



**5G;
High power UE (power class 1.5 or 2) for NR Inter-band Carrier
Aggregation (CA)/Dual Connectivity (DC) with/without
Supplementary Uplink (SUL) with high power on TDD band(s)
(3GPP TR 38.746 version 19.0.0 Release 19)**



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- 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.

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- 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.

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- 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 one of four technical reports for High power UE (power class 1.5 or 2) for NR Inter-band Carrier Aggregation (CA)/Dual Connectivity (DC) with/without Supplementary Uplink (SUL) with high power on TDD band(s) under Rel-19 timeframe. The objective is to gather the relevant background information and studies in order to complete the band-combination specific requirements for the newly requested band combinations for power class 2 and power class 1.5 UE. Table 1-1 lists the band combinations covered by this TR with three power class cases for uplink.

Table 1-1 High power UE (power class 1.5 or 2) inter-band CA/DC and SUL band combinations

#	Band combination List	Power class cases for uplink
1	High power UE (power class 1.5 or 2) for NR Inter-band Carrier Aggregation (CA)/Dual connectivity (DC) with/without Supplementary uplink (SUL) with high power on TDD band(s) Note: Including PC3 FDD/TDD+ PC3 TDD case	PC2 inter-band CA/DC: 1UL(TDD): PC2 on TDD band 2UL (TDD+TDD): PC3 or PC2 on TDD band 2UL (FDD+TDD): PC3 on FDD band, PC3 or PC2 on TDD band
		PC1.5 inter-band CA/DC: 1UL(TDD): PC 1.5 on TDD band 2UL (TDD+TDD): PC3, PC2 or PC1.5 on TDD band 2UL (FDD+TDD): PC3 on FDD band, PC1.5 on TDD band
		PC2 SUL band combinations with or without CA: SUL: PC3 or PC2 on SUL band NUL(TDD): PC2 on TDD band PC1.5 SUL band combinations with or without CA: SUL: PC3 or PC2 on SUL band NUL(TDD): PC1.5 on TDD band NUL = Normal Uplink in contrast to SUL.

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] 3GPP RP-241679: "Rel-19 High power UE (power class 1.5 or 2) for NR intra-band Carrier Aggregation (CA) or NR inter-band CA/Dual connectivity (DC) band combinations with/without NR Supplementary uplink (SUL)".

3 Definitions of terms, symbols and abbreviations

3.1 Terms

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

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

3.2 Symbols

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

<symbol>	<Explanation>
$\Delta R_{IB,c}$	Allowed reference sensitivity relaxation due to support for inter-band CA operation, for serving cell <i>c</i> .
$\Delta T_{IB,c}$	Allowed maximum configured output power relaxation due to support for inter-band CA operation, for serving cell <i>c</i> .

3.3 Abbreviations

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

<ABBREVIATION>	<Expansion>
BS	Base Station
BCS	Bandwidth Combination Set
CA	Carrier Aggregation
CC	Component Carriers
DC	Dual Connectivity
DL	Downlink
FDD	Frequency Division Duplex
MPR	Allowed maximum power reduction
MSD	Maximum Sensitivity Degradation
REFSENS	Reference Sensitivity power level
SCS	Subcarrier spacing
SUL	Supplementary uplink
TDD	Time Division Duplex
UE	User Equipment
UL	Uplink

4 Background

At 3GPP RAN#104 meeting, a basket Work Item on “High power UE (power class 1.5 or 2) for NR intra-band Carrier Aggregation (CA) or NR inter-band CA/Dual connectivity (DC) band combinations with/without NR Supplementary uplink (SUL)” [2] was approved for Rel-19. There are four objectives of the core part of the basket work item. The objectives covered by this TR are as follows:

Specify the band-combination specific RF requirements for all band combinations cases captured in table 1-1. The band combinations are defined in the attached excel file of this WI.

The requirements that need to analyse and specify include

- Maximum output power, Tx power tolerance and A-MPR (Additional Maximum Power Reduction) requirements if needed
- Analysing combinations that have self-desensitization, applicable $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ and reference sensitivity exceptions including MSD test cases.
- Other additional impact to the requirements due to the high power on UL, if necessary

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

4.1 TR Maintenance

A single company is responsible for introducing all approved TPs in the current TR, i.e. TR editor. However, it is the responsibility of the contact person of each band/band combination to ensure that the TPs related to the band/band combination have been implemented.

5 High Power UE CA of 2 bands DL and 1 or 2 bands UL

5.0 CA_nX-nY

5.0.1 Configurations

<Editor's note: the CA configurations and bandwidth combinations sets should be kept same as defined in 38.101-1 Table 5.5A.3.1-1x unless additional clarification>

Table 5.0.1-1: NR CA configurations and bandwidth combinations sets defined for inter-band CA (two bands)

NR CA configuration	Uplink CA configuration or single uplink carrier	NR Band	Channel bandwidth (MHz)	Bandwidth combination set
CA_nX-nY	$nX^{8,9,13,14}$, $nY^{8,9,13,14}$, CA_nX-nY ^{8,9,13,14}	nX		
		nY		

NOTE 8: Minimum requirements for Power Class 2 are applicable for this uplink combination with 1Tx antenna connector in each band or single uplink carrier with up to 2Tx antenna connectors in this downlink/uplink combination

NOTE 9: Minimum requirements for Power Class 1.5 are applicable for this uplink combination with 1Tx antenna connector in each band or single uplink carrier with up to 2Tx antenna connectors in this downlink/uplink combination

...

NOTE 13: Minimum requirements for Power Class 2 are applicable for this uplink configuration with 1Tx antenna connector in one band and 2Tx antenna connectors in the other band.

NOTE 14 Minimum requirements for Power Class 1.5 are applicable for this uplink configuration with 1Tx antenna connector in one band and 2Tx antenna connectors in the other band.

5.0.2 Maximum output power

<Editor's note: In table 5.0.2-1, the power class 2 cases supported by the uplink CA should be kept as the same numbering and others that not supported should be removed. >

Table 5.0.2-1 UE Power Class 2 for uplink inter-band CA (two bands)

Uplink configuration	CA	Power class 2 cases for CA_nX-nY	CA power class	Carrier X power class	Carrier Y power class
CA_nX-nY		Case a	26dBm	23dBm	23dBm
		Case b	26dBm	23dBm	26dBm
		Case c	26dBm	26dBm	23dBm
		Case d	26dBm	26dBm	26dBm

Table 5.0.2-2 UE Power Class 1.5 for uplink inter-band CA (two bands)

Uplink configuration	CA	Power class 1.5 cases for CA_nX-nY	CA power class	Carrier X power class	Carrier Y power class
CA_nX-nY		Case a	29dBm	26dBm	26dBm
		Case b	29dBm	23dBm	29dBm
		Case c	29dBm	29dBm	23dBm

	Case d	29dBm	26dBm	29dBm
	Case e	29dBm	29dBm	26dBm

5.0.3 REFSENS requirements

<Editor's note: This agenda will capture the Reference sensitivity exceptions or MSD requirements due to higher power for CA carrier, please use the same table format as in 38101-1. >

- 5.0.3.1 Power class 2 case a
- 5.0.3.2 Power class 2 case b
- 5.0.3.3 Power class 2 case c
- 5.0.3.4 Power class 1.5 case a
- 5.0.3.5 Power class 1.5 case b
- 5.0.3.6 Power class 1.5 case c
- 5.0.3.7 Power class 1.5 case d
- 5.0.3.8 Power class 1.5 case e
- 5.0.3.9 Power class 1.5 for single uplink nX
- 5.0.3.10 Power class 1.5 for single uplink nY

5.0.4 Δ TIB and Δ RIB values

<Editor's note: If no change by comparing to the values for power class 3 CA, this section will be void.>

5.1 CA_n1-n78

5.1.1 Operating bands for CA

Table 5.1.1-1: CA band combination of band n1+n78

NR CA Band combination	NR Band
CA_n1-n78	n1, n78

5.1.2 Maximum output power for inter-band CA

Table 5.1.2-1: UE Power Class for 3Tx inter-band CA with UL MIMO

NR UL CA Configuration	Class 1.5 (dBm)	Tolerance (dB)	Class 2 (dBm)	Tolerance (dB)	Class 3 (dBm)	Tolerance (dB)
CA_n1A-n78A	29 ³	+2/-3	26 ²	+2/-3	23	+2/-3
NOTE 1: (Void in this TR)						
NOTE 2: The UE supports PC3 in FDD band and PC3 or PC2 with UL MIMO in TDD band.						
NOTE 3: The UE supports PC3 in FDD band and PC1.5 with UL MIMO in TDD band.						

Table 5.1.2-2: UE Power Class for 3Tx inter-band CA with TxD

NR UL CA Configuration	Class 1.5 (dBm)	Tolerance (dB)	Class 2 (dBm)	Tolerance (dB)	Class 3 (dBm)	Tolerance (dB)
CA_n1A-n78A	29 ³	+2/-3	26 ²	+2/-3	23	+2/-3
NOTE 1: (Void in this TR)						
NOTE 2: The UE supports PC3 in FDD band and PC2 with Tx Diversity in TDD band.						
NOTE 3: The UE supports PC3 in FDD band and PC1.5 with Tx Diversity in TDD band.						

5.1.3 MSD scenario studies

Table 5.13-1 and 5.1.3-2 summarizes frequency ranges where harmonics mixing, cross band leakage, IMD interferences occur for CA_n1-n78.

Table 5.1.3-1: MSD scenarios for CA_n1-n78 with total power class 2

	Aggressor Tx	Victim Rx	Whether 2Tx requirements exists
Harmonic mixing	N/A	N/A	N/A
Cross band leakage	N/A	N/A	N/A
IMD4	3 * n1 – n78	n1	Yes

Table 5.1.3-2: MSD scenarios for CA_n1-n78 with total power class 1.5

	Aggressor Tx	Victim Rx	Whether 2Tx requirements exists
Harmonic mixing	N/A	N/A	N/A
Cross band leakage	N/A	N/A	N/A
IMD4	3 * f n1 – f n78	n1	No

5.1.4 REFSENS requirements

5.1.4.1 REFSENS requirements for total power class 2

The 2Tx MSD due to IMD4 has already been specified, which is applicable for 3Tx.

5.1.4.2 REFSENS requirements for total power class 1.5

The MSD due to IMD4 for PC1.5 3Tx are specified in the following table. The IMD4 MSD values for CA_n1-n78 and CA_n2-n77 are the same. Therefore, the CA_n1-n78 PC1.5 MSD values are reused from CA_n2-n77 PC1.5 MSD values.

Table 5.1.4.2-1: 2DL/2UL inter-band Reference sensitivity QPSK P_{REFSENS} and uplink/downlink configurations for PC1.5 CA

Band / Channel bandwidth / NRB / Duplex mode								Source of IMD
NR CA Configuration	NR band	UL F_c (MHz)	UL/DL BW (MHz)	UL L_{CRB}	DL F_c (MHz)	MSD (dB)	Duplex mode	
CA_n1-n78	n1	1950	5	25	2140	26.4	FDD	IMD4
	n78	3710	10	50	3710	N/A	TDD	N/A

Cross band MSD is defined for CA_n2-n77 therefore it is also needed for CA_n1-n78 since band n1 is even closer than band n2. Same MSD value as cor CA_n2-n77 are used.

Table 5.1.4.2-2: Reference sensitivity exceptions (MSD) and uplink/downlink configurations due to cross band isolation from a PC1.5 aggressor NR single UL band for DL NR CA FR1

UL band	DL band	UL F_c	UL BW	SCS of UL band	UL RB Allocation	DL F_c	DL BW	MSD	Cross-band Interference source
		(MHz)	(MHz)	(kHz)	L_{CRB}	(MHz)	(MHz)	(dB)	
n78	n1	3350	100	30	270 (RBstart=0)	1987.5	5	2.7	>ACLR2

5.2 CA_n3-n78

5.2.1 Operating bands for CA

Table 5.2.1-1: CA band combination of band n3+n78

NR CA Band combination	NR Band
CA_n3-n78	n3, n78

5.2.2 Maximum output power for inter-band CA

Table 5.2.2-1: UE Power Class for 3Tx inter-band CA with UL MIMO

NR UL CA Configuration	Class 1.5 (dBm)	Tolerance (dB)	Class 2 (dBm)	Tolerance (dB)	Class 3 (dBm)	Tolerance (dB)
CA_n3A-n78A	29 ³	+2/-3	26 ²	+2/-3	23	+2/-3
NOTE 1: (Void in this TR)						
NOTE 2: The UE supports PC3 in FDD band and PC3 or PC2 with UL MIMO in TDD band.						
NOTE 3: The UE supports PC3 in FDD band and PC1.5 with UL MIMO in TDD band.						

Table 5.2.2-2: UE Power Class for 3Tx inter-band CA with TxD

NR UL CA Configuration	Class 1.5 (dBm)	Tolerance (dB)	Class 2 (dBm)	Tolerance (dB)	Class 3 (dBm)	Tolerance (dB)
CA_n3A-n78A	29 ³	+2/-3	26 ²	+2/-3	23	+2/-3
NOTE 1: (Void in this TR)						
NOTE 2: The UE supports PC3 in FDD band and PC2 with Tx Diversity in TDD band.						
NOTE 3: The UE supports PC3 in FDD band and PC1.5 with Tx Diversity in TDD band.						

5.2.3 MSD scenario studies

Table 5.10.3-1 and 5.10.3-2 summarizes frequency ranges where harmonics mixing, cross band leakage, IMD interferences occur for CA_n3-n78.

Table 5.2.3-1: MSD scenarios for CA_n3-n78 with total power class 2

	Aggressor Tx	Victim Rx	Whether 2Tx requirements exists
Harmonic mixing	n78 (UL1/DL2)	n3	Yes
Cross band leakage	N/A	N/A	N/A
IMD2	n78 – n3	n3	Yes
IMD4	3 * n3 – n78	n3	Yes

Table 5.2.3-2: MSD scenarios for CA_n3-n78 with total power class 1.5

	Aggressor Tx	Victim Rx	Whether 2Tx requirements exists
Harmonic mixing	n78 (UL1/DL2)	n3	Yes
Cross band leakage	N/A	N/A	N/A
IMD2	f n78 – f n3	n3	No
IMD4	3 * f n3 – f n78	n3	No

5.2.4 REFSENS requirements

5.2.4.1 REFSENS requirements for total power class 2

The 2Tx MSD due to harmonic mixing has already been specified, which is applicable for 3Tx.

The 2Tx MSD due to IMD2 has already been specified, which is applicable for 3Tx.

The 2Tx MSD due to IMD4 has already been specified, which is applicable for 3Tx.

5.2.4.2 REFSENS requirements for total power class 1.5

The 2Tx MSD due to harmonic mixing has already been specified, which is applicable for 3Tx.

The MSD due to IMD2 and IMD4 for PC1.5 3Tx are specified in the following table. The IMD2 and IMD4 MSD values for CA_n3-n78 and CA_n2-n77 are the same. Therefore, the CA_n3-n78 PC1.5 MSD values are reused from CA_n2-n77 PC1.5 MSD values.

Table 5.2.4.2-1: 2DL/2UL inter-band Reference sensitivity QPSK P_{REFSENS} and uplink/downlink configurations for PC1.5 CA

Band / Channel bandwidth / NRB / Duplex mode								Source of IMD
NR CA Configuration	NR band	UL F_c (MHz)	UL/DL BW (MHz)	UL L_{CRB}	DL F_c (MHz)	MSD (dB)	Duplex mode	
CA_n3-n78	n3	1750	5	25	1845	35.2	FDD	IMD2
	n78	3595	10	50	3595	N/A	TDD	N/A
	n3	1770	5	25	1865	26.4	FDD	IMD4
	n78	3445	10	50	3445	N/A	TDD	N/A

Harmonic mixing defined in Table 5.10.4.2-2 below.

Table 5.2.4.2-2: Reference sensitivity exceptions and uplink/downlink configurations due to harmonic mixing from a PC1.5 aggressor NR UL band for NR DL CA FR1

UL band	DL band	UL BW	SCS of UL band	UL RB Allocation	DL BW	MSD	UL/DL fc condition	UL/DL harmonic order
		(MHz)	(kHz)	L _{CRB}	(MHz)	(dB)		
n78	n3	5	15	25 (RBstart=0)	5	11.1	NOTE 4	UL1/DL2
n78	n3	40	15	216 (RBstart=0)	40	4	NOTE 4	UL1/DL2

5.3 CA_n7-n78

5.3.1 Operating bands for CA

Table 5.3.1-1: CA band combination of band n7+n78

NR CA Band combination	NR Band
CA_n7-n78	n7, n78

5.3.2 Maximum output power for inter-band CA

Table 5.3.2-1: UE Power Class for 3Tx inter-band CA with UL MIMO

NR UL CA Configuration	Class 1.5 (dBm)	Tolerance (dB)	Class 2 (dBm)	Tolerance (dB)	Class 3 (dBm)	Tolerance (dB)
CA_n7A-n78A	29 ³	+2/-3	26 ²	+2/-3	23	+2/-3
NOTE 1: (Void in this TR)						
NOTE 2: The UE supports PC3 in FDD band and PC3 or PC2 with UL MIMO in TDD band.						
NOTE 3: The UE supports PC3 in FDD band and PC1.5 with UL MIMO in TDD band.						

Table 5.3.2-2: UE Power Class for 3Tx inter-band CA with Tx D

NR UL CA Configuration	Class 1.5 (dBm)	Tolerance (dB)	Class 2 (dBm)	Tolerance (dB)	Class 3 (dBm)	Tolerance (dB)
CA_n7A-n78A	29 ³	+2/-3	26 ²	+2/-3	23	+2/-3
NOTE 1: (Void in this TR)						
NOTE 2: The UE supports PC3 in FDD band and PC2 with Tx Diversity in TDD band.						
NOTE 3: The UE supports PC3 in FDD band and PC1.5 with Tx Diversity in TDD band.						

5.3.3 MSD scenario studies

Table 5.10.3-1 and 5.10.3-2 summarizes frequency ranges where harmonics mixing, cross band leakage, IMD interferences occur for CA_n7-n78.

Table 5.3.3-1: MSD scenarios for CA_n7-n78 with total power class 2

	Aggressor Tx	Victim Rx	Whether 2Tx requirements exists
Harmonic mixing	N/A	N/A	N/A

Cross band leakage	n78	n7	Yes
IMD	N/A	N/A	N/A

Table 5.3.3-2: MSD scenarios for CA_n7-n78 with total power class 1.5

	Aggressor Tx	Victim Rx	Whether 2Tx requirements exists
Harmonic mixing	N/A	N/A	N/A
Cross band leakage	n78	n7	Yes
IMD	N/A	N/A	N/A

5.3.4 REFSSENS requirements

5.3.4.1 REFSSENS requirements for total power class 2

The 2Tx MSD due to cross band isolation has already been specified, which is applicable for 3Tx.

The 2Tx MSD due to IMD4 has already been specified, which is applicable for 3Tx.

5.3.4.2 REFSSENS requirements for total power class 1.5

The 2Tx MSD due to cross band isolation is specified below with same MSD value as used for CA_n7-n78.

Table 5.3.4.2-1: Reference sensitivity exceptions (MSD) and uplink/downlink configurations due to cross band isolation from a PC1.5 aggressor NR single UL band for DL NR CA FR1

UL band	DL band	UL F_c	UL BW	SCS of UL band	UL RB Allocation	DL F_c	DL BW	MSD	Cross-band Interference source
		(MHz)	(MHz)	(kHz)	L_{CRB}	(MHz)	(MHz)	(dB)	
n78	n7	3350	100	30	270 (RBstart=0)	2687.5	5	9.0	>ACLR2
NOTE 1: Applicable only when harmonic mixing MSD for this combination is not applied. NOTE 2: Void. NOTE 3: The requirements only apply for UEs supporting inter-band carrier aggregation with simultaneous Rx/Tx capability. Simultaneous Rx/Tx capability does not apply for UEs supporting band n78 with a n77 implementation.									

5.4 CA_n28-n78

5.4.1 Operating bands for CA

Table 5.4.1-1: CA band combination of band n28+n78

NR CA Band combination	NR Band
CA_n28-n78	n28, n78

5.4.2 Maximum output power for inter-band CA

Table 5.4.2-1: UE Power Class for 3Tx inter-band CA with UL MIMO

NR UL CA Configuration	Class 1.5 (dBm)	Tolerance (dB)	Class 2 (dBm)	Tolerance (dB)	Class 3 (dBm)	Tolerance (dB)
CA_n28A-n78A	29 ³	+2/-3	26 ²	+2/-3	23	+2/-3
NOTE 1: (Void in this TR)						
NOTE 2: The UE supports PC3 in FDD band and PC3 or PC2 with UL MIMO in TDD band.						
NOTE 3: The UE supports PC3 in FDD band and PC1.5 with UL MIMO in TDD band.						

Table 5.4.2-2: UE Power Class for 3Tx inter-band CA with TxD

NR UL CA Configuration	Class 1.5 (dBm)	Tolerance (dB)	Class 2 (dBm)	Tolerance (dB)	Class 3 (dBm)	Tolerance (dB)
CA_n28A-n78A	29 ³	+2/-3	26 ²	+2/-3	23	+2/-3
NOTE 1: (Void in this TR)						
NOTE 2: The UE supports PC3 in FDD band and PC2 with Tx Diversity in TDD band.						
NOTE 3: The UE supports PC3 in FDD band and PC1.5 with Tx Diversity in TDD band.						

5.4.3 MSD scenario studies

Table 5.10.3-1 and 5.10.3-2 summarizes frequency ranges where harmonics mixing, cross band leakage, IMD interferences occur for CA_n28-n78.

Table 5.4.3-1: MSD scenarios for CA_n28-n78 with total power class 2

	Aggressor Tx	Victim Rx	Whether 2Tx requirements exists
Harmonic mixing	n78 (UL1/DL5)	n28	Yes
Cross band leakage	N/A	N/A	N/A
IMD5	4 * n28 – n78	n28	No

Table 5.4.3-2: MSD scenarios for CA_n28-n78 with total power class 1.5

	Aggressor Tx	Victim Rx	Whether 2Tx requirements exists
Harmonic mixing	n78 (UL1/DL5)	n28	No
Cross band leakage	N/A	N/A	N/A
IMD5	4 * f n28 – f n78	n28	No

5.4.4 REFSSENS requirements

5.4.4.1 REFSSENS requirements for total power class 2

The MSD due to IMD5 for PC2 is specified in the following table.

Table 5.4.4.1-1: 2DL/2UL inter-band Reference sensitivity QPSK P_{REFSENS} and uplink/downlink configurations for PC2 CA

Band / Channel bandwidth / NRB / Duplex mode								Source of IMD
NR CA Configuration	NR band	UL F_c (MHz)	UL/DL BW (MHz)	UL L_{CRB}	DL F_c (MHz)	MSD (dB)	Duplex mode	
CA_n28-n78	n28	705.5	5	25	760.5	19.2	FDD	IMD5
	n78	3582.5	10	50	3582.5	N/A	TDD	N/A

5.4.4.2 REFSENS requirements for total power class 1.5

The MSD due to IMD5 for PC1.5 3Tx are specified in the following table. The IMD5 MSD values for CA_n28-n78 and CA_n5-n77 are the same. Therefore, the CA_n28-n78 PC1.5 MSD values are reused from CA_n5-n77 PC1.5 MSD values.

Table 5.4.4.2-1: 2DL/2UL inter-band Reference sensitivity QPSK P_{REFSENS} and uplink/downlink configurations for PC1.5 CA

Band / Channel bandwidth / NRB / Duplex mode								Source of IMD
NR CA Configuration	NR band	UL F_c (MHz)	UL/DL BW (MHz)	UL L_{CRB}	DL F_c (MHz)	MSD (dB)	Duplex mode	
CA_n28-n78	n28	705.5	5	25	760.5	24.3	FDD	IMD5
	n78	3582.5	10	50	3582.5	N/A	TDD	N/A

5.5 CA_n1-n77

5.5.1 Operating bands for CA

Table 5.5.1-1: CA band combination of band n1+n77

NR CA Band combination	NR Band
CA_n1-n77	n1, n77

5.5.2 Maximum output power for inter-band CA

Table 5.5.2-1: UE Power Class for 3Tx inter-band CA with UL MIMO

NR UL CA Configuration	Class 1.5 (dBm)	Tolerance (dB)	Class 2 (dBm)	Tolerance (dB)	Class 3 (dBm)	Tolerance (dB)
CA_n1A-n77A			26 ⁷	+2/-3	23	+2/-3

NOTE 7: The UE supports PC3 with UL MIMO in FDD band and PC3 or PC2 in TDD band.

5.5.3 MSD scenario studies

For inter-band UL CA_n1A-n77A, IMD2 and IMD4 fall into n1 DL, and the corresponding MSD values are already specified in Table 7.3A.5-1a of latest version of TS38.101-1_[4].

Table 5.10.3-1 summarizes frequency ranges where harmonics mixing, cross band leakage, IMD interferences occur for CA_n1-n77.

Table 5.5.3-1: MSD scenarios for CA_n1-n77 with total power class 2

	Aggressor Tx	Victim Rx	Whether 2Tx requirements exists
Harmonic mixing	N/A	N/A	N/A
Cross band leakage	N/A	N/A	N/A
IMD2	1*f_n77-1*f_n1	n1 DL	Yes
IMD4	3*f_n1-1*f_n77	n1 DL	Yes

5.5.4 REFSENS requirements

5.5.4.1 REFSENS requirements for total power class 2

- The 2Tx MSD due to IMD2 has already been specified, which is applicable for 3Tx.
- The 2Tx MSD due to IMD4 has already been specified, which is applicable for 3Tx.

5.6 CA_n3-n77

5.6.1 Operating bands for CA

Table 5.6.1-1: CA band combination of band n3+n77

NR CA Band combination	NR Band
CA_n3-n77	n3, n77

5.6.2 Maximum output power for inter-band CA

Table 5.6.2-1: UE Power Class for 3Tx inter-band CA with UL MIMO

NR UL CA Configuration	Class 1.5 (dBm)	Tolerance (dB)	Class 2 (dBm)	Tolerance (dB)	Class 3 (dBm)	Tolerance (dB)
CA_n3A-n77A			26 ⁷	+2/-3	23	+2/-3
NOTE 7: The UE supports PC3 with UL MIMO in FDD band and PC3 or PC2 in TDD band.						

