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| 3GPP TR 38.718-03-01 V0.4.0 (2023-03) | |
| Technical Report | |
| 3rd Generation Partnership Project;  Technical Specification Group Radio Access Network;  Rel-18 NR Inter-band Carrier Aggregation/Dual Connectivity for3 bands DL with x bands UL (x=1,2)  (Release 18) | |
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# Foreword

This Technical Report has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the document.

In the present document, modal verbs have the following meanings:

**shall** indicates a mandatory requirement to do something

**shall not** indicates an interdiction (prohibition) to do something

The constructions "shall" and "shall not" are confined to the context of normative provisions, and do not appear in Technical Reports.

The constructions "must" and "must not" are not used as substitutes for "shall" and "shall not". Their use is avoided insofar as possible, and they are not used in a normative context except in a direct citation from an external, referenced, non-3GPP document, or so as to maintain continuity of style when extending or modifying the provisions of such a referenced document.

**should** indicates a recommendation to do something

**should not** indicates a recommendation not to do something

**may** indicates permission to do something

**need not** indicates permission not to do something

The construction "may not" is ambiguous and is not used in normative elements. The unambiguous constructions "might not" or "shall not" are used instead, depending upon the meaning intended.

**can** indicates that something is possible

**cannot** indicates that something is impossible

The constructions "can" and "cannot" are not substitutes for "may" and "need not".

**will** indicates that something is certain or expected to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

**will not** indicates that something is certain or expected not to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

**might** indicates a likelihood that something will happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

**might not** indicates a likelihood that something will not happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

In addition:

**is** (or any other verb in the indicative mood) indicates a statement of fact

**is not** (or any other negative verb in the indicative mood) indicates a statement of fact

The constructions "is" and "is not" do not indicate requirements.

# 1 Scope

The present document is a technical report for power class 3 NR inter-band CA and DC for 3 bands DL with up to 2 bands UL under Rel-18 time frame. The purpose is to gather the relevant background information and studies in order to address NR inter-band CA and DC for 3 bands DL with up to 2 bands UL for the Rel-18 band combinations.

This TR contains the RF requirements of band specific combination part. The actual requirements are added to the corresponding technical specifications.

# 2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non‑specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 38.101-1: "NR; User Equipment (UE) radio transmission and reception; Part 1: Range 1 Standalone".

[3] 3GPP TS 38.101-2: "NR; User Equipment (UE) radio transmission and reception; Part 2: Range 2 Standalone".

[4] 3GPP TS 38.101-3: "NR; User Equipment (UE) radio transmission and reception; Part 3: Range 1 and Range 2 Interworking operation with other radios".

# 3 Definitions of terms, symbols and abbreviations

## 3.1 Terms

For the purposes of the present document, the terms given in TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [1].

**Carrier aggregation**: Aggregation of two or more component carriers in order to support wider transmission bandwidths.

**Inter-band carrier aggregation:** Carrier aggregation of component carriers in different operating bands.

NOTE: Carriers aggregated in each band can be contiguous or non-contiguous.

## 3.2 Symbols

For the purposes of the present document, the following symbols apply:

ΔRIB,c Allowed reference sensitivity relaxation due to support for inter-band CA operation, for serving cell *c*

ΔTIB,c Allowed maximum configured output power relaxation due to support for inter-band CA operation, inter-band NR-DC operation and due to support for SUL operations, for serving cell *c*

## 3.3 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1].

BS Base Station

CA Carrier Aggregation

DC Dual Connectivity

DL DownLink

FDD Frequency Division Duplex

IMD Inter-modulation

MSD Maximum Sensitivity Deduction

SCS Subcarrier spacing

TDD Time Division Duplex

UE User Equipment

UL UpLink

# 4 Background

## 4.1 Introduction

The present document is a technical report for NR inter-band CA and DC for 3 bands DL with up to 2 bands UL under Rel-18 time frame. The document covers the RF requirements for each band combination specific issues (i.e. one sub-clause defined per band combination) including:

1: Common issues for both 1 band UL and 2 bands UL NR CA, including ∆TIB and ∆RIB requirements.

2: 2 bands UL NR CA specific issues, including MSD caused by IMD issue, etc.

It shall be noted that no new issue for inter-band NR DC combination, and the 2 bands UL NR CA specific issues shall be re-used.

## 4.2 TR Maintenance

A single company is responsible for introducing all approved TPs in the current TR, i.e. TR editor. However, it is the responsibility of the contact person of each band combination to ensure that the TPs related to the band combination have been implemented.

Editor's note: It is not recommended to bring TP to TR for the following cases:

1. NR CA configurations with additional BCS other than BCS0 (such as BCS1) if there is no additional technical issue.

2. High order DL NR CA configurations, such as DL NR CA configuration CA\_nXA-nYA-nZC

# 5 Both bands within FR1 Carrier Aggregation: Specific Band Combination Part

## 5.x CA\_nX-nY-nZ

### 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: Inter-band CA operating bands involving FR1 (three bands)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 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 | | |
| nX |  | – |  |  | – |  |  |
| nY |  | – |  |  | – |  |  |
| nZ |  | – |  |  | – |  |  |

#### 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 nX+nY+nZ

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NR CA configuration | Uplink CA configuration or single uplink carrier | NR Band | Channel bandwidth (MHz) | Bandwidth combination set |
| CA\_nXA-nYA-nZA | -\*  or  CA\_nXA-nYA  CA\_nXA-nZA  CA\_nYA-nZA | nX | 5, 10, 15, 20 | 0 |
|  |  | nY | 5, 10, 15, 20, 25, 30 |  |
|  |  | nZ | 5, 10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100 |  |

Editor's note\*: ‘-’ is for 1UL

Editor's note: The table format can be referred to Table 5.5A.3.2-1 in TS38.101-1

#### 5.x.1.3 ∆TIB,c and ∆RIB,c values

Editor’s note: for the table of ∆TIB,c and ∆RIB,c values, please use the same table format as in the latest TS 38.101-1, the table below is from the latest Rel.18 38.101-1.

For CA\_nX-nY-nZ, the ΔTIB,c and ΔRIB,c values are given in the tables below.

Table 5.x.1.3-1: ΔTIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔTIB,c for NR bands (dB)\*** | | |
| **Component band in order of bands in configuration\*\*** | | |
| CA\_nx-ny-nz |  |  |  |
| NOTE \*: “-” denotes ΔTIB,c = 0.  NOTE \*\*: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n5 the band order from left to right is n1, n3 and n5. | | | |

Table 5.x.1.3-2: ΔRIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔRIB,c for NR bands (dB)\*** | | |
| **Component band in order of bands in configuration\*\*** | | |
| CA\_nx-ny-nz |  |  |  |
| NOTE \*: “-” denotes ΔRIB,c = 0.  NOTE \*\*: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n8 the band order from left to right is n1, n3 and n8. | | | |

### 5.x.2 Specific for 2 bands UL CA

Editor's note: Text will be added if 2 bands UL CA are supported, otherwise all the clauses shall be void.

#### 5.x.2.1 UE co-existence studies

Editor's note: No co-existence study tables are recommended to be included, since it was already incorporated in the corresponding 2DL fallback band combination TR.

#### 5.x.2.2 REFSENS requirements

Editor's note: Text will be added on reference sensitivity exceptions if IMD issue due to dual uplink operation falling into DL of the third band are identified.

## 5.1 CA\_n1-n41-n79

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

#### 5.1.1.1 Operating bands for CA

Table 5.1.1.1-1: Inter-band CA operating bands involving FR1 (three bands)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 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 | | |
| n1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | FDD |
| n41 | 2496 MHz | – | 2690 MHz | 2496 MHz | – | 2690 MHz | TDD |
| n79 | 4400 MHz | – | 5000 MHz | 4400 MHz | – | 5000 MHz | TDD |

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

Table 5.1.1.2-1: Supported bandwidths per CA band combination of band n1+n41+n79

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NR CA configuration | Uplink CA configuration or single uplink carrier | NR Band | Channel bandwidth (MHz) | Bandwidth combination set |
| CA\_n1A-n41A-n79A | CA\_n1A-n41A  CA\_n1A-n79A  CA\_n41A-n79A | n1 | 5, 10, 15, 20 | 0 |
|  |  | n41 | 10, 15, 20 30, 40, 50, 60, 80, 90, 100 |  |
|  |  | n79 | 40, 50, 60, 80, 100 |  |

#### 5.1.1.3 ∆TIB,c and ∆RIB,c values

For CA\_n1-n41-n79, the ΔTIB,c and ΔRIB,c values are given in the tables below.

Table 5.1.1.3-1: ΔTIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔTIB,c for NR bands (dB)8** | | |
| **Component band in order of bands in configuration9** | | |
| CA\_n1-n41-n79 | 0.5 | 0.5 | 0.8 |
| NOTE 8: “-” denotes ΔTIB,c = 0.  NOTE 9: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n5 the band order from left to right is n1, n3 and n5. | | | |

Table 5.1.1.3-2: ΔRIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔRIB,c for NR bands (dB)9** | | |
| **Component band in order of bands in configuration10** | | |
| CA\_n1-n41-n79 | - | 0.5 | 0.5 |
| NOTE 9: “-” denotes ΔRIB,c = 0.  NOTE 10: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n8 the band order from left to right is n1, n3 and n8. | | | |

### 5.1.2 Specific for 2 bands UL CA

#### 5.1.2.1 UE co-existence studies

UE co-existence has been already studied for 2DL/1UL fallback combinations such as CA n1-n41, CA\_n1-n79 and n41-n79 and the impact of harmonic interference has been clarified. The own Rx impact of the 3rd band is shown as the followings.

– 2nd and 5th order IMD generated by dual uplink of Band n1 + Band n41 may fall into own Rx of Band n79.

– 2nd and 5th order IMD generated by dual uplink of Band n1 + Band n79 may fall into own Rx of Band n41.

– 2nd and 5th order IMD generated by dual uplink of Band n41 + Band n79 may fall into own Rx of Band n1.

#### 5.1.2.2 REFSENS requirements

Table 5.1.2.2-1 lists the MSD required for the dual connectivity configuration for the cases that IMD interference fall into the own 3rd Rx frequency band.

Table 5.1.2.2-1: MSD for the CA configuration

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Band / Channel bandwidth / NRB / Duplex mode | | | | | | | | Source of IMD |
| NR CA band combination | NR band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  CLRB | DL Fc (MHz) | MSD  (dB) | Duplex mode |  |
| CA\_n1-n41-n79 | n1 | 1970 | 5 | 25 | 2160 | N/A | FDD | N/A |
|  | n41 | 2530 | 10 | 50 | 2530 | N/A | TDD | N/A |
|  | n79 | 4500 | 40 | 216 | 4500 | 19.0 | TDD | IMD21 |
|  | n1 | 1970 | 5 | 25 | 2160 | N/A | FDD | N/A |
|  | n79 | 4500 | 40 | 216 | 4500 | N/A | TDD | N/A |
|  | n41 | 2530 | 10 | 50 | 2530 | 29.4 | TDD | IMD21 |
|  | n41 | 2530 | 10 | 50 | 2530 | N/A | TDD | N/A |
|  | n79 | 4690 | 40 | 216 | 4690 | N/A | TDD | N/A |
|  | n1 | 1970 | 5 | 25 | 2160 | 29.9 | FDD | IMD21 |
| NOTE 1: This band is subject to IMD5 also which MSD is not specified. | | | | | | | | |

## 5.2 CA\_n41-n77-n79

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

#### 5.2.1.1 Operating bands for CA

Table 5.2.1.1-1: Inter-band CA operating bands involving FR1 (three bands)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 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 | | |
| n41 | 2496 MHz | – | 2690 MHz | 2496 MHz | – | 2690 MHz | TDD |
| n77 | 3300 MHz | – | 4200 MHz | 3300 MHz | – | 4200 MHz | TDD |
| n79 | 4400 MHz | – | 5000 MHz | 4400 MHz | – | 5000 MHz | TDD |

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

Table 5.2.1.2-1: Supported bandwidths per CA band combination of band n41+n77+n79

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NR CA configuration | Uplink CA configuration or single uplink carrier | NR Band | Channel bandwidth (MHz) | Bandwidth combination set |
| CA\_n41A-n77A-n79A | CA\_n41A-n77A  CA\_n41A-n79A  CA\_n77A-n79A | n41 | 10, 15, 20, 30, 40, 50, 60, 80, 90, 100 | 0 |
|  |  | n77 | 10, 15, 20, 40, 50, 60, 80, 90, 100 |  |
|  |  | n79 | 40, 50, 60, 80, 100 |  |
| CA\_n41A-n77(2A)-n79A | CA\_n41A-n77A  CA\_n41A-n79A  CA\_n77A-n79A | n41 | 10, 15, 20, 30, 40, 50, 60, 80, 90, 100 | 0 |
|  |  | n77 | CA\_n77(2A)\_BCS0 |  |
|  |  | n79 | 40, 50, 60, 80, 100 |  |

#### 5.2.1.3 ∆TIB,c and ∆RIB,c values

For CA\_n41-n77-n79, the ΔTIB,c and ΔRIB,c values are given in the tables below.

Table 5.2.1.3-1: ΔTIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔTIB,c for NR bands (dB)8** | | |
| **Component band in order of bands in configuration9** | | |
| CA\_n41-n77-n79 | 0.3 | 0.8 | 0.8 |
| NOTE 8: “-” denotes ΔTIB,c = 0.  NOTE 9: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n5 the band order from left to right is n1, n3 and n5. | | | |

Table 5.2.1.3-2: ΔRIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔRIB,c for NR bands (dB)9** | | |
| **Component band in order of bands in configuration10** | | |
| CA\_n41-n77-n79 | 0.5 | 0.5 | 0.5 |
| NOTE 9: “-” denotes ΔRIB,c = 0.  NOTE 10: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n8 the band order from left to right is n1, n3 and n8. | | | |

### 5.2.2 Specific for 2 bands UL CA

#### 5.2.2.1 UE co-existence studies

UE co-existence has been already studied for 2DL/1UL fallback combinations such as CA n41-n77, CA\_n41-n79 and n77-n79 and the impact of harmonic interference has been clarified. The own Rx impact of the 3rd band is shown as the followings. Note that there is no IMD impact on CA\_n41-n77 to n79 Rx and that on CA\_n41-n79 to n77 Rx since CA\_n77-n79 is synchronous operation.

– 3rd, 4th and 5th order IMD generated by dual uplink of Band n77 + Band n79 may fall into own Rx of Band n41.

#### 5.2.2.2 REFSENS requirements

Table 5.2.2.2-1 lists the MSD required for the dual connectivity configuration for the cases that IMD interference fall into the own 3rd Rx frequency band.

Table 5.2.2.2-1: MSD for the CA configuration

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Band / Channel bandwidth / NRB / Duplex mode | | | | | | | | Source of IMD |
| NR CA band combination | NR band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  CLRB | DL Fc (MHz) | MSD  (dB) | Duplex mode |  |
| CA\_n41-n77-n79 | n77 | 3600 | 10 | 50 | 3600 | N/A | TDD | N/A |
|  | n79 | 4600 | 40 | 216 | 4600 | N/A | TDD | N/A |
|  | n41 | 2600 | 10 | 50 | 2600 | 10.7 | TDD | IMD31,2 |
| NOTE 1: This band is subject to IMD5 also which MSD is not specified.  NOTE 2: This band is subject to IMD4 also which MSD is not specified. | | | | | | | | |

## 5.3 CA\_n3-n28-n40

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

#### 5.3.1.1 Operating bands for CA

Table 5.3.1.1-1: Inter-band CA operating bands involving FR1 (three bands)

|  |  |  |
| --- | --- | --- |
| **NR CA Band** | **NR Band**  **(Table 5.2-1)** | **DL interruption allowed**  **(Note 4)** |
| CA\_n3-n28-n403 | n3, n28, n40 |  |
| NOTE 3: Applicable for UE supporting inter-band carrier aggregation with mandatory simultaneous Rx/Tx capability | | |

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

Table 5.3.1.2-1: Supported bandwidths per CA band combination of band n3+n28+n40

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **NR CA configuration** | **Uplink CA configuration or single uplink carrier** | **NR Band** | **Channel bandwidth (MHz)** | **Bandwidth combination set** |
| CA\_n3A-n28A-n40A | CA\_n3A-n28A  CA\_n3A-n40A  CA\_n28A-n40A | n3 | 5, 10, 15, 20 | 0 |
|  |  | n28 | 5, 10 |  |
|  |  | n40 | 20, 40 |  |

#### 5.3.1.3 ∆TIB,c and ∆RIB,c values

For CA\_n3-n28-n40, the ΔTIB,c and ΔRIB,c values are given in the tables below, reuse the values of CA\_3-28-40.

Table 5.3.1.3-1: ΔTIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔTIB,c for NR bands (dB)8** | | |
| **Component band in order of bands in configuration9** | | |
| CA\_n3-n28-n40 | 0.5 | 0.3 | 0.5 |
| NOTE 8: “-” denotes ΔTIB,c = 0.  NOTE 9: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n5 the band order from left to right is n1, n3 and n5. | | | |

Table 5.3.1.3-2: ΔRIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔRIB,c for NR bands (dB)9** | | |
| **Component band in order of bands in configuration10** | | |
| CA\_n3-n28-n40 | - | - | - |
| NOTE 9: “-” denotes ΔRIB,c = 0.  NOTE 10: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n8 the band order from left to right is n1, n3 and n8. | | | |

### 5.3.2 Specific for 2 bands UL CA

#### 5.3.2.1 UE co-existence studies

For CA combinations with 3 bands DL and 2bands UL, only IMD issues due to dual Tx operation of two bands falling to the third band Rx need to be considered.

Based on the calculation, there is no additional IMD issue.

#### 5.3.2.2 REFSENS requirements

Based on co-existence studies on 5.3.2.1, no need to define exceptional REFSENS requirements.

## 5.4 CA\_n3-n8-n41

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

#### 5.4.1.1 Operating bands for CA

Table 5.4.1.1-1: Inter-band CA operating bands involving FR1 (three bands)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 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 | | |
| n3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | FDD |
| n8 | 880 MHz | – | 915 MHz | 925 MHz | – | 960 MHz | FDD |
| n41 | 2496 MHz | – | 2690 MHz | 2496 MHz | – | 2690 MHz | TDD |

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

Table 5.4.1.2-1: Supported bandwidths per CA band combination of band n3+n8+n41

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NR CA configuration | Uplink CA configuration or single uplink carrier | NR Band | Channel bandwidth (MHz) | Bandwidth combination set |
| CA\_n3A-n8A-n41A | CA\_n3A-n8A  CA\_n3A-n41A  CA\_n8A-n41A | n3 | 5, 10, 15, 20, 25, 30 | 0 |
|  |  | n8 | 5, 10, 15, 20 |  |
|  |  | n41 | 10, 15, 20, 30, 40, 50, 60, 80, 90, 100 |  |

#### 5.4.1.3 ∆TIB,c and ∆RIB,c values

For CA\_n3A-n8A-n41A, the ΔTIB,c and ΔRIB,c values have already been included in the TS38.101-1.

