**3GPP TSG-RAN WG4 Meeting # 112 R4-2411935**

**Maastricht, Netherlands, Aug.19th – 23th, 2024**

Source: ZTE Corporation, Skyworks Solutions, Inc.

Title: TP for TR38.719-02-01\_CA\_n8A-n104A

Agenda Item: 7.3.3

Document for: Approval

# **Introduction**

CA\_n8A-n104A\_BCS0 was requested and included in the new R19 basket WID[1], Hence, we provide a TP to TR38.719-02-01 to introduce intra-band UL CA\_n8A-n104A.

# **Reference**

[1] RP-241674, New 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

[2] TR38.719-02-01,Rel-19 NR Inter-band Carrier Aggregation/Dual Connectivity for 2 bands DL with x bands UL (x=1,2)

# Text Proposal

**----- Start of TP -----**

## 5.x CA\_n8-n104

### 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 n8+n104

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **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** |
| n8 | 880 MHz | **-** | 915 MHz | 925 MHz | **-** | 960 MHz | FDD |
| n104 | 6425 MHz | **-** | 7125 MHz | 6425 MHz | **-** | 7125 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 of band n8+n104

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **NR CA configuration** | **Uplink CA configuration or single uplink carrier** | **NR Band** | **Channel bandwidth (MHz)** | **Bandwidth combination set** |
| CA\_n8A-n104A | CA\_n8A-n104A | n8 | 5, 10, 15, 20, 25, 30, 35 | 0 |
|  |  | n104 | 20, 30, 40, 50, 60, 70, 80, 90, 100 |  |

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

Table 5.x.1.3-1 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA\_n8-n104.

**Table 5.x.1.3-1 UL/DL harmonics/harmonic mixing analysis**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **UL/DL** | | **n8** | **UL12** | **UL2** | **UL33** | **UL4** | **UL5** |  |
| **harmonics** | | **fLow** | 880 | 1760 | 2640 | 3520 | 4400 | **MSD type** |
| **n104** | **fLow** | **fHigh** | 915 | 1830 | 2745 | 3660 | 4575 |  |
| **DL1** | 6425 | 7125 | N/A | - | - | - | - | **UL harmonic** |
| **DL23** | 12850 | 14250 | - | N/A | - | N/A | N/A | **Harmonic mixing** |
| **DL34** | 19275 | 21375 | - | - | N/A | - | N/A |
| **DL4** | 25700 | 28500 | - | N/A | N/A | N/A | N/A |
| **DL54** | 32125 | 35625 | - | - | N/A | N/A | N/A |
| **Analysis** | | | Neither direct hit nor near miss n8 ULx / n104 DLy (5MHz) | | | | | |
| **UL/DL** | | **n104** | **UL14** | **UL2** | **UL33** | **UL4** | **UL5** | **MSD type** |
| **harmonics** | | **fLow** | 6425 | 12850 | 19275 | 25700 | 32125 |
| **n8** | **fLow** | **fHigh** | 7125 | 14250 | 21375 | 28500 | 35625 |
| **DL1** | 925 | 960 | N/A | - | - | - | - | **UL harmonic** |
| **DL23** | 1850 | 1920 | - | N/A | - | N/A | N/A | **Harmonic mixing** |
| **DL34** | 2775 | 2880 | - | - | N/A | - | N/A |
| **DL4** | 3700 | 3840 | - | N/A | N/A | N/A | N/A |
| **DL54** | 4625 | 4800 | - | - | N/A | N/A | N/A |
| **Analysis** | | | Neither direct hit nor near miss n104 ULx / n8 DLy (20MHz) | | | | | |
| Note 1: ULx means UL xth harmonic frequency, and DLy means DL yth harmonic frequency range Note 2: When a collision is detected with an overlap >0Hz between the ULx with DLy frequency ranges, the ULx/DLy cell is marked “D” for direct hit.  When the gap between ULx and DLy frequency range is from 0Hz to x\*MinULCBW, the ULx/DLy cell is marked “N” for Near miss. Note 3: UL3/DL2 harmonic mixing direct hit case for PC3/5 only apply for DL>3GHz Note 4: For harmonic mixing, near-miss cases only apply for UL1 and odd DLy orders. | | | | | | | | |

Table 5.x.1.3-2 summarizes frequency ranges where cross band isolation may occur for CA\_n8-n104.

