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Technical Report

3rd Generation Partnership Project; Technical Specification Group Radio Access Network; NR inter-band Carrier Aggregation (CA) for 3 Down Link (DL) / 1 Up Link (UL) (Release 17)

3GPP

Postal address

3GPP support office address
650 Route des Lucioles - Sophia Antipolis
Valbonne - FRANCE
Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Internet
http://www.3gpp.org

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:

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where:

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  - 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.
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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 Rel-17 NR 3DL/1UL Inter-band Carrier Aggregation. The purpose is to gather the relevant background information and studies in order to address 3DL/1UL Inter-band Carrier Aggregation requirements for the Rel-17 band combinations in Table 1-1. UL carrier shall be supported in each of the 3 bands being aggregated unless otherwise specified.

Table 1-1: Release 17 3DL/1UL inter-band carrier aggregation combinations

CA combination	REL independent from
CA_x1A-yA-zA	

The present document 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] RP-200922: " New WID: Rel-17 NR inter-band CA for 3 bands DL with 1 band UL ", RAN#88e.

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

[4] 3GPP TS 38.101-2: "NR; User Equipment (UE) radio transmission and reception; Part 2: Range 2 Standalone".

[5] 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".

[6] 3GPP TR 37.865-01-01

3 Definitions, symbols and abbreviations

3.1 Definitions

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

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 operation, for serving cell *c*.

3.3 Abbreviations

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

BS Base Station
BCS Bandwidth Combination Set
CA Carrier Aggregation
CA_X Intra-band contiguous CA of component carriers in one sub-block within Band X where X is the applicable NR operating band
CA_X-X Intra-band non-contiguous CA of component carriers in two sub-blocks within Band X where X is the applicable NR operating band
CA_X-Y Inter-band CA of component carrier(s) in one sub-block within Band X and component carrier(s) in one sub-block within Band Y where X and Y are the applicable NR operating band
CA_X-X-Y CA of component carriers in two sub-blocks within Band X and component carrier(s) in one sub-block within Band Y where X and Y are the applicable NR operating bands
CC Component Carriers
DL Downlink
FDD Frequency Division Duplex
IMD Inter-modulation
MSD Maximum Sensitivity Degradation
SCS Subcarrier Spacing
TDD Time Division Duplex
PA Power Amplifier
PCC Primary Component Carrier
REFSENS Reference Sensitivity power level
SCC Secondary Component Carrier
TDD Time Division Duplex
UE User Equipment
UL Uplink

4 Background

The present document is a technical report for 3DL/1UL Inter-band Carrier Aggregation 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).

The specific band combination parts are independent and therefore, the working speed also differs.

4.1 The present document maintenance

A single company is responsible for introducing all approved TPs in the present document, i.e. editor of the present document. 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 3 Band Carrier Aggregation with Single UL: General Part

<Text will be added.>

6 3 Band Carrier Aggregation with Single UL: Specific Band Combination Part

6.1 CA_n1-n77-n79

6.1.1 Operating bands for CA

Table 6.1.1-1: 3DL Inter-band CA operating bands

NR CA Band	NR Band	Uplink (UL) operating band BS receive / UE transmit F_{UL_low} – F_{UL_high}			Downlink (DL) operating band BS transmit / UE receive F_{DL_low} – F_{DL_high}			Duplex Mode
CA_n1-n77-n79	n1	1920 MHz	–	1980 MHz	2110 MHz	–	2170 MHz	FDD
	n77	3300 MHz	–	4200 MHz	3300 MHz	–	4200 MHz	TDD
	n79	4400 MHz	–	5000 MHz	4400 MHz	–	5000 MHz	TDD

6.1.2 Channel bandwidths per operating band for CA

Table 6.1.2-1: Supported channel bandwidths per CA configuration for 3DL inter-band CA

NR CA config	UL config	NR Band	SCS (kHz)	5	10	15	20	25	30	40	50	60	70	80	90	100	Bandwidth combination set
CA_n1A-n77A-n79A[1]	-	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	
		n79	15							Yes	Yes						
			30							Yes	Yes	Yes		Yes		Yes	
			60							Yes	Yes	Yes		Yes		Yes	
NOTE 1: The minimum requirements only apply for non simultaneous Tx/Rx between all carriers for TDD combinations.																	