5.6.3 MSD scenario studies

The 2nd order harmonic mixing falls into Rx frequencies of n3, and the corresponding MSD values are already specified in Table 7.3A.4.4a-1 of latest version of TS38.101-1_[4].

For inter-band UL CA_n3A-n77A, IMD2, IMD4 and IMD5 of dual UL falls into n3 DL, and the corresponding MSD values are already specified in Table 7.3A.5-1a of latest version of TS38.101-1_[4].

Table 5.10.3-1 summarizes frequency ranges where harmonics mixing, cross band leakage, IMD interferences occur for CA_n3-n77.

Table 5.6.3-1: MSD scenarios for CA_n3-n77 with total power class 2

	Aggressor Tx	Victim Rx	Whether 2Tx requirements exists
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Harmonic mixing	n77(UL1/DL2)	n3	Yes
Cross band leakage	N/A	N/A	N/A
IMD2	$1*f_{n77} - 1*f_{n3}$	n3 DL	Yes
IMD4	$3*f_{n3} - 1*f_{n77}$	n3 DL	Yes

5.6.4 REFSENS requirements

5.6.4.1 REFSENS requirements for total power class 2

- The 2Tx MSD due to harmonic mixing has already been specified, which is applicable for 3Tx.
- The 2Tx MSD due to IMD2 has already been specified, which is applicable for 3Tx.
- The 2Tx MSD due to IMD4 has already been specified, which is applicable for 3Tx.

5.7 CA_n28-n77

5.7.1 Operating bands for CA

Table 5.7.1-1: CA band combination of band n28+n77

NR CA Band combination	NR Band
CA_n28-n77	n28, n77

5.7.2 Maximum output power for inter-band CA

Table 5.7.2-1: UE Power Class for 3Tx inter-band CA with UL MIMO

NR UL CA Configuration	Class 1.5 (dBm)	Tolerance (dB)	Class 2 (dBm)	Tolerance (dB)	Class 3 (dBm)	Tolerance (dB)
CA_n28A-n77A			26 ⁷	+2/-3	23	+2/-3
NOTE 7: The UE supports PC3 with UL MIMO in FDD band and PC3 or PC2 in TDD band.						

5.7.3 MSD scenario studies

The 5th order harmonic mixing falls into Rx frequencies of n28, and the corresponding MSD values are already specified in Table 7.3A.4.4a-1 of latest version of TS38.101-1_[4].

For inter-band UL CA_n28A-n77A, IMD5 of dual UL falls into n28 DL, and the corresponding MSD values are already specified in Table 7.3A.5-1a of latest version of TS38.101-1_[4].

Table 5.10.3-1 summarizes frequency ranges where harmonics mixing, cross band leakage, IMD interferences occur for CA_n28-n77.

Table 5.7.3-1: MSD scenarios for CA_n28-n77 with total power class 2

	Aggressor Tx	Victim Rx	Whether 2Tx requirements exists
Harmonic mixing	n77(UL1/DL5)	n28	Yes

Cross band leakage	N/A	N/A	N/A
IMD5	1*f_n28 - 4*f_n77	n28 DL	Yes

5.7.4 REFSENS requirements

5.7.4.1 REFSENS requirements for total power class 2

The 2Tx MSD due to harmonic mixing has already been specified, which is applicable for 3Tx.

The 2Tx MSD due to IMD5 has already been specified, which is applicable for 3Tx.

5.8 CA_n26-n78

5.8.1 Operating bands for CA

Table 5.8.1-1: CA band combination of band n26+n78

NR CA Band combination	NR Band
CA_n26-n78	n26, n78

5.8.2 Maximum output power for inter-band CA

Table 5.8.2-1: UE Power Class for 3Tx inter-band CA with UL MIMO

NR UL CA Configuration	Class 1.5 (dBm)	Tolerance (dB)	Class 2 (dBm)	Tolerance (dB)	Class 3 (dBm)	Tolerance (dB)
CA_n26A-n78A	29 ³	+2/-3	26 ²	+2/-3	23	+2/-3
NOTE 1: (Void in this TR)						
NOTE 2: The UE supports PC3 in FDD band and PC3 or PC2 with UL MIMO in TDD band.						
NOTE 3: The UE supports PC3 in FDD band and PC1.5 with UL MIMO in TDD band.						

Table 5.8.2-2: UE Power Class for 3Tx inter-band CA with TxD

NR UL CA Configuration	Class 1.5 (dBm)	Tolerance (dB)	Class 2 (dBm)	Tolerance (dB)	Class 3 (dBm)	Tolerance (dB)
CA_n26A-n78A	29 ³	+2/-3	26 ²	+2/-3	23	+2/-3
NOTE 1: (Void in this TR)						
NOTE 2: The UE supports PC3 in FDD band and PC2 with Tx Diversity in TDD band.						
NOTE 3: The UE supports PC3 in FDD band and PC1.5 with Tx Diversity in TDD band.						

5.8.3 MSD scenario studies

Table 5.10.3-1 and 5.10.3-2 summarizes frequency ranges where harmonic mixing, cross band leakage, IMD interferences occur for CA_n26-n78.

Table 5.8.3-1: MSD scenarios for CA_n26-n78 with total power class 2

	Aggressor Tx	Victim Rx	Whether 2Tx requirements exists
Harmonic mixing	n78 (UL1/DL4)	n26	Yes
Cross band leakage	N/A	N/A	N/A

IMD4	$f_{n78} - 3 * f_{n26}$	n26	Yes
------	-------------------------	-----	-----

Table 5.8.3-2: MSD scenarios for CA_n26-n78 with total power class 1.5

	Aggressor Tx	Victim Rx	Whether 2Tx requirements exists
Harmonic mixing	n78 (UL1/DL4)	n26	Yes
Cross band leakage	N/A	N/A	N/A
IMD4	$f_{n78} - 3 * f_{n26}$	n26	No

5.8.4 REFSENS requirements

5.8.4.1 REFSENS requirements for total power class 2

The MSD due to harmonic mixing PC2 is already specified in 38.101-1.

The MSD due to IMD4 for PC2 is already specified in 38.101-1.

5.8.4.2 REFSENS requirements for total power class 1.5

The MSD due to harmonic mixing PC1.5 is already specified in 38.101-1.

The MSD due to IMD5 for PC1.5 3Tx are specified in the following table. MSD value is reused from CA_n5-n77,

Table 5.8.4.2-1: 2DL/2UL inter-band Reference sensitivity QPSK P_{REFSENS} and uplink/downlink configurations for PC1.5 CA

Band / Channel bandwidth / NRB / Duplex mode								Source of IMD
NR CA Configuration	NR band	UL F_c (MHz)	UL/DL BW (MHz)	UL L_{CRB}	DL F_c (MHz)	MSD (dB)	Duplex mode	
CA_n26-n78	n26	836.5	5	25	881.5	25.5	FDD	IMD4
	n78	3391	10	50	3391	N/A	TDD	N/A

5.9 CA_n25-n77 3Tx

5.9.1 Operating bands for CA and Configurations

Table 5.9.1-1: CA band combination of band n25+n77

NR CA Band combination	NR Band
CA_n25-n77	n25, n77

Table 5.9.1-2: NR CA configurations and bandwidth combinations sets defined for inter-band CA (two bands)

NR CA configuration	Uplink CA configuration or single uplink carrier ⁶	NR Band	Channel bandwidth (MHz) (NOTE 3)	Bandwidth combination set
CA_n25A-n77A	n25 ⁸ n77 ^{8,9} CA_n25A-n77A ^{8,13,14}	n25	5, 10, 15, 20	0
		n77	10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100	
		n25	5, 10, 15, 20, 25, 30, 40	1
		n77	10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100	
		n25	n25 channel bandwidths in Table 5.3.5-1	4 and 5
		n77	n77 channel bandwidths in Table 5.3.5-1	

5.9.2 Maximum output power for inter-band CA

Table 5.10.2-1: UE Power Class for 3Tx inter-band CA with UL MIMO

NR UL CA Configuration	Class 1.5 (dBm)	Tolerance (dB)	Class 2 (dBm)	Tolerance (dB)	Class 3 (dBm)	Tolerance (dB)
CA_n25A-n77A	29 ³	+2/-3	26 ²	+2/-3	23	+2/-3
NOTE 1: (Void in this TR)						
NOTE 2: The UE supports PC3 in FDD band and PC3 or PC2 with UL MIMO in TDD band.						
NOTE 3: The UE supports PC3 in FDD band and PC1.5 with UL MIMO in TDD band.						

Table 5.10.2-2: UE Power Class for 3Tx inter-band CA with TxD

NR UL CA Configuration	Class 1.5 (dBm)	Tolerance (dB)	Class 2 (dBm)	Tolerance (dB)	Class 3 (dBm)	Tolerance (dB)
CA_n25A-n77A	29 ³	+2/-3	26 ²	+2/-3	23	+2/-3
NOTE 1: (Void in this TR)						
NOTE 2: The UE supports PC3 in FDD band and PC2 with Tx Diversity in TDD band.						
NOTE 3: The UE supports PC3 in FDD band and PC1.5 with Tx Diversity in TDD band.						

5.9.3 MSD scenario studies

Table 5.10.3-1 and 5.10.3-2 summarizes frequency ranges where harmonic mixing, cross band leakage, IMD interferences occur for CA_n77-n85.

Table 5.10.3-1: MSD scenarios for CA_n77-n85 with total power class 2

	Aggressor Tx	Victim Rx	Whether 2Tx requirements exists
Harmonic mixing	n77 (UL1/DL2)	n25	Yes
Cross band leakage	n77	n25	Yes
IMD2	f n77 – f n25	n25	Yes
IMD4	3*f n25 – f n77	n25	Yes

5.9.4 REFSENS requirements

5.9.4.1 REFSENS requirements for total power class 2

The MSD due to harmonic mixing PC2 is already specified in 38.101-1.

The MSD due to cross band leakage PC2 is already specified in 38.101-1.

The MSD due to IMD2 for PC2 is already specified in 38.101-1.

The MSD due to IMD4 for PC2 is already specified in 38.101-1.

5.10 CA_n77-n85 3Tx

5.10.1 Operating bands for CA and Configurations

Table 5.10.1-1: CA band combination of band n77+n85

NR CA Band combination	NR Band
CA_n77-n85	n77, n85

Table 5.10.1-2: NR CA configurations and bandwidth combinations sets defined for inter-band CA (two bands)

NR CA configuration	Uplink CA configuration or single uplink carrier ⁶	NR Band	Channel bandwidth (MHz) (NOTE 3)	Bandwidth combination set
CA_n77A-n85A	n77 ^{8,9} CA_n77A-n85A ^{8,13,14}	n77	See n77 channel bandwidths in Table 5.3.5-1	4 and 5
		n85	See n85 channel bandwidths in Table 5.3.5-1	

5.10.2 Maximum output power for inter-band CA

Table 5.10.2-1: UE Power Class for 3Tx inter-band CA with UL MIMO

NR UL CA Configuration	Class 1.5 (dBm)	Tolerance (dB)	Class 2 (dBm)	Tolerance (dB)	Class 3 (dBm)	Tolerance (dB)
CA_n77A-n85A	29 ³	+2/-3	26 ²	+2/-3	23	+2/-3

NOTE 1: (Void in this TR)

NOTE 2: The UE supports PC3 in FDD band and PC3 or PC2 with UL MIMO in TDD band.

NOTE 3: The UE supports PC3 in FDD band and PC1.5 with UL MIMO in TDD band.

Table 5.10.2-2: UE Power Class for 3Tx inter-band CA with TxD

NR UL CA Configuration	Class 1.5 (dBm)	Tolerance (dB)	Class 2 (dBm)	Tolerance (dB)	Class 3 (dBm)	Tolerance (dB)
CA_n77A-n85A	29 ³	+2/-3	26 ²	+2/-3	23	+2/-3
NOTE 1: (Void in this TR)						
NOTE 2: The UE supports PC3 in FDD band and PC2 with Tx Diversity in TDD band.						
NOTE 3: The UE supports PC3 in FDD band and PC1.5 with Tx Diversity in TDD band.						

5.10.3 MSD scenario studies

Table 5.10.3-1 and 5.10.3-2 summarizes frequency ranges where harmonic mixing, cross band leakage, IMD interferences occur for CA_n77-n85.

Table 5.10.3-1: MSD scenarios for CA_n77-n85 with total power class 2

	Aggressor Tx	Victim Rx	Whether 2Tx requirements exists
Harmonic mixing	n77 (UL1/DL5)	n85	Yes
Cross band leakage	N/A	N/A	N/A
IMD5	f n77 – 4 * f n85	n85	Yes

Table 5.10.3-2: MSD scenarios for CA_n26-n78 with total power class 1.5

	Aggressor Tx	Victim Rx	Whether 2Tx requirements exists
Harmonic mixing	n77 (UL1/DL5)	n85	Yes
Cross band leakage	N/A	N/A	N/A
IMD5	f n77 – 4 * f n85	n85	No

5.10.4 REFSENS requirements

5.10.4.1 REFSENS requirements for total power class 2

The MSD due to harmonic mixing PC2 is already specified in 38.101-1.

The MSD due to IMD5 for PC2 is already specified in 38.101-1.

5.10.4.2 REFSENS requirements for total power class 1.5

The MSD due to harmonic mixing PC1.5 is already specified in 38.101-1.

For UL CA_n77A-n85A PC1.5, since the n25 power remains PC3, the n41 power increases by 4.7 dB compared to PC2 UL CA_n77A-n85A.

For the CA_n77A-n85A IMD3, since only the n41 power is changing by 4.7 dB, the interferer increases by $X=1*4.7 = 4.7$ dB, so the MSD increases from 11.7 dB to 16.2 dB, using the following equation:

$$= 10 * \log_{10} \left(1 + 10^{X/10} (10^{MSD/10} - 1) \right)$$

The MSD due to IMD5 for PC1.5 3Tx is specified in the following table.

Table 5.10.4.2-1: 2DL/2UL inter-band Reference sensitivity QPSK P_{REFSENS} and uplink/downlink configurations for PC1.5 CA

Band / Channel bandwidth / NRB / Duplex mode								Source of IMD
NR CA Configuration	NR band	UL F_c (MHz)	UL/DL BW (MHz)	UL L_{CRB}	DL F_c (MHz)	MSD (dB)	Duplex mode	
CA_n77-n85	n77	3540	10	50	3540	N/A	TDD	N/A
	n85	702	5	20	732	16.2	FDD	IMD5

5.11 CA_n7-n78

5.11.1 Operating bands for CA

Table 5.11.1-1: CA band combination of band n7+n78

NR CA Band combination	NR Band
CA_n7-n78	n7, n78

5.11.2 Maximum output power for inter-band CA

Table 5.11.2-1: UE Power Class for 3Tx inter-band CA with UL MIMO

NR UL CA Configuration	Class 1.5 (dBm)	Tolerance (dB)	Class 2 (dBm)	Tolerance (dB)	Class 3 (dBm)	Tolerance (dB)
CA_n7A-n78A	29 ³	+2/-3	26 ²	+2/-3	23	+2/-3
NOTE 1: (Void in this TR)						
NOTE 2: The UE supports PC3 in FDD band and PC3 or PC2 with UL MIMO in TDD band.						
NOTE 3: The UE supports PC3 in FDD band and PC1.5 with UL MIMO in TDD band.						

Table 5.11.2-2: UE Power Class for 3Tx inter-band CA with TxD

NR UL CA Configuration	Class 1.5 (dBm)	Tolerance (dB)	Class 2 (dBm)	Tolerance (dB)	Class 3 (dBm)	Tolerance (dB)
CA_n7A-n78A	29 ³	+2/-3	26 ²	+2/-3	23	+2/-3
NOTE 1: (Void in this TR)						
NOTE 2: The UE supports PC3 in FDD band and PC2 with Tx Diversity in TDD band.						
NOTE 3: The UE supports PC3 in FDD band and PC1.5 with Tx Diversity in TDD band.						

5.11.3 MSD scenario studies

Table 5.11.3-1 and 5.11.3-2 summarizes frequency ranges where harmonics mixing, cross band leakage, IMD interferences occur for CA_n7-n78.

Table 5.11.3-1: MSD scenarios for CA_n7-n78 with total power class 2

	Aggressor Tx	Victim Rx	Whether 2Tx requirements exists
Harmonic mixing	N/A	N/A	N/A
Cross band leakage	n78	n7	Yes
IMD	N/A	N/A	N/A

Table 5.11.3-2: MSD scenarios for CA_n7-n78 with total power class 1.5

	Aggressor Tx	Victim Rx	Whether 2Tx requirements exists
Harmonic mixing	N/A	N/A	N/A
Cross band leakage	n78	n7	Yes
IMD	N/A	N/A	N/A

5.11.4 REFSSENS requirements

5.11.4.1 REFSSENS requirements for total power class 2

The 2Tx MSD due to cross band isolation has already been specified, which is applicable for 3Tx.

The 2Tx MSD due to IMD4 has already been specified, which is applicable for 3Tx.

5.11.4.2 REFSSENS requirements for total power class 1.5

The PC1.5 MSD due to IMD4 is specified using the same value as for CA_n7-n77

Table 5.11.4.2-1: 2DL/2UL inter-band Reference sensitivity QPSK P_{REFSENS} and uplink/downlink configurations for PC1.5 CA

Band / Channel bandwidth / N_{RB} / Duplex mode								Source of IMD
NR CA Configuration	NR band	UL F_c (MHz)	UL/DL BW (MHz)	UL C_{LRB}	DL F_c (MHz)	MSD (dB)	Duplex mode	
CA_n7-n78	n7	2520	5	25	2640	29.7	FDD	IMD4
	n78	3780	10	50	3780	N/A	TDD	N/A

The 2Tx MSD due to crossband isolation is specified below with same MSD value as used for CA_n7-n77.

Table 5.11.4.2-2: Reference sensitivity exceptions (MSD) and uplink/downlink configurations due to cross band isolation from a PC1.5 aggressor NR single UL band for DL NR CA FR1

UL band	DL band	UL F_c	UL BW	SCS of UL band	UL RB Allocation	DL F_c	DL BW	MSD	Cross-band Interference source
		(MHz)	(MHz)	(kHz)	L_{CRB}	(MHz)	(MHz)	(dB)	
n78	n7	3350	100	30	270 (RBstart=0)	2687.5	5	9.0	>ACLR2
NOTE 1: Applicable only when harmonic mixing MSD for this combination is not applied.									
NOTE 2: Void.									
NOTE 3: The requirements only apply for UEs supporting inter-band carrier aggregation with simultaneous Rx/Tx capability. Simultaneous Rx/Tx capability does not apply for UEs supporting band n78 with a n77 implementation.									

5.12 CA_n74-n77

5.12.1 Configurations

Table 5.12.1-1: NR CA configurations and bandwidth combinations sets defined for inter-band CA (two bands)

NR CA configuration	Uplink CA configuration or single uplink carrier	NR Band	Channel bandwidth (MHz)	Bandwidth combination set
CA_n74A-n77A	n77 ⁸ CA_n74A-n77A ⁸	n74	5, 10, 15, 20	0
		n77	10, 15, 20, 40, 50, 60, 80, 90, 100	
NOTE 8: Minimum requirements for Power Class 2 are applicable for this uplink combination with 1Tx antenna connector in each band or single uplink carrier with up to 2Tx antenna connectors in this downlink/uplink combination.				

5.12.2 Maximum output power for inter-band CA

The UE Power class 2 for uplink Configuration for CA_n74-n77 is shown in Table 5.6.2-1.

Table 5.12.2-1: UE Power Class 2 for uplink inter-band CA (two bands)

Uplink CA configuration	Power class 2 cases for CA_nX-nY	CA power class	Carrier X power class	Carrier Y power class
CA_n74-n77	Case a	26dBm	23dBm	23dBm
	Case b	26dBm	23dBm	26dBm
	Case c	26dBm	26dBm	23dBm
	Case d	26dBm	26dBm	26dBm

5.12.3 MSD scenario studies

For single UL n77, there is no IMD issue and no harmonic mixing issue and no cross-band leakage issue. Therefore, there is no MSD issue. For inter-band UL CA_n74-n77, with high power on n77, IMD5 and IMD6 fall into n74 DL. However, MSD test point is not valid as there is no possible MSD where the n74DL is at duplex distance of n74UL. Therefore, there is no MSD for this scenario.

5.12.4 Δ TIB and Δ RIB values

There is no change by comparing to the values for PC3 CA.

5.13 CA_n18-n77

5.13.1 Configurations

Table 5.13.1-1: NR CA configurations and bandwidth combinations sets defined for inter-band CA (two bands)

NR CA configuration	Uplink CA configuration or single uplink carrier	NR Band	Channel bandwidth (MHz)	Bandwidth combination set
CA_n18A-n77(2A)	CA_n77(2A) ⁸	n18	5, 10, 15	0

		n77	CA_n77(2A)_BCS0	
NOTE 8: Minimum requirements for Power Class 2 are applicable for this uplink combination with 1Tx antenna connector in each band or single uplink carrier with up to 2Tx antenna connectors in this downlink/uplink combination				

5.13.2 Maximum output powers

It is omitted here because it is already defined.

5.13.3 REFSENS requirements.

Based on analysis,

- there is no IMD issue and no harmonic issue for UL n77 to DL CA_n18-n77.
- 4th harmonic mixing of n18 DL falls into n77 UL from 3440 to 3500MHz, within the range of global band 3300-4200MHz.

Unaffected parts, such as inter-band cases, are omitted.

5.13.3.1 Power class 2 for single uplink n77

In the latest TS 38.101-1-i90, the impact of the 4th harmonic mixing of n18 to n77 UL for CA_n18-n77 is not included because of the historical background.

The PC3 case is proposed in R4-2507279 and the corresponding MSD values are 5.4dB for DL BW =5 MHz and 2.5 dB for DL BW=15 MHz.

For PC2 case, when PC3 MSD is 5.4, Δ MSD = 2.3, when PC3 MSD is 2.5, Δ MSD = 1.6, and the MSD values are calculated as 7.7 and 4.1 respectively and are presented in Table 5.13.5.

Table 5.13.3.1: Reference sensitivity exceptions and uplink/downlink configurations due to harmonic mixing from a PC2 aggressor NR UL band for DL NR CA FR1

UL band	DL band	UL BW	SCS of UL band	UL RB Allocation	DL BW	MSD	UL/DL fc condition	UL/DL harmonic order
		(MHz)	(kHz)	L _{CRB}	(MHz)	(dB)		
n77	n18	10	15	25	5	7.7	NOTE 5	UL1/DL4 ^x
n77	n18	10	15	25	15	4.1	NOTE 5	UL1/DL4 ^x
Unaffected part (NOTE 8) is omitted.								
NOTE X: For a UE which supports this band combination only when the Band n77 frequency range restriction of 3400 – 4100 MHz applies, the MSD test point(s) cannot be verified for the band combination and the test point(s) can be skipped.								

5.13.4 Power class 2 for uplink CA_n77(2A)

Band n18 is affected by IMD components IMD4 (2, -2), IMD6 (3, -3) and IMD11 (6, -5), resulting from the uplink operation of CA_n77(2A). For this TDD uplink band, the MSD analysis results corresponding to IMD6 and IMD11 can be disregarded. The MSD value aligns with the PC3 case [3], consistent with the guideline specified in reference [5].

Table 5.13.4-1: 2DL/2UL inter-band Reference sensitivity QPSK P_{REFSENS} and uplink/downlink configurations for PC2 CA

Band / Channel bandwidth / N_{RB} / Duplex mode								Source of IMD
NR CA band combination	NR band	UL F_c (MHz)	UL/DL BW (MHz)	UL L_{CRB}	DL F_c (MHz)	MSD (dB)	Duplex mode	
CA_n18-n77	n18	N/A	N/A	N/A	N/A	N/A	FDD	IMD2 ⁷
	n77 ¹²	N/A	N/A	N/A	N/A	N/A	TDD	N/A
	n18	N/A	5	N/A	870	8.6	FDD	IMD4
	n77 ¹²	3480	10	1 ($\text{RB}_{\text{START}}=25$)	3480	N/A	TDD	N/A
		3915	10	1 ($\text{RB}_{\text{START}}=25$)	3800			
NOTE 7: In current release the maximum separation bandwidth class is 600MHz, therefore, no IMD MSD requirement apply for this CA configuration when two uplink sub blocks are assigned within CA_77(2A).								
NOTE 12: This band supports intra-band non-contiguous uplink configuration.								

5.13.5 ΔTIB and ΔRIB values

There is no change by comparing to the values for PC3 CA.

5.14 CA_n25-n41

5.14.1 Configurations

<Editor's note: the CA configurations and bandwidth combinations sets should be kept same as defined in 38.101-1 Table 5.5A.3.1-1x unless additional clarification>

Table 5.14.1-1: NR CA configurations and bandwidth combinations sets defined for inter-band CA (two bands)

NR CA configuration	Uplink CA configuration or single uplink carrier	NR Band	Channel bandwidth (MHz)	Bandwidth combination set
CA_n25A-n41C	n25 ⁸ n41 ^{8,9} CA_n25A-n41A ^{8,13,14} CA_n41C ^{8,9}	n25	5, 10, 15, 20	0
		n41	CA_n41C_BCS0	
		n25	5, 10, 15, 20, 25, 30, 40	1
		n41	CA_n41C_BCS1	
	n25 ⁸ n41 ^{8,9} CA_n25A-n41A ^{8,13,14} CA_n41C ^{8,9} CA_n25A-n41C ^{8,13,14}	n25	n25 channel bandwidths in Table 5.3.5-1	4 and 5
		n41	CA_n41C_BCS 4 and 5	

- NOTE 8: Minimum requirements for Power Class 2 are applicable for this uplink combination with 1Tx antenna connector in each band or single uplink carrier with up to 2Tx antenna connectors in this downlink/uplink combination
- NOTE 9: Minimum requirements for Power Class 1.5 are applicable for this uplink combination with 1Tx antenna connector in each band or single uplink carrier with up to 2Tx antenna connectors in this downlink/uplink combination
- ...
- NOTE 13: Minimum requirements for Power Class 2 are applicable for this uplink configuration with 1Tx antenna connector in one band and 2Tx antenna connectors in the other band.
- NOTE 14: Minimum requirements for Power Class 1.5 are applicable for this uplink configuration with 1Tx antenna connector in one band and 2Tx antenna connectors in the other band.

