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Technical Report

3rd Generation Partnership Project;

Technical Specification Group Radio Access Network;

Rel-17 NR inter-band Carrier Aggregation/Dual connectivity for 2 bands DL with x bands UL (x=1, 2)

(Release 17)

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Contents

Foreword

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

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

Version x.y.z

where:

- x the first digit:
  - 1 presented to TSG for information;
  - 2 presented to TSG for approval;
  - 3 or greater indicates TSG approved document under change control.
- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
- z the third digit is incremented when editorial only changes have been incorporated in the document.

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

shall indicates a mandatory requirement to do something

shall not indicates an interdiction (prohibition) to do something

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

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

should indicates a recommendation to do something

should not indicates a recommendation not to do something

may indicates permission to do something

need not indicates permission not to do something

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

can indicates that something is possible

cannot indicates that something is impossible

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

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

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

In addition:

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

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

1 Scope

The present document is a technical report for power class 3 NR inter-band CA and DC for 2 bands DL with up to 2 bands UL under Rel-17 time frame. The purpose is to gather the relevant background information and studies in order to address NR inter-band CA and DC for 2 bands DL with up to 2 bands UL for the Rel-17 band combinations.

This TR contains a general part and band specific combination part. The actual requirements are added to the corresponding technical specifications.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 38.101-1: "NR; User Equipment (UE) radio transmission and reception; Part 1: Range 1 Standalone".

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

[4] 3GPP TS 38.101-3: "NR; User Equipment (UE) radio transmission and reception; Part 3: Range 1 and Range 2 Interworking operation with other radios".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions 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].

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

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

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

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

3.2 Symbols

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

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

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].

BS	Base Station
CA	Carrier Aggregation
DC	Dual Connectivity
DL	DownLink
FDD	Frequency Division Duplex
IMD	Inter-modulation
MSD	Maximum Sensitivity Deduction
SCS	Subcarrier spacing
TDD	Time Division Duplex
UE	User Equipment
UL	UpLink

4 Background

The present document is a technical report for NR inter-band CA and DC for 2 bands DL with up to 2 bands UL under Rel-17 time frame. It covers both the UE and BS side. The document is divided in two different parts:

- General part: this part covers BS and UE specific which is band combination independent.

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

4.1 TR Maintenance

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

5 NR Inter-Band Combination: General Part

The general issue for NR inter-band combination including:

1: common issues for both 1 band UL and 2 bands UL NR CA, including the impact of UL/DL harmonic/ harmonic mixing associated with REFSEN, delta Tib and delta Rib, and OOB blocking exception, etc.

2: 2 bands UL NR CA specific issues, including MSD caused by IMD issue, etc.

3: No new issue for inter-band NR DC combination, the 2 bands UL NR CA specific issues shall be re-used.

6 Both bands within FR1 Carrier Aggregation: Specific Band Combination Part

6.1 CA_n5-n25

6.1.1 Common for 1 band UL and 2 bands UL CA

6.1.1.1 Operating bands for CA

Table 6.1.1-1: CA band combination of band n5 + n25

NR CA Band Combination	NR Band	Uplink (UL) band	Downlink (DL) band	Duplex mode
		BS receive / UE transmit	BS transmit / UE receive	
		F_{UL_low} – F_{UL_high}	F_{DL_low} – F_{DL_high}	
CA_n5-n25	n5	824 MHz – 849 MHz	869 MHz – 894 MHz	FDD
	n25	1850 MHz – 1915 MHz	1930 MHz – 1995 MHz	FDD

6.1.1.2 Channel bandwidths per operating band for CA

Table 8.x.2-1: Supported bandwidths per CA band combination of band n2+n78

NR CA configuration / Bandwidth combination set [MHz]																	
NR CA configuration	**UL configuration**	**NR Band**	**SCS (kHz)**	**5**	**10**	**15**	**20**	**25**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**Bandwidth combination set**
CA_n5A-n25A	CA_n5A-n25A	n5	15	Yes	Yes	Yes	Yes										0
			30		Yes	Yes	Yes										
			60														
		n25	15	Yes	Yes	Yes	Yes	Yes	Yes	Yes							
			30		Yes	Yes	Yes	Yes	Yes	Yes							
			60		Yes	Yes	Yes	Yes	Yes	Yes							
CA_n5A-n25(2A)	CA_n5A-n25A	n5	15	Yes	Yes	Yes	Yes										0
			30		Yes	Yes	Yes										

			60													
		n25	See CA_n25(2A) Bandwidth Combination Set 0 in Table 5.5A.2-1													

6.1.1.3 Co-existence studies

Table 6.1.1.3-1/2 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA_n5-n25.

Table 6.1.1.3-1: Impact of UL/DL Harmonic

					2nd Harmonic		3rd Harmonic	
Band	**UL Low Band Edge**	**UL High Band Edge**	**DL Low Band Edge**	**DL High Band Edge**	**UL Low Band Edge**	**UL High Band Edge**	**UL Low Band Edge**	**UL High Band Edge**
n5	824	849	869	894	1648	1698	2472	2547
n25	1850	1915	1930	1995	3700	3830	5550	5745

Based on above table, there is no harmonic issue for CA_n5-n25.

Table 6.1.1.3-2: Impact of UL/DL Harmonic mixing

					2nd Harmonic		3rd Harmonic	
Band	**UL Low Band Edge**	**UL High Band Edge**	**DL Low Band Edge**	**DL High Band Edge**	**DL Low Band Edge**	**DL High Band Edge**	**DL Low Band Edge**	**DL High Band Edge**
n5	824	849	869	894	1738	1788	2607	2682
n25	1850	1915	1930	1995	3860	3990	5790	5985

Based on above table, there is no harmonics mixing issue for CA_n5-n25.

6.1.1.4 ΔT_{IB} and ΔR_{IB} values

For CA_n5-n25, the $\Delta T_{IB,c}$ and ΔR_{IB} values are given in the tables below.

Table 6.1.1.4-1: $\Delta T_{IB,c}$

Inter-band CA Configuration	**NR Band**	**$\Delta T_{IB,c}$ [dB]**
CA_n5-n25	n5	0.3
	n25	0.3

Table 6.1.1.4-2: ΔR_{IB}

Inter-band CA Configuration	**NR Band**	**ΔR_{IB} [dB]**
CA_n5-n25	n5	0
	n25	0

6.1.1.5 REFSENs requirements

There is no harmonic issue for the CA combination.

6.1.1.6 OOB blocking exception requirements

There is no OOB exception for the CA combination.

6.1.2 Specific for 2 bands UL CA

6.1.2.1 Maximum output power for inter-band CA

Table 6.1.2.1-1: UE Power Class for uplink inter-band CA

Uplink CA Configuration	Class 3 (dBm)	Tolerance (dB)
CA_n5A-n25A	23	+2/-3[2]
NOTE 2: 2 refers to the transmission bandwidths confined within F_{UL_low} and F_{UL_low} + 4 MHz or F_{UL_high} – 4 MHz and F_{UL_high}, the maximum output power requirement is relaxed by reducing the lower tolerance limit by 1.5 dB		

6.1.2.2 UE co-existence

Table 6.1.2.2-1 gives IMD interference analysis for CA_ n5-n25 with 2 ULs.

Table 6.1.2.2-1: Harmonic and IMD analysis

UE UL carriers	fx_low	fx_high	fy_low	fy_high
UL frequency (MHz)	824	849	1850	1915
Two tone 2nd order IMD products	fy_low – fx_high	fy_high – fx_low	fx_low + fy_low	fx_high + fy_high
IMD frequency limits (MHz)	1001	1091	2674	2764
Two-tone 3rd order IMD products	|2*fx_low – fy_high|	|2*fx_high – fy_low|	2*fy_low – fx_high	2*fy_high – fx_low
IMD frequency limits (MHz)	267	152	2851	3006
Two-tone 3rd order IMD products	2*fx_low + fy_low	2*fx_high + fy_high	2*fy_low + fx_low	2*fy_high + fx_high
IMD frequency limits (MHz)	3498	3613	4524	4679
Two-tone 4th order IMD products	|3*fx_low – fy_high|	|3*fx_high – fy_low|	3*fy_low – fx_high	3*fy_high – fx_low
IMD frequency limits (MHz)	557	697	4701	4921
Two-tone 4th order IMD products	3*fx_low + fy_low	3*fx_high + fy_high	3*fy_low + fx_low	3*fy_high + fx_high
IMD frequency limits (MHz)	4322	4462	6374	6569
Two-tone 4th order IMD products	2*fy_low – 2*fx_high	2*fy_high – 2*fx_low	2*fx_low + 2*fy_low	2*fx_high + 2*fy_high
IMD frequency limits (MHz)	2002	2182	5348	5528
Two-tone 5th order IMD products	|4*fx_low – fy_high|	|4*fx_high – fy_low|	4*fy_low – fx_high	4*fy_high – fx_low
IMD frequency limits (MHz)	1381	1546	6551	6836
Two-tone 5th order IMD products	4*fx_low + fy_low	4*fx_high + fy_high	4*fy_low + fx_low	4*fy_high + fx_high

IMD frequency limits (MHz)	5146	5311	8224	8509
Two-tone 5th order IMD products	|3*fx_low – 2*fy_high|	|3*fx_high – 2*fy_low|	3*fy_low – 2*fx_high	3*fy_high – 2*fx_low
IMD frequency limits (MHz)	1358	1153	3852	4097
Two-tone 5th order IMD products	2*fx_low + 3*fy_low	2*fx_high + 3*fy_high	2*fy_low + 3*fx_low	2*fy_high + 3*fx_high
IMD frequency limits (MHz)	7198	7443	6172	6377

Based on the table 6.x.2.2-1, there is no IMD issue for CA_n5-n25.

Table 6.1.2.2-2 lists the protected bands required for the 2UL bands CA configuration.

Table 6.1.2.2-2: Protected bands for the 2UL bands CA configuration

NR CA Configuration	Spurious emission						
	Protected band	Frequency range (MHz)			Maximum Level (dBm)	MBW (MHz)	NOTE
CA_n5-n25	E-UTRA Band 4, 5, 10, 12, 13, 14, 17, 24, 26, 28, 29, 30, 42, 48, 53, 66, 70, 71, 85	F_{DL_low}	-	F_{DL_high}	-50	1	
	E-UTRA Band 41, 43	F_{DL_low}	-	F_{DL_high}	-50	1	2
	E-UTRA Band 2, 25	F_{DL_low}	-	F_{DL_high}	-50	1	4
NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.6.3.1-2 are permitted for each assigned E-UTRA carrier used in the measurement due to 2nd, 3rd, 4th or 5th harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2 MHz + N x L_{CRB} x 180 kHz), where N is 2, 3, 4, 5 for the 2nd, 3rd, 4th or 5th harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval. NOTE 4: These requirements also apply for the frequency ranges that are less than F_{OOB} (MHz) in Table 6.1.3.1-1 from the edge of the channel bandwidth.							

6.1.2.3 REFSENS requirements

There is no MSD issue for the CA combination.

6.2 CA_n71-n78

6.2.1 Common for 1 band UL and 2 bands UL CA

6.2.1.1 Operating bands for CA

Table 6.2.1-1: CA band combination of band n38 + n66

NR CA Band Combination	NR Band	Uplink (UL) band	Downlink (DL) band	Duplex mode
		BS receive / UE transmit	BS transmit / UE receive	
		F_{UL_low} – F_{UL_high}	F_{DL_low} – F_{DL_high}	
CA_n71-n78	n71	663 MHz – 698 MHz	617 MHz – 652 MHz	FDD
	n78	3300 MHz – 3800 MHz	3300 MHz – 3800 MHz	TDD

6.2.1.2 Channel bandwidths per operating band for CA

Table 8.x.2-1: Supported bandwidths per CA band combination of band n2+n78

NR CA configuration / Bandwidth combination set [MHz]																	
NR CA configuration	UL configuration	NR Band	SCS (kHz)	5	10	15	20	25	30	40	50	60	70	80	90	100	Bandwidth combination set
CA_n71A-n78A	CA_n71A-n78A	n71	15	Yes	Yes	Yes	Yes										0
			30		Yes	Yes	Yes										
			60														
		n78	15		Yes	Yes	Yes	Yes	Yes	Yes	Yes						
			30		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
			60		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
CA_n71A-n78(2A)	CA_n71A-n78A	n71	15	Yes	Yes	Yes	Yes										0
			30		Yes	Yes	Yes										
			60														
		n78	See CA_n78(2A) Bandwidth Combination Set 2 in Table 5.5A.2-1														

6.2.1.3 Co-existence studies

DC_71A_n78A is defined in Rel-16. Co-existence studies for DC_71A_n78A can be reused for CA_n71-n78.

