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Technical Report

3rd Generation Partnership Project;

Technical Specification Group Radio Access Networks;

LTE inter-band CA for 4 bands DL with 1 band UL

(Release 16)



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Contents

Foreword 4

1 Scope 5

2 References 5

3 Definitions, symbols and abbreviations 6

3.1 Definitions 6

3.2 Symbols 6

3.3 Abbreviations 6

4 Background 6

4.1 TR Maintenance 6

5 4 Band Carrier Aggregation with Single UL: Specific Band Combination Part 7

5.1 CA\_n1A-n3A-n8A-n78A 7

5.1.1 Channel bandwidths per operating bands for CA 7

5.1.2 ∆TIB,c and ∆RIB,c values 7

5.1.3 REFSENS requirements 7

5.2 CA\_n1A-n3A-n28A-n78A 8

5.2.1 Channel bandwidths per operating bands for CA 8

5.2.2 ∆TIB,c and ∆RIB,c values 8

5.2.3 REFSENS requirements 8

5.3 CA\_n3-n28-n77-n257 9

5.3.1 Channel bandwidths per operating bands for CA 9

5.3.2 ∆TIB,c and ∆RIB,c values 9

5.3.3 REFSENS requirements 10

5.4 CA\_n3-n28-n78-n257 10

5.4.1 Channel bandwidths per operating bands for CA 10

5.4.2 ∆TIB,c and ∆RIB,c values 11

5.4.3 REFSENS requirements 11

5.5 CA\_n7-n25-n66-n78 12

5.5.1 Channel bandwidths per operating band for CA 12

5.5.2 ∆TIB and ∆RIB values 12

5.5.3 REFSENS requirements 12

5.6 CA\_n1A-n3A-n7A-n28A, CA\_n1A-n3A-n7B-n28A 13

5.6.1 Channel bandwidths per operating bands for CA 13

5.6.2 ∆TIB,c and ∆RIB,c values 13

5.6.3 REFSENS requirements 13

5.7 CA\_n1A-n3A-n7A-n78A, CA\_n1A-n3A-n7B-n78A 14

5.7.1 Channel bandwidths per operating bands for CA 14

5.7.2 ∆TIB,c and ∆RIB,c values 14

5.7.3 REFSENS requirements 14

5.8 CA\_n3A-n7A-n28A-n78A, CA\_n3A-n7B-n28A-n78A 15

5.8.1 Channel bandwidths per operating bands for CA 15

5.8.2 ∆TIB,c and ∆RIB,c values 15

5.8.3 REFSENS requirements 16

Annex A: Change history 16

# 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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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 on inter-band CA for 4 bands DL with 1 band UL under Rel-16 time frame. The purpose is to gather the relevant background information and studies in order to address 4 bands DL/1 band UL Inter-band Carrier Aggregation requirements for the Rel-16 band combinations in Table 1-1.

Table 1-1: Release 16 4 bands DL/1 band UL inter-band carrier aggregation combinations

|  |
| --- |
| CA combination |
| CA\_n1A-n3A-n8A-n78A |
| CA\_n1A-n3A-n28A-n78A |
| CA\_n3A-n28A-n77A-n257A |
| CA\_n3A-n28A-n77A-n257D |
| CA\_n3A-n28A-n77A-n257G |
| CA\_n3A-n28A-n77A-n257H |
| CA\_n3A-n28A-n77A-n257I |
| CA\_n3A-n28A-n78A-n257A |
| CA\_n3A-n28A-n78A-n257D |
| CA\_n3A-n28A-n78A-n257G |
| CA\_n3A-n28A-n78A-n257H |
| CA\_n3A-n28A-n78A-n257I |
| CA\_n3A-n28A-n77(2A)-n257A |
| CA\_n3A-n28A-n77(2A)-n257D |
| CA\_n3A-n28A-n77(2A)-n257G |
| CA\_n3A-n28A-n77(2A)-n257H |
| CA\_n3A-n28A-n77(2A)-n257I |
| CA\_n3A-n28A-n77(3A)-n257A |
| CA\_n3A-n28A-n77(3A)-n257D |
| CA\_n3A-n28A-n77(3A)-n257G |
| CA\_n3A-n28A-n77(3A)-n257H |
| CA\_n3A-n28A-n77(3A)-n257I |
| CA\_n7A-n25A-n66A-n78A |
| CA\_n1A-n3A-n7A-n28A |
| CA\_n1A-n3A-n7B-n28A |
| CA\_n1A-n3A-n7A-n78A |
| CA\_n1A-n3A-n7B-n78A |
| CA\_n3A-n7A-n28A-n78A |
| CA\_n3A-n7B-n28A-n78A |
| CA\_n2A-n5A-n66A-n260A |
| CA\_n2A-n5A-n30A-n260A |
| CA\_n5A-n30A-n66A-n260A |
| CA\_n2A-n30A-n66A-n260A |
| CA\_n2A-n5A-n66A-n260M |
| CA\_n2A-n5A-n30A-n260M |
| CA\_n5A-n30A-n66A-n260M |
| CA\_n2A-n30A-n66A-n260M |
| CA\_n2(2A)-n5A-n30A-n66A |
| CA\_n2A-n5A-n30A-n66(2A) |
| CA\_n2A-n5A-n30A-n66A |

