**3GPP T****SG-RAN WG4 Meeting#110 R4-2401064**

**Athens, 26th Feb – 1st March, 2024**

**Agenda item:** 7.1

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

**Title:** Topic summary for [110][105] 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: Rules and guidelines TP/TR MSD analysis:

Moderator: Based on the feedback from the RAN4 chairman, the contributions in this topic will not be treated officially, this is because the SimBC SI is closed, and no CR will be allowed until the start of new R19 related WI/SI, and the fact that we cannot make any decision yet for R19. Still, it is recognized that this topic is of importance to prepare the R19 band combination basket work and thus companies are encouraged to discuss the topic and documents offline.

The documents are still taken in the summary and we can have an offline thread covering this where I can collect inputs back into this document. I still also encourage the experts to discuss the technical documents on the different MSD types to be able to capture the consensus position. If there is time left during the ad-hoc session we can possibly discuss how we want to work on this topic until June.

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

## Companies’ contributions summary

|  |  |  |  |
| --- | --- | --- | --- |
| **T-doc number** | **Title** | **Company** | **Proposals / Observations** |
| [R4-2400642](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110/Docs/R4-2400642.zip) | MSD for UL CA\_n3B | Qualcomm France | MSD analysis For UL CA\_n3B was provided with the following proposals for MSD: PCC: 41.2dB, SCC: 18.9dB |
| [R4-2400367](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110/Docs/R4-2400367.zip) | PC3 CA\_n3B BCS4-5 MSD | Skyworks Solutions Inc. | Proposal: Adopt the CA\_n3B BCS4/5 REFSENS test point highlighted in green in Table 2: PCC: 39.7dB, SCC: 14.2dB |
| [R4-2400672](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110/Docs/R4-2400672.zip) | DraftCR 38.101-1 Addition of CA\_n5B\_n12A CA\_n5B\_n14A CA\_n5B\_n29A Combinations | AT&T, Skyworks, Qualcomm, Apple, Murata | Moderator: this CR captures MSD agreements in last meeting |
| [R4-2400902](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110/Docs/R4-2400902.zip) | MSD analysis for DL band combinations with ULCA\_n77C configuration | Verizon, Samsung, Ericsson | CA\_n77C IMD MSD analysis for CA\_n2(2A)-n77C, CA\_n13A-n77C, CA\_n66(3A)-n77C and CA\_n48A-n77C. concludes no MSD as IMD17/29/15 for the first 3 and non-SimRx/Tx for the last one. Moderator: review associated draft CR below |
| [**R4-2400926**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110/Docs/R4-2400926.zip) | TS 38.101-1: DraftCR for introducing UL CA\_n77C configuration | Verizon, Ericsson, Samsung | Draft CR with justification in discussion paper above |
| [R4-2401272](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110/Docs/R4-2401272.zip) | TP for TR38.718-02-01\_CA\_n40A-n41C | ZTE Corporation | Proposes 21.7dB MSD for IMD3 of n41C falling into n40 |
| [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: the following table summarizes the inputs from Qualcomm and Skyworks

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **company** | **CA configuration** | **SCS**  **(PCC/SCC)**  **(kHz)** | **FC PCC/**  **SCC UL** | **FC PCC/**  **SCC DL** | **Aggregated channel bandwidth (PCC+SCC)** | **UL PCC allocation**  **(LCRB)** | **UL SCC allocation**  **(LCRB)** | **PCC ΔRIBC (dB)** | **SCC ΔRIBC (dB)** | **Duplex mode** |
| Skyworks | CA\_n3B | 15/15 |  |  | 25MHz + 50MHz | 16 (RBSTART = 40) | 32 (RBSTART = 160) | 39.7 | 14.2 | FDD |
| Qualcomm | CA\_n3B**X** | 15/15 | 1722.5/ 1759.7 | 1817.5/ 1854.7 | 25MHz + 50MHz | 16 (RBSTART = 60) | 32 (RBSTART = 165) | 41.2 | 18.9 | FDD |
| NOTE X:  Applicable only to BCS 4-5 | | | | | | | | | |

* + FUL: Qualcomm proposes to add UL frequencies
  + UL configurations: same CBW and RB values but different RB starts
  + MSD values: Qualcomm/Skyworks PCC=41.2/39.7 SCC=18.9/14.2
  + Note: Qualcomm proposes to add a note that this is applicable to BCS4/5 only
* Recommended WF
  + FUL: The current table does not have UL frequencies and since this is contiguous ULCA it is unclear why this would be needed => Moderator suggests that UL frequencies are not required
  + UL configurations: Moderator suggests that proponents discuss RB starts and check if it influences MSD value
  + MSD values: Moderator: assuming the RBstarts only influences the MSD values marginally, the MSD values are similar enough that averaging may be used
  + Note: Since CA\_n3B is only BCS4/5 so far is there a need for a note?

### Sub-topic 1-2 CA\_n5B\_n12A CA\_n5B\_n14A CA\_n5B\_n29A CR

Recommended WF: The CR is based on the agreements from previous meeting and should be agreeable. A separate email thread will be used with below table to review offline and check during Ad-hoc

|  |  |
| --- | --- |
| **T-doc** | **Company/Review comment** |
| [R4-2400672](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110/Docs/R4-2400672.zip) DraftCR 38.101-1 Addition of CA\_n5B\_n12A CA\_n5B\_n14A CA\_n5B\_n29A Combinations | Company A: |
| Company B: |
| Company X: |

### Sub-topic 1-3 CA\_n77C IMD MSD CA\_n2(2A)/n13/n66(3A)/n48A-n77C

**Issue 1-3: CA\_n77C IMD MSD analysis**

* Proposals: concludes no MSD as IMD17/29/15 CA\_n2(2A)/n13/n66(3A)/n48A-n77C and non-SimRx/Tx for CA\_n48A-n77C.
* Recommended WF: The conclusions seem justified, the below draft CR can be reviewed directly

|  |  |
| --- | --- |
| **T-doc** | **Company/Review comment** |
| [**R4-2400926**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110/Docs/R4-2400926.zip) TS 38.101-1: DraftCR for introducing UL CA\_n77C configuration | Company A: |
| Company B: |
| Company X: |

### Sub-topic 1-4 CA\_n40A-n41C and CA\_n41A-n79C and CA\_n41C-n79A TRs

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

* Proposals: Proposes 21.7dB MSD for IMD3 of n41C falling into n40
* Recommended WF: discuss the proposed number with experts and review draft CR below

|  |  |
| --- | --- |
| **T-doc** | **Company/Review comment** |
| [R4-2401272](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110/Docs/R4-2401272.zip) TP for TR38.718-02-01\_CA\_n40A-n41C | Company A: |
| Company B: |
| Company X: |

**Issue 1-4b: CA\_n41A-n79C and CA\_n41C-n79A**

* Proposals: Proposes 3.1dB MSD for IMD4 of n41C falling into n79
* Recommended WF: discuss the proposed number with experts (this IMD4 is not covered by another case) and review draft CR below

|  |  |
| --- | --- |
| **T-doc** | **Company/Review comment** |
| [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 | Company A: |
| Company B: |
| Company X: |

# Topic #2: Band combination with close proximity issues

## Companies’ contributions summary

|  |  |  |  |
| --- | --- | --- | --- |
| **T-doc number** | **Title** | **Company** | **Proposals / Observations** |
| [R4-2400373](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110/Docs/R4-2400373.zip) | CA\_n1-n3 BCS4-5 2UL cross-band MSD | Skyworks Solutions Inc. | Observation:  For CA\_n1A-n3A BCS4/5, the Band n3 50MHz PC3 MSD due to the simultaneous overlap of Band n1 and Band n3 ACLR1/2:   * Can be neglected for band n1/n3 UL RB configuration of 128(RBstart=0) and 50(RBstart=220) respectively; * Is ~9.6dB for fully allocated UL carriers.   These measurements indicate that the new test points of Table 7.3A.6-3 should be kept for difficult low-band/low-band combinations. There is no need to introduce such test points for CA\_n1-n3 PC3 operation.  Moderator: Since this is for discussion and confirms the agreement that 2UL cross band MSD is restricted to LBLB this will not be discussed. If needed, that confirmation could be captured in meeting notes |
| [R4-2400641](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110/Docs/R4-2400641.zip) | UL CA\_n5A-n13A | Qualcomm France | Proposal 1: 25dB CA\_n5-n13 UL IMD3 MSD in n5  Proposal 2: 17.8dB CA\_n5-n13 UL IMD3 MSD in n13  Proposal 3: 2.4dB n5 UL >ACLR2 MSD in n13, 2.1dB n13 UL >ACLR2 MSD in n5  Proposal 4: Delta T/R 0.5/0 for n5 and 0.5/0 for n13 |

