**3GPP TSG-RAN WG4 Meeting #95 *R4-2006457***

**25th to 29th May 2020**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *CR-Form-v11.4* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **37.863-01-01** | **CR** | **0008** | **rev** | **1** | **Current version:** | **15.3.0** |  |
|  | | | | | | | | |
| *For* ***HE******LP*** *on using this form: comprehensive instructions can be found at  http://www.3gpp.org/Change-Requests.* | | | | | | | | |
|  | | | | | | | | |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network |  | Core Network |  |

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | | | | | | | | | |
| ***Title:*** | CR for TR37.863-01-01: TP for missing MSD due to UL harmonic and cross band isolation for band combinations | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | MediaTek Inc. | | | | | | | | | |
| ***Source to TSG:*** | R4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_newRAT-Core | | | | |  | ***Date:*** | | | 2020-05-25 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **F** |  | | | | | ***Release:*** | | | Rel-15 |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP TR 21.900. | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) Rel-12 (Release 12)* *Rel-13 (Release 13) Rel-14 (Release 14) Rel-15 (Release 15) Rel-16 (Release 16)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | Follow the endorsed draft CR R4-2005202 in RAN4#94bis-e meeting   1. MSD due to UL harmonic for DC\_B28-n51 were missed. 2. MSD due to corss band isolation for DC\_1A\_n40A, DC\_3A\_n51A , DC\_30A\_n66A and DC\_46A/C/D/E\_n78A were missed | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | 1. Add missing MSD numbers due to UL harmonic for DC\_B28-n51, DC\_1A\_n40A, DC\_3A\_n51A , DC\_30A\_n66A and DC\_46A/C/D/E\_n78A 2. Remove incompleted combination DC\_3A\_n50A from Rel-15 TR | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | TS38.101-3 sub clause 7.3B.2 MSD numbers due to UL harmonic for DC\_B28-n51 and MSD due to cross band isolation for DC\_1A\_n40A, DC\_3A\_n51A , DC\_30A\_n66A and DC\_46A/C/D/E\_n78A are missed | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 6.71, 6.75, 6.76, 6.82, 6.94, 6.110 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **X** | Other core specifications | | | |  | | |
| ***affected:*** | | **X** |  | Test specifications | | | | TS 38.101-3 | | |
| ***(show related CRs)*** | |  | **X** | O&M Specifications | | | |  | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |

## <<< Start of changed sections>>>

<<< Unchanged Parts Skipped>>>

## 6.71 DC\_46A\_n78A

### 6.71.1 Operating bands for DC

Table 6.71.1-1: DC band combination of LTE 1DL/1UL + one NR band

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **E-UTRA and NR DC Band** | **E-UTRA and 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** | | |
| DC\_46A\_n78A | 46 | 5150 MHz | – | 5925 MHz | 5150 MHz | – | 5925 MHz | TDD |
| n78 | 3300 MHz | – | 3800 MHz | 3300 MHz | – | 3800 MHz |

### 6.71.2 Channel bandwidths per operating band for DC

Table 6.71.2-1: Supported bandwidths per DC band combination of LTE 1DL/1UL + one NR band

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **DC operating / channel bandwidth** | | | | | | | | | | | | | | |
| **E-UTRA and NR DC Configuration** | **E-UTRA and NR Band** | **Subcarrier spacing**  **[kHz]** | **5**  **MHz** | **10**  **MHz** | **15**  **MHz** | **20**  **MHz** | **25**  **MHz** | **30**  **MHz** | **40**  **MHz** | **50**  **MHz** | **60**  **MHz** | **80**  **MHz** | **100 MHz** | **Maximum aggregated bandwidth**  **[MHz]** |
| DC\_46A\_n78A1 | 46 | 15 |  | Yes |  | Yes |  |  |  |  |  |  |  | 120 |
| n78 | 15 |  | Yes |  | Yes |  |  | Yes | Yes |  |  |  |
| 30 |  | Yes |  | Yes |  |  | Yes | Yes | Yes | Yes | Yes |
| 60 |  | Yes |  | Yes |  |  | Yes | Yes | Yes | Yes | Yes |
| NOTE 1: Restricted to E-UTRA operation when inter-band carrier aggregation is configured. The downlink operating band for Band 46 is paired with the uplink operating band (external E-UTRA band) of the carrier aggregation configuration that is supporting the configured Pcell. | | | | | | | | | | | | | | |