NOTE: For the UE that signals support of any bandwidth combination set for carrier aggregation, the UE shall support all single carrier bandwidths for the constituent bands as defined in Table 5.3.5-1 of TS 38.101-1 and in Table 5.3.5-1 of TS 38.101-2 when operating in single carrier mode.

6.1.3 Co-existence studies

Co-existence studies can be omitted because harmonic interference from n1 to n77 and n79, and from n77 to n1 and n79, and from n79 to n1 and n77 have been already studied for 3DL/1UL fallback combinations CA n1-n77 and CA_n1-n79 and n77-n79.

6.1.4 $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values

For three simultaneous DLs and one UL of Band n1, n77 and n79, the $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values are shown in table 6.1.4-1 and table 6.1.4-2, respectively.

Table 6.1.4-1: $\Delta T_{IB,c}$ for 3DL aggregation

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n1-n77-n79	n1	0.6
	n77	0.8
	n79	0.5

Table 6.1.4-2: $\Delta R_{IB,c}$ for 3DL aggregation

Inter-band CA Configuration	NR Band	$\Delta R_{IB,c}$ [dB]
CA_n1-n77-n79	n1	0.2
	n77	0.5
	n79	0

6.1.5 REFSENS requirements

MSD studies can be omitted because harmonic interference from n1 to n77 and n79, and from n77 to n1 and n79, and from n79 to n1 and n77 have been already studied for 3DL/1UL fallback combinations CA n1-n77 and CA_n1-n79 and n77-n79.

6.2 CA_n1-n78-n79

6.2.1 Operating bands for CA

Table 6.2.1-1: 3DL Inter-band CA operating bands

NR CA Band	NR Band	Uplink (UL) operating band BS receive / UE transmit F_{UL_low} – F_{UL_high}			Downlink (DL) operating band BS transmit / UE receive F_{DL_low} – F_{DL_high}			Duplex Mode
CA_n1-n78-n79	n1	1920 MHz	–	1980 MHz	2110 MHz	–	2170 MHz	FDD
	n78	3300 MHz	–	3800 MHz	3300 MHz	–	3800 MHz	TDD
	n79	4400 MHz	–	5000 MHz	4400 MHz	–	5000 MHz	TDD

6.2.2 Channel bandwidths per operating band for CA

Table 6.2.2-1: Supported channel bandwidths per CA configuration for 3DL inter-band CA

NR CA config	UL config	NR Band	SCS (kHz)	5	10	15	20	25	30	40	50	60	70	80	90	100	Bandwidth combination set
CA_n1A-n78A-n79A[1]	-	n1	15	Yes	Yes	Yes	Yes										0
			30		Yes	Yes	Yes										
			60		Yes	Yes	Yes										
		n78	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	
		n79	15							Yes	Yes						
			30							Yes	Yes	Yes		Yes		Yes	
			60							Yes	Yes	Yes		Yes		Yes	
NOTE 1: Simultaneous Rx/Tx capability for TDD combinations does not apply for UEs supporting band n78 with a n77 implementation.																	

NOTE: For the UE that signals support of any bandwidth combination set for carrier aggregation, the UE shall support all single carrier bandwidths for the constituent bands as defined in Table 5.3.5-1 of TS 38.101-1 and in Table 5.3.5-1 of TS 38.101-2 when operating in single carrier mode.

6.2.3 Co-existence studies

Co-existence studies can be omitted because harmonic interference from n1 to n78 and n79, and from n78 to n1 and n79, and from n79 to n1 and n78 have been already studied for 3DL/1UL fallback combinations CA n1-n78 and CA_n1-n79 and n78-n79.