## Open issues summary

### Sub-topic 2-1 CA\_n5-n13 2DL/2UL

**Issue 2-1: CA\_n5-n13 2DL/2UL MSD and Delta T/R**

* Proposals:
* **Proposal 1**: Use the following MSD test point for n5 IMD3:

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

* **Proposal 2**: If MSD test point for n13 IMD3 is specified, use the following test point:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Band / Channel bandwidth / NRB / Duplex mode** | | | | | | | | **Source** |
| **NR CA band combination** | **NR band** | **UL Fc** | **UL/DL BW** | **UL** | **DL Fc (MHz)** | **MSD** | **Duplex mode** | **of IMD** |
| **(MHz)** | **(MHz)** | **CLRB** | **(dB)** |
| CA\_n5-n13 | n5 | 826.5 | 5 | 25 (RBstart=0) | 871.5 | N/A | FDD | N/A |
|  | n13 | 782 | 10 | 20 (RBstart=32) | 751 | 17.8 | FDD | IMD3 |

* **Proposal 3**: Use the following Cross-band MSD:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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 |

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

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

* Recommended WF
  + All proposed MSD are valid for LBLB case => Experts to review the MSD test points and Values and see if additional evaluation is needed or whether proposals are acceptable as is.
  + The Delta T/R are consistent with other LBLB cases => Experts to review if proposal is acceptable as is.

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

## Companies’ contributions summary

|  |  |  |  |
| --- | --- | --- | --- |
| **T-doc number** | **Title** | **Company** | **Proposals / Observations** |
| [R4-2401764](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110/Docs/R4-2401764.zip) | Discussion on MSD 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**.**  Moderator: on architecture, it seems that 4Rx is no supported while mandatory in these bands. Can the proponent clarify?  **Observation 2:** for band n77/n78 filter, the attenuation performance can be assumed as 20~25dB at frequency range 6425~7125MHz.  **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.  **Observation 5:** for band n104 filter, the attenuation performance can be assumed as 20~25dB at frequency range 3300~3800MHz.  **Proposal 1: it’s necessary to consider the simultaneous Rx/Tx operation when CA\_n78-n104 is specified.**  **Observation 6:** 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 7:** 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 2: To consider the following assumption for CA\_n78-n104 MSD analysis.**  1) MSD due to cross band isolation:  PA output noise PSD for both n78 and n104: **-120~-130dBm/Hz**  Both n78 and n104 filter attenuation: **25dB**  Antenna isolation: **10dB**  Diplexer isolation between band n78 and n104 is no more than **10dB** in main path.  2) MSD due to harmonic interference:  n78 PA 2nd harmonic attenuation: **30dB**  Both n78 and n104 filter attenuation: **25dB**  Antenna isolation: **10dB**  Diplexer isolation between band n78 and n104 is no more than **10dB** in main path.  3) MSD due to harmonic mixing interference:  n78 LO 2nd harmonic attenuation: **50dB**  Both n78 and n104 filter attenuation: **25dB**  Antenna isolation: **10dB**  Diplexer isolation between band n78 and n104 is no more than **10dB** in main path.  **Proposal 3: To consider the following test configurations for CA\_n78-n104 MSD analysis.**  1) MSD due to cross band isolation:  2) MSD due to harmonic interference:  3) MSD due to harmonic mixing interference:  Moderator: all are TBD values and do use the agreed Min/Max UL/DL CBW according to the MSD type |
| [R4-2400724](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110/Docs/R4-2400724.zip) | CA\_n78-n104 and associated 3.3-7.1GHz architecture and challenges | Skyworks Solutions Inc. | **Observations:**   * Simultaneous Tx/Rx is already supported between the 3.3-5 and 5.15-7.125GHz range * Outside indoor or private networks we do not see how non-simultaneous Tx/Rx between the 3.3-5 and 5.15-7.125GHz range can be guaranteed:   + - NR-U would have first to co-exist with WiFi operation in the phone and in the network so it is unlikely that it can guarantee non-simultaneous Rx/Tx with NR band n48/n77/n78/n104     - Since there is no guard band between n102 and n104 it is unclear to us how the band n104 will support non-simultaneous Rx/Tx with NR band n77/78/n79 at the expense of simultaneous Tx/Rx with n102 and n46.   **Proposal on Sim Tx/Rx: as a general principle, Sim Tx/Rx operation should be assumed between the 3.3-5GHz and 5.15-7.125GHz range and the associated CA requirements must account for increased Delta T/R with significant MSDs.**  Observations:   * One of the critical aspects of implementing NR/NR-U/WiFi bands in the 3.3-7.125GHz range is how to combine all the different bands and concurrent Rx/Tx use cases together with DL and UL CA and MIMO operation. * This requires implementations in terms of antenna sharing, filtering, use case management and feature support that is beyond the scope of what can be discussed with 3GPP and involve critical cost trade offs * Thus, we are not ready to discuss detailed solutions and performance numbers under many scenarios * If a specific n104 add-on may be implemented in the future, the first implementations will share the antenna and RFFE HW with WiFi/NR-U and will still have to solve the concurrent operation with n46/n102 unlicensed bands which will come at extra cost.   **Proposal on architecture and RFFE front end performance assumptions:**   * **For combinations between the 3.3-5GHz and 5.15-7.125GHz frequency ranges, the assumptions should account for the implementation of all the possible cases and not focus on an optimization for a specific two band case or feature support.** * **The assumptions for minimum requirements should be based on best effort implementation with 4 antennas of a UE supporting the WW roaming bands for NR/NR-U and Wi-Fi 6/6E/7 and a possible n79 add-on and assume that n104 will share the n46/n96/n102 HW in early implementations**   **Proposal on valid test points for UL harmonics and harmonic mixing:**   * **Table 1 below is used for evaluation where n104 minimum CBW is corrected at 20MHz** * **The copied CA\_n7-n46 test point shall be corrected for the band n46 CBW** * **At this time, we do not have MSD values to propose, but higher values than the respective 23.9/8.3dB initially proposed shall be expected as n77 filter used for n78 does not have the rejection that the n7 FDD UL filter + HB/VHB diplexer.**   Observations:   * Where SimRx/Tx is properly accounted for a licensed band or unlicensed band above 5.925GHz, a DeltaT of 1.5dB is specified for similar cases. * For DeltaT/R, the licensed bands have 0.5dB while the unlicensed bands > 5.925GHz have 0dB as the REFSENS of NR-U bands already account for a higher DL losses.   **Proposal:**   * **Delta T/R should be assessed based on 4Rx n104 implemented with a 5.15-7.125GHz filters, multiplexed with a 4Rx n77 filters with 4 antennas assuming 2Tx in each band. Additional losses should be accounted for a band n79 add-on.** * **The DeltaT/R values below are tentatively considered for CA\_n78-n102**   + **DeltaT of [1.5dB/1.5dB] for n78/n104**   + **DeltaR of [0.5dB/0.5dB] for n78/n104**   **Proposal on cross band MSD: the following Table 3 is proposed for MSD test point and values. [17]dB for n78 UL into n104 and [13]dB for n104 UL into n78 DL**  **Proposal for UL harmonic and harmonic mixing MSD evaluation: a band-to-band rejection of around 20dB is assumed between n78 to n104 for the evaluation and there is no need for BW corrections.** |
| [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-n104A  n78/n104UL2/DL1 direct-hit at 44.9dB and UL2/DL1 Near-miss at 16.2dB  n104/n78 UL1/DL2 at 24.5dB  n104 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 Sim Rx/Tx CA\_n78-n104

