**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 the 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 3DL/1or2UL block approval TPs

This way forward scope is for clauses 5. 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. The text proposal below only addresses the coexistence analysis part of the template, other parts like ∆TIB,c and ∆RIB,c and MOP are not cavered and should be part of the complete template.

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* Start of template from section 5\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

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

*Editor's note: For band definition, relevant rows can be copied directly from Table 5.2-1 in 38.101-1 to Table 5.X.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 |  |

#### 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

*Editor’s 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.*

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

*Editor’s Note: 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. Only one example table is provided in this template but there may be up to three cases for the victim DL band and as many tables may be needed.*

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.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| UE UL carriers | fx\_low | fx\_high | fy\_low | fy\_high |
| 2nd order IMD products | |fy\_low – fx\_high| | |fy\_high – fx\_low| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | – | – |
| Two-tone 3rd order IMD products | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| |
| IMD frequency limits (MHz) | – | – |
| Two-tone 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
| IMD frequency limits (MHz) | – | – |
| Two-tone 4th order IMD 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| |
| IMD frequency limits (MHz) | – | – |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | |2\*fx\_high –2\* fy\_low| |  |  |
| IMD frequency limits (MHz) | – |  |
| Two-tone 4th order IMD 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| |
| IMD frequency limits (MHz) | – | – |
| Two-tone 4th order IMD products | |2\*fx\_low +2\* fy\_low| | |2\*fx\_high +2\* fy\_high| |  |  |
| IMD frequency limits (MHz) | – |  |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | – | – |
| Two-tone 5th order IMD 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| |
| IMD frequency limits (MHz) | – | – |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | – | – |
| Two-tone 5th order IMD 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| |
| IMD frequency limits (MHz) | – | – |
| NOTE : For each IMD item, when two bound values before taking absolute have different signs, the relevant IMD range shall be set such that (1) the lower bound is 0 and (2) the upper bound is the bigger value of the two after taking absolute. 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)

*Editor’s 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 IMD issues should be stated, and the related TPs referenced. Only one example table is provided in this template but there may be up to three cases for the victim DL band and as many tables may be needed.*

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 analysis.**

|  |  |  |
| --- | --- | --- |
| **Band / CA1** | **nX** | **CA\_nYB/C** |
| **Frequency limit (all MHz)** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| **fUL**  | – | – |
| **fDL** | – | N/A | N/A |
| **2CCBW2** | N/A | N/A | Minimum  | Maximum |
| – |
| **IMD3 products** | fxUL\_low-max2CCBW | fxUL\_low | fxUL\_high | fxUL\_high+max2CCBW |
| **IMD3 (MHz)** | – | – |
| **Analysis** |  |
| Note 1: If the two bands are not part of the same or adjacent band groups as defined in table A.1, 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. |

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* section omitted in this version of the template \*\*\*\*\*\*\*\*\*

#### 5.x.2.3 REFSENS requirements

*Editor's note 1: Text can be added if IMD due to 2 bands UL with 2 UL carriers or triple beat due to 2 bands UL with 3 UL carriers issues are identified in table 5.x.2.2-1 and table 5.x.2.2-2, respectively.*

*Editor's note 2:* *Proponent are encouraged to provide the detailed technical analysis of the MSD requirements. For example: RF architecrture, RFcomponents parameter, and etc. In the case where the proponent is missing some elements to calculate the REFSENS exception cases, the TP can be submitted to the “not for block approval” AI for expert support.*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*Rend of template modification \*\*\*\*\*\*\*\*\*

# 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: Band group definition

For three DL and 2UL/3CC triple beat MSD to be considered, the victim band should be part of the same or adjacent band group than one of the UL band 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: Valid UL configurations

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 \*\*\*\*\*\*\*\*\*

# 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