**3GPP TSG-RAN WG4 Meeting #94-e R4-2001531**

**Online, 24th February – 6th March 2020**

**Source:** Ericsson, Rogers

**Title:** TP for TR 37.716-11-11: DC\_71\_n78

**Agenda item:** 9.3.2

**Document for:** Approval

# 1. Introduction

Rel-16 LTE-NR DC combinations LTE 1 band + NR 1 band combination are defined in the WID [1]. This contribution is a text proposal for TR 37.716-11-11 to include DC\_71\_n78.

# 2. Text Proposal

# ---Start of changes---

6.1.x DC\_71A\_n78A

6.1.x.1 Operating bands for DC

**Table 6.1.x.1-1: DC band combination of 1 LTE band + 1 NR band**

| EN-DC band | E-UTRA Band | NR Band | Single UL allowed |
| --- | --- | --- | --- |
| DC\_71\_n78 | 71 | n78 | No |

6.1.x.2 Configuration for DC

**Table 6.x.2.2-1: Inter-band EN-DC configurations of 1 LTE band + 1 NR band**

| EN-DC  configuration | Uplink EN-DC  configuration  (NOTE 1) | E-UTRA configuration | NR configuration |
| --- | --- | --- | --- |
| DC\_71A\_n78A | DC\_71A\_n78A | 71A | n78A |

6.1.x.3 Maximum output power for DC

**Table 6.1.x.3-1:** **Maximum output power for inter-band EN-DC of 1 LTE band + 1 NR band**

| DC configuration | Power class 3  (dBm) | Tolerance  (dB) |
| --- | --- | --- |
| DC\_71A\_n78A | 23 | +2/-3 |

6.1.x.4 Spurious emission band UE co-existence for DC

**Table 6.1.x.4-1: Spurious emissions for inter-band EN-DC of 1 LTE band + 1 NR band**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **E-UTRA and NR DC Configuration** | **Spurious emission** | | | | | | |
| **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** |
| DC\_71A\_n78A | E-UTRA Band 5, 26 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 41 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.6.3.1-2 are permitted for each assigned E-UTRA 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 180 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. | | | | | | | |

6.1.x.5 MSD analysis for DC

For 2UL/2DL UE coexistence study 2nd, 3rd, 4th and 5th order harmonics and 2nd, 3rd, 4th and 5th order intermodulation products were calculated and presented in Table 6.1.x.5-1

**Table 6.1.x.5-1: Harmonic and IMD analysis**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| UL frequency (MHz) | 663 | 698 | 3300 | 3800 |
| 2nd harmonics frequency limits | 2\* fy\_low | 2\* fy\_high | 2\*fx\_low | 2\*fx\_high |
| 2nd harmonics frequency limits (MHz) | 1326 | 1396 | 6600 | 7600 |
| 3rd harmonics frequency limits | 3\* fy\_low | 3\* fy\_high | 3\*fx\_low | 3\*fx\_high |
| 3rd harmonics frequency limits (MHz) | 1989 | 2094 | 9900 | 11400 |
| 4th harmonics frequency limits | 4\* fy\_low | 4\* fy\_high | 4\*fx\_low | 4\*fx\_high |
| 4th harmonics frequency limits (MHz) | 2652 | 2792 | 13200 | 15200 |
| 5th harmonics frequency limits | 5\* fy\_low | 5\* fy\_high | 5\*fx\_low | 5\*fx\_high |
| 5th harmonics frequency limits (MHz) | 3315 | 3490 | 16500 | 19000 |
| 6th harmonics frequency limits | 6\* fy\_low | 6\* fy\_high | 6\*fx\_low | 6\*fx\_high |
| 6th harmonics frequency limits (MHz) | 3978 | 4188 | 19800 | 22800 |
| 7th harmonics frequency limits | 7\* fy\_low | 7\* fy\_high | 7\*fx\_low | 7\*fx\_high |
| 7th harmonics frequency limits (MHz) | 4641 | 4886 | 23100 | 26600 |
| 2nd order IMD products | |fy\_high – fx\_low| | |fy\_low – fx\_high| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 3137 | 2602 | 3963 | 4498 |
| 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) | 2474 | 1904 | 5902 | 6937 |
| 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) | 4626 | 5196 | 7263 | 8298 |
| 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) | 6274 | 5204 | 7926 | 8996 |
| 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) | 1811 | 1206 | 9202 | 10737 |
| 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) | 5289 | 5894 | 10563 | 12098 |
| 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) | 14537 | 12502 | 508 | 1148 |
| 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) | 13863 | 15898 | 5952 | 6592 |
| 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) | 10074 | 8504 | 4506 | 5611 |
| 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) | 11226 | 12796 | 8589 | 9694 |