**Issue 3-1: Sim Rx/Tx**

* Proposals
  + Option 1: Huawei Sim Rx/Tx is supported
  + Option 2: Skyworks Sim Rx/Tx is supported
  + Option 3: Murata although not stated the MSD studies assume Sim Rx/Tx is supported
  + Option 4: Qualcomm Sim Rx/Tx is supported
* Recommended WF: Sim Rx/Tx is supported

### Sub-topic 3-2 front end architecture for CA\_n78-n104

**Issue 3-2a: Antenna sharing**

* Proposals
  + Option 1: Huawei, 3 architecture proposed
  + = QCOM Case 1: 4 separate n78/n104 for main+diversity (+4 separate for 4Rx in n78 and n104)? 8 total
  + = QCOM Case 2: 3 separate n78/n104 UL for main+diversity (+2 shared for 4Rx in n78 and n104)? 5 total
  + = QCOM Case 3: 2 shared n78/n104 UL/DL for main+diversity (+2 shared for 4Rx in n78 and n104)? 4 total
  + Option 2: Murata, 3 antennas used for main+diversity.
  + = QCOM Case 2: 3 separate n78/n104 UL for main+diversity (+2 shared for 4Rx in n78 and n104)? 5 total
  + Option 3: Skyworks, 4 antennas shared n78/n104 UL/DL for main+diversity+MIMO for mainstream and roaming implementations. 4 total
  + Option 4: Qualcomm, 4 antennas used for main+diversity:
  + Case 1: 4 separate n78/n104 for main+diversity (+4 separate for 4Rx in n78 and n104)? 8 total
  + Case 2: 3 separate n78/n104 UL for main+diversity (+2 shared for 4Rx in n78 and n104)? 5 total
  + Case 3: 2 shared n78/n104 UL/DL for main+diversity (+2 shared for 4Rx in n78 and n104)? 4 total
* Recommended WF:
  + Discuss if all antennas are shared with 4Rx mandatory in both bands. And if additional antennas are needed to separate n104 and n78 ULs from the other band DL (diversity and MIMO).
  + Discuss if all, one or worst case should be supported by the specification and which total number of antennas is reasonable.

**Issue 3-2a: Filter assumption**

* Proposals
  + Option 1: Huawei, n77 filter + dedicated n104 filter + n77/n104 diplexer. How is n79 added? Antenna and filter performance values.
  + Option 2: Murata, n77 filter + 5.1-7.125GHz filter  + n77/XXX diplexing ?
  + Option 3: Skyworks, n77 filter + 5.1-7.125GHz filter with direct diplexing and room for n79 add-on for mainstream and roaming implementations.
  + Option 4: Qualcomm, n77 filter + n104/n102+n104/5.1-7.125GHz filter with n77/>5.15 diplexing?
* Recommended WF
  + Antenna and filter performance values: in general, there is no agreement on component values as every contributing company can use different values, especially with different architectures in mind. However, companies are encouraged to provide the background to their proposed values, which is the case for the 3 contributions.
  + Filter assumptions: Discuss is a specific architecture/filter assumption should drive the requirement or if any approach can be used to derive the requirement.
  + Filter multiplexing: Discuss overall antenna multiplexing with filters for all bands in 3.3-7.125GHz: Skyworks assumption is direct diplexing of n77 filter with 5.15-7.125 filter and option to add n79 filter while other companies assume further isolation by diplexer or separate antennas but it is unclear how other bands are multiplexed.

### Sub-topic 3-3 MSD test points for CA\_n78-n104

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

* Proposals
  + Option 1: Huawei based on n104 dedicated filter and diplexer/antenna isolation

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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) |
| n78 | n104 | 3750 | 100 | 30 | 270 (RBstart=0) | 6435 | 20 | TBD | >ACLR2 |
| n104 | n78 | 6475 | 100 | 30 | 270 (RBstart=0) | 3795 | 10 | TBD | >ACLR2 |

* + Option 2: Murata

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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) |
| n78 | n104 | 3750 | 100 | 30 | 270(RBstart=0) | 6435 | 20 | 10.3 | >ACLR2 |
| n104 | n78 | 6475 | 100 | 30 | 270 (RBstart=0) | 3795 | 10 | 17.2 | >ACLR2 |

* + Option 3: Skyworks

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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) |
| n78 | n104 | 3750 | 100 | 30 | 270 (RBstart=3) | 6435 | 20 | [17] | >ACLR2 |
| n104 | n78 | 6475 | 100 | 30 | 270 (RBstart=0) | 3790 | 10 | [13] | >ACLR2 |

* + Option 4: Qualcomm

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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)** |
| n104 | n78 | 6475 | 100 | 30 | 270 (RBstart=0) | 3795 | 10 | 4.3 | >ACLR2 |
| n78 | n104 | 3750 | 100 | 20 | 270 (RBstart=3) | 6435 | 20 | 4.8 | >ACLR2 |

* Recommended WF
  + Test point: 3790MHz is an error in Skyworks input (should be 3795MHz) thus all test points definitions are the same and can be used for the discussion on MSD values
  + MSD values: n78/n104 TBD for Huawei, 10.3/17.2dB for n78/n104 UL for Murata, [17]/[13dB] for Skyworks, 4.8/4.3dB for Qualcomm => propose to discuss values proposed but with an understanding of the differences coming from

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

* Proposals
  + Option 1: Huawei based on n104 dedicated filter and diplexer/antenna isolation

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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) |
| n78 | n104 | 10 | 30 | 24 (RBstart=0) | 20 | TBD | NOTE 2 | UL2/DL1  direct-hit |

* + Option 2: Murata base on 3 antennas + 2MIMO antnennas? – Filter?

|  |  |  |  |
| --- | --- | --- | --- |
|  | **NR Band / Harmonic order / Channel BW in UL** | | |
| **UL Band** | **Harmonic order** | **DL Band** | BWChannel |
| n78 | 2 | n104 | +/- 2\* BWChannel |
| NOTE 1: Even though UL harmonic does not fall directly into the DL band the exclusion region still applies.  NOTE 2: The centre of the exclusion region is obtained by multiplying the UL channel centre frequency by the harmonic order. | | | |

* + Option 3: Skyworks > 23.9dB

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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) |
| n78 | n104 | 10 | 15 | 25 (RBstart=0) | ~~10~~20 | ~~23.9~~ TBD | NOTE 2 | UL2/DL1 direct-hit |

* + Option 4: 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)** |
| n78 | n104 | 10 | 15 | 50 (RBstart=0) | 20 | 44.9 | NOTE 2 | UL2/DL1  direct-hit |
| n78 | n104 | 10 | 15 | 50 (RBstart=0) | 20 | 16.2 | NOTE 6 | UL2/DL1  Near-miss |

* + Recommended WF:
  + Two companies are still TBD on a UL harmonic MSD, one proposes REFSENS exclusion, on proposes 44.9/16.2dB for direct-hit/Near miss
  + In this meeting discuss if REFSENS exclusion is acceptable knowing that so far, it has been restricted to unlicensed bands.
  + Also agree on test points to be evaluated based on Qualcomm input: RB=25 or 50RB, both direct hit and near-miss needed?

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

* Proposals
  + Option 1: Huawei based on n104 dedicated filter and diplexer/antenna isolation

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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) | 20 | TBD | 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: Skyworks > 8.3dB

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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 | 12 (RBstart=0) | 10 | ~~8.3~~ TBD | NOTE 7 | UL1/DL2 |

* + Option 4: 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 |

* Recommended WF
  + Two companies are still TBD on a UL harmonic MSD while one proposes two test points and another 1 test point
    - Discuss if two test points are needed. Note that 5MHz does not exist for n104.
    - Discuss test point LCRB
  + The Proposed MSD value of 17.6dB for 10MHz is discussed as the mandatory test point amongst experts.