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-191196, “New WID Rel-16 NR inter-band CA for 4 bands DL with 1 band UL”, RAN#84, Ericsson

# 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 4 bands DL/1 band UL Inter-band Carrier Aggregation under Rel-16 timeframe. The document covers each band combination specific issues (i.e. one sub-clause defined per band combination)

## 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 4 Band Carrier Aggregation with Single UL: Specific Band Combination Part

## 5.1 CA\_n1A-n3A-n8A-n78A

### 5.1.1 Channel bandwidths per operating bands for CA

Table 5.1.2-1: Supported channel bandwidths per CA configuration for 3DL inter-band CA

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Configuration** | **UL Config** | **NR Band** | **SCS [kHz]** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n1A-n3A-n8A-n78A | - | n1 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n3 | 15 | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| n8 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| n78 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes1 | Yes |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes1 | Yes |
| NOTE 1: This UE channel bandwidth is optional in this release of the specification. | | | | | | | | | | | | | | | | |

### 5.1.2 ∆TIB,c and ∆RIB,c values

For three simultaneous DLs and one UL of Band n1, n3, n8 and n78, the ΔTIB,c and ΔRIB,c  values are shown in table 5.1.4-1 and table 5.1.4-2, respectively. Values are derived from DC\_1-3-8\_n78.

Table 5.1.4-1: ΔTIB,c for 3DL aggregation

| **Inter-band CA Configuration** | **NR Band** | **ΔTIB,c [dB]** |
| --- | --- | --- |
| CA\_n1-n3-n8-n78 | n1 | 0.6 |
| n3 | 0.6 |
| n8 | 0.6 |
| n78 | 0.8 |

Table 5.1.4-2: ΔRIB,c for 3DL aggregation

| **Inter-band CA Configuration** | **NR Band** | **ΔRIB,c [dB]** |
| --- | --- | --- |
| CA\_n1-n3-n8-n78 | n1 | 0.2 |
| n3 | 0.2 |
| n8 | 0.2 |
| n78 | 0.5 |

### 5.1.3 REFSENS requirements

MSD requirements are captured in lower order combinations.

## 5.2 CA\_n1A-n3A-n28A-n78A

### 5.2.1 Channel bandwidths per operating bands for CA

Table 5.2.2-1: Supported channel bandwidths per CA configuration for 3DL inter-band CA

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Configuration** | **UL Config** | **NR Band** | **SCS [kHz]** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n1A-n3A-n28A-n78A | - | n1 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n3 | 15 | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| n28 | 15 | Yes | Yes | Yes | Yes2 |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes2 |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| n78 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes1 | Yes |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes1 | Yes |
| NOTE 1: This UE channel bandwidth is optional in this release of the specification.  NOTE 2: For the 20 MHz bandwidth, the minimum requirements are specified for NR UL carrier frequencies confined to either 713-723 MHz or 728-738 MHz. | | | | | | | | | | | | | | | | |

### 5.2.2 ∆TIB,c and ∆RIB,c values

For three simultaneous DLs and one UL of Band n1, n3, n28 and n78, the ΔTIB,c and ΔRIB,c  values are shown in table 5.2.4-1 and table 5.2.4-2, respectively. Values are derived from DC\_1-3-28\_n78.

