3GPP TSG-RAN WG4 Meeting #102-e R4-2205247

Electronic Meeting, 21 February– 3 March, 2022

**Source:** Huawei, HiSilicon

**Title:** Updated TP for TR 37.717-21-11 add MSD due to harmonic interference between band n28 and 32

**Agenda Item:** 9.15.2

**Document for:** Approval

# Introduction

The WID for NR DC was updated in RAN #94e meeting. This contribution provides a TP for TR 37.717-31-11 to finish the UE RF requirements for the band combination.

# References

[1] RP-212901, “Revised WID on Rel-17 Dual Connectivity (DC) of 3 bands LTE inter-band CA (3DL/1UL) and 1 NR band (1DL/1UL)”, Ericsson

# Text Proposal

**<TP for TR 37.717-21-11>**

## 5.8 DC\_7-32\_n28

### 5.8.1 Configurations for DC

Table 5.8.1-1: Inter-band DC configurations (three bands)

| DC  configuration | Uplink configuration |
| --- | --- |
| DC\_7A-32A\_n28A | DC\_7A\_n28A |

### 5.8.2 Co-existence studies

Table 5.8.2-1 lists the Band 7A + Band n28A 2UL DC 2nd and 3rd order harmonics and 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

Table 5.8.2-1: Band 7 and Band n28 UL harmonics and IMD products

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | | **fn\_low** | **fn\_high** | |
| UL frequency (MHz) | 2500 | 2570 | | 703 | 748 | |
| 2nd harmonics frequency limits | 2\*fx\_low | 2\*fx\_high | | 2\* fn\_low | 2\* fn\_high | |
| 2nd harmonics frequency limits (MHz) | 5000 – 5140 | | | 1406 – 1496 | | |
| 3rd harmonics frequency limits | 3\*fx\_low | | 3\*fx\_high | 3\* fn\_low | | 3\* fn\_high |
| 3rd harmonics frequency limits (MHz) | 7500 – 5940 | | | 2109 – 2244 | | |
| 2nd order IMD products | |fn\_low – fx\_high| | |fn\_high – fx\_low| | | |fn\_low + fx\_low| | |fn\_high + fx\_high| | |
| IMD frequency limits (MHz) | 1752 – 1867 | | | 3203 – 3318 | | |
| Two-tone 3rd order IMD products | |2\*fx\_low – fn\_high| | |2\*fx\_high – fn\_low| | | |2\*fn\_low – fx\_high| | |2\*fn\_high – fx\_low| | |
| IMD frequency limits (MHz) | 4252 – 4437 | | | 1074 – 1164 | | |
| Two-tone 3rd order IMD products | |2\*fx\_low + fn\_low| | |2\*fx\_high + fn\_high| | | |2\*fn\_low + fx\_low| | |2\*fn\_high + fx\_high| | |
| IMD frequency limits (MHz) | 5703 – 5888 | | | 3906 – 4066 | | |
| Two-tone 3rd order IMD products | (fx\_low – max BW fn) | | (fx\_high + max BW fn) | (fn\_low – max BW fx) | | (fn\_high + max BW fx) |
| IMD frequency limits (MHz) | 2470 – 2600 | | | 683 – 768 | | |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fn\_high| | | |3\*fx\_high – 1\*fn\_low| | |3\*fn\_low – 1\*fx\_high| | | |3\*fn\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 6752 – 7007 | | | 256 – 461 | | |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fn\_high| | | |2\*fx\_high –2\* fn\_low| |  | |  |
| IMD frequency limits (MHz) | 3504 – 3734 | | |  | | |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fn\_low| | | |3\*fx\_high + 1\*fn\_high| | |3\*fn\_low + 1\*fx\_low| | | |3\*fn\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 8203 – 8458 | | | 4029 – 4224 | | |
| Two-tone 4th order IMD products | |2\*fx\_low +2\* fn\_low| | | |2\*fx\_high +2\* fn\_high| |  | |  |
| IMD frequency limits (MHz) | 6406 – 6636 | | |  | | |
| Two-tone 5th order IMD products | |fx\_low – 4\*fn\_high| | | |fx\_high – 4\*fn\_low| | |fn\_low – 4\*fx\_high| | | |fn\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 242 – 492 | | | 6932 – 7217 | | |
| Two-tone 5th order IMD products | |2\*fx\_low - 3\*fn\_high| | | |2\*fx\_high - 3\*fn\_low| | |2\*fn\_low - 3\*fx\_high| | | |2\*fn\_high -3\*fx\_low| |
| IMD frequency limits (MHz) | 2756 – 3031 | | | 4264 – 4534 | | |
| Two-tone 5th order IMD products | |fx\_low + 4\*fn\_low| | | |fx\_high + 4\*fn\_high| | |fn\_low + 4\*fx\_low| | | |fn\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 5312 – 5562 | | | 8383 – 8668 | | |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fn\_low| | | |2\*fx\_high + 3\*fn\_high| | |2\*fn\_low + 3\*fx\_low| | | |2\*fn\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 7109 – 7384 | | | 8906 – 9206 | | |

