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| 3GPP RAN4 PRD 01 v0.1.0 (2024-10) |
| Permanent Reference Document |
| 3rd Generation Partnership Project;Technical Specification Group RAN WG4;Permanent Reference Document (PRD);Rules, guidelines and ways of working for introduction of band combinations in NR and LTE(Release 19 and later releases) |
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# Foreword

This Permanent Reference Document (PRD) has been produced by the 3rd Generation Partnership Project (3GPP) TSG RAN Working Group 4 (RAN WG4 = RAN4).

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.

# Introduction

PRD01 describes the working procedures for introduction of band combinations in NR and LTE.

At 3GPP RAN4#112 meeting it was agreed to start a permanent reference document (PRD) to capture. The original first baseline for PRD01 was created using the technical report 38.846 V18.1.0 produced in the RAN4 Rel-18 study item for band combination simplification.

# 1 Scope

The present document is a Permanent Reference Document with the purpose of capturing the working procedures and the rules for how to specify band combinations for NR and LTE.

# 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-221790, “Revised SID: Study on simplification of band combination specification for NR and LTE”, RAN#96.

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

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

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

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

[7] TR38.862: "Study on band combination handling in RAN4".

[8] RP-202832, “New WID: Introduction of bandwidth combination set 4 (BCS4) for NR”, RAN#90-e.

[9] R4-2220556, WF on triple beat rules and MSD for inter-band with 2UL with intra-band ULCA, RAN4#105.

# 3 Definitions of terms, symbols and abbreviations

## 3.1 Terms

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

**Aggregated Channel Bandwidth**: The RF bandwidth in which a UE transmits and receives multiple contiguously aggregated carriers.

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

**Carrier aggregation band**: A set of one or more operating bands across which multiple carriers are aggregated with a specific set of technical requirements.

**Carrier aggregation bandwidth class**: A class defined by the aggregated transmission bandwidth configuration and maximum number of component carriers supported by a UE.

**Carrier aggregation configuration**: A combination of CA operating band(s) and CA bandwidth class(es) supported by a UE.

**Contiguous carriers**: A set of two or more carriers configured in a spectrum block where there are no RF requirements based on co-existence for un-coordinated operation within the spectrum block.

**Fallback group:** Group of carrier aggregation bandwidth classes for which it is mandatory for a UE to be able to fallback to lower order CA bandwidth class configuration. It is not mandatory for a UE to be able to fallback to lower order CA bandwidth class configuration that belong to a different fallback group.

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

NOTE: Carriers aggregated in each band can be contiguous or non-contiguous.

**Intra-band contiguous carrier aggregation**: Contiguous carriers aggregated in the same operating band.

**Intra-band non-contiguous carrier aggregation**: Non-contiguous carriers aggregated in the same operating band.

**Sub-block:** This is one contiguous allocated block of spectrum for transmission and reception by the same UE. There may be multiple instances of sub-blocks within an RF bandwidth.

## 3.2 Symbols

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

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

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

BWChannel Channel bandwidth

BWChannel\_CA Aggregated channel bandwidth, expressed in MHz

NRB Transmission bandwidth configuration, expressed in units of resource blocks

## 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].

BCS Bandwidth Combination Set

BS Base Station

BW Bandwidth

CA Carrier Aggregation

CA\_nX-nY Inter-band CA of component carrier(s) in one sub-block within Band nX and component carrier(s) in one sub-block within Band nY where nX and nY are the applicable NR *operating band*s.

