|  |  |
| --- | --- |
| 3GPP TR 38.862 V0.3.0 (2021-08) | |
| Technical Report | |
| 3rd Generation Partnership Project;  Technical Specification Group Radio Access Networks;  Study on band combination handling in RAN4  (Release 17) | |
|  | |
| *5G-logo_175px* | 3GPP-logo_web |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  | |
| The present document has been developed within the 3rd Generation Partnership Project (3GPP TM) and may be further elaborated for the purposes of 3GPP. The present document has not been subject to any approval process by the 3GPPOrganizational Partners and shall not be implemented. This Specification is provided for future development work within 3GPPonly. The Organizational Partners accept no liability for any use of this Specification. Specifications and Reports for implementation of the 3GPP TM system should be obtained via the 3GPP Organizational Partners' Publications Offices. | |

|  |
| --- |
|  |
| ***3GPP***  Postal address  3GPP support office address  650 Route des Lucioles - Sophia Antipolis  Valbonne - FRANCE  Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16  Internet  http://www.3gpp.org |
| ***Copyright Notification***  No part may be reproduced except as authorized by written permission. The copyright and the foregoing restriction extend to reproduction in all media.  © 2020, 3GPP Organizational Partners (ARIB, ATIS, CCSA, ETSI, TSDSI, TTA, TTC).  All rights reserved.  UMTS™ is a Trade Mark of ETSI registered for the benefit of its members  3GPP™ is a Trade Mark of ETSI registered for the benefit of its Members and of the 3GPP Organizational Partners LTE™ is a Trade Mark of ETSI registered for the benefit of its Members and of the 3GPP Organizational Partners  GSM® and the GSM logo are registered and owned by the GSM Association |

Contents

Foreword 5

1 Scope 7

2 References 7

3 Definitions of terms, symbols and abbreviations 7

3.1 Terms 7

3.2 Symbols 7

3.3 Abbreviations 8

4 Background 8

5 Rules and guidelines of specifying band combinations 8

5.1 General 8

5.2 Notation of lists of bands and bandwidths within a configuration 9

5.2.1 Band numbers 9

5.2.2 Bandwidth classes 10

5.2.2.1 Bandwidth classes for LTE 10

5.2.2.2 Bandwidth classes for NR 10

5.3 Rules to be used for the notation of CA or DC configurations 11

5.4 xxxx 12

6 Introduction of band combinations 12

6.1 General 12

6.2 Band combination request 12

6.2.1 Band combination workflow 12

6.2.1.1 The workflow on introduction of band combinations for block approval 12

6.2.2 Template of band combination request sheet, status report and band combinations table in basket WI 13

6.2.3 Template of TP for basket WIDs 15

6.2.4 xxxx 15

6.3 Usage of band combination 15

6.3.1 Notation of CA or DC configurations in the request sheets and work item descriptions 15

6.4 xxxx 15

6.4.1 xxxx 15

7 Guidelines for technical studies for band combinations 15

7.1 xxxx 15

8 Optimization on band combinations 16

8.1 General 16

8.2 Improving RAN4 specification structures 16

8.2.1 RAN4 specification structure 16

8.2.2 CA and DC configuration table structure 16

8.2.3 xxxxx 16

8.3 Reducing redundant contents in RAN4 specification 16

8.3.1 Configuration tables 16

8.3.1.1 CA configuration table 16

8.3.1.2 DC configuration table 19

8.3.1.3 SUL configuration table 19

8.3.2 ΔTIB,c and ΔRIB,c for DC 22

8.3.2.1 ΔTIB,c table 22

8.3.2.2 ΔRIB,c table 22

8.3.3 xxxxx 22

8.4 xxxx 22

8.4.1 xxxx 22

9 <Other aspects to be studied> 22

Annex A: Change history 23

# Foreword

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

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

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

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

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

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

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

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

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

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

**should** indicates a recommendation to do something

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

**may** indicates permission to do something

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

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

**can** indicates that something is possible

**cannot** indicates that something is impossible

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

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

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

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

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

In addition:

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

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

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

# 1 Scope

The present document is a technical report on band combination handling and rule collection for RAN4 specifications. The purpose is to create a document to collect the rules of band combinations, which can be widely known not only by RAN4 but also by other 3GPP working groups or even by other industrial partners outside 3GPP. It aims to improve the band combination in the current RAN4 specifications and collect the rules what RAN4 has been achieved during the timescale of Rel-17.

This TR contains a band combination specific part. The agreements on the rules of specifying band combinations, and facilitate understanding of the complex notations of CA/DC combinations are provided.

# 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-210773, “New SID: Study on band combination handling in RAN4”, RAN#91-e.

[3] 3GPP TR 38.817-01: “General aspects for User Equipment (UE) Radio Frequency (RF) for NR”.

[4] 3GPP TR 38.101-01: “NR; User Equipment (UE) radio transmission and reception; Part 1: Range 1 Standalone”.

[5] 3GPP TR 38.101-02: “NR; User Equipment (UE) radio transmission and reception; Part 2: Range 2 Standalone”.

[6] 3GPP TR 38.101-03: “NR; User Equipment (UE) radio transmission and reception; Part 3: Range 1 and Range 2 Interworking operation with other radios”.

# 3 Definitions of terms, symbols and abbreviations

## 3.1 Terms

For the purposes of the present document, the terms given in 3GPP TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in 3GPP TR 21.905 [1].

**example:** text used to clarify abstract rules by applying them literally.

## 3.2 Symbols

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

<symbol> <Explanation>

## 3.3 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in 3GPP TR 21.905 [1].

<ABBREVIATION> <Expansion>

# 4 Background

At 3GPP RAN#91-e meeting, a new Rel-17 Study Item “Study on band combination handling in RAN4” was approved. The objectives are as follows,

* Study the adequate information on what needs for introducing band combinations and capture TP formats.
* Collect agreements on the rules and guidelines of specifying band combinations, such as the notations of CA/DC combinations, etc.
* Analyse and identify the redundant contents in RAN4 specifications.
* Study potential future-proof solutions for band combination configuration tables in RAN4 specifications for concise representation, better readability and better trackability and editability.

The target is that after the completion of the study item, a guidance on band combination handling, rule collections and band combination optimization for RAN4 specifications will be approved. It is suggested to be applied to the latest RAN4 specifications after the completion of the SI.

# 5 Rules and guidelines of specifying band combinations

## 5.1 General

The notation of the band combinations in the 38.101 specifications as well as the combination request lists by the operators and the basket WIDs can have significant impact, as it can become unclear what combination is really meant in the request or specification in cases of errors. Then the combination may be misinterpreted, not taken into account when implementing combinations in BS or UEs or even removed from specs or requests. Also automated processing of the tables will become difficult with too many bugs.

Generally the notation of band combinations starts with the type of the configuration (mainly CA or DC), followed by one list (either LTE or NR) or two lists (first LTE, then NR) of bands with bandwidths. The following types of band combinations are defined in 3GPP specifications:

Carrier Aggregation: Starts with “CA\_” as the first three characters. Then either a list of LTE or NR carriers is following, where the carriers or bands are always separated by “-“. LTE and NR carriers cannot be combined, that would be a DC combination. Examples:

- CA\_1A-2A (LTE)

- CA\_n1A-n2A (NR)

- Examples for wrong notations: CA\_1A\_2A (“\_” instead of “-“ between the carriers/bands), CA-1A-2A (no “\_” but “-“ after “CA”, CA\_1A\_n2A (this would need to be a DC combination)

- NOTE: LTE examples are provided for information only

Dual Connectivity: Starts with “DC\_” as the first three characters, then for EN-DC configurations followed by the list of LTE carriers, a “\_” as separation between the LTE and NR carriers and then the list of NR carriers. For NE-DC configurations the list begins with NR carriers, a “\_” as separation between the NR and LTE carriers, and then the list of LTE carriers. There are exceptions for SUL EN-DC combinations, which separate the LTE and NR carriers by “\_SUL\_” instead of “\_”, and contiguous intra-band EN-DC combinations using “(n)” instead of “\_” and the “n” of the first NR band in the list. DC configurations within LTE or NR just list the carriers after “DC\_”. For EN-DC combinations for V2X the “DC\_” at the beginning is replaced by V2X\_”, even if it is still a EN-DC combination. Examples:

- DC\_1A\_n2A (EN-DC)

- DC\_1A-2A (LTE-DC)

- DC\_n1A-n2A (NR-DC)

- DC\_(n)1AA (EN-DC with contiguous intra-band LTE and NR carriers)

- DC\_1(n)AA (NE-DC with contiguous intra-band NR and LTE carriers)

- DC\_1A-(n)2AA (EN-DC with one LTE carrier followed by contiguous intra-band LTE and NR carriers)

- DC\_2(n)AA-1A (NE-DC with one LTE carrier followed by contiguous intra-band NR and LTE carriers)

- DC\_n78A\_1A-3A (NE-DC)

- Examples for wrong notations: DC\_1A-n2A (“-” instead of “\_“ between the LTE and NR carriers/bands for EN-DC combinations), DC-1A-2A (no “\_” but “-“ after “DC”, DC\_n1A\_n2A (“\_” instead of “-“ between the NR carriers/bands for NR-DC combinations)

Supplementary UL: NR SA configurations start with SUL\_ as the first four characters, as it is only NR without LTE, if it is within an EN-DC combination there is a \_SUL\_ between the LTE and the NR part instead of the “SUL\_” at the beginning, using the usual “DC\_” as the first characters. For uplink EN-DC configuration, if TDM operation of uplink sharing from UE perspective (ULSUP) is chosen, the notation of “\_ULSUP-TDM\_” is used. The FDM operation of uplink sharing from UE perspective is not supported in current specifications. Examples:

- SUL\_n2A-n80A (n80 being the SUL band)

- DC\_1A\_SUL\_n2A-n80A (n80 being the SUL band)

- DC\_3A\_n80A\_ULSUP-TDM\_n78A (TDM operation on SUL\_n78-n80)

In summary the following types and notations are defined:

- CA\_ …: A Carrier Aggregation configuration followed by the list of either LTE or NR carriers.

