n41 | n40 | N/A | 5 | N/A | **2353.5** | **20.8** | Apple | IMD3 |
| **2358** | **should >50dB be captured?** | Qualcomm |
| **2358.5** | **42.5** | Skyworks/ZTE |
| n41 | 2545 | 60 | 1 (RBSTART= 0) | 2545 | N/A |  | N/A |
| 2625 | 100 | 1 (RBSTART= 272) | 2625 |

* Recommended WF: discuss with experts and review if the proposed MPR assumptions and MSD are agreeable in TP below.

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| **T-doc**  | **Company/Review comment** |
| [**R4-2405240**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110bis/Docs/R4-2405240.zip)TP for TR38.718-02-01\_CA\_n40A-n41C | Company A: |
| Company B: |
| Company X: |

### Sub-topic 1-4 CA\_n41A-n79C and CA\_n41C-n79A TRs

**Issue 1-4a: CA\_** **n40A-n41C**

* Band n79 MSD proposals are summarized in the table below:
	+ Qualcomm proposes 17.4dB MSD.
	+ ZTE/Mediatek propose 3.1dB MSD.

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| **Band / Channel bandwidth / NRB / Duplex mode** |
| **NR CA band combination** | **NR band** | **UL Fc (MHz)** | **UL/DL BW (MHz)** | **UL LCRB** | **DL Fc (MHz)** | **MSD (dB)** | **Source** | **Source of IMD** |
| CA\_n41-n79 | n41 | 2545 | 60 | 1 (RBSTART= 0) | 2545 | N/A |  | N/A |
| 2625 | 100 | 1 (RBSTART= 272) | 2625 |
| n79 | N/A | 40 | N/A | 4872.5 | 17.415 | Qualcomm | IMD4 |
| [3.1]15 | ZTE/Mediatek | IMD4 |
| NOTE 15: This band is subject to IMD6 also which MSD is not specified |

* Recommended WF: Considering the large difference in MSD, averaging may not be considered. Discuss the proposed MSD values from the contributions and capture comments on the TP for TR below.

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| **T-doc**  | **Company/Review comment** |
| [**R4-2405241**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110bis/Docs/R4-2405241.zip) TP for TR38.718-02-01\_CA\_n41A-n79C and CA\_n41C-n79A | Company A: |
| Company B: |
| Company X: |

# Topic #2: Band combination with close proximity issues

## Companies’ contributions summary

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| **TDoc** | **Title** | **Source** | **Proposals / Observations** |
| [**R4-2405324**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110bis/Docs/R4-2405324.zip) | Discussion and TP for TR 38.718-02-01 to introduce CA\_n3A-n39A | Huawei, HiSilicon | **Proposes:****-** 1.5dB MSD for cross-band isolation interference from Band n3.- There is no need to specify OOB blocking exception for CA\_n3-n39 but following clarifications is proposed: “…the requirements for Band n3 and Band n39 apply with FDL\_low given by the lower limit of the restricted operating frequency range in Band n3 and FDL\_high by Band n39.”Moderator: the RF architecture assumes 3 antennas for 2x2 using a combined n3-n39 filter on diversity path.  |
| [**R4-2405443**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110bis/Docs/R4-2405443.zip) | Considerations on CA\_n3A-n39A | Qualcomm France | **Proposal 1**: RAN4 to tudy the feasibility of expanding n3 DPX to cover n39 and to study the feasibility of combined n3-n39 DRX filter**Proposal 2**: Assume Fdl\_low and Fdl\_high for UE supporting CA\_n3-n39 should be according to n3 Fdl\_low and n39 Fdl\_high. |
| [**R4-2405454**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110bis/Docs/R4-2405454.zip) | UL CA\_n5A-n13A | Qualcomm France | **Proposal 1**: 25dB MSD for band n5 5MHz CBW due to dual-UL IMD3 and n13 UL Lcrb=20(RBstart=0) and band n5 UL Lcrb=25(RBstart=0).**Proposal 2**: Further discuss in RAN4#110bis on if MSD test point for n13 DL is specified.**Proposal 3**: * 2.4dB MSD for band n13 5MHz CBW due to cross-band isolation interference from band n13
* 2.1dB MSD for band n5 5MHz CBW due to cross-band isolation interference from band n5.

**Proposal 4**: Use the following ΔTIB and ΔRIB

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| --- | --- | --- | --- |
| **Inter-band CA Configuration** | **NR Band** | **ΔTIB,c [dB]** | **ΔRIB,c [dB]** |
| CA\_n5A-n13A | n5 | 0.5 | 0 |
| n13 | 0.5 | 0 |

  |
| [**R4-2405954**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110bis/Docs/R4-2405954.zip) | CA\_n5-n13 REFSENS | Skyworks Solutions Inc. | **Observes** that MSD test point candidates for band n13 MSD due to cross-band isolation do not comply to the guidelines on MSD test points due to dual-UL IMD interference.**Proposes** 25dB MSD for band n5 using Lcrb=25(RBstart=0) for band n5 and to correct to the band n13 UL RB allocation to Lcrb=25(RBstart=0). |
| [**R4-2404614**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110bis/Docs/R4-2404614.zip) | TP for TR 38.718: PC3 inter-band CA\_n5-n13 | Verizon, Samsung | **Proposes** 25dB MSD for band n5 using Lcrb=25(RBstart=0) for both UL band n13 and n5.**Proposes** the following ΔTIB and ΔRIB:

| **Inter-band CA Configuration** | **NR Band** | **ΔRIB [dB]** |
| --- | --- | --- |
| CA\_n5-n13 | n5 | 0 |
| n13 | 0 |

| **Inter-band CA Configuration** | **NR Band** | **ΔTIB,c [dB]** |
| --- | --- | --- |
| CA\_n5-n13 | n5 | 0.5 |
| n13 | 0.5 |

**Moderator**: It is proposed to skip discussions on ΔTIB and ΔRIB since both proposals are identical. |

## Open issues summary

### Sub-topic 2-1 CA\_n3-n39

**Issue 2-1: CA\_n3-n39 cross-band isolation MSD**

* Proposals:
* **Proposal 1** (R4-2405324): the following MSD test configuration can be considered.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **UL band** | **DL band** | **UL Fc** | **UL BW** | **SCS of UL band** | **UL RB Allocation** | **DL Fc** | **DL BW** | **MSD** | **Cross-band****Interference****source** |
| **(MHz)** | **(MHz)** | **(kHz)** | **LCRB** | **(MHz)** | **(MHz)** | **(dB)** |
| n3 | n39 | 1770 | 30 | 15 | 160 (RBstart=0) | 1882.5 | 5 | 1.5 dB | >ACLR2 |

* **Proposal 2** (R4-2405443): RAN4 to study the feasibility of expanding n3 DPX to cover n39 and to study the feasibility of combined n3-n39 DRX filter.
* Recommended WF
	+ Further discuss if:
		- the combined n3-n39 filter rejection performance assumed in R4-2405324 are acceptable, and if MSD proposal is acceptable.
		- other RFFE architectures should be considered for MSD analysis.

**Issue 2-2: CA\_n3-n39 OOB blocking exception requirements.**

* Proposals:
* **Proposal 1** (R4-2405324): the following note can be introduced into table 7.6.3-2 of TS 38.101-1.

“For a UE supporting CA\_n3A-n39A and higher order band combinations in which CA\_n3A-n39A is a subset, the requirements for Band n3 and Band n39 apply with FDL\_low given by the lower limit of the restricted operating frequency range in Band n3 and FDL\_high by Band n39.”

* **Proposal 2** (R4-2405443): Assume Fdl\_low and Fdl\_high for UE supporting CA\_n3-n39 should be according to n3 Fdl\_low and n39 Fdl\_high.
* Recommended WF
	+ - Both proposals seem aligned. Review if text proposal from R4-2405324 is acceptable.

### Sub-topic 2-1 CA\_n5-n13

Moderator: As background information, the WF R4-2403717 (Qualcomm) was agreed at meeting #110 to:

* propose dual-UL IMD3 MSD test points were agreed based on R4-2400641 (Qualcomm),
* invite companies to evaluate cross-band isolation MSD requirements.

**Issue 2-3: CA\_n5-n13 - n5 MSD due to dual-UL IMD3**

* Proposals are summarized below:
* Band n5 MSD is proposed at 25dB in both proposals.
* Skyworks proposes to change the WF R4-2403717 band n13 Lcrb to 25(RBstart=0) to comply with the guidelines on MSD test points due to dual-UL IMD interference – see yellow highlights.
* Verizon/Samsung propose the WF R4-2403717 test point with Band n13 Lcrb = 25(RBstart=0).

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| **Band / Channel bandwidth / NRB / Duplex mode**  | **Source of****IMD** |
| **NR CA band combination** | **Source** | **NR band** | **UL Fc****(MHz)** | **UL/DL BW****(MHz)** | **UL****LCRB** | **DL Fc (MHz)** | **MSD****(dB)** | **Duplex mode** |
| CA\_n5-n13  | Qualcomm | n5 | 828 | 5 | 25 (RBstart=0) | 873 | 25 | FDD | IMD3 |
| n13 | 783 | 5 | 20 (RBstart=0) | 752 | N/A | FDD | N/A |
| SkyworksVerizonSamsung | n5 | 828 | 5 | 25 (RBstart=0) | 873 | 25 | FDD | IMD3 |
| n13 | 783 | 5 | 25 (RBstart=0) | 752 | N/A | FDD | N/A |

* Recommended WF
	+ - Review test point proposal from R4-2405954/R4-2404614 is acceptable.

**Issue 2-3: CA\_n5-n13 – n13 MSD due to dual-UL IMD3**

* Proposals:
* Qualcomm R4-2405454: Further discuss in RAN4#110bis on if MSD test point for n13 DL is specified.
* Skyworks R4-2405954: None of the two candidates for band n13 MSD meet the guidelines on MSD test points due to dual-UL IMD, hence no test point has been proposed.
* Verizon/Samsung R4-2404614: No test point proposed - IMD3 falling into band n13 cannot be defined.
* Recommended WF
	+ - Do not introduce a dual-UL IMD MSD test point for Band n13 in CA\_n5-n13.

Moderator: It should be noted that even if no test point is specified for band n13, the band n13 10MHz CBW may reach up to 20dB MSD for certain RB allocations – refer to [R4-2405954] for details.