6.2.4 $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values

For three simultaneous DLs and one UL of Band n1, n78 and n79, the $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values are shown in table 6.2.4-1 and table 6.2.4-2, respectively.

Table 6.2.4-1: $\Delta T_{IB,c}$ for 3DL aggregation

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n1-n78-n79	n1	0.3
	n78	0.8
		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 6.2.4-2: $\Delta R_{IB,c}$ for 3DL aggregation

Inter-band CA Configuration	NR Band	$\Delta R_{IB,c}$ [dB]
CA_n1-n78-n79	n1	0
	n78	0.5
	n79	0

6.2.5 REFSENS requirements

MSD studies can be omitted because harmonic interference from n1 to n78 and n79, and from n78 to n1 and n79, and from n79 to n1 and n78 have been already studied for 3DL/1UL fallback combinations CA n1-n78 and CA_n1-n79 and n78-n79.

6.3 CA_n3-n28-n41

6.3.1 Operating bands for CA

Table 6.3.1-1: 3DL Inter-band CA operating bands

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 – 1880MHz	FDD
n28	703 MHz – 748 MHz	758 MHz – 803 MHz	FDD
n41	2496 MHz – 2690 MHz	2496 MHz – 2690 MHz	TDD

6.3.2 Channel bandwidths per operating band for CA

Table 6.3.2-1: Supported bandwidths per CA band combination of band n3+n28+n41

NR CA configuration	NR 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_n3A-n28A-n41A	-	n3	15	Yes	Yes	Yes	Yes	Yes	Yes	Yes							0
			30		Yes	Yes	Yes	Yes	Yes	Yes							
			60		Yes	Yes	Yes	Yes	Yes	Yes							
		n28	15	Yes	Yes	Yes	Yes		Yes								
			30		Yes	Yes	Yes		Yes								
			60														
		n41	15		Yes	Yes	Yes		Yes	Yes	Yes						
			30		Yes	Yes	Yes		Yes	Yes	Yes	Yes		Yes	Yes	Yes	
			60		Yes	Yes	Yes		Yes	Yes	Yes	Yes		Yes	Yes	Yes	

6.3.3 UE co-existence studies

Co-existence studies of CA_n3-n28-n41 with 1UL have been covered in the constituent fall-back modes.

6.3.4 ΔTIB and ΔRIB values

For three DLs of Band n3, n28 and n41, the same $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values specified for LTE CA_3-28-41 are used as below.

Table 6.3.4-1: $\Delta T_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n3-n28-n41	n3	0.5
	n28	0.3
	n41	0.3[1]/0.8[2]
NOTE 1: Applicable for the frequency range of 2515-2690 MHz. NOTE 2: Applicable for the frequency range of 2496-2515 MHz.		

Table 6.3.4-2: $\Delta R_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta R_{IB,c}$ [dB]
CA_n3-n28-n41	n3	0
	n28	0
	n41	0[1]/0.5[2]
NOTE 1: Applicable for the frequency range of 2515-2690 MHz. NOTE 2: Applicable for the frequency range of 2496-2515 MHz.		

6.3.5 REFSENS requirements

There are no additional MSD requirements for this band combination

6.4 CA_n3-n41-n78

6.4.1 Operating bands for CA

Table 6.4.1-1: 3DL Inter-band CA operating bands

NR CA Band	NR Band	Uplink (UL) operating band BS receive / UE transmit F_{UL_low} – F_{UL_high}			Downlink (DL) operating band BS transmit / UE receive F_{DL_low} – F_{DL_high}			Duplex Mode
CA_n3-n41-n78	n3	1710MHz	–	1780MHz	1805MHz	–	1880MHz	FDD
	n41	2496MHz	–	2690MHz	2496MHz	–	2690MHz	TDD
	n78	3300MHz	–	3800MHz	3300MHz	–	3800MHz	TDD

6.4.2 Channel bandwidths per operating band for CA

Table 6.4.2-1: Supported channel bandwidths per CA configuration for 3DL inter-band CA