### 5.4.2 Specific for 2 bands UL CA

#### 5.4.2.1 UE co-existence studies

The co-existence for the fallback 2DL/2UL of CA\_n3A-n8A, CA\_n3A-n41A and CA\_n8A-n41A have already been analyzed. In terms of the co-existence studies of corresponding fallbacks, it can be observed:

IMD 2 and IMD3 caused by n3+n8 may fall into the its own band n41 Rx

IMD 2 and IMD3 caused by n3+n41 may fall into the its own band n8 Rx

IMD2 caused by n8+n41 may fall into the its own band n3 Rx

#### 5.4.2.2 REFSENS requirements

For IMD2 caused by n8+n41, the IMD2 frequency range is calculated by the lower edge and upper edge of the bands, which is 1581MHz~1810MHz (i.e. f41-f8) , while the band n3 DL frequency range is 1805MHz~1880MHz, the overlapping frequency range is only 5MHz. However, considering the minimum channel bandwidths of band n8 and n41, which are 5MHz and 10MHz, respectively. The IMD2 frequency range is 1588.5 MHz ~ 1802.5 MHz, which means there are no test points of the IMD2 product fall into the own band n3 DL frequency range. Therefore, there is no need to define such MSD values.

For the other IMDs, the MSD requirement are defined in table 5.4.2.2-1:

Table 5.4.2.2-1: 3DL/2UL inter-band Reference sensitivity QPSK PREFSENS and uplink/downlink configurations

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Band / Channel bandwidth / NRB / Duplex mode | | | | | | | | Source of IMD |
| NR CA band combination | NR band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  CLRB | DL Fc (MHz) | MSD  (dB) | Duplex mode |  |
| CA\_n3-n8-n41 | n3 | 1722.5 | 5 | 25 | 1817.5 | N/A | FDD | N/A |
|  | n8 | 887.5 | 5 | 25 | 932.5 | N/A | FDD | N/A |
|  | n41 | 2610 | 10 | 50 | 2610 | 28.0 | FDD | IMD24 |
|  | n3 | 1725 | 5 | 25 | 1820 | N/A | FDD | N/A |
|  | n8 | 900 | 5 | 25 | 945 | 26.0 | FDD | IMD24 |
|  | n41 | 2516 | 10 | 50 | 2516 | N/A | FDD | N/A |
| NOTE 4: This band is subject to IMD3 also which MSD is not specified. | | | | | | | | |

## 5.5 CA\_n1-n3-n26

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

#### 5.5.1.1 Operating bands for CA

Table 5.5.1.1-1: 3DL Inter-band CA operating bands

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band** | **NR Band** | **Uplink (UL) operating band** | | | **Downlink (DL) operating band** | | | **Duplex Mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n1-n3-n26 | n1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | FDD |
| n3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | FDD |
| n26 | 814 MHz | – | 849 MHz | 859 MHz | – | 894 MHz | FDD |

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

Table 5.5.1.2-1: Supported bandwidths per CA band combination of band n1+n3+n26

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NR CA configuration | Uplink CA configuration or single uplink carrier | NR Band | Channel bandwidth (MHz) | Bandwidth combination set |
| CA\_n1A-n3A-n26A | CA\_n1A-n3A  CA\_n1A-n26A  CA\_n3A-n26A | n1 | 5, 10, 15, 20 | 0 |
|  |  | n3 | 5, 10, 15, 20, 25, 30, 40 |  |
|  |  | n26 | 5, 10, 15, 20 |  |

#### 5.5.1.3 ∆TIB,c and ∆RIB,c values

For CA\_n1-n3-n26, the ΔTIB,c and ΔRIB,c values are reused from CA\_1-3-26 and are given in the tables below.

Table 5.5.1.3-1: ΔTIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔTIB,c for NR bands (dB)8** | | |
| **Component band in order of bands in configuration9** | | |
| CA\_n1-n3-n26 | 0.3 | 0.3 | 0.3 |
| NOTE 8: “-” denotes ΔTIB,c = 0.  NOTE 9: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n5 the band order from left to right is n1, n3 and n5. | | | |

Table 5.5.1.3-2: ΔRIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔRIB,c for NR bands (dB)9** | | |
| **Component band in order of bands in configuration10** | | |
| CA\_n1-n3-n26 | - | - | - |
| NOTE 9: “-” denotes ΔRIB,c = 0.  NOTE 10: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n8 the band order from left to right is n1, n3 and n8. | | | |

### 5.5.2 Specific for 2 bands UL CA

#### 5.5.2.1 UE co-existence studies

UL n1-n26 does not affect DL n3.

UL n3-n26 does not affect DL n1.

UL n1-n3 does not affect DL n26.

#### 5.5.2.2 REFSENS requirements

Based on the co-existence studies there are no need to defined MSD values.

## 5.6 CA\_n1-n26-n78

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

#### 5.6.1.1 Operating bands for CA

Table 5.6.1.1-1: 3DL Inter-band CA operating bands

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band** | **NR Band** | **Uplink (UL) operating band** | | | **Downlink (DL) operating band** | | | **Duplex Mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n1-n26-n78 | n1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | FDD |
| n26 | 814 MHz | – | 849 MHz | 859 MHz | – | 894 MHz | FDD |
| n78 | 3300 MHz | – | 3800 MHz | 3300 MHz | – | 3800 MHz | TDD |

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

Table 5.6.1.2-1: Supported bandwidths per CA band combination of band n1+n26+n78

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NR CA configuration | Uplink CA configuration or single uplink carrier | NR Band | Channel bandwidth (MHz) | Bandwidth combination set |
| CA\_n1A-n26A-n78A | CA\_n1A-n26A  CA\_n1A-n78A  CA\_n26A-n78A | n1 | 5, 10, 15, 20 | 0 |
|  |  | n26 | 5, 10, 15, 20 |  |
|  |  | n78 | 10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100 |  |

#### 5.6.1.3 ∆TIB,c and ∆RIB,c values

For CA\_n1-n26-n78, the ΔTIB,c and ΔRIB,c values are reused from CA\_n1-n5-n78 and are given in the tables below.

Table 5.6.1.3-1: ΔTIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔTIB,c for NR bands (dB)8** | | |
| **Component band in order of bands in configuration9** | | |
| CA\_n1-n26-n78 | 0.6 | 0.6 | 0.8 |
| NOTE 8: “-” denotes ΔTIB,c = 0.  NOTE 9: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n5 the band order from left to right is n1, n3 and n5. | | | |

Table 5.6.1.3-2: ΔRIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔRIB,c for NR bands (dB)9** | | |
| **Component band in order of bands in configuration10** | | |
| CA\_n1-n26-n78 | 0.2 | 0.2 | 0.5 |
| NOTE 9: “-” denotes ΔRIB,c = 0.  NOTE 10: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n8 the band order from left to right is n1, n3 and n8. | | | |

### 5.6.2 Specific for 2 bands UL CA

#### 5.6.2.1 UE co-existence studies

UL n1-n26 gives IMD3 into DL n78.

UL n1-n78 gives IMD5 into DL n26.

UL n26-n78 gives IMD3 into DL n1.

#### 5.6.2.2 REFSENS requirements

Based on the co-existence studies there are a need to define MSD values. MSD values from CA\_n1-n5-n78 are reused.

Table 5.6.2.2-1: 3DL/2UL inter-band Reference sensitivity QPSK PREFSENS and uplink/downlink configurations

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Band / Channel bandwidth / NRB / Duplex mode | | | | | | | | Source of IMD |
| NR CA band combination | NR band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  CLRB | DL Fc (MHz) | MSD  (dB) | Duplex mode |  |
| CA\_n1-n26-n78 | n1 | 1932 | 5 | 25 | 2122 | 18.1 | FDD | IMD3 |
|  | n26 | 829 | 5 | 25 | 874 | N/A | FDD | N/A |
|  | n78 | 3780 | 10 | 50 | 3780 | N/A | TDD | N/A |
|  | n1 | 1975 | 5 | 25 | 2165 | N/A | FDD | N/A |
|  | n26 | 840 | 5 | 25 | 885 | 3.1 | FDD | IMD5 |
|  | n78 | 3405 | 10 | 50 | 3405 | N/A | TDD | N/A |
|  | n1 | 1950 | 5 | 25 | 2140 | N/A | FDD | N/A |
|  | n26 | 830 | 5 | 25 | 875 | N/A | FDD | N/A |
|  | n78 | 3610 | 10 | 50 | 3610 | 15.7 | TDD | IMD3 |

## 5.7 CA\_n3-n26-n78

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

#### 5.7.1.1 Operating bands for CA

Table 5.7.1.1-1: 3DL Inter-band CA operating bands

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band** | **NR Band** | **Uplink (UL) operating band** | | | **Downlink (DL) operating band** | | | **Duplex Mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n3-n26-n78 | n3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | FDD |
| n26 | 814 MHz | – | 849 MHz | 859 MHz | – | 894 MHz | FDD |
| n78 | 3300 MHz | – | 3800 MHz | 3300 MHz | – | 3800 MHz | TDD |

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

Table 5.7.1.2-1: Supported bandwidths per CA band combination of band n3+n26+n78

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NR CA configuration | Uplink CA configuration or single uplink carrier | NR Band | Channel bandwidth (MHz) | Bandwidth combination set |
| CA\_n3A-n26A-n78A | CA\_n3A-n26A  CA\_n3A-n78A  CA\_n26A-n78A | n3 | 5, 10, 15, 20, 25, 30, 40 | 0 |
|  |  | n26 | 5, 10, 15, 20 |  |
|  |  | n78 | 10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100 |  |

#### 5.7.1.3 ∆TIB,c and ∆RIB,c values

For CA\_n3-n26-n78, the ΔTIB,c and ΔRIB,c values are reused from CA\_n3-n5-n78 and are given in the tables below.

Table 5.7.1.3-1: ΔTIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔTIB,c for NR bands (dB)8** | | |
| **Component band in order of bands in configuration9** | | |
| CA\_n3-n26-n78 | 0.6 | 0.6 | 0.8 |
| NOTE 8: “-” denotes ΔTIB,c = 0.  NOTE 9: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n5 the band order from left to right is n1, n3 and n5. | | | |

Table 5.7.1.3-2: ΔRIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔRIB,c for NR bands (dB)9** | | |
| **Component band in order of bands in configuration10** | | |
| CA\_n3-n26-n78 | 0.2 | 0.2 | 0.5 |
| NOTE 9: “-” denotes ΔRIB,c = 0.  NOTE 10: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n8 the band order from left to right is n1, n3 and n8. | | | |

### 5.7.2 Specific for 2 bands UL CA

#### 5.7.2.1 UE co-existence studies

UL n3-n26 gives IMD3 and IMD5 into DL n78.

UL n3-n78 gives no IMD into DL n26.

UL n26-n78 gives IMD3 into DL n3.

#### 5.7.2.2 REFSENS requirements

Based on the co-existence studies there are a need to define MSD values. MSD values from CA\_n3-n5-n78 are reused.

Table 5.7.2.2-1: 3DL/2UL inter-band Reference sensitivity QPSK PREFSENS and uplink/downlink configurations

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Band / Channel bandwidth / NRB / Duplex mode | | | | | | | | Source of IMD |
| NR CA band combination | NR band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  CLRB | DL Fc (MHz) | MSD  (dB) | Duplex mode |  |
| CA\_n3-n26-n78 | n3 | 1730 | 5 | 25 | 1825 | N/A | FDD | N/A |
|  | n26 | 839 | 5 | 25 | 884 | N/A | FDD | N/A |
|  | n78 | 3408 | 10 | 50 | 3408 | 16.1 | TDD | IMD3 |
|  | n3 | 1730 | 5 | 25 | 1825 | N/A | FDD | N/A |
|  | n26 | 839 | 5 | 25 | 884 | N/A | FDD | N/A |
|  | n78 | 3512 | 10 | 50 | 3512 | 4.5 | TDD | IMD5 |
|  | n3 | 1767 | 5 | 25 | 1862 | 15.7 | FDD | IMD3 |
|  | n26 | 839 | 5 | 25 | 884 | N/A | FDD | N/A |
|  | n78 | 3540 | 10 | 50 | 3540 | N/A | TDD | N/A |

## 5.8 CA\_n1-n7-n26

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

#### 5.8.1.1 Operating bands for CA

Table 5.8.1.1-1: 3DL Inter-band CA operating bands

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band** | **NR Band** | **Uplink (UL) operating band** | | | **Downlink (DL) operating band** | | | **Duplex Mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n1-n7-n26 | n1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | FDD |
| n7 | 2500 MHz | – | 2570 MHz | 2620 MHz | – | 2690 MHz | FDD |
| n26 | 814 MHz | – | 849 MHz | 859 MHz | – | 894 MHz | FDD |

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

Table 5.8.1.2-1: Supported bandwidths per CA band combination of band n1+n7+n26

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NR CA configuration | Uplink CA configuration or single uplink carrier | NR Band | Channel bandwidth (MHz) | Bandwidth combination set |
| CA\_n1A-n7A-n26A | CA\_n1A-n26A  CA\_n1A-n7A  CA\_n7A-n26A | n1 | 5, 10, 15, 20 | 0 |
|  |  | n7 | 5, 10, 15, 20, 25, 30, 40, 50 |  |
|  |  | n26 | 5, 10, 15, 20 |  |
| CA\_n1A-n7B-n26A | CA\_n1A-n26A  CA\_n1A-n7A  CA\_n7A-n26A  CA\_n7B | n1 | 5, 10, 15, 20 | 0 |
|  |  | n7 | CA\_n7B\_BCS0 |  |
|  |  | n26 | 5, 10, 15, 20 |  |

#### 5.8.1.3 ∆TIB,c and ∆RIB,c values

For CA\_n1-n7-n26, the ΔTIB,c and ΔRIB,c values are reused from CA\_1-3-26 and are given in the tables below.

Table 5.8.1.3-1: ΔTIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔTIB,c for NR bands (dB)8** | | |
| **Component band in order of bands in configuration9** | | |
| CA\_n1-n7-n26 | 0.5 | 0.6 | 0.3 |
| NOTE 8: “-” denotes ΔTIB,c = 0.  NOTE 9: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n5 the band order from left to right is n1, n3 and n5. | | | |

Table 5.8.1.3-2: ΔRIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔRIB,c for NR bands (dB)9** | | |
| **Component band in order of bands in configuration10** | | |
| CA\_n1-n7-n26 | - | - | - |
| NOTE 9: “-” denotes ΔRIB,c = 0.  NOTE 10: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n8 the band order from left to right is n1, n3 and n8. | | | |

### 5.8.2 Specific for 2 bands UL CA

#### 5.8.2.1 UE co-existence studies

UL n1-n7 gives IMD5 into DL n26.

UL n1-n26 does not affect DL n7.

UL n7-n26 does not affect DL n1.

#### 5.8.2.2 REFSENS requirements

Based on the co-existence studies there are a need to define MSD values. MSD values from CA\_1-7-26 are reused.

Table 5.8.2.2-1: 3DL/2UL inter-band Reference sensitivity QPSK PREFSENS and uplink/downlink configurations

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Band / Channel bandwidth / NRB / Duplex mode | | | | | | | | Source of IMD |
| NR CA band combination | NR band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  CLRB | DL Fc (MHz) | MSD  (dB) | Duplex mode |  |
| CA\_n1-n7-n26 | n1 | 1965 | 5 | 25 | 2155 | N/A | FDD | N/A |
|  | n7 | 2510 | 10 | 50 | 2630 | N/A | FDD | N/A |
|  | n26 | 830 | 5 | 50 | 875 | 3.5 | FDD | IMD5 |

## 5.9 CA\_n3-n7-n26

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

#### 5.9.1.1 Operating bands for CA

Table 5.9.1.1-1: 3DL Inter-band CA operating bands

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band** | **NR Band** | **Uplink (UL) operating band** | | | **Downlink (DL) operating band** | | | **Duplex Mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n3-n7-n26 | n3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | FDD |
| n7 | 2500 MHz | – | 2570 MHz | 2620 MHz | – | 2690 MHz | FDD |
| n26 | 814 MHz | – | 849 MHz | 859 MHz | – | 894 MHz | FDD |

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

Table 5.9.1.2-1: Supported bandwidths per CA band combination of band n3+n7+n26

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NR CA configuration | Uplink CA configuration or single uplink carrier | NR Band | Channel bandwidth (MHz) | Bandwidth combination set |
| CA\_n3A-n7A-n26A | CA\_n3A-n26A  CA\_n3A-n7A  CA\_n7A-n26A | n3 | 5, 10, 15, 20, 25, 30, 40 | 0 |
|  |  | n7 | 5, 10, 15, 20, 25, 30, 40, 50 |  |
|  |  | n26 | 5, 10, 15, 20 |  |
| CA\_n3A-n7B-n26A | CA\_n3A-n26A  CA\_n3A-n7A  CA\_n7A-n26A  CA\_n7B | n3 | 5, 10, 15, 20, 25, 30, 40 | 0 |
|  |  | n7 | CA\_n7B\_BCS0 |  |
|  |  | n26 | 5, 10, 15, 20 |  |

#### 5.9.1.3 ∆TIB,c and ∆RIB,c values

For CA\_n3-n7-n26, the ΔTIB,c and ΔRIB,c values are reused from CA\_1-3-26 and are given in the tables below.

Table 5.9.1.3-1: ΔTIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔTIB,c for NR bands (dB)8** | | |
| **Component band in order of bands in configuration9** | | |
| CA\_n3-n7-n26 | 0.5 | 0.5 | 0.3 |
| NOTE 8: “-” denotes ΔTIB,c = 0.  NOTE 9: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n5 the band order from left to right is n1, n3 and n5. | | | |

Table 5.9.1.3-2: ΔRIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔRIB,c for NR bands (dB)9** | | |
| **Component band in order of bands in configuration10** | | |
| CA\_n3-n7-n26 | - | - | - |
| NOTE 9: “-” denotes ΔRIB,c = 0.  NOTE 10: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n8 the band order from left to right is n1, n3 and n8. | | | |

### 5.9.2 Specific for 2 bands UL CA

#### 5.9.2.1 UE co-existence studies

UL n3-n7 gives IMD3 into DL n26.