CC Component carrier

DC Dual Connectivity

DL DownLink

E-UTRA Evolved Universal Terrestrial Radio Access

EN-DC E-UTRA/NR DC

FDD Frequency Division Duplex

IMD Inter-modulation

LTE Long Term Evolution

MR-DC Multi-radio DC

MSD Maximum Sensitivity Deduction

NE-DC NR/E-UTRA DC

NR New Radio

NR-DC NR/NR DC

RF Radio Frequency

Rx Receiver

SCS Subcarrier spacing

TDD Time Division Duplex

Tx Transmitter

UE User Equipment

UL UpLink

V2X Vehicle to Everything

# 4 Working procedure of specifying band combinations

## 4.1 General

TBD

## 4.2 Band combination request

### 4.2.1 Band combination workflow

#### 4.2.1.1 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 5.1A.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. If a draft CR or TP is depending on approval of lower order fallbacks submitted at the same meeting, this need to be clearly mentioned in the cover sheet of the draft CR or in the heading of the TP.

#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. If there are no technical concerns and if all the needed fallbacks are completed, the band combinations can be approved. 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 4.2.1.1-1 The workflow on the introduction of band combinations for block approval

### 4.2.2 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.

#### 4.2.2.1 Template for requesting band combinations

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.

#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. For BCS4/BCS5 there is no need to add information in the BCS sheet since there is no channel BW details to be filled in for them.

#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.

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| --- | --- |
| 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.

#### 4.2.2 Templates for high power UE band combinations

Specifying HPUE band combination follows the same procedure as PC3 band combination. Request for additions of HPUE band combinations shall be provided by the proponents and sent to the *3GPP\_TSG\_RAN\_WG4\_NR\_BANDS* email reflector before a RAN4 Tdoc submission deadline and no new band combinations are allowed to be requested after the deadline except to correct the missing fallback and add more supporting companies for the proposed band combinations.

Because there is no MSD analysis for FR1+FR2 NR-CA, NR-DC and EN-DC combinations (3x7.125 GHz = 21.375 GHz which is below the lower edge of the TN FR2 range of 24.25 GHz), there is no need to request HPUE for FR1+FR2 combinations, or to document support for HPUE for FR1+FR2 combinations in 38.101-3. The FR1 HPUE requirements for the FR1 fallbacks of FR1+FR2 combinations apply to the FR1 part of FR1+FR2 combinations.

## 4.3 Fallback aspects for specifying band combinations

For companies to propose the new band combinations in the band combination basket WIDs, some restrictions on the fallback aspects should be taken into account. The proponents should propose all the necessary fallback modes together with the proposed band combinations. To make the rules on fallback aspects common understanding in RAN4 and to facilitate delegates who are not very familiar with such rules when preparing the band combination proposals, the following text is suggested to be captured in the justification of each band combination basket WID.

*- Request for additions of band combinations to this WI shall be provided using an agreed template and sent to the 3GPP\_TSG\_RAN\_WG4\_NR\_BANDS email reflector before a RAN4 Tdoc submission deadline and no new band combinations are allowed to be requested after the deadline except to correct the missing fallback and add more supporting companies for the proposed band combinations.*

- *When a proponent requests a new band combination, all the next level fallback configurations shall be listed and recorded in the request template and the status (“New”, “Ongoing”, “Completed”) of all the fallback configurations shall be declared accurately and clearly. For “New” fallback configurations, the proponent shall ensure these fallback configurations are also requested together with the higher order band combination in the same meeting.*

- *A band combination configuration can only be considered as completed when all of the fallback configurations are completed and specified in advance or at the same meeting. It is the responsibility of the proponent to ensure the status of all of the fallback mode configurations. Rapporteurs and other companies are encouraged to check the status of all of the fallback configurations once the higher order band combinations are declared as completed.*

*(Note: 3GPP\_TSG\_RAN\_WG4\_CA is used for the LTE CA baskets WI)* When the below approved rule is not followed by the proponents, TP/draft CR could be flagged by rapporteurs/ interested companies, and the TP/draft CR shall be noted if the lower order fallbacks are missing.

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

# Proponents should clearly mention the following two conditions in the cover sheet of the draft CR or in the heading of the TP.