### 6.71.3 Co-existence studies

N/A

### 6.71.4 ∆TIB and ∆RIB values

For DC\_46A-n78A, the ΔTIB,c and ΔRIB values are given in the tables below.

Table 6.71.4-1: ΔTIB,c

| Inter-band DC Configuration | E-UTRA and NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| DC\_46A-n78A | n78 | 0.8 |

Table 6.71.4-2: ΔRIB

| Inter-band DC Configuration | E-UTRA and NR Band | ΔRIB [dB] |
| --- | --- | --- |
| DC\_46A-n78A | n78 | 0.5 |

### 6.71.5 MSD

DC\_46A\_n78A is subjected to MSD due to cross band isolation referring same mechanism of LTE CA\_46A-48A result. The MSD due to cross band isolation is calculated as below tables:

Table 6.71.5-1: Reference sensitivity exceptions (MSD) due to cross band isolation 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) |
| n78 | 46 |  |  |  | 7 |  |  |  |  |  |  |  |  |

Table 6.71.5-2: Uplink configuration for reference sensitivity exceptions due to cross band isolation for EN-DC in NR FR1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | E-UTRA or NR Band / SCS / Channel bandwidth of the affected DL band / UL RB allocation of the agressor band | | | | | | | | | | | | | |
| UL band | DL band | | SCS of UL band (kHz) | 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) |
| n78 | 46 | | 30 |  |  |  | 270 |  |  |  |  |  |  |  |  |

<<< Unchanged Parts Skipped>>>

## 6.75 DC\_3A-n50A

Void

The imcompleted combination is removed in Rel-15



























<<< Unchanged Parts Skipped>>>

### 6.76.5 MSD

DC\_3A\_n51A is subjected to MSD due to cross band isolation referring same mechanism of DC\_11A\_n3A (R4-2002558) result with further calculations to all channel bandwidths. The MSD due to cross band isolation is calculated as below tables:

Table 6.75.5-1: Reference sensitivity exceptions (MSD) due to cross band isolation 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) |
| 3 | n51 | 6.4 |  |  |  |  |  |  |  |  |  |  |  |

Table 6.75.5-2: Uplink configuration for reference sensitivity exceptions due to cross band isolation for EN-DC in NR FR1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | E-UTRA or NR Band / SCS / Channel bandwidth of the affected DL band / UL RB allocation of the agressor band | | | | | | | | | | | | | |
| UL band | DL band | | SCS of UL band (kHz) | 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) |
| 3 | n51 | | 15 | 25 |  |  |  |  |  |  |  |  |  |  |  |

<<< Unchanged Parts Skipped>>>

## 6.82 DC\_28A-n51A

6.82.1 Operating bands for DC

Table 6.82.1-1: DC band combination of LTE 1DL/1UL + one NR band

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **E-UTRA and NR DC Band** | **E-UTRA and 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** | | |
| DC\_28A-n51A | 28 | 703 MHz | – | 748 MHz | 758 MHz | – | 803 MHz | FDD |
| n51 | 1427 MHz | – | 1432 MHz | 1427 MHz | – | 1432 MHz | TDD |