UL n3-n26 gives IMD2 and IMD3 into DL n7.

UL n7-n26 does not affect DL n3.

#### 5.9.2.2 REFSENS requirements

Based on the co-existence studies there are a need to define MSD values. MSD values from CA\_3-7-26 are reused.

Table 5.9.2.2-1: 3DL/2UL inter-band Reference sensitivity QPSK PREFSENS and uplink/downlink configurations

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Band / Channel bandwidth / NRB / Duplex mode | | | | | | | | Source of IMD |
| NR CA band combination | NR band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  CLRB | DL Fc (MHz) | MSD  (dB) | Duplex mode |  |
| CA\_n3-n7-n26 | n3 | 1720 | 5 | 25 | 1815 | N/A | FDD | N/A |
|  | n7 | 2560 | 10 | 50 | 2680 | N/A | FDD | N/A |
|  | n26 | 835 | 5 | 25 | 880 | 17.5 | FDD | IMD3 |
|  | n3 | 1780 | 5 | 25 | 1875 | N/A | FDD | N/A |
|  | n7 | 2505 | 10 | 50 | 2625 | 29.0 | FDD | IMD24 |
|  | n26 | 845 | 5 | 25 | 890 | N/A | FDD | N/A |
| NOTE 4: This band is subject to IMD3 also which MSD is not specified | | | | | | | | |

## 5.10 CA\_n7-n26-n78

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

#### 5.10.1.1 Operating bands for CA

Table 5.10.1.1-1: 3DL Inter-band CA operating bands

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band** | **NR Band** | **Uplink (UL) operating band** | | | **Downlink (DL) operating band** | | | **Duplex Mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n7-n26-n78 | n7 | 2500 MHz | – | 2570 MHz | 2620 MHz | – | 2690 MHz | FDD |
| n26 | 814 MHz | – | 849 MHz | 859 MHz | – | 894 MHz | FDD |
| n78 | 3300 MHz | – | 3800 MHz | 3300 MHz | – | 3800 MHz | TDD |

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

Table 5.10.1.2-1: Supported bandwidths per CA band combination of band n7+n26+n78

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NR CA configuration | Uplink CA configuration or single uplink carrier | NR Band | Channel bandwidth (MHz) | Bandwidth combination set |
| CA\_n7A-n26A-n78A | CA\_n7A-n26A  CA\_n7A-n78A  CA\_n26A-n78A | n7 | 5, 10, 15, 20, 25, 30, 40, 50 | 0 |
|  |  | n26 | 5, 10, 15, 20 |  |
|  |  | n78 | 10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100 |  |
| CA\_n7B-n26A-n78A | CA\_n7A-n26A  CA\_n7A-n78A  CA\_n26A-n78A  CA\_n7B | n7 | CA\_n7B\_BCS0 | 0 |
|  |  | n26 | 5, 10, 15, 20 |  |
|  |  | n78 | 10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100 |  |

#### 5.10.1.3 ∆TIB,c and ∆RIB,c values

For CA\_n7-n26-n78, the ΔTIB,c and ΔRIB,c values are reused from CA\_n5-n7-n78 and are given in the tables below.

Table 5.10.1.3-1: ΔTIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔTIB,c for NR bands (dB)8** | | |
| **Component band in order of bands in configuration9** | | |
| CA\_n7-n26-n78 | 0.6 | 0.6 | 0.8 |
| NOTE 8: “-” denotes ΔTIB,c = 0.  NOTE 9: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n5 the band order from left to right is n1, n3 and n5. | | | |

Table 5.10.1.3-2: ΔRIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔRIB,c for NR bands (dB)9** | | |
| **Component band in order of bands in configuration10** | | |
| CA\_n7-n26-n78 | 0.2 | 0.2 | 0.5 |
| NOTE 9: “-” denotes ΔRIB,c = 0.  NOTE 10: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n8 the band order from left to right is n1, n3 and n8. | | | |

### 5.10.2 Specific for 2 bands UL CA

#### 5.10.2.1 UE co-existence studies

UL n7-n26 gives IMD2 into DL n78.

UL n7-n78 gives IMD2 and IMD5 into DL n26.

UL n26-n78 gives IMD2 into DL n7.

#### 5.10.2.2 REFSENS requirements

Based on the co-existence studies there are a need to define MSD values. MSD values from CA\_n5-n7-n78 are reused.

Table 5.10.2.2-1: 3DL/2UL inter-band Reference sensitivity QPSK PREFSENS and uplink/downlink configurations

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Band / Channel bandwidth / NRB / Duplex mode | | | | | | | | Source of IMD |
| NR CA band combination | NR band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  CLRB | DL Fc (MHz) | MSD  (dB) | Duplex mode |  |
| CA\_n7-n26-n78 | n7 | 2550 | 5 | 25 | 2670 | N/A | FDD | N/A |
|  | n26 | 834 | 5 | 25 | 879 | 30.2 | FDD | IMD2 |
|  | n78 | 3429 | 10 | 50 | 3429 | N/A | TDD | N/A |
|  | n7 | 2525 | 5 | 25 | 2645 | N/A | FDD | N/A |
|  | n26 | 830 | 5 | 25 | 875 | 3.3 | FDD | IMD5 |
|  | n78 | 3350 | 10 | 50 | 3350 | N/A | TDD | N/A |
|  | n7 | 2525 | 5 | 25 | 2645 | 30.1 | FDD | IMD2 |
|  | n26 | 844 | 5 | 25 | 889 | N/A | FDD | N/A |
|  | n78 | 3489 | 10 | 50 | 3489 | N/A | TDD | N/A |
|  | n7 | 2540 | 5 | 25 | 2660 | N/A | FDD | N/A |
|  | n26 | 835 | 5 | 25 | 880 | N/A | FDD | N/A |
|  | n78 | 3375 | 10 | 50 | 3375 | 29.7 | TDD | IMD2 |

## 5.11 CA\_n3-n41-n79

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

#### 5.11.1.1 Operating bands for CA

Table 5.11.1.1-1: Inter-band CA operating bands involving FR1 (three bands)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 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 | | |
| n3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | FDD |
| n41 | 2496 MHz | – | 2690 MHz | 2496 MHz | – | 2690 MHz | TDD |
| n79 | 4400 MHz | – | 5000 MHz | 4400 MHz | – | 5000 MHz | TDD |

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

Table 5.11.1.2-1: Supported bandwidths per CA band combination of band n3+n41+n79

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NR CA configuration | Uplink CA configuration or single uplink carrier | NR Band | Channel bandwidth (MHz) | Bandwidth combination set |
| CA\_n3A-n41A-n79A | CA\_n3A-n41A  CA\_n3A-n79A  CA\_n41A-n79A | 3DL/1UL has already been specified. | | |

#### 5.11.1.3 ∆TIB,c and ∆RIB,c values

Since 3DL/1UL has already been specified, ∆TIB,c and ∆RIB,c values have also been specified.

### 5.11.2 Specific for 2 bands UL CA

#### 5.11.2.1 UE co-existence studies

UE co-existence has been already studied for 2DL/1UL fallback combinations such as CA n3-n41, CA\_n3-n79 and n41-n79 and the impact of harmonic interference has been clarified. The own Rx impact of the 3rd band is shown as the followings.

– 2nd and 5th order IMD generated by dual uplink of Band n3 + Band n41 may fall into own Rx of Band n79

– 2nd and 5th order IMD generated by dual uplink of Band n3 + Band n79 may fall into own Rx of Band n41

– 2nd and 5th order IMD generated by dual uplink of Band n41 + Band n79 may fall into own Rx of Band n3

#### 5.11.2.2 REFSENS requirements

Table 5.11.2.2-1 lists the MSD required for the dual connectivity configuration for the cases that IMD interference fall into the own 3rd Rx frequency band. For the exception by dual uplink of Band n3 + Band n41, the same exception value in DC\_3A\_n41A-n79A is used. For the exception by dual uplink of Band n3 + Band n79 and Band n41 + Band n79, the same exception values in DC\_3A-41A\_n79A are used.

Table 5.11.2.2-1: MSD for the CA configuration

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Band / Channel bandwidth / NRB / Duplex mode | | | | | | | | Source of IMD |
| NR CA band combination | NR band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  CLRB | DL Fc (MHz) | MSD  (dB) | Duplex mode |  |
| CA\_n3-n41-n79 | n3 | 1755 | 5 | 25 | 1850 | 29.4 | FDD | IMD21 |
|  | n41 | 2570 | 10 | 50 | 2570 | N/A | TDD | N/A |
|  | n79 | 4420 | 40 | 216 | 4420 | N/A | TDD | N/A |
|  | n3 | 1770 | 5 | 25 | 1865 | N/A | FDD | N/A |
|  | n41 | 2670 | 10 | 50 | 2670 | 30.2 | TDD | IMD21 |
|  | n79 | 4440 | 40 | 216 | 4440 | N/A | TDD | N/A |
|  | n3 | 1770 | 5 | 25 | 1865 | N/A | FDD | N/A |
|  | n41 | 2670 | 10 | 50 | 2670 | N/A | TDD | N/A |
|  | n79 | 4440 | 40 | 216 | 4440 | 30.8 | TDD | IMD21 |
| NOTE 1: This band is subject to IMD5 also which MSD is not specified. | | | | | | | | |

## 5.12 CA\_n29-n70-n71

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

#### 5.12.1.1 Operating bands for CA

Table 5.12.1.1-1: 3DL Inter-band CA operating bands

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band** | **NR Band** | **Uplink (UL) operating band** | | | **Downlink (DL) operating band** | | | **Duplex Mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n29-n70-n71 | n29 | N/A | – | N/A | 717 MHz | – | 728 MHz | SDL |
| n70 | 1695 MHz | – | 1710 MHz | 1995 MHz | – | 2020 MHz | FDD |
| n71 | 663 MHz | – | 698 MHz | 617 MHz | – | 652 MHz | FDD |

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

Table 5.12.1.2-1: Supported bandwidths per CA band combination of band nX+nY+nZ

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NR CA configuration | Uplink CA configuration or single uplink carrier | NR Band | Channel bandwidth (MHz) | Bandwidth combination set |
| CA\_n29A-n70A-n71A | CA\_n70A-n71A | n29 | 5, 10 | 0 |
| n70 | 5, 10, 15, 201, 251 |
| n71 | 5, 10, 15, 20 |

The following notes are applied to the above tables:

NOTE 1: This UE channel bandwidth is applicable only to downlink.

#### 5.12.1.3 ∆TIB,c and ∆RIB,c values

For CA\_n29-n70-n71,

– The ΔTIB,c values are reused from CA\_n70-n71.

– The ΔRIB,cvalues are reused from CA\_n5-n14-n77 for n29 and n71, and n70 value from n2 three combinations (0.2dB is used when n2 is the only mid band).

These are given in the tables below.

Table 5.12.1.3-1: ΔTIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔTIB,c for NR bands (dB)8** | | |
| **Component band in order of bands in configuration9** | | |
| CA\_n29-n70-n71 | - | 0.3 | 0.6 |
| NOTE 8: “-” denotes ΔTIB,c = 0.  NOTE 9: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n5 the band order from left to right is n1, n3 and n5. | | | |

Table 5.12.1.3-2: ΔRIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔRIB,c for NR bands (dB)9** | | |
| **Component band in order of bands in configuration10** | | |
| CA\_n29-n70-n71 | 0.2 | 0.2 | 0.2 |
| NOTE 9: “-” denotes ΔRIB,c = 0.  NOTE 10: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n8 the band order from left to right is n1, n3 and n8. | | | |

### 5.12.2 Specific for 2 bands UL CA

#### 5.12.2.1 UE co-existence studies

UE co-existence has already been studied for 2DL/1UL fallback combinations. The impact to the 3rd band Rx is following:

– No IMD generated by dual uplink of Band n70 + Band n71 falls into Band n29 DL.

#### 5.12.2.2 REFSENS requirements

Based on the co-existence studies there is no need to define MSD values.

## 5.13 CA\_n48-n71-n77

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

#### 5.13.1.1 Operating bands for CA

Table 5.13.1.1-1: 3DL Inter-band CA operating bands

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band** | **NR Band** | **Uplink (UL) operating band** | | | **Downlink (DL) operating band** | | | **Duplex Mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n48-n71-n77 | n48 | 3550 MHz | – | 3700 MHz | 3550 MHz | – | 3700 MHz | TDD |
| n71 | 663 MHz | – | 698 MHz | 617 MHz | – | 652 MHz | FDD |
| n77 | 3300 MHz | – | 4200 MHz | 3300 MHz | – | 4200 MHz | TDD |

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

Table 5.13.1.2-1: Supported bandwidths per CA band combination of band nX+nY+nZ

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NR CA configuration | Uplink CA configuration or single uplink carrier | NR Band | Channel bandwidth (MHz) | Bandwidth combination set |
| CA\_n48A-n71A-n77A | CA\_n48A-n71A | n48 | 5, 10, 15, 20, 30, 40, 50, 60, 70, 80, 90, 100 | 0 |
|  | CA\_n71A-n77A | n71 | 5, 10, 15, 20 |  |
|  |  | n77 | 10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100 |  |

#### 5.13.1.3 ∆TIB,c and ∆RIB,c values

For CA\_n48-n71-n77, the ΔTIB,c and ΔRIB,c values are reused from CA\_n5-n48-n77 and are given in the tables below.

Table 5.13.1.3-1: ΔTIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔTIB,c for NR bands (dB)8** | | |
| **Component band in order of bands in configuration9** | | |
| CA\_n48-n71-n77 | 0.8 | 0.6 | 0.8 |
| NOTE 8: “-” denotes ΔTIB,c = 0.  NOTE 9: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n5 the band order from left to right is n1, n3 and n5. | | | |

Table 5.13.1.3-2: ΔRIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔRIB,c for NR bands (dB)9** | | |
| **Component band in order of bands in configuration10** | | |
| CA\_n48-n71-n77 | 0.5 | 0.2 | 0.5 |
| NOTE 9: “-” denotes ΔRIB,c = 0.  NOTE 10: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n8 the band order from left to right is n1, n3 and n8. | | | |

### 5.13.2 Specific for 2 bands UL CA

#### 5.13.2.1 UE co-existence studies

Table 5.13.2.2-1 lists Band n71 + Band n77 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE coexistence analysis.

Table 5.13.2.2-2 lists Band n48 + Band n71 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE coexistence analysis.

**Table 5.13.2.2-1: Band n48 and Band n71 UL harmonics and IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **f1\_low** | **f1\_high** | **f2\_low** | **f2\_high** |
| UL frequencies (MHz) | 663 | 698 | 3450 | 3600 |
| 2nd order IMD products | |fy\_high – fx\_low| | |fy\_low – fx\_high| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 2752 | 2937 | 4113 | 4298 |
| 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) | 2274 | 2054 | 6202 | 6537 |
| 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) | 4776 | 4996 | 7563 | 7898 |
| 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) | 1611 | 1356 | 9652 | 10137 |
| 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) | 5439 | 5694 | 7563 | 11498 |
| 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) | 5504 | 5874 | 8226 | 8596 |
| 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) | 948 | 658 | 13102 | 13737 |
| 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) | 6102 | 6392 | 14463 | 15098 |
| 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) | 5211 | 4806 | 8954 | 9474 |
| 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) | 11676 | 12196 | 8889 | 9294 |

**Table 5.13.2.2-1: Band n71 and Band n77 UL harmonics and IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **f1\_low** | **f1\_high** | **f2\_low** | **f2\_high** |
| UL frequencies (MHz) | 663 | 698 | 3300 | 4200 |
| 2nd order IMD products | |fy\_high – fx\_low| | |fy\_low – fx\_high| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 2602 | 3537 | 3963 | 4898 |
| 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) | 2874 | 1904 | 5902 | 7737 |
| 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 4626 | 5596 | 7263 | 9098 |
| 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) | 2211 | 1206 | 9202 | 11937 |
| 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) | 5289 | 6294 | 7263 | 13298 |
| 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) | 5204 | 7074 | 7926 | 9796 |
| 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) | 1548 | 508 | 12502 | 16137 |
| 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) | 5952 | 6992 | 13863 | 17498 |
| 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) | 6411 | 4506 | 8504 | 11274 |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 11226 | 13996 | 8589 | 10494 |

Based on the tables above it can be seen that

– n48 + n71 IMD2 may affect Rx frequencies of band n77.

– n71 + n77 IMD2 may affect Rx frequencies of band n48.

#### 5.13.2.2 REFSENS requirements

Looking at further on the IMD impacts, there are no IMD products falling into Rx frequencies of n48 or n77 in the USA. Since in the USA, n77 band is restricted to 3450 – 3550 MHz and 3700 – 3980 MHz, IMD products are calculated based on those frequencies. For Canada, this combination does not apply as n48 is US-only.

**Table 5.13.2.3-1: MSD due to IMD issue**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Band / Channel bandwidth / NRB / Duplex mode | | | | | | | | Source of IMD |
| NR CA band combination | NR band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  CLRB | DL Fc (MHz) | MSD  (dB) | Duplex mode |  |
| CA\_n48-n71-n775 | n48 | N/A | N/A | N/A | N/A | N/A | FDD | N/A |
|  | n71 | N/A | N/A | N/A | N/A | N/A | FDD | N/A |
|  | n77 | N/A | N/A | N/A | N/A | N/A | FDD | IMD2 |
|  | n48 | N/A | N/A | N/A | N/A | N/A | FDD | IMD2 |
|  | n71 | N/A | N/A | N/A | N/A | N/A | FDD | N/A |
|  | n77 | N/A | N/A | N/A | N/A | N/A | FDD | N/A |
| NOTE 5: For a UE which supports this band combination only when the Band n77 frequency range restriction defined in NOTE 12 of Table 5.2-1 applies, the MSD test point(s) cannot be verified for the band combination and the test point(s) can be skipped. | | | | | | | | |

## 5.14 CA\_n1-n3-n38

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

#### 5.14.1.1 Operating bands for CA

Table 5.14.1.1-1: Inter-band CA operating bands involving FR1 (three bands)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 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 | | |
| n1 | 1920MHz | – | 1980MHz | 2110MHz | – | 2170MHz | FDD |
| n3 | 1710MHz | – | 1785MHz | 1805MHz | – | 1880MHz | FDD |
| n38 | 2570MHz | – | 2620MHz | 2570MHz | – | 2620MHz | TDD |

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

Table 5.14.1.2-1: Supported bandwidths per CA band combination of band CA\_n1-n3-n38

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NR CA configuration | Uplink CA configuration or single uplink carrier | NR Band | Channel bandwidth (MHz) | Bandwidth combination set |
| CA\_n1A-n3A-n38A | - | n1 | 5, 10, 15, 20, 25, 30, 40, 50 | 0 |
|  |  | n3 | 5, 10, 15, 20, 25, 30, 40, 50 |  |
|  |  | n38 | 5, 10, 15, 20, 25, 30, 40 |  |
| CA\_n1A-n3B-n38A | - | n1 | 5, 10, 15, 20, 25, 30, 40, 50 | 0 |
|  |  | n3 | CA\_n3B\_BCS0 |  |
|  |  | n38 | 5, 10, 15, 20, 25, 30, 40 |  |
| CA\_n1(2A)-n3A-n38A | - | n1 | CA\_n1(2A)\_BCS0 | 0 |
|  |  | n3 | 5, 10, 15, 20, 25, 30, 40, 50 |  |
|  |  | n38 | 5, 10, 15, 20, 25, 30, 40 |  |
| CA\_n1(2A)-n3B-n38A | - | n1 | CA\_n1(2A)\_BCS0 | 0 |
|  |  | n3 | CA\_n3B\_BCS0 |  |
|  |  | n38 | 5, 10, 15, 20, 25, 30, 40 |  |
| CA\_n1A-n3(2A)-n38A | - | n1 | 5, 10, 15, 20, 25, 30, 40, 50 | 0 |
|  |  | n3 | CA\_n3(2A)\_BCS1 |  |
|  |  | n38 | 5, 10, 15, 20, 25, 30, 40 |  |
| CA\_n1(2A)-n3(2A)-n38A | - | n1 | CA\_n1(2A)\_BCS0 | 0 |
|  |  | n3 | CA\_n3(2A)\_BCS1 |  |
|  |  | n38 | 5, 10, 15, 20, 25, 30, 40 |  |

#### 5.14.1.3 ∆TIB,c and ∆RIB,c values

For CA\_n1-n3-n38, the ΔTIB,c and ΔRIB,c values are given in the tables below.

