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Technical Report

3rd Generation Partnership Project;

Technical Specification Group Radio Access Networks;

LTE Advanced inter-band Carrier Aggregation for 2B DL/1B UL

(Release 16)

** 

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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:

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x the first digit:

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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.

# 1 Scope

The present document is a technical report for 2B DL/1B UL Inter-band Carrier Aggregation under Rel-16 time frame. The purpose is to gather the relevant background information and studies in order to address 2B DL/1B UL Inter-band Carrier Aggregation requirements for the Rel-16 band combinations in Table 1-1.

Table 1-1: Release 16 2BDL/1BUL inter-band carrier aggregation combinations

|  |  |
| --- | --- |
| CA combination | REL-independent from |
| 7A-7A-46E\_BCS0 | REL-15 |
| 41A-42A-42A\_BCS0 | REL-11 |
| 41C-42A-42A\_BCS0 | REL-11 |
| 41A-42A-42C\_BCS0 | REL-11 |
| 41A-42C-42C\_BCS0 | REL-12 |
| 41C-42A-42C\_BCS0 | REL-12 |
| 41C-42C-42C\_BCS0 | REL-15 |
| 41A-42A-42C\_UL\_42C\_BCS0 | REL-12 |
| 41A-42C-42C\_UL\_42C\_BCS0 | REL-12 |
| 41C-42A-42C\_UL\_42C\_BCS0 | REL-12 |
| 41C-42C-42C\_UL\_42C\_BCS0 | REL-15 |
| 7A-7A-28A\_BSC0 | Rel-11 |
| 3C\_28A\_UL\_3C\_BCS0 | Rel-11 |
| 18A-42C\_BCS0 | REL-12 |
| 18A-42A\_BCS0 | REL-12 |
| 3A-42A-42C\_UL\_42C\_BCS0 | REL-12 |
| 3A-42C-42C\_UL\_42C\_BCS0 | REL-12 |
| 46C-48C\_UL\_48C\_BCS0 | Rel-13 |
| 46A-48C\_UL\_48C\_BCS0 | Rel-13 |
| 46A-48D\_UL\_48C\_BCS0 | REL-13 |
| 46C-48D\_UL\_48C\_BCS0 | REL-13 |
| 46A-48E\_UL\_48C\_BCS0 | REL-13 |
| 46C-48E\_UL\_48C\_BCS0 | REL-15 |
| 7A-7A-29A\_BCS0 | REL-11 |
| 7C-29A\_BCS0 | REL-11 |
| 7A-29A\_BCS0 | REL-11 |
| 28A-42A-42A\_BCS0 | REL-12 |
| 28A-42A-42C\_BCS0 | REL-12 |
| 28A-42C-42C\_BCS0 | REL-12 |
| 28A-42A-42C\_UL\_42C\_BCS0 | REL-12 |
| 28A-42C-42C\_UL\_42C\_BCS0 | REL-12 |
| 5B-46E\_BCS0 | Rel-15 |
| 5B-46D\_BCS0 | Rel-13 |
| 5B-46C\_BCS0 | Rel-13 |
| 5B-46A\_BCS0 | Rel-13 |
| 46E-66A-66A\_BCS0 | Rel-15 |
| 2A-2A-5B\_BCS0 | Rel-11 |
| 2A-5B\_BCS0 | Rel-11 |
| 3A-3A-7C\_BCS0 | Rel-12 |
| 3A-3A-7C\_UL\_7C\_BCS0 | Rel-12 |
| 25A-25A-41E\_BCS0 | REL-15 |
| 25A-41F\_BCS0 | REL-15 |
| 25A-25A-41F\_BCS0 | REL-12 |
| 7C-46E\_BCS0 | REL-15 |
| 1A-1A-3C\_UL\_3C\_BCS0 | Rel-12 |
| 1A-1A-7C\_UL\_7C\_BCS0 | Rel-12 |
| 25A-41E\_BCS0 | REL-13 |
| 28A-66A\_BCS0 | REL-11 |
| 3A-3A-5A\_BCS0 | REL-12 |
| 3A-3A-46C\_BCS0 | REL-12 |
| 7A-13A\_BCS0 | REL-11 |
| 7C-13A\_BCS0 | REL-11 |
| 7A-7A-13A\_BCS0 | REL-12 |
| 7A-7A-20A\_BCS0 | REL-12 |
| 2A-66A\_BCS0 | REL-11 |
| 26A-66A\_BCS0 | REL-11 |
| 20A-41A\_BSC0 | Rel-12 |
| 20A-41C\_BSC0 | Rel-12 |
| 20A-41D\_BCS0 | Rel-12 |
| 1A-41C\_41C | REL-12 |
| 18A-41A\_BSC0 | REL-12 |
| 18A-41C\_UL\_41C\_BSC0 | REL-12 |
| 46A-48B\_UL48B\_BSC0 | REL-13 |
| 46C-48B\_UL48B\_BSC0 | REL-13 |
| 46D-48B\_UL48B\_BSC0 | REL-13 |
| 46E-48B\_UL48B\_BSC0 | REL-15 |

This TR contains a 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] RP-181441, “New WID on Rel16 LTE inter-band CA for 2 bands DL with 1 band UL”, RAN#80.

# 3 Definitions, symbols and abbreviations

## 3.1 Definitions

For the purposes of the present document, the terms and definitions 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].

## 3.2 Symbols

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

<symbol> <Explanation>

## 3.3 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [2] 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 [2].

# 4 Background

The present document is a technical report for 2B DL/1B UL Inter-band Carrier Aggregation under Rel-16 timeframe. The document covers each band combination specific issues.

## 4.1 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.

# 5 2 Bands DL with 1 Band UL Carrier Aggregation: Specific Band Combination Part

## 5.1 CA\_7-46

### 5.1.1 Channel bandwidths per operating band for CA

Table 5.1.1-1: Inter-band CA operating bands

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| E‑UTRA Operating Band | Uplink (UL) operating band BS receive UE transmit | | | Downlink (DL) operating band BS transmit  UE receive | | | Duplex Mode |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| 7 | 2500 MHz | – | 2570 MHz | 2620 MHz | – | 2690 MHz | FDD |
| 46 | 5150 MHz | – | 5925 MHz | 5150 MHz | – | 5925 MHz | TDD |

Table 5.1.1-2: E-UTRA CA configurations and bandwidth combination sets defined for inter-band CA

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| E-UTRA CA configuration / Bandwidth combination set | | | | | | | | | | |
| E-UTRA CA Configuration | Uplink CA configurations | E-UTRA Bands | 1.4 MHz | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz | Maximum aggregated bandwidth  [MHz] | Bandwidth combination set |
| CA\_7A-7A-46E | - | 7 | See CA\_7A-7A Bandwidth combination set 1 in table 5.6A.1-3 of 36.101 | | | | | | 120 | 0 |
| 46 | See CA\_46D Bandwidth combination set 0 in table 5.6A.1-3 of 36.101 | | | | | |
| CA\_7C-46E | - | 7 | See CA\_7C Bandwidth Combination Set 2 in Table 5.6A.1-1 | | | | | | 120 | 0 |
| 46 | See CA\_46E Bandwidth Combination Set 0 in Table 5.6A.1-1 | | | | | |

### 5.1.2 Co-existence studies

The 2nd and 3rd harmonics products caused in the UE by transmitting CA\_7A-7A-46E\_BCS0 carriers are derived in the constituent 2DL and 3DL CAs.

### 5.1.3 ∆TIB,c and ∆RIB,c values

For 6DL/1UL CA\_6DL\_7A-7A-46E, the ΔTIB,c and ΔRIB,c values are shown in table 5.1.3-1 and table 5.1.3-2, respectively.

**Table 5.1.3-1: ΔTIB,c(two bands)**

| **Inter-band CA Configuration** | **E-UTRA Band** | **ΔTIB,c [dB]** |
| --- | --- | --- |
| CA\_7A-7A-46E | 7 | 0 |

**Table 5.1.3-2: ΔRIB,c (two bands)**

| **Inter-band CA Configuration** | **E-UTRA Band** | **ΔRIB,c [dB]** |
| --- | --- | --- |
| CA\_7A-7A-46E | 7 | 0 |

### 5.1.4 REFSENS

The REFSENS requirements CA\_7A-7A-46E are shown in Table 5.1.4-1 with the uplink configuration specified in Table 7.3.1-2 of TS36.101.

Table 5.1.4-1: Reference sensitivity for carrier aggregation QPSK PREFSENS, CA (CA with band 46)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Channel bandwidth | | | | | | | | |
| EUTRA CA Configuration | EUTRA band | 1.4 MHz  (dBm) | 3 MHz  (dBm) | 5 MHz  (dBm) | 10 MHz  (dBm) | 15 MHz  (dBm) | 20 MHz  (dBm) | Duplex mode |
| CA\_7A-7A-46E | 7 |  |  | -98 | -95 | -93.2 | -92 | FDD |
| 46 |  |  |  |  |  | -90 | TDD |
| CA\_7C-46E | 7 |  |  | -98 | -95 | -93.2 | -92 | FDD |
| 46 |  |  |  |  |  | -90 | TDD |

## 5.2 CA\_18-42

### 5.2.1 Channel bandwidths per operating band for CA

Table 5.2.1-1: Inter-band CA operating bands

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| E-UTRA CA Band | E-UTRA 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\_18-42 | 18 | 815 MHz | – | 830 MHz | 860 MHz | – | 875 MHz | FDD |
| 42 | 3400 MHz | – | 3600 MHz | 3400 MHz | – | 3600 MHz | TDD |

Table 5.2.1-2: E-UTRA CA configurations and bandwidth combination sets defined for inter-band CA

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| E-UTRA CA configuration / Bandwidth combination set | | | | | | | | | | |
| E-UTRA CA Configuration | Uplink CA configurations | E-UTRA Bands | 1.4 MHz | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz | Maximum aggregated bandwidth  [MHz] | Bandwidth combination set |
| CA\_18A-42A | - | 18 |  |  | Yes | Yes | Yes |  | 35 | 0 |
| 42 |  |  | Yes | Yes | Yes | Yes |
| CA\_18A-42C | - | 18 |  |  | Yes | Yes | Yes |  | 55 | 0 |
| 42 | See the CA\_42C Bandwidth combination set 0 in Table 5.6A.1-1 | | | | | |

### 5.2.2 Co-existence studies

Table 5.2.2-1 summarizes frequency ranges where harmonics occur for CA \_ 18-42.