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

* Proposals
* Option 1: Skyworks DeltaT of [1.5dB/1.5dB] for n78/n104, DeltaR of [0.5dB/0.5dB] for n78/n104. based on 4Rx n104 implemented with a 5.15-7.125GHz filters multiplexed with a 4Rx n77 filters with 4 antennas assuming 2Tx in each band. Additional losses should be accounted for a band n79 add-on.
* Option 2: Qualcomm DeltaT of [0.8dB/1.0dB] for n78/n104, DeltaR of [0.8dB/1.0dB] for n78/n104.
* Recommended WF
  + Discuss DeltaT/R based on architecture assumptions to be discussed above

# Topic #4: CRs requiring expert review

## Companies’ contributions summary

|  |  |  |  |
| --- | --- | --- | --- |
| **T-doc number** | **Title** | **Company** | **Proposals / Observations** |
| [R4-2400792](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110/Docs/R4-2400792.zip) | draft CR for TS38.101-1 to clarify 1 UL configuration for NR CA | Huawei, HiSilicon, Skyworks Solutions, Inc. | Add in text to 5.5A.0 to clarify UL configurations:  By default, unless otherwise noted and except for NR band restrictred to operation with share spectrum access channel, power class 3 applies to:   * all NR FR1 band valid single uplink configurations, * all NR FR1 band specified intra-band uplink CA configurations, * all inter-band CA configurations.   For NR bands with operation restricted to shared spectrum channel access, by default power class 5 applies to all valid single uplink configurations and to all specified intra-band uplink CA configuration. The applicability of higher power class(es) is explicitly indicated in the CA configuration tables in clauses 5.5A.1, 5.5A.2 and 5.5A.3. A UE supporting a given power class for a CA configuration shall meet the corresponding transmitter and receiver requirements in Clause 6 and Clause 7, respectively.  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 constituent band of the inter-band downlink CA combination can be configured as a valid single uplink carrier, * No other single uplink carrier configurations than those specified are valid UL configurations,   If an uplink CA configuration is supported, its fallback single uplink is also supported.  Moderator: the CRs is for review in 4.2.1 Sub-topic 4-1 |
| [R4-2402072](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110/Docs/R4-2402072.zip) | Discussion on various correction to MSD values and definitions | Nokia | Justification for  Correction of CA\_n48-n96 harmonic mixing from UL2/DL3 to UL1/DL2. **P1 agree DCR R4-2402074**  Correction to IMD test points for DC\_2A-66A\_n77A and DC\_2A-n66A\_n77A. **P2: add IMD2 to requirement section of Note 11 usage of 32.1dB, same as section wo. Note 11 including new test frequency points. P3: Proposal 3: add Note 4 on DC\_2A\_n66A-n77A**  Correction to IMD test points for DC\_2A-66A\_n78A / DC\_2A-n66A\_n78A: DC\_2A\_n66A-n78 cannot have IMD2 in band 2A. **P4: group DC\_2A-66A\_n78A and DC\_2A\_n66A-n78A separately and correct IMD2 case in 2A when there’s 2 NR bands**  Correction to IMD test points for DC\_66A\_n2A-n77A: missed the IMD2 into n77A. **P5: add IMD2 into n77 for DC\_66A\_n2A-n77A with MSD values from DC\_2A\_n66A-n77A P6: agree DCR R4-2402077 and R4-2402078**  Correction for Missing IMD2 and IMD4 for CA\_n25-n66-n78:   * n25 + n66 IMD2 and IMD4 may affect Rx frequencies of band n78. This test is missing in existing 38.101-1, re-use CA\_n25-n66-n77 MSD values. * n25 + n78 IMD4 may affect Rx frequencies of band n66. This test has been missed. Re-use CA\_n25-n66-n77 MSD values. * n66 + n78 IMD2, IMD4 and IMD5 may affect Rx frequencies of band n25. These tests have been missed. Re-use CA\_n25-n66-n77 MSD values.   **P7: add missing IMD2 and IMD4 cases to CA\_n25-n66-n78. P8: Agree correction in R4-2402076**  Correction to CA\_n3-n7-n8 use of note 11   * The only combination using a summation of IMD is CA\_n3-n7-n8 in 38.101-1. * There is already another note in 38.101-1 which can be applied instead of Note 11. Note 4 have been used among other places at the following combinations: * CA\_n3-n7-n8 implicitly already uses Note 4 since n41 has the same downlink frequencies as n7. In the cases that define the IMD with notes stating that also IMD4 and IMD5 occurrences will impact the receive band, there are no similar combinations like IMD2+IMD4 and IMD3+IMD5. Therefore, we propose to remove the “+IMD3” that is used only in this single case. We propose to void note 11 and we propose to add note 4 to the combination CA\_n3-n7-n8.   **P9: Proposal 9: Use note 4 and delete IMD2+IMD3, replace with IMD2 only P10: Proposal 10: Void note 11, that is only used in this one CA case. P11: Agree correction in R4-2402073**  Correction of MSD values for CA\_n1-n77-n79 **P12: Reuse the MSD of CA\_n1-n78-n79 for CA\_n1-n77-n79**  Correction of MSD values for CA\_n3-n7-n28 **P13: Align MSD between DC\_3-n7-n28 and CA\_n3-n7-n28** **P14: Correct CA\_n3-n7-n28 MSD value of 26dB at n3**  Correction of MSD values for CA\_n3-n78-n105 **P15: Proposal 15: Correct CA\_n3-n78-n105 to 9dB on IMD4 of n78 P16: Agree corrections in R4-2402073**  Moderator: the associated CRs are for review in 4.2.1 Sub-topic 4-1 |

## Open issues summary

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

### 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. Draft CRs R4-2402073-2078 have associated discussion paper [R4-2402072](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110/Docs/R4-2402072.zip) for justification and the paper may be discussed during Ad-hoc where necessary.

|  |  |
| --- | --- |
| **T-doc** | **Company/Review comment** |
| [R4-2400792](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110/Docs/R4-2400792.zip) draft CR for TS38.101-1 to clarify 1 UL configuration for NR CA | Company A: |
| Company B: |
| Company X: |
| [R4-2402073](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110/Docs/R4-2402073.zip) draftCR to 38.101-1 - Correcting MSD value of CA\_n1-n77-n79 CA\_n3-n7-n28 CA\_n3-n78-n105 | Company A: |
| Company B: |
| Company X: |
| [R4-2402074](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110/Docs/R4-2402074.zip) draftCR to 38.101-1 - Correction to CA\_n48-n96 harmonic mixing | Company A: |
| Company B: |
| Company X: |
| [R4-2402075](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110/Docs/R4-2402075.zip) draftCR to 38.101-1 - Correction to IMD2 IMD3 notation for CA\_n3-n7-n8 | Company A: |
| Company B: |
| Company X: |
| [R4-2402076](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110/Docs/R4-2402076.zip) draftCR to 38.101-1 - Updates to CA\_n25-n66-n78 and other editorials | Company A: |
| Company B: |
| Company X: |
| [R4-2402077](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110/Docs/R4-2402077.zip) draftCR to 38.101-3 - Updates to DC\_2A-66A-n77An78A | Company A: |
| Company B: |
| Company X: |
| [R4-2402078](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110/Docs/R4-2402078.zip) draftCR to 38.101-3 - Updates to DC\_2A-n66A-n77An78A DC\_66A\_n2A-n77An78A | Company A: |
| Company B: |
| Company X: |

# Topic #5: Rules and guidelines TP/TR MSD analysis

**Moderator: Based on the feedback from the RAN4 chairman, the contributions in this topic will not be treated officially, this is because the SimBC SI is closed, and no CR will be allowed until the start of new R19 related WI/SI, and the fact that we cannot make any decision yet for R19. Still, it is recognized that this topic is of importance to prepare the R19 band combination basket work and thus companies are encouraged to discuss the topic and documents offline.**

