**3GPP TSG-RAN WG4 Meeting #100-e R4-2113578**

**Electronic Meeting, 16 August – 27 August 2021**

**Source:** Ericsson, Telstra

**Title:** TP for TR 38.717-02-01: CA\_n5-n7

**Agenda item:** 8.8.2

**Document for:** Approval

# 1. Introduction

This contribution is a text proposal for TR 38.716-02-00 to include CA\_n5A-n7A as defined in WID [1].

# 2. Text Proposal

# ---Start of changes---

## 6.72 n5-n7

### 6.72.1 Common for 1 band UL and 2 bands UL CA

#### 6.72.1.1 Operating bands for CA

Table 6.72.1.1-1: CA band combination of band n5 and n7

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 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 | | |
| n5 | 824 MHz | – | 849 MHz | 869 MHz | – | 894 MHz | FDD |
| n7 | 2500 MHz | – | 2570 MHz | 2620 MHz | – | 2690 MHz | FDD |

#### 6.72.1.2 Channel bandwidths per operating band for CA

Table 6.72.1.2-1: Supported bandwidths per CA band combination of band n5 and n7

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA configuration** | **Uplink CA configuration** | **NR Band** | **SCS**  **(kHz)** | **5**  **MHz** | **10**  **MHz** | **15**  **MHz** | **20**  **MHz** | **25 MHz** | **30 MHz** | **40**  **MHz** | **50**  **MHz** | **60**  **MHz** | **80**  **MHz** | **90**  **MHz** | **100 MHz** | **Bandwidth combination set** |
| CA\_n5A-n7A | CA\_n5A-n7A | n5 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| n7 | 15 | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |
| CA\_n5A-n7B | CA\_n5A-n7A | n5 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| n7 | See CA\_n7B Bandwidth Combination Set 0 in Table 5.5A.1-1 | | | | | | | | | | | | |

#### 6.72.1.3 UE co-existence studies

Table 6.72.1.3-1 lists up to 7th harmonics for n5-n7. As can be seen there are no harmonic issues.

**Table 6.72.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | | **5th Harmonic** | | **6th Harmonic** | | **7th Harmonic** | |
| **Band** | **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** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** |
| n5 | 824 | 849 | 1648 | 1698 | 2472 | 2547 | 3296 | 3396 | 4120 | 4245 | 4944 | 5094 | 5768 | 5943 |
| n7 | 2500 | 2570 | 5000 | 5140 | 7500 | 7710 | 10000 | 10280 | 12500 | 12850 | 15000 | 15420 | 17500 | 17990 |

Table 6.72.1.3-2 list harmonic mixing issue for the 2DL bands CA with 1 UL. As can be seen there are no harmonic mixing issues.

Table 6.72.1.3-2 Harmonic mixing for 2DLs/1UL

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th 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 |
| n5 | 824 | 849 | 869 | 894 | 1738 | 1788 | 2607 | 2682 | 3476 | 3576 |
| n7 | 2500 | 2570 | 2620 | 2690 | 5240 | 5380 | 7860 | 8070 | 10480 | 10760 |

#### 6.72.1.4 ∆TIB and ∆RIB values

For CA\_n5-n7, the ΔTIB,c and ΔRIB,c values are same as for DC\_5\_n7 and are given in the tables below.

**Table 6.72.1.4-1: ΔTIB,c**

| NR CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n5-n7 | n5 | 0.3 |
| n7 | 0.3 |

**Table 6.72.1.4-2: ΔRIB,c**

| NR CA Configuration | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n5-n7 | n5 | 0 |
| n7 | 0 |

#### 6.72.1.5 REFSENS requirements

As can be seen in the co-existence studies in 6.72.1.3 there are no harmonics issues.