Table 5.2.2-1: Impact of UL/DL Harmonic

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** |
| 18 | 815 | 830 | 860 | 875 | 1630 | 1660 | 2445 | 2490 | 1720 | 1750 | 2580 | 2625 | 3260 | 3320 |
| 42 | 3400 | 3600 | 3400 | 3600 | 6800 | 7200 | 10200 | 10800 | 6800 | 7200 | 10200 | 10800 | 13600 | 14400 |

Table 5.2.2-2 summarizes frequency ranges where harmonics mixing occurs for CA \_ 18-42.

**Table 5.2.2-2: Impact of UL/DL Harmonic mixing**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge |
| 18 | 815 | 830 | 860 | 875 | 1720 | 1750 | 2580 | 2625 | 3440 | 3500 |
| 42 | 3400 | 3600 | 3400 | 3600 | 6800 | 7200 | 10200 | 10800 | 13600 | 14400 |

4th Harmonic mixing of band 42 may fall down in the DL of band 18. The same 4th Harmonic mixing issue occurs in band 19 which is the adjacent band of band 18 and has the same bandwidth. Since there is no additional requirement for CA\_19-42, no requirement is needed for CA\_18-42.

### 5.2.3 ∆TIB and ∆RIB values

For CA\_18-42, the same requirements on ∆TIB and ∆RIB of CA\_19-42 case can be applied.

Table 5.2.3-1: IB,c

| Inter-band CA Configuration | E-UTRA Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_18-42 | 18 | 0.3 |
| 42 | 0.8 |

Table 5.2.3-2: R IB,c

| Inter-band CA Configuration | E-UTRA Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_18-42 | 18 | 0 |
| 42 | 0.5 |

### 5.2.4 REFSENS

As mentioned in 5.2.2, no additional requirements are needed for this configuration.

## 5.3 7-7-28

### 5.3.1 Channel bandwidths per operating band for CA

Table 5.3.1-1: Inter-band CA operating bands

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| E‑UTRA Operating Band | Uplink (UL) operating band BS receive UE transmit | | | Downlink (DL) operating band BS transmit  UE receive | | | Duplex Mode |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| 7 | 2500 MHz | – | 2570 MHz | 2620 MHz | – | 2690 MHz | FDD |
| 28 | 703 MHz | – | 748 MHz | 758 MHz | – | 803 MHz | FDD |

Table 5.3.1-2: Supported E-UTRA bandwidths per CA configuration for inter-band CA

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| E-UTRA CA configuration / Bandwidth combination set | | | | | | | | | | |
| E-UTRA CA Configuration | Uplink CA configurations | E-UTRA Bands | 1.4 MHz | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz | Maximum aggregated bandwidth  [MHz] | Bandwidth combination set |
| CA\_7A-7A-28A | - | 7 | See CA\_7A-7A Bandwidth combination set 3 in Table 5.6A.1-3 | | | | | | 60 | 0 |
| 28 |  |  |  | Yes | Yes | Yes |

### 5.3.2 Co-existence studies

Table 5.3.2-1 summarizes frequency ranges where harmonics occur due to Band 7 and Band 28 CA with 1 UL.

Table 5.3.2-1: Impact of 1 UL Harmonic Interference

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  | | **2nd Harmonic** | | **3rd Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** |
| 7 | 2500 | 2570 | 2620 | 2690 | 5000 | 5140 | 7500 | 7710 |
| 28 | 703 | 748 | 758 | 803 | 1406 | 1496 | 2109 | 2244 |

It can be seen from Table 5.3.2-1 that there is no harmonic impact towards any of its own downlink bands.

### 5.3.3 ΔTIB,c and ΔRIB,c values

CA\_7A-7A-28A has the same ΔTIB,c and ΔRIB,c  as existing combination CA\_7A-28A.

Table 5.3.3-1: ΔTIB,c for 3DLs aggregation

|  |  |  |
| --- | --- | --- |
| Inter-band CA Configuration | E-UTRA Band | ΔTIB,c [dB] |
| CA\_7-7-28 | 7 | 0.3 |
| 28 | 0.3 |

Table 5.3.3-2: ΔRIB,c for 3DLs aggregation

|  |  |  |
| --- | --- | --- |
| Inter-band CA Configuration | E-UTRA Band | ΔRIB,c [dB] |
| CA\_7-7-28 | 7 | 0 |
| 28 | 0 |

### 5.3.4 REFSENS requirements

There are no reference sensitivity requirements needed.

## 5.4 CA\_3-28

### 5.4.1 Channel bandwidths per operating band for CA

Table 5.4.1-1: Inter-band CA operating bands

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| E‑UTRA Operating Band | Uplink (UL) operating band BS receive UE transmit | | | Downlink (DL) operating band BS transmit  UE receive | | | Duplex Mode |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| 3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | FDD |
| 28 | 703 MHz | – | 748 MHz | 758 MHz | – | 803 MHz | FDD |

Table 5.4.1-2: Supported E-UTRA bandwidths per CA configuration for inter-band CA

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| E-UTRA CA configuration / Bandwidth combination set | | | | | | | | | | |
| E-UTRA CA Configuration | Uplink CA configurations | E-UTRA Bands | 1.4 MHz | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz | Maximum aggregated bandwidth  [MHz] | Bandwidth combination set |
| CA\_3C-28A | CA\_3C | 3 | See the CA\_3C Bandwidth combination set 0 in Table 5.6A.1-1 | | | | | | 60 | 0 |
| 28 |  |  | Yes | Yes | Yes | Yes |

### 5.4.2 Co-existence studies

Table 5.4.2-1 summarizes frequency ranges where harmonics occur for CA\_3-28 with 1 band uplink.

**Table 5.4.2-1: Impact of 1 UL Harmonic Interference**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge |
| 3 | 1710 | 1785 | 1805 | 1880 | 3420 | 3570 | 5130 | 5355 |
| 28 | 703 | 748 | 758 | 803 | 1406 | 1496 | 2109 | 2244 |

Within Table 5.4.2-1 for CA\_3C-28A there is no harmonic interference from uplink bands towards the downlink bands.

### 5.4.3 ΔTIB,c and ΔRIB,c values

The ΔTIB,c and ΔRIB,c values for two band Carrier Aggregation of Band 3 and Band 28 are covered in TS 36.101 Table 6.2.5-2 (two bands) for ΔTIB,c and Table 7.3.1-1A (two bands) for ΔRIB,c.

### 5.4.4 Reference sensitivity

MSD study not required as there is no harmonic interference from uplink bands towards the downlink bands.

## 5.5 CA\_3-42

### 5.5.1 Channel bandwidths per operating band for CA

Table 5.5.1-1: Inter-band CA operating bands

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| E‑UTRA Operating Band | Uplink (UL) operating band BS receive UE transmit | | | Downlink (DL) operating band BS transmit  UE receive | | | Duplex Mode |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| 3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | FDD |
| 42 | 3400 MHz | – | 3600 MHz | 3400 MHz | – | 3600 MHz | TDD |

Table 5.5.1-2: E-UTRA CA configurations and bandwidth combination sets defined for inter-band CA

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| E-UTRA CA configuration / Bandwidth combination set | | | | | | | | | | |
| E-UTRA CA Configuration | Uplink CA configurations | E-UTRA Bands | 1.4 MHz | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz | Maximum aggregated bandwidth  [MHz] | Bandwidth combination set |
| CA\_3A-42A-42C | CA\_42C | 3 |  |  | Yes | Yes | Yes | Yes | 80 | 0 |
| 42 | See the CA\_42A-42C Bandwidth combination set 0 in Table 5.6A.1-3 | | | | | |

### 5.5.2 Co-existence studies

Since the co-existence has been studied in lower order CAs of CA\_3-42 and this CA can reuse the result. Thus there is no need to specify a new requirement.

### 5.5.3 ∆TIB and ∆RIB values

Since delta TIB and RIB have been studied in lower order CAs of CA\_3-42, this CA combination can reuse the results. Thus there is no need to specify a new requirement.

### 5.5.4 REFSENS

Since REFSENS has been studied in lower order CAs of CA\_3-42, this CA can reuse the result. Thus there is no need to specify a new requirement.

## 5.6 CA\_28-32

### 5.6.1 Channel bandwidths per operating band for CA

Table 5.6.1-1: Supported E-UTRA bandwidths per CA configuration for inter-band CA

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| E-UTRA CA configuration / Bandwidth combination set | | | | | | | | | | |
| E-UTRA CA Configuration | Uplink CA configurations | E-UTRA Bands | 1.4 MHz | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz | Maximum aggregated bandwidth  [MHz] | Bandwidth combination set |
| CA\_28A-32A | - | 28 |  |  | Yes | Yes | Yes | Yes | 40 | 0 |
| 32 |  |  | Yes | Yes | Yes | Yes |

### 5.6.2 UE co-existence studies

Table 5.6.2-1 gives the harmonic frequency limits for Band 28 and Band 32 2DL CA. As shown in table 5.6.2-1, UL carrier of band 28 is not located at 2nd order harmonics or 3rd order harmonics of DL carriers.

