3GPP TSG-RAN WG4 Meeting #94-e Rev\_R4-2000143

Online, 24 February – 6th March, 2020

**Agenda item: 9.2.2**

**Source: Dish Network**

**Title: TP for TR38.716-02-00: Requirements for DL CA\_n29A-n70A, DL CA\_n29A-n66B, DL CA\_n29A-n66(2A) and for UL CA\_n66A-n71A, UL CA\_n70A-n71A**

**Document for: Approval**

# 1 Introduction

 This TP captures the requirements for DL CA\_n29A-n70A, DL CA\_n29A-n66B, DL CA\_n29A-n66(2A) and for UL CA\_n66A-n71A, UL CA\_n70A-n71A.

# 2 TP for TR38.716-02-00

##

## 6.4 CA\_n66-n71

### 6.4.1 Common for 1 band UL and 2 bands UL CA

#### 6.4.1.1 Operating bands for CA

Table 6.4.1.1-1: CA band combination of band n66+n71

|  |  |  |  |
| --- | --- | --- | --- |
| NR Band | Uplink (UL) band | Downlink (DL) band | Duplexmode |
| BS receive / UE transmit | BS transmit / UE receive |
| FUL\_low – FUL\_high | FDL\_low – FDL\_high |
| n66 |  1710 |  – | 1780 |  2110 | – | 2200 | FDD |
| n71 |  663 |  – | 698 |  617 | – | 652 | FDD |

#### 6.4.1.2 Channel bandwidths per operating band for CA

Table 6.4.1.2-1: Supported bandwidths per CA band combination of band n66+n71

|  |
| --- |
| **CA operating / channel bandwidth [MHz]** |
| **NR CA Configuration** | **UL Configuration** | **NR Band** | **SCS [kHz]** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n66A-n71A | CA\_n66A-n71A | n66 | 15 | Yes | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  |
| n71 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| CA\_n66(2A)-n71A | - | n66 | See CA\_n66(2A) Bandwidth Combination Set 0 in Table 5.5A.2-1 in TS38.101-1 | 0 |
| n71 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| CA\_n66B-n71A |  | n66 | See CA\_n66B Bandwidth Combination Set 0 in Table 5.5A.1-1 in TS38.101-1 | 0 |
| n71 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |

#### 6.4.1.3 UE co-existence studies

Table 6.4.1.3-1/2 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA\_n66-n71.

**Table 6.4.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | **3rd Harmonic** | **nth 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 |
| n66 | 1710 | 1780 | 2110 | 2200 | 3420 | 3560 | 5130 | 5340 |  |  |
| n71 | 663 | 698 | 617 | 652 | 1326 | 1396 | 1989 | 2094 |  |  |

Based on the table above, there is no harmonic relation.

**Table 6.4.1.3-2: Impact of UL/DL Harmonic mixing**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | **3rd Harmonic** | **mth 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 |
| n66 | 1710 | 1780 | 2110 | 2200 | 4220 | 4400 | 6330 | 6600 |  |  |
| n71 | 663 | 698 | 617 | 652 | 1234 | 1304 | 1851 | 1956 |  |  |

Based on the table above, there is no harmonic mixing relation.

#### 6.4.1.4 ∆TIB and ∆RIB values

For CA\_n66-n71, the ΔTIB,c and ΔRIB,c values are given in the tables below.

Table 6.4.1.4-1: ΔTIB,c

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n66-n71 | n66 | 0.3 |
| n71 | 0.3 |

Table 6.1.x.4-2: ΔRIB,c

| Inter-band CA Configuration | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n66-n71 | n66 | 0 |
| n71 | 0 |

#### 6.4.1.5 REFSENS requirements

There are no specific REFSENS requirements for 1 band UL.

### 6.4.2 Specific for 2 bands UL CA

#### 6.4.2.1 UE co-existence studies

**Table 6.4.2.1-1: Impact of Intermodulations**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| UL frequency (MHz) | 1710 | 1780 | 663 | 698 |
| 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) | 1117 | 1012 | 2373 | 2478 |
| 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) | 2722 | 2897 | 454 | 314 |
| 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) | 4083 | 4258 | 3036 | 3176 |
| 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) | 4432 | 4677 | 209 | 384 |
| 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) | 5793 | 6038 | 3036 | 3874 |
| 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) | 2234 | 2024 | 4746 | 4956 |
| 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) | 6142 | 6457 | 872 | 1082 |
| 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) | 7503 | 7818 | 4362 | 4572 |
| 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) | 3734 | 4014 | 1571 | 1326 |
| 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) | 5409 | 5654 | 6456 | 6736 |

Based on the table above, there is IMD4 falling on top of n66 DL. There is pretty similar combination in EN-DC, DC\_66A\_n71A where MSD is defined for B66. Because the IMD mechanisms and frequencies are exactly the same, we propose to reuse that MSD number for n66.

