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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 17)

** 

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# Foreword

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

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# 1 Scope

The present document is a technical report for 2B DL/1B UL Inter-band Carrier Aggregation under Rel-17 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-17 band combinations in Table 1-1.

Table 1-1: Release 17 2BDL/1BUL inter-band carrier aggregation combinations

|  |  |
| --- | --- |
| CA combination | REL-independent from |
|  |  |

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".

# 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 [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].

# 4 Background

The present document is a technical report for 2B DL/1B UL Inter-band Carrier Aggregation under Rel-17 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\_48-53

### 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 bandBS receiveUE transmit | Downlink (DL) operating bandBS transmit UE receive | Duplex Mode |
| FUL\_low – FUL\_high | FDL\_low – FDL\_high |
| 48 | 3550 MHz | – | 3700 MHz | 3550 MHz | – | 3700 MHz | TDD |
| 53 | 2483.5 MHz | – | 2495 MHz | 2483.5 MHz | – | 2495 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 | 1.4MHz | 3MHz | 5MHz | 10MHz | 15MHz | 20MHz | Maximum aggregated bandwidth[MHz] | Bandwidth combination set |
| CA\_48A\_53A | - | 48 |   |   | Yes | Yes | Yes | Yes | 30 | 0 |
| 53 |   |   | Yes | Yes |   |   |
| CA\_48C\_53A | - | 48 | See CA\_48C Bandwidth combination set 0 in Table 5.6A.1-1 | 50 | 0 |
| 53 |  |  | Yes | Yes |  |  |
| CA\_48D\_53A | - | 48 | See CA\_48D Bandwidth combination set 0 in Table 5.6A.1-1 | 70 | 0 |
| 53 |  |  | Yes | Yes |  |  |

### 5.1.2 Co-existence studies

Table 5.1.2-1 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA \_ 48-53.

**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** |
| **48** | 3550 | 3700 | 3550 | 3700 | 7100 | 7400 | 10650 | 11100 | 14200 | 14800 |
| **53** | 2483.5 | 2495 | 2483.5 | 2495 | 4967 | 4990 | 7450.5 | 7485 | 9934 | 9980 |

**Table 5.x.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 |
| **48** | 3550 | 3700 | 3550 | 3700 | 7100 | 7400 | 10650 | 11100 | 14200 | 14800 |
| **53** | 2483.5 | 2495 | 2483.5 | 2495 | 4967 | 4990 | 7450.5 | 7485 | 9934 | 9980 |

### 5.1.3 ∆TIB and ∆RIB values

Relaxation values are re-used from CA\_41-53 which is similar.

Table 5.1.3-1: IB,c

|  |  |  |
| --- | --- | --- |
| CA\_48-53 | 48 | 0.54 |
| 53 | 04 |
| NOTE 4: Only applicable for UE supporting inter-band carrier aggregation with uplink in one E-UTRA band and without simultaneous Rx/Tx. |

Table 5.1.3-2: R IB,c

|  |  |  |
| --- | --- | --- |
| CA\_48-53 | 48 | 0.54 |
| 53 | 04 |
| NOTE 4: Only applicable for UE supporting inter-band carrier aggregation with uplink in one E-UTRA band and without simultaneous Rx/Tx. |

### 5.1.4 REFSENS

No additional REFSENS requirement is needed.

## 5.2 CA\_7-25

### 5.2.1 Channel bandwidths per operating band for CA

Table 5.2.1-1: Inter-band CA operating bands

|  |  |  |  |
| --- | --- | --- | --- |
| E‑UTRA Operating Band | Uplink (UL) operating bandBS receiveUE transmit | Downlink (DL) operating bandBS transmit UE receive | Duplex Mode |
| FUL\_low – FUL\_high | FDL\_low – FDL\_high |
| 7 | 2500 MHz | – | 2570 MHz | 2620 MHz | – | 2690 MHz | FDD |
| 25 | 1850 MHz | – | 1915 MHz | 1930 MHz | – | 1995 MHz | FDD |