Table 5.6.2-1: DL harmonics frequency limits for CA of Band 28 and Band 32

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **DL carriers** | **f1\_low** | **f1\_high** | **f2\_low** | **f2\_high** |
| DL frequency (MHz) | 758 | 803 | 1452 | 1496 |
| 2nd order DL harmonics frequency range (MHz) | 1516 – 1606 | | 2904 – 2992 | |
| 3rd order DL harmonics frequency range (MHz) | 2274 - 2409 | | 4356 - 4488 | |

As shown in Table 5.6.2-2, the 2nd harmonic frequencies of Band 28 UL might affect the band 32 DL.

Table 5.6.2-2: UL harmonics frequency limits for CA of Band 28 and Band 32

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** |
| 28 | 703 | 748 | 758 | 803 | 1406 | 1496 | 2109 | 2244 |
| 32 | N/A | N/A | 1452 | 1496 | N/A | N/A | N/A | N/A |

### 5.6.3 ΔTIB,c and ΔRIB,c values

The ΔTIB,c and ΔRIB,c values are derived from existing combination CA\_8-32 and CA\_20-32 with the low band 8 or 20 replaced with low band 28, and are specified by the following inclusions into tables in TS 36.101.

Table 5.6.3-1: ΔTIB,c (two bands)

|  |  |  |
| --- | --- | --- |
| E-UTRA operating band combination | E-UTRA Band | ΔTIB,c [dB] |
| CA\_28-32 | 28 | 0.3 |

Table 5.6.3.-2: ΔRIB,c (two bands)

|  |  |  |
| --- | --- | --- |
| E-UTRA operating band combination | E-UTRA Band | ΔRIB,c [dB] |
| CA\_28-32 | 28 | 0 |

### 5.6.4 REFSENS requirements

REFSENS requirements are needed since second UL harmonic of band 28 is affecting band 32 DL. Similar values as from CA\_3-42 which also has 2nd harmonic issues, and need to be specified by the following inclusions into tables in TS 36.101

Table 7.3.1A-0a: Reference sensitivity for carrier aggregation QPSK PREFSENS, CA (exceptions due to harmonic issue)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Channel bandwidth | | | | | | | | |
| EUTRA CA Configuration | EUTRA band | 1.4 MHz (dBm) | 3 MHz (dBm) | 5 MHz (dBm) | 10 MHz (dBm) | 15 MHz (dBm) | 20 MHz (dBm) | Duplex mode |
| CA\_28A-32A9,10 | 32 |  |  | -72.2 | -72.2 | -72.2 | -72.2 | FDD |
| CA\_28A-32A11 | 32 |  |  | -97.6 | -95.2 | -93.7 | -93.0 | FDD |
| NOTE 9: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of the aggressor (lower) band for which the 2nd transmitter harmonic is within the downlink transmission bandwidth of a victim (higher) band and a range FHD above and below the edge of this downlink transmission bandwidth. The value FHD depends on the E-UTRA configuration: FHD = 10 MHz for CA\_3A-42A, CA\_3A-3A-42A, CA\_3A-42A-42A, CA\_1A-3A-20A-32A-42A, CA\_3A-42A-43A, CA\_3A-32A-42A-43A, CA\_1A-3A-42A, CA\_2A-13A-48A-66A, CA\_2A-48A, CA\_2A-48C, CA\_2A-48D, CA\_48A-66A, CA\_3A-7A-42A, CA\_3A-19A-42A, CA\_3A-20A-42A, CA\_3A-28A-42A, CA\_1A-3A-7A-42A, CA\_13A-48A-66A, CA\_13A-48A-66B, CA\_13A-48A-66C, CA\_13A-48A-48A-66A, CA\_13A-48C-66A, CA\_28A-32A, CA\_48A-66A-66A, CA\_48A-66B , CA\_48A-66C, CA\_48A-48A-66A, CA\_48C-66A, CA\_48A-48A-66A-66A, CA\_48A-48A-66B, CA\_48A-48A-66C, CA\_48C-66B, CA\_48C-66C, CA\_48E-66A, CA\_1A-3A-19A-42A, CA\_1A-3A-32A-42A, CA\_3A-7A-20A-42A, CA\_3A-20A-32A-42A and CA\_3A-28A-41A-42A. FHD = 0MHz for CA\_11A-28A, CA\_1A-11A-28A and CA\_3A-11A-28A.  NOTE 10: The requirements should be verified for UL EARFCN of the aggressor (lower) band (superscript LB) such that in MHz and  with carrier frequency in the victim (higher) band in MHz and  the channel bandwidth configured in the lower band.  NOTE 11: The requirements are only applicable to channel bandwidths 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. | | | | | | | | |

Table 7.3.1A-0b: Uplink configuration for the low band (exceptions due to harmonic issue)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| E-UTRA Band / Channel bandwidth of the high band / NRB / Duplex mode | | | | | | | | |
| EUTRA CA Configuration | UL band | 1.4 MHz | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz | Duplex mode |
| CA\_28A-32A | 28 |  |  | 12 | 25 | 36 | 50 | FDD | |

## 5.7 CA\_46-48

### 5.7.1 Channel bandwidths per operating band for CA

Table 5.7.1-1: Inter-band CA operating bands

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| E‑UTRA Operating Band | Uplink (UL) operating band BS receive UE transmit | | | Downlink (DL) operating band BS transmit  UE receive | | | Duplex Mode |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| 46 | 5150 MHz | – | 5925 MHz | 5150 MHz | – | 5925 MHz | TDD |
| 48 | 3550 MHz | – | 3700 MHz | 3550 MHz | – | 3700 MHz | TDD |

Table 5.7.1-2: Supported E-UTRA bandwidths per CA configuration for inter-band CA

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| E-UTRA CA configuration / Bandwidth combination set | | | | | | | | | | | | | | | | | |
| E-UTRA CA Configuration | Uplink CA configurations | E-UTRA Bands | 1.4 MHz | | 3 MHz | | 5 MHz | | | 10 MHz | | 15 MHz | | 20 MHz | | Maximum aggregated bandwidth  [MHz] | Bandwidth combination set |
| CA\_46A-48C | CA\_48C | 46 |  | |  | |  | | |  | |  | | Yes | | 60 | 0 |
| 48 | See CA\_48C Bandwidth combination set 0 in Table 5.6A.1-1 | | | | | | | | | | | | |
| CA\_46A-48D | CA\_48C | 46 |  | |  | | |  | |  | |  | | | Yes | 80 | 0 |
| 48 | See CA\_48D Bandwidth Combination Set 0 in Table 5.6A.1-1 | | | | | | | | | | | | |
| CA\_46C-48C | CA\_48C | 46 | See CA\_46C Bandwidth Combination Set 0 in Table 5.6A.1-1 | | | | | | | | | | | | | 80 | 0 |
| 48 | See CA\_48C Bandwidth Combination Set 0 in Table 5.6A.1-1 | | | | | | | | | | | | |
| CA\_46A-48E | CA\_48C | 46 |  |  | |  | | |  | |  | | Yes | | | 100 | 0 |
| 48 | See CA\_48E Bandwidth combination set 0 in the Table 5.6A.1-1 | | | | | | | | | | | | |
| CA\_46C-48D | CA\_48C | 46 | See CA\_46C Bandwidth combination set 0 in the Table 5.6A.1-1 | | | | | | | | | | | | | 100 | 0 |
| 48 | See CA\_48D Bandwidth combination set 0 in the Table 5.6A.1-1 | | | | | | | | | | | | |
| CA\_46C-48E | CA\_48C | 46 | See the CA\_46C Bandwidth combination set 0 in Table 5.6A.1-1 | | | | | | | | | | | | | 120 | 0 |
| 48 | See the CA\_48E Bandwidth combination set 0 in Table 5.6A.1-1 | | | | | | | | | | | | |

### 5.7.2 ΔTIB,c and ΔRIB,c values

The ΔTIB,c and ΔRIB,c values for two band CA\_46-48 are covered in TS 36.101 Table 6.2.5-2 (two bands) for ΔTIB,c and Table 7.3.1-1A (two bands) for ΔRIB,c.

### 5.7.3 REFSENS requirements

There are no additional reference sensitivity requirements needed.

## 5.8 CA 7-29

### 5.8.1 Channel bandwidths per operating band for CA

Table 5.8.1-1: Inter-band CA operating bands

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| E‑UTRA Operating Band | Uplink (UL) operating band BS receive UE transmit | | | Downlink (DL) operating band BS transmit  UE receive | | | Duplex Mode |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| 7 | 2500 MHz | – | 2570 MHz | 2620 MHz | – | 2690 MHz | FDD |
| 29 |  | – |  | 717 MHz | – | 728 MHz | FDD |

Table 5.8.1-2: E-UTRA CA configurations and bandwidth combination sets defined for inter-band CA

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| E-UTRA CA configuration / Bandwidth combination set | | | | | | | | | | |
| E-UTRA CA Configuration | Uplink CA configurations | E-UTRA Bands | 1.4 MHz | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz | Maximum aggregated bandwidth  [MHz] | Bandwidth combination set |
| CA\_7A-29A | - | 7 |  |  | Yes | Yes | Yes | Yes | 30 | 0 |
| 29 |  |  | Yes | Yes |  |  |
| CA\_7A-7A-29A | - | 7 | See CA\_7A-7A Bandwidth combination set 1 in table 5.6A.1-3 of 36.101 | | | | | | 50 | 0 |
| 29 |  |  | Yes | Yes |  |  |
| CA\_7C-29A | - | 7 | See CA\_7C Bandwidth combination set 2 in table 5.6A.1-1 of 36.101 | | | | | | 50 | 0 |
| 29 |  |  | Yes | Yes |  |  |

### 5.8.2 Co-existence studies

Table 5.8.2-1 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA 7A-29A and 7A-7A-29A and CA 7C-29A.