5.14.2 Maximum output power

Table 5.14.2-1 UE Power Class 1.5 for uplink intra-band CA

Uplink configuration	CA	Power class 1.5 cases for CA_nX-nY	CA power class	Carrier X power class
CA_n41C		Case a	29dBm	29dBm

Table 5.14.2-2 UE Power Class 2 for uplink inter-band CA (two bands)

Uplink configuration	CA	Power class 2 cases for CA_nX-nY	CA power class	Carrier X power class	Carrier Y power class
CA_n25A-n41C		Case a	26dBm	23dBm	23dBm
		Case b	26dBm	23dBm	26dBm
		Case d	26dBm	26dBm	26dBm

Table 5.14.2-3 UE Power Class 1.5 for uplink inter-band CA (two bands)

Uplink configuration	CA	Power class 1.5 cases for CA_nX-nY	CA power class	Carrier X power class	Carrier Y power class
CA_n25A-n41C		Case a	29dBm	26dBm	26dBm
		Case b	29dBm	23dBm	29dBm

5.14.3 REFSENS requirements

The PC1.5 IMD

5.14.3.1 UL CA_n41C Power Class 1.5 case a

The PC1.5 MSD for UL CA_n41C into DL n25 is the same as for PC3 and PC2.

Table 5.14.3-1 UE Power Class 1.5 MSD

Band / Channel bandwidth / N _{RB} / Duplex mode								Source of IMD
NR CA Configuration	NR band	UL F _c (MHz)	UL/DL BW (MHz)	UL L _{CRB}	DL F _c (MHz)	MSD (dB)	Duplex mode	
CA_n25-n41	n25	N/A	5	N/A	1992.5	8.5	FDD	IMD7
	n41	2545 2640	90 100	1 (RBstart=0) 1 (RBstart=221)	2545 2640	N/A	TDD	N/A

5.14.3.2 UL CA_n25A-n41C Power Class 2 case a, b, d

For CA_n25A-n41C triple beat the key is that the FDD band increases by 3dB for inter-band PC2 but the CA_n41C is subject to MPR/A-MPR to meet IMD and only increases by 2dB for PC2 vs PC3. Therefore, IMD power increase is $2*3+1*2=8\text{dB}$ for PC2. Thus,

- PC2 CA_n25A-n41C triple beat $15.3+8=23.3\text{dB}$

Table 5.14.3.2-1 UE Power Class 1.5 MSD

Band / Channel bandwidth / N _{RB} / Duplex mode								Source of IMD
NR CA Configuration	NR band	UL F _c (MHz)	UL/DL BW (MHz)	UL L _{CRB}	DL F _c (MHz)	MSD (dB)	Duplex mode	
CA_n25-n41	n25	1860	5	25	1940	23.3	FDD	IMD3
	n41	2501	10	1 (RBstart = 25)	2501	N/A	TDD	N/A
		2556	100	1 (RBstart = 208)	2556			

5.14.3.3 UL CA_n25A-n41C Power Class 1.5 case a, b

For CA_n25A-n41C triple beat the key is that the FDD band increases by 6dB with inter-band PC1.5 but the CA_n41C is subject to MPR/A-MPR to meet IMD and only increases by 3dB for PC1.5 vs PC3. Therefore, IMD power increase is $2*6+1*3=15\text{dB}$ for PC1.5. Thus,

- PC1.5 CA_n25A-n41C triple beat $15.3+15=30.3\text{dB}$

Table 5.14.3.3-1 UE Power Class 1.5 MSD

Band / Channel bandwidth / N _{RB} / Duplex mode								Source of IMD
NR CA Configuration	NR band	UL F _c (MHz)	UL/DL BW (MHz)	UL L _{CRB}	DL F _c (MHz)	MSD (dB)	Duplex mode	
CA_n25-n41	n25	1860	5	25	1940	30.3	FDD	IMD3
	n41	2501	10	1 (RBstart = 25)	2501	N/A	TDD	N/A
		2556	100	1 (RBstart = 208)	2556			

5.14.4 ΔTIB and ΔRIB values

There is no change compared to the values for PC3 CA.

5.15 CA_n74-n77

5.15.1 Configurations

Table 5.15.1-1: NR CA configurations and bandwidth combinations sets defined for inter-band CA (two bands)

NR CA configuration	Uplink CA configuration or single uplink carrier	NR Band	Channel bandwidth (MHz)	Bandwidth combination set
CA_n74A-n77(2A)	n77(2A) ⁸	n74	5, 10, 15, 20	0
		n77	CA_n77(2A)_BCS1	

NOTE 8: Minimum requirements for Power Class 2 are applicable for this uplink combination with 1Tx antenna connector in each band or single uplink carrier with up to 2Tx antenna connectors in this downlink/uplink combination

5.15.2 Maximum output power

Already in clause 5.15.1.

5.15.3 REFSENS requirements

Based on co-existence studies presented for PC3(in R4-2510047), IMD6/7 of ULCA_n77(2A) falls into the n74DL, and the MSD requirements are defined as following.

Table 5.15.3-1: 2DL/2UL inter-band Reference sensitivity QPSK P_{REFSENS} and uplink/downlink configurations for PC2 CA

Band / Channel bandwidth / N_{RB} / Duplex mode								Source of IMD
NR CA band combination	NR band	UL F_c (MHz)	UL/DL BW (MHz)	UL L_{CRB}	DL F_c (MHz)	MSD (dB)	Duplex mode	
CA_n74-n77	n74	N/A	5	N/A	1500	4.6	FDD	IMD6
	n77 ¹²	3505 4005	10 10	1(Rbstart=26) 1(Rbstart=26)	3505 4005	N/A	TDD	N/A
	n74	N/A	5	N/A	1505	1.7	FDD	IMD7
	n77 ¹²	3305 3905	10 10	1(Rbstart=26) 1(Rbstart=26)	3305 3905	N/A	TDD	N/A
NOTE 12: This band supports intra-band non-contiguous uplink configuration.								

5.15.4 ΔTIB and ΔRIB values

There is no change by comparing to the values for PC3 CA.

5.16 CA_n5-n77

5.16.1 Configurations

Table 5.16.1-1: NR CA configurations and bandwidth combinations sets defined for inter-band CA (two bands)

NR CA configuration	Uplink CA configuration or single uplink carrier n77 ^{8,9}	NR Band	Channel bandwidth (MHz)	Bandwidth combination set
CA_n5A-n77C	CA_n5A-n77A ⁸ CA_n77C	n5	5, 10, 15, 20	0
		n77	CA_n77C_BCS0	
		n5	5, 10, 15, 20	1
		n77	CA_n77C_BCS1	
	n77 ^{8,9} CA_n5A-n77A CA_n77C CA_n5A-n77C	n5	See n5 channel bandwidths in Table 5.3.5-1	4 and 5

		n77	CA_n77C_BCS 4 and 5	
CA_n5B-n77A	n77 ^{8,9} CA_n5A-n77A ⁸ CA_n5B	n5	CA_n5B_BCS0	0
		n77	10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100	
	n77 ^{8,9} CA_n5A-n77A CA_n5B	n5	CA_n5B_BCS 4 and 5	4 and 5
		n77	n77 channel bandwidths in Table 5.3.5-1	
CA_n5B-n77C	n77 ^{8,9} CA_n5A-n77A ⁸ CA_n5B CA_n77C	n5	CA_n5B_BCS0	0
		n77	CA_n77C_BCS0	
		n5	CA_n5B_BCS0	1
		n77	CA_n77C_BCS1	
	n77 ^{8,9} CA_n5A-n77A CA_n5B CA_n77C CA_n5A-n77C	n5	CA_n5B_BCS 4 and 5	4 and 5
		n77	CA_n77C_BCS 4 and 5	
NOTE 8: Minimum requirements for Power Class 2 are applicable for this uplink combination with 1Tx antenna connector in each band or single uplink carrier with up to 2Tx antenna connectors in this downlink/uplink combination				
NOTE 9: Minimum requirements for Power Class 1.5 are applicable for this single uplink carrier with up to 2Tx antenna connectors in this downlink/uplink combination				

Note: On top of the existing specification, the new added configurations are highlighted in yellow for convenience.

5.16.2 MSD scenario studies

5.16.2.1 Harmonic Issues

Issues have been identified as captured in TR 38.719-02-01 where it is noted that UL4/DL and UL5/DL1 issues exists for band n5. Since this band is not impacted by the addition in this TP no additional MSD is needed.

5.16.2.2 Harmonic Mixing Issues:

Issues have been identified as captured in TR 38.719-02-01 where it is noted that UL1/DL4 issues exists for band n77. When adding HPUE support it is needed to verify MSD has been defined. In this case where PC2 and PC1.5 is added for n77 MSD has already need defined in TS 38.101-1 Table 7.3A.4-4a-1 and Table 7.3A.4-4b for PC2 and PC1.5 respectively.

5.16.2.3 Cross-band isolation Issues:

No cross-band isolation issues were identified.

5.16.2.4 IMD Issues:

IMD2, 4 and 5 issues have been identified as captured in TR 38.719-02-01. Corresponding MSD have already been defined for PC2 and PC1.5 in TS 38.101-1 Table 7.3A.5-1a and Table 7.3A.5-1b respectively.

5.16.3 REFSSENS requirements

5.16.3.1 Power class 2 for single uplink n77

No additional MSD is needed defined

5.16.3.2 Power class 1.5 for single uplink n77

No additional MSD is needed defined

5.17 CA_n48-n77

5.17.1 Configurations

Table 5.17.1-1: NR CA configurations and bandwidth combinations sets defined for inter-band CA (two bands)

NR CA configuration	Uplink CA configuration or single uplink carrier	NR Band	Channel bandwidth (MHz)	Bandwidth combination set
CA_n48A-n77C	n77 ^{8,9} CA_n77C	n48	5, 10, 15, 20, 30, 40, 50 ⁶ , 60 ⁶ , 70 ⁶ , 80 ⁶ , 90 ⁶ , 100 ⁶	0
		n77	CA_n77C_BCS0	
		n48	5, 10, 15, 20, 30, 40, 50 ⁶ , 60 ⁶ , 70 ⁶ , 80 ⁶ , 90 ⁶ , 100 ⁶	1
		n77	CA_n77C_BCS1	
	n77 ^{8,9} CA_n77C	n48	See n48 channel bandwidths in Table 5.3.5-1	4 and 5
		n77	CA_n77C_BCS4 and 5	
CA_n48B-n77A CA_n48B-n77C	CA_n48B n77 ^{8,9}	n48	CA_n48B_BCS0	0
		n77	10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100	
		n48	CA_n48B_BCS1	1
		n77	10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100	
		n48	CA_n48B_BCS2	2
		n77	10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100	
	n77 ^{8,9} CA_n48B CA_n48B n77 ^{8,9} CA_n77C	n48	CA_n48B_BCS4 and 5	4 and 5
		n77	See n77 channel bandwidths in Table 5.3.5-1	
		n48	CA_n48B_BCS0	0
		n77	CA_n77C_BCS0	
		n48	CA_n48B_BCS0	1
		n77	CA_n77C_BCS1	
		n48	CA_n48B_BCS2	2
		n77	CA_n77C_BCS0	
		n48	CA_n48B_BCS2	3
		n77	CA_n77C_BCS1	
	n77 ^{8,9} CA_n48B	n48	CA_n48B_BCS4 and 5	4 and 5
		n77	CA_n77C_BCS4 and 5	

NOTE 8: Minimum requirements for Power Class 2 are applicable for this uplink combination with 1Tx antenna connector in each band or single uplink carrier with up to 2Tx antenna connectors in this downlink/uplink combination

NOTE 9: Minimum requirements for Power Class 1.5 are applicable for this single uplink carrier with up to 2Tx antenna connectors in this downlink/uplink combination

Note: On top of the existing specification, the new added configurations are highlighted in yellow for convenience.

5.17.2 MSD scenario studies

5.17.2.1 Harmonic Issues

This combination has not been captured in TR 38.719-02-01 hence the study is included here for convenience.

Table 5.17.2-1 UL/DL harmonics/harmonic mixing analysis

UL/DL harmonics		n48	UL1 ²	UL2	UL3 ³	UL4	UL5	MSD type
		fLow	3550	7100	10650	14200	17750	
n77	fLow	fHigh	3700	7400	11100	14800	18500	UL harmonic
DL1	3300	4200	N/A	-	-	-	-	Harmonic mixing
DL2 ³	6600	8400	-	N/A	-	N/A	N/A	
DL3 ⁴	9900	12600	-	-	N/A	-	N/A	
DL4	13200	16800	-	N/A	N/A	N/A	N/A	
DL5 ⁴	16500	21000	-	-	N/A	N/A	N/A	
Analysis			No issues found.					
UL/DL harmonics		n77	UL1 ⁴	UL2	UL3 ³	UL4	UL5	MSD type
		fLow	3300	6600	9900	13200	16500	
n48	fLow	fHigh	4200	8400	12600	16800	21000	UL harmonic
DL1	3550	3700	N/A	-	-	-	-	Harmonic mixing
DL2 ³	7100	7400	-	N/A	-	N/A	N/A	
DL3 ⁴	10650	11100	-	-	N/A	-	N/A	
DL4	14200	14800	-	N/A	N/A	N/A	N/A	
DL5 ⁴	17750	18500	-	-	N/A	N/A	N/A	
Analysis			No issues found.					
Note 1: ULx means UL xth harmonic frequency, and DLy means DL yth harmonic frequency range								
Note 2: When a collision is detected with an overlap >0Hz between the ULx with DLy frequency ranges, the ULx/DLy cell is marked “D” for direct hit.								
When the gap between ULx and DLy frequency range is from 0Hz to x*MinULCBW, the ULx/DLy cell is marked “N” for Near miss.								
Note 3: UL3/DL2 harmonic mixing direct hit case for PC3/5 only apply for DL>3GHz								
Note 4: For harmonic mixing, near-miss cases only apply for UL1 and odd DLy orders.								

No issues found.

5.17.2.2 Harmonic Mixing Issues:

The study has been included in the above section. No issues found

5.17.2.3 Cross-band isolation Issues:

This combination has not been captured in TR 38.719-02-01 hence the study is included here for **convenience**.

Table 5.17.1.3-2: Cross-band isolation analysis

Bands	n48		n77	
Frequency limit	flow	fhigh	flow	fhigh
fUL (MHz)	3550	3700	3300	4200

fDL (MHz)	3550	3700	3300	4200
UL CBW (MHz) ²	Minimum CBW	Maximum CBW	Minimum CBW	Maximum CBW
	10	40	10	100
ACLR1 range	$f_{x_{low}} - \max_{ULCBWx}$	$f_{x_{high}} + \max_{ULCBWx}$	$f_{y_{low}} - \max_{ULCBWy}$	$f_{y_{high}} + \max_{ULCBW}$
ACLR1 (MHz)	3510	3740	3200	4300
ACLR2 range	$f_{x_{low}} - 2 * \max_{ULCBWx}$	$f_{x_{high}} + 2 * \max_{ULCBWx}$	$f_{y_{low}} - 2 * \max_{ULCBWy}$	$f_{y_{high}} + 2 * \max_{ULCBW}$
ACLR2 (MHz)	3470	3780	3100	4400
ACLR3 range	$f_{x_{low}} - 3 * \max_{ULCBWx}$	$f_{x_{high}} + 3 * \max_{ULCBWx}$	$f_{y_{low}} - 3 * \max_{ULCBWy}$	$f_{y_{high}} + 3 * \max_{ULCBW}$
ACLR3 (MHz)	3430	3820	3000	4500
ACLR4 range	$f_{x_{low}} - 4 * \max_{ULCBWx}$	$f_{x_{high}} + 4 * \max_{ULCBWx}$	$f_{y_{low}} - 4 * \max_{ULCBWy}$	$f_{y_{high}} + 4 * \max_{ULCBW}$
ACLR4 (MHz)	3390	3860	2900	4600
ACLR5 range ¹	$f_{x_{low}} - 5 * \max_{ULCBWx}$	$f_{x_{high}} + 5 * \max_{ULCBWx}$	$f_{y_{low}} - 5 * \max_{ULCBWy}$	$f_{y_{high}} + 5 * \max_{ULCBW}$
ACLR5 (MHz)	3350	3900	2800	4700
Analysis	There is an issue of ACLR1 into n77		No issues found	

NOTE 1: Even if there is no overlap up to ACLR5, MSD beyond the ACLR5 range should be evaluated further if:

- The UL aggressor band and DL aggressor band are part of the same or adjacent band group as described in table A.1
- If the DL band is above the UL band, it's lower frequency edge must be below the UL lowest 2nd harmonic frequency
- As an indicative threshold, if >45dB UL rejection at the DL band frequency can be guaranteed, assuming a -130dBm/Hz T noise floor level, the transmitter noise floor related MSD should be negligible

NOTE 2: The maximum UL channel bandwidth of the BCS (noted maxULCBW) is used to calculate the band ACLR ranges while the minimum DL channel bandwidth of the BCS (noted minDLCBW) is used for the DL band victim channel bandwidth.

Cross-band isolation issues were identified. However, according to TS 38.101-1 Table 5.2A.2.1-1:

NOTE 14: The band n48 and n77 will synchronize their uplink and downlink configurations and in commonly TDD network coordination

The synchronizaton will mean there is no need for additional MSD defined.

5.17.2.4 IMD Issues:

This combination has not been captured in TR 38.719-02-01 hence the study is included here for convenience.

Table 5.17.2.2-1: Band n48 and Band n77 for 2CC UL IMD products

UE UL carriers	f_{x_low}	f_{x_high}	f_{y_low}	f_{y_high}
2nd order IMD products	$ f_{y_low} - f_{x_high} $	$ f_{y_high} - f_{x_low} $	$ f_{y_low} + f_{x_low} $	$ f_{y_high} + f_{x_high} $
IMD frequency limits (MHz)	400 - 650		6850 - 7900	
Two-tone 3 rd order IMD products	$ 2*f_{x_low} - f_{y_high} $	$ 2*f_{x_high} - f_{y_low} $	$ 2*f_{y_low} - f_{x_high} $	$ 2*f_{y_high} - f_{x_low} $
IMD frequency limits (MHz)	2900 - 4100		2900 - 4850	
Two-tone 3 rd order IMD products	$ 2*f_{x_low} + f_{y_low} $	$ 2*f_{x_high} + f_{y_high} $	$ 2*f_{y_low} + f_{x_low} $	$ 2*f_{y_high} + f_{x_high} $
IMD frequency limits (MHz)	10400 - 11600		10150 - 12100	
Two-tone 4 th order IMD products	$ 3*f_{x_low} - 1*f_{y_high} $	$ 3*f_{x_high} - 1*f_{y_low} $	$ 3*f_{y_low} - 1*f_{x_high} $	$ 3*f_{y_high} - 1*f_{x_low} $
IMD frequency limits (MHz)	6450 - 7800		6200 - 9050	
Two-tone 4 th order IMD products	$ 2*f_{x_low} - 2*f_{y_high} $	$ 2*f_{x_high} - 2*f_{y_low} $		
IMD frequency limits (MHz)	800 - 1300			
Two-tone 4 th order IMD products	$ 3*f_{x_low} + 1*f_{y_low} $	$ 3*f_{x_high} + 1*f_{y_high} $	$ 3*f_{y_low} + 1*f_{x_low} $	$ 3*f_{y_high} + 1*f_{x_high} $
IMD frequency limits (MHz)	13950 - 15300		13450 - 16300	
Two-tone 4 th order IMD products	$ 2*f_{x_low} + 2*f_{y_low} $	$ 2*f_{x_high} + 2*f_{y_high} $		
IMD frequency limits (MHz)	13700 - 15800			
Two-tone 5 th order IMD products	$ f_{x_low} - 4*f_{y_high} $	$ f_{x_high} - 4*f_{y_low} $	$ f_{y_low} - 4*f_{x_high} $	$ f_{y_high} - 4*f_{x_low} $
IMD frequency limits (MHz)	9500 - 13250		10000 - 11500	
Two-tone 5 th order IMD products	$ 2*f_{x_low} - 3*f_{y_high} $	$ 2*f_{x_high} - 3*f_{y_low} $	$ 2*f_{y_low} - 3*f_{x_high} $	$ 2*f_{y_high} - 3*f_{x_low} $
IMD frequency limits (MHz)	2500 - 5500		2250 - 4500	
Two-tone 5 th order IMD products	$ f_{x_low} + 4*f_{y_low} $	$ f_{x_high} + 4*f_{y_high} $	$ f_{y_low} + 4*f_{x_low} $	$ f_{y_high} + 4*f_{x_high} $
IMD frequency limits (MHz)	16750 - 20500		17500 - 19000	
Two-tone 5 th order IMD products	$ 2*f_{x_low} + 3*f_{y_low} $	$ 2*f_{x_high} + 3*f_{y_high} $	$ 2*f_{y_low} + 3*f_{x_low} $	$ 2*f_{y_high} + 3*f_{x_high} $
IMD frequency limits (MHz)	17000 - 20000		17250 - 19500	

NOTE : For each IMD item, when two bound values before taking absolute have different signs, the relevant IMD range shall be set such that (1) the lower bound is 0 and (2) the upper bound is the bigger value of the two after taking absolute. The lowest even order and lowest odd order IMD MSDs shall be considered.

No IMD issues found.

5.17.3 REFSENS requirements

5.17.3.1 Power class 2 for single uplink n77

No additional MSD is needed defined

5.17.3.2 Power class 1.5 for single uplink n77

No additional MSD is needed defined

5.18 CA_n66-n77

5.18.1 Operating bands for CA

Table 5.18.1-1: NR CA configurations and bandwidth combinations sets defined for inter-band CA (two bands)

NR CA configuration	Uplink CA configuration or single uplink carrier ¹⁰	NR Band	Channel bandwidth (MHz) (NOTE 3)	Bandwidth combination set
CA_n66A-n77C	n77 ^{8,9} CA_n77C ⁸ CA_n66A-n77A ⁸	n66	5, 10, 15, 20, 25, 30, 40	0
		n77	CA_n77C_BCS1	
		n66	5, 10, 15, 20, 25, 30, 40	1
		n77	CA_n77C_BCS1	
	n77 ^{8,9} CA_n77C ⁸ CA_n66A-n77A CA_n66A-n77C	n66	n66 channel bandwidths in Table 5.3.5-1	4 and 5
		n77	CA_n77C_BCS 4 and 5	
CA_n66(2A)-n77C	n77 ^{8,9} CA_n77C ⁸ CA_n66A-n77A ⁸	n66	CA_n66(2A)_BCS0	0
		n77	CA_n77C_BCS1	
		n66	CA_n66(2A)_BCS1	1
		n77	CA_n77C_BCS1	
	n77 ^{8,9} CA_n77C ⁸ CA_n66A-n77A CA_n66A-n77C	n66	CA_n66(2A)_BCS 4 and 5	4 and 5
		n77	CA_n77C_BCS 4 and 5	

Note: The above foot-script note number is same as clause 5.5A.3.1 in TS38.101-1

Note: On top of the existing specification, the new added configurations are highlighted in yellow for convenience.

5.18.2 MSD scenario studies

For harmonic MSD by HPUE n77:

- According to the co-existence study in TR38.719-02-01, there is an issue found at n66 UL2 harmonic falls into n77 DL. However, due to the power of band n66 is still kept as PC3, so there is no additional harmonic MSD need to be defined comparing to the existing harmonic MSD requirements in the TS38.101-1.

For harmonic mixing MSD caused by HPUE n77:

- According to the co-existence study in TR38.719-02-01, the frequency range of n77 UL2 is from 6600~8400MHz, while the frequency range of n66 DL3 is from 6330~6600MHz, it can be seen that the lower edge of n77 UL2 is exact the same as the upper edge of n66 DL3. However, according to the following guidelines,

- When a collision is detected with an overlap >0Hz between the ULx with DLy frequency ranges, the ULx/DLy cell is marked "D" for direct hit. When the gap between ULx and DLy frequency range is from 0Hz to $x \times \text{MinULCBW}$, the ULx/DLy cell is marked "N" for Near miss.
- For harmonic mixing, near-miss cases only apply for UL1 and odd DLy orders.

We can see that there is no need to define the near-missing harmonic mixing MSD for HPUE n77 for CA_n66-n77 for BCS0, 1, 4 and 5.

For cross-band isolation MSD by HPUE n77

- According to the co-existence study in TR38.719-02-01, there is no issue found for cross-band isolation MSD for n77 into n66, there is for PC2 and PC1.5. The same n77A cross-band isolation MSD will also apply for UL CA_n77C for power class 2 and power class 1.5.

For IMD MSD caused by PC2 CA_n77C

- According to the co-existence study in TR38.719-02-01, IMD 13 of n77 falls into n66. however, due to n66 and n77 are not the two bands in adjacent band group, there is no need to check IMD 13 MSD according to the following guidance

- For intra-band ULCA within a FDD band, IMD order up to 13 should be considered for bands in the same band group and MPR is not assumed. If justified by poor filtering performance, higher order IMD may need to be specified.

5.18.3 REFSENS requirements

5.18.3.1 REFSENS requirements for total power class 2

Comparing the existing MSD in TS38.101-1, there are no additional MSD requirement needed to be specified.

5.18.3.2 REFSENS requirements for total power class 1.5

Comparing the existing MSD in TS38.101-1, there are no additional MSD requirement needed to be specified.

5.19 CA_n18-n40

5.19.1 Configurations

Table 5.19.1-1: NR CA configurations and bandwidth combinations sets defined for inter-band CA (two bands)

NR CA configuration	Uplink CA configuration or single uplink carrier ¹⁰	NR Band	Channel bandwidth (MHz) (NOTE 3)	Bandwidth combination set
CA_n18A-n40A	CA_n18A-n40A	n18	5, 10, 15	0
		n40	10, 15, 20, 30, 40	
	n40 ^{8,9} CA_n18A-n40A ^{8,9}	n18	n18 channel bandwidths in Table 5.3.5-1	4 and 5
		n40	n40 channel bandwidths in Table 5.3.5-1	
NOTE 8: Minimum requirements for Power Class 2 are applicable for this uplink CA configuration according to clause 6.2A.1.1 or 6.2A.1.2 or 6.2A.1.3 or single uplink carrier configuration according to clauses 6.2.1 or 6.2D.1 or 6.2G.1 in this downlink/uplink combination.				
NOTE 9: Minimum requirements for Power Class 1.5 are applicable for this uplink CA configuration according to clause 6.2A.1.3 or single uplink carrier according to clauses 6.2.1 or 6.2D.1 or 6.2G.1 in this downlink/uplink combination.				
NOTE 13: Minimum requirements for Power Class 2 are applicable for this uplink CA configuration according to clause 6.2H.3.1 or 6.2L.3.1.				
NOTE 14: Minimum requirements for Power Class 1.5 are applicable for this uplink CA configuration according to clause 6.2H.3.1 or 6.2L.3.1.				

