**3GPP TSG-RAN WG4 Meeting #112 R4-2411255**

**Maastricht Netherlands, August 19 – 23, 2024**

Source: Verizon, Skyworks Solutions Inc., Qualcomm, Ericsson, Samsung

Title: TP for TR 38.719-02-01: PC3 NR BCS4/5 inter-band CA

Agenda item: x.x.x

Document for: Discussion/Approval

# **Introduction**

This is a TP to TR 38.719-02-01, and it proposes PC3 BCS4 and 5 inter-band uplink CA for following CA combos which are specified in 38.101-1 [2].

* CA\_n2-n5
* CA\_n2-n48
* CA\_n2-n66
* CA\_n5-n48
* CA\_n48-n66

For introducing new BCS 4 and 5 inter-band uplink CA to the existing combos, the analyses are mainly focusing on the required sensitivity degradation from UL/DL harmonics/harmonic mixing and Cross-band isolation. The format of each proposal is following the proposed “Template for 2 band DL 1or2 band UL inter-band combination TR and TP” [3].

# **Reference**

[1] [RP-241674](https://urldefense.proofpoint.com/v2/url?u=https-3A__www.3gpp.org_ftp_TSG-5FRAN_TSG-5FRAN_TSGR-5F104_Docs_RP-2D241674.zip&d=DwMGaQ&c=udBTRvFvXC5Dhqg7UHpJlPps3mZ3LRxpb6__0PomBTQ&r=gkdaVlH8E3iGHLmRXXVtiIE0l9tA1RmsuKY7g2Dox6c&m=q_N0UWjWBzpP5g3wA9c4zk2mWGa0jERrj8yx8176jgiF2aEhNwtgzFb_ga89WPbs&s=nDEWWDK4DFI5Efa0y8kMO7C7tpKWTL_94pJKAzzncS4&e=), New WID: Rel-19 NR Carrier Aggregation (CA)/Dual Connectivity (DC) for x bands DL with y bands UL (x<7, y<3) and Supplementary Uplink (SUL) band combinations/CA band combinations with a single

[2] 38.101-1 ([18.6.0](https://www.3gpp.org/ftp/Specs/archive/38_series/38.101-1/38101-1-i60.zip)): User Equipment (UE) radio transmission and reception; Part 1: Range 1 Standalone

[3] [R4-2407231:](https://urldefense.proofpoint.com/v2/url?u=https-3A__www.3gpp.org_ftp_TSG-5FRAN_WG4-5FRadio_TSGR4-5F111_Docs_R4-2D2407231.zip&d=DwMGaQ&c=udBTRvFvXC5Dhqg7UHpJlPps3mZ3LRxpb6__0PomBTQ&r=gkdaVlH8E3iGHLmRXXVtiIE0l9tA1RmsuKY7g2Dox6c&m=q_N0UWjWBzpP5g3wA9c4zk2mWGa0jERrj8yx8176jgiF2aEhNwtgzFb_ga89WPbs&s=xw83k_QUG9JK4IcSLs4r4wRWKX3QRNU9m2prYIgNAeI&e=)  Template for 2 band DL 1or2 band UL inter-band combination TR and TP, Skyworks, Nokia

[4] [R4-2408845](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2408845.zip): Adding missing MSD for CA\_n2A-n66A and for CA\_n25A-n66A PC3, Qualcomm France, Skyworks Inc.

# **Text proposal**

**====================== <Start of Text Proposal> ======================**

## 5.x CA\_n2-n5

### 5.x.1 Common for 1 band UL and 2 bands UL CA

#### 5.x.1.1 Operating bands for CA

**Table 5.x.1.1-1: CA band combination of band n2+n5**

|  |  |  |  |
| --- | --- | --- | --- |
| **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** |
| n2 | 1850 MHz | – | 1910 MHz | 1930 MHz | – | 1990 MHz | FDD |
| n5 | 824 MHz |  – | 849 MHz | 869 MHz | – | 894 MHz | FDD |

#### 5.x.1.2 Channel bandwidths per operating band for CA

**Table 5.x.1.2-1: Supported bandwidths per CA band combination of band n2+n5**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **NR CA configuration** | **Uplink CA configuration or single uplink carrier** | **NR Band** | **Channel bandwidth (MHz)** | **Bandwidth combination set** |
| CA\_n2A-n5A | CA\_n2A-n5A | n2 | n2 channel bandwidths in Table 5.3.5-1 of 38.101-1  | 4 and 5 |
| n5 | n5 channel bandwidths in Table 5.3.5-1 of 38.101-1 |

#### 5.x.1.3 UE co-existence studies for 1 band UL

5.X.1.3.1 Co-existence studies for 2UL band with 1CC per band

Table 5.X.1.3.1-1 summarizes frequency ranges where harmonics and/or harmonic mixing occur for CA\_n2A-n5A.