1) Whether there are pending lower order fallbacks submitted at the same meeting related to the combos in this draft CR/TP. (Yes with Tdoc numbers or No)

2) Whether there were lower order fallbacks approved in the last meeting related to the combos in this draft CR/TP, if the last meeting is a bis meeting. (Yes with Tdoc numbers or No)

Examples for the cases when the last meeting is a bis meeting:

#1: The draft CRs/or TPs for the fallback combinations in the same meeting: R4-xxxxxxx.
There is no related lower order fallbacks in the last bis meeting.

#2: There is no pending lower order fallbacks in the same meeting.
The draft CRs/or TPs for the fallback combinations in the last bis meeting: R4-xxxxxxx

#3: There is no pending lower order fallbacks in the same meeting.
There is no related lower order fallbacks in the last bis meeting.

#4: The draft CRs/or TPs for the fallback combinations in the same meeting: R4-xxxxxxx.
The draft CRs/or TPs for the fallback combinations in the last bis meeting: R4-xxxxxxx

### 4.3.1 General definition of fallbacks

In the 36.101 and 38.101 specs thousands of band combinations for LTE, EN-DC, NR-DC… are specified having at least two carriers, but in most cases many more than two carriers. There are already many rules and definitions for these configurations.

Definitions:

– A fallback DC, CA or SUL configuration is a configuration, where one of the carriers of the higher order configuration is removed.

– A mandatory fallback is a fallback that is mandatory to be specified in the UE specification and supported by the UE.

– A Fallback Group is specified for contiguous CA, only fallback configurations within the same fallback group need to be supported.

Explanations and rules:

– A higher order configuration has generally the same number of fallbacks as it has carriers, i.e. a configuration with 4 carriers has 4 next level fallbacks.

*-* Example: CA\_n1A-n2A-n3A-n4A has the 4 next level fallbacks CA\_n2A-n3A-n4A, CA\_n1A-n3A-n4A, CA\_n1A-n2A-n4A, CA\_n1A-n2A-n3A, where the first, the second, the third and the fourth carrier have been removed.

- For intra-band CA some of the fallbacks are identical, so that the number of unique fallbacks can be lower than the number of carriers. For contiguous intra-band CA there is only one unique fallback, for non-contiguous intra-band CA as well. For contiguous intra-band configurations removing one of the middle carriers would not result in a valid fallback, since this would transform the contiguous configuration to a non-contiguous configuration. But for the combination of contiguous and non-contiguous intra-band CA there will usually be more than one unique fallback left.

*-* Example: CA\_n1(3A) would have three fallbacks, where the first, the second or the third carrier would be removed, but in all three cases the resulting fallback is the same: CA\_n1(2A), so we only have one unique fallback configuration left out of the three.

*-* Example: CA\_n1D would have three fallbacks, where the first, the second or the third carrier would be removed, but in all three cases the resulting fallback is the same: CA\_n1C, so we only have one unique fallback configuration left out of the three. Additionally removing the middle carrier doesn’t result in a valid fallback, since it would change the contiguous configuration to a non-contiguous one.

*-* Example: CA\_n265R12 would have twelve fallbacks, where the first, the second … twelfth carrier would be removed, but in all twelve cases the resulting fallback is the same: CA\_n265R11, so we only have one unique fallback configuration left out of the twelve. Also here removing one of the middle carrier doesn’t result in a valid fallback, since it would change the contiguous configuration to a non-contiguous one.

*-* Example: CA\_n1(A-C) would have three fallbacks, where the first, the second or the third carrier would be removed, this would result in CA\_n1C, CA\_n1(2A), CA\_n1(2A) as fallbacks, where the last two are duplicates, so in this case we have two unique fallback configurations left out of the three: CA\_n1C and CA\_n1(2A).

- For intra-band contiguous CA we have to follow the fallback groups. Only fallbacks within this group can be used, BW classes outside the fallback group are no legal fallbacks.

- Example: CA\_n1D falls back to CA\_n1C.

*-* Example: CA\_n1C falls back to CA\_n1A, BUT NOT to CA\_n1B, since this is in a different fallback group.

*-* Example: CA\_n265I (FR2) falls back to CA\_n265H, this falls back to CA\_n265G, this falls back to CA\_n265A, NOT to CA\_n265F.