5.19.2 Maximum output powers for inter-band CA

The UE Power class 2 and Power class 1.5 for uplink Configuration for CA_n18-n40 is as shown in Table 5.19.2-1 and Table 5.19.2-2 respectively.

Table 5.19.2-1: UE Power Class 2 for uplink inter-band CA (two bands)

Uplink CA configuration	Power class 2 cases for CA_nX-nY	CA power class	Carrier X power class	Carrier Y power class
CA_n18-n40	Case a	26dBm	23dBm	23dBm
	Case b	26dBm	23dBm	26dBm
	Case c	26dBm	26dBm	23dBm
	Case d	26dBm	26dBm	26dBm

Table 5.19.2-2 UE Power Class 1.5 for uplink inter-band CA (two bands)

Uplink CA configuration	Power class 1.5 cases for CA_nX-nY	CA power class	Carrier X power class	Carrier Y power class
CA_n18-n40	Case a	29dBm	26dBm	26dBm
	Case b	29dBm	23dBm	29dBm
	Case c	29dBm	29dBm	23dBm
	Case d	29dBm	26dBm	29dBm
	Case e	29dBm	29dBm	26dBm

5.19.3 REFSENS requirements.

Based on analysis,

- there is no IMD issue and no harmonic issue for UL n40 to DL CA_n18-n40.

- For UL CA_n18A-n40A with BCS 4 and 5, IMD5(4,-1) interference falls at the edge of n18 but not in n18 downlink, resulting in negligible MSD, similar to the BCS 0 case for PC3. Technical analysis indicates the MSD values for PC2 and PC1.5 can be regarded as small. PC2 and PC1.5 in DL CA_n18A-n40A with UL CA_n18A-n40A:

Therefore, in accordance with the approved WF R4-2507935, MSD requirements for CA_n18-n40 HPUE PC2 and PC1.5 do not need to be specified.

5.19.4 Δ TIB and Δ RIB values

There is no change by comparing to the values for PC3 case.

5.20 CA_n1-n79

5.20.1 Operating band

Table 5.20.1-1: CA band combination of band n1+n79

NR CA Band combination	NR Band
CA n1-n79	n1, n79

5.20.2 Maximum output power

Maximum output power for inter-band CA

Table 5.20.2-1: UE Power Class for 3Tx inter-band CA with UL MIMO

NR UL CA Configuration	Class 1.5 (dBm)	Tolerance (dB)	Class 2 (dBm)	Tolerance (dB)	Class 3 (dBm)	Tolerance (dB)
CA_n1A-n79A			26	+2/-3	23	+2/-3
NOTE 1: An uplink CA configuration in which at least one of the bands has NOTE 3 in Table 6.2.1-1 is allowed to reduce the lower tolerance limit by 1.5 dB when the transmission bandwidths of at least one of the bands is confined within F_{UL_low} and $F_{UL_low} + 4$ MHz or $F_{UL_high} - 4$ MHz and F_{UL_high} . NOTE 2: The per band power class applicable to REFSSENS exceptions is specified in Table 6.2H.3.1-2. NOTE 5: Power class 3 is default power class unless otherwise stated.						

5.20.3 MSD scenario studies

Based on TR38.716-02-00_[6] Table 6.6.1.3-2, there is no harmonic mixing issue for the band combination of n1 and n79.

Based on TR38.716-02-00_[6] Table 6.6.2.1-1, the 3rd and 4th order IMD may fall into own Rx of band n79. Since band n79 is TDD band, it is no need to consider the IMD issue for band n79 which means no self-interference for the TDD band n79.

Table 5.20.3-1 summarizes frequency ranges where harmonics mixing, cross band leakage, IMD interferences occur for CA_n1-n79.

Table 5.20.3-1: MSD scenarios for CA_n1-n79 with total power class 2

	Aggressor Tx	Victim Rx	Whether 2Tx requirements exists
Harmonic mixing	N/A	N/A	N/A

Cross band leakage	N/A	N/A	N/A
IMD	N/A	N/A	N/A

5.20.4 REFSENS requirements

5.20.4.1 REFSENS requirements for total power class 2

- There is no 2Tx MSD due to harmonic mixing, cross band leakage and IMD, which is applicable for 3Tx.

5.21 CA_n3-n79

5.21.1 Operating band

Table 5.21.1-1: CA band combination of band n3+n79

NR CA Band combination	NR Band
CA_n3-n79	n3, n79

5.21.2 Maximum output power

Maximum output power for inter-band CA

Table 5.21.2-1: UE Power Class for 3Tx inter-band CA with UL MIMO

NR UL CA Configuration	Class 1.5 (dBm)	Tolerance (dB)	Class 2 (dBm)	Tolerance (dB)	Class 3 (dBm)	Tolerance (dB)
CA_n3A-n79A			26	+2/-3	23	+2/-3
NOTE 1: An uplink CA configuration in which at least one of the bands has NOTE 3 in Table 6.2.1-1 is allowed to reduce the lower tolerance limit by 1.5 dB when the transmission bandwidths of at least one of the bands is confined within F_{UL_low} and $F_{UL_low} + 4$ MHz or $F_{UL_high} - 4$ MHz and F_{UL_high} . NOTE 2: The per band power class applicable to REFSENS exceptions is specified in Table 6.2H.3.1-2. NOTE 5: Power class 3 is default power class unless otherwise stated.						

5.21.3 MSD scenario studies

Based on TR37.865-01-01^[5] Table 6.6.1.3-1 and 6.6.1.3-2, there is no harmonic issue for the band combination of n3 and n79.

Based on analysis of TR38.716-02-00^[6] clause 6.2.2.2, no IMD issues are expected for this CA configuration with dual uplink carrier.

Table 5.21.3-1 summarizes frequency ranges where harmonics mixing, cross band leakage, IMD interferences occur for CA_n3-n79.

Table 5.21.3-1: MSD scenarios for CA_n3-n79 with total power class 2

	Aggressor Tx	Victim Rx	Whether 2Tx requirements exists
Harmonic mixing	N/A	N/A	N/A
Cross band leakage	N/A	N/A	N/A

IMD	N/A	N/A	N/A
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5.21.4 REFSENS requirements

5.21.4.1 REFSENS requirements for total power class 2

- There is no 2Tx MSD due to harmonic mixing, cross band leakage and IMD, which is applicable for 3Tx.

5.22 CA_n28-n79

5.22.1 Operating band

Table 5.22.1-1: CA band combination of band n28+n79

NR CA Band combination	NR Band
CA_n28-n79	n28, n79

5.22.2 Maximum output power

Maximum output power for inter-band CA

Table 5.22.2-1: UE Power Class for 3Tx inter-band CA with UL MIMO

NR UL CA Configuration	Class 1.5 (dBm)	Tolerance (dB)	Class 2 (dBm)	Tolerance (dB)	Class 3 (dBm)	Tolerance (dB)
CA_n28A-n79A			26	+2/-3	23	+2/-3
NOTE 1: An uplink CA configuration in which at least one of the bands has NOTE 3 in Table 6.2.1-1 is allowed to reduce the lower tolerance limit by 1.5 dB when the transmission bandwidths of at least one of the bands is confined within F_{UL_low} and $F_{UL_low} + 4$ MHz or $F_{UL_high} - 4$ MHz and F_{UL_high} . NOTE 2: The per band power class applicable to REFSENS exceptions is specified in Table 6.2H.3.1-2. NOTE 5: Power class 3 is default power class unless otherwise stated.						

5.22.3 MSD scenario studies

Based on TR38.716-02-00_[6] Table 6.9.1.3-2, there is no harmonic mixing issue for the band combination of n28 and n79.

Based on TR38.716-02-00_[6] Table 6.9.2.2-1, there is no IMD issue for band combination of n28 and n79.

Table 5.22.3-1 summarizes frequency ranges where harmonics mixing, cross band leakage, IMD interferences occur for CA_n28-n79.

Table 5.22.3-1: MSD scenarios for CA_n28-n79 with total power class 2

	Aggressor Tx	Victim Rx	Whether 2Tx requirements exists
Harmonic mixing	N/A	N/A	N/A
Cross band leakage	N/A	N/A	N/A
IMD	N/A	N/A	N/A

5.22.4 REFSSENS requirements

5.22.4.1 REFSSENS requirements for total power class 2

- There is no 2Tx MSD due to harmonic mixing, cross band leakage and IMD, which is applicable for 3Tx.

-- End of TP --

-- Unaffected parts omitted --

6 High Power UE CA of 3 bands DL and 1 or 2 bands UL

6.0 CA_nX-nY-nZ

6.0.1 Configurations

<Editor's note: the CA configurations and bandwidth combinations sets should be kept same as defined in 38.101-1 Table 5.5A.3.2-1x unless additional clarification>

Table 6.0.1-1: NR CA configurations and bandwidth combinations sets defined for inter-band CA (three bands)

NR CA configuration	Uplink CA configuration or single uplink carrier	NR Band	Channel bandwidth (MHz)	Bandwidth combination set
CA_nX-nY-nZ	nX ^{7,9} , nY ^{7,9} , CA_nX-nY ^{7,9}	nX		
		nY		
		nZ		
NOTE 7: Minimum requirements for Power Class 2 are applicable for this uplink combination or single uplink carrier in this downlink/uplink combination				
NOTE 9: Minimum requirements for Power Class 1.5 are applicable for this uplink combination or single uplink carrier in this downlink/uplink combination				

6.0.2 Maximum output power

<Editor's note: In table 6.0.2-1, the power class 2 cases supported by the uplink CA should be kept as the same numbering and others that not supported should be removed. >

Table 6.0.2-1 UE Power Class 2 for uplink inter-band CA (Three bands)

Uplink CA configuration	Power class 2 cases for CA_nX-nY	CA power class	Carrier X power class	Carrier Y power class
CA_nX-nY	Case a	26dBm	23dBm	23dBm
	Case b	26dBm	23dBm	26dBm
	Case c	26dBm	26dBm	23dBm
	Case d	26dBm	26dBm	26dBm

Table 6.0.2-2 UE Power Class 1.5 for uplink inter-band CA (Three bands)

Uplink configuration	CA	Power class 1.5 cases for CA_nX-nY	CA power class	Carrier X power class	Carrier Y power class
CA_nX-nY		Case a	29dBm	26dBm	26dBm
		Case b	29dBm	23dBm	29dBm
		Case c	29dBm	29dBm	23dBm
		Case d	29dBm	26dBm	29dBm
		Case e	29dBm	29dBm	26dBm

6.0.3 REFSENS requirements

<Editor's note: This agenda will capture the Reference sensitivity exceptions or MSD requirements due to higher power for CA carrier, please use the same table format as in 38101-1. The requirements in this TR are intended to be power class 2 cases based, however how to address in the spec will be further discussed. >

6.0.3.1 Power class 2 case a

6.0.4 Δ TIB and Δ RIB values

<Editor's note: If no change by comparing to the values for power class 3 CA, this section will be void.>

6.1 CA_n1-n18-n41

6.1.1 Configurations

Table 6.1.1-1: NR CA configurations and bandwidth combinations sets defined for inter-band CA (three bands)

NR CA configuration	Uplink CA configuration or single uplink carrier	NR Band	Channel bandwidth (MHz)	Bandwidth combination set
CA_n1A-n18A-n41A	CA_n1A-n41A ⁷ CA_n18A-n41A ⁷	n1	5, 10, 15, 20, 25, 30, 40, 50	0
		n18	5, 10, 15	
		n41	10, 15, 20, 30, 40, 50, 60, 80, 90, 100	
NOTE 7: Minimum requirements for Power Class 2 are applicable for this uplink combination or single uplink carrier in this downlink/uplink combination				

6.1.2 Maximum output power

Table 6.1.2-1 UE Power Class 2 for uplink inter-band CA (Three bands)

Uplink configuration	CA	Power class 2 cases for CA_nX-nY	CA power class	Carrier X power class	Carrier Y power class
CA_n1-n41		Case a	26dBm	23dBm	23dBm
		Case b	26dBm	23dBm	26dBm
CA_n18-n41		Case a	26dBm	23dBm	23dBm
		Case b	26dBm	23dBm	26dBm

6.1.3 REFSSENS requirements

Analysis of REFSSENS exceptions or MSD requirements is needed due to higher power uplink.

6.1.3.1 Power class 2 case a, b

Based on calculation, IMD5 of dual UL CA_n1A-n41A falls into n18 DL. The MSD exception is defined as below.

Table 6.1.3-1: 3DL/2UL inter-band Reference sensitivity QPSK PREFSENS and uplink/downlink configurations for PC2 CA

Band / Channel bandwidth / N _{RB} / Duplex mode								Source of IMD
NR CA Configuration	NR band	UL F _c (MHz)	UL/DL BW (MHz)	UL C _{LRB}	DL F _c (MHz)	MSD (dB)	Duplex mode	
CA_n1-n18-n41	n1	1960	5	25	2150	N/A	FDD	N/A
	n41	2505	10	50	2505	N/A	TDD	N/A
	n18	N/A	5	N/A	870	12.4	FDD	IMD5

6.1.4 Δ TIB and Δ RIB values

There is no change by comparing to the values for PC3 CA.

6.2 CA_n3-n18-n41

6.2.1 Configurations

Table 6.2.1-1: NR CA configurations and bandwidth combinations sets defined for inter-band CA (three bands)

NR CA configuration	Uplink CA configuration or single uplink carrier	NR Band	Channel bandwidth (MHz)	Bandwidth combination set
CA_n3A-n18A-n41A	CA_n3A-n41A ⁷ CA_n18A-n41A ⁷	n3	5, 10, 15, 20, 25, 30, 40	0
		n18	5, 10, 15	
		n41	10, 15, 20, 30, 40, 50, 60, 80, 90, 100	
NOTE 7: Minimum requirements for Power Class 2 are applicable for this uplink combination or single uplink carrier in this downlink/uplink combination				

6.2.2 Maximum output power

Table 6.2.2-1 UE Power Class 2 for uplink inter-band CA (Three bands)

Uplink CA configuration	Power class 2 cases for CA_nX-nY	CA power class	Carrier X power class	Carrier Y power class
CA_n3-n41	Case a	26dBm	23dBm	23dBm
	Case b	26dBm	23dBm	26dBm
CA_n18-n41	Case a	26dBm	23dBm	23dBm
	Case b	26dBm	23dBm	26dBm

6.2.3 REFSSENS requirements

Analysis of REFSSENS exceptions or MSD requirements is needed due to higher power uplink.

6.2.3.1 Power class 2 case a, b

Based on calculation, IMD2 and IMD3 of dual UL CA_n3A-n41A fall into n18 DL, and IMD2 of dual UL CA_n18A-n41A falls in to n3 DL. The MSD exceptions are defined as follows.

Table 6.2.3-1: 3DL/2UL inter-band Reference sensitivity QPSK PREFSENS and uplink/downlink configurations for PC2 CA

Band / Channel bandwidth / N _{RB} / Duplex mode								Source of IMD
NR CA Configuration	NR band	UL F _c (MHz)	UL/DL BW (MHz)	UL C _{LRB}	DL F _c (MHz)	MSD (dB)	Duplex mode	
CA_n3-n18-n41	n18	N/A	5	N/A	865	34.9	FDD	IMD2
	n3	1765	5	25	1860	N/A	FDD	N/A
	n41	2630	10	50	2630	N/A	TDD	N/A
	n18	N/A	5	N/A	875	28	FDD	IMD3
	n3	1725	5	25	1820	N/A	FDD	N/A
	n41	2670	5	25	2670	N/A	TDD	N/A
	n3	N/A	5	N/A	1850	34.8	FDD	IMD2
	n41	2670	10	50	2670	N/A	TDD	N/A
	n18	820	5	25	865	N/A	FDD	N/A

6.2.4 ΔTIB and ΔRIB values

There is no change by comparing to the values for PC3 CA.

6.3 CA_n18-n28-n41

6.3.1 Configurations

Table 6.3.1-1: NR CA configurations and bandwidth combinations sets defined for inter-band CA (three bands)

NR CA configuration	Uplink CA configuration or single uplink carrier	NR Band	Channel bandwidth (MHz)	Bandwidth combination set
CA_n18A-n28A-n41A	CA_n18A-n41A ⁷ CA_n28A-n41A ⁷	n18	5, 10, 15	0
		n28	5, 10	
		n41	10, 15, 20, 30, 40, 50, 60, 80, 90, 100	
NOTE 7: Minimum requirements for Power Class 2 are applicable for this uplink combination or single uplink carrier in this downlink/uplink combination				

6.3.2 Maximum output power

Table 6.3.2-1 UE Power Class 2 for uplink inter-band CA (Three bands)

Uplink CA configuration	Power class 2 cases for CA_nX-nY	CA power class	Carrier X power class	Carrier Y power class
CA_n18-n41	Case a	26dBm	23dBm	23dBm

	Case b	26dBm	23dBm	26dBm
CA_n28-n41	Case a	26dBm	23dBm	23dBm
	Case b	26dBm	23dBm	26dBm

6.3.3 REFSENS requirements

Analysis of REFSENS exceptions or MSD requirements is needed due to higher power uplink.

6.3.3.1 Power class 2 case a, b

Based on calculation, IMD5 of dual UL CA_n18A-n41A falls into n28 DL. The MSD exception is defined as below.

Table 6.3.3-1: 3DL/2UL inter-band Reference sensitivity QPSK PREFSENS and uplink/downlink configurations for PC2 CA

Band / Channel bandwidth / N _{RB} / Duplex mode								Source of IMD
NR CA Configuration	NR band	UL F _c (MHz)	UL/DL BW (MHz)	UL C _{LRB}	DL F _c (MHz)	MSD (dB)	Duplex mode	
CA_n18-n28-n41	n18	825	5	25	870	N/A	FDD	N/A
	n41	2505	10	50	2505	N/A	TDD	N/A
	n28	N/A	5	N/A	795	16.9	FDD	IMD5

6.3.4 Δ TIB and Δ RIB values

There is no change by comparing to the values for PC3 CA.

6.4 CA_n1-n18-n77

6.4.1 Configurations

Table 6.4.1-1: NR CA configurations and bandwidth combinations sets defined for inter-band CA (three bands)

NR CA configuration	Uplink CA configuration or single uplink carrier	NR Band	Channel bandwidth (MHz)	Bandwidth combination set
CA_n1A-n18A-n77A CA_n1A-n18A-n77(2A)	CA_n1A-n77A ⁷ CA_n18A-n77A ⁷	n1	5, 10, 15, 20, 25, 30, 40, 50	0
		n18	5, 10, 15	
		n77	10, 15, 20, 40, 50, 60, 80, 90, 100	
		n77	CA_n77(2A)_BCS1	
NOTE 7: Minimum requirements for Power Class 2 are applicable for this uplink combination or single uplink carrier in this downlink/uplink combination.				
NOTE 9: Minimum requirements for Power Class 1.5 are applicable for this uplink combination or single uplink carrier in this downlink/uplink combination.				

6.4.2 Maximum output power

Table 6.4.2-1 UE Power Class 2 for uplink inter-band CA (Three bands)

Uplink CA configuration	Power class 2 cases for CA_nX-nY	CA power class	Carrier X power class	Carrier Y power class
CA_n1-n77	Case a	26dBm	23dBm	23dBm
	Case b	26dBm	23dBm	26dBm

CA_n18-n77	Case a	26dBm	23dBm	23dBm
	Case b	26dBm	23dBm	26dBm

6.4.3 REFSSENS requirements

Analysis of REFSSENS exceptions or MSD requirements is needed due to higher power uplink.

6.4.3.1 Power class 2 case a, b

Based on calculation, IMD5 of dual UL CA_n1A-n77A falls into n18 DL, IMD3 of dual UL CA_n18A-n77A falls into n1 DL, the MSD exceptions are defined as below

Table 6.4.3-1: 3DL/2UL inter-band Reference sensitivity QPSK PREFSENS and uplink/downlink configurations for PC2 CA

Band / Channel bandwidth / N _{RB} / Duplex mode								Source of IMD
NR CA band combination	NR band	UL F _c (MHz)	UL/DL BW (MHz)	UL L _{CRB}	DL F _c (MHz)	MSD (dB)	Duplex mode	
CA_n1-n18-n77 CA_n1-n18-n77(2A)	n1	1970	5	25	2160	N/A	FDD	N/A
	n77	3390	10	50	3390	N/A	TDD	N/A
	n18	N/A	5	N/A	870	18.6	FDD	IMD5
	n1	N/A	5	N/A	2120	25.4	FDD	IMD3
	n18	825	5	25	870	N/A	FDD	N/A
	n77	3770	10	50	3770	N/A	TDD	N/A

6.4.4 Δ TIB and Δ RIB values

There is no change by comparing to the values for PC3 CA.

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6.5 CA_n1-n26-n78

6.5.1 Configurations

Table 6.5.1-1: NR CA configurations and bandwidth combinations sets defined for inter-band CA (three bands)

NR CA configuration	Uplink CA configuration or single uplink carrier	NR Band	Channel bandwidth (MHz)	Bandwidth combination set
CA_n1A-n26A-n78A	CA_n1A-n26A CA_n1A-n78A ⁷ CA_n26A-n78A ⁷	n1	5, 10, 15, 20	0
		n26	5, 10, 15, 20	
		n78	10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100	
CA_n1A-n26A-n78C	CA_n78C CA_n1A-n26A CA_n1A-n78A ⁷ CA_n26A-n78A ⁷	n1	5, 10, 15, 20	0
		n26	5, 10, 15, 20	
		n78	CA_n78C_BCS0	
CA_n1A-n26(2A)-n78A	CA_n1A-n26A CA_n1A-n78A ⁷ CA_n26A-n78A ⁷ CA_n26(2A)	n1	5, 10, 15, 20, 25, 30, 40, 45, 50	0
		n26	CA_n26(2A)_BCS0	
		n78	10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100	
CA_n1A-n26A-n78(2A)	CA_n1A-n26A CA_n1A-n78A ⁷ CA_n26A-n78A ⁷	n1	5, 10, 15, 20, 25, 30, 40, 45, 50	0
		n26	5, 10, 15, 20, 25, 30	
		n78	CA_n78(2A)_BCS0	
CA_n1A-n26(2A)-n78(2A)	CA_n1A-n26A CA_n1A-n78A ⁷ CA_n26A-n78A ⁷ CA_n26(2A)	n1	5, 10, 15, 20, 25, 30, 40, 45, 50	0
		n26	CA_n26(2A)_BCS0	
		n78	CA_n78(2A)_BCS0	
CA_n1A-n26(2A)-n78C	CA_n26(2A) CA_n78C CA_n1A-n26A CA_n1A-n78A ⁷ CA_n26A-n78A ⁷	n1	5, 10, 15, 20, 25, 30, 40, 45, 50	0
		n26	CA_n26(2A)_BCS0	
		n78	CA_n78C_BCS0	
NOTE 7: Minimum requirements for Power Class 2 are applicable for this uplink combination or single uplink carrier in this downlink/uplink combination				

6.5.2 Maximum output power

Table 6.5.2-1 UE Power Class 2 for uplink inter-band CA (Three bands)

Uplink CA configuration	Power class 2 cases for CA_nX-nY	CA power class	Carrier X power class	Carrier Y power class
CA_n1-n78	Case a	26dBm	23dBm	23dBm
	Case b	26dBm	23dBm	26dBm
CA_n26-n78	Case a	26dBm	23dBm	23dBm
	Case b	26dBm	23dBm	26dBm

6.5.3 REFSSENS requirements

Analysis of REFSSENS exceptions or MSD requirements is needed due to higher power uplink.

6.5.3.1 Power class 2 case a, b

Based on calculation, IMD5 of dual UL CA_n1A-n78A falls into n26 DL.

Based on calculation, IMD3 of dual UL CA_n26A-n78A falls into n1 DL.

The MSD exception is defined as below.

Table 6.5.3-1: 3DL/2UL inter-band Reference sensitivity QPSK P_{REFSENS} and uplink/downlink configurations for PC2 CA

Band / Channel bandwidth / N_{RB} / Duplex mode								Source of IMD
NR CA Configuration	NR band	UL F_c (MHz)	UL/DL BW (MHz)	UL C_{LRB}	DL F_c (MHz)	MSD (dB)	Duplex mode	
CA_n1-n26-n78	n1	N/A	5	N/A	2122	27.0	FDD	IMD3
	n26	829	5	25	874	N/A	FDD	N/A
	n78	3780	10	50	3780	N/A	TDD	N/A
	n1	1975	5	25	2165	N/A	FDD	N/A
	n26	N/A	5	N/A	885	15.3	FDD	IMD5
	n78	3405	10	50	3405	N/A	TDD	N/A

6.5.4 ΔTIB and ΔRIB values

There is no change by comparing to the values for PC3 CA.