6.2.1.4 ΔT_{IB} and ΔR_{IB} values

For CA_n71-n78, the $\Delta T_{IB,c}$ and ΔR_{IB} values are given in the tables below.

Table 6.2.1.4-1: $\Delta T_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n71-n78	n71	0.5
	n78	0.8

Table 6.2.1.4-2: ΔR_{IB}

Inter-band CA Configuration	NR Band	ΔR_{IB} [dB]
CA_n71-n78	n71	0.2
	n78	0.5

6.2.1.5 REFSENs requirements

There is no harmonic issue for the CA combination.

6.2.1.6 OOB blocking exception requirements

Table 6.2.1.6-1: CA band combination with exceptions allowed

CA band combination
CA_n71-n78

6.2.2 Specific for 2 bands UL CA

6.2.2.1 Maximum output power for inter-band CA

Table 6.2.2.1-1: UE Power Class for uplink inter-band CA

Uplink CA Configuration	Class 3 (dBm)	Tolerance (dB)
CA_n71A-n78A	23	+2/-3[2]
NOTE 2: 2 refers to the transmission bandwidths confined within F_{UL_low} and F_{UL_low} + 4 MHz or F_{UL_high} – 4 MHz and F_{UL_high}, the maximum output power requirement is relaxed by reducing the lower tolerance limit by 1.5 dB		

6.2.2.2 UE co-existence

Table 6.2.2.2-2 lists the protected bands required for the 2UL bands CA configuration.

Table 6.2.2.2-2: Protected bands for the 2UL bands CA configuration

NR CA Configuration	Spurious emission						
	Protected band	Frequency range (MHz)			Maximum Level (dBm)	MBW (MHz)	NOTE
CA_n71-n78	E-UTRA Band 5, 26	F_{DL_low}	-	F_{DL_high}	-50	1	
	E-UTRA Band 41	F_{DL_low}	-	F_{DL_high}	-50	1	2
NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.2.3.1-2 are permitted for each assigned E-UTRA carrier used in the measurement due to 2nd, 3rd, 4th or 5th harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2 MHz + N x L_{CRB} x 180 kHz), where N is 2, 3, 4, 5 for the 2nd, 3rd, 4th or 5th harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval.							

6.2.2.3 REFSENS requirements

DC_71A_n78A is defined in existing Rel-16 TS 38.101-3. Two-tone 5th order IMD products may fall into the own Rx Band of Band n71. The MSD value can be reused from DC_71A_n78A.

Table 6.2.2.3: 2DL/2UL interband Reference sensitivity QPSK $P_{REFSENS}$ and uplink/downlink configurations

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_n71A-n78A	n71	681.5	5	25	635.5	5.5	FDD	IMD5
CA_n71A-n78(2A)	n78	3361.5	10	50	3582.5	N/A	TDD	N/A

6.3 CA_n7-n66

6.3.1 Common for 1 band UL and 2 bands UL CA

6.3.1.1 Operating bands for CA

Table 6.3.1.1-1: CA band combination of band n7+n66

NR Band	Uplink (UL) band	Downlink (DL) band	Duplex mode
	BS receive / UE transmit	BS transmit / UE receive	
	F_{UL_low} – F_{UL_high}	F_{DL_low} – F_{DL_high}	
n7	2500 MHz – 2570 MHz	2620 MHz – 2690 MHz	FDD
n66	1710 MHz – 1780 MHz	2110 MHz – 2200 MHz	FDD

6.3.1.2 Channel bandwidths per operating band for CA

Table 6.3.1.2-1: Supported bandwidths per CA band combination of band n7+n66

CA operating / channel bandwidth [MHz]																
NR CA Configuration	**UL Configuration**	**NR Band**	**SCS [kHz]**	**5**	**10**	**15**	**20**	**25**	**30**	**40**	**50**	**60**	**80**	**90**	**100**	**Bandwidth combination set**
CA_n7A-n66A	CA_n7A-n66A	n7	15	Yes	Yes	Yes	Yes	Yes	Yes	Yes						1
			30		Yes	Yes	Yes	Yes	Yes	Yes						
			60		Yes	Yes	Yes	Yes	Yes	Yes						
		n66	15	Yes	Yes	Yes	Yes	Yes	Yes	Yes						
			30		Yes	Yes	Yes	Yes	Yes	Yes						
			60		Yes	Yes	Yes	Yes	Yes	Yes						
CA_n7A-n66(2A)	CA_n7A-n66A	n7	15	Yes	Yes	Yes	Yes	Yes	Yes	Yes						0
			30		Yes	Yes	Yes	Yes	Yes	Yes						
			60		Yes	Yes	Yes	Yes	Yes	Yes						
		n66	See CA_n66(2A) Bandwidth Combination Set 1 in Table 5.5A.2-1													
CA_n7(2A)-n66	CA_n7A-n66A	n7	See CA_n7(2A) Bandwidth Combination Set 0 in Table 5.5A.2-1													0
		n66	15		Yes	Yes	Yes	Yes	Yes	Yes						
			30		Yes	Yes	Yes	Yes	Yes	Yes						
			60		Yes	Yes	Yes	Yes	Yes	Yes						
CA_n7(2A)-n66(2A)	CA_n7A-n66A	n7	See CA_n7(2A) Bandwidth Combination Set 0 in Table 5.5A.2-1													0
		n66	See CA_n66(2A) Bandwidth Combination Set 1 in Table 5.5A.2-1													

6.3.1.3 UE co-existence studies

Table 6.3.1.3-1/2 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA_n7-n66.

Table 6.3.1.3-1: Impact of UL/DL Harmonic

					2nd Harmonic		3rd Harmonic		nth Harmonic	
Band	**UL Low Band Edge**	**UL High Band Edge**	**DL Low Band Edge**	**DL High Band Edge**	**UL Low Band Edge**	**UL High Band Edge**	**UL Low Band Edge**	**UL High Band Edge**	**UL Low Band Edge**	**UL High Band Edge**
n7	2500	2570	2620	2690	5000	5140	7500	7710		
n66	1710	1780	2110	2200	3420	3560	5130	5340		

Table 6.3.1.3-2: Impact of UL/DL Harmonic mixing

					2nd Harmonic		3rd Harmonic		mth Harmonic	
Band	**UL Low Band Edge**	**UL High Band Edge**	**DL Low Band Edge**	**DL High Band Edge**	**DL Low Band Edge**	**DL High Band Edge**	**DL Low Band Edge**	**DL High Band Edge**	**DL Low Band Edge**	**DL High Band Edge**
n7	2500	2570	2620	2690	5240	5380	7860	8070		
n66	1710	1780	2110	2200	4220	4400	6330	6660		

Based on above table, there is no harmonic issue for the band combination of n7 and n66.

Based on above table, there is no harmonic mixing issue for the band combination of n7 and n66.

6.3.1.4 ΔT_{IB} and ΔR_{IB} values

For CA_n7-n66 , the $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values are given in the tables below.

Table 6.3.1.4-1: $\Delta T_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n7-n66	n7	0.5
	n66	0.5

Table 6.1.x.4-2: $\Delta R_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta R_{IB,c}$ [dB]
CA_n7-n66	n7	0.5
	n66	0.5

6.3.1.5 REFSENS requirements

There are no specific REFSENS requirements for 1 band UL.

6.3.1.6 OOB blocking exception requirements

There is no OOB blocking exception for this CA band combination.

6.3.2 Specific for 2 bands UL CA

6.3.2.1 Maximum output power for inter-band CA

Table 6.3.2.2-1: UE Power Class for uplink inter-band CA

Uplink CA Configuration	Class 3 (dBm)	Tolerance (dB)
CA_n7A-n66A	23	+2/-3[2]
NOTE 2: 2 refers to the transmission bandwidths confined within F_{UL_low} and F_{UL_low} + 4 MHz or F_{UL_high} – 4 MHz and F_{UL_high}, the maximum output power requirement is relaxed by reducing the lower tolerance limit by 1.5 dB		

6.3.2.2 UE co-existence studies

Table 6.3.2.1-1 lists Band n7 +Band n66 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

Table 6.3.2.2-1: Band n7 and Band n66 UL IMD products

UE UL carriers	f1_low	f1_high	f2_low	f2_high
UL frequencies (MHz)	1710	1780	2500	2570
2nd order IMD products	f2_low – f1_high	f2_high – f1_low	f2_low + f1_low	f2_high + f1_high
IMD frequency limit (MHz)	720	860	4210	4350
3rd order IMD products	2*f1_low – f2_high	2*f1_high – f2_low	2*f2_low – f1_high	2*f2_high – f1_low
IMD frequency limit (MHz)	850	1060	3220	3430
3rd order IMD products	2*f1_low + f2_low	2*f1_high + f2_high	2*f2_low + f1_low	2*f2_high + f1_high
IMD frequency limit (MHz)	5920	6130	6710	6920

4th order IMD products	3*f1_low – f2_high	3*f1_high – f2_low	3*f2_low – f1_high	3*f2_high – f1_low
IMD frequency limit (MHz)	2560	2840	5720	6000
4th order IMD products	3*f1_low + f2_low	3*f1_high + f2_high	3*f2_low + f1_low	3*f2_high + f1_high
IMD frequency limit (MHz)	7630	7910	9210	9490
4th order IMD products	2*f1_low – 2*f2_high	2*f1_high – 2*f2_low	2*f1_low + 2*f2_low	2*f1_high + 2*f2_high
IMD frequency limit (MHz)	-1720	-1440	8420	8700
5th order IMD products	f1_low – 4*f2_high	f1_high – 4*f2_low	f2_low – 4*f1_high	f2_high – 4*f1_low
IMD frequency limit (MHz)	-8570	-8220	-4620	-4270
5th order IMD products	f1_low + 4*f2_low	f1_high + 4*f2_high	f2_low + 4*f1_low	f2_high + 4*f1_high
IMD frequency limit (MHz)	11710	12060	9340	9690
5th order IMD products	2*f1_low – 3*f2_high	2*f1_high - 3*f2_low	2*f2_low – 3*f1_high	2*f2_high – 3*f1_low
IMD frequency limit (MHz)	-4290	-3940	-340	10
5th order IMD products	2*f1_low + 3*f2_low	2*f1_high + 3*f2_high	2*f2_low + 3*f1_low	2*f2_high + 3*f1_high
IMD frequency limit (MHz)	10920	11270	10130	10480

Based on the table above, the 4th order IMD may fall into Rx frequencies of band n7.

Table 6.3.2.2-2 lists the protected bands required for the 2UL bands CA configuration.

Table 6.3.2.2-2: Protected bands for the 2UL bands CA configuration

UL NR CA Configuration	Spurious emission						
	Protected band	Frequency range (MHz)			Maximum Level (dBm)	MBW (MHz)	NOTE
CA_n7-n66	E-UTRA Band 2, 4, 5, 7, 10, 12, 13, 14, 17, 26, 27, 28, 29, 30, 43, 50, 51, 66, 74, 85	F_{DL_low}	-	F_{DL_high}	-50	1	
	E-UTRA Band 42, 48 NR band n77, n78	F_{DL_low}	-	F_{DL_high}	-50	1	2
	Frequency range	2570	-	2575	+1.6	5	15, 21, 26
	Frequency range	2575	-	2595	-15.5	5	15, 21, 26
	Frequency range	2595	-	2620	-40	5	15, 21
NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.5.3.1-2 are permitted for each assigned NR carrier used in the measurement due to 2nd, 3rd, 4th or 5th harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2 MHz + N x LCRB x RBsize kHz), where N is 2, 3, 4, 5 for the 2nd, 3rd, 4th or 5th harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval. NOTE 15: These requirements also apply for the frequency ranges that are less than FOOB (MHz) in Table 6.5.3.1-1 from the edge of the channel bandwidth. NOTE 21: This requirement is applicable for any channel bandwidths within the range 2500 - 2570 MHz with the following restriction: for carriers of 15 MHz bandwidth when carrier centre frequency is within the range 2560.5 - 2562.5 MHz and for carriers of 20 MHz bandwidth when carrier centre frequency is within the range 2552 - 2560 MHz the requirement is applicable only for an uplink transmission bandwidth less than or equal to 54 RB. NOTE 26: For these adjacent bands, the emission limit could imply risk of harmful interference to UE(s) operating in the protected operating band.						

