3GPP TSG-RAN WG4 Meeting # 102-e R4-2205669

Electronic Meeting, February 21 – March 3, 2022

**Source:** Charter Communications

**Title:** TP to TR 38.717.02-01 for CA\_n48-n96 and DC\_n48-n96

**Agenda item:** 9.6.1

**Document for:** Approval

# Background

This contribution provides text proposal on the NR CA and DC CA band combination CA\_n48A-n96A as defined in revised WID on Rel-17 NR Inter-band Carrier Aggregation/Dual Connectivity for 2 bands DL with x bands UL (x=1,2) RP-212877[1]..

# Text Proposal

##### ---Start of changes---

## 6.X CA\_n48-n96

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

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

Table 6.X.1.1-1: CA band combination of band n48+ n96

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **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\_ n48-n96 | n48 | 3550 MHz | – | 3700 MHz | 3550 MHz | – | 3700 MHz | TDD |
| n96 | 5925 MHz  | – | 7125 MHz | 5925 MHz  | – | 7125 MHz | TDD |

#### 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 n48 + n96

|  |
| --- |
| **CA operating/channel bandwidth [MHz]** |
| **NR CA configuration** | **Uplink CA configuration** | **NR Band** | **5 MHz** | **10 MHz** | **15MHz** | **20 MHz** | **25 MHz** | **30 MHz** | **40MHz** | **50MHz** | **60MHz** | **70MHz** | **80 MHz** | **90 MHz** | **100 MHz** | **Bandwidth combination set** |
| CA\_n48A-n96A | CA\_n48A-n96A | n48 | 5 | 10 | 15 | 20 |  | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 0 |
| n96 |  |  |  | 20 |  |  | 40 |  | 60 |  | 80 |  |  |  |
| CA\_n48B-n96A | CA\_n48A-n96A CA\_n48B-n96A | n48 | See CA\_n48B Bandwidth Combination Set 0 in Table 5.5A.1-1 | 0 |
| n96 |  |  |  | 20 |  |  | 40 |  | 60 |  | 80 |  |  |  |
| CA\_n48C-n96A | CA\_n48A-n96A  | n48 | See CA\_n48C Bandwidth Combination Set 0 in Table 5.5A.1-1 | 0 |
| n96 |  |  |  | 20 |  |  | 40 |  | 60 |  | 80 |  |  |  |
| CA\_n48A-n96B | CA\_n48A-n96A  | n48 | 5 | 10 | 15 | 20 |  | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 0 |
| n96 | See CA\_n96B Bandwidth Combination Set 0 in Table 5.5A.1-1 |  |
| CA\_n48B-n96B | CA\_n48A-n96A CA\_n48B-n96A | n48 | See CA\_n48B Bandwidth Combination Set 0 in Table 5.5A.1-1 | 0 |
| n96 | See CA\_n96B Bandwidth Combination Set 0 in Table 5.5A.1-1 |  |
| CA\_n48C-n96B | CA\_n48A-n96A  | n48 | See CA\_n48C Bandwidth Combination Set 0 in Table 5.5A.1-1 | 0 |
| n96 | See CA\_n96B Bandwidth Combination Set 0 in Table 5.5A.1-1 |  |
| CA\_n48A-n96C | CA\_n48A-n96A | n48 | 5 | 10 | 15 | 20 |  | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 0 |
| n96 | See CA\_n96C Bandwidth Combination Set 0 in Table 5.5A.1-1 |  |
| CA\_n48B-n96C | CA\_n48A-n96A CA\_n48B-n96A | n48 | See CA\_n48B Bandwidth Combination Set 0 in Table 5.5A.1-1 | 0 |
| n96 | See CA\_n96C Bandwidth Combination Set 0 in Table 5.5A.1-1 |  |
| CA\_n48C-n96C | CA\_n48A-n96A  | n48 | See CA\_n48C Bandwidth Combination Set 0 in Table 5.5A.1-1 | 0 |
| n96 | See CA\_n96C Bandwidth Combination Set 0 in Table 5.5A.1-1 |  |
| CA\_n48A-n96D | CA\_n48A-n96A | n48 | 5 | 10 | 15 | 20 |  | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 0 |
| n96 | See CA\_n96D Bandwidth Combination Set 0 in Table 5.5A.1-1 |  |
| CA\_n48B-n96D | CA\_n48A-n96A CA\_n48B-n96A | n48 | See CA\_n48B Bandwidth Combination Set 0 in Table 5.5A.1-1 | 0 |
| n96 | See CA\_n96D Bandwidth Combination Set 0 in Table 5.5A.1-1 |  |
| CA\_n48C-n96D | CA\_n48A-n96A  | n48 | See CA\_n48C Bandwidth Combination Set 0 in Table 5.5A.1-1 | 0 |
| n96 | See CA\_n96D Bandwidth Combination Set 0 in Table 5.5A.1-1 |  |
| CA\_n48A-n96E | CA\_n48A-n96A | n48 | 5 | 10 | 15 | 20 |  | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 0 |
| n96 | See CA\_n96E Bandwidth Combination Set 0 in Table 5.5A.1-1 |  |
| CA\_n48B-n96E | CA\_n48A-n96A CA\_n48B-n96A | n48 | See CA\_n48B Bandwidth Combination Set 0 in Table 5.5A.1-1 | 0 |
| n96 | See CA\_n96E Bandwidth Combination Set 0 in Table 5.5A.1-1 |  |
| CA\_n48C-n96E | CA\_n48A-n96A  | n48 | See CA\_n48C Bandwidth Combination Set 0 in Table 5.5A.1-1 | 0 |
| n96 | See CA\_n96E Bandwidth Combination Set 0 in Table 5.5A.1-1 |  |