6.6 CA_n3-n26-n78

6.6.1 Configurations

Table 6.6.1-1: NR CA configurations and bandwidth combinations sets defined for inter-band CA (three bands)

CA_n3A-n26A-n78A	CA_n3A-n26A CA_n3A-n78A ⁷ CA_n26A-n78A ⁷	n3	5, 10, 15, 20, 25, 30, 40	0
		n26	5, 10, 15, 20	
		n78	10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100	
CA_n3A-n26A-n78(2A)	CA_n3A-n26A CA_n3A-n78A ⁷ CA_n26A-n78A ⁷	n3	5, 10, 15, 20, 25, 30, 35, 40, 45, 50	0
		n26	5, 10, 15, 20, 25, 30	
		n78	CA_n78(2A)_BCS0	
CA_n3A-n26A-n78C	CA_n3A-n26A CA_n3A-n78A ⁷ CA_n26A-n78A ⁷ CA_n78C	n3	5, 10, 15, 20, 25, 30, 35, 40, 45, 50	0
		n26	5, 10, 15, 20, 25, 30	
		n78	CA_n78C_BCS0	
CA_n3A-n26(2A)-n78A	CA_n3A-n26A CA_n3A-n78A ⁷ CA_n26A-n78A ⁷ CA_n26(2A)	n3	5, 10, 15, 20, 25, 30, 35, 40, 45, 50	0
		n26	CA_n26(2A)_BCS0	
		n78	10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100	
CA_n3A-n26(2A)-n78(2A)	CA_n3A-n26A CA_n3A-n78A ⁷ CA_n26A-n78A ⁷ CA_n26(2A)	n3	5, 10, 15, 20, 25, 30, 35, 40, 45, 50	0
		n26	CA_n26(2A)_BCS0	
		n78	CA_n78(2A)_BCS0	
CA_n3A-n26(2A)-n78C	CA_n3A-n26A CA_n3A-n78A ⁷ CA_n26A-n78A ⁷ CA_n26(2A) CA_n78C	n3	5, 10, 15, 20, 25, 30, 35, 40, 45, 50	0
		n26	CA_n26(2A)_BCS0	
		n78	CA_n78C_BCS0	
CA_n3B-n26A-n78A	CA_n3A-n26A CA_n3A-n78A ⁷ CA_n26A-n78A ⁷	n3	CA_n3B_BCS0	0
		n26	5, 10, 15, 20, 25, 30	
		n78	10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100	
CA_n3B-n26A-n78(2A)	CA_n3A-n26A CA_n3A-n78A ⁷ CA_n26A-n78A ⁷	n3	CA_n3B_BCS0	0
		n26	5, 10, 15, 20, 25, 30	
		n78	CA_n78(2A)_BCS0	
CA_n3B-n26A-n78C	CA_n3A-n26A CA_n3A-n78A ⁷ CA_n26A-n78A ⁷ CA_n78C	n3	CA_n3B_BCS0	0
		n26	5, 10, 15, 20, 25, 30	
		n78	CA_n78B_BCS0	
CA_n3B-n26(2A)-n78A	CA_n3A-n26A CA_n3A-n78A ⁷ CA_n26A-n78A ⁷ CA_n26(2A)	n3	CA_n3B_BCS0	0
		n26	CA_n26(2A)_BCS0	
		n78	10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100	
CA_n3B-n26(2A)-n78(2A)	CA_n3A-n26A CA_n3A-n78A ⁷ CA_n26A-n78A ⁷ CA_n26(2A)	n3	CA_n3B_BCS0	0
		n26	CA_n26(2A)_BCS0	
		n78	CA_n78(2A)_BCS0	

CA_n3B-n26(2A)-n78C	CA_n3A-n26A CA_n3A-n78A ⁷ CA_n26A-n78A ⁷ CA_n26(2A) CA_n78C	n3	CA_n3B_BCS0	0
		n26	CA_n26(2A)_BCS0	
		n78	CA_n78C_BCS0	
NOTE 7: Minimum requirements for Power Class 2 are applicable for this uplink combination or single uplink carrier in this downlink/uplink combination				

6.6.2 Maximum output power

Table 6.6.2-1 UE Power Class 2 for uplink inter-band CA (Three bands)

Uplink configuration	CA	Power class 2 cases for CA_nX-nY	CA power class	Carrier X power class	Carrier Y power class
CA_n3-n78		Case a	26dBm	23dBm	23dBm
		Case b	26dBm	23dBm	26dBm
CA_n26-n78		Case a	26dBm	23dBm	23dBm
		Case b	26dBm	23dBm	26dBm

6.6.3 REFSSENS requirements

Analysis of REFSSENS exceptions or MSD requirements is needed due to higher power uplink.

6.6.3.1 Power class 2 case a, b

Based on calculation, no IMD of dual UL CA_n3A-n78A falls into n26 DL.

Based on calculation, IMD3 of dual UL CA_n26A-n78A falls into n3 DL.

The MSD exception is defined as below.

Table 6.6.3-1: 3DL/2UL inter-band Reference sensitivity QPSK PREFSENS and uplink/downlink configurations for PC2 CA

CA_n3-n26-n78	n3	N/A	5	N/A	1862	24.6	FDD	IMD3
	n26	839	5	25	884	N/A	FDD	N/A
	n78	3540	10	50	3540	N/A	TDD	N/A

6.6.4 Δ TIB and Δ RIB values

There is no change by comparing to the values for PC3 CA.

6.9 CA_n25-n41-n77 2Tx and 3Tx

6.9.1 Operating bands for CA and Configurations

Table 6.9.1-1: CA band combination of band n25+n41+n77

NR CA Band combination	NR Band
CA_n25-n41-n77	n25, n41, n77

Table 6.9.1-2: NR CA configurations and bandwidth combinations sets defined for inter-band CA (three bands)

NR CA configuration	Uplink CA configuration or single uplink carrier ⁶	NR Band	Channel bandwidth (MHz) (NOTE 3)	Bandwidth combination set
CA_n25A-n41A-n77A	n41 ^{7,9} n77 ^{7,9} CA_n25A-n41A ^{7,13,14} CA_n25A-n77A ^{7,13} CA_n41A-n77A ^{7,9,13,14}	n25	5, 10, 15, 20, 25, 30, 40	0
		n41	10, 15, 20, 30, 40, 50, 60, 80, 90, 100	
		n77	10, 15, 20, 25, 30, 40, 50, 60, 80, 90, 100	
		n25	5, 10, 15, 20, 25, 30, 40	1
		n41	10, 15, 20, 30, 40, 50, 60, 80, 90, 100	
		n77	10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100	
		n25	n25 channel bandwidths in Table 5.3.5-1	4 and 5
		n41	n41 channel bandwidths in Table 5.3.5-1	
		n77	n77 channel bandwidths in Table 5.3.5-1	
NOTE 7: Minimum requirements for Power Class 2 are applicable for this uplink combination or single uplink carrier in this downlink/uplink combination				
NOTE 9: Minimum requirements for Power Class 1.5 are applicable for this uplink combination or single uplink carrier in this downlink/uplink combination				
NOTE 13: Minimum requirements for Power Class 2 are applicable for this uplink configuration with 1Tx antenna connector in one band and 2Tx antenna connectors in the other band.				
NOTE 14: Minimum requirements for Power Class 1.5 are applicable for this uplink configuration with 1Tx antenna connector in one band and 2Tx antenna connectors in the other band.				

6.9.2 Maximum output power for inter-band CA

Changes needed to the 3Tx tables in 38.101-1 highlighted in yellow. 2Tx UL PC1.5 Is being completed at RAN4#116.

Table 6.9.2-1: UE Power Class for 3Tx inter-band CA with UL MIMO and/or TxD

NR UL CA Configuration	Class 1.5 (dBm)	Tolerance (dB)	Class 2 (dBm)	Tolerance (dB)	Class 3 (dBm)	Tolerance (dB)
CA_n25A-n41A	29 ³	+2/-3	26 ²	+2/-3	23	+2/-3
CA_n41A-n77A	29	+2/-3	26 ²	+2/-3	23	+2/-3
NOTE 1: (Void in this TR) NOTE 2: The UE supports PC3 in FDD band and PC3 or PC2 with UL MIMO in TDD band. NOTE 3: The UE supports PC3 in FDD band and PC1.5 with UL MIMO in TDD band.						

Table 6.9.2-2: Void

Table 6.9.2-3: UE Power Class for uplink inter-band CA (two bands)

Uplink CA Configuration	Class 1.5 (dBm)	Tolerance (dB)	Class 2 (dBm)	Tolerance (dB)	Class 3 (dBm)	Tolerance (dB)	Class 5 (dBm)	Tolerance (dB)
CA_n41A-n77A	29 ^x	+2/-3	26 ⁹	+2/-3	23	+2/-3		
NOTE 1: Void NOTE 2: An uplink CA configuration in which at least one of the bands has NOTE 3 in Table 6.2.1-1 is allowed to reduce the lower tolerance limit by 1.5 dB when the transmission bandwidths of at least one of the bands is confined within F_{UL_low} and $F_{UL_low} + 4$ MHz or $F_{UL_high} - 4$ MHz and F_{UL_high}. NOTE 3: $P_{PowerClass}$ is the maximum UE power specified without taking into account the tolerance NOTE 4: For inter-band carrier aggregation the maximum power requirement should apply to the total transmitted power over all component carriers (per UE). NOTE 5: Power class 3 is the default power class unless otherwise stated. NOTE 6: The UE supports PC3 within NR FDD band, and supports either PC3 or PC2 within NR TDD band. NOTE 7: The UE that supports a PC2 uplink CA configuration with single carrier for each individual band and a composite of supporting PC3 within an NR TDD or FDD band and PC2 within a second NR TDD band may signal a <i>higherPowerLimit-r17</i> capability whereby the maximum output power indicated in the table may be exceeded in accordance with sub-clause 6.2A.4.1.3. The power classes referenced are according to the reported <i>ue-PowerClassPerBandPerBC-r17</i> if indicated or <i>ue-PowerClass</i> otherwise. NOTE 8: The UE that supports a PC3 uplink CA configuration with a composite of supporting PC3 within an NR TDD or FDD band and PC5 within a second NR band listed in Table 6.2F.1-1 may signal a <i>higherPowerLimit-r17</i> capability whereby the maximum output power indicated in the table may be exceeded in accordance with sub-clause 6.2A.4.1.3. The power classes referenced are according to the reported <i>ue-PowerClassPerBandPerBC-r17</i> if indicated or <i>ue-PowerClass</i> otherwise. NOTE 9: The UE supports either PC3 or PC2 within each NR TDD band. NOTE x: The UE supports PC2 within each band.								

6.9.3 MSD scenario studies

3BDL/2BUL configurations only have MSD requirements for intermodulation.

Table 6.9.3-1 and 6.9.3-2 summarizes frequency ranges where harmonic mixing, cross band leakage, IMD interferences occur for CA_n25-n41-n77.

Table 6.9.3-1: Intermodulation MSD scenarios for DL CA_n25A-n41A-n77A with total power class 2

Uplink combination	IMD	Aggressor Tx	Victim Rx	Whether 2Tx requirements exists
CA_n25A-n41A	IMD3	$2*f_{n41} - f_{n25}$	n77	Yes
	IMD5	$3*f_{n41} - 2*f_{n25}$	n77	Yes
CA_n25A-n77A	IMD5	$2*f_{n77} - 3*f_{n25}$	n41	Yes (but not testable for US deployments)
CA_n41A-n77A	IMD3	$2*f_{n41} - f_{n77}$	n25	Yes (but not testable for US deployments)
	IMD4	$2*f_{n77} - 2*f_{n41}$	n25	Yes

Table 6.9.3-2: Intermodulation MSD scenarios for DL CA_n25A-n41A-n77A with total power class 1.5

Uplink combination	IMD	Aggressor Tx	Victim Rx	Whether 2Tx requirements exists
CA_n25A-n41A	IMD3	$2*f_{n41} - f_{n25}$	n77	No
	IMD5	$3*f_{n41} - 2*f_{n25}$	n77	No
CA_n25A-n41A	IMD5	$2*f_{n77} - 3*f_{n25}$	n41	Yes (but not testable for US deployments)
CA_n41A-n77A	IMD3	$2*f_{n41} - f_{n77}$	n25	Yes (but not testable for US deployments)
	IMD4	$2*f_{n77} - 2*f_{n41}$	n25	Yes

6.9.4 REFSSENS requirements

6.9.4.1 REFSSENS requirements for total power class 2

- The MSD due to intermodulation PC2 for UL CA_n25A-n41A is already specified in 38.101-1.
- The MSD due to intermodulation PC2 for UL CA_n25A-n77A is already specified in 38.101-1.
- The MSD due to intermodulation PC2 for UL CA_n41A-n77A is already specified in 38.101-1.

6.9.4.2 REFSSENS requirements for total power class 1.5

For UL CA_n25A-n41A PC1.5 with 3Tx, since the n25 power remains PC3, the n41 power increases by 4.7 dB compared to PC2 UL CA_n25A-n41A.

For the CA_n25A-n41A IMD3, since only the n41 power is changing by 4.7 dB, the interferer increases by $X=2*4.7 = 9.4$ dB, so the MSD increases from 23.7 dB to 33.1 dB, using the following equation:

$$= 10 * \log_{10} \left(1 + 10^{X/10} (10^{MSD/10} - 1) \right)$$

For the CA_n25A-n41A IMD5, since only the n41 power is changing by 4.7 dB, the interferer increases by $X=3*4.7 = 14.1$ dB, so the MSD increases from 17.2 dB to 31.2 dB, using the equation above.

The MSD due to IMDs for PC1.5 3Tx are specified in the following table. At the time of this TP, the 3DL/2UL PC1.5 table does not yet exist in 38.101.1.

Table 6.9.4.2-1: 3DL/2UL inter-band Reference sensitivity QPSK PREFSENS and uplink/downlink configurations for PC1.5 CA

NR CA Configuration	Band / Channel bandwidth / NRB / Duplex mode							Source of IMD
	NR band	UL F _c (MHz)	UL/DL BW (MHz)	UL L _{CRB}	DL F _c (MHz)	MSD (dB)	Duplex mode	
CA_n25-n41-n77	n25	1870	5	25	1950	N/A	FDD	N/A
	n41	2670	5	25	2670	N/A	TDD	N/A
	n77	N/A	10	N/A	3470	33.1	TDD	IMD3
	n25	1900	5	25	1980	N/A	FDD	N/A
	n41	2525	5	25	2645	N/A	TDD	N/A
	n77	N/A	10	N/A	3775	31.2	TDD	IMD5

6.9.4.3 REFSENS requirements for total PC2 and PC1.5 based on LUT

The FDD+TDD PC1.5 MSD in 6.9.4.2 was based on 23 dBm in the FDD band and 27.8 dBm in the TDD band. The 26+26 dBm MSD can be calculated using the Look Up Table approach.

Table 6.9.4.3-1 UE PC35A-n41A-n77A with U MSD

Uplink CA configuration	Victim Band	IMD	PC3 MSD (dB)
CA_n25-n41	n77	IMD3	14.8
		IMD5	4.2
CA_n25-n77	n41	IMD5	5.3
CA_n41-n77	n25	IMD3	17.6
		IMD4	8.6

6.9.5 Δ TIB and Δ RIB values

There is no change by comparing to the values for PC3 CA.

6.10 CA_n41-n66-n77 2Tx and 3Tx

6.10.1 Operating bands for CA and Configurations

Table 6.10.1-1: CA band combination of band n25+n41+n77

NR CA Band combination	NR Band
CA n41-n66-n77	n25, n41, n77

Table 6.10.1-1: NR CA configurations and bandwidth combinations sets defined for inter-band CA (three bands)

NR CA configuration	Uplink CA configuration or single uplink carrier ⁶ n41 ^{7,9} n77 ^{7,9} CA_n41A-n66A ^{7,13,14} CA_n41A-n77A ^{7,9,13,14} CA_n66A-n77A ^{7,13,14}	NR Band	Channel bandwidth (MHz) (NOTE 3)	Bandwidth combination set
		n41	10, 15, 20, 30, 40, 50, 60, 80, 90, 100	
CA_n41A-n66A-n77A		n66	5, 10, 15, 20, 25, 30, 40	0
		n77	10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100	
		n41	10, 15, 20, 30, 40, 50, 60, 70, 80, 90, 100	1
		n66	5, 10, 15, 20, 25, 30, 40	
		n77	10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100	
		n41	n41 channel bandwidths in Table 5.3.5-1	4 and 5
		n66	n66 channel bandwidths in Table 5.3.5-1	
		n77	n77 channel bandwidths in Table 5.3.5-1	

6.10.2 Maximum output power for inter-band CA

No changes needed to the 3Tx tables in 38.101-1. Changes for UL CA_n41A-n77A PC1.5 are captured in 6.9.2.

Table 6.10.2-1: UE Power Class for 3Tx inter-band CA with UL MIMO

NR UL CA Configuration	Class 1.5 (dBm)	Tolerance (dB)	Class 2 (dBm)	Tolerance (dB)	Class 3 (dBm)	Tolerance (dB)
CA_n41A-n66A	29 ³	+2/-3	26 ²	+2/-3	23	+2/-3
CA_n66A-n77A	29 ³	+2/-3	26 ²	+2/-3	23	+2/-3
NOTE 1: (Void in this TR)						
NOTE 2: The UE supports PC3 in FDD band and PC3 or PC2 with UL MIMO in TDD band.						
NOTE 3: The UE supports PC3 in FDD band and PC1.5 with UL MIMO in TDD band.						

Table 6.10.2-2: UE Power Class for 3Tx inter-band CA with TxD

NR UL CA Configuration	Class 1.5 (dBm)	Tolerance (dB)	Class 2 (dBm)	Tolerance (dB)	Class 3 (dBm)	Tolerance (dB)
CA_n41A-n66A	29 ³	+2/-3	26 ²	+2/-3	23	+2/-3
CA_n66A-n77A	29 ³	+2/-3	26 ²	+2/-3	23	+2/-3
NOTE 1: (Void in this TR)						
NOTE 2: The UE supports PC3 in FDD band and PC2 with Tx Diversity in TDD band.						
NOTE 3: The UE supports PC3 in FDD band and PC1.5 with Tx Diversity in TDD band.						

6.10.3 MSD scenario studies

3BDL/2BUL configurations only have MSD requirements for intermodulation.

Table 6.10.3-1 and 6.10.3-2 summarizes frequency ranges where harmonic mixing, cross band leakage, IMD interferences occur for DL CA_n41-n66-n77.

Table 6.10.3-1: Intermodulation MSD scenarios for DL CA_n41A-n66A-n77A with total power class 2

Uplink combination	IMD	Aggressor Tx	Victim Rx	Whether 2Tx requirements exists
CA_n41A-n66A	IMD3	$2*f_{n41} - f_{n66}$	n77	Yes
CA_n41A-n77A	IMD4	$2*f_{n77} - 2*f_{n41}$	n66	Yes
CA_n66A-n77A	IMD5	$4*f_{n66} - f_{n41}$	n41	Yes (But not testable for US n77 configurations)

Table 6.10.3-2: Intermodulation MSD scenarios for DL CA_n411A-n66A-n77A with total power class 1.5

Uplink combination	IMD	Aggressor Tx	Victim Rx	Whether 2Tx requirements exists
CA_n41A-n66A	IMD3	$2*f_{n41} - f_{n66}$	n77	No
CA_n41A-n77A	IMD4	$2*f_{n77} - 2*f_{n41}$	n66	Yes
CA_n66A-n77A	IMD5	$4*f_{n66} - f_{n41}$	n41	No

6.10.4 REFSSENS requirements

6.10.4.1 REFSSENS requirements for total power class 2

- The MSD due to intermodulation PC2 for UL CA_n41A-n66A is already specified in 38.101-1.
- The MSD due to intermodulation PC2 for UL CA_n66A-n77A is already specified in 38.101-1.
- The MSD due to intermodulation PC2 for UL CA_n66A-n77A is already specified in 38.101-1.

6.10.4.2 REFSSENS requirements for total power class 1.5

For 2Tx UL CA_n41A-n77A the power increase by 6 dB compared to the PC3 case. The LUT approach should be used to calculate the IMD4 MSD.

For 3Tx UL CA_n41A-n66A PC1.5, since the n66 power remains PC3, the n41 power increases by 4.7 dB compared to UL CA_n41A-n66A PC2.

For the UL CA_n41A-n66A IMD3, since only the n41 power is changing by 4.7 dB, the interferer increases by $X=2*4.7 = 9.4$ dB, so the MSD increases from 25.0 dB to 34.4 dB, using the following equation:

$$New_MSD = 10 * \log_{10} \left(1 + 10^{X/10} (10^{MSD/10} - 1) \right)$$

For the UL CA_n66A-n77A IMD5, since only the n41 power is changing by 4.7 dB, the interferer increases by $X=1*4.7 = 4.7$ dB, so the MSD increases from 18.7 dB to 23.4 dB, using the equation above.

The MSD due to IMDs for PC1.5 3Tx are specified in the following table. At the time of this TP, the 3DL/2UL PC1.5 table does not yet exist in 38.101.1.

Table 6.10.4.2-1: 3DL/2UL inter-band Reference sensitivity QPSK PREFSENS and uplink/downlink configurations for PC1.5 CA

Band / Channel bandwidth / NRB / Duplex mode								Source of IMD
NR CA Configuration	NR band	UL F _c (MHz)	UL/DL BW (MHz)	UL L _{CRB}	DL F _c (MHz)	MSD (dB)	Duplex mode	
CA_n41-n66-n77	n41	2600	5	25	2600	N/A	TDD	N/A
	n66	1730	5	25	2130	N/A	FDD	N/A
	n77	N/A	10	N/A	3470	34.4	TDD	IMD3 ^{1,2}
	n41	N/A	5	N/A	2670	23.4	TDD	IMD5 ⁵
	n66	1715	5	25	2115	N/A	FDD	N/A
	n77	4190	10	50	4190	N/A	TDD	N/A
NOTE 1: This band is subject to IMD5 also which MSD is not specified. NOTE 2: This band is subject to IMD4 also which MSD is not specified. NOTE 3: The requirements only apply for UEs supporting inter-band carrier aggregation with simultaneous Rx/Tx capability. Simultaneous Rx/Tx capability does not apply for UEs supporting band n78 with a n77 implementation. NOTE 4: This band is subject to IMD3 also which MSD is not specified. NOTE 5: For a UE which supports this band combination only when the Band n77 frequency range restriction defined in NOTE 12 of Table 5.2-1 applies, the MSD test point(s) cannot be verified for the band combination and the test point(s) can be skipped. NOTE 6: Both of the transmitters shall be set min(+23 dBm, P_{CMAX,L,f,c}) as defined in clause 6.2A.4								

6.10.4.3 REFSENS requirements based on LUT for PC2 and PC1.5

The PC1.5 analysis in 6.10.4.2 used 23 dBm for n66 and with 27.8 dBm for n41 and n66. The Look Up Table approach analysis uses equal power and can be used to determine the PC2 and PC1.5 MSD.

Table 6.10.4.3-1 UE PC2 and PC1.5 LUT MSD

Uplink CA configuration	Victim Band	IMD	PC3 MSD (dB)
CA_n41A-n66A	n77	IMD3	16.1
CA_n41A-n77A	n66	IMD4	9.0
CA_n66A-n77A	n41	IMD5	5.2

6.11 CA_n41-n66-n77 3Tx

6.11.1 Operating bands for CA and Configurations

Table 6.11.1-1: CA band combination of band n25+n41+n77

NR CA Band combination	NR Band
CA_n25-n41-n77	n25, n41, n77

Table 6.11.1-1: NR CA configurations and bandwidth combinations sets defined for inter-band CA (three bands)

NR CA configuration	Uplink CA configuration or single uplink carrier ⁶ n41 ^{7,9} n77 ^{7,9} CA_n41A-n66A ^{7,13,14} CA_n41A-n77A ⁷ CA_n66A-n77A ^{7,13,14}	NR Band	Channel bandwidth (MHz) (NOTE 3)	Bandwidth combination set
		n41	10, 15, 20, 30, 40, 50, 60, 80, 90, 100	
CA_n41A-n66A-n77A		n66	5, 10, 15, 20, 25, 30, 40	0
		n77	10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100	
		n41	10, 15, 20, 30, 40, 50, 60, 70, 80, 90, 100	
		n66	5, 10, 15, 20, 25, 30, 40	1
		n77	10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100	
		n41	n41 channel bandwidths in Table 5.3.5-1	
		n66	n66 channel bandwidths in Table 5.3.5-1	4 and 5
		n77	n77 channel bandwidths in Table 5.3.5-1	

6.11.2 Maximum output power for inter-band CA

No changes needed to the 3Tx tables in 38.101-1.

Table 6.11.2-1: UE Power Class for 3Tx inter-band CA with UL MIMO

NR UL CA Configuration	Class 1.5 (dBm)	Tolerance (dB)	Class 2 (dBm)	Tolerance (dB)	Class 3 (dBm)	Tolerance (dB)
CA_n41A-n66A	29 ³	+2/-3	26 ²	+2/-3	23	+2/-3
CA_n66A-n77A	29 ³	+2/-3	26 ²	+2/-3	23	+2/-3
NOTE 1: (Void in this TR)						
NOTE 2: The UE supports PC3 in FDD band and PC3 or PC2 with UL MIMO in TDD band.						
NOTE 3: The UE supports PC3 in FDD band and PC1.5 with UL MIMO in TDD band.						

Table 6.11.2-2: UE Power Class for 3Tx inter-band CA with Tx D

NR UL CA Configuration	Class 1.5 (dBm)	Tolerance (dB)	Class 2 (dBm)	Tolerance (dB)	Class 3 (dBm)	Tolerance (dB)
CA_n41A-n66A	29 ³	+2/-3	26 ²	+2/-3	23	+2/-3
CA_n66A-n77A	29 ³	+2/-3	26 ²	+2/-3	23	+2/-3
NOTE 1: (Void in this TR)						
NOTE 2: The UE supports PC3 in FDD band and PC2 with Tx Diversity in TDD band.						
NOTE 3: The UE supports PC3 in FDD band and PC1.5 with Tx Diversity in TDD band.						

6.11.3 MSD scenario studies

3BDL/2BUL configurations only have MSD requirements for intermodulation.

Table 6.11.3-1 and 6.11.3-2 summarizes frequency ranges where harmonic mixing, cross band leakage, IMD interferences occur for DL CA_n41-n66-n77.

Table 6.11.3-1: Intermodulation MSD scenarios for DL CA_n25A-n41A-n77A with total power class 2

Uplink combination	IMD	Aggressor Tx	Victim Rx	Whether 2Tx requirements exists
CA_n41A-n66A	IMD3	2*f n41 – f n66	n77	Yes
CA_n66A-n77A	IMD5	4*f n66 – f n41	n41	Yes (But not testable for US n77 configurations)

Table 6.11.3-2: Intermodulation MSD scenarios for DL CA_n25A-n41A-n77A with total power class 1.5

Uplink combination	IMD	Aggressor Tx	Victim Rx	Whether 2Tx requirements exists
CA_n41A-n66A	IMD3	2*f n41 – f n66	n77	No
CA_n66A-n77A	IMD5	4*f n66 – f n41	n77	No

6.11.4 REFSENS requirements

6.11.4.1 REFSENS requirements for total power class 2

- The MSD due to intermodulation PC2 for UL CA_n41A-n66A is already specified in 38.101-1.
- The MSD due to intermodulation PC2 for UL CA_n66A-n77A is already specified in 38.101-1.