**Table 5.X.1.3.1-1: UL/DL harmonics/harmonic mixing analysis**

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| **UL/DL** | **n5** | **UL1** | **UL2** | **UL3** | **UL4** | **UL5** | **MSD type** |
| **harmonics** | **fLow** | 824 | 1648 | 2472 | 3296 | 4120 |
| **n2** | **fLow** | **fHigh** | 849 | 1698 | 2547 | 3396 | 4245 |
| **DL1** | 1930 | 1990 | N/A |  |  |  |  | **UL Harmonic** |
| **DL2** | 3860 | 3980 |  | N/A |  | N/A | N/A | **Harmonic Mixing** |
| **DL3** | 5790 | 5970 |  |  | N/A |  | N/A |
| **DL4** | 7720 | 7960 |  | N/A | N/A | N/A | N/A |
| **DL5** | 9650 | 9950 |  |  | N/A | N/A | N/A |
| **Analysis** | There is no collision detected with both harmonic and harmonic mixing. |
| **UL/DL** | **n2** | **UL13** | **UL2** | **UL3** | **UL4** | **UL5** | **MSD type** |
| **harmonics** | **fLow** | 1850 | 3700 | 5550 | 7400 | 9250 |
| **n5** | **fLow** | **fHigh** | 1910 | 3820 | 5730 | 7640 | 9550 |
| **DL1** | 869 | 894 | N/A |  |  |  |  | **UL Harmonic** |
| **DL2** | 1738 | 1788 |  | N/A |  | N/A | N/A | **Harmonic Mixing** |
| **DL3** | 2607 | 2682 |  |  | N/A |  | N/A |
| **DL4** | 3476 | 3576 |  | N/A | N/A | N/A | N/A |
| **DL5** | 4345 | 4470 |  |  | N/A | N/A | N/A |
| **Analysis** | There is no collision detected with both harmonic and harmonic mixing. |

Based on the above table:

* There is no harmonic or harmonic mixing collision detected for this band combination.

Table 5.X.1.3.1-2 summarizes frequency ranges where cross-band isolation may occur for CA\_n2A-n5A.

**Table 5.X.1.3.1-2: Cross-band isolation analysis**

|  |  |  |
| --- | --- | --- |
| **Bands** | **n2** | **n5** |
| **Frequency limit** | **fx\_low / min** | **fx\_high / max** | **fy\_low / min** | **fy\_high / max** |
| **fUL (MHz)** | 1850 | 1910 | 824 | 849 |
| **fDL (MHz)** | 1930 | 1990 | 869 | 894 |
| **CBW (MHz)** | 5 | 40 | 5 | 20 |
| **ACLR1 range** | fxULlow-maxULCBWx | fxULhigh+maxULCBWx | fyULlow-maxULCBWy | fyULhigh+maxULCBWy |
| **ACLR1 (MHz)** | 1810 | 1950 | 804 | 869 |
| **ACLR2 range** | fxULlow-2\*maxULCBWx | fxULhigh+2\*maxULCBWx | fyULlow-2\*maxULCBWy | fyULhigh+2\*maxULCBWy |
| **ACLR2 (MHz)** | 1770 | 1990 | 784 | 889 |
| **ACLR3 range** | fxULlow-3\*maxULCBWx | fxULhigh+3\*maxULCBWx | fyULlow-3\*maxULCBWy | fyULhigh+3\*maxULCBWy |
| **ACLR3 (MHz)** | 1730 | 2030 | 764 | 909 |
| **ACLR4 range** | fxULlow-4\*maxULCBWx | fxULhigh+4\*maxULCBWx | fyULlow-4\*maxULCBWy | fyULhigh+4\*maxULCBWy |
| **ACLR4 (MHz)** | 1690 | 2070 | 744 | 929 |
| **ACLR5 range1** | fxULlow-5\*maxULCBWx | fxULhigh+5\*maxULCBWx | fyULlow-5\*maxULCBWy | fyULhigh+5\*maxULCBWy |
| **ACLR5 (MHz)** | 1650 | 2110 | 724 | 949 |
| **Analysis** | There is no overlap of the band n2 ACLR range with the band n5 DL up to order 5. The sufficient rejection of the transmitter noise floor should be at band n5 so no cross-band MSD is needed. | There is no overlap of the band n5 ACLR range with the band n2 DL up to order 5. The sufficient rejection of the transmitter noise floor should be at band n2 so no cross-band MSD is needed. |

Based on the above table:

* There is no uplink band overlapping with the downlink in ACLR range. The existing diplexer isolation should provide sufficient rejection.