**Issue 2-4: CA\_n5-n13 – n13 MSD due to cross-band isolation**

* Proposal see table below:
* Only Qualcomm R4-2405454 evaluated band n5 and band n13 cross-band isolation MSD. Initial in R4-2400641.

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| **UL band** | **DL band** | **UL Fc** | **UL BW** | **SCS of UL band** | **UL RB Allocation** | **DL Fc** | **DL BW** | **MSD** | **Cross-band****Interference****source** |
| **(MHz)** | **(MHz)** | **(kHz)** | **LCRB** | **(MHz)** | **(MHz)** | **(dB)** |
| n5 | n13 | 826.5 | 20 | 15 | 20 (RBstart=0) | 753.5 | 5 | 2.4 | >ACLR2 |
| n13 |  n5 | 782 | 10 | 15 | 20 (RBstart=32) | 871.5 | 5 | 2.1 | >ACLR2 |

Moderator: UL/DL Fc need to be changed to 834MHz/879MHz for Band n5, and Band n13 DL Fc to be changed to 751MHz.

* Recommended WF
	+ Experts to review if the MSD proposal is acceptable with suggested corrections to UL/DL Fc.

# Topic #3: Band combination within 3.3-7.125GHz range

## Companies’ contributions summary

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| **TDoc** | **Title** | **Source** | **Proposals / Observations** |
| [**R4-2405325**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110bis/Docs/R4-2405325.zip) | Discussion on RF requirements for CA\_n78A-n104A | Huawei, HiSilicon | **Observation 1**: Generally, there are three RF architecture for CA\_n78-n104 at least. i.e. separate antenna RF architecture, common antenna in diversity path and common antenna in both main and diversity path. The antenna isolation could be assumed as 10~15dB. The diplexer isolation between band n78 and n104 is not more than 10dB in main path. **Observation 2**: for band n77/n78 filter, the attenuation performance can be assumed as 20~25dB at frequency range 6425~7125MHz for standardization.**Observation 3**: it’s obvious that Alt.3 (6425-7125 MHz) is the easiest implementation for band n104 and good performance can be achieved more easily than Alt 1 and Alt 2.**Observation 4**: due to the RF specification difference of band licensed band n104 and unlicensed band n96, it’s very hard to share the same filter between them.**Observation 5**: for band n104 filter, the attenuation performance can be assumed as 20~25dB at frequency range 3300~3800MHz for standardization.**Observation 6**: the MSD issues should be analysed based on simultaneous Rx/Tx operation for CA\_n78-n104.**Observation 7**: due to the 2nd harmonic frequency of band n78 UL overlapping with DL band n104, the MSD due to 2nd harmonic interference should be investigated for band n104 DL.**Observation 8**: due to the 2nd harmonic frequency of band n78 DL overlapping with UL band n104, the MSD due to 2nd harmonic mixing interference should be investigated for band n78 DL.**Proposal 1**: Cross-band isolation MSD:* 4.78 ~ 12.82 dB MSD for band n104 20MHz CBW,
* 6.29 ~ 17.12 dB MSD for band n78 10MHz CBW.

n104 20MHz UL harmonic UL2/DL1 direct-hit: n104 20MHz UL harmonic MSD:* 23.6 ~ 32.9 dB MSD,

n78 UL1/DL2 Rx harmonic mixing: * 5.9~24.8dB MSD for10MHz CBW,
* 0.8~15.1dB MSD for 100MHz CBW.

**Proposal 2**: 0.8dB for ∆TIB and 0.5 dB for ∆RIB are proposed for both band n78 and n104. (It implies that the insertion loss is still assumed as 1.6dB). |
| [**R4-2405326**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110bis/Docs/R4-2405326.zip) | TP for TR 38.718-02-01 to introduce CA\_n78A-n104A | Huawei, HiSilicon | This TP captures the MSD analysis proposals from discussion paper [**R4-2405325**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110bis/Docs/R4-2405325.zip)**.** |
| [**R4-2405688**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110bis/Docs/R4-2405688.zip) | CA\_n78-n104 Simultaneous RX/TX Analysis | Murata Manufacturing Co Ltd. | Filter option1 (n46U+n96U): full band 5.150-7.125G FilterFilter option2 (n96U = n102U+n104L): 5.925-7.125G FilterFilter option 3 (n104L only): 6.425-7.125G Filter**Observation 1**: The co-banding filtering option 1 for both the UHB and 5-7GHz band groups reduces the need to increase ΔTIB and ΔRIB for simultaneous RX/TX operation if ample MSD is provided. The disadvantage of option 1 is the coexistence performance between n102U and n104.**Proposal 1**: Consider Cross band noise MSD [Moderator: see summary below]* [10.3] dB MSD for band n104 20MHz CBW,
* [17.2] dB MSD for band n78 10MHz CBW.

**Observation 2**: Near Miss H2 MSD is negligible compared to the cross-band noise MSD. It maybe preferred not to specify the near-miss MSD or include the cross-band noise MSD in the near miss H2 calculation. The latter is chosen in this contribution.**Proposal 2**: Define H2 direct hit and near miss MSD [Moderator: see summary below] for n104 20MHz:* Direct-hit: [38.7] dB MSD,
* Near-miss: [10.6] dB MSD.

**Observation 3**: Harmonic Mixing MSD includes the effect of the Cross Band noise**Proposal 3**: Consider 2nd harmonic mixing MSD in Table 2.1.2-4. [Moderator: see summary below]Band n78 UL1/DL2 Rx harmonic mixing: * [17.6]dB for 10MHz CBW,
* [9.9]dB for 100MHz CBW.
 |
| [**R4-2405450**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110bis/Docs/R4-2405450.zip) | Requirements for CA\_n78A-n104A | Qualcomm France | **Proposal 1**: Use the following MSD results in deciding requirements for CA\_n78A-n104A [Moderator: see summary below]UL2/DL1 direct hit and near miss MSD for Band n104 20MHz :* Direct-hit: [44.9] dB MSD,
* Near-miss: [16.2] dB MSD.

UL1/DL2 Rx harmonic mixing MSD for Band n78 10MHz :* 24.5 dB MSD,

Cross-band isolation MSD :* 4.3dB MSD for band n78 10MHz CBW,
* 4.8dB MSD for band n104 20MHz CBW.
 |
| [**R4-2405876**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110bis/Docs/R4-2405876.zip) | On CA\_n78-n104 and 3300-7125MHz RFFE architecture | Skyworks Solutions Inc. | **Proposal on DeltaT/R** to enable support of n78 within n77 filter and n104 within n96 filter with antenna multiplexing of n77/78+n79 with n46 or n102+n104:* Delta T/R for n78 of 1/0.5dB
* Delta T/R for 1.2/0.7dB.

**Proposal on cross band MSD**:* 10.1dB MSD for band n78 10MHz CBW,
* 17.2dB MSD for band n104 20MHz CBW.

**Proposal on H2 MSD on n104**:* direct-hit 38.8dB MSD for 20MHz CBW,

**Proposal for n78 UL1/DL2 MSD**:* 34.1dB MSD for 10MHz CBW.
 |

|  |  |  |  |
| --- | --- | --- | --- |
| [R4-2400716](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110/Docs/R4-2400716.zip) | CA\_n78-n104 Simultaneous RX/TX Analysis | Murata Manufacturing Co Ltd. | **Observation 1:** The co-banding filtering option 1 for both the UHB and 5-7GHz band groups reduces the need to increase ΔTIB and ΔRIB for simultaneous RX/TX operation if ample MSD is provided. The disadvantage of option 1 is the coexistence performance between n102U and n104.Moderator: architecture using 3 antennas with 1main n104, 1 main n78, 1 div n78+n104. Question does this mean 5 antennas for mandatory 4RX support in both bands? what filter assumption is used for the calculations?**Observation 2**: No 2nd UL harmonic requirement is defined where the victim band is > 5GHz because PCB isolation and filtering of the 2nd harmonic are poor.**Proposal 1: Define an exclusion zone for REFSENS for UL harmonic landing in NR band n104 as shown in Table 2.1.2-2 or N/A requirement as shown in Table 2.1.2-3.**Moderator: REFSENS exclusion is only defined for unlicensed bands sor (the reason is not the frequency range but the nature of the band that is anyhow shared)**Proposal 2: Consider Cross band noise MSD in Table 2-1.2-6. 17.2dB for n104 UL in n78 DL and 10.3dB for n78 UL in n104 DL**Moderator: Should we assume the n104UL into n78DL should be assessed outside the harmonic mixing condition?**Observation 3**: Harmonic Mixing MSD includes the effect of the Cross Band noise.**Proposal 3: Consider 2nd harmonic mixing MSD in Table 2-1.2-8. n104 UL1 with n78 DL2 at 17.6/9.9dB for 10/100MHz DL respectively**Moderator: only first 10MHz DL test point is mandatory, should both be specified? Can proponent clarify? |
| [**R4-2400643**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110/Docs/R4-2400643.zip) | Requirements for CA\_n78A-n104A | Qualcomm France | **Proposal 1**: Use the following MSD exceptions for CA\_n78A-n104An78/n104UL2/DL1 direct-hit at 44.9dB and UL2/DL1 Near-miss at 16.2dBn104/n78 UL1/DL2 at 24.5dBn104 UL cross band into n78DL at 4.3dB and n78 UL cross band into n104DL at 4.8dB**Proposal 2:** Specify CA\_n78A-n104A assuming simultaneous TX/RX**Proposal 3**: Use the following ΔTIB and ΔRIB for CA\_n78A-n104A n78/n104 DR and TR 0.8/1dB |

## Open issues summary

### Sub-topic 3-1 MSD for CA\_n78-n104

**Issue 3-3a: Cross band MSDs**

* Proposals are summarized in a single table due to common UL/DL configurations across companies:

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **UL band** | **DL band** | **UL Fc** | **UL BW** | **SCS of UL band** | **UL RB Allocation** | **DL Fc** | **DL BW** | **Cross-band****Interference****source** | **Huawei****option 1** | **Murata****option 2** | **Qualcomm****option 3** | **Skyworks****option 4** |
| **(MHz)** | **(MHz)** | **(kHz)** | **LCRB** | **(MHz)** | **(MHz)** | **MSD (dB)** |
| n78 | n104 | 3750 | 100 | 30 | 270 (RBstart=0) | 6435 | 20 | >ACLR2 | 4.78 ~ 12.82 | [10.3] | 4.8 | 17.2 |
| n104 | n78 | 6475 | 100 | 30 | 270 (RBstart=0) | 3795 | 10 | >ACLR2 | 26.29 ~ 17.12 | [17.2] | 4.3 | 10.1 |

* Recommended WF: proposes to further discuss the proposed values and understand the reasons for the large spread of values.