**The documents are still taken in the summary and we can have an offline thread covering this where I can collect inputs back into this document. I still also encourage the experts to discuss the technical documents on the different MSD types to be able to capture the consensus position. If there is time left during the ad-hoc session we can possibly discuss how we want to work on this topic until June.**

**To organize the offline, this section will be copied in a separate document in a specific Offline folder in the [105] folder and companies can comment directly (similar to the remote process). With any offline time we can find with interested companies we can review the status and check if there is some consensus.**

**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** |
| [R4-2402425](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110/Docs/R4-2402425.zip) | Handling of release independent issue for spectrum/basket WIs | Huawei, HiSilicon | **Observation:** For most spectrum related WIs, the release independent requirements are core requirements rather than perf requirements.  **Proposal 1: 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 2: 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 3: The TS 3x.307 should not be listed as perf spec without careful checking whether the affected requirements are core part of perf part.** |
| [R4-2400645](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110/Docs/R4-2400645.zip) | RX Mixing evaluations | Qualcomm France | **Proposal 1**: Use the following tables to capture which RX Mixing MSD cases should be analysed in band combination specific manner.  **Table 6.5.1-1: PC3 and PC5 harmonic mixing rules**  **Table 6.5.1-2: PC2 and PC1.5 harmonic mixing rules** |
| [R4-2402426](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110/Docs/R4-2402426.zip) | Restructure TR for basket WI with MSD analysis | 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 from technical point of 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 restructure the TR for basket WI with MSD analysis including more technical information from Rel-19.**  **Proposal 2: It is proposed to capture the agreement once reached on restructuring of the basket WI with MSD analysis in TR 38.846.**  Moderator: given that 38.846 is closed and MCC does not allow CRs to a closed SI, this may not be feasible. |
| [R4-2400257](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110/Docs/R4-2400257.zip) | Further improvements to the block approval process in R19 | Skyworks Solutions Inc., Nokia | **Proposed set of block approval TP templates for Release 19 and their content:**   * **Intra-band DLCA**   + Band combination BCS => provide a clear way to list the related UL configurations and their interference bandwidths to be considered   + 1CC UL configuration: MSD to SCC for FDD bands => provide ACLR range calculations and guidelines   + 2CC UL configuration: MSD to PCC/SCC for FDD bands and check of NS for A-MPR for FDD and TDD bands => provide IMD range calculations and guidelines. * **Two band DLCA**   + Band definition => Criteria on how to apply frequency range restrictions when possible   + Band combination BCS => provide a clear way to list the related UL configurations and their interference bandwidths to be considered   + Delta T/R => Provide guidelines vs cases, especially for LBLB 2UL cases   + 1 band 1CC UL configuration:     - UL harmonic => Stable but may discuss harmonic order > 5 for HPUE     - Harmonic mixing => Need to agree on even harmonic cases and some odd cases versus power class     - Cross-band isolation => Need to provide table for calculation of ACLR range to consider and UL noise floor warning   + 1 band 2CC UL configuration: IMDs of intra-band ULCA => need to provide a simplified set of IMD orders and indexes to be analysed   + 2 band 1CC per band UL configuration:     - IMDs of the two UL bands => Stable, can improve for guidelines     - Need to decide if 2UL cross-band MSD introduced for LBLB is added   + 2 band UL configuration with 2CC in one UL band:     - Triple beat of the 3CC => Stable in not for block approval thread, need to provide calculation table and simplify indexes that are not needed. * **Three band DLCA**   + Band definition => Criteria on how to apply frequency range restrictions when possible   + Band combination BCS => provide a clear way to list the related UL configurations and their interference bandwidths to be considered   + Delta T/R => Provide guidelines vs cases, especially for LBLBLB 2UL cases   + 2 band 1CC per band UL configuration:     - IMDs of the two UL bands into third DL band => Stable, can improve for guidelines     - Need to decide if 2UL cross-band MSD to third band is added   + 2 band UL configuration with 2CC in one UL band:     - Triple beat of the 3CC into the third DL band => Stable in not for block approval thread, need to provide calculation table and simplify indexes that are not needed   The above is summarized in Table 1 below and provides criteria for the different types of analysis.   * **In principle, for cases not listed in Table 1 it should be feasible to use draftCRs to the TS, but draftCRs should not be used when a new UL configuration is introduced (for 1, 2, 3 band DL) without a thorough analysis of potential simultaneous Tx/Rx MSDs.**   Table 1: Coexistence analysis versus band combination DL and UL configurations  **To achieve the above goal, we will provide a set of dedicated discussion contributions in this meeting and the April/May meetings and we would welcome collaboration or sharing of the work:**   * **February meeting:**   + Discussion paper with proposal on IMD products and MSD for 2 band DL and 1 band UL/2CC [21]   + Discussion paper with proposals on triple beat products and MSD for 2 band DL and 2 band UL with one band with 2CC [22]   + Discussion paper with proposal on harmonic mixing products to be considered versus power classes [23]   + Discussion paper with proposal on cross-band MSD calculations and guidelines [24]   + Discussion paper on applicable UL/DL frequency range restrictions for co-existence studies [25]   + Discussion paper on two DL band TP template with examples [26]. * **April meeting:**    + Extend to intra-band and three DL band MSD cases as derivatives of the two-band case   + Agree on the two DL band TP template. * **May meeting**   + Agree on the intra-band and three DL band TP template and CR   + Integrate the TP templates in their related R19 draftTRs which may be expected to be submitted for information prior to the RAN#104 meeting in June. * **Future Release 19 meetings**   + Use the TP templates for block approval, and even if the proponent needs expert input for the MSD value, the TP should be complete and provided as an input with TBD values where needed.   + Keep the “not block approval AI” to manage critical flags and band combinations A-MPR and MSD studies when needed   + Update R19 SimBC TR with latest guidelines, tables, templates, annexes (the priority is to settle on the templates first and capture in SimBC TR when finished).   Moderator: given the current situation with SimBC SI closed and R19 decision not possible the above plan is no longer realistic |
| [R4-2400258](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110/Docs/R4-2400258.zip) | On cross-band isolation MSD analysis | Skyworks Solutions Inc., Nokia | **Proposal:**   * **Above the ACLR5 range, only the transmitter noise floor can be considered for cross-band isolation MSD for PC3.** * **To consider the Tx noise floor two criteria should be met:**   + **The UL aggressor band and DL aggressor band should be part of the same or adjacent band group of Table 2**   + **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 and is also used up to ACLR5 range** * **The MSD due to the transmitter noise floor should be evaluated further if:**   + **There is no overlap up to ACLR5**   + **The UL aggressor band and DL aggressor band are part of the same or adjacent band group defined for triple beat**   + **If the DL band is above the UL band, it’s lower frequency edge must be below the UL lowest harmonic two frequency**   + **As an indicative threshold, if >45dB rejection at the DL band frequency can be guaranteed with assuming -130dBm/Hz TX noise floor level, the MSD should be negligible**   + **Triple beat band group table is added in annex of the TPs and TR for two DL band.** |
| [R4-2400259](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110/Docs/R4-2400259.zip) | On harmonic mixing orders and analysis | Skyworks Solutions Inc., Nokia | **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.**  Table 3: harmonic mixing rules of analysis applicability  **Proposal on new table format for UL harmonic and harmonic mixing table:**   * **The below table is used in the two DL one UL section of the block approval TPs.** * **When a collision is detected with an overlap of ULX range with DLY range, the ULX/DLY cell is marked “D” for direct hit (red highlight)** * **When ULX range is less than X times the UL channel bandwidth away from DLY range, the ULX/DLY cell is marked “N” for Near miss (orange highlight) and only the orders where X+Y<5 are considered.** * **A specific row is added to capture conclusions on the UL harmonic and harmonic mixing analysis.** * **Notes are provided for guidance and harmonic mixing cases that are conditional to an UL harmonic range.** |
| [R4-2400260](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110/Docs/R4-2400260.zip) | On simplifying analysis for 2DL-1 band intra-band ULCA IMD products | Skyworks Solutions Inc., Nokia | Simplification of formulas and removal of IMDs already covered by other 1UL analysis  **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.** |
| [R4-2400261](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110/Docs/R4-2400261.zip) | On simplifying analysis for triple beat products | Skyworks Solutions Inc., Nokia | Simplification of formulas and removal of IMDs already covered by other 1UL analysis  **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)** * **The associated annex for the band group criteria is also added to either:**   + **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)**   + **Alternatively, the band group definition is given directly in the Note section.**   Table 2: Triple beat IMD analysis of CA\_nXA-nYC UL  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 1 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 |
| [R4-2400262](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110/Docs/R4-2400262.zip) | On applicable UL/DL frequency range restrictions for co-existence studies | Skyworks Solutions Inc. | **Proposal for operator-based frequency range and ambiguous applicability of restricted frequency range:**   * **For operator specific ranges in Japan, it should be verified first if using the Japan restricted frequency range is sufficient:**   + **In [1] it was concluded that using Japan frequency range is sufficient for same cases and A CR was agreed for 38.101-1 for Chapter 7 and the same effort can be done for Chapter 5 and also for 38.101-3** * **For band n79 and band n40 cases, it should be confirmed if this combination may be valid in Japan on top of China.**   **Proposal: The frequency range restriction section between the \*\*\*\* marks below is added to the “Operating bands for CA” section of the two and three DL bands TP to TR templates and proponent should clarify and justify the frequency range restriction(s) apply to the band(s) for the coexistence study by filling in the greyed parts.**  *Note: For certain band combinations, frequency range restrictions may be applicable when the band combination can be uniquely identifiable to a region or a country. Operator holding frequency range restrictions are not allowed and frequency ranges derived from additional emission requirements (NS) are not relevant. Related frequency range restrictions can be found in annex Y. Such frequency range restriction(s) are captured in Table X and used for the coexistence study tables.*  **Table XXX: Applicable frequency range restrictions for coexistence study**  **Proposal on capturing frequency range restriction: The applicable frequency range restriction table and associated guidelines below between the \*\*\*\*\* marks below are captured:**   * **In Annex Y in the templates of TPs to 1/2/3DL band combination TRs outside the TP section and is not copied back into the TR** * **In Annex Y of the 1/2/3DL band combination TRs to have a reference of the applicable frequency range restrictions used in a given release for band combination basket WI.** * **When available, the table and its justification is captured in the Release 19 SimBC TR.** * **This annex and table is not captured in RAN4 TS.**   **\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*beginning of proposed Annex section \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***  Annex Y  For certain band combinations, frequency range restrictions may be applicable when the band combination can be uniquely identifiable to a region or a country. Operator holding frequency range restrictions are not allowed and frequency ranges derived from additional emission requirements (NS) are not relevant. Related frequency range restrictions are captured in Table X and used for the coexistence study tables.  The table provides per bands and the region(s)/countries where the restricted frequency range applies:   * The nominal UL/DL frequency range for the band in the TS 38.101-1 * The restricted UL/DL frequency range applicable * Which band associated with the band in the first column can help determine if the band combination is unique to the given region and in some cases which other condition may apply. This list of bands is indicative and may not be exhaustive.   **Table X: Applicable frequency range restrictions for coexistence studies** |
| [R4-2400263](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_110/Docs/R4-2400263.zip) | Proposal for extended two DL with one or two UL co-existence study template | Skyworks Solutions Inc. | **List of proposed enhancements for 2DL/1or2UL bands block approval TP template for Release 19 as discussed in [1]:**   * **Addition at the end of section “5.XX.1.1 Operating bands for CA” of a table to capture and justify potential frequency range restriction(s) for the co-existence analysis as discussed in [2]** * **Addition at the end of section “5.XX.1.2 Channel bandwidths per operating band for CA” of:**   + **A question related to the support of SimRx/Tx, or otherwise for TDD/TDD cases.**   + **A table that sorts the applicable UL configuration and their related MSD studies** * **For the 2DL/1UL section:**   + **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 [3]**     - **A new calculation table for cross-band isolation MSD is added, as discussed in [4]**   + **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 [5]** * **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:**   + **Slightly updated 2DL 2UL with 1CC/band IMD table, with an analysis and Note section**   + **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 [6]** * **For the annex section to be added to the TP template, and to the related TR (the annex section of each TP is not copied in the TR and can be omitted in the TP submission)**   + **Addition of annex A, covering the applicable frequency range restrictions as discussed in [2]**   + **Addition of annex B, covering band group definition and criteria as discussed in [4,6].** |

