**Fukuoka, Japan, 20 – 24 May, 2024 draftR4-2410653**

**Title:** draftWF on three band DL band combination template

**Source:** Skyworks Solutions Inc., Nokia

**Agenda Item:** 12.3 RAN4 basket WI work plan (according to WF R4-2403721)

**Document for:** Approval

# 1 Background

In RAN4#111, a number of contributions in Reference section proposed a template for the 3 DL band inter-band combination block approval TP and related TR. This way forward provides the text proposal that RAN4 recommends to be included in the 3 DL inter-band band combination TR for use in Release 19.

# Way Forward on template for 2DL/1or2UL block approval TPs

In the proposed template the fields to be completed by the proponent in are highlighted in grey. The note part of the table may become redundant for the different TPs captured in the TR. The rapporteur updating the TR may decide to omit the note section of the tables when copying the TPs in the related TR.

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* Start of template \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

5.X CA\_nX-nY-nZ

5.X.1 Common for 1 band UL and 2 bands UL CA

#### 5.X.1.1 Operating bands for CA

*Note: For band definition, relevant rows can be copied directly from Table 5.2-1 in 38.101-1 to Table 5.XX.1.1-1 below.*

**Table 5.X.1.1-1: CA band combination constituent bands definition.**

|  |  |  |  |
| --- | --- | --- | --- |
| **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** |
| nX | xxxx MHz – xxxx MHz | xxxx MHz – xxxx MHz | XXX |
| nY | xxxx MHz – xxxx MHz | xxxx MHz – xxxx MHz | XXX |
| nZ | xxxx MHz – xxxx MHz | xxxx MHz – xxxx MHz | XXX |

#### 5.X.1.2 Channel bandwidths per operating band for CA

**Table 5.X.1.2-1: Supported bandwidths per CA band combination.**

|  |
| --- |
| **CA operating/channel bandwidth [MHz]** |
| **NR CA configuration** | **Uplink CA configuration or single uplink carrier** | **NR Band** | **Channel bandwidth (MHz)** | **Bandwidth combination set** |
| CA\_nXA-nYA-nZA | CA\_nXA-nYA | nX | Channel BWs | X |
|  | CA\_nXA-nZA | nY | Channel BWs |  |
|  | CA\_nYA-nZA | nZ | Channel BWs |  |
| CA\_nXA/B/C(2A)-nYA/B/C/(2A)- nZA/B/C/(2A) | CA\_nXA/B/C-nYA/B/CCA\_nXA/B/C-nZA/B/CCA\_nYA/B/C-nZA/B/C | nX | Channel BW or CA BCS | X |
|  |  | nY | Channel BW or CA BCS |  |
|  |  | nZ | Channel BW or CA BCS |  |

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

**Table 5.X.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** |
| 2UL bands1CC per band | CA\_nXA-nYACA\_nXA-nZACA\_nYA-nZA | 3 | Third band is simultaneous Rx with the other two bands Tx | IMDs of the two UL bands falling into third band DL | 5.X.2.2.1-1 |
| 2UL bands incl.1UL band with 2CC | CA\_nXA/B/C-nYA/B/CCA\_nXA/B/C-nZA/B/CCA\_nYA/B/C-nZA/B/C | 3 | Triple beat into the third band DL of the three UL CCs if the third bands is in the same or adjacent band group than one of the UL | 5.X.2.2.2-1 |

#### 5.X.1.3 ∆TIB,c and ∆RIB,c values

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* Delta T/R section is omitted in this version of the proposal \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

5.X.2 Specific for 2 bands UL CA

#### 5.X.2.1 UE co-existence

5.X.2.2.1 Co-existence studies for 2UL band with 1CC per band

*Note: The tables in this section are provided to identify potential issues to be analysed based on interference frequency range calculations, whether to specify the MSD related to collisions with the victim receiver frequency range should be based on the detailed REFSENS analysis.*

*Since the IMD tables have already been calculated for the different two band fallbacks, the tables below may skip the IMD calculations and refer to the relevant two band TP tables. Nonetheless, the IMD issues should be stated, and the related TPs referenced.*

Table 5.X.2.2.1-1 provides the two UL bands with one CC per band IMD interference analysis for CA\_nXA-nYA-nZA with UL CA\_nXA-nYA.