### 6.82.2 Channel bandwidths per operating band for DC

Table 6.82.2-1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **DC operating / channel bandwidth** | | | | | | | | | | | | | | |
| **E-UTRA and NR DC Configuration** | | | **E-UTRA and NR Band** | **Subcarrier spacing**  **[kHz]** | **5**  **MHz** | **10**  **MHz** | **15**  **MHz** | **20**  **MHz** | **25**  **MHz** | **30**  **MHz** | **40**  **MHz** | **50**  **MHz** | **60**  **MHz** | **80**  **MHz** | **100 MHz** | **Maximum aggregated bandwidth**  **[MHz]** |
| DC\_28A-n51A | | | 28 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  | 25 |
| n51 | 15 | Yes |  |  |  |  |  |  |  |  |  |  |
| 30 |  |  |  |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |

### 6.82.3 Co-existence studies

Table 6.82.3-1 lists Band 28 + Band n51 2UL DC 2nd and 3rd order harmonics and 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

Table 6.82.3-1: Band 28 and Band n51 UL harmonics and IMD products

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| UE UL carriers | fx\_low | fx\_high | fy\_low | fy\_high |
| UL frequency (MHz) | 703 | 748 | 1427 | 1432 |
| 2nd harmonics frequency limits | 2\*fx\_low | 2\*fx\_high | 2\* fy\_low | 2\* fy\_high |
| 2nd harmonics frequency limits (MHz) | 1406 | 1496 | 2854 | 2864 |
| 3rd harmonics frequency limits | 3\*fx\_low | 3\*fx\_high | 3\* fy\_low | 3\* fy\_high |
| 3rd harmonics frequency limits (MHz) | 2109 | 2244 | 4281 | 4296 |
| Two tone 2nd order IMD products | (fx\_low – fy\_high) | (fx\_high – fy\_low) | (fx\_low + fy\_low) | (fx\_high + fy\_high) |
| IMD frequency limits (MHz) | 679 | 729 | 2130 | 2180 |
| Two-tone 3rd order IMD products | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | (2\*fx\_low – fy\_high) | (2\*fx\_high – fy\_low) |
| IMD frequency limits (MHz) | 26 | 69 | 2106 | 2161 |
| Two-tone 3rd order IMD products | (2\*fx\_low + fy\_low) | (2\*fx\_high + fy\_high) | (2\*fx\_low + fy\_low) | (2\*fx\_high + fy\_high) |
| IMD frequency limits (MHz) | 2833 | 2928 | 3557 | 3612 |
| Two-tone 3rd order IMD products | (fx\_low – max BW fy) | (fx\_high + max BW fy) | (fy\_low – max BW fx) | (fy\_high + max BW fx) |
| IMD frequency limits (MHz) | 698 | 753 | 1407 | 1452 |
| 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) | 677 | 817 | 3533 | 3593 |
| Two-tone 4th order IMD products | (2\*fy\_low – 2\*fx\_high) | (2\*fy\_high – 2\*fx\_low) |  |  |
| IMD frequency limits (MHz) | 1358 | 1458 |  |  |
| 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) | 3536 | 3676 | 4984 | 5044 |
| Two-tone 4th order IMD products | (2\*fx\_low + 2\*fy\_low) | (2\*fx\_high + 2\*fy\_high) |  |  |
| IMD frequency limits (MHz) | 4260 | 4360 |  |  |
| Two-tone 5th order IMD products | (4\*fy\_low – fx\_high) | (4\*fy\_high – fx\_low) | |4\*fx\_low – fy\_high| | |4\*fx\_high – fy\_low| |
| IMD frequency limits (MHz) | 4960 | 5025 | 1380 | 1565 |
| Two-tone 5th order IMD products | (3\* fy\_low-2\*fx\_high ) | (3\*fy\_high-2\*fx\_low) | |2\*fy\_low –3\* fx\_high| | |2\*fy\_high – 3\*fx\_low| |
| IMD frequency limits (MHz) | 2785 | 2890 | 610 | 755 |
| Two-tone 5th order IMD products | (4\*fy\_low + fx\_low ) | (4\*fy\_high +fx\_high) | (4\*fx\_low + fy\_low) | (4\*fx\_high + fy\_high) |
| IMD frequency limits (MHz) | 6411 | 6476 | 4239 | 4424 |
| Two-tone 5th order IMD products | (3\*fy\_low + 2\*fx\_low ) | (3\*fy\_high +2\*fx\_high) | (3\*fx\_low +2\* fy\_low) | (3\*fx\_high + 2\*fy\_high) |
| IMD frequency limits (MHz) | 5687 | 5792 | 4963 | 5108 |