Table 5.14.1.3-1: ΔTIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔTIB,c for NR bands (dB)\*** | | |
| **Component band in order of bands in configuration\*\*** | | |
| CA\_n1-n3-n38 | 0.5 | 0.5 | 0.3 |
| NOTE \*: “-” denotes ΔTIB,c = 0.  NOTE \*\*: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n5 the band order from left to right is n1, n3 and n5. | | | |

Table 5.14.1.3-2: ΔRIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔRIB,c for NR bands (dB)\*** | | |
| **Component band in order of bands in configuration\*\*** | | |
| CA\_n1-n3-n38 | 0.2 | 0.2 | - |
| NOTE \*: “-” denotes ΔRIB,c = 0.  NOTE \*\*: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n8 the band order from left to right is n1, n3 and n8. | | | |

## 5.15 CA\_n1-n7-n38

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

#### 5.15.1.1 Operating bands for CA

Table 5.15.1.1-1: Inter-band CA operating bands involving FR1 (three bands)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 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 | | |
| n1 | 1920MHz | – | 1980MHz | 2110MHz | – | 2170MHz | FDD |
| n7 | 2500MHz | – | 2570MHz | 2620MHz | – | 2690MHz | FDD |
| n38 | 2570MHz | – | 2620MHz | 2570MHz | – | 2620MHz | TDD |

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

The following sentence can be introduced into TS 38.101-1 in general clause 5.5A.0 to avoid lots of similar Notes.

*For a band combination which include band n7 and n38 simultaneously, carriers in band n7 and n38 can only be configured as downlink carriers. Power imbalance between downlink carriers on Band n7 and Band n38 is assumed to be within 6dB.*

Table 5.15.1.2-1: Supported bandwidths per CA band combination of band CA\_n1-n7-n38

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NR CA configuration | Uplink CA configuration or single uplink carrier | NR Band | Channel bandwidth (MHz) | Bandwidth combination set |
| CA\_n1A-n7A-n38AX | n1A | n1 | 5, 10, 15, 20, 25, 30, 40, 50 | 0 |
|  |  | n7 | 5, 10, 15, 20, 25, 30, 40, 50 |  |
|  |  | n38 | 5, 10, 15, 20, 25, 30, 40 |  |
| CA\_n1(2A)-n7A-n38AX | n1A | n1 | CA\_n1(2A)\_BCS0 | 0 |
|  |  | n7 | 5, 10, 15, 20, 25, 30, 40, 50 |  |
|  |  | n38 | 5, 10, 15, 20, 25, 30, 40 |  |
| NOTE X: For a band combination which include band n7 and n38 simultaneously, carriers in band n7 and n38 can only be configured as downlink carriers. Power imbalance between downlink carriers on Band n7 and Band n38 is assumed to be within 6dB. | | | | |

#### 5.15.1.3 ∆TIB,c and ∆RIB,c values

For CA\_n1-n7-n38, the ΔTIB,c and ΔRIB,c values are given in the tables below.

Table 5.15.1.3-1: ΔTIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔTIB,c for NR bands (dB)\*** | | |
| **Component band in order of bands in configuration\*\*** | | |
| CA\_n1-n7-n38 | 0.5 | - | - |
| NOTE \*: “-” denotes ΔTIB,c = 0.  NOTE \*\*: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n5 the band order from left to right is n1, n3 and n5. | | | |

Table 5.15.1.3-2: ΔRIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔRIB,c for NR bands (dB)\*** | | |
| **Component band in order of bands in configuration\*\*** | | |
| CA\_n1-n7-n38 | - | - | - |
| NOTE \*: “-” denotes ΔRIB,c = 0.  NOTE \*\*: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n8 the band order from left to right is n1, n3 and n8. | | | |

## 5.16 CA\_n3-n7-n38

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

#### 5.16.1.1 Operating bands for CA

Table 5.16.1.1-1: Inter-band CA operating bands involving FR1 (three bands)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 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 | | |
| n3 | 1710MHz | – | 1785MHz | 1805MHz | – | 1880MHz | FDD |
| n7 | 2500MHz | – | 2570MHz | 2620MHz | – | 2690MHz | FDD |
| n38 | 2570MHz | – | 2620MHz | 2570MHz | – | 2620MHz | TDD |

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

The following sentence can be introduced into TS 38.101-1 in general clause 5.5A.0 to avoid lots of similar Notes.

*For a band combination which include band n7 and n38 simultaneously, carriers in band n7 and n38 can only be configured as downlink carriers. Power imbalance between downlink carriers on Band n7 and Band n38 is assumed to be within 6dB.*

Table 5.16.1.2-1: Supported bandwidths per CA band combination of band CA\_n3-n7-n38

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NR CA configuration | Uplink CA configuration or single uplink carrier | NR Band | Channel bandwidth (MHz) | Bandwidth combination set |
| CA\_n3A-n7A-n38AX | n3A | n3 | 5, 10, 15, 20, 25, 30, 40, 50 | 0 |
|  |  | n7 | 5, 10, 15, 20, 25, 30, 40, 50 |  |
|  |  | n38 | 5, 10, 15, 20, 25, 30, 40 |  |
| CA\_n3B-n7A-n38AX | n3A | n3 | CA\_n3B\_BCS0 | 0 |
|  |  | n7 | 5, 10, 15, 20, 25, 30, 40, 50 |  |
|  |  | n38 | 5, 10, 15, 20, 25, 30, 40 |  |
| CA\_n3(2A)-n7A-n38AX | n3A | n3 | CA\_n3(2A)\_BCS1 | 0 |
|  |  | n7 | 5, 10, 15, 20, 25, 30, 40, 50 |  |
|  |  | n38 | 5, 10, 15, 20, 25, 30, 40 |  |
| NOTE X: For a band combination which include band n7 and n38 simultaneously, carriers in band n7 and n38 can only be configured as downlink carriers. Power imbalance between downlink carriers on Band n7 and Band n38 is assumed to be within 6dB. | | | | |

#### 5.16.1.3 ∆TIB,c and ∆RIB,c values

For CA\_n3-n7-n38, the ΔTIB,c and ΔRIB,c values are given in the tables below.

Table 5.16.1.3-1: ΔTIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔTIB,c for NR bands (dB)\*** | | |
| **Component band in order of bands in configuration\*\*** | | |
| CA\_n3-n7-n38 | 0.5 | - | - |
| NOTE \*: “-” denotes ΔTIB,c = 0.  NOTE \*\*: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n5 the band order from left to right is n1, n3 and n5. | | | |

Table 5.16.1.3-2: ΔRIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔRIB,c for NR bands (dB)\*** | | |
| **Component band in order of bands in configuration\*\*** | | |
| CA\_n3-n7-n38 | 0 | 0.5 | 0.5 |
| NOTE \*: “-” denotes ΔRIB,c = 0.  NOTE \*\*: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n8 the band order from left to right is n1, n3 and n8. | | | |

## 5.17 CA\_n3-n78-n79

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

#### 5.17.1.1 Operating bands for CA

Table 5.17.1.1-1: Inter-band CA operating bands involving FR1 (three bands)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 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 | | |
| n3 | 1710MHz | – | 1785MHz | 1805MHz | – | 1880MHz | FDD |
| n78 | 3300MHz | – | 3800MHz | 3300MHz | – | 3800MHz | TDD |
| n79 | 4400MHz | – | 5000MHz | 4400MHz | – | 5000MHz | TDD |

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

Table 5.17.1.2-1: Supported bandwidths per CA band combination of band CA\_n3-n78-n79

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NR CA configuration | Uplink CA configuration or single uplink carrier | NR Band | Channel bandwidth (MHz) | Bandwidth combination set |
| CA\_n3A-n78A-n79A | - | n3 | 5, 10, 15, 20, 25, 30, 40, 50 | 0 |
|  |  | n78 | 10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100 |  |
|  |  | n79 | 40, 50, 60, 80, 100 |  |
| CA\_n3A-n78A-n79C | - | n3 | 5, 10, 15, 20, 25, 30, 40, 50 | 0 |
|  |  | n78 | 10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100 |  |
|  |  | n79 | CA\_n79C\_BCS0 |  |
| CA\_n3B-n78A-n79A | - | n3 | CA\_n3B\_BCS0 | 0 |
|  |  | n78 | 10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100 |  |
|  |  | n79 | 40, 50, 60, 80, 100 |  |
| CA\_n3B-n78A-n79C | - | n3 | CA\_n3B\_BCS0 | 0 |
|  |  | n78 | 10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100 |  |
|  |  | n79 | CA\_n79C\_BCS0 |  |
| CA\_n3(2A)-n78A-n79A | - | n3 | CA\_n3(2A)\_BCS1 | 0 |
|  |  | n78 | 10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100 |  |
|  |  | n79 | 40, 50, 60, 80, 100 |  |
| CA\_n3(2A)-n78A-n79C | - | n3 | CA\_n3(2A)\_BCS1 | 0 |
|  |  | n78 | 10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100 |  |
|  |  | n79 | CA\_n79C\_BCS0 |  |
|  | | | | |

#### 5.17.1.3 ∆TIB,c and ∆RIB,c values

For CA\_n3-n78-n79, the ΔTIB,c and ΔRIB,c values are given in the tables below.

Table 5.17.1.3-1: ΔTIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔTIB,c for NR bands (dB)\*** | | |
| **Component band in order of bands in configuration\*\*** | | |
| CA\_n3-n78-n79 | 0.6 | 0.8 | 0.8 |
| NOTE \*: “-” denotes ΔTIB,c = 0.  NOTE \*\*: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n5 the band order from left to right is n1, n3 and n5. | | | |

Table 5.17.1.3-2: ΔRIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔRIB,c for NR bands (dB)\*** | | |
| **Component band in order of bands in configuration\*\*** | | |
| CA\_n3-n78-n79 | 0.2 | 0.5 | 0.5 |
| NOTE \*: “-” denotes ΔRIB,c = 0.  NOTE \*\*: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n8 the band order from left to right is n1, n3 and n8. | | | |

## 5.18 CA\_n5-n7-n77

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

#### 5.18.1.1 Operating bands for CA

Table 5.18.1.1-1: 3DL Inter-band CA operating bands

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band** | **NR Band** | **Uplink (UL) operating band** | | | **Downlink (DL) operating band** | | | **Duplex Mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n5A-n7A-n77A | n5 | 824 MHz | – | 849 MHz | 869 MHz | – | 894 MHz | FDD |
|  | n7 | 2500 MHz | – | 2570 MHz | 2620 MHz | – | 2690 MHz | FDD |
|  | n77 | 3300 MHz | – | 4200 MHz | 3300 MHz | – | 4200 MHz | TDD |

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

Table 5.x.1.2-1: Supported bandwidths per CA band combination of band n5+n7+n77

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NR CA configuration | Uplink CA configuration or single uplink carrier | NR Band | Channel bandwidth (MHz) | Bandwidth combination set |
| CA\_n5A-n7A-n77A | CA\_n5A-n7A CA\_n5-n77A CA\_n7-n77A | n5 | See n5A channel bandwidths in Table 5.3.5-1 | 0 |
|  |  | n7 | See n7A channel bandwidths in Table 5.3.5-1 |  |
|  |  | n77 | See n77A channel bandwidths in Table 5.3.5-1 |  |

#### 5.18.1.3 ∆TIB,c and ∆RIB,c values

For CA\_n5-n7-n77, the ΔTIB,c and ΔRIB,c values are reused from DC\_5-7\_n77 and are given in the tables below.

Table 5.18.1.3-1: ΔTIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔTIB,c for NR bands (dB)8** | | |
| **Component band in order of bands in configuration9** | | |
| CA\_n5-n7-n77 | 0.6 | 0.6 | 0.8 |
| NOTE 8: “-” denotes ΔTIB,c = 0.  NOTE 9: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n5 the band order from left to right is n1, n3 and n5. | | | |

Table 5.18.1.3-2: ΔRIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔRIB,c for NR bands (dB)9** | | |
| **Component band in order of bands in configuration10** | | |
| CA\_n5-n7-n77 | 0.2 | 0.2 | 0.5 |
| NOTE 9: “-” denotes ΔRIB,c = 0.  NOTE 10: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n8 the band order from left to right is n1, n3 and n8. | | | |

### 5.18.2 Specific for 2 bands UL CA

#### 5.18.2.1 UE co-existence studies

UL n5-n7 gives IMD2, IMD3 and IMD4 into DL n77.

UL n5-n77 gives IMD2 into DL n7.

UL n7-n77 gives IMD2 and IMD3 into DL n5.

#### 5.18.2.2 REFSENS requirements

Based on the co-existence studies there are a need to define MSD values. MSD values from DC\_5-7\_n77 are reused, where possible, while n5+n7 into n77 is added in same range of MSD as the other two MSD values.

Table 5.18.2.2-1: 3DL/2UL inter-band Reference sensitivity QPSK PREFSENS and uplink/downlink configurations

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Band / Channel bandwidth / NRB / Duplex mode | | | | | | | | Source of IMD |
| NR CA band combination | NR band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  CLRB | DL Fc (MHz) | MSD  (dB) | Duplex mode |  |
| CA\_n5-n7-n77 | n5 | 844 | 5 | 25 | 889 | N/A | FDD | N/A |
|  | n7 | 2525 | 5 | 25 | 2645 | 30.1 | FDD | IMD2 |
|  | n77 | 3489 | 10 | 50 | 3489 | N/A | TDD | N/A |
|  | n5 | 834 | 5 | 25 | 879 | 30.2 | FDD | IMD21 |
|  | n7 | 2550 | 5 | 25 | 2670 | N/A | FDD | N/A |
|  | n77 | 3429 | 10 | 50 | 3429 | N/A | TDD | N/A |
|  | n5 | 827 | 5 | 25 | 852 | N/A | FDD | N/A |
|  | n7 | 2503 | 5 | 25 | 2623 | N/A | FDD | N/A |
|  | n77 | 3330 | 10 | 50 | 3330 | 30.2 | TDD | IMD21 |
| NOTE 1: This band is subject to IMD3 also which MSD is not specified | | | | | | | | |

## 5.19 CA\_n7-n71-n77

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

#### 5.19.1.1 Operating bands for CA

Table 5.19.1.1-1: 3DL Inter-band CA operating bands

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band** | **NR Band** | **Uplink (UL) operating band** | | | **Downlink (DL) operating band** | | | **Duplex Mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n7A-n71A-n77A | n7 | 2500 MHz | – | 2570 MHz | 2620 MHz | – | 2690 MHz | FDD |
|  | n71 | 663 MHz | – | 698 MHz | 617 MHz | – | 652 MHz | FDD |
|  | n77 | 3300 MHz | – | 4200 MHz | 3300 MHz | – | 4200 MHz | TDD |

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

Table 5.19.1.2-1: Supported bandwidths per CA band combination of band n7+n71+n77

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NR CA configuration | Uplink CA configuration or single uplink carrier | NR Band | Channel bandwidth (MHz) | Bandwidth combination set |
| CA\_n7A-n71A-n77A | CA\_n7A-n71A CA\_n7A-n77A CA\_n71-n77A | n7 | See n7A channel bandwidths in Table 5.3.5-1 | 0 |
|  |  | n71 | See n71A channel bandwidths in Table 5.3.5-1 |  |
|  |  | n77 | See n77A channel bandwidths in Table 5.3.5-1 |  |

#### 5.19.1.3 ∆TIB,c and ∆RIB,c values

For CA\_n7-n71-n77, the ΔTIB,c and ΔRIB,c values are reused from DC\_7\_n71-n78 and are given in the tables below.

Table 5.19.1.3-1: ΔTIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔTIB,c for NR bands (dB)8** | | |
| **Component band in order of bands in configuration9** | | |
| CA\_n7-n71-n77 | 0.3 | 0.5 | 0.8 |
| NOTE 8: “-” denotes ΔTIB,c = 0.  NOTE 9: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n5 the band order from left to right is n1, n3 and n5. | | | |

Table 5.19.1.3-2: ΔRIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔRIB,c for NR bands (dB)9** | | |
| **Component band in order of bands in configuration10** | | |
| CA\_n7-n71-n77 | - | 0.2 | 0.5 |
| NOTE 9: “-” denotes ΔRIB,c = 0.  NOTE 10: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n8 the band order from left to right is n1, n3 and n8. | | | |

### 5.19.2 Specific for 2 bands UL CA

#### 5.19.2.1 UE co-existence studies

UL n7-n71 gives IMD3 and IMD4 into DL n77.

UL n7-n77 does not affect DL n71.

UL n71-n77 gives IMD2 into DL n7.

#### 5.19.2.2 REFSENS requirements

Based on the co-existence studies there are a need to define MSD values. MSD values from DC\_7-71\_n78 are reused, for IMD2 into n7, while n7+n71 into n77 is added in same range of MSD as DC\_2\_n5-n77, since this is the same product that hits n77 (2 times lowband + midband = highband).

