**3GPP T****SG-RAN WG4 Meeting#99 Rev 1 of R4-2109401**

**E-meeting, 19th – 27th May, 2021**

**Title: TP to TR 38.717-02-01 Addition of CA\_n12A-n66A**

**Source: AT&T, Nokia**

**Agenda item: 8.10.2**

**Document for: Approval**

# 1 Introduction

This contribution is a TP to TR 38.717-02-01 to introduce CA\_n12A-n66A.

# 2 Text Proposal

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* Start of the TP \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

## 6.X CA\_n12-n66

### 6.X.1 Common for 1 band UL and 2 bands UL CA

#### 6.X.1.1 Operating bands for CA

Table 6.X.1-1: CA band combination of band CA\_n12 + n66

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR CA Band Combination | 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 | | |
| CA\_n12-n66 | n12 | 699 MHz | – | 716 MHz | 729 MHz | – | 746 MHz | FDD |
| n66 | 1710 MHz | – | 1780 MHz | 2110 MHz | – | 2200 MHz | FDD |

#### 6.X.1.2 Channel bandwidths per operating band for CA

Table 6.X.1.2-1: Supported bandwidths per CA band combination of band CA\_n12 + n66

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR CA configuration | UL configuration | NR Band | 5 | 10 | 15 | 20 | 25 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | Bandwidth combination set |
| CA\_n12A-n66A | CA\_n12A-n66A | n12 | 5 | 10 | 15 |  |  |  |  |  |  |  |  |  |  | 0 |
| n66 | 5 | 10 | 15 | 20 |  |  | 40 |  |  |  |  |  |  |

#### 6.X.1.3 Co-existence studies

Table 6.X.1.3-1/2 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA\_n12-n66.

Table 6.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 |
| n12 | 699 | 716 | 729 | 746 | 1398 | 1432 | 2097 | 2148 | 2796 | 2864 | 3495 | 3580 |
| n66 | 1710 | 1780 | 2110 | 2200 | 3420 | 3560 | 5130 | 5340 | 6840 | 7120 | 8550 | 8900 |

Based on above table, the 3rd harmonic of n12 UL may fall into the lower DL frequency range of n66.

Table 6.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 |
| n12 | 699 | 716 | 729 | 746 | 1458 | 1492 | 2187 | 2238 | 2916 | 2984 | 3645 | 3730 |
| n66 | 1710 | 1780 | 2110 | 2200 | 4220 | 4400 | 6330 | 6600 | 8440 | 8800 | 10550 | 11000 |

Based on above table, there is no harmonic mixing issue for the band combination CA\_n12-n66.

#### 6.X.1.4 ∆TIB and ∆RIB values

For CA\_n12-n66, the ΔTIB,c and ΔRIB,c values are reused from the EN-DC combination DC\_12\_n66, and are given in the tables below.

Table 6.X.1.4-1: ΔTIB,c

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n12-n66 | n12 | 0.8 |
| n66 | 0.3 |

Table 6.X.1.4-2: ΔRIB

| Inter-band CA Configuration | NR Band | ΔRIB [dB] |
| --- | --- | --- |
| CA\_n12-n66 | n12 | 0.5 |
| n66 | 0 |

#### 6.X.1.5 REFSENS requirements

Due to the identified harmonic issues, MSD is derived by reusing the values specified for DC\_12A-n66A and needs to be defined in 38.101-1 as defined below.

Table 6.X.1.5-1: Reference sensitivity exceptions due to UL harmonic for NR CA FR1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| MSD due to harmonic exception for the DL band | | | | | | | | | | | | | |
| UL band | DL band | 5 MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 30 MHz | 40 MHz | 50 MHz | 60 MHz | 80 MHz | 90 MHz | 100 MHz |
| dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB |
| n12 | n668,9 | 10 | 7.5 | 6.2 | 5.5 |  |  | 2.4 |  |  |  |  |  |
| NOTE 8: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of the aggressor (lower) band for which the 3rd transmitter harmonic is within the downlink transmission bandwidth of a victim (higher) band.  NOTE 9: The requirements should be verified for UL NR-ARFCN of the aggressor (lower) band (superscript LB) such that in MHz and  with carrier frequency in the victim (higher) band in MHz and  the channel bandwidth configured in the lower band. | | | | | | | | | | | | | |

Table 6.X.1.5-2: Uplink configuration for reference sensitivity exceptions due to UL harmonic interference for NR CA, FR1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band / Channel bandwidth of the high band | | | | | | | | | | | | | |
| UL band | DL band | 5 MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 30 MHz | 40 MHz | 50 MHz | 60 MHz | 80 MHz | 90 MHz | 100 MHz |
| n12 | n66 | 8 | 16 | 20 | 20 |  |  | 20 |  |  |  |  |  |

#### 6.X.1.6 OOB blocking exception requirements

No need to specify OOB exception requirement for CA\_n12-n66.