6.11.4.2 REFSENS requirements for total power class 1.5

For UL CA_n41A-n66A PC1.5, since the n66 power remains PC3, the n41 power increases by 4.7 dB compared to UL CA_n41A-n66A PC2.

For the UL CA_n41A-n66A IMD3, since only the n41 power is changing by 4.7 dB, the interferer increases by $X=2*4.7 = 9.4$ dB, so the MSD increases from 25.0 dB to 34.4 dB, using the following equation:

$$New_MSD = 10 * \log_{10} \left(1 + 10^{X/10} (10^{MSD/10} - 1) \right)$$

For the UL CA_n66A-n77A IMD5, since only the n41 power is changing by 4.7 dB, the interferer increases by $X=1*4.7 = 4.7$ dB, so the MSD increases from 18.7 dB to 23.4 dB, using the equation above.

The MSD due to IMDs for PC1.5 3Tx are specified in the following table. At the time of this TP, the 3DL/2UL PC1.5 table does not yet exist in 38.101.1.

Table 6.11.4.2-1: 3DL/2UL inter-band Reference sensitivity QPSK P_{REFSENS} and uplink/downlink configurations for PC1.5 CA

Band / Channel bandwidth / NRB / Duplex mode								Source of IMD
NR CA Configuration	NR band	UL F_c (MHz)	UL/DL BW (MHz)	UL L_{CRB}	DL F_c (MHz)	MSD (dB)	Duplex mode	
CA_n41-n66-n77	n41	2600	5	25	2600	N/A	TDD	N/A
	n66	1730	5	25	2130	N/A	FDD	N/A
	n77	N/A	10	N/A	3470	34.4	TDD	IMD3 ^{1,2}
	n41	N/A	5	N/A	2670	23.4	TDD	IMD5 ⁵
	n66	1715	5	25	2115	N/A	FDD	N/A
	n77	4190	10	50	4190	N/A	TDD	N/A
NOTE 1: This band is subject to IMD5 also which MSD is not specified. NOTE 2: This band is subject to IMD4 also which MSD is not specified. NOTE 3: The requirements only apply for UEs supporting inter-band carrier aggregation with simultaneous Rx/Tx capability. Simultaneous Rx/Tx capability does not apply for UEs supporting band n78 with a n77 implementation. NOTE 4: This band is subject to IMD3 also which MSD is not specified. NOTE 5: For a UE which supports this band combination only when the Band n77 frequency range restriction defined in NOTE 12 of Table 5.2-1 applies, the MSD test point(s) cannot be verified for the band combination and the test point(s) can be skipped. NOTE 6: This band combination is specified with support of two band inter-band UL CA with UL MIMO or Tx diversity capabilities, and the transmitter shall be set at min (+23 dBm, $\text{PCMAX}_{\text{L,f,c}}$) for the UL band with single Tx antenna connector as defined in clause 6.2A.4, and set at min (+27.8 dBm, $\text{PCMAX}_{\text{L,f,c}}$) for the UL band with two Tx antenna connectors as defined in clause 6.2H.3.4 or 6.2L.3.4.								

6.12 CA_n41-n71-n77 2Tx and 3Tx

6.12.1 Operating bands for CA and Configurations

Table 6.12.1-1: CA band combination of band n41+n71+n77

NR CA Band combination	NR Band
CA_n41-n71-n77	n25, n41, n77

Table 6.12.1-1: NR CA configurations and bandwidth combinations sets defined for inter-band CA (three bands)

NR CA configuration	Uplink CA configuration or single uplink carrier ⁶	NR Band	Channel bandwidth (MHz) (NOTE 3)	Bandwidth combination set
CA_n41A-n71A-n77A	n41 ^{7,9} n77 ^{7,9} CA_n41A-n71A ^{7,13,14} CA_n41A-n77A ^{7,9,13,14} CA_n71A-n77A ^{7,13,14}	n41	10, 15, 20, 30, 40, 50, 60, 80, 90, 100	0
		n71	5, 10, 15, 20	
		n77	10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100	
		n41	10, 15, 20, 30, 40, 50, 60, 70, 80, 90, 100	1
		n71	5, 10, 15, 20	
		n77	10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100	
		n41	n41 channel bandwidths in Table 5.3.5-1	4 and 5
		n71	n71 channel bandwidths in Table 5.3.5-1	
		n77	n77 channel bandwidths in Table 5.3.5-1	

6.12.2 Maximum output power for inter-band CA

No changes needed to the 3Tx tables in 38.101-1.

Table 6.12.2-1: UE Power Class for 3Tx inter-band CA with UL MIMO

NR UL CA Configuration	Class 1.5 (dBm)	Tolerance (dB)	Class 2 (dBm)	Tolerance (dB)	Class 3 (dBm)	Tolerance (dB)
CA_n41A-n71A	29 ³	+2/-3	26 ²	+2/-3	23	+2/-3
CA_n71A-n77A	29 ³	+2/-3	26 ²	+2/-3	23	+2/-3
NOTE 1: (Void in this TR)						
NOTE 2: The UE supports PC3 in FDD band and PC3 or PC2 with UL MIMO in TDD band.						
NOTE 3: The UE supports PC3 in FDD band and PC1.5 with UL MIMO in TDD band.						

Table 6.12.2-2: UE Power Class for 3Tx inter-band CA with TxD

NR UL CA Configuration	Class 1.5 (dBm)	Tolerance (dB)	Class 2 (dBm)	Tolerance (dB)	Class 3 (dBm)	Tolerance (dB)
CA_n41A-n71A	29 ³	+2/-3	26 ²	+2/-3	23	+2/-3
CA_n71A-n77A	29 ³	+2/-3	26 ²	+2/-3	23	+2/-3
NOTE 1: (Void in this TR)						
NOTE 2: The UE supports PC3 in FDD band and PC2 with Tx Diversity in TDD band.						
NOTE 3: The UE supports PC3 in FDD band and PC1.5 with Tx Diversity in TDD band.						

Changes for 2Tx UL CA_n41A-n77A PC1.5 are captured in 6.9.2.

6.12.3 MSD scenario studies

3BDL/2BUL configurations only have MSD requirements for intermodulation.

Table 6.12.3-1 and 6.12.3-2 summarizes frequency ranges where harmonic mixing, cross band leakage, IMD interferences occur for DL CA_n41-n71-n77.

Table 6.12.3-1: Intermodulation MSD scenarios for DL CA_n25A-n41A-n77A with total power class 2

Uplink combination	IMD	Aggressor Tx	Victim Rx	Whether 2Tx requirements exists
CA_n41A-n71A	IMD2	$f_{n41} + f_{n71}$	n77	Yes
	IMD3	$f_{n41} + 2 \cdot f_{n71}$	n77	Yes
	IMD4	$2 \cdot f_{n41} - 2 \cdot f_{n71}$	n77	Yes
CA_n71A-n77A	IMD2	$f_{n77} - f_{n71}$	n41	Yes
	IMD3	$f_{n77} - 2 \cdot f_{n71}$	n41	Yes

Table 6.12.3-2: Intermodulation MSD scenarios for DL CA_n25A-n41A-n77A with total power class 1.5

Uplink combination	IMD	Aggressor Tx	Victim Rx	Whether 2Tx requirements exists
CA_n41A-n71A	IMD2	$f_{n41} + f_{n71}$	n77	No
	IMD3	$f_{n41} + 2 \cdot f_{n71}$	n77	No
	IMD4	$2 \cdot f_{n41} - 2 \cdot f_{n71}$	n77	No
CA_n71A-n77A	IMD2	$f_{n77} - f_{n71}$	n41	No
	IMD3	$f_{n77} - 2 \cdot f_{n71}$	n41	No

6.12.4 REFSSENS requirements

6.12.4.1 REFSSENS requirements for total power class 2

- The MSD due to intermodulation PC2 for UL CA_n41A-n71A is already specified in 38.101-1.
- The MSD due to intermodulation PC2 for UL CA_n71A-n77A is already specified in 38.101-1.

6.12.4.2 REFSSENS requirements for total power class 1.5

For UL CA_n41A-n71A PC1.5, since the n71 power remains PC3, the n41 power increases by 4.7 dB compared to UL CA_n41A-n71A PC2.

For the UL CA_n41A-n71A IMD2, since only the n41 power is changing by 4.7 dB, the interferer increases by $X=1 \cdot 4.7 = 4.7$ dB, so the MSD increases from 35.1 dB to 39.8 dB, using the following equation:

$$New_MSD = 10 * \log_{10} \left(1 + 10^{X/10} (10^{MSD/10} - 1) \right)$$

For the UL CA_n41A-n71A IMD3, since only the n41 power is changing by 4.7 dB, the interferer increases by $X=1 \cdot 4.7 = 4.7$ dB, so the MSD increases from 25.2 dB to 29.9 dB, using the equation above.

For the UL CA_n41A-n71A IMD4, since only the n41 power is changing by 4.7 dB, the interferer increases by $X=2 \cdot 4.7 = 9.4$ dB, so the MSD increases from 21.9 dB to 31.3 dB, using the

For the UL CA_n71A-n77A IMD2, since only the n77 power is changing by 4.7 dB, the interferer increases by $X=1 \cdot 4.7 = 4.7$ dB, so the MSD increases from 34.7 dB to 39.4 dB, using the equation above.

For the UL CA_n71A-n77A IMD3, since only the n77 power is changing by 4.7 dB, the interferer increases by $X=1 \cdot 4.7 = 4.7$ dB, so the MSD increases from 24.4 dB to 29.1 dB, using the equation above.

The MSD due to IMDs for PC1.5 3Tx are specified in the following table. At the time of this TP, the 3DL/2UL PC1.5 table does not yet exist in 38.101.1.

Table 6.12.4.2-1: 3DL/2UL inter-band Reference sensitivity QPSK P_{REFSENS} and uplink/downlink configurations for PC1.5 CA

Band / Channel bandwidth / NRB / Duplex mode								Source of IMD
NR CA Configuration	NR band	UL F_c (MHz)	UL/DL BW (MHz)	UL L_{CRB}	DL F_c (MHz)	MSD (dB)	Duplex mode	
CA_n41-n71-n77	n41	2615	5	25	2615	N/A	TDD	N/A
	n71	693	5	25	647	N/A	FDD	N/A
	n77	N/A	10	N/A	3308	39.8	TDD	IMD2 ^{1,5}
	n41	2564	5	25	2564	N/A	TDD	N/A
	n71	693	5	25	647	N/A	FDD	N/A
	n77	N/A	10	N/A	3950	29.9	TDD	IMD3 ¹
	n41	2580	5	25	2580	N/A	TDD	N/A
	n71	693	5	25	647	N/A	FDD	N/A
	n77	N/A	10	N/A	3774	31.3	TDD	IMD4 ¹
	n41	N/A	5	N/A	2615	39.4	TDD	IMD2 ⁵
	n71	693	5	25	647	N/A	FDD	N/A
	n77	3308	10	50	3308	N/A	TDD	N/A
	n41	N/A	5	N/A	2564	29.1	TDD	IMD3
	n71	693	5	25	647	N/A	FDD	N/A
	n77	3950	10	50	3950	N/A	TDD	N/A
NOTE 1: This band is subject to IMD5 also which MSD is not specified.								
NOTE 2: This band is subject to IMD4 also which MSD is not specified.								
NOTE 3: The requirements only apply for UEs supporting inter-band carrier aggregation with simultaneous Rx/Tx capability. Simultaneous Rx/Tx capability does not apply for UEs supporting band n78 with a n77 implementation.								
NOTE 4: This band is subject to IMD3 also which MSD is not specified.								
NOTE 5: For a UE which supports this band combination only when the Band n77 frequency range restriction defined in NOTE 12 of Table 5.2-1 applies, the MSD test point(s) cannot be verified for the band combination and the test point(s) can be skipped.								
NOTE 6: Both of the transmitters shall be set min(+23 dBm, $P_{\text{CMAX_L,f,c}}$) as defined in clause 6.2A.4								

For 2Tx and 3Tx UL CA_n41A-n77A there is an IMD2 into the n71 DL. The PC3 MSD is 30.8 dB. The PC1.5 MSD calculated based on the Look Up Table approach is 42.8 dB. 6.12.4.3 REFSENS requirements for total power class 2 and power class 3 based on the LUT

The MSD requirements 38.101-1 are based on calculations, but the PC1.5 MSD for CA_n41-n71 and CA_n71-n77 were based on 23+29 dBm. The LUT approach is used to calculate the equal power MSD.

Table 6.12.4.3-1 PC3 MSD

Uplink CA configuration	Victim Band	Power class 2 cases for CA_nX-nY	PC3 MSD (dB)
CA_n41-n71	n77	IMD2	29.1
		IMD3	16.3
		IMD4	10.3
CA_n71-n77	n41	IMD2	28.7
		IMD3	15.5
CA_n41-n77	n71	IMD2	30.8

6.13 CA_n41-n77-n79

6.13.1 Operating bands for CA and Configurations

Table 6.13.1-1: NR CA configurations and bandwidth combinations sets defined for inter-band CA (three bands)

NR CA configuration	Uplink CA configuration or single uplink carrier	NR Band	Channel bandwidth (MHz)	Bandwidth combination set
CA_n41A-n77A-n79A	n41 ^{7,9} n77 ^{7,9} n79 ^{7,9} CA_n41A-n77A ⁷ CA_n41A-n79A ⁷ CA_n77A-n79A ⁷	n41	10, 15, 20, 30, 40, 50, 60, 80, 90, 100, 10, 15, 20, 25, 30, 40, 50	0
		n77	10, 15, 20, 40, 50, 60, 80, 90, 100	
		n79	40, 50, 60, 80, 100	
CA_n41A-n77(2A)-n79A	n41 ^{7,9} n77 ^{7,9} n79 ^{7,9} CA_n41A-n77A ⁷ CA_n41A-n79A ⁷ CA_n77A-n79A ⁷ CA_n77(2A) ⁷	n41	10, 15, 20, 30, 40, 50, 60, 80, 90, 100, 10, 15, 20, 25, 30, 40, 50	0
		n77	CA_n77(2A)_BCS0	
		n79	40, 50, 60, 80, 100	
NOTE 7: Minimum requirements for Power Class 2 are applicable for this uplink combination or single uplink carrier in this downlink/uplink combination.				
NOTE 9: Minimum requirements for Power Class 1.5 are applicable for this uplink combination or single uplink carrier in this downlink/uplink combination.				

6.13.2 Maximum output power for inter-band CA

Table 6.13.2-1 UE Power Class 2 for uplink inter-band CA (Three bands)

Uplink CA configuration	Power class 2 cases for CA_nX-nY	CA power class	Carrier X power class	Carrier Y power class
CA_n41-n77	Case a	26dBm	23dBm	23dBm
	Case b	26dBm	23dBm	26dBm
	Case c	26dBm	26dBm	23dBm
	Case d	26dBm	26dBm	26dBm
CA_n41-n79	Case a	26dBm	23dBm	23dBm
	Case b	26dBm	23dBm	26dBm
	Case c	26dBm	26dBm	23dBm
	Case d	26dBm	26dBm	26dBm
CA_n77-n79	Case a	26dBm	23dBm	23dBm
	Case b	26dBm	23dBm	26dBm
	Case c	26dBm	26dBm	23dBm
	Case d	26dBm	26dBm	26dBm

6.13.3 REFSENS requirements

Analysis of REFSENS exceptions or MSD requirements is needed due to higher power uplink.

6.13.3.1 Power class 2 case a, b, c, d

Based on Reference sensitivity exceptions due to harmonic interference for CA in TS38.101-1_[2], 3rd harmonics of n41 may fall into n77 DL. And 3rd harmonics of n77 also may fall into n41 DL. However, non-simultaneous Rx-Tx operation for this combination is assumed, therefore no MSD is needed for single uplink.

PC3's UE co-existence has been already studied for 2DL/1UL fallback combinations such as CA n41-n77, CA_n41-n79 and CA_n77-n79 in TR38.718-03-01_[3], and the impact of harmonic interference has been clarified. The own Rx impact of the 3rd band is shown as the followings. Note that there is no IMD impact on CA_n41-n77 to n79 Rx and that on CA_n41-n79 to n77 Rx since CA_n77-n79 is synchronous operation.

- 3rd, 4th and 5th order IMD generated by dual uplink of Band n77 + Band n79 may fall into own Rx of Band n41.

And MSD for PC2 UL CA can be calculated from its PC3's result.

If the input signal increases by 3dB, the IMD3 increases by $3 \times 3 = 9$ dB.

So, the MSD exception is defined as below.

Table 6.13.3-1: 3DL/2UL inter-band Reference sensitivity QPSK PREFSENS and uplink/downlink configurations for PC2 CA

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_n41-n77-n79	n77	3600	10	50	3600	N/A	TDD	N/A
	n79	4600	40	216	4600	N/A	TDD	N/A
	n41	2600	10	50	2600	19.7	TDD	IMD3 ^{1,2}
NOTE 1: This band is subject to IMD5 also which MSD is not specified.								
NOTE 2: This band is subject to IMD4 also which MSD is not specified.								

For CA_n77(2A), fallback combination's study has already done in TS38.101-1 Table 7.3A.5-1a: 2DL/2UL inter-band Reference sensitivity QPSK PREFSENS and uplink/downlink configurations for PC2 CA_[2], the MSD exception is defined as below.

Table 6.13.3-2: 3DL/2UL inter-band Reference sensitivity QPSK PREFSENS and uplink/downlink configurations for PC2 CA

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_n41-n77-n79	n41	2545 2625	60 100	1 (RBstart=0) 1 (RBstart=272)	2545 2625	N/A	TDD	N/A
	n77	N/A	10	N/A	3305	2.7	TDD	IMD9
	n41	N/A	10	N/A	2565	32	TDD	IMD5 ¹⁶
	n77 ¹²	3485	10	1 (RBSTART=2 5)	3485	N/A	TDD	N/A
		3945	10	1 (RBSTART=2 5)	3945			
NOTE 12: This band supports intra-band non-contiguous uplink configuration.								
NOTE 16: In Japan, n77 band is restricted to 3400 – 4100 MHz frequency range, and there are no valid MSD test points when using this restricted frequency range								

6.13.4 Δ TIB and Δ RIB values

There is no change by comparing to the values for PC3 CA.

6.14 CA_n3-n41-n79

6.14.1 Operating bands for CA and Configurations

Table 6.14.1-1: NR CA configurations and bandwidth combinations sets defined for inter-band CA (three bands)

NR CA configuration	Uplink CA configuration or single uplink carrier	NR Band	Channel bandwidth (MHz)	Bandwidth combination set
CA_n3A-n41A-n79A	n3 n41 ^{7, 9} n79 ^{7, 9} CA_n3A-n41A ⁷ CA_n3A-n79A ⁷ CA_n41A-n79A ⁷	n3	15, 10, 15, 20	0
		n41	10, 15, 20, 30, 40, 50, 60, 80, 90, 100, 10, 15, 20, 25, 30, 40, 50	
		n79	40, 50, 60, 80, 100	
NOTE 7: Minimum requirements for Power Class 2 are applicable for this uplink combination or single uplink carrier in this downlink/uplink combination.				
NOTE 9: Minimum requirements for Power Class 1.5 are applicable for this uplink combination or single uplink carrier in this downlink/uplink combination.				

6.14.2 Maximum output power

Table 6.14.2-1 UE Power Class 2 for uplink inter-band CA (Three bands)

Uplink CA configuration	Power class 2 cases for CA_nX-nY	CA power class	Carrier X power class	Carrier Y power class
CA_n3-n41	Case a	26dBm	23dBm	23dBm
	Case b	26dBm	23dBm	26dBm
CA_n3-n79	Case a	26dBm	23dBm	23dBm
	Case b	26dBm	23dBm	26dBm
CA_n41-n79	Case a	26dBm	23dBm	23dBm
	Case b	26dBm	23dBm	26dBm
	Case c	26dBm	26dBm	23dBm
	Case d	26dBm	26dBm	26dBm

6.14.3 REFSENS requirements

Analysis of REFSENS exceptions or MSD requirements is needed due to higher power uplink.

6.14.3.1 Power class 2 case a, b, c, d

Based on Reference sensitivity exceptions due to harmonic interference for CA in TS38.101-1_[2], no MSD is needed for single uplink.

UE co-existence has been already studied for 2DL/1UL fallback combinations such as CA n3-n41, CA_n3-n79 and n41-n79 and the impact of harmonic interference has been clarified. The own Rx impact of the 3rd band is shown as the followings.

- 2nd and 5th order IMD generated by dual uplink of Band n3 + Band n41 may fall into own Rx of Band n79.
- 2nd and 5th order IMD generated by dual uplink of Band n3 + Band n79 may fall into own Rx of Band n41.
- 2nd and 5th order IMD generated by dual uplink of Band n41 + Band n79 may fall into own Rx of Band n3.

And MSD for PC2 UL CA can be calculated from its PC3's result.

If the input signal increases by 3dB, the IMD2 increases by $3 \times 2 = 6$ dB.

So, the MSD exception is defined as below.

Table 6.14.3-1: 3DL/2UL inter-band Reference sensitivity QPSK PREFSENS and uplink/downlink configurations for PC2 CA

Band / Channel bandwidth / N _{RB} / Duplex mode								Source of IMD
NR CA band combination	NR band	UL F _c (MHz)	UL/DL BW (MHz)	UL C _{LRB}	DL F _c (MHz)	MSD (dB)	Duplex mode	
CA_n3-n41-n79	n3	1755	5	25	1850	35.4	FDD	IMD2 ¹
	n41	2570	10	50	2570	N/A	TDD	N/A
	n79	4420	40	216	4420	N/A	TDD	N/A
	n3	1770	5	25	1865	N/A	FDD	N/A
	n41	2670	10	50	2670	36.2	TDD	IMD2 ¹
	n79	4440	40	216	4440	N/A	TDD	N/A
	n3	1770	5	25	1865	N/A	FDD	N/A
	n41	2670	10	50	2670	N/A	TDD	N/A
	n79	4440	40	216	4440	36.8	TDD	IMD2 ¹
NOTE 1: This band is subject to IMD5 also which MSD is not specified.								

6.14.4 ΔTIB and ΔRIB values

There is no change by comparing to the values for PC3 CA.

6.15 CA_n28-n41-n79

6.15.1 Operating bands for CA and Configurations

Table 6.15.1-1: NR CA configurations and bandwidth combinations sets defined for inter-band CA (three bands)

NR CA configuration	Uplink CA configuration or single uplink carrier	NR Band	Channel bandwidth (MHz)	Bandwidth combination set
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CA_n28A-n41A-n79A	n28 n41 ^{7, 9} n79 ^{7, 9} CA_n28A-n41A ⁷ CA_n28A-n79A ⁷ CA_n41A-n79A ⁷	n28	5, 10, 15, 20, 25, 30	0
		n41	10, 15, 20, 30, 40, 50, 60, 80, 90, 100, 10, 15, 20, 25, 30, 40, 50	
		n79	40, 50, 60, 80, 100	
NOTE 7: Minimum requirements for Power Class 2 are applicable for this uplink combination or single uplink carrier in this downlink/uplink combination.				
NOTE 9: Minimum requirements for Power Class 1.5 are applicable for this uplink combination or single uplink carrier in this downlink/uplink combination.				

6.15.2 Maximum output power

Table 6.15.2-1 UE Power Class 2 for uplink inter-band CA (Three bands)

Uplink CA configuration	Power class 2 cases for CA_nX-nY	CA power class	Carrier X power class	Carrier Y power class
CA_n28-n41	Case a	26dBm	23dBm	23dBm
	Case b	26dBm	23dBm	26dBm
CA_n28-n79	Case a	26dBm	23dBm	23dBm
	Case b	26dBm	23dBm	26dBm
CA_n41-n79	Case a	26dBm	23dBm	23dBm
	Case b	26dBm	23dBm	26dBm
	Case c	26dBm	26dBm	23dBm
	Case d	26dBm	26dBm	26dBm

6.15.3 REFSSENS requirements

Analysis of REFSSENS exceptions or MSD requirements is needed due to higher power uplink.

6.15.3.1 Power class 2 case a, b, c, d

Based on Reference sensitivity exceptions due to harmonic interference for CA in TS38.101-1_[2], no MSD is needed for single uplink.

PC3's UE co-existence studies for the UL CA configurations of CA_n28A-n41A, CA_n28A-n79A, CA_n41A-n79A have already captured in TR 38.716-02-00_[4], where:

- 3rd and 5th intermodulations caused by 2UL CA_n41A-n79A may fall into band n28 own DL Rx range.
- 3rd and 4th intermodulations caused by 2UL CA_n28A-n41A may fall into band n79 own DL Rx range.
- 4th intermodulations caused by 2UL CA_n28A-n79A may fall into band n41 own DL Rx range.

And MSD for PC2 UL CA can be calculated from its PC3's result.

If the input signal increases by 3dB, the IMD3 increases by 3*3 = 9dB, and the IMD4 increases by 3*4 = 12dB.

So, the MSD exception is defined as below.

Table 6.15.3-1: 3DL/2UL inter-band Reference sensitivity QPSK PREFSENS and uplink/downlink configurations for PC2 CA

Band / Channel bandwidth / NRB / Duplex mode								Source of IMD
NR CA Configuration	NR band	UL Fc (MHz)	UL/DL BW (MHz)	UL CLRB	DL Fc (MHz)	MSD (dB)	Duplex mode	
CA_n28-n41-n79	n28	725	5	25	780	22	FDD	IMD3 ¹
	n41	2600	10	50	2600	N/A	TDD	N/A
	n79	4600	40	216	4600	N/A	TDD	N/A
	n28	720	5	25	780	N/A	FDD	N/A
	n41	2600	10	50	2600	N/A	TDD	N/A
	n79	4480	40	216	4600	19.1	TDD	IMD3 ²
	n28	735	5	25	790	N/A	FDD	N/A
	n41	2645	10	50	2645	22.4	TDD	IMD4
	n79	4850	40	216	4850	N/A	TDD	N/A
NOTE 1: This band is subject to IMD5 also which MSD is not specified.								
NOTE 2: This band is subject to IMD4 also which MSD is not specified.								

6.15.4 Δ TIB and Δ RIB values

There is no change by comparing to the values for PC3 CA.