**Table 5.X.2.2.1-1: Two UL bands IMD analysis.**

|  |  |  |
| --- | --- | --- |
| Bands | nX | nY |
| Frequency  | fx\_low | fx\_high | fy\_low | fy\_high |
| fUL (MHz) | X | X | X | X |
| nZ fDL (MHz) | X | X | N/A | N/A |
| IMD2 products | |fyULlow – fxULhigh| | |fyULhigh – fxULlow| | |fyULlow + fxULlow| | |fyULhigh + fxULhigh| |
| IMD2 (MHz) | X | X | X | X |
| IMD3 products | |2\*fxULlow – fyULhigh| | |2\*fxULhigh – fyULlow| | |2\*fyULlow – fxULhigh| | |2\*fyULhigh – fxULlow| |
| IMD3 (MHz) | X | X | X | X |
| IMD3 products | |2\*fxULlow + fyULlow| | |2\*fxULhigh + fyULhigh| | |2\*fyULlow + fxULlow| | |2\*fyULhigh + fxULhigh| |
| IMD3 (MHz) | X | X | X | X |
| IMD4 products | |3\*fxULlow –1\* fyULhigh| | |3\*fxULhigh – 1\*fyULlow| | |3\*fyULlow – 1\*fxULhigh| | |3\*fyULhigh – 1\*fxULlow| |
| IMD4 (MHz) | X | X | X | X |
| IMD4 products | |2\*fxULlow –2\* fyULhigh| | |2\*fxULhigh –2\* fyULlow| | |2\*fxULlow +2\* fyULlow| | |2\*fxULhigh +2\* fyULhigh| |
| IMD4 (MHz) | X | X | X | X |
| IMD4 products | |3\*fxULlow +1\* fyULlow| | |3\*fxULhigh + 1\*fyULhigh| | |3\*fyULlow + 1\*fxULlow| | |3\*fyULhigh + 1\*fxULhigh| |
| IMD4 (MHz) | X | X | X | X |
| IMD5 products | |fxULlow – 4\*fyULhigh| | |fxULhigh – 4\*fyULlow| | |fyULlow – 4\*fxULhigh| | |fyULhigh – 4\*fxULlow| |
| IMD5 (MHz) | X | X | X | X |
| IMD5 products | |2\*fxULlow - 3\*fyULhigh| | |2\*fxULhigh - 3\*fyULlow| | |2\*fyULlow - 3\*fxULhigh| | |2\*fyULhigh -3\*fxULlow| |
| IMD5 (MHz) | X | X | X | X |
| IMD5 products | |fxULlow + 4\*fyULlow| | |fxULhigh + 4\*fyULhigh| | |fyULlow + 4\*fxULlow| | |fyULhigh + 4\*fxULhigh| |
| IMD5 (MHz) | X | X | X | X |
| IMD5 products | |2\*fxULlow + 3\*fyULlow| | |2\*fxULhigh + 3\*fyULhigh| | |2\*fyULlow + 3\*fxULlow| | |2\*fyULhigh + 3\*fxULhigh| |
| IMD5 (MHz) | X | X | X | X |
| Analysis | text |
| Note: The lowest even order and lowest odd order IMD MSDs shall be considered. |

Table 5.X.2.2.1-2 provides the two UL bands with one CC per band IMD interference analysis for CA\_nXA-nYA-nZA with UL CA\_nXA-nZA.

**Table 5.X.2.2.1-2: Two UL bands IMD analysis.**

|  |  |  |
| --- | --- | --- |
| Bands | nX | nZ |
| Frequency  | fx\_low | fx\_high | fy\_low | fy\_high |
| fUL (MHz) | X | X | X | X |
| nY fDL (MHz) | X | X | N/A | N/A |
| IMD2 products | |fyULlow – fxULhigh| | |fyULhigh – fxULlow| | |fyULlow + fxULlow| | |fyULhigh + fxULhigh| |
| IMD2 (MHz) | X | X | X | X |
| IMD3 products | |2\*fxULlow – fyULhigh| | |2\*fxULhigh – fyULlow| | |2\*fyULlow – fxULhigh| | |2\*fyULhigh – fxULlow| |
| IMD3 (MHz) | X | X | X | X |
| IMD3 products | |2\*fxULlow + fyULlow| | |2\*fxULhigh + fyULhigh| | |2\*fyULlow + fxULlow| | |2\*fyULhigh + fxULhigh| |
| IMD3 (MHz) | X | X | X | X |
| IMD4 products | |3\*fxULlow –1\* fyULhigh| | |3\*fxULhigh – 1\*fyULlow| | |3\*fyULlow – 1\*fxULhigh| | |3\*fyULhigh – 1\*fxULlow| |
| IMD4 (MHz) | X | X | X | X |
| IMD4 products | |2\*fxULlow –2\* fyULhigh| | |2\*fxULhigh –2\* fyULlow| | |2\*fxULlow +2\* fyULlow| | |2\*fxULhigh +2\* fyULhigh| |
| IMD4 (MHz) | X | X | X | X |
| IMD4 products | |3\*fxULlow +1\* fyULlow| | |3\*fxULhigh + 1\*fyULhigh| | |3\*fyULlow + 1\*fxULlow| | |3\*fyULhigh + 1\*fxULhigh| |
| IMD4 (MHz) | X | X | X | X |
| IMD5 products | |fxULlow – 4\*fyULhigh| | |fxULhigh – 4\*fyULlow| | |fyULlow – 4\*fxULhigh| | |fyULhigh – 4\*fxULlow| |
| IMD5 (MHz) | X | X | X | X |
| IMD5 products | |2\*fxULlow - 3\*fyULhigh| | |2\*fxULhigh - 3\*fyULlow| | |2\*fyULlow - 3\*fxULhigh| | |2\*fyULhigh -3\*fxULlow| |
| IMD5 (MHz) | X | X | X | X |
| IMD5 products | |fxULlow + 4\*fyULlow| | |fxULhigh + 4\*fyULhigh| | |fyULlow + 4\*fxULlow| | |fyULhigh + 4\*fxULhigh| |
| IMD5 (MHz) | X | X | X | X |
| IMD5 products | |2\*fxULlow + 3\*fyULlow| | |2\*fxULhigh + 3\*fyULhigh| | |2\*fyULlow + 3\*fxULlow| | |2\*fyULhigh + 3\*fxULhigh| |
| IMD5 (MHz) | X | X | X | X |
| Analysis | text |
| Note: The lowest even order and lowest odd order IMD MSDs shall be considered. |

