**3GPP TSG-RAN WG4 Meeting #111 R4-24xxxxx**

**Fukuoka, Japan, 20th May – 24th May 2024**

**Source:** Ericsson, Telstra

**Title:** TP for 38.718-02-01 adding UL CA\_n26(2A) and UL CA\_n7B to CA\_n7-n26

**Agenda item:** 6.10.2

**Document for:** Approval

# 1. Introduction

This contribution is a text proposal for 38.718-02-01 adding UL CA\_n26(2A) and UL CA\_n7B to CA\_n7-n26.

# 2. Text Proposal

# ---Start of changes---

## 5.3 CA\_n7-n26

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

##### 5.3.1.1 Operating bands for CA

Table 5.3.1.1-1: CA band combination of band n7 and n26

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 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 | | |
| n7 | 2500 MHz | – | 2570 MHz | 2620 MHz | – | 2690 MHz | FDD |
| n26 | 814 MHz | – | 849 MHz | 859 MHz | – | 894 MHz | FDD |

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

Yellow marks in Table 5.3.1.2-1 indicated the configurations added compared to TS 38.101-1 18.5.0.

Table 5.3.1.2-1: Supported bandwidths per CA band combination of band n7+n26

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NR CA configuration | Uplink CA configuration or single uplink carrier | NR Band | Channel bandwidth (MHz) | Bandwidth combination set |
| CA\_n7A-n26A | CA\_n7A-n26A | n7 | 5, 10, 15, 20, 25, 30, 40, 50 | 0 |
|  |  | n26 | 5, 10, 15, 20 |  |
| CA\_n7B-n26A | CA\_n7A-n26A  CA\_n7B | n7 | CA\_n7B\_BCS0 | 0 |
|  |  | n26 | 5, 10, 15, 20 |  |
| CA\_n7A-n26(2A) | CA\_n26(2A)  CA\_n7A-n26A | n7 | 5, 10, 15, 20, 25, 30, 35, 40, 50 | 0 |
|  |  | n26 | CA\_n26(2A)\_BCS0 |  |
| CA\_n7B-n26A | CA\_n7A-n26A  CA\_n7B | n7 | CA\_n7B\_BCS0 | 0 |
|  |  | n26 | 5, 10, 15, 20 |  |
| CA\_n7B-n26(2A) | CA\_n7B CA\_n26(2A)  CA\_n7A-n26A | n7 | CA\_n7B\_BCS0 | 0 |
|  |  | n26 | CA\_n26(2A)\_BCS0 |  |

##### 5.3.1.3 UE co-existence studies

Table 5.3.1.3-1/2 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA\_ n7-n26. It is shown that there are no harmonic issues to consider.

**Table 5.3.1.3-1: 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 |
| n7 | 2500 | 2570 | 2620 | 2690 | 5000 | 5140 | 7500 | 7710 | 10000 | 10280 | 12500 | 12850 |
| n26 | 814 | 849 | 859 | 894 | 1628 | 1698 | 2442 | 2547 | 3256 | 3396 | 4070 | 4245 |

**Table 5.3.1.3-2: 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 |
| n7 | 2500 | 2570 | 2620 | 2690 | 5240 | 5380 | 7860 | 8070 | 10480 | 10760 | 13100 | 13450 |
| n26 | 814 | 849 | 859 | 894 | 1718 | 1788 | 2577 | 2682 | 3436 | 3576 | 4295 | 4470 |

##### 5.3.1.4 ∆TIB and ∆RIB values

For CA\_n7-n26, the ΔTIB,c and ΔRIB,c values are same as for CA\_3-26 and are given in the tables below.