## 5.x CA\_n2-n48

### 5.x.1 Common for 1 band UL and 2 bands UL CA

#### 5.x.1.1 Operating bands for CA

**Table 5.x.1.1-1: CA band combination of band n2+n48**

|  |  |  |  |
| --- | --- | --- | --- |
| **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** |
| n2 | 1850 MHz | – | 1910 MHz | 1930 MHz | – | 1990 MHz | FDD |
| n48 | 3550 MHz |  – | 3700 MHz | 3550 MHz | – | 3700 MHz | TDD |

#### 5.x.1.2 Channel bandwidths per operating band for CA

**Table 5.x.1.2-1: Supported bandwidths per CA band combination of band n2+n48**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **NR CA configuration** | **Uplink CA configuration or single uplink carrier** | **NR Band** | **Channel bandwidth (MHz)** | **Bandwidth combination set** |
| CA\_n2A-n48A | CA\_n2A-n48A | n2 | n5 channel bandwidths in Table 5.3.5-1 of 38.101-1  | 4 and 5 |
| n48 | n48 channel bandwidths in Table 5.3.5-1 of 38.101-1 |

#### 5.x.1.3 UE co-existence studies for 1 band UL

5.X.1.3.1 Co-existence studies for 2UL band with 1CC per band

Table 5.X.1.3.1-1 summarizes frequency ranges where harmonics and/or harmonic mixing occur for CA\_n2-n48.

**Table 5.X.1.3.1-1: UL harmonics and harmonic mixing analysis**

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| **UL/DL** | **n48** | **UL1** | **UL2** | **UL3** | **UL4** | **UL5** | **MSD type** |
| **harmonics** | **fLow** | 3550 | 7100 | 10650 | 14200 | 17750 |
| **n2** | **fLow** | **fHigh** | 3700 | 7400 | 11100 | 14800 | 18500 |
| **DL1** | 1930 | 1990 | N/A |  |  |  |  | **UL Harmonic** |
| **DL2** | 3860 | 3980 |  | N/A |  | N/A | N/A | **Harmonic Mixing** |
| **DL3** | 5790 | 5970 |  |  | N/A |  | N/A |
| **DL4** | 7720 | 7960 |  | N/A | N/A | N/A | N/A |
| **DL5** | 9650 | 9950 |  |  | N/A | N/A | N/A |
| **Analysis** | There is no collision detected with both harmonic and harmonic mixing. |
| **UL/DL** | **n2** | **UL13** | **UL2** | **UL3** | **UL4** | **UL5** | **MSD type** |
| **harmonics** | **fLow** | 1850 | 3700 | 5550 | 7400 | 9250 |
| **n48** | **fLow** | **fHigh** | 1910 | 3820 | 5730 | 7640 | 9550 |
| **DL1** | 3550 | 3700 | N/A | N |  |  |  | **UL Harmonic** |
| **DL2** | 7100 | 7400 |  | N/A |  | N/A | N/A | **Harmonic Mixing** |
| **DL3** | 10650 | 11100 |  |  | N/A |  | N/A |
| **DL4** | 14200 | 14800 |  | N/A | N/A | N/A | N/A |
| **DL5** | 17750 | 18500 |  |  | N/A | N/A | N/A |
| **Analysis** | There is a near miss collision between the band n2 2nd harmonic to the band n48 DL.  |

Based on the above table:

* For the n2 uplink 2nd harmonic falling to the band n48, the MSD defined in Table 7.3A.4-1 of 38.101-1 can be applied. There is no newer requirement needed.

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Table 5.X.1.3.1-2 summarizes frequency ranges where cross-band isolation issues may occur for both UL bands into the other band DL.

