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| Technical Report | |
| 3rd Generation Partnership Project;  Technical Specification Group Radio Access Network;  Study on simplification of band combination specification for NR and LTE  (Release 18) | |
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# Foreword

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

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

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

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

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

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

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

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

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

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

**should** indicates a recommendation to do something

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

**may** indicates permission to do something

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

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

**can** indicates that something is possible

**cannot** indicates that something is impossible

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

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

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

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

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

In addition:

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

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

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

# 1 Scope

The present document is a technical report for simplification of band combination specification for NR and LTE. The purpose of this TR is to further optimize and improve the working procedure for specifying band combination. A technical report will be created to collect the rules of band combination during the timescale of Rel-18 so as to improve the efficiency of band combination specifying and the quality of specifications. The dependency and applicability for RF requirements among different features for the same spectrum combination to reduce the redundant tests will also be investigated in the TR.

# 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".

# 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 Background

At 3GPP RAN#96 meeting, a revised Rel-18 Study Item “Study on simplification of band combination specification for NR and LTE” was approved. The objectives are as follows,

■ Investigate and simplify the working procedure for approving documents for TS and TR to improve the efficiency to specify band combinations and the quality of specifications

– Improve the efficiency considering

*○* RAN4 reduces the redundant and unnecessary work for big CRs, draft CRs and/or TPs, if any

*○* The following rules will be investigated and defined if necessary

*•* Investigate whether the workflow can be improved under the condition that quality can be guaranteed.

*•* Develop rules or guidelines covering the process of not for block approval.

*○* Develop the necessary tools to reduce RAN4’s workloads if feasible

– Improve the quality considering

*○* RAN4 improves the procedures for cross-checking to avoid conflict between big CR/CRs across basket WIs and other WIs

– RAN4 captures the agreements about the rules and guidelines including but not being limited to the outcome of the above sub-bullets in the corresponding TR

■ Investigate the feasibility and optimize the specification structure and reduce the test burden

– Study the methodology to simplify the test efforts for a UE supporting multiple features, e.g., NR-CA, EN-DC on the same band combination

*○* Study of similarity and dependency of RF requirements for different features on the same band combination

– Study the methodology to simplify RF requirement specifications for

*○* MSD requirements in 38.101-1 and 38.101-3, e.g., reducing the test configurations with different bandwidth combinations

*○* For Delta\_TIB and Delta\_RIB requirements, investigate and define the framework of the general principle or requirements with band-combination specific exceptions

*○* For Delta\_TC,c, investigate whether it can be removed in low boundary formula for Pcmax

■ A simplified approach aiming to allow operation of any PC5 configuration (LTE PC5, NR PC5, CA on PC5) with any Uu configuration (any LTE CA/DC, EN-DC, NR DC) should be investigated in order to minimise the specification efforts for such automotive relevant combinations.

■ NOTE 1: The requirements applicable to UE won’t be changed or increased.

■ NOTE 2: The work should be applied to all the power classes

The target is that after the completion of the study item, the working procedure to specify the band combinations will be refined and the quality of specifications will be improved in the stage of Rel-18. A set of new guidance on band combination handling, rule collections and band combination optimization for RAN4 specifications will be approved. The feasibility to reduce the test burden of band combinations will be discussed. It is suggested that the rules related to the band combinations should be applied to the latest RAN4 specifications after the completion of the SI.

# 5 Working procedure of specifying band combinations

## 5.1 General

< Editor's note: In this section, the working procedure of specifying band combinations to improve the work efficiency and the quality of RAN4 specifications will be discussed>

In order to make the band combinations work more efficient, RAN4 has decided to re-organize the corresponding basket WIs in Rel-18 with the following agreements.

|  |
| --- |
| –  *General:*  *○ To merge 1BUL and 2BUL basket WI for NR CA, i.e. merged into xBUL (x=1,2).*  *○ To establish one basket WI for SUL and one basket WI for V2X.*  *• NR\_SUL\_combos\_R18.*  *• NR\_LTE\_V2X\_PC5\_combos\_R18.*  *○ 2UL CA in FR1 + 1UL in FR2 can be treated in 2UL since we don’t need to count the number of FR2 UL.*  *○ There is no need to set a dedicated WI for non-block approval combos.*  – *Consider the following NR CA/DC band combination basket WIDs in Rel-18.*  *○ NR CA/DC*  *• NR\_CA\_R18\_intra including TR and TP’s.*  *• NR\_CADC\_R18\_2BDL\_xBUL (x=1,2) including TR and TP’s.*  *• NR\_CADC\_R18\_3BDL\_xBUL (x=1,2) including TR and TP’s.*  *• NR\_CADC\_R18\_yBDL\_xBUL (y=4,5,6, x=1,2) without TR and TP’s.*  *○ MR DC*  *• DC\_R18\_1BLTE\_1BNR\_2DL2UL.*  *• DC\_R18\_2BLTE\_1BNR\_3DL2UL.*  *• DC\_R18\_xBLTE\_1BNR\_yDL2UL (x= 3, 4, 5).*  *• DC\_R18\_xBLTE\_2BNR\_yDL2UL.*  *• DC\_R18\_xBLTE\_yBNR\_zDL2UL (x=1, 2, 3, y>2 , z≤6).*  *• DC\_R18\_xBLTE\_yBNR\_zDL3UL (x=1, 2, 3, 4, y=1, 2; 3≤z≤6).* |

Regarding to the simplification of working procedure, the following agreements have been achieved.

– *The proponent of new BC request should be the first responsible person for checking the fallback BCs for a new BC request, and all companies are encouraged to check the fallbacks.*

– *With regard to the order of the request BC and its fallbacks, it is agreed that the higher order combination and its fallbacks request could be in parallel.*

– *For the deadline of BC request, same deadline as RAN4 Tdoc submission is supposed.*

*○ No request of adding new band combinations into basket WIs will be handled for bis-meeting and ad-hoc meeting.*

*○ No new band combination is allowed to be requested after the deadline.*

*• It is allowed to only correct the missing fallback and add more supporting companies for the proposed band combinations.*

– *For V2X basket WI, the working procedure agreed in normal CA/DC basket WIs also be applied.*

– *To ensure the higher order combination not earlier than the lower order combinations in the spec, the following guidelines applied.*

*○ Document the definition of fallback modes and the rules related to fallback mode in RAN4 TR.*

*○ The big CRs for higher and lower order band combinations should be agreed in the same meeting.*

*○ The rapporteurs do not have bland rows in the WID spreadsheets to facilitate the readers to sort out the interested band combinations.*

## 5.2 New templates for specifying band combinations

### 5.2.1 Templates for PC3 band combinations

The R18 PC3 basket WID items were improved in RAN#96 meeting, including PC3 ENDC/NEDC, NR CA/DC, SUL and V2X basket WIDs, due to some of the R17 PC3 basket WID items are merged into one R18 PC3 basket WID, and also the table templates in the specification were changed during R17 discussion. Therefore, the original templates of band combination request sheet, status report and band combinations table should be updated accordingly.