Table 5.19.2.2-1: 3DL/2UL inter-band Reference sensitivity QPSK PREFSENS and uplink/downlink configurations

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Band / Channel bandwidth / NRB / Duplex mode | | | | | | | | Source of IMD |
| NR CA band combination | NR band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  CLRB | DL Fc (MHz) | MSD  (dB) | Duplex mode |  |
| CA\_n7-n71-n77 | n7 | 2505 | 5 | 25 | 2625 | N/A | FDD | N/A |
|  | n71 | 666 | 5 | 25 | 620 | N/A | FDD | N/A |
|  | n77 | 3837 | 10 | 50 | 3837 | 16.0 | TDD | IMD3 |
|  | n7 | 2550 | 5 | 25 | 2670 | 29.6 | FDD | IMD2 |
|  | n71 | 680 | 5 | 25 | 634 | N/A | FDD | N/A |
|  | n77 | 3350 | 10 | 50 | 3350 | N/A | TDD | N/A |

## 5.20 CA\_n48-n70-n77

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

#### 5.20.1.1 Operating bands for CA

Table 5.20.1.1-1: 3DL Inter-band CA operating bands

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band** | **NR Band** | **Uplink (UL) operating band** | | | **Downlink (DL) operating band** | | | **Duplex Mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n48-n70-n77 | n48 | 3550 MHz | – | 3700 MHz | 3550 MHz | – | 3700 MHz | TDD |
| n70 | 1695 MHz | – | 1710 MHz | 1995 MHz | – | 2020 MHz | FDD |
| n77 | 3300 MHz | – | 4200 MHz | 3300 MHz | – | 4200 MHz | TDD |

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

Table 5.20.1.2-1: Supported bandwidths per CA band combination of band n48+n70+n77

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NR CA configuration | Uplink CA configuration or single uplink carrier | NR Band | Channel bandwidth (MHz) | Bandwidth combination set |
| CA\_n48A-n70A-n77A | CA\_n48A-n70A | n48 | 5, 10, 15, 20, 30, 40, 50, 60, 70, 80, 90, 100 | 0 |
|  | CA\_n70A-n77A | n70 | 5, 10, 15, 20, 25 |  |
|  |  | n77 | 10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100 |  |

#### 5.20.1.3 ∆TIB,c and ∆RIB,c values

For CA\_n48-n70-n77, the ΔTIB,c and ΔRIB,c values are reused from CA\_n2-n48-n77 and are given in the tables below.

Table 5.20.1.3-1: ΔTIB,c

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔTIB,c for NR bands (dB)\*** | | |
| **Component band in order of bands in configuration\*\*** | | |
| CA\_n48-n70-n77 | 0.8 | 0.6 | 0.8 |
| NOTE \*: “-” denotes ΔTIB,c = 0.  NOTE \*\*: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n5 the band order from left to right is n1, n3 and n5. | | | |

Table 5.20.1.3-2: ΔRIB,c

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔRIB,c for NR bands (dB)\*** | | |
| **Component band in order of bands in configuration\*\*** | | |
| CA\_n48-n70-n77 | 0.5 | 0.2 | 0.5 |
| NOTE \*: “-” denotes ΔRIB,c = 0.  NOTE \*\*: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n8 the band order from left to right is n1, n3 and n8. | | | |

### 5.20.2 Specific for 2 bands UL CA

#### 5.20.2.1 UE co-existence studies

Table 5.20.2.2-1 lists Band n48 + Band n70 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE coexistence analysis.

Table 5.20.2.2-2 lists Band n70 + Band n77 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE coexistence analysis.

**Table 5.20.2.2-1: Band n48 and Band n70 UL harmonics and IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **f1\_low** | **f1\_high** | **f2\_low** | **f2\_high** |
| UL frequencies (MHz) | 1695 | 1710 | 3550 | 3700 |
| 2nd order IMD products | |fy\_high – fx\_low| | |fy\_low – fx\_high| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 1840 | 2005 | 5245 | 5410 |
| 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) | 310 | 130 | 5390 | 5705 |
| 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) | 6940 | 7120 | 8795 | 9110 |
| 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) | 1385 | 1580 | 8940 | 9405 |
| 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) | 8635 | 8830 | 8795 | 12810 |
| 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) | 3680 | 4010 | 10490 | 10820 |
| 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) | 3080 | 3290 | 12490 | 13105 |
| 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) | 10330 | 10540 | 15895 | 16510 |
| 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) | 2315 | 1970 | 7230 | 7710 |
| 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) | 14040 | 14520 | 12185 | 12530 |

**Table 5.20.2.2-2: Band n70 and Band n77 UL (3450-3550 MHz) IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **f1\_low** | **f1\_high** | **f2\_low** | **f2\_high** |
| UL frequencies (MHz) | 1695 | 1710 | 3300 | 4200 |
| 2nd order IMD products | |fy\_high – fx\_low| | |fy\_low – fx\_high| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 1740 | 1855 | 4114 | 5049 |
| 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) | 160 | 30 | 5751 | 7586 |
| 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) | 6840 | 6970 | 7414 | 9249 |
| 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) | 1535 | 1680 | 9051 | 11786 |
| 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) | 8535 | 8680 | 7414 | 13449 |
| 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) | 3480 | 3710 | 8228 | 10098 |
| 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) | 3230 | 3390 | 12351 | 15986 |
| 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) | 10230 | 10390 | 14014 | 17649 |
| 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) | 2015 | 1770 | 8202 | 10972 |
| 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) | 13740 | 14070 | 9042 | 10947 |

Based on the tables above it can be seen that

n48 + n70 IMD4 may affect Rx frequencies of band n77.

n70 + n77 IMD4 and IMD5 may affect Rx frequencies of band n48.

#### 5.20.2.2 REFSENS requirements

IMD frequencies shown in the previous section do not apply as there is no simultaneous Tx/Rx operation between NR n48 and n77 carriers. Thus, there is no additional co-existence issue is identified.

## 5.21 CA\_n66-n70-n77

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

#### 5.21.1.1 Operating bands for CA

Table 5.21.1.1-1: 3DL Inter-band CA operating bands

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band** | **NR Band** | **Uplink (UL) operating band** | | | **Downlink (DL) operating band** | | | **Duplex Mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n66-n70-n77 | n66 | 1710 MHz | – | 1780 MHz | 2110 MHz | – | 2200 MHz | FDD |
| n70 | 1695 MHz | – | 1710 MHz | 1995 MHz | – | 2020 MHz | FDD |
| n77 | 3300 MHz | – | 4200 MHz | 3300 MHz | – | 4200 MHz | TDD |

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

Table 5.21.1.2-1: Supported bandwidths per CA band combination of band n66+n70+n77

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NR CA configuration | Uplink CA configuration or single uplink carrier | NR Band | Channel bandwidth (MHz) | Bandwidth combination set |
| CA\_n66A-n70A-n77A | CA\_n66A-n77A | n66 | 5, 10, 15, 20, 25, 30, 35, 40 | 0 |
|  | CA\_n70A-n77A | n70 | 5, 10, 15, 20, 25 |  |
|  |  | n77 | 10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100 |  |

#### 5.21.1.3 ∆TIB,c and ∆RIB,c values

For CA\_n66-n70-n77, the ΔTIB,c and ΔRIB,c values are reused from CA\_n2-n66-n77 and are given in the tables below.

Table 5.21.1.3-1: ΔTIB,c

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔTIB,c for NR bands (dB)\*** | | |
| **Component band in order of bands in configuration\*\*** | | |
| CA\_n66-n70-n77 | 0.6 | 0.6 | 0.8 |
| NOTE \*: “-” denotes ΔTIB,c = 0.  NOTE \*\*: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n5 the band order from left to right is n1, n3 and n5. | | | |

Table 5.21.1.3-2: ΔRIB,c

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔRIB,c for NR bands (dB)\*** | | |
| **Component band in order of bands in configuration\*\*** | | |
| CA\_n66-n70-n77 | 0.2 | 0.2 | 0.5 |
| NOTE \*: “-” denotes ΔRIB,c = 0.  NOTE \*\*: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n8 the band order from left to right is n1, n3 and n8. | | | |

### 5.21.2 Specific for 2 bands UL CA

#### 5.21.2.1 UE co-existence studies

Table 5.21.2.2-1lists Band n66 + Band n77 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE coexistence analysis.

Table 5.21.2.2-2 lists Band n70 + Band n77 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE coexistence analysis.

**Table 5.21.2.2-1: Band n70 and Band n77 UL harmonics and IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **f1\_low** | **f1\_high** | **f2\_low** | **f2\_high** |
| UL frequencies (MHz) | 663 | 698 | 3300 | 4200 |
| 2nd order IMD products | |fy\_high – fx\_low| | |fy\_low – fx\_high| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 2602 | 3537 | 3963 | 4898 |
| 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) | 2874 | 1904 | 5902 | 7737 |
| 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 4626 | 5596 | 7263 | 9098 |
| 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) | 2211 | 1206 | 9202 | 11937 |
| 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) | 5289 | 6294 | 7263 | 13298 |
| 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) | 5204 | 7074 | 7926 | 9796 |
| 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) | 1548 | 508 | 12502 | 16137 |
| 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) | 5952 | 6992 | 13863 | 17498 |
| 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) | 6411 | 4506 | 8504 | 11274 |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 11226 | 13996 | 8589 | 10494 |

**Table 5.21.2.2-2: Band n70 and Band n77 UL harmonics and IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **f1\_low** | **f1\_high** | **f2\_low** | **f2\_high** |
| UL frequencies (MHz) | 1695 | 1710 | 3300 | 4200 |
| 2nd order IMD products | |fy\_high – fx\_low| | |fy\_low – fx\_high| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 1590 | 2505 | 4995 | 5910 |
| 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) | 810 | 120 | 4890 | 6705 |
| 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) | 6690 | 7620 | 8295 | 10110 |
| 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) | 885 | 1830 | 8190 | 10905 |
| 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) | 8385 | 9330 | 8295 | 14310 |
| 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) | 3180 | 5010 | 9990 | 11820 |
| 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) | 2580 | 3540 | 11490 | 15105 |
| 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) | 10080 | 11040 | 14895 | 18510 |
| 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) | 3315 | 1470 | 6480 | 9210 |
| 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) | 13290 | 16020 | 11685 | 13530 |

Based on the tables above it can be seen that

n66 + n77 IMD2, IMD4 or IMD5 may affect Rx frequencies of band n70.

n70 + n77 IMD2 or IMD5 may affect Rx frequencies of band n66.

#### 5.21.2.2 REFSENS requirements

Looking further on the IMD impacts, in both cases, only IMD2 products may fall into Rx frequencies of n66 or n70 in the USA. Since in the USA, n77 band is restricted to 3450 – 3550 MHz and 3700 – 3980 MHz, IMD products are calculated based on those frequencies.

MSD values are reused from CA\_n2A-n66A-n77A.

**Table 5.21.2.3-1: MSD due to IMD issue**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Band / Channel bandwidth / NRB / Duplex mode | | | | | | | | Source of IMD |
| NR CA band combination | NR band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  CLRB | DL Fc (MHz) | MSD  (dB) | Duplex mode |  |
| CA\_n66-n70-n77 | n66 | 1757.5 | 5 | 25 | 2157.5 | N/A | FDD | N/A |
|  | n70 | 1707.5 | 5 | 25 | 2007.5 | 32.1 | FDD | IMD2x,y |
|  | n77 | 3765 | 10 | 50 | 3765 | N/A | TDD | N/A |
|  | n66 | 1762.5 | 5 | 25 | 2162.5 | 29.2 | FDD | IMD2y |
|  | n70 | 1702.5 | 5 | 25 | 2002.5 | N/A | FDD | N/A |
|  | n77 | 3865 | 10 | 50 | 3865 | N/A | TDD | N/A |
| NOTE x: This band is subject to IMD4 also which MSD is not specified.  NOTE y: This band is subject to IMD5 also which MSD is not specified. | | | | | | | | |

## 5.22 CA\_n70-n71-n77

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

#### 5.22.1.1 Operating bands for CA

Table 5.22.1.1-1: 3DL Inter-band CA operating bands

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band** | **NR Band** | **Uplink (UL) operating band** | | | **Downlink (DL) operating band** | | | **Duplex Mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n70-n71-n77 | n70 | 1695 MHz | – | 1710 MHz | 1995 MHz | – | 2020 MHz | FDD |
| n71 | 663 MHz | – | 698 MHz | 617 MHz | – | 652 MHz | FDD |
| n77 | 3300 MHz | – | 4200 MHz | 3300 MHz | – | 4200 MHz | TDD |

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

Table 5.22.1.2-1: Supported bandwidths per CA band combination of band n70+n71+n77

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NR CA configuration | Uplink CA configuration or single uplink carrier | NR Band | Channel bandwidth (MHz) | Bandwidth combination set |
| CA\_n70A-n71A-n77A | CA\_n70A-n71A  CA\_n70A-n77A | n70 | 5, 10, 15, 20, 25 | 0 |
|  | CA\_n71A-n77A | n71 | 5, 10, 15, 20 |  |
|  |  | n77 | 10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100 |  |

#### 5.22.1.3 ∆TIB,c and ∆RIB,c values

For CA\_n70-n71-n77, the ΔTIB,c and ΔRIB,c values are reused from CA\_n2-n12-n77 and are given in the tables below.

Table 5.22.1.3-1: ΔTIB,c

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔTIB,c for NR bands (dB)\*** | | |
| **Component band in order of bands in configuration\*\*** | | |
| CA\_n70-n71-n77 | 0.6 | 0.3 | 0.8 |
| NOTE \*: “-” denotes ΔTIB,c = 0.  NOTE \*\*: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n5 the band order from left to right is n1, n3 and n5. | | | |

Table 5.22.1.3-2: ΔRIB,c

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔRIB,c for NR bands (dB)\*** | | |
| **Component band in order of bands in configuration\*\*** | | |
| CA\_n70-n71-n77 | 0.2 | 0.2 | 0.5 |
| NOTE \*: “-” denotes ΔRIB,c = 0.  NOTE \*\*: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n8 the band order from left to right is n1, n3 and n8. | | | |

### 5.22.2 Specific for 2 bands UL CA

#### 5.22.2.1 UE co-existence studies

Table 5.22.2.2-1 lists Band n70 + Band n71 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE coexistence analysis.

Table 5.22.2.2-2 lists Band n70 + Band n77 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE coexistence analysis.

Table 5.22.2.2-3 lists Band n71 + Band n77 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE coexistence analysis.

**Table 5.22.2.2-1: Band n70 and Band n71 UL harmonics and IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **f1\_low** | **f1\_high** | **f2\_low** | **f2\_high** |
| UL frequencies (MHz) | 663 | 698 | 1695 | 1710 |
| 2nd order IMD products | |fy\_high – fx\_low| | |fy\_low – fx\_high| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 997 | 1047 | 2358 | 2408 |
| 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) | 384 | 299 | 2692 | 2757 |
| 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) | 3021 | 3106 | 4053 | 4118 |
| 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) | 279 | 399 | 4387 | 4467 |
| 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) | 3684 | 3804 | 4053 | 5828 |
| 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) | 1994 | 2094 | 4716 | 4816 |
| 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) | 942 | 1097 | 6082 | 6177 |
| 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) | 4347 | 4502 | 7443 | 7538 |
| 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) | 1431 | 1296 | 3689 | 3804 |
| 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) | 6411 | 6526 | 5379 | 5514 |

**Table 5.22.2.2-2: Band n70 and Band n77 UL harmonics and IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **f1\_low** | **f1\_high** | **f2\_low** | **f2\_high** |
| UL frequencies (MHz) | 1695 | 1710 | 3300 | 4200 |
| 2nd order IMD products | |fy\_high – fx\_low| | |fy\_low – fx\_high| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 1740 | 1855 | 4114 | 5049 |
| 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) | 160 | 30 | 5751 | 7586 |
| 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) | 6840 | 6970 | 7414 | 9249 |
| 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) | 1535 | 1680 | 9051 | 11786 |
| 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) | 8535 | 8680 | 7414 | 13449 |
| 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) | 3480 | 3710 | 8228 | 10098 |
| 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) | 3230 | 3390 | 12351 | 15986 |
| 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) | 10230 | 10390 | 14014 | 17649 |
| 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) | 2015 | 1770 | 8202 | 10972 |
| 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) | 13740 | 14070 | 9042 | 10947 |

**Table 5.22.2.2-3: Band n71 and Band n77 UL harmonics and IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **f1\_low** | **f1\_high** | **f2\_low** | **f2\_high** |
| UL frequencies (MHz) | 663 | 698 | 3300 | 4200 |
| 2nd order IMD products | |fy\_high – fx\_low| | |fy\_low – fx\_high| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 2602 | 3537 | 3963 | 4898 |
| 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) | 2874 | 1904 | 5902 | 7737 |
| 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 4626 | 5596 | 7263 | 9098 |
| 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) | 2211 | 1206 | 9202 | 11937 |
| 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) | 5289 | 6294 | 7263 | 13298 |
| 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) | 5204 | 7074 | 7926 | 9796 |
| 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) | 1548 | 508 | 12502 | 16137 |
| 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) | 5952 | 6992 | 13863 | 17498 |
| 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) | 6411 | 4506 | 8504 | 11274 |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 11226 | 13996 | 8589 | 10494 |

Based on the tables above it can be seen that

n70 + n71 IMD3, IMD4, and IMD5 may affect Rx frequencies of band n77。

n71 + n77 IMD3 and IMD4 may affect Rx frequencies of band n70.

#### 5.22.2.2 REFSENS requirements

Looking further on the IMD impacts, only IMD4 and IMD5 products of n70+n71 may fall into Rx frequencies of n77 in the USA. Other MSD test points are not applicable. Since in the USA, n77 band is restricted to 3450 – 3550 MHz and 3700 – 3980 MHz, IMD products are calculated based on those frequencies.

MSD values are reused from CA\_n5A-n66A-n77A.