**Issue 3-3b: UL harmonic MSD**

* Proposals are summarized in a single table below.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **UL band** | **DL band** | **UL BW** | **SCS of UL band** | **UL RB Allocation** | **DL BW** | **UL/DL fc condition** | **UL/DL harmonic order** | **Huawei****option 1** | **Murata****option 2** | **Qualcomm****option 3** | **Skyworks****option 4** |
| **(MHz)** | **(kHz)** | **LCRB** | **(MHz)** | **MSD (dB)** |
| n78 | n104 | 10 | [15] | 50 (RBstart=0) | 20 | NOTE 2 | UL2/DL1direct-hit | 23.6~32.9 dBLcrb=24RB | [38.7] | 44.9 | 38.8 |
| n78 | n104 | 10 | [15] | 50 (RBstart=0) | 20 | NOTE 6 | UL2/DL1near-miss |  | [10.6] | 16.2 |  |

* + Recommended WF:
	+ Two companies have not proposed near-miss MSD test points.

Moderator: In an effort to further simplify MSD tables due to harmonic interference (both UL and Rx harmonic mixing) There are proposals discussed in thread [141] to specify near-miss MSD only when there is no direct hit collision. For direct-hit, it is encouraged to check if Huawei UL RB allocation difference may impact the proposed MSD levels.

* + In this meeting,
		- Discuss if an agreement can be reached for direct-hit MSD
		- based on moderator’s comment, discuss if near-miss MSD test point is really needed for CA\_n78-n104.

**Issue 3-3c: Harmonic mixing MSDs**

* Proposals – Discrepancies highlighted in yellow prevent summarizing into a single table.
	+ Option 1: Huawei

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **UL band** | **DL band** | **UL BW** | **SCS of UL band** | **UL RB Allocation** | **DL BW** | **MSD** | **UL/DL fc condition** | **UL/DL harmonic order** |
| **(MHz)** | **(kHz)** | **LCRB** | **(MHz)** | **(dB)** |
| n104 | n78 | 20 | 30 | 50 (RBstart=0) | 10 | 5.9~24.8dB | NOTE 1 | UL1/DL2 |
| n104 | n78 | 20 | 30 | 50 (RBstart=0) | 100 | 0.8~15.1dB | NOTE 1 | UL1/DL2 |

* + Option 2: Murata

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **UL band** | **DL band** | **UL BW** | **SCS of UL band** | **UL RB Allocation** | **DL BW** | **MSD** | **UL/DL fc condition** | **UL/DL harmonic order** |
| **(MHz)** | **(kHz)** | **LCRB** | **(MHz)** | **(dB)** |
| n104 | n78 | 5 | 15 | 25 (RBstart=0) | 10 | [17.6] | NOTE 7 | UL1/DL2 |
| n104 | n78 | 20 | 15 | 100 (RBstart=0) | 100 | [9.9] | NOTE 7 | UL1/DL2 |
| NOTE 7: The requirements should be verified for UL NR-ARFCN of the aggressor (higher) band (superscript HB) such that  in MHz and  with  the carrier frequency in the victim (lower) band and  the channel bandwidth configured in the higher band. |

* + Option 3: Qualcomm

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **UL band** | **DL band** | **UL BW** | **SCS of UL band** | **UL RB Allocation** | **DL BW** | **MSD** | **UL/DL fc condition** | **UL/DL harmonic order** |
| **(MHz)** | **(kHz)** | **LCRB** | **(MHz)** | **(dB)** |
| n104 | n78 | 20 | 15 | 50 (RBstart=0) | 10 | 24.5 | NOTE 7 | UL1/DL2 |

* + Option 4: Skyworks

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **UL band** | **DL band** | **UL BW** | **SCS of UL band** | **UL RB Allocation** | **DL BW** | **MSD** | **UL/DL fc condition** | **UL/DL harmonic order** |
| **(MHz)** | **(kHz)** | **LCRB** | **(MHz)** | **(dB)** |
| n104 | n78 | 20 | 15 | 50 (RBstart=0) | 10 | 34.1 | NOTE 7 | UL1/DL2 |

* Recommended WF
* Band n104 UL configuration: [Moderator: according to guidelines on MSD test points for harmonic interference, the UL band Lcrb shall be configured using the RB allocation that corresponds to the specified CBW and of the smallest supported SCS for that CBW]
	+ - WF agreement was for band n104 20MHz UL CBW. Based on moderator’s comment Lcrb should be Lcrb=100(RBstart=0),
		- 5MHz CBW is not supported by n104.
		- SCS30kHz is not the smallest CBW supported by n104 20MHz CBW.
		- This meeting: reach agreement on a single UL configuration for Rx harmonic mixing test point.
	+ Number of test points: two companies evaluate two test points, two companies evaluated only the “guideline’s mandatory” test point, that which specifies the band n78 lowest CBW of 10MHz.
		- This meeting; reach agreement on whether RAN4 should capture 1 or 2 test points.
	+ Footnote: - NOTE 7 seems the correct footnote. Reach agreement this is the correct footnote.
* The proposed MSD for the n78 10MHz CBW ranges from: 5.9~24.8dB, 17.6, 24.5 and 34.1dB. The spread is too large to consider averaging, experts to understand the reasons for such a large spread of values.

**Issue 3-3d: Delta T/R**

* Proposals
* Option 1: Huawei assumes insertion loss is 1.6dB
	+ ∆TIB: 0.8dB for n78 and n104
	+ ∆RIB: 0.5dB for n78 and n104.
* Option 2: Qualcomm:
	+ ∆TIB: 1.0dB for n78 and n104
	+ ∆RIB: 1.2dB for n78 and n104.
* Option 3: Skyworks:
	+ ∆TIB: 1.0dB for n78 and 1.2dB for n104
	+ ∆RIB: 0.5dB for n78 and 0.7dB for n104.
* Recommended WF
	+ Discuss DeltaT/R based on architecture assumptions to be discussed above.

# Topic #4: CRs requiring expert review

## Companies’ contributions summary

|  |  |  |  |
| --- | --- | --- | --- |
| **TDoc** | **Title** | **Source** | **Proposals / Observations** |
| [**R4-2405300**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110bis/Docs/R4-2405300.zip) | draft CR for TS38.101-3 to clarify 1 UL configuration for NR Inter-band CA configurations between FR1 and FR2 | Huawei, HiSilicon,[Skyworks Solutions Inc.] | This draftCR aligns TS 38.101-3 with last meeting agreed CR for TS38.101-1 on clarifying the valid 1UL configurations. In Clause 5.5A.1.0, it is proposed to add the following:In the CA configuration tables of clause 5.5A.1:* Uplink CA configuration entries with "-" mean that any valid constituent band of the downlink inter-band CA combination can be configured as a single uplink carrier,
* Unless otherwise noted, all of the valid downlink constituent bands can be configured as a single uplink carrier,
* If an uplink CA configuration is supported, its fallback single uplink is also supported.
 |
| [**R4-2405301**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110bis/Docs/R4-2405301.zip) | draft CR for TS38.101-2 to clarify 1 UL configuration for CA | Huawei, HiSilicon | This draftCR aligns TS 38.101-2 with last meeting agreed CR for TS38.101-1 on clarifying the valid 1UL configurations. In Clause 5.5A, it is proposed to add the following:In the CA configuration tables of clause 5.5A.1 and clause 5.5A.2:* Unless otherwise noted/stated, Uplink CA configuration entries with "-" mean single uplink carrier is valid for downlink intra-band CA,

In the CA configuration tables of clause 5.5A.3:* Uplink CA configuration entries with "-" mean that any valid constituent band of the downlink inter-band CA combination can be configured as a single uplink carrier,
* Unless otherwise noted, all of the valid downlink constituent bands can be configured as a single uplink carrier,
* If an uplink CA configuration is supported, its fallback single uplink is also supported.
 |
| [**R4-2405353**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110bis/Docs/R4-2405353.zip) | DraftCR to TS38.101-3 addition of the missing NE-DC requirements | Huawei Technologies France | This CR adds core requirements for the following new clauses:6.2B.1.5a Inter-band NE-DC including both FR1 and FR26.2B.2.5a Inter-band NE-DC including both FR1 and FR26.2B.3.5a Inter-band NE-DC including both FR1 and FR26.2B.4.1.5a Inter-band NE-DC including both FR1 and FR26.2B.4.2.5a Inter-band NE-DC including both FR1 and FR26.2B.4.2.5a.1 ΔTIB,c for NE-DC three bands6.2B.4.2.5a.2 ΔTIB,c for NE-DC four bands6.2B.4.2.5a.4 ΔTIB,c for NE-DC six bands7.3B.2.4a Inter-band NE-DC including FR27.3B.2.4a.1 Void7.3B.2.5a Inter-band NE-DC including both FR1 and FR27.3B.2.5a.1 Reference sensitivity exceptions due to UL harmonic interference for NE-DC including both FR1 and FR27.3B.3.1a Intra-band contiguous NE-DC within FR17.3B.3.5a Inter-band NE-DC including both FR1 and FR27.6B.2.5a Inter-band NE-DC including both FR1 and FR27.6B.3.5a Inter-band NE-DC including both FR1 and FR27.6B.4.5a Inter-band NE-DC including both FR1 and FR27.7B.5a Inter-band NE-DC including both FR1 and FR27.8B.2.5a Inter-band NE-DC including both FR1 and FR27.9B.5a Inter-band NE-DC including both FR1 and FR2Moderator: This CR addresses flags from the last meeting where it was commented that several requirements are missing for NE-DC.  |

## Open issues summary

Moderator: unless otherwise needed, the draft CRs will not be discussed in details in the Ad-hoc.

