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| 3GPP TR 37.877 V18.0.0 (2023-12) | |
| Technical Report | |
| 3rd Generation Partnership Project;  Technical Specification Group Radio Access Network;  Rel-18 downlink interruption for NR and EN-DC band combinations at dynamic Tx switching;  (Release 18) | |
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Contents

Foreword 4

1 Scope 6

2 References 6

3 Definitions of terms, symbols and abbreviations 6

3.1 Terms 6

3.2 Symbols 6

3.3 Abbreviations 6

4 Background 7

4.1 TR Maintenance 7

5 Specific Band Combinations 7

5.1 NR band combinations 7

5.1.1 CA\_n1-n5-n78 7

5.1.1.1 Configurations 7

5.1.1.2 Technical analysis 7

5.1.1.3 Conclusion 7

5.1.2 CA\_n3-n5-n78 8

5.1.2.1 Configurations 8

5.1.2.2 Technical analysis 8

5.1.2.3 Conclusion 8

6 Release Independent Requirements 8

6.1 Inter-band CA 8

6.2 Inter-band EN-DC 9

Annex A (informative): Common UE RF requirements 9

A.1 Common UE RF requirements for Inter-band EN-DC with tx switching 9

A.2 Common UE RF requirements for Inter-band CA configurations with tx switching within NR FR1 10

Annex B (informative): Change history 11

# 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 WI “Rel-18 downlink interruption for NR and EN-DC band combinations at dynamic Tx Switching in Uplink” under Rel-18 time frame. The purpose is to gather the relevant background information and studies in order to address the band combinations requested for mandating no DL interruption to conduct dynamic Tx switching in uplink listed in Table 1-1.

Table 1-1: Band combinations requested for mandating no DL interruption

|  |  |
| --- | --- |
| Configuration | Uplink configuration |
| CA\_n1-n5-n78 | CA\_n1-n78, CA\_n5-n78 |
| CA\_n3-n5-n78 | CA\_n3-n78, CA\_n5-n78 |

# 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] TS38.101-1, NR; User Equipment (UE) radio transmission and reception; Part 1: Range 1 Standalone

[3] 3GPP TS 38.133: "NR; Requirements for support of radio resource management".

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

# 3 Definitions of terms, symbols and abbreviations

## 3.1 Terms

For the purposes of the present document, the terms given in 3GPP 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 3GPP TR 21.905 [1].

## 3.2 Symbols

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

## 3.3 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP 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 3GPP TR 21.905 [1].

# 4 Background

At 3GPP RAN#96 meeting, a new basket Work Item “Rel-18 downlink interruption for NR and EN-DC band combinations at dynamic Tx Switching in Uplink” was approved. The objectives are as following,

For the core part:

- Discuss and specify inter-band uplink CA and EN-DC combinations for which DL interruption is not allowed when dynamic switching between two uplink carriers is conducted.

1) Based on the requested band combinations from operators, analyze if it is feasible to specify no DL interruption in RAN4 specification.

2) Based on the feasibility analysis for specific combination, decide to introduce no DL interruption in RAN4 specification.

For the performance part:

- For 2CC 1Tx-2Tx switching, the mandating of no DL interruption for new band combinations is release independent from Rel-16.

- For 3CC 1Tx-2Tx switching and 2CC or 3CC 2Tx-2Tx switching, the mandating of no DL interruption for new band combinations is release independent from Rel-17.

The present document is the technical report for this basket Work Item.

## 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/band combination to ensure that the TPs related to the band/band combination have been implemented.

# 5 Specific Band Combinations

## 5.1 NR band combinations

### 5.1.1 CA\_n1-n5-n78

#### 5.1.1.1 Configurations

Table 5.1.1.1-1: CA configuration for mandating no DL interruption

|  |  |
| --- | --- |
| Configuration | Uplink configuration |
| CA\_n1-n5-n78 | CA\_n1-n78, CA\_n5-n78 |

#### 5.1.1.2 Technical analysis

For CA\_n1-n78 and CA\_n5-n78, no DL interruption allowed has been specified as mandated in 38101-1, which means switching from n1/n5 to n78 has no impact to n1/n5 downlink. Thus there is no DL interruption for CA\_n1-n5-n78 with CA\_n1-n78 or CA\_n5-n78 uplink configuration when conducting dynamic Tx switching.