**Table 5.22.2.3-1: MSD due to IMD issue**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Band / Channel bandwidth / NRB / Duplex mode | | | | | | | | Source of IMD |
| NR CA band combination | NR band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  CLRB | DL Fc (MHz) | MSD  (dB) | Duplex mode |  |
| CA\_n70-n71-n775 | n70 | N/A | N/A | N/A | N/A | N/A | FDD | N/A |
|  | n71 | N/A | N/A | N/A | N/A | N/A | FDD | N/A |
|  | n77 | N/A | N/A | N/A | N/A | N/A | TDD | IMD35 |
|  | n70 | 1702.5 | 5 | 25 | 2002.5 | N/A | FDD | N/A |
|  | n71 | 680.5 | 5 | 25 | 834.5 | N/A | FDD | N/A |
|  | n77 | 3745 | 10 | 50 | 3745 | 8.2 | TDD | IMD4 |
|  | n70 | 1702.5 | 5 | 25 | 2002.5 | N/A | FDD | N/A |
|  | n71 | 680.5 | 5 | 25 | 834.5 | N/A | FDD | N/A |
|  | n77 | 3745 | 10 | 50 | 3745 | 3.3 | TDD | IMD5 |
|  | n70 | N/A | N/A | N/A | N/A | N/A | FDD | IMD35 |
|  | n71 | N/A | N/A | N/A | N/A | N/A | FDD | N/A |
|  | n77 | N/A | N/A | N/A | N/A | N/A | TDD | N/A |
|  | n70 | N/A | N/A | N/A | N/A | N/A | FDD | IMD45 |
|  | n71 | N/A | N/A | N/A | N/A | N/A | FDD | N/A |
|  | n77 | N/A | N/A | N/A | N/A | N/A | TDD | N/A |
| NOTE 5: For a UE which supports this band combination only when the Band n77 frequency range restriction defined in NOTE 12 of Table 5.2-1 applies, the MSD test point(s) cannot be verified for the band combination and the test point(s) can be skipped. | | | | | | | | |

## 5.23 CA\_n1-n3-n38

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

#### 5.23.1.1 Operating bands for CA

Table 5.23.1.1-1: Inter-band CA operating bands involving FR1 (three bands)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band** | **NR Band** | **Uplink (UL) operating band** | | | **Downlink (DL) operating band** | | | **Duplex Mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n1-n3-n38 | n1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | FDD |
| n3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | FDD |
| n38 | 2570MHz |  | 2620MHz | 2570MHz |  | 2620MHz | TDD |

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

Table 5.23.1.2-1: Supported bandwidths per CA band combination of band n1+n3+n38

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NR CA configuration | Uplink CA configuration or single uplink carrier | NR Band | Channel bandwidth (MHz) | Bandwidth combination set |
| CA\_n1A-n3A-n38A | - | n1 | 5, 10, 15, 20, 30, 40, 50 | 0 |
|  |  | n3 | 5, 10, 15, 20, 30, 40, 50 |  |
|  |  | n38 | 5, 10, 15, 20, 30, 40 |  |

#### 5.23.1.3 ∆TIB,c and ∆RIB,c values

For CA\_n1-n3-n38, the ΔTIB,c and ΔRIB,c values are reused from CA\_n1-n3-n7 and are given in the tables below.

Table 5.23.1.3-1: ΔTIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔTIB,c for NR bands (dB)8** | | |
| **Component band in order of bands in configuration9** | | |
| CA\_n1-n3-n38 | 0.6 | 0.6 | 0.6 |
| NOTE 8: “-” denotes ΔTIB,c = 0.  NOTE 9: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n5 the band order from left to right is n1, n3 and n5. | | | |

Table 5.23.1.3-2: ΔRIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔRIB,c for NR bands (dB)9** | | |
| **Component band in order of bands in configuration10** | | |
| CA\_n1-n3-n38 | - | - | - |
| NOTE 9: “-” denotes ΔRIB,c = 0.  NOTE 10: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n8 the band order from left to right is n1, n3 and n8. | | | |

## 5.24 CA\_n1-n7-n38

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

#### 5.24.1.1 Operating bands for CA

Table 5.24.1.1-1: Inter-band CA operating bands involving FR1 (three bands)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band** | **NR Band** | **Uplink (UL) operating band** | | | **Downlink (DL) operating band** | | | **Duplex Mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n1-n7-n38 | n1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | FDD |
| n7 | 2500 MHz | – | 2570 MHz | 2620 MHz | – | 2690 MHz | FDD |
| n38 | 2570MHz |  | 2620MHz | 2570MHz |  | 2620MHz | TDD |

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

Table 5.24.1.2-1: Supported bandwidths per CA band combination of band n1+n7+n38

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NR CA configuration | Uplink CA configuration or single uplink carrier | NR Band | Channel bandwidth (MHz) | Bandwidth combination set |
| CA\_n1A-n7A-n38A | - | n1 | 5, 10, 15, 20, 30, 40, 50 | 0 |
|  |  | n7 | 5, 10, 15, 20, 30, 40, 50 |  |
|  |  | n38 | 5, 10, 15, 20, 30, 40 |  |

#### 5.24.1.3 ∆TIB,c and ∆RIB,c values

For CA\_n1-n7-n38, the ΔTIB,c and ΔRIB,c values are reused from CA\_n1-n7 and are given in the tables below.

Table 5.24.1.3-1: ΔTIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔTIB,c for NR bands (dB)8** | | |
| **Component band in order of bands in configuration9** | | |
| CA\_n1-n7-n38 | 0.5 | 0.6 | 0.6 |
| NOTE 8: “-” denotes ΔTIB,c = 0.  NOTE 9: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n5 the band order from left to right is n1, n3 and n5. | | | |

Table 5.24.1.3-2: ΔRIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔRIB,c for NR bands (dB)9** | | |
| **Component band in order of bands in configuration10** | | |
| CA\_n1-n7-n38 | - | - | - |
| NOTE 9: “-” denotes ΔRIB,c = 0.  NOTE 10: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n8 the band order from left to right is n1, n3 and n8. | | | |

## 5.25 CA\_n3-n7-n38

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

#### 5.25.1.1 Operating bands for CA

Table 5.x.1.1-1: Inter-band CA operating bands involving FR1 (three bands)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band** | **NR Band** | **Uplink (UL) operating band** | | | **Downlink (DL) operating band** | | | **Duplex Mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n3-n7-n38 | n3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | FDD |
| n7 | 2500 MHz | – | 2570 MHz | 2620 MHz | – | 2690 MHz | FDD |
| n38 | 2570MHz |  | 2620MHz | 2570MHz |  | 2620MHz | TDD |

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

Table 5.x.1.2-1: Supported bandwidths per CA band combination of band n3+n7+n38

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NR CA configuration | Uplink CA configuration or single uplink carrier | NR Band | Channel bandwidth (MHz) | Bandwidth combination set |
| CA\_n3A-n7A-n38A | - | n3 | 5, 10, 15, 20, 30, 40, 50 | 0 |
|  |  | n7 | 5, 10, 15, 20, 30, 40, 50 |  |
|  |  | n38 | 5, 10, 15, 20, 30, 40 |  |

#### 5.25.1.3 ∆TIB,c and ∆RIB,c values

For CA\_n3-n7-n38, the ΔTIB,c and ΔRIB,c values are reused from DC\_3\_n7 and are given in the tables below.

Table 5.25.1.3-1: ΔTIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔTIB,c for NR bands (dB)8** | | |
| **Component band in order of bands in configuration9** | | |
| CA\_n3-n7-n38 | 0.5 | 0.5 | 0.5 |
| NOTE 8: “-” denotes ΔTIB,c = 0.  NOTE 9: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n5 the band order from left to right is n1, n3 and n5. | | | |

Table 5.25.1.3-2: ΔRIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔRIB,c for NR bands (dB)9** | | |
| **Component band in order of bands in configuration10** | | |
| CA\_n3-n7-n38 | - | - | - |
| NOTE 9: “-” denotes ΔRIB,c = 0.  NOTE 10: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n8 the band order from left to right is n1, n3 and n8. | | | |

## 5.26 CA\_n3-n28-n38

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

#### 5.26.1.1 Operating bands for CA

Table 5.26.1.1-1: Inter-band CA operating bands involving FR1 (three bands)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band** | **NR Band** | **Uplink (UL) operating band** | | | **Downlink (DL) operating band** | | | **Duplex Mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n3-n28-n38 | n3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | FDD |
| n28 | 703 MHz | – | 748 MHz | 758 MHz | – | 803 MHz | FDD |
| n38 | 2570MHz |  | 2620MHz | 2570MHz |  | 2620MHz | TDD |

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

Table 5.26.1.2-1: Supported bandwidths per CA band combination of band n3+n28+n38

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NR CA configuration | Uplink CA configuration or single uplink carrier | NR Band | Channel bandwidth (MHz) | Bandwidth combination set |
| CA\_n3A-n28A-n38A | - | n3 | 5, 10, 15, 20, 30, 40, 50 | 0 |
|  |  | n28 | 5, 10, 15, 20 |  |
|  |  | n38 | 5, 10, 15, 20, 30, 40 |  |

#### 5.26.1.3 ∆TIB,c and ∆RIB,c values

For CA\_n3-n28-n38, the ΔTIB,c and ΔRIB,c values are reused from CA\_n3-n7-n28 and are given in the tables below.

Table 5.26.1.3-1: ΔTIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔTIB,c for NR bands (dB)8** | | |
| **Component band in order of bands in configuration9** | | |
| CA\_n3-n28-n38 | 0.5 | 0.5 | 0.3 |
| NOTE 8: “-” denotes ΔTIB,c = 0.  NOTE 9: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n5 the band order from left to right is n1, n3 and n5. | | | |

Table 5.26.1.3-2: ΔRIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔRIB,c for NR bands (dB)9** | | |
| **Component band in order of bands in configuration10** | | |
| CA\_n3-n28-n38 | - | - | - |
| NOTE 9: “-” denotes ΔRIB,c = 0.  NOTE 10: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n8 the band order from left to right is n1, n3 and n8. | | | |

## 5.27 CA\_n7-n28-n38

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

#### 5.27.1.1 Operating bands for CA

Table 5.27.1.1-1: Inter-band CA operating bands involving FR1 (three bands)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band** | **NR Band** | **Uplink (UL) operating band** | | | **Downlink (DL) operating band** | | | **Duplex Mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n7-n28-n38 | n7 | 2500 MHz | – | 2570 MHz | 2620 MHz | – | 2690 MHz | FDD |
| n28 | 703 MHz | – | 748 MHz | 758 MHz | – | 803 MHz | FDD |
| n38 | 2570MHz |  | 2620MHz | 2570MHz |  | 2620MHz | TDD |

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

Table 5.27.1.2-1: Supported bandwidths per CA band combination of band n7+n28+n38

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NR CA configuration | Uplink CA configuration or single uplink carrier | NR Band | Channel bandwidth (MHz) | Bandwidth combination set |
| CA\_n7A-n28A-n38Ax | n28 | n7 | 5, 10, 15, 20, 30, 40, 50 | 0 |
|  |  | n28 | 5, 10, 15, 20 |  |
|  |  | n38 | 5, 10, 15, 20, 30, 40 |  |
| NOTE x: UL carrier shall be supported in Band n28 only. Power imbalance between downlink carriers on Band 7 and Band 38 is assumed to be within 6dB. | | | | |

#### 5.27.1.3 ∆TIB,c and ∆RIB,c values

For CA\_n7-n28-n38, the ΔTIB,c and ΔRIB,c values are reused from CA\_n7-n28 and are given in the tables below.

Table 5.27.1.3-1: ΔTIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔTIB,c for NR bands (dB)8** | | |
| **Component band in order of bands in configuration9** | | |
| CA\_n7-n28-n38 | 0.3 | 0.3 | 0.3 |
| NOTE 8: “-” denotes ΔTIB,c = 0.  NOTE 9: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n5 the band order from left to right is n1, n3 and n5. | | | |

Table 5.27.1.3-2: ΔRIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔRIB,c for NR bands (dB)9** | | |
| **Component band in order of bands in configuration10** | | |
| CA\_n7-n28-n38 | - | - | - |
| NOTE 9: “-” denotes ΔRIB,c = 0.  NOTE 10: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n8 the band order from left to right is n1, n3 and n8. | | | |

## 5.28 CA\_n39-n41-n79

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

#### 5.28.1.1 Operating bands for CA

Table 5.28.1.1-1: Inter-band CA operating bands involving FR1 (three bands)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 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 | | |
| n39 | 1880 MHz | – | 1920 MHz | 1880 MHz | – | 1920 MHz | TDD |
| n41 | 2496 MHz | – | 2690 MHz | 2496 MHz | – | 2690 MHz | TDD |
| n79 | 4400 MHz | – | 5000 MHz | 4400 MHz | – | 5000 MHz | TDD |

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

Table 5.28.1.2-1: Supported bandwidths per CA band combination of band n39+n41+n79

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NR CA configuration | Uplink CA configuration or single uplink carrier | NR Band | Channel bandwidth (MHz) | Bandwidth combination set |
| CA\_n39A-n41A-n79A | CA\_n39A-n41A  CA\_n39A-n79A  CA\_n41A-n79A | n39 | 5, 10, 15, 20, 25, 30, 40 | 0 |
|  |  | n41 | 10, 15, 20, 40, 50, 60, 80, 90, 100 |  |
|  |  | n79 | 40, 50, 60, 80, 100 |  |
|  |  | n39 | 5, 10, 15, 20, 25, 30, 40 | 1 |
|  |  | n41 | 10, 15, 20, 40, 50, 60 |  |
|  |  | n79 | 40, 50, 60, 80, 100 |  |

#### 5.28.1.3 ∆TIB,c and ∆RIB,c values

For CA\_n39A-n41A-n79, the ΔTIB,c and ΔRIB,c values have already been included in the TS38.101-1.

### 5.28.2 Specific for 2 bands UL CA

#### 5.28.2.1 UE co-existence studies

Due to synchronization between band n39 and n41, so there are no IMD issues for n41caused by n39-n79, or n39 caused by n41-n79.

However, asynchronization between band n39 and n79 or n41 and n79, in terms of the co-existence studies of CA\_n39-n41, it can be observed:

IMD2 caused by 2UL n39+n41 may fall into the its own band n79 Rx (4376MHz~4610MHz)

#### 5.28.2.2 REFSENS requirements

In terms of the co-existence studies, the impacted n79 Rx frequency range is from 4376MHz~4610MHz caused by 2UL n39 and n41. However, in China, the n79 frequency range is restricted to 4800-5000MHz. Therefore, considering this frequency range, n79 will not be impacted by IMD2 caused by 2UL n39 and n41. In the other words, there is no need to define the IMD2 MSD for CA n39A-n41A-n79. The MSD requirement are defined in table 5.28.2.2-1:

Table 5.28.2.2-1: 3DL/2UL interband Reference sensitivity QPSK PREFSENS and uplink/downlink configurations

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Band / Channel bandwidth / NRB / Duplex mode | | | | | | | | Source of IMD |
| NR CA band combination | NR band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  CLRB | DL Fc (MHz) | MSD  (dB) | Duplex mode |  |
| CA\_n39-n41-n79 | n39 | N/A | N/A | N/A | N/A | N/A | TDD | N/A |
|  | n41 | N/A | N/A | N/A | N/A | N/A | TDD | N/A |
|  | n79 | N/A | N/A | N/A | N/A | N/A | TDD | IMD2x |
| NOTE x: There is no IMD2 product in band n79 downlink for n79 operating in 4800 – 5000 MHz frequency range. | | | | | | | | |

## 5.29 CA\_n1-n3-n40

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

#### 5.29.1.1 Operating bands for CA

Table 5.29.1.1-1: Inter-band CA operating bands involving FR1 (three bands)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band** | **NR Band** | **Uplink (UL) operating band** | | | **Downlink (DL) operating band** | | | **Duplex Mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n1-n3-n40 | n1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | FDD |
| n3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | FDD |
| n40 | 2300 MHz | – | 2400 MHz | 2300 MHz | – | 2400 MHz | TDD |

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

Table 5.29.1.2-1: Supported bandwidths per CA band combination of band n1+n3+n40

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NR CA configuration | Uplink CA configuration or single uplink carrier | NR Band | Channel bandwidth (MHz) | Bandwidth combination set |
| CA\_n1A-n3A-n40A | CA\_n1A-n3A  CA\_n1A-n40A  CA\_n3A-n40A | n1 | 5, 10, 15, 20, 30, 40, 45, 50 | 0 |
|  |  | n3 | 5, 10, 15, 20, 30, 35, 40, 45, 50 |  |
|  |  | n40 | 10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100 |  |

#### 5.29.1.3 ∆TIB,c and ∆RIB,c values

For CA\_n1-n3-n40, the ΔTIB,c and ΔRIB,c values are reused from DC\_1-3\_n40 and are given in the tables below.

Table 5.29.1.3-1: ΔTIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔTIB,c for NR bands (dB)8** | | |
| **Component band in order of bands in configuration9** | | |
| CA\_n1-n3-n40 | 0.5 | 0.5 | 0.5 |
| NOTE 8: “-” denotes ΔTIB,c = 0.  NOTE 9: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n5 the band order from left to right is n1, n3 and n5. | | | |

Table 5.29.1.3-2: ΔRIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔRIB,c for NR bands (dB)9** | | |
| **Component band in order of bands in configuration10** | | |
| CA\_n1-n3-n40 | - | - | - |
| NOTE 9: “-” denotes ΔRIB,c = 0.  NOTE 10: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n8 the band order from left to right is n1, n3 and n8. | | | |

### 5.29.2 Specific for 2 bands UL CA

#### 5.29.2.1 UE co-existence studies

UL n1-n3 gives IMD5 into DL n40.

UL n1-n40 does not affect DL n3.

UL n3-n40 does not affect DL n1.

#### 5.29.2.2 REFSENS requirements

Based on the co-existence studies there is a need to define MSD values. MSD value from CA\_1-3-40 is reused.

Table 5.29.2.2-1: 3DL/2UL inter-band Reference sensitivity QPSK PREFSENS and uplink/downlink configurations

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Band / Channel bandwidth / NRB / Duplex mode | | | | | | | | Source of IMD |
| NR CA band combination | NR band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  CLRB | DL Fc (MHz) | MSD  (dB) | Duplex mode |  |
| CA\_n1-n3-n40 | n1 | 1950 | 5 | 25 | 2140 | N/A | FDD | N/A |
|  | n3 | 1735 | 5 | 25 | 1830 | N/A | FDD | N/A |
|  | n40 | 2380 | 5 | 25 | 2380 | 8.0 | TDD | IMD5 |

## 5.30 CA\_n1-n40-n77

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

#### 5.30.1.1 Operating bands for CA

Table 5.30.1.1-1: Inter-band CA operating bands involving FR1 (three bands)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band** | **NR Band** | **Uplink (UL) operating band** | | | **Downlink (DL) operating band** | | | **Duplex Mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n1-n40-n77 | n1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | FDD |
| n40 | 2300 MHz | – | 2400 MHz | 2300 MHz | – | 2400 MHz | TDD |
| n77 | 3300 MHz | – | 4200 MHz | 3300 MHz | – | 4200 MHz | TDD |

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

Table 5.30.1.2-1: Supported bandwidths per CA band combination of band n1+n40+n77

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NR CA configuration | Uplink CA configuration or single uplink carrier | NR Band | Channel bandwidth (MHz) | Bandwidth combination set |
| CA\_n1A-n40A-n77A | CA\_n1A-n40A  CA\_n1A-n77A  CA\_n40A-n77A | n1 | 5, 10, 15, 20, 30, 40, 45, 50 | 0 |
|  |  | n40 | 10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100 |  |
|  |  | n77 | 10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100 |  |
| CA\_n1A-n40A-n77(2A) | CA\_n1A-n40A  CA\_n1A-n77A  CA\_n40A-n77A | n1 | 5, 10, 15, 20, 30, 40, 45, 50 | 0 |
|  |  | n40 | 10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100 |  |
|  |  | n77 | CA\_n77(2A)\_BCS1 |  |

#### 5.30.1.3 ∆TIB,c and ∆RIB,c values

For CA\_n1-n40-n77, the ΔTIB,c and ΔRIB,c values are reused from CA\_n1-n40-n78 and are given in the tables below.