Based on Table 6.82.3-1

2nd order harmonic may fall into Rx frequencies of band 21, 32, 45, 50, n51 own RX range, 75 and 76.

3rd order harmonic may fall into Rx frequencies of band 1, 4, 10, 23, 65 and 66.

2nd order IMD may fall into Rx frequencies of bands 1, 4, 10, 65 and 66.

3rd order IMD may fall into Rx frequencies of bands 1, 4, 10, 22, 32, 42, 43, 45, 50, 65, 66, 75, n77 and n78.

4th order IMD may fall into Rx frequencies of bands 20, 22, 28, 32, 42, 43, 45, 50, 67, 75, n77, n78 and n79.

5th order IMD may fall into Rx frequencies of bands 21, 24, 32, 45, 46, 50, 67, 71, 75, and n79.

It should be noted that IMD will not be an issue for band n51 (no self-interference for the TDD band) even through the IMD products may fall into the concerning band.

When 2UL inter-band 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 6.82.3-2 lists if up to 3rd order harmonics and IMD up to 5th order falls into one of these receiving bands.

Table 6.82.3-2: 2UL Band 28 +Band n51 harmonic and IMD for ISM and GNSS bands

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Victim Systems** | **Frequency range [MHz]** | | | **Impact** | **Regions** | **Comments** |
| COMPASS  (Beidou) | 1559 | - | 1591 | Yes |  | IMD5 |
| Galileo | 1559 | - | 1591 | Yes |  | IMD5 |
| GLONASS | 1591 | - | 1610 | No |  |  |
| GPS | 1563 | - | 1587 | Yes |  | IMD4 |
| ISM band  (2.4GHz) | 2400 | - | 2483.5 | No | US/Europe |  |
| 2400 | - | 2494 | No | Asia |  |
| ISM band  (5GHz) | 5150 | - | 5925 | Yes | US | IMD5 |
| 5150 | - | 5350 | No | Europe |  |
| 5470 | - | 5725 | Yes | IMD5 |
| 5150 | - | 5825 | Yes | Asia | IMD5 |

Table 6.82.3-3 lists the protected bands required for the dual connectivity configuration.

Table 6.82.3-3: Protected bands for the dual connectivity configuration

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **E-UTRA DC Configuration** | **Spurious emission** | | | | | | |
| **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** |
| DC\_28A-n51A | E-UTRA Band 2, 3, 5, 7, 8, 25, 26, 31, 34, 38, 40, 41, 66, 72 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 4, 10, 20, 22, 24, 32, 42, 43, 45, 46, 65, 66, 71, 73  NR band n78, n79 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| E-UTRA Band 1 | FDL\_low | - | FDL\_high | -50 | 1 | 2, 19, 25 |
| Frequency range | 470 | - | 694 | -42 | 8 | 15, 35 |
| Frequency range | 470 | - | 710 | -26.2 | 6 | 34 |
| Frequency range | 662 | - | 694 | -26.2 | 6 | 15 |
| Frequency range | 758 | - | 773 | -32 | 1 | 15 |
| Frequency range | 773 | - | 803 | -50 | 1 |  |
| 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 (2MHz + 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 15: These requirements also apply for the frequency ranges that are less than FOOB (MHz) in Table 6.6.3.1-1 and Table 6.6.3.1A-1 from the edge of the channel bandwidth.  NOTE 19: Applicable when the assigned E-UTRA carrier is confined within 718 MHz and 748 MHz and when the channel bandwidth used is 5 or 10 MHz.  NOTE 25: As exceptions, measurements with a level up to the applicable requirement of -36 dBm/MHz is permitted for each assigned E-UTRA carrier used in the measurement due to 3rd harmonic spurious emissions. An exception is allowed if there is at least one individual RB within the transmission bandwidth (see Figure 5.6-1) for which the 3rd harmonic totally or partially overlaps the measurement bandwidth (MBW).  NOTE 34: This requirement is applicable for 5 and 10 MHz E-UTRA channel bandwidth allocated within 718-728MHz. For carriers of 10 MHz bandwidth, this requirement applies for an uplink transmission bandwidth less than or equal to 30 RB with RBstart > 1 and RBstart<48.  NOTE 35: This requirement is applicable in the case of a 10 MHz E-UTRA carrier confined within 703 MHz and 733 MHz, otherwise the requirement of -25 dBm with a measurement bandwidth of 8 MHz applies. | | | | | | | |