#### 5.1.1.3 Conclusion

No DL interruption for CA\_n1-n5-n78 with CA\_n1-n78 or CA\_n5-n78 uplink configuration is mandated.

Table 5.1.1.3-1: Inter-band CA operating bands involving FR1 (three bands)

|  |  |  |
| --- | --- | --- |
| NR CA Band | NR Band  (Table 5.2-1) | DL interruption allowed (Note 3) |
| CA\_n1-n5-n78 | n1, n5, n78 | No for CA\_n1-n78, CA\_n5-n78 |
| NOTE 4: Applicable when dynamic Tx switching is conducted. The DL interruption requirement is specified in clause 8.2.2.2.10 of 38.133 [3]. | | |

### 5.1.2 CA\_n3-n5-n78

#### 5.1.2.1 Configurations

Table 5.1.2.1-1: CA configuration for mandating no DL interruption

|  |  |
| --- | --- |
| Configuration | Uplink configuration |
| CA\_n3-n5-n78 | CA\_n3-n78, CA\_n5-n78 |

#### 5.1.2.2 Technical analysis

For CA\_n3-n78 and CA\_n5-n78, no DL interruption allowed has been specified as mandated in 38101-1, which means switching from n3/n5 to n78 has no impact to n3/n5 downlink. Thus there is no DL interruption for CA\_n3-n5-n78 with CA\_n3-n78 or CA\_n5-n78 uplink configuration when conducting dynamic Tx switching.

#### 5.1.2.3 Conclusion

No DL interruption for CA\_n3-n5-n78 with CA\_n3-n78 or CA\_n5-n78 uplink configuration is mandated.

Table 5.1.2.3-1: Inter-band CA operating bands involving FR1 (three bands)

|  |  |  |
| --- | --- | --- |
| NR CA Band | NR Band  (Table 5.2-1) | DL interruption allowed (Note 3) |
| CA\_n3-n5-n78 | n3, n5, n78 | No for CA\_n3-n78, CA\_n5-n78 |
| NOTE 4: Applicable when dynamic Tx switching is conducted. The DL interruption requirement is specified in clause 8.2.2.2.10 of 38.133 [3]. | | |

# 6 Release Independent Requirements

The mandating of no DL interruption requirement belongs to the feature of inter-band CA or EN-DC with tx switching. Thus to specify the release independent requirement shall involve the feature of tx switching. The specific requirements need to be fulfilled include downlink interruption requirement, mandating no DL interruption requirement and time mask requirements as specified in the 38.133 [3] and 38.101-1 [2]. Because RRM downlink interruption requirement is referred when specifying mandating no DL interruption in 38.101-1, only UE RF requirements are listed in the last column of the table in the clause 6.1 and 6.2, which are the requirements to be fulfilled by inter-band CA or EN-DC to support tx switching feature.

## 6.1 Inter-band CA

Requirements for a Rel-16 UE for additional NR inter-band CA configurations within FR1 compared to TS 38.101-1 of Rel-16 [2] are introduced via this clause.

Requirements for a Rel-17 UE for additional NR inter-band CA configurations within FR1 compared to TS 38.101-1 of Rel-17 [2] are introduced via this clause.