Table 5.x.1.3-1: ΔTIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔTIB,c for NR bands (dB)8** | | |
| **Component band in order of bands in configuration9** | | |
| CA\_n1-n40-n77 | 0.3 | 0.5 | 0.8 |
| NOTE 8: “-” denotes ΔTIB,c = 0.  NOTE 9: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n5 the band order from left to right is n1, n3 and n5. | | | |

Table 5.x.1.3-2: ΔRIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔRIB,c for NR bands (dB)9** | | |
| **Component band in order of bands in configuration10** | | |
| CA\_n1-n40-n77 | - | - | 0.5 |
| NOTE 9: “-” denotes ΔRIB,c = 0.  NOTE 10: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n8 the band order from left to right is n1, n3 and n8. | | | |

### 5.30.2 Specific for 2 bands UL CA

#### 5.30.2.1 UE co-existence studies

UL n1-n40 gives IMD4 and IMD5 into DL n77.

UL n1-n77 gives IMD4 and IMD5 into DL n40.

UL n40-n77 gives IMD4 into DL n1.

#### 5.30.2.2 REFSENS requirements

Based on the co-existence studies there are a need to define MSD values. MSD values from CA\_n1-n40-n78 are reused.

Table 5.30.2.2-1: 3DL/2UL inter-band Reference sensitivity QPSK PREFSENS and uplink/downlink configurations

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Band / Channel bandwidth / NRB / Duplex mode | | | | | | | | Source of IMD |
| NR CA band combination | NR band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  CLRB | DL Fc (MHz) | MSD  (dB) | Duplex mode |  |
| CA\_n1-n40-n77 | n1 | 1930 | 5 | 25 | 2120 | N/A | FDD | N/A |
|  | n40 | 2310 | 5 | 25 | 2310 | N/A | TDD | N/A |
|  | n77 | 3480 | 10 | 50 | 3480 | 9.8 | TDD | IMD41 |
|  | n1 | 1930 | 5 | 25 | 2120 | N/A | FDD | N/A |
|  | n40 | 2340 | 5 | 25 | 2340 | 10.6 | TDD | IMD41 |
|  | n77 | 3450 | 10 | 50 | 3450 | N/A | TDD | N/A |
|  | n1 | 1950 | 5 | 25 | 2140 | 9.1 | FDD | IMD4 |
|  | n40 | 2380 | 5 | 25 | 2380 | N/A | TDD | N/A |
|  | n77 | 3450 | 10 | 50 | 3450 | N/A | TDD | N/A |
| NOTE 1: This band is subject to IMD5 also which MSD is not specified. | | | | | | | | |

## 5.31 CA\_n3-n40-n77

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

#### 5.31.1.1 Operating bands for CA

Table 5.31.1.1-1: Inter-band CA operating bands involving FR1 (three bands)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band** | **NR Band** | **Uplink (UL) operating band** | | | **Downlink (DL) operating band** | | | **Duplex Mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n3-n40-n77 | n3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | FDD |
| n40 | 2300 MHz | – | 2400 MHz | 2300 MHz | – | 2400 MHz | TDD |
| n77 | 3300 MHz | – | 4200 MHz | 3300 MHz | – | 4200 MHz | TDD |

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

Table 5.31.1.2-1: Supported bandwidths per CA band combination of band n3+n40+n77

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NR CA configuration | Uplink CA configuration or single uplink carrier | NR Band | Channel bandwidth (MHz) | Bandwidth combination set |
| CA\_n3A-n40A-n77A | CA\_n3A-n40A  CA\_n3A-n77A  CA\_n40A-n77A | n3 | 5, 10, 15, 20, 30, 35, 40, 45, 50 | 0 |
|  |  | n40 | 10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100 |  |
|  |  | n77 | 10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100 |  |
| CA\_n3A-n40A-n77(2A) | CA\_n3A-n40A  CA\_n3A-n77A  CA\_n40A-n77A | n3 | 5, 10, 15, 20, 30, 35, 40, 45, 50 | 0 |
|  |  | n40 | 10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100 |  |
|  |  | n77 | CA\_n77(2A)\_BCS1 |  |

#### 5.31.1.3 ∆TIB,c and ∆RIB,c values

For CA\_n3-n40-n77, the ΔTIB,c and ΔRIB,c values are reused from DC\_3\_n40-n78 and are given in the tables below.

Table 5.31.1.3-1: ΔTIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔTIB,c for NR bands (dB)8** | | |
| **Component band in order of bands in configuration9** | | |
| CA\_n3-n40-n77 | 0.6 | 0.5 | 0.8 |
| NOTE 8: “-” denotes ΔTIB,c = 0.  NOTE 9: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n5 the band order from left to right is n1, n3 and n5. | | | |

Table 5.31.1.3-2: ΔRIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔRIB,c for NR bands (dB)9** | | |
| **Component band in order of bands in configuration10** | | |
| CA\_n3-n40-n77 | - | - | - |
| NOTE 9: “-” denotes ΔRIB,c = 0.  NOTE 10: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n8 the band order from left to right is n1, n3 and n8. | | | |

### 5.31.2 Specific for 2 bands UL CA

#### 5.31.2.1 UE co-existence studies

UL n3-n40 gives IMD2 and IMD5 into DL n77.

UL n3-n77 gives IMD2 and IMD5 into DL n40.

UL n40-n77 gives IMD2 and IMD4 into DL n3.

#### 5.31.2.2 REFSENS requirements

Based on the co-existence studies there are a need to define MSD values. MSD values from CA\_n1-n41-n79 are reused.

Table 5.31.2.2-1: 3DL/2UL inter-band Reference sensitivity QPSK PREFSENS and uplink/downlink configurations

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Band / Channel bandwidth / NRB / Duplex mode | | | | | | | | Source of IMD |
| NR CA band combination | NR band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  CLRB | DL Fc (MHz) | MSD  (dB) | Duplex mode |  |
| CA\_n3-n40-n77 | n3 | 1730 | 5 | 25 | 1825 | N/A | FDD | N/A |
|  | n40 | 2320 | 5 | 25 | 2320 | N/A | TDD | N/A |
|  | n77 | 4050 | 10 | 50 | 4050 | 19.0 | TDD | IMD21 |
|  | n3 | 1720 | 5 | 25 | 1815 | N/A | FDD | N/A |
|  | n40 | 2310 | 5 | 25 | 2310 | 29.4 | TDD | IMD21 |
|  | n77 | 4030 | 10 | 50 | 4030 | N/A | TDD | N/A |
|  | n3 | 1725 | 5 | 25 | 1820 | 29.9 | FDD | IMD22 |
|  | n40 | 2310 | 5 | 25 | 2310 | N/A | TDD | N/A |
|  | n77 | 4130 | 10 | 50 | 4130 | N/A | TDD | N/A |
| NOTE 1: This band is subject to IMD5 also which MSD is not specified.  NOTE 2: This band is subject to IMD4 also which MSD is not specified. | | | | | | | | |

## 5.32 CA\_n28-n40-n77

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

#### 5.32.1.1 Operating bands for CA

Table 5.32.1.1-1: Inter-band CA operating bands involving FR1 (three bands)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band** | **NR Band** | **Uplink (UL) operating band** | | | **Downlink (DL) operating band** | | | **Duplex Mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n28-n40-n77 | n28 | 703 MHz | – | 748 MHz | 758 MHz | – | 803 MHz | FDD |
| n40 | 2300 MHz | – | 2400 MHz | 2300 MHz | – | 2400 MHz | TDD |
| n77 | 3300 MHz | – | 4200 MHz | 3300 MHz | – | 4200 MHz | TDD |

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

Table 5.32.1.2-1: Supported bandwidths per CA band combination of band n28+n40+n77

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NR CA configuration | Uplink CA configuration or single uplink carrier | NR Band | Channel bandwidth (MHz) | Bandwidth combination set |
| CA\_n28A-n40A-n77A | CA\_n28A-n40A  CA\_n28A-n77A  CA\_n40A-n77A | n28 | 5, 10, 15, 20, 25, 30 | 0 |
|  |  | n40 | 10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100 |  |
|  |  | n77 | 10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100 |  |
| CA\_n28A-n40A-n77(2A) | CA\_n28A-n40A  CA\_n28A-n77A  CA\_n40A-n77A | n28 | 5, 10, 15, 20, 25, 30 | 0 |
|  |  | n40 | 10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100 |  |
|  |  | n77 | CA\_n77(2A)\_BCS1 |  |

#### 5.32.1.3 ∆TIB,c and ∆RIB,c values

For CA\_n28-n40-n77, the ΔTIB,c and ΔRIB,c values are reused from CA\_n28-n40-n78 and are given in the tables below.

Table 5.32.1.3-1: ΔTIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔTIB,c for NR bands (dB)8** | | |
| **Component band in order of bands in configuration9** | | |
| CA\_n28-n40-n77 | 0.5 | 0.3 | 0.8 |
| NOTE 8: “-” denotes ΔTIB,c = 0.  NOTE 9: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n5 the band order from left to right is n1, n3 and n5. | | | |

Table 5.32.1.3-2: ΔRIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔRIB,c for NR bands (dB)9** | | |
| **Component band in order of bands in configuration10** | | |
| CA\_n28-n40-n77 | - | - | 0.5 |
| NOTE 9: “-” denotes ΔRIB,c = 0.  NOTE 10: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n8 the band order from left to right is n1, n3 and n8. | | | |

### 5.32.2 Specific for 2 bands UL CA

#### 5.32.2.1 UE co-existence studies

UL n28-n40 gives IMD3 and IMD4 into DL n77.

UL n28-n77 gives IMD3 into DL n40.

UL n40-n77 gives IMD3 and IMD5 into DL n28.

#### 5.32.2.2 REFSENS requirements

Based on the co-existence studies there are a need to define MSD values. MSD values from CA\_n28-n40-n78 are reused.

Table 5.32.2.2-1: 3DL/2UL inter-band Reference sensitivity QPSK PREFSENS and uplink/downlink configurations

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Band / Channel bandwidth / NRB / Duplex mode | | | | | | | | Source of IMD |
| NR CA band combination | NR band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  CLRB | DL Fc (MHz) | MSD  (dB) | Duplex mode |  |
| CA\_n28-n40-n77 | n28 | 745.5 | 5 | 25 | 800.5 | 11 | FDD | IMD31 |
|  | n40 | 2302.5 | 5 | 25 | 2302.5 | N/A | TDD | N/A |
|  | n77 | 3795 | 10 | 50 | 3795 | N/A | TDD | N/A |
|  | n28 | 708 | 5 | 25 | 2120 | N/A | FDD | N/A |
|  | n40 | 2310 | 5 | 25 | 2310 | N/A | TDD | N/A |
|  | n77 | 3736 | 10 | 50 | 3736 | 16.0 | TDD | IMD32 |
|  | n28 | 708 | 5 | 25 | 763 | N/A | FDD | N/A |
|  | n40 | 2134 | 5 | 25 | 2134 | 15.7 | TDD | IMD3 |
|  | n77 | 3550 | 10 | 50 | 3550 | N/A | TDD | N/A |
| NOTE 1: This band is subject to IMD5 also which MSD is not specified.  NOTE 2: This band is subject to IMD4 also which MSD is not specified. | | | | | | | | |

## 5.33 CA\_n1-n3-n8

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

#### 5.33.1.1 Operating bands for CA

Table 5.33.1.1-1: Inter-band CA operating bands involving FR1 (three bands)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 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 | | |
| n1 | 1920 MHz | – | 1980MHz | 2110 MHz | – | 2170 MHz | FDD |
| n3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | FDD |
| n8 | 880 MHz | – | 915 MHz | 925 MHz | – | 960 MHz | FDD |

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

Table 5.33.1.2-1: Supported bandwidths per CA band combination of band nX+nY+nZ

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NR CA configuration | Uplink CA configuration or single uplink carrier | NR Band | Channel bandwidth (MHz) | Bandwidth combination set |
| CA\_n1A-n3A-n8A | **CA\_n1A-n3A**  **CA\_n1A-n8A**  **CA\_n3A-n8A** | n1 | 5, 10, 15, 20 | 0 |
|  |  | n3 | 5, 10, 15, 20, 25, 30 |  |
|  |  | n8 | 5, 10, 15, 20 |  |

#### 5.33.1.3 ∆TIB,c and ∆RIB,c values

Note that CA\_n1A-n3A-n8A 1UL/3DL CA had been introduced in Rel.17 38.101-1, related sections for 1UL/3DL CA can be found in TR 38.717-03-01 section 6.103.

### 5.33.2 Specific for 2 bands UL CA

#### 5.33.2.1 UE co-existence studies

Since the UE co-existence tables have already been provided in 2DL/2UL fallback combinations, CA\_n1-n3, CA\_n1-n8, CA\_n3-n8, which are studied in section 6.43, 6.38, 6.19 of TR 38.716-02-00, here we list the own Rx impact on the 3rd band below.

- No IMD generated by dual uplink of Band n1 + Band n3 will fall into own Rx of Band n8.

- No IMD generated by dual uplink of Band n1 + Band n8 will fall into own Rx of Band n3.

- No IMD generated by dual uplink of Band n3 + Band n8 will fall into own Rx of Band n1.

#### 5.33.2.2 REFSENS requirements

No additional MSD requirement for IMD is expected.

## 5.34 CA\_n3-n67-n78

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

#### 5.34.1.1 Operating bands for CA

Table 5.34.1.1-1: Inter-band CA operating bands involving FR1 (three bands)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band** | **NR Band** | **Uplink (UL) operating band** | | | **Downlink (DL) operating band** | | | **Duplex Mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n3-n67-n78 | n3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | FDD |
| n67 |  | N/A |  | 783 MHz | – | 758 MHz | SDL |
| n78 | 3300 MHz | – | 3800 MHz | 3300 MHz | – | 3800 MHz | TDD |

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

Table 5.34.1.2-1: Supported bandwidths per CA band combination of band n3-n67-n78

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NR CA configuration | Uplink CA configuration or single uplink carrier | NR Band | Channel bandwidth (MHz) | Bandwidth combination set |
| CA\_n3A-n67A-n78A | CA\_n3A-n78A | n3 | 5, 10, 15, 20, 25, 30, 40 | 0 |
|  |  | n67 | 5, 10, 15, 20 |  |
|  |  | n78 | 10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100 |  |
| CA\_n3A-n67A-n78(2A) | CA\_n78(2A)  CA\_n3A-n78A | n3 | 5, 10, 15, 20, 25, 30, 40 | 0 |
|  |  | n67 | 5, 10, 15, 20 |  |
|  |  | n78 | CA\_n78(2A)\_BCS2 |  |

#### 5.34.1.3 ∆TIB,c and ∆RIB,c values

For CA\_n3-n67-n78, the ΔTIB,c and ΔRIB,c values are reused from CA\_n3-n28-n78 and are given in the tables below.

Table 5.34.1.3-1: ΔTIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔTIB,c for NR bands (dB)8** | | |
| **Component band in order of bands in configuration9** | | |
| CA\_n3-n67-n78 | 0.5 | - | 0.8 |
| NOTE 8: “-” denotes ΔTIB,c = 0.  NOTE 9: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n5 the band order from left to right is n1, n3 and n5. | | | |

Table 5.34.1.3-2: ΔRIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔRIB,c for NR bands (dB)9** | | |
| **Component band in order of bands in configuration10** | | |
| CA\_n3-n67-n78 | - | 0.2 | 0.5 |
| NOTE 9: “-” denotes ΔRIB,c = 0.  NOTE 10: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n8 the band order from left to right is n1, n3 and n8. | | | |

### 5.34.2 Specific for 2 bands UL CA

#### 5.34.2.1 UE co-existence studies

Table 5.x.2.1-1 lists up to 7th order IMD from UL CA\_n78(2A) UE-to-UE coexistence analysis

**Table 5.34.2.1-1: CA\_n78(2A) IMD products**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| CC location | fU1L | fU2L | fU3L | fU1H | fU2H | fU3H |
| Frequency | 3300 | 3320 | 3780 | 3800 | 3780 | 3320 |
| 2nd | I fU1L-fU2L I | I fU1L-fU3L I | fU1L + fU2L | fU1H+fU2H |  |  |
| Ranges | 20 | 480 | 6620 | 7580 |  |  |
| 3rd | 2\*fU1L-fU3L | 2\*fU1H-fU3H | 2\*fU1L + fU2L | 2\*fU1H + fU2H |  |  |
| Ranges | 2820 | 4280 | 9920 | 11380 |  |  |
| 4th | I 2\*fU1L - 2\*fU2L I | I 2\*fU1H - 2\*fU3H I | 3\*fU1L - fU3L | 3\*fU1H - fU3H | 3\*fU1L + fU2L | 3\*fU1H + fU2H |
| Ranges | 40 | 960 | 6120 | 8080 | 13220 | 15180 |
| 5th | I 3\*fUL1-2\*fU3L I | I 3\*fUH1-2\*fU3H I | 4\*fUL1-fU3L | 4\*fUH1-fU3H | 4\*fUL1+fU2L | 4\*fUH1+fU2H |
| Ranges | 2340 | 4760 | 9420 | 11880 | 16520 | 18980 |
| 6th | I 3\*fUL1-3\*fU2L I | I 3\*fUH1-3\*fU3H I | 4\*fUL1-2\*fU3L | 4\*fUH1-2\*fU3H | 5\*fUL1-fU3L | 5\*fUH1-fU3H |
| Ranges | 60 | 1440 | 5640 | 8560 | 12720 | 15680 |
| 7th | I 4\*fUL1-3\*fU3L I | I 4\*fUH1-3\*fU3H I | 5\*fUL1-2\*fU3L | 5\*fUH1-2\*fU3H | 6\*fUL1-fU3L | 6\*fUH1-fU3H |
| Ranges | 1860 | 5240 | 8940 | 12360 | 16020 | 19480 |

As can be seen in the co-existence analysis above there are IMD4 and IMD6 products from CA\_n78(2A) affecting band n67 DL and IMD7 product from CA\_n78(2A) affecting band n3 DL.