Table 6.4.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 6.4.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |
| --- | --- |
| NR CA combination | Spurious emission |
| Protected Band | Frequency range (MHz) | Maximum Level (dBm) | MBW (MHz) | NOTE |
| CA\_n66-n71 | E-UTRA Band 4, 5, 7, 10, 12, 13, 14, 17, 26, 27, 30, 43, 50, 51, 53, 66, 70, 71, 74, 85 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 2, 25, 41, 42, 48 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| E-UTRA Band 29 | FDL\_low | - | FDL\_high | -38 | 1 | 4 |
| E-UTRA Band 71 | FDL\_low | - | FDL\_high | -38 | 1 | 4 |
| NOTE 1: FDL\_low and FDL\_high refer to each frequency band specified in Table 5.2-1 in TS 38.101-1 or Table 5.5-1 in TS 36.101NOTE 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 3: Applicable when co-existence with PHS system operating in 1884.5 -1915.7 MHzNOTE 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.NOTE 5: This requirement is applicable only for the following cases: A: for carriers of 5 MHz channel bandwidth when carrier centre frequency (Fc) is within the range 902.5 MHz ≤ Fc < 907.5 MHz with an uplink transmission bandwidth less than or equal to 20 RB; B: for carriers of 5 MHz channel bandwidth when carrier centre frequency (Fc) is within the range 907.5 MHz ≤ Fc ≤ 912.5 MHz without any restriction on uplink transmission bandwidth; D: for carriers of 10 MHz channel bandwidth when carrier centre frequency (Fc) is Fc = 910 MHz with an uplink transmission bandwidth less than or equal to 32 RB with RBstart > 3.NOTE 6: 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.NOTE 7: For these adjacent bands, the emission limit could imply risk of harmful interference to UE(s) operating in the protected operating band.NOTE 8: This requirement is only applicable for carriers with bandwidth confined within 1885-1920 MHz (requirement for carriers with at least 1RB confined within 1880 - 1885 MHz is not specified). This requirement applies for an uplink transmission bandwidth less than or equal to 54 RB for carriers of 15 MHz bandwidth when carrier center frequency is within the range 1892.5 - 1894.5 MHz and for carriers of 20 MHz bandwidth when carrier center frequency is within the range 1895 - 1903 MHz.NOTE 9: This requirement applies for 5, 10, 15 and 20 MHz NR channel bandwidth allocated within 1744.9 MHz and 1784.9 MHz.NOTE 10: This requirement applies when the NR carrier is confined within 2545 - 2575 MHz or 2595 – 2645vMHz and the channel bandwidth is 10 or 20 MHz.NOTE 11:Applicable when the assigned NR carrier is confined within 718 MHz and 748 MHz and when the channel bandwidth used is 5 or 10 MHz.NOTE 12: As exceptions, measurements with a level up to the applicable requirement of -36 dBm/MHz is permitted for each assigned NR 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 5.3.1-1) for which the 3rd harmonic totally or partially overlaps the measurement bandwidth (MBW).NOTE 13: This requirement is applicable for 5 and 10 MHz NR channel bandwidth allocated within 718 - 728 MHz. 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 14: This requirement is applicable in the case of a 10 MHz NR carrier confined within 703 MHz and 733 MHz, otherwise the requirement of -25 dBm with a measurement bandwidth of 8 MHz applies.NOTE 15: As exceptions, measurements with a level up to the applicable requirement of -38 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 17: Applicable when NS\_05 in clause 6.6.3.3.1 is signalled by the network.NOTE 18: This requirement is applicable for any channel bandwidths within the range 2500 – 2570 MHz with the following restriction: for carriers of 15 MHz bandwidth when carrier centre frequency is within the range 2560.5 - 2562.5 MHz and for carriers of 20 MHz bandwidth when carrier centre frequency is within the range 2552 – 2560 MHz the requirement is applicable only for an uplink transmission bandwidth less than or equal to 54 RB. |

#### 6.4.2.2 REFSENS requirements

MSD is defined for n66 as follows.