- DC\_ …: A Dual Connectivity configuration followed by the list of either LTE carriers for LTE-DC or NR carriers for NR-DC or for EN-DC first LTE carriers, then “\_” and the NR carriers. In case of a DC combination for V2X, the “DC\_” is replaced with “V2X\_”.

- SUL\_ …: A Carrier Aggregation configuration including one SUL band followed by the list of NR carriers, one of them being a SUL carrier. In case of a DC configuration with SUL, the “SUL\_” is shifted behind the “\_” separating the LTE and NR carriers and the configuration starts with “DC\_” as usual for DC configurations. In case of an uplink EN-DC configuration with SUL, “\_ULSUP-TDM\_” is applied for TDM operation for uplink sharing from UE perspective.

## 5.2 Notation of lists of bands and bandwidths within a configuration

### 5.2.1 Band numbers

A list of LTE or NR carriers within a CA or DC configuration is a either a single or multiple LTE or NR carriers. The simplest one is just a single carrier. It consists of the band number followed by the bandwidth class, which is “A” for a single carrier. For LTE the band number is just the number of the band, for NR carriers the numerical part of the band notation is preceded by a “n”, indicating this is a NR band, not a LTE band. NR bands above n256 are FR2 bands, below n256 are FR1 bands. The band number is always followed by the bandwidth class, which can be quite complicated for NR combinations with intra-band CA. Bandwidth classes other than “A” indicate multiple carriers in that band. In the list there can be multiple entries for inter-band CA configurations (in LTE also intra-band non-contiguous CA), which are always separated by “-“. The band numbers are sorted in increasing numbers. LTE and NR bands in the same frequency range usually have the same band number. Examples:

- Notation of a single LTE carrier: 1A, 2A, 3A etc.

- Notation of a single NR carrier: n1A, n2A, n3A etc.

- List of multiple LTE carriers on different bands: 1A-2A-3A.

- List of multiple NR carriers on different bands: n1A-n2A-n3A.

### 5.2.2 Bandwidth classes

#### 5.2.2.1 Bandwidth classes for LTE

An entry within the list of carriers always starts with the band number followed by the bandwidth class. In LTE the bandwidth classes (if not “A”) mean this is a contiguous CA configuration with multiple carriers. They are specified in table 5.6A-1 in 36.101 and can range from “A” for a single carrier up to F for 5 carriers. BW class I is specified for 8 carriers, but is not used. Non-contiguous CA combinations are just listing multiple sub-blocks separated by “-“. Examples:

- CA\_1B: Two contiguously aggregated LTE carriers with 20MHz or less in band 1.

- CA\_2F: Five contiguously aggregated LTE carriers with up to 100MHz in band 2.

- CA\_3A-3A: Two non-contiguously aggregated LTE carriers in band 3

- CA\_4A-4E: A single carrier followed by a gap and then followed by four contiguously aggregated carriers with up to 80MHz

- A single carrier is no CA configuration as there is nothing aggregated, so there is no CA\_5A, this is just 5A.

#### 5.2.2.2 Bandwidth classes for NR

NR bandwidth classes are much more complicated. Also here an entry within the list of carriers always starts with the band number followed by the bandwidth class. But in NR the bandwidth class includes contiguous and non-contiguous CA and a mixture of contiguous and non-contiguous CA. For contiguous CA the bandwidth classes are specified similar to LTE, but separate for FR1 and FR2. For FR1 contiguous CA BW classes are specified in table 5.3A.5-1 in 38.101-1 ranging from A to O, for FR2 in 5.3A.4-1 in 38.101-2 ranging from A to Q.

A special kind or BW class specification is when there are intra-band contiguous LTE and NR carriers within a DC combination like DC\_(n)1AA. In this case the LTE and NR carriers within that band are combined to a single entry of the list of carriers starting with (n) indicating that it can be “n” for the NR carrier, or no “n” for the LTE carrier. This is followed by the numerical value of the band (here “1”) and then the contiguous BW class for the LTE part and the contiguous BW class for the NR part. So DC\_(n)1AA means that there is a single carrier for LTE and a single carrier for NR side-by-side contiguously aggregated in band 1. This can be extended by more contiguous carriers on the LTE or NR side or both, for example DC\_(n)41DA means three contiguous carriers for LTE besides a single carrier for NR. This can be extended by other LTE carriers in front of the combination of carriers with (n) or with other NR carriers behind the (n) part, for example DC\_1A-(n)2AA or DC\_(n)2AA-n3A. The (n) part is considered as the last LTE combination in the list or the first NR combination in the list, therefore adding it with a “-“ instead of a “\_”.

However, the BW class part of a NR configuration also includes non-contiguous intra-band CA. For a combination containing any non-contiguous CA, i.e. a gap between any aggregated carriers, each block of single or contiguously aggregated carriers is called a sub-block, where a sub-block can also consist of the contiguously aggregated carriers as stated above. While in LTE single non-contiguously aggregated carriers are just duplicated like CA\_1A-1A, in NR the number of non-contiguous carriers of a BW class is counted and put in parenthesis with the number of subblocks of this type preceding the bandwidth class. Therefore a configuration with two non-contiguous carriers will have a BW class (2A) in NR, so the combination will be named CA\_n1(2A), meaning there are two non-contiguous carriers with BW class A in band n1.

However, there can also be the combination of contiguous and non-contiguous intra-band CA in NR. In. this case the sub-blocks of each BW class are separately counted and added within the brackets. For example if there are in a n260 FR2 CA combination two sub-blocks of BW class “A” (single carriers), three of BW class “G” (two contiguous carriers up to 100MHz) and one of BW class O (two carriers with 50 or 100MHz), the full combination will be named CA\_n260(2A-3G-Q), having 6 sub-blocks with in total 10 carriers. Examples:

- CA\_n1B: Two contiguously aggregated NR carriers with 100MHz or less in band n1 (FR1).

- CA\_n2D: Three contiguously aggregated NR carriers with up to 300MHz in band n2.

- CA\_n3(2A): Two non-contiguously aggregated NR carriers in band n3

- CA\_n260G: Two contiguously aggregated NR carriers with 150 or 200MHz in band n260 (FR2).

- CA\_n260M: Eight contiguously aggregated NR carriers with 750 or 800MHz in band n260 (FR2).

- CA\_n260(2A): Two non-contiguously aggregated NR carriers in band n260 with up to 800MHz (2x400MHz)

- CA\_n260(A-M): A single carrier followed by a gap and then followed by eight contiguously aggregated carriers with up to 100MHz each

- CA\_n260(2A-3G-Q): Two single carriers up to 400MNHz each, three sub-blocks with two carriers each of 150 or 200MHz per sub-block followed by another subblock with two carriers of 50 or 100MHz each.

## 5.3 Rules to be used for the notation of CA or DC configurations

The following are the rules for generating the configuration notations:

- Each configuration needs to start with “CA\_”, “DC\_”, “SUL\_” or “V2X\_”.

- DC combinations include a list of LTE carriers first, followed by the list of NR carriers.

- Entries within a list of either LTE carriers or NR carriers need to be separated by “-“, not “\_”.

- The list of LTE carriers and the list of NR carriers within an EN\_DC combination need to be separated by “\_”, for contiguous intra-band EN-DC the two lists are connected with the (n)xxAA like notation, not “\_” (xx is the band number) , for contiguous intra-band NE-DC the two lists are connected with the xx(n)AA like notation, not “\_” (xx is the band number). In specific cases “\_SUL\_” connects the two lists.

- Contiguous LTE+NR intra-band carriers within a DC combination are using the notation (n)xxAA (xx is the band number) , Contiguous NR+LTE intra-band carriers within a DC combination are using the notation xx(n)AA (xx is the band number).

- No other characters than “A” to “Z”, “0” to “9”, “(“, “)”, “-“ “\_” and “n” are allowed within the notation, especially no spaces “ “, “/”, “.”, “.”, LineFeed, CR, other special characters.

- Entries within the list of carriers need to be sorted in numerical order, i.e. first band n1, then n2, then n3, then n260, i.e. CA\_1A-2A, not CA\_2A-1A, but LTE and NR combinations are separately sorted, i.e. DC\_2A\_n1A, entries with (n) are always between the LTE and NR lists.

- Bandwidth notations are either a single character according to the BW class lists of contiguously aggregated carriers, two of these characters in case of combinations with (n) or for NR non-contiguous intra-band combinations specific expressions listing multiple carriers within “()”.

- Within the “()” of non-contiguous NR combinations there will only be BW class letters for the BW class of contiguous sub-blocks preceded by a number indicating the number of sub-blocks of this BW class, if there are multiple different BW classes they are listed in ascending BW class order separated by “-“.