**Table 5.X.2-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge |
| 7 | 2500 | 2570 | 2620 | 2690 | 5000 | 5140 | 7500 | 7710 |  |  |
| 29 | N/A | N/A | 717 | 728 | N/A | N/A | N/A | N/A |  |  |

No specific harmonic, so no requirement is needed for CA 7A-29A and 7A-7A-29A and CA 7C-29A.

### 5.8.3 ∆TIB and ∆RIB values

Table 5.8.3-1: IB,c

|  |  |  |
| --- | --- | --- |
| CA\_7-29 | 7 | 0.3 |
| 29 | N/A |

Table 5.8.3-2: R IB,c

|  |  |  |
| --- | --- | --- |
| CA\_7-29 | 7 | 0 |
| 29 | N/A |

### 5.8.4 REFSENS

The REFSENS requirements CA\_7A-29A and CA\_7A-7A-29A and CA\_7C-29A are shown in Table 5.8.4-1 with the uplink configuration specified in Table 7.3.1-2 of TS36.101.

Table 5.8.4-1: Reference sensitivity for carrier aggregation QPSK PREFSENS, CA

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Channel bandwidth** | | | | | | | | |
| **EUTRA CA Configuration** | **EUTRA band** | 1.4 MHz  **(dBm)** | 3 MHz  **(dBm)** | 5 MHz  **(dBm)** | 10 MHz  **(dBm)** | 15 MHz  **(dBm)** | 20 MHz  **(dBm)** | **Duplex mode** |
| CA\_7A-29A  CA\_7A-7A-29A  CA\_7C-29A | 7 |  |  | -98 | -95 | -93.2 | -92 | FDD |
| 29 |  |  | -97 | -94 |  |  |

## 5.9 CA\_3-7

### 5.9.1 Channel bandwidths per operating band for CA

Table 5.X.1-1: Inter-band CA operating bands

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| E‑UTRA Operating Band | Uplink (UL) operating band BS receive UE transmit | | | Downlink (DL) operating band BS transmit  UE receive | | | Duplex Mode |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| 3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | FDD |
| 7 | 2500 MHz | – | 2570 MHz | 2620 MHz | – | 2690 MHz | FDD |

Table 5.9.1-2: Supported E-UTRA bandwidths per CA configuration for inter-band CA

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| E-UTRA CA configuration / Bandwidth combination set | | | | | | | | | | |
| E-UTRA CA Configuration | Uplink CA configurations | E-UTRA Bands | 1.4 MHz | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz | Maximum aggregated bandwidth  [MHz] | Bandwidth combination set |
| CA\_3A-3A-7C | 7C | 3 | See CA\_3A-3A Bandwidth Combination Set 0 in Table 5.6A.1-3 | | | | | | 80 | 0 |
| 7 | See CA\_7C in Table 5.6A.1-1 of 36.101 Bandwidth combination set 2 | | | | | |

### 5.9.2 ΔTIB,c and ΔRIB,c values

The ΔTIB,c and ΔRIB,c values for two band CA\_3-7 are covered in TS 36.101 Table 6.2.5-2 (two bands) for ΔTIB,c and Table 7.3.1-1A (two bands) for ΔRIB,c.

### 5.9.3 REFSENS requirements

There are no reference sensitivity requirements needed.

## 5.10 CA\_25-41

### 5.10.1 Channel bandwidths per operating band

Table 5.10.1-1: CA band combination of bands

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| E-Utra 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 | | |
| 25 | 1850 MHz | – | 1915 MHz | 1930 MHz | – | 1995 MHz | FDD |
| 41 | 2496 MHz | – | 2690 MHz | 2496 MHz | – | 2690 MHz | TDD |

Table 5.10.1-2: E-UTRA CA configurations and bandwidth combination sets

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **E-UTRA CA configuration / Bandwidth combination set** | | | | | | | | | | |
|
| **E-UTRA CA Configuration** | **Uplink CA configurations (NOTE 4)** | **E-UTRA Bands** | **1.4**  **MHz** | **3**  **MHz** | **5**  **MHz** | **10**  **MHz** | **15**  **MHz** | **20**  **MHz** | **Maximum aggregated bandwidth**  **[MHz]** | **Bandwidth combination set** |
| CA\_25A-41E | **-** | 25 |  |  | yes | yes | yes | yes | 100 | 0 |
| 41 | See CA\_41E Bandwidth combination set 0 in Table 5.6A.1-1 | | | | | |
| CA\_25A-41F | - | 25 |  |  | yes | yes | yes | yes | 120 | 0 |
| 41 | See CA\_41F Bandwidth combination set 0 in Table 5.6A.1-1 | | | | | |
| CA\_25A-25A-41E | - | 25 | See CA\_25A-25A Bandwidth Combination Set 1 in Table 5.6A.1-3 | | | | | | 120 | 0 |
| 41 | See CA\_41E Bandwidth combination set 0 in Table 5.6A.1-1 | | | | | |
| CA\_25A-25A-41F | - | 25 | See CA\_25A-25A Bandwidth Combination Set 1 in Table 5.6A.1-3 | | | | | | 140 | 0 |
| 41 | See CA\_41F Bandwidth combination set 0 in Table 5.6A.1-1 | | | | | |

### 5.10.2 UE Co-existence studies

Table 5.10.2-1 summarizes frequency ranges where harmonics occur due to Band 25 and Band 41 CA with 1 UL.

**Table 5.10.2-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **nth Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** |
| 25 | 1850 | 1915 | 1930 | 1995 | 3700 | 3830 | 3860 | 3990 |  |  |
| 41 | 2496 | 2690 | 2496 | 2690 | 4992 | 5380 | 4992 | 5380 |  |  |

It can be seen from Table 5.10.2-1 that there is no harmonic interference for CA\_25A-41E/F and CA\_25A-25A-41E/F towards its own receive bands for this CA combination.

#### 5.10.3∆TIB and ∆RIB values

For CA\_25-41 , the ΔTIB,c and ΔRIB,c values are given in the tables below.

Table 5.10.3-1: ΔTIB,c

| Inter-band CA Configuration | E-UTRA Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_25-41,  CA\_25-25-41 | 25 | 0.5 |
| 41 | 0.41 |
| 0.92 |
| NOTE 1: The requirement is applied for UE transmitting on the frequency range of 2545-2690 MHz.  NOTE 2: The requirement is applied for UE transmitting on the frequency range of 2496-2545 MHz. | | |

Table 5.10.3-2: ΔRIB,c

| Inter-band CA Configuration | E-UTRA Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_25-41,  CA\_25-25-41 | 41 | 01 |
| 0.52 |
| NOTE 1: The requirement is applied for UE transmitting on the frequency range of 2545-2690MHz.  NOTE 2: The requirement is applied for UE transmitting on the frequency range of 2496-2545MHz. | | |

#### 5.10.4 REFSENS requirements

For these combinations, sensitivity degradation is allowed for a band if it is impacted by the UL of another band that is part of the same DC configuration due to cross band isolation issues. RAN4 studied the impact of cross band isolation between Band 25 and n41 for DC\_25A\_n41A and decided that the MSD would be [0.6] dB the B25 DL due to n41 UL, and no MSD for the n41 DL due to the B25 UL. The same analysis is applied to the LTE CA combinations between B25 and B41. Reference sensitivity is specified in Table 5.x.4-1 with uplink configuration specified in Table 5.10.4-2.

Table 5.x.4-1: Reference sensitivity with cross band isolation

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| EUTRA CA Configuration | EUTRA band | Channel bandwidth | | | | | | Duplex mode | Applicable active UL band |
| 1.4 MHz (dBm) | 3 MHz (dBm) | 5 MHz (dBm) | 10 MHz (dBm) | 15 MHz (dBm) | 20 MHz (dBm) |
| CA\_25A-41E, CA\_25A-41F | 25 |  |  | [-95.9] | [-92.9] | [-91.1] | [-89.9] | FDD | 41 |

Table 5.x.4-2: Uplink configuration for reference sensitivity exceptions due to cross band isolation

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| UL band | DL band | 5 MHz | 10 MHz | 15 MHz | 20 MHz |
| 41 | 25 | 25 | 50 | 75 | 100 |

## 5.11 CA\_28-66

### 5.11.1 Channel bandwidths per operating band for CA

Table 5.11.1-1: E-UTRA CA configurations and bandwidth combination sets defined for inter-band CA

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| E-UTRA CA configuration / Bandwidth combination set | | | | | | | | | | |
| E-UTRA CA Configuration | Uplink CA configurations | E-UTRA Bands | 1.4 MHz | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz | Maximum aggregated bandwidth  [MHz] | Bandwidth combination set |
| CA\_28A-66A | - | 28 |  |  | Yes | Yes | Yes | Yes | 40 | 0 |
| 66 |  |  | Yes | Yes | Yes | Yes |

### 5.11.2 Co-existence studies

Table 5.11.2-1: Impact of UL/DL Harmonic

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** |
| **28** | 703 | 748 | 758 | 803 | 1406 | 1496 | 2109 | 2244 | 2812 | 3212 |
| **66** | 1710 | 1780 | 2110 | 2200 | 3420 | 3560 | 5130 | 5340 | 6840 | 7120 |

3rd harmonic of band 28 uplink hits downlink of band 66.

Table 5.11.2-2: Impact of UL/DL Harmonic mixing

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** |
| **28** | 703 | 748 | 758 | 803 | 1516 | 1606 | 2274 | 2409 | 3032 | 3212 |
| **66** | 1710 | 1780 | 2110 | 2200 | 4220 | 4400 | 6330 | 6600 | 8440 | 8800 |

There is no harmonic mixing for 28+66.

### 5.11.3 ∆TIB and ∆RIB values

dTib and dRib values are copied from CA\_7-8 which has also third harmonic relation.

