**3GPP TSG-RAN WG4 Meeting #113 R4-2419022**

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

**Source:** Huawei, Hisilicon

**Title:** TP to TR 38.719-03-01 to add CA\_n1A-n40A-n41A

**Agenda item:**  6.3.4

**Document for:** Approval

1. Introduction

The latest version of related basket WID was approved in [1]. This contribution provides a text proposal for TR 38.719-03-01 to include CA\_n1A-n40A-n41A.

# 2. 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

3. Text Proposal

**<Start of Text Proposal>**

5.x CA\_n1-n40-n41

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 constituent bands definition**

|  |  |  |  |
| --- | --- | --- | --- |
| **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** |
| n1 | 1920 MHz – 1980 MHz | 2110 MHz – 2170 MHz | FDD |
| n40 | 2300 MHz – 2400 MHz | 2300 MHz – 2400 MHz | TDD |
| n41 | 2496 MHz – 2690 MHz | 2496 MHz – 2690 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**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CA operating/channel bandwidth (MHz)** | | | | |
| **NR CA configuration** | **Uplink CA configuration or single uplink carrier** | **NR Band** | **Channel bandwidth (MHz)** | **Bandwidth combination set** |
| CA\_n1A-n40A-n41A | CA\_n1A-n40A  CA\_n1A-n41A  CA\_n40A-n41A | n1 | n1 channel bandwidths in Table 5.3.5-1 | 4 and 5 |
|  |  | n40 | n40 channel bandwidths in Table 5.3.5-1 |  |
|  |  | n41 | n41 channel bandwidths in Table 5.3.5-1 |  |

5.x.1.3 ∆TIB,c and ∆RIB,c values

For CA\_n1-n40-n41, the ΔTIB,c values are given in the tables below, which are the existing requirements for DC\_1-7\_n40. Reasons are:

* With existing requirements for CA\_n1-n40 and CA\_n1-n41, all bands are allowed to have 0.5dB relaxation, respectively.
* It is noticeable the requirements for DC\_1-7\_n40 provide 0.6dB relaxation for band 1, 0.8dB relaxation for band 7 and 0.9dB relaxation for band n40.

**Table 5.x.1.3-1: ΔTIB,c due to NR CA (three bands)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔTIB,c for NR bands (dB)\*** | | |
| **Component band in order of bands in configuration\*\*** | | |
| CA\_n1-n40-n41 | 0.6 | 0.9 | 0.8 |

As for the ΔRIB,c values, the existing requirements for CA\_n1-n7-n40 can be reused here.

**Table 5.x.1.3-2: ΔRIB,c due to NR CA (three bands)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔRIB,c for NR bands (dB)\*** | | |
| **Component band in order of bands in configuration\*\*** | | |
| CA\_n1-n40-n41 | - | 0.8 | 0.3 |
| NOTE \*: “-” denotes ΔRIB,c = 0. | | | |

5.x.2 Specific for 2 bands UL CA

5.x.2.1 UE co-existence studies

5.x.2.1.1 Co-existence studies for 2UL band with 1CC per band

Table 5.x.2.1.1-1~3 provide the two UL bands with one CC per band IMD interference analysis for CA\_n1A-n40A-n41A with UL CA\_n1A-n40A, CA\_n1A-n41A and CA\_n40A-n41A respectively.

**Table 5.x.2.1.1-1: UL CA\_n1A-n40A IMD analysis**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 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) | 320 – 480 | | 4220 – 4380 | |
| 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) | 1440 – 1660 | | 2620 – 2880 | |
| 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) | 6140 – 6360 | | 6520 – 6780 | |
| 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) | 3360 – 3640 | | 4920 – 5280 | |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | |2\*fx\_high –2\* fy\_low| |  | |
| IMD frequency limits (MHz) | 640 – 840 | |
| 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) | 8060 – 8340 | | 8820 – 9180 | |
| Two-tone 4th order IMD products | |2\*fx\_low +2\* fy\_low| | |2\*fx\_high +2\* fy\_high| |  | |
| IMD frequency limits (MHz) | 8440 – 8760 | |
| 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) | 7220 – 7680 | | 5280 – 5620 | |
| 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) | 2940 – 3360 | | 960 – 1340 | |
| 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) | 11120 – 11580 | | 9980 –10320 | |
| 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) | 10740 – 11160 | | 10360 – 10740 | |
| 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 the above analysis, 3rd order IMD generated by UL CA\_n1A-n40A may fall into the Rx of Band n41.