The updated EXCEL templates of band combination request sheet, status report and band combinations table for Rel-18 PC3 band combinations were already approved in RAN4#104e meeting, and it have already been uploaded to the following 3GPP ftp server.

[*https://www.3gpp.org/ftp/tsg\_ran/WG4\_Radio/Templates/*](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/Templates/)

*(Editor’s note: The approved latest template is* *R4-2214978)*

Besides the updated EXCEL templates, the other general rules captured in the section 6.2.2 in TR 38.862 [7] are still valid.

The update templates for PC3 NR CA, EN-DC, SUL and V2X band combinations in Rel-18 include the sheets for *‘Cover sheet’, ‘Band combination table’, ‘FR1 intra-band CA BCS table’, ‘FR2 intra-band CA BCS table’, ‘FR2 intra-band NCCA BCS table’, ‘Intra-band ENDC BCS table’, ‘FR1 inter-band BCS table’, ‘FR2 inter-band BCS table’, ‘FR1+FR2 inter-band BCS table’, ‘SUL band combination BCS table’ and ‘V2X band combination BCS table’:*

– *Merging all the channel bandwidth columns into one column.*

– *Using ‘,’ between two adjacent channel bandwidths.*

– *Removing the channel bandwidth number in the table head.*

– *Only for inter-band NR CA) Using simple texts like ‘CA\_nXC\_BCS0’ or ‘CA\_nX(2A)\_BCS0’ for the constitute band supporting intra-band contiguous or non-contiguous CA , respectively, associated with a new note of “The CA configurations are given in Table 5.5A.1-1 or Table 5.5A.2-1 in this specification”.*

### 5.2.2 Template for high power UE band combinations

FFS.

### 5.2.3 New templates of delta TIB / RIB due to NE-DC and SUL band combinations in Rel-18

For inter-band NE-DC within FR1, unless otherwise stated, the value of ΔTIB,c for the correspondingly specified EN-DC combination is applicable. However, for some specific NE-DC combinations, there are no corresponding EN-DC combinations defined in the spec. To unify the template as the cases in EN-DC combinations, the new delta TIB template in Table 5.2.3-1 and delta RIB template in Table 5.2.3-2 for NE-DC combinations applies respectively, two bands as an example.

Table 5.2.3-1: New template for ΔTIB,c due to NE-DC (two bands)

| Inter-band NE-DC configuration | **ΔTIB,c for NR band / E-UTRA band (dB)\*** | |
| --- | --- | --- |
| **Component band in order of bands in configuration\*\*** | |
| DC\_nx\_y |  |  |
| NOTE \*: “-” denotes ΔTIB,c = 0.  NOTE \*\*: The component band order in the configuration should be listed by the order of NR band and E-UTRA band respectively. | | |

Table 5.2.3-2: New template for ΔRIB,c due to NE-DC (two bands)

| Inter-band NE-DC configuration | **ΔRIB,c for NR band / E-UTRA band (dB)\*** | |
| --- | --- | --- |
| **Component band in order of bands in configuration\*\*** | |
| DC\_nx\_y |  |  |
| NOTE \*: “-” denotes ΔRIB,c = 0.  NOTE \*\*: The component band order in the configuration should be listed by the order of NR band and E-UTRA band respectively. | | |

For the UE which supports SUL band combination, the template for ΔTIB,c in Table 5.2.3-3 and ΔRIB,c in Table 5.2.3-4 applies respectively, three bands as an example.

Table 5.2.3-3: New template for ΔTIB,c due to SUL band combination (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Band combination for SUL** | **ΔTIB,c for NR bands / SUL band (dB)\*** | | |
| **Component band in order of bands in configuration\*\*** | | |
| CA\_nx\_SUL\_ny-nz |  |  |  |
| NOTE \*: “-” denotes ΔTIB,c = 0.  NOTE \*\*: The component band order in the configuration should be listed by the order of NR bands and SUL band, such as for CA\_n79\_SUL\_n41-n83 the band order from left to right is n41, n79 and n83. | | | |

Table 5.2.3-4: New template for ΔRIB,c due to SUL band combination (three bands)

|  |  |  |  |
| --- | --- | --- | --- |
| **Band combination for SUL** | **ΔRIB,c for NR bands / SUL band (dB)\*** | | |
| **Component band in order of bands in configuration\*\*** | | |
| CA\_nx\_SUL\_ny-nz |  |  |  |
| NOTE \*: “-” denotes ΔRIB,c = 0.  NOTE \*\*: The component band order in the configuration should be listed by the order of NR bands and SUL band, such as for CA\_n1\_SUL\_n78-n80 the band order from left to right is n1, n78 and n80. | | | |

## 5.3 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. 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*.

*(Note: The above rule is captured in TR 38.862-h10)*

# 6 Guidelines of specifying band combinations

## 6.1 General

< Editor's note: This section will collect the new agreements on the rules and guidelines of specifying band combinations. The possible optimization to the band combination will also be discussed in this section.>

## 6.2 Guidelines on band combination fallbacks

### 6.2.1 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.

### 6.2.2 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 6.2.2-1: 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.

### 6.2.3 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.

### 6.2.4 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.

### 6.2.5 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.

## 6.3 Guidelines on delta TIB and RIB due to band combinations

To optimize the tables of ΔTIB,c and ΔRIB,c due to band combinations, a new template for Rel-18 is proposed in clause 8.3.2 in TR 38.862.

Regarding to the optimized template for ΔTIB,c and ΔRIB,c tables, only the configurations having the same component E-UTRA / NR bands can be grouped into one cell (row). For example, in Table 6.3-1 for the ΔTIB,c of the following inter-band EN-DC configurations, since the component bands are not the same, two rows should be filled separately in the new template. However, for the configurations “DC\_3-7-8\_n1-n78”, “DC\_3-3-7-8\_n1-n78”, “DC\_3-7-7-8\_n1-n78” and “DC\_3-3-7-7-8\_n1-n78” having the same component bands, they should be merged into one cell.