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

Table 6.X.1.3-1/2 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA\_n48-n96.

**Table 6.X.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 | 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 | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge |
| n48 | 3550 | 3700 | 3550 | 3700 | 7100 | 7400 | 10650 | 11100 | 14200 | 14800 | 17750 | 18500 | 21300 | 22200 | 24850 | 25900 |
| n96 | 5925 | 7125 | 5925 | 7125 | 11850 | 14250 | 17775 | 21375 | 23700 | 28500 | 29625 | 35625 | 35550 | 42750 | 41475 | 49875 |

Based on above table, there is no harmonic interference.

**Table 5.X.1.3-2: Impact of UL/DL Harmonic mixing**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | **3rd Harmonic** | **4th Harmonic** | **5th harmonic** | **6th Harmonic** | **7th 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 | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge |
| n48 | 3550 | 3700 | 3550 | 3700 | 7100 | 7400 | 10650 | 11100 | 14200 | 14800 | 17750 | 18500 | 21300 | 22200 | 24850 | 25900 |
| n96 | 5925 | 7125 | 5925 | 7125 | 11850 | 14250 | 17775 | 21375 | 23700 | 28500 | 29625 | 35625 | 35550 | 42750 | 41475 | 49875 |

Based on above table, there is no harmonic issue for CA\_n48-n96.

#### 6.X.1.4 ∆TIB and ∆RIB values

For CA\_n48-n96, the ΔTIB,c and ΔRIB are given in the tables below.

Table 6.X.1.4-1: ΔTIB,c

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n48-n96 | n48 | 0.5 |
| n96 | 0.5 |

Table 5.X.1.4-2: ΔRIB

| Inter-band CA Configuration | NR Band | ΔRIB [dB] |
| --- | --- | --- |
| CA\_ n48-n96 | n48 | 0.5 |
| n96 | 0 |
|  |

#### 6.X.1.5 REFSENs requirements

There are no harmonic or IMD overlaps as a result of non-simultaneous Tx/Rx.

Note: if support for simultaneous Tx/Rx for combinations with n96 are needed then these combinations will be subject to MSD or exclusion in the region where MSD would occur

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

There is no OOB blocking exception requirement for CA\_n48-n96.

### 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\_n48A-n96ACA\_n48B-n96A | 23 | +2/-3 |
|  |

#### 6.X.2.2 UE co-existence

Table 6.1.2.2-1 gives IMD interference analysis for CA\_ n48-n96 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) | 3550 | 3700 | 5925 | 7125 |
| Two tone 2nd order IMD products | fy\_low – fx\_high | fy\_high – fx\_low | fx\_low + fy\_low | fx\_high + fy\_high |
| IMD frequency limits (MHz) | 2225 | 3575 | 9475 | 10825 |
| 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) | 25 | 1475 | 8150 | 10700 |
| 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) | 13025 | 14525 | 15400 | 17950 |
| 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) | 3525 | 5175 | 14075 | 17825 |
| 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) | 16575 | 18225 | 21325 | 25075 |
| Two-tone 4th order IMD products | 2\*fy\_low – 2\*fx\_high | 2\*fy\_high – 2\*fx\_low | 2\*fx\_low + 2\*fy\_low | 2\*fx\_high + 2\*fy\_high |
| IMD frequency limits (MHz) | 4450 | 7150 | 18950 | 21650 |
| Two-tone 5th order IMD products | |4\*fx\_low – fy\_high| | |4\*fx\_high – fy\_low| | 4\*fy\_low – fx\_high | 4\*fy\_high – fx\_low |
| IMD frequency limits (MHz) | 7075 | 8875 | 20000 | 24950 |
| Two-tone 5th order IMD products | 4\*fx\_low + fy\_low | 4\*fx\_high + fy\_high | 4\*fy\_low + fx\_low | 4\*fy\_high + fx\_high |
| IMD frequency limits (MHz) | 20125 | 21925 | 27250 | 32200 |
| Two-tone 5th order IMD products | |3\*fx\_low – 2\*fy\_high| | |3\*fx\_high – 2\*fy\_low| | 3\*fy\_low – 2\*fx\_high | 3\*fy\_high – 2\*fx\_low |
| IMD frequency limits (MHz) | 3600 | 750 | 10375 | 14275 |
| 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) | 24875 | 28775 | 22500 | 25350 |

Based on the table 6.x.2.2-1, there is no IMD issue for CA\_n48-n96.