Table 5.X.2.2.1-3 provides the two UL bands with one CC per band IMD interference analysis for CA\_nXA-nYA-nZA with UL CA\_nYA-nZA.

**Table 5.X.2.2.1-3: Two UL bands IMD analysis.**

|  |  |  |
| --- | --- | --- |
| Bands | nY | nZ |
| Frequency  | fx\_low | fx\_high | fy\_low | fy\_high |
| fUL (MHz) | X | X | X | X |
| nX fDL (MHz) | X | X | N/A | N/A |
| IMD2 products | |fyULlow – fxULhigh| | |fyULhigh – fxULlow| | |fyULlow + fxULlow| | |fyULhigh + fxULhigh| |
| IMD2 (MHz) | X | X | X | X |
| IMD3 products | |2\*fxULlow – fyULhigh| | |2\*fxULhigh – fyULlow| | |2\*fyULlow – fxULhigh| | |2\*fyULhigh – fxULlow| |
| IMD3 (MHz) | X | X | X | X |
| IMD3 products | |2\*fxULlow + fyULlow| | |2\*fxULhigh + fyULhigh| | |2\*fyULlow + fxULlow| | |2\*fyULhigh + fxULhigh| |
| IMD3 (MHz) | X | X | X | X |
| IMD4 products | |3\*fxULlow –1\* fyULhigh| | |3\*fxULhigh – 1\*fyULlow| | |3\*fyULlow – 1\*fxULhigh| | |3\*fyULhigh – 1\*fxULlow| |
| IMD4 (MHz) | X | X | X | X |
| IMD4 products | |2\*fxULlow –2\* fyULhigh| | |2\*fxULhigh –2\* fyULlow| | |2\*fxULlow +2\* fyULlow| | |2\*fxULhigh +2\* fyULhigh| |
| IMD4 (MHz) | X | X | X | X |
| IMD4 products | |3\*fxULlow +1\* fyULlow| | |3\*fxULhigh + 1\*fyULhigh| | |3\*fyULlow + 1\*fxULlow| | |3\*fyULhigh + 1\*fxULhigh| |
| IMD4 (MHz) | X | X | X | X |
| IMD5 products | |fxULlow – 4\*fyULhigh| | |fxULhigh – 4\*fyULlow| | |fyULlow – 4\*fxULhigh| | |fyULhigh – 4\*fxULlow| |
| IMD5 (MHz) | X | X | X | X |
| IMD5 products | |2\*fxULlow - 3\*fyULhigh| | |2\*fxULhigh - 3\*fyULlow| | |2\*fyULlow - 3\*fxULhigh| | |2\*fyULhigh -3\*fxULlow| |
| IMD5 (MHz) | X | X | X | X |
| IMD5 products | |fxULlow + 4\*fyULlow| | |fxULhigh + 4\*fyULhigh| | |fyULlow + 4\*fxULlow| | |fyULhigh + 4\*fxULhigh| |
| IMD5 (MHz) | X | X | X | X |
| IMD5 products | |2\*fxULlow + 3\*fyULlow| | |2\*fxULhigh + 3\*fyULhigh| | |2\*fyULlow + 3\*fxULlow| | |2\*fyULhigh + 3\*fxULhigh| |
| IMD5 (MHz) | X | X | X | X |
| Analysis | text |
| Note: The lowest even order and lowest odd order IMD MSDs shall be considered. |

5.X.2.2.2 Co-existence studies for 2UL band with 3CC (2CC intra-band in one band)

*Note: Since the triple beat tables have already been calculated for the different two-band fallbacks, the tables below may skip the IMD calculations and refer to the relevant two-band TP tables. Nonetheless, the triple beat issues should be stated, and the related TPs referenced.*

Table 5.X.2.2.2-1 provides the two UL band with one band, along with 2CC intra-band uplink CA triple beat products into band nZ interference analysis for CA\_nXA/B/C-nYA/B/C with nX/YB/C transmitting with a XXXMHz maximum instantaneous bandwidth.