## Open issues summary

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

### Sub-topic 5-1 Technical input on MSD calcualtion rules and tables

**Issue 5-1a: Harmonic mixing rules and Harmonic related table R4-2400645 and R4-2400259**

* Proposals for **Harmonic mixing orders**: Qualcomm / Skyworks+Nokia color where there is a difference

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **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 / UL > 2GHz  (DL>3GHz) | N/A | All | | N/A | All | N/A |
| **DL3** | All | All | N/A | All\* | All | | All | N/A | All |
| **DL4** | All / UL > 4.2GHz (DL> 1GHz) | N/A | N/A / UL > 6.4GHz  (DL> ~5GHz) | N/A | All | | N/A | N/A / UL > 4.2GHz  (DL>3.15GHz) | N/A |
| **DL5** | All | All / UL > 1.5GHz  (all DL but 450MHz) | N/A | N/A | All | | All | N/A | N/A |
| \*: All UL band except 450MHz bands | | | | | | | | | | |

* + Issue 1: Frequency limited provided in terms of UL or DL? Note UL3/DL1 is the same proposal but expressed in UL or DL frequency
  + Issue 2: Excluding 450MHz bands or not in DL?
  + Issue 3: UL3/DL4 analysed or not (all PC)
  + Issue 4: UL1/DL4 with frequency limitation or all for PC3?
  + Issue 5: UL2/DL5 Excluding 450MHz bands or all for PC3?
* Proposals for **Harmonic table**:
  + Merge UL harmonic and Harmonic mixing into a matrix table with indication of direct hit/near miss
  + Add analysis and Note row
  + Add Notes on guidance on frequency limitation (will be updated depending on agreements above)

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **UL/DL harmonics** | | **nX** | **UL1** | **UL2** | **UL3** | **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** |
| **DL32** | 3\*fDLlow | 3\*fDLhigh |  |  | N/A |  | N/A |
| **DL42** | 4\*fDLlow | 4\*fDLhigh |  | N/A |  | N/A | N/A |
| **DL52** | 5\*fDLlow | 5\*fDLhigh |  |  | N/A | N/A | N/A |
| **Analysis** | | | text | | | | | |
| **UL/DL harmonics** | | **nY** | **UL1** | **UL2** | **UL3** | **UL4** | **UL5** | **MSD type** |
| **fLow** | fULlow | 2\*fULlow | 3\*fULlow | 4\*fULlow | 5\*fULlow |
| **nX** | **fLow** | fULhigh | 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** |
| **DL32** | 3\*fDLlow | 3\*fDLhigh |  |  | N/A |  | N/A |
| **DL42** | 4\*fDLlow | 4\*fDLhigh |  | N/A |  | N/A | N/A |
| **DL52** | 5\*fDLlow | 5\*fDLhigh |  |  | N/A | N/A | N/A |
| **Analysis** | | | text | | | | | |
| Note 1: When a collision is detected with an overlap of UL(X) range with DL(Y) range, the UL(X)/DL(Y) cell is marked “D” for direct hit. When UL(X) range is less than an X\*ULCBW away from DL(Y) range, the UL(X)/DL(Y) cell is marked “N” for Near miss and only the orders where X+Y<5 are considered.  Note 2: Conditions on UL frequency apply for some ULX/DLY harmonic mixing case for PC3/5: UL>2GHz for UL3/DL2, all UL except 450MHz bands for UL4/DL3, UL>4.2GHz for UL1/DL4, UL>6.4GHz for UL3/DL4, UL>1.5GHz for UL2/DL5 | | | | | | | | |