Table 6.3-1: Example for ΔTIB,c for Inter-band EN-DC configurations

| Inter-band EN-DC configuration | E-UTRA or NR Band | ΔTIB,c (dB) |
| --- | --- | --- |
| DC\_3-7-8\_n1-n78  DC\_3-3-7-8\_n1-n78  DC\_3-7-7-8\_n1-n78  DC\_3-3-7-7-8\_n1-n78  DC\_3-7\_n1-n8-n78  DC\_3-3-7\_n1-n8-n78  DC\_3-7-7\_n1-n8-n78  DC\_3-3-7-7\_n1-n8-n78 | 3 | 0.6 |
|  | 7 | 0.6 |
|  | 8 or n8 | 0.6 |
|  | n1 | 0.6 |
|  | n78 | 0.8 |

| Inter-band EN-DC configuration | ΔTIB,c for E-UTRA band / NR band (dB)6 | | | | |
| --- | --- | --- | --- | --- | --- |
| Component band in order of bands in configuration7 | | | | |
| DC\_3-7-8\_n1-n78  DC\_3-3-7-8\_n1-n78  DC\_3-7-7-8\_n1-n78  DC\_3-3-7-7-8\_n1-n78 | 0.6 | 0.6 | 0.6 | 0.6 | 0.8 |
| DC\_3-7\_n1-n8-n78  DC\_3-3-7\_n1-n8-n78  DC\_3-7-7\_n1-n8-n78  DC\_3-3-7-7\_n1-n8-n78 | 0.6 | 0.6 | 0.6 | 0.6 | 0.8 |

**Guideline 1: It is supposed that only the configurations having the same component E-UTRA / NR bands can be grouped into one cell (row) for the new ΔTIB,c and ΔRIB,c templates.**

With regard to the values for a band combination in the ΔTIB,c / ΔRIB,c table, considering that a statement of ‘Unless otherwise stated, ΔTIB,c / ΔRIB,c is set to zero’ having been specified in the general part of specification, it is reasonable to remove the combination in the ΔTIB,c / ΔRIB,c table with all component band having the value of ‘-’ (zero). For example in the following ΔRIB,c Table 6.3-2, the CA combinations CA\_n1-n3-n5, CA\_n1-n3-n18 and CA\_n1-n3-n20 do not need to be listed in the table.

Table 6.3-2: Example for ΔRIB,c for Inter-band CA configurations

|  |  |  |  |
| --- | --- | --- | --- |
| **Inter-band CA combination** | **ΔRIB,c for NR bands (dB)9** | | |
| **Component band in order of bands in configuration10** | | |
| ~~CA\_n1-n3-n5~~ | - | - | - |
| CA\_n1-n3-n8 | 0.2 | 0.2 | 0.5 |
| ~~CA\_n1-n3-n18~~ | - | - | - |
| ~~CA\_n1-n3-n20~~ | - | - | - |

**Guideline 2: For the band combination with all the component bands having the ΔTIB,c / ΔRIB,c values as ‘-’ (zero), there is no need to be listed in the ΔTIB,c / ΔRIB,c table.**

# 7 Test burden reduction for band combinations

## 7.1 General

< Editor's note: In this section, technical studies related to band combinations will be investigated, such as the aspects to reduce the test burden includes but not limited to,

1. Study the methodology to simplify the test efforts for a UE supporting multiple features on the same band combination.

2. Study the methodology to simplify RF requirement specifications.

It is noted that the requirements applicable to UE won’t be changed or increased.>

One of the objectives in this SI is to investigate the feasibility and optimize the specification structure and reduce the test burden. Currently, the main RF requirements related to specific band combinations include maximum output power (MOP), spurious emission for UE-to-UE coexistence, REFSENS and REFSENS exceptions due to harmonic/harmonic mixing/cross band isolation/IMD interference. Obviously, RF requirements for different features on the same band combination have some similarities and dependency. Especially, the RF implementations are similar and RF architectures can be reused for different features on the same band combination. It’s very meaningful to study the similarity and dependency of RF requirements for different features on the same band combination and find out the feasibility to further optimize the specification structure and reduce the test burden. For example, CA\_nA-nB (NR CA), DC\_nA-nB (NR-DC), DC\_A\_nB (EN-DC), DC\_B\_nA (EN-DC), DC\_nB\_A (NE-DC), DC\_nA\_B (NE-DC) (different features on same band combination) can use same RF implementation.

## 7.2 Similarity and Dependency of Tx RF requirements for different features on the same band combination

### 7.2.1 Maximum output power

As an example, PC3 MOP requirements for all the UL NR CA, UL NR DC, EN-DC and NE-DC band combinations in table 7.2.1-1 based on the TS 38.101-1-h60 and TS 38.101-3-h60. One band combination may be chosen to verify PC3 MOP testing for some band combinations in same row in table 7.2.1-1, as a result of reducing test burden. It’s suggested to randomly choose one band combination that UE support for MOP testing. The proposed test reduction could be considered for an informative annex in the TS since the final decision should be taken by RAN5 based on the industry certification testing needs.

Table 7.2.1-1: Band combination PC3 MOP requirements for the same frequency range with different features