- For combined contiguous and non-contiguous intra-band CA, which is mainly used for FR2, there will be many fallbacks, especially when there is a large number of carriers, but also there some fallbacks after removing a carrier may be duplicates.

*-* Example: CA\_n265(A-G-H), removing the “A” carrier results in CA\_n265(G-H), removing one of the “G” carriers results in CA\_n265(A-A-H), which will be correctly written as CA\_n265(2A-H), removing one of the “H” carrier will result in CA\_n265(A-G-G), which will be correctly written as CA\_n265(A-2G), so we get three unique configurations out of these six carriers.

### 4.3.2 Mandatory Fallbacks

In general all fallbacks need to be specified and supported until we end up at a single carrier. So it is necessary to generate a fallback tree starting at the configuration with the highest number of carriers down to a single carrier.

– A configuration has as many fallback levels as the highest order combination has carriers. For example a four carrier combination will have four three carrier fallbacks, each of these has three two carrier fallbacks, each of these would end up in single carriers. However, in this chain there will again be some duplicates.

Example: CA\_n1A-n2A-n3A-n4An has these fallbacks:

- CA\_n2A-n3A-n4A, CA\_n1A-n3A-n4A, CA\_n1A-n2A-n4A, CA\_n1A-n2A-n3A.

These four combinations have these two carrier fallbacks (colors as above):

- CA\_n3A-n4A, CA\_n2A-n4A, CA\_n2A-n3A, CA\_n3A-n4A, CA\_n1A-n4A, CA\_n1A-n3A, CA\_n2A-n4A, CA\_n1A-n4A, CA\_n1A-n2A, CA\_n2A-n3A, CA\_n1A-n3A, CA\_n1A-n2A.

As we see there are several duplicates, removing these we end up with these second level fallbacks:

- CA\_n3A-n4A, CA\_n2A-n4A, CA\_n2A-n3A, CA\_n1A-n4A, CA\_n1A-n3A, CA\_n1A-n2A.

*-* All of these end up in 4 single carriers of n1A, n2A, n3A and n4A.

- This is a recursive action, we first have to check the next lower level fallbacks, then take these as the basis for the next lower level and so on, until we end up with single carriers.

- All fallbacks for these DC, CA or SUL combinations are mandatory to be supported, as long as the corresponding UL is supported as well.

One relatively simple example of such a combination is DC\_2A\_n261(H-I). But already this simple example generates a fallback tree with 12 fallbacks when going from 8 carriers to a single dual carrier DC combination. This is shown in figure 6.2.2-1:



Figure 4.3.2-1: Fallback tree for DC\_2A\_n261(H-I)

There are much more complicated CA combinations that will create many more combinations like CA\_n260(2A-2O-Q) and there are many of these combinations. For CA\_n260(2A-2O-Q) for example there is a fallback tree with 46 unique fallback combinations (all duplicates already removed). This combination is already in 38.101, however, most of these fallbacks were initially missing and added later.

All of these fallbacks have to be specified in 38.101 specs and need to be supported by the UE.

### 4.3.3 Fallbacks of EN-DC Configurations

In 38.101-3 we find this general rule on fallbacks for EN-DC combinations:

*“A terminal which supports an inter-band EN-DC configuration with a certain UL configuration shall support the all lower order DL configurations of the lower order EN-DC combinations, which have this certain UL configuration and the fallbacks of this UL configuration. ”*

Of course this means that we have to support all fallbacks for which this rule is fulfilled.

This rule is a restriction of the general rule that all fallbacks need to be supported. The reason is that there can be combinations, for which the UL is not supported, of course when there is no UL, also the DL combination doesn’t make sense anymore.

- Assumption: DC\_1A-2A\_n3A is the DL configuration and DC\_1A\_n3A is supported as the UL.

*-* DC\_1A-2A\_n3A as DL configuration has DC\_1A\_n3A, DC\_2A\_n3A as next level fallbacks.