Table 5.2.4-1: ΔTIB,c for 3DL aggregation

| **Inter-band CA Configuration** | **NR Band** | **ΔTIB,c [dB]** |
| --- | --- | --- |
| CA\_n1-n3-n28-n78 | n1 | 0.6 |
| n3 | 0.6 |
| n28 | 0.6 |
| n78 | 0.8 |

Table 5.2.4-2: ΔRIB,c for 3DL aggregation

| **Inter-band CA Configuration** | **NR Band** | **ΔRIB,c [dB]** |
| --- | --- | --- |
| CA\_n1-n3-n28-n78 | n1 | 0.2 |
| n3 | 0.2 |
| n28 | 0.2 |
| n78 | 0.5 |

### 5.2.3 REFSENS requirements

MSD requirements are captured in lower order combinations.

## 5.3 CA\_n3-n28-n77-n257

### 5.3.1 Channel bandwidths per operating bands for CA

Table 5.3.2-1: Supported channel bandwidths per CA configuration for 4DL inter-band CA

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Configuration** | **UL Config** | **NR Band** | **SCS [kHz]** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **80** | **90** | **100** | **200** | **400** | **Bandwidth combination set** |
| CA\_n3A-n28A-n77A-n257A | - | n3 | 15 | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n28 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| n77 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| n257 | 60 |  |  |  |  |  |  |  | Yes |  |  |  | Yes | Yes |  |
| 120 |  |  |  |  |  |  |  | Yes |  |  |  | Yes | Yes | Yes |
| CA\_n3A-n28A-n77A-n257D | - | n3 | 15 | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n28 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| n77 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| n257 | See CA\_n257D BCS0 in Table 5.5A.1-1 in TS 38.101-2 | | | | | | | | | | | | | | |
| CA\_n3A-n28A-n77A-n257G | - | n3 | 15 | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n28 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| n77 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| n257 | See CA\_n257G BCS0 in Table 5.5A.1-1 in TS 38.101-2 | | | | | | | | | | | | | | |
| CA\_n3A-n28A-n77A-n257H | - | n3 | 15 | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n28 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| n77 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| n257 | See CA\_n257H BCS0 in Table 5.5A.1-1 in TS 38.101-2 | | | | | | | | | | | | | | |
| CA\_n3A-n28A-n77A-n257I | - | n3 | 15 | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n28 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| n77 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| n257 | See CA\_n257I BCS0 in Table 5.5A.1-1 in TS 38.101-2 | | | | | | | | | | | | | | |

### 5.3.2 ∆TIB,c and ∆RIB,c values

For three simultaneous DLs and one UL of Band combinations n3-n28-n77, n3-n28-n257, n3-n77-n257 and n28-n77-n257, the ΔTIB,c and ΔRIB,c  values are shown in table 5.3.4-1 and table 5.3.4-2, respectively.

Table 5.3.4-1: ΔTIB,c for 4DL aggregation

| **Inter-band CA Configuration** | **NR Band** | **ΔTIB,c [dB]** |
| --- | --- | --- |
| CA\_n3-n28-n77-n257 | n3 | 0.6 |
| n28 | 0.5 |
| n77 | 0.8 |
| n257 | 0 |

Table 5.3.4-2: ΔRIB,c for 4DL aggregation

| **Inter-band CA Configuration** | **NR Band** | **ΔRIB,c [dB]** |
| --- | --- | --- |
| CA\_n3-n28-n77-n257 | n3 | 0.2 |
| n28 | 0.2 |
| n77 | 0.5 |
| n257 | 0 |

### 5.3.3 REFSENS requirements

MSD requirements are captured in the lower order combinations.

