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| 3GPP TR 38.792 V0.2.0 (2025-05) | |
| Technical Report | |
| 3rd Generation Partnership Project;  Technical Specification Group Radio Access Network;  High power UE (power class 1.5) for NR Inter-band Carrier Aggregation (CA)/Dual connectivity (DC) with high power on both  FDD and TDD bands  (Release 19) | |
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# Foreword

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

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

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

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

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

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

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

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

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

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

**should** indicates a recommendation to do something

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

**may** indicates permission to do something

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

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

**can** indicates that something is possible

**cannot** indicates that something is impossible

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

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

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

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

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

In addition:

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

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

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

# 1 Scope

The present document is a technical report for UE requirements for PC1.5 inter-band UL CA and DC with HPUE in both FDD and TDD bands under Rel-19 time-frame. The purpose is to gather the relevant background information and studies of these 3Tx band combinations.

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

# 2 References

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

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

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

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

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

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

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

[4] WI description, RP-231719: "WID revision for Core part 4Rx handheld UE for low NR bands (1GHz) and/or 3Tx for NR inter-band UL Carrier Aggregation (CA) and EN-DC"

[5] WI description, RP-232674: "New WID: Rel-18 new basket WI for 3Tx inter-band UL CA and EN-DC"

[6] WI description, RP-241679: "New WID: Rel-19 HPUE (PC1.5 or 2) for NR intra-band CA or NR inter-band CA/DC band combinations with/without NR SUL"

[7] 3GPP R4-2507935 WF on new MSD rules, Skyworks, Murata Manufacturing Co Ltd., Nokia, Samsung, Qualcomm, Apple, Vivo, ZTE, Mediatek, Huawei, Oppo, RAN4#115 2025-05

# 3 Definitions of terms, symbols and abbreviations

## 3.1 Terms

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

**3Tx**: UE transmit with one Tx chain on one band and two Tx chains on the other band in CA or EN-DC band combinations.

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

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

## 3.2 Symbols

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

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

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

## 3.3 Abbreviations

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

CA Carrier Aggregation

DC Dual Connectivity

IMD Inter-modulation

MSD Maximum Sensitivity Deduction

SCS Subcarrier spacing

# 4 Background

## 4.1 Introduction

General requirements for 3Tx feature was introduced in Rel-18 RAN4 specification 38.101-1 and 38.101-3 via WI [4]. After that, some band combinations are proposed and introduced via Rel-18 basket WI [5]. In Rel-19, basket WI [6] will introduce more band combination for PC1.5 with high power on both FDD and TDD bands.

The present document is a technical report for the Rel-19 basket WI and covers band combinations for PC1.5 with high power on both FDD and TDD bands.

It covers the RF requirements for each band combination specific issues (i.e. one sub-clause defined per band combination) mainly MSD analysis caused by harmonic mixing, cross band leakage and IMD issue.

For the band combinations whose 2Tx MSD is not specified in the spec yet, 3Tx MSD needs to be evaluated. And it is encouraged to align the requirements between 2Tx and 3Tx band combinations.

## 4.2 TR Maintenance

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

# 5 PC1.5 FDD+TDD CA band combinations with high power on both FDD and TDD bands

## 5.x CA\_nX-nY (Example)

### 5.x.1 Operating bands for CA

Table 5.x.1-1: CA band combination of band nX+nY

|  |  |
| --- | --- |
| NR CA Band combination | NR Band |
| CA\_nX-nY | nX, nY |

### 5.x.2 Maximum output power for inter-band CA

Table 5.x.2-1: UE CA Power Class

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **NR UL CA Configuration** | **Class 1.5 (dBm)** | **Tolerance (dB)** | **Class 2 (dBm)** | **Tolerance (dB)** | **Class 3 (dBm)** | **Tolerance (dB)** |
| CA\_nXA-nYA | 29a | +2/-3 | 26 | +2/-3 | 23 | +2/-3 |
| NOTE a: The maximum output power in NR band X and band Y are PC2 or PC1.5. | | | | | | |

### 5.x.3 MSD scenario studies

Table 5.x.3-1 summarizes frequency ranges where harmonics mixing, cross band leakage, IMD interferences occur for CA\_ nX-nY.