6.16 CA_n3-n78-n79

6.16.1 Configurations

Table 6.16.1-1: NR CA configurations and bandwidth combinations sets defined for inter-band CA (three bands)

NR CA configuration	Uplink CA configuration or single uplink carrier	NR Band	Channel bandwidth (MHz)	Bandwidth combination set
CA_n3A-n78A-n79A ⁵	n78 ^{7,9} n79 ⁷ CA_n3A-n78A ⁷ CA_n3A-n79A ⁷ CA_n78A-n79A ^{5,7}	n3	5, 10, 15, 20, 25, 30, 40, 50	0
		n78	10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100	
		n79	40, 50, 60, 80, 100	
NOTE 5: Simultaneous Rx/Tx capability for TDD combinations does not apply for UEs supporting band n78 with an n77 implementation.				
NOTE 7: Minimum requirements for Power Class 2 are applicable for this uplink combination or single uplink carrier in this downlink/uplink combination.				
NOTE 9: Minimum requirements for Power Class 1.5 are applicable for single uplink carrier in this downlink/uplink combination.				

6.16.2 Maximum output power

Table 6.16.2-1 UE Power Class 2 for uplink inter-band CA (Three bands)

Uplink CA configuration	Power class 2 cases for CA_nX-nY	CA power class	Carrier X power class	Carrier Y power class
CA_n3-n78	Case a	26dBm	23dBm	23dBm
	Case b	26dBm	23dBm	26dBm
CA_n3-n79	Case a	26dBm	23dBm	23dBm
	Case b	26dBm	23dBm	26dBm
CA_n78-n79	Case a	26dBm	23dBm	23dBm
	Case b	26dBm	23dBm	26dBm
	Case c	26dBm	26dBm	23dBm
	Case d	26dBm	26dBm	26dBm

6.16.3 REFSSENS requirements

Analysis of REFSSENS exceptions or MSD requirements is needed due to higher power uplink.

6.16.3.1 Power class 2 case a, b, c, d

Based on Reference sensitivity exceptions due to harmonic interference for CA in TS38.101-1_[2], no MSD is needed for single uplink.

PC3's UE co-existence studies for the UL CA configurations of CA_n3A-n78A, CA_n3A-n79A, CA_n78A-n79A have already captured in TR 38.719-03-01_[3], where:

The 3rd IMD generated by UL CA_n3A-n78A may fall into own Rx of Band n79.

The 5th IMD generated by UL CA_n3A-n79A may fall into own Rx of Band n78.

The 3rd, 4th and 5th IMD generated by UL CA_n78A-n79A may fall into own Rx of Band n3.

And MSD for PC2 UL CA can be calculated from its PC3's result.

If the input signal increases by 3dB, the IMD3 increases by $3 \times 3 = 9$ dB. So, the MSD exception is defined as below.

Table 6.16.3-1: 3DL/2UL inter-band Reference sensitivity QPSK PREFSENS and uplink/downlink configurations for PC2 CA

Band / Channel bandwidth / N _{RB} / Duplex mode								Source of IMD
NR CA band combination	NR band	UL F _c (MHz)	UL/DL BW (MHz)	UL C _{LRB}	DL F _c (MHz)	MSD (dB)	Duplex mode	
CA_n3-n78-n79	n3	1780	5	25	1875	N/A	FDD	N/A
	n78	3320	10	50	3320	N/A	TDD	N/A
	n79	N/A	10	N/A	4860	22.1	TDD	IMD3
	n3	1780	5	25	1875	N/A	FDD	N/A
	n78	N/A	10	N/A	3480	8.5	TDD	IMD5
	n79	4410	10	50	4410	N/A	TDD	N/A
	n3	1765	5	25	1860	24.7	FDD	IMD3 ¹
	n78	3350	10	50	3350	N/A	TDD	N/A
	n79	4840	10	50	4840	N/A	TDD	N/A
	n3	1745	5	25	1840	11.5	FDD	IMD4
	n78	3780	10	50	3780	N/A	TDD	N/A
	n79	4700	10	50	4700	N/A	TDD	N/A

NOTE 1: This band is subject to IMD5 also which MSD is not specified.

6.16.4 Δ TIB and Δ RIB values

There is no change by comparing to the values for PC3 CA.

6.17 CA_n28-n41-n74

6.17.1 Configurations

Table 6.17.1-1: NR CA configurations and bandwidth combinations sets defined for inter-band CA (three bands)

NR CA configuration	Uplink CA configuration or single uplink carrier	NR Band	Channel bandwidth (MHz)	Bandwidth combination set
CA_n28A-n41A-n74A	CA_n28A-n41A ⁷ CA_n41A-n74A ⁷	n28	5, 10, 15, 20	0
		n41	10, 15, 20, 40, 50, 60, 80, 90, 100	
		n74	5, 10, 15, 20	
NOTE 7: Minimum requirements for Power Class 2 are applicable for this uplink combination or single uplink carrier in this downlink/uplink combination.				

6.17.2 Maximum output power

Table 6.17.2-1 UE Power Class 2 for uplink inter-band CA (Three bands)

Uplink CA configuration	Power class 2 cases for CA_nX-nY	CA power class	Carrier X power class	Carrier Y power class
CA_n28-n41	Case a	26dBm	23dBm	23dBm
	Case b	26dBm	23dBm	26dBm
CA_n41-n74	Case a	26dBm	23dBm	23dBm
	Case b	26dBm	26dBm	23dBm

6.17.3 REFSENS requirements

Analysis of REFSENS exceptions or MSD requirements is needed due to higher power uplink.

6.17.3.1 Power class 2 case a, b

Based on calculation, for dual UL CA_n28A-n41, the 2nd order harmonic of n28 drops to n74 DL, while for dual UL CA_n41A-n74A, IMD5 affects n28 DL.

As to the impact of 2nd order harmonic of n28 to n74 DL, using the method agreed upon in previous meeting [4], for 1UL MSD values, 3dB and 6dB should be added to the corresponding PC3 values, respectively. The results are shown in following table.

Table 7.3A.4-2a: Reference sensitivity exceptions and uplink/downlink configurations due to UL harmonic from a PC2 aggressor NR UL band for NR DL CA FR1

UL band	DL band	UL BW	SCS of UL band	UL RB Allocation	DL BW	MSD (NOTE 7)	MSD (NOTE 8)	UL/DL fc condition	UL/DL harmonic order
		(MHz)	(kHz)	L _{CRB}	(MHz)	(dB)	(dB)		
n28	n74	5	15	12	5	31.1	34.1	NOTE 2	UL2/DL1 direct-hit
n28	n74	5	15	12	20	21	24	NOTE 2	UL2/DL1 direct-hit

The MSD exceptions due to the IMD5 are defined as follows:

- For the PC3 case, the MSD value corresponding to IMD5 to n28 is 3.5dB, as proposed in [3].
- For the PC2 case, introducing an additional 15dB interference to the PC3 scenario resulted in a 14dB increase in DESENS, leading to an overall MSD of 17.5dB.

The calculated MSD value and the relevant test points are presented in Table 6.17.3-1.

Table 6.17.3-1: 3DL/2UL inter-band Reference sensitivity QPSK PREFSENS and uplink/downlink configurations for PC2 CA

Band / Channel bandwidth / N _{RB} / Duplex mode								Source of IMD
NR CA band combination	NR band	UL F _c (MHz)	UL/DL BW (MHz)	UL L _{CRB}	DL F _c (MHz)	MSD (dB)	Duplex mode	
CA_n28-n41-n74	n28	N/A	5	N/A	782	17.5	FDD	IMD5
	n41	2569	10	50	2569	N/A	TDD	N/A
	n74	1452	5	25	1500	N/A	FDD	N/A

6.17.4 Δ TIB and Δ RIB values

There is no change by comparing to the values for PC3 CA.

6.18 CA_n28-n74-n77

6.18.1 Configurations

Table 6.18.1-1: NR CA configurations and bandwidth combinations sets defined for inter-band CA (three bands)

NR CA configuration	Uplink CA configuration or single uplink carrier	NR Band	Channel bandwidth (MHz)	Bandwidth combination set
CA_n28A-n74A-n77A	CA_n28A-n77A ⁷ CA_n74A-n77A ⁷	n28	5, 10, 15, 20, 30	0
		n74	5, 10, 15, 20	

		n77	10, 15, 20, 40, 50, 60, 80, 90, 100
NOTE 7: Minimum requirements for Power Class 2 are applicable for this uplink combination or single uplink carrier in this downlink/uplink combination.			

6.18.2 Maximum output power

Table 6.18.2-1 UE Power Class 2 for uplink inter-band CA (Three bands)

Uplink CA configuration	Power class 2 cases for CA_nX-nY	CA power class	Carrier X power class	Carrier Y power class
CA_n28-n77	Case a	26dBm	23dBm	23dBm
	Case b	26dBm	23dBm	26dBm
CA_n74-n77	Case a	26dBm	23dBm	23dBm
	Case b	26dBm	23dBm	26dBm

6.18.3 REFSENS requirements

Analysis of REFSENS exceptions or MSD requirements is needed due to higher power uplink.

6.18.3.1 Power class 2 case a, b

Based on calculation

- IMD4 due to UL CA_n28A-n77A falls into n74 DL
- IMD3/4 due to UL CA_n74A-n77A falls into n28 DL

The MSD exceptions corresponding to the IMD4 when UL CA_n28A-n77A falls into n74, MSD for PC2 is calculated by are defined as below by adding 12dB to interference which caused 9dB PC3 MSD, resulting in 20.7dB IMD5 to n74

Moreover, for the cases of IMD3/4 due to UL CA_n74A-n77A falls into n28 DL,

for IMD3, adding 9dB to the PC3 MSD value, 18.7, resulting in PC2 MSD, 27.7dB

for IMD4 adding 12dB to interference to the 13.1dB PC3 MSD, resulting in 25.1dB

Table 6.18.3-1: 3DL/2UL inter-band Reference sensitivity QPSK PREFSENS and uplink/downlink configurations for PC2 CA

Band / Channel bandwidth / N _{RB} / Duplex mode								Source of IMD
NR CA band combination	NR band	UL F _c (MHz)	UL/DL BW (MHz)	UL L _{CRB}	DL F _c (MHz)	MSD (dB)	Duplex mode	
CA_n28-n74-n77	n28	730	5	25	785	N/A	FDD	N/A
	n74	N/A	5	25	1500	20.7	FDD	IMD4
	n77	3690	10	50	3690	N/A	TDD	N/A
	n28	N/A	5	25	785	27.7	FDD	IMD3
	n74	1452	5	25	1500	N/A	FDD	N/A
	n77	3689	10	50	1818.5	N/A	FDD	N/A
	n28	N/A	5	25	785	25.1	FDD	IMD4
	n74	1458	5	25	1516	N/A	FDD	N/A
	n77	3589	10	50	1818.5	N/A	FDD	N/A

6.18.4 Δ TIB and Δ RIB values

There is no change by comparing to the values for PC3 CA.

6.19 CA_n25-n41-n66

6.19.1 Configurations

Table 6.19.1-1: NR CA configurations and bandwidth combinations sets defined for inter-band CA (three bands)

NR CA configuration	Uplink CA configuration or single uplink carrier	NR Band	Channel bandwidth (MHz)	Bandwidth combination set
CA_n25A-n41A-n66A	n25 ⁷ n41 ^{7,9} n66 ⁷ CA_n25A-n41A ⁷ CA_n25A-n66A ⁷ CA_n41A-n66A ^{7,13,14}	n25	5, 10, 15, 20	0
		n41	10, 15, 20, 30, 40, 50, 60, 80, 90, 100	
		n66	5, 10, 15, 20, 40	
		n25	5, 10, 15, 20, 25, 30, 40	1
		n41	10, 15, 20, 30, 40, 50, 60, 70, 80, 90, 100	
		n66	5, 10, 15, 20, 25, 30, 40	
		n25	n25 channel bandwidths in Table 5.3.5-1	4 and 5
		n41	n41 channel bandwidths in Table 5.3.5-1	
		n66	n66 channel bandwidths in Table 5.3.5-1	

NOTE 7: Minimum requirements for Power Class 2 are applicable for this uplink combination or single uplink carrier in this downlink/uplink combination

NOTE 9: Minimum requirements for Power Class 1.5 are applicable for this uplink combination or single uplink carrier in this downlink/uplink combination

NOTE 13: Minimum requirements for Power Class 2 are applicable for this uplink configuration with 1Tx antenna connector in one band and 2Tx antenna connectors in the other band.

NOTE 14 Minimum requirements for Power Class 1.5 are applicable for this uplink configuration with 1Tx antenna connector in one band and 2Tx antenna connectors in the other band.

6.19.2 Maximum output power

<Editor's note: In table 6.19.2-1, the power class 2 cases supported by the uplink CA should be kept as the same numbering and others that not supported should be removed. >

Table 6.19.2-1 UE Power Class 2 for uplink inter-band CA (Three bands)

Uplink CA configuration	Power class 2 cases for CA_nX-nY	CA power class	Carrier X power class	Carrier Y power class
CA_n41-n66	Case c	26dBm	26dBm	23dBm

Table 6.19.2-2 UE Power Class 1.5 for uplink inter-band CA (Three bands)

Uplink CA configuration	Power class 1.5 cases for CA_n41-n66	CA power class	Carrier X power class	Carrier Y power class
CA_n41-n66	Case c	29dBm	29dBm	23dBm

6.19.3 REFSSENS requirements

Analysis of REFSSENS exceptions or MSD requirements is needed due to higher power uplink.

6.19.3.1 Power class 2 case c

There is an IMD4 from UL CA_n41A-n66A into the n25 DL. The PC3 MSD is 11.0 dB. The PC2 MSD is calculated with the LUT approach.

6.19.3.2 Power class 1.5 case c

There is an IMD4 from UL CA_n41A-n66A into the n25 DL. The PC3 MSD is 11.0 dB. The PC1.5 MSD is calculated with the LUT approach.

6.19.4 Δ TIB and Δ RIB values

There is no change compared to the values for PC3 CA.

6.20 CA_n25-n66-n77

6.20.1 Configurations

Table 6.20.1-1: NR CA configurations and bandwidth combinations sets defined for inter-band CA (three bands)

NR CA configuration	Uplink CA configuration or single uplink carrier	NR Band	Channel bandwidth (MHz)	Bandwidth combination set
CA_n25A-n66A-n77A	n25 ⁷ n66 ⁷ n77 ^{7,9} CA_n25A-n66A ⁷ CA_n25A-n77A ^{7,13,14} CA_n66A-n77A ^{7,13,14}	n25	5, 10, 15, 20, 25, 30, 40	0
		n66	5, 10, 15, 20, 25, 30, 40	
		n77	10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100	

		n25	n25 channel bandwidths in Table 5.3.5-1	4 and 5
		n66	n66 channel bandwidths in Table 5.3.5-1	
		n77	n77 channel bandwidths in Table 5.3.5-1	
NOTE 7: Minimum requirements for Power Class 2 are applicable for this uplink combination or single uplink carrier in this downlink/uplink combination				
NOTE 9: Minimum requirements for Power Class 1.5 are applicable for this uplink combination or single uplink carrier in this downlink/uplink combination				
NOTE 13: Minimum requirements for Power Class 2 are applicable for this uplink configuration with 1Tx antenna connector in one band and 2Tx antenna connectors in the other band.				
NOTE 14: Minimum requirements for Power Class 1.5 are applicable for this uplink configuration with 1Tx antenna connector in one band and 2Tx antenna connectors in the other band.				

6.20.2 Maximum output power

Table 6.20.2-1 UE Power Class 2 for uplink inter-band CA (Three bands)

Uplink configuration	CA	Power class 2 cases for CA_nX-nY	CA power class	Carrier X power class	Carrier Y power class
CA_n25-n77		Case b	26dBm	23dBm	26dBm
CA_n66-n77		Case b	26dBm	23dBm	26dBm

Table 6.20.2-2 UE Power Class 1.5 for uplink inter-band CA (Three bands)

Uplink configuration	CA	Power class 1.5 cases for CA_n41-n66	CA power class	Carrier X power class	Carrier Y power class
CA_n25-n77		Case b	29dBm	23dBm	29dBm
CA_n66-n77		Case b	29dBm	23dBm	29dBm

6.20.3 REFSSENS requirements

Analysis of REFSSENS exceptions or MSD requirements is needed due to higher power uplink.

6.20.3.1 Power Class 2 and Power Class 1.5 MSD

There are several IMDs for the two uplink configurations. The Look Up Table approach is used to calculate the PC2 and PC1.5 MSD.

Table 6.20.3-1 UE Power Class 2 for uplink inter-band CA (Three bands)

Uplink configuration	CA	Victim Band	IMD	PC3 MSD (dB)
CA_n25-n77		n66	IMD2	29.2
			IMD4	10.4
			IMD5	4.0
CA_n66-n77		n25	IMD2	32.1
			IMD4	9.1
			IMD5	2.1

6.20.4 Δ TIB and Δ RIB values

There is no change compared to the values for PC3 CA.

6.21 CA_n25-n71-n77

6.21.1 Configurations

Table 6.21.1-1: NR CA configurations and bandwidth combinations sets defined for inter-band CA (three bands)

NR CA configuration	Uplink CA configuration or single uplink carrier	NR Band	Channel bandwidth (MHz)	Bandwidth combination set
CA_n25A-n71A-n77A	n25 ⁷ n71 ⁷ n77 ^{7,9} CA_n25A-n71A ⁷ CA_n25A-n77A ^{7,13,14} CA_n71A-n77A ^{7,13,14}	n25	5, 10, 15, 20, 25, 30, 40	0
		n71	5, 10, 15, 20	
		n77	10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100	
		n25	n25 channel bandwidths in Table 5.3.5-1	4 and 5
		n71	n71 channel bandwidths in Table 5.3.5-1	
		n77	n77 channel bandwidths in Table 5.3.5-1	
		NOTE 7: Minimum requirements for Power Class 2 are applicable for this uplink combination or single uplink carrier in this downlink/uplink combination		
NOTE 9: Minimum requirements for Power Class 1.5 are applicable for this uplink combination or single uplink carrier in this downlink/uplink combination				
NOTE 13: Minimum requirements for Power Class 2 are applicable for this uplink configuration with 1Tx antenna connector in one band and 2Tx antenna connectors in the other band.				
NOTE 14: Minimum requirements for Power Class 1.5 are applicable for this uplink configuration with 1Tx antenna connector in one band and 2Tx antenna connectors in the other band.				

6.21.2 Maximum output power

Only UL combinations with IMD MSD are included in this section.

Table 6.21.2-1 UE Power Class 2 for uplink inter-band CA (Three bands)

Uplink CA configuration	Power class 2 cases for CA_nX-nY	CA power class	Carrier X power class	Carrier Y power class
CA_n71-n77	Case b	26dBm	23dBm	26dBm

Table 6.21.2-2 UE Power Class 1.5 for uplink inter-band CA (Three bands)

Uplink CA configuration	Power class 1.5 cases for CA_n41-n66	CA power class	Carrier X power class	Carrier Y power class
CA_n71-n77	Case b	29dBm	23dBm	29dBm

6.21.3 REFSSENS requirements

Analysis of REFSSENS exceptions or MSD requirements is needed due to higher power uplink.

6.21.3.1 Power Class 2 and Power Class 1.5 MSD

There is and IMD3 from CA_n71A-n77A into n25. The Look Up Table approach is used to calculate the PC2 and PC1.5 MSD. There is no MSD for UL CA_n25-n77.

Table 6.21.3-1 UE PC2 and PC1.5 LUT MSD

Uplink CA configuration	Victim Band	IMD	PC3 MSD (dB)	PC2 MSD (dB)	P{C1.5 MSD (dB)
CA_n71-n77	n25	IMD3	16.5	25.5	34,5

6.21.4 Δ TIB and Δ RIB values

There is no change compared to the values for PC3 CA.

6.22 CA_n66-n71-n77

6.22.1 Configurations

Table 6.22.1-1: NR CA configurations and bandwidth combinations sets defined for inter-band CA (three bands)

NR CA configuration	Uplink CA configuration or single uplink carrier	NR Band	Channel bandwidth (MHz)	Bandwidth combination set
CA_n66A-n71A-n77A	n66 ⁷ n71 ⁷ n77 ^{7,9} CA_n66A-n71A ⁷ CA_n66A-n77A ^{7,13,14} CA_n71A-n77A ^{7,13,14}	n66	5, 10, 15, 20, 25, 30, 40	0
		n71	5, 10, 15, 20	
		n77	10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100	
		n66	n66 channel bandwidths in Table 5.3.5-1	4 and 5
		n71	n71 channel bandwidths in Table 5.3.5-1	
		n77	n77 channel bandwidths in Table 5.3.5-1	
NOTE 7: Minimum requirements for Power Class 2 are applicable for this uplink combination or single uplink carrier in this downlink/uplink combination				
NOTE 9: Minimum requirements for Power Class 1.5 are applicable for this uplink combination or single uplink carrier in this downlink/uplink combination				
NOTE 13: Minimum requirements for Power Class 2 are applicable for this uplink configuration with 1Tx antenna connector in one band and 2Tx antenna connectors in the other band.				
NOTE 14 Minimum requirements for Power Class 1.5 are applicable for this uplink configuration with 1Tx antenna connector in one band and 2Tx antenna connectors in the other band.				

6.22.2 Maximum output power

Table 6.22.2-1 UE Power Class 2 for uplink inter-band CA (Three bands)

Uplink CA configuration	Power class 2 cases for CA_nX-nY	CA power class	Carrier X power class	Carrier Y power class
CA_n66-n77	Case b	26dBm	23dBm	26dBm
CA_n71-n77	Case b	26dBm	23dBm	26dBm

Table 6.22.2-2 UE Power Class 1.5 for uplink inter-band CA (Three bands)

Uplink CA configuration	Power class 1.5 cases for CA_n41-n66	CA power class	Carrier X power class	Carrier Y power class
CA_n66-n77	Case b	29dBm	23dBm	29dBm
CA_n71-n77	Case b	29dBm	23dBm	29dBm

6.22.3 REFSENS requirements

Analysis of REFSENS exceptions or MSD requirements is needed due to higher power uplink.

6.22.3.1 Power Class 2 and Power Class 1.5 MSD

There are IMD3s for the two uplink configurations. The Look Up Table approach is used to calculate the PC2 and PC1.5 MSD.

Table 6.22.3-1 UE PC2 and PC1.5 LUT MSD

Uplink CA configuration	Victim Band	IMD	PC3 MSD (dB)
CA_n66-n77	n71	IMD3	15.3
CA_n71-n77	n66	IMD3	15.5

6.22.4 Δ TIB and Δ RIB values

There is no change compared to the values for PC3 CA.

6.23 CA_n41-n74-n77

6.23.1 Configurations

Table 6.23.1-1: NR CA configurations and bandwidth combinations sets defined for inter-band CA (three bands)

NR CA configuration	Uplink CA configuration or single uplink carrier	NR Band	Channel bandwidth (MHz)	Bandwidth combination set
CA_n41A-n74A-n77A	CA_n41A-n74A ⁷ CA_n41A-n77A ⁷ CA_n74A-n77A ⁷	n41	10, 15, 20, 40, 50, 60, 80, 90, 100	0
		n74	5, 10, 15, 20	
		n77	10, 15, 20, 40, 50, 60, 80, 90, 100	

NOTE 7: Minimum requirements for Power Class 2 are applicable for this uplink combination or single uplink carrier in this downlink/uplink combination.

6.23.2 Maximum output power

Table 6.23.2-1 UE Power Class 2 for uplink inter-band CA (Three bands)

Uplink CA configuration	Power class 2 cases for CA_nX-nY	CA power class	Carrier X power class	Carrier Y power class
CA_n41-n74	Case a	26dBm	23dBm	23dBm
	Case b	26dBm	23dBm	26dBm
CA_n41-n77	Case a	26dBm	23dBm	23dBm
	Case b	26dBm	23dBm	26dBm
CA_n74-n77	Case a	26dBm	23dBm	23dBm
	Case b	26dBm	23dBm	26dBm

6.23.3 REFSENS requirements

Analysis of REFSENS exceptions or MSD requirements is needed due to higher power uplink.

6.23.3.1 Power class 2 case a, b

Based on calculation

- IMD2/3/4 due to UL CA_n41A-n77A falls into n74 DL
- IMD2/5 due to UL CA_n74A-n77A falls into n41 DL
- IMD2/3/5 due to UL CA_n41A-n74A falls into n77 DL

The MSD exceptions corresponding to the above IMDs for PC2 are shown in Table 6.23.3-1. They are evaluated by calculated by adding the corresponding interference defined in [4] 12dB to the MSDs for PC2 defined in [3].

Table 6.23.3-1: 3DL/2UL inter-band Reference sensitivity QPSK PREFSENS and uplink/downlink configurations for PC2 CA

Band / Channel bandwidth / N _{RB} / Duplex mode								Source of IMD
NR CA band combination	NR band	UL F _c (MHz)	UL/DL BW (MHz)	UL L _{CRB}	DL F _c (MHz)	MSD (dB)	Duplex mode	
CA_n41-n74-n77	n41	2650	10	50	2650	N/A	TDD	N/A
	n74	N/A	5	N/A	1500	35.2	FDD	IMD2 ²
	n77	4150	10	50	4150	NA	TDD	N/A
	n41	2525	10	50	2525	N/A	TDD	N/A
	n74	N/A	5	N/A	1500	24	FDD	IMD3
	n77	3550	10	50	3550	N/A	TDD	N/A
	n41	N/A	10	N/A	2650	34	TDD	IMD2
	n74	1450	5	25	1500	N/A	FDD	N/A
	n77	4100	10	50	4150	N/A	TDD	N/A
	n41	N/A	10	N/A	2518	13.9	TDD	IMD5
	n74	1454	5	25	1502	N/A	FDD	N/A
	n77	3440	10	50	3440	N/A	TDD	N/A
	n41	2650	10	50	2650	N/A	TDD	N/A
	n74	1450	5	25	1500	N/A	FDD	N/A
	n77	N/A	10	N/A	4100	33	TDD	IMD2
	n41	2525	10	50	2525	N/A	TDD	N/A
	n74	1450	5	25	1498	N/A	FDD	N/A
	n77	N/A	10	N/A	3600	23	TDD	IMD3 ¹
NOTE 1: This band is subject to IMD5 also which MSD is not specified.								
NOTE 2: This band is subject to IMD4 also which MSD is not specified.								