## 5.4 CA\_n3-n28-n78-n257

### 5.4.1 Channel bandwidths per operating bands for CA

Table 5.4.2-1: Supported channel bandwidths per CA configuration for 4DL inter-band CA

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Configuration** | **UL Config** | **NR Band** | **SCS [kHz]** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **80** | **90** | **100** | **200** | **400** | **Bandwidth combination set** |
| CA\_n3A-n28A-n78A-n257A | - | n3 | 15 | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n28 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| n78 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| n257 | 60 |  |  |  |  |  |  |  | Yes |  |  |  | Yes | Yes |  |
| 120 |  |  |  |  |  |  |  | Yes |  |  |  | Yes | Yes | Yes |
| CA\_n3A-n28A-n78A-n257D | - | n3 | 15 | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n28 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| n78 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| n257 | See CA\_n257D BCS0 in Table 5.5A.1-1 in TS 38.101-2 | | | | | | | | | | | | | | |
| CA\_n3A-n28A-n78A-n257G | - | n3 | 15 | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n28 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| n78 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| n257 | See CA\_n257G BCS0 in Table 5.5A.1-1 in TS 38.101-2 | | | | | | | | | | | | | | |
| CA\_n3A-n28A-n78A-n257H | - | n3 | 15 | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n28 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| n78 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| n257 | See CA\_n257H BCS0 in Table 5.5A.1-1 in TS 38.101-2 | | | | | | | | | | | | | | |
| CA\_n3A-n28A-n78A-n257I | - | n3 | 15 | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n28 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| n78 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| n257 | See CA\_n257I BCS0 in Table 5.5A.1-1 in TS 38.101-2 | | | | | | | | | | | | | | |

### 5.4.2 ∆TIB,c and ∆RIB,c values

For three simultaneous DLs and one UL of Band combinations n3-n28-n78, n3-n28-n257, n3-n78-n257 and n28-n78-n257, the ΔTIB,c and ΔRIB,c  values are shown in table 5.4.4-1 and table 5.4.4-2, respectively.

Table 5.4.4-1: ΔTIB,c for 4DL aggregation

| **Inter-band CA Configuration** | **NR Band** | **ΔTIB,c [dB]** |
| --- | --- | --- |
| CA\_n3-n28-n78-n257 | n3 | 0.6 |
| n28 | 0.5 |
| n78 | 0.8 |
| n257 | 0 |

Table 5.4.4-2: ΔRIB,c for 4DL aggregation

| **Inter-band CA Configuration** | **NR Band** | **ΔRIB,c [dB]** |
| --- | --- | --- |
| CA\_n3-n28-n78-n257 | n3 | 0.2 |
| n28 | 0.2 |
| n78 | 0.5 |
| n257 | 0 |

### 5.4.3 REFSENS requirements

MSD requirements are captured in the lower order combinations.

### 5.5 CA\_n7-n25-n66-n78

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

Table 5.5.1-1: Supported channel bandwidths per CA configuration for 4DL inter-band CA

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CA operating / channel bandwidth [MHz]** | | | | | | | | | | | | | | | | | |
| **NR CA Configuration** | **UL Configuration** | **NR Band** | **SCS [kHz]** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **70** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n7A-n25A-n66A-n78A | - | n7 | 15 | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| n25 | 15 | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| n66 | 15 | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| n78 | 15 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

#### 5.5.2 ∆TIB and ∆RIB values

For three simultaneous DLs and one UL of Band combinations n7-n25-n66, n7-n66-n78 and n25-n66-n78, the ΔTIB,c and ΔRIB,c  values are shown in table 5.5.2-1 and table 5.5.2-2, respectively.

Table 5.5.2-1: ΔTIB,c for 4DL aggregation

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n7-n25-n66-n78 | n7 | 0.5 |
| n25 | 0.6 |
| n66 | 0.6 |
| n78 | 0.8 |

Table 5.5.2-2: ΔRIB,c for 4DL aggregation

| Inter-band CA Configuration | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n7-n25-n66-n78 | n7 | 0.5 |
| n25 | 0.6 |
| n66 | 0.6 |
| n78 | 0.8 |

#### 5.5.3 REFSENS requirements

MSD requirements are captured in the lower order combinations.

## 5.6 CA\_n1A-n3A-n7A-n28A, CA\_n1A-n3A-n7B-n28A

### 5.6.1 Channel bandwidths per operating bands for CA

Table 5.6.2-1: Supported channel bandwidths per CA configuration for 3DL inter-band CA

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Configuration** | **UL Config** | **NR Band** | **SCS [kHz]** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n1A-n3A-n7A-n28A | - | n1 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n3 | 15 | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| n7 | 15 | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |
| n28 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| CA\_n1A-n3A-n7B-n28A | - | n1 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n3 | 15 | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| n7 | See CA\_n7B Bandwidth Combination Set 0 in Table 5.5A.1-1 from 38.101-1 | | | | | | | | | | | | |
| n28 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |

### 5.6.2 ∆TIB,c and ∆RIB,c values

For CA\_n1-n3-n7-n28 the ΔTIB,c and ΔRIB,c  values are shown in table 5.6.2-1 and table 5.6.2-2, respectively. Values are derived from DC\_1-3-7\_n28.

