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Technical Report

3rd Generation Partnership Project;

Technical Specification Group Radio Access Networks;

NR Supplementary uplink (SUL)

(Release 16)



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# Foreword

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

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

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where:

x the first digit:

1 presented to TSG for information;

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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.

# 1 Scope

The present document is a technical report for SA NR Supplementary uplink (SUL), NSA NR SUL and NSA NR SUL with UL sharing from the UE perspective (ULSUP) under Rel-16 time frame. The purpose is to gather the relevant background information and studies in order to address NR SUL for the Rel-16 bands/band combinations in Table 1-1 to Table 1-4.

Table 1-1: Release 16 SUL bands

|  |  |  |  |
| --- | --- | --- | --- |
| **Band number** | **UL** | **DL** | **Duplex mode** |
| n89 | 824 – 849 MHz | N/A | SUL |
| n95 | 2010 – 2015 MHz | N/A | SUL |

Table 1-2: Release 16 SA SUL band combinations

|  |  |
| --- | --- |
| **SA SUL band combination** | **REL independent from** |
| SUL\_n79-n84 | Rel-15 |
| SUL\_n41-n80 | Rel-15 |
| SUL\_n41-n81 | Rel-15 |
| SUL\_n41-n95 | Rel-15 |
| SUL\_n77\_n80 | Rel-15 |
| SUL\_n77\_n84 | Rel-15 |
| SUL\_n79-n95 | Rel-15 |

Table 1-3: Release 16 NSA SUL band combinations

|  |  |
| --- | --- |
| **NSA SUL band combination** | **REL independent from** |
| DC\_1\_SUL\_n78-n80 | Rel-15 |
| DC\_7\_SUL\_n78-n80 | Rel-15 |
| DC\_20\_SUL\_n78-n80 | Rel-15 |
| DC\_8\_SUL\_n78-n80 | Rel-15 |
| DC\_1\_SUL\_n77-n80 | Rel-15 |
| DC\_3\_SUL\_n77-n84 | Rel-15 |
| DC\_3\_SUL\_n78-n84 | Rel-15 |

Table 1-4: Release 16 NSA SUL with ULSUP band combinations

|  |  |
| --- | --- |
| **NSA SUL with ULSUP band combination** | **REL independent from** |
| DC\_1\_SUL\_n79-n84 | Rel-15 |
| DC\_3\_SUL\_n41-n80 | Rel-15 |
| DC\_8\_SUL\_n41-n81 | Rel-15 |
| DC\_3\_SUL\_n78-n80 | Rel-15 |
| DC\_1-3\_SUL\_n78-n80 | Rel-15 |
| DC\_3-7\_SUL\_n78-n80 | Rel-15 |
| DC\_3-8\_SUL\_n78-n80 | Rel-15 |
| DC\_3\_20\_SUL\_n78-n80 | Rel-15 |
| DC\_3\_SUL\_n77-n80 | Rel-15 |
| DC\_1\_SUL\_n77-n84 | Rel-15 |

This TR contains a general part and specific band 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-180967, “New WID on Band combinations for SA NR Supplementary uplink (SUL), NSA NR SUL, NSA NR SUL with UL sharing from the UE perspective (ULSUP)”, RAN #80.

# 3 Definitions, symbols and abbreviations

## 3.1 Definitions

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

## 3.2 Symbols

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

<symbol> <Explanation>

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, 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].

BS Base Station

BCS Bandwidth Combination Set

CA Carrier Aggregation

CC Component Carriers

DC Dual Connectivity

DL Downlink

E-UTRA Evolved UMTS Terrestrial Radio Access

FDD Frequency Division Duplex

MPR Allowed maximum power reduction

MSD Maximum Sensitivity Degradation

REFSENS Reference Sensitivity power level

SCS Subcarrier spacing

SUL Supplementary uplink

TDD Time Division Duplex

UE User Equipment

UL Uplink

ULSUP UL sharing from the UE perspective

# 4 Background

The present document is a technical report for SA NR SUL, NSA NR SUL and NSA NR SUL with UL sharing from ULSUP under Rel-15 time frame. It covers both the UE and BS side. The document is divided in different parts:

- Specific SA NR SUL part: this part covers each band combination and its specific issues independently from each other (i.e. one subclause is defined per band combination)

- Specific NSA NR SUL part: this part covers each band combination and its specific issues independently from each other (i.e. one subclause is defined per band combination)

- Specific NSA NR SUL with UL sharing from ULSUP part: this part covers each band combination and its specific issues independently from each other (i.e. one subclause is 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/band combination to ensure that the TPs related to the band/band combination have been implemented.

# 5 SA NR SUL band combination: Specific Band Combination Part

## 5.1 SUL\_ n79A-n84A

### 5.1.1 Operating bands

**Table 5.1.1-1: SUL band combination**

|  |  |
| --- | --- |
| NR Band combination for SUL | NR Band  (Table 5.2-1) |
| SUL\_n79-n842 | n79, n84 |
| NOTE 1: If a UE is configured with both NR UL and NR SUL carriers in a cell, the switching time between NR UL carrier and NR SUL carrier is 0 us.  NOTE 2: For UE supporting SUL band combination simultaneous Rx/Tx capability is mandatory. | |

### 5.1.2 Channel bandwidths per operating band

**Table 5.1.2-1: Supported bandwidths per SUL band combination**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **SUL Configuration** | **NR Band** | **Subcarrier spacing**  **[kHz]** | **5**  **MHz** | **10**  **MHz** | **15**  **MHz** | **20**  **MHz** | **25**  **MHz** | **30**  **MHz** | **40**  **MHz** | **50**  **MHz** | **60**  **MHz** | **80**  **MHz** | **90**  **MHz** | **100 MHz** |
| SUL\_ n79A-n84A | n79 | 15 |  |  |  |  |  |  | Yes | Yes |  |  |  |  |
| 30 |  |  |  |  |  |  | Yes | Yes | Yes | Yes |  | Yes |
| 60 |  |  |  |  |  |  | Yes | Yes | Yes | Yes |  | Yes |
| n84 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |

### 5.1.3 Maximum output power

There is only single UL in uplink so this requirement is not applicable.

### 5.1.4 Spurious emission band UE co-existence

There is only single UL in uplink so this requirement is not applicable*.*

### 5.1.5 MSD

For SUL operation, the reference receive sensitivity (REFSENS) requirement for downlink bands shall be met for an supplementary uplink transmission bandwidth less than or equal to that in Table 5.1.5-1.

Table 5.1.5-1: Supplementary Uplink configuration for reference sensitivity

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| DL band/ UL band / SCS / Channel bandwidth of the affected DL band / NRB | | | | | | | | | | | | | | |
| DL band | UL band | SCS of UL band  (kHz) | 5  MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 30 MHz | 40 MHz | 50 MHz | 60 MHz | 80 MHz | 90 MHz | 100 MHz |
| n79 | n84 | 15 |  |  |  |  |  |  | 100 | 100 | 100 | 100 |  | 100 |

For SUL\_n79-n84, there is no harmonic or harmonic mixing product generated by Band n84 that may fall into the RX band of Band n79. Therefore, MSD due to harmonic or harmonic mixing is not needed.

### 5.1.6 ∆TIB and ∆RIB values

For SUL\_n79-n84, the TIB,c and RIB values are given in the tables below.

**Table 5.1.6-1: ΔTIB,c**

| SUL Band combination | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| SUL\_n79-n84 | n79 | 0 |
| n84 | 0 |

**Table 5.1.6-2: ΔRIB,c**

| SUL Band combination | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| SUL\_n79-n84 | n79 | 0 |
| n84 | 0 |

## 5.2 SUL\_n41-n80

### 5.2.1 Operating bands

**Table 5.2.1-1: SUL band combination**

|  |  |
| --- | --- |
| NR Band combination for SUL | NR Band  (Table 5.2-1) |
| SUL\_n41-n80 | n41, n80 |
| NOTE 1: If a UE is configured with both NR UL and NR SUL carriers in a cell, the switching time between NR UL carrier and NR SUL carrier is 0 us.  NOTE 2: For UE supporting SUL band combination simultaneous Rx/Tx capability is mandatory. | |

### 5.2.2 Channel bandwidths per operating band

**Table 5.2.2-1: Supported bandwidths per SUL band combination**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **SUL Configuration** | **NR Band** | **Subcarrier spacing**  **[kHz]** | **5**  **MHz** | **10**  **MHz** | **15**  **MHz** | **20**  **MHz** | **25**  **MHz** | **30**  **MHz** | **40**  **MHz** | **50**  **MHz** | **60**  **MHz** | **80**  **MHz** | **90**  **MHz** | **100 MHz** |
| SUL\_n41A-n80A | n41 | 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 |
| n80 | 15 | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |

### 5.2.3 Maximum output power

There is only single UL in uplink so this requirement is not applicable.

### 5.2.4 Spurious emission band UE co-existence

There is only single UL in uplink so this requirement is not applicable*.*

### 5.2.5 MSD

For SUL operation, the reference receive sensitivity (REFSENS) requirement for downlink bands shall be met for an supplementary uplink transmission bandwidth less than or equal to that in Table 5.2.5-1.

Table 5.2.5-1: Supplementary Uplink configuration for reference sensitivity

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| DL band/ UL band / SCS / Channel bandwidth of the affected DL band / NRB | | | | | | | | | | | | | | |
| DL band | UL band | SCS of UL band  (kHz) | 5  MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 30 MHz | 40 MHz | 50 MHz | 60 MHz | 80 MHz | 90 MHz | 100 MHz |
| n41 | n80 | 15 |  | 50 | 75 | 100 |  |  | 100 | 100 |  |  |  |  |

For SUL\_n41-n80, there is no harmonic or harmonic mixing product generated by Band n80 that may fall into the RX band of Band n41. Therefore, MSD due to harmonic or harmonic mixing is not needed.

However, since n41 is very close to Wi-Fi spectrum so the filter needs to provide enough rejection to Wi-Fi. This would impact the filter rejection to n80, so cross band isolation issue needs to be considered for this band combination. Following DC\_3\_n41 requirement, reference sensitivity exception requirements are defined in Table 5.2.5-2 with uplink configuration in Table 5.2.5-3.

**Table 5.2.5-2: Reference sensitivity exceptions due to cross band isolation**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| UL band | DL band | 5 MHz  (dBm) | 10 MHz  (dBm) | 15 MHz  (dBm) | 20 MHz  (dBm) | 25 MHz  (dBm) | 40 MHz  (dBm) | 50 MHz  (dBm) | 60 MHz  (dBm) | 80 MHz  (dBm) | 90 MHz  (dBm) | 100 MHz  (dBm) |
| n80 | n41 |  | [4.3] | [4.0] | [3.9] |  | [3.9] | [3.5] | [3.3] | [3.2] | [3.1] | [3.0] |
| NOTE 1: The B41 requirements are modified by -0.5dB when carrier frequency of the assigned E-UTRA channel bandwidth is within 2515-2690 MHz. | | | | | | | | | | | | |

**Table 5.2.5-3: Uplink configuration for reference sensitivity exceptions due to cross band isolation**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| UL band | DL band | 5 MHz  (dBm) | 10 MHz  (dBm) | 15 MHz  (dBm) | 20 MHz  (dBm) | 25 MHz  (dBm) | 40 MHz  (dBm) | 50 MHz  (dBm) | 60 MHz  (dBm) | 80 MHz  (dBm) | 90 MHz  (dBm) | 100 MHz  (dBm) |
| n80 | n41 |  | 50 | 50 | 50 |  | 50 | 50 | 50 | 50 | 50 | 50 |
| NOTE 1: 15 kHz SCS is assumed for UL band. | | | | | | | | | | | | |

### 5.2.6 ∆TIB and ∆RIB values

For SUL\_n41-n80, the TIB,c and RIB values are given in the tables below.

**Table 5.2.6-1: ΔTIB,c**

| SUL Band combination | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| SUL\_n41-n80 | n41 | 0.31 |
| 0.82 |
| n80 | 0.5 |
| NOTE 1: The requirement is applied for UE transmitting on the frequency range of 2515-2690MHz.  NOTE 2: The requirement is applied for UE transmitting on the frequency range of 2496-2515MHz. | | |

**Table 5.2.6-2: ΔRIB,c**

| SUL Band combination | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| SUL\_n41-n80 | n41 | 01 |
| 0.52 |
| n80 | 0 |
| NOTE 1: The requirement is applied for UE transmitting on the frequency range of 2515-2690MHz.  NOTE 2: The requirement is applied for UE transmitting on the frequency range of 2496-2515MHz. | | |

## 5.3 SUL\_n41-n81

### 5.3.1 Operating bands

**Table 5.3.1-1: SUL band combination**

|  |  |
| --- | --- |
| NR Band combination for SUL | NR Band  (Table 5.2-1) |
| SUL\_n41-n81 | n41, n81 |
| NOTE 1: If a UE is configured with both NR UL and NR SUL carriers in a cell, the switching time between NR UL carrier and NR SUL carrier is 0 us.  NOTE 2: For UE supporting SUL band combination simultaneous Rx/Tx capability is mandatory. | |

### 5.3.2 Channel bandwidths per operating band

**Table 5.3.2-1: Supported bandwidths per SUL band combination**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **SUL Configuration** | **NR Band** | **Subcarrier spacing**  **[kHz]** | **5**  **MHz** | **10**  **MHz** | **15**  **MHz** | **20**  **MHz** | **25**  **MHz** | **30**  **MHz** | **40**  **MHz** | **50**  **MHz** | **60**  **MHz** | **80**  **MHz** | **90**  **MHz** | **100 MHz** |
| SUL\_n41A-n81A | n41 | 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 |
| n81 | 15 | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |

### 5.3.3 Maximum output power

There is only single UL in uplink so this requirement is not applicable.