**Table 5.x.1.3-2: Cross-band isolation** **analysis**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Bands** | **n8** | | **n104** | |
| **Frequency limit** | **flow** | **fhigh** | **flow** | **fhigh** |
| **fUL (MHz)** | 880 | 915 | 6425 | 7125 |
| **fDL (MHz)** | 925 | 960 | 6425 | 7125 |
| **UL CBW (MHz)2** | Minimum CBW | Maximum CBW | Minimum CBW | Maximum CBW |
| 5 | 35 | 20 | 100 |
| **ACLR1 range** | fxULlow-maxULCBWx | fxULhigh+maxULCBWx | fyULlow-maxULCBWy | fyULhigh+maxULCBWy |
| **ACLR1 (MHz)** | 845 | 950 | 6325 | 7225 |
| **ACLR2 range** | fxULlow-2\*maxULCBWx | fxULhigh+2\*maxULCBWx | fyULlow-2\*maxULCBWy | fyULhigh+2\*maxULCBWy |
| **ACLR2 (MHz)** | 810 | 985 | 6225 | 7325 |
| **ACLR3 range** | fxULlow-3\*maxULCBWx | fxULhigh+3\*maxULCBWx | fyULlow-3\*maxULCBWy | fyULhigh+3\*maxULCBWy |
| **ACLR3 (MHz)** | 775 | 1020 | 6125 | 7425 |
| **ACLR4 range** | fxULlow-4\*maxULCBWx | fxULhigh+4\*maxULCBWx | fyULlow-4\*maxULCBWy | fyULhigh+4\*maxULCBWy |
| **ACLR4 (MHz)** | 740 | 1055 | 6025 | 7525 |
| **ACLR5 range1** | fxULlow-5\*maxULCBWx | fxULhigh+5\*maxULCBWx | fyULlow-5\*maxULCBWy | fyULhigh+5\*maxULCBWy |
| **ACLR5 (MHz)** | 705 | 1090 | 5925 | 7625 |
| **Analysis** | There are no cross-band isolation problem for n8 UL to n104 DL up to ACLR 5 according to the calculation. Moreover, n8 and n104 are not the same or adjacent band group as described in table A.1, so there is no need to check >ACLR5 MSD. | | There are no cross-band isolation problem for n104 UL to n8 DL up to ACLR 5 according to the calculation. Moreover, n8 and n104 are not the same or adjacent band group as described in table A.1, so there is no need to check >ACLR5 MSD. | |
| Note 1: Even if there is no overlap up to ACLR5, MSD beyond the ACLR5 range should be evaluated further if: -The UL aggressor band and DL aggressor band are part of the same or adjacent band group as described in table A.1. -If the DL band is above the UL band, it’s lower frequency edge must be below the UL lowest 2nd harmonic frequency -As an indicative threshold, if >45dB UL rejection at the DL band frequency can be guaranteed, assuming a -130dBm/Hz TX noise floor level, the transmitter noise floor related MSD should be negligible Note 2: The maximum UL channel bandwidth of the BCS (noted maxULCBW) is used to calculate the band ACLR ranges while the minimum DL channel bandwidth of the BCS (noted minDLCBW) is used for the DL band victim channel bandwidth. | | | | |
|

#### 5.x.1.4 ∆TIB,c and ∆RIB,c values

For CA\_n8-n104, the ΔTIB,c and ΔRIB,c requirements are given in the tables below.

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\_n8-n104 | 0.3 | 0.8 |
| 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-n8 the band order from left to right is n1 and n8. | | |

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\_n8-n104 | - | 0.5 |
| 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

There are no harmonic/harmonic mixing/cross band isolation co-existence problem according to UE co-existence study in section 5.x.1.3, so there is no need to defined additional REFSEN requirements(MSD).

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

Since band n8 is a low band and n104 is a high and wide band, the OOBB exception is needed.

Table 5.x.1.6-1: CA band combination with exceptions allowed

|  |
| --- |
| CA band combination |
| CA\_n8-n104 |

### 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\_n8A-n104A | 23 | +2/-3 |

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

Table 5.x.2.2-1 lists Band n8 + Band n104 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 n8 and Band n104 for 2CC UL IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| **UL frequency** | **880** | **915** | **6425** | **7125** |
| 2nd order IMD products | |fy\_low-fx\_high| | |fy\_high-fx\_low| | |fy\_low+fx\_low| | |fy\_high+fx\_high| |
| IMD frequency limits (MHz) | 5510 -- 6220 | | 7305 -- 8015 | |
| 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) | 5340 -- 4595 | | 11935 -- 13320 | |
| 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) | 8185 -- 8930 | | 13730 -- 15115 | |
| 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) | 4460 -- 3680 | | 18360 -- 20420 | |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | |2\*fx\_high– 2\*fy\_low| |  |  |
| IMD frequency limits (MHz) | 12440 -- 11020 | |  |  |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | |3\*fx\_high +1\*y\_high| | |3\*fy\_low + 1\*fx\_low| | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 9065 -- 9845 | | 20155 -- 22215 | |
| Two-tone 4th order IMD products | |2\*fx\_low +2\* fy\_low| | |2\*fx\_high+2\*fy\_high| |  |  |
| IMD frequency limits (MHz) | 14610 -- 16030 | |  |  |
| 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) | 27520 -- 24785 | | 2765 -- 3580 | |
| 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) | 19540 -- 17445 | | 10105 -- 11560 | |
| 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) | 26580 -- 29315 | | 9945 -- 10760 | |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | |2\*fx\_high+ \*fy\_high| | |2\*fy\_low+3\*fx\_low| | |2\*fy\_high+3\*fx\_high| |
| IMD frequency limits (MHz) | 21035 -- 23130 | | 15490 -- 16945 | |
| 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, No IMD fall into Rx frequencies of bands n8.

For CA\_n8-n104, although PHS frequency range 1884.5-1915.7MHz is as pretected band of band n8, due to this combination will not be deployed in the PHS region, there is no need to add PHS frequency range as protected band for CA\_n8-n104. Thus no protected bands are needed.



#### 5.x.2.3 REFSENS requirements

There are no IMD co-existence problem according to UE co-existence study in section 5.x.2.2, so there is no need to defined additional REFSEN requirements(MSD).

**----- End of TP -----**