6.3.2.3 REFSENS requirements

Table 6.3.2.3-1 lists the MSD required due to the 4th IMD for the dual uplink configuration The MSD value is reused from E-UTRA CA_4-7.

Table 6.3.2.3-1: MSD due to IMD issue

Operating band / Channel bandwidth / N_{RB} / Duplex mode								Source of IMD
CA Configuration	Operating band	UL F_c (MHz)	UL/DL BW (MHz)	UL L_{CRB}	DL F_c (MHz)	MSD (dB)	Duplex mode	
CA_n7A-n66A	n7	2535	5	25	2655	15	FDD	IMD4
	n66	1730	5	25	2130	N/A	TDD	N/A

6.8 CA_n25-38

6.4.1 Common for 1 band UL and 2 bands UL CA

6.4.1.2 Channel bandwidths per operating band for CA

Table 6.4.1.1-1: CA band combination of band n25+n38

NR Band	Uplink (UL) band BS receive / UE transmit F_{UL_low} – F_{UL_high}	Downlink (DL) band BS transmit / UE receive F_{DL_low} – F_{DL_high}	Duplex mode
n25	1850 MHz – 1915 MHz	1930 MHz – 1995 MHz	FDD
n38	2570 MHz – 2620 MHz	2570 MHz – 2620 MHz	TDD

6.4.1.2 Channel bandwidths per operating band for CA

Table 6.4.1.2-1: Supported bandwidths per CA band combination of band n25+n38

CA operating / channel bandwidth [MHz]																
NR CA Configuration	UL Configuration	NR Band	SCS [kHz]	5	10	15	20	25	30	40	50	60	80	90	100	Bandwidth combination set
CA_n25A-n38A	CA_n25A-n38A	n25	15	Yes	Yes	Yes	Yes	Yes	Yes	Yes						0
			30		Yes	Yes	Yes	Yes	Yes	Yes						
			60		Yes	Yes	Yes	Yes	Yes	Yes						
		n38	15	Yes	Yes	Yes	Yes	Yes	Yes	Yes						
			30		Yes	Yes	Yes	Yes	Yes	Yes						
			60		Yes	Yes	Yes	Yes	Yes	Yes						
CA_n25(2A)-n38A	CA_n25A-n38A	n25	See CA_n25(2A) Bandwidth Combination Set 0 in Table 5.5A.2-1													0
		n38	15	Yes	Yes	Yes	Yes	Yes	Yes	Yes						
			30		Yes	Yes	Yes	Yes	Yes	Yes						
			60		Yes	Yes	Yes	Yes	Yes	Yes						

6.4.1.3 UE co-existence studies

Table 6.4.1.3-1 summarizes frequency ranges where harmonics occur for CA_n25-n38.

Table 6.4.1.3-1: Impact of UL/DL Harmonic

					2nd Harmonic		3rd Harmonic		nth Harmonic	
Band	**UL Low Band Edge**	**UL High Band Edge**	**DL Low Band Edge**	**DL High Band Edge**	**UL Low Band Edge**	**UL High Band Edge**	**UL Low Band Edge**	**UL High Band Edge**	**UL Low Band Edge**	**UL High Band Edge**
n25	1850	1915	1930	1995	3700	3830	5550	5745		
n38	2570	2620	2570	2620	5140	5240	7710	7860		

Based on above table, there is no harmonic issue for the band combination of n25 and n38.

Table 6.4.1.3-2 summarizes frequency ranges where harmonics mixing occur for CA_n25-n38.

Table 6.4.1.3-2: Impact of UL/DL Harmonic mixing

					2nd Harmonic		3rd Harmonic		mth Harmonic	
Band	**UL Low Band Edge**	**UL High Band Edge**	**DL Low Band Edge**	**DL High Band Edge**	**DL Low Band Edge**	**DL High Band Edge**	**DL Low Band Edge**	**DL High Band Edge**	**DL Low Band Edge**	**DL High Band Edge**
n25	1850	1915	1930	1995	3700	3830	5550	5745		
n38	2570	2620	2570	2620	5140	5240	7710	7860		

Based on above table, there is no harmonic mixing issue for the band combination of n25 and n38.

6.4.1.4 ΔT_{IB} and ΔR_{IB} values

For CA_n25-n38 , the $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values are given according to the general framework for the high-high band combination.

Table 6.4.1.4-1: $\Delta T_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n25-n38	n25	0.5
	n38	0.5

Table 6.4.1.4-2: $\Delta R_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta R_{IB,c}$ [dB]
CA_n25-n38	n25	0
	n38	0

6.4.1.5 REFSENS requirements

Since the UE RF architecture for CA_n25-n38 is similar to CA_n25-n41, MSD due to cross band isolation defined for CA_n25-n41 is assumed.

Table 6.4.2.3-1: Reference sensitivity exceptions (MSD) due to cross band isolation for NR CA FR1

NR Band / Channel bandwidth of the affected DL band														
UL band	DL band	5 MHz (dB)	10 MHz (dB)	15 MHz (dB)	20 MHz (dB)	25 MHz (dB)	30 MHz (dB)	40 MHz (dB)	50 MHz (dB)	60 MHz (dB)	70 MHz (dB)	80 MHz (dB)	90 MHz (dB)	100 MHz (dB)
n38	n25	0.6	0.6	0.6	0.6	0.6	0.6	0.6						

Table 6.4.2.3-2: Uplink configuration for reference sensitivity exceptions due to cross band isolation for NR CA FR1

NR Band / SCS / Channel bandwidth of the affected DL band															
UL band	DL band	SCS of UL band (kHz)	5 MHz	10 MHz	15 MHz	20 MHz	25 MHz	30 MHz	40 MHz	50 MHz	60 MHz	70 MHz	80 MHz	90 MHz	100 MHz
n38	n25	15	160	160	160	160	160	160	160						

6.4.1.6 OOB blocking exception requirements

There is no OOB blocking exception for this CA band combination.

6.4.2 Specific for 2 bands UL CA

6.4.2.1 Maximum output power for inter-band CA

Table 6.4.2.2-1: UE Power Class for uplink inter-band CA

Uplink CA Configuration	Class 3 (dBm)	Tolerance (dB)
CA_25A-n38A	23	+2/-3[2]
NOTE 2: 2 refers to the transmission bandwidths confined within F_{UL_low} and F_{UL_low} + 4 MHz or F_{UL_high} – 4 MHz and F_{UL_high}, the maximum output power requirement is relaxed by reducing the lower tolerance limit by 1.5 dB		

6.4.2.2 UE co-existence studies

Table 6.4.2.2-1 lists Band n25 +Band n38 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

Table 6.4.2.2-1: Band n25 and Band n38 UL harmonics and IMD products

UE UL carriers	f1_low	f1_high	f2_low	f2_high
UL frequencies (MHz)	1850	1915	2570	2620
2nd order IMD products	f2_low – f1_high	f2_high – f1_low	f2_low + f1_low	f2_high + f1_high
IMD frequency limit (MHz)	655	770	4420	4535
3rd order IMD products	2*f1_low – f2_high	2*f1_high – f2_low	2*f2_low – f1_high	2*f2_high – f1_low
IMD frequency limit (MHz)	1080	1260	3225	3390
3rd order IMD products	2*f1_low + f2_low	2*f1_high + f2_high	2*f2_low + f1_low	2*f2_high + f1_high
IMD frequency limit (MHz)	6270	6450	6990	7155

4th order IMD products	3*f1_low – f2_high	3*f1_high – f2_low	3*f2_low – f1_high	3*f2_high – f1_low
IMD frequency limit (MHz)	2930	3175	5795	6010
4th order IMD products	3*f1_low + f2_low	3*f1_high + f2_high	3*f2_low + f1_low	3*f2_high + f1_high
IMD frequency limit (MHz)	8120	8365	9560	9775
4th order IMD products	2*f1_low – 2*f2_high	2*f1_high – 2*f2_low	2*f1_low + 2*f2_low	2*f1_high + 2*f2_high
IMD frequency limit (MHz)	-1540	-1310	8840	9070
5th order IMD products	f1_low – 4*f2_high	f1_high – 4*f2_low	f2_low – 4*f1_high	f2_high – 4*f1_low
IMD frequency limit (MHz)	-8630	-8365	-5090	-4780
5th order IMD products	f1_low + 4*f2_low	f1_high + 4*f2_high	f2_low + 4*f1_low	f2_high + 4*f1_high
IMD frequency limit (MHz)	12130	12395	9970	10280
5th order IMD products	2*f1_low – 3*f2_high	2*f1_high - 3*f2_low	2*f2_low – 3*f1_high	2*f2_high – 3*f1_low
IMD frequency limit (MHz)	-4160	-3880	-605	-310
5th order IMD products	2*f1_low + 3*f2_low	2*f1_high + 3*f2_high	2*f2_low + 3*f1_low	2*f2_high + 3*f1_high
IMD frequency limit (MHz)	11410	11690	10690	10985

Based on the table above, no IMD issue is identified for this band combination.

Table 6.4.2.2-2 lists the protected bands required for the 2UL bands CA configuration.

Table 6.4.2.2-2: Protected bands for the 2UL bands CA configuration

UL NR CA Configuration	Spurious emission						
	Protected band	**Frequency range (MHz)**			**Maximum Level (dBm)**	**MBW (MHz)**	**NOTE**
CA_n25-n38	E-UTRA Band 4, 5, 10, 12, 13, 14, 17, 27, 29, 30, 42, 48, 66, 71, 85	F_{DL_low}	-	F_{DL_high}	-50	1	
	E-UTRA Band 2	F_{DL_low}	-	F_{DL_high}	-50	1	15
	E-UTRA Band 25	F_{DL_low}	-	F_{DL_high}	-50	1	15
	E-UTRA Band 43, 48 NR band n77, n78	F_{DL_low}	-	F_{DL_high}	-50	1	2
	Frequency range	2620	-	2645	-15.5	5	15, 21, 26
	Frequency range	2645	-	2690	-40	1	15, 21

NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.5.3.1-2 are permitted for each assigned NR carrier used in the measurement due to 2nd, 3rd, 4th or 5th harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2 MHz + N x LCRB x RBsize kHz), where N is 2, 3, 4, 5 for the 2nd, 3rd, 4th or 5th harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval.

NOTE 15: These requirements also apply for the frequency ranges that are less than FOOB (MHz) in Table 6.5.3.1-1 from the edge of the channel bandwidth.

NOTE 21: This requirement is applicable for any channel bandwidths within the range 2500 - 2570 MHz with the following restriction: for carriers of 15 MHz bandwidth when carrier centre frequency is within the range 2560.5 - 2562.5 MHz and for carriers of 20 MHz bandwidth when carrier centre frequency is within the range 2552 - 2560 MHz the requirement is applicable only for an uplink transmission bandwidth less than or equal to 54 RB.

NOTE 26: For these adjacent bands, the emission limit could imply risk of harmful interference to UE(s) operating in the protected operating band.

6.4.2.3 REFSENS requirements

There is no specific REFSENS requirement for 2 band UL.

6.5 CA_n1-n77

6.5.1 Common for 1 band UL and 2 bands UL CA

6.5.1.1 Operating bands for CA

Table 6.5.1.1-1: CA band combination of band n1+n77

NR Band	Uplink (UL) band BS receive / UE transmit F_{UL_low} – F_{UL_high}	Downlink (DL) band BS transmit / UE receive F_{DL_low} – F_{DL_high}	Duplex mode
n1	1920 MHz – 1980 MHz	2110 MHz – 2170 MHz	FDD
n77	3300 MHz – 4200 MHz	3300 MHz – 4200 MHz	TDD

6.5.1.2 Channel bandwidths per operating band for CA

Table 6.5.1.2-1: Supported bandwidths per CA band combination of band n1+n77

NR CA configuration	Uplink CA configuration	NR Band	SCS (kHz)	5 MHz	10 MHz	15 MHz	20 MHz	25 MHz	30 MHz	40 MHz	50 MHz	60 MHz	70 MHz	80 MHz	90 MHz	100 MHz	Bandwidth combination set
CA_n1A-n77A	CA_n1A-n77A	n1	15	Yes	Yes	Yes	Yes										0
			30		Yes	Yes	Yes										
			60		Yes	Yes	Yes										
		n77	15		Yes	Yes	Yes			Yes	Yes						
			30		Yes	Yes	Yes			Yes	Yes	Yes		Yes	Yes	Yes	
			60		Yes	Yes	Yes			Yes	Yes	Yes		Yes	Yes	Yes	

6.5.1.3 UE co-existence studies

This section is skipped since CA_n1-n77 without 2UL CA has been already specified in TS 38.101-1, and impact of harmonic issue has been studied in TR 38.716-02-00.