| Uplink NR CA Configuration | Uplink NR DC Configuration | Uplink EN-DC Configuration | Uplink NE-DC Configuration | Class 3 (dBm) | Tolerance (dB) |
| --- | --- | --- | --- | --- | --- |
| CA\_n1A-n3A | DC\_n1A-n3A | DC\_1A\_n3A  DC\_3A\_n1A  DC\_1A\_n80A  DC\_3A\_n84A | DC\_n3A\_1A | 23 | +2/-3 |
| CA\_n1A-n5A |  | DC\_1A\_n5A |  | 23 | +2/-3 |
| CA\_n1A-n7A | DC\_n1A-n7A | DC\_1A\_n7A  DC\_7A\_n1A |  | 23 | +2/-3 |
| CA\_n1A-n8A |  | DC\_1A\_n8A  DC\_8A\_n1A | DC\_n8A\_1A | 23 | +2/-3 |
| CA\_n1A-n18A |  |  |  | 23 | +2/-3 |
| CA\_n1A-n20A |  | DC\_1A\_n20A  DC\_20A\_n1A |  | 23 | +2/-3 |
| CA\_n1A-n28A | DC\_n1A-n28A | DC\_1A\_n28A  DC\_28A\_n1A | DC\_n1A\_28A | 23 | +2/-3 |
|  |  | DC\_1A\_n38A  DC\_38A\_n1A |  | 23 | +2/-3 |
| CA\_n1A-n40A |  | DC\_1A\_n40A  DC\_40A\_n1A |  | 23 | +2/-3 |
| CA\_n1A-n41A | DC\_n1A-n41A | DC\_1A\_n41A  DC\_41A\_n1A |  | 23 | +2/-3 |
|  |  | DC\_1A\_n50A |  | 23 | +2/-3 |
|  |  | DC\_1A\_n51A |  | 23 | +2/-3 |
|  |  | DC\_1A\_n71A |  | 23 | +2/-3 |
| CA\_n1A-n74A |  |  |  | 23 | +2/-3 |
| CA\_n1A-n77A | DC\_n1A-n77A | DC\_1A\_n77A  DC\_1A\_n84A\_ULSUP-TDM\_n77A | DC\_n77A\_1A | 23 | +2/-3 |
| CA\_n1A-n78A | DC\_n1A-n78A | DC\_1A\_n78A  DC\_1A\_n84A\_ULSUP-TDM\_n78A | DC\_n78A\_1A | 23 | +2/-3 |
| CA\_n1A-n79A | DC\_n1A-n79A | DC\_1A\_n79A  DC\_1A\_n84A\_ULSUP-TDM\_n79A |  | 23 | +2/-3 |
| CA\_n2A-n5A | DC\_n2A-n5A | DC\_2A\_n5A  DC\_5A\_n2A |  | 23 | +2/-3 |
| CA\_n2A-n7A |  | DC\_2A\_n7A  DC\_7A\_n2A |  | 23 | +2/-3 |
| CA\_n2A-n12A |  | DC\_2A\_n12A  DC\_12A\_n2A |  | 23 | +2/-3 |
| CA\_n2A-n14A |  | DC\_14A\_n2A |  | 23 | +2/-3 |
|  |  | DC\_2A\_n25A |  | 23 | +2/-3 |
|  |  | DC\_2A\_n28A  DC\_28A\_n2A |  | 23 | +2/-3 |
| CA\_n2A-n30A |  | DC\_2A\_n30A  DC\_30A\_n2A |  | 23 | +2/-3 |
|  |  | DC\_2A\_n38A |  | 23 | +2/-3 |
|  |  | DC\_2A\_n41A |  | 23 | +2/-3 |
|  |  | DC\_2A\_n46A |  | 23 | +2/-3 |
| CA\_n2A-n48A | DC\_n2A-n48A | DC\_2A\_n48A  DC\_48A\_n2A |  | 23 | +2/-3 |
| CA\_n2A-n66A | DC\_n2A-n66A | DC\_2A\_n66A  DC\_66A\_n2A |  | 23 | +2/-3 |
|  |  | DC\_2A\_n71A  DC\_71A\_n2A |  | 23 | +2/-3 |
| CA\_n2A-n77A | DC\_n2A-n77A | DC\_2A\_n77A |  | 23 | +2/-3 |
| CA\_n2A-n78A |  | DC\_2A\_n78A |  | 23 | +2/-3 |
| CA\_n3A-n5A |  | DC\_3A\_n5A |  | 23 | +2/-3 |
| CA\_n3A-n7A |  | DC\_3A\_n7A  DC\_7A\_n3A  DC\_7A\_n80A |  | 23 | +2/-3 |
| CA\_n3A-n8A |  | DC\_3A\_n8A  DC\_8A\_n3A  DC\_8A\_n80A | DC\_n3A\_8A  DC\_n8A\_3A | 23 | +2/-3 |
| CA\_n3A-n18A |  | DC\_18A\_n3A |  | 23 | +2/-3 |
| CA\_n3A-n20A |  | DC\_3A\_n20A  DC\_3A\_n82A  DC\_20A\_n3A  DC\_20A\_n80A |  | 23 | +2/-3 |
| CA\_n3A-n28A | DC\_n3A-n28A | DC\_3A\_n28A  DC\_28A\_n3A | DC\_n28A\_3A | 23 | +2/-3 |
| CA\_n3A-n34A |  |  |  | 23 | +2/-3 |
| CA\_n3-n38A |  | DC\_3A\_n38A  DC\_38A\_n3A |  | 23 | +2/-3 |
| CA\_n3A-n40A |  | DC\_3A\_n40A |  | 23 | +2/-3 |
| CA\_n3A-n41A | DC\_n3A-n41A | DC\_3A\_n41A  DC\_3A\_n80A\_ULSUP-TDM\_n41  DC\_41A\_n3A | DC\_n41A\_3A | 23 | +2/-3 |
|  |  | DC\_3A\_n50A |  | 23 | +2/-3 |
|  |  | DC\_3A\_n51A |  | 23 | +2/-3 |
|  |  | DC\_3A\_n71A |  | 23 | +2/-3 |
| CA\_n3A-n74A |  |  |  | 23 | +2/-3 |
| CA\_n3A-n77A | DC\_n3A-n77A | DC\_3A\_n77A  DC\_3A\_n80A\_ULSUP-TDM\_n77A | DC\_n77A\_3A | 23 | +2/-3 |
| CA\_n3A-n78A | DC\_n3A-n78A | DC\_3A\_n78A  DC\_3A\_n80A\_ULSUP-TDM\_n78A | DC\_n78A\_3A | 23 | +2/-3 |
| CA\_n3A-n79A | DC\_n3A-n79A | DC\_3A\_n79A  DC\_3A\_n80A\_ULSUP-TDM\_n79A |  | 23 | +2/-3 |
|  |  | DC\_4A\_n2A |  | 23 | +2/-3 |
|  |  | DC\_4A\_n5A |  | 23 | +2/-3 |
|  |  | DC\_4A\_n7A |  | 23 | +2/-3 |
|  |  | DC\_4A\_n28A |  | 23 | +2/-3 |
|  |  | DC\_4A\_n38A |  | 23 | +2/-3 |
|  |  | DC\_4A\_n41A |  | 23 | +2/-3 |
|  |  | DC\_4A\_n78A |  | 23 | +2/-3 |
| CA\_n5A-n7A |  | DC\_5A\_n7A  DC\_7A\_n5A |  | 23 | +2/-3 |
| CA\_n5A-n12A |  | DC\_5A\_n12A  DC\_12A\_n5A |  | 23 | +2/-3 |
| CA\_n5A-n14A |  | DC\_14A\_n5A |  | 23 | +2/-3 |
| CA\_n5A-n25A |  |  |  | 23 | +2/-3 |
| CA\_n5A-n30A |  | DC\_5A\_n30A  DC\_30A\_n5A |  | 23 | +2/-3 |
|  |  | DC\_5A\_n38A |  | 23 | +2/-3 |
| CA\_n5A-n40A |  | DC\_5A\_n40A |  | 23 | +2/-3 |
| CA\_n5A-n48A | DC\_n5A-n48A | DC\_5A\_n48A  DC\_48A\_n5A |  | 23 | +2/-3 |