NR CA Configuration	UL Config	NR Band	SCS [kHz]	5	10	15	20	25	30	40	50	60	70	80	90	100	Bandwidth combination set
CA_n3A-n41A-n78A	-	n3	15	Yes	Yes	Yes	Yes	Yes	Yes	Yes							0
			30		Yes	Yes	Yes	Yes	Yes	Yes							
			60		Yes	Yes	Yes	Yes	Yes	Yes							
		n41	15		Yes	Yes	Yes		Yes	Yes	Yes						
			30		Yes	Yes	Yes		Yes	Yes	Yes	Yes		Yes	Yes	Yes	
			60		Yes	Yes	Yes		Yes	Yes	Yes	Yes		Yes	Yes	Yes	
		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_n3A-n41A-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							
		n41	15		Yes	Yes	Yes		Yes	Yes	Yes						
			30		Yes	Yes	Yes		Yes	Yes	Yes	Yes		Yes	Yes	Yes	
			60		Yes	Yes	Yes		Yes	Yes	Yes	Yes		Yes	Yes	Yes	
		n78	See CA_n78(2A) Bandwidth Combination Set 2 in Table 5.5A.2-1 in TS 38.101-1														

NOTE: For the UE that signals support of any bandwidth combination set for carrier aggregation, the UE shall support all single carrier bandwidths for the constituent bands as defined in Table 5.3.5-1 of TS 38.101-1 [3] and in Table 5.3.5-1 of TS 38.101-2 when operating in single carrier mode.

6.4.3 Co-existence studies

Co-existence studies of CA_n3-n41-n78 with 1UL are already covered in the constituent fall-back modes.

6.4.4 $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values

For CA_n3-n41-n78, the $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values can reuse the values for DC_3-41_n78 as shown in table 6.4.4-1 and table 6.4.4-2, respectively.

Table 6.4.4-1: $\Delta T_{IB,c}$ for 3DL aggregation

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n3-n41-n78	n3	0.6
	n41	0.3[1]/0.8[2]
	n78	0.8
NOTE 1: The requirement is applied for UE transmitting on the frequency range of 2515-2690 MHz.		
NOTE 2: The requirement is applied for UE transmitting on the frequency range of 2496-2515 MHz.		

Table 6.4.4-2: $\Delta R_{IB,c}$ for 3DL aggregation

Inter-band CA Configuration	NR Band	$\Delta R_{IB,c}$ [dB]
CA_n3-n41-n78	n3	0.2
	n41	0[1]/0.5[2]
	n78	0.5
NOTE 1: The requirement is applied for UE transmitting on the frequency range of 2515-2690 MHz. NOTE 2: The requirement is applied for UE transmitting on the frequency range of 2496-2515 MHz.		

6.4.5 REFSENS requirements

There are no additional MSD requirements for this band combination

6.5 CA_n5-n25-n66

6.5.1 Operating bands for CA

Table 6.5.1-1: 3DL Inter-band CA operating bands

NR CA Band	NR Band	Uplink (UL) operating band BS receive / UE transmit F_{UL_low} – F_{UL_high}			Downlink (DL) operating band BS transmit / UE receive F_{DL_low} – F_{DL_high}			Duplex Mode
CA_n5-n25-n66	n5	824 MHz	–	849 MHz	869 MHz	–	894 MHz	FDD
	n25	1850 MHz	–	1915 MHz	1930 MHz	–	1995 MHz	FDD
	n66	1710 MHz	–	1780 MHz	2110 MHz	–	2200 MHz	TDD

6.5.2 Channel bandwidths per operating band for CA

Table 6.5.2-1: Supported channel bandwidths per CA configuration for 3DL inter-band CA

NR CA Configuration	UL Config	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_n5A-n25A-n66A	-	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						
		n66	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)-n66A	-	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													
		n66	15	Yes	Yes	Yes	Yes	Yes	Yes	Yes						
			30		Yes	Yes	Yes	Yes	Yes	Yes						
			60		Yes	Yes	Yes	Yes	Yes	Yes						
CA_n5A-n25A-n66(2A)	-	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						
		n66	See CA_n66(2A) Bandwidth Combination Set 1 in Table 5.5A.2-1													

CA_n5A-n25(2A)-n66(2A)	-	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												
		n66	See CA_n66(2A) Bandwidth Combination Set 1 in Table 5.5A.2-1												

6.5.3 Co-existence studies

Table 6.5.3-1 summarizes frequency ranges where harmonics occur due to 3DL bands CA with 1 UL. No harmonic issue is identified for this band combination.