Examples of correct notations are as follows:

- DC\_1A-2A\_n260(A-M)

- DC\_1A-2A-2A-2A\_n3(3A)

- DC\_1A-(n)2AA-n3A

- DC\_1A-2A-3A-4A-5A\_n6A-n260(2A-3G-Q)

- Some incorrect examples we have seen: DC\_1A-2A\_n3A(3A) (no “A” before the bracket); DC\_2A-1A\_n3(3A) (wrong sort order of LTE bands); DC\_1A- 2A\_n260(A-M) (a “ “ (space) between the “-“ and the “2”; DC\_1A-2A\_n260A/G/H/I/J/K/L/M (no “/” allowed within a configuration, multiple configurations not allowed within the notation, use separate configuration notations for each configuration).

Currently this notation for the CA/DC configurations is used as specified in 36.101 for LTE and 38.101 for NR. However, multiple errors within the specifications have been observed, which motivate the need to define the following rules how to handle the CA/DC configurations in the -101 specs. Below are the general rules how to implement these band combinations within the CA/DC configurations within the tables in clause 5.5:

- Each cell of the configuration table should contain only one combination of bands in the first column with the exception that combinations having the same bands but different intra-band contiguous BW classes can be listed in the same cell. Also all non-contiguous combinations can be listed in one cell, but separated from the contiguous combinations in another cell.

- In the UL column there shall only be UL configurations that belong to the configurations in the first column. Unfortunately this means that in the UL column there can be higher order configurations than some of the configurations in the first column, however, they cannot be used with such a lower order combination. This was agreed some time ago as a “table simplification”, but creates some hassle as there are UL combinations listed that cannot be supported with the DLs.

- Multiple configurations with different bandwidth classes shall be separated by pressing the return key, you will see the  sign at the end of the line if you activated the button to view these special characters, no other special characters to separate configuration shall be used.

- There shall be no special characters not belonging to the combinations in any configuration cell, no spaces “ “, “/”, “.”, “.”, or any other special characters.

- If there are notes for a specific configuration, the note shall be using superscript font and added at the end of the configuration list within a cell, not anywhere within the configuration or separated with any other characters, multiple notes shall be separated just by a comma, all in superscript.

## 5.4 Adding or removing channel BW’s in NR CA configurations

### 5.4.1 Adding channel BW’s in NR CA configurations

If it is discovered that it was forgotten to define a channel bandwidth when defining a band combination, the correct way is to define a new BCS row for that band combination. Such a definition of a new BCS follows the normally procedures of definitions of new BCS’s.

Preferably no exceptions should be made to the rule above. Exception can only be if all UE vendors can confirm that ...

a) no existing UE advertises the affected channel bandwidth (in the channel-BW bitmap) or the affected band combination (in the supportedBandCombinationList), or

b) all existing UEs that advertise the affected channel bandwidth and the band combination support and accept the configuration of that channel bandwidth in that BC.

The rule to follow by CR-authors and basket WI rapporteurs:

* *If a channel bandwidth is added to an existing bandwidth combination set and if this channel bandwidth was already defined in Table 5.3.5-1 (“Channel bandwidths for each NR band”) in a previous version of the specification:*
  + *The change is non-backwards-compatible and needs to be documented on the CR cover page with the wording “*The addition of the channel bandwidth XXX to BCS#Y of band combination ABC is intentional and potential non-backwards compatible (NBC) impact have been considered.

### 5.4.2 Removing channel BW’s in NR CA configurations

#### 5.4.2.1 Removing of not possible channel BW’s

If it is discovered that a channel bandwidth in a band combination set is defined for a band that is not defined in Table 5.3.5-1 (“Channel bandwidths for each NR band”) it needs to be removed. Such a removal is not a non-backward compatible change. This is a correction of an inconsistency in the specification.

#### 5.4.2.1 Removing of possible channel BW’s

If it is discovered that a channel bandwidth was mistakenly included when defining the band combination, the correct way is to define a new BCS row in that band combination. Such a definition of a new BCS follows the normally procedures of definitions of new BCS’s.

Preferably no exceptions should be made to that rule. Exception can only be if all UE vendors can confirm that ...

a) no existing UE advertises the affected channel bandwidth (in the channel-BW bitmap) or the affected band combination (in the supportedBandCombinationList).

The rule to follow by CR-authors and basket WI rapporteurs:

* *If a channel bandwidth is removed from an existing bandwidth combination set and if this channel bandwidth was already defined in Table 5.3.5-1 (“Channel bandwidths for each NR band”) in a previous version of the specification:*
  + *The change is non-backwards-compatible and needs to be documented on the CR cover page with the wording “*The removal of the channel bandwidth XXX to BCS#Y of band combination ABC is intentional and potential non-backwards compatible (NBC) impact have been considered.

# 6 Introduction of band combinations

## 6.1 General

<Some guidelines on introduction of band combinations will be added. >

## 6.2 Band combination request

### 6.2.1 Band combination workflow

#### 6.2.1.1 The workflow on introduction of band combinations for block approval

In order to improve the efficiency of RAN4’s work, it’s necessary to introduce a clear workflow on the introduction of band combinations for block approval. The workflow on the introduction of band combinations for block approval is shown as figure 6.2.1.1-1 as a typical example for one RAN4 meeting in one quarter. The specific steps are listed as below.

#1 Band combinations should be requested by contact person using request template. And the request spread sheet should be shared in the reflector 3GPP\_TSG\_RAN\_WG4\_NR\_BANDS for NR CA, MR DC and SUL band combinations or 3GPP\_TSG\_RAN\_WG4\_CA for LTE CA band combinations before RAN4#(X-1) meeting.

#2 Band combinations should be captured into the draft revised WIDs during RAN4#(X-1) meeting by rapporteurs.

#3 The official revised basket WIDs can be approved together with requested band combinations during RAN#(Y-1) meeting.

#4 Proponents should prepare and submit the corresponding contributions, e.g. draft CR, TP before RAN4#X meeting.

#5 The Block/Approval procedure is applicable to the band combinations in one week before formal RAN4#X meeting, if there is no general issues observed.

#6 The contributions will be discussed during RAN4#X meeting. And the final decision will be made by chairman.

#7 If the contributions are approved or endorsed, the corresponding band combinations should be captured into the big CRs and/or TRs by rapporteurs. Note: The big CR is an official CR which is used to capture all the corrections for one specification by rapporteur under basket WI.

#8 Email approval can be used for the big CRs and/or TRs in one week after formal RAN4#X meeting.

#9 The status of band combinations should be shared by contact person after formal RAN4#X meeting.

#10 The status of band combinations should be captured into the WID and/or SR by rapporteurs.

#11 RAN #Y will approve the big CRs and revised WIDs.

#12 The agreed band combinations will be introduced into the specification in next version.

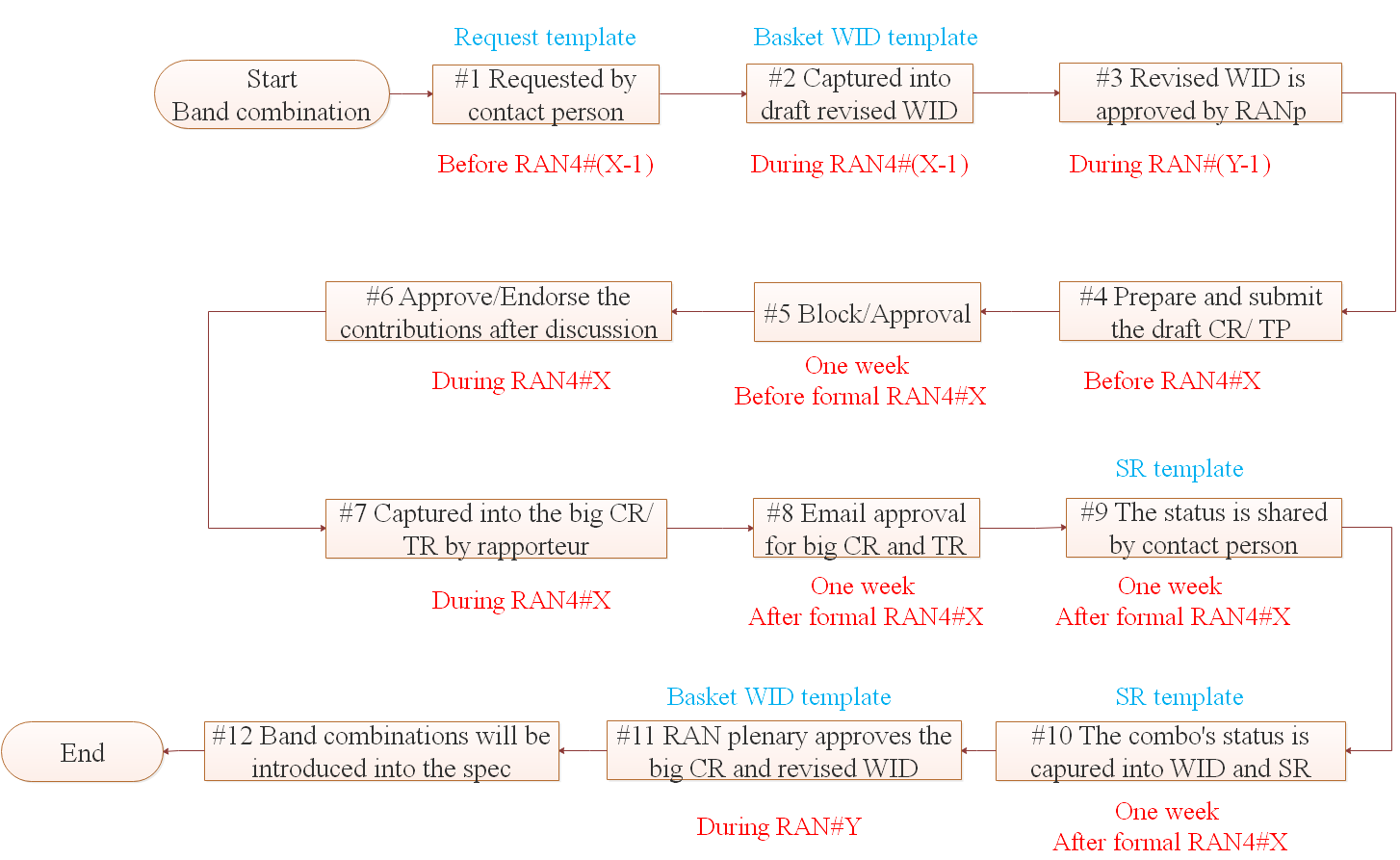


Figure 6.2.1.1-1 The workflow on the introduction of band combinations for block approval