### 5.3.4 Spurious emission band UE co-existence

There is only single UL in uplink so this requirement is not applicable.

### 5.3.5 MSD

For SUL operation, the reference receive sensitivity (REFSENS) requirement for downlink bands shall be met for an supplementary uplink transmission bandwidth less than or equal to that in Table 5.3.5-1.

Table 5.3.5-1: Supplementary Uplink configuration for reference sensitivity

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| DL band/ UL band / SCS / Channel bandwidth of the affected DL band / NRB | | | | | | | | | | | | | | |
| DL band | UL band | SCS of UL band  (kHz) | 5  MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 30 MHz | 40 MHz | 50 MHz | 60 MHz | 80 MHz | 90 MHz | 100 MHz |
| n41 | n81 | 15 |  | 50 | 75 | 100 |  |  | 100 | 100 |  |  |  |  |

For SUL\_n41-n81, there is 3rd harmonic product generated by Band n81 that may fall into the RX band of Band n41. Therefore, MSD due to harmonic is needed and the specific value can be the same as the MSD for DC\_8\_n41.

.

### 5.3.6 ∆TIB and ∆RIB values

For SUL\_n41-n81, the TIB,c and RIB values are given in the tables below.

**Table 5.3.6-1: ΔTIB,c**

| SUL Band combination | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| SUL\_n41-n81 | n41 | 0.3 |
| n81 | 0.3 |

**Table 5.3.6-2: ΔRIB,c**

| SUL Band combination | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| SUL\_n41-n81 | n41 | 0 |
| n81 | 0 |

5.4 SUL\_n77-n80

5.4.1 Operating bands

**Table 5.4.1-1: SUL band combination**

|  |  |
| --- | --- |
| NR Band combination for SUL | NR Band  (Table 5.2-1) |
| SUL\_n77-n802 | n77, n80 |
| NOTE 1: If a UE is configured with both NR UL and NR SUL carriers in a cell, the switching time between NR UL carrier and NR SUL carrier is 0 us.  NOTE 2: For UE supporting SUL band combination simultaneous Rx/Tx capability is mandatory. | |

5.4.2 Channel bandwidths per operating band

**Table 5.4.2-1: Supported bandwidths per SUL band combination**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **SUL configuration** | **NR Band** | **Subcarrier spacing**  **(kHz)** | **5**  **MHz** | **10**  **MHz** | **15**  **MHz** | **20**  **MHz** | **25 MHz** | **30 MHz** | **40**  **MHz** | **50**  **MHz** | **60**  **MHz** | **80**  **MHz** | 90  MHz | **100 MHz** | **Bandwidth combination set** |
| SUL\_n77A-n80A | n77 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| n80 | 15 | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |

5.4.3 Maximum output power

There is only single UL in uplink so this requirement is not applicable.

5.4.4 Spurious emission band UE co-existence

There is only single UL in uplink so this requirement is not applicable*.*

5.4.5 MSD

For SUL operation, the reference receive sensitivity (REFSENS) requirement for downlink bands shall be met for an supplementary uplink transmission bandwidth less than or equal to that in Table 5.4.5-1.

Table 5.4.5-1: Supplementary Uplink configuration for reference sensitivity

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| DL band/ UL band / SCS / Channel bandwidth of the affected DL band / NRB | | | | | | | | | | | | | | |
| DL band | UL band | SCS of UL band  (kHz) | 5  MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 30 MHz | 40 MHz | 50 MHz | 60 MHz | 80 MHz | 90 MHz | 100 MHz |
| n77 | n80 | 15 |  | 50 | 75 | 100 |  |  | 100 | 100 |  |  |  |  |

For SUL\_n77-n80, there is 3rd harmonic product generated by Band n80 that may fall into the RX band of Band n77. Following DC\_3-n77 requirement, reference sensitivity exception requirements are defined in Table 5.4.5-2 with uplink configuration in Table 5.4.5-3.

**Table 5.4.5-2: Reference sensitivity exceptions due to harmonic issue**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band / Channel bandwidth of the high band | | | | | | | | | | | | | |
| UL band | DL band | **5 MHz** | **10 MHz** | **15 MHz** | **20 MHz** | **25 MHz** | 30 MHz | **40 MHz** | 50 MHz | 60 MHz | 80 MHz | 90 MHz | 100 MHz |
| dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB |
| n80 | n771,2 |  | 23.9 | 22.1 | 20.9 |  |  | 17.9 | 16.8 | 16.0 | 14.8 | 14.3 | 13.8 |
| n773 |  | 1.1 | 0.8 | 0.3 |  |  | 0 | 0 | 0 | 0 | 0 | 0 |
| NOTE 1: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of the aggressor (lower) band for which the 2nd transmitter harmonic is within the downlink transmission bandwidth of a victim (higher) band.  NOTE 2: The requirements should be verified for UL EARFCN of the aggressor (lower) band (superscript LB) such that in MHz and  with carrier frequency in the victim (higher) band in MHz and the channel bandwidth configured in the lower band.  NOTE 3: The requirements are only applicable to channel bandwidths with a carrier frequency at  MHz offset from  in the victim (higher band) with , whereandare the channel bandwidths configured in the aggressor (lower) and victim (higher) bands in MHz, respectively.  NOTE 4: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of the aggressor (lower) band for which the 4th transmitter harmonic is within the downlink transmission bandwidth of a victim (higher) band.  NOTE 5: The requirements should be verified for UL EARFCN of the aggressor (lower) band (superscript LB) such that in MHz and  with carrier frequency in the victim (higher) band in MHz and the channel bandwidth configured in the lower band.  NOTE 6: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of the aggressor (lower) band for which the 5th transmitter harmonic is within the downlink transmission bandwidth of a victim (higher) band.  NOTE 7: The requirements should be verified for UL NR-ARFCN of the aggressor (lower) band (superscript LB) such that in MHz and  with carrier frequency in the victim (higher) band in MHz and the channel bandwidth configured in the lower band. | | | | | | | | | | | | | |

**Table 5.4.5-3: Uplink configuration for reference sensitivity exceptions due to harmonic issue**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band / Channel bandwidth of the high band | | | | | | | | | | | | | |
| UL band | DL band | 5 MHz (NRB) | 10 MHz (NRB) | 15 MHz (NRB) | 20 MHz (NRB) | 25 MHz (NRB) | 30 MHz (NRB) | 40 MHz (NRB) | 50 MHz (NRB) | 60 MHz (NRB) | 80 MHz (NRB) | 90 MHz (NRB) | 100 MHz (NRB) |
| n80 | n77 |  | 25 | 36 | 50 |  |  | 50 | 50 | 50 | 50 | 50 | 50 |
| NOTE 1: 15 kHz SCS is assumed for UL band.  NOTE 2: The UL configuration applies regardless of the channel bandwidth of the low band unless the UL resource blocks exceed that specified in Table 7.3.2-3 for the uplink bandwidth in which case the allocation according to Table 7.3.2-3 applies. | | | | | | | | | | | | | |

5.4.6 ∆TIB and ∆RIB values

For SUL\_n77-n80, the TIB,c and RIB values are given in the tables below.

**Table 5.4.6-1: ΔTIB,c**

| SUL Band combination | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| SUL\_n77-n80 | n77 | 0.8 |
| n80 | 0.6 |

**Table 5.4.6-2: ΔRIB,c**

| SUL Band combination | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| SUL\_n77-n80 | n77 | 0.5 |

5.5 SUL\_n77-n84

5.5.1 Operating bands

**Table 5.5.1-1: SUL band combination**

|  |  |
| --- | --- |
| NR Band combination for SUL | NR Band  (Table 5.2-1) |
| SUL\_n77-n842 | n77, n84 |
| NOTE 1: If a UE is configured with both NR UL and NR SUL carriers in a cell, the switching time between NR UL carrier and NR SUL carrier is 0 us.  NOTE 2: For UE supporting SUL band combination simultaneous Rx/Tx capability is mandatory. | |

5.5.2 Channel bandwidths per operating band

**Table 5.5.2-1: Supported bandwidths per SUL band combination**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **SUL configuration** | **NR Band** | **Subcarrier spacing**  **(kHz)** | **5**  **MHz** | **10**  **MHz** | **15**  **MHz** | **20**  **MHz** | **25 MHz** | **30 MHz** | **40**  **MHz** | **50**  **MHz** | **60**  **MHz** | **80**  **MHz** | 90  MHz | **100 MHz** | **Bandwidth combination set** |
| SUL\_n77A-n84A | n77 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| n84 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |

5.5.3 Maximum output power

There is only single UL in uplink so this requirement is not applicable.

5.5.4 Spurious emission band UE co-existence

There is only single UL in uplink so this requirement is not applicable*.*

5.5.5 MSD

For SUL operation, the reference receive sensitivity (REFSENS) requirement for downlink bands shall be met for an supplementary uplink transmission bandwidth less than or equal to that in Table 5.5.5-1.

Table 5.5.5-1: Supplementary Uplink configuration for reference sensitivity

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| DL band/ UL band / SCS / Channel bandwidth of the affected DL band / NRB | | | | | | | | | | | | | | |
| DL band | UL band | SCS of UL band  (kHz) | 5  MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 30 MHz | 40 MHz | 50 MHz | 60 MHz | 80 MHz | 90 MHz | 100 MHz |
| n77 | n84 | 15 |  | 50 | 75 | 100 |  |  | 100 | 100 |  |  |  |  |

For SUL\_n77-n84, there is 3rd harmonic product generated by Band n84 that may fall into the RX band of Band n77. Following DC\_1-n77 requirement, reference sensitivity exception requirements are defined in Table 5.5.5-2 with uplink configuration in Table 5.5.5-3.

**Table 5.5.5-2: Reference sensitivity exceptions due to harmonic issue**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band / Channel bandwidth of the high band | | | | | | | | | | | | | |
| UL band | DL band | **5 MHz** | **10 MHz** | **15 MHz** | **20 MHz** | **25 MHz** | 30 MHz | **40 MHz** | 50 MHz | 60 MHz | 80 MHz | 90 MHz | 100 MHz |
| dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB |
| n84 | n771,2 |  | 23.9 | 22.1 | 20.9 |  |  | 17.9 | 16.8 | 16.0 | 14.8 | 14.3 | 13.8 |
| n773 |  | 1.1 | 0.8 | 0.3 |  |  | 0 | 0 | 0 | 0 | 0 | 0 |
| NOTE 1: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of the aggressor (lower) band for which the 2nd transmitter harmonic is within the downlink transmission bandwidth of a victim (higher) band.  NOTE 2: The requirements should be verified for UL EARFCN of the aggressor (lower) band (superscript LB) such that in MHz and  with carrier frequency in the victim (higher) band in MHz and the channel bandwidth configured in the lower band.  NOTE 3: The requirements are only applicable to channel bandwidths with a carrier frequency at  MHz offset from  in the victim (higher band) with , whereandare the channel bandwidths configured in the aggressor (lower) and victim (higher) bands in MHz, respectively.  NOTE 4: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of the aggressor (lower) band for which the 4th transmitter harmonic is within the downlink transmission bandwidth of a victim (higher) band.  NOTE 5: The requirements should be verified for UL EARFCN of the aggressor (lower) band (superscript LB) such that in MHz and  with carrier frequency in the victim (higher) band in MHz and the channel bandwidth configured in the lower band.  NOTE 6: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of the aggressor (lower) band for which the 5th transmitter harmonic is within the downlink transmission bandwidth of a victim (higher) band.  NOTE 7: The requirements should be verified for UL NR-ARFCN of the aggressor (lower) band (superscript LB) such that in MHz and  with carrier frequency in the victim (higher) band in MHz and the channel bandwidth configured in the lower band. | | | | | | | | | | | | | |

**Table 5.5.5-3: Uplink configuration for reference sensitivity exceptions due to harmonic issue**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band / Channel bandwidth of the high band | | | | | | | | | | | | | |
| UL band | DL band | 5 MHz (NRB) | 10 MHz (NRB) | 15 MHz (NRB) | 20 MHz (NRB) | 25 MHz (NRB) | 30 MHz (NRB) | 40 MHz (NRB) | 50 MHz (NRB) | 60 MHz (NRB) | 80 MHz (NRB) | 90 MHz (NRB) | 100 MHz (NRB) |
| n84 | n77 |  | 25 | 36 | 50 |  |  | 100 | 100 | 100 | 100 | 100 | 100 |
| NOTE 1: 15 kHz SCS is assumed for UL band.  NOTE 2: The UL configuration applies regardless of the channel bandwidth of the low band unless the UL resource blocks exceed that specified in Table 7.3.2-3 for the uplink bandwidth in which case the allocation according to Table 7.3.2-3 applies. | | | | | | | | | | | | | |

5.5.6 ∆TIB and ∆RIB values

For SUL\_n77-n84, the TIB,c and RIB values are given in the tables below.