Offline discussion comments

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| **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 5-1b: Cross band MSD rules and calculation tables R4-2400258**

* Proposals
  + Addition of a calculation table for ACLR ranges up to ACLR5
  + Addition of Analysis and Notes
  + Addition of a specific Note for TX noise floor beyond ACLR5
  + Addition of a rule with FR1 band groups
  + Possibility to use frequency range restrictions or not

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **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 due to transmitter noise floor 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 rejection at the DL band frequency can be guaranteed with assuming -130dBm/Hz TX noise floor level, the MSD should be negligible ]  Note 2: The maximum UL channel bandwidth of the BCS (noted maxULCBW) and 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.  [Note 3: If the band combination can be uniquely identified to a given region/country, UL or DL frequency range restriction may apply] | | | | |

Offline discussion comments

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| **Company/Delegate** | **Comment** |
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**Issue 5-1c: 1UL 2CC IMD calculation table R4-2400260**

* Proposals
  + Addition of Analysis and Notes
  + Simplification of formulas
  + Removal of IMDs already covered by other analysis

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| All in MHz | flow/Min | fhigh/Max | BB IMD range3 | | |
| fUL5 |  |  | Order | flow | fhigh |
| 2CCBW1 |  |  | IMD2 (1-1) | Min2CCBW | Max2CCBW |
| fDL5 |  |  |  |  |
| 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\*Max2CCBW | 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 and MPR is not assumed  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 case by case for FDD or SimRx/Tx TDD bands <1.68GHz]  Note 4: The harmonic 2 and 3 IMD ranges should only be considered if the DL band is above the UL band  [Note 5: If the band combination can be uniquely identified to a given region/country, UL or DL frequency range restriction may apply] | | | | | |

Offline discussion comments

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| **Company/Delegate** | **Comment** |
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**Issue 5-1d: 2UL 1CC/band IMD calculation table R4-2400263**

* Proposals
  + Addition of Analysis and Notes

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Bands | nX | | nY | |
| Frequency limit | fx\_low | fx\_high | fy\_low | fy\_high |
| UL (MHz) |  |  |  |  |
| DL (MHz) |  |  |  |  |
| IMD2 products | |fy\_low – fx\_high| | |fy\_high – fx\_low| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD2 (MHz) |  |  |  |  |
| IMD3 products | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| |
| IMD3 (MHz) |  |  |  |  |
| IMD3 products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
| IMD3 (MHz) |  |  |  |  |
| IMD4 products | |3\*fx\_low –1\* fy\_high| | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | |3\*fy\_high – 1\*fx\_low| |
| IMD4 (MHz) |  |  |  |  |
| IMD4 products | |2\*fx\_low –2\* fy\_high| | |2\*fx\_high –2\* fy\_low| | |2\*fx\_low +2\* fy\_low| | |2\*fx\_high +2\* fy\_high| |
| IMD4 (MHz) |  |  |  |  |
| IMD4 products | |3\*fx\_low +1\* fy\_low| | |3\*fx\_high + 1\*fy\_high| | |3\*fy\_low + 1\*fx\_low| | |3\*fy\_high + 1\*fx\_high| |
| IMD4 (MHz) |  |  |  |  |
| IMD5 products | |fx\_low – 4\*fy\_high| | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
| IMD5 (MHz) |  |  |  |  |
| IMD5 products | |2\*fx\_low - 3\*fy\_high| | |2\*fx\_high - 3\*fy\_low| | |2\*fy\_low - 3\*fx\_high| | |2\*fy\_high -3\*fx\_low| |
| IMD5 (MHz) |  |  |  |  |
| IMD5 products | |fx\_low + 4\*fy\_low| | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | |fy\_high + 4\*fx\_high| |
| IMD5 (MHz) |  |  |  |  |
| IMD5 products | |2\*fx\_low + 3\*fy\_low| | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
| IMD5 (MHz) |  |  |  |  |
| Analysis | text | | text | |
| Note: The lowest even order and lowest odd order IMD MSDs shall be considered. | | | | |

Offline discussion comments

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| **Company/Delegate** | **Comment** |
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**Issue 5-1e: 2UL 3CC triple beat calculation table R4-2400261**

* Proposals
  + Addition of Analysis and Notes
  + Simplification of formulas
  + Removal of IMDs already covered by other analysis
  + FR1 band groups added in annex (also used for cross band)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Band / CA1** | **nX** | | **CA\_nYC** | |
| **Frequency limit** | **fx\_low** | **fx\_high** | **fy\_low / min** | **fy\_high / max** |
| **F\_UL (MHz)3** |  |  |  |  |
| **F\_DL (MHz)3** |  |  |  |  |
| **2CCBW (MHz)2** | N/A | N/A |  |  |
| **IMD3 products** | fx\_low-max2CCBW | fx\_low | fx\_high | fx\_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/maximum separation BW is 0MHz / Min(fy\_high-fy\_low, maximum aggregated BW) respectively.  [Note 3: If the band combination can be uniquely identified to a given region/country, UL or DL frequency range restriction may apply] | | | | |

Offline discussion comments

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| **Company/Delegate** | **Comment** |
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**Issue 5-1f: clarification and annex for applicable frequency range restriction in a band R4-2400262**

* Proposals
  + **Adding an explicit restricted range table in band definition when applicable**

*Note: For certain band combinations, frequency range restrictions may be applicable when the band combination can be uniquely identifiable to a region or a country. Operator holding frequency range restrictions are not allowed and frequency ranges derived from additional emission requirements (NS) are not relevant. Related frequency range restrictions can be found in annex Y. Such frequency range restriction(s) are captured in Table X and used for the coexistence study tables.*

**Table XXX: Applicable frequency range restrictions for coexistence study**

|  |  |  |  |
| --- | --- | --- | --- |
| **NR Band** | **Uplink (UL) band** | **Downlink (DL) band** | **Duplex**  **mode** |
| **BS receive / UE transmit** | **BS transmit / UE receive** |
| **FUL\_low – FUL\_high** | **FDL\_low – FDL\_high** |
| nXXX | xxxx MHz – xxxx MHz | xxxx MHz – xxxx MHz | XXX |
| Justification | text | | |

* + **Adding a list of applicable frequency range restrictions:**
    - **Operator based is not valid**
    - **Not in TS**
    - **In TR (BC or SimBC)**
    - **In annex of TPs?**

Annex Y

For certain band combinations, frequency range restrictions may be applicable when the band combination can be uniquely identifiable to a region or a country. Operator holding frequency range restrictions are not allowed and frequency ranges derived from additional emission requirements (NS) are not relevant. Related frequency range restrictions are captured in Table X and used for the coexistence study tables.

The table provides per bands and the region(s)/countries where the restricted frequency range applies:

* The nominal UL/DL frequency range for the band in the TS 38.101-1
* The restricted UL/DL frequency range applicable
* Which band associated with the band in the first column can help determine if the band combination is unique to the given region and in some cases which other condition may apply. This list of bands is indicative and may not be exhaustive.