6.23.4 Δ TIB and Δ RIB values

There is no change by comparing to the values for PC3 CA.

6.24 CA_n1-n78-n79

6.24.1 Configurations

Table 6.24.1-1: NR CA configurations and bandwidth combinations sets defined for inter-band CA (three bands)

NR CA configuration	Uplink CA configuration or single uplink carrier	NR Band	Channel bandwidth (MHz)	Bandwidth combination set
CA_n1A-n78A-n79A	CA_n1A-n78A ⁷ CA_n1A-n79A ⁷ CA_n78A-n79A ⁷	n1	5, 10, 15, 20	0
		n78	10, 15, 20, 40, 50, 60, 80, 90, 100	
		n79	40, 50, 60, 80, 100	
		n1	5, 10, 15, 20	1

		n78	10, 15, 20, 25, 30, 40, 50, 60, 80, 90, 100	4 and 5
		n79	40, 50, 60, 80, 100	
		n1	n1 channel bandwidths in Table 5.3.5-1	
		n78	n78 channel bandwidths in Table 5.3.5-1	
		n79	n79 channel bandwidths in Table 5.3.5-1	
NOTE 7: Minimum requirements for Power Class 2 are applicable for this uplink combination or single uplink carrier in this downlink/uplink combination				

6.24.2 Maximum output power

Table 6.24.2-1 UE Power Class 2 for uplink inter-band CA (Three bands)

Uplink CA configuration	Power class 2 cases for CA_nX-nY	CA power class	Carrier X power class	Carrier Y power class
CA_n1-n78	Case a	26dBm	23dBm	23dBm
	Case b	26dBm	23dBm	26dBm
CA_n1-n79	Case a	26dBm	23dBm	23dBm
	Case b	26dBm	23dBm	26dBm
CA_n78-n79	Case a	26dBm	23dBm	23dBm
	Case b	26dBm	23dBm	26dBm
	Case c	26dBm	26dBm	23dBm
	Case d	26dBm	26dBm	26dBm

6.24.3 REFSSENS requirements

Analysis of REFSSENS exceptions or MSD requirements is needed due to higher power uplink.

6.24.3.1 Power class 2 case a, b, c, d

Based on calculation,

IMD3/IMD5 due to UL CA_n1A-n78A falls into n79 DL. The IMD3 value is calculated by adding 9dB to the PC3 MSD value, resulting in 24.9dB.

IMD5 due to UL CA_n1A-n79A falls into n78 DL. The IMD5 value is calculated by adding 12.4dB to the PC3 MSD value, resulting in 17dB.

IMD3/IMD4/IMD5 due to UL CA_n78A-n79A falls into n1 DL. The IMD3 value is calculated by adding 9dB to the PC3 MSD value, resulting in 24.6dB. PC2 IMD4 is 3.8dB.

The MSD exception is defined as below.

Table 6.24.3-1: 3DL/2UL inter-band Reference sensitivity QPSK PREFSENS and uplink/downlink configurations for PC2 CA

Band / Channel bandwidth / N _{RB} / Duplex mode								Source of IMD
NR CA band combination	NR band	UL F _c (MHz)	UL/DL BW (MHz)	UL L _{CRB}	DL F _c (MHz)	MSD (dB)	Duplex mode	
CA_n1-n78-n79	n1	1950	5	25	2140	N/A	FDD	N/A
	n78	3410	10	50	3410	N/A	TDD	N/A
	n79	N/A	40	N/A	4870	24.9	TDD	IMD3 ^{1,3}
	n1	1950	5	25	2140	N/A	FDD	N/A
	n78	N/A	10	N/A	3490	17	TDD	IMD5 ³
	n79	4670	40	216	4670	N/A	TDD	N/A
	n1	N/A	5	N/A	2140	24.6	FDD	IMD3 ¹
	n78	3400	10	50	3400	N/A	TDD	N/A
	n79	4660	40	216	4660	N/A	TDD	N/A
	n1	N/A	5	N/A	2140	3.8	FDD	IMD4 ¹
	n78	3590	10	50	3590	N/A	TDD	N/A
	n79	4660	40	216	4660	N/A	TDD	N/A
NOTE 1: This band is subject to IMD5 also which MSD is not specified. NOTE 3: The requirements only apply for UEs supporting inter-band carrier aggregation with simultaneous Rx/Tx capability. Simultaneous Rx/Tx capability does not apply for UEs supporting band n78 with a n77 implementation.								

6.24.4 Δ TIB and Δ RIB values

There is no change by comparing to the values for PC3 CA.

6.25 CA_n28-n78-n79

6.25.1 Configurations

Table 6.25.1-1: NR CA configurations and bandwidth combinations sets defined for inter-band CA (three bands)

NR CA configuration	Uplink CA configuration or single uplink carrier	NR Band	Channel bandwidth (MHz)	Bandwidth combination set
CA_n28A-n78A-n79A	CA_n28A-n78A ⁷ CA_n28A-n79A ⁷ CA_n78A-n79A ⁷	n28	5, 10, 15, 20	0
		n78	10, 15, 20, 25, 30, 40, 50, 60, 80, 90, 100	

		n79	40, 50, 60, 80, 100	
	CA_n28A-n78A CA_n28A-n79A CA_n78A-n79A	n28	n28 channel bandwidths in Table 5.3.5-1	4 and 5
		n78	n78 channel bandwidths in Table 5.3.5-1	
		n79	n79 channel bandwidths in Table 5.3.5-1	
NOTE 7: Minimum requirements for Power Class 2 are applicable for this uplink combination or single uplink carrier in this downlink/uplink combination				

6.25.2 Maximum output power

Table 6.25.2-1 UE Power Class 2 for uplink inter-band CA (Three bands)

Uplink CA configuration	Power class 2 cases for CA_nX-nY	CA power class	Carrier X power class	Carrier Y power class
CA_n28-n78	Case a	26dBm	23dBm	23dBm
	Case b	26dBm	23dBm	26dBm
CA_n28-n79	Case a	26dBm	23dBm	23dBm
	Case b	26dBm	23dBm	26dBm
CA_n78-n79	Case a	26dBm	23dBm	23dBm
	Case b	26dBm	23dBm	26dBm
	Case c	26dBm	26dBm	23dBm
	Case d	26dBm	26dBm	26dBm

6.25.3 REFSENS requirements

Analysis of REFSENS exceptions or MSD requirements is needed due to higher power uplink.

6.25.3.1 Power class 2 case a, b, c, d

Based on calculation,

- IMD2/IMD3/IMD5 due to UL CA_n28A-n78A fall into n79 DL. The IMD2 value is calculated by adding 6dB to the PC3 MSD value, resulting in 32.2dB. PC2 IMD5 value is 5.7dB.
- IMD2/IMD3 due to UL CA_n28A-n79A fall into n78 DL. The IMD2 value is calculated by adding 6dB to the PC3 MSD value, resulting in 32.9dB. PC2 IMD3 value is 16.8dB.

NOTE: As the PC3 IMD3 may have been missed, this PC2 value may be revised at RAN4#116-Bis with new the requirement for PC3.

- IMD2 /IMD5 due to UL CA_n78A-n79A fall into n28 DL. The IMD2 value is calculated by adding 6dB to the PC3 MSD value, resulting in 22.2dB. PC2 IMD5 value is 5.7dB.

The MSD exception is defined as below.

Table 6.25.3-1: 3DL/2UL inter-band Reference sensitivity QPSK P_{REFSENS} and uplink/downlink configurations for PC2 CA

Band / Channel bandwidth / N_{RB} / Duplex mode								Source of IMD
NR CA band combination	NR band	UL F_c (MHz)	UL/DL BW (MHz)	UL L_{CRB}	DL F_c (MHz)	MSD (dB)	Duplex mode	
CA_n28-n78-n79	n28	740	5	25	795	N/A	FDD	N/A
	n78	3700	10	50	3700	N/A	TDD	N/A
	n79	N/A	40	N/A	4440	32.2	TDD	IMD2 ^{3,4}
	n28	740	5	25	795	N/A	FDD	N/A
	n78	3320	10	50	3320	N/A	TDD	N/A
	n79	N/A	40	N/A	4440	5.7	TDD	IMD5 ^{3,4}
	n28	740	5	25	795	N/A	FDD	N/A
	n78	N/A	10	N/A	3700	32.9	TDD	IMD2 ³
	n79	4440	40	216	4440	N/A	TDD	N/A
	n28	740	5	25	795	N/A	FDD	N/A
	n78	N/A	10	N/A	3420	16.8	TDD	IMD3 ³
	n79	4900	40	216	4900	N/A	TDD	N/A
	n28	N/A	5	N/A	800	22.2	FDD	IMD2
	n78	3620	10	50	3620	N/A	TDD	N/A
	n79	4420	40	216	4420	N/A	TDD	N/A
	n28	N/A	5	N/A	790	5.7	FDD	IMD5
	n78	3530	10	50	3530	N/A	TDD	N/A
	n79	4900	40	216	4900	N/A	TDD	N/A
NOTE 3: The requirements only apply for UEs supporting inter-band carrier aggregation with simultaneous Rx/Tx capability. Simultaneous Rx/Tx capability does not apply for UEs supporting band n78 with a n77 implementation.								
NOTE 4: This band is subject to IMD3 also which MSD is not specified.								

6.25.4 ΔTIB and ΔRIB values

There is no change by comparing to the values for PC3 CA.

6.26 CA_n40-n41-n77

6.26.1 Configurations

Table 6.26.1-1: NR CA configurations and bandwidth combinations sets defined for inter-band CA (three bands)

CA operating/channel bandwidth (MHz)				
NR CA configuration	Uplink CA configuration or single uplink carrier	NR Band	Channel bandwidth (MHz)	Bandwidth combination set
CA_n40A-n41A-n77A CA_n40A-n41B-n77A	n40 ^{7,9} n41 ^{7,9} n77 ^{7,9} CA_n40A-n41A ^{7,9} CA_n40A-n77A ^{7,9} CA_n41A-n77A ^{7,9}	n40	n40 channel bandwidths in Table 5.3.5-1	4 and 5
		n41	n41 channel bandwidths in Table 5.3.5-1	
		n77	n77 channel bandwidths in Table 5.3.5-1	
NOTE 7: Minimum requirements for Power Class 2 are applicable for this uplink combination or single uplink carrier in this downlink/uplink combination NOTE 9: Minimum requirements for Power Class 1.5 are applicable for this uplink combination or single uplink carrier in this downlink/uplink combination				

6.26.2 Maximum output power

Table 6.26.2-1 UE Power Class 2 for uplink inter-band CA (Three bands)

Uplink CA configuration	Power class 2 cases for CA_nX-nY	CA power class	Carrier X power class	Carrier Y power class
CA_n40-n41	Case a	26dBm	23dBm	23dBm
	Case b	26dBm	23dBm	26dBm
	Case c	26dBm	26dBm	23dBm
	Case d	26dBm	26dBm	26dBm
CA_n40-n77	Case a	26dBm	23dBm	23dBm
	Case b	26dBm	23dBm	26dBm
	Case c	26dBm	26dBm	23dBm
	Case d	26dBm	26dBm	26dBm
CA_n41-n77	Case a	26dBm	23dBm	23dBm
	Case b	26dBm	23dBm	26dBm
	Case c	26dBm	26dBm	23dBm
	Case d	26dBm	26dBm	26dBm

Table 6.26.2-2 UE Power Class 1.5 for uplink inter-band CA (Three bands)

Uplink CA configuration	Power class 1.5 cases for CA_nX-nY	CA power class	Carrier X power class	Carrier Y power class
CA_n40-n41	Case a	29dBm	26dBm	26dBm
	Case b	29dBm	23dBm	29dBm
	Case c	29dBm	29dBm	23dBm
	Case d	29dBm	26dBm	29dBm
	Case e	29dBm	29dBm	26dBm
CA_n40-n77	Case a	29dBm	26dBm	26dBm
	Case b	29dBm	23dBm	29dBm
	Case c	29dBm	29dBm	23dBm
	Case d	29dBm	26dBm	29dBm
	Case e	29dBm	29dBm	26dBm
CA_n41-n77	Case a	29dBm	26dBm	26dBm
	Case b	29dBm	23dBm	29dBm
	Case c	29dBm	29dBm	23dBm
	Case d	29dBm	26dBm	29dBm
	Case e	29dBm	29dBm	26dBm

6.26.3 REFSENS requirements

Analysis of REFSENS exceptions or MSD requirements is needed due to higher power uplink.

For single UL n40, n41 and n77, there is neither IMD issue nor harmonic mixing issue, hence there is no MSD for the each of the three single UL for both PC2 and PC1.5.

For the three 2-band UL cases, IMDs exist. Therefore, the MSD values for HPUE need to be defined.

- UL CA_n40A-n41A has IMD5, IMD6 and IMD7 into n77, and the PC3 IMD5 MSD is 5.2dB.
- UL CA_n40-n77A has IMD4, IMD6 and IMD7 into n41, and the PC3 IMD4 MSD is 13.1dB

- UL CA_n41-n77A has IMD4, IMD6 and IMD7 into n40, and the PC3 IMD4 MSD is 15dB

Therefore, the MSD values for HPUE need to be defined.

6.26.3.1 Power class 2 case a, b, c, d

Based on the approved WF on MSD simplification for HPUE [4],

- The PC2 MSD value corresponding to IMD5 due to UL CA_n40A-n41A falling into n77 DL is calculated by adding 7.1dB to the PC3 MSD value, resulting in 12.3dB.
- The PC2 MSD value corresponding to IMD4 due to UL CA_n40A-n77A falling into n41 DL is calculated by adding 9dB to the PC3 MSD value, resulting in 22.1dB.
- The PC2 MSD value corresponding to IMD4 due to UL CA_n41A-n77A falling into n40 DL is calculated by adding 9dB to the PC3 MSD value, resulting in 24dB.

Table 6.26.3-1: 3DL/2UL inter-band Reference sensitivity QPSK PREFSENS and uplink/downlink configurations for PC2 CA

Band / Channel bandwidth / N _{RB} / Duplex mode								Source of IMD
NR CA band combination	NR band	UL F _c (MHz)	UL/DL BW (MHz)	UL L _{CRB}	DL F _c (MHz)	MSD (dB)	Duplex mode	
n40-n41-n77	n40	2305	10	50	2305	N/A	TDD	N/A
	n41	2685	10	50	2685	N/A	TDD	N/A
	n77	N/A	10	N/A	3445	12.3	TDD	IMD5 ^x
	n40	2305	10	50	2305	N/A	TDD	N/A
	n41	N/A	10	N/A	2600	22.1	TDD	IMD4 ^x
	n77	3605	10	50	3605	N/A	TDD	N/A
	n40	N/A	10	N/A	2350	24	TDD	IMD4 ^x
	n41	2550	10	50	2550	N/A	TDD	N/A
	n77	3725	10	50	3725	N/A	TDD	N/A
NOTE X: This band is subject to IMD6 also which MSD is not specified.								

6.26.3.2 Power class 1.5 case a, b, c, d, e

Based on the approved WF on MSD simplification for HPUE [4],

- The PC1.5 MSD value corresponding to IMD5 due to UL CA_n40A-n41A falls into n77 DL is calculated by adding 15.8dB to the PC3 MSD value, resulting in 21dB.
- The PC1.5 MSD value corresponding to IMD4 due to UL CA_n40A-n77A falls into n41 DL is calculated by adding 18dB to the PC3 MSD value, 13.1dB, resulting in 31.1dB.
- The PC1.5 MSD value corresponding to IMD4 due to UL CA_n41A-n77A falls into n40 DL is calculated by adding 18dB to the PC3 MSD value, 15dB, resulting in 33dB.

Table 6.26.3-2: 3DL/2UL inter-band Reference sensitivity QPSK PREFSENS and uplink/downlink configurations for PC1.5 CA

Band / Channel bandwidth / N _{RB} / Duplex mode								Source of IMD
NR CA band combination	NR band	UL F _c (MHz)	UL/DL BW (MHz)	UL L _{CRB}	DL F _c (MHz)	MSD (dB)	Duplex mode	
n40-n41-n77	n40	2305	10	50	2305	N/A	TDD	N/A
	n41	2685	10	50	2685	N/A	TDD	N/A
	n77	N/A	10	N/A	3445	5.2	TDD	IMD5 ^x
	n40	2305	10	50	2305	N/A	TDD	N/A
	n41	N/A	10	N/A	2600	13.1	TDD	IMD4 ^x
	n77	3605	10	50	3605	N/A	TDD	N/A
	n40	N/A	10	N/A	2350	15	TDD	IMD4 ^x
	n41	2550	10	50	2550	N/A	TDD	N/A
	n77	3725	10	50	3725	N/A	TDD	N/A
NOTE: This band is subject to IMD6 also which MSD is not specified.								

6.26.4 Δ TIB and Δ RIB values

There is no change by comparing to the values for PC3 CA.

6.27 CA_n18-n40-n77

6.27.1 Configurations

Table 6.27.1-1: NR CA configurations and bandwidth combinations sets defined for inter-band CA (three bands)

CA operating/channel bandwidth (MHz)				
NR CA configuration	Uplink CA configuration or single uplink carrier	NR Band	Channel bandwidth (MHz)	Bandwidth combination set
CA_n18A-n40A-n77A	n40 ^{7,9} n77 ^{7,9} CA_n18A-n40A ^{7,9} CA_n18A-n77A ^{7,9} CA_n40A-n77A ^{7,9}	n18	n18 channel bandwidths in Table 5.3.5-1	4 and 5
		n40	n40 channel bandwidths in Table 5.3.5-1	
		n77	n77 channel bandwidths in Table 5.3.5-1	
NOTE 7: Minimum requirements for Power Class 2 are applicable for this uplink combination or single uplink carrier in this downlink/uplink combination				
NOTE 9: Minimum requirements for Power Class 1.5 are applicable for this uplink combination or single uplink carrier in this downlink/uplink combination				

6.27.2 Maximum output power

Table 6.27.2-1 UE Power Class 2 for uplink inter-band CA (Three bands)

Uplink CA configuration	Power class 2 cases for CA_nX-nY	CA power class	Carrier X power class	Carrier Y power class
CA_n18-n40	Case a	26dBm	23dBm	23dBm
	Case b	26dBm	23dBm	26dBm
CA_n18-n77	Case a	26dBm	23dBm	23dBm
	Case b	26dBm	23dBm	26dBm
CA_n40-n77	Case a	26dBm	23dBm	23dBm
	Case b	26dBm	23dBm	26dBm
	Case c	26dBm	26dBm	23dBm
	Case d	26dBm	26dBm	26dBm

Table 6.27.2-2 UE Power Class 1.5 for uplink inter-band CA (Three bands)

Uplink CA configuration	Power class 1.5 cases for CA_nX-nY	CA power class	Carrier X power class	Carrier Y power class
CA_n18-n40	Case b	29dBm	23dBm	29dBm
CA_n18-n77	Case b	29dBm	23dBm	29dBm
CA_n40-n77	Case a	29dBm	26dBm	26dBm
	Case b	29dBm	23dBm	29dBm
	Case c	29dBm	29dBm	23dBm
	Case d	29dBm	26dBm	29dBm
	Case e	29dBm	29dBm	26dBm

6.27.3 REFSENS requirements

Analysis of REFSENS exceptions or MSD requirements is needed due to higher power uplink. ,

For single UL n40 and n77, there is neither IMD issue nor harmonic mixing issue, hence there is no MSD for the either UL n40 nor UL n77 for both PC2 and PC1.5.

6.27.3.1 Power class 2 case a, b, c, d

Based on analysis, for the three 2-bands interband UL cases, IMD3 etc. exist.

- IMD3 and IMD5 due to UL CA_n40A-n77A falls into n18 DL. The MSD value corresponding to this IMD3 is calculated by adding 9dB to the PC3 MSD value, resulting in 24.2dB.
- IMD3 due to UL CA_n18A-n40A falls into n77 DL. The MSD value corresponding to this IMD3 is calculated by adding 9dB to the PC3 MSD value, resulting in 25.1dB.
- IMD3 due to UL CA_n18A-n77A falls into n40 DL. The MSD value corresponding to this IMD3 is calculated by adding 9dB to the PC3 MSD value, resulting in 22.2dB.

The test points and the MSD values are shown in Table 6.27.3-1.

Table 6.27.3-1: 3DL/2UL inter-band Reference sensitivity QPSK PREFSENS and uplink/downlink configurations for PC2 CA

Band / Channel bandwidth / N _{RB} / Duplex mode								Source of IMD
NR CA band combination	NR band	UL F _c (MHz)	UL/DL BW (MHz)	UL L _{CRB}	DL F _c (MHz)	MSD (dB)	Duplex mode	
CA_n18-n40-n77	n18	N/A	5	N/A	862.5	24.2	FDD	IMD3 ¹
	n40	2302.5	5	25	2302.5	N/A	TDD	N/A
	n77	3742.5	10	50	3742.5	N/A	TDD	N/A
	n18	817.5	5	25	862.5	N/A	FDD	N/A
	n40	2350	5	25	2350	N/A	TDD	N/A
	n77	N/A	10	N/A	3882.5	25.1	TDD	IMD3
	n18	817.5	5	25	862.5	N/A	FDD	N/A
	n40	N/A	5	N/A	2367.5	22.2	TDD	IMD3
	n77	4002.5	10	50	4002.5	N/A	TDD	N/A

NOTE 1: This band is subject to IMD5 also which MSD is not specified.

6.27.3.2 Power class 1.5 case a, b, c, d, e

Based on calculation, for the three 2-band interband UL cases, IMD3 etc. exist. The test points and the MSD values are shown in Table 6.27.3-2.

- IMD3 and IMD5 due to UL CA_n40A-n77A falls into n18 DL. The MSD value corresponding to this IMD3 is calculated by adding 18dB to the PC3 MSD value, resulting in 33.2dB.
- IMD3 due to UL CA_n18A-n40A falls into n77 DL. The MSD value corresponding to this IMD3 is calculated by adding 18dB to the PC3 MSD value, resulting in 34.1dB.
- IMD3 due to UL CA_n18A-n77A falls into n40 DL. The MSD value corresponding to this IMD3 is calculated by adding 18dB to the PC3 MSD value, resulting in 31.2dB.

Table 6.27.3-2: 3DL/2UL inter-band Reference sensitivity QPSK PREFSENS and uplink/downlink configurations for PC1.5 CA

Band / Channel bandwidth / N _{RB} / Duplex mode								Source of IMD
NR CA band combination	NR band	UL F _c (MHz)	UL/DL BW (MHz)	UL L _{CRB}	DL F _c (MHz)	MSD (dB)	Duplex mode	
CA_n18-n40-n77	n18	N/A	5	N/A	862.5	33.2	FDD	IMD3 ¹
	n40	2302.5	5	25	2302.5	N/A	TDD	N/A
	n77	3742.5	10	50	3742.5	N/A	TDD	N/A
	n18	817.5	5	25	862.5	N/A	FDD	N/A
	n40	2350	5	25	2350	N/A	TDD	N/A
	n77	N/A	10	N/A	3882.5	34.1	TDD	IMD3
	n18	817.5	5	25	862.5	N/A	FDD	N/A
	n40	N/A	5	N/A	2367.5	31.2	TDD	IMD3
	n77	4002.5	10	50	4002.5	N/A	TDD	N/A

NOTE 1: This band is subject to IMD5 also which MSD is not specified.

6.27.4 Δ TIB and Δ RIB values

There is no change by comparing to the values for PC3 CA.

7 High Power UE CA with SUL

7.0 CA_nW-nX_SUL_nY-nZ

7.0.1 Configurations

<Editor’s note: the CA configurations and bandwidth combinations sets should be kept same as defined in 38.101-1 Table 5.5C-4 unless additional clarification>

Table 7.0.1-1: NR CA configurations and bandwidth combinations sets for supporting power class 2

NR CA configuration	Uplink configuration	NR Band	Channel Bandwidth	Bandwidth combination set
CA_nW-nX_SUL_nY-nZ	SUL_nY-nZ	nW		
		nX		
		nY		
		nZ		

7.0.2 Maximum output power

7.0.3 REFSENS requirements

<Editor’s note: This agenda will capture the Reference sensitivity exceptions or MSD requirements due to higher power for CA carrier, please use the same table format as in 38101-1. >

7.0.4 ΔTIB and ΔRIB values

<Editor’s note: If no change by comparing to the values for power class 3 CA, this section will be void.>

Annex A:

Valid UL configurations

For High Power UE CA of 2 or 3 bands DL with 1 or 2 bands UL, the following UL configurations are applicable, subject to the general requirements:

- One band UL with one CC: nXA, nYA
- One band UL with two CC: CA_nXB, CA_nXC, CA_nX(2A), CA_nYB, CA_nYC, CA_nY(2A)
- two band UL with one CC per band: CA_nXA-nYA
- two band UL with two CC in one band: CA_nXB-nYA, CA_nXC-nYA, CA_nXA-nYB, CA_nXA-nYC

The following three UL cluster cases are not supported: CA_nX(2A)-nYA, CA_nXA-nY(2A)

- Combinations with four UL CCs are not supported.

Annex B (informative):
 Change history

Change history							
Date	Meeting	TDoc	CR	Rev	Cat	Subject/Comment	New version
2024-08	RAN4 #112	R4-2412268				Endorsed TR skeleton	0.1.0
2024-10	RAN4 #112-bis	R4-2414979				Endorsed text proposal	0.2.0
2025-03	RAN4 #114	R4-2500694				Endorsed text proposal	0.3.0
2025-06	RAN4 #115	R4-2505367				Endorsed text proposal	0.4.0
2025-09	RAN4 #116	R4-2509076				Endorsed text proposal	0.5.0
2025-09	RAN#109	RP-252472				For RAN submission	1.0.0
2025-10	RAN4#11 6bis	R4-2513265				Endorsed text proposal	1.1.0(wit hdrawn)
2025-11	RAN4#11 7	R4-2521301				Endorsed text proposal	1.2.0
2025-12	RAN#110	RP-253442				For RAN submission	2.0.0
2025-12	RAN#110	RP-253761				For RAN submission	2.0.1

Change history							
Date	Meeting	TDoc	CR	Rev	Cat	Subject/Comment	New version
2025-12	RAN#110					Approved by plenary – Rel-19 spec under change control	19.0.0

History

Version	Date	Status
V19.0.0	February 2026	Publication