Table 5.11.3-1: IB,c

|  |  |  |
| --- | --- | --- |
| CA\_28-66 | 28 | 0.6 |
| 66 | 0.3 |

Table 5.11.3-2: R IB,c

|  |  |  |
| --- | --- | --- |
| CA\_28-66 | 28 | 0.2 |
| 66 | 0 |

### 5.11.4 REFSENS

Similar MSD has been applied to band 66 as band 7 has in CA\_7-8, this is because both cases have third harmonic relation.

Table 7.3.1A-0a: Reference sensitivity for carrier aggregation QPSK PREFSENS, CA (exceptions due to harmonic issue)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Channel bandwidth** | | | | | | | | |
| **EUTRA CA Configuration** | **EUTRA band** | 1.4 MHz  **(dBm)** | 3 MHz  **(dBm)** | 5 MHz  **(dBm)** | 10 MHz  **(dBm)** | 15 MHz  **(dBm)** | 20 MHz  **(dBm)** | **Duplex mode** |
| CA\_28A-66A5,6 | 66 |  |  | -89,5 | -88,9 | -88,5 | -88,2 | FDD |
| NOTE 5: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of a low band for which the 3rd transmitter harmonic is within the downlink transmission bandwidth of a high band.  NOTE 6: The requirements should be verified for UL EARFCN of a low band (superscript LB) such that in MHz and  with the carrier frequency of a high band in MHz and  the channel bandwidth configured in the low band. | | | | | | | | |

Table 7.3.1A-0b: Uplink configuration for the low band (exceptions due to harmonic issue)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| E-UTRA Band / Channel bandwidth of the high band / NRB / Duplex mode | | | | | | | | |
| EUTRA CA Configuration | UL band | 1.4 MHz | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz | Duplex mode |
| CA\_28A-66A | 28 |  |  | 8 | 16 | 25 | 25 | FDD |

## 5.12 CA\_3-3-5

### 5.12.1 Channel bandwidths per operating band for CA

Table 5.12.1-1: E-UTRA CA configurations and bandwidth combination sets defined for inter-band CA

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **E-UTRA CA configuration / Bandwidth combination set** | | | | | | | | | | |
|
| **E-UTRA CA Configuration** | **Uplink CA configurations** | **E-UTRA Bands** | **1.4** | **3** | **5** | **10** | **15** | **20** | **Maximum aggregated bandwidth** | **Bandwidth combination set** |
| **MHz** | **MHz** | **MHz** | **MHz** | **MHz** | **MHz** | **[MHz]** |
| CA\_3A-3A-5A | - | 3 | See CA\_3A-3A Bandwidth Combination Set 0 in Table 5.6A.1-3 | | | | | | 50 | 0 |
| 5 |  |  | Yes | Yes |  |  |

### 5.12.2 Co-existence studies

Table 5.12.2-1: Impact of UL/DL Harmonic

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** |
| **3** | 1710 | 1785 | 1805 | 1880 | 3420 | 3570 | 5130 | 5355 | 6840 | 7520 |
| **5** | 824 | 849 | 869 | 894 | 1648 | 1698 | 2472 | 2547 | 3296 | 3396 |

There is no ul harmonic issue for 3+5

Table 5.12.2-2: Impact of UL/DL Harmonic mixing

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** |
| **3** | 1710 | 1785 | 1805 | 1880 | 3610 | 3760 | 5415 | 5640 | 7220 | 7520 |
| **5** | 824 | 849 | 869 | 894 | 1738 | 1788 | 2607 | 2682 | 3476 | 3576 |

Band 5 receiver 2nd harmonic overlaps band 3 Tx.

### 5.12.3 ∆TIB and ∆RIB values

3+5 which has been specified is a high-low combination with harmonic issues hence dTib and dRib are as follows

Table 5.12.3-1: IB,c

|  |  |  |
| --- | --- | --- |
| CA\_3-3-5 | 3 | 0.3 |
| 5 | 0.3 |

Table 5.12.3-2: R IB,c

|  |  |  |
| --- | --- | --- |
| CA\_3-3-5 | 3 | 0 |
| 5 | 0 |

### 5.12.4 REFSENS

Band 5 receiver 2nd harmonic overlaps band 3 Tx but no MSD is specified for fallback CA\_3A-5A

## 5.13 CA\_3-3-46

### 5.13.1 Channel bandwidths per operating band for CA

Table 5.13.1-1: E-UTRA CA configurations and bandwidth combination sets defined for inter-band CA

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **E-UTRA CA configuration / Bandwidth combination set** | | | | | | | | | | |
|
| **E-UTRA CA Configuration** | **Uplink CA configurations** | **E-UTRA Bands** | **1.4** | **3** | **5** | **10** | **15** | **20** | **Maximum aggregated bandwidth** | **Bandwidth combination set** |
| **MHz** | **MHz** | **MHz** | **MHz** | **MHz** | **MHz** | **[MHz]** |
| CA\_3A-3A-46C | - | 3 | See CA\_3A-3A Bandwidth Combination Set 0 in Table 5.6A.1-3 | | | | | | 80 | 0 |
| 46 | See  CA\_46C Bandwidth Combination Set 0 in Table 5.6A.1-1 | | | | | |

### 5.13.2 Co-existence studies

Table 5.13.2-1: Impact of UL/DL Harmonic

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** |
| **3** | 1710 | 1785 | 1805 | 1880 | 3420 | 3570 | 5130 | 5355 | 6840 | 7140 |
| **46** | 5150 | 5925 | 5150 | 5925 | 10300 | 11850 | 15450 | 17775 | 20600 | 23700 |

3rd harmonic of band 3 uplink hits downlink of band 46.

Table 5.13.2-2: Impact of UL/DL Harmonic mixing

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** |
| **3** | 1710 | 1785 | 1805 | 1880 | 3610 | 3760 | 5415 | 5640 | 7220 | 7520 |
| **46** | 5150 | 5925 | 5150 | 5925 | 10300 | 11850 | 15450 | 17775 | 20600 | 23700 |

Band 3 has receiver 3rd harmonic mixing problem.

### 5.13.3 ∆TIB and ∆RIB values

No dTib and dRib necessary for band combination with band 46.

Table 5.13.3-1: IB,c

|  |  |  |
| --- | --- | --- |
| **E-UTRA operating band combination** | **E-UTRA Band** | **ΔTIB,c [dB]** |
| CA\_3-46 | 3 | 0 |

Table 5.13.3-2: R IB,c

|  |  |  |
| --- | --- | --- |
| **E-UTRA operating band combination** | **E-UTRA Band** | **ΔRIB,c [dB]** |
| CA\_3-46 | 3 | 0 |

### 5.13.4 REFSENS

MSD has been already specified for CA\_3A-3A-46A and can be re-used for CA\_3A-3A-46C.

Table 7.3.1A-0eA: Reference sensitivity QPSK PREFSENS (CA with band 46 or Band 49)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Channel bandwidth | | | | | | | | |
| EUTRA CA Configuration | EUTRA band | 1.4 MHz  (dBm) | 3 MHz  (dBm) | 5 MHz  (dBm) | 10 MHz  (dBm) | 15 MHz  (dBm) | 20 MHz  (dBm) | Duplex mode |
| CA\_3A-3A-46A  CA\_3C-46C  CA\_3C-46D  CA\_3A-3A-46C | 3 |  |  | -97 | -94 | -92.2 | -91 | FDD |
| 46 |  |  |  |  |  | -90 | TDD |

## 5.14 CA\_1-1-3

### 5.14.1 Channel bandwidths per operating band for CA

Table 5.14.1-1: Inter-band CA operating bands

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| E‑UTRA Operating Band | Uplink (UL) operating band BS receive UE transmit | | | Downlink (DL) operating band BS transmit  UE receive | | | Duplex Mode |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| 1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | FDD |
| 3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | FDD |

Table 5.14.1-2: Supported E-UTRA bandwidths per CA configuration for inter-band CA

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| E-UTRA CA configuration / Bandwidth combination set | | | | | | | | | | |
| E-UTRA CA Configuration | Uplink CA configurations | E-UTRA Bands | 1.4 MHz | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz | Maximum aggregated bandwidth  [MHz] | Bandwidth combination set |
| CA\_1A-1A-3C | CA\_3C | 1 | See CA\_1A-1A Bandwidth Combination Set 0 in Table 5.6A.1-3 | | | | | | 80 | 0 |
| 3 | See CA\_3C in Table 5.6A.1-1 of 36.101 Bandwidth combination set 0 | | | | | |

### 5.14.2 ΔTIB,c and ΔRIB,c values

The ΔTIB,c and ΔRIB,c values for two band CA\_1-3 are covered in TS 36.101 Table 6.2.5-2 (two bands) for ΔTIB,c and Table 7.3.1-1A (two bands) for ΔRIB,c.

### 5.14.3 REFSENS requirements

There are no additional reference sensitivity requirements needed.

## 5.15 CA\_1-1-7

### 5.15.1 Channel bandwidths per operating band for CA

Table 5.15.1-1: Inter-band CA operating bands

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| E‑UTRA Operating Band | Uplink (UL) operating band BS receive UE transmit | | | Downlink (DL) operating band BS transmit  UE receive | | | Duplex Mode |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| 1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | FDD |
| 7 | 2500 MHz | – | 2570 MHz | 2620 MHz | – | 2690 MHz | FDD |

Table 5.15.1-2: Supported E-UTRA bandwidths per CA configuration for inter-band CA

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| E-UTRA CA configuration / Bandwidth combination set | | | | | | | | | | |
| E-UTRA CA Configuration | Uplink CA configurations | E-UTRA Bands | 1.4 MHz | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz | Maximum aggregated bandwidth  [MHz] | Bandwidth combination set |
| CA\_1A-1A-7C | CA\_7C | 1 | See CA\_1A-1A Bandwidth Combination Set 0 in Table 5.6A.1-3 | | | | | | 80 | 0 |
| 7 | See CA\_7C in Table 5.6A.1-1 of 36.101 Bandwidth combination set 2 | | | | | |

### 5.15.2 ΔTIB,c and ΔRIB,c values

The ΔTIB,c and ΔRIB,c values for two band CA\_1-7 are covered in TS 36.101 Table 6.2.5-2 (two bands) for ΔTIB,c and Table 7.3.1-1A (two bands) for ΔRIB,c.