**Table 5.5.6-1: ΔTIB,c**

| SUL Band combination | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| SUL\_n77-n84 | n77 | 0.8 |
| n84 | 0.6 |

**Table 5.5.6-2: ΔRIB,c**

| SUL Band combination | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| SUL\_n77-n84 | n77 | 0.5 |

5.6 SUL\_ n79A-n95A

5.6.1 Operating bands

**Table 5.6.1-1: SUL band combination**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **SUL Band combination** | **NR Band** | **Uplink (UL) band** | **Downlink (DL) band** | **Duplex**  **mode** |
| **BS receive / UE transmit** | **BS transmit / UE receive** |
| **FUL\_low – FUL\_high** | **FDL\_low – FDL\_high** |
| SUL\_ n79A-n95A | n79 | 4400 MHz – 5000 MHz | 4400 MHz – 5000 MHz | TDD |
| n95 | 2010 MHz – 2025 MHz | N/A | SUL |

5.6.2 Channel bandwidths per operating band

**Table 5.6.2-1: Supported bandwidths per SUL band combination**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **SUL configuration** | **NR Band** | **Subcarrier spacing**  **(kHz)** | **5**  **MHz** | **10**  **MHz** | **15**  **MHz** | **20**  **MHz** | **25 MHz** | **30 MHz** | **40**  **MHz** | **50**  **MHz** | **60**  **MHz** | **80**  **MHz** | **90**  **MHz** | **100 MHz** | **Bandwidth combination set** |
| SUL\_n79A-n95A | n79 | 15 |  |  |  |  |  |  | Yes | Yes |  |  |  |  | 0 |
| 30 |  |  |  |  |  |  | Yes | Yes | Yes | Yes |  | Yes |
| 60 |  |  |  |  |  |  | Yes | Yes | Yes | Yes |  | Yes |
| n95 | 15 | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes |  |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes |  |  |  |  |  |  |  |  |  |

5.6.3 Maximum output power

There is only single UL in uplink so this requirement is not applicable.

5.6.4 Spurious emission band UE co-existence

There is only single UL in uplink so this requirement is not applicable*.*

5.6.5 MSD

For SUL\_n79-n95, there is no harmonic or harmonic mixing product generated by Band n95 that may fall into the RX band of Band n79. Therefore, MSD due to harmonic or harmonic mixing is not needed.

5.6.6 ∆TIB and ∆RIB values

For SUL\_n79-n95, the ΔTIB,c and ΔRIB values are given in the tables below.

**Table 5.6.6-1: ΔTIB,c**

| SUL Band combination | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| SUL\_n79-n95 | n79 | 0 |
| n95 | 0 |

**Table 5.6.6-2: ΔRIB,c**

| SUL Band combination | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| SUL\_n79-n95 | n79 | 0 |

5.7 SUL\_n41A-n95A

5.7.1 Operating bands

**Table 5.7.1-1: SUL band combination**

|  |  |
| --- | --- |
| NR Band combination for SUL | NR Band  (Table 5.2-1 from 38.101-1) |
| SUL\_n41-n95 | n41, n95 |
| NOTE 1: If a UE is configured with both NR UL and NR SUL carriers in a cell, the switching time between NR UL carrier and NR SUL carrier is 0 us.  NOTE 2: For UE supporting SUL band combination simultaneous Rx/Tx capability is mandatory.  NOTE 3: For UE supporting SUL band combination, UL MIMO is not configured on SUL carrier | |

5.7.2 Channel bandwidths per operating band

**Table 5.7.2-1: Supported bandwidths per SUL band combination**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **SUL configuration** | **NR Band** | **Subcarrier spacing**  **(kHz)** | **5**  **MHz** | **10**  **MHz** | **15**  **MHz** | **20**  **MHz** | **25 MHz** | **30 MHz** | **40**  **MHz** | **50**  **MHz** | **60**  **MHz** | **80**  **MHz** | **90**  **MHz** | **100 MHz** | **Bandwidth combination set** |
| SUL\_n41A-n95A | n41 | 15 |  | Yes | Yes | Yes |  | Yes | Yes | Yes |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| 60 |  | Yes | Yes | Yes |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| n95 | 15 | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes |  |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes |  |  |  |  |  |  |  |  |  |

5.7.3 Maximum output power

There is only single UL in uplink so this requirement is not applicable.

5.7.4 Spurious emission band UE co-existence

There is only single UL in uplink so this requirement is not applicable*.*

5.7.5 MSD

For SUL\_n41-n95, there is no harmonic or harmonic mixing product generated by Band n95 that may fall into the RX band of Band n41. Therefore, MSD due to harmonic or harmonic mixing is not needed.

Based on the cross band isolation analysis in R4-2008370, the MSD exception for SUL\_n41-n95 are specified below.

Table 5.7.5-1: Reference sensitivity exceptions due to cross band isolation

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| UL band | | DL band | 5 MHz  (dBm) | 10 MHz  (dBm) | 15 MHz  (dBm) | 20 MHz  (dBm) | 25 MHz  (dBm) | 30MHz  (dBm) | 40 MHz  (dBm) | 50 MHz  (dBm) | 60 MHz  (dBm) | 80 MHz  (dBm) | 90 MHz  (dBm) | 100 MHz  (dBm) |
| n95 | | n41 |  | 6.1 | 6.1 | 6.1 |  | 6.1 | 6.1 | 6.1 | 6.1 | 6.1 | 6.1 | 6.1 |
| NOTE 1:   The B41 requirements are modified by -0.5dB when carrier frequency of the assigned E-UTRA channel bandwidth is within 2515 – 2690 MHz. | | | | | | | | | | | | | | |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Table 5.7.5-2: Uplink configuration for reference sensitivity exceptions due to cross band isolation

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| UL band | DL band | 5 MHz  (dBm) | 10 MHz  (dBm) | 15 MHz  (dBm) | 20 MHz  (dBm) | 25 MHz  (dBm) | 30MHz  (dBm) | 40 MHz  (dBm) | 50 MHz  (dBm) | 60 MHz  (dBm) | 80 MHz  (dBm) | 90 MHz  (dBm) | 100 MHz  (dBm) |
| n95 | n41 |  | 75 | 75 | 75 |  | 75 | 75 | 75 | 75 | 75 | 75 | 75 |
| NOTE:      15 kHz SCS is assumed for UL band. | | | | | | | | | | | | | |

5.7.6 ∆TIB and ∆RIB values

For SUL\_n41-n95, the ΔTIB,c and ΔRIB,c values are given in the tables below.

**Table 5.7.6-1: ΔTIB,c**

| SUL Band combination | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| SUL\_n41-n95 | n41 | 0 |
| n95 | 0 |

**Table 5.7.6-2: ΔRIB,c**

| SUL Band combination | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| SUL\_n41-n95 | n41 | 0.2 |

## 5.X SUL\_nX-nY

### 5.X.1 Operating bands

### 5.X.2 Configuration

### 5.X.3 Maximum output power

*<Editor’s note: This requirement is only applicable when there is simultaneous transmission in the band combination.>*

### 5.X.4 Spurious emission band UE co-existence

*<Editor’s note: This requirement is only applicable when there is simultaneous transmission in the band combination.>*

### 5.X.5 MSD

### 5.X.6 ∆TIB and ∆RIB values

# 6 NSA NR SUL band combination: Specific Band Combination Part

## 6.1 DC\_1\_SUL\_n78-n80

### 6.1.1 Operating bands

**Table 6.1.1-1: EN-DC band combination**

| EN-DC Band | E-UTRA Band | NR Band | Single UL allowed |
| --- | --- | --- | --- |
| DC\_1\_SUL\_n78-n802 | 1 | SUL\_n78-n801 | No |
| NOTE 1: If a UE is configured with both NR UL and NR SUL carriers in a cell, the switching time between NR UL carrier and NR SUL carrier can be up to 140us and placed in SUL resources.  NOTE 2: Applicable for UE supporting inter-band carrier aggregation with mandatory simultaneous Rx/Tx capability. | | | |

### 6.1.2 Configuration

Table 6.1.2-1: Inter-band EN-DC configurations

| EN-DC  configuration | Uplink EN-DC  configuration  (NOTE 1) | E-UTRA configuration | NR configuration |
| --- | --- | --- | --- |
| DC\_1A\_SUL\_n78A-n80A | DC\_1A\_n78A  DC\_1A\_n80A | 1A | SUL\_n78A-n80A |

### 6.1.3 Maximum output power

DC\_1A\_n78A is already specified in current specification so no new requirement is needed for this uplink configuration.

Table 6.1.3-1: Maximum output power for inter-band EN-DC

| DC configuration | Power class 3  (dBm) | Tolerance  (dB) |
| --- | --- | --- |
| DC\_1A\_n80A | 23 | +2/-3 |

### 6.1.4 Spurious emission band UE co-existence

DC\_1\_n78 is already specified in current specification so no new requirement is needed for this uplink configuration.

Table 6.1.4-1: Spurious emissions for inter-band EN-DC

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **EN-DC Configuration** | **Spurious emission** | | | | | | |
| **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** |
| DC\_1\_n80 | E-UTRA Band 1, 5, 7, 8, 11, 18, 19, 20, 21, 26, 27, 28, 31, 32, 38, 40, 41, 43, 44, 45, 50, 51, 65, 67, 68, 69, 72, 73,74, 75, 76,  NR Band n79 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 3, 34 | FDL\_low | - | FDL\_high | -50 | 1 | 5 |
| E-UTRA Band 22, 42,  NR Band n77, n78 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 13 |

### 6.1.5 MSD

There is IMD3 product produced by Band 1 and n80 that impact the reference sensitivity of Band 1 and IMD4 product produced by Band 1 and n80 that impact the reference sensitivity of Band n78. Following LTE CA\_1-3-42 requirement, reference sensitivity exception requirements are defined in Table 6.1.5-3.

**Table 6.1.5-3: Reference sensitivity exceptions for PCell due to dual uplink operation**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR or E-UTRA Band / Channel bandwidth / NRB / MSD | | | | | | | | |
| EN-DC  Configuration | EUTRA or NR band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  LCRB | DL Fc (MHz) | MSD  (dB) | Duplex mode | IMD order |
| DC\_1A\_SUL\_n78A-n80A | 1 | 1950 | 5 | 25 | 2140 | 23 | FDD | IMD3 |
| n80 | 1760 | 5 | 25 |  | N/A | SUL | N/A |
| 1 | 1922.5 | 5 | 25 | 2112.5 | N/A | FDD | N/A |
| n80 | 1782.5 | 5 | 25 |  | N/A | SUL | N/A |
| n78 | 3425 | 10 | 50 | 3425 | 13.0 | TDD | IMD4 |

### 6.1.6 ∆TIB and ∆RIB values

For DC\_1\_SUL\_n78-n80, the TIB,c and RIB values are referred to CA\_1-3-42 and given in the tables below.

**Table 6.1.6-1: ΔTIB,c**

| SUL Band combination | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| DC\_1\_SUL\_n78-n80 | 1 | 0.6 |
| n80 | 0.6 |
| n78 | 0.8 |

**Table 6.1.6-2: ΔRIB,c**

| SUL Band combination | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| DC\_1\_SUL\_n78-n80 | 1 | 0.2 |
| n78 | 0.5 |

## 6.2 DC\_7\_SUL\_n78-n80

### 6.2.1 Operating bands

**Table 6.2.1-1: EN-DC band combination**

| EN-DC Band | E-UTRA Band | NR Band | Single UL allowed |
| --- | --- | --- | --- |
| DC\_7\_SUL\_n78-n802 | 7 | SUL\_n78-n801 | No |
| NOTE 1: If a UE is configured with both NR UL and NR SUL carriers in a cell, the switching time between NR UL carrier and NR SUL carrier can be up to 140us and placed in SUL resources.  NOTE 2: Applicable for UE supporting inter-band carrier aggregation with mandatory simultaneous Rx/Tx capability. | | | |

### 6.2.2 Configuration

Table 6.2.2-1: Inter-band EN-DC configurations

| EN-DC  configuration | Uplink EN-DC  configuration  (NOTE 1) | E-UTRA configuration | NR configuration |
| --- | --- | --- | --- |
| DC\_7A\_SUL\_n78A-n80A | DC\_7A\_n78A  DC\_7A\_n80A | 7A | SUL\_n78A-n80A |

### 6.2.3 Maximum output power

DC\_7A\_n78A is already specified in current specification so no new requirement is needed for this uplink configuration.

Table 6.2.3-1: Maximum output power for inter-band EN-DC

| DC configuration | Power class 3  (dBm) | Tolerance  (dB) |
| --- | --- | --- |
| DC\_7A\_n80A | 23 | +2/-3 |

### 6.2.4 Spurious emission band UE co-existence

DC\_7\_n78 is already specified in current specification so no new requirement is needed for this uplink configuration.