### 6.2.2 Template of band combination request sheet, status report and band combinations table in basket WI

Some general rules are listed about the Excel spread sheet template.

#1 The Excel spread sheet can be used as the templates of request sheet, status report, and band combinations table in basket WI. The templates can be found in the following 3GPP ftp server.

<https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/Templates/>

*(Editor’s note: The approved latest template R4-2016936 for Rel-17 will be uploaded into the server after RAN4#99-e meeting)*

#2 All request table, status report table and band combination index table of basket WID are unified to use one template for band combination information sheet.

#3 Cover sheet which is the first sheet in the template can be only used by Contact Company which needs to request new band combinations or some modifications or report the band combinations’ status instead of the official basket WID or Status Report. Cover sheet can be further updated after additional basket WIs are approved in RAN plenary.

#4 Rapporteurs can choose some of these BCS table sheets to suit their WID.

#5 Only one sheet/Excel attachment is used for both the WID and the status report by rapporteurs.

#6 The following rules and marks can be used to indicate the change marks for the band combinations in the Excel spread sheet.

1) The Excel sheet included in the status report and the WID would have 2 worksheets.

   - Details of band combinations status of RAN #Y-1. It’s the simple copy from last RAN meeting.

- Details of band combinations status of RAN #Y

2) The worksheet of RAN #Y would have an extra column A "Are there any change marks?" which includes 4 words:

**New** *for new if the whole line is new. Those lines could be marked in blue.*

**Modified** *for modified if any field in this line is modified. The modified field could be marked in yellow.*

**Deleted** *for deleted if the whole line needs to be removed. The whole line could be marked in red.*

**Unchanged** *for all the information about combination aren’t changed.*

|  |  |
| --- | --- |
| **Change marks** | **Explanation** |
| New | Each new row from a contact company request is marked in blue with New in first column. |
| Modified | Some columns of the row are modified. The rapporteur will mark those changed cells in yellow and use Modified in the first column. |
| Deleted | For a removed band combination, the rapporteur marks the row in red and uses Deleted in first column. |
| Unchanged | No changes in any field of the row |

3) How would this Excel sheet be used:

3.1) WID update:

   - Excel lists from RAN #Y-1 are taken, all lines with “Deleted” are removed, all yellow and blue highlights are removed, all words “New” and ” Modified” in "changes" column A are changed to “Unchanged”

       - This provides the updated intermediate Excel lists of RAN #Y-1 and copies of both lists are made to make the intermediate lists for RAN #Y

      If we start this with new release, then the RAN #Y-1 lists would not be needed because there are no new release combinations yet.

   - Now lists of RAN #Y are updated:

       - all new lines coming from contact company requests are inserted and marked in blue with “New” in first line

       - There may be some to be modified, so rapporteur will mark changed fields in yellow and use “Modified” in first column

       - There may be a few to be deleted, so rapporteur marks the line in red and uses “Deleted” in first column

- If all the information about combination aren’t changed, rapporteur marks the line in unfilled colour and uses “Unchanged” in first column.

- For the changes in the BCS sheet, rapporteurs and proponent can mark change fields in yellow.

3.2) Status Report update:

- Assuming the WID update Excel list is ready after the RAN4 meeting,

        The rapporteur can use the same Excel list for the status report: i.e.

         - Contact companies can easily filter for ongoing combinations of their company and then

             - Leave the line unchanged if all the information about combination aren’t changed.

             - Change the status to completed, fill in column A~T, then these mark all these modified field in yellow and indicate Modified in first column

             - Change the status to stopped, mark this field in yellow and indicate “Modified” in first column.

         - Rapporteurs can check and take over the different inputs into their master copy.

### 6.2.3 Template of TP for basket WIDs

<Text will be added if it’s necessary.>

### 6.2.4 xxxx

<Text will be added if it’s necessary.>

## 6.3 Usage of band combination

### 6.3.1 Notation of CA or DC configurations in the request sheets and work item descriptions

The configurations notation discussed in Clause 5 are also used for the CA/DC configurations in the columns for the CA/DC configurations for DL and UL in the request sheets and the combination tables within the WIDs. However, multiple errors within the specifications have been observed, which motivate the need to define the following rules how to implement these band combinations within the CA/DC configurations lists within the excel tables in the request sheets and WIDs:

- Each cell of the CA or DC configuration column in the Excel tables shall contain only one single CA/DC configuration using the notation of the configurations as discussed above

- Similar CA or DC configurations with different bandwidth classes shall use another row in the same column of the table.

- The UL configurations column shall only contain the UL configurations valid for the CA/DC configuration in the same row, if there are multiple valid UL configurations they can be listed one after the other separated with “, “ (a comma followed by a space), but they can also be using a single completely filled row for each of the valid UL configurations

- There shall be no merged cells in the table

- The WI rapporteur checks if the notation of the CA/DC configurations is correct and if not returns the request to the requestor. Incorrect requests should not be added to the table in the WID

## 6.4 xxxx

### 6.4.1 xxxx

<Text will be added if it’s necessary.>

# 7 Guidelines for technical studies for band combinations

## 7.1 Guidelines on the band edge relaxation for MOP for CA/DC band combination

The following are the guidelines for the band edge relaxation for MOP for CA/DC band combination.

**Guideline 1: The superscript of the NOTE on band edge relaxation is not needed in the Tables for band configurations consisting of different bands in TS38.101-1 specification.**

**Guideline 2: For intra-band contiguous CA or intra-band non-contiguous CA, apply band edge relaxation to the uplink configurations if this band has band edge relaxation for MOP as single band usage**.

For Guideline 2, the NOTE for single band, i.e. “Refers to the transmission bandwidths confined within FUL\_low and FUL\_low + 4 MHz or FUL\_high – 4 MHz and FUL\_high, the maximum output power requirement is relaxed by reducing the lower tolerance limit by 1.5 dB.” should be applied.

The following are some examples to explain the above guidelines further.

First, assuming NR FDD band nX and NR TDD bands nY and nZ, where PC3 is only applied to band nX, PC1.5/PC2/PC3 are applied to band nY, and PC2/PC3 are applied to band nZ. See Table 7.1-1.

Table 7.1-1 Power class only for NR single band PC1.5/2/3

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR  band | Class 1 (dBm) | Tolerance (dB) | Class 1.5 (dBm) | Tolerance (dB) | Class 2 (dBm) | Tolerance (dB) | Class 3 (dBm) | Tolerance (dB) |
| nX |  |  |  |  |  |  | 23 | ±2 |
| nY |  |  | 29 | +2/-33 | 26 | +2/-33 | 23 | ±23 |
| nZ |  |  |  |  | 26 | +2/-3 | 23 | ±2 |
| NOTE 3: Refers to the transmission bandwidths confined within FUL\_low and FUL\_low + 4 MHz or FUL\_high – 4 MHz and FUL\_high, the maximum output power requirement is relaxed by reducing the lower tolerance limit by 1.5 dB. | | | | | | | | |

In Table 7.1-1, band edge relaxation (i.e. NOTE 3) for MOP is only applied for band nY, and no band edge relaxation for MOP is applied for band nX and nZ.

1) When HPUE NR inter-band CA constitute of bands nX, nY and nZ, i.e. HPUE NR inter-band CA CA\_nXA-nYA, CA\_nXA-nZA,

- According to Guideline 1, due to the band nY as single band usage has band edge relaxation for MOP and band nX and band nZ as single band usage have no such band edge relaxation for MOP, so for the uplink HPUE band(s) in CA\_nXA-nYA and CA\_nXA-nZA, the band edge relaxation is applied for HPUE TDD band nY, while no band edge relaxation is applied for HPUE TDD band nZ.

2) When uplink inter-band CA or DC constitute of band nX, nY and nZ, i.e. uplink inter-band CA CA\_nXA-nYA, CA\_nXA-nZA, and uplink inter-band DC\_nXA-nYA, DC\_nXA-nZA,

- According to Guideline 1, due to the band nY as single band usage has band edge relaxation for MOP and band nX and band nZ as single band usage have no such band edge relaxation for MOP, therefore band edge relaxation for PC1.5, PC2 and PC3 to the uplink configurations of CA\_nXA-nYA are applied, while no band edge relaxation for PC2 and PC3 to the uplink configurations of CA\_nXA-nZA are applied.