### 5.15.3 REFSENS requirements

There are no additional reference sensitivity requirements needed.

## 5.16 CA\_7-13

### 5.16.1 Channel bandwidths per operating band for CA

Table 5.16.1-1: Supported E-UTRA bandwidths per CA configuration for 2DL inter-band CA

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| E-UTRA CA configuration / Bandwidth combination set | | | | | | | | | | |
| E-UTRA CA Configuration | Uplink CA configurations | E-UTRA Bands | 1.4 MHz | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz | Maximum aggregated bandwidth  [MHz] | Bandwidth combination set |
| CA\_7A-13A | - | 7 |  |  | Yes | Yes | Yes | Yes | 30 | 0 |
| 13 |  |  | Yes | Yes |  |  |
| CA\_7C-13A | - | 7 | See CA\_7C Bandwidth combination set 1 in Table 5.6A.1-1 | | | | | | 50 | 0 |
| 13 |  |  | Yes | Yes |  |  |
| CA\_7A-7A-13A | - | 7 | See CA\_7A-7A Bandwidth combination set 1 in Table 5.6A.1-3 | | | | | | 50 | 0 |
| 13 |  |  | Yes | Yes |  |  |
|  | | | | | | | | | | |

### 5.16.2 Co-existence studies

Table 5.16.2-1: Impact of UL/DL Harmonic

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** |
| **7** | 2500 | 2570 | 2620 | 2690 | 5000 | 5140 | 7500 | 7710 | 10000 | 10280 |
| **13** | 777 | 787 | 746 | 756 | 1554 | 1574 | 2331 | 2361 | 3180 | 3148 |

There is no harmonic interference for CA\_7-13.

Table 5.16.2-2: Impact of UL/DL Harmonic mixing

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** |
| **7** | 2500 | 2570 | 2620 | 2690 | 5240 | 5380 | 7860 | 8070 | 10480 | 10760 |
| **13** | 777 | 787 | 746 | 756 | 1492 | 1512 | 2238 | 2268 | 2983 | 3024 |

There is no harmonic mixing for CA\_7-13.

### 5.16.3 ΔTIB,c and ΔRIB,c values

ΔRIB,c values for CA\_7-13 are derived from CA\_7-28. For the ΔTIB,c the values from CA\_7-28 are reused. Values will be defined in the following tables in TS 36.101.

Table 5.16.3-1: ΔTIB,c (two bands)

|  |  |  |
| --- | --- | --- |
| E-UTRA operating band combination | E-UTRA Band | ΔTIB,c [dB] |
| CA\_7-13, CA\_7-7-13 | 7 | 0.3 |
| 13 | 0.3 |

Table 5.16.3-2: ΔRIB,c (two bands)

|  |  |  |
| --- | --- | --- |
| E-UTRA operating band combination | E-UTRA Band | ΔRIB,c [dB] |
| CA\_7-13, CA\_7-7-13 | 7 | 0 |
| 13 | 0 |

### 5.16.4 REFSENS requirements

There are no reference sensitivity requirements needed.

## 5.17 CA\_7-7-20

### 5.17.1 Channel bandwidths per operating band for CA

Table 5.17.1-1: Supported E-UTRA bandwidths per CA configuration for 2-band DL inter-band CA

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| CA operating / Channel bandwidth | | | | | | | | | |
| CA Configuration | E-UTRA Bands | 1.4 MHz | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz | **Maximum aggregated bandwidth**  [MHz] | Bandwidth Combination Set |
| CA\_7A-7A-20A | 7 | See CA\_7A-7A Bandwidth Combination Set 3 in Table 5.6A.1-3 | | | | | | 60 | 0 |
| 20 |  |  | Yes | Yes | Yes | Yes |

### 5.17.2 ∆TIB and ∆RIB values

The ∆TIB and ∆RIB values of CA\_7-7-20 is proposed to be the same as CA\_7-20 already specified in TS 36.101.

Table 5.17.2-1: ΔTIB,c for 3DL aggregation

| **Inter-band CA Configuration** | **E-UTRA Band** | **ΔTIB,c [dB]** |
| --- | --- | --- |
| CA\_7-7-20 | 7 | 0.3 |
| 20 | 0.3 |

Table 5.17.2-2: ΔRIB,c for 3DL aggregation

| **Inter-band CA Configuration** | **E-UTRA Band** | **ΔRIB,c [dB]** |
| --- | --- | --- |
| CA\_7-7-20 | 7 | 0 |
| 20 | 0 |

### 5.17.3 REFSENS requirements

There is no REFSENS exception for CA\_7A-7A-20A.

## 5.18 CA\_2-26

### 5.18.1 Channel bandwidths per operating band for CA

Table 5.18.1-1: Supported E-UTRA bandwidths per CA configuration for 2-band DL inter-band CA

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| CA operating / Channel bandwidth | | | | | | | | | |
| CA Configuration | E-UTRA Bands | 1.4 MHz | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz | **Maximum aggregated bandwidth**  [MHz] | Bandwidth Combination Set |
| CA\_2A-26A | 2 |  | Yes | Yes | Yes | Yes | Yes | 35 | 0 |
| 26 |  | Yes | Yes | Yes | Yes |  |

### 5.18.2 Coexistence study

The impacts of UL/DL harmonics and harmonic mixing are studied below.

Table 5.18.2-1: Impact of UL/DL Harmonic

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** |
| **2** | 1850 | 1910 | 1930 | 1990 | 3700 | 3820 | 5550 | 5734 | 7400 | 7640 |
| **26** | 814 | 849 | 859 | 894 | 1628 | 1698 | 2442 | 2547 | 3256 | 3396 |

There is no harmonic relation for 2+26.

Table 5.18.2-2: Impact of UL/DL Harmonic mixing

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** |
| **2** | 1850 | 1910 | 1930 | 1990 | 3860 | 3980 | 5790 | 5970 | 7720 | 7960 |
| **26** | 814 | 849 | 859 | 894 | 1718 | 1788 | 2577 | 2682 | 3436 | 3576 |

There is no harmonic mixing for 2+26.

### 5.18.3 ∆TIB and ∆RIB values

Since ther is no harmonic relation for this band combination, the proposed ∆TIB and ∆RIB values of CA\_2-26 are based on a typical high-low band dixpler architecture without a harmonic trap filter, which is 0.3dB for Tx and 0.0dB for Rx.

Table 5.18.3-1: ΔTIB,c for 2DL aggregation

| **Inter-band CA Configuration** | **E-UTRA Band** | **ΔTIB,c [dB]** |
| --- | --- | --- |
| CA\_2-26 | 2 | 0.3 |
| 26 | 0.3 |

Table 5.18.3-2: ΔRIB,c for 2DL aggregation

| **Inter-band CA Configuration** | **E-UTRA Band** | **ΔRIB,c [dB]** |
| --- | --- | --- |
| CA\_2-26 | 2 | 0 |
| 26 | 0 |

### 5.18.4 REFSENS requirements

There is no REFSENS exception for CA\_2A-26A.

## 5.19 CA\_26-66

### 5.19.1 Channel bandwidths per operating band for CA

Table 5.19.1-1: Supported E-UTRA bandwidths per CA configuration for 2-band DL inter-band CA

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| CA operating / Channel bandwidth | | | | | | | | | |
| CA Configuration | E-UTRA Bands | 1.4 MHz | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz | **Maximum aggregated bandwidth**  [MHz] | Bandwidth Combination Set |
| CA\_26A-66A | 26 |  | Yes | Yes | Yes | Yes |  | 35 | 0 |
| 66 |  | Yes | Yes | Yes | Yes | Yes |

### 5.19.2 Coexistence study

The impacts of UL/DL harmonics and harmonic mixing are studied below.

Table 5.19.2-1: Impact of UL/DL Harmonic

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** |
| **26** | 814 | 849 | 859 | 894 | 1628 | 1698 | 2442 | 2547 | 3256 | 3396 |
| **66** | 1710 | 1780 | 2110 | 2200 | 3420 | 3560 | 5130 | 5340 | 6840 | 7120 |

There is no harmonic relation for 26+66.

Table 5.19.2-2: Impact of UL/DL Harmonic mixing

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** |
| **26** | 814 | 849 | 859 | 894 | 1718 | 1788 | 2577 | 2682 | 3436 | 3576 |
| **66** | 1710 | 1780 | 2110 | 2200 | 4220 | 4400 | 6330 | 6600 | 8440 | 8800 |

There is a harmonic mixing of the second order for band 26+66.

### 5.19.3 ∆TIB and ∆RIB values

Since ther is no harmonic relation for this band combination, the proposed ∆TIB and ∆RIB values of CA\_26-66 are based on a typical high-low band dixpler architecture without a harmonic trap filter, which is 0.3dB for Tx and 0.0dB for Rx.

Table 5.19.3-1: ΔTIB,c for 2DL aggregation

| **Inter-band CA Configuration** | **E-UTRA Band** | **ΔTIB,c [dB]** |
| --- | --- | --- |
| CA\_26-66 | 26 | 0.3 |
| 66 | 0.3 |

Table 5.19.3-2: ΔRIB,c for 2DL aggregation

| **Inter-band CA Configuration** | **E-UTRA Band** | **ΔRIB,c [dB]** |
| --- | --- | --- |
| CA\_26-66 | 26 | 0 |
| 66 | 0 |

### 5.19.4 REFSENS requirements

No REFSENS exception is defined for CA\_26A-66A. It is noted that there is a harmonic mixing relation as presented above.