**Table 6.4.2.2-1: 2DL/2UL interband Reference sensitivity QPSK PREFSENS and uplink/downlink configurations**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA****Configuration** | **NR band** | **UL Fc (MHz)** | **UL/DL BW (MHz)** | **UL CLRB** | **DL Fc (MHz)** | **MSD (dB)** | **Duplex mode** | **Source of IMD** |
| CA\_n66A-n71A | n66 | 1750 | 5 | 25 | 2150 | 5 | FDD | IMD4 |
| n71 | 675 | 5 | 25 | 629 | N/A | FDD | N/A |

## 6.14 CA\_n70-n71

### 6.14.1 Common for 1 band UL and 2 bands UL CA

#### 6.14.1.1 Operating bands for CA

**Table 6.14.1.1-1: CA band combination of band n70+n71**

|  |  |  |  |
| --- | --- | --- | --- |
| NR Band | Uplink (UL) band | Downlink (DL) band | Duplexmode |
| BS receive / UE transmit | BS transmit / UE receive |
| FUL\_low – FUL\_high | FDL\_low – FDL\_high |
| n70 |  1695 |  – | 1710 |  1995 | – | 2020 | FDD |
| n71 |  663 |  – | 698 |  617 | – | 652 | FDD |

#### 6.14.1.2 Channel bandwidths per operating band for CA

**Table 6.14.1.2-1: Supported bandwidths per CA band combination of band n70+n71**

|  |
| --- |
| **CA operating / channel bandwidth [MHz]** |
| **NR CA Configuration** | **UL Configuration** | **NR Band** | **SCS [kHz]** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n70A-n71A | CA\_n70A-n71A | n70 | 15 | Yes | Yes | Yes | Yes1 | Yes1 |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes1 | Yes1 |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes1 | Yes1 |  |  |  |  |  |  |  |
| n71 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| NOTE 1: This UE channel bandwidth is applicable only to downlink. |

#### 6.14.1.3 UE co-existence studies

Table 6.14.1.3-1/2 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA \_ n70-n71.

**Table 6.14.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | **3rd Harmonic** | **nth 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 |
| n70 | 1695 | 1710 | 1995 | 2020 | 3390 | 3420 | 5085 | 5130 |  |  |
| n71 | 663 | 698 | 617 | 652 | 1326 | 1396 | 1989 | 2094 |  |  |

Based on the table above, the 3rd harmonic of n71 UL lands on top of n70 DL.

**Table 6.14.1.3-2: Impact of UL/DL Harmonic mixing**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | **3rd Harmonic** | **mth 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 |
| n70 | 1695 | 1710 | 1995 | 2020 | 3990 | 4040 | 5985 | 6060 |  |  |
| n71 | 663 | 698 | 617 | 652 | 1234 | 1304 | 1851 | 1956 |  |  |

Based on the table above, the is no harmonic mixing relation.

#### 6.14.1.4 ∆TIB and ∆RIB values

For CA\_n70-n71, the TIB,c and RIB,c values are given in the tables below.

**Table 6.14.1.4-1: ΔTIB,c**

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n70-n71 | n70 | 0.3 |
| n71 | 0.6 |

**Table 6.14.1.4-2: ΔRIB,c**

| Inter-band CA Configuration | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n70-n71 | n70 | 0 |
| n71 | 0 |

#### 6.14.1.5 REFSENS requirements

Table 6.14.1.5-1: 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 |
| n71 | n701,2 | 9.9 | 7.1 | 6.7 | 4.9 | 4.1 |  |  |  |  |  |  |  |
| NOTE 1: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of the aggressor (lower) band for which the 3nd transmitter harmonic is within the downlink transmission bandwidth of a victim (higher) band.NOTE 2: 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 6.14.1.5-2: 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 |
| n71 | n70 | 8 | 16 | 20 | 20 | 20 |  |  |  |  |  |  |  |
| NOTE: 15kHz SCS is assumed for UL band. |