### Sub-topic 4-1 38.101-1 Draft CR reviewSub-topic 4-2 Draft CR review

Recommended WF: The CR should be reviewed offline to preserve ad-hoc time. A separate email thread will be used with below table to review offline and check during Ad-hoc.

|  |  |
| --- | --- |
| **T-doc** | **Company/Review comment** |
| [**R4-2405300**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110bis/Docs/R4-2405300.zip)draft CR for TS38.101-3 to clarify 1 UL configuration for NR Inter-band CA configurations between FR1 and FR2 | Company A: |
| Company B: |
| Company X: |
| [**R4-2405301**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110bis/Docs/R4-2405301.zip)draft CR for TS38.101-2 to clarify 1 UL configuration for CA | Company A: |
| Company B: |
| Company X: |
| [**R4-2405353**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110bis/Docs/R4-2405353.zip)DraftCR to TS38.101-3 addition of the missing NE-DC requirements | Company A: |
| Company B: |
| Company X: |

# Topic #5: Others: EN-DC notation, NR-U, Tdoc moved from other AI.

## Companies’ contributions summary

|  |  |  |  |
| --- | --- | --- | --- |
| **TDoc** | **Title** | **Source** | **Proposals / Observations** |
| [**R4-2405061**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110bis/Docs/R4-2405061.zip) | Clarification on notation of EN-DC and NE-DC combinations with intra-band components | CHTTL | **Observation 1:** Based on the current rules in TR 38.846, the notation of EN-DC combinations with one intra-band 2CC contiguous component are based on the structure, DC\_{Sorted LTE carriers}-(n)xxAA-{Sorted NR carriers}, while the notation of NE-DC combinations with one intra-band 2CC contiguous component are based on the structure, DC\_{Sorted NR carriers}-xx(n)AA-{Sorted LTE carriers}.**Proposal 1:** Confirm that for the notation of inter-band EN-DC combinations with intra-band contiguous components, each combination include a list of sorted LTE carriers first, followed by the intra-band EN-DC components, then the sorted NR carriers at the end.**Proposal 2:** Confirm that for the notation of inter-band NE-DC combinations with intra-band contiguous components, each combination include a list of sorted NR carriers first, followed by the intra-band NE-DC components, then the sorted LTE carriers at the end.With P1 & P2, the correct notation will be DC\_n8A-3(n)AA, DC\_n77A-3(n)AA, DC\_n257A-3(n)AA for NE-DC.**Proposal 3:** When a combination contains intra-band EN-DC or NE-DC components, (n)xxAA or xx(n)AA like notation, they are connected with other carriers by “-” in any case.**Proposal 4:** If a configuration contains multiple entries with (n), they are needed to be sorted in numerical order.With P1,P2,P3 & P4 the correct notation will be DC\_1A-(n)3AA-(n)7AA-n77A for EN-DC, and DC\_n77A-3(n)AA-7(n)AA-1A for NE-DC, however those combinations are just for example, not proposed to the baskets yet.Then, it is necessary to update those rules in the related specifications, starting from the draft CR for TR 38.846 in section 5.**Proposal 5:** Update the related combinations in the specifications to be aligned with proposal 1,2,3 and 4. |
| [**R4-2405959**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110bis/Docs/R4-2405959.zip) | On NR-U Nominal Channel Spacing | Skyworks Solutions Inc., Nokia | **Observation 1:*** To address the concerns raised in [1], there appears to be a consensus that RAN4 needs to specify NR-U exception rules to the NCS defined in clause 5.4.1.1 and 5.4A.1,
* Proposal 1 [1] addresses this concern with a list of deviations for each type of NCS,
* Proposal 2 [2,3] partially addresses this concern:
	+ This proposal is incomplete and requires additional work:
		- to cover all CC CBW combinations, and
		- to address the exceptions to the NCS rules of clause 5.4.1.1,
		- to become NR-U frequency band agnostic
	+ This proposal would make the TS more complex than Proposal 1 and more difficult to maintain in case new NR-U CC CBWs are introduced in the future.

Moderator: [1] = R4-2400364, [3] = R4-2001318.**Observation 2:** RAN4 may consider two alternative solutions to capture the NR-U deviations from the NR NCS equations.Alternative #1: It is sufficient to specify a single value of the NR-U channel spacing maximum deviation from the NCS, as defined in clause 5.4.1.1 and 5.4A.1.Alternative #2: For NR-U, the channel spacing between two adjacent component carriers is equal to* + AggBW/2 for 60, 120 and 180 MHz AggBW,
	+ AggBW/2 + {-0.02,0.04} for 40, 100 and 160 MHz AggBW
	+ AggBW/2 + {-0.04,0.02} for 80, 140 and [200] MHz AggBW,

where “AggBW” is the aggregated CBW of the two adjacent component carriers and is defined as AggBW = CC1CBW+CC1CBW.**Proposal 3:** In TS 38.101-1, capture the NR-U channel spacing exception to the NR nominal channel spacing rules by adopting the Observation 2 Alternative#1 solution:* **To Clause 5.4.1.1, add the following sentence:**

For NR bands restricted to operation with shared-spectrum channel access, the maximum deviation from the nominal channel spacing is [40] kHz.* **To Clause 5.4A.1, add the following sentence:**

The channel spacing for intra-band contiguous carrier aggregation can be adjusted to any multiple of least common multiple of channel raster and sub-carrier spacing less than the nominal channel spacing to optimize performance in a particular deployment scenario. For intra-band contiguous carrier aggregation in NR bands restricted to operation with shared-spectrum channel access, the maximum deviation from the nominal channel spacing is [300] kHz. |
| [**R4-2405449**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110bis/Docs/R4-2405449.zip) | Missing MSD for PC3 CA\_n71B BCS4/5 | Qualcomm France | **Proposal 1**: Add the following MSD test point for PC3 n71B:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CA configuration** | **SCS****(PCC/SCC)****(kHz)** | **Aggregated channel bandwidth (PCC+SCC)** | **UL PCC allocation****(LCRB)** | **ΔRIBC (dB)** | **Duplex mode** |
| CA\_n71B | 15/15 | 20MHz + 15MHz | 20 (RBSTART = 0) | 5.1 | FDD |

**Proposal 2**: Add the following text into 7.3A.2.1:For specific uplink and downlink test points which are specified in Table 7.3A.2.X-Y and the reference sensitivity power level increased by ΔRIBC. The requirements apply with all downlink carriers active. Unless given by Table 7.3.2-4, the reference sensitivity requirements shall be verified with the network signaling value NS\_01 (Table 6.2.3.1-1) configured.Moderator: Cross-alignment with PC2 test points discussed in thread [111] may be needed. |
| [**R4-2404937**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110bis/Docs/R4-2404937.zip) | On PC3 MSD values for DC\_18\_n77A and CA\_n18-n77A in Rel-18 | KDDI Corporation,Samsung, LGE, Murata, Skyworks | **Proposes** Band n18/B18 and band n77 dual UL IMD MSD test points.**Table 1 . PC3 MSD results for DC\_18A\_n77A and CA\_n18A-n77A**

| **NR or E-UTRA Band / Channel bandwidth / NRB / MSD** |
| --- |
| **NR-CA or ENDC****Configuration** | **EUTRA or NR band** | **UL Fc (MHz)** | **UL/DL BW (MHz)** | **UL LCRB** | **DL Fc (MHz)** | **MSD (dB)** | **IMD order** |
| DC\_18A\_n77A | 18 | 827.5 | 5 | 25 | 872.5 | 8.4 | IMD4 X |
|  | n77 | 3355 | 10 | 50 | 3355 | N/A | N/A |
|  | 18 | 817.5 | 5 | 25 | 862.5 | 4.5 | IMD5 X |
|  | n77 | 4130 | 10 | 50 | 4130 | N/A | N/A |
| CA\_n18A-n77A | n18 | 827.5 | 5 | 25 | 872.5 | 8.4 | IMD4 X |
|  | n77 | 3355 | 10 | 50 | 3355 | N/A | N/A |
|  | n18 | 817.5 | 5 | 25 | 862.5 | 4.5 | IMD5 X |
|  | n77 | 4130 | 10 | 50 | 4130 | N/A | N/A |
| NOTE X: In Japan, n77 band is restricted to 3400 – 4100 MHz frequency range, and there are no valid MSD test points when using this restricted frequency range. |

 |

## Open issues summary

### Sub-topic 5-1 on notation of EN-DC and NE-DC combinations with intra-band components

* Proposals.
* **Proposal 1:** Confirm that for the notation of inter-band EN-DC combinations with intra-band contiguous components, each combination include a list of sorted LTE carriers first, followed by the intra-band EN-DC components, then the sorted NR carriers at the end
* **Proposal 2:** Confirm that for the notation of inter-band NE-DC combinations with intra-band contiguous components, each combination include a list of sorted NR carriers first, followed by the intra-band NE-DC components, then the sorted LTE carriers at the end.
* **Proposal 3:** When a combination contains intra-band EN-DC or NE-DC components, (n)xxAA or xx(n)AA like notation, they are connected with other carriers by “-” in any case.
* **Proposal 4:** If a configuration contains multiple entries with (n), they are needed to be sorted in numerical order.
* **Proposal 5:** Update the related combinations in the specifications to be aligned with proposal 1,2,3 and 4.

Examples:

* With P1 & P2, the correct notation will be DC\_n8A-3(n)AA, DC\_n77A-3(n)AA, DC\_n257A-3(n)AA for NE-DC
* With P1,P2,P3 & P4 the correct notation will be DC\_1A-(n)3AA-(n)7AA-n77A for EN-DC, and DC\_n77A-3(n)AA-7(n)AA-1A for NE-DC.

Way forward: It is proposed to initiate a separate email thread with the table below to review offline and check during Ad-hoc.

|  |  |
| --- | --- |
| **Proposal** | **Company/Review comment** |
| **Proposal 1** | Company A: |
| Company B: |
| Company X: |
| **Proposal 2** | Company A: |
| Company B: |
| Company X: |
| **Proposal 3** | Company A: |
| Company B: |
| Company X: |
| **Proposal 4** | Company A: |
| Company B: |
| Company X: |
| **Proposal 5** | Company A: |
| Company B: |
| Company X: |

###  Sub-topic 5-2 NR-U deviations from the NR bands nominal channel spacing

* Proposal.
	+ **To Clause 5.4.1.1, add the following sentence:**

For NR bands restricted to operation with shared-spectrum channel access, the maximum deviation from the nominal channel spacing is [40] kHz.

* + **To Clause 5.4A.1, add the following sentence:**

The channel spacing for intra-band contiguous carrier aggregation can be adjusted to any multiple of least common multiple of channel raster and sub-carrier spacing less than the nominal channel spacing to optimize performance in a particular deployment scenario.