Table 5.x.3-1: MSD scenarios for CA\_nX-nY with total power class 1.5

|  |  |  |  |
| --- | --- | --- | --- |
|  | Aggressor Tx | Victim Rx | Whether 2Tx requirements exists |
| **Harmonic mixing** | M order of nY UL | N order of nX DL | Yes or No? |
| … | … | … |
| **Cross band leakage** | nY UL | nX DL | Yes or No? |
| … | … | … |
| **IMD** | IMD order (M order of nX UL + N order of nY UL) | nX DL | Yes or No? |
| … | … | … |

Editor's note: only list the MSD scenario that exists for this band combination.

### 5.x.4 REFSENS requirements

Editor's note1: Make it clear whether the existing 2Tx requirements are reused or newly analysed due to for example missing of the 2Tx requirements.

Editor's note2: If reused, just say to reuse the existing 2Tx MSD requirements for MSD type harmonic mixing, or cross band leakage or IMD.

Editor’s note3: If MSD is newly specified, either the LUT (look up table) approach [7] or calculation can be used to get the MSD requirements, and if calculation is used it would be useful to give some key parameters as reference.

#### 5.x.4.1 REFSENS requirements for total power class 1.5

# 6 PC1.5 FDD+TDD NR DC band combinations with high power on both FDD and TDD bands

## 6.x DC\_nx-nY (Example)

### 6.x.1 Operating bands for NR DC

Table 6.x.1-1: DC band combination of band nX+nY

|  |  |
| --- | --- |
| NR CA Band combination | Bands |
| DC\_nX-nY | nX, nY |

### 6.x.2 Maximum output power for inter-band NR DC

Table 6.x.2-1: UE Power Class for inter-band NR DC

| DC configuration | Power class 1.5  (dBm) | Tolerance  (dB) | Power class 2  (dBm) | Tolerance  (dB) | Power class 3  (dBm) | Tolerance  (dB) |
| --- | --- | --- | --- | --- | --- | --- |
| DC\_nXA-nYA | 29a | +2/-3 | 26 | +2/-3 | 23 | +2/-3 |
| NOTE a: The maximum output power in NR band X and band Y are PC2 or PC1.5. | | | | | | |

### 6.x.3 MSD scenario studies

Table 6.x.3-1 summarizes frequency ranges where harmonics mixing, cross band leakage, IMD interferences occur for DC\_bX-nY.

Table 6.x.3-1: MSD scenarios for DC\_nX-nY with total power class 1.5

|  |  |  |  |
| --- | --- | --- | --- |
|  | Aggressor Tx band | Victim Rx band | Whether 2Tx requirements exists |
| **Harmonic mixing** | M order of nY UL | N order of bX DL | Yes or No? |
| … | … | … |
| **Cross band leakage** | nY UL | bX DL | Yes or No? |
| … | … | … |
| **IMD** | IMD order (M order of bX UL + N order of nY UL) | bX DL | Yes or No? |
| … | … | … |

Editor's note: only list the MSD scenario that exists for this band combination.

### 6.x.4 REFSENS requirements

Editor's note1: Make it clear whether the existing 2Tx requirements are reused or newly analysed due to for example missing of the 2Tx requirements.

Editor's note2: If reused, just say to reuse the existing 2Tx MSD requirements for MSD type harmonic mixing, or cross band leakage or IMD.

Editor’s note3: If MSD is newly specified, it would be useful to give some key parameters as reference.

#### 6.x.4.1 REFSENS requirements for total power class 1.5

Annex A: Valid UL configurations

For 3Tx PC1.5 inter-band UL CA with 2 bands UL, the following UL configurations are applicable:

- two band UL with one CC per band: CA\_nXA-nYA

- two band UL with two CC in one band: CA\_nXB-nYA, CA\_nXC-nYA, CA\_nXA-nYB, CA\_nXA-nYC

The following three UL cluster cases are not supported: CA\_nX(2A)-nYA, CA\_nXA-nY(2A)

Combinations with four UL CCs are not supported.

Annex B (informative): Change history

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Change history | | | | | | | |
| Date | Meeting | TDoc | CR | Rev | Cat | Subject/Comment | New version |
| 2024-08 | RAN4 #112 | R4-24xxxxx |  |  |  | TR skeleton | 0.0.1 |
| 2024-11 | RAN4#113 | R4-2417918 |  |  |  | Capture the TP to TR from R4-2418709 | 0.1.0 |
| 2025-05 | RAN4#115 | R4-2508043 |  |  |  | TP to TR38.792 on MSD definition approach for PC1.5 with HPUE on both FDD and TDD | 0.2.0 |
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