### 6.82.4 ∆TIB and ∆RIB values

For DC\_28A-n51A, the ΔTIB,c and ΔRIB values are given in the tables below.

Table 6.82.4-1: ΔTIB,c

| Inter-band DC Configuration | E-UTRA and NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| DC\_28A-n51A | 28 | 0.5 |
| n51 | 0.5 |

Table 6.82.4-2: ΔRIB

| Inter-band DC Configuration | E-UTRA and NR Band | ΔRIB [dB] |
| --- | --- | --- |
| DC\_28A-n51A | n51 | 0.2 |

### 6.82.5 MSD

It may have 2nd, 3rd, 4th, 5th order IMDs when the UP of the band 28 and the UP of the band n51 is used in the same time without precaution. Thus, if the UL of the both bands are not used in the same time, all IMD issues are canceled, and there is no MSD issue for this DC configuration

Table 6.81.5-1 lists the MSD required for the dual connectivity configuration DC\_28A\_n51A.

Table 6.81.5-1: MSD for the DC configuration

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **E-UTRA and NR Band / Channel bandwidth / NRB / Duplex mode / MSD / Single UL** | | | | | | | | | |
| **DC**  **Configuration** | **EUTRA and NR band** | **UL Fc  (MHz)** | **UL/DL BW  (MHz)** | **UL  CLRB** | **DL Fc (MHz)** | **MSD  (dB)** | **Duplex mode** | **IMD order** | **Single UL allowed** |
| DC\_28A-n51A | 28 | 725.5 | 20 | 25 | 765.5 | 5 | FDD | IMD 4, 5 | Yes |
| n51 | 1429.5 | 5 | 25 | 1429.5 | 5 | TDD | IMD 4, 5 |

MSD due to B28 uplink harmonic is derived from LTE CA\_28A-32A.

Table 6.81.5-2: 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) |
| 28 | n512 | 27.8 |  |  |  |  |  |  |  |  |  |  |  |
| NOTE 2: The requirements should be verified for UL EARFCN or 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 6.81.5-3: 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) |
| 28 | n51 | 12 |  |  |  |  |  |  |  |  |  |  |  |

### 6.82.6 Self-interference analysis

This section provides the formulation to determine whether the DL carriers would be impacted by UL harmonics, 2UL inter-modulation products (IMD), or DL harmonic mixing with UL interferer based on UL and DL channel combinations. The potential self-interference mechanism has been identified in section 6.82.3 co-existence studies except for harmonic mixing which are used to generate an interference mixing coefficient table for this DC combination, as shown in Table 6.82.6-1.

