3GPP TSG-RAN WG4 Meeting # 106-bis-e R4-2304965

**E-Meeting, April 17th – April 26th, 2023**

**Title: TP to TR 36.718-02-01 Addition of CA\_2A-4A-28A w ULCA**

**Source: Nokia, AMX**

**Agenda item: 6.1.2.1**

**Document for: Approval**

# 1 Introduction

This TP is to add CA\_2A-4A-28A with ULCA. This TP has dependencies to the fallback combination CA\_2A-28A w. ULCA submitted for the same meeting in R4-2304964.

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5.4.x CA\_2-4-28

5.4.x.1 Channel bandwidths per operating band for CA

**Table 5.4.x.1-1: Inter-band CA operating bands**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **E‑UTRA Operating Band** | **Uplink (UL) operating band BS receive UE transmit** | | | **Downlink (DL) operating band BS transmit  UE receive** | | | **Duplex Mode** |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| 2 | 1850 MHz | – | 1910 MHz | 1930 MHz | – | 1990 MHz | FDD |
| 4 | 1710 MHz | – | 1755 MHz | 2110 MHz | – | 2155 MHz | FDD |
| 28 | 703 MHz | – | 748 MHz | 758 MHz | – | 803 MHz | FDD |

**Table 5.4.x.1-2: E-UTRA CA configurations and bandwidth combination sets defined for inter-band CA**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **E-UTRA CA configuration / Bandwidth combination set** | | | | | | | | | | |
| **E-UTRA CA Configuration** | **Uplink CA configurations** | **E-UTRA Bands** | **1.4 MHz** | **3 MHz** | **5 MHz** | **10 MHz** | **15 MHz** | **20 MHz** | **Maximum aggregated bandwidth**  **[MHz]** | **Bandwidth combination set** |
| CA\_2A-4A-28A | CA\_2A-4A  CA\_2A-28A  CA\_4A-28A | 2 |  |  | Yes | Yes | Yes | Yes | 60 | 0 |
| 4 |  |  | Yes | Yes | Yes | Yes |
| 28 |  |  | Yes | Yes | Yes | Yes |

5.4.x.2 Co-existence studies

For 2UL / 2DL own receiver desensitization study 2nd and 3rd order harmonics and 2nd, 3rd, 4th and 5th order intermodulation products were calculated and presented in Table 5.4.x.2-1, in Table 5.4.x.2-2 and in Table 5.4.x.2-3

**Table 5.4.x.2-1: Harmonic and IMD analysis UL\_CA\_2A-4A**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| UL Frequency [MHz] | 1850 | 1910 | 1710 | 1755 |
| DL Frequency [MHz] | 1930 | 1990 | 2110 | 2155 |
| 2nd order IMD products | |fy\_low – fx\_high| | |fy\_high – fx\_low| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 200 | 95 | 3560 | 3665 |
| 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) | 1945 | 2110 | 1510 | 1660 |
| 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) | 5410 | 5575 | 5270 | 5420 |
| 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) | 3795 | 4020 | 3220 | 3415 |
| 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) | 190 | 400 | 7120 | 7330 |
| 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) | 7260 | 7485 | 6980 | 7175 |
| 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) | 5170 | 4930 | 5930 | 5645 |
| 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) | 1565 | 1310 | 2310 | 2040 |
| 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) | 8690 | 8930 | 9110 | 9395 |
| 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) | 8830 | 9085 | 8970 | 9240 |

Based on Table 5.4.x.2-1, there are no IMD issues falling inside the third RX band 28.

**Table 5.4.x.2-2: Harmonic and IMD analysis UL\_CA\_2A-28A**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| UL Frequency [MHz] | 1850 | 1910 | 703 | 748 |
| DL Frequency [MHz] | 1930 | 1990 | 758 | 803 |
| 2nd order IMD products | |fy\_low – fx\_high| | |fy\_high – fx\_low| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 1207 | 1102 | 2553 | 2658 |
| 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) | 2952 | 3117 | 504 | 354 |
| 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) | 4403 | 4568 | 3256 | 3406 |
| 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) | 4802 | 5027 | 199 | 394 |
| 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) | 2204 | 2414 | 5106 | 5316 |
| 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) | 6253 | 6478 | 3959 | 4154 |
| 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) | 1142 | 902 | 6937 | 6652 |
| 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) | 1456 | 1711 | 4324 | 4054 |
| 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) | 4662 | 4902 | 8103 | 8388 |
| 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) | 5809 | 6064 | 6956 | 7226 |

Based on Table 5.4.x.2-2, there are no IMD issues falling inside the third RX band 4.

**Table 5.4.x.2-3: Harmonic and IMD analysis UL\_CA\_4A-28A**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| UL Frequency [MHz] | 1710 | 1755 | 703 | 748 |
| DL Frequency [MHz] | 2110 | 2155 | 758 | 803 |
| 2nd order IMD products | |fy\_low – fx\_high| | |fy\_high – fx\_low| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 1052 | 962 | 2413 | 2503 |
| 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) | 2672 | 2807 | 349 | 214 |
| 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) | 4123 | 4258 | 3116 | 3251 |
| 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) | 4382 | 4562 | 354 | 534 |
| 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) | 1924 | 2104 | 4826 | 5006 |
| 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) | 5833 | 6013 | 3819 | 3999 |
| 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) | 1282 | 1057 | 6317 | 6092 |
| 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) | 1176 | 1401 | 3859 | 3634 |
| 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) | 4522 | 4747 | 7543 | 7768 |
| 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) | 5529 | 5754 | 6536 | 6761 |

Based on Table 5.4.x.2-3, there are 4th order IMD issues falling inside the third RX band 2.

5.4.x.3 ∆TIB and ∆RIB values

Already included in TS 36.101.

5.4.x.4 REFSENS Requirements

Based on the co-existence studies there is a need to define additional REFSENS requirements. MSD value and test points are taken from DC\_2A-4A\_n28A, which also has two mid-band + one low band configuration.

Table 5.4.x.4-1: 3DL/2UL interband Reference sensitivity QPSK PREFSENS and uplink/downlink configurations

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| E-UTRA Band / Channel bandwidth / NRB / Duplex mode | | | | | | | | | | Source of IMD |
| EUTRA CA | EUTRA CA | EUTRA band | UL Fc | UL BW | UL | DL Fc | DL BW | MSD | Duplex mode |
| DL Configuration | UL Configuration | (MHz) | (MHz) | CLRB | (MHz) | (MHz) | (dB) |
| CA\_2A-4A-28A | CA\_4A-28A | 2 | 1880 | 5 | 25 | 1960 | 11.0 | IMD4 | FDD | IMD4 |
| 4 | 1720 | 5 | 25 | 2120 | N/A | N/A | N/A |
| 28 | 740 | 5 | 25 | 795 | N/A | N/A | N/A |

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