**Table 5.X.1.3.1-2: Cross-band isolation analysis**

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| --- | --- | --- |
| **Bands** | **n2** | **n48** |
| **Frequency limit** | **fx\_low / min** | **fx\_high / max** | **fy\_low / min** | **fy\_high / max** |
| **fUL (MHz)** | 1850 | 1910 | 3550 | 3700 |
| **fDL (MHz)** | 1930 | 1990 | 3550 | 3700 |
| **CBW (MHz)** | 5 | 40 | 5 | 100 |
| **ACLR1 range** | fxULlow-maxULCBWx | fxULhigh+maxULCBWx | fyULlow-maxULCBWy | fyULhigh+maxULCBWy |
| **ACLR1 (MHz)** | 1810 | 1950 | 3450 | 3800 |
| **ACLR2 range** | fxULlow-2\*maxULCBWx | fxULhigh+2\*maxULCBWx | fyULlow-2\*maxULCBWy | fyULhigh+2\*maxULCBWy |
| **ACLR2 (MHz)** | 1770 | 1990 | 3350 | 3900 |
| **ACLR3 range** | fxULlow-3\*maxULCBWx | fxULhigh+3\*maxULCBWx | fyULlow-3\*maxULCBWy | fyULhigh+3\*maxULCBWy |
| **ACLR3 (MHz)** | 1730 | 2030 | 3250 | 4000 |
| **ACLR4 range** | fxULlow-4\*maxULCBWx | fxULhigh+4\*maxULCBWx | fyULlow-4\*maxULCBWy | fyULhigh+4\*maxULCBWy |
| **ACLR4 (MHz)** | 1690 | 2070 | 3150 | 4100 |
| **ACLR5 range1** | fxULlow-5\*maxULCBWx | fxULhigh+5\*maxULCBWx | fyULlow-5\*maxULCBWy | fyULhigh+5\*maxULCBWy |
| **ACLR5 (MHz)** | 1650 | 2110 | 3050 | 4200 |
| **Analysis** | There is no overlap of the band n2 ACLR range with the band n48 DL up to order 5. The sufficient rejection of the transmitter noise floor should be at band n48 so no cross-band MSD is needed. | There is no overlap of the band n48 ACLR range with the band n2 DL up to order 5. The sufficient rejection of the transmitter noise floor should be at band n2 so no cross-band MSD is needed. |

Based on the above table:

* There is no uplink band overlapping with the downlink in ACLR range. The existing diplexer isolation should provide sufficient rejection.

## 5.x CA\_n2-n66

### 5.x.1 Common for 1 band UL and 2 bands UL CA

#### 5.x.1.1 Operating bands for CA

Table 5.x.1.1-1: CA band combination of band n2+n66

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| --- | --- | --- | --- |
| **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** |
| n2 | 1850 MHz | – | 1910 MHz | 1930 MHz | – | 1990 MHz | FDD |
| n66 | 1710 MHz |  – | 1780 MHz | 2110 MHz | – | 2200 MHz | FDD |

#### 5.x.1.2 Channel bandwidths per operating band for CA

Table 5.x.1.2-1: Supported bandwidths per CA band combination of band n2+n66

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **NR CA configuration** | **Uplink CA configuration or single uplink carrier** | **NR Band** | **Channel bandwidth (MHz)** | **Bandwidth combination set** |
| CA\_n2A-n66A | CA\_n2A-n66A | n2 | See n2 channel bandwidths in Table 5.3.5-1 of 38.101-1 | 4 and 5 |
| n66 | See n66 channel bandwidths in Table 5.3.5-1 of 38.101-1 |

#### 5.x.1.3 UE co-existence studies for 1 band UL

5.X.1.3.1 Co-existence studies for 2UL band with 1CC per band

Table 5.X.1.3.1-1 summarizes frequency ranges where harmonics and/or harmonic mixing occur for CA\_n2-n66.

**Table 5.X.1.3.1-1: UL harmonics and harmonic mixing analysis**

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| .**UL/DL** | **n66** | **UL1** | **UL2** | **UL3** | **UL4** | **UL5** | **MSD type** |
| **harmonics** | **fLow** | 1710 | 3420 | 5130 | 6840 | 8550 |
| **n2** | **fLow** | **fHigh** | 1780 | 3560 | 5340 | 7120 | 8900 |
| **DL1** | 1930 | 1990 | N/A |  |  |  |  | **UL Harmonic** |
| **DL2** | 3860 | 3980 |  | N/A |  | N/A | N/A | **Harmonic Mixing** |
| **DL3** | 5790 | 5970 |  |  | N/A |  | N/A |
| **DL4** | 7720 | 7960 |  | N/A | N/A | N/A | N/A |
| **DL5** | 9650 | 9950 |  |  | N/A | N/A | N/A |
| **Analysis** | There is no collision detected with both harmonic and harmonic mixing. |
| **UL/DL** | **n2** | **UL13** | **UL2** | **UL3** | **UL4** | **UL5** | **MSD type** |
| **harmonics** | **fLow** | 1850 | 3700 | 5550 | 7400 | 9250 |
| **n66** | **fLow** | **fHigh** | 1910 | 3820 | 5730 | 7640 | 9550 |
| **DL1** | 2110 | 2200 | N/A |  |  |  |  | **UL Harmonic** |
| **DL2** | 4220 | 4400 |  | N/A |  | N/A | N/A | **Harmonic Mixing** |
| **DL3** | 6330 | 6600 |  |  | N/A |  | N/A |
| **DL4** | 8440 | 8800 |  | N/A | N/A | N/A | N/A |
| **DL5** | 10550 | 11000 |  |  | N/A | N/A | N/A |
| **Analysis** | There is no collision detected with both harmonic and harmonic mixing. |