Table 6.82.6-1: Band 28 and Band n51 interference mixing coefficients

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| EUTRA-NR DC Configuration | EUTRA/NR Band | UL Coefficient | | DL Coefficient | | Harmonic/IMD Order | Victim Band | Interference Type |
| DC\_28A\_n51A | 28 | a | 3 | b | -1 | 4 | 28 | IMD |
| n51 | c | -1 | d | 0 |
| DC\_28A\_n51A | 28 | a | 2 | b | 0 | 2 | n51 | Harmonic |
| n51 | c | 0 | d | -1 |

Equations (6.82.6.1) and (6.82.6.2) below are used to calculate the interference center frequency (*fINT*) and its effective bandwidth (*BWINT*) where coefficients a, b, c, and d are defined in Table 6.82.6-1 and *CBW* stands for channel bandwidth.

 (6.82.6.1)

 (6.82.6.2)

Formula (6.82.6.3-1) and (6.82.6.3-2) below are then used to indicate when the interference is overlapping with *RX1* and *RX2*, respectively.

 (6.82.6.3-1)

 (6.82.6.3-2)

<<< Unchanged Parts Skipped>>>

6.94 DC\_1A\_n40A

### 6.94.1 Operating bands for DC

Table 6.94.1-1: DC band combination of LTE 1DL/1UL + one NR band

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **E-UTRA and NR DC Band Combination** | **E-UTRA and 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** | | |
| DC\_1A\_n40A | 1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | FDD |
| n40 | 2300 MHz | – | 2400 MHz | 2300 MHz | – | 2400 MHz | TDD |

### 6.94.2 Channel bandwidths per operating band for DC

Table 6.94.2-1 Supported bandwidths per DC band combination of LTE 1DL/1UL + one NR band

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **DC operating / channel bandwidth** | | | | | | | | | | | | | | |
| **E-UTRA and NR DC Configuration** | **E-UTRA and NR Band** | **Subcarrier spacing**  **[kHz]** | **5**  **MHz** | **10**  **MHz** | **15**  **MHz** | **20**  **MHz** | **25**  **MHz** | **30**  **MHz** | **40**  **MHz** | **50**  **MHz** | **60 MHz** | **70 MHz** | **80 MHz** | **Maximum aggregated bandwidth**  **[MHz]** |
| DC\_1A\_n40A | 1 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  | 70 |
| n40 | 15 | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |

### 6.94.3 Co-existence studies

Table 6.94.3-1 lists up to 7th harmonic and 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis for Band 1+Band n40 2UL DC.

Table 6.94.3-1: Band 1 and Band n40 UL harmonics and IMD products

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | | **fy\_low** | **fy\_high** |
| UL frequency (MHz) | 1920 | 1980 | | 2300 | 2400 |
| 2nd harmonics frequency limits | 2\*fx\_low | 2\*fx\_high | | 2\* fy\_low | 2\* fy\_high |
| 2nd harmonics frequency limits (MHz) | 3840 | | 3960 | 4600 | 4800 |
| 3rd harmonics frequency limits | 3\*fx\_low | | 3\*fx\_high | 3\* fy\_low | 3\* fy\_high |
| 3rd harmonics frequency limits (MHz) | 5760 | | 5940 | 6900 | 7200 |
| 4th harmonics frequency limits | 4\*fx\_low | 4\*fx\_high | | 4\* fy\_low | 4\* fy\_high |
| 4th harmonics frequency limits (MHz) | 7680 | 7920 | | 9200 | 9600 |
| 5th harmonics frequency limits | 5\*fx\_low | 5\*fx\_high | | 5\* fy\_low | 5\* fy\_high |
| 5th harmonics frequency limits (MHz) | 9600 | | 9900 | 11500 | 12000 |
| 6th harmonics frequency limits | 6\*fx\_low | 6\*fx\_high | | 6\* fy\_low | 6\* fy\_high |
| 6th harmonics frequency limits (MHz) | 11520 | | 11880 | 13800 | 14400 |
| 7th harmonics frequency limits | 7\*fx\_low | | 7\*fx\_high | 7\* fy\_low | 7\* fy\_high |
| 7th harmonics frequency limits (MHz) | 13440 | | 13860 | 16100 | 16800 |
| 2nd order IMD products | |fy\_high – fx\_low| | | |fy\_low – fx\_high| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 480 | | 320 | 4220 | 4380 |
| 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) | 1440 | | 1660 | 2620 | 2880 |
| 3rd order IMD products | |2\*fx\_low + fy\_low|e | | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 6140 | | 6360 | 6520 | 6780 |
| 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) | 960 | | 640 | 8440 | 8760 |
| 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) | 3360 | | 3640 | 4920 | 5280 |
| 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) | 8060 | | 8340 | 8820 | 9180 |
| 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) | 7680 | | 7220 | 5620 | 5280 |
| 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) | 11120 | | 11580 | 9980 | 10320 |
| 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) | 3360 | | 2940 | 1340 | 960 |
| 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) | 10740 | | 11160 | 10360 | 10740 |