Based on Table 6.1.X.5-1, it can be seen that

* 3rd order harmonic may fall into Rx frequencies of bands 25, 34, 36 and 70.
* 4th order harmonic may fall into Rx frequencies of 7, 38, 41, 69 and n90.
* 5th order harmonic may fall into Rx frequencies of 42, 52, n77 and n78
* 2nd order IMD products may fall into Rx frequencies of bands 7, 38, 41, 69, n77 and n79.
* 3rd order IMD products may fall into Rx frequencies of bands 1, 2, 4, 10, 23, 25, 30, 33, 34, 35, 36, 37, 39, 40, 46, 47, 65, 66, 70 and n79.
* 4th order IMD products may fall into Rx frequencies of bands 3, 11, 21, 24, 32, 45, 46, 47, 50, 51, 74, 75, and 76
* 5th order IMD products may fall into Rx frequencies of bands 5, 6, 8, 12, 13, 17, 18, 19, 20, 26, 27, 28, 29, 44, 46, 67, 68 and n79, and also own RX frequencies of band 71.

When 2UL inter-band EN-DC UE is operating with other systems such as WiFi, Bluetooth and GNSS system, the harmonics and intermodulation products can have impact on these systems. Table 6.1.X.5-2 lists up to 7th order harmonics and IMD up to 5th order falls into one of these receiving bands.

**6.1.x.5-2: Band 71 and Band n78 harmonic and IMD for ISM and GNSS bands**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Victim Systems** | **Frequency range [MHz]** | | | **Impact** | **Regions** | **Comments** |
| COMPASS  (Beidou) | 1559 | - | 1591 | Yes |  | 4th IMD |
| Galileo | 1559 | - | 1591 | Yes |  | 4th IMD |
| GLONASS | 1591 | - | 1610 | Yes |  | 4th IMD |
| GPS | 1563 | - | 1587 | Yes |  | 4th IMD |
| ISM band  (2.4GHz) | 2400 | - | 2483.5 | Yes |  | 3rd IMD |
| 2400 | - | 2494 | Yes |  | 3rd IMD |
| ISM band  (5GHz) | 5150 | - | 5925 | Yes | US | 3rd, 4th, 5th IMD |
| 5150 | - | 5350 | Yes | Europe | 3rd, 4th, 5th IMD |
| 5470 | - | 5725 | Yes | 4th, 5th IMD |
| 5150 | - | 5825 | Yes | Asia | 3rd, 4th, 5th IMD |
| 45GHz Unlicensed Bands | 42300 | - | 47000 | No | China |  |
| 47200 | - | 48400 | No | China |  |
| 60GHz Unlicensed Bands | 57000 | - | 66000 | No | Europe |  |
| 57050 | - | 64000 | No | USA Canada |  |
| 57000 | - | 64000 | No | South Korea |  |
| 59000 | - | 66000 | No | Japan |  |
| 59000 | - | 64000 | No | China |  |
| 59400 | - | 62900 | No | Australia |  |

6.1.x.6 ∆TIB and ∆RIB values

For DC\_71\_n78, the ΔTIB,c and ΔRIB,c values are reused from DC\_28\_n78 and are given in the tables below.

**Table 6.1.x.6-1: ΔTIB,c**

| E-UTRA and NR DC Configuration | E-UTRA and NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| DC\_71\_n78 | 71 | 0.5 |
| n78 | 0.8 |

**Table 6.1.x.6-2: ΔRIB,c**

| E-UTRA and NR DC Configuration | E-UTRA and NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| DC\_71\_n78 | 71 | 0.2 |
| n78 | 0.5 |

6.1.x.7 MSD

Based on the co-existence studies for DC\_71\_n78, MSD need to be defined in TS 38.101-3 like in table below. MSD value reused from DC\_28A\_n78A.

Table 7.3B.2.3.5.1-1: MSD test points for PCell due to dual uplink operation for EN-DC in NR FR1 (two bands)

| NR or E-UTRA Band / Channel bandwidth / NRB / MSD | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| EN-DC  Configuration | EUTRA or NR band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  LCRB | DL Fc (MHz) | MSD  (dB) | IMD order |
| DC\_71A\_n78A | 71 | 681.5 | 5 | 25 | 635.5 | 5.5 | IMD5 |
| n78 | 3361.5 | 10 | 50 | 3582.5 | N/A | N/A |

Due to 5th order harmonics from band 71 UL affecting band n78 DL MSD need to be defined. MSD values are derived from band 12 affecting band n78.

Table 7.3B.2.3.1-1: 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) |
| 71 | n784,5 |  | 10.4 | 8.9 | 7.8 |  |  | 4.7 | 3.7 | 3 | 1.7 | 1.2 | 0.7 |
| NOTE 4: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of the aggressor (lower) band for which the 5th transmitter harmonic is within the downlink transmission bandwidth of a victim (higher) band.  NOTE 5: The requirements should be verified for UL EARFCN 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 7.3B.2.3.1-2: 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 agressor 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) |
| 71 | n78 |  | 10 | 15 | 20 |  |  | 25 | 25 | 25 | 25 | 25 | 25 |

---End of changes---

# Reference

[1] RP‑192742, “Revised WID on EN-DC for 2 bands DL with 2 bands UL (1 LTE band + 1 NR band)”, CHTTL