Based on the above table:

* There is no harmonic or harmonic mixing collision detected for this band combination.

Table 5.X.1.3.1-2 summarizes frequency ranges where cross-band isolation issues may occur for both UL bands into the other band DL.

**Table 5.X.1.3.1-2: Cross-band isolation analysis**

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| --- | --- | --- |
| **Bands** | **n2** | **n66** |
| **Frequency limit** | **fx\_low / min** | **fx\_high / max** | **fy\_low / min** | **fy\_high / max** |
| **fUL (MHz)** | 1850 | 1910 | 1710 | 1780 |
| **fDL (MHz)** | 1930 | 1990 | 2110 | 2200 |
| **CBW (MHz)** | 5 | 40 | 5 | 45 |
| **ACLR1 range** | fxULlow-maxULCBWx | fxULhigh+maxULCBWx | fyULlow-maxULCBWy | fyULhigh+maxULCBWy |
| **ACLR1 (MHz)** | 1810 | 1950 | 1665 | 1825 |
| **ACLR2 range** | fxULlow-2\*maxULCBWx | fxULhigh+2\*maxULCBWx | fyULlow-2\*maxULCBWy | fyULhigh+2\*maxULCBWy |
| **ACLR2 (MHz)** | 1770 | 1990 | 1620 | 1870 |
| **ACLR3 range** | fxULlow-3\*maxULCBWx | fxULhigh+3\*maxULCBWx | fyULlow-3\*maxULCBWy | fyULhigh+3\*maxULCBWy |
| **ACLR3 (MHz)** | 1730 | 2030 | 1575 | 1915 |
| **ACLR4 range** | fxULlow-4\*maxULCBWx | fxULhigh+4\*maxULCBWx | fyULlow-4\*maxULCBWy | fyULhigh+4\*maxULCBWy |
| **ACLR4 (MHz)** | 1690 | 2070 | 1530 | 1960 |
| **ACLR5 range1** | fxULlow-5\*maxULCBWx | fxULhigh+5\*maxULCBWx | fyULlow-5\*maxULCBWy | fyULhigh+5\*maxULCBWy |
| **ACLR5 (MHz)** | 1650 | 2110 | 1485 | 2005 |
| **Analysis** | There is an overlap of the band n2 ACLR5 range with the band n66 DL. Therefore, the cross-band isolation MSD should be studied. | There are an overlaps of the band n66 ACLR 4 and 5 ranges with the band n2 DL. Therefore, the cross-band isolation MSD should be studied. |

Based on the table above:

* For the cross-band overlapping from uplink n66 to n2 downlink, the same degradation proposal approved in CR [4] will be applied as shown below. No additional MSD is needed.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **UL band** | **DL band** | **UL Fc** | **UL BW** | **SCS of UL band** | **UL RB Allocation** | **DL Fc** | **DL BW** | **MSD** | **Cross-band****Interference****source** |
| **(MHz)** | **(MHz)** | **(kHz)** | **LCRB** | **(MHz)** | **(MHz)** | **(dB)** |
| n66 | n2 | 1757.5 | 45 | 15 | 240 (RBstart=2) | 1932.5 | 5 | 1.2 | >ACLR2 |

* For the cross-band overlapping from uplink n2 to n66 downlink, the RBs in uplink n2 are never fully loaded in REFSENS configuration. There is no issue and there is no need to specify MSD for the PC3.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **UL band** | **DL band** | **UL Fc** | **UL BW** | **SCS of UL band** | **UL RB Allocation** | **DL Fc** | **DL BW** | **MSD** | **Cross-band****Interference****source** |
| **(MHz)** | **(MHz)** | **(kHz)** | **LCRB** | **(MHz)** | **(MHz)** | **(dB)** |
| n2 | n66 | 1910 | 40 | 15 | 40 (RBstart=176) | 2112.5 | 5 | [0] | >ACLR2 |