6.5.1.4 ΔT_{IB} and ΔR_{IB} values

For CA_n1-n77 , the $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values are given in the tables below. The same values are shown as what are specified in TS 38.101-1.

Table 6.5.1.4-1: $\Delta T_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n1-n77	n1	0.6
	n77	0.8

Table 6.5.1.4-2: $\Delta R_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta R_{IB,c}$ [dB]
CA_n1-n77	n1	0.2
	n77	0.5

6.5.1.5 REFSENS requirements

This section is skipped since CA_n1-n77 without 2UL CA has been already specified in TS 38.101-1, and impact of harmonic issue has been studied in TR 38.716-02-00.

6.5.1.6 OOB blocking exception requirements

This section is skipped since CA_n1-n77 without 2UL CA has been already specified.

6.5.2 Specific for 2 bands UL CA

6.5.2.1 Maximum output power for inter-band CA

Table 6.5.2.1-1: UE Power Class for uplink inter-band CA

Uplink CA Configuration	Class 3 (dBm)	Tolerance (dB)
CA_n1A-n77A	23	+2/-3[2]
NOTE 2: 2 refers to the transmission bandwidths confined within F_{UL_low} and F_{UL_low} + 4 MHz or F_{UL_high} – 4 MHz and F_{UL_high}, the maximum output power requirement is relaxed by reducing the lower tolerance limit by 1.5 dB		

6.5.2.2 UE co-existence studies

Table 6.5.2.2-1 lists Band n1 +Band n77 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

Table 6.5.2.2-1: Band n1 and Band n77 UL IMD products

UE UL carriers	fx_low	fx_high	fy_low	fy_high
2nd order IMD products	|fy_low – fx_high|	|fy_high – fx_low|	|fy_low + fx_low|	|fy_high + fx_high|
IMD frequency limits (MHz)	1320 – 2280		5220 – 6180	
Two-tone 3rd order IMD products	|2*fx_low – fy_high|	|2*fx_high – fy_low|	|2*fy_low – fx_high|	|2*fy_high – fx_low|
IMD frequency limits (MHz)	360 – 660		4620 – 6480	
Two-tone 3rd order IMD products	|2*fx_low + fy_low|	|2*fx_high + fy_high|	|2*fy_low + fx_low|	|2*fy_high + fx_high|
IMD frequency limits (MHz)	1920 – 1980		3300 – 4200	
Two-tone 3rd order IMD products	(fx_low – max BW fy)	(fx_high + max BW fy)	(fy_low – max BW fx)	(fy_high + max BW fx)
IMD frequency limits (MHz)	1820 – 2080		3280 – 4220	
Two-tone 4th order IMD products	|3*fx_low –1* fy_high|	|3*fx_high – 1*fy_low|	|3*fy_low – 1*fx_high|	|3*fy_high – 1*fx_low|
IMD frequency limits (MHz)	1560 – 2640		7920 – 10680	
Two-tone 4th order IMD products	|2*fx_low –2* fy_high|	|2*fx_high –2* fy_low|		
IMD frequency limits (MHz)	2640 – 4560			
Two-tone 4th order IMD products	|3*fx_low +1* fy_low|	|3*fx_high + 1*fy_high|	|3*fy_low + 1*fx_low|	|3*fy_high + 1*fx_high|
IMD frequency limits (MHz)	9060 – 10140		11820 – 14580	
Two-tone 4th order IMD products	|2*fx_low +2* fy_low|	|2*fx_high +2* fy_high|		
IMD frequency limits (MHz)	10440 – 12360			
Two-tone 5th order IMD products	|fx_low – 4*fy_high|	|fx_high – 4*fy_low|	|fy_low – 4*fx_high|	|fy_high – 4*fx_low|
IMD frequency limits (MHz)	11220 – 14880		3480 – 4620	
Two-tone 5th order IMD products	|2*fx_low - 3*fy_high|	|2*fx_high - 3*fy_low|	|2*fy_low - 3*fx_high|	|2*fy_high - 3*fx_low|
IMD frequency limits (MHz)	5940 – 8760		660 – 2640	
Two-tone 5th order IMD products	|fx_low + 4*fy_low|	|fx_high + 4*fy_high|	|fy_low + 4*fx_low|	|fy_high + 4*fx_high|
IMD frequency limits (MHz)	15120 – 18780		10980 – 12120	
Two-tone 5th order IMD products	|2*fx_low + 3*fy_low|	|2*fx_high + 3*fy_high|	|2*fy_low + 3*fx_low|	|2*fy_high + 3*fx_high|
IMD frequency limits (MHz)	13740 – 16560		12360 – 14340	
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.				

Based on above Table , it can be seen that

- 2nd order IMD products may fall into Rx frequencies of bands 1, 2, 3, 4, 9, 10, 11, 21, 23, 24, 25, 32, 33, 34, 35, 36, 37, 39, 45, 46, 47, 50, 51, 65, 66, 70, 74, 75, 76, n91, n92, n93, n94
- 3rd order IMD products may fall into Rx frequencies of bands 2, 3, 9, 22, 25, 31, 33, 34, 35, 36, 37, 39, 42, 43, 46, 47, 48, 49, 52, 70, 71, 72, 73, n77, n78, n79, n87, n88
- 4th order IMD products may fall into Rx frequencies of bands 1, 2, 3, 4, 7, 9, 10, 22, 23, 25, 30, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 48, 49, 52, 53, 65, 66, 69, 70, n77, n78, n79, n90
- 5th order IMD products may fall into Rx frequencies of bands 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 48, 49, 50, 51, 53, 65, 66, 67, 68, 69, 70, 74, 75, 76, n77, n78, n79, 85, n90, n91, n92 ,n93, n94

Self-interference to own Rx frequencies are shown as red.

Table 6.5.2.2-2 lists the protected bands required for the 2UL bands CA configuration.

Table 6.5.2.2-2: Protected bands for the 2UL bands CA configuration

UL NR CA Configuration	Spurious emission						
	Protected band	Frequency range (MHz)			Maximum Level (dBm)	MBW (MHz)	NOTE
CA_n1-n77	E-UTRA Band 1, 5, 7, 8, 11, 18, 19, 20, 21, 26, 27, 28, 40, 41, 65, 74	F_{DL_low}	-	F_{DL_high}	-50	1	
	E-UTRA Band 3, 34	F_{DL_low}	-	F_{DL_high}	-50	1	4
	Frequency range	1880	-	1895	-40	1	4, 6
	Frequency range	1895	-	1915	-15.5	5	4, 6, 7
	Frequency range	1915	-	1920	+1.6	5	4, 6, 7
NOTE 4: These requirements also apply for the frequency ranges that are less than F_{OOB} (MHz) in Table 6.5.3.1-1 from the edge of the channel bandwidth. NOTE 6: This requirement is applicable for any channel bandwidths within the range 1920 – 1980 MHz with the following restriction: for carriers of 15 MHz bandwidth when carrier centre frequency is within the range 1927.5 - 1929.5 MHz and for carriers of 20 MHz bandwidth when carrier centre frequency is within the range 1930 – 1938 MHz the requirement is applicable only for an uplink transmission bandwidth less than or equal to 54 RB. NOTE 7: For these adjacent bands, the emission limit could imply risk of harmful interference to UE(s) operating in the protected operating band.							

6.5.2.3 REFSENS requirements

MSD for harmonic issues is already covered by the study for fallback combinations of 1UL/2DL. Therefore, here we focus on MSD for IMD issues.

Table 6.5.2.3-1 lists the MSD required due to 2nd and 4th IMD for the dual uplink configuration. We use same MSD as DC_1_n77 specified in TS 38.101-3. Note that no MSD for 3rd, 4th and 5th IMD to n77 is specified in TS 38.101-3, and then we follow the result.

Table 6.5.2.3-1: MSD due to IMD issue

Operating band / Channel bandwidth / N_{RB} / Duplex mode								Source of IMD
CA Configuration	Operating band	UL F_c (MHz)	UL/DL BW (MHz)	UL L_{CRB}	DL F_c (MHz)	MSD (dB)	Duplex mode	
CA_n1A-n77A	1	1950	5	25	2140	29.8 32.5 [5]	FDD	IMD2[4]
	n77	4090	10	50	4090	N/A	TDD	N/A
CA_n1A-n77A	1	1950	5	25	2140	8.0 10.7[5]	FDD	IMD4[4]
	n77	3710	10	50	3710	N/A	TDD	N/A
NOTE 4: This band is subject to IMD5 also which MSD is not specified. NOTE 5: Applicable only if operation with 4 antenna ports is supported in the band with EN-DC configured.								

6.6 CA_n77-n79

6.6.1 Common for 1 band UL and 2 bands UL CA

6.6.1.1 Operating bands for CA

Table 6.6.1.1-1: CA band combination of band n77+n79

NR Band	Uplink (UL) band BS receive / UE transmit F_{UL_low} – F_{UL_high}	Downlink (DL) band BS transmit / UE receive F_{DL_low} – F_{DL_high}	Duplex mode
n77	3300 MHz – 4200 MHz	3300 MHz – 4200 MHz	TDD
n79	4400 MHz – 5000 MHz	4400 MHz – 5000 MHz	TDD

6.6.1.2 Channel bandwidths per operating band for CA

Table 6.6.1.2-1: Supported bandwidths per CA band combination of band n77+n79

NR CA configuration	Uplink CA configuration	NR Band	SCS (kHz)	5 MHz	10 MHz	15 MHz	20 MHz	25 MHz	30 MHz	40 MHz	50 MHz	60 MHz	70 MHz	80 MHz	90 MHz	100 MHz	Bandwidth combination set
CA_n77A-n79A	CA_n77A-n79A	n77	15		Yes	Yes	Yes			Yes	Yes						0
			30		Yes	Yes	Yes			Yes	Yes	Yes		Yes	Yes	Yes	
			60		Yes	Yes	Yes			Yes	Yes	Yes		Yes	Yes	Yes	
		n79	15							Yes	Yes						
			30							Yes	Yes	Yes		Yes		Yes	
			60							Yes	Yes	Yes		Yes		Yes	

6.6.1.3 UE co-existence studies

This section is skipped since CA_n77-n79 without 2UL CA has been already specified in TS 38.101-1, and impact of harmonic issue has been discussed in TR 37.865-01-01, where n77 and n79 is assumed as synchronous operation.

6.6.1.4 ΔT_{IB} and ΔR_{IB} values

For CA_n77-n79 , the $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values are given in the tables below. The same values are shown as what are specified in TS 38.101-1.

Table 6.6.1.4-1: $\Delta T_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n77-n79	n77	0.5
	n79	0.5

Table 6.6.1.4-2: $\Delta R_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta R_{IB,c}$ [dB]
CA_n77-n79	n77	0
	n79	0

6.6.1.5 REFSENS requirements

This section is skipped since CA_n77-n79 without 2UL CA has been already specified in TS 38.101-1, and impact of harmonic issue has been discussed in TR 37.865-01-01, where n77 and n79 is assumed as synchronous operation.

6.6.1.6 OOB blocking exception requirements

This section is skipped since CA_n77-n79 without 2UL CA has been already specified.