Based on Table 5.8.2-1,

- 2nd order harmonics may fall into Rx frequencies of bands 11, 21, 32, 45, 75 and 76

- 3rd order harmonics may fall into Rx frequencies of bands 1, 4, 10, 23, 65 and 66

- 2nd order IMD may fall into Rx frequencies of bands 3, 9, 35 and 77

- 3rd order IMD may fall into Rx frequencies of bands 46, 47 and 77

- 4th order IMD may fall into Rx frequencies of bands 22, 42, 43, 48 and 77

- 5th order IMD may fall into Rx frequencies of bands 31 and 46

When a 2UL inter-band DC UE is operating with other systems such as Wi-Fi, Bluetooth and GNSS, the harmonics and intermodulation products can have an impact on these systems. Table 5.8.2-2 lists if up to 3rd order harmonics and IMD up to 5th order falls into one of these receiving bands.

Table 5.8.2-2: 2UL Band 7 + Band n28 harmonic and IMD for ISM and GNSS bands

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Victim Systems** | **Frequency range [MHz]** | | | **Impact** | **Regions** | **Comments** |
| COMPASS  (Beidou) | 1559 | - | 1591 | No |  |  |
| Galileo | 1559 | - | 1591 | No |  |  |
| GLONASS | 1591 | - | 1610 | No |  |  |
| GPS | 1563 | - | 1587 | No |  |  |
| ISM band  (2.4GHz) | 2400 | - | 2483.5 | Yes | US/Europe | IMD3 |
| 2400 | - | 2494 | Yes | Asia | IMD3 |
| ISM band  (5GHz) | 5150 | - | 5925 | Yes | US | IMD3, IMD5 |
| 5150 | - | 5350 | Yes | Europe | IMD 5 |
| 5470 | - | 5725 | Yes | IMD3, IMD5 |
| 5150 | - | 5825 | Yes | Asia | IMD3, IMD5 |

The requirements for coexistence with protected bands, excluding band 32, exist for DC\_7A\_n28A in 38101-3.

### 5.8.3 ∆TIB and ∆RIB values

Table 5.8.3-1: ΔTIB,c

| Inter-band DC Configuration | E-UTRA and NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| DC\_7A-32A\_n28 | 7 | 0.3 |
| n28 | 0.7 |

**Table 5.8.3-2: ΔRIB**

| Inter-band DC Configuration | E-UTRA and NR Band | ΔRIB [dB] |
| --- | --- | --- |
| DC\_7A-32A\_n28 | 7 | 0 |
| 32 | 0 |
| n28 | 0.2 |

### 5.8.4 Reference sensitivity exceptions

The entries in tables 5.8.4-1 and 5.8.4-2 are to be added to TS38101-3 tables 7.3B.2.3.1-1 and 7.3B.2.3.1-2 respectively.