## 5.x CA\_n5-n48

### 5.x.1 Common for 1 band UL and 2 bands UL CA

#### 5.x.1.1 Operating bands for CA

Table 5.x.1.1-1: CA band combination of band n5+n48

|  |  |  |  |
| --- | --- | --- | --- |
| **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** |
| n5 | 824 MHz |  – | 849 MHz | 869 MHz | – | 894 MHz | FDD |
| n48 | 3550 MHz |  – | 3700 MHz | 3550 MHz | – | 3700 MHz | TDD |

#### 5.x.1.2 Channel bandwidths per operating band for CA

Table 5.x.1.2-1: Supported bandwidths per CA band combination of band n5+n48

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **NR CA configuration** | **Uplink CA configuration or single uplink carrier** | **NR Band** | **Channel bandwidth (MHz)** | **Bandwidth combination set** |
| CA\_n5A-n48A | CA\_n5A-n48A | n5 | n5 channel bandwidths in Table 5.3.5-1 of 38.101-1 | 4 and 5 |
| n48 | n48 channel bandwidths in Table 5.3.5-1 of 38.101-1 |
| NOTE 3: This UE channel bandwidth is applicable only to downlink.NOTE 6: For this bandwidth, the minimum requirements are restricted to operation when carrier is configured as a downlink SCell part of CA configuration. |

#### 5.x.1.3 UE co-existence studies for 1 band UL

5.X.1.3.1 Co-existence studies for 2UL band with 1CC per band

Table 5.X.1.3.1-1 summarizes frequency ranges where harmonics and/or harmonic mixing occur for CA\_n5-n48.

**Table 5.X.1.3.1-1: UL harmonics and harmonic mixing analysis**

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| --- | --- | --- | --- | --- | --- | --- | --- |
| **UL/DL** | **n48** | **UL1** | **UL2** | **UL3** | **UL4** | **UL5** | **MSD type** |
| **harmonics** | **fLow** | 3550 | 7100 | 10650 | 14200 | 17750 |
| **n5** | **fLow** | **fHigh** | 3700 | 7400 | 11100 | 14800 | 18500 |
| **DL1** | 869 | 894 | N/A |  |  |  |  | **UL Harmonic** |
| **DL2** | 1738 | 1788 |  | N/A |  | N/A | N/A | **Harmonic Mixing** |
| **DL3** | 2607 | 2682 |  |  | N/A |  | N/A |
| **DL4** | 3476 | 3576 | D | N/A | N/A | N/A | N/A |
| **DL5** | 4345 | 4470 |  |  | N/A | N/A | N/A |
| **Analysis** | There is collision detected from downlink band n5 4th harmonic mixing with n48 uplink. |
| **UL/DL** | **n5** | **UL13** | **UL2** | **UL3** | **UL4** | **UL5** | **MSD type** |
| **harmonics** | **fLow** | 824 | 1648 | 2472 | 3296 | 4120 |
| **n48** | **fLow** | **fHigh** | 849 | 1698 | 2547 | 3396 | 4245 |
| **DL1** | 3550 | 3700 | N/A |  |  |  |  | **UL Harmonic** |
| **DL2** | 7100 | 7400 |  | N/A |  | N/A | N/A | **Harmonic Mixing** |
| **DL3** | 10650 | 11100 |  |  | N/A |  | N/A |
| **DL4** | 14200 | 14800 |  | N/A | N/A | N/A | N/A |
| **DL5** | 17750 | 18500 |  |  | N/A | N/A | N/A |
| **Analysis** | There is no collision detected with both harmonic and harmonic mixing. |

Based on the above table:

* For the 4th DL harmonic-mixing falling on the downlink, the BSD for CA\_n5-n48 for PC3 should be same as the defined CA\_n26-n48. This is because the new higher channel bandwidth introduced for band n48 BCS 4 and 5 is the same as the BCS 0 and 1.

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| **UL band** | **DL band** | **UL BW** | **SCS of UL band** | **UL RB Allocation** | **DL BW** | **MSD** | **UL/DL fc condition** | **UL/DL harmonic order** |
| **(MHz)** | **(kHz)** | **LCRB** | **(MHz)** | **(dB)** |
| n48 | n5 | 10 | 15 | 25 (RBstart=0) | 5 | 5.7 | NOTE 8 | UL1/DL4 |

Table 5.X.1.3.1-2 summarizes frequency ranges where cross-band isolation issues may occur for both UL bands into the other band DL.