6.6.2 Specific for 2 bands UL CA

6.6.2.1 Maximum output power for inter-band CA

Table 6.6.2.1-1: UE Power Class for uplink inter-band CA

Uplink CA Configuration	Class 3 (dBm)	Tolerance (dB)
CA_n77A-n79A	23	+2/-3[2]
NOTE 2: 2 refers to the transmission bandwidths confined within F_{UL_low} and F_{UL_low} + 4 MHz or F_{UL_high} – 4 MHz and F_{UL_high}, the maximum output power requirement is relaxed by reducing the lower tolerance limit by 1.5 dB		

6.6.2.2 UE co-existence studies

Table 6.6.2.2-1 lists Band n77 +Band n79 2UL bands CA 2^{nd}, 3^{rd}, 4^{th} and 5^{th} order IMD for the UE-to-UE coexistence analysis.

Table 6.6.2.2-1: Band n77 and Band n79 UL IMD products

UE UL carriers	fx_low	fx_high	fy_low	fy_high
2nd order IMD products	|fy_low – fx_high|	|fy_high – fx_low|	|fy_low + fx_low|	|fy_high + fx_high|
IMD frequency limits (MHz)	200 – 1700		7700 – 9200	
Two-tone 3rd order IMD products	|2*fx_low – fy_high|	|2*fx_high – fy_low|	|2*fy_low – fx_high|	|2*fy_high – fx_low|
IMD frequency limits (MHz)	1600 – 4000		4600 – 6700	
Two-tone 3rd order IMD products	|2*fx_low + fy_low|	|2*fx_high + fy_high|	|2*fy_low + fx_low|	|2*fy_high + fx_high|
IMD frequency limits (MHz)	11000 – 13400		12100 – 14200	
Two-tone 3rd order IMD products	(fx_low – max BW fy)	(fx_high + max BW fy)	(fy_low – max BW fx)	(fy_high + max BW fx)
IMD frequency limits (MHz)	3200 – 4300		4300 – 5100	
Two-tone 4th order IMD products	|3*fx_low –1* fy_high|	|3*fx_high – 1*fy_low|	|3*fy_low – 1*fx_high|	|3*fy_high – 1*fx_low|
IMD frequency limits (MHz)	4900 – 8200		9000 – 11700	
Two-tone 4th order IMD products	|2*fx_low –2* fy_high|	|2*fx_high –2* fy_low|		
IMD frequency limits (MHz)	400 – 3400			
Two-tone 4th order IMD products	|3*fx_low +1* fy_low|	|3*fx_high + 1*fy_high|	|3*fy_low + 1*fx_low|	|3*fy_high + 1*fx_high|
IMD frequency limits (MHz)	14300 – 17600		16500 – 19200	
Two-tone 4th order IMD products	|2*fx_low +2* fy_low|	|2*fx_high +2* fy_high|		
IMD frequency limits (MHz)	15400 – 18400			
Two-tone 5th order IMD products	|fx_low – 4*fy_high|	|fx_high – 4*fy_low|	|fy_low – 4*fx_high|	|fy_high – 4*fx_low|
IMD frequency limits (MHz)	13400 – 16700		8200 – 12400	
Two-tone 5th order IMD products	|2*fx_low - 3*fy_high|	|2*fx_high - 3*fy_low|	|2*fy_low - 3*fx_high|	|2*fy_high - 3*fx_low|
IMD frequency limits (MHz)	4800 – 8400		100 – 3800	
Two-tone 5th order IMD products	|fx_low + 4*fy_low|	|fx_high + 4*fy_high|	|fy_low + 4*fx_low|	|fy_high + 4*fx_high|
IMD frequency limits (MHz)	20900 – 24200		17600 – 21800	
Two-tone 5th order IMD products	|2*fx_low + 3*fy_low|	|2*fx_high + 3*fy_high|	|2*fy_low + 3*fx_low|	|2*fy_high + 3*fx_high|
IMD frequency limits (MHz)	19800 – 23400		18700 – 22600	
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.				

Based on above Table, it can be seen that

- 2nd order IMD products may fall into Rx frequencies of bands 5, 6, 8, 11, 12, 13, 14, 17, 18, 19, 20, 21, 24, 26, 27, 28, 29, 32, 44, 45, 50, 51, 67, 68, 71, 72, 73, 74, 75, 76, 85, n91, n92, n93, n94
- 3rd order IMD products may fall into Rx frequencies of bands 1, 2, 3, 4, 7, 9, 10, 22, 23, 25, 30, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 46, 47, 48, 49, 52, 53, 65, 66, 69, 70, n77, n78, n79, n90
- 4th order IMD products may fall into Rx frequencies of bands 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 17, 18, 19, 20, 21, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 44, 45, 46, 47, 50, 51, 52, 53, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, n77, n78, n79, 85, 87, 88, n90, n91, n92, n93, n94
- 5th order IMD products may fall into Rx frequencies of bands 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, n77, n78, n79, 85, 87, 88, n90, n91, n92, n93, n94

Table 6.6.2.2-2 lists the protected bands required for the 2UL bands CA configuration.

Table 6.6.2.2-2: Protected bands for the 2UL bands CA configuration

UL NR CA Configuration	Spurious emission						
	Protected band	Frequency range (MHz)			Maximum Level (dBm)	MBW (MHz)	NOTE
CA_n77-n79	E-UTRA Band 1, 3, 5, 8, 11, 18, 19, 21, 28, 34, 40, 41, 65, 74	F_{DL_low}	-	F_{DL_high}	-50	1	
	Frequency range	1884.5	-	1915.7	-41	0.3	3
NOTE 3: Applicable when co-existence with PHS system operating in 1884.5 - 1915.7 MHz.							

6.6.2.3 REFSENS requirements

Considering both n77 and n79 are TDD bands and synchronous operation for CA_n77-n79 is assumed, no MSD needed for dual UL of CA_n77-n79.

6.7 CA_n78-n79

6.7.1 Common for 1 band UL and 2 bands UL CA

6.7.1.1 Operating bands for CA

Table 6.7.1.1-1: CA band combination of band n78+n79

NR Band	Uplink (UL) band BS receive / UE transmit F_{UL_low} – F_{UL_high}	Downlink (DL) band BS transmit / UE receive F_{DL_low} – F_{DL_high}	Duplex mode
n78	3300 MHz – 3800 MHz	3300 MHz – 3800 MHz	TDD
n79	4400 MHz – 5000 MHz	4400 MHz – 5000 MHz	TDD

6.7.1.2 Channel bandwidths per operating band for CA

Table 6.7.1.2-1: Supported bandwidths per CA band combination of band n78+n79

NR CA configuration	Uplink CA configuration	NR Band	SCS (kHz)	5 MHz	10 MHz	15 MHz	20 MHz	25 MHz	30 MHz	40 MHz	50 MHz	60 MHz	70 MHz	80 MHz	90 MHz	100 MHz	Bandwidth combination set
CA_n78A-n79A[X]	CA_n78A-n79A[Y]	n78	15		Yes	Yes	Yes			Yes	Yes						0
			30		Yes	Yes	Yes			Yes	Yes	Yes		Yes	Yes	Yes	
			60		Yes	Yes	Yes			Yes	Yes	Yes		Yes	Yes	Yes	
		n79	15							Yes	Yes						
			30							Yes	Yes	Yes		Yes		Yes	
			60							Yes	Yes	Yes		Yes		Yes	
NOTE X: Simultaneous Rx/Tx capability does not apply for UEs supporting band n78 with a n77 implementation. NOTE Y: Simultaneous Rx/Tx capability does not apply to uplink CA transmission, and only apply to single uplink transmission.																	

6.7.1.3 UE co-existence studies

This section is skipped since CA_n78-n79 without 2UL CA has been already specified in TS 38.101-1, and impact of harmonic issue has been discussed in TR 37.865-01-01.

Furthermore, ΔTIB and ΔRIB and MSD requirements have been specified for asynchronous operation in TS 38.101-1.

6.7.1.4 ΔT_{IB} and ΔR_{IB} values

For CA_n77-n79 , the $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values are given in the tables below. The same values are shown as what are specified in TS 38.101-1.

Table 6.7.1.4-1: $\Delta T_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n78-n79	n78	0.5
		1.5[8]
	n79	0.5
		1.5[8]
NOTE 8: The requirements only apply for UE supporting inter-band carrier aggregation with simultaneous Rx/Tx capability, and NR UL carrier frequencies are confined to 3700 MHz-3800MHz for n78 and 4400 MHz-4500MHz for n79. Simultaneous Rx/Tx capability does not apply for UEs supporting band n78 with a n77 implementation.		

Table 6.7.1.4-2: $\Delta R_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta R_{IB,c}$ [dB]
CA_n78-n79	n78	0
	n79	0

6.7.1.5 REFSENS requirements

This section is skipped since CA_n78-n79 without 2UL CA has been already specified in TS 38.101-1, and impact of harmonic issue has been discussed in TR 37.865-01-01.

Furthermore, ΔTIB and ΔRIB and MSD requirements have been specified for asynchronous operation in TS 38.101-1.

6.7.1.6 OOB blocking exception requirements

This section is skipped since CA_n78-n79 without 2UL CA has been already specified.

6.7.2 Specific for 2 bands UL CA

6.7.2.1 Maximum output power for inter-band CA

Table 6.7.2.1-1: UE Power Class for uplink inter-band CA

Uplink CA Configuration	Class 3 (dBm)	Tolerance (dB)
CA_n78A-n79A	23	+2/-3[2]
NOTE 2: 2 refers to the transmission bandwidths confined within F_{UL_low} and F_{UL_low} + 4 MHz or F_{UL_high} – 4 MHz and F_{UL_high}, the maximum output power requirement is relaxed by reducing the lower tolerance limit by 1.5 dB		

6.7.2.2 UE co-existence studies

Table 6.7.2.2-1 lists Band n78 +Band n79 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

Table 6.7.2.2-1: Band n78 and Band n79 UL IMD products

UE UL carriers	fx_low	fx_high	fy_low	fy_high
2nd order IMD products	|fy_low – fx_high|	|fy_high – fx_low|	|fy_low + fx_low|	|fy_high + fx_high|
IMD frequency limits (MHz)	600 – 1700		7700 – 8800	
Two-tone 3rd order IMD products	|2*fx_low – fy_high|	|2*fx_high – fy_low|	|2*fy_low – fx_high|	|2*fy_high – fx_low|
IMD frequency limits (MHz)	1600 – 3200		5000 – 6700	
Two-tone 3rd order IMD products	|2*fx_low + fy_low|	|2*fx_high + fy_high|	|2*fy_low + fx_low|	|2*fy_high + fx_high|
IMD frequency limits (MHz)	11000 – 12600		12100 – 13800	
Two-tone 3rd order IMD products	(fx_low – max BW fy)	(fx_high + max BW fy)	(fy_low – max BW fx)	(fy_high + max BW fx)
IMD frequency limits (MHz)	3200 – 3900		4300 – 5100	
Two-tone 4th order IMD products	|3*fx_low –1* fy_high|	|3*fx_high – 1*fy_low|	|3*fy_low – 1*fx_high|	|3*fy_high – 1*fx_low|
IMD frequency limits (MHz)	4900 – 7000		9400 – 11700	
Two-tone 4th order IMD products	|2*fx_low –2* fy_high|	|2*fx_high –2* fy_low|		
IMD frequency limits (MHz)	1200 – 3400			
Two-tone 4th order IMD products	|3*fx_low +1* fy_low|	|3*fx_high + 1*fy_high|	|3*fy_low + 1*fx_low|	|3*fy_high + 1*fx_high|
IMD frequency limits (MHz)	14300 – 16400		16500 – 18800	
Two-tone 4th order IMD products	|2*fx_low +2* fy_low|	|2*fx_high +2* fy_high|		
IMD frequency limits (MHz)	15400 – 17600			
Two-tone 5th order IMD products	|fx_low – 4*fy_high|	|fx_high – 4*fy_low|	|fy_low – 4*fx_high|	|fy_high – 4*fx_low|
IMD frequency limits (MHz)	13800 – 16700		8200 – 10800	
Two-tone 5th order IMD products	|2*fx_low - 3*fy_high|	|2*fx_high - 3*fy_low|	|2*fy_low - 3*fx_high|	|2*fy_high - 3*fx_low|
IMD frequency limits (MHz)	5600 – 8400		100 – 2600	
Two-tone 5th order IMD products	|fx_low + 4*fy_low|	|fx_high + 4*fy_high|	|fy_low + 4*fx_low|	|fy_high + 4*fx_high|
IMD frequency limits (MHz)	20900 – 23800		17600 – 20200	
Two-tone 5th order IMD products	|2*fx_low + 3*fy_low|	|2*fx_high + 3*fy_high|	|2*fy_low + 3*fx_low|	|2*fy_high + 3*fx_high|
IMD frequency limits (MHz)	19800 – 22600		18700 – 21400	
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.				