## 5.20 CA\_20-41

### 5.20.1 Channel bandwidths per operating band for CA

Table 5.20.1-1: Inter-band CA operating bands

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| E‑UTRA Operating Band | Uplink (UL) operating band BS receive UE transmit | | | Downlink (DL) operating band BS transmit  UE receive | | | Duplex Mode |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| 20 | 832 MHz | – | 862 MHz | 791 MHz | – | 821 MHz | FDD |
| 41 | 2496 MHz | – | 2690 MHz | 2496 MHz | – | 2690 MHz | TDD |

Table 5.20.1-2: E-UTRA CA configurations and bandwidth combination sets defined for inter-band CA

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| E-UTRA CA configuration / Bandwidth combination set | | | | | | | | | | |
| E-UTRA CA Configuration | Uplink CA configurations | E-UTRA Bands | 1.4 MHz | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz | Maximum aggregated bandwidth  [MHz] | Bandwidth combination set |
| CA\_20A-41A | - | 20 |  |  | Yes | Yes | Yes | Yes | 40 | 0 |
| 41 |  |  | Yes | Yes | Yes | Yes |
| CA\_20A-41C | - | 20 |  |  | Yes | Yes | Yes | Yes | 60 | 0 |
| 41 | See CA\_41C in Table 5.6A.1-1 of 36.101 Bandwidth combination set 1 | | | | | |
| CA\_20A-41D | - | 20 |  |  | Yes | Yes | Yes | Yes | 80 | 0 |
| 41 | See CA\_41D in Table 5.6A.1-1 of 36.101 Bandwidth combination set 0 | | | | | |

### 5.20.2 Co-existence studies

Table 5.20.2-1 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA \_ 20-41.

**Table 5.20.2-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge |
| 20 | 832 | 862 | 791 | 821 | 1664 | 1724 | 2496 | 2586 | 3328 | 3448 |
| 41 | 2496 | 2690 | 2496 | 2690 | 4992 | 5380 | 7488 | 8070 | 9984 | 10760 |

**Table 5.20.2-2: Impact of UL/DL Harmonic mixing**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge |
| 20 | 832 | 862 | 791 | 821 | 1582 | 1642 | 2373 | 2463 | 3164 | 3284 |
| 41 | 2496 | 2690 | 2496 | 2690 | 4992 | 5380 | 7488 | 8070 | 9984 | 10760 |

3nd order harmonic products of band 20 Tx may also fall into Rx frequencies of band 41.

### 5.20.3 ∆TIB and ∆RIB values

Table 5.20.3-1: IB,c

|  |  |  |
| --- | --- | --- |
| CA\_20-41 | 20 | 0.3 |
| 41 | 0.3 |

Table 5.20.3-2: R IB,c

|  |  |  |
| --- | --- | --- |
| CA\_20-41 | 20 | 0 |
| 41 | 0 |

### 5.20.4 REFSENS

Referring to the harmonic exception for DC\_20\_n38 in 38.101-3, the REFSEN can be specified as below.

Table 5.20.4-1: Reference sensitivity for carrier aggregation QPSK PREFSENS, CA (exceptions due to harmonic issue)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Channel bandwidth** | | | | | | | | |
| **EUTRA CA Configuration** | **EUTRA band** | 1.4 MHz  **(dBm)** | 3 MHz  **(dBm)** | 5 MHz  **(dBm)** | 10 MHz  **(dBm)** | 15 MHz  **(dBm)** | 20 MHz  **(dBm)** | **Duplex mode** |
| CA\_20A-41A5,6  CA\_20A-41C5,6  CA\_20A-41D5,6 | 41 |  |  | -85.1 | -84.7 | -84.8 | -84.6 | TDD |
| NOTE 5: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of a low band for which the 3rd transmitter harmonic is within the downlink transmission bandwidth of a high band.  NOTE 6: The requirements should be verified for UL EARFCN of a low band (superscript LB) such that in MHz and  with the carrier frequency of a high band in MHz and  the channel bandwidth configured in the low band. | | | | | | | | |

Table 5.20.4-2: Uplink configuration for the low band (exceptions due to harmonic issue)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| E-UTRA Band / Channel bandwidth of the high band / NRB / Duplex mode | | | | | | | | |
| EUTRA CA Configuration | UL band | 1.4 MHz | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz | Duplex mode |
| CA\_20A-41A  CA\_20A-41C  CA\_20A-41D | 20 |  |  | 8 | 16 | 25 | 25 | FDD |

## 5.21 CA\_1-41

### 5.21.1 Channel bandwidths per operating band for CA

Table 5.21.1-1: Inter-band CA operating bands

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| E‑UTRA Operating Band | Uplink (UL) operating band BS receive UE transmit | | | Downlink (DL) operating band BS transmit  UE receive | | | Duplex Mode |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| 1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | FDD |
| 41 | 2496 MHz | – | 2690 MHz | 2496 MHz | – | 2690 MHz | TDD |

Table 5.21.1-2: Supported E-UTRA bandwidths per CA configuration for inter-band CA

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| E-UTRA CA configuration / Bandwidth combination set | | | | | | | | | | |
| E-UTRA CA Configuration | Uplink CA configurations | E-UTRA Bands | 1.4 MHz | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz | Maximum aggregated bandwidth  [MHz] | Bandwidth combination set |
| CA\_1A-41C | CA\_41C | 1 |  |  | Yes | Yes | Yes | Yes | 60 | 0 |
| 41 | See CA\_41C Bandwidth Combination Set 1 in Table 5.6A.1-1 | | | | | |

### 5.21.2 Co-existence studies

Table 5.21.2-1 summarizes frequency ranges where harmonics occur due to Band 1 and Band 41 CA with 1 UL.

Table 5.21.2-1: Impact of 1 UL Harmonic Interference

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  | | **2nd Harmonic** | | **3rd Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** |
| 1 | 1920 | 1980 | 2110 | 2170 | 3840 | 3960 | 5760 | 5940 |
| 41 | 2496 | 2690 | 2496 | 2690 | 4992 | 5380 | 7488 | 8070 |

It can be seen from Table 5.21.2-1 that there is no harmonic impact towards any of its own downlink bands.

### 5.21.3 ΔTIB,c and ΔRIB,c values

CA\_1A-41C has the same ΔTIB,c and ΔRIB,c  as existing combination CA\_1A-41A.

Table 5.21.3-1: ΔTIB,c for 2DLs aggregation

|  |  |  |
| --- | --- | --- |
| Inter-band CA Configuration | E-UTRA Band | ΔTIB,c [dB] |
| CA\_1-41 | 1 | 0.5 |
| 41 | 0.5 |

Table 5.21.3-2: ΔRIB,c for 2DLs aggregation

|  |  |  |
| --- | --- | --- |
| Inter-band CA Configuration | E-UTRA Band | ΔRIB,c [dB] |
| CA\_1-41 | 1 | 0 |
| 41 | 0 |

## 5.22 CA\_18-41

### 5.22.1 Channel bandwidths per operating band for CA

Table 5.22.1-1: Inter-band CA operating bands

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| E‑UTRA Operating Band | Uplink (UL) operating band BS receive UE transmit | | | Downlink (DL) operating band BS transmit  UE receive | | | Duplex Mode |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| 18 | 815 MHz | – | 830 MHz | 860 MHz | – | 875 MHz | FDD |
| 41 | 2496 MHz | – | 2690 MHz | 2496 MHz | – | 2690 MHz | TDD |

Table 5.22.1-2: Supported E-UTRA bandwidths per CA configuration for inter-band CA

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| E-UTRA CA configuration / Bandwidth combination set | | | | | | | | | | |
| E-UTRA CA Configuration | Uplink CA configurations | E-UTRA Bands | 1.4 MHz | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz | Maximum aggregated bandwidth  [MHz] | Bandwidth combination set |
| CA\_18A-41A | - | 18 |  |  | Yes | Yes | Yes |  | 35 | 0 |
| 41 |  |  | Yes | Yes | Yes | Yes |
| CA\_18A-41C | CA\_41C | 18 |  |  | Yes | Yes | Yes |  | 55 | 0 |
| 41 | See CA\_41C Bandwidth Combination Set 1 in Table 5.6A.1-1 | | | | | |

### 5.22.2 Co-existence studies

Table 5.22.2-1 summarizes frequency ranges where harmonics occur due to Band 18 and Band 41 CA with 1 UL.

Table 5.22.2-1: Impact of 1 UL Harmonic Interference

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  | | **2nd Harmonic** | | **3rd Harmonic** | | **2nd Harmonic** | | **3rd Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** |
| 18 | 815 | 830 | 860 | 875 | 1630 | 1660 | 2445 | 2490 | 1720 | 1750 | 2580 | 2625 |
| 41 | 2496 | 2690 | 2496 | 2690 | 4992 | 5380 | 7488 | 8070 | 4992 | 5380 | 7488 | 8070 |

It can be seen from Table 5.22.2-1 that there is 3rd harmonic mixing may impact Band18 Rx, and no requirements apply similar with CA\_5-41.

### 5.22.3 ΔTIB,c and ΔRIB,c values

Table 5.22.3-1 and table 5.22.3-2 show the ΔTIB,c and ΔRIB,c  for CA\_18-41 according to Low-High band combinations’ values.

Table 5.22.3-1: ΔTIB,c for 2DLs aggregation

|  |  |  |
| --- | --- | --- |
| Inter-band CA Configuration | E-UTRA Band | ΔTIB,c [dB] |
| CA\_18-41 | 18 | 0.3 |
| 41 | 0.3 |

Table 5.22.3-2: ΔRIB,c for 2DLs aggregation

|  |  |  |
| --- | --- | --- |
| Inter-band CA Configuration | E-UTRA Band | ΔRIB,c [dB] |
| CA\_18-41 | 18 | 0 |
| 41 | 0 |

### 5.22.4 REFSENS

Table 5.22.4-1 shows the required MSD levels for CA\_18-41 due to harmonic mixing.