| CA\_n5A-n66A | DC\_n5A-n66A | DC\_5A\_n66A  DC\_66A\_n5A |  | 23 | +2/-3 |
|  |  | DC\_5A\_n71A  DC\_71A\_n5A |  | 23 | +2/-3 |
| CA\_n5A-n77A | DC\_n5A-n77A | DC\_5A\_n77A |  | 23 | +2/-3 |
| CA\_n5A-n78A |  | DC\_5A\_n78A | DC\_n78A\_5A | 23 | +2/-3 |
| CA\_n5A-n79A |  | DC\_5A\_n79A |  | 23 | +2/-3 |
|  |  | DC\_7A\_n8A  DC\_8A\_n7A |  | 23 | +2/-3 |
|  |  | DC\_7A\_n20A  DC\_20A\_n7A |  | 23 | +2/-3 |
| CA\_n7A-n25A |  | DC\_7A\_n25A |  | 23 | +2/-3 |
| CA\_n7A-n28A |  | DC\_7A\_n28A  DC\_28A\_n7A |  | 23 | +2/-3 |
| CA\_n7A-n40A |  | DC\_7A\_n40A |  | 23 | +2/-3 |
| CA\_n7A-n46A | DC\_n7A-n46A |  |  | 23 | +2/-3 |
|  |  | DC\_7A\_n51A |  | 23 | +2/-3 |
| CA\_n7A-n66A |  | DC\_7A\_n66A  DC\_66A\_n7A |  | 23 | +2/-3 |
|  |  | DC\_7A\_n71A |  | 23 | +2/-3 |
| CA\_n7A-n77A |  | DC\_7A\_n77A |  | 23 | +2/-3 |
| CA\_n7A-n78A | DC\_n7A-n78A | DC\_7A\_n78A | DC\_n78A\_7A | 23 | +2/-3 |
|  |  | DC\_7A\_n79A |  | 23 | +2/-3 |
|  |  | DC\_8A\_n2A |  | 23 | +2/-3 |
|  |  | DC\_8A\_n20A  DC\_20A\_n8A |  | 23 | +2/-3 |
|  |  | DC\_8A\_n28A  DC\_28A\_n8A | DC\_n28A\_8A |  |  |
| CA\_n8A-n34A |  | DC\_8A\_n34A |  | 23 | +2/-3 |
| CA\_n8A-n39A |  | DC\_8A\_n39A |  | 23 | +2/-3 |
| CA\_n8A-n40A |  | DC\_8A\_n40A |  | 23 | +2/-3 |
| CA\_n8A-n41A |  | DC\_8A\_n41A  DC\_8A\_n81A\_ULSUP-TDM\_n41 | DC\_n41A\_8A | 23 | +2/-3 |
| CA\_n8A-n77A |  | DC\_8A\_n77A | DC\_n77A\_8A | 23 | +2/-3 |
| CA\_n8A-n78A |  | DC\_8A\_n78A  DC\_8A\_n81A\_ULSUP-TDM\_n78A | DC\_n78A\_8A | 23 | +2/-3 |
| CA\_n8A-n79A |  | DC\_8A\_n79A  DC\_8A\_n81A\_ULSUP-TDM\_n79A |  | 23 | +2/-3 |
|  |  | DC\_11A\_n1A |  | 23 | +2/-3 |
|  |  | DC\_11A\_n3A |  | 23 | +2/-3 |
|  |  | DC\_11A\_n28A |  | 23 | +2/-3 |
|  |  | DC\_11A\_n41A |  | 23 | +2/-3 |
|  |  | DC\_11A\_n77A |  | 23 | +2/-3 |
|  |  | DC\_11A\_n78A |  | 23 | +2/-3 |
|  |  | DC\_11A\_n79A |  | 23 | +2/-3 |
|  |  | DC\_12A\_n7A |  | 23 | +2/-3 |
|  |  | DC\_12A\_n25A |  | 23 | +2/-3 |
| CA\_n12A-n30A |  | DC\_12A\_n30A |  | 23 | +2/-3 |
|  |  | DC\_12A\_n38A |  | 23 | +2/-3 |
|  |  | DC\_12A\_n41A |  | 23 | +2/-3 |
| CA\_n12A-n66A |  | DC\_12A\_n66A  DC\_66A\_n12A |  | 23 | +2/-3 |
|  |  | DC\_12A\_n71A |  | 23 | +2/-3 |
| CA\_n12A-n77A |  | DC\_12A\_n77A |  | 23 | +2/-3 |
|  |  | DC\_12A\_n78A |  | 23 | +2/-3 |
|  |  | DC\_13A\_n2A |  | 23 | +2/-3 |
|  |  | DC\_13A\_n5A |  | 23 | +2/-3 |
|  |  | DC\_13A\_n7A |  | 23 | +2/-3 |
| CA\_n13A-n25A |  | DC\_13A\_n25A |  | 23 | +2/-3 |
|  |  | DC\_13A\_n48A |  | 23 | +2/-3 |
| CA\_n13A-n66A |  | DC\_13A\_n66A |  | 23 | +2/-3 |
|  |  | DC\_13A\_n71A |  | 23 | +2/-3 |
| CA\_n13A-n77A |  | DC\_13A\_n77A |  | 23 | +2/-3 |
|  |  | DC\_13A\_n78A |  | 23 | +2/-3 |
| CA\_n14A-n30A |  | DC\_14A\_n30A |  | 23 | +2/-3 |
| CA\_n14A-n66A |  | DC\_14A\_n66A |  | 23 | +2/-3 |
| CA\_n14A-n77A |  | DC\_14A\_n77A |  | 23 | +2/-3 |
| CA\_n18A-n28A |  | DC\_18A\_n28A |  | 23 | +2/-3 |
| CA\_n18A-n41A |  | DC\_18A\_n41A |  | 23 | +2/-3 |
| CA\_n18A-n74A |  |  |  | 23 | +2/-3 |
| CA\_n18A-n77A |  | DC\_18A\_n77A |  | 23 | +2/-3 |
| CA\_n18A-n78A |  | DC\_18A\_n78A |  | 23 | +2/-3 |
|  |  | DC\_18A\_n79A |  | 23 | +2/-3 |
|  |  | DC\_19A\_n1A |  | 23 | +2/-3 |
|  |  | DC\_19A\_n77A |  | 23 | +2/-3 |
|  |  | DC\_19A\_n78A |  | 23 | +2/-3 |
|  |  | DC\_19A\_n79A |  | 23 | +2/-3 |
| CA\_n20A-n28A |  | DC\_20A\_n28A  DC\_20A\_n83A | DC\_n28A\_20A | 23 | +2/-3 |
|  |  | DC\_20A\_n38A |  | 23 | +2/-3 |
|  |  | DC\_20A\_n41A |  | 23 | +2/-3 |
|  |  | DC\_20A\_n50A |  | 23 | +2/-3 |
|  |  | DC\_20A\_n51A |  | 23 | +2/-3 |
|  |  | DC\_20A\_n77A |  | 23 | +2/-3 |
| CA\_n20A-n78A |  | DC\_20A\_n78A  DC\_20A\_n82A\_ULSUP-TDM\_n78A |  | 23 | +2/-3 |
|  |  | DC\_21A\_n1A |  | 23 | +2/-3 |
|  |  | DC\_21A\_n28A |  | 23 | +2/-3 |
|  |  | DC\_21A\_n77A |  | 23 | +2/-3 |
|  |  | DC\_21A\_n78A |  | 23 | +2/-3 |
|  |  | DC\_21A\_n79A |  | 23 | +2/-3 |
| CA\_n24A-n41A |  |  |  | 23 | +2/-3 |
| CA\_n24A-n48A |  |  |  | 23 | +2/-3 |
| CA\_n24A-n77A |  |  |  | 23 | +2/-3 |
| CA\_n25A-n38A |  | DC\_25A\_n41A |  | 23 | +2/-3 |
| CA\_n25A-n41A |  |  |  | 23 | +2/-3 |
| CA\_25A-n48A |  | DC\_48A\_n25A |  | 23 | +2/-3 |
| CA\_n25A-n66A |  | DC\_66A\_n25A |  | 23 | +2/-3 |