**Table 5.8.4-1: Reference sensitivity exceptions (MSD) due to UL harmonic for EN-DC in NR FR1**

| E-UTRA or NR Band / Channel bandwidth of the affected DL band / MSD | | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| UL band | DL band | 5 MHz  (dB) | 10 MHz  (dB) | 15 MHz  (dB) | 20 MHz  (dB) | 25 MHz  (dB) | 30 MHz (dB) | 40 MHz  (dB) | 50 MHz  (dB) | 60 MHz  (dB) | 80 MHz  (dB) | 90 MHz  (dB) | 100 MHz  (dB) |
| n28 | 32 | 28.1 | 25.3 | 24.0 | 22.8 |  |  |  |  |  |  |  |  |

**Table 5.8.4-2: Uplink configuration for reference sensitivity exceptions due to UL harmonic interference for EN-DC in NR FR1**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| E-UTRA or NR Band / Channel bandwidth of the affected DL band / UL RB allocation of the aggressor band | | | | | | | | | | | | | |
| UL band | DL band | 5  MHz  (LCRB) | 10 MHz  (LCRB) | 15 MHz  (LCRB) | 20 MHz  (LCRB) | 25 MHz  (LCRB) | 30 MHz  (LCRB) | 40 MHz  (LCRB) | 50 MHz  (LCRB) | 60 MHz  (LCRB) | 80 MHz  (LCRB) | 90 MHz  (LCRB) | 100 MHz  (LCRB) |
| n28 | 32 | 12 | 25 | 25 | 25 |  |  |  |  |  |  |  |  |

**<Next of TP >**

## 5.10 DC\_20-32\_n28

### 5.10.1 Configurations for DC

Table 5.10.1-1: Inter-band DC configurations (three bands)

| DC  configuration | Uplink configuration |
| --- | --- |
| DC\_20A-32A\_n28A | DC\_20A\_n28A |

### 5.10.2 Co-existence studies

Table 5.10.2-1 lists the Band 20A + Band n28A 2UL DC 2nd and 3rd order harmonics and 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

Table 5.10.2-1: Band 20 and Band n28 UL harmonics and IMD products

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | | **fn\_low** | **fn\_high** | |
| UL frequency (MHz) | 832 | 862 | | 703 | 748 | |
| 2nd harmonics frequency limits | 2\*fx\_low | 2\*fx\_high | | 2\* fn\_low | 2\* fn\_high | |
| 2nd harmonics frequency limits (MHz) | 1664 – 1724 | | | 1406 – 1496 | | |
| 3rd harmonics frequency limits | 3\*fx\_low | | 3\*fx\_high | 3\* fn\_low | | 3\* fn\_high |
| 3rd harmonics frequency limits (MHz) | 2496 – 2586 | | | 2109 – 2244 | | |
| 2nd order IMD products | |fn\_low – fx\_high| | |fn\_high – fx\_low| | | |fn\_low + fx\_low| | |fn\_high + fx\_high| | |
| IMD frequency limits (MHz) | 84 – 159 | | | 1535 – 1610 | | |
| Two-tone 3rd order IMD products | |2\*fx\_low – fn\_high| | |2\*fx\_high – fn\_low| | | |2\*fn\_low – fx\_high| | |2\*fn\_high – fx\_low| | |
| IMD frequency limits (MHz) | 916 – 1021 | | | 544 – 634 | | |
| Two-tone 3rd order IMD products | |2\*fx\_low + fn\_low| | |2\*fx\_high + fn\_high| | | |2\*fn\_low + fx\_low| | |2\*fn\_high + fx\_high| | |
| IMD frequency limits (MHz) | 2367 – 2472 | | | 2238 – 2358 | | |
| Two-tone 3rd order IMD products | (fx\_low – max BW fn) | | (fx\_high + max BW fn) | (fn\_low – max BW fx) | | (fn\_high + max BW fx) |
| IMD frequency limits (MHz) | 802 – 892 | | | 703 – 748 | | |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fn\_high| | | |3\*fx\_high – 1\*fn\_low| | |3\*fn\_low – 1\*fx\_high| | | |3\*fn\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 1748 – 1883 | | | 1247 – 1412 | | |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fn\_high| | | |2\*fx\_high –2\* fn\_low| |  | |  |
| IMD frequency limits (MHz) | 168 – 318 | | |  | | |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fn\_low| | | |3\*fx\_high + 1\*fn\_high| | |3\*fn\_low + 1\*fx\_low| | | |3\*fn\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 3199 – 3334 | | | 4029 – 4224 | | |
| Two-tone 4th order IMD products | |2\*fx\_low +2\* fn\_low| | | |2\*fx\_high +2\* fn\_high| |  | |  |
| IMD frequency limits (MHz) | 3070 – 3220 | | |  | | |
| Two-tone 5th order IMD products | |fx\_low – 4\*fn\_high| | | |fx\_high – 4\*fn\_low| | |fn\_low – 4\*fx\_high| | | |fn\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 1950 – 2160 | | | 6932 – 7217 | | |
| Two-tone 5th order IMD products | |2\*fx\_low - 3\*fn\_high| | | |2\*fx\_high - 3\*fn\_low| | |2\*fn\_low - 3\*fx\_high| | | |2\*fn\_high -3\*fx\_low| |
| IMD frequency limits (MHz) | 385 – 580 | | | 4264 – 4534 | | |
| Two-tone 5th order IMD products | |fx\_low + 4\*fn\_low| | | |fx\_high + 4\*fn\_high| | |fn\_low + 4\*fx\_low| | | |fn\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 3644 – 3854 | | | 8383 – 8668 | | |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fn\_low| | | |2\*fx\_high + 3\*fn\_high| | |2\*fn\_low + 3\*fx\_low| | | |2\*fn\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 3773 – 3968 | | | 3902 – 4082 | | |