Based on Table 6.94.3-1, it can be seen that

- 2nd order harmonic may fall into Rx frequencies of bands n77 and n79.

- 3rd order harmonic may fall into Rx frequencies of band 46 or 47.

- 2nd order IMD may fall into Rx frequencies of bands 31 or 72.

- 3rd order IMD may fall into Rx frequencies of bands 21, 24, 32, 38, 41, 45, 50, 69, 74 or 75.

- 4th order IMD may fall into Rx frequencies of bands 5, 6, 8, 12, 13, 17, 18, 19, 20, 22, 26, 27, 28, 29, 42, 43, 44, 46, 48, 49, 67, 68, 71, 77, 78 or 79.

- 5th order IMD may fall into Rx frequencies of bands 8, 46, 77 or 78.

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 6.94.3-2 lists up to 7th order harmonics and IMD up to 5th order falls into one of these receiving bands.

Table 6.94.3-2: Band 1 and Band n40 harmonic and IMD for ISM and GNSS bands

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Victim Systems** | **Frequency range [MHz]** | | | **Impact** | **Regions** | **Comments** |
| COMPASS  (Beidou) | 1559 | - | 1591 | Yes |  | IMD3 |
| Galileo | 1559 | - | 1591 | Yes |  | IMD3 |
| GLONASS | 1591 | - | 1610 | Yes |  | IMD3 |
| GPS | 1563 | - | 1587 | Yes |  | IMD3 |
| ISM band  (2.4GHz) | 2400 | - | 2483.5 | No | US/Europe |  |
| 2400 | - | 2494 | No | Asia |  |
| ISM band  (5GHz) | 5150 | - | 5925 | Yes | US | IMD4, IMD5  3rd harmonic |
| 5150 | - | 5350 | Yes | Europe | IMD4, IMD5 |
| 5470 | - | 5725 | Yes | IMD5 |
| 5150 | - | 5825 | Yes | Asia | IMD4, IMD5  3rd harmonic |
| 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 |  |

Table 6.94.3-3 lists the protected bands required for the dual connectivity configuration.