*-* The fallback DC\_1A\_n3A has the same UL DC\_1A\_n3A as the higher order combination, therefore this fallback is mandatory to be supported.

*-* The fallback DC\_2A\_n3A would need DC\_2A\_n3A as the UL, but only DC\_1A\_n3A is supported for the UL of the higher order combination, therefore this fallback is not mandatory to be supported.

Fallbacks from EN-DC to E-UTRA only or NR only configurations need to be supported as well. For example if we have a configuration DC\_1A-2A-3A\_n4A-n5A of course the constituent LTE combination CA\_1A-2A-3A as well as NR CA\_n4A-n5A need to be specified in 36.101 and 38.101 respectively and it is mandatory to support them, since the EN-DC combination is based on them.

### 4.3.4 Fallbacks of UL Configurations

Of course fallbacks of UL configurations need to be specified and supported as well.

– All fallbacks of UL configurations with higher order need to be supported down to a single carrier.

*-* Example: UL CA\_n265M needs these UL fallbacks: CA\_n265L, CA\_n265K, CA\_n265J, CA\_n265I, CA\_n265H, CA\_n265G, n265A.

*-* Example: UL EN-DC DC\_1A\_n265M needs these UL fallbacks: DC\_1A\_n265L, DC\_1A\_n265K, DC\_1A\_n265J, DC\_1A\_n265I, DC\_1A\_n265H, DC\_1A\_n265G, DC\_1A\_n265A.

Generally there is the rule that UL configurations can only have the same, or less carriers that are part of the DL configuration, as an example it is not allowed to have an UL configuration DC\_1A\_n265M for a DL configuration DC\_1A\_n265H.

### 4.3.5 Fallback rules for some exceptional cases

For some band combinations which include SDL bands (e.g. band n75) and/or only DL Scell bands (band combinations including band n7/7 and band n38/38 together), some fallback band combinations which can’t be deployed in reality can’t be considered as fallbacks.

For example:

– DC\_1A\_n75A-n78A: fallback is DC\_1A\_n78A. And DC\_1A\_n75A which can’t be deployed in reality can’t be considered as fallbacks. All fallbacks of UL configurations with higher order need to be supported down to a single carrier.

– DC\_1A-7A\_n38A-n78A: fallbacks are DC\_1A-7A\_n78A and DC\_1A\_n38A-n78A. DC\_1A-7A\_n38A and DC\_7A\_n38A-78A which can’t be deployed in reality can’t be considered as fallbacks.

– DL CA\_n1A-n7A-n38A: fallbacks are DL CA\_n1A-n7A and DL CA\_n1A-n38A. DL CA\_n7A-n38A which can’t be deployed in reality can’t be considered as fallbacks.

Generally, this special principle can be summarized as below. For a band combinations, if one RAT (LTE part or NR part) of this BC only include SDL band(s) and/or only DL Scell band(s), this BC which can’t be deployed in reality can’t be considered as fallbacks.

### 4.3.6 Guidelines on valid CBW for higher order BC depending on fallbacks

In current RAN4 specifications, for traditional BCS, some new CBWs such as 35MHz/45MHz were added in the higher order combinations but not yet introduced in the corresponding fallback lower order combinations. It results in the inconsistencies and leads some extra maintenance work to remove the CBWs in the higher order combinations that are missing in the lower fallbacks for traditional BCS. The following guidelines on valid CBW for new higher order BC request in traditional BCS from Rel-18 are to be supported. Note that for BCS4 and 5, the guideline does not apply.

– The per band supported channel bandwidths in a new higher order band combination from Rel-18 with traditional BCS should be a subset of or equal to channel bandwidths supported for the same band in at least one of the corresponding lower order band combination of the BCS.

– Band combination with the supported per channel bandwidths not meeting the above guidance should not be requested.

## 4.4 Submitting technical contributions (Tdoc) for specifying band combinations

### 4.4.1 Text Proposal (TP) or Draft Change Request (draft CR)

When providing technical contributions for the inclusion of a band combination there are two possible approaches.