Table 6.2.4-1: Spurious emissions for inter-band EN-DC

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **EN-DC Configuration** | **Spurious emission** | | | | | | |
| **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** |
| DC\_7\_n80 | E-UTRA Band 1, 5, 7, 8, 20, 26, 27, 28, 31, 32, 33, 34, 40, 42, 43, 50, 51, 65, 67, 68, 72, 74, 75, 76.  NR Band n79 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 3, 34 | FDL\_low | - | FDL\_high | -50 | 1 | 5 |
| E-UTRA Band 22, 42,  NR Band n77, n78 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| Frequency range | 2570 | - | 2575 | +1.6 | 5 | 5, 6, 7 |
| Frequency range | 2575 | - | 2595 | -15.5 | 5 | 5, 6, 7 |
| Frequency range | 2595 | - | 2620 | -40 | 1 | 5, 6 |

### 6.2.5 MSD

There is IMD4 product produced by Band 7 and n80 that impact the reference sensitivity of Band 7. Following DC\_3\_n7 requirement, reference sensitivity exception requirements are defined in Table 6.2.5-3.

**Table 6.2.5-3: Reference sensitivity exceptions for PCell due to dual uplink operation**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR or E-UTRA Band / Channel bandwidth / NRB / MSD | | | | | | | | |
| EN-DC  Configuration | EUTRA or NR band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  LCRB | DL Fc (MHz) | MSD  (dB) | Duplex mode | IMD order |
| DC\_7A\_SUL\_n78A-n80A | n80 | 1730 | 5 | 25 |  | N/A | SUL | N/A |
| 7 | 2535 | 10 | 50 | 2655 | 13 | FDD | IMD4 |

### 6.2.6 ∆TIB and ∆RIB values

For DC\_7\_SUL\_n78-n80, the TIB,c and RIB values are referred to DC\_3-7-n78 and given in the tables below.

**Table 6.2.6-1: ΔTIB,c**

| SUL Band combination | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| DC\_7\_SUL\_n78-n80 | 7 | 0.6 |
| n80 | 0.6 |
| n78 | 0.8 |

**Table 6.2.6-2: ΔRIB,c**

| SUL Band combination | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| DC\_7\_SUL\_n78-n80 | 7 | 0.2 |
| n78 | 0.5 |

## 6.3 DC\_20\_SUL\_n78-n80

### 6.3.1 Operating bands

**Table 6.3.1-1: EN-DC band combination**

| EN-DC Band | E-UTRA Band | NR Band | Single UL allowed |
| --- | --- | --- | --- |
| DC\_20\_SUL\_n78-n802 | 20 | SUL\_n78-n801 | No |
| NOTE 1: If a UE is configured with both NR UL and NR SUL carriers in a cell, the switching time between NR UL carrier and NR SUL carrier can be up to 140us and placed in SUL resources.  NOTE 2: Applicable for UE supporting inter-band carrier aggregation with mandatory simultaneous Rx/Tx capability. | | | |

### 6.3.2 Configuration

Table 6.3.2-1: Inter-band EN-DC configurations

| EN-DC  configuration | Uplink EN-DC  configuration  (NOTE 1) | E-UTRA configuration | NR configuration |
| --- | --- | --- | --- |
| DC\_20A\_SUL\_n78A-n80A | DC\_20A\_n78A  DC\_20A\_n80A | 20A | SUL\_n78A-n80A |

### 6.3.3 Maximum output power

DC\_20A\_n78A is already specified in current specification so no new requirement is needed for this uplink configuration.

Table 6.3.3-1: Maximum output power for inter-band EN-DC

| DC configuration | Power class 3  (dBm) | Tolerance  (dB) |
| --- | --- | --- |
| DC\_20A\_n80A | 23 | +2/-3 |

### 6.3.4 Spurious emission band UE co-existence

DC\_20\_n78 is already specified in current specification so no new requirement is needed for this uplink configuration.

Table 6.3.4-1: Spurious emissions for inter-band EN-DC

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **EN-DC Configuration** | **Spurious emission** | | | | | | |
| **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** |
| DC\_20\_n80 | E-UTRA Band 1, 7, 8, 27, 28, 31, 32, 33, 34, 40, 43, 50, 51, 65, 67, 68, 72, 74, 75, 76.  NR Band n79 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 3, 20 | FDL\_low | - | FDL\_high | -50 | 1 | 5 |
| E-UTRA Band 22, 42,  NR Band n77, n78 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |

### 6.3.5 MSD

There are IMD4 product produced by Band 20 and n80 that impact the reference sensitivity of Band 20. Following CA\_3\_20 requirement, reference sensitivity exception requirements are defined in Table 6.3.5-3.

**Table 6.3.5-3: Reference sensitivity exceptions for PCell due to dual uplink operation**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR or E-UTRA Band / Channel bandwidth / NRB / MSD | | | | | | | | |
| EN-DC  Configuration | EUTRA or NR band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  LCRB | DL Fc (MHz) | MSD  (dB) | Duplex mode | IMD order |
| DC\_20A\_SUL\_n78A-n80A | 20 | 847 | 5 | 25 | 806 | 9 | FDD | IMD4 |
| n80 | 1735 | 5 | 25 |  | N/A | SUL | N/A |

### 6.3.6 ∆TIB and ∆RIB values

For DC\_20\_SUL\_n78-n80, the TIB,c and RIB values are referred to DC\_3-20-n78 and given in the tables below.

**Table 6.3.6-1: ΔTIB,c**

| SUL Band combination | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| DC\_20\_SUL\_n78-n80 | 20 | 0.3 |
| n80 | 0.5 |
| n78 | 0.8 |

**Table 6.3.6-2: ΔRIB,c**

| SUL Band combination | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| DC\_20\_SUL\_n78-n80 | n78 | 0.5 |

## 6.4 DC\_8\_SUL\_n78-n80

### 6.4.1 Operating bands

**Table 6.4.1-1: EN-DC band combination**

| EN-DC Band | E-UTRA Band | NR Band | Single UL allowed |
| --- | --- | --- | --- |
| DC\_8\_SUL\_n78-n802 | 8 | SUL\_n78-n801 | No |
| NOTE 1: If a UE is configured with both NR UL and NR SUL carriers in a cell, the switching time between NR UL carrier and NR SUL carrier can be up to 140us and placed in SUL resources.  NOTE 2: Applicable for UE supporting inter-band carrier aggregation with mandatory simultaneous Rx/Tx capability. | | | |

### 6.4.2 Configuration

Table 6.4.2-1: Inter-band EN-DC configurations

| EN-DC  configuration | Uplink EN-DC  configuration  (NOTE 1) | E-UTRA configuration | NR configuration |
| --- | --- | --- | --- |
| DC\_8A\_SUL\_n78A-n80A | DC\_8A\_n78A  DC\_8A\_n80A | 8A | SUL\_n78A-n80A |

### 6.4.3 Maximum output power

DC\_8A\_n78A is already specified in current specification so no new requirement is needed for this uplink configuration.

Table 6.4.3-1: Maximum output power for inter-band EN-DC

| DC configuration | Power class 3  (dBm) | Tolerance  (dB) |
| --- | --- | --- |
| DC\_8A\_n80A | 23 | +2/-3 |

### 6.4.4 Spurious emission band UE co-existence

DC\_8\_n78 is already specified in current specification so no new requirement is needed for this uplink configuration.

Table 6.4.4-1: Spurious emissions for inter-band EN-DC

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **EN-DC Configuration** | **Spurious emission** | | | | | | |
| **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** |
| DC\_8\_n80 | E-UTRA Band 1, 20, 28, 31, 32, 33, 34, 38, 39, 40, 45, 50, 51, 65, 67, 68, 69, 72, 73, 74, 75, 76  NR Band n79 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 3, 8 | FDL\_low | - | FDL\_high | -50 | 1 | 5 |
| E-UTRA Band 3, 7, 22, 41, 42, 43, 52  NR Band n77, n78 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| E-UTRA Band 11, 21 | FDL\_low | - | FDL\_high | -50 | 1 | 13 |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 3 |

### 6.4.5 MSD

There is IMD4 product produced by Band 8 and n80 that impact the reference sensitivity of Band 8. Following CA\_3-8 requirement, reference sensitivity exception requirements are defined in Table 6.4.5-3. There are also IMD3 and IMD5 product produced by Band 8 and n80 that impact the reference sensitivity of Band 78. Refereeing to CA\_1-28-42 requirement and based on further evaluation, reference sensitivity exception requirements due to IMD3 are defined in Table 6.4.5-3 and MSD due to IMD5 is not specified because the degradation is too little and can be overlooked.

**Table 6.4.5-3: Reference sensitivity exceptions for PCell due to dual uplink operation**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR or E-UTRA Band / Channel bandwidth / NRB / MSD | | | | | | | | |
| EN-DC  Configuration | EUTRA or NR band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  LCRB | DL Fc (MHz) | MSD  (dB) | Duplex mode | IMD order |
| DC\_8A\_SUL\_n78A-n80A | n80 | 1755 | 10 | 50 |  | N/A | SUL | N/A |
| 8 | 900 | 5 | 25 | 945 | 8 | FDD | IMD4 |
| n80 | 1750 | 10 | 50 |  | N/A | SUL | N/A |
| 8 | 900 | 5 | 25 | 945 | N/A | FDD | N/A |
| n78 | 3550 | 10 | 50 | 3550 | 8 | TDD | IMD33 |
| 10.74 |

### 6.4.6 ∆TIB and ∆RIB values

For DC\_8\_SUL\_n78-n80, the TIB,c and RIB values are referred to DC\_3-8\_n78 and given in the tables below.

**Table 6.4.6-1: ΔTIB,c**

| SUL Band combination | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| DC\_8\_SUL\_n78-n80 | 8 | 0.6 |
| n80 | 0.6 |
| n78 | 0.8 |

**Table 6.4.6-2: ΔRIB,c**

| SUL Band combination | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| DC\_8\_SUL\_n78-n80 | 8 | 0.2 |
| n78 | 0.5 |

## 6.5 DC\_1\_SUL\_n77-n80

### 6.5.1 Operating bands

**Table 6.5.1-1: EN-DC band combination**

| EN-DC Band | E-UTRA Band | NR Band | Single UL allowed |
| --- | --- | --- | --- |
| DC\_1\_SUL\_n77-n802 | 1 | SUL\_n77-n801 | DC\_1\_n77 |
| NOTE 1: If a UE is configured with both NR UL and NR SUL carriers in a cell, the switching time between NR UL carrier and NR SUL carrier can be up to 140us and placed in SUL resources.  NOTE 2: Applicable for UE supporting inter-band carrier aggregation with mandatory simultaneous Rx/Tx capability. | | | |

### 6.5.2 Configuration

Table 6.5.2-1: Inter-band EN-DC configurations

| EN-DC  configuration | Uplink EN-DC  configuration  (NOTE 1) | E-UTRA configuration | NR configuration |
| --- | --- | --- | --- |
| DC\_1A\_SUL\_n77A-n80A | DC\_1A\_n77A  DC\_1A\_n80A | 1A | SUL\_n77A-n80A |

### 6.5.3 Maximum output power

DC\_1A\_n77A and DC\_1A\_n80A are already specified in current specification so no new requirement is needed for these uplink configuration.

### 6.5.4 Spurious emission band UE co-existence

DC\_1A\_n77A and DC\_1A\_n80A are already specified in current specification so no new requirement is needed for these uplink configuration.

### 6.5.5 MSD

There is IMD3 product produced by Band 1 and n80 that impact the reference sensitivity of Band 1 and IMD4 product produced by Band 1 and n80 that impact the reference sensitivity of Band n77. Following LTE CA\_1-3-42 requirement, reference sensitivity exception requirements are defined in Table 6.5.5-1.

**Table 6.5.5-1: Reference sensitivity exceptions for PCell due to dual uplink operation**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR or E-UTRA Band / Channel bandwidth / NRB / MSD | | | | | | | | |
| EN-DC  Configuration | EUTRA or NR band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  LCRB | DL Fc (MHz) | MSD  (dB) | Duplex mode | IMD order |
| DC\_1A-SUL\_n77A-n80A | 1 | 1950 | 5 | 25 | 2140 | 23 | FDD | IMD3 |
| n80 | 1760 | 5 | 25 |  | N/A | SUL | N/A |
| 1 | 1922.5 | 5 | 25 | 2112.5 | N/A | FDD | N/A |
| n80 | 1782.5 | 5 | 25 |  | N/A | SUL | N/A |
| n78 | 3425 | 10 | 50 | 3425 | 13.0 | TDD | IMD4 |

### 6.5.6 ∆TIB and ∆RIB values

For DC\_1\_SUL\_n77-n80, the TIB,c and RIB values are referred to DC\_1-n77 and given in the tables below.