### 6.72.2 Specific for 2 bands UL CA

#### 6.72.2.1 Maximum output power for inter-band CA

**Table 6.72.2.1-1: UE Power Class for uplink inter-band CA**

|  |  |  |
| --- | --- | --- |
| Uplink CA Configuration | Class 3 (dBm) | Tolerance (dB) |
| CA\_n5A-n7A | 23 | +2/-32 |
| NOTE 2: 2 refers to the transmission bandwidths confined within FUL\_low and FUL\_low + 4 MHz or FUL\_high – 4 MHz and FUL\_high, the maximum output power requirement is relaxed by reducing the lower tolerance limit by 1.5 dB | | |

#### 6.72.2.2 UE co-existence studies

Table 6.72.2.2-1 lists Band n5 + Band n7 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

**Table 6.72.2.2-1: Band n5 and Band n7 UL harmonics and IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **f1\_low** | **f1\_high** | **f2\_low** | **f2\_high** |
| UL frequencies (MHz) | 824 | 849 | 2500 | 2570 |
| 2nd order IMD products | |fy\_high – fx\_low| | |fy\_low – fx\_high| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 1746 | 1651 | 3324 | 3419 |
| 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) | 922 | 802 | 4151 | 4316 |
| 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) | 4148 | 4268 | 5824 | 5989 |
| 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) | 3492 | 3302 | 6648 | 6838 |
| 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) | 98 | 47 | 6651 | 6886 |
| 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) | 4972 | 5117 | 8324 | 8559 |
| 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) | 9456 | 9151 | 896 | 726 |
| 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) | 10824 | 11129 | 5796 | 5966 |
| 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) | 6062 | 5802 | 2453 | 2668 |
| 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) | 9148 | 9408 | 7472 | 7687 |

Based on the table above:

- The are IMD3 and IMD5 that might fall into Rx frequencies of band n5.

- The are IMD5 that might fall into Rx frequencies of band n7.

Table 6.72.2.2-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 6.72.2.2-2: 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** |
| CA\_n5-n7 | E-UTRA Band 1, 2, 3, 4, 5, 8, 12, 13, 14, 17, 28, 29, 30, 31, 34, 40, 42, 43, 65, 66, 71, 85  NR Band n7 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 52  NR Band n77, n78 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| E-UTRA band 26 | 859 | - | 869 | -27 | 1 |  |
| Frequency range | 2570 | - | 2575 | +1.6 | 5 | 4, 7, 18 |
| Frequency range | 2575 | - | 2595 | -15.5 | 5 | 4, 7, 18 |
| Frequency range | 2595 | - | 2620 | -40 | 1 | 4, 13 |
| NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.5.3.1-2 are permitted for each assigned NR carrier used in the measurement due to 2nd, 3rd, 4th or 5th harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2 MHz + N x LCRB x 180kHz), where N is 2, 3, 4, 5 for the 2nd, 3rd, 4th or 5th harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval.  NOTE 4: These requirements also apply for the frequency ranges that are less than FOOB (MHz) in Table 6.5.3.1-1 from the edge of the channel bandwidth.  NOTE 7: For these adjacent bands, the emission limit could imply risk of harmful interference to UE(s) operating in the protected operating band.  NOTE 13: This requirement is applicable for 5 and 10 MHz NR channel bandwidth allocated within 718 - 728 MHz. For carriers of 10 MHz bandwidth, this requirement applies for an uplink transmission bandwidth less than or equal to 30 RB with RBstart > 1 and Rbstart < 48.  NOTE 18: This requirement is applicable for any channel bandwidths within the range 2500 – 2570 MHz with the following restriction: for carriers of 15 MHz bandwidth when carrier centre frequency is within the range 2560.5 - 2562.5 MHz and for carriers of 20 MHz bandwidth when carrier centre frequency is within the range 2552 – 2560 MHz the requirement is applicable only for an uplink transmission bandwidth less than or equal to 54 RB. | | | | | | | |

#### 6.72.2.3 REFSENS requirements

Based on the co-existence studies for CA\_n5-n7, MSD is needed for IMD3 in n5, frequencies and MSD value are same as in DC\_5A\_n7A, DC\_7A\_n5A and CA\_5A-7A.

Based on the co-existence studies IMD5 also might fall into band n7. However, based on previously specified combinations CA\_5-7, DC\_5\_n7 and DC\_7\_n5, this MSD can be seen as negligible and is not needed to be specified.

**Table 7.72.2.3-1: MSD due to IMD issue**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Operating 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\_n5-n7 | n5 | 834 | 5 | 25 | 879 | 12 | FDD | IMD34 |
| n7 | 2547 | 10 | 50 | 2667 | N/A | FDD | N/A |
| NOTE 4: This band is subject to IMD5 also which MSD is not specified. | | | | | | | | |

---End of changes---

# Reference

[1] RP-211058, Rel-17 NR Inter-band Carrier Aggregation/Dual Connectivity for 2 bands DL with x bands UL (x=1,2), ZTE