**Table 5.3.1.4-1: ΔTIB,c**

|  |  |  |
| --- | --- | --- |
| Inter-band CA combination | ΔTIB,c for NR bands (dB)9 | |
| Component band in order of bands in configuration10 | |
| CA\_n7-n26 | 0.3 | 0.3 |
| 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 5.3.1.4-2: ΔRIB,c**

|  |  |  |
| --- | --- | --- |
| Inter-band CA combination | ΔRIB,c for NR bands (dB)8 | |
| Component band in order of bands in configuration9 | |
| CA\_n7-n26 | - | - |
| 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. | | |

##### 5.3.1.5 REFSENS requirements

As can be seen in the co-existence studies in 5.3.1.3 there are no harmonics issues.

Based on the co-existence studies there are near miss3rd harmonic mixing from band n26 DL into band n7 UL. MSD value based on the Skyworks discussion paper R4-2215516: MSD for CA\_n7A-n26A.

Table 5.3.1.5-2: 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)** |
| n7 | n263 | 25 | 15 | 25 (RBstart=104) | 5 | 2.0 | NOTE X | UL1/DL3 near-miss |
| NOTE X: The requirements should be verified for the lowest NR ARFCN of the affected DL (lower) band and for the highest NR ARFCN of the UL (higher) band | | | | | | | | |

##### 5.3.1.6 OOB blocking exception requirements

There is no OOB exception for this CA combination.

Table 5.3.1.6-1: CA band combination with exceptions allowed

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

#### 5.3.2 Specific for 2 bands UL CA

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

**Table 5.3.2.1-1: UE Power Class for uplink inter-band CA**

|  |  |  |
| --- | --- | --- |
| Uplink CA Configuration | Class 3 (dBm) | Tolerance (dB) |
| CA\_n7A-n26A | 23 | +2/-3 |

##### 5.3.2.2 UE co-existence studies

Table 5.3.2.2-1 lists Band n7 + Band n26 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

**Table 5.3.2.2-1: Band n7 and Band n26 UL harmonics and IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **f1\_low** | **f1\_high** | **f2\_low** | **f2\_high** |
| UL frequencies (MHz) | 814 | 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) | 1756 | 1651 | 3314 | 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) | 942 | 802 | 4151 | 4326 |
| 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) | 4128 | 4268 | 5814 | 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) | 3512 | 3302 | 6628 | 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) | 128 | 47 | 6651 | 6896 |
| 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) | 4942 | 5117 | 8314 | 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) | 9466 | 9151 | 896 | 686 |
| 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) | 10814 | 11129 | 5756 | 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) | 6082 | 5802 | 2453 | 2698 |
| 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) | 9128 | 9408 | 7442 | 7687 |

Based on the table above it can be seen that IMD5 may affect own Rx frequencies of band n7 and that IMD3 and IMD5 may affect band n26.

**Table 5.3.2.2-2: 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\_n7-n26 | E-UTRA Band 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 22, 26, 29, 30, 31, 40, 42, 43, 65, 66, 85, 103 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| NR Band n77, n78, n79 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| Frequency range | 2570 | - | 2575 | +1.6 | 5 | 4, 7, 8 |
| Frequency range | 2575 | - | 2595 | -15.5 | 5 | 4, 7, 8 |
| Frequency range | 2595 | - | 2620 | -40 | 1 | 4, 14 |
| Frequency range | 703 | - | 799 | -50 | 1 |  |
| Frequency range | 799 | - | 803 | -40 | 1 | 4 |
| Frequency range | 945 | - | 960 | -50 | 1 |  |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 3 |
| 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 3: Applicable when co-existence with PHS system operating in 1884.5 -1915.7 MHz  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 8: This requirement is only applicable for carriers with bandwidth confined within 1885-1920 MHz (requirement for carriers with at least 1RB confined within 1880 - 1885 MHz is not specified). This requirement applies for an uplink transmission bandwidth less than or equal to 54 RB for carriers of 15 MHz bandwidth when carrier center frequency is within the range 1892.5 - 1894.5 MHz and for carriers of 20 MHz bandwidth when carrier center frequency is within the range 1895 - 1903 MHz. | | | | | | | |

##### 5.3.2.3 REFSENS requirements

Based on the co-existence there are potential IMD5 issues into band n7 and potential IMD3 and IMD5 issues into band n26. MSD values are reused from CA\_3A-26A.