Based on above Table, it can be seen that

- 2nd order IMD products may fall into Rx frequencies of bands 5, 6, 8, 11, 12, 13, 14, 17, 18, 19, 20, 21, 24, 26, 27, 28, 29, 32, 44, 45, 50, 51, 67, 68, 71, 74, 75, 76, 85, n91, n92, n93, n94
- 3rd order IMD products may fall into Rx frequencies of bands 1, 2, 3, 4, 7, 9, 10, 22, 23, 25, 30, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 46, 47, 48, 49, 52, 53, 65, 66, 69, 70, n77, n78, n79, n90
- 4th order IMD products may fall into Rx frequencies of bands 1, 2, 3, 4, 7, 9, 10, 11, 21, 23, 24, 25, 30, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 45, 46, 47, 50, 51, 52, 53, 65, 66, 69, 70, 74, 75, 76, n77, n78, n79, n90, n91, n92, n93, n94

- 5th order IMD products may fall into Rx frequencies of bands 1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14, 17, 18, 19, 20, 21, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 44, 45, 46, 47, 50, 51, 53, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 85, n87, n88, n90, n91, n92, n93, n94

Table 6.7.2.2-2: Protected bands for the 2UL bands CA configuration

UL NR CA Configuration	Spurious emission						
	Protected band	Frequency range (MHz)			Maximum Level (dBm)	MBW (MHz)	NOTE
CA_n78-n79	E-UTRA Band 1, 3, 5, 8, 11, 18, 19, 21, 28, 34, 40, 41, 65, 74	F_{DL_low}	-	F_{DL_high}	-50	1	
	Frequency range	1884.5	-	1915.7	-41	0.3	3
NOTE 3: Applicable when co-existence with PHS system operating in 1884.5 - 1915.7 MHz.							

6.7.2.3 REFSENS requirements

For harmonic, MSD studies can be omitted since MSD studies have been already conducted in 1UL/2DL NR CA fallback combinations.

For IMD, Considering both n78 and n79 are TDD bands and IMD occurs when UE transmit in both n77 and n79 and receive in neither n77 and n79, no MSD are needed for dual UL of CA_n78-n79.

6.8 n25-n48

6.8.1 Common for 1 band UL and 2 bands UL CA

6.8.1.1 Operating bands for CA

Table 6.8.1.1-1: CA band combination of band n25 and n48

NR Band	Uplink (UL) band	Downlink (DL) band	Duplex mode
	BS receive / UE transmit	BS transmit / UE receive	
	F_{UL_low} – F_{UL_high}	F_{DL_low} – F_{DL_high}	
n25	1850 MHz – 1915 MHz	1930 MHz – 1995 MHz	FDD
n48	3550 MHz – 3700 MHz	3550 MHz – 3700 MHz	TDD

6.8.1.2 Channel bandwidths per operating band for CA

Table 6.8.1.2-1: Supported bandwidths per CA band combination of band n25 and n48

NR CA configuration	UL	NR Band	SCS (kHz)	5 MHz	10 MHz	15 MHz	20 MHz	25 MHz	30 MHz	40 MHz	50 MHz	60 MHz	70 MHz	80 MHz	90 MHz	100 MHz	BCS
CA_n25A-n48A	-	n25	15	Yes	Yes	Yes	Yes										0
			30		Yes	Yes	Yes										
			60		Yes	Yes	Yes										
		n48	15	Yes	Yes	Yes	Yes			Yes	Yes						
			30		Yes	Yes	Yes			Yes	Yes	Yes		Yes	Yes	Yes	
			60		Yes	Yes	Yes			Yes	Yes	Yes		Yes	Yes	Yes	
CA_n25A-n48(2A)	-	n25	15	Yes	Yes	Yes	Yes										0
			30		Yes	Yes	Yes										
			60		Yes	Yes	Yes										
		n48	See CA_n48(2A) Bandwidth Combination Set 0 in Table 5.5A.2-1														
CA_n25A-n48C	-	n25	15	Yes	Yes	Yes	Yes										0
			30		Yes	Yes	Yes										
			60		Yes	Yes	Yes										
		n48	See CA_n48C Bandwidth Combination Set 0 in Table 5.5A.1-1														

6.8.1.3 UE co-existence studies

Table 6.8.1.3-1 lists up to 7th harmonics for n25A-n48A which shows that there are 2nd harmonics issues.

Table 6.8.1.3-1: Impact of UL/DL Harmonic

			2nd Harmonic		3rd Harmonic		4th Harmonic		5th Harmonic		6th Harmonic		7th Harmonic	
	UL Low Band Edge	UL High Band Edge	UL Low Band Edge	UL High Band Edge	UL Low Band Edge	UL High Band Edge	UL Low Band Edge	UL High Band Edge	UL Low Band Edge	UL High Band Edge	UL Low Band Edge	UL High Band Edge	UL Low Band Edge	UL High Band Edge
n25	1850	1915	3700	3830	5550	5745	7400	7660	9250	9575	11100	11490	12950	13405
n48	3550	3700	7100	7400	10650	11100	14200	14800	17750	18500	21300	22200	24850	25900

Table 6.8.1.3-2 list harmonic mixing issue for the 2DL bands CA with 1 UL. As can be seen there are no harmonic mixing issues.

Table 6.8.1.3-2 Harmonic mixing for 2DLs/1UL

					2nd Harmonic		3rd Harmonic		4th Harmonic	
Band	UL Low Band Edge	UL High Band Edge	DL Low Band Edge	DL High Band Edge	DL Low Band Edge	DL High Band Edge	DL Low Band Edge	DL High Band Edge	DL Low Band Edge	DL High Band Edge
n25	1850	1915	1930	1995	3860	3990	5790	5985	7720	7980
n48	3550	3700	3550	3700	7400	10650	11100	14200	14800	7400

6.8.1.4 ΔT_{IB} and ΔR_{IB} values

For CA_n25-n48, the $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values are derived from CA_2-48 and CA_n2-n48 and are given in the tables below.

Table 6.8.1.4-1: $\Delta T_{IB,c}$

NR CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n25-n48	n25	0.6
	n48	0.8

Table 6.8.1.4-2: $\Delta R_{IB,c}$

NR CA Configuration	NR Band	$\Delta R_{IB,c}$ [dB]
CA_n25-n48	n25	0.2
	n48	0.5

6.8.1.5 REFSENS requirements

As can be seen in the co-existence studies in 6.8.1.3 there are 2nd harmonics issues from n25 UL into the n48 DL. MSD values are same as for CA_n2A-n48A and need to be inserted into the 38.101-1 tables below.

CA_n25-n48 need to be added in NOTE 1 of Table 7.3A.4-1.

Table 7.3A.4-1: Reference sensitivity exceptions due to UL harmonic for NR CA FR1

MSD due to harmonic exception for the DL band													
UL band	**DL band**	**5 MHz**	**10 MHz**	**15 MHz**	**20 MHz**	**25 MHz**	**30 MHz**	**40 MHz**	**50 MHz**	**60 MHz**	**80 MHz**	**90 MHz**	**100 MHz**
		dB	**dB**	**dB**	**dB**	**dB**	**dB**	**dB**	**dB**	**dB**	**dB**	**dB**	**dB**
n25	n48[1, 2]	27.1	23.9	22.1	20.9			17.9	16.9[12]	16.1[12]	14.8[12]	14.3[12]	13.8[12]
	n48[3]	1.9	1.1	0.8	0.3								

NOTE 1: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of the aggressor (lower) band for which the 2nd transmitter harmonic is within the downlink transmission bandwidth of a victim (higher) band and a range ΔF_{HD} above and below the edge of this downlink transmission bandwidth. The value ΔF_{HD} depends on the band combination: ΔF_{HD} = 10 MHz for CA_n1-n77, CA_n2-n78, CA_n3-n77, CA_n3-n78, CA_n2-n48, CA_n25-n48, CA_n25-n78, CA_n48-n66, CA_n66-n78.

NOTE 2: The requirements should be verified for UL NR-ARFCN of the aggressor (lower) band (superscript LB) such that $f_{UL}^{LB} = \lfloor f_{DL}^{HB} / 0.2 \rfloor 0.1$ in MHz and $F_{UL\_low}^{LB} + BW_{Channel}^{LB} / 2 \le f_{UL}^{LB} \le F_{UL\_high}^{LB} - BW_{Channel}^{LB} / 2$ with f_{DL}^{HB} carrier frequency in the victim (higher) band in MHz and $BW_{Channel}^{LB}$ the channel bandwidth configured in the lower band.

NOTE 3: The requirements are only applicable to channel bandwidths no larger than 20 MHz and with a carrier frequency at $\pm(20 + BW_{Channel}^{HB} / 2)$ MHz offset from $2 f_{UL}^{LB}$ in the victim (higher band) with $F_{UL\_low}^{LB} + BW_{Channel}^{LB} / 2 \le f_{UL}^{LB} \le F_{UL\_high}^{LB} - BW_{Channel}^{LB} / 2$, where $BW_{Channel}^{LB}$ and $BW_{Channel}^{HB}$ are the channel bandwidths configured in the aggressor (lower) and victim (higher) bands in MHz, respectively.

NOTE 12: For these bandwidths, the minimum requirements are restricted to operation when carrier is configured as a downlink carrier part of CA configuration.

Table 7.3A.4-2: Uplink configuration for reference sensitivity exceptions due to UL harmonic interference for NR CA, FR1

NR Band / Channel bandwidth of the high band													
UL band	**DL band**	**5 MHz**	**10 MHz**	**15 MHz**	**20 MHz**	**25 MHz**	**30 MHz**	**40 MHz**	**50 MHz**	**60 MHz**	**80 MHz**	**90 MHz**	**100 MHz**
n25	n48	25	50	50	50			50	50	50	50	50	50

6.8.1.6 OOB blocking exception requirements

No need to specify OOB exception requirement for CA_n25-n48 since it belongs to H-H configuration-

Table 6.8.1.6-1: CA band combination with exceptions allowed

CA band combination
No exceptions

6.9 CA_n28-n79

6.9.1 Common for 1 band UL and 2 bands UL CA

6.9.1.1 Operating bands for CA

Table 6.9.1.1-1: CA band combination CA_n28A-n79A

NR CA Band Combination	NR Band	Uplink (UL) band	Downlink (DL) band	Duplex mode
		BS receive / UE transmit	BS transmit / UE receive	
		F_{UL_low} – F_{UL_high}	F_{DL_low} – F_{DL_high}	
CA_n28-n79	n28	703 MHz – 748 MHz	758 MHz – 803 MHz	FDD
	n79	4400 MHz – 5000 MHz	4400 MHz – 5000 MHz	TDD

6.9.1.2 Channel bandwidths per operating band for CA

Table 6.9.1.2-1: Supported bandwidths per CA band combination CA_n28A-n79A

	CA operating / channel bandwidth [MHz]																
NR CA Configuration	UL Configuration	NR Band	SCS [kHz]	5	10	15	20	25	30	40	50	60	70	80	90	100	Bandwidth combination set
CA_n28A-n79A	CA_n28A-n79A	n28	15	Yes	Yes	Yes	Yes		Yes								0
			30		Yes	Yes	Yes		Yes								
			60														
		n79	15							Yes	Yes						
			30							Yes	Yes	Yes		Yes		Yes	
			60							Yes	Yes	Yes		Yes		Yes	

6.9.1.3 UE Co-existence studies

Table 6.9.1.3-1/2 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA_n28-n79.

Table 6.9.1.3-1: Impact of UL/DL Harmonic

					2nd Harmonic		3rd Harmonic		4th Harmonic	
Band	UL Low Band Edge	UL High Band Edge	DL Low Band Edge	DL High Band Edge	UL Low Band Edge	UL High Band Edge	UL Low Band Edge	UL High Band Edge	UL Low Band Edge	UL High Band Edge
n28	703	748	758	803	1406	1496	2109	2244	2812	2992
n79	4400	5000	4400	5000	8800	10000	13200	15000	17600	20000

Based on above table, there is no harmonic interference.