Based on Table 5.10.2-1,

- 2nd order harmonics may fall into Rx frequencies of bands 11, 21, 32, 38, 41, 45, 69, 75 and 76

- 3rd order harmonics may fall into Rx frequencies of bands 1, 4, 10, 23, 65 and 66

- 2nd order IMD may fall into Rx frequencies of band 24

- 3rd order IMD may fall into Rx frequencies of bands 8, 30 and 40

- 4th order IMD may fall into Rx frequencies of bands 3, 9, 35, 39 and 77

- 5th order IMD may fall into Rx frequencies of bands 1, 2, 4, 7, 10, 25, 31, 34, 36, 38, 41, 43, 48, 65, 66, 69, 70 and 77

When a 2UL inter-band DC UE is operating with other systems such as Wi-Fi, Bluetooth and GNSS, the harmonics and intermodulation products can have an impact on these systems. Table 5.10.2-2 lists if up to 3rd order harmonics and IMD up to 5th order falls into one of these receiving bands.

Table 5.10.2-2: 2UL Band 20 + Band n28 harmonic and IMD for ISM and GNSS bands

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Victim Systems** | **Frequency range [MHz]** | | | **Impact** | **Regions** | **Comments** |
| COMPASS  (Beidou) | 1559 | - | 1591 | Yes |  | IMD 2 |
| Galileo | 1559 | - | 1591 | Yes |  | IMD 2 |
| GLONASS | 1591 | - | 1610 | Yes |  | IMD 2 |
| GPS | 1563 | - | 1587 | Yes |  | IMD 2 |
| ISM band  (2.4GHz) | 2400 | - | 2483.5 | Yes | US/Europe | IMD 2 |
| 2400 | - | 2494 | Yes | Asia | IMD 2 |
| ISM band  (5GHz) | 5150 | - | 5925 | No | US |  |
| 5150 | - | 5350 | No | Europe |  |
| 5470 | - | 5725 | No |  |
| 5150 | - | 5825 | No | Asia |  |

The requirements for coexistence with protected bands (including band 32) exist for DC\_20A\_n28A in 38101-3.

### 5.10.3 ∆TIB and ∆RIB values

Table 5.10.3-1: ΔTIB,c

| Inter-band DC Configuration | E-UTRA and NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| DC\_20A-32A\_n28 | 20 | 0.5 |
| n28 | 0.7 |

**Table 5.10.3-2: ΔRIB**

| Inter-band DC Configuration | E-UTRA and NR Band | ΔRIB [dB] |
| --- | --- | --- |
| DC\_20A-32A\_n28 | 20 | 0 |
| 32 | 0 |
| n28 | 0.2 |

### 5.10.4 Reference sensitivity exceptions

The band 32 MSD due to the 2nd harmonic interferene from band n28 can refer to the definition in clause 5.8.4 of this TR.

**<End of TP >**