**Table 5.X.2.2.2-1: Two UL band with intra-band ULCA Triple beat IMD analysis.**

|  |  |  |
| --- | --- | --- |
| **Band / CA1** | **nX** | **CA\_nYB/C** |
| **Frequency limit** | **fx\_low / min** | **fx\_high / max** | **fy\_low / min** | **fy\_high / max** |
| **fUL (MHz)** | X | X | X | X |
| **nZ fDL (MHz)** | X | X | N/A | N/A |
| **2CCBW (MHz)2** | N/A | N/A | X | X |
| **IMD3 products** | fxULlow-max2CCBW | fxULlow | fxULhigh | fxULhigh+max2CCBW |
| **IMD3 (MHz)** | X | X | X | X |
| **Analysis** | text |
| Note 1: If the third band is not part of the same or adjacent band groups of one of the UL bands as defined in Annex A, 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. |

Table 5.X.2.2.2-2 provides the two UL band with one band, along with 2CC intra-band uplink CA triple beat products into band nY interference analysis for CA\_nXA/B/C-nYA/B/C with nX/YB/C transmitting with a XXXMHz maximum instantaneous bandwidth.

**Table 5.X.2.2.2-2: Two UL band with intra-band ULCA Triple beat IMD analysis.**

|  |  |  |
| --- | --- | --- |
| **Band / CA1** | **nX** | **CA\_nZB/C** |
| **Frequency limit** | **fx\_low / min** | **fx\_high / max** | **fy\_low / min** | **fy\_high / max** |
| **fUL (MHz)** | X | X | X | X |
| **nY fDL (MHz)** | X | X | N/A | N/A |
| **2CCBW (MHz)2** | N/A | N/A | X | X |
| **IMD3 products** | fxULlow-max2CCBW | fxULlow | fxULhigh | fxULhigh+max2CCBW |
| **IMD3 (MHz)** | X | X | X | X |
| **Analysis** | text |
| Note 1: If the third band is not part of the same or adjacent band groups of one of the UL bands as defined in Annex A, 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. |

Table 5.X.2.2.2-3 provides the two UL band with one band, along with 2CC intra-band uplink CA triple beat products into band nX interference analysis for CA\_nYA/B/C-nYA/B/C with nX/YB/C transmitting with a XXXMHz maximum instantaneous bandwidth.

**Table 5.X.2.2.2-3: Two UL band with intra-band ULCA Triple beat IMD analysis.**

|  |  |  |
| --- | --- | --- |
| **Band / CA1** | **nY** | **CA\_nZB/C** |
| **Frequency limit** | **fx\_low / min** | **fx\_high / max** | **fy\_low / min** | **fy\_high / max** |
| **fUL (MHz)** | X | X | X | X |
| **nX fDL (MHz)** | X | X | N/A | N/A |
| **2CCBW (MHz)2** | N/A | N/A | X | X |
| **IMD3 products** | fxULlow-max2CCBW | fxULlow | fxULhigh | fxULhigh+max2CCBW |
| **IMD3 (MHz)** | X | X | X | X |
| **Analysis** | text |
| Note 1: If the third band is not part of the same or adjacent band groups of one of the UL bands as defined in Annex A, 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. |

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*REFSENS section omitted in this version of the template – end of template\*\*\*\*\*\*\*\*\*

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# Way Forward on Annex for 3DL/1or2UL TR

Since the band group definition is used as the criteria for Triple beat MSD, it is proposed to have its definition in Annex A, while the valid two UL bands configurations for three-band DL are provided in Annex B.

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* Start of annex \*\*\*\*\*\*\*\*\*

Annex A

For three DL and 2UL/3CC triple beat MSD to be considered, the two bands should be part of the same or adjacent band group as defined in Table A.

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

|  |
| --- |
| FR1 band group range |
| Name | **FR1-a** | **FR1-b** | **FR1-c** | **FR1-d** | **FR1-e** |
| Range (MHz) | 600-1000 | 1400-2200 | 2300-2700 | 3300-5000 | 5150-7125 |
| Duplex mode | Mostly FDD | Mostly FDD | FDD and TDD | TDD only | TDD only |

Annex B

For CA\_nX-nY-nZ three band DL inter band combinations with two UL bands, the following UL configurations are applicable:

* two band UL with one CC per band: CA\_nXA-nYA
* two band UL with two CC in one band: CA\_nXB-nYA, CA\_nXC-nYA, CA\_nXA-nYB, CA\_nXA-nYC
* The following three UL cluster cases are not supported: CA\_nX(2A)-nYA, CA\_nXA-nY(2A)
* Combinations with four UL CCs are not supported.

 \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* End of annex \*\*\*\*\*\*\*\*\*

# Background: Example on how to use the template

The selected example is based on CA\_n1-n77-n102. This combination is not requested or specified, but instead is selected as it contains several of the different types of UL configurations, and can be considered to be fairly complete in terms of MSD studies. Although it does not result in an actual MSD specified for all the MSD types, it provides a good example of how the proposed template could function for a concrete case.

Text is color coded with highlights, this provides indication on how to derive the information to be filled in:

* Yellow highlights correspond to data related to the bands definitions
* Cyan highlights correspond to data related to the BCS DL, UL, channel bandwidths, and intra-band CA BW from the BCS definitions
* Green highlights correspond to data that can be calculated with the equations provided
* Pink highlights correspond to text that is provided in support of the analysis of the table results.
* When a part of the table is not relevant for a given case, the cell is with a grey background.