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 | 1.4MHz | 3MHz | 5MHz | 10MHz | 15MHz | 20MHz | Maximum aggregated bandwidth[MHz] | Bandwidth combination set |
| CA\_7A-25A | - | 7 |  |  | Yes | Yes | Yes | Yes | 40 | 0 |
| 25 | Yes | Yes | Yes | Yes | Yes | Yes |
| CA\_7A-7A-25A | - | 7 | See CA\_7A-7A Bandwidth Combination Set 1 in Table 5.6A.1-3 | 60 | 0 |
| 25 | Yes | Yes | Yes | Yes | Yes | Yes |
| CA\_7C-25A | - | 7 | See CA\_7C Bandwidth Combination Set 1 in Table 5.6A.1-1 | 60 | 0 |
| 25 | Yes | Yes | Yes | Yes | Yes | Yes |
| CA\_7A-25A-25A | - | 7 |  |  | Yes | Yes | Yes | Yes | 60 | 0 |
| 25 | See CA\_25A-25A Bandwidth Combination Set 1 in Table 5.6A.1-3 |
| CA\_7A-7A-25A-25A | - | 7 | See CA\_7A-7A Bandwidth Combination Set 1 in Table 5.6A.1-3 | 80 | 0 |
| 25 | See CA\_25A-25A Bandwidth Combination Set 1 in Table 5.6A.1-3 |
| CA\_7C-25A-25A | - | 7 | See CA\_7C Bandwidth Combination Set 1 in Table 5.6A.1-1 | 80 | 0 |
| 25 | See CA\_25A-25A Bandwidth Combination Set 1 in Table 5.6A.1-3 |

### 5.2.2 Co-existence studies

Table 5.2.2-1 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA\_7-25.

**Table 5.2.2-1: 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 |
| 7 | 2500 | 2570 | 2620 | 2690 | 5000 | 5140 | 7500 | 7710 | - | - |
| 25 | 1850 | 1915 | 1930 | 1995 | 3700 | 3830 | 5550 | 5745 | - | - |

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

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | **3rd Harmonic** | **mth Harmonic** |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge |
| 7 | 2500 | 2570 | 2620 | 2690 | 5240 | 5380 | 7860 | 8070 | - | - |
| 25 | 1850 | 1915 | 1930 | 1995 | 3860 | 3990 | 5790 | 5985 | - | - |

There is no harmonic or harmonic mixing issue for this band combination.

### 5.2.3 ∆TIB and ∆RIB values

Relaxation values for this band combination is based on the general framework for high – high band combination.

Table 5.2.3-1: IB,c

|  |  |  |
| --- | --- | --- |
| CA\_7-25 | 7 | 0.5 |
| 25 | 0.5 |

Table 5.2.3-2: R IB,c

|  |  |  |
| --- | --- | --- |
| CA\_7-25 | 7 | 0 |
| 25 | 0 |

### 5.2.4 REFSENS

REFSENS exceptions are not required for this band combination due to no harmonic or harmonic mixing issue.

## 5.3 CA\_25-66

### 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 bandBS receiveUE transmit | Downlink (DL) operating bandBS transmit UE receive | Duplex Mode |
| FUL\_low – FUL\_high | FDL\_low – FDL\_high |
| 25 | 1850 MHz | – | 1915 MHz | 1930 MHz | – | 1995 MHz | FDD |
| 66 | 1710 MHz | – | 1780 MHz | 2110 MHz | – | 2200 MHz | FDD |

Table 5.3.1-2: 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 | 1.4MHz | 3MHz | 5MHz | 10MHz | 15MHz | 20MHz | Maximum aggregated bandwidth[MHz] | Bandwidth combination set |
| CA\_25A-66A | - | 25 | Yes | Yes | Yes | Yes | Yes | Yes | 40 | 0 |
| 66 | Yes | Yes | Yes | Yes | Yes | Yes |
| CA\_25A-25A-66A | - | 25 | See CA\_25A-25A Bandwidth Combination Set 1 in Table 5.6A.1-3 | 60 | 0 |
| 66 | Yes | Yes | Yes | Yes | Yes | Yes |

### 5.3.2 Co-existence studies

Table 5.3.2-1/2 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA\_25-66.

**Table 5.3.2-1: 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 | 5550 | 5745 | - | - |
| 66 | 1710 | 1780 | 2110 | 2200 | 3420 | 3560 | 5130 | 5340 | - | - |

**Table 5.3.2-2: Impact of UL/DL Harmonic mixing**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | **3rd Harmonic** | **mth Harmonic** |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge |
| 25 | 1850 | 1915 | 1930 | 1995 | 3700 | 3830 | 5550 | 5745 | - | - |
| 66 | 1710 | 1780 | 2110 | 2200 | 4220 | 4400 | 6330 | 6600 | - | - |

There is no harmonic or harmonic mixing issue for this band combination.