1) Text Proposal (TP) to a Technical Report (TR) for the specific basket Work Item (WI).

2) Draft Change Request (draft CR) to the Technical Specification (TS)

RAN4 have agreed that if there is a need for any technical study/analysis as UE coexistence studies potentially resulting in relaxations needed defined this needs to be provided via a TP to a TR such that this study/analysis is captured in the TR. For new band combinations which does not require any technical study/analysis RAN4 has agreed to introduce these via draft CR directly to the TS. It shall be noted that not all the basket WIs have a TR indicating for which technical study/analysis may be needed and for which there is no need.

### 4.4.2 Specific for Text Proposal (TP)

TPs shall be drafted using the latest version of the corresponding TR as baseline and if included to the TR the provided template in the TR. All additions intended to be captured to the TR shall be marked with change-marks.

Sourcing company/companies are encouraged to combine all related band combinations to a single Tdoc for the TR containing one or more TPs with the needed technical analysis.

### 4.4.3 Specific for Draft Change Request (draft CR)

Draft CRs shall be drafted using the latest version of the corresponding TS as baseline. All additions intended to be captured to the TR shall be marked with change-marks.

Sourcing company/companies shall provide a single draft CR per basket WI corresponding to an individual agenda item at the RAN4 meetings. Noting that if a company is working with multiple other companies for providing technical input (draft CRs) for the same type of combinations (i.e. basket WI) each different group of sourcing companies shall be allowed to submit individual Tdocs. It shall also be noted that if different types of draftCRs are needed (e.g. Cat.B and Cat.F) a single draftCR per type is allowed.

### 4.4.4 Which agenda to submit the Tdoc for

The TP or draft CR shall be submitted to the agenda corresponding to the basket WI for which the specific band combination belongs (i.e.is included in the WID). Attention shall be made to which type of combinations it is under the basket if there are different sub-agendas for e.g. with or without FR2 parts of the combination.

# 5 Guidelines of specifying band combinations

## 5.1 General

The notation of the band combinations in the TS 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 an 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 for SUL band combination with single carrier, 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. If SUL band combination with intra-band contiguous CA, intra-band non-contiguous CA or inter-band CA, the notation starts with “CA\_” as the first three characters. Examples:

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

- CA\_n41C-n80A (n80 being the SUL band)

- CA\_n78(2A)-n86A (n86 being the SUL band)

- CA\_n1A\_n78A-n81A (n81 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, or SUL band combination with NR intra-band contiguous, non-contiguous or inter-band CA 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 or for NE-DC first NR carriers, then “\_” and the LTE 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 a single NR 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 an “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 (F is not used), in which the classes M, N and O are applicable for the use with shared spectrum channel access. For FR2 in 5.3A.4-1 in 38.101-2 ranging from A to W(N is not used), and R2 to R12, in which the classes V and W are applicable only for FR2-2 operating bands. The CA bandwidth classes for NR are categorized into different fallback groups (FBG). It is mandatory for a UE to be able to fallback to lower order NR CA bandwidth class configuration within a FBG, and not mandatory for a UE to be able to fallback to lower order NR CA bandwidth class configuration that belong to a different FBG.

A special kind or BW class specification is when there are intra-band contiguous LTE and NR carriers within an EN-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 “\_”. For intra-band contiguous NE-DC configuration, instead of (n)X in EN-DC, the notation X(n) is used. In this case, DC\_X(n)yz indicates the contiguous NR Band carriers with channel bandwidth class y in Band nX is followed by the contiguous LTE carries with channel bandwidth z in Band X. For example, DC\_3(n)AA denotes the NE-DC combination of single carrier for NR in Band n3 and single carrier for LTE in Band 3.