For intra-band contiguous carrier aggregation in NR bands restricted to operation with shared-spectrum channel access, the maximum deviation from the nominal channel spacing is [300] kHz.

* Wayforward:
	+ - Discuss amongst experts if this proposal is acceptable.

###  Sub-topic 5-3 CA\_n71B PC3 MSD

**Issue 5-1: 1UL SCC MSD**

* Proposals:

Add the following MSD test point for PC3 n71B:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CA configuration** | **SCS****(PCC/SCC)****(kHz)** | **Aggregated channel bandwidth (PCC+SCC)** | **UL PCC allocation****(LCRB)** | **ΔRIBC (dB)** | **Duplex mode** |
| CA\_n71B | 15/15 | 20MHz + 15MHz | 20 (RBSTART = 0) | 5.1 | FDD |

* Wayforward:
	+ - Discuss amongst experts if this proposal is acceptable.

**Issue 5-2: 1UL SCC MSD**

Add the following text into 7.3A.2.1:

For specific uplink and downlink test points which are specified in Table 7.3A.2.X-Y and the reference sensitivity power level increased by ΔRIBC. The requirements apply with all downlink carriers active. Unless given by Table 7.3.2-4, the reference sensitivity requirements shall be verified with the network signaling value NS\_01 (Table 6.2.3.1-1) configured.

* Wayforward:
	+ - Discuss if proposal is agreeable.
		- Moderator: this new table is needed for PC3 and for PC2. As background, a new table format has been agreed at last meeting to capture PC2 1Tx and PC2 2Tx requirements.

###  Sub-topic 5-4 DC\_18-n77 / CA\_n18-n77 MSD

* Proposals.

**PC3 MSD results for DC\_18A\_n77A and CA\_n18A-n77A**

| **NR or E-UTRA Band / Channel bandwidth / NRB / MSD** |
| --- |
| **NR-CA or ENDC****Configuration** | **EUTRA or NR band** | **UL Fc (MHz)** | **UL/DL BW (MHz)** | **UL LCRB** | **DL Fc (MHz)** | **MSD (dB)** | **IMD order** |
| DC\_18A\_n77A | 18 | 827.5 | 5 | 25 | 872.5 | 8.4 | IMD4 X |
|  | n77 | 3355 | 10 | 50 | 3355 | N/A | N/A |
|  | 18 | 817.5 | 5 | 25 | 862.5 | 4.5 | IMD5 X |
|  | n77 | 4130 | 10 | 50 | 4130 | N/A | N/A |
| CA\_n18A-n77A | n18 | 827.5 | 5 | 25 | 872.5 | 8.4 | IMD4 X |
|  | n77 | 3355 | 10 | 50 | 3355 | N/A | N/A |
|  | n18 | 817.5 | 5 | 25 | 862.5 | 4.5 | IMD5 X |
|  | n77 | 4130 | 10 | 50 | 4130 | N/A | N/A |
| NOTE X: In Japan, n77 band is restricted to 3400 – 4100 MHz frequency range, and there are no valid MSD test points when using this restricted frequency range. |

* Wayforward:
	+ - Discuss if proposal is agreeable.

# Topic #6: Rules and guidelines TP/TR MSD analysis

**Moderator: At last meeting, it was recognized that this topic is of importance to prepare the R19 band combination basket work and thus companies are encouraged to discuss this topic. Considering the large number of documents to be treated in this thread, it is proposed to discuss these documents offline unless a 2nd ad-hoc is allocated (unlikely).**

**To organize the offline, this section will be copied in a separate document in a specific Offline folder in the [103] folder and companies can comment directly (similar to the remote process/electronic meetings).**

**Based on the outcome, we may check with the RAN4 chairman if some of the consensus/conclusions may be captured in a way forward.**

## Companies’ contributions summary

Moderator: tables are not copied here as they will be part of the Issue section

|  |  |  |  |
| --- | --- | --- | --- |
| **T-doc number** | **Title** | **Company** | **Proposals / Observations** |
| [**R4-2404180**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110bis/Docs/R4-2404180.zip) | Reconsideration on MSD requirements with intra-band contiguous UL CA | Apple | **Observation 1**: MSD test configurations consisting of intra-band contiguous UL CA have been specified with relatively small RB allocations non-contiguously between the two contiguous UL carriers.**Observation 2**: As UL CA is configured primarily to increase the UL throughout, it does not seem to be very practical to schedule small RB allocations non-contiguously between the two contiguous UL carriers where the total resource allocation is even less than a single carrier can already provide.**Observation 3**: Non-contiguous UL allocations may be subject to higher MPR/A-MPR in order to fulfill the emission requirements and may result in relatively high MSD due to clustered inter-modulation product falling onto victim DL carrier. **Observation 4**: Network should always avoid scheduling small non-contiguous RB allocations for intra-band contiguous UL CA where the same throughput can be achieved with single carrier with better efficiency.**Proposal**: RAN4 to reconsider whether the MSD requirements resulting from intra-band contiguous UL CA are necessitated with good technical justifications. |
| [**R4-2405935**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110bis/Docs/R4-2405935.zip)**(**[**R4-2404243**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110bis/Docs/R4-2404243.zip) is withdrawn) | Improved harmonic related MSDs template | Skyworks Solutions Inc., Nokia | **Proposal on a new table format for UL harmonic and harmonic mixing**: The below table is used in the two DL one UL with one CC section of the block approval TPs.• When a collision is detected with an overlap of ULX range with DLY range >0Hz, the ULX/DLY cell is marked “D” for direct hit.o For an odd DL harmonic order, a UL+DL order of up to 7 for harmonic mixing and up to UL5 for UL harmonics shall be considered o For an even DL harmonic order, a UL+DL order of up to 5 shall be considered• When the ULX range is less than X\*Minimum UL channel bandwidth away from DLY range (the gap is between 0Hz and X\*MinULCBW), the ULX/DLY cell is marked “N” for Near miss and is only specified if there is no direct hit case for the same UL and DL orders. For harmonic mixing, only UL1 and odd DL orders are to be considered• Note that when both UL and DL guard bands are accounted for, when designing the test point, there may no longer be an applicable Direct hit and/or Near miss case.• A specific row is added to capture conclusions on the UL harmonic and harmonic mixing analysis.• Notes are provided for guidance and orders to be considered. |
| [**R4-2404244**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110bis/Docs/R4-2404244.zip) | On valid harmonic mixing orders | Skyworks Solutions Inc., Nokia, Qualcomm | **Proposal on harmonic mixing orders to be considered** and associated conditions on UL frequencies: the following table is used to determine which harmonic mixing cases should be studied.• Direct hit is when there is an overlap >0Hz between the DLX and ULY frequency ranges• Near-miss is when the gap between the DLX and UL1 frequency ranges is comprised between 0Hz and the lowest UL channel BW.• For odd DL harmonic orders:o UL+DL order up to 7 shall be considered for direct hito UL1 cases shall be considered for near-miss if there is no direct-hit case for the same UL1/DLX order.• For even DL harmonic orders:o UL+DL order up to 5 shall be considered for direct hito Near-miss is ignored• The rules are applied from Rel-19 and may be used for the Rel-18 harmonic mixing tables clean-up |
| [**R4-2404248**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110bis/Docs/R4-2404248.zip) | On simplifying analysis for triple beat products | Skyworks Solutions Inc., Nokia, Murata | **Proposal on updated triple beat analysis table**:• The table is used for triple beat analysis for both two and three band DL TPs with only the DL band frequencies changed to the third band (non-UL band)o f\_DL is the FDD DL of the same band used for F\_UL (the band of the two bands not supporting CA) for the two DL bands case.o f\_DL is the DL band of the third non-UL band for the three DL bands case.• The associated annex for the band group criteria is also added to either:o The related two or three DL band TP template (as reference outside the TP portion) and the three DL band TR template (this is our preference as the band group definition can be used for other cases)o Alternatively, the band group definition is given directly in the Note section. |
| [**R4-2404249**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110bis/Docs/R4-2404249.zip) | On simplifying analysis for 2DL-1 band intra-band ULCA IMD products | Skyworks Solutions Inc., Nokia, Murata | **Proposal**: For IMD products to be studied for the 1UL band 2CC intra-band case, the following table is used:• The analysis section should capture the cases that collide with the victim DL band,• The notes section provides guidance for the analysis and the 2CCBW minimum and maximum values for contiguous and non-contiguous ULCA. |
| [**R4-2404250**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110bis/Docs/R4-2404250.zip) | On cross-band isolation MSD analysis | Skyworks Solutions Inc., Nokia, Murata | **Proposal:** • Beyond the ACLR5 range, on the transmitter side, the transmitter noise floor can be considered for cross-band isolation MSD for PC3 when the UL filter has insufficient rejection at the DL band frequency range.• Similarly, the UL blocker level and receiver IP2 can be considered beyond the ACL5 range when the DL filter has insufficient rejection at the UL band frequency range.• To consider the issues beyond ACLR5, two criteria should be met:o The UL aggressor band and DL aggressor band should be part of the same or adjacent band group of Table 2o If the DL band is above the UL band, it’s lower frequency edge should be below the UL lowest harmonic two frequency.**Proposal on cross-band isolation analysis table**:• Table 3 below, including the analysis and note rows, is used as calculation template to detect potential cross-band isolation MSD for up to the ACLR5 range. This applies for the mandatory test point that uses the largest UL CBW.• MSD beyond the ACLR5 range should be evaluated further if:o There is no overlap up to ACLR5o The UL aggressor band and DL victim band are part of the same or adjacent band group defined for triple beato If the DL victim band is above the UL aggressor band, it’s lower frequency edge must be below the UL harmonic two frequencyo As an indicative threshold, if >45dB UL rejection at the DL band frequency can be guaranteed, the transmitter noise floor MSD should be negligible assuming a -130dBm/Hz TX noise floor levelo [Triple beat band group table is added in annex of the TPs and TR for two DL band.] |
| [**R4-2404449**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110bis/Docs/R4-2404449.zip) | On RAN4 basket WI work plan | CATT | **Proposal 1**: Rel-19 baskets should be planned and improved based on the previous practice and lessons, thus not necessarily identical to the previous basket split.**Proposal 2**: When planning baskets in Rel-19, balancing anticipated workload among baskets and sharing workload among companies should be taken into account.**Proposal 3:** MCC to consider to develop a certain tool to facilitate band combination works. |
| [**R4-2404897**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110bis/Docs/R4-2404897.zip) | Discussion on band combination basket WI TR template in Rel-19 | ZTE Corporation | **Observation 1** In the current basket WI TR, how to derive the MSD values and the delta TIB/RIB values in detail are not captured.**Proposal 1** It is suggested to capture the detail process of MSD value and delta TIB/RIB value derivation in the basket WI TR.**Observation 2** In the current basket WI TR, some contents such as the info for operating bands and channel bandwidths per CA operating bands for each band combination are cumbersome.**Proposal 2** It is suggested to establish a common clause in the TR which captures the general information as compared to the specific part for each band combination. ­ An example (Figure 3 and 4) for the restructure of common part and specific part for 3DLxUL basket WI TR is recommended for reference.­ For UE co-existence studies table, if the studies have already been analyzed in the other fallback band combination TR, there is no need to repeat the co-existence calculation. A reference table to the fallback band combination TR is required for the higher order band combination TR. |
| [**R4-2405037**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110bis/Docs/R4-2405037.zip) | On RAN4 basket WI work planning | Nokia | [**Proposal 1:** RAN4 shall discuss potential Rel-19 band combination baskets to ensure technical considerations before RAN treats these at RAN#104.](#_Toc163498555)[**Observation 1:** The number of band combination baskets has only increased after their introduction.](#_Toc163498556)[**Observation 2:** Band combinations with the same type of technical study and belonging to the same specification can be grouped into one basket.](#_Toc163498557)[**Observation 3:** Work on guidelines and unified templates for technical studies for band combinations is still needed by RAN4.](#_Toc163498558)[**Proposal 2:** RAN4 shall work on preparing templates for the coming TRs such that the needed technical study is captured correctly.](#_Toc163498559)[**Observation 4:** Pre-defined TR templates with additional guidance decrease the possibility of missing or making mistakes in the technical study for specific types of band combinations.](#_Toc163498560) |
| [**R4-2405104**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110bis/Docs/R4-2405104.zip) | Work plan for one-two-three band DL coexistence study templates | Skyworks Solutions Inc. | **Proposal on the two band DL TP work plan**:• In RAN4#110bis target a way forward covering all the MSD issue detection tables for 2DL band / 1or2 UL band / up to 3 ULCC cases based on approval or modifications as needed of:o [3, 4] for UL harmonic and harmonic mixing MSD issue detection tableo [5] for cross-band MSD issue detection tableo [6] for 1 band UL 2ULCC IMD MSD issue detectiono [8] for 2 band UL 1ULCC/band IMD MSD issue detectiono [7] for 2 band UL 3ULCC triple beat MSD issue detectiono [8] for the overall template structure• In RAN4#111 approve a two band DL TP template with:o MSD issues detection tables based on RAN4#110biso Addition of guidelines and tables for the MSD test points design for all related MSDs on:* Covering 2DL, 1or2UL with up to 3ULCC cases.
* UL and DL CBW and RB allocations to be used
* Design of the CC and allocation position
* How to deal with frequency range restriction if any.

