**3GPP TSG-RAN WG4 Meeting # 113 *R4-2420414***

**Orlando, US, 18th – 22nd November, 2024**

**Source:** Huawei, HiSilicon

**Title:** TP for TR 38.719-02-01 to introduce UL CA\_n5-n8

**Agenda item:** 6.3.3

**Document for:** Approval

# 1 Background

This contribution provides text proposal on the NR band combination UL CA\_n5-n8.

# 2 Text Proposal

##### ---Start of changes---

## 5.x CA\_n5-n8

### 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 of band nX+nY

|  |  |  |  |
| --- | --- | --- | --- |
| **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** |
| n5 | 824 MHz – 849 MHz | 869 MHz – 894 MHz | FDD |
| n8 | 880 MHz – 915 MHz | 925 MHz – 960 MHz | FDD |
|  | | | |

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

Table 5.x.1.2-1: Supported bandwidths per CA band combination of band nX+nY

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **NR CA configuration** | **Uplink CA configuration or single uplink carrier** | **NR Band** | **Channel bandwidth (MHz)** | **Bandwidth combination set** |
| CA\_n5A-n8A | CA\_n5A-n8A | n5 | 5, 10 | 0 |
|  |  | n8 | 5, 10 |  |

NOTE 15: Uplink is only in n5 for one uplink CA\_n5-n8. 2UL/2DL CA\_n5A-8A is supported using non-concurrent n5 DL and n8 UL.

#### 5.x.1.3 UE co-existence studies for 1 band UL

The UL/DL harmonics/harmonic mixing analysis and cross band isolation can be found in the clause 5.1.2 of TR 38.872.

#### 5.x.1.4 ∆TIB,c and ∆RIB,c values

For CA\_n5-n8, the ΔTIB,c and ΔRIB,c values are given in the tables below, which have been specified in the spec.

Table 5.x.1.4-1: ΔTIB,c

|  |  |  |
| --- | --- | --- |
| Inter-band CA combination | ΔTIB,c for NR bands (dB)\* | |
| Component band in order of bands in configuration\*\* | |
| CA\_n5-n8 | 0.5 | 0.5 |
| NOTE \*: “-” denotes ΔTIB,c = 0.  NOTE \*\*: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3 the band order from left to right is n1 and n3. | | |

Table 5.x.1.4-2: ΔRIB,c

|  |  |  |
| --- | --- | --- |
| Inter-band CA combination | ΔRIB,c for NR bands (dB)\* | |
| Component band in order of bands in configuration\*\* | |
| CA\_n5-n8 | 0.4 | 0.4 |
| NOTE \*: “-” denotes ΔRIB,c = 0.  NOTE \*\*: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n77 the band order from left to right is n1 and n77. | | |

#### 5.x.1.5 REFSENS requirements

The MSD due to cross band isolation for DL band n8 from aggressor UL n5 has been specified in the spec.

Table 5.x.1.5-1: MSD due to cross band isolation for CA\_n5-n8

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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 | n8 | 844 | 10 | 15 | 25 (RBstart=27) | 951.5 | 5 | 2.8 | >ACLR2 |

As there is no concurrent between UL n8 and n5 DL, there is no need to specify the MSD due to cross band isolation for DL band n5 from aggressor UL n8.

#### 5.x.1.6 OOB blocking exception requirements

There is no OOB blocking exception requirements for CA\_n5-n8.

### 5.x.2 Specific for 2 bands UL CA

#### 5.x.2.1 Maximum output power for inter-band CA

**Table 5.x.2.1-1: UE Power Class for uplink inter-band CA**

|  |  |  |
| --- | --- | --- |
| Uplink CA Configuration | Power Class 3 (dBm) | Tolerance (dB) |
| CA\_n5A-n8A | 23 | +2/-3 |

#### 5.x.2.2 UE co-existence studies for 2 bands UL

Table 5.x.2.2-1 lists Band n5 + Band n8 2 bands UL CA(2CC) 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

**Table 5.x.2.2-1:** **Band n5 and Band n8 for 2CC UL IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **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) | 91 | 69 | 1728 | 1750 |
| 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) | 973 | 1006 | 733 | 766 |
| 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) | 2632 | 2665 | 2552 | 2585 |
| 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) | 1877 | 1921 | 1557 | 1601 |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | |2\*fx\_high –2\* fy\_low| |  |  |
| IMD frequency limits (MHz) | 138 | 182 |  |  |
| 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) | 3536 | 3580 | 3376 | 3420 |
| Two-tone 4th order IMD products | |2\*fx\_low +2\* fy\_low| | |2\*fx\_high +2\* fy\_high| |  |  |
| IMD frequency limits (MHz) | 3456 | 3500 |  |  |
| 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) | 2436 | 2381 | 2836 | 2781 |
| 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) | 697 | 642 | 1097 | 1042 |
| 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) | 4200 | 4255 | 4440 | 4495 |
| 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) | 4280 | 4335 | 4360 | 4415 |
| 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. | | | | |

Based on Table 5.x.2.2-1, there is no IMD issue for CA\_n5-n8 with the following frequency range restriction.

n5 UL: 824 MHz – 835 MHz DL: 869 MHz – 880 MHz;

n8 UL: 904 MHz – 915 MHz DL: 949 MHz – 960 MHz.

However, IMD3 may fall into the DL band n8 if both band n5 and n8 transmit the signal without frequency restriction.

#### 5.x.2.3 REFSENS requirements

Referring to the IMD3 MSD value from CA\_n8-n20, 25dB MSD can be specified for UL CA\_n5-n8 without frequency range restriction by implementing non-concurrent n5 DL and n8 UL solution.

**Table 5.x.2.3-1: MSD test parameters due to the two UL IMD3**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Band / Channel bandwidth / NRB / Duplex mode | | | | | | | | Source of IMD |
| NR CA band combination | NR band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  LCRB | DL Fc (MHz) | MSD  (dB) | Duplex mode |  |
| CA\_n5-n81 | n5 | 837.5 | 5 | 25 | 882.5 | N/A | FDD | N/A |
|  | n8 | 882.5 | 5 | 25 | 927.5 | 25 | FDD | IMD3 |
| NOTE 1: This test point is applicable to the 2UL/2DL CA\_n5A-8A using non-concurrent n5 DL and n8 UL. | | | | | | | | |

##### ---End of changes---

# Reference

[1] RP-241833, “Revised WID: Rel-19 NR Carrier Aggregation (CA)/Dual Connectivity (DC) for x bands DL with y bands UL (x<7, y<3) and Supplementary Uplink (SUL) band combinations/CA band combinations with a single SUL or two SUL cells”, Ericsson, ZTE, Huawei, HiSilicon