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 sub-blocks 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 sub-block 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 Guidelines on delta TIB and RIB

TBD

## 5.5 Guidelines on MSD

TBD

## 5.6 Guidelines on MPR

TBD

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

### 5.7.1 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.

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

#### 5.7.2.1 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.

#### 5.7.2.2 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.

### 5.7.3 Introduction of BCS4/BCS5

In NR band combination, it is a challenge for operators to request new NR CA and SUL band combinations when new channel bandwidths are added to existing bands in the band combinations. Operators have to go back and create new Bandwidth Combinations Sets for existing band combinations in order to be able to use those new channel bandwidths in NR CA and SUL. To reduce the workload in RAN4, a new WID for creating a new type of BCS was approved in [8].

BCS4/BCS5 are allowed to be applied to new band combinations in RAN4 which indicate UE to support up to all of the channel bandwidths for the band in the band combination. BCS4 is release independent to Rel-15 with no new signalling while BCS5 is functionally equivalent to BCS4 except that the new signalling [*supportedMinBandwidthDL/supportedMinBandwidthUL*] introduced in Rel-17 such as the limitation to the supporting channel bandwidth in each band within the band combination would apply, and BCS5 with the signalling [*supportedMinBandwidthDL/supportedMinBandwidthUL*] is allowed for early implementation from Rel-15. For a legacy gNB that was not upgraded to understand BCS4 or BCS5 with the new signalling, it would enable to ignore BCS4 or BCS5 with the new signalling.

Considering that BCSs are not defined or reported separately for UL and DL for traditional BCSs, there is also no need to differentiate BCS4/BCS5 for UL and DL. BCS4/BCS5 can be used for FR1 intra-band UL CA. Table 6.6.1-1 shows the template for NR CA configurations for intra-band contiguous CA with BCS4/BCS5. Table 6.6.1-2 shows the template for NR CA configurations for intra-band non-contiguous CA with BCS4/BCS5. For inter-band CA combinations including FR1 intra-band CA and with BCS4/BCS5, the bandwidth combination sets for the FR1 intra-band CA are BCS4/BCS5. The BCS4/BCS5 are represented in the inter-band CA configuration table by using the option which covers inter-band and intra-band as shown in Table 6.6.1-3. For SUL band combinations, BCS4/BCS5 reuse the same template with inter-band CA as in Table 6.6.1-3.

Table 5.7.3-1: Template for NR intra-band contiguous CA configurations with BCS4/BCS5

|  |
| --- |
| NR CA configuration / Bandwidth combination set |
| NR CA configuration | Uplink CA configurations | Channel bandwidths for carrier (MHz) | Channel bandwidths for carrier (MHz) | Channel bandwidths for carrier (MHz) | Channel bandwidths for carrier (MHz) | Channel bandwidths for carrier (MHz) | Maximum aggregated bandwidth (MHz) | Bandwidth combination set |
| CA\_nXC | CA\_nXC | 40 | 80, 100 |  |  |  | 180 | 0 |
| 50, 60, 80 | 60, 80, 100 |  |  |  |  |  |
| … | … |  |  |  | … | … |
|  |  | See nX channel bandwidths in Table 5.3.5-1 for each carrier2 |  |  |  | TBD | 4 and 5 |
| NOTE 1: 5 MHz is not applicable for 30/60 kHz SCS.NOTE 2: The aggregated bandwidth must be greater than or equal to the minimum for the bandwidth class defined in Table 5.3A.5-1, and smaller than or equal to the maximum aggregated bandwidth. |

Table 5.7.3-2: Template for NR intra-band non-contiguous CA configurations with BCS4/BCS5

|  |
| --- |
| NR CA configuration / Bandwidth combination set |
| NR CA configuration | Uplink CA configurations | Channel bandwidths for carrier (MHz) | Channel bandwidths for carrier (MHz) | Channel bandwidths for carrier (MHz) | Channel bandwidths for carrier (MHz) | Maximum aggregated bandwidth (MHz) | Bandwidth combination set |
| CA\_nX(2A) | CA\_nX(2A) | 40, 50, 60, 80,100 | 40, 50, 60, 80, 100 |  |  | 180 | 0 |
| … | … |  |  | … | … |
|  |  | See nX channel bandwidths in Table 5.3.5-1 for each carrier |  |  | TBD | 4 and 5 |