### 5.3.3 ∆TIB and ∆RIB values

Relaxation values for this band combination is based on the similar combination, CA\_2-4.

Table 5.3.3-1: IB,c

|  |  |  |
| --- | --- | --- |
| CA\_25-66 | 25 | 0.5 |
| 66 | 0.5 |

Table 5.3.3-2: R IB,c

|  |  |  |
| --- | --- | --- |
| CA\_25-66 | 25 | 0.3 |
| 66 | 0.3 |

### 5.3.4 REFSENS

REFSENS exceptions are not required for this band combination due to no harmonic or harmonic mixing issue.

## 5.4 CA\_2-8

### 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 bandBS receiveUE transmit | Downlink (DL) operating bandBS transmit UE receive | Duplex Mode |
| FUL\_low – FUL\_high | FDL\_low – FDL\_high |
| 2 | 1850 MHz | – | 1910 MHz | 1930 MHz | – | 1990 MHz | FDD |
| 8 | 880 MHz | – | 915 MHz | 925 MHz | – | 960 MHz | FDD |

Table 5.4.1-2: 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 | 1.4MHz | 3MHz | 5MHz | 10MHz | 15MHz | 20MHz | Maximum aggregated bandwidth[MHz] | Bandwidth combination set |
| CA\_2A-8A | - | 2 |  |  | Yes | Yes | Yes | Yes | 30 | 0 |
| 8 |  |  | Yes | Yes |  |  |

### 5.4.2 Co-existence studies

Table 5.4.2-1 and 5.4.2-2 summarize frequency ranges where harmonics and/or harmonics mixing occur for CA \_ 2-8.

**Table 5.4.2-1: 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 | 5730 | 7400 | 7640 |
| 8 | 880 | 915 | 925 | 960 | 1760 | 1830 | 2640 | 2745 | 3520 | 3660 |

**Table 5.4.2-2: 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 |
| 8 | 880 | 915 | 925 | 960 | 1850 | 1920 | 2775 | 2880 | 3700 | 3840 |

The 2nd harmonic of band 8 Rx may fall into frequency range of band 2 Tx.

### 5.4.3 ∆TIB and ∆RIB values

Table 5.4.3-1: IB,c

|  |  |  |
| --- | --- | --- |
| CA\_2-8 | 2 | 0.3 |
| 8 | 0.3 |

Table 5.4.3-2: R IB,c

|  |  |  |
| --- | --- | --- |
| CA\_2-8 | 2 | 0 |
| 8 | 0 |

### 5.4.4 REFSENS

In LTE, we only consider the harmonic mixing relaxation of REFSENS for odd harmonics and not even harmonics referring to R4-1909937. Thus, there is no need to specify MSD for CA\_2-8. The same principle is also used for DC\_3\_n78.

## 5.5 CA\_46-53

### 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 bandBS receiveUE transmit | Downlink (DL) operating bandBS transmit UE receive | Duplex Mode |
| FUL\_low – FUL\_high | FDL\_low – FDL\_high |
| 46 | 5150 MHz | – | 5925 MHz | 5150 MHz | – | 5925 MHz | TDD8 |
| 53 | 2483.5 MHz | – | 2495 MHz | 2483.5 MHz | – | 2495 MHz | TDD |
| NOTE 8: This band is an unlicensed band restricted to licensed-assisted operation using Frame Structure Type 3  |

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 | 1.4MHz | 3MHz | 5MHz | 10MHz | 15MHz | 20MHz | Maximum aggregated bandwidth[MHz] | Bandwidth combination set |
| CA\_46A\_53A | - | 46 |  |  |  |  |  | Yes | 30 | 0 |
| 53 |  |  | Yes | Yes |  |  |
| CA\_46C\_53A | - | 46 | See CA\_46C Bandwidth combination set 0 in Table 5.6A.1-1 | 50 | 0 |
| 53 |  |  | Yes | Yes |  |  |
| CA\_46D\_53A | - | 46 | See CA\_46D Bandwidth combination set 0 in Table 5.6A.1-1 | 70 | 0 |
| 53 |  |  | Yes | Yes |  |  |
| CA\_46E\_53A | - | 46 | See CA\_46E Bandwidth combination set 0 in Table 5.6A.1-1 | 90 | 0 |
| 53 |  |  | Yes | Yes |  |  |

### 5.5.2 Co-existence studies

Table 5.5.2-1 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA \_46-53.