Commentary text can be added below each table. In this example, we did not retain the note section of the tables as this will not need duplication in the TR. However, in TPs, this information may be a useful reference for TP reviewers during the flagging process.

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* Start of example TP \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

5.XX CA\_n1-n77-n102

5.X.1 Common for 1 band UL and 2 bands UL CA

#### 5.X.1.1 Operating bands for CA

**Table 5.X.1.1-1: CA band combination constituent bands definition.**

|  |  |  |  |
| --- | --- | --- | --- |
| **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** |
| n1 | 1920 MHz – 1980 MHz | 2110 MHz – 2170 MHz | FDD |
| n77 | 3300 MHz – 4200 MHz | 3300 MHz – 4200 MHz | TDD |
| n102 | 5925 MHz – 6425 MHz | 5925 MHz – 6425 MHz | TDD |

5.X.1.2 Channel bandwidths per operating band for CA

**Table 5.X.1.2-1: Supported bandwidths per CA band combination.**

|  |
| --- |
| **CA operating/channel bandwidth [MHz]** |
| **NR CA configuration** | **Uplink CA configuration or single uplink carrier** | **NR Band** | **Channel bandwidth (MHz)** | **Bandwidth combination set** |
| CA\_n1A-n77A-n102A | CA\_n1A-n102ACA\_n1A-n77ACA\_n77A-n102A | n1 | 5, 10, 15, 20, 25, 30, 40, 50 | 0 |
|  |  | n77 | 10, 20, 30, 40, 50, 60, 70, 80, 90, 100 |  |
|  |  | n102 | 20, 40, 60, 80, 100 |  |
| CA\_n1A-n77C-n102A | CA\_n1A-n77C CA\_n77C-n102A | n1 | 5, 10, 15, 20, 25, 30, 40, 50 | 0 |
|  |  | n77 | CA\_n77C\_BCS0 |  |
|  |  | n102 | 20, 40, 60, 80, 100 |  |
| CA\_n1A-n77A-n102C | CA\_n1A-n102CCA\_n77A-n102C | n1 | 5, 10, 15, 20, 25, 30, 40, 50 | 0 |
|  |  | n77 | 10, 20, 30, 40, 50, 60, 70, 80, 90, 100 |  |
|  |  | n102 | CA\_n102C\_BCS0 |  |

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

**Table 5.X.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** |
| 2UL bands1CC per band | CA\_n1A-n102ACA\_n1A-n77ACA\_n77A-n102A | 3 | Third band is simultaneous RX with the other two bands Tx | IMDs of the two UL bands | 5.X.2.2.1-1 |
| 2UL bands incl.1UL band with 2CC | CA\_n1A-n77C CA\_n77C-n102ACA\_n1A-n102CCA\_n77A-n102C | 33 | Triple beat of the three UL CCs, if the two bands are in adjacent band groups | 5.X.2.2.2-1 |

\*\*\*\*\*\*\*\*\* Delta T/R section is omitted in this version of the example \*\*\*\*\*\*\*\*\*

5.X.2 Specific for 2 bands UL CA

#### 5.X.2.1 UE co-existence

5.X.2.2.1 Co-existence studies for 2UL band with 1CC per band

Table 5.X.2.2.1-1 provides the two UL bands with one CC per band IMD interference analysis for CA\_n1A-n77A-n102A with UL CA\_n1A-n77A.