Table 6.94.3-3: Protected bands for the dual connectivity configuration

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **E-UTRA and NR DC Configuration** | **Spurious emission** | | | | | | | | | |
| **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** | |
| DC\_1A\_n40A | Band 1, 5, 7, 8, 11, 18, 19, 20, 21, 22, 26, 27, 28, 31, 32, 38, 40, 41, 42, 43, 44, 45, 50, 51, 52, 65, 67, 68, 69, 72, 73, 74, 75, 76 | FDL\_low | - | FDL\_high | -50 | 1 |  | | |
| Band 3, 34 | FDL\_low | - | FDL\_high | -50 | 1 | 15 | |
| Frequency range | 1880 |  | 1895 | -40 | 1 | 15, 27 | |
| Frequency range | 1895 |  | 1915 | -15.5 | 5 | 15, 26, 27 | |
| Frequency range | 1915 |  | 1920 | +1.6 | 5 | 15, 26, 27 | |
| NOTE 15:These requirements also apply for the frequency ranges that are less than FOOB (MHz) in Table 6.6.3.1-1 and Table 6.6.3.1A-1 from the edge of the channel bandwidth.  NOTE 26: For these adjacent bands, the emission limit could imply risk of harmful interference to UE(s) operating in the protected operating band.  NOTE 27: This requirement is applicable for any channel bandwidths within the range 1920 - 1980 MHz with the following restriction: for carriers of 15 MHz bandwidth when carrier centre frequency is within the range 1927.5 - 1929.5 MHz and for carriers of 20 MHz bandwidth when carrier centre frequency is within the range 1930 - 1938 MHz the requirement is applicable only for an uplink transmission bandwidth less than or equal to 54 RB. | | | | | | | | |

### 6.94.4 ∆TIB and ∆RIB values

For DC\_1A\_n40A, the ΔTIB,c and ΔRIB,c values are given in the tables below, and they are reused from LTE combination CA\_1A-40A.

Table 6.94.4-1: ΔTIB,c

| E-UTRA and NR DC Configuration | E-UTRA and NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| DC\_1A\_n40A | 1 | 0.5 |
| n40 | 0.5 |

Table 6.94.4-2: ΔRIB,c

| E-UTRA and NR DC Configuration | E-UTRA and NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| DC\_1A\_n40A | 1 | 0 |
| n40 | 0 |

### 6.94.5 REFSENS requirements

No IMD issues are expected for this DC configuration and furthermore, up to 7th order harmonics have no impact to Rx frequency in either the LTE band or the NR band. But according to TS 36.101 in table 7.3.1A-0bE, there is a cross band isolation issue for DC\_1A\_n40A. The MSD for DC\_40\_n1 is shown as below.

Table 6.94.5-1: Reference sensitivity exceptions (MSD) due to cross band isolation 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) |
| 1 | | n40 | 6.6 | 6.6 | 6.6 | 6.6 | 6.6 | 6.6 | 6.6 | 6.6 | 6.6 | 6.6 |  |  |
| n40 | | 1 | 8.3 | 8.3 | 8.3 | 8.3 |  |  |  |  |  |  |  |  |

Table 6.94.5-2: Uplink configuration for reference sensitivity exceptions due to cross band isolation for EN-DC in NR FR1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| E-UTRA or NR Band / SCS / Channel bandwidth of the affected DL band / UL RB allocation of the agressor band | | | | | | | | | | | | | | |
| UL band | DL band | SCS of UL band (kHz) | 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) |
| 1 | n40 | 15 | 25 | 50 | 75 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |  |  |
| n40 | 1 | 15 | 25 | 50 | 75 | 100 |  |  |  |  |  |  |  |  |

<<< Unchanged Parts Skipped>>>

### 

### 6.110.5 REFSENS requirements

Referring to DC\_1A\_n40A, according to TS 36.101 in table 7.3.1A-0bE, there is a cross band isolation issue for DC\_30A\_n66A. The MSD for DC\_30A\_n66A is shown as below.

Table 6.110.5-1: Reference sensitivity exceptions (MSD) due to cross band isolation 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) |
| 30 | | n66 | 8.3 | 8.3 | 8.3 | 8.3 |  |  | 8.3 |  |  |  |  |  |

Table 6.110.5-2: Uplink configuration for reference sensitivity exceptions due to cross band isolation for EN-DC in NR FR1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| E-UTRA or NR Band / SCS / Channel bandwidth of the affected DL band / UL RB allocation of the agressor band | | | | | | | | | | | | | | |
| UL band | DL band | SCS of UL band (kHz) | 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) |
| 30 | n66 | 15 | 25 | 25 | 25 | 25 |  |  | 25 |  |  |  |  |  |

<<< End of changed sections>>>