Table 5.22.4-1: Reference sensitivity for carrier aggregation QPSK PREFSENS, CA (exceptions due to harmonic issue)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Channel bandwidth | | | | | | | | |
| EUTRA CA Configuration | EUTRA band | 1.4 MHz (dBm) | 3 MHz (dBm) | 5 MHz (dBm) | 10 MHz (dBm) | 15 MHz (dBm) | 20 MHz (dBm) | Duplex mode |
| CA\_18A-41A19  CA\_18A-41C19 | 41 |  |  | N/A | N/A | N/A | N/A | TDD |
| NOTE 19: No requirements apply for the case that there is at least one individual RE within the uplink transmission bandwidth of the relative higher band and when the frequency range of relative higher band’s uplink channel bandwidth or uplink 1st adjacent channel bandwidth is fully or partially overlapped with the 3 times of the frequency range of the relative lower band’s downlink channel bandwidth. The reference sensitivity is only verified when this is not the case (the requirements specified in clause 7.3.1 apply). | | | | | | | | |

## 5.23 CA\_46-48

### 5.23.1 Channel bandwidths per operating band for CA

Table 5.23.1-1: Inter-band CA operating bands

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| E‑UTRA Operating Band | Uplink (UL) operating band BS receive UE transmit | | | Downlink (DL) operating band BS transmit  UE receive | | | Duplex Mode |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| **46** | **5150 MHz** | **–** | **5925 MHz** | **5150 MHz** | **–** | **5925 MHz** | **TDD** |
| **48** | **3550 MHz** | **–** | **3700 MHz** | **3550 MHz** | **–** | **3700 MHz** | **TDD** |

Table 5.23.1-2: E-UTRA CA configurations and bandwidth combination sets defined for inter-band CA

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| E-UTRA CA configuration / Bandwidth combination set | | | | | | | | | | |
| E-UTRA CA Configuration | Uplink CA configurations (NOTE 4) | E-UTRA Bands | 1.4 MHz | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz | Maximum aggregated bandwidth  [MHz] | Bandwidth combination set |
| **CA\_46A-48B** | CA\_48B | 46 |  |  |  |  |  | yes | 40 | 0 |
| 48 | See CA\_48B Bandwidth combination set 0 in 36.101 Table 5.6A.1-1 | | | | | |
| **CA\_46C-48B** | **CA\_48B** | 46 | **See CA\_46C Bandwidth combination set 0 in 36.101 Table 5.6A.1-1** | | | | | | 60 | 0 |
| 48 | **See CA\_48B Bandwidth combination set 0 in 36.101 Table 5.6A.1-1** | | | | | |
| **CA\_46D-48B** | **CA\_48B** | 46 | **See CA\_46D Bandwidth combination set 0 in 36.101 Table 5.6A.1-1** | | | | | | 80 | 0 |
| 48 | **See CA\_48B Bandwidth combination set 0 in 36.101 Table 5.6A.1-1** | | | | | |
| **CA\_46E-48B** | **CA\_48B** | 46 | **See CA\_46E Bandwidth combination set 0 in 36.101 Table 5.6A.1-1** | | | | | | 100 | 0 |
| 48 | **See CA\_48B Bandwidth combination set 0 in 36.101 Table 5.6A.1-1** | | | | | |

### 5.23.2 Co-existence studies

Table 5.23.2-1 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA \_ 46-48.

**Table 5.23.2-1: Impact of UL/DL Harmonic mixing**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | | **5th Harmonic** | | **6th Harmonic** | | **7th**  **Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge |
| **46** | **5150** | **5925** | **5150** | **5925** | **10300** | **11850** | **15450** | **17775** | **20600** | **23700** | **25750** | **29625** | **30900** | **35550** | **36050** | **41475** |
| **48** | **3550** | **3700** | **3550** | **3700** | **7100** | **7400** | **10650** | **11100** | **14200** | **14800** | **17750** | **18500** | **21300** | **22200** | **24850** | **25900** |

### 5.23.3 ∆TIB and ∆RIB values

**The ΔTIB,c and ΔRIB,c values for two band CA\_46-48 are covered in TS 36.101 Table 6.2.5-2 (two bands) for ΔTIB,c and Table 7.3.1-1A (two bands) for ΔRIB,c.**

### 5.23.4 REFSENS

**There are no additional reference sensitivity requirements needed.**

Annex A: Change history

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Change history** | | | | | | | |
| **Date** | **Meeting** | **Tdoc** | **CR** | **Rev** | **Cat** | **Subject/Comment** | **New version** |
| 2018-08 | RAN4#88 | R4-1810797 |  |  |  | Initial TR skeleton | 0.0.1 |
| 2018-10 | RAN4#88bis | R4-1813258 |  |  |  | The following agreed text proposals have been included:  R4-1811452, TP for TR 36.716-02-01:CA\_7-46, Huawei, HiSilicon  R4-1811453, TP for TR 36.716-02-01: CA\_18-42, KDDI Corporation  R4-1810400, TP to 36.716-02-01, CA\_7A-7A-28A, Ericsson, Telefonica  R4-1810404, TP to 36.716-02-01, 3C-28A\_1UL\_3C\_BCS0, Ericsson, Telefonica  R4-1810452, TP on TR 36.716-02-01 for CA\_3-42, SoftBank Corp | 0.1.0 |
| 2018-11 | RAN4#89 | R4-1815340 |  |  |  | R4-1813860, TP to TR 36.716-02-01: Addition of LTE configuration for CA\_28-32, Ericsson | 0.2.0 |
| 2019-04 | RAN4#90bis | R4-1904088 |  |  |  | The following agreed text proposals have been included:  R4-1900750, Update TR scope for LTE inter-band Carrier Aggregation for 2 bands DL with 1 band UL, Qualcomm Incorporated  R4-1902186, TP to TR 36.716-02-01: adding 48C in UL to 46-48 band combinations, Ericsson, T-Mobile US, Charter communications  R4-1902183, TP to TR 36.716-02-01 for CA 7-29, Huawei, Hisilicon  R4-1901463, TP for 36.716-02-01 to include CA\_3A-3A-7C, Ericsson, Telstra | 0.3.0 |
| 2019-05 | RAN4#91 | R4-1906836 |  |  |  | The following agreed text proposals have been included:  R4-1904086, Update TR scope for LTE inter-band Carrier Aggregation for 2 bands DL with 1 band UL, Qualcomm Incorporated  R4-1904903, TP for 36.716-02-01 on 1BUL\_25A-41A\_BCS0, SPRINT Corporation  R4-1904920, TP to TR 36.716-02-01: 28A-66A\_BCS0, Nokia, AMX  R4-1903533, TP to TR 36.716-02-01: 3A-3A-5A\_BCS0, Nokia, AMX  R4-1904906, TP to TR 36.716-02-01: 3A-3A-46C\_BCS0, Nokia, AMX | 0.4.0 |
| 2019-08 | RAN4#92 | R4-1909575 |  |  |  | The following agreed text proposals have been included:  R4-1905883, TP for TR 36.716-02-01 Introduction of CA\_7-46, Nokia, Nokia Shanghai Bell | 0.5.0 |
| 2019-10 | RAN4#92Bis | R4-1911678 |  |  |  | The following agreed text proposals have been included:  R4-1909841, TP for TR 36.716-02-01 to include CA configurations for 1-3, 1-7, Ericsson, Telstra | 0.6.0 |
| 2019-11 | RAN4#93 | R4-1915085 |  |  |  | The following agreed text proposals have been included:  R4-1911679, Update TR scope for LTE inter-band Carrier Aggregation for 2 bands DL with 1 band UL, Qualcomm Incorporated  R4-1911463, TP for TR 36.716-02-01 for CA\_7A-13A, CA\_7C-13A , CA\_7A-7A-13A, Huawei, HiSilicon  R4-1911806, TP to TR 36.716-02-01: CA\_7-7-20, Orange  R4-1912581, TP to TR 36.716-02-01: Addition of CA\_1A-1A-3A-3A, Ericsson, Telstra | 0.7.0 |
| 2020-04 | RAN4#94e-bis | R4-2003834 |  |  |  | The following agreed text proposals have been included:  R4-2002564, TP to TR 36.716-02-01: CA\_2-26, Nokia, Nokia Shanghai Bell, [AT&T]  R4-2002565, TP to TR 36.716-02-01: CA\_26-66, Nokia, Nokia Shanghai Bell, [AT&T] | 0.8.0 |
| 2020-05 | RAN4#94e-bis | R4-2003834 |  |  |  | The following agreed text proposals have been included:  R4-2005042, TP for TR 36.716-02-01: CA\_20A-41A\CA\_20A-41C\CA\_20A-41D, Huawei, HiSilicon  R4-2003113, TP for TR 36.716-02-01: CA\_1A-41C, Samsung, KDDI  R4-2005037, TP for TR 36.716-02-01: CA\_18-41, Samsung, KDDI  R4-2005041, TP for TR 36.716-02-01-070 for CA band combinations CA\_46A-48B, CA\_46B-48B, CA\_46C-48B, CA\_46D-48B and CA\_46E-48B for single UL and dual UL, Charter Communications, Inc | 0.9.0 |
| 2020-06 | RAN4#95e | R4-2007562 |  |  |  | Update the editorial correctios | 10.0.0 |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Change history** | | | | | | | |
| **Date** | **Meeting** | **TDoc** | **CR** | **Rev** | **Cat** | **Subject/Comment** | **New version** |
| 2020-06 | RAN#88 |  |  |  |  | Approved by plenary – Rel-16 spec under change control | 16.0.0 |