**Proposal on the three band DL TP work plan**:• In RAN4#111 approve a three band DL TP template with:o MSD issues detection tables based on adapting for 3 bands the RAN4#110 approved or modified as needed versions of:* [8] for 2 band UL 1ULCC/band IMD MSD issue detection adapted for 3 bands DL
* [7] for 2 band UL 3ULCC triple beat MSD issue detection adapted for 3 bands DL

o Addition of guidelines and tables for the MSD test points design for all related MSDs on:* Covering 3DL, 2UL with up to 3ULCC cases.
* UL and DL CBW and RB allocations to be used
* Design of the CC and allocation position
* How to deal with frequency range restriction if any.

 **Proposal on the intra-band DLCA TP work plan**:• In RAN4#111 approve a FDD contiguous and non-contiguous intra-band DLCA TP template with:o MSD issues detection tables based on adapting for intra-band contiguous and non-contiguous DLCA the RAN4#110 approved or modified as needed versions of:* [5] for cross-band MSD issue detection table adapted for the one UL CC intra-band case for MSD in SCC
* [6] for 1 band UL 2ULCC IMD MSD issue detection adapted for the two UL CC intra-band case for MSD in PCC/SCC

o Addition of guidelines and tables for the MSD test points design for all related MSDs on:* Covering intra-band contiguous and non-contiguous DL cases with one or two UL CCs
* UL and DL CBW and RB allocations to be used
* Design of the CC and allocation position.

**Suggestion for Release 19 one, two and three band combination baskets**:• The related templates elaborated in RAN4#110bis and #111 are adopted by the moderators of the intra-band, 2DL band and 3DL band baskets for the TR and associated TP templates and are used from RAN4#112 onwards• The relevant part (MSD test point design) is also adopted by the intra-band, two band DL and three band DL HPUE CA basket moderators, and rules for scaling MSD with power class and 1/2Tx are developed• The rules and templates are captured in a permanent RAN4 document that can be maintained and updated across releases and used as a reference. |
| [**R4-2405489**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110bis/Docs/R4-2405489.zip) | On basket WI TR and WID improvement | Huawei, HiSilicon | *Observation 1: For MSD analysis, the reference UE architecture, assumptions for RF components are important for the final requirements.**Observation 2: The analysis procedure is not recorded in the technical report though they are the most valuable part for the MSD requirements in terms of technical view.**Observation 3: Retrospect the MSD requirements sometimes in the group due to identified issues with development of the specific band combination is difficult since the analysis procedure is missing in the TR.**Observation 4: The TRs for existing basket WIs do not provide sufficient information with technical analysis for the suggested values if MSD is identified for the band combination.****Proposal 1: It is proposed to improve the TR structure for basket WI to include more technical information and simplify the content which are not essential for specifying the requirements and duplicated as in the spec from Rel-19.*** ***Proposal 2: It is proposed to capture at least the references, if not the content, for the architectures, possible WF, discussion paper with proposals which are utilized for final averaging for deriving the MSD requirements.******Proposal 3: It is proposed to have a systematic solution for the diversified delta Tib and Rib values for different kinds of band combinations. Simplified rules-based delta Tib and Rib values are preferred rather than case by case tedious practice.****Observation 5: For most spectrum related WIs, the release independent requirements are core requirements rather than perf requirements.****Proposal 4: It is proposed to start discussion on the content of draft WID for release 19 with consistent format which can cover specific issues for the corresponding WIs but with unified style in order to avoid inconsistent handling for the following SR.*** ***Proposal 5: In general, if the configurations in a spectrum/basket WI have been included in the TS 3x.307 already, no need to include the release independent spec in the affected spec list in the WID. For this case, some clarification would be needed in the WID to mention the introduced band(s) or CA/DC combinations in the WI can be release independent from which release.******Proposal 6: If it is not clear whether release independent CR would be needed when the spectrum/basket WI is established, TS 3x.307 can still be listed as one of the affected Spec in the WID.******Proposal 7: The TS 3x.307 should not be listed as perf spec without careful checking whether the affected requirements are core part of perf part*** |
| [**R4-2405554**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110bis/Docs/R4-2405554.zip) | Template example for 2 band DL with 1 or 2 band UL up to 3 UL CCs | Skyworks Solutions Inc. | **Proposed enhancements for 2DL/1or2UL bands block approval TP template for Release 19**:• Addition at the end of section “5.XX.1.2 Channel bandwidths per operating band for CA” of:o A question related to the support of SimRx/Tx, or otherwise for TDD/TDD cases.o A table that sorts the applicable UL configuration and their related MSD studies• For the 2DL/1UL section:o The addition of a specific section for “Co-existence studies for 1UL band with 1CC”- UL harmonic and harmonic mixing tables are updated in a matrix form with additional guidelines as discussed in [4]- A new calculation table for cross-band isolation MSD is added, as discussed in [5]o The addition of a specific section for “Co-existence studies for 1UL band with 2CC intra-band”- The IMD range table is updated and simplified as discussed in [6]• For this meeting, the delta T/R, REFSENS and OOB exception sections are not covered, However, these may be part of further guidelines/proposals on how to design MSD test points.• For the 2DL/1UL section:o Slightly updated 2DL 2UL with 1CC/band IMD table, with an analysis and Note sectiono Added section “5.XX.2.2.1 Co-existence studies for 2UL band with 3CC (2CC intra-band in one band)”, with a calculation table that includes an analysis and Note section, as discussed in [7]• For the TR and/or TP, annexes may be added to provide further guidelines and calculations. |

## Open issues summary

### Sub-topic 6-1 MSD resulting from intra-band UL-CA

* Proposals.

RAN4 to reconsider whether the MSD requirements resulting from intra-band contiguous UL CA are necessitated with good technical justifications.

* Offline discussion comments

|  |  |
| --- | --- |
| **Company/Delegate** | **Comment** |
| XXX/YYY |  |
| XXX/YYY |  |
|  |  |
|  |  |
|  |  |

### Sub-topic 6-2 Technical input on MSD calcualtion rules and tables

**Issue 6-1a: Harmonic mixing rules**

* Proposals for **Harmonic mixing orders** (R4-2405935)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **UL/DLharmonics** | **nX** | **UL13** | **UL2** | **UL32** | **UL4** | **UL5** | **MSD type** |
| **fLow** | fULlow | 2\*fULlow | 3\*fULlow | 4\*fULlow | 5\*fULlow |
| **nY** | **fLow** | **fHigh** | fULhigh | 2\*fULhigh | 3\*fULhigh | 4\*fULhigh | 5\*fULhigh |
| **DL1** | fDLlow | fDLhigh | N/A |  |  |  |  | **UL harmonic** |
| **DL22** | 2\*fDLlow | 2\*fDLhigh |  | N/A |  | N/A | N/A | **Harmonic mixing** |
| **DL33** | 3\*fDLlow | 3\*fDLhigh |  |  | N/A |  | N/A |
| **DL4** | 4\*fDLlow | 4\*fDLhigh |  | N/A | N/A | N/A | N/A |
| **DL53** | 5\*fDLlow | 5\*fDLhigh |  |  | N/A | N/A | N/A |
| **Analysis** | text |
| **UL/DLharmonics** | **nY** | **UL13** | **UL2** | **UL32** | **UL4** | **UL5** | **MSD type** |
| **fLow** | fULlow | 2\*fULlow | 3\*fULlow | 4\*fULlow | 5\*fULlow |
| **nX** | **fLow** | **fHigh** | fULhigh | 2\*fULhigh | 3\*fULhigh | 4\*fULhigh | 5\*fULhigh |
| **DL1** | fDLlow | fDLhigh | N/A |  |  |  |  | **UL harmonic** |
| **DL22** | 2\*fDLlow | 2\*fDLhigh |  | N/A |  | N/A | N/A | **Harmonic mixing** |
| **DL33** | 3\*fDLlow | 3\*fDLhigh |  |  | N/A |  | N/A |
| **DL4** | 4\*fDLlow | 4\*fDLhigh |  | N/A | N/A | N/A | N/A |
| **DL53** | 5\*fDLlow | 5\*fDLhigh |  |  | N/A | N/A | N/A |
| **Analysis** | text |
| Note 1: When a collision is detected with an overlap >0Hz between the UL(X) with DL(Y) frequency ranges, the UL(X)/DL(Y) cell is marked “D” for direct hit. When the gap between UL(X) and DL(Y) frequency range is from 0Hz to X\*MinULCBW, the UL(X)/DL(Y) cell is marked “N” for Near miss.Note 2: UL3/DL2 harmonic mixing direct hit case for PC3/5 only apply for DL>3GHzNote 3: For harmonic mixing, near-miss cases only apply for UL1 and odd DL orders. |