**Table 5.X.1.3.1-2: Cross-band isolation analysis**

|  |  |  |
| --- | --- | --- |
| **Bands** | **n5** | **n48** |
| **Frequency limit** | **fx\_low / min** | **fx\_high / max** | **fy\_low / min** | **fy\_high / max** |
| **fUL (MHz)** | 824 | 849 | 3550 | 3700 |
| **fDL (MHz)** | 869 | 894 | 3550 | 3700 |
| **CBW (MHz)** | 5 | 25 | 5 | 100 |
| **ACLR1 range** | fxULlow-maxULCBWx | fxULhigh+maxULCBWx | fyULlow-maxULCBWy | fyULhigh+maxULCBWy |
| **ACLR1 (MHz)** | 799 | 874 | 3450 | 3800 |
| **ACLR2 range** | fxULlow-2\*maxULCBWx | fxULhigh+2\*maxULCBWx | fyULlow-2\*maxULCBWy | fyULhigh+2\*maxULCBWy |
| **ACLR2 (MHz)** | 774 | 899 | 3350 | 3900 |
| **ACLR3 range** | fxULlow-3\*maxULCBWx | fxULhigh+3\*maxULCBWx | fyULlow-3\*maxULCBWy | fyULhigh+3\*maxULCBWy |
| **ACLR3 (MHz)** | 749 | 924 | 3250 | 4000 |
| **ACLR4 range** | fxULlow-4\*maxULCBWx | fxULhigh+4\*maxULCBWx | fyULlow-4\*maxULCBWy | fyULhigh+4\*maxULCBWy |
| **ACLR4 (MHz)** | 724 | 949 | 3150 | 4100 |
| **ACLR5 range1** | fxULlow-5\*maxULCBWx | fxULhigh+5\*maxULCBWx | fyULlow-5\*maxULCBWy | fyULhigh+5\*maxULCBWy |
| **ACLR5 (MHz)** | 699 | 974 | 3050 | 4200 |
| **Analysis** | There is no overlap of the band n5 ACLR range with the band n48 DL up to order 5. The sufficient rejection of the transmitter noise floor should be at band n48 so no cross-band MSD is needed. | There is no overlap of the band n48 ACLR range with the band n5 DL up to order 5. The sufficient rejection of the transmitter noise floor should be at band n5 so no cross-band MSD is needed. |

Based on the above table:

* There is no uplink band overlapping with the downlink in ACLR range. The existing diplexer isolation should provide sufficient rejection.

## 5.x CA\_n48-n66

### 5.x.1 Common for 1 band UL and 2 bands UL CA

#### 5.x.1.1 Operating bands for CA

Table 5.x.1.1-1: CA band combination of band n48+n66

|  |  |  |  |
| --- | --- | --- | --- |
| **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** |
| n48 | 3550 MHz |  – | 3700 MHz | 3550 MHz | – | 3700 MHz | TDD |
| n66 | 1710 MHz |  – | 1780 MHz | 2110 MHz | – | 2200 MHz | FDD |

#### 5.x.1.2 Channel bandwidths per operating band for CA

Table 5.x.1.2-1: Supported bandwidths per CA band combination of band n48+n66

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **NR CA configuration** | **Uplink CA configuration or single uplink carrier** | **NR Band** | **Channel bandwidth (MHz)** | **Bandwidth combination set** |
| CA\_n48A-n66A | CA\_n48A-n66A | n48 | See n48 channel bandwidths in Table 5.3.5-1 of 38.101-1 | 4 and 5 |
| n66 | See n66 channel bandwidths in Table 5.3.5-1 of 38.101-1 |
| NOTE 6: For this bandwidth, the minimum requirements are restricted to operation when carrier is configured as a downlink SCell part of CA configuration. |

#### 5.x.1.3 UE co-existence studies for 1 band UL

5.X.1.3.1 Co-existence studies for 2UL band with 1CC per band

Table 5.X.1.3.1-1 summarizes frequency ranges where harmonics and/or harmonic mixing occur for CA\_n48-n66.