| CA\_n25A-n77A |  | DC\_25A\_n77A |  | 23 | +2/-3 |
| CA\_n25A-n78A |  | DC\_25A\_n78A |  | 23 | +2/-3 |
|  |  | DC\_26A\_n25A |  | 23 | +2/-3 |
|  |  | DC\_26A\_n41A |  | 23 | +2/-3 |
| CA\_n26A-n66A |  |  |  | 23 | +2/-3 |
| CA\_n26A-n70A |  |  |  | 23 | +2/-3 |
|  |  | DC\_26A\_n77A |  | 23 | +2/-3 |
|  |  | DC\_26A\_n78A | DC\_n78A\_26A | 23 | +2/-3 |
|  |  | DC\_26A\_n79A |  | 23 | +2/-3 |
|  |  | DC\_28A\_n5A |  | 23 | +2/-3 |
| CA\_n28A-n34A |  |  | DC\_n28A\_34A | 23 | +2/-3 |
| CA\_n28A-n39A |  |  | DC\_n28A\_39A | 23 | +2/-3 |
| CA\_n28A-n40A |  | DC\_28A\_n40A | DC\_n28A\_40A | 23 | +2/-3 |
| CA\_n28A-n41A | DC\_n28A-n41A | DC\_28A\_n41A  DC\_28A\_n83A\_ULSUP-TDM\_n41A  DC\_41A\_n28A |  | 23 | +2/-3 |
| CA\_n28A-n46A | DC\_n28A-n46A |  |  | 23 | +2/-3 |
| CA\_n28A-n50A |  | DC\_28A\_n50A |  | 23 | +2/-3 |
|  |  | DC\_28A\_n51A |  | 23 | +2/-3 |
|  |  | DC\_28A\_n66A  DC\_66A\_n28A |  | 23 | +2/-3 |
| CA\_n28A-n74A |  |  |  | 23 | +2/-3 |
| CA\_n28A-n77A | DC\_n28A-n77A | DC\_28A\_n77A |  | 23 | +2/-3 |
| CA\_n28A-n78A | DC\_n28A-n78A | DC\_28A\_n78A  DC\_28A\_n83A\_ULSUP-TDM\_n78A |  | 23 | +2/-3 |
| CA\_n28A-n79A | DC\_n28A-n79A | DC\_28A\_n79A |  | 23 | +2/-3 |
| CA\_n34A-n79A |  |  |  | 23 | +2/-3 |
| CA\_n30A-n66A |  | DC\_30A\_n66A  DC\_66A\_n30A |  | 23 | +2/-3 |
| CA\_n30A-n77A |  | DC\_30A\_n77A |  | 23 | +2/-3 |
| CA\_n34A-n40A |  |  |  | 23 | +2/-3 |
| CA\_n34A-n41A |  |  | DC\_n41A\_34A | 23 | +2/-3 |
|  |  | DC\_38A\_n8A |  | 23 | +2/-3 |
|  |  | DC\_38A\_n28A |  | 23 | +2/-3 |
| CA\_n38A-n66A |  | DC\_66A\_n38A |  | 23 | +2/-3 |
| CA\_n38A-n78A |  | DC\_38A\_n78A |  | 23 | +2/-3 |
|  |  | DC\_38A\_n79A |  | 23 | +2/-3 |
| CA\_n39A-n40A |  | DC\_39A\_n40A |  | 23 | +2/-3 |
| CA\_n39A-n41A |  | DC\_39A\_n41A | DC\_n41A\_39A | 23 | +2/-3 |
|  |  | DC\_39A\_n78A |  | 23 | +2/-3 |
| CA\_n39A-n79A |  | DC\_39A\_n79A |  | 23 | +2/-3 |
| CA\_n40A-n41A |  | DC\_40A\_n41A | DC\_n41A\_40A | 23 | +2/-3 |
| CA\_n40A-n77A |  | DC\_40A\_n77A |  | 23 | +2/-3 |
| CA\_n40A-n78A |  | DC\_40A\_n78A |  | 23 | +2/-3 |
| CA\_n40A-n79A |  | DC\_40A\_n79A |  | 23 | +2/-3 |
| CA\_n41A-n48A |  |  |  | 23 | +2/-3 |
| CA\_n41A-n50A |  |  |  | 23 | +2/-3 |
| CA\_n41A-n66A |  | DC\_66A\_n41A |  | 23 | +2/-3 |
| CA\_n41A-n70A |  |  |  | 23 | +2/-3 |
| CA\_n41A-n71A |  | DC\_71A\_n41A |  | 23 | +2/-3 |
| CA\_n41A-n74A |  |  |  | 23 | +2/-3 |
| CA\_n41A-n77A | DC\_n41A-n77A | DC\_41A\_n77A |  | 23 | +2/-3 |
| CA\_n41A-n78A | DC\_n41A-n78A | DC\_41A\_n78A |  | 23 | +2/-3 |
| CA\_n41A-n79A |  | DC\_41A\_n79A |  | 23 | +2/-3 |
|  |  | DC\_42A\_n1A |  | 23 | +2/-3 |
|  |  | DC\_42A\_n3A |  | 23 | +2/-3 |
|  |  | DC\_42A\_n28A |  | 23 | +2/-3 |
|  |  | DC\_42A\_n51A |  | 23 | +2/-3 |
|  |  | DC\_42A\_n77A |  | 23 | +2/-3 |
|  |  | DC\_42A\_n78A |  | 23 | +2/-3 |
|  |  | DC\_42A\_n79A |  | 23 | +2/-3 |
| CA\_n46A-n48A | DC\_n46A-n48A |  |  | 23 | +2/-3 |
| CA\_n46A-n48B | DC\_n46A-n48B |  |  | 23 | +2/-3 |
| CA\_n46A-n78A | DC\_n46A-n78A |  |  | 23 | +2/-3 |
|  |  | DC\_48A\_n12A |  | 23 | +2/-3 |
| CA\_n48A-n66A | DC\_n48A-n66A | DC\_48A\_n66A  DC\_66A\_n48A |  | 23 | +2/-3 |
| CA\_n48A-n70A | DC\_n48A-n70A |  |  | 23 | +2/-3 |
| CA\_n48A-n71A | DC\_n48A-n71A | DC\_48A\_n71A  DC\_71A\_n48A |  | 23 | +2/-3 |
| CA\_n48A-n96A | DC\_n48A-n96A |  |  | 23 | +2/-3 |
| CA\_n48B-n96A | DC\_n48B-n96A |  |  | 23 | +2/-3 |
| CA\_n48A-n96B |  |  |  | 23 | +2/-3 |
| CA\_n50A-n78A |  |  |  | 23 | +2/-3 |
|  |  | DC\_66A\_n46A |  | 23 | +2/-3 |
| CA\_n66A-n71A |  | DC\_66A\_n71A  DC\_71A\_n66A |  | 23 | +2/-3 |
| CA\_n66A-n77A | DC\_n66A-n77A | DC\_66A\_n77A |  | 23 | +2/-3 |
| CA\_n66A-n78A |  | DC\_66A\_n78A  DC\_66A\_n86A\_ULSUP-TDM\_n78A |  | 23 | +2/-3 |
| CA\_n70A-n71A |  |  |  | 23 | +2/-3 |
| CA\_n70A-n78A |  |  |  | 23 | +2/-3 |
|  |  | DC\_71A\_n38A |  | 23 | +2/-3 |
| CA\_n71A-n77A |  |  |  | 23 | +2/-3 |
| CA\_n71A-n78A |  | DC\_71A\_n78A |  | 23 | +2/-3 |
| CA\_n74A-n77A |  |  |  | 23 | +2/-3 |
| CA\_n74A-n78A |  |  |  | 23 | +2/-3 |
| CA\_n77A-n79A | DC\_n77A-n79A |  |  | 23 | +2/-3 |
| CA\_n78A-n79A |  |  |  | 23 | +2/-3 |
| CA\_n78A-n92A |  |  |  | 23 | +2/-3 |