**Table 5.5.2-1: 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** |
| **46** | 5150 | 5925 | 5150 | 5925 | 10300 | 11850 | 15450 | 17775 | 20600 | 23700 |
| **53** | 2483.5 | 2495 | 2483.5 | 2495 | 4967 | 4990 | 7450.5 | 7485 | 9934 | 9980 |

**Table 5.5.2-2: 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 |
| **46** | 5150 | 5925 | 5150 | 5925 | 10300 | 11850 | 15450 | 17775 | 20600 | 23700 |
| **53** | 2483.5 | 2495 | 2483.5 | 2495 | 4967 | 4990 | 7450.5 | 7485 | 9934 | 9980 |

No harmonic issues identified.

### 5.5.3 ∆TIB and ∆RIB values

Relaxation values are re-used from CA\_46-53 which is similar.

Table 5.5.3-1: IB,c

|  |  |  |
| --- | --- | --- |
| CA\_46-53 | 53 | 0 |

Table 5.5.3-2: R IB,c

|  |  |  |
| --- | --- | --- |
| CA\_46-53 | 53 | 0 |

### 5.5.4 REFSENS

No additional REFSENS requirement is needed.

## 5.6 CA\_3A-3A-38A

### 5.6.1 Channel bandwidths per operating band for CA

Table 5.6.1-1: Supported channel bandwidths per CA configuration for 2DL inter-band CA

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **E-UTRA CA Configuration** | **UL 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-38A | - | 3 | See CA\_3A-3A Bandwidth Combination Set 0 in Table 5.6A.1-3 | 60 | 0 |
| 38 |  |  | Yes | Yes | Yes | Yes |

### 5.6.2 ∆TIB and ∆RIB values

For CA\_3-3-38, the ΔTIB,c and ΔRIB,c values are shown in table 5.6.2-1 and table 5.6.2-2, respectively.

Table 5.6.2-1: ΔTIB,c for 2DL aggregation

| **Inter-band CA Configuration** | **E-UTRA Band** | **ΔTIB,c [dB]** |
| --- | --- | --- |
| CA\_3-3-38 | 3 | 0.5 |
| 38 | 0.5 |

Table 5.6.2-2: ΔRIB,c for 2DL aggregation

| **Inter-band CA Configuration** | **E-UTRA Band** | **ΔRIB,c [dB]** |
| --- | --- | --- |
| CA\_3-3-38 | 3 | 0 |
| 38 | 0 |

### 5.6.3 REFSENS

No additional MSD required for this combination.

## 5.7 CA\_32A-38A

### 5.7.1 Channel bandwidths per operating band for CA

Table 5.7.1-1: Supported channel bandwidths per CA configuration for 2DL inter-band CA

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **E-UTRA CA Configuration** | **UL 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\_32A-38A | - | 32 |  |  | Yes | Yes | Yes | Yes | 40 | 0 |
| 38 |  |  | Yes | Yes | Yes | Yes |

### 5.7.2 ∆TIB and ∆RIB values

For CA\_32-38, the ΔTIB,c and ΔRIB,c values are shown in table 5.7.2-1 and table 5.7.2-2, respectively.

Table 5.7.2-1: ΔTIB,c for 2DL aggregation

| **Inter-band CA Configuration** | **E-UTRA Band** | **ΔTIB,c [dB]** |
| --- | --- | --- |
| CA\_32-38 | 38 | 0.7 |

Table 5.7.2-2: ΔRIB,c for 2DL aggregation

| **Inter-band CA Configuration** | **E-UTRA Band** | **ΔRIB,c [dB]** |
| --- | --- | --- |
| CA\_32-38 | 32 | 0 |
| 38 | 0 |

### 5.7.3 REFSENS

No additional MSD required for this combination.

## 5.8 CA\_38-66

### 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 bandBS receiveUE transmit | Downlink (DL) operating bandBS transmit UE receive | Duplex Mode |
| FUL\_low – FUL\_high | FDL\_low – FDL\_high |
| 38 | 2570 MHz | – | 2620 MHz | 2570 MHz | – | 2620 MHz | TDD |
| 66 | 1710 MHz | – | 1780 MHz | 2110 MHz | – | 2200 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 | 1.4MHz | 3MHz | 5MHz | 10MHz | 15MHz | 20MHz | Maximum aggregated bandwidth[MHz] | Bandwidth combination set |
| CA\_38A-66A | - | 38 |  |  | Yes | Yes | Yes | Yes | 40 | 0 |
| 66 |  |  | Yes | Yes | Yes | Yes |
| CA\_38C-66A | **-** | 38 | See CA\_38C Bandwidth Combination Set 0 in Table 5.6A.1-1 | 60 | 0 |
| 66 |  |  | Yes | Yes | Yes | Yes |

### 5.8.2 Co-existence studies

Table 5.8.2-1 and 5.8.2-2 summarize frequency ranges where harmonics and/or harmonics mixing occur for CA \_ 38-66.