- Similarly, band edge relaxation to the uplink configurations of DC\_nXA-nYA are applied, while no band edge relaxation to the uplink configurations of DC\_nXA-nZA are applied.

3) When NR band nX, nY, nZ support intra-band contiguous/non-contiguous CA,

- According to Guideline 2, due to the band nY as single band usage has band edge relaxation for MOP and band nX and band nZ as single band usage have no such band edge relaxation for MOP, therefore band edge relaxation for PC1.5, PC2 and PC3 to the uplink configurations of band nYC or band nY(2A) are applied. While no band edge relaxation for PC2 and PC3 to the uplink configurations of band nZC or band nZ(2A) are applied, and also no band edge relaxation for PC3 to the uplink configurations of band nXC or band nX(2A) are applied.

# 8 Optimization on band combinations

## 8.1 General

<Some guidelines on optimization on band combinations will be added. >

## 8.2 Improving RAN4 specification structures

### 8.2.1 RAN4 specification structure

<Text will be added if it’s necessary.>

### 8.2.2 CA and DC configuration table structure

<Text will be added if it’s necessary.>

### 8.2.3 xxxxx

<Text will be added if it’s necessary.>

## 8.3 Reducing redundant contents in RAN4 specification

### 8.3.1 Configuration tables

#### 8.3.1.1 CA configuration table

The CA configuration table in TS 38.101-1/-2/-3 provides the information of channel bandwidth, SCS and bandwidth combination set of the bands for each CA configuration. The uplink CA configuration information is also included in the configuration tables for the allowed UL CA configurations supported by the specification.

For CA within FR1 bands, TS 38.101-1 [4] provides the CA configuration tables for intra-band contiguous CA, intra-band non-contiguous CA and inter-band CA for NR FR1 bands. The additional information for maximum aggregated bandwidth is set for intra-band contiguous and intra-band non-contiguous CA configuration tables for FR1.

For CA within FR2 bands, TS 38.101-2 [5] provides the CA configuration tables for intra-band contiguous CA, intra-band non-contiguous CA and inter-band CA for NR FR2 bands. The additional information for maximum aggregated bandwidth is set for intra-band contiguous and intra-band non-contiguous CA configuration tables in TS 38.101-2 [5]. For intra-band non-contiguous CA, the concept of sub-block is applied to FR2. Sub-blocks belonging to a CA configuration can be in any order. This means a certain CA configuration acronym includes all sub-block arrangements which have exactly the same sub-block set. As an example, CA\_n260(2G-3O) denotes CA\_n260(2O-2G-O), CA\_n260(G-3O-G) etc, but these are not listed in tables separately.

For CA between FR1 and FR2 bands, TS 38.101-3 [6] provides the inter-band CA configuration tables for NR bands between FR1 and FR2.

For the uplink CA configuration, “-” in the configuration table denotes that non-CA operation is supported in this configuration, i.e. only single carrier operation for the constituent band is used for uplink.

For the sake of brevity and to reduce the size of CA configuration tables, instead of showing explicitly in the CA configuration tables, the SCS info for each NR band in the configuration is referred to the channel bandwidths for each NR band in clause 5.3.5 of TS 38.101-1 [4] and TS 38.101-2 [5]. For configurations including intra-band contiguous part, the detail configuration for this part is referred to the corresponding intra-band contiguous CA configuration table. Examples:

For NR inter-band CA configuration with two bands in FR1, Table 8.3.1.1-1 illustrates that,

- CA\_n1A-n3A consists of two NR bands n1 and n3 whose SCS values are defined in Table 8.3.1.1-2. For example, for NR band n1, the supported channel bandwidth in BCS0 is 5MHz, 10MHz, 15MHz and 20MHz where channel bandwidth 5MHz supports SCS with only 15kHz, channel bandwidths 10MHz, 15MHz and 20MHz support all SCS of {15kHz, 30kHz, 60kHz}.

- CA\_n1B-n3A having intra-band contiguous part CA\_n1B, the configuration of band n1 for the corresponding CA part is referred to CA\_n1B\_BCS0 defined in intra-band contiguous CA configuration table.

- CA\_n2A-n66A consists of two BCSs. The UL CA configurations denote the allowed UL CA configurations supported by the specification. For BCS0, the uplink configuration “-” indicates that non-CA operation is supported and only single carrier operation is used in uplink. For BCS1, the uplink configuration supports CA configuration CA\_n2A-n66A.

- For some configurations, there are regional spectrum limitations to the corresponding bands and the notes can be found in the configuration table, such as for CA\_n2A-n48A, the channel bandwidths 50MHz, 60MHz, 80MHz, 90MHz and 100MHz are applicable only to downlink.

For channel bandwidth per operating band defined in clause 5.3.5 of TS 38.101-1/-2 and TS 38.104, Table 8.3.1.1-2 illustrates that,

- The requirements for each configuration should be complied with the combination of channel bandwidths, SCS for each operating band defined in the table.

- For some bands the limitations to the bandwidth may be captured with notes in the table, such as for NR band n48, the channel bandwidth 5MHz is restricted to operation when carrier is configured as an SCell part of DC or CA configuration.

Table 8.3.1.1-1: NR CA configurations and bandwidth combinations sets defined for inter-band CA (two bands)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR CA configuration | Uplink CA configuration | NR Band | Channel bandwidth (MHz) | | | | | | | | | | | | | Bandwidth combination set |
|  |  |  | 5 | 10 | 15 | 20 | 25 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |  |
| CA\_n1A-n3A | CA\_n1A-n3A | n1 | 5 | 10 | 15 | 20 |  |  |  |  |  |  |  |  |  | 0 |
|  |  | n3 | 5 | 10 | 15 | 20 | 25 | 30 |  |  |  |  |  |  |  |  |
|  |  | n1 | 5 | 10 | 15 | 20 | 25 | 30 | 40 | 50 |  |  |  |  |  | 1 |
|  |  | n3 | 5 | 10 | 15 | 20 | 25 | 30 | 40 |  |  |  |  |  |  |  |
| CA\_n1B-n3A | CA\_n1A-n3A | n1 | See CA\_n1B Bandwidth Combination Set 0 in Table 5.5A.1-1 | | | | | | | | | | | | | 0 |
|  |  | n3 | 5 | 10 | 15 | 20 | 25 | 30 |  |  |  |  |  |  |  |  |
| CA\_n1A-n3(2A) | CA\_n1A-n3A | n1 | 5 | 10 | 15 | 20 |  |  |  |  |  |  |  |  |  | 0 |
|  |  | n3 | See CA\_n3(2A) bandwidth combination set 0 in Table 5.5A.2-1 | | | | | | | | | | | | |  |
| … | … | … | … | | | | | | | | | | | | | … |
| CA\_n2A-n48A | CA\_n2A-n48A | n2 | 5 | 10 | 15 | 20 |  |  |  |  |  |  |  |  |  | 0 |
|  |  | n48 | 5 | 10 | 15 | 20 |  |  | 40 | 501 | 601 |  | 801 | 901 | 1001 |  |
| … | … | … | … | | | | | | | | | | | | | … |
| CA\_n2A-n66A | - | n2 | 5 | 10 | 15 | 20 |  |  |  |  |  |  |  |  |  | 0 |
|  |  | n66 | 5 | 10 | 15 | 20 |  |  | 40 |  |  |  |  |  |  |  |
|  | CA\_n2A-n66A | n2 | 5 | 10 | 15 | 20 |  |  |  |  |  |  |  |  |  | 1 |
|  |  | n66 | 5 | 10 | 15 | 20 | 25 | 30 | 40 |  |  |  |  |  |  |  |
| NOTE 1: This UE channel bandwidth is applicable only to downlink. | | | | | | | | | | | | | | | | |