### 6.14.2 Specific for 2 bands UL CA

#### 6.14.2.1 UE co-existence studies

**Table 6.14.2.1-1: Impact of Intermodulations**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| UL frequency (MHz) | 1695 | 1710 | 663 | 698 |
| 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) | 1047 | 997 | 2358 | 2408 |
| 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) | 2692 | 2757 | 384 | 299 |
| 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) | 4053 | 4118 | 3021 | 3106 |
| 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) | 4387 | 4467 | 279 | 399 |
| 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) | 5748 | 5828 | 3021 | 3804 |
| 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) | 2094 | 1994 | 4716 | 4816 |
| 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) | 6082 | 6177 | 942 | 1097 |
| 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) | 7443 | 7538 | 4347 | 4502 |
| 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) | 3689 | 3804 | 1431 | 1296 |
| 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) | 5379 | 5514 | 6411 | 6526 |

Based on the table above, there is IMD4 falling on top of n70 DL. There is pretty similar combination in EN-DC, DC\_66A\_n71A with same IMD source (2\*66 UL-2\*71UL=66 DL) where MSD is defined for B66. Because the IMD mechanisms are exactly the same, we propose to reuse that MSD number for n70 recognizing MSD for n70 is not fully optimized as in CA\_n70A-n71A MSD hits only partially on top of n70 while in DC\_66A\_n71A there is full hit.

Furthermore, the 3rd harmonic relation has MSD specified for n70, but the frequency arrangement for IMD4 is such that the 3rd harmonic does not occur at n70 in IMD4 requirement.

Table 6.14.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 6.14.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |
| --- | --- |
| NR CA combination | Spurious emission |
| Protected Band | Frequency range (MHz) | Maximum Level (dBm) | MBW (MHz) | NOTE |
| CA\_n70-n71 | E-UTRA Band 4, 5, 7, 10, 12, 13, 14, 17, 26, 27, 29, 30, 48, 66, 74, 85 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 2, 25, 41, 70 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| E-UTRA Band 29 | FDL\_low | - | FDL\_high | -38 | 1 | 4 |
| E-UTRA Band 71 | FDL\_low | - | FDL\_high | -38 | 1 | 4 |
| NOTE 1: FDL\_low and FDL\_high refer to each frequency band specified in Table 5.2-1 in TS 38.101-1 or Table 5.5-1 in TS 36.101NOTE 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 3: Applicable when co-existence with PHS system operating in 1884.5 -1915.7 MHzNOTE 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.NOTE 5: This requirement is applicable only for the following cases: A: for carriers of 5 MHz channel bandwidth when carrier centre frequency (Fc) is within the range 902.5 MHz ≤ Fc < 907.5 MHz with an uplink transmission bandwidth less than or equal to 20 RB; B: for carriers of 5 MHz channel bandwidth when carrier centre frequency (Fc) is within the range 907.5 MHz ≤ Fc ≤ 912.5 MHz without any restriction on uplink transmission bandwidth; D: for carriers of 10 MHz channel bandwidth when carrier centre frequency (Fc) is Fc = 910 MHz with an uplink transmission bandwidth less than or equal to 32 RB with RBstart > 3.NOTE 6: 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.NOTE 7: For these adjacent bands, the emission limit could imply risk of harmful interference to UE(s) operating in the protected operating band.NOTE 8: This requirement is only applicable for carriers with bandwidth confined within 1885-1920 MHz (requirement for carriers with at least 1RB confined within 1880 - 1885 MHz is not specified). This requirement applies for an uplink transmission bandwidth less than or equal to 54 RB for carriers of 15 MHz bandwidth when carrier center frequency is within the range 1892.5 - 1894.5 MHz and for carriers of 20 MHz bandwidth when carrier center frequency is within the range 1895 - 1903 MHz.NOTE 9: This requirement applies for 5, 10, 15 and 20 MHz NR channel bandwidth allocated within 1744.9 MHz and 1784.9 MHz.NOTE 10: This requirement applies when the NR carrier is confined within 2545 - 2575 MHz or 2595 – 2645vMHz and the channel bandwidth is 10 or 20 MHz.NOTE 11:Applicable when the assigned NR carrier is confined within 718 MHz and 748 MHz and when the channel bandwidth used is 5 or 10 MHz.NOTE 12: As exceptions, measurements with a level up to the applicable requirement of -36 dBm/MHz is permitted for each assigned NR 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 5.3.1-1) for which the 3rd harmonic totally or partially overlaps the measurement bandwidth (MBW).NOTE 13: This requirement is applicable for 5 and 10 MHz NR channel bandwidth allocated within 718 - 728 MHz. 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 14: This requirement is applicable in the case of a 10 MHz NR carrier confined within 703 MHz and 733 MHz, otherwise the requirement of -25 dBm with a measurement bandwidth of 8 MHz applies.NOTE 15: As exceptions, measurements with a level up to the applicable requirement of -38 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 17: Applicable when NS\_05 in clause 6.6.3.3.1 is signalled by the network.NOTE 18: This requirement is applicable for any channel bandwidths within the range 2500 – 2570 MHz with the following restriction: for carriers of 15 MHz bandwidth when carrier centre frequency is within the range 2560.5 - 2562.5 MHz and for carriers of 20 MHz bandwidth when carrier centre frequency is within the range 2552 – 2560 MHz the requirement is applicable only for an uplink transmission bandwidth less than or equal to 54 RB. |