Table 5.6.2-1: ΔTIB,c for 4DL aggregation

| **Inter-band CA Configuration** | **NR Band** | **ΔTIB,c [dB]** |
| --- | --- | --- |
| CA\_n1-n3-n7-n28 | n1 | 0.6 |
| n3 | 0.6 |
| n7 | 0.6 |
| n28 | 0.6 |

Table 5.6.2-2: ΔRIB,c for 4DL aggregation

| **Inter-band CA Configuration** | **NR Band** | **ΔRIB,c [dB]** |
| --- | --- | --- |
| CA\_n1-n3-n7-n28 | n1 | 0 |
| n3 | 0 |
| n7 | 0 |
| n28 | 0.2 |

### 5.6.3 REFSENS requirements

MSD requirements are captured in lower order combinations.

## 5.7 CA\_n1A-n3A-n7A-n78A, CA\_n1A-n3A-n7B-n78A

### 5.7.1 Channel bandwidths per operating bands for CA

Table 5.7.2-1: Supported channel bandwidths per CA configuration for 3DL inter-band CA

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Configuration** | **UL Config** | **NR Band** | **SCS [kHz]** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **70** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n1A-n3A-n7A-n78A | - | n1 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |
| n3 | 15 | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |
| n7 | 15 | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| n78 | 15 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| 15 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| CA\_n1A-n3A-n7B-n78A | - | n1 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |
| n3 | 15 | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |
| n7 | See CA\_n7B Bandwidth Combination Set 0 in Table 5.5A.1-1 from 38.101-1 | | | | | | | | | | | | | |
| n78 | 15 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| 15 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

### 5.7.2 ∆TIB,c and ∆RIB,c values

For CA\_n1-n3-n7-n78 the ΔTIB,c and ΔRIB,c  values are shown in table 5.7.2-1 and table 5.7.2-2, respectively. Values are derived from DC\_1-3-7\_n78.

Table 5.7.2-1: ΔTIB,c for 4DL aggregation

| **Inter-band CA Configuration** | **NR Band** | **ΔTIB,c [dB]** |
| --- | --- | --- |
| CA\_n1-n3-n7-n78 | n1 | 0.7 |
| n3 | 0.7 |
| n7 | 0.7 |
| n78 | 0.8 |

Table 5.7.2-2: ΔRIB,c for 4DL aggregation

| **Inter-band CA Configuration** | **NR Band** | **ΔRIB,c [dB]** |
| --- | --- | --- |
| CA\_n1-n3-n7-n78 | n1 | 0.3 |
| n3 | 0.3 |
| n7 | 0.3 |
| n78 | 0.5 |

### 5.7.3 REFSENS requirements

MSD requirements are captured in lower order combinations.

## 5.8 CA\_n3A-n7A-n28A-n78A, CA\_n3A-n7B-n28A-n78A

### 5.8.1 Channel bandwidths per operating bands for CA

Table 5.8.2-1: Supported channel bandwidths per CA configuration for 3DL inter-band CA

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Configuration** | **UL Config** | **NR Band** | **SCS [kHz]** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n3A-n7A-n28A-n78A | - | n3 | 15 | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| n7 | 15 | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |
| n28 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| n78 | 15 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| 15 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| CA\_n3A-n7B-n28A-n78A | - | n3 | 15 | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| n7 | See CA\_n7B Bandwidth Combination Set 0 in Table 5.5A.1-1 from 38.101-1 | | | | | | | | | | | | |
| n28 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| n78 | 15 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| 15 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

### 5.8.2 ∆TIB,c and ∆RIB,c values

For CA\_n3-n7-n28-n78 the ΔTIB,c and ΔRIB,c  values are shown in table 5.8.2-1 and table 5.8.2-2, respectively. Values are derived from DC\_3-7-28\_n78.