Table 8.3.1.1-2: Channel bandwidths for each NR band

| NR Band | SCS (kHz) | UE Channel bandwidth (MHz) | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 5 | 10 | 15 | 20 | 25 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
| n1 | 15 | 5 | 10 | 15 | 20 | 25 | 30 | 40 | 50 |  |  |  |  |  |
|  | 30 |  | 10 | 15 | 20 | 25 | 30 | 40 | 50 |  |  |  |  |  |
|  | 60 |  | 10 | 15 | 20 | 25 | 30 | 40 | 50 |  |  |  |  |  |
| n2 | 15 | 5 | 10 | 15 | 20 |  |  |  |  |  |  |  |  |  |
|  | 30 |  | 10 | 15 | 20 |  |  |  |  |  |  |  |  |  |
|  | 60 |  | 10 | 15 | 20 |  |  |  |  |  |  |  |  |  |
| n3 | 15 | 5 | 10 | 15 | 20 | 25 | 30 | 40 |  |  |  |  |  |  |
|  | 30 |  | 10 | 15 | 20 | 25 | 30 | 40 |  |  |  |  |  |  |
|  | 60 |  | 10 | 15 | 20 | 25 | 30 | 40 |  |  |  |  |  |  |
| … | … | … | … | … | … | … | … | … | … | … | … | … | … | … |
| n41 | 15 |  | 10 | 15 | 20 |  | 30 | 40 | 50 |  |  |  |  |  |
|  | 30 |  | 10 | 15 | 20 |  | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
|  | 60 |  | 10 | 15 | 20 |  | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
| … | … | … | … | … | … | … | … | … | … | … | … | … | … | … |
| n48 | 15 | 55 | 10 | 15 | 20 |  | 30 | 40 | 506 |  |  |  |  |  |
|  | 30 |  | 10 | 15 | 20 |  | 30 | 40 | 506 | 606 | 706 | 806 | 906,4 | 1006 |
|  | 60 |  | 10 | 15 | 20 |  | 30 | 40 | 506 | 606 | 706 | 806 | 906,4 | 1006 |
| … | … | … | … | … | … | … | … | … | … | … | … | … | … | … |
| n66 | 15 | 5 | 10 | 15 | 20 | 25 | 30 | 40 |  |  |  |  |  |  |
|  | 30 |  | 10 | 15 | 20 | 25 | 30 | 40 |  |  |  |  |  |  |
|  | 60 |  | 10 | 15 | 20 | 25 | 30 | 40 |  |  |  |  |  |  |
| … | … | … | … | … | … | … | … | … | … | … | … | … | … | … |
| n78 | 15 |  | 10 | 15 | 20 | 25 | 30 | 40 | 50 |  |  |  |  |  |
|  | 30 |  | 10 | 15 | 20 | 25 | 30 | 40 | 50 | 60 | 704 | 80 | 90 | 100 |
|  | 60 |  | 10 | 15 | 20 | 25 | 30 | 40 | 50 | 60 | 704 | 80 | 90 | 100 |
| … | … | … | … | … | … | … | … | … | … | … | … | … | … | … |
| n80 | 15 | 5 | 10 | 15 | 20 | 25 | 30 | 40 |  |  |  |  |  |  |
|  | 30 |  | 10 | 15 | 20 | 25 | 30 | 40 |  |  |  |  |  |  |
|  | 60 |  | 10 | 15 | 20 | 25 | 30 | 40 |  |  |  |  |  |  |
| … | … | … | … | … | … | … | … | … | … | … | … | … | … | … |
| n86 | 15 | 5 | 10 | 15 | 20 |  |  | 40 |  |  |  |  |  |  |
|  | 30 |  | 10 | 15 | 20 |  |  | 40 |  |  |  |  |  |  |
|  | 60 |  | 10 | 15 | 20 |  |  | 40 |  |  |  |  |  |  |
| … | … | … | … | … | … | … | … | … | … | … | … | … | … | … |
| NOTE 1: Void.  NOTE 2: Void.  NOTE 3: This UE channel bandwidth is applicable only to downlink.  NOTE 4: This UE channel bandwidth is optional in this release of the specification.  NOTE 5: For this bandwidth, the minimum requirements are restricted to operation when carrier is configured as an SCell part of DC or CA configuration.  NOTE 6: For this bandwidth, the minimum requirements are restricted to operation when carrier is configured as a downlink SCell part of CA configuration. | | | | | | | | | | | | | | |

#### 8.3.1.2 DC configuration table

NR-DC configurations within FR1 are specified in clause 5.5B of TS 38.101-1. In the configuration table, only NR-DC configurations and uplink NR-DC configurations are listed. The bandwidth combination sets for the corresponding inter-band CA, i.e., dual uplink inter-band carrier aggregation with uplink assigned to two NR bands, are applicable to Dual Connectivity.

EN-DC and NE-DC configurations are specified in clause 5.5B of TS 38.101-3. In the configuration table, in addition to the downlink configurations and uplink configurations, the combinations of intra-band contiguous, non-contiguous and inter-band within FR1 also include the column of “Single UL allowed”. The combination of some frequency bands in the configuration might be a bit problematic due to self-interference, as defined in TS38.306. UE may indicate capability of not supporting simultaneous dual and triple uplink operation due to possible intermodulation interference to its own primary downlink channel bandwidth if the intermodulation order is 2 or if the intermodulation order is 3 for the combinations when both operating bands are between 450 MHz – 960 MHz or between 1427 MHz – 2690 MHz. In case for the EN-DC configurations for which the intermodulation products caused by the dual and triple uplink operation fall into the receive band but do not interfere with the own primary downlink channel bandwidth as defined in Annex-I of TS 38.101-3 the UE is mandated to operate in dual and triple uplink mode. Single Uplink is also allowed for certain band combinations where intermodulation or reverse intermodulation products could create difficulty for meeting emission requirements. For EN-DC and NE-DC combinations of order 3 or higher, “Single Uplink allowed” UL configurations captured in the corresponding order 2 tables apply. As for an example, to mitigate the self-interference issue, the EN-DC configuration DC\_3A\_n78A has specified which band combinations are allowed to stray from the stringent requirement for simultaneous transmission and reception. The uplink needs to alternate between 1.8GHz and 3.5GHz. While 3.5GHz uplink transmission is ongoing, no data should be scheduled by the network on the 1.8GHz LTE carrier.

Apart from the above EN-DC and NE-DC configurations, TS 38.101-3 also specified inter-band NR-DC configuration between FR1 and FR2. The configurations and bandwidth combination sets for the FR1-FR2 NR-DC combinations are defined in the tables for FR1-FR2 inter-band carrier aggregation.

In order to reduce the EN-DC, NE-DC and NR-DC configuration table size, the following rules should be applied to the grouping of the configurations.

- Grouping of DC configurations is based on common band combination.

- In case E-UTRA or/and NR has non-contiguous CA, it will be on a separate row compared to cases when DC configuration has only single carrier or contiguous CA operation.

- Common band combination should be considered as the configurations having the same band sequence, such as DC\_x-y-y\_nz and DC\_x-x-y\_nz are different band combinations, while all configurations with DC\_x-y\_nz(\*) having non-contiguous parts in band nz are considered as common band combination.

*Examples* (*EN-DC with NR band having non-contiguous part*)*:*

|  |  |
| --- | --- |
| EN-DC  configuration | Uplink EN-DC  configuration |
| DC\_2A\_n258A  DC\_2A\_n258D  DC\_2A\_n258G  DC\_2A\_n258H  DC\_2A\_n258O  DC\_2A\_n258P  DC\_2A\_n258Q | DC\_2A\_n258A  DC\_2A\_n258D  DC\_2A\_n258G  DC\_2A\_n258H  DC\_2A\_n258O  DC\_2A\_n258P  DC\_2A\_n258Q |
| DC\_2A\_n258(2A)  DC\_2A\_n258(3A)  DC\_2A\_n258(4A)  DC\_2A\_n258(5A) | DC\_2A\_n258A |

*Examples* (*EN-DC with E-UTRA band having non-contiguous part*)*:*

|  |  |
| --- | --- |
| EN-DC  configuration | Uplink EN-DC  configuration |
| DC\_7A\_n257A  DC\_7A\_n257D  DC\_7A\_n257E  DC\_7A\_n257F  DC\_7A\_n257G  DC\_7A\_n257H  DC\_7A\_n257I  DC\_7A\_n257J  DC\_7A\_n257K  DC\_7A\_n257L  DC\_7A\_n257M | DC\_7A\_n257A  DC\_7A\_n257D  DC\_7A\_n257G  DC\_7A\_n257H  DC\_7A\_n257I |
| DC\_7A-7A\_n257A  DC\_7A-7A\_n257D  DC\_7A-7A\_n257E  DC\_7A-7A\_n257F  DC\_7A-7A\_n257G  DC\_7A-7A\_n257H  DC\_7A-7A\_n257I  DC\_7A-7A\_n257J  DC\_7A-7A\_n257K  DC\_7A-7A\_n257L  DC\_7A-7A\_n257M | DC\_7A\_n257A  DC\_7A\_n257D  DC\_7A\_n257G  DC\_7A\_n257H  DC\_7A\_n257I |

*Examples* (*NE-DC with E-UTRA band having non-contiguous part*)*:*

|  |  |
| --- | --- |
| NE-DC  configuration | Uplink NE-DC  configuration |
| DC\_n257A\_7A  DC\_n257G\_7A  DC\_n257H\_7A  DC\_n257I\_7A  DC\_n257J\_7A  DC\_n257K\_7A  DC\_n257L\_7A  DC\_n257M\_7A | DC\_n257A\_7A |
| DC\_n257A\_7A-7A  DC\_n257G\_7A-7A  DC\_n257H\_7A-7A  DC\_n257I\_7A-7A  DC\_n257J\_7A-7A  DC\_n257K\_7A-7A  DC\_n257L\_7A-7A  DC\_n257M\_7A-7A | DC\_n257A\_7A |

*Examples* (*NR-DC with NR band having non-contiguous part*)*:*

|  |  |
| --- | --- |
| NR-DC  configuration | Uplink NR-DC  configuration |
| DC\_n3A-n257A  DC\_n3A-n257D  DC\_n3A-n257G  DC\_n3A-n257H  DC\_n3A-n257I | DC\_n3A-n257A  DC\_n3A-n257D  DC\_n3A-n257G  DC\_n3A-n257H  DC\_n3A-n257I |
| DC\_n3(2A)-n257A  DC\_n3(2A)-n257G  DC\_n3(2A)-n257H  DC\_n3(2A)-n257I | DC\_n3A-n257A  DC\_n3A-n257G  DC\_n3A-n257I  DC\_n3A-n257H |