### 7.2.2 Spurious emission for UE-to-UE coexistence

Generally, if CA\_nA-nB, DC\_A\_nB (DC\_A\_nD), DC\_B\_nA (DC\_B\_nC), DC\_nB\_A, DC\_nA\_B have same spurious emission requirements for UE to UE coexistence, it may not be needed to test the spurious emission requirements for UE to UE coexistence for each UL configuration again and again. Once one of these UL configurations is verified, the other UL configurations for different feature in same band combination can be considered as being capable of meeting these requirements.

NOTE: Band nC and nD are the corresponding SUL bands with same UL frequency range of band nA and nB, e.g. SUL band n80 has same UL frequency range of band n3.

## 7.3 Similarity and Dependency of Rx RF requirements for different features on the same band combination

### 7.3.1 REFSENS exception due to harmonic/harmonic mixing interference for inter-band combinations (two bands)

For reference sensitivity exception due to harmonic/harmonic mixing specified for ENDC/NEDC band combinations, it’s suggested to follow the same principles as for NR CA BCS4 WI in WF R4-2210565 as a starting point.

### 7.3.2 REFSENS exception due to cross band isolation interference for inter-band combinations (two bands)

For reference sensitivity exception due to cross band isolation specified for ENDC band combinations, it’s suggested to follow the same principles as for NR CA BCS4 WI in WF R4-2210565 as a starting point.

### 7.3.3 REFSENS exception due to inter-modulation distortion for inter-band combinations (two bands)

### 7.3.4 REFSENS requirements without any degradation for inter-band combinations (two bands)

For band combinations DL\_nA-nB\_UL\_nA-nB / DL\_B\_nA\_UL\_B\_nA / DL\_A\_nB\_UL\_A\_nB / DL\_nB\_A\_UL\_nB\_A / DL\_nA\_B\_UL\_nA\_B which doesn’t have any MSD requirements, it’s suggested to test one of them in order to reduce the test burden for REFSENS requirements and final decision is up to RAN5. The reason is that the same Rx RF implementation is used to achieve these band combinations.

For some special cases which have different delta Rib requirements, the requirements specified in clause 7.3A.3.2 from TS 38.101-1 can be reused.

## 7.4 Test burden reduction for multiple MSD

In current RAN4 spec, there are tables for the reference sensitivity exceptions due to intermodulation interference with 2UL CA. The test points in the reference sensitivity requirements specified for the single band are relaxed by the amount of the corresponding MSD values, shown as an example in Table 7.4-1. For some CA configurations such as CA\_n2-n77, CA\_n3-n77 and CA\_n3-n78, multiple test points with different order IMD are defined, while for some other CA configurations such as CA\_n2-n78, only 2nd order IMD2 having the worst case MSD are defined, although the corresponding band is subject to the 5th order IMD5. At the end of the table, a “Note 4” is set to indicate that MSD is not specified for the interfered band although IMD5 may fall into the Rx frequencies of the interfered band. To reduce the test burden, the following guidelines for handling multiple MSD should be taken into consideration.