**Table 5.8.2-1: 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 |
| 38 | 2570 | 2620 | 2570 | 2620 | 5140 | 5240 | 7710 | 7860 | 10280 | 10480 |
| 66 | 1710 | 1780 | 2110 | 2200 | 3420 | 3560 | 5130 | 5340 | 6840 | 7120 |

**Table 5.8.2-2: 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 |
| 38 | 2570 | 2620 | 2570 | 2620 | 5140 | 5240 | 7710 | 7860 | 10280 | 10480 |
| 66 | 1710 | 1780 | 2110 | 2200 | 4220 | 4400 | 6330 | 6600 | 8440 | 8800 |

There is no harmonic issues for this band combinations.

### 5.8.3 ∆TIB and ∆RIB values

Referring to DC\_66\_n38, the ∆TIB and ∆RIB values can be specified as below.

Table 5.8.3-1: IB,c

|  |  |  |
| --- | --- | --- |
| CA\_38-66 | 38 | 0.5 |
| 66 | 0.5 |

Table 5.8.3-2: R IB,c

|  |  |  |
| --- | --- | --- |
| CA\_38-66 | 38 | 0.5 |
| 66 | 0.5 |

### 5.8.4 REFSENS

Referring to the DC\_66\_n38, the REFSENS exception for CA\_38-66 can be specified as below.

Table 5.8.4-1: Reference sensitivity for carrier aggregation QPSK PREFSENS, CA (exceptions due to cross band isolation issues of TDD and FDD bands)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 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\_38A-66ACA\_38C-66A | 66 |  |  | -97.6 | -94.6 | -92.8 | -91.6 | FDD | 38 |

Table 5.8.4-2: Uplink configuration for reference sensitivity (exceptions due to cross band isolation issues of TDD and FDD bands)

|  |
| --- |
| E-UTRA Band / Channel bandwidth of the affected DL band / NRB / Duplex mode |
| EUTRA CA Configuration | E-UTRA Band | 1.4 MHz | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz | Duplex Mode |
| CA\_38A-66ACA\_38C-66A | 38 |  |  | 100 | 100 | 100 | 100 | TDD |

## 5.9 CA\_26-38

### 5.9.1 Channel bandwidths per operating band for CA

Table 5.9.1-1: Inter-band CA operating bands

|  |  |  |  |
| --- | --- | --- | --- |
| E‑UTRA Operating Band | Uplink (UL) operating bandBS receiveUE transmit | Downlink (DL) operating bandBS transmit UE receive | Duplex Mode |
| FUL\_low – FUL\_high | FDL\_low – FDL\_high |
| 26 | 814 MHz | – | 849 MHz | 859 MHz | – | 894 MHz | FDD |
| 38 | 2570 MHz | – | 2620 MHz | 2570 MHz | – | 2620 MHz | TDD |

Table 5.9.1-2: 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 | 1.4MHz | 3MHz | 5MHz | 10MHz | 15MHz | 20MHz | Maximum aggregated bandwidth[MHz] | Bandwidth combination set |
| CA\_26A-38A | - | 26 |  |  | Yes | Yes | Yes |  | 35 | 0 |
| 38 |  |  | Yes | Yes | Yes | Yes |
| CA\_26A-38C | **-** | 26 |  |  | Yes | Yes | Yes |  | 55 | 0 |
| 38 | See CA\_38C Bandwidth Combination Set 0 in Table 5.6A.1-1 |

### 5.9.2 Co-existence studies

Table 5.9.2-1 and 5.9.2-2 summarize frequency ranges where harmonics and/or harmonics mixing occur for CA \_ 26-38.