* Proposals for **Harmonic mixing orders** (R4-2404244)

|  |  |  |
| --- | --- | --- |
|  | **PC3 and PC5 of UL band** | **PC2 and PC1.5 of UL band** |
|   | **UL1** | **UL2** | **UL3** | **UL4** | **UL1** | **UL2** | **UL3** | **UL4** |
| **DL2** | All | N/A | DL > 3GHz | N/A | All | N/A | All | N/A |
| **DL3** | All\* | All | N/A | All | All | All | N/A | All |
| **DL4** | All | N/A | N/A | N/A | All | N/A | N/A | N/A |
| **DL5** | All\* | All | N/A | N/A | All | All | N/A | N/A |
| \*: All Near miss shall be evaluated if there is no direct-hit case for the same UL and DL order |

* + Issue 1: Near-miss cases restricted to UL1/DL3 and UL1/DL5.
	+ Issue 2: UL3/DL4 not analysed
	+ Issue 3: PC3/PC5 UL3/DL1 direct-hit to apply only for DL>3GHz.
	+ Issue 4: UL1/DL4 without any frequency limitation
	+ Issue5: Near miss shall be evaluated if there is no direct-hit case for the same UL and DL order

Moderator: Similar proposal on MSD table clean-up is discussed in thread [141] both for UL harmonic and Rx harmonic mixing.

Offline discussion comments

|  |  |
| --- | --- |
| **Company/Delegate** | **Comment** |
| XXX/YYY | **Harmonic mixing order:****Harmonic Table:** |
|  | **Harmonic mixing order:****Harmonic Table:** |
|  | **Harmonic mixing order:****Harmonic Table:** |
|  | **Harmonic mixing order:****Harmonic Table:** |
|  | **Harmonic mixing order:****Harmonic Table:** |

**Issue 6-1b: Triple-beat IMD analysis**

* Proposal for triple-beat IMD analysis of UL CA\_nXA-nYC (R4-2404248)

|  |  |  |
| --- | --- | --- |
| **Band / CA1** | **nX** | **CA\_nYC** |
| **Frequency limit (all MHz)** | **fx\_low** | **fx\_high** | **fy\_low / min** | **fy\_high / max** |
| **f\_UL** |  |  |  |  |
| **f\_DL** |  |  |  |  |
| **2CCBW2** | N/A | N/A |  |  |
| **IMD3 products** | fxUL\_low-max2CCBW | fxUL\_low | fxUL\_high | fxUL\_high+max2CCBW |
| **IMD3 (MHz)** |  |  |  |  |
| **Analysis** |  |
| Note 1: If the two bands are not part of the same or adjacent band groups as defined in Annex D, the analysis can be ignored.Note 2: For contiguous intra-band ULCA, the minimum and maximum separation BW are 0MHz and Min(fy\_high-fy\_low, maximum aggregated BW) respectively. |

**Annex X**

**Before the analysis of potential triple beat issues for two or three down-link bands band combinations, a band-group criterion as defined in Table X can be applied:**

* **In a two down-link band combination, if the two bands are not part of the same or adjacent band group, the triple beat analysis is not needed.**
* **In a three down-link band combination, if the third band is not part of the same or adjacent band group as one of the UL band, the triple beat analysis is not needed.**

**Table X: Band group definition for same or adjacent band-group criterion**

|  |
| --- |
| **FR1 band group range** |
| **Name** | **FR1-a (LB)** | **FR1-b (MB)** | **FR1-c (HB)** | **FR1-d (VHB)** | **FR1-e (UHB)** |
| **Range (MHz)** | 600-1000 | 1400-2200 | 2300-2700 | 3300-5000 | 5250-7125 |
| **Duplex mode** | Mostly FDD | Mostly FDD | FDD and TDD | TDD only | TDD only |

Offline discussion comments

|  |  |
| --- | --- |
| **Company/Delegate** | **Comment** |
| XXX/YYY |  |
|  |  |
|  |  |
|  |  |
|  |  |

**Issue 6-1c: 2DL 1 band intra-band IMD**

* Proposal For IMD products to be studied for the 1UL band 2CC intra-band case (R4-2404249)

|  |  |  |  |
| --- | --- | --- | --- |
| **All in MHz** | **flow/Min** | **fhigh/Max** | **BB IMD range3** |
| **fUL** |  |  | **Order** | **flow** | **fhigh** |
| **2CCBW1** |  |  | **IMD2(1-1)** | Min2CCBW | Max2CCBW |
| **fDL** |  |  |  |  |
| **Close to UL IMD range2** | **IMD4(2-2)** | 2\*Min2CCBW | 2\*Max2CCBW |
| **Order** | **flow** | **fhigh** |  |  |
| **IMD3(2-1)** | fULlow-Max2CCBW | fULhigh+Max2CCBW | **IMD6(3-3)** | 3\*Min2CCBW | 3\*Max2CCBW |
|  |  |  |  |
| **IMD5(3-2)** | fULlow-2\*Max2CCLBW | fULhigh+2\*Max2CCBW | **Close to H2 IMD range4** |
|  |  | **Order** | **flow** | **fhigh** |
| **IMD7(4-3)** | fULlow-3\*Max2CCBW | fULhigh+3\*Max2CCBW | **IMD4(3-1)** | 2\*fULlow-Max2CCBW | 2\*fULhigh+Max2CCBW |
|  |  |  |  |
| **IMD9(5-4)** | fULlow-4\*Max2CCBW | fULhigh+4\*Max2CCBW | **IMD6(4-2)** | 2\*fULlow-2\*Max2CCBW | 2\*fULhigh+2\*Max2CCBW |
|  |  |  |  |
| **IMD11(6-5)** | fULlow-5\*Max2CCBW | fULhigh+5\*Max2CCBW | **Close to H3 IMD range4** |
|  |  | **Order** | **flow** | **fhigh** |
| **IMD13(7-6)** | fULlow-6\*Max2CCBW | fULhigh+6\*Max2CCBW | **IMD5(4-1)** | 3\*fULlow-Max2CCBW | 3\*fULhigh+Max2CCBW |
|  |  |  |  |
| **Analysis** |   |
| Note 1: 2CCBW is the instantaneous transmit bandwidth of the two intra-band UL CCs:- The minimum 2CCBW for contiguous / non-contiguous intra-band ULCA is 0 / minimum UL channel bandwidth- The maximum 2CCBW for contiguous / non-contiguous ULCA is Min(maximum aggregated bandwidth / maximum separation bandwidth(600MHz),fULhigh-fULlow)Note 2: The close to UL IMD range is the most critical when the victim DL band in proximity to the UL band:- For contiguous/non-contiguous intra-band ULCA within a TDD band, IMD order up to 9/7 should be considered and MPR assumed- For intra-band ULCA within a FDD band, IMD order up to 13 should be considered for bands in the same band group and MPR is not assumed. If justified by poor filtering performance, higher order IMD may need to be specified.Note 3: The BB IMD range should only be considered if the DL band is below the UL band and for non-contiguous ULCA within a TDD band >3GHz (assuming CA with 450MHz bands is not considered)-IMD2 is not considered assuming CA with 450MHz bands is not considered-IMD4 is considered for FDD or SimRx/Tx TDD bands <1GHz-IMD6 is considered for FDD or SimRx/Tx TDD bands <1.68GHzNote 4: The harmonic 2 and 3 IMD ranges should only be considered if the DL band is above the UL band |

Offline discussion comments

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**Issue 6-1d: Cross band MSD analysis**

* Proposals (R4-2404250)
	+ Calculation for ACLR ranges up to ACLR5
	+ Addition of Analysis
	+ Addition of a Note on applicable band groups of the constituent bands and for TX noise floor for > ACLR5.