**Table 6.5.6-1: ΔTIB,c**

| SUL Band combination | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| DC\_1\_SUL\_n77-n80 | 1 | 0.6 |
| n80 | 0.6 |
| n77 | 0.8 |

**Table 6.5.6-2: ΔRIB,c**

| SUL Band combination | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| DC\_1\_SUL\_n77-n80 | 1 | 0.2 |
| n77 | 0.5 |

## 6.6 DC\_3\_SUL\_n77-n84

### 6.6.1 Operating bands

**Table 6.6.1-1: EN-DC band combination**

| EN-DC Band | E-UTRA Band | NR Band | Single UL allowed |
| --- | --- | --- | --- |
| DC\_3\_SUL\_n77-n842 | 3 | SUL\_n77-n841 | DC\_3\_n77 |
| NOTE 1: If a UE is configured with both NR UL and NR SUL carriers in a cell, the switching time between NR UL carrier and NR SUL carrier can be up to 140us and placed in SUL resources.  NOTE 2: Applicable for UE supporting inter-band carrier aggregation with mandatory simultaneous Rx/Tx capability. | | | |

### 6.6.2 Configuration

Table 6.6.2-1: Inter-band EN-DC configurations

| EN-DC  configuration | Uplink EN-DC  configuration  (NOTE 1) | E-UTRA configuration | NR configuration |
| --- | --- | --- | --- |
| DC\_3A\_SUL\_n77A-n84A | DC\_3A\_n77A  DC\_3A\_n84A | 3A | SUL\_n77A-n84A |

### 6.6.3 Maximum output power

DC\_3A\_n77A is already specified in current specification so no new requirement is needed for this uplink configuration.

Table 6.6.3-1: Maximum output power for inter-band EN-DC

| EN-DC configuration | Power class 3  (dBm) | Tolerance  (dB) |
| --- | --- | --- |
| DC\_3A\_n84A | 23 | +2/-3 |

### 6.6.4 Spurious emission band UE co-existence

DC\_3A\_n77A is already specified in current specification so no new requirement is needed for this uplink configuration.

Table 6.6.4-1: Spurious emissions for inter-band EN-DC

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **EN-DC Configuration** | **Spurious emission** | | | | | | |
| **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** |
| DC\_3\_n84 | E-UTRA Band 1, 5, 7, 8, 11, 18, 19, 20, 21, 26, 27, 28, 31, 32, 38, 40, 41, 43, 44, 45, 50, 51, 65, 67, 68, 69, 72, 73,74, 75, 76  NR Band n79 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 3 | FDL\_low | - | FDL\_high | -50 | 1 | 5 |
| NR Band n77, n78 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |

### 6.6.5 MSD

There is IMD4 product produced by Band 3 and n84 that impact the reference sensitivity of Band n77. Following LTE CA\_1-3-42 requirement, reference sensitivity exception requirements are defined in Table 6.6.5-1.

**Table 6.6.5-1: Reference sensitivity exceptions for PCell due to dual uplink operation**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR or E-UTRA Band / Channel bandwidth / NRB / MSD | | | | | | | | |
| EN-DC  Configuration | EUTRA or NR band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  LCRB | DL Fc (MHz) | MSD  (dB) | Duplex mode | IMD order |
| DC\_3\_SUL\_n77-n84 | 3 | 1782.5 | 5 | 25 | 1877.5 | N/A | FDD | N/A |
| n84 | 1922.5 | 5 | 25 |  | N/A | SUL | N/A |
| n77 | 3425 | 10 | 50 | 3425 | 13.0 | TDD | IMD4 |

In addition, there is also sensitivity degradation for DC\_3\_SUL\_n77-n84 impacted by close proximity of UL of band n84 and DL of band 3. Reference sensitivity exceptions are specified in Table 6.6.5-2 with uplink configuration specified in Table 6.6.5-3.

Table 6.6.5-2: Reference sensitivity exceptions due to close proximity of bands for EN-DC

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| E-UTRA or NR Band / Channel bandwidth of the affected DL band | | | | | | | | | | | | |
| UL band | DL band | 5 MHz  (dB) | 10 MHz  (dB) | 15 MHz  (dB) | 20 MHz  (dB) | 25 MHz  (dB) | 40 MHz  (dB) | 50 MHz  (dB) | 60 MHz  (dB) | 80 MHz  (dB) | 90 MHz  (dB) | 100 MHz  (dB) |
| n841 | 3 | 3 | 2.3 | 2 | 1.8 |  |  |  |  |  |  |  |
| NOTE 1: These requirements apply when the uplink is active in Band n84 and the separation between the lower edge of the uplink channel in Band n84 and the upper edge of the downlink channel in Band 3 is < 60 MHz. For each channel bandwidth in Band 3, the requirement applies regardless of channel bandwidth in Band n84. | | | | | | | | | | | | |

Table 6.6.5-3: Uplink configuration for reference sensitivity exceptions due to close proximity of bands for EN-DC

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| E-UTRA or NR Band / SCS / Channel bandwidth of the affected DL band | | | | | | | | | | | | | |
| UL band | DL band | SCS of UL band (kHz) | 5 MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 40 MHz | 50 MHz | 60 MHz | 80 MHz | 90 MHz | 100 MHz |
| n841 | 3 | 15 | 25 | 25 | 25 | 25 |  |  |  |  |  |  |  |
| NOTE 1: The UL configuration applies regardless of the channel bandwidth of the UL band. UL resource blocks allocation in the table shall be further limited to that specified in Table 7.3.1-2 in TS 36.101 [4] or Table 7.3.2-3 in TS 38.101-1 [2].  NOTE 2: refers to the UL resource blocks shall be located as close as possible to the downlink channel in Band 3 but confined within the transmission bandwidth configuration for the channel bandwidth in the uplink channel in Band n84. | | | | | | | | | | | | | |

### 6.6.6 ∆TIB and ∆RIB values

For DC\_3\_SUL\_n77-n84, the TIB,c and RIB values are referred to DC\_1-3-n77 and given in the tables below.

**Table 6.6.6-1: ΔTIB,c**

| SUL Band combination | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| DC\_3\_SUL\_n77-n84 | 3 | 0.6 |
| n84 | 0.6 |
| n77 | 0.8 |

**Table 6.6.6-2: ΔRIB,c**

| SUL Band combination | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| DC\_3\_SUL\_n77-n84 | 3 | 0.2 |
| n77 | 0.5 |

## 6.7 DC\_3\_SUL\_n78-n84

### 6.7.1 Operating bands

**Table 6.7.1-1: EN-DC band combination**

| EN-DC Band | E-UTRA Band | NR Band | Single UL allowed |
| --- | --- | --- | --- |
| DC\_3\_SUL\_n78-n842 | 3 | SUL\_n78-n841 | DC\_3\_n78 |
| NOTE 1: If a UE is configured with both NR UL and NR SUL carriers in a cell, the switching time between NR UL carrier and NR SUL carrier can be up to 140us and placed in SUL resources.  NOTE 2: Applicable for UE supporting inter-band carrier aggregation with mandatory simultaneous Rx/Tx capability. | | | |

### 6.7.2 Configuration

Table 6.7.2-1: Inter-band EN-DC configurations

| EN-DC  configuration | Uplink EN-DC  configuration  (NOTE 1) | E-UTRA configuration | NR configuration |
| --- | --- | --- | --- |
| DC\_3A\_SUL\_n78A-n84A | DC\_3A\_n78A  DC\_3A\_n84A | 3A | SUL\_n78A-n84A |

### 6.7.3 Maximum output power

DC\_3A\_n78A is already specified in current specification so no new requirement is needed for this uplink configuration.

Table 6.7.3-1: Maximum output power for inter-band EN-DC

| EN-DC configuration | Power class 3  (dBm) | Tolerance  (dB) |
| --- | --- | --- |
| DC\_3A\_n84A | 23 | +2/-3 |

### 6.7.4 Spurious emission band UE co-existence

DC\_3A\_n78A is already specified in current specification so no new requirement is needed for this uplink configuration.

Table 6.7.4-1: Spurious emissions for inter-band EN-DC

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **EN-DC Configuration** | **Spurious emission** | | | | | | |
| **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** |
| DC\_3\_n84 | E-UTRA Band 1, 5, 7, 8, 11, 18, 19, 20, 21, 26, 27, 28, 31, 32, 38, 40, 41, 43, 44, 45, 50, 51, 65, 67, 68, 69, 72, 73,74, 75, 76  NR Band n79 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 3 | FDL\_low | - | FDL\_high | -50 | 1 | 5 |
| NR Band n78, n78 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |

### 6.7.5 MSD

There is IMD4 product produced by Band 3 and n84 that impact the reference sensitivity of Band n78. Following LTE CA\_1-3-42 requirement, reference sensitivity exception requirements are defined in Table 6.7.5-1.

**Table 6.7.5-1: Reference sensitivity exceptions for PCell due to dual uplink operation**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR or E-UTRA Band / Channel bandwidth / NRB / MSD | | | | | | | | |
| EN-DC  Configuration | EUTRA or NR band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  LCRB | DL Fc (MHz) | MSD  (dB) | Duplex mode | IMD order |
| DC\_3\_SUL\_n78-n84 | 3 | 1782.5 | 5 | 25 | 1877.5 | N/A | FDD | N/A |
| n84 | 1922.5 | 5 | 25 |  | N/A | SUL | N/A |
| n78 | 3425 | 10 | 50 | 3425 | 13.0 | TDD | IMD4 |

In addition, there is also sensitivity degradation for DC\_3\_SUL\_n78-n84 impacted by close proximity of UL of band n84 and DL of band 3. Reference sensitivity exceptions are specified in Table 6.7.5-2 with uplink configuration specified in Table 6.7.5-3.

Table 6.7.5-2: Reference sensitivity exceptions due to close proximity of bands for EN-DC

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| E-UTRA or NR Band / Channel bandwidth of the affected DL band | | | | | | | | | | | | |
| UL band | DL band | 5 MHz  (dB) | 10 MHz  (dB) | 15 MHz  (dB) | 20 MHz  (dB) | 25 MHz  (dB) | 40 MHz  (dB) | 50 MHz  (dB) | 60 MHz  (dB) | 80 MHz  (dB) | 90 MHz  (dB) | 100 MHz  (dB) |
| n841 | 3 | 3 | 2.3 | 2 | 1.8 |  |  |  |  |  |  |  |
| NOTE 1: These requirements apply when the uplink is active in Band n84 and the separation between the lower edge of the uplink channel in Band n84 and the upper edge of the downlink channel in Band 3 is < 60 MHz. For each channel bandwidth in Band 3, the requirement applies regardless of channel bandwidth in Band n84. | | | | | | | | | | | | |

Table 6.7.5-3: Uplink configuration for reference sensitivity exceptions due to close proximity of bands for EN-DC

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| E-UTRA or NR Band / SCS / Channel bandwidth of the affected DL band | | | | | | | | | | | | | |
| UL band | DL band | SCS of UL band (kHz) | 5 MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 40 MHz | 50 MHz | 60 MHz | 80 MHz | 90 MHz | 100 MHz |
| n841 | 3 | 15 | 25 | 25 | 25 | 25 |  |  |  |  |  |  |  |
| NOTE 1: The UL configuration applies regardless of the channel bandwidth of the UL band. UL resource blocks allocation in the table shall be further limited to that specified in Table 7.3.1-2 in TS 36.101 [4] or Table 7.3.2-3 in TS 38.101-1 [2].  NOTE 2: refers to the UL resource blocks shall be located as close as possible to the downlink channel in Band 3 but confined within the transmission bandwidth configuration for the channel bandwidth in the uplink channel in Band n84. | | | | | | | | | | | | | |

### 6.7.6 ∆TIB and ∆RIB values

For DC\_3\_SUL\_n78-n84, the TIB,c and RIB values are referred to DC\_1-3-n78 and given in the tables below.

**Table 6.7.6-1: ΔTIB,c**

| SUL Band combination | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| DC\_3\_SUL\_n78-n84 | 3 | 0.6 |
| n84 | 0.6 |
| n78 | 0.8 |

**Table 6.7.6-2: ΔRIB,c**

| SUL Band combination | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| DC\_3\_SUL\_n78-n84 | 3 | 0.2 |
| n78 | 0.5 |

## 6.X DC\_X\_SUL\_nY-nZ

### 6.X.1 Operating bands

### 6.X.2 Configuration

### 6.X.3 Maximum output power

### 6.X.4 Spurious emission band UE co-existence

### 6.X.5 MSD

### 6.X.6 ∆TIB and ∆RIB values

# 7 NSA NR SUL with UL sharing from ULSUP band combination: Specific Band Combination Part

## 7.1 DC\_1A-SUL\_n79A-n84A

### 7.1.1 Operating bands

**Table 7.1.1-1: EN-DC band combination**

| EN-DC Band | E-UTRA Band | NR Band | Single UL allowed |
| --- | --- | --- | --- |
| DC\_1\_SUL\_n79-n842 | 1 | SUL\_n79-n84 | No |
| NOTE 1: If a UE is configured with both NR UL and NR SUL carriers in a cell, the switching time between NR UL carrier and NR SUL carrier can be up to 140us and placed in SUL resources.  NOTE 2: Applicable for UE supporting inter-band carrier aggregation with mandatory simultaneous Rx/Tx capability. | | | |

### 7.1.2 Configuration

For uplink configuration of DC\_1A\_n84A\_ULSUP-FDM, some requirements such as MPR for transmissions with non-contiguous resource allocation in single component carrier have not been specified yet. So we only consider ULSUP-TDM configuration at this time.