Table 6.X.1.6-1: CA band combination with exceptions allowed

|  |
| --- |
| CA band combination |
| No exceptions |

### 6.X.2 Specific for 2 bands UL CA

#### 6.X.2.1 Maximum output power for inter-band CA

Table 6.X.2.1-1: UE Power Class for uplink inter-band CA

|  |  |  |
| --- | --- | --- |
| Uplink CA Configuration | Class 3 (dBm) | Tolerance (dB) |
| CA\_n12A-n66A | 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.X.2.2 UE co-existence

Table 6.X.2.2-1 gives IMD interference analysis for CA\_ n12-n66 with 2 ULs.

Table 6.X.2.2-1: Harmonic and IMD analysis

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| UE UL carriers | fx\_low | fx\_high | fy\_low | fy\_high |
| UL frequency (MHz) | 699 | 716 | 1710 | 1780 |
| DL frequency (MHz) | 729 | 746 | 2110 | 2200 |
| 2nd harmonics frequency limits | 2\*fx\_low | 2\*fx\_high | 2\* fy\_low | 2\* fy\_high |
| 2nd harmonics frequency limits (MHz) | 1398 | 1432 | 3420 | 3560 |
| 3rd harmonics frequency limits | 3\*fx\_low | 3\*fx\_high | 3\* fy\_low | 3\* fy\_high |
| 3rd harmonics frequency limits (MHz) | 2097 | 2148 | 5130 | 5340 |
| 4th harmonics frequency limits | 4\*fx\_low | 4\*fx\_high | 4\* fy\_low | 4\* fy\_high |
| 4th harmonics frequency limits (MHz) | 2796 | 2864 | 6840 | 7120 |
| 5th harmonics frequency limits | 5\*fx\_low | 5\*fx\_high | 5\* fy\_low | 5\* fy\_high |
| 5th harmonics frequency limits (MHz) | 3495 | 3580 | 8550 | 8900 |
| Two tone 2nd order IMD products | |fy\_low - fx\_high| | |fy\_high - fx\_low| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 994 | 1081 | 2409 | 2496 |
| 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) | 382 | 278 | 2704 | 2861 |
| 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) | 3108 | 3212 | 4119 | 4276 |
| Two-tone 4th order IMD products | |3\*fx\_low - fy\_high| | |3\*fx\_high - fy\_low| | |3\*fy\_low - fx\_high| | |3\*fy\_high - fx\_low| |
| IMD frequency limits (MHz) | 317 | 438 | 4414 | 4641 |
| Two-tone 4th order IMD products | |3\*fx\_low + fy\_low| | |3\*fx\_high + fy\_high| | |3\*fy\_low + fx\_low| | |3\*fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 3807 | 3928 | 5829 | 6056 |
| 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) | 2162 | 1988 | 4818 | 4992 |
| 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) | 6421 | 6124 | 1154 | 1016 |
| 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) | 7539 | 7836 | 4506 | 4644 |
| 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) | 3942 | 3698 | 1272 | 1463 |
| 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) | 6528 | 6772 | 5517 | 5708 |

Based on the table above:

- There are no IMD products that fall into Rx frequencies of band n12.

- There is a 4th order IMD product that may fall into Rx frequencies of band n66.

Table 6.X.2.2-2 lists the protected bands required for the 2UL bands CA configuration.

Table 6.X.2.2-2: Protected bands for the 2UL bands CA configuration

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| NR CA Configuration | Spurious emission | | | | | | |
| Protected band | Frequency range (MHz) | | | Maximum Level (dBm) | MBW (MHz) | NOTE |
| CA\_n12-n66 | E-UTRA Band 2, 5, 13, 14, 17, 25, 26, 27, 30, 41, 53, 71, 74 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 4, 48, 50, 51, 66, 70  NR Band n77 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| E-UTRA Band 12, 85 | FDL\_low | - | FDL\_high | -50 | 1 | 4 |
| 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. | | | | | | | |

#### 6.X.2.3 REFSENS requirements

Based on the co-existence studies for CA\_n12-n66, MSD due to IMD4 is required. The MSD values can be reused from CA\_n66-n71.

**Table 6.X.2.3-1: MSD due to IMD issue**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Operating band / Channel bandwidth / NRB / Duplex mode | | | | | | | Source of IMD |
| CA  Configuration | Operating band | UL Fc (MHz) | UL/DL BW  (MHz) | UL  LCRB | DL Fc (MHz) | MSD  (dB) |
| CA\_n12A-n66A | n12 | 707.5 | 5 | 25 | 737.5 | N/A | N/A |
| n66 | 1765 | 5 | 25 | 2165 | 5.0 | IMD4 |

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# 3 References