Table 6.9.1.3-2: Impact of UL/DL Harmonic mixing

					2nd Harmonic		3rd Harmonic		4th Harmonic	
Band	UL Low Band Edge	UL High Band Edge	DL Low Band Edge	DL High Band Edge	DL Low Band Edge	DL High Band Edge	DL Low Band Edge	DL High Band Edge	DL Low Band Edge	DL High Band Edge
n28	703	748	758	803	1516	1606	2274	2409	3032	3212
n79	4400	5000	4400	5000	8800	10000	13200	15000	17600	20000

Based on above table, there is no harmonic mixing issue.

6.9.1.4 ΔTIB and ΔRIB values

For CA_n28A-n79A, the $\Delta T_{IB,c}$ and ΔR_{IB} are given in the tables below.

Table 6.9.1.4-1: $\Delta T_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n28-n79	n28	0.5
	n79	0.8

Table 6.9.1.4-2: ΔR_{IB}

Inter-band CA Configuration	NR Band	ΔR_{IB} [dB]
CA_n28-n79	n28	0.2
	n79	0.5

6.9.1.5 REFSENs requirements

There is no MSD exception requirement.

6.9.1.6 OOB blocking exception requirements

Since band n28 is a low band and n79 is a wide band, the OOBB exception is needed.

Table 6.9.1.6-1: CA band combination with exceptions allowed

CA band combination
CA_n28-n79

6.9.2 Specific for 2 bands UL CA

6.9.2.1 Maximum output power for inter-band CA

Table 6.9.2.1-1: UE Power Class for uplink inter-band CA

Uplink CA Configuration	Class 3 (dBm)	Tolerance (dB)
CA_n28A-n79A	23	+2/-3[2]
NOTE 2: 2 refers to the transmission bandwidths confined within F_{UL_low} and F_{UL_low} + 4 MHz or F_{UL_high} – 4 MHz and F_{UL_high}, the maximum output power requirement is relaxed by reducing the lower tolerance limit by 1.5 dB		

6.9.2.2 UE co-existence studies

Table 6.9.2.2-1 gives IMD interference analysis for CA_n28-n79 with 2 ULs.

UE UL carriers	fx_low	fx_high	fy_low	fy_high
UL frequency (MHz)	703	748	4400	5000
2nd order IMD products	|fy_low – fx_high|	|fy_high – fx_low|	|fy_low + fx_low|	|fy_high + fx_high|
IMD frequency limits (MHz)	3652	4297	5103	5748
Two-tone 3rd order IMD products	|2*fx_low – fy_high|	|2*fx_high – fy_low|	|2*fy_low – fx_high|	|2*fy_high – fx_low|
IMD frequency limits (MHz)	3594	2904	8052	9297
Two-tone 3rd order IMD products	|2*fx_low + fy_low|	|2*fx_high + fy_high|	|2*fy_low + fx_low|	|2*fy_high + fx_high|
IMD frequency limits (MHz)	5806	6496	9503	10748
Two-tone 4th order IMD products	|3*fx_low –1* fy_high|	|3*fx_high – 1*fy_low|	|3*fy_low – 1*fx_high|	|3*fy_high – 1*fx_low|
IMD frequency limits (MHz)	2891	2156	12452	14297
Two-tone 4th order IMD products	|3*fx_low +1* fy_low|	|3*fx_high + 1*fy_high|	|3*fy_low + 1*fx_low|	|3*fy_high + 1*fx_high|
IMD frequency limits (MHz)	6509	7244	13903	15748
Two-tone 4th order IMD products	|2*fx_low –2* fy_high|	|2*fx_high –2* fy_low|	|2*fx_low +2* fy_low|	|2*fx_high +2* fy_high|
IMD frequency limits (MHz)	8594	7304	10206	11496
Two-tone 5th order IMD products	|fx_low – 4*fy_high|	|fx_high – 4*fy_low|	|fy_low – 4*fx_high|	|fy_high – 4*fx_low|
IMD frequency limits (MHz)	19297	16852	1408	2188
Two-tone 5th order IMD products	|2*fx_low - 3*fy_high|	|2*fx_high - 3*fy_low|	|2*fy_low - 3*fx_high|	|2*fy_high - 3*fx_low|
IMD frequency limits (MHz)	13594	11704	6556	7891
Two-tone 5th order IMD products	|fx_low + 4*fy_low|	|fx_high + 4*fy_high|	|fy_low + 4*fx_low|	|fy_high + 4*fx_high|
IMD frequency limits (MHz)	18303	20748	7212	7992
Two-tone 5th order IMD products	|2*fx_low + 3*fy_low|	|2*fx_high + 3*fy_high|	|2*fy_low + 3*fx_low|	|2*fy_high + 3*fx_high|
IMD frequency limits (MHz)	14606	16496	10909	12244

For band combination CA_n28-n79, no IMD interference will fall into Rx.

Table 6.9.2.2-2 lists the protected bands required for the 2UL bands CA configuration.

Table 6.9.2.2-2: Protected bands for the 2UL bands CA configuration

NR CA Configuration	Spurious emission						
	Protected Band	Frequency range (Mhz)			Maximum Level (dBm)	MBW (MHz)	NOTE
CA_n28-n79	E-UTRA Band 3, 5, 8, 18, 19, 34, 39, 40, 41,	F_{DL_low}	-	F_{DL_high}	-50	1	
	E-UTRA Band 1, 42, 65, 74	F_{DL_low}	-	F_{DL_high}	-50	1	2
	E-UTRA Band 11, 21	F_{DL_low}	-	F_{DL_high}	-50	1	10
	Frequency range	470	-	694	-42	8	4, 14
	Frequency range	470	-	710	-26.2	6	13
	Frequency range	662	-	694	-26.2	6	4
	Frequency range	758	-	773	-32	1	4
	Frequency range	773	-	803	-50	1	
	Frequency range	1884.5	-	1915.7	-41	0.3	3, 10, 11

NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.5.3.1-2 are permitted for each assigned NR carrier used in the measurement due to 2nd, 3rd, 4th or 5th harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2 MHz + N x L_{CRB} x 180kHz), where N is 2, 3, 4, 5 for the 2nd, 3rd, 4th or 5th harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval.

NOTE 3: Applicable when co-existence with PHS system operating in 1884.5 -1915.7 MHz

NOTE 4: These requirements also apply for the frequency ranges that are less than F_{OOB} (MHz) in Table 6.5.3.1-1 from the edge of the channel bandwidth.

NOTE 10: This requirement applies when the NR carrier is confined within 2545 - 2575 MHz or 2595 – 2645vMHz and the channel bandwidth is 10 or 20 MHz.

NOTE 11: Applicable when the assigned NR carrier is confined within 718 MHz and 748 MHz and when the channel bandwidth used is 5 or 10 MHz.

NOTE 13: This requirement is applicable for 5 and 10 MHz NR channel bandwidth allocated within 718 - 728 MHz. For carriers of 10 MHz bandwidth, this requirement applies for an uplink transmission bandwidth less than or equal to 30 RB with RBstart > 1 and Rbstart < 48.

NOTE 14: This requirement is applicable in the case of a 10 MHz NR carrier confined within 703 MHz and 733 MHz, otherwise the requirement of -25 dBm with a measurement bandwidth of 8 MHz applies.

6.9.2.3 REFSENS requirements

There is no additional MSD requirements for two UL CA_n28A-n79A

6.10 CA_n3-n77

6.10.1 Common for 1 band UL and 2 bands UL CA

6.10.1.1 Operating bands for CA

Table 6.10.1.1-1: CA band combination of band n3+n77

NR Band	Uplink (UL) band BS receive / UE transmit F_{UL_low} – F_{UL_high}	Downlink (DL) band BS transmit / UE receive F_{DL_low} – F_{DL_high}	Duplex mode
n3	1710 MHz – 1785 MHz	1805 MHz – 1880 MHz	FDD
n77	3300 MHz – 4200 MHz	3300 MHz – 4200 MHz	TDD

6.10.1.2 Channel bandwidths per operating band for CA

Table 6.10.1.2-1: Supported bandwidths per CA band combination of band n3+n77

CA operating / channel bandwidth [MHz]																
NR CA Configuration	UL Configuration	NR Band	SCS [kHz]	5	10	15	20	25	30	40	50	60	80	90	100	Bandwidth combination set
CA_n3A-n77(2A)	CA_n77(2A)	n3	15	Yes	Yes	Yes	Yes	Yes	Yes	Yes						0
			30		Yes	Yes	Yes	Yes	Yes	Yes						
			60		Yes	Yes	Yes	Yes	Yes	Yes						
		n77	See CA_n77(2A) Bandwidth Combination Set 0 in Table 5.5A.2-1													

6.10.1.3 Co-existence studies

The studies for 1 band UL for the CA band combination of band n3 + n77 have been already completed and captured into TR 37.865-01-01, there is no IMD issue for band n3 + n77.

The IMD5 of n77(2A) may fall into band n3 DL when the two UL carriers are at the same time assigned within the frequency range of 3300MHz-3400MHz and the frequency range of 4000MHz-4200MHz separately.

6.10.1.4 ΔT_{IB} and ΔR_{IB} values

For CA_n3-n77, the $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values are already specified in TR37.865-01-01.

6.10.1.5 REFSENS requirements

Table 6.10.1.5-1 shows the MSD requirement for CA_n3-n77(2A) with UL CA_n77(2A).Table 6.10.1.5-1: 2DL/2UL interband Reference sensitivity QPSK PREFSENS and uplink/downlink configurations

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_n3A-n77(2A)	n3	N/A	N/A	N/A	N/A	N/A[6]	FDD	IMD5
	n77	N/A	N/A	N/A	N/A	N/A	TDD	N/A
NOTE 6: Considering the spectrum holdings of the operator for CA_n77(2A) (when one uplink sub block is assigned within 3300-3400MHz, the other uplink sub block is not assigned within 4000-4200MHz or vice versa), no IMD5 result will fall in Rx frequency range of band n3. Therefore, no MSD requirement apply for this CA configuration when two uplink sub blocks are assigned within CA_77(2A).								

6.10.1.6 OOB blocking exception requirements

Table 6.10.1.6-1: CA band combination with exceptions allowed

CA band combination
No exception

6.11 CA_n3-n78

6.11.1 Common for 1 band UL and 2 bands UL CA

6.11.1.1 Operating bands for CA

Table 6.11.1.1-1: CA band combination of band n3+n78

NR Band	Uplink (UL) band	Downlink (DL) band	Duplex mode
	BS receive / UE transmit	BS transmit / UE receive	
	F_{UL_low} – F_{UL_high}	F_{DL_low} – F_{DL_high}	
n3	1710 MHz – 1785 MHz	1805 MHz – 1880 MHz	FDD
n78	3300 MHz – 3800 MHz	3300 MHz – 3800 MHz	TDD

6.11.1.2 Channel bandwidths per operating band for CA

Table 6.11.1.2-1: Supported bandwidths per CA band combination of band n3+n78

CA operating / channel bandwidth [MHz]															
NR CA Configuration	UL Configuration	NR Band	SCS [kHz]	5	10	15	20	25	30	40	50	60	80	90	100	Bandwidth combination set
CA_n3A-n78(2A)	CA_n78(2A)	n3	15	Yes	Yes	Yes	Yes	Yes	Yes	Yes						0
			30		Yes	Yes	Yes	Yes	Yes	Yes						
			60		Yes	Yes	Yes	Yes	Yes	Yes						
		n78	See CA_n78(2A) Bandwidth Combination Set 0 in Table 5.5A.2-1													

6.11.1.3 Co-existence studies

The studies for 1 band UL for the CA band combination of band n3 + n78 have been already completed and captured into TR 37.865-01-01, there is no IMD issue for band n3 + n78.

6.11.1.4 ΔT_{IB} and ΔR_{IB} values

For CA_n3-n78, the $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values are already specified in TR37.865-01-01.

6.11.1.5 REFSENS requirements

No additional MSD requirement need to be defined for this dual connectivity configuration..