#### 6.14.2.2 REFSENS requirements

MSD is defined for n70 as follows.

**Table 6.14.2.2-1: 2DL/2UL interband Reference sensitivity QPSK PREFSENS and uplink/downlink configurations**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA****Configuration** | **NR band** | **UL Fc (MHz)** | **UL/DL BW (MHz)** | **UL CLRB** | **DL Fc (MHz)** | **MSD (dB)** | **Duplex mode** | **Source of IMD** |
| CA\_n70A-n71A | n70 | 1697.5 | 5 | 25 | 1997.5 | 5 | FDD | IMD4 |
| n71 | 695.5 | 5 | 25 | 649.5 | N/A | FDD | N/A |

## 6.x CA\_n29-n70

### 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 n29+n70

|  |  |  |  |
| --- | --- | --- | --- |
| NR Band | Uplink (UL) band | Downlink (DL) band | Duplexmode |
| BS receive / UE transmit | BS transmit / UE receive |
| FUL\_low – FUL\_high | FDL\_low – FDL\_high |
| n29 | N/A |  717 | – | 728 | SDL |
| n70 |  1695 |  – | 1710 |  1995 | – | 2020 | 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 n29+n70

|  |
| --- |
| **CA operating / channel bandwidth [MHz]** |
| **NR CA Configuration** | **UL Configuration** | **NR Band** | **SCS [kHz]** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n29A-n70A | - | n29 | 15 | Yes | Yes |  |  |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes |  |  |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| n70 | 15 | Yes | Yes | Yes | Yes1 | Yes1 |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes1 | Yes1 |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes1 | Yes1 |  |  |  |  |  |  |  |
| NOTE 1: This UE channel bandwidth is applicable only to downlink  |

#### 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\_n29-n70.

**Table 6.x.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | **3rd Harmonic** | **nth 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 |
| n29 | N/A | N/A | 717 | 728 | N/A | N/A | N/A | N/A | N/A | N/A |
| n70 | 1695 | 1710 | 1995 | 2020 | 3390 | 3420 | 5085 | 5130 |  |  |

Based on the table above, there is no harmonic relation.

**Table 6.x.1.3-2: Impact of UL/DL Harmonic mixing**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | **3rd Harmonic** | **mth 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 |
| n29 | N/A | N/A | 717 | 728 | 1434 | 1456 | 2151 | 2184 | N/A | N/A |
| n70 | 1695 | 1710 | 1995 | 2020 | 3990 | 4040 | 5985 | 6060 |  |  |

Based on the table above, there is no harmonic mixing relation.

#### 6.x.1.4 ∆TIB and ∆RIB values

For CA\_n29-n70, the ΔTIB,c and ΔRIB,c values are given in the tables below.

Table 6.x.1.4-1: ΔTIB,c

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n29-n70 | n70 | 0.3 |

Table 6.x.1.4-2: ΔRIB,c

| Inter-band CA Configuration | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n29-n70 | n70 | 0 |

#### 6.x.1.5 REFSENS requirements

REFSENS is defined in TS38.101-1 Table 7.3A.2.4-1, because n29A is an SDL band.