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

**Table 6.8.2.2-2: 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\_n48-n96 | E-UTRA Band 2, 4, 5, 10, 12, 13, 14, 17, 24, 25, 26, 29, 30, 50, 51, 53, 66, 70, 71, 85 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 41, NR band n79 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| 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 RBsize kHz), 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. |

#### 7.3G.5.X Reference sensitivity exceptions due to cross band isolation

For unsynchronized operation, Rx de-sensing in one band will be caused by another band due to lack of isolation in the band filters. Reference sensitivity exceptions for cross band are specified in Table 7.3G.5.X-1 with uplink configuration specified in Table 7.3G.5.X-2.

Table 7.3G.5.X-1: MSD due to cross band isolation

|  |
| --- |
| **Operating Band / Channel bandwidth of the affected DL band** |
| **CA Configuration** | **UL band** | **DL band** | **5MHz (dB)** | **10MHz (dB)** | **15MHz (dB)** | **20MHz (dB)** | **25MHz (dB)** | **30 MHz (dB)** | **40 MHz (dB)** | **50 MHz (dB)** | **60 MHz (dB)** | **80 MHz (dB)** | **90 MHz (dB)** | **100 MHz (dB)** |
| CA\_n46A-n48A | n46 | n48 | 13.3 | 13.3 | 11.8 | 10.7 | - | 9.4 | 8.5 | 7.9 | 7.3 | 7.0 | 6.4 | 6.2 |
|  | n48 | n46 | - | - | - | 15.7 | - | - | 15.7 | - | 15.7 | 15.7 | - | - |
| CA\_n48A-n96A | n96 | n48 | 4.3 | 4.1 | 4.0 | 3.9 |  | 3.9 | 3.9 | 3.9 | 3.8 | 3.8 | 3.8 | 3.8 |
|  | n48 | n96 |  |  |  | 5.8 |  |  | 5.6 |  | 5.5 | 5.5 |  |  |

Table 7.3G.5.X-2: Uplink configuration for reference sensitivity exceptions due to cross band isolation

|  |
| --- |
| **Operating Band / SCS / Channel bandwidth of the affected DL band** |
| **UL band** | **DL band** | **SCS of UL band (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** |
| n46 | n48 | 30 | 216 | 216 | 216 | 216 |  |  | 216 | 216 | 216 | 216 | 216 | 216 |
| n48 | n46 | 15 |  |  |  | 216 |  |  | 216 |  | 216 | 216 |  |  |
| n96 | n48 | 30 | 216 | 216 | 216 | 216 |  | 216 | 216 | 216 | 216 | 216 | 216 | 216 |
| n48 | n96 | 15 |  |  |  | 216 |  |  | 216 |  | 216 | 216 |  |  |
| NOTE 1: The UL configuration applies regardless of the channel bandwidth of the UL band unless the UL resource blocks exceed that specified in Table 7.3.2-3 for the uplink bandwidth in which case the allocation according to Table 7.3.2-3 applies.NOTE 2: Refers to the UL resource blocks shall be located as close as possible to the downlink operating band but confined within the transmission bandwidth configuration for the channel bandwidth in Table 5.3.2-1. |

## 9.X DC\_n48-n96

9.X.1 Operating bands for DC n48-n96

Table 9.X.1-1: **Inter-band NR DC operating bands within FR1**

|  |  |
| --- | --- |
| **NR DC Band** | **NR Band** |
| DC\_n48-n969 | n48, n96 |

### 9.x.2 Configurations for DC\_n48-n96

**Table 9.X.2-1: Inter-band NR DC configurations within FR1**

| NR DCconfiguration | Uplink NR DCconfiguration |
| --- | --- |
| DC\_n48A-n96A DC\_n48B-n96A DC\_n48C-n96A DC\_n48A-n96B DC\_n48B-n96B DC\_n48C-n96B DC\_n48A-n96C DC\_n48B-n96C DC\_n48C-n96C DC\_n48A-n96D DC\_n48B-n96D DC\_n48C-n96D DC\_n48A-n96E DC\_n48B-n96E DC\_n48C-n96E | DC\_n48A-n96ADC\_n48B-n96A |

9.X.3 Maximum output power for NR-DC

**Table 9.X.3-1** **UE Power Class for uplink inter-band CA**

|  |  |  |
| --- | --- | --- |
| Uplink CA Configuration | Class 3 (dBm) | Tolerance (dB)  |
| DC\_n48A-n96ADC\_n48B-n96A | 23 | +2/-3 |

##### ---End of changes---

# Reference

[1] RP-212877, “Revised WID on Rel-17 NR Inter-band Carrier Aggregation/Dual Connectivity for 2 bands DL with x bands UL (x=1,2)”, ZTE Corporation