Table 5.7.3-3: Template for NR inter-band CA configurations including FR1 intra-band CA with BCS4/BCS5

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NR CA configuration | Uplink CA configuration | NR Band | Channel bandwidth (MHz) | Bandwidth combination set |
|  |  |  | 5 | 10 | 15 | 20 | 25 | 30 | … | 100 |  |
| CA\_nXA-nYA | CA\_nXA-nYA | nX | 5 | 10 | 15 | 20 |  |  |  |  | 0 |
|  |  | nY | 5 | 10 | 15 | 20 | 25 | 30 |  |  |  |
|  |  | nX | See nX channel bandwidths in Table 5.3.5-1 | 4 and 5 |
|  |  | nY | See nY channel bandwidths in Table 5.3.5-1 |  |
| CA\_nXA-nYC | CA\_nXA-nYA | nX | 5 | 10 | 15 | 20 |  |  |  |  | 0 |
|  |  | nY | 5 | 10 | 15 | 20 | 25 | 30 |  |  |  |
|  |  | nX | See nX channel bandwidths in Table 5.3.5-1 | 4 and 5 |
|  |  | nY | See nY channel bandwidths in Table 5.5A.1-1 |  |

With regards to the applicability of BCS4/BCS5 to FR2 intra-band combinations, since all FR2 combinations only have BCS0 and new channel bandwidth have not been added, BCS4/BCS5 are probably not needed for FR2. For FR1+FR2 BCS4/BCS5 combinations the configuration table shall state that BCS0 applies for the intra-band FR2 part (when applicable).

#### 5.7.3.1 Guidelines for band combination with BCS4/BCS5

The following are the rules for applying BCS4/BCS5 for band combination request:

- BCS4/BCS5 apply to SUL, NR CA, NR DC and SUL and/or NR CA part of inter-band MR-DC while it does not apply to intra-band MR DC.

- BCS4/ BCS5 shall be requested together, but BCS5 can’t be reported together with BCS4.

- For BCS4/BCS5 there is no need to add information in a BCS sheet about which channel bandwidths that are supported since there is no such details to be filled in for BCS4 and BCS5. For BCS4 and BCS5 it is enough just to fill in the band combination table sheet.

- If needed, traditional BCSs are allowed for all releases. For a new band combination in Rel-17 and onwards, if BCS4/BCS5 are requested, traditional BCSs are allowed pending on the proponents, the network of the proponents of BCS4/BCS5 is demanded to recognize BCS4/BCS5.

#### 5.7.3.2 The maximum aggregated bandwidth for intra-band CA with BCS4/BCS5

To guarantee the BCS4/BCS5 can cover all the possible bandwidth configurations for intra-band CA, the maximum aggregated bandwidth chosen for BCS4/BCS5 should equal to- min{n\*max channel bandwidth of each carrier, BWChannel\_CA of each CA bandwidth class, Maximum frequency range of each band} for intra-band contiguous CA.

- min{n\*max channel bandwidth of each carrier, Maximum frequency range of each band - Minimum sub-block gaps} for intra-band non-contiguous CA.

where n is the number of aggregated CCs, minimum sub-block gaps indicates the sum of the min sub-block gap between the upper edge of lower component carrier and lower edge of higher component carrier that UE can support per band combination in two adjacent non-contiguous component carriers.

The value of min sub-block gaps could be clarified by the request operator but it should try to cover the needs of all possible operators.

Annex A (informative):
Change history

|  |
| --- |
| **Change history** |
| **Date** | **Meeting** | **TDoc** | **CR** | **Rev** | **Cat** | **Subject/Comment** | **New version** |
| 2024-10 | RAN4#112-bis | R4-2416422 | - | - | - | Initial version partly based on the technical report 38.846 V18.1.0 | 0.1.0 |