Table 6.x.1.5-1: Reference sensitivity for SDL bands

|  |
| --- |
| NR Band/Channel bandwidth |
| NR CA Configuration | NR band | SCS (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 |
| dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB |
| CA\_n29A-n70A | n29 | 15 | -97.0 | -93.8 |  |  |  |  |  |  |  |  |  |  |
| 30 |  | -94.1 |  |  |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| n70 | 15 | -100 | -96.8 | -95.0 | -93.8 | -92.7 |  |  |  |  |  |  |  |
| 30 |  | -97.1 | -95.1 | -94.0 | -92.8 |  |  |  |  |  |  |  |
| 60 |  | -97.5 | -95.4 | -94.2 | -93.0 |  |  |  |  |  |  |  |
| NOTE 1: The transmitter shall be set to PUMAX, as defined in subclause 6.2.4.NOTE 2: Four Rx antenna ports shall be the baseline for this operating band, except for two Rx vehicular UE. |

## 6.x CA\_n29-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.1.1-1: CA band combination of band n29+n66

|  |  |  |  |
| --- | --- | --- | --- |
| NR Band | Uplink (UL) band | Downlink (DL) band | Duplexmode |
| BS receive / UE transmit | BS transmit / UE receive |
| FUL\_low – FUL\_high | FDL\_low – FDL\_high |
| n29 | N/A |  717 | – | 728 | SDL |
| n66 |  1710 |  – | 1780 |  2110 | – | 2200 | 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 n29+n66

|  |
| --- |
| **CA operating / channel bandwidth [MHz]** |
| **NR CA Configuration** | **UL Configuration** | **NR Band** | **SCS [kHz]** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n29A-n66B | **-** | n29 | 15 | Yes | Yes |  |  |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes |  |  |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| n66 | See CA\_n66B Bandwidth Combination Set 0 in Table 5.5A.1-1 in TS38.101-1 |
| CA\_n29A-n66(2A) | **-** | n29 | 15 | Yes | Yes |  |  |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes |  |  |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| n66 | See CA\_n66(2A) Bandwidth Combination Set 0 in Table 5.5A.2-1 in TS38.101-1 |

#### 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\_n29-n66.

**Table 6.x.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | **3rd Harmonic** | **nth 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 |
| n29 | N/A | N/A | 717 | 728 | N/A | N/A | N/A | N/A | N/A | N/A |
| n66 | 1710 | 1780 | 2110 | 2200 | 3420 | 3560 | 5130 | 5340 |  |  |

Based on the table above, there is no harmonic relation.

**Table 6.x.1.3-2: Impact of UL/DL Harmonic mixing**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | **3rd Harmonic** | **mth 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 |
| n29 | N/A | N/A | 717 | 728 | 1434 | 1456 | 2151 | 2184 | N/A | N/A |
| n66 | 1710 | 1780 | 2110 | 2200 | 4220 | 4400 | 6330 | 6600 |  |  |

Based on the table above, there is no harmonic mixing relation.

#### 6.x.1.4 ∆TIB and ∆RIB values

For CA\_n29-n66, the ΔTIB,c and ΔRIB,c values are already defined in CA\_n29A-n66A

#### 6.x.1.5 REFSENS requirements

REFSENS is defined in TS38.101-1 Table 7.3A.2.4-1, because n29A is an SDL band.

Table 6.x.1.5-1: Reference sensitivity for SDL bands

|  |
| --- |
| NR Band/Channel bandwidth |
| NR CA Configuration | NR band | SCS (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 |
| dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB |
| CA\_n29A-n66B | n29 | 15 | -97.0 | -93.8 |  |  |  |  |  |  |  |  |  |  |
| 30 |  | -94.1 |  |  |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| n66 | 15 | -99.5 | -96.3 | -94.5 | -93.3 |  |  | -90.1 |  |  |  |  |  |
| 30 |  | -96.6 | -94.6 | -93.5 |  |  | -90.2 |  |  |  |  |  |
| 60 |  | -97.0 | -94.9 | -93.7 |  |  | -90.4 |  |  |  |  |  |
| CA\_n29A-n66(2A) | n29 | 15 | -97.0 | -93.8 |  |  |  |  |  |  |  |  |  |  |
| 30 |  | -94.1 |  |  |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| n66 | 15 | -99.5 | -96.3 | -94.5 | -93.3 |  |  | -90.1 |  |  |  |  |  |
| 30 |  | -96.6 | -94.6 | -93.5 |  |  | -90.2 |  |  |  |  |  |
| 60 |  | -97.0 | -94.9 | -93.7 |  |  | -90.4 |  |  |  |  |  |
| NOTE 1: The transmitter shall be set to PUMAX, as defined in subclause 6.2.4.NOTE 2: Four Rx antenna ports shall be the baseline for this operating band, except for two Rx vehicular UE. |

# 4 References