**Table 5.x.2.1.1-2: UL CA\_n1A-n41A IMD analysis**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 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) | 516 – 770 | | 4416 – 4670 | |
| 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) | 1150 – 1464 | | 3012 – 3460 | |
| 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) | 6336 – 6650 | | 6912 – 7360 | |
| 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) | 3070 – 3444 | | 5508 – 6150 | |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | |2\*fx\_high –2\* fy\_low| |  | |
| IMD frequency limits (MHz) | 1032 – 1420 | |
| 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) | 8256 – 8630 | | 9408 – 10050 | |
| Two-tone 4th order IMD products | |2\*fx\_low +2\* fy\_low| | |2\*fx\_high +2\* fy\_high| |  | |
| IMD frequency limits (MHz) | 8832 - 9340 | |
| 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) | 8004 – 8840 | | 4990 – 5424 | |
| 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) | 3528 – 4230 | | 380 – 948 | |
| 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) | 11904 – 12740 | | 10176 –10610 | |
| 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) | 11328 – 12030 | | 10752 – 11320 | |
| 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 the above analysis, no IMD generated by UL CA\_n1A-n41A would fall into the Rx of concerned bands.

**Table 5.x.2.1.1-3: UL CA\_n40A-n41A IMD analysis**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 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) | 96 –390 | | 4796 – 5090 | |
| 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) | 1910 – 2304 | | 2592 – 3080 | |
| 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) | 7096 – 7490 | | 7292 – 7780 | |
| 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) | 4210 – 4704 | | 5088 – 5770 | |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | |2\*fx\_high –2\* fy\_low| |  | |
| IMD frequency limits (MHz) | 192 – 580 | |
| 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) | 9396 – 9890 | | 9788 – 10470 | |
| Two-tone 4th order IMD products | |2\*fx\_low +2\* fy\_low| | |2\*fx\_high +2\* fy\_high| |  | |
| IMD frequency limits (MHz) | 9592 - 10180 | |
| 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) | 7584 - 8460 | | 6510 – 7104 | |
| 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) | 2688 – 3470 | | 1520 – 2208 | |
| 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) | 12284 – 13160 | | 11696 –12290 | |
| 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) | 12088 – 12870 | | 11892 – 12580 | |
| 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 the above analysis, 3rd order IMD and 5th order IMD generated by UL CA\_n40A-n41A may fall into the Rx of Band n1.

5.x.2.2 REFSENS requirements

Based on the co-existence studies, there is a need to define MSD. The defined requirements for DC\_1A\_7A-n40A and DC\_7A\_n1A-n40A are reused here.

**Table 5.x.2.2-3: MSD for the CA configuration**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Band / Channel bandwidth / NRB / Duplex mode** | | | | | | | | **Source of IMD** |
| **NR CA band combination** | **NR band** | **UL Fc (MHz)** | **UL/DL BW (MHz)** | **UL CLRB** | **DL Fc (MHz)** | **MSD (dB)** | **Duplex mode** |  |
| CA\_n1-n40-n41 | n1 | 1970 | 5 | 25 | 2160 | N/A | FDD | N/A |
|  | n40 | 2390 | 5 | 25 | 2390 | N/A | TDD | N/A |
|  | n41 | N/A | 5 | N/A | 2630 | 23 | TDD | IMD3 |
|  | n1 | N/A | 5 | N/A | 2130 | 15.2 | FDD | IMD3\* |
|  | n40 | 2335 | 5 | 25 | 2335 | N/A | TDD | N/A |
|  | n41 | 2540 | 5 | 25 | 2660 | N/A | TDD | N/A |
| Note \*: This band is subject to IMD5 also which MSD is not specified. | | | | | | | | |

**<End of Text Proposal>**