**Table X: Applicable frequency range restrictions for coexistence studies**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **NR**  **Band** | **Uniquely**  **Identifiable**  **Region** | **Uplink (UL) band** | **Downlink (DL) band** | **Restricted range (UL)** | **Restricted range (DL)** | **Associated band or condition for region/country uniqueness** |
| **Flow-Fhigh (MHz)** | | | |
| **n24** | North America | 1626.5-1660.5 | 1525-1559 | 1627.5-1637.5  1646.5-1656.5 | 1526-1536 | Only used in North America |
| **n28** | Europe | 703-748 | 758-803 | 703-733 | 758-788 | [(n)7,20,38,65,75/76,91,92,109] |
| **n28** | Japan | 718-748 | 773-803 | [(n)11,18,19,21,74] |
| **n40** | Japan | 2300-2400 | 2300-2400 | 2330-2370 | 2330-2370 | [(n)11,18,19,21,74] |
| **n41** | China | 2496-2690 | 2496-2690 | 2515-2675 | 2515-2675 | [(n)34(95),39(98),50/51] |
| **n41** | Japan | 2545-2645 | 2545-2645 | [(n)11,18,19,21,74 or when n90 is signalled] |
| **n46** | North America | 5150-5925 | 5150-5925 | 5150-5350  5470-5850 | 5150-5350  5470-5850 | [(n)2,12,13,14,24,25,30,48/49,66(86),70,71,85] |
| **n46** | Rest of the world | 5150-5350  5470-5730 | 5150-5350  5470-5730 | [(n)1,3,8,11,18,19,20,21,28,34(95), 39(98),40,50/51,74,75/76,91,92,93,94,109] |
| **n77** | Japan | 3300-4200 | 3300-4200 | 3400-4100 | 3400-4100 | [(n)1,3,11,18,19,21,40,74] |
| **n77** | North America | 3450-3980 | 3450-3980 | [(n)2,12,13,14,24,25,30,48/49,66(86),70,71,85] |
| **n78** | China | 3300-3800 | 3300-3800 | 3300-3600 | 3300-3600 | [(n)34(95),39(98),50/51] |
| **n78** | Europe, Asia except China | 3400-3800 | 3400-3800 | [(n)7,11,18,19,20,21,28,38,65,74,75/76,109] |
| **n79** | China | 4400-5000 | 4400-5000 | 4800-5000 | 4800-5000 | [(n)34(95),39(98),50/51] |
| **n79** | Japan | 4500-4900 | 4500-4900 | [(n)11,18,19,21,74] |
| **n102** | N/A | 5925-6425 | 5925-6425 | 5945-6425 | 5945-6425 | Band definition for in band PSD |

* + **Applicable to all MSD types?**
  + **Should we still specify MSD outside the range with N/A MSD value and note on restricted range**

Offline discussion comments

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**Issue 5-1g: requested UL configuration and related MSD analysis summary table R4-2400263**

* Proposals
  + Addition of a table summarizing the UL configurations and related MSD analysis in the BCS table section

To determine the coexistence study cases to be analyzed, the following question and UL configuration types table should be completed. The allowable UL configurations are listed in annex B.

If the band combination is TDD/TDD, is SimRx/Tx supported (YES/NO/N-A)? XXX

**Table 5.XX.1.2-2: Supported UL configurations and required coexistence studies**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Type of UL Configuration** | **UL**  **Configuration** | **Power**  **class** | **Condition** | **Coexistence analysis to be performed** | **Coexistence study Tables** |
| 1UL band  with 1CC | nX,  nY | 3  3 | One band is FDD  Or  SimRx/Tx TDD/TDD | UL harmonic, harmonic mixing and cross-band MSD should be studied | 5.XX.1.3.1-1  5.XX.1.3.1-2 |
| 1UL band  with 2CC | CA\_nXornYB/C/(2A) | 3 | IMDs of the two intra-band UL CCs | 5.XX.1.3.2-1 |
| 2UL bands  1CC per band | CA\_nXA-nYA | 3 | FDD/FDD  Or  FDD/TDD | IMDs of the two UL bands | 5.XX.2.2.1-1 |
| 2UL bands incl.  1UL band with 2CC | CA\_nXA/B/C-nYA/B/C | 3  3 | Triple beat of the three UL CCs if the two bands are in adjacent band groups | 5.XX.2.2.2-1 |

Offline discussion comments

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**Issue 5-1h: FR1 band group in annex R4-2400261 and R4-2400258**

* Proposals
  + Used for triple beat and cross band isolation
  + Addition of the FR1 band group table in annex of band combination TR
  + Duplication for reference in the TP template

**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 1 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

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| --- | --- | --- | --- | --- | --- |
| 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

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### Sub-topic 5-2 Input on TP/TR structure

*Sub-topic description*

*Open issues and candidate options before meeting:*

**Issue 5-2a: Release independence R4-2402425**

* Proposals: Huawei
* Proposal 1: 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 2: 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 3: The TS 3x.307 should not be listed as perf spec without careful checking whether the affected requirements are core part of perf part.Option 2: TBA

Offline discussion comments

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**Issue 5-2b: Band combination TR structure: technical background on calculations R4-2402426**

* Proposals: Huawei:
* Proposal 1: It is proposed to restructure the TR for basket WI with MSD analysis including more technical information from Rel-19.
* Proposal 2: It is proposed to capture the agreement once reached on restructuring of the basket WI with MSD analysis in TR 38.846.

Offline discussion comments

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**Issue 5-2c: Band combination templates for TPs of 1/2/3 band DL R4-2400257**

* Proposals: Skyworks, Nokia: list of templates by DL bands and UL configurations and corresponding Co-ex analysis

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| --- | --- | --- | --- | --- |
| **Type of DL configuration** | **Type of UL Configuration** | **UL**  **Configuration** | **Condition** | **Coexistence analysis to be performed** |
| 1DL band with 2CC  Intra-band DLCA | 1UL band/1CC | nX, nY | FDD band | Tx isolation to SCC (ACLR range) |
| 1UL band/2CC | CA\_nXB/C/2A | intra-band UL IMDs |
| 2DL bands  Inter-band DLCA | 1UL band/1CC | nX, nY | One band is FDD  Or SimRx/Tx TDD/TDD | UL harmonic, Harmonic mixing, Cross-band isolation |
| 1UL band/2CC | CA\_nXB/C/2A, CA\_nYA-nXB/C | intra-band UL IMDs |
| 2UL bands/1CC per band | CA\_nYA-nXA | FDD/FDD  Or  FDD/TDD | IMDs of the two UL bands  [If DL band is between two close proximity UL bands, 2UL cross-band may be considered] |
| 2UL bands incl.  1UL band with 2CC | CA\_nYA-nXB/C | Triple beat of the tree UL CCs if the two bands are in adjacent band groups |
| 3DL bands | 2UL bands/1CC per band | CA\_nYA-nXA | FDD or Sim Rx/Tx third band | IMDs of the two UL bands in third DL band  [If third DL band is between two close proximity UL bands, 2UL cross-band may be considered] |
| 2UL bands incl.  1UL band with 2CC | CA\_nYA-nXB/C | Triple beat of the tree UL CCs if the third DL bands is in an adjacent band groups of one UL |

Offline discussion comments

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**Issue 5-2c: Band combination TP template details for 2 band DL with 1/2UL and up to 3 UL CC R4-2400263**

* Proposals: Skyworks: **List of proposed enhancements for 2DL/1or2UL bands block approval TP template for R19:**
* **Addition at the end of section “5.XX.1.1 Operating bands for CA” of a table to capture and justify potential frequency range restriction(s) for the co-existence analysis as discussed in [Issue 5-1f]**
* **Addition at the end of section “5.XX.1.2 Channel bandwidths per operating band for CA” of:**
  + **A question related to the support of SimRx/Tx, or otherwise for TDD/TDD cases.**
  + **A table that sorts the applicable UL configuration and their related MSD studies [Issue 5-1g]**
* **For the 2DL/1UL section:**
  + **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 [Issue 5-1a]**
    - **A new calculation table for cross-band isolation MSD is added, as discussed in [Issue 5-1b]**
  + **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 [Issue 5-1c]**
* **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:**
  + **Slightly updated 2DL 2UL with 1CC/band IMD table, with an analysis and Note section [Issue 5-1d]**
  + **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 [Issue 5-1e]**
* **For the annex section to be added to the TP template, and to the related TR (the annex section of each TP is not copied in the TR and can be omitted in the TP submission)**
  + **Addition of annex A, covering the applicable frequency range restrictions as discussed in [Issue 5-1f]**
  + **Addition of annex B, covering band group definition and criteria as discussed in [Issue 5-1h]**

Offline discussion comments

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**Issue 5-2e: How to work on a plan for R19 basket improvments**

* Proposals
  + Any suggestion?

Offline discussion comments

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