Table 7.1.2-1: Inter-band EN-DC configurations

| EN-DC  configuration | Uplink EN-DC  configuration  (NOTE 1) | E-UTRA configuration | NR configuration |
| --- | --- | --- | --- |
| DC\_1A-SUL\_n79A-n84A | DC\_1A\_n79A  DC\_1A\_n84A\_ULSUP-TDM, | 1A | SUL\_n79A-n84A |

### 7.1.3 Maximum output power

Table 7.1.3-1: Maximum output power for inter-band EN-DC

| DC configuration | Power class 3  (dBm) | Tolerance  (dB) |
| --- | --- | --- |
| DC\_1A\_n79A DC\_1A\_n84A\_ULSUP-TDM, | 23 | +2/-3 |

### 7.1.4 Spurious emission band UE co-existence

Table 7.1.4-1: Spurious emissions for inter-band EN-DC

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **EN-DC Configuration** | **Spurious emission** | | | | | | |
| **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** |
| DC\_1A\_n79A DC\_1A\_n84A\_ULSUP-TDM, | E-UTRA Band 1, 3, 5, 7, 8, 11, 18, 19, 21, 26, 28, 34, 40, 41, 42, 65 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| NR Band n257 | 26500 | - | 29500 | -5 | 100 |  |
| Frequency range | 1880 | - | 1895 | -40 | 1 | 5, 9 |
| Frequency range | 1895 | - | 1915 | -15.5 | 5 | 5, 7, 9 |
| Frequency range | 1915 | - | 1920 | +1.6 | 5 | 5, 7, 9 |

### 7.1.5 MSD

For DC\_1\_SUL\_n79-n84, there are neither harmonic and harmonic mixing products generated by Band 1/n84 that may fall into the RX band of Band n79 nor IMD products produced by Band 1 and n79 that impact the reference sensitivity of Band 1. Therefore, MSD requirements are not needed for this configuration.

### 7.1.6 ∆TIB and ∆RIB values

For DC\_1\_SUL\_n79-n84, the TIB,c and RIB values are given in the tables below.

**Table 7.1.6-1: ΔTIB,c**

| EN-DC Band combination | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| DC\_1-SUL\_n79-n84 | 1 | 0 |
| n79 | 0 |
| n84 | 0 |

**Table 7.1.6-2: ΔRIB,c**

| EN-DC Band combination | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| DC\_1-SUL\_n79-n84 | 1 | 0 |
| n79 | 0 |
| n84 | 0 |

## 7.2 DC\_3\_SUL\_n41-n80

### 7.2.1 Operating bands

**Table 7.2.1-1: EN-DC band combination**

| EN-DC Band | E-UTRA Band | NR Band | Single UL allowed |
| --- | --- | --- | --- |
| DC\_3\_SUL\_n41-n80 | 3 | SUL\_n41-n80 | No |
| NOTE 1: If a UE is configured with both NR UL and NR SUL carriers in a cell, the switching time between NR UL carrier and NR SUL carrier can be up to 140us and placed in SUL resources.  NOTE 2: Applicable for UE supporting inter-band carrier aggregation with mandatory simultaneous Rx/Tx capability. | | | |

### 7.2.2 Configuration

Table 7.2.2-1: Inter-band EN-DC configurations

| EN-DC  configuration | Uplink EN-DC  configuration  (NOTE 1) | E-UTRA configuration | NR configuration |
| --- | --- | --- | --- |
| DC\_3A\_SUL\_n41A-n80A | DC\_3A\_n41A  DC\_3A\_n80A\_ULSUP-TDM\_n41A | 3A | SUL\_n41A-n80A |
| DC\_3C\_SUL\_n41A-n80A | DC\_3C\_n41A  DC\_3C\_n80A\_ULSUP-TDM\_n41A | 3C | SUL\_n41A-n80A |

### 7.2.3 Maximum output power

Table 7.2.3-1: Maximum output power for inter-band EN-DC

| DC configuration | Power class 3  (dBm) | Tolerance  (dB) |
| --- | --- | --- |
| DC\_3A\_n41A,  DC\_3A\_n80A\_ULSUP-TDM\_n41A  DC\_3C\_n41A,  DC\_3C\_n80A\_ULSUP-TDM\_n41A | 23 | +2/-3 |

### 7.2.4 Spurious emission band UE co-existence

Table 7.2.4-1: Spurious emissions for inter-band EN-DC

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **EN-DC Configuration** | **Spurious emission** | | | | | | |
| **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** |
| DC\_3A\_n41A,  DC\_3A\_n80A\_ULSUP-TDM\_n41A,  DC\_3C\_n41A,  DC\_3C\_n80A\_ULSUP-TDM\_n41A | E-UTRA Band 1, 5, 8, 26, 27, 28, 34, 39, 40, 44, 45, 50, 51, 65, 73, 74 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 11, 18, 19, 21 | FDL\_low | - | FDL\_high | -50 | 1 | 30 |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 8, 30 |

### 7.2.5 MSD

For DC\_3\_SUL\_n41-n80, there is no harmonic or harmonic mixing product generated by Band 3/n80 that may fall into the RX band of Band n41/3. Therefore, MSD due to harmonic or harmonic mixing is not needed.

However, since n41 is very close to Wi-Fi spectrum so the filter needs to provide enough rejection to Wi-Fi. This would impact the filter rejection to 3/n80, so cross band isolation issue needs to be considered for this band combination. Following DC\_3\_n41 requirement, reference sensitivity exception requirements are defined in Table 7.2.5-1 with uplink configuration in Table 7.2.5-2.

**Table 7.2.5-1: Reference sensitivity exceptions due to cross band isolation**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| UL band | DL band | 5 MHz  (dBm) | 10 MHz  (dBm) | 15 MHz  (dBm) | 20 MHz  (dBm) | 25 MHz  (dBm) | 30 MHz  (dBm) | 40 MHz  (dBm) | 50 MHz  (dBm) | 60 MHz  (dBm) | 80 MHz  (dBm) | 90 MHz  (dBm) | 100 MHz  (dBm) |
| 3 | n41 |  | [4.3] | [4.0] | [3.9] |  |  |  | [3.5] | [3.3] | [3.2] | [3.1] | [3.0] |
| n41 | 3 | [0.6] | [0.6] | [0.6] | [0.6] | [0.6] | [0.6] |  |  |  |  |  |  |
|  | NOTE 1: The B41 requirements are modified by -0.5dB when carrier frequency of the assigned E-UTRA channel bandwidth is within 2515-2690 MHz. | | | | | | | | | | | | |

**Table 7.2.5-2: Uplink configuration for reference sensitivity exceptions due to cross band isolation**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| UL band | DL band | SCS of UL band (kHz) | 5 MHz  (dBm) | 10 MHz  (dBm) | 15 MHz  (dBm) | 20 MHz  (dBm) | 25 MHz  (dBm) | 30 MHz  (dBm) | 40 MHz  (dBm) | 50 MHz  (dBm) | 60 MHz  (dBm) | 80 MHz  (dBm) | 90 MHz  (dBm) | 100 MHz  (dBm) |
| 3 | n41 | 15 | 50 | 50 | 50 | 50 | 50 |  |  |  |  |  |  |  |
| n41 | 3 | 30 | 160 | 160 | 160 | 160 | 160 | 160 |  |  |  |  |  |  |

There are also IMD4 product produced by Band 3 and n41 that impact the reference sensitivity of Band 3. Following LTE CA\_3-41 requirement, reference sensitivity exception requirements are defined in Table 7.2.5-3.

**Table 7.2.5-3: Reference sensitivity exceptions for PCell due to dual uplink operation**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR or E-UTRA Band / Channel bandwidth / NRB / MSD | | | | | | | | |
| EN-DC  Configuration | EUTRA or NR band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  LCRB | DL Fc (MHz) | MSD  (dB) | Duplex mode | IMD order |
| DC\_3A\_SUL\_n41A-n80A, DC\_3C\_SUL\_n41A-n80A | 3 | 1740 | 5 | 25 | 1835 | 8.2 | FDD | IMD4 |
| n41 | 2657.5 | 10 | 50 | 2657.5 | N/A | TDD | N/A |

### 7.2.6 ∆TIB and ∆RIB values

For DC\_3\_SUL\_n41-n80, the TIB,c and RIB values are given in the tables below.

**Table 7.2.6-1: ΔTIB,c**

| SUL Band combination | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| DC\_3\_SUL\_n41-n80 | 3 | 0.5 |
| n41 | 0.31 |
| 0.82 |
| n80 | 0.5 |
| NOTE 1: The requirement is applied for UE transmitting on the frequency range of 2515-2690MHz.  NOTE 2: The requirement is applied for UE transmitting on the frequency range of 2496-2515MHz. | | |

**Table 7.2.6-2: ΔRIB,c**

| SUL Band combination | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| DC\_3\_SUL\_n41-n80 | 3 | 0 |
| n41 | 01 |
| 0.52 |
| n80 | 0 |
| NOTE 1: The requirement is applied for UE transmitting on the frequency range of 2515-2690MHz.  NOTE 2: The requirement is applied for UE transmitting on the frequency range of 2496-2515MHz. | | |

## 7.3 DC\_8\_SUL\_n41-n81

### 7.3.1 Operating bands

**Table 7.3.1-1: EN-DC band combination**

| EN-DC Band | E-UTRA Band | NR Band | Single UL allowed |
| --- | --- | --- | --- |
| DC\_8\_SUL\_n41-n81 | 8 | SUL\_n41-n81 | No |
| NOTE 1: If a UE is configured with both NR UL and NR SUL carriers in a cell, the switching time between NR UL carrier and NR SUL carrier can be up to 140us and placed in SUL resources.  NOTE 2: Applicable for UE supporting inter-band carrier aggregation with mandatory simultaneous Rx/Tx capability. | | | |

### 7.3.2 Configuration

Table 7.3.2-1: Inter-band EN-DC configurations

| EN-DC  configuration | Uplink EN-DC  configuration  (NOTE 1) | E-UTRA configuration | NR configuration |
| --- | --- | --- | --- |
| DC\_8A\_SUL\_n41A-n81A | DC\_8A\_41A,  DC\_8A\_n81A\_ULSUP-TDM\_n41A | 8A | SUL\_n41A-n81A |

### 7.3.3 Maximum output power

Table 7.3.3-1: Maximum output power for inter-band EN-DC

| DC configuration | Power class 3  (dBm) | Tolerance  (dB) |
| --- | --- | --- |
| DC\_8A\_41A,  DC\_8A\_n81A\_ULSUP-TDM\_n41A | 23 | +2/-3 |

### 7.3.4 Spurious emission band UE co-existence

Table 7.3.4-1: Spurious emissions for inter-band EN-DC

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **EN-DC Configuration** | **Spurious emission** | | | | | | |
| **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** |
| DC\_8A\_41A,  DC\_8A\_n81A\_ULSUP-TDM\_n41A | E-UTRA Band 1, 28, 34, 39, 40, 45, 50, 51, 65, 73, 74 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA band 3, 42 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| E-UTRA 8 | FDL\_low | - | FDL\_high | -50 | 1 | 15 |
| E-UTRA Band 11, 21 | FDL\_low | - | FDL\_high | -50 | 1 | 30 |
| Frequency range | 1884.5 |  | 1915.7 | -41 | 0.3 | 8, 30 |

### 7.3.5 MSD

For DC\_8\_SUL\_n41-n81, there is 3rd harmonic product generated by Band n81 or Band 8 that may fall into the RX band of Band n41. Therefore, MSD due to harmonic is needed and the specific value can be the same as the MSD for DC\_8\_n41.

There are IMD3 product produced by Band 8 and n41 that impact the reference sensitivity of Band 8. Following LTE CA\_8-41 requirement, reference sensitivity exception requirements are defined in Table 7.3.5-1.

**Table 7.3.5-1: Reference sensitivity exceptions for PCell due to dual uplink operation**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR or E-UTRA Band / Channel bandwidth / NRB / MSD | | | | | | | | |
| EN-DC  Configuration | EUTRA or NR band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  LCRB | DL Fc (MHz) | MSD  (dB) | Duplex mode | IMD order |
| DC\_8A\_SUL\_n41A-n81A | 8 | 882.5 | 5 | 25 | 927.5 | 12.1 | FDD | IMD31 |
| n41 | 2685 | 10 | 50 | 2685 | N/A | TDD | N/A |
| NOTE 1: This band is subject to IMD5 also which MSD is not specified. | | | | | | | | |

### 7.3.6 ∆TIB and ∆RIB values

For DC\_8\_SUL\_n41-n81, the TIB,c and RIB values are given in the tables below.

**Table 7.3.6-1: ΔTIB,c**

| SUL Band combination | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| DC\_8\_SUL\_n41-n81 | 8 | 0.3 |
| n41 | 0.3 |
| n81 | 0.3 |

**Table 7.3.6-2: ΔRIB,c**

| SUL Band combination | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| DC\_8\_SUL\_n41-n81 | 8 | 0 |
| n41 | 0 |
| n81 | 0 |

## 7.4 DC\_3\_SUL\_n78-n80

### 7.4.1 Operating bands

Operating bands for DC\_3\_SUL\_n78-n80 is already specified in current specification.