*Examples* (*Incorrect grouping case*)*:*

|  |  |
| --- | --- |
| EN-DC  configuration | Uplink EN-DC  configurationp |
| DC\_2A\_n261A  DC\_2A\_n261(2A)  DC\_2A\_n261(3A)  DC\_2A\_n261(4A) | DC\_2A\_n261A |
| DC\_2A\_n261B  DC\_2A\_n261C  DC\_2A\_n261D  DC\_2A\_n261E  DC\_2A\_n261F  DC\_2A\_n261G  DC\_2A\_n261H  DC\_2A\_n261I  DC\_2A\_n261J  DC\_2A\_n261K  DC\_2A\_n261L  DC\_2A\_n261M  DC\_2A\_n261O  DC\_2A\_n261P  DC\_2A\_n261Q | DC\_2A\_n261A  DC\_2A\_n261B  DC\_2A\_n261C  DC\_2A\_n261D  DC\_2A\_n261E  DC\_2A\_n261F  DC\_2A\_n261G  DC\_2A\_n261H  DC\_2A\_n261I  DC\_2A\_n261O  DC\_2A\_n261P  DC\_2A\_n261Q |

In this case, for DC\_2\_n261, the configurations with non-contiguous CA part CA\_n261(\*) such as DC\_2A\_n261(2A), DC\_2A\_n261(3A) and DC\_2A\_n261(4A) are mis-grouped with DC\_2A\_n261A which has only single carrier. They should be revised as follows.

|  |  |
| --- | --- |
| EN-DC  configuration | Uplink EN-DC  configuration |
| DC\_2A\_n261A  DC\_2A\_n261B  DC\_2A\_n261C  DC\_2A\_n261D  DC\_2A\_n261E  DC\_2A\_n261F  DC\_2A\_n261G  DC\_2A\_n261H  DC\_2A\_n261I  DC\_2A\_n261J  DC\_2A\_n261K  DC\_2A\_n261L  DC\_2A\_n261M  DC\_2A\_n261O  DC\_2A\_n261P  DC\_2A\_n261Q | DC\_2A\_n261A  DC\_2A\_n261B  DC\_2A\_n261C  DC\_2A\_n261D  DC\_2A\_n261E  DC\_2A\_n261F  DC\_2A\_n261G  DC\_2A\_n261H  DC\_2A\_n261I  DC\_2A\_n261O  DC\_2A\_n261P  DC\_2A\_n261Q |
| DC\_2A\_n261(2A)  DC\_2A\_n261(3A)  DC\_2A\_n261(4A) | DC\_2A\_n261A |

Regarding to the common band combination, it means the configurations having the same band sequence. For example, DC\_x-x-y\_nz and DC\_x-y-y\_nz are not considered as the common band combination.

*Examples* (*Incorrect understanding of common band combination*)*:*

|  |  |
| --- | --- |
| EN-DC configuration | Uplink EN-DC configuration |
| DC\_2A-66A\_n261A  DC\_2A-66A\_n261G  DC\_2A-66A\_n261H  DC\_2A-66A\_n261I  DC\_2A-66A\_n261J  DC\_2A-66A\_n261K  DC\_2A-66A\_n261L  DC\_2A-66A\_n261M | DC\_2A\_n261A  DC\_66A\_n261A  DC\_2A\_n261G  DC\_66A\_n261G  DC\_2A\_n261H  DC\_66A\_n261H  DC\_2A\_n261I  DC\_66A\_n261I |
| DC\_2A-2A-66A\_n261A  DC\_2A-2A-66A\_n261G  DC\_2A-2A-66A\_n261H  DC\_2A-2A-66A\_n261I  DC\_2A-2A-66A\_n261J  DC\_2A-2A-66A\_n261K  DC\_2A-2A-66A\_n261L  DC\_2A-2A-66A\_n261M  DC\_2A-66A-66A\_n261A  DC\_2A-66A-66A\_n261G  DC\_2A-66A-66A\_n261H  DC\_2A-66A-66A\_n261I  DC\_2A-66A-66A\_n261J  DC\_2A-66A-66A\_n261K  DC\_2A-66A-66A\_n261L  DC\_2A-66A-66A\_n261M | DC\_2A\_n261A  DC\_66A\_n261A  DC\_2A\_n261G  DC\_66A\_n261G  DC\_2A\_n261H  DC\_66A\_n261H  DC\_2A\_n261I  DC\_66A\_n261I |

In this case, the configurations DC\_2-66\_n261, DC\_2-2-66\_n261 and DC\_2-66-66\_n261 are not common band combinations. They should be re-grouped as follows.

|  |  |
| --- | --- |
| EN-DC configuration | Uplink EN-DC configuration |
| DC\_2A-66A\_n261A  DC\_2A-66A\_n261G  DC\_2A-66A\_n261H  DC\_2A-66A\_n261I  DC\_2A-66A\_n261J  DC\_2A-66A\_n261K  DC\_2A-66A\_n261L  DC\_2A-66A\_n261M | DC\_2A\_n261A  DC\_66A\_n261A  DC\_2A\_n261G  DC\_66A\_n261G  DC\_2A\_n261H  DC\_66A\_n261H  DC\_2A\_n261I  DC\_66A\_n261I |
| DC\_2A-2A-66A\_n261A  DC\_2A-2A-66A\_n261G  DC\_2A-2A-66A\_n261H  DC\_2A-2A-66A\_n261I  DC\_2A-2A-66A\_n261J  DC\_2A-2A-66A\_n261K  DC\_2A-2A-66A\_n261L  DC\_2A-2A-66A\_n261M | DC\_2A\_n261A  DC\_66A\_n261A  DC\_2A\_n261G  DC\_66A\_n261G  DC\_2A\_n261H  DC\_66A\_n261H  DC\_2A\_n261I  DC\_66A\_n261I |
| DC\_2A-66A-66A\_n261A  DC\_2A-66A-66A\_n261G  DC\_2A-66A-66A\_n261H  DC\_2A-66A-66A\_n261I  DC\_2A-66A-66A\_n261J  DC\_2A-66A-66A\_n261K  DC\_2A-66A-66A\_n261L  DC\_2A-66A-66A\_n261M | DC\_2A\_n261A  DC\_66A\_n261A  DC\_2A\_n261G  DC\_66A\_n261G  DC\_2A\_n261H  DC\_66A\_n261H  DC\_2A\_n261I  DC\_66A\_n261I |

For the uplink support in the configuration table, the valid uplink configurations are specified that uplink does not have more carriers than downlink. For the UL configuration type, it should be consistent within one row, i.e., there should not be a mixture of contiguous and non-contiguous UL CA within a row. If multiple UL DC configurations are indicated with multiple DL DC configurations, only UL DC configurations with the same or a lower number of carriers in the same fallback group are valid UL configurations.

*Examples:*

- DC\_5A\_n261G is not a valid uplink configuration for DC\_5A\_n261A.

- DC\_5A\_n261(2A) and DC\_5A\_n261A are not allowed to be in the same row in the configuration table.

For the sequence of EN-DC combinations, the following rules apply.

- EN-DC configurations should be sorted by LTE band combination, then NR band combination.

- LTE combinations should be sorted by the first band number, then the first bandwidth character, then the second band number, then the second bandwidth character and so on.

- The same sort order should be applied for the NR part, there combinations with () should be sorted alphanumerically within the brackets after the contiguous combinations.

For the sequence of NE-DC combinations, the following rules apply.

- NE-DC configurations should be sorted by NR band combination, then LTE band combination.

- NR combinations should be sorted by the first band number, then the first bandwidth character, then the second band number, then the second bandwidth character and so on. For the combinations with () should be sorted alphanumerically within the brackets after the contiguous combinations.

- LTE combinations should be sorted by the first band number, then the first bandwidth character, then the second band number, then the second bandwidth character and so on.

For the sequence of NR-DC combinations, the following rules apply.

- DC combinations should be sorted by the first band number, then the first bandwidth character, then the second band number, then the second bandwidth character and so on.

- For the combinations with () should be sorted alphanumerically within the brackets after the contiguous combinations.

*Examples:*

- DC\_1A\_n77A

- DC\_1A\_n77C

- DC\_1C\_n77A

- DC\_1C-2A\_n77A

- DC\_41A-42A\_n79A

- DC\_41A-42C\_n79A

- DC\_41C-42A\_n79A

- DC\_41C-42C\_n79A

- DC\_41C-42C\_n257A

- DC\_41C-42C\_n257M

- DC\_41C-42C\_n257(2A)

- DC\_41C-42C\_n257(2A-2O)

- DC\_41C-42C\_n257(8A)

- DC\_41C-42C\_n257(D-G)

#### 8.3.1.3 SUL configuration table

The SUL band combination with CA in TS 38.101-1 [4] provides the configurations of channel bandwidth, SCS and bandwidth combination set of the bands for each SUL combination. The SUL configuration information is also included in the configuration tables for the allowed SUL configurations supported by the specification.