Table 6.1-1: NR inter-band CA within FR1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Feature | DL/UL | Maximum number of bands | number of CCs | CA BW Classes | Duplex-mode | Release  independent from | requirements to be fulfilled  (see 38.307 of the REL in which the CA configuration was introduced) |
| Inter-band CA configurations with 1Tx-2Tx switching within NR FR1 | UL | 2 | 2 | A | TDD, FDD and TDD | Rel-16 | Table A.2-1 |
| Inter-band CA configurations with 1Tx-2Tx switching within NR FR1 | UL | 2 | 3 | A, B, C | TDD, FDD and TDD | Rel-17 | Table A.2-1 |
| Inter-band CA configurations with 2Tx-2Tx switching within NR FR1 | UL | 2 | 2 | A | TDD, FDD and TDD | Rel-17 | Table A.2-1 |
|  |  | 2 | 3 | A, B, C |  |  |  |

## 6.2 Inter-band EN-DC

Requirements for a Rel-16 UE for additional EN-DC inter-band configurations within FR1 compared to TS 38.101-3 of Rel-16 [4] are introduced via this clause.

Table 6.2-1: EN-DC inter-band configurations without SUL within FR1

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Feature | DL/UL | maximum number of E-UTRA bands | maximum number of E-UTRA CCs | maximum number of NR bands | maximum number of NR CCs | Duplex-mode | | Release  independent from | requirements to be fulfilled  (see 38.307 of the REL in which the CA configuration was introduced) |
| Inter-band EN-DC with 1Tx-2Tx switching | UL | 1 | 1 | 1 | 1 | | TDD, FDD and TDD | Rel-16 | Table A.1-1 |

Annex A (informative): Common UE RF requirements

## A.1 Common UE RF requirements for Inter-band EN-DC with tx switching

The requirements and test cases listed in Table A.1-1 are specified in in REL-16 version of TS 38.101-3 [4].

Table A.1-1: Common UE RF requirements for Inter-band EN-DC with tx switching

|  |  |
| --- | --- |
| Clause | Description |
| 5.5B.4 | Configuration for Inter-band EN-DC within FR1 |
| 6.3B.4 | Output power dynamics for switching between two uplink carriers |

## A.2 Common UE RF requirements for Inter-band CA configurations with tx switching within NR FR1

The requirements and test cases listed in Table A.2-1 are specified in Rel-16 version of TS 38.101-1 [2].

The requirements and test cases listed in Table A.2-1 are specified in Rel-17 version of TS 38.101-1 [2].

Table A.2-1: Common UE RF requirements for Inter-band CA configurations with tx switching within NR FR1

|  |  |
| --- | --- |
| Clause | Description |
| 5.2A.2 | Operating bands for inter-band CA |
| 6.3A.3.3 | Transmit ON/OFF time mask for inter-band CA |

Annex B (informative): Change history

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Change history** | | | | | | | |
| **Date** | **Meeting** | **TDoc** | **CR** | **Rev** | **Cat** | **Subject/Comment** | **New version** |
| 2022-08 | RAN4 #104-e | R4-2212699 |  |  |  | TR skeleton | 0.0.1 |
| 2022-10 | RAN4#104-bis-e | R4-2216097 |  |  |  | Implement the following TPs from RAN4#104-bis-e:  R4-2216096, TP to 37.877 DL interruption clarification for CA\_n1-n5-n78 at dynamic Tx switching, China Telecom | 0.1.0 |
| 2022-11 | RAN4#105 | R4-2218608 |  |  |  | Implement the following TPs from RAN4#105:  R4-2218607, TP to 37.877 DL interruption clarification for CA\_n3-n5-n78 at dynamic Tx switching, China Telecom | 0.2.0 |
| 2023-04 | RAN4#106bis-e | R4-2305155 |  |  |  | Implement the following TPs from RAN4#106bis-e:  R4-2306549, TP to TR 37.877: Release independence on mandating no DL interruption for Tx Switching, China Telecom | 0.3.0 |
| 2023-12 | RAN#102 | RP-23xxxx |  |  |  | Editorial change and change history update | 1.0.0 |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Change history** | | | | | | | |
| **Date** | **Meeting** | **TDoc** | **CR** | **Rev** | **Cat** | **Subject/Comment** | **New version** |
| 2023-12 | RAN#102 |  |  |  |  | Approved by plenary – Rel-18 spec under change control | 18.0.0 |