3GPP TSG-RAN WG4 Meeting #110 R4-2400323

Athens, GR, 26th February - 1st March 2024

Title: TP for TR38.718-02-01 Support of CA\_n77-n78

Source: Softbank

Agenda Item: 7.10.2

Document for: Approval

# **Introduction**

This contribution is a text proposal for TR 38.718-02-01[1] to include the following NRCA combinations as requested in RAN4#108.

* CA\_n77-n78

# **Reference**

[1] TR38.718-02-01, “Rel-18 NR Inter-band Carrier Aggregation/Dual Connectivity for 2 bands DL with x bands UL (x=1,2)”, V0.9.0

[2] TS38.101-1, “NR; User Equipment (UE) radio transmission and reception; Part 1: Range 1 Standalone”, V18.4.0

# **Text Proposal**

# **-- Start of TP –**

**-- Unaffected parts omitted --**

5.x CA\_n77-n78

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 n77 and n78**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **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** | | |
| n77 | 3300 MHz | – | 4200 MHz | 3300 MHz | – | 4200 MHz | TDD |
| n78 | 3300 MHz | – | 3800 MHz | 3300 MHz | – | 3800 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 n77+n78**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **NR CA configuration** | **Uplink CA configuration or single uplink carrier** | **NR Band** | **Channel bandwidth (MHz)** | **Bandwidth combination set** |
| CA\_n77A-n78A2 | CA\_n77A-n78A2 | n77 | 10, 15, 20, 40, 50, 60, 80, 90, 100 | 0 |
|  |  | n78 | 10, 15, 20, 40, 50, 60, 80, 90, 100 |  |
|  |  | n77 | See n77 channel bandwidths in Table 5.3.5-1 | 4 and 5 |
|  |  | n78 | See n78 channel bandwidths in Table 5.3.5-1 |  |
| NOTE 2: The minimum requirements for intra-band contiguous or non-contiguous CA apply. | | | | |

5.x.1.3 UE co-existence studies

Table 5.x.1.3-1 lists up to 5th harmonics for CA\_n77-n78 which shows that there are no harmonic issues.

**Table 5.x.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | | **5th Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** |
| n77 | 3300 | 4200 | 3300 | 4200 | 6600 | 8400 | 9900 | 12600 | 13200 | 16800 | 16500 | 21000 |
| n78 | 3300 | 3800 | 3300 | 3800 | 6600 | 7600 | 9900 | 11400 | 13200 | 15200 | 16500 | 19000 |

Table 5.x.1.3-2 list harmonic mixing issue for the 2DL bands CA with 1 UL. As can be seen there is no harmonic mixing issues.

**Table 5.x.1.3-2: Impact of UL/DL Harmonic mixing**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | | **5th Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** |
| n77 | 3300 | 4200 | 3300 | 4200 | 6600 | 8400 | 9900 | 12600 | 13200 | 16800 | 16500 | 21000 |
| n78 | 3300 | 3800 | 3300 | 3800 | 6600 | 7600 | 9900 | 11400 | 13200 | 15200 | 16500 | 19000 |

As both band n77 and n78 are TDD band and the band operation is fully synchronized, there is no intermodulation issue.

5.x.1.4 ∆TIB,c and ∆RIB,c values

For CA\_n77-n78, the ΔTIB,c and ΔRIB,c values are same as for CA\_n48\_n77 and are given in the tables below.

**Table 5.5.1.4-1: ΔTIB,c**

|  |  |  |
| --- | --- | --- |
| **Inter-band CA combination** | **ΔTIB,c for NR bands (dB)9** | |
| **Component band in order of bands in configuration10** | |
| CA\_n77-n78 | - | - |
| NOTE 9: “-” denotes ΔTIB,c = 0.  NOTE 10: 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 5.5.1.4-2: ΔRIB,c**

|  |  |  |
| --- | --- | --- |
| **Inter-band CA combination** | **ΔRIB,c for NR bands (dB)8** | |
| **Component band in order of bands in configuration9** | |
| CA\_n77-n78 | - | - |
| NOTE 8: “-” denotes ΔRIB,c = 0.  NOTE 9: 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

As can be seen in the co-existence studies in 5.x.1.3, there is no harmonic issues.

5.x.1.6 OOB blocking exception requirements

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

|  |
| --- |
| **CA band combination** |
|  |

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** | **Class 3 (dBm)** | **Tolerance (dB)** |
| CA\_n77A-n78A | 23 | +2/-3 |

5.x.2.2 UE co-existence studies

Table 5.x.2.2-1 lists Band n77 + Band n78 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

**Table 5.x.2.2-1: Band n77 and Band n78 UL harmonics and IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| UL frequencies (MHz) | 3300 | 4200 | 3300 | 3800 |
| 2nd order IMD products | |fy\_low - fx\_high| | |fy\_high - fx\_low| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 500 | 900 | 6600 | 8000 |
| 3rd order IMD products | |fy\_high - 2\*fx\_low| | |fy\_low - 2\*fx\_high| | |2\*fy\_low - fx\_high| | |2\*fy\_high - fx\_low| |
| IMD frequency limits (MHz) | 2800 | 5100 | 2400 | 4300 |
| 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) | 9900 | 12200 | 9900 | 11800 |
| Two-tone 4th order IMD products | |2\*fx\_low -2\* fy\_high| | |2\*fx\_high - 2\*fy\_low| | |2\*fx\_low +2\* fy\_low| | |2\*fx\_high +2\* fy\_high| |
| IMD frequency limits (MHz) | 1000 | 1800 | 13200 | 16000 |
| 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) | 6100 | 9300 | 5700 | 8100 |
| 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) | 13200 | 16400 | 13200 | 15600 |
| 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) | 11900 | 9000 | 13500 | 9400 |
| 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) | 16500 | 19400 | 16500 | 20600 |
| 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) | 4800 | 1500 | 6000 | 2300 |
| 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) | 16500 | 19800 | 16500 | 20200 |

Based on the table above, there is no IMD issue for CA\_n77-n78 with 2UL.

The Protected bands for the 2UL bands CA configuration are same for CA\_n77 is defined in Table 6.5A.3.2-1-1 in TS38.101-1[2] as below.

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

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **UL NR CA Configuration** | **Spurious emission** | | | | | | |
| **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 5 |

5.x.2.3 REFSENS requirements

Based on co-existence studies on 5.x.2.2, no need to define exceptional REFSENS requirements.

**-- Unaffected parts omitted --**

**-- End of TP --**