**Table 5.X.2.2.1-1: Two UL bands IMD analysis.**

|  |  |  |
| --- | --- | --- |
| Bands | n1 | n77 |
| Frequency  | fx\_low | fx\_high | fy\_low | fy\_high |
| fUL (MHz) | 1920 | 1980 | 3300 | 4200 |
| n102 fDL (MHz) | 5925 | 6425 | N/A | N/A |
| IMD2 products | |fyULlow – fxULhigh| | |fyULhigh – fxULlow| | |fyULlow + fxULlow| | |fyULhigh + fxULhigh| |
| IMD2 (MHz) | 1320 | 2280 | 5220 | 6180 |
| IMD3 products | |2\*fxULlow – fyULhigh| | |2\*fxULhigh – fyULlow| | |2\*fyULlow – fxULhigh| | |2\*fyULhigh – fxULlow| |
| IMD3 (MHz) | -360 | 660 | 4620 | 6480 |
| IMD3 products | |2\*fxULlow + fyULlow| | |2\*fxULhigh + fyULhigh| | |2\*fyULlow + fxULlow| | |2\*fyULhigh + fxULhigh| |
| IMD3 (MHz) | 7140 | 8160 | 8520 | 10380 |
| IMD4 products | |3\*fxULlow –1\* fyULhigh| | |3\*fxULhigh – 1\*fyULlow| | |3\*fyULlow – 1\*fxULhigh| | |3\*fyULhigh – 1\*fxULlow| |
| IMD4 (MHz) | 1560 | 2640 | 7920 | 10680 |
| IMD4 products | |2\*fxULlow –2\* fyULhigh| | |2\*fxULhigh –2\* fyULlow| | |2\*fxULlow +2\* fyULlow| | |2\*fxULhigh +2\* fyULhigh| |
| IMD4 (MHz) | 4560 | 2640 | 10440 | 12360 |
| IMD4 products | |3\*fxULlow +1\* fyULlow| | |3\*fxULhigh + 1\*fyULhigh| | |3\*fyULlow + 1\*fxULlow| | |3\*fyULhigh + 1\*fxULhigh| |
| IMD4 (MHz) | 9060 | 10140 | 11820 | 14580 |
| IMD5 products | |fxULlow – 4\*fyULhigh| | |fxULhigh – 4\*fyULlow| | |fyULlow – 4\*fxULhigh| | |fyULhigh – 4\*fxULlow| |
| IMD5 (MHz) | 14880 | 11220 | 4620 | 3480 |
| IMD5 products | |2\*fxULlow - 3\*fyULhigh| | |2\*fxULhigh - 3\*fyULlow| | |2\*fyULlow - 3\*fxULhigh| | |2\*fyULhigh -3\*fxULlow| |
| IMD5 (MHz) | 8760 | 5940 | 660 | 2640 |
| IMD5 products | |fxULlow + 4\*fyULlow| | |fxULhigh + 4\*fyULhigh| | |fyULlow + 4\*fxULlow| | |fyULhigh + 4\*fxULhigh| |
| IMD5 (MHz) | 15120 | 18780 | 10980 | 12120 |
| IMD5 products | |2\*fxULlow + 3\*fyULlow| | |2\*fxULhigh + 3\*fyULhigh| | |2\*fyULlow + 3\*fxULlow| | |2\*fyULhigh + 3\*fxULhigh| |
| IMD5 (MHz) | 13740 | 16560 | 12360 | 14340 |
| Analysis | IMD2, IMD3 and IMD5 fall in band n102 DL: MSD may occur and should be studied for IMD2 and IMD3. |

Table 5.X.2.2.1-2 provides the two UL bands with one CC per band IMD interference analysis for CA\_n1A-n77A-n102A with UL CA\_n1A-n102A.

**Table 5.X.2.2.1-2: Two UL bands IMD analysis.**

|  |  |  |
| --- | --- | --- |
| Bands | n1 | n102 |
| Frequency  | fx\_low | fx\_high | fy\_low | fy\_high |
| fUL (MHz) | 1920 | 1980 | 5925 | 6425 |
| n77 fDL (MHz) | 3300 | 4200 | N/A | N/A |
| IMD2 products | |fyULlow – fxULhigh| | |fyULhigh – fxULlow| | |fyULlow + fxULlow| | |fyULhigh + fxULhigh| |
| IMD2 (MHz) | 3945 | 4505 | 7845 | 8405 |
| IMD3 products | |2\*fxULlow – fyULhigh| | |2\*fxULhigh – fyULlow| | |2\*fyULlow – fxULhigh| | |2\*fyULhigh – fxULlow| |
| IMD3 (MHz) | 2585 | 1965 | 9870 | 10930 |
| IMD3 products | |2\*fxULlow + fyULlow| | |2\*fxULhigh + fyULhigh| | |2\*fyULlow + fxULlow| | |2\*fyULhigh + fxULhigh| |
| IMD3 (MHz) | 9765 | 10385 | 13770 | 14830 |
| IMD4 products | |3\*fxULlow –1\* fyULhigh| | |3\*fxULhigh – 1\*fyULlow| | |3\*fyULlow – 1\*fxULhigh| | |3\*fyULhigh – 1\*fxULlow| |
| IMD4 (MHz) | 665 | 15 | 15795 | 17355 |
| IMD4 products | |2\*fxULlow –2\* fyULhigh| | |2\*fxULhigh –2\* fyULlow| | |2\*fxULlow +2\* fyULlow| | |2\*fxULhigh +2\* fyULhigh| |
| IMD4 (MHz) | 9010 | 7890 | 15690 | 16810 |
| IMD4 products | |3\*fxULlow +1\* fyULlow| | |3\*fxULhigh + 1\*fyULhigh| | |3\*fyULlow + 1\*fxULlow| | |3\*fyULhigh + 1\*fxULhigh| |
| IMD4 (MHz) | 11685 | 12365 | 19695 | 21255 |
| IMD5 products | |fxULlow – 4\*fyULhigh| | |fxULhigh – 4\*fyULlow| | |fyULlow – 4\*fxULhigh| | |fyULhigh – 4\*fxULlow| |
| IMD5 (MHz) | 23780 | 21720 | 1995 | 1255 |
| IMD5 products | |2\*fxULlow – 3\*fyULhigh| | |2\*fxULhigh – 3\*fyULlow| | |2\*fyULlow – 3\*fxULhigh| | |2\*fyULhigh -3\*fxULlow| |
| IMD5 (MHz) | 15435 | 13815 | 5910 | 7090 |
| IMD5 products | |fxULlow + 4\*fyULlow| | |fxULhigh + 4\*fyULhigh| | |fyULlow + 4\*fxULlow| | |fyULhigh + 4\*fxULhigh| |
| IMD5 (MHz) | 25620 | 27680 | 13605 | 14345 |
| IMD5 products | |2\*fxULlow + 3\*fyULlow| | |2\*fxULhigh + 3\*fyULhigh| | |2\*fyULlow + 3\*fxULlow| | |2\*fyULhigh + 3\*fxULhigh| |
| IMD5 (MHz) | 21615 | 23235 | 17610 | 18790 |
| Analysis | IMD3 fall in band n77 DL: MSD may occur. |