For the sake of brevity and to reduce the size of SUL band combination with intra-band contiguous CA, intra-band non-contiguous CA and inter-band CA, instead of showing explicitly in the SUL configuration tables, the SCS info for each NR band and SUL band in the configuration is referred to the channel bandwidths for each NR band in clause 5.3.5 of TS 38.101-1 [4]. Examples:

For SUL band combination with intra-band non-contiguous CA, Table 8.3.1.3-1 illustrates that,

- SUL\_n78(2A)-n86A consists of NR band n78 and SUL band n86 whose SCS values are defined in Table 8.3.1.1-2. For example, for SUL band n86, the supported channel bandwidth in BCS0 is 5MHz, 10MHz, 15MHz and 20MHz where channel bandwidth 5MHz supports SCS with only 15kHz, channel bandwidths 10MHz, 15MHz and 20MHz support all SCS of {15kHz, 30kHz, 60kHz}.

- CA\_n78(2A) with intra-band non-contiguous CA, the configuration is referred to BCS0 defined in clause 5.5A.2 for intra-band non-contiguous CA configuration table.

- The SUL configuration for SUL\_n78A-n86A can be referred to Table 8.3.1.3-4.

For SUL band combination with intra-band contiguous CA, Table 8.3.1.3-2 illustrates that,

- SUL\_n41C-n80A consists of NR band n41 and SUL band n80 whose SCS values are defined in Table 8.3.1.1-2. For example, for SUL band n80, the supported channel bandwidth in BCS0 is 5MHz, 10MHz, 15MHz, 20MHz, 25MHz, 30MHz and 40MHz where channel bandwidth 5MHz supports SCS with only 15kHz, channel bandwidths 10MHz, 15MHz, 20MHz, 25MHz, 30MHz and 40MHz support all SCS of {15kHz, 30kHz, 60kHz}.

- CA\_n41C with intra-band contiguous CA, the configuration is referred to BCS0 defined in clause 5.5A.1 for intra-band contiguous CA configuration table.

- The SUL configuration for SUL\_n41A-n80A can be referred to Table 8.3.1.3-4.

For SUL band combination with inter-band CA, Table 8.3.1.3-3 illustrates that,

- CA\_n1A\_SUL\_n78A-n80A consists of NR band n1 and SUL band combination of SUL\_n78A-n80A, whose SCS values are defined in Table 8.3.1.1-2. For example, for NR band n1, the supported channel bandwidth in BCS0 is 5MHz, 10MHz, 15MHz, 20MHz, 25MHz, 30MHz, 40MHz and 50MHz where channel bandwidth 5MHz supports SCS with only 15kHz, channel bandwidths 10MHz, 15MHz, 20MHz, 25MHz, 30MHz, 40MHz and 50MHz support all SCS of {15kHz, 30kHz, 60kHz}.

- The SUL configuration for SUL\_n78A-n80A can be referred to Table 8.3.1.3-4.

Table 8.3.1.3-1: Supported channel bandwidths per SUL band combination with intra-band non-contiguous CA

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| SUL band combination with intra-band non-contiguous CA | SUL configuration | NR Band | Channel bandwidth (MHz) (NOTE 1) | | | | | | | | | | | | Bandwidth combination set |
|  |  |  | 5 | 10 | 15 | 20 | 25 | 30 | 40 | 50 | 60 | 80 | 90 | 100 |  |
| SUL\_n78(2A)-n86A | SUL\_n78A-n86A | n78 | See CA\_n78(2A) Bandwidth Combination Set 0 in Table 5.5A.2-1 | | | | | | | | | | | | 0 |
|  |  | n86 | 5 | 10 | 15 | 20 |  |  |  |  |  |  |  |  |  |
| NOTE 1: The SCS of each channel bandwidth for NR band refers to Table 5.3.5-1. | | | | | | | | | | | | | | | |

Table 8.3.1.3-2: Supported channel bandwidths per SUL band combination with intra-band contiguous CA

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| SUL band combination with CA | SUL configuration | NR Band | 5  MHz | 10  MHz | 15  MHz | 20  MHz | 25 MHz | 30 MHz | 40  MHz | 50  MHz | 60  MHz | 70  MHz | 80  MHz | 90  MHz | 100 MHz | Bandwidth combination set |
| SUL\_n41C-n80A | SUL\_n41A-n80A | n41 | See CA\_n41C Bandwidth Combination Set 1 in Table 5.5A.1-1 | | | | | | | | | | | | | 0 |
|  |  | n80 | 5 | 10 | 15 | 20 | 25 | 30 | 40 |  |  |  |  |  |  |  |
| … | … | … | … | … | … | … | … | … | … | … | … | … | … | … | … | … |

Table 8.3.1.3-3: Supported channel bandwidths per SUL band combination with inter-band CA

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| SUL band combination with CA | SUL configuration | NR Band | 5  MHz | 10  MHz | 15  MHz | 20  MHz | 25 MHz | 30 MHz | 40  MHz | 50  MHz | 60  MHz | 70  MHz | 80  MHz | 90  MHz | 100 MHz | Bandwidth combination set |
| CA\_n1A\_SUL\_n78A-n80A | SUL\_n78A-n80A | n1 | 5 | 10 | 15 | 20 | 25 | 30 | 40 | 50 |  |  |  |  |  | 0 |
|  |  | n78 |  | 10 | 15 | 20 | 25 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |  |
|  |  | n80 | 5 | 10 | 15 | 20 | 25 | 30 | 40 |  |  |  |  |  |  |  |
| … | … | … | … | … | … | … | … | … | … | … | … | … | … | … | … | … |

Table 8.3.1.3-4: Supported channel bandwidths per SUL band combination

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| SUL configuration | NR Band | Channel bandwidth (MHz) (NOTE 1) | | | | | | | | | | | | | Bandwidth combination set |
|  |  | 5 | 10 | 15 | 20 | 25 | 30 | 40 | 50 | 60 | **70** | 80 | 90 | 100 |  |
| SUL\_n41A-n80A | n41 |  | 10 | 15 | 20 |  |  | 40 | 50 | 60 |  | 80 | 90 | 100 | 0 |
|  | n80 | 5 | 10 | 15 | 20 | 25 | 30 |  |  |  |  |  |  |  |  |
|  | n41 |  | 10 | 15 | 20 |  | 30 | 40 | 50 | 60 |  | 80 | 90 | 100 | 1 |
|  | n80 | 5 | 10 | 15 | 20 | 25 | 30 | 40 |  |  |  |  |  |  |  |
| … | … | … | … | … | … | … | … | … | … | … | … | … | … | … | … |
| SUL\_n78A-n80A | n78 |  | 10 | 15 | 20 |  |  | 40 | 50 | 60 |  | 80 | 90 | 100 | 0 |
|  | n80 | 5 | 10 | 15 | 20 | 25 | 30 |  |  |  |  |  |  |  |  |
|  | n78 |  | 10 | 15 | 20 | 25 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 1 |
|  | n80 | 5 | 10 | 15 | 20 | 25 | 30 | 40 |  |  |  |  |  |  |  |
| … | … | … | … | … | … | … | … | … | … | … | … | … | … | … | … |
| SUL\_n78A-n86A | n78 |  | 10 | 15 | 20 |  |  | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 0 |
|  | n86 | 5 | 10 | 15 | 20 |  |  |  |  |  |  |  |  |  |  |
| … | … | … | … | … | … | … | … | … | … | … | … | … | … | … | … |

### 8.3.2 ΔTIB,c and ΔRIB,c for DC

#### 8.3.2.1 ΔTIB,c table

<Text will be added if it’s necessary.>

#### 8.3.2.2 ΔRIB,c table

<Text will be added if it’s necessary.>

### 8.3.3 xxxxx

<Text will be added if it’s necessary.>

## 8.4 xxxx

### 8.4.1 xxxx

<Text will be added if it’s necessary.>

# 9 <Other aspects to be studied>

<Other aspects to be studied if it’s necessary. >

# Annex A: Change history

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Change history** | | | | | | | |
| **Date** | **Meeting** | **TDoc** | **CR** | **Rev** | **Cat** | **Subject/Comment** | **New version** |
| 2021-04 | 3GPP RAN4#98bis-e | R4-2105431 |  |  |  | Initial TR skeleton | 0.0.1 |
| 2021-04 | 3GPP RAN4#98bis-e | R4-2105430 |  |  |  | TP on rules and guidelines for specifying band combinations | 0.1.0 |
| 2021-05 | 3GPP RAN4#99-e | R4-2107889 |  |  |  | TP on rules of CA configuration table | 0.2.0 |
| 2021-05 | 3GPP RAN4#99-e | R4-2107890 |  |  |  | TP for 38.xxx to capture the request’s template and workflow | 0.2.0 |
| 2021-08 | 3GPP RAN4#100-e | R4-2112719 |  |  |  | TP on rules of DC configuration table | 0.3.0 |
| 2021-08 | 3GPP RAN4#100-e | R4-2112720 |  |  |  | TP on channel bandwidth for CA configuration table | 0.3.0 |
| 2021-08 | 3GPP RAN4#100-e | R4-2115052 |  |  |  | TP on the rules of NE-DC with contiguous intra-band | 0.3.0 |
| 2021-08 | 3GPP RAN4#100-e | R4-2115053 |  |  |  | TP on ULSUP notation | 0.3.0 |
| 2021-08 | 3GPP RAN4#100-e | R4-2115054 |  |  |  | TP for TR 38.862 on addition or removal of channel BWs in existing BCSs | 0.3.0 |
| 2021-08 | 3GPP RAN4#100-e | R4-2115055 |  |  |  | TP to TR38.862\_Guidelines on the band edge relaxation for MOP for band combination | 0.3.0 |