### 7.4.2 Configuration

Table 7.4.2-1: Inter-band EN-DC configurations

| EN-DC  configuration | Uplink EN-DC  configuration  (NOTE 1) | E-UTRA configuration | NR configuration |
| --- | --- | --- | --- |
| DC\_3C\_SUL\_n78A-n80A | DC\_3A\_n78A DC\_3A\_n80A\_ULSUP-TDM\_n78A | 3C | SUL\_n78A-n80A |

### 7.4.3 Maximum output power

Maximum output power requirements for uplink configurations listed in table 7.4.2-1 are already specified in current specification so no new requirement is needed for this band combination.

### 7.4.4 Spurious emission band UE co-existence

Spurious emission band UE co-existence requirements for uplink configurations listed in table 7.4.2-1 are already specified in current specification so no new requirement is needed for this band combination.

### 7.4.5 MSD

MSD requirement for DC\_3C\_SUL\_n78A-n80A can reuse the same requirement for DC\_3A\_SUL\_n78A-n80A.

### 7.4.6 ∆TIB and ∆RIB values

For DC\_3\_SUL\_n78-n80, the TIB,c and RIB values are already specified in current specification.

## 7.5 DC\_1-3\_SUL\_n78-n80

### 7.5.1 Operating bands

**Table 7.5.1-1: EN-DC band combination**

| EN-DC Band | E-UTRA Band | NR Band | Single UL allowed |
| --- | --- | --- | --- |
| DC\_1-3\_SUL\_n78-n802 | CA\_1-3 | SUL\_n78-n801 | DC\_3\_n78 |
| NOTE 1: If a UE is configured with both NR UL and NR SUL carriers in a cell, the switching time between NR UL carrier and NR SUL carrier can be up to 140us and placed in SUL resources.  NOTE 2: Applicable for UE supporting inter-band carrier aggregation with mandatory simultaneous Rx/Tx capability. | | | |

### 7.5.2 Configuration

Table 7.5.2-1: Inter-band EN-DC configurations

| EN-DC  configuration | Uplink EN-DC  configuration  (NOTE 1) | E-UTRA configuration | NR configuration |
| --- | --- | --- | --- |
| DC\_1A-3A\_SUL\_n78A-n80A | DC\_1A\_n78A  DC\_1A\_n80A  DC\_3A\_n78A  DC\_3A\_n80A\_ULSUP-TDM\_n78A | CA\_1A-3A | SUL\_n78A-n80A |

### 7.5.3 Maximum output power

Maximum output power requirements for uplink configurations listed in table 7.5.2-1 are either already specified in current specification or defined in section for fallback mode of this band combination so no new requirement is needed here.

### 7.5.4 Spurious emission band UE co-existence

Spurious emission band UE co-existence requirements for uplink configurations listed in table 7.5.2-1 are either already specified in current specification or defined in section for fallback mode of this band combination so no new requirement is needed here.

### 7.5.5 MSD

There is no new MSD requirement for this band combination.

### 7.5.6 ∆TIB and ∆RIB values

For DC\_1-3\_SUL\_n78-n80, the TIB,c and RIB values are referred to DC\_1\_SUL\_n78-n80 and given in the tables below.

**Table 7.5.6-1: ΔTIB,c**

| SUL Band combination | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| DC\_1-3\_SUL\_n78-n80 | 1 | 0.6 |
| 3, n80 | 0.6 |
| n78 | 0.8 |

**Table 7.5.6-2: ΔRIB,c**

| SUL Band combination | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| DC\_1-3\_SUL\_n78-n80 | 1 | 0.2 |
| 3 | 0.2 |
| n78 | 0.5 |

## 7.6 DC\_3-7\_SUL\_n78-n80

### 7.6.1 Operating bands

**Table 7.6.1-1: EN-DC band combination**

| EN-DC Band | E-UTRA Band | NR Band | Single UL allowed |
| --- | --- | --- | --- |
| DC\_3-7\_SUL\_n78-n802 | CA\_3-7 | SUL\_n78-n801 | DC\_3\_n78 |
| NOTE 1: If a UE is configured with both NR UL and NR SUL carriers in a cell, the switching time between NR UL carrier and NR SUL carrier can be up to 140us and placed in SUL resources.  NOTE 2: Applicable for UE supporting inter-band carrier aggregation with mandatory simultaneous Rx/Tx capability. | | | |

### 7.6.2 Configuration

Table 7.6.2-1: Inter-band EN-DC configurations

| EN-DC  configuration | Uplink EN-DC  configuration  (NOTE 1) | E-UTRA configuration | NR configuration |
| --- | --- | --- | --- |
| DC\_3A-7A\_SUL\_n78A-n80A | DC\_3A\_n78A  DC\_3A\_n80A\_ULSUP-TDM\_n78A  DC\_7A\_n78A  DC\_7A\_n80A | CA\_3A-7A | SUL\_n78A-n80A |
| DC\_3C-7A\_SUL\_n78A-n80A | DC\_3A\_n78A  DC\_3A\_n80A\_ULSUP-TDM\_n78A  DC\_7A\_n78A  DC\_7A\_n80A | CA\_3C-7A | SUL\_n78A-n80A |

### 7.6.3 Maximum output power

Maximum output power requirements for uplink configurations listed in table 7.6.2-1 are either already specified in current specification or defined in section for fallback mode of this band combination so no new requirement is needed here.

### 7.6.4 Spurious emission band UE co-existence

Spurious emission band UE co-existence requirements for uplink configurations listed in table 7.6.2-1 are either already specified in current specification or defined in section for fallback mode of this band combination so no new requirement is needed here.

### 7.6.5 MSD

There are IMD3 and IMD4 product produced by Band 7 and n78 that impact the reference sensitivity of Band 3. Following DC\_3-7\_n78 requirement, reference sensitivity exception requirements are defined in Table 7.6.5-3.

**Table 7.6.5-3: Reference sensitivity exceptions for PCell due to dual uplink operation**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR or E-UTRA Band / Channel bandwidth / NRB / MSD | | | | | | | | |
| EN-DC  Configuration | EUTRA or NR band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  LCRB | DL Fc (MHz) | MSD  (dB) | Duplex mode | IMD order |
| DC\_3A-7A\_SUL\_n78A-n80A  DC\_3C-7A\_SUL\_n78A-n80A | 3 | 1725 | 5 | 25 | 1820 | 17.6 | FDD | IMD3 |
| 7 | 2565 | 5 | 25 | 2685 | N/A | FDD | N/A |
| n78 | 3310 | 10 | 50 | 3310 | N/A | TDD | N/A |
| 3 | 1725 | 5 | 25 | 1820 | 8.6 | FDD | IMD4 |
| 7 | 2565 | 5 | 25 | 2685 | N/A | FDD | N/A |
| n78 | 3475 | 10 | 50 | 3475 | N/A | TDD | N/A |

### 7.6.6 ∆TIB and ∆RIB values

For DC\_3-7\_SUL\_n78-n80, the TIB,c and RIB values are referred to DC\_7\_SUL\_n78-n80 and given in the tables below.

**Table 7.6.6-1: ΔTIB,c**

| SUL Band combination | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| DC\_3-7\_SUL\_n78-n80 | 7 | 0.6 |
| 3, n80 | 0.6 |
| n78 | 0.8 |

**Table 7.6.6-2: ΔRIB,c**

| SUL Band combination | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| DC\_3-7\_SUL\_n78-n80 | 7 | 0.2 |
| 3 | 0.2 |
| n78 | 0.5 |

## 7.7 DC\_3-8\_SUL\_n78-n80

### 7.7.1 Operating bands

**Table 7.7.1-1: EN-DC band combination**

| EN-DC Band | E-UTRA Band | NR Band | Single UL allowed |
| --- | --- | --- | --- |
| DC\_3-8\_SUL\_n78-n802 | CA\_3-8 | SUL\_n78-n801 | DC\_3\_n78 |
| NOTE 1: If a UE is configured with both NR UL and NR SUL carriers in a cell, the switching time between NR UL carrier and NR SUL carrier can be up to 140us and placed in SUL resources.  NOTE 2: Applicable for UE supporting inter-band carrier aggregation with mandatory simultaneous Rx/Tx capability. | | | |

### 7.7.2 Configuration

Table 7.7.2-1: Inter-band EN-DC configurations

| EN-DC  configuration | Uplink EN-DC  configuration  (NOTE 1) | E-UTRA configuration | NR configuration |
| --- | --- | --- | --- |
| DC\_3A-8A\_SUL\_n78A-n80A | DC\_3A\_n78A  DC\_3A\_n80A\_ULSUP-TDM\_n78A  DC\_8A\_n78A  DC\_8A\_n80A | CA\_3A-8A | SUL\_n78A-n80A |

### 7.7.3 Maximum output power

Maximum output power requirements for uplink configurations listed in table 7.7.2-1 are either already specified in current specification or defined in section for fallback mode of this band combination so no new requirement is needed here.

### 7.7.4 Spurious emission band UE co-existence

Spurious emission band UE co-existence requirements for uplink configurations listed in table 7.7.2-1 are either already specified in current specification or defined in section for fallback mode of this band combination so no new requirement is needed here.

### 7.7.5 MSD

There is no new MSD requirement for this band combination referring to DC\_3-8\_n78.

### 7.7.6 ∆TIB and ∆RIB values

For DC\_3-8\_SUL\_n78-n80, the TIB,c and RIB values are referred to DC\_3-8\_n78 and given in the tables below.

**Table 7.7.6-1: ΔTIB,c**

| SUL Band combination | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| DC\_3-8\_SUL\_n78-n80 | 3, n80 | 0.6 |
| 8 | 0.6 |
| n78 | 0.8 |

**Table 7.7.6-2: ΔRIB,c**

| SUL Band combination | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| DC\_3-8\_SUL\_n78-n80 | 3 | 0.2 |
| 8 | 0.2 |
| n78 | 0.5 |

## 7.8 DC\_3\_20\_SUL\_n78-n80

### 7.8.1 Operating bands

**Table 7.8.1-1: EN-DC band combination**

| EN-DC Band | E-UTRA Band | NR Band | Single UL allowed |
| --- | --- | --- | --- |
| DC\_3\_20\_SUL\_n78-n802 | CA\_3\_20 | SUL\_n78-n801 | DC\_3\_n78 |
| NOTE 1: If a UE is configured with both NR UL and NR SUL carriers in a cell, the switching time between NR UL carrier and NR SUL carrier can be up to 140us and placed in SUL resources.  NOTE 2: Applicable for UE supporting inter-band carrier aggregation with mandatory simultaneous Rx/Tx capability. | | | |

### 7.8.2 Configuration

Table 7.8.2-1: Inter-band EN-DC configurations

| EN-DC  configuration | Uplink EN-DC  configuration  (NOTE 1) | E-UTRA configuration | NR configuration |
| --- | --- | --- | --- |
| DC\_3A\_20A\_SUL\_n78A-n80A | DC\_3A\_n78A  DC\_3A\_n80A\_ULSUP-TDM\_n78A  DC\_20A\_n78A  DC\_20A\_n80A | CA\_3A\_20A | SUL\_n78A-n80A |
| DC\_3C\_20A\_SUL\_n78A-n80A | DC\_3A\_n78A  DC\_3A\_n80A\_ULSUP-TDM\_n78A  DC\_20A\_n78A  DC\_20A\_n80A | CA\_3C\_20A | SUL\_n78A-n80A |

### 7.8.3 Maximum output power

Maximum output power requirements for uplink configurations listed in table 7.8.2-1 are either already specified in current specification or defined in section for fallback mode of this band combination so no new requirement is needed here.

### 7.8.4 Spurious emission band UE co-existence

Spurious emission band UE co-existence requirements for uplink configurations listed in table 7.8.2-1 are either already specified in current specification or defined in section for fallback mode of this band combination so no new requirement is needed here.

### 7.8.5 MSD

There are IMD3 and IMD4 product produced by Band 7 and n78 that impact the reference sensitivity of Band 3. Following DC\_3-7\_n78 requirement, reference sensitivity exception requirements are defined in Table 7.8.5-3.

**Table 7.8.5-3: Reference sensitivity exceptions for PCell due to dual uplink operation**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR or E-UTRA Band / Channel bandwidth / NRB / MSD | | | | | | | | |
| EN-DC  Configuration | EUTRA or NR band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  LCRB | DL Fc (MHz) | MSD  (dB) | Duplex mode | IMD order |
| DC\_3A\_20A\_SUL\_n78A-n80A  DC\_3C\_20A\_SUL\_n78A-n80A | 3 | 1725 | 5 | 25 | 1820 | 17.3 | FDD | IMD3 |
| 20 | 845 | 5 | 25 | 804 | N/A | FDD | N/A |
| n78 | 3510 | 10 | 50 | 3510 | N/A | TDD | N/A |

### 7.8.6 ∆TIB and ∆RIB values

For DC\_3\_20\_SUL\_n78-n80, the TIB,c and RIB values are referred to DC\_3\_20\_n78 and given in the tables below.