Table 5.X.2.2.1-3 provides the two UL bands with one CC per band IMD interference analysis for CA\_n1A-n77A-n102A with UL CA\_n77A-n102A.

**Table 5.X.2.2.1-3: Two UL bands IMD analysis.**

|  |  |  |
| --- | --- | --- |
| Bands | n77 | n102 |
| Frequency  | fx\_low | fx\_high | fy\_low | fy\_high |
| fUL (MHz) | 3300 | 4200 | 5925 | 6425 |
| n1 fDL (MHz) | 2110 | 2170 | N/A | N/A |
| IMD2 products | |fyULlow – fxULhigh| | |fyULhigh – fxULlow| | |fyULlow + fxULlow| | |fyULhigh + fxULhigh| |
| IMD2 (MHz) | 1725 | 3125 | 9225 | 10625 |
| IMD3 products | |2\*fxULlow – fyULhigh| | |2\*fxULhigh – fyULlow| | |2\*fyULlow – fxULhigh| | |2\*fyULhigh – fxULlow| |
| IMD3 (MHz) | 175 | 2475 | 7650 | 9550 |
| IMD3 products | |2\*fxULlow + fyULlow| | |2\*fxULhigh + fyULhigh| | |2\*fyULlow + fxULlow| | |2\*fyULhigh + fxULhigh| |
| IMD3 (MHz) | 12525 | 14825 | 15150 | 17050 |
| IMD4 products | |3\*fxULlow –1\* fyULhigh| | |3\*fxULhigh – 1\*fyULlow| | |3\*fyULlow – 1\*fxULhigh| | |3\*fyULhigh – 1\*fxULlow| |
| IMD4 (MHz) | 3475 | 6675 | 13575 | 15975 |
| IMD4 products | |2\*fxULlow –2\* fyULhigh| | |2\*fxULhigh –2\* fyULlow| | |2\*fxULlow +2\* fyULlow| | |2\*fxULhigh +2\* fyULhigh| |
| IMD4 (MHz) | 6250 | 3450 | 18450 | 21250 |
| IMD4 products | |3\*fxULlow +1\* fyULlow| | |3\*fxULhigh + 1\*fyULhigh| | |3\*fyULlow + 1\*fxULlow| | |3\*fyULhigh + 1\*fxULhigh| |
| IMD4 (MHz) | 15825 | 19025 | 21075 | 23475 |
| IMD5 products | |fxULlow – 4\*fyULhigh| | |fxULhigh – 4\*fyULlow| | |fyULlow – 4\*fxULhigh| | |fyULhigh – 4\*fxULlow| |
| IMD5 (MHz) | 22400 | 19500 | 10875 | 6775 |
| IMD5 products | |2\*fxULlow - 3\*fyULhigh| | |2\*fxULhigh - 3\*fyULlow| | |2\*fyULlow - 3\*fxULhigh| | |2\*fyULhigh -3\*fxULlow| |
| IMD5 (MHz) | 12675 | 9375 | -750 | 2950 |
| IMD5 products | |fxULlow + 4\*fyULlow| | |fxULhigh + 4\*fyULhigh| | |fyULlow + 4\*fxULlow| | |fyULhigh + 4\*fxULhigh| |
| IMD5 (MHz) | 27000 | 29900 | 19125 | 23225 |
| IMD5 products | |2\*fxULlow + 3\*fyULlow| | |2\*fxULhigh + 3\*fyULhigh| | |2\*fyULlow + 3\*fxULlow| | |2\*fyULhigh + 3\*fxULhigh| |
| IMD5 (MHz) | 24375 | 27675 | 21750 | 25450 |
| Analysis | IMD2, IMD3 and IMD5 fall in band n1 DL: MSD may occur and should be studied for IMD2 and IMD3. |

5.X.2.2.2 Co-existence studies for 2UL band with 3CC (2CC intra-band in one band)

Table 5.X.2.2.2-1 provides the two UL band with one band, along with 2CC intra-band uplink CA triple beat products into band n102 interference analysis for CA\_n1A-n77C, with n77C transmitting with a 200 MHz maximum instantaneous bandwidth.