**Table 5.9.2-1: 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 |
| 38 | 2570 | 2620 | 2570 | 2620 | 5140 | 5240 | 7710 | 7860 | 10280 | 10480 |

**Table 5.9.2-2: 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 |
| 38 | 2570 | 2620 | 2570 | 2620 | 5140 | 5240 | 7710 | 7860 | 10280 | 10480 |

The 3rd harmonic of band 26 DL frequency is overlapping with the UL frequency of band 38.

### 5.9.3 ∆TIB and ∆RIB values

Referring to CA\_5-38, the ∆TIB and ∆RIB values can be specified as below.

Table 5.9.3-1: IB,c

|  |  |  |
| --- | --- | --- |
| CA\_26-38 | 26 | 0.3 |
| 38 | 0.3 |

Table 5.9.3-2: R IB,c

|  |  |  |
| --- | --- | --- |
| CA\_26-38 | 26 | 0 |
| 38 | 0 |

### 5.9.4 REFSENS

Referring to the DC\_26\_n41, the REFSENS exception due to harmonic mixing issue for CA\_26-38 can be specified as below.

Table 5.9.4-1: 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\_26A-38A15, 16CA\_26A-38C15, 16 | 26 |  |  | -73.2 | -70.3 | -70.2 |  | FDD |
| NOTE 15: These requirements apply when there is at least one individual RE within the downlink transmission bandwidth of the victim (lower) band for which the 3rd harmonic is within the uplink transmission bandwidth or the uplink adjacent channel’s transmission bandwidth of an aggressor (higher) band.NOTE 16: The requirements should be verified for UL EARFCN of the aggressor (higher) band (superscript HB) such that  in MHz and  with  the carrier frequency in the victim (lower) band and  the channel bandwidth configured in the higher band. |

Table 5.9.4-2: 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\_26A-38ACA\_26A-38C | 38 |  |  | 25 | 50 | 75 |  | TDD |
|  |

## 5.10 CA\_2-38

### 5.10.1 Channel bandwidths per operating band for CA

Table 5.10.1-1: Inter-band CA operating bands

|  |  |  |  |
| --- | --- | --- | --- |
| E‑UTRA Operating Band | Uplink (UL) operating bandBS receiveUE transmit | Downlink (DL) operating bandBS transmit UE receive | Duplex Mode |
| FUL\_low – FUL\_high | FDL\_low – FDL\_high |
| 2 | 1850 MHz | – | 1910 MHz | 1930 MHz | – | 1990 MHz | FDD |
| 38 | 2570 MHz | – | 2620 MHz | 2570 MHz | – | 2620 MHz | TDD |

Table 5.10.1-2: 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 | 1.4MHz | 3MHz | 5MHz | 10MHz | 15MHz | 20MHz | Maximum aggregated bandwidth[MHz] | Bandwidth combination set |
| CA\_2A-38A | - | 2 |  |  | Yes | Yes | Yes | Yes | 40 | 0 |
| 38 |  |  | Yes | Yes | Yes | Yes |

### 5.10.2 Co-existence studies

Table 5.10.2-1 and 5.10.2-2 summarize frequency ranges for harmonics and/or harmonics mixing.

**Table 5.10.2-1: 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 | 5730 | 7400 | 7640 |
| 38 | 2570 | 2620 | 2570 | 2620 | 5140 | 5240 | 7710 | 7860 | 10280 | 10480 |

**Table 5.10.2-2: 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 |
| 38 | 2570 | 2620 | 2570 | 2620 | 5140 | 5240 | 7710 | 7860 | 10280 | 10480 |

There is no harmonics or harmonics mixing relations for this band combination.

### 5.10.3 ∆TIB and ∆RIB values

The relaxations are for the high-high band combination.

Table 5.10.3-1: IB,c

|  |  |  |
| --- | --- | --- |
| CA\_2-38 | 2 | 0.5 |
| 38 | 0.5 |

Table 5.10.3-2: R IB,c

|  |  |  |
| --- | --- | --- |
| CA\_2-38 | 2 | 0 |
| 38 | 0 |

### 5.10.4 REFSENS

No REFSENS exception is needed for this band combination.

