**3GPP TSG-RAN WG4 Meeting # 112 R4-2411936**

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

Source: ZTE Corporation, [Skyworks Solutions, Inc.]

Title: TP for TR38.719-02-01\_CA\_n41A-n104A

Agenda Item: 7.3.3

Document for: Approval

# **Introduction**

CA\_n41A-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\_n41A-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\_n41-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 n41+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** |
| n41 | 2496 MHz | **-** | 2690 MHz | 2496 MHz | **-** | 2690 MHz | TDD |
| n104 | 6425 MHz | **-** | 7125 MHz | 6425 MHz | **-** | 7125 MHz | TDD |
| NOTE 1: Applicable for UE supporting inter-band carrier aggregation with mandatory simultaneous Rx/Tx capability. | | | | | | | |

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

#### 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 n41+n104

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **NR CA configuration** | **Uplink CA configuration or single uplink carrier** | **NR Band** | **Channel bandwidth (MHz)** | **Bandwidth combination set** |
| CA\_n41A-n104A | CA\_n41A-n104A | n41 | 10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100 | 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\_n41-n104.

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

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **UL/DL** | | **n41** | **UL12** | **UL2** | **UL33** | **UL4** | **UL5** |  |
| **harmonics** | | **fLow** | 2496 | 4992 | 7488 | 9984 | 12480 | **MSD type** |
| **n104** | **fLow** | **fHigh** | 2690 | 5380 | 8070 | 10760 | 13450 |  |
| **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 n41 ULx / n104 DLy (5MHz) | | | | | |
| **UL/DL** | | **n104** | **UL14** | **UL2** | **UL33** | **UL4** | **UL5** | **MSD type** |
| **harmonics** | | **fLow** | 6425 | 12850 | 19275 | 25700 | 32125 |
| **n41** | **fLow** | **fHigh** | 7125 | 14250 | 21375 | 28500 | 35625 |
| **DL1** | 2496 | 2690 | N/A | - | - | - | - | **UL harmonic** |
| **DL23** | 4992 | 5380 | - | N/A | - | N/A | N/A | **Harmonic mixing** |
| **DL34** | 7488 | 8070 | - | - | N/A | - | N/A |
| **DL4** | 9984 | 10760 | - | N/A | N/A | N/A | N/A |
| **DL54** | 12480 | 13450 | - | D | N/A | N/A | N/A |
| **Analysis** | | | UL2 of n104 direct hit the DL5 of n41. There are no near miss n104 ULx / n41 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\_n41-n104.

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

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Bands** | **n41** | | **n104** | |
| **Frequency limit** | **flow** | **fhigh** | **flow** | **fhigh** |
| **fUL (MHz)** | 2496 | 2690 | 6425 | 7125 |
| **fDL (MHz)** | 2496 | 2690 | 6425 | 7125 |
| **UL CBW (MHz)2** | Minimum CBW | Maximum CBW | Minimum CBW | Maximum CBW |
| 5 | 100 | 20 | 100 |
| **ACLR1 range** | fxULlow-maxULCBWx | fxULhigh+maxULCBWx | fyULlow-maxULCBWy | fyULhigh+maxULCBWy |
| **ACLR1 (MHz)** | 2396 | 2790 | 6325 | 7225 |
| **ACLR2 range** | fxULlow-2\*maxULCBWx | fxULhigh+2\*maxULCBWx | fyULlow-2\*maxULCBWy | fyULhigh+2\*maxULCBWy |
| **ACLR2 (MHz)** | 2296 | 2890 | 6225 | 7325 |
| **ACLR3 range** | fxULlow-3\*maxULCBWx | fxULhigh+3\*maxULCBWx | fyULlow-3\*maxULCBWy | fyULhigh+3\*maxULCBWy |
| **ACLR3 (MHz)** | 2196 | 2990 | 6125 | 7425 |
| **ACLR4 range** | fxULlow-4\*maxULCBWx | fxULhigh+4\*maxULCBWx | fyULlow-4\*maxULCBWy | fyULhigh+4\*maxULCBWy |
| **ACLR4 (MHz)** | 2096 | 3090 | 6025 | 7525 |
| **ACLR5 range1** | fxULlow-5\*maxULCBWx | fxULhigh+5\*maxULCBWx | fyULlow-5\*maxULCBWy | fyULhigh+5\*maxULCBWy |
| **ACLR5 (MHz)** | 1996 | 3190 | 5925 | 7625 |
| **Analysis** | There are no cross-band isolation problem for n41 UL to n104 DL up to ACLR 5 according to the calculation. Moreover, n41 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 n41 DL up to ACLR 5 according to the calculation. Moreover, n41 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\_n41-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\_n41-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-n41 the band order from left to right is n1 and n41. | | |

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\_n41-n104 | 0.5 | 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/cross band isolation co-existence problem according to UE co-existence study in section 5.x.1.3 except harmonic mixing UL2/DL5 MSD, so there is need to defined additional REFSEN requirements(MSD).

Considering the n41 is high band and n104 is ultra-higher band, here we use the full separate antenna RF architecture assumption for the MSD derivation. The MSD is proposed in Table 5.x.1.5-1:

Table 5.x.1.5-1: Reference sensitivity exceptions and uplink/downlink configurations due to harmonic mixing from a PC3 aggressor NR UL band for DL NR CA FR1

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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 | n41 | 20 | 15 | 100 (RBstart=0) | 10 | 22.0 | NOTE x | UL2/DL5 |
| n104 | n41 | 20 | 15 | 100 (RBstart=0) | 100 | 11.9 | NOTE x | UL2/DL5 |
| NOTE x: The requirements should be verified for DL NR-ARFCN of the Victim (lower) band (superscript LB) such that and with the UL carrier frequency and the channel bandwidth configured in the higher band, both in MHz. | | | | | | | | |

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

No OOB blocking issues for CA\_n41-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\_n41A-n104A | 23 | +2/-3 |

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

Since both n41 and n104 are TDD band, so there is no need to check the 2UL IMD for the UE-to-UE coexistence analysis..

Table 5.x.2.2-3 lists the protected bands required for the 2UL bands CA configuration.

**Table 5.x.2.2-3: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Configuration** | **Spurious emission** | | | | | | |
| **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** |
| CA\_n41-n104 | Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 3 |
| NOTE 3: Applicable when co-existence with PHS system operating | | | | | | | |

#### 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 -----**