**Table 5.X.2.2.2-1: Two UL band with intra-band ULCA Triple beat IMD analysis.**

|  |  |  |
| --- | --- | --- |
| **Band / CA1** | **n1** | **CA\_n77C** |
| **Frequency limit** | **fx\_low / min** | **fx\_high / max** | **fy\_low / min** | **fy\_high / max** |
| **fUL (MHz)** | 1920 | 1980 | 3300 | 4200 |
| **n102 fDL (MHz)** | 5925 | 6425 | N/A | N/A |
| **2CCBW (MHz)2** | N/A | N/A | 0 | 200 |
| **IMD3 products** | fxULlow-max2CCBW | fxULlow | fxULhigh | fxULhigh+max2CCBW |
| **IMD3 (MHz)** | 1720 | 1920 | 1980 | 2180 |
| **Analysis** | There is no triple beat product overlapping with n102. |

Table 5.X.2.2.2-2 provides the two UL band with one band, along with 2CC intra-band uplink CA triple beat products into band n77 interference analysis for CA\_n1A-n102C, with n102C transmitting with a 200MHz maximum instantaneous bandwidth.

**Table 5.X.2.2.2-2: Two UL band with intra-band ULCA Triple beat IMD analysis.**

|  |  |  |
| --- | --- | --- |
| **Band / CA1** | **n1** | **CA\_n102C** |
| **Frequency limit** | **fx\_low / min** | **fx\_high / max** | **fy\_low / min** | **fy\_high / max** |
| **fUL (MHz)** | 1920 | 1980 | 5925 | 6425 |
| **n77 fDL (MHz)** | 3300 | 4200 | N/A | N/A |
| **2CCBW (MHz)2** | N/A | N/A | 0 | 200 |
| **IMD3 products** | fxULlow-max2CCBW | fxULlow | fxULhigh | fxULhigh+max2CCBW |
| **IMD3 (MHz)** | 1720 | 1920 | 1980 | 2180 |
| **Analysis** | There is no triple beat product overlapping with n77. |

Table 5.X.2.2.2-3 provides the two UL band with one band, along with 2CC intra-band uplink CA triple beat products into band n1 interference analysis for CA\_n77A-n102C with n102C transmitting with a 200 MHz maximum instantaneous bandwidth.

**Table 5.X.2.2.2-3: Two UL band with intra-band ULCA Triple beat IMD analysis.**

|  |  |  |
| --- | --- | --- |
| **Band / CA1** | **n77** | **CA\_n102C** |
| **Frequency limit** | **fx\_low / min** | **fx\_high / max** | **fy\_low / min** | **fy\_high / max** |
| **fUL (MHz)** | 3300 | 4200 | 5925 | 6425 |
| **n1 fDL (MHz)** | 2110 | 2170 | N/A | N/A |
| **2CCBW (MHz)2** | N/A | N/A | 0 | 200 |
| **IMD3 products** | fxULlow-max2CCBW | fxULlow | fxULhigh | fxULhigh+max2CCBW |
| **IMD3 (MHz)** | 3100 | 3300 | 4200 | 4400 |
| **Analysis** | Since band n1 is no part of the same or adjacent band group to n77 and n102, the analysis can be ignored. However, there is no triple beat product overlapping with n1. |

Table 5.X.2.2.2-4 provides the two UL band with one band, along with 2CC intra-band uplink CA triple beat products into band n1 interference analysis for CA\_n77C-n102A with n77C transmitting with a 200 MHz maximum instantaneous bandwidth.

**Table 5.X.2.2.2-4: Two UL band with intra-band ULCA Triple beat IMD analysis.**

|  |  |  |
| --- | --- | --- |
| **Band / CA1** | **n102** | **CA\_n77C** |
| **Frequency limit** | **fx\_low / min** | **fx\_high / max** | **fy\_low / min** | **fy\_high / max** |
| **fUL (MHz)** | 5925 | 6425 | 3300 | 4200 |
| **n1 fDL (MHz)** | 2110 | 2170 | N/A | N/A |
| **2CCBW (MHz)2** | N/A | N/A | 0 | 200 |
| **IMD3 products** | fxULlow-max2CCBW | fxULlow | fxULhigh | fxULhigh+max2CCBW |
| **IMD3 (MHz)** | 5725 | 5925 | 6425 | 6625 |
| **Analysis** | Since band n1 is no part of the same or adjacent band group to n77 and n102, the analysis can be ignored. However, there is no triple beat product overlapping with n1. |

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*REFSENS section omitted in this version of the example \*\*\*\*\*\*\*\*\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* End of example TP \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

# References

[1] R4-2406685 WF on band combination TR template, ZTE, Nokia, Skyworks, Ericsson, RAN4#110bis

[2] R4-2404248 On simplifying analysis for triple beat products, Skyworks Solutions Inc., Nokia, Murata, RAN4#110bis

[3] R4-2405554 Template example for 2 band DL with 1 or 2 band UL up to 3 UL CCs, Skyworks Solutions Inc. , RAN4#110bis

[4] R4-2407231 Template for 2 band DL 1or2 band UL inter-band combination TR and TP, Skyworks Solutions Inc., Nokia, RAN4#111

[5] R4-2407232 Template for 3 band DL 1or2 band UL inter-band combination TR and TP, Skyworks Solutions Inc., Nokia, RAN4#111