**Table 5.3.2.3-1: 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\_n7-n26 | n7 | 2556 | 5 | 25 | 2676 | N/A | FDD | N/A |
| n26 | 837 | 5 | 25 | 882 | 16.0 | FDD | IMD311 |
|  | n7 | 2567.5 | 5 | 25 | 2687.5 | 2.5 | FDD | IMD5 |
| n26 | 816.5 | 5 | 25 | 861.5 | N/A | FDD | N/A |
| NOTE 11: This band is subject to IMD5 also which MSD is not specified. | | | | | | | | |

In Table 5.3.2.3-2, up to 9th order IMD ranges for 2CCs on intra-band CA\_n26(2A) are listed. As can be seen in Table 5.3.2.3-2, there are no IMD impact from UL CA\_n26(2A) into DL band n7.

Table 5.3.2.3-2: Co-existence studies for intra-band UL CA\_n26(2A)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Configuration | Channel  BW | Minimum  Channel  separation | Maximum  Instantaneous UL BW | Minimum  frequency | Maximum  frequency | (MHz) |
| Data | 3+3, 10+10 | 0 | 20 | 814 | 849 | - |
| CC location | fU1L | fU2L | fU3L | fU1H | fU2H | fU3H |
| Frequency | 814 | 817 | 834 | 849 | 846 | 829 |
| 2nd | I fU1L - fU2L I | I fU1L - fU3L I | fU1L + fU2L | fU1H + fU2H | - | - |
| Interference ranges | 3 | 20 | 1631 | 1695 | - | - |
| 3rd | 2\*fU1L - fU3L | 2\*fU1H - fU3H | 2\*fU1L + fU2L | 2\*fU1H + fU2H | - | - |
| Interference ranges | 811 | 864 | 2445 | 2544 | - | - |
| 4th | I 2\*fU1L - 2\*fU2L I | I 2\*fU1H - 2\*fU3H I | 3\*fU1L - fU3L | 3\*fU1H - fU3H | 3\*fU1L + fU2L | 3\*fU1H + fU2H |
| Interference ranges | 6 | 40 | 1608 | 1718 | 3259 | 3393 |
| 5th | I 3\*fU1L - 2\*fU3L I | I 3\*fU1H-2\*fU3H I | 4\*fU1L - fU3L | 4\*fU1H - fU3H | 4\*fU1L + fU2L | 4\*fU1H + fU2H |
| Interference ranges | 774 | 889 | 2422 | 2567 | 4073 | 4242 |
| 6th | I 3\*fU1L - 3\*fU2L I | I 3\*fU1H-3\*fU3H I | 4\*fU1L - 2\*fU3L | 4\*fU1H - 2\*fU3H | 5\*fU1L - fU3L | 5\*fU1H - fU3H |
| Interference ranges | 9 | 60 | 1588 | 1598 | 3236 | 3416 |
| 7th | I 4\*fU1L - 3\*fU3L I | I 4\*fU1H-3\*fU3H I | 5\*fU1L - 2\*fU3L | 5\*fU1H - 2\*fU3H | 6\*fU1L - fU3L | 6\*fU1H - fU3H |
| Interference ranges | 754 | 909 | 2402 | 2577 | 4050 | 4265 |
| 9th | I 5\*fU1L - 4\*fU3L I | I 5\*fU1H-4\*fU3H I | 6\*fU1L - 3\*fU3L | 6\*fU1H - 3\*fU3H | 7\*fU1L - 2\*fU3L | 7\*fU1H - 2\*fU3H |
| Interference ranges | 734 | 929 | 2382 | 2607 | 4030 | 4285 |

---End of changes---

# Reference

[1] R4-2405246 TR38.718-02-01 v0.11.0: Rel-18 NR Inter-band Carrier Aggregation/Dual Connectivity for 2 bands DL with x bands UL (x=1,2), ZTE Corporation