## 5.11 CA\_30-48

### 5.11.1 Channel bandwidths per operating band for CA

Table 5.11.1-1: Inter-band CA operating bands

|  |  |  |  |
| --- | --- | --- | --- |
| E‑UTRA Operating Band | Uplink (UL) operating bandBS receiveUE transmit | Downlink (DL) operating bandBS transmit UE receive | Duplex Mode |
| FUL\_low – FUL\_high | FDL\_low – FDL\_high |
| 30 | 2305 MHz | – | 2315 MHz | 2350 MHz | – | 2360 MHz | FDD |
| 48 | 3550 MHz | – | 3700 MHz | 3550 MHz | – | 3700 MHz | TDD |

Table 5.11.1-2: 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 | 1.4MHz | 3MHz | 5MHz | 10MHz | 15MHz | 20MHz | Maximum aggregated bandwidth[MHz] | Bandwidth combination set |
| CA\_30A\_48A | - | 30 |   |   | Yes | Yes |  |  | 30 | 0 |
| 48 |   |   | Yes | Yes | Yes | Yes |

### 5.11.2 Co-existence studies

Table 5.11.2-1 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA\_30-48.

**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** |
| **30** | 2305 | 2315 | 2305 | 2315 | 4610 | 4630 | 6915 | 6945 | 9220 | 9260 |
| 48 | 3550 | 3700 | 3550 | 3700 | 7100 | 7400 | 10650 | 11100 | 14200 | 14800 |

**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 |
| **30** | 2305 | 2315 | 2305 | 2315 | 4700 | 4720 | 7050 | 7080 | 9400 | 9440 |
| 48 | 3550 | 3700 | 3550 | 3700 | 7100 | 7400 | 10650 | 11100 | 14200 | 14800 |

No harmonic issues identified.

### 5.11.3 ∆TIB and ∆RIB values

Relaxation values are re-used from CA\_41-48 which is similar.

Table 5.11.3-1: IB,c

|  |  |  |
| --- | --- | --- |
| CA\_30-48 | 30 | 04 |
| 48 | 0.54 |
| NOTE 4: Only applicable for UE supporting inter-band carrier aggregation with uplink in one E-UTRA band and without simultaneous Rx/Tx. |

Table 5.11.3-2: R IB,c

|  |  |  |
| --- | --- | --- |
| CA\_30-48 | 30 | 04 |
| 48 | 0.54 |
| NOTE 4: Only applicable for UE supporting inter-band carrier aggregation with uplink in one E-UTRA band and without simultaneous Rx/Tx. |

### 5.1.4 REFSENS

No additional REFSENS requirement is needed.

# Annex A: Change history

|  |
| --- |
| **Change history** |
| **Date** | **Meeting** | **Tdoc** | **CR** | **Rev** | **Cat** | **Subject/Comment** | **New version** |
| 2020-08 | RAN4#96e | R4-2011334 |  |  |  | Initial TR skeleton | 0.0.1 |
| 2021-02 | RAN4#98e | R4-2102496 |  |  |  | The following approved TPs were captured in the TR:* R4-2100151, TP to TR 36.717-02-01: Addition of CA\_48-53, Nokia, Globalstar
* R4-2100729, TP to TR 36.717-02-01 CA\_7-25, Nokia, Nokia Shanghai Bell
* R4-2100730, TP to TR 36.717-02-01 CA\_25-66, Nokia, Nokia Shanghai Bell
* R4-2101575, TP for TR 36.717-02-01: CA\_2A-8A, Huawei, HiSilicon
* R4-2101936, TP to TR 36.717-02-01 Addition of CA\_46-53, Nokia, Globalstar
 | 0.2.0 |
| 2021-08 | RAN4#100e | R4-2112239 |  |  |  | The following approved TPs were captured in the TR:* R4-2112966, TP for TR 36.717-02-01: CA\_3A-3A-38A, VODAFONE Group Plc
* R4-2112967, TP for TR 36.717-02-01: CA\_32A-38A, VODAFONE Group Plc
 | 0.5.0 |
| 2021-11 | RAN4#101e | R4-2118140 |  |  |  | The following approved TPs were captured in the TR:* R4-2119741, TP for TR 36.717-02-01 CA\_38A-66A and CA\_38C-66A, Huawei, HiSilicon, AT&T
* R4-2118553, TP for TR 36.717-02-01: CA\_26A-38A and CA\_26A-38C, Huawei, HiSilicon, AT&T
 | 0.6.0 |
| 2022-03 | RAN4#101-bis-eRAN4#102e | R4-2204498 |  |  |  | The following apporved TPs were captured in the TR:* R4-2200349, TP to TR 36.717-02-01: CA\_2-38, Nokia, Nokia Shanghai Bell
* R4-2202240, TP for TR 36.717-02-01 to include CA\_30A-48A, Ericsson, AT&T
 | 0.7.0 |