#### 5.34.2.2 REFSENS requirements

The MSD value due to IMD4 and 6 is defined in CA\_n67-n78(2A)

Table 5.x.2.2-1 lists the MSD required due to IMD7 for the dual uplink configuration.

**Table 5.34.2.2-1: MSD due to IMD issue**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Operating band / Channel bandwidth / NRB / Duplex mode | | | | | | | | Source of IMD |
| NR CA band combination | NR band | UL Fc (MHz) | UL/DL BW  (MHz) | UL  CLRB | DL Fc (MHz) | MSD  (dB) | Duplex mode |
| CA\_n3-n67-n78 | n3 | N/A | 5 | 25 | 1877.5 | 2.2 | FDD | IMD7 |
|  | n67 | N/A | 5 | N/A | N/A | N/A | SDL | N/A |
| n7812 | 3305 | 10 | 1 RBSTART=25 | 3305 | N/A | TDD | N/A |
|  |  | 3780 | 10 | 1 RBSTART=25 | 3780 |  |  |  |
| NOTE 12: This band supports intra-band non-contiguous uplink configuration | | | | | | | | |

## 5.35 CA\_n3-n20-n28

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

#### 5.35.1.1 Operating bands for CA

Table 5.35.1.1-1: Inter-band CA operating bands involving FR1 (three bands)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band** | **NR Band** | **Uplink (UL) operating band** | | | **Downlink (DL) operating band** | | | **Duplex Mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n3-n20-n28 | n3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | FDD |
| n20 | 832 MHz | – | 862 MHz | 791 MHz | – | 821 MHz | FDD |
| n281 | 703 MHz | – | 748 MHz | 758 MHz | – | 803 MHz | FDD |
| NOTE1: For this band combination the band n28 spectrum is restricted to the lower 30 MHz of the band | | | | | | | | |

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

Table 5.35.1.2-1: Supported bandwidths per CA band combination of band n3-n20-n28

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NR CA configuration | Uplink CA configuration or single uplink carrier | NR Band | Channel bandwidth (MHz) | Bandwidth combination set |
| CA\_n3A-n20A-n28A | CA\_n3A-n20A  CA\_n3A-n28A  CA\_n20A-n28A | n3 | 5, 10, 15, 20, 25, 30, 40 | 0 |
|  |  | n20 | 5, 10, 15, 20 |  |
|  |  | n28 | 5, 10, 15, 20, 30 |  |

#### 5.35.1.3 ∆TIB,c and ∆RIB,c values

For CA\_n3-n20-n28, the ΔTIB,c and ΔRIB,c values are reused from DC\_3-20\_n28 and are given in the tables below.

Table 5.35.1.3-1: ΔTIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔTIB,c for NR bands (dB)8** | | |
| **Component band in order of bands in configuration9** | | |
| CA\_n3-n20-n28 | 0.3 | 0.5 | 0.5 |
| NOTE 8: “-” denotes ΔTIB,c = 0.  NOTE 9: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n5 the band order from left to right is n1, n3 and n5. | | | |

Table 5.35.1.3-2: ΔRIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔRIB,c for NR bands (dB)9** | | |
| **Component band in order of bands in configuration10** | | |
| CA\_n3-n20-n28 | - | 0.1 | 0.1 |
| NOTE 9: “-” denotes ΔRIB,c = 0.  NOTE 10: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n8 the band order from left to right is n1, n3 and n8. | | | |

### 5.35.2 Specific for 2 bands UL CA

#### 5.35.2.1 UE co-existence studies

UL n3-n20 gives IMD4 into DL n28.

UL n20-n28 gives IMD4 into DL n3.

#### 5.35.2.2 REFSENS requirements

Based on the co-existence studies there is a need to define MSD values. MSD value of n3 from DC\_3-20-n28 is reused. MSD value of n28 from CA\_n3-n20-n67 is reused.

Table 5.35.2.2-1: 3DL/2UL inter-band Reference sensitivity QPSK PREFSENS and uplink/downlink configurations

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Band / Channel bandwidth / NRB / Duplex mode | | | | | | | | Source of IMD |
| NR CA band combination | NR band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  CLRB | DL Fc (MHz) | MSD  (dB) | Duplex mode |  |
| CA\_n3-n20-n28 | n3 | 1733 | 5 | 25 | 1828 | 9.4 | FDD | IMD4 |
|  | n20 | 852 | 5 | 25 | 811 | N/A | FDD | N/A |
|  | n28 | 728 | 5 | 25 | 783 | N/A | FDD | N/A |
|  | n3 | 1748 | 5 | 25 | 1843 | N/A | FDD | N/A |
|  | n20 | 847 | 5 | 25 | 806 | N/A | FDD | N/A |
|  | n28 | 738 | 5 | 25 | 793 | 9.4 | FDD | IMD4 |

## 5.36 CA\_n3-n7-n79

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

#### 5.36.1.1 Operating bands for CA

**Table 5.36.1.1-1: 3DL Inter-band CA operating bands**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band** | **NR Band** | **Uplink (UL) operating band** | | | **Downlink (DL) operating band** | | | **Duplex Mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n3-n7-n79 | n3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | FDD |
| n7 | 2500 MHz | – | 2570 MHz | 2620 MHz | – | 2690 MHz | FDD |
| n79 | 4400 MHz | – | 5000 MHz | 4400 MHz | – | 5000 MHz | TDD |

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

**Table 5.X.1.2-1: Supported channel bandwidths**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **NR CA configuration** | **Uplink CA configuration**  **or single uplink carrier6** | **NR Band** | **Channel bandwidth (MHz) (NOTE 3)** | **Bandwidth combination set** |
| CA\_n3A-n7A-n79A | - | n3 | 5. 10, 15, 20, 25, 30, 40 | 0 |
|  |  | n7 | 5. 10, 15, 20, 25, 30, 40, 50 |  |
|  |  | n79 | 40, 50, 60, 70, 80, 90, 100 |  |

#### 5.36.1.3 ∆TIB,c and ∆RIB,c values

For CA\_n3-n7-n79, the ΔTIB,c and ΔRIB,c values are given in the tables below.

Table 5.36.1.3-1: ΔTIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔTIB,c for NR bands (dB)\*** | | |
| **Component band in order of bands in configuration\*\*** | | |
| CA\_n3-n7-n79 | 0.5 | 0.5 | 0.8 |
| NOTE \*: “-” denotes ΔTIB,c = 0.  NOTE \*\*: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n5 the band order from left to right is n1, n3 and n5. | | | |

Table 5.36.1.3-2: ΔRIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔRIB,c for NR bands (dB)\*** | | |
| **Component band in order of bands in configuration\*\*** | | |
| CA\_n3-n7-n79 | - | - | 0.5 |
| NOTE \*: “-” denotes ΔRIB,c = 0.  NOTE \*\*: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n8 the band order from left to right is n1, n3 and n8. | | | |

#### 5.36.1.4 MSD requirement

Since CA\_n7-n79 is a fallback combination of CA\_n3-n7-n79, and the MSD due to near-miss 2nd harmonic interference for CA\_n7-n79 can be specified as below referring to DC\_7\_n79 in TS 38.101-3.

Table 5.36.1.4-1: Reference sensitivity exceptions and uplink/downlink configurations due to UL harmonic from a PC3 aggressor NR UL band for NR DL CA FR1

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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) |
| n7 | n79 | 5 | 15 | 25 (RBstart=0) | 10 | 1.1 | NOTE 6 | UL2/DL1  near-miss |
| NOTE 6: The requirements are only applicable to channel bandwidths no larger than 20 MHz and with a carrier frequency at  MHz offset from  in the victim (higher band) with , whereandare the channel bandwidths configured in the aggressor (lower) and victim (higher) bands in MHz, respectively. | | | | | | | | |

## 5.37 CA\_n3-n7-n67

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

#### 5.37.1.1 Operating bands for CA

Table 5.37.1.1-1: Inter-band CA operating bands involving FR1 (three bands)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band** | **NR Band** | **Uplink (UL) operating band** | | | **Downlink (DL) operating band** | | | **Duplex Mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n3-n7-n67 | n3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | FDD |
| n7 | 2500 MHz | – | 2570 MHz | 12620MHz | – | 2690MHz | FDD |
| n67 |  | N/A |  | 783 MHz | – | 758 MHz | SDL |

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

Table 5.37.1.2-1: Supported bandwidths per CA band combination of band n3-n7-n67

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NR CA configuration | Uplink CA configuration or single uplink carrier | NR Band | Channel bandwidth (MHz) | Bandwidth combination set |
| CA\_n3A-n7A-n67A | CA\_n3A-n7A | n3 | 5, 10, 15, 20, 25, 30, 40 | 0 |
|  |  | n7 | 5, 10, 15, 20, 25, 30, 35, 40, 50 |  |
|  |  | n67 | 5, 10, 15, 20 |  |

#### 5.37.1.3 ∆TIB,c and ∆RIB,c values

For CA\_n3-n7-n67, the ΔTIB,c and ΔRIB,c values are reused from DC\_3\_n7-n28 and are given in the tables below.

Table 5.37.1.3-1: ΔTIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔTIB,c for NR bands (dB)8** | | |
| **Component band in order of bands in configuration9** | | |
| CA\_n3-n7-n67 | 0.5 | 0.5 | - |
| NOTE 8: “-” denotes ΔTIB,c = 0.  NOTE 9: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n5 the band order from left to right is n1, n3 and n5. | | | |

Table 5.37.1.3-2: ΔRIB,c due to NR CA (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔRIB,c for NR bands (dB)9** | | |
| **Component band in order of bands in configuration10** | | |
| CA\_n3-n7-n67 | - | - | - |
| NOTE 9: “-” denotes ΔRIB,c = 0.  NOTE 10: The component band order in the configuration should be listed by the order of NR bands, such as for CA\_n1-n3-n8 the band order from left to right is n1, n3 and n8. | | | |

### 5.37.2 Specific for 2 bands UL CA

#### 5.37.2.1 UE co-existence studies

UL n3-n7 gives IMD2 into DL n67.

#### 5.37.2.2 REFSENS requirements

Based on the co-existence studies there is a need to define MSD values. MSD value from CA\_n3-n7-n28 is reused.

Table 5.37.2.2-1: 3DL/2UL inter-band Reference sensitivity QPSK PREFSENS and uplink/downlink configurations

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Band / Channel bandwidth / NRB / Duplex mode | | | | | | | | Source of IMD |
| NR CA band combination | NR band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  CLRB | DL Fc (MHz) | MSD  (dB) | Duplex mode |  |
| CA\_n3-n7-n67 | n3 | 1770 | 5 | 25 | 1865 | N/A | FDD | N/A |
|  | n7 | 2520 | 5 | 25 | 2640 | N/A | FDD | N/A |
|  | n67 | N/A | 5 | 25 | 750 | 20 | SDL | IMD2 |

# 6 Dual Connectivity: Specific Band Combination Part

## 6.x DC\_nX-nY-nZ

Editor’s note: The texts for NR DC can only be added associated with the texts for the corresponding inter-band 2 bands UL CA above, which means pure TP to TR to included NR DC configuration is not allowed.

### 6.x.1 Configurations for DC\_nX-nY-nZ

Table 6.x.1-1: Inter-band NR DC configurations

| NR DC  configuration | Uplink NR DC  configuration |
| --- | --- |
| DC\_nXA-nYA-nZ | DC\_nXA-nYA  DC\_nXA-nZA  DC\_nYA-nZA |

## 6.1 DC\_n3-n67-n78

### 6.1.1 Configurations for DC\_n3-n67-n78

Table 6.1.1-1: Inter-band NR DC configurations

| NR DC  configuration | Uplink NR DC  configuration |
| --- | --- |
| DC\_n3A-n67A-n78A  DC\_n3A-n67A-n78(2A) | DC\_n3A-n78A |

## 6.2 DC\_n3-n7-n67

### 6.2.1 Configurations for DC\_n3-n7-n67

Table 6.2.1-1: Inter-band NR DC configurations

| NR DC  configuration | Uplink NR DC  configuration |
| --- | --- |
| DC\_n3A-n7A-n67A | DC\_n3A-n7A |

Annex <X> (informative):  
Change history

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Change history | | | | | | | |
| Date | Meeting | TDoc | CR | Rev | Cat | Subject/Comment | New version |
| 2022-08 | RAN4 #104-e | R4-2213383 |  |  |  | TR skeleton | 0.0.0 |
| 2022-08 | RAN4 #104-e | R4-2213384 |  |  |  | 1. R4-2212449, TP for TR 38.xxx-xx-xx: CA\_n1-n41-n79, SoftBank Corp., LG Electronics  2. R4-2212456, TP for TR 38.xxx-xx-xx: CA\_n41-n77-n79, SoftBank Corp., LG Electronics  3. R4-2212545, TP for TR 38.XXX-XX-XX: CA\_n3A-n28A-n40A, Samsung, KDDI  4. R4-2212725, TP for TR38.xxx-xx-xx\_3DL/2UL CA\_n3A-n8A-n41A, ZTE Corporation  5. R4-2213107, TP for TR 38.818-03-01: CA\_n1-n3-n26, Ericsson, Telstra  6. R4-2213109, TP for TR 38.818-03-01: CA\_n1-n26-n78, Ericsson, Telstra  7. R4-2213111, TP for TR 38.818-03-01: CA\_n3-n26-n78, Ericsson, Telstra  8. R4-2213108, TP for TR 38.818-03-01: CA\_n1-n7-n26, Ericsson, Telstra  9. R4-2213110, TP for TR 38.818-03-01: CA\_n3-n7-n26, Ericsson, Telstra  10. R4-2213112, TP for TR 38.818-03-01: CA\_n7-n26-n78, Ericsson, Telstra | 0.1.0 |
| 2022-10 | RAN4 #104-bis-e | R4-2216720 |  |  |  | 1. R4-2215444, TP for TR 38.718-03-01: CA\_n41-n77-n79, SoftBank Corp.  2. R4-2216627, TP for TR 38.718-03-01 on table templates and error corrections, ZTE Corporation  3. R4-2217043, TP for TR 38.718-03-01: CA\_n3-n41-n79, SoftBank Corp.  4. R4-2217045, TP for TR 38.718-03-01: CA\_n29-n70-n71, DISH Network, Samsung  5. R4-2217046, TP for TR 38.718-03-01: CA\_n48-n71-n77, DISH Network, Samsung  6. R4-2217048, TP for TR 38.718-03-01 to introduce CA\_n1-n3-n38, Huawei, HiSilicon  7. R4-2217049, TP for TR 38.718-03-01 to introduce CA\_n1A-n7A-n38A and CA\_n1(2A)-n7A-n38A, Huawei, HiSilicon  8. R4-2217050, TP for TR 38.718-03-01 to introduce CA\_n3A-n7A-n38A, CA\_n3B-n7A-n38A and CA\_n3(2A)-n7A-n38A, Huawei, HiSilicon  9. R4-2217051, TP for TR 38.718-03-01 to introduce CA\_n3-n78-n79, Huawei, HiSilicon | 0.2.0 |
| 2022-11 | RAN4 #105 | R4-2219763 |  |  |  | 1. R4-2219090, TP to TR 38.717-03-01: Addition of CA\_n5-n7-n77, Nokia, Bell, Telus  2. R4-2219091, TP to TR 38.717-03-01: Addition of CA\_n7-n71-n77, Nokia, Bell, Telus  3. R4-2220793, TP for TR 38.718-03-01: CA\_n48-n70-n77, DISH Network, Samsung  4. R4-2220794, TP for TR 38.718-03-01: CA\_n66-n70-n77, DISH Network, Samsung  5. R4-2220795, TP for TR 38.718-03-01: CA\_n70-n71-n77, DISH Network, Samsung  6. R4-2220796, TP for TR [38.718-03-01](https://www.3gpp.org/DynaReport/38718-02-01.htm): CA\_n1-n3-n38, Ericsson  7. R4-2220797, TP for TR [38.718-03-01](https://www.3gpp.org/DynaReport/38718-02-01.htm): CA\_n1-n7-n38, Ericsson  8. R4-2220799, TP for TR [38.718-03-01](https://www.3gpp.org/DynaReport/38718-02-01.htm): CA\_n3-n28-n38, Ericsson  9. R4-2220800, TP for TR [38.718-03-01](https://www.3gpp.org/DynaReport/38718-02-01.htm): CA\_n7-n28-n38, Ericsson  10. R4-2219204, TP for TR 38.718-03-01\_3DL\_2UL CA\_n39A-n41A-n79, ZTE Corporation | 0.3.0 |
| 2023-03 | RAN4#106 | R4-2302552 |  |  |  | 1. R4-2301075, TP for TR [38.718-03-01](https://www.3gpp.org/DynaReport/38718-02-01.htm" \t "_blank): CA\_n1-n3-n40, Ericsson  2. R4-2301077, TP for TR [38.718-03-01](https://www.3gpp.org/DynaReport/38718-02-01.htm" \t "_blank): CA\_n1-n40-n77, Ericsson  3. R4-2301078, TP for TR [38.718-03-01](https://www.3gpp.org/DynaReport/38718-02-01.htm" \t "_blank): CA\_n3-n40-n77, Ericsson  4. R4-2301079, TP for TR [38.718-03-01](https://www.3gpp.org/DynaReport/38718-02-01.htm" \t "_blank): CA\_n28-n40-n77, Ericsson  5. R4-2302499, TP for TR 38.718-03-01: support of CA\_n1-n3-n8 2UL/3DL, CHTTL  6. R4-2303599, TP for TR [38.718-03-01](https://www.3gpp.org/DynaReport/38718-02-01.htm" \t "_blank): CA\_n3-n7-n67 and DC\_n3-n7-n67, Ericsson, BT  7. R4-2303600, TP for TR [38.718-03-01](https://www.3gpp.org/DynaReport/38718-02-01.htm" \t "_blank) to include CA\_n3-n67-n78 and DC\_n3-n67-n78, Ericsson, BT  8. R4-2303601, TP for TR [38.718-03-01](https://www.3gpp.org/DynaReport/38718-02-01.htm" \t "_blank): CA\_n3A-n20A-n28A, Ericsson, BT  9. R4-2303603, TP for TR 38.718-03-01 to introduce CA\_n3A-n7A-n79A\_BCS0, Huawei, HiSilicon | 0.4.0 |