6.11.1.6 OOB blocking exception requirements

Table 6.11.1.6-1: CA band combination with exceptions allowed

CA band combination
No exception

6.12 CA_n28-n77

6.12.1 Common for 1 band UL and 2 bands UL CA

6.12.1.1 Operating bands for CA

Table 6.12.1.1-1: CA band combination of band n28+n77

NR CA Band	NR Band	Uplink (UL) band	Downlink (DL) band	Duplex mode
		BS receive / UE transmit	BS transmit / UE receive	
		F_{UL_low} – F_{UL_high}	F_{DL_low} – F_{DL_high}	
CA_n28-n77	n28	703 MHz – 748 MHz	758 MHz – 803 MHz	FDD
	n77	3300 MHz – 4200 MHz	3300 MHz – 4200 MHz	TDD

6.12.1.2 Channel bandwidths per operating band for CA

Table 6.12.1.2-1: Supported bandwidths per CA band combination of band n28+n77

NR CA configuration	Uplink CA configuration	NR Band	SCS (kHz)	5 MHz	10 MHz	15 MHz	20 MHz	25 MHz	30 MHz	40 MHz	50 MHz	60 MHz	80 MHz	90 MHz	100 MHz	Bandwidth combination set
CA_n28A-n77(2A)	CA_n77(2A)[3]	n28	15	Yes	Yes	Yes	Yes									0
			30		Yes	Yes	Yes									
			60													
		n77	See CA_n77(2A) in Table 5.5A.2-1 in TS 38.101-1													

6.12.1.3 Co-existence studies

The studies for 1 band UL for the CA band combination of band n28 + n78 have been already completed and captured into TR 38.716-02-00.

The IMD2 of n77(2A) may fall into band n28 DL when the two UL carriers are at the same time assigned within the frequency range of 3300MHz-3400MHz and the frequency range of 4000MHz-4200MHz separately.

6.12.1.4 ΔT_{IB} and ΔR_{IB} values

For CA_n28-n77, the $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values are already specified in TR38.716-02-00.

6.12.1.5 REFSENS requirements

Table 6.12.1.5-1 shows the MSD requirement for CA_n28-n77(2A) with UL CA_n77(2A).

Table 6.12.1.5-1: 2DL/2UL interband Reference sensitivity QPSK PREFSENS and uplink/downlink configurations

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_n28A-n77(2A)	n28	N/A	N/A	N/A	N/A	N/A[7]	FDD	IMD2
	n77	N/A	N/A	N/A	N/A	N/A	TDD	N/A
NOTE 7: Considering the spectrum holdings of the operator for CA_n77(2A) (when one uplink sub block is assigned within 3300-3400MHz, the other uplink sub block is not assigned within 4000-4200MHz or vice versa), no IMD2 result will fall in Rx frequency range of band n28. Therefore, no MSD requirement apply for this CA configuration when two uplink sub blocks are assigned within CA_77(2A).								

6.12.1.6 OOB blocking exception requirements

Table 6.12.1.6-1: CA band combination with exceptions allowed

CA band combination
CA_n28-n77

6.13 CA_n28-n78

6.13.1 Common for 1 band UL and 2 bands UL CA

6.13.1.1 Operating bands for CA

Table 6.13.1.1-1: CA band combination of band n28+n78

NR CA Band	NR Band	Uplink (UL) band	Downlink (DL) band	Duplex mode
		BS receive / UE transmit	BS transmit / UE receive	
		F_{UL_low} – F_{UL_high}	F_{DL_low} – F_{DL_high}	
CA_n28-n78	n28	703 MHz – 748 MHz	758 MHz – 803 MHz	FDD
	n78	3300 MHz – 3800 MHz	3300 MHz – 3800 MHz	TDD

6.13.1.2 Channel bandwidths per operating band for CA

Table 6.13.1.2-1: Supported bandwidths per CA band combination of band n28+n78

NR CA configuration	Uplink CA configuration	NR Band	SCS (kHz)	5 MHz	10 MHz	15 MHz	20 MHz	25 MHz	30 MHz	40 MHz	50 MHz	60 MHz	80 MHz	90 MHz	100 MHz	Bandwidth combination set
CA_n28A-n78(2A)	CA_n78 (2A)	n28	15	Yes	Yes	Yes	Yes		Yes							0
			30		Yes	Yes	Yes		Yes							
			60													
		n78	See CA_n78(2A) Bandwidth Combination Set 0 in Table 5.5A.2-1													

6.13.1.3 Co-existence studies

The studies for 1 band UL for the CA band combination of band n28 + n78 have been already completed and captured into TR 37.865-01-01, there is no IMD issue for band n28 + n78.

6.13.1.4 ΔT_{IB} and ΔR_{IB} values

For CA_n28-n78, the $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values are already specified in TR37.865-01-01.

6.13.1.5 REFSENS requirements

No additional MSD requirement need to be defined for this band combs configuration.

6.13.1.6 OOB blocking exception requirements

Table 6.13.1.6-1: CA band combination with exceptions allowed

CA band combination
CA_n28-n78

7 Both bands within FR2 Carrier Aggregation: Specific Band Combination Part

7.x CA_nX-nY

7.x.1 Common for 1 band UL and 2 bands UL CA

7.x.1.1 Operating bands for CA

Table 7.x.1.1-1: CA band combination of band nX+nY

NR Band	Uplink (UL) band	Downlink (DL) band	Duplex mode
	BS receive / UE transmit	BS transmit / UE receive	
	F_{UL_low} – F_{UL_high}	F_{DL_low} – F_{DL_high}	
nX	–	–	
nY	–	–	

7.x.1.2 Channel bandwidths per operating band for CA

Table 7.x.1.2-1: Supported bandwidths per CA band combination of band nX+nY

< Editor's note: Align with the table format in TS38.101-2 later>

7.x.1.3 UE co-existence studies

< Editor's note: Text will be added, the example is given as follows. The harmonics issues should be analyzed based on this table. >

Table 7.x.1.3-1 lists up to n^{th} harmonics for CA _ nX-nY.

Table 7.x.1.3-1: Impact of UL/DL Harmonic

			2nd Harmonic		3rd Harmonic		nth Harmonic	
Band	UL Low Band Edge	UL High Band Edge	UL Low Band Edge	UL High Band Edge	UL Low Band Edge	UL High Band Edge	UL Low Band Edge	UL High Band Edge
nX								
nY								

7.x.1.4 ΔT_{IB} and ΔR_{IB} values

For CA_nX-nY , the $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values are given in the tables below.

Table 7.x.1.4-1: $\Delta T_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_nX-nY	nX	
	nY	

Table 7.x.1.4-2: $\Delta R_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta R_{IB,c}$ [dB]
CA_nX-nY	nX	
	nY	

7.x.1.5 REFSENS requirements

< Editor's note: Text will be added if harmonics issues are identified, and only REFSENS numbers for bands have these issues need to be provided in the table. >

7.x.2 Specific for 2 bands UL CA

< Editor's note: Text will be added if 2 bands UL CA are supported, otherwise all the clauses shall be void. >

7.x.2.1 UE co-existence studies

< Editor's note: Text will be added. >

7.x.2.2 REFSENS requirements

< Editor's note: Text will be added if IMD due to 2 bands UL issues are identified. >

8 FR1+FR2 Carrier Aggregation: Specific Band Combination Part

8.x CA_nX-nY

8.x.1 Common for 1 band UL and 2 bands UL CA

8.x.1.1 Operating bands for CA

Table 8.x.1.1-1: CA band combination of band nX+nY

NR Band	Uplink (UL) band	Downlink (DL) band	Duplex mode
	BS receive / UE transmit	BS transmit / UE receive	
	F_{UL_low} – F_{UL_high}	F_{DL_low} – F_{DL_high}	
nX	–	–	
nY	–	–	

8.x.1.2 Channel bandwidths per operating band for CA

Table 8.x.1.2-1: Supported bandwidths per CA band combination of band nX+nY

< Editor's note: see Table 5.5A.1-1 in TS38.101-3 for the table format>

8.x.1.3 ΔT_{IB} and ΔR_{IB} values

For CA_nX-nY, the ΔTIB,c and ΔRIB,c values are given in the tables below.

Table 8.x.1.3-1: $\Delta T_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_nX-nY	nX	
	nY	

Table 8.x.1.4-2: $\Delta R_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta R_{IB,c}$ [dB]
CA_nX-nY	nX	
	nY	

8.x.1.4 REFSENS requirements

< Editor's note: Text will be added if harmonics issues are identified, and only REFSENS numbers for bands have these issues need to be provided in the table.>

8.x.2 Specific for 2 bands UL CA

< Editor's note: Text will be added if 2 bands UL CA are supported, otherwise all the clauses shall be void. >

8.x.2.1 REFSENS requirements

< Editor's note: Text will be added if IMD due to 2 bands UL issues are identified. >

9 2 bands Dual Connectivity: Specific Band Combination Part

9.X DC_nX-nY

< Editor's note: The texts for NR DC can only be added associated with the texts for the corresponding inter-band 2 bands UL CA above, which means contribution only adding pure NR DC texts is not allowed.>

9.x.1 Operating bands for DC_nX-nY

Table 9.X.1-1: Inter-band NR DC operating bands within FR1

NR DC Band	NR Band
DC_nX-nY	nX, nY

Table 9.X.1-2: Inter-band NR DC operating bands for FR1+FR2

NR DC Band	NR Band
DC_nX-nY	nX, nY

9.x.2 Configurations for DC_nX-nY

Table 9.x.2-1: Inter-band NR DC configurations within FR1

NR DC configuration	Uplink NR DC configuration
DC_nXA-nYA	DC_nXA-nYA

Table 9.x.2-2: Inter-band NR DC configurations for FR1+FR2

NR DC configuration	Uplink NR DC configuration
DC_nXA-nYA	DC_nXA-nYA

9.x.3 Maximum output power for NR-DC

< Editor's note: Text will be added, the examples is given as follows. More information can be referred to Table 6.2B.1.3-1 in TS38.101-1. It shall be noted that no need to specify the UE power class for FR1+FR2 NR DC combination. For FR2-FR2 NR DC combination, it is FFS.>

Table 9.x.3-1: UE Power Class for uplink inter-band CA

Uplink CA Configuration	Class 3 (dBm)	Tolerance (dB)
DC_nXA-nYA	23	+x/-y[1]
NOTE 1: refers to the transmission bandwidths confined within F_{UL_low} and F_{UL_low} + 4 MHz or F_{UL_high} – 4 MHz and F_{UL_high}, the maximum output power requirement is relaxed by reducing the lower tolerance limit by 1.5 dB		

Annex A:
Change history

Change history							
Date	**Meeting**	**TDoc**	**CR**	**Rev**	**Cat**	**Subject/Comment**	**New version**
2020-08	RAN4#96-e	R4-2011626				TR skeleton	0.0.1
2020-08	RAN4#96-e	R4-2010792				The following approved TP in RAN4 #96-e meeting are included: 1. R4-2011637 TP for TR 38.717-02-01: CA_n5-n25, Huawei, HiSilicon, Bell Mobility, Telus 2. R4-2011638 TP for TR 38.717-02-01: CA_n71-n78, Huawei, HiSilicon, Bell Mobility, Telus 3. R4-2011639 TP to TR 38.717-02-01: CA_n7-n66, Nokia, Bell Mobility 4. R4-2011640 TP to TR 38.717-02-00: CA_n25-n38, Nokia, Bell Mobility 5. R4-2010539 TP for CA 2DL2UL n1-n77 for TR 38.717-02-01, NTT DOCOMO INC. 6. R4-2010560 TP for CA 2DL2UL n77-n79 for TR 38.717-02-01, NTT DOCOMO INC. 7. R4-2011643 TP for CA 2DL2UL n78-n79 for TR 38.717-02-01, NTT DOCOMO INC. 8. R4-2011645 TP for TR 38.717-02-00 to include CA_n25A-n48A, CA_n25A-n48(2A), CA_n25A-n48C, Ericsson, T-Mobile US 9. R4-2011646 TP for TR 38.717-02-01: CA_n28A-n79A, Huawei, HiSilicon,CBN 10. R4-2011628 TP for TR 38.717-02-01 CA_n3-n77(2A) _UL_n77(2A),Samsung, KDDI 11. R4-2011629 TP for TR 38.717-02-01 CA_n3-n78(2A) _UL_n78(2A), Samsung, KDDI 12. R4-2011630 TP for TR 38.717-02-01 CA_n28-n77(2A) _UL_n77(2A), Samsung, KDDI 13. R4-2011631 TP for TR 38.717-02-01 CA_n28-n78(2A) _UL_n78(2A), Samsung, KDDI	0.1.0