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| **Bands3** | **nX** | **nY** |
| **Frequency limit** | **fx\_low / min** | **fx\_high / max** | **fy\_low / min** | **fy\_high / max** |
| **fUL (MHz)** |  |  |  |  |
| **fDL (MHz)** |  |  |  |  |
| **CBW (MHz)2** |  |  |  |  |
| **ACLR1 range** | fxULlow-maxULCBWx | fxULhigh+maxULCBWx | fyULlow-maxULCBWy | fyULhigh+maxULCBWy |
| **ACLR1 (MHz)** |  |  |  |  |
| **ACLR2 range** | fxULlow-2\*maxULCBWx | fxULhigh+2\*maxULCBWx | fyULlow-2\*maxULCBWy | fyULhigh+2\*maxULCBWy |
| **ACLR2 (MHz)** |  |  |  |  |
| **ACLR3 range** | fxULlow-3\*maxULCBWx | fxULhigh+3\*maxULCBWx | fyULlow-3\*maxULCBWy | fyULhigh+3\*maxULCBWy |
| **ACLR3 (MHz)** |  |  |  |  |
| **ACLR4 range** | fxULlow-4\*maxULCBWx | fxULhigh+4\*maxULCBWx | fyULlow-4\*maxULCBWy | fyULhigh+4\*maxULCBWy |
| **ACLR4 (MHz)** |  |  |  |  |
| **ACLR5 range1** | fxULlow-5\*maxULCBWx | fxULhigh+5\*maxULCBWx | fyULlow-5\*maxULCBWy | fyULhigh+5\*maxULCBWy |
| **ACLR5 (MHz)** |  |  |  |  |
| **Analysis** |  |  |
| Note 1: Even if there is no overlap up to ACLR5, MSD beyond the ACLR5 range should be evaluated further if: -The UL aggressor band and DL aggressor band are part of the same or adjacent band group as described in annex Y -If the DL band is above the UL band, it’s lower frequency edge must be below the UL lowest harmonic 2 frequency -As an indicative threshold, if >45dB UL rejection at the DL band frequency can be guaranteed, assuming a -130dBm/Hz TX noise floor level, the transmitter noise floor related MSD should be negligibleNote 2: The maximum UL channel bandwidth of the BCS (noted maxULCBW) is used to calculate the band ACLR ranges while the minimum DL channel bandwidth of the BCS (noted minDLCBW) is used for the DL band victim channel bandwidth. |

Offline discussion comments

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**Issue 6-1e: 2DL/1or2UL bands block approval TP template for Release 19**

* Proposals (R4-2405554):

• Addition at the end of section “5.XX.1.2 Channel bandwidths per operating band for CA” of:

o A question related to the support of SimRx/Tx, or otherwise for TDD/TDD cases.

o A table that sorts the applicable UL configuration and their related MSD studies

• For the 2DL/1UL section:

o The addition of a specific section for “Co-existence studies for 1UL band with 1CC”

- UL harmonic and harmonic mixing tables are updated in a matrix form with additional guidelines as discussed in [4]

- A new calculation table for cross-band isolation MSD is added, as discussed in [5]

o The addition of a specific section for “Co-existence studies for 1UL band with 2CC intra-band”

- The IMD range table is updated and simplified as discussed in [6]

• For this meeting, the delta T/R, REFSENS and OOB exception sections are not covered, However, these may be part of further guidelines/proposals on how to design MSD test points.

• For the 2DL/1UL section:

o Slightly updated 2DL 2UL with 1CC/band IMD table, with an analysis and Note section

o Added section “5.XX.2.2.1 Co-existence studies for 2UL band with 3CC (2CC intra-band in one band)”, with a calculation table that includes an analysis and Note section, as discussed in [7]

• For the TR and/or TP, annexes may be added to provide further guidelines and calculations.

Offline discussion comments

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### Sub-topic 5-2 Input on Work plan and WI TR WID Improvements

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**Issue 6-2a: Proposals for organizing Rel-19 basket works**

* Proposals: CATT (R4-2404449):
* Proposal 1: Rel-19 baskets should be planned and improved based on the previous practice and lessons, thus not necessarily identical to the previous basket split.
* Proposal 2: When planning baskets in Rel-19, balancing anticipated workload among baskets and sharing workload among companies should be taken into account.
* Proposal 3: MCC to consider to develop a certain tool to facilitate band combination works.Offline discussion comments

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**Issue 6-2b: Proposal on handling basket WI work in Rel-19**

* Proposals: ZTE (R4-2404897)

**Observation 1**: In the current basket WI TR, how to derive the MSD values and the delta TIB/RIB values in detail are not captured.

**Proposal 1**: It is suggested to capture the detail process of MSD value and delta TIB/RIB value derivation in the basket WI TR.

**Observation 2**: In the current basket WI TR, some contents such as the info for operating bands and channel bandwidths per CA operating bands for each band combination are cumbersome.

**Proposal 2**: It is suggested to establish a common clause in the TR which captures the general information as compared to the specific part for each band combination.

* An example (Figure 3 and 4) for the restructure of common part and specific part for 3DLxUL basket WI TR is recommended for reference.
* For UE co-existence studies table, if the studies have already been analyzed in the other fallback band combination TR, there is no need to repeat the co-existence calculation. A reference table to the fallback band combination TR is required for the higher order band combination TR.

Offline discussion comments

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**Issue 6-2c: On RAN4 basket WI work plan**

* Proposals: Nokia (R4-2405037)

[**Proposal 1: RAN4 shall discuss potential Rel-19 band combination baskets to ensure technical considerations before RAN treats these at RAN#104.**](#_Toc163498555)

[**Observation 1:** The number of band combination baskets has only increased after their introduction.](#_Toc163498556)

[**Observation 2:** Band combinations with the same type of technical study and belonging to the same specification can be grouped into one basket.](#_Toc163498557)

[**Observation 3:** Work on guidelines and unified templates for technical studies for band combinations is still needed by RAN4.](#_Toc163498558)

[**Proposal 2: RAN4 shall work on preparing templates for the coming TRs such that the needed technical study is captured correctly.**](#_Toc163498559)

[**Observation 4:** Pre-defined TR templates with additional guidance decrease the possibility of missing or making mistakes in the technical study for specific types of band combinations.](#_Toc163498560)

Offline discussion comments

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**Issue 6-2e: On improving the TR quality for basket WI and issue of spec impact for release independency in the WID for Rel-19.**

* Proposal: Huawei (R4-2405489)

*Observation 1: For MSD analysis, the reference UE architecture, assumptions for RF components are important for the final requirements.*

*Observation 2: The analysis procedure is not recorded in the technical report though they are the most valuable part for the MSD requirements in terms of technical view.*

*Observation 3: Retrospect the MSD requirements sometimes in the group due to identified issues with development of the specific band combination is difficult since the analysis procedure is missing in the TR.*

*Observation 4: The TRs for existing basket WIs do not provide sufficient information with technical analysis for the suggested values if MSD is identified for the band combination.*

***Proposal 1: It is proposed to improve the TR structure for basket WI to include more technical information and simplify the content which are not essential for specifying the requirements and duplicated as in the spec from Rel-19.***

***Proposal 2: It is proposed to capture at least the references, if not the content, for the architectures, possible WF, discussion paper with proposals which are utilized for final averaging for deriving the MSD requirements.***

***Proposal 3: It is proposed to have a systematic solution for the diversified delta Tib and Rib values for different kinds of band combinations. Simplified rules-based delta Tib and Rib values are preferred rather than case by case tedious practice.***

*Observation 5: For most spectrum related WIs, the release independent requirements are core requirements rather than perf requirements.*

***Proposal 4: It is proposed to start discussion on the content of draft WID for release 19 with consistent format which can cover specific issues for the corresponding WIs but with unified style in order to avoid inconsistent handling for the following SR.***

***Proposal 5: In general, if the configurations in a spectrum/basket WI have been included in the TS 3x.307 already, no need to include the release independent spec in the affected spec list in the WID. For this case, some clarification would be needed in the WID to mention the introduced band(s) or CA/DC combinations in the WI can be release independent from which release.***

***Proposal 6: If it is not clear whether release independent CR would be needed when the spectrum/basket WI is established, TS 3x.307 can still be listed as one of the affected Spec in the WID.***

***Proposal 7: The TS 3x.307 should not be listed as perf spec without careful checking whether the affected requirements are core part of perf part.***

Offline discussion comments

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**Issue 6-2f: On templates for the block approval TPS for one, two and three band DL cases**

* Proposal: Skyworks (R4-2405104)

**Proposal on the two band DL TP work plan:**

* **In RAN4#110bis target a way forward covering all the MSD issue detection tables for 2DL band / 1or2 UL band / up to 3 ULCC cases based on approval or modifications as needed of:**
	+ **[3, 4] for UL harmonic and harmonic mixing MSD issue detection table**
	+ **[5] for cross-band MSD issue detection table**
	+ **[6] for 1 band UL 2ULCC IMD MSD issue detection**
	+ **[8] for 2 band UL 1ULCC/band IMD MSD issue detection**
	+ **[7] for 2 band UL 3ULCC triple beat MSD issue detection**
	+ **[8] for the overall template structure**
* **In RAN4#111 approve a two band DL TP template with:**
	+ **MSD issues detection tables based on RAN4#110bis**
	+ **Addition of guidelines and tables for the MSD test points design for all related MSDs on:**
		- **Covering 2DL, 1or2UL with up to 3ULCC cases.**
		- **UL and DL CBW and RB allocations to be used**
		- **Design of the CC and allocation position**
		- **How to deal with frequency range restriction if any.**

**Proposal on the three band DL TP work plan:**

* **In RAN4#111 approve a three band DL TP template with:**
	+ **MSD issues detection tables based on adapting for 3 bands the RAN4#110 approved or modified as needed versions of:**
		- **[8] for 2 band UL 1ULCC/band IMD MSD issue detection adapted for 3 bands DL**
		- **[7] for 2 band UL 3ULCC triple beat MSD issue detection adapted for 3 bands DL**
	+ **Addition of guidelines and tables for the MSD test points design for all related MSDs on:**
		- **Covering 3DL, 2UL with up to 3ULCC cases.**
		- **UL and DL CBW and RB allocations to be used**
		- **Design of the CC and allocation position**
		- **How to deal with frequency range restriction if any.**

**Proposal on the intra-band DLCA TP work plan:**

* **In RAN4#111 approve a FDD contiguous and non-contiguous intra-band DLCA TP template with:**
	+ **MSD issues detection tables based on adapting for intra-band contiguous and non-contiguous DLCA the RAN4#110 approved or modified as needed versions of:**
		- **[5] for cross-band MSD issue detection table adapted for the one UL CC intra-band case for MSD in SCC**
		- **[6] for 1 band UL 2ULCC IMD MSD issue detection adapted for the two UL CC intra-band case for MSD in PCC/SCC**
	+ **Addition of guidelines and tables for the MSD test points design for all related MSDs on:**
		- **Covering intra-band contiguous and non-contiguous DL cases with one or two UL CCs**
		- **UL and DL CBW and RB allocations to be used**
		- **Design of the CC and allocation position.**

**Suggestion for Release 19 one, two and three band combination baskets:**

* **The related templates elaborated in RAN4#110bis and #111 are adopted by the moderators of the intra-band, 2DL band and 3DL band baskets for the TR and associated TP templates and are used from RAN4#112 onwards**
* **The relevant part (MSD test point design) is also adopted by the intra-band, two band DL and three band DL HPUE CA basket moderators, and rules for scaling MSD with power class and 1/2Tx are developed**
* **The rules and templates are captured in a permanent RAN4 document that can be maintained and updated across releases and used as a reference.**

Offline discussion comments

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