Table 7.4-1: Example for inter-band reference sensitivity with multiple MSD

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Band / Channel bandwidth / NRB / Duplex mode | | | | | | | | Source of IMD |
| NR CA band combination | NR band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  CLRB | DL Fc (MHz) | MSD  (dB) | Duplex mode |  |
| CA\_n1-n3 | n1 | 1950 | 5 | 25 | 2140 | 23 | FDD | IMD3 |
|  | n3 | 1760 | 5 | 25 | 1855 | N/A | TDD | N/A |
| CA\_n1-n8 | n1 | 1965 | 5 | 25 | 2155 | 6.0 | FDD | IMD4 |
|  | n8 | 887.5 | 5 | 25 | 932.5 | N/A | FDD | N/A |
| CA\_n1-n78 | n1 | 1950 | 5 | 25 | 2140 | 8.0 | FDD | IMD4 |
|  | n78 | 3710 | 10 | 50 | 3710 | N/A | TDD | N/A |
| CA\_n2-n48 | n2 | 1852.5 | 5 | 25 | 1932.5 | 12 | FDD | IMD4 |
|  | n48 | 3625 | 20 | 100 | 3625 | N/A | TDD | N/A |
| CA\_n2-n77 | n2 | 1855 | 5 | 25 | 1935 | 26 | FDD | IMD2 |
|  | n77 | 3790 | 10 | 50 | 3790 | N/A | TDD | N/A |
|  | n2 | 1900 | 5 | 25 | 1980 | 8.0 | FDD | IMD4 |
|  | n77 | 3720 | 10 | 50 | 3720 | N/A | TDD | N/A |
|  | n2 | 1885 | 5 | 25 | 1965 | 5 | FDD | IMD5 |
|  | n77 | 3810 | 10 | 50 | 3810 | N/A | TDD | N/A |
| CA\_n2-n78 | n2 | 1855 | 5 | 25 | 1935 | 26 | FDD | IMD24 |
|  | n78 | 3790 | 10 | 50 | 3790 | N/A | TDD | N/A |
| CA\_n3-n7 | n3 | 1730 | 5 | 25 | 1825 | N/A | FDD | N/A |
|  | n7 | 2535 | 10 | 50 | 2655 | 10.2 | FDD | IMD4 |
| CA\_n3-n8 | n3 | 1755 | 10 | 50 | 1850 | N/A | FDD | N/A |
|  | n8 | 900 | 5 | 25 | 945 | 8 | FDD | IMD44 |
|  | n3 | 1747.5 | 10 | 50 | 1842.5 | 6.4 | FDD | IMD5 |
|  | n8 | 897.5 | 5 | 25 | 942.5 | N/A | FDD | N/A |
| CA\_n3-n38 | n3 | 1713 | 5 | 25 | 1808 | 8.2 | FDD | IMD4 |
| n38 | 2617 | 5 | 25 | 2617 | N/A | TDD | N/A |
| CA\_n3-n41 | n3 | 1740 | 5 | 25 | 1835 | 8.2 | FDD | IMD4 |
|  | n41 | 2657.5 | 10 | 50 | 2657.5 | N/A | TDD | N/A |
| CA\_n3-n77 | n3 | 1740 | 5 | 25 | 1835 | 26 | FDD | IMD24 |
|  | n77 | 3575 | 10 | 50 | 3575 | N/A | TDD | N/A |
|  | n3 | 1765 | 5 | 25 | 1860 | 8.0 | FDD | IMD44 |
|  | n77 | 3435 | 10 | 50 | 3435 | N/A | TDD | N/A |
| CA\_n3-n78 | n3 | 1740 | 5 | 25 | 1835 | 26 | FDD | IMD24 |
|  | n78 | 3575 | 10 | 25 | 3575 | N/A | TDD | N/A |
|  | n3 | 1765 | 5 | 25 | 1860 | 8.0 | FDD | IMD44 |
|  | n78 | 3435 | 10 | 25 | 3435 | N/A | TDD | N/A |
| … | … | … | … | … | … | … | … | … |
| NOTE 4: This band is subject to IMD5 also which MSD is not specified. | | | | | | | | |

For a given 2 band DL CA combination, MSD test points corresponding to type 1,2,3 UL configuration are captured in the same table entry.

– **Type 1**: UL configuration = 2 UL CCs configured with intra-band UL CA configured in one of the two band. Intra-band UL CA may be contiguous (like UL CA\_n41C) or non-contiguous (like CA\_n78(2A)).

– **Type 2**: UL configuration = 2 UL CCs configured with 1UL CC in each of UL band. Example: UL CA\_n3A\_n78A.

– **Type 3**: UL configuration = 3 UL CCs with 1 CC in one UL band, and 2UL CCs configured intra-band CA in the other band. Example: UL CA\_n3A-n41C.

**Guideline 1: It is proposed that for the test points for reference sensitivity exceptions due to intermodulation interference with 2UL CA, the limitation to higher order IMD source could be a solution to reduce test burden.**

– The existing IMD MSD requirements in Rel-17 specifications are kept unchanged.

– For Rel-18 new introduced band combination,

– For type 1 UL configurations (eg. UL\_CA\_n41C or CA\_n78(2A))

*○* The lowest order IMD is recommended as worst case to represent single band UL transmission with UL configured intra-band CA.

*○* A footnote shall be attached to the UL band that is configured intra-band UL CA to distinguish the case of intra-band contiguous vs intra-band non-contiguous CA.

– For type 2 UL configurations (eg. UL\_CA\_n1A-n3A)

*○* If only one IMD order occurs per victim band, the MSD value if any shall be defined in the specifications.

*○* If multiple IMD orders occur per victim band, the MSD value of lowest order IMD per victim band if any shall be defined in the specifications.

*•* The lowest order IMD is recommended as worst case to represent the whole spectrum of the inter-band CA combinations.

*•* Optionally, a second MSD test point may be specified on a case by case basis to account for additional IMD orders. It is recommended this 2nd MSD test point corresponds to the lowest even and the lowest odd order IMD. For example, if DL band is affected by IMD2/3/5, we may consider a maximum of test points: one for IMD2 and one for IMD3.

∎ Any additional IMD order that is not specified shall be indicated by a note in the table.

– For type 3 UL configurations (eg. CA\_n3A-n41C)

*○* For the case the victim band is affected by a 1st order triple-beat product, an additional IMD3 test point shall be defined per victim band.

# 8 Simplification to PC5 configurations with Uu configuration

## 8.1 General

< Editor's note: This section will analyse the simplified approach aiming to allow operation of any PC5 configuration with any Uu configuration.>

Annex <X> (informative):  
Change history

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Change history | | | | | | | |
| Date | Meeting | TDoc | CR | Rev | Cat | Subject/Comment | New version |
| 2022-08 | RAN4 #104-e | R4-2215080 |  |  |  | TR skeleton | 0.0.1 |
| 2022-10 | RAN4 #104-bis-e | R4-2216616 |  |  |  | 1. R4-2216620, TP for TR 38.846 on rules of delta TIB and RIB due to band combinations, ZTE  2. R4-2217719, TP for TR38.846\_Update template for R18 PC3 basket WIDs, ZTE  3. R4-2217720, TP on test burden reduction, Huawei, HiSilicon  4. R4-2217721, Fallbacks in 38.101 specs, Apple  5. R4-2217722, TP for TR 38.846 on working procedure of specifying band combinations, ZTE | 0.1.0 |
| 2022-11 | RAN4 #105 | R4-2219762 |  |  |  | 1. R4-2220510, TP for TR 38.846 to capture some agreements for REFSENS test burden reduction, Huawei, HiSilicon  2. R4-2220511, TP for TR 38.846 on test burden reduction for multiple MSD in band combinations, ZTE Corporation  3. R4-2219626, TP for TR 38.846 to capture the fallback rules with exceptional cases, Huawei, HiSilicon  4. R4-2219759, TP for TR 38.846 on templates of delta TIB and RIB for NE-DC and SUL band combinations, ZTE Corporation | 0.2.0 |