Table 5.8.2-1: ΔTIB,c for 4DL aggregation

| **Inter-band CA Configuration** | **NR Band** | **ΔTIB,c [dB]** |
| --- | --- | --- |
| CA\_n3-n7-n28-n78 | n3 | 0.6 |
| n7 | 0.6 |
| n28 | 0.6 |
| n78 | 0.6 |

Table 5.8.2-2: ΔRIB,c for 4DL aggregation

| **Inter-band CA Configuration** | **NR Band** | **ΔRIB,c [dB]** |
| --- | --- | --- |
| CA\_n3-n7-n28-n78 | n3 | 0.2 |
| n7 | 0.2 |
| n28 | 0.2 |
| n78 | 0.5 |

### 5.8.3 REFSENS requirements

MSD requirements are captured in lower order combinations.

# Annex A: Change history

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Change history** | | | | | | | |
| **Date** | **TSG #** | **TSG Doc.** | **CR** | **Rev** | **Subject/Comment** | **Old** | **New** |
| 2019-08 | 3GPP RAN4#92 | R4-1909786 |  |  | Initial TR skeleton |  | 0.0.1 |
| 2019-11 | 3GPP RAN4#93 | R4-1914684 |  |  | Implemented TP´s from RAN4 #92bis:  R4-1912260, “TP for TR 38.716-04-01 to include CA\_n1-n3-n8-n78”, Ericsson, Swisscom  R4-1912261, “TP for TR 38.716-04-01 to include CA\_n1-n3-n28-n78”, Ericsson, Swisscom | 0.0.1 | 0.1.0 |
| 2020-02 | 3GPP RAN4#94 | R4-2001504 |  |  | Implemented TP´s from RAN4 #92bis:  R4-1912238, “TP for TR 38.716-04-01: updated scope of the NR 4-band CA REL-16 WI”, Ericsson  Implemented TP´s from RAN4 #93:  [R4-1913672](file:///D:\RAN4\TSGRAN4_93\Docs\R4-1913672.zip), “TP for TR 38.716-04-01: NR CA\_n3-n28-n77-n257”, SoftBank Corp  [R4-1913673](file:///D:\RAN4\TSGRAN4_93\Docs\R4-1913673.zip), “TP for TR 38.716-04-01: NR CA\_n3-n28-n78-n257”, SoftBank Corp | 0.1.0 | 0.2.0 |
| 2020-04 | 3GPP RAN4#94 bis | R4-2004578 |  |  | Correction of implementation of TP from RAN4 #93:  [R4-1913673](file:///D:\RAN4\TSGRAN4_93\Docs\R4-1913673.zip), “TP for TR 38.716-04-01: NR CA\_n3-n28-n78-n257”, SoftBank Corp  Implemented TP from RAN4 #94:  R4-2001508, “TP for TR 38.716-04-01 for updated scope from RAN #86”, Ericsson | 0.2.0 | 0.3.0 |
| 2020-05 | 3GPP RAN4#94 bis | R4-2005869 |  |  | Implemented TP from RAN4 #94bis:  R4-2004581, “TP for TR 38.716-04-01 for updated scope from RAN #87”, Ericsson  R4-2004072, “TP to TR 38.716-04-01 for CA\_n7-n25-n66-n78”, Huawei, HiSilicon, Bell Mobility, Telus | 0.3.0 | 0.4.0 |
| 2020-06 | 3GPP RAN4#95 | R4-2006047 |  |  | Implemented TP’s from RAN4 #95:  R4-2006611, “TP to TR 38.716-04-01 for CA\_n7-n25-n66-n78”, Huawei, HiSilicon, Bell Mobility, Telus  R4-2007631, “TP for TR 38.716-04-01 to include CA\_n1-n3-n7-n28”, Ericsson, Telstra  R4-2007632, “TP for TR 38.716-04-01 to include CA\_n1-n3-n7-n78”, Ericsson, Telstra  R4-2007633, “TP for TR 38.716-04-01 to include CA\_n3-n7-n28-n78”, Ericsson, Telstra | 0.4.0 | 0.5.0 |
| 2020-06 | 3GPP RAN #88 | RP-200662 |  |  | No TP’s implemented. Presented for approval at RAN plenary. | 0.5.0 | 1.0.0 |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **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 |