**Table 7.8.6-1: ΔTIB,c**

| SUL Band combination | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| DC\_3\_20\_SUL\_n78-n80 | 3, n80 | 0.5 |
| 20 | 0.3 |
| n78 | 0.8 |

**Table 7.8.6-2: ΔRIB,c**

| SUL Band combination | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| DC\_3\_20\_SUL\_n78-n80 | 3 | 0.2 |
| n78 | 0.5 |

## 7.9 DC\_3\_SUL\_n77-n80

### 7.9.1 Operating bands

**Table 7.9.1-1: EN-DC band combination**

| EN-DC Band | E-UTRA Band | NR Band | Single UL allowed |
| --- | --- | --- | --- |
| DC\_3\_SUL\_n77-n802 | 3 | SUL\_n77-n80 | DC\_3\_n77 |
| NOTE 1: If a UE is configured with both NR UL and NR SUL carriers in a cell, the switching time between NR UL carrier and NR SUL carrier can be up to 140us and placed in SUL resources.  NOTE 2: Applicable for UE supporting inter-band carrier aggregation with mandatory simultaneous Rx/Tx capability. | | | |

### 7.9.2 Configuration

Table 7.9.2-1: Inter-band EN-DC configurations

| EN-DC  configuration | Uplink EN-DC  configuration  (NOTE 1) | E-UTRA configuration | NR configuration |
| --- | --- | --- | --- |
| DC\_3A\_SUL\_n77A-n80A | DC\_3A\_n77A  DC\_3A\_n80A\_ULSUP-TDM\_n77A | 3A | SUL\_n77A-n80A |

### 7.9.3 Maximum output power

Table 7.9.3-1: Maximum output power for inter-band EN-DC

| DC configuration | Power class 3  (dBm) | Tolerance  (dB) |
| --- | --- | --- |
| DC\_3A\_n77A  DC\_3A\_n80A\_ULSUP-TDM\_n77A | 23 | +2/-3 |

### 7.9.4 Spurious emission band UE co-existence

Table 7.9.4-1: Spurious emission band UE co-existence for inter-band EN-DC

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| EN-DC Configuration | Spurious emission | | | | | | |
| Protected band | Frequency range (MHz) | | | Maximum Level (dBm) | MBW (MHz) | NOTE |
| DC\_3\_n77  DC\_3\_n80\_ULSUP-TDM\_n77 | E-UTRA Band 1, 3, 5, 7, 8, 11, 18, 19, 20, 21, 26, 28, 34, 39, 40, 41, 65 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 3 |

### 7.9.5 MSD

There is IMD2 product produced by Band 3 and n77 that impact the reference sensitivity of Band 3 and IMD4 product produced by Band 3 and n77 that impact the reference sensitivity of Band n77. Following DC\_3-n77 requirement, reference sensitivity exception requirements are defined in Table 7.9.5-3.

**Table 7.9.5-3: Reference sensitivity exceptions for PCell due to dual uplink operation**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR or E-UTRA Band / Channel bandwidth / NRB / MSD | | | | | | | | |
| EN-DC  Configuration | EUTRA or NR band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  LCRB | DL Fc (MHz) | MSD  (dB) | Duplex mode | IMD order |
| DC\_3A\_SUL\_n77A-n80A | 3 | 1740 | 5 | 25 | 1835 | 26 | FDD | IMD23 |
| 28.74 |
| n77 | 3575 | 10 | 50 | 3575 | N/A | TDD | N/A |
| DC\_3A-SUL\_n77A-n80A | 3 | 1765 | 5 | 25 | 1860 | 8.0 | FDD | IMD43 |
| 10.74 |
| n77 | 3435 | 10 | 50 | 3435 | N/A | TDD | N/A |

### 7.9.6 ∆TIB and ∆RIB values

For DC\_3\_SUL\_n77-n80, the TIB,c and RIB values are referred to DC\_3-n77 and given in the tables below.

**Table 7.9.6-1: ΔTIB,c**

| SUL Band combination | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| DC\_3\_SUL\_n77-n80 | 3 | 0.6 |
| n80 | 0.6 |
| n77 | 0.8 |

**Table 7.9.6-2: ΔRIB,c**

| SUL Band combination | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| DC\_3\_SUL\_n77-n80 | 3 | 0.2 |
| n77 | 0.5 |

## 7.10 DC\_1\_SUL\_n77-n84

### 7.10.1 Operating bands

**Table 7.10.1-1: EN-DC band combination**

| EN-DC Band | E-UTRA Band | NR Band | Single UL allowed |
| --- | --- | --- | --- |
| DC\_1\_SUL\_n77-n842 | 1 | SUL\_n77-n84 | DC\_1\_n77 |
| NOTE 1: If a UE is configured with both NR UL and NR SUL carriers in a cell, the switching time between NR UL carrier and NR SUL carrier can be up to 140us and placed in SUL resources.  NOTE 2: Applicable for UE supporting inter-band carrier aggregation with mandatory simultaneous Rx/Tx capability. | | | |

### 7.10.2 Configuration

Table 7.10.2-1: Inter-band EN-DC configurations

| EN-DC  configuration | Uplink EN-DC  configuration  (NOTE 1) | E-UTRA configuration | NR configuration |
| --- | --- | --- | --- |
| DC\_1A\_SUL\_n77A-n84A | DC\_1A\_n77A  DC\_1A\_n84A\_ULSUP-TDM\_n77A | 1A | SUL\_n77A-n84A |

### 7.10.3 Maximum output power

Table 7.10.3-1: Maximum output power for inter-band EN-DC

| DC configuration | Power class 3  (dBm) | Tolerance  (dB) |
| --- | --- | --- |
| DC\_1A\_n77A  DC\_1A\_n84A\_ULSUP-TDM\_n77A | 23 | +2/-3 |

### 7.10.4 Spurious emission band UE co-existence

Table 7.10.4-1: Spurious emission band UE co-existence for inter-band EN-DC

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| EN-DC Configuration | Spurious emission | | | | | | |
| Protected band | Frequency range (MHz) | | | Maximum Level (dBm) | MBW (MHz) | NOTE |
| DC\_1\_n77  DC\_1\_n84\_ULSUP-TDM\_n77 | E-UTRA Band 1, 3, 5, 7, 8, 11, 18, 19, 20, 21, 26, 28, 34, 39, 40, 41, 65 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| Frequency range | 1880 | - | 1895 | -40 | 1 | 5, 8 |
| Frequency range | 1895 | - | 1915 | -15.5 | 5 | 5, 7, 8 |
| Frequency range | 1915 | - | 1920 | +1.6 | 5 | 5, 7, 8 |

### 7.10.5 MSD

There is IMD2 product produced by Band 1 and n77 that impact the reference sensitivity of Band 1 and IMD4 product produced by Band 1 and n77 that impact the reference sensitivity of Band 1. Following DC\_1-n77 requirement, reference sensitivity exception requirements are defined in Table 7.10.5-3.

**Table 7.10.5-3: Reference sensitivity exceptions for PCell due to dual uplink operation**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR or E-UTRA Band / Channel bandwidth / NRB / MSD | | | | | | | | |
| EN-DC  Configuration | EUTRA or NR band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  LCRB | DL Fc (MHz) | MSD  (dB) | Duplex mode | IMD order |
| DC\_1A\_SUL\_n77A-n84A | 1 | 1950 | 5 | 25 | 2140 | 29.8 | FDD | IMD23 |
| 32.54 |
| n77 | 4090 | 10 | 50 | 4090 | N/A | TDD | N/A |
| DC\_1A-SUL\_n77A-n84A | 1 | 1950 | 5 | 25 | 2140 | 8.0 | FDD | IMD43 |
| 10.74 |
| n77 | 3710 | 10 | 50 | 3710 | N/A | TDD | N/A |

### 7.10.6 ∆TIB and ∆RIB values

For DC\_1\_SUL\_n77-n84, the TIB,c and RIB values are referred to DC\_1-n77 and given in the tables below.

**Table 7.10.6-1: ΔTIB,c**

| SUL Band combination | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| DC\_1\_SUL\_n77-n84 | 1 | 0.6 |
| n84 | 0.6 |
| n77 | 0.8 |

**Table 7.10.6-2: ΔRIB,c**

| SUL Band combination | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| DC\_1\_SUL\_n77-n84 | 1 | 0.2 |

## 7.X DC\_X\_SUL\_nY-nZ

### 7.X.1 Operating bands

### 7.X.2 Configuration

### 7.X.3 Maximum output power

### 7.X.4 Spurious emission band UE co-existence

### 7.X.5 MSD

### 7.X.6 ∆TIB and ∆RIB values

# Annex A: Change history

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Change history** | | | | | | | |
| **Date** | **Meeting** | **TDoc** | **CR** | **Rev** | **Cat** | **Subject/Comment** | **New version** |
| 2018-8 | 3GPP RAN4#88 | R4-1809929 |  |  |  | Initial TR skeleton | 0.0.1 |
| 2018-10 | 3GPP RAN4#88bis | R4-1813417 |  |  |  | Implemented TP´s from RAN4 #88:  R4-1810441, TP for TR 37.716-00-00 Update scope of SUL band combinations, Huawei, HiSilicon | 0.1.0 |
| 2018-11 | 3GPP RAN4#89 | R4-1814906 |  |  |  | Implemented TP´s from RAN4 #88bis:  R4-1812288 TP for TR 37.716-00-00: Specific requirements for new SUL band combinations, Huawei, HiSilicon  R4-1813772 TP for TR 37.716-00-00: DC\_1A-SUL\_n79A-n84A, KDDI Corporation  R4-1813824 TP for TR 37.716-00-00: SUL\_n79A-n84A, KDDI Corporation | 0.2.0 |
| 2019-03 | 3GPP RAN4#90 | R4-1903153 |  |  |  | Implemented TP´s from RAN4 #90:  R4-1900647 TP for TR 37.716-00-00 Specific requirements for DC\_3\_SUL\_n78\_n80 Huawei, HiSilicon  R4-1900653 TP for TR 37.716-00-00 Updated specific requirements for SUL band combinations Huawei, HiSilicon  R4-1902197 TP for TR 37.716-00-00 Specific requirements for DC\_1\_SUL\_n78\_n80 Huawei, HiSilicon  R4-1902198 TP for TR 37.716-00-00 Specific requirements for DC\_7\_SUL\_n78\_n80 Huawei, HiSilicon  R4-1902199 TP for TR 37.716-00-00 Specific requirements for DC\_20\_SUL\_n78\_n80 Huawei, HiSilicon  R4-1902200 TP for TR 37.716-00-00 Specific requirements for DC\_1-3\_SUL\_n78\_n80 Huawei, HiSilicon  R4-1902201 TP for TR 37.716-00-00 Specific requirements for DC\_3-7\_SUL\_n78\_n80 Huawei, HiSilicon  R4-1902202 TP for TR 37.716-00-00 Specific requirements for DC\_8\_SUL\_n78\_n80 Huawei, HiSilicon  R4-1902203 TP for TR 37.716-00-00 Specific requirements for DC\_3-8\_SUL\_n78\_n80 Huawei, HiSilicon  R4-1902204 TP for TR 37.716-00-00 Specific requirements for DC\_3-20\_SUL\_n78\_n80 Huawei, HiSilicon | 0.3.0 |
| 2019-05 | 3GPP RAN4#91 | R4-1905411 |  |  |  | Implemented TP´s from RAN4 #90bis:  R4-1903157 TP for TR 37.716-00-00 Specific requirements for SUL\_n77\_n80  R4-1903158 TP for TR 37.716-00-00 Specific requirements for SUL\_n77\_n84  R4-1903159 TP for TR 37.716-00-00 Specific requirements for DC\_3\_SUL\_n77\_n80  R4-1903160 TP for TR 37.716-00-00 Specific requirements for DC\_1\_SUL\_n77\_n84  R4-1903161 TP for TR 37.716-00-00 Specific requirements for DC\_1\_SUL\_n77\_n80  R4-1903162 TP for TR 37.716-00-00 Specific requirements for DC\_3\_SUL\_n77\_n84  R4-1903163 TP for TR 37.716-00-00 Specific requirements for DC\_3\_SUL\_n78\_n84  R4-1903164 TP for TR 37.716-00-00 Updated band combinations for SUL | 0.4.0 |
| 2020-04 | 3GPP RAN4#94bis-e | R4-2004136 |  |  |  | Implemented TP´s from RAN4 #92:  R4-1908945 updated TP for TR 37.716-00-00, Huawei, HiSilicon | 0.5.0 |
| 2020-04 | 3GPP RAN4#94bis-e | R4-2004137 |  |  |  | Implemented TP´s from RAN4 #94bis-e  R4-2004139 Updated TP for TR 37.716-00-00: to clean up, Huawei, HiSilicon  R4-2004962 TP for TR 37.716-00-00 for SUL\_n79A-n95A, CMCC, Huawei, HiSilicon | 0.6.0 |
| 2020-05 | 3GPP RAN4#95-e | R4-2008067 |  |  |  | Implemented TP´s from RAN4 #95-e  R4-2008370 TP for TR 37.716-00-00 for SUL\_n41A-n95A, Huawei, HiSilicon | 0.7.0 |
| 2020-06 | 3GPP RAN#88-e | RP-20xxxx |  |  |  | TR 37.716-00-00 v1.0.0 | 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 |