**Table 5.X.1.3.1-1: UL harmonics and harmonic mixing analysis**

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| **UL/DL** | **n66** | **UL1** | **UL2** | **UL3** | **UL4** | **UL5** | **MSD type** |
| **harmonics** | **fLow** | 1710 | 3420 | 5130 | 6840 | 8550 |
| **n48** | **fLow** | **fHigh** | 1780 | 3560 | 5340 | 7120 | 8900 |
| **DL1** | 3550 | 3700 | N/A | D |  |  |  | **UL Harmonic** |
| **DL2** | 7100 | 7400 |  | N/A |  | N/A | N/A | **Harmonic Mixing** |
| **DL3** | 10650 | 11100 |  |  | N/A |  | N/A |
| **DL4** | 14200 | 14800 |  | N/A | N/A | N/A | N/A |
| **DL5** | 17750 | 18500 |  |  | N/A | N/A | N/A |
| **Analysis** |  There is a direct hit from the band n66 2nd harmonic to the band n48 |
| **UL/DL** | **n48** | **UL13** | **UL2** | **UL3** | **UL4** | **UL5** | **MSD type** |
| **harmonics** | **fLow** | 3550 | 7100 | 10650 | 14200 | 17750 |
| **n66** | **fLow** | **fHigh** | 3700 | 7400 | 11100 | 14800 | 18500 |
| **DL1** | 2110 | 2200 | N/A |  |  |  |  | **UL Harmonic** |
| **DL2** | 4220 | 4400 |  | N/A |  | N/A | N/A | **Harmonic Mixing** |
| **DL3** | 6330 | 6600 |  |  | N/A |  | N/A |
| **DL4** | 8440 | 8800 |  | N/A | N/A |  | N/A |
| **DL5** | 10550 | 11000 |  |  | N/A | N/A | N/A |
| **Analysis** | There is no collision detected with both harmonic and harmonic mixing |

Based on the above table:

* For the uplink n66 2nd harmonic falling to the band n77, the MSD value has been defined in Table 7.3A.4-1 of 38.101-1. In fact, the band n66 channel bandwidth for BCS 4/5 is the same as BCS 2. Therefore, there is no newer requirement needed.

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Table 5.X.1.3.1-2 summarizes frequency ranges where cross-band isolation issues may occur for both UL bands into the other band DL.

**Table 5.X.1.3.1-2: Cross-band isolation analysis**

|  |  |  |
| --- | --- | --- |
| **Bands** | **n48** | **n66** |
| **Frequency limit** | **fx\_low / min** | **fx\_high / max** | **fy\_low / min** | **fy\_high / max** |
| **fUL (MHz)** | 3550 | 3700 | 1710 | 1780 |
| **fDL (MHz)** | 3550 | 3700 | 2110 | 2200 |
| **CBW (MHz)** | 5 | 100 | 5 | 45 |
| **ACLR1 range** | fxULlow-maxULCBWx | fxULhigh+maxULCBWx | fyULlow-maxULCBWy | fyULhigh+maxULCBWy |
| **ACLR1 (MHz)** | 3450 | 3800 | 1665 | 1825 |
| **ACLR2 range** | fxULlow-2\*maxULCBWx | fxULhigh+2\*maxULCBWx | fyULlow-2\*maxULCBWy | fyULhigh+2\*maxULCBWy |
| **ACLR2 (MHz)** | 3350 | 3900 | 1620 | 1870 |
| **ACLR3 range** | fxULlow-3\*maxULCBWx | fxULhigh+3\*maxULCBWx | fyULlow-3\*maxULCBWy | fyULhigh+3\*maxULCBWy |
| **ACLR3 (MHz)** | 3250 | 4000 | 1575 | 1915 |
| **ACLR4 range** | fxULlow-4\*maxULCBWx | fxULhigh+4\*maxULCBWx | fyULlow-4\*maxULCBWy | fyULhigh+4\*maxULCBWy |
| **ACLR4 (MHz)** | 3150 | 4100 | 1530 | 1960 |
| **ACLR5 range1** | fxULlow-5\*maxULCBWx | fxULhigh+5\*maxULCBWx | fyULlow-5\*maxULCBWy | fyULhigh+5\*maxULCBWy |
| **ACLR5 (MHz)** | 3050 | 4200 | 1485 | 2005 |
| **Analysis** | There is no overlap of the band n48 ACLR range with the band n66 DL up to order 5. The sufficient rejection of the transmitter noise floor should be at band n66 so no cross-band MSD is needed. | There is no overlap of the band n66 ACLR range with the band n48 DL up to order 5. The sufficient rejection of the transmitter noise floor should be at band n48 so no cross-band MSD is needed. |

Based on the above table:

* There is no uplink band overlapping with the downlink in ACLR range. The existing diplexer isolation should provide sufficient rejection.

**====================== <End of Text Proposal> ======================**