Table 6.5.3-1: Harmonic Interference for 3DLs/1UL

					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**
n5	824	849	869	894	1648	1698	2472	2547		
n25	1850	1915	1930	1995	3700	3830	5550	5745		
n66	1710	1780	2110	2200	3420	3560	5130	5340		

Table 6.5.3-2 gives harmonic mixing issue for CA with Band n5, n25 and n66. No harmonic mixing issue is identified for this band combination.

Table 6.5.3-2 Harmonic mixing for 3DLs/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**
n5	824	849	869	894	1738	1788	2607	2682		
n25	1850	1915	1930	1995	3860	3990	5790	5985		
n66	1710	1780	2110	2200	4220	4400	6330	6600		

For single uplink, the UE coexistence is already considered for these bands in TS 38.101-1 [3].

6.5.4 $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values

For three simultaneous DLs and one UL of Band n5, n25 and n66, the $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values are shown in table 6.5.4-1 and table 6.5.4-2, respectively. The requirement is reused from the similar combination, CA_2-5-66.

Table 6.5.4-1: $\Delta T_{IB,c}$ for 3DL aggregation

Inter-band CA Configuration	NR Band	ΔTIB,c [dB]
CA_n5-n25-n66	n5	0.3
	n25	0.5
	n66	0.5
NOTE 1: The requirement is applied for UE transmitting on the frequency range of 2515-2690 MHz. NOTE 2: The requirement is applied for UE transmitting on the frequency range of 2496-2515 MHz.		

Table 6.5.4-2: $\Delta R_{IB,c}$ for 3DL aggregation

Inter-band CA Configuration	NR Band	ΔRIB,c [dB]
CA_n5-n25-n66	n5	0
	n25	0
	n66	0

6.5.5 REFSENS requirements

There is no specific REFSENS requirement for 1 band UL of this combination.

6.6 CA_n5-n25-n78

6.6.1 Operating bands for CA

Table 6.6.1-1: 3DL Inter-band CA operating bands

NR CA Band	NR Band	Uplink (UL) operating band BS receive / UE transmit F_{UL_low} – F_{UL_high}			Downlink (DL) operating band BS transmit / UE receive F_{DL_low} – F_{DL_high}			Duplex Mode
CA_n5-n25-n78	n5	824 MHz	–	849 MHz	869 MHz	–	894 MHz	FDD
	n25	1850 MHz	–	1915 MHz	1930 MHz	–	1995 MHz	FDD
	n78	3300 MHz	–	3800 MHz	3300 MHz	–	3800 MHz	TDD

6.6.2 Channel bandwidths per operating band for CA

Table 6.6.2-1: Supported channel bandwidths per CA configuration for 3DL inter-band CA

NR CA Configuration	UL Config	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_n5A-n25A-n78A	-	n5	15	Yes	Yes	Yes	Yes										0
			30		Yes	Yes	Yes										
			60		Yes	Yes	Yes										
		n25	15	Yes	Yes	Yes	Yes	Yes	Yes	Yes							
			30		Yes	Yes	Yes	Yes	Yes	Yes							
			60		Yes	Yes	Yes	Yes	Yes	Yes							
		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_n5A-n25(2A)-n78A	-	n5	15	Yes	Yes	Yes	Yes										0
			30		Yes	Yes	Yes										
			60		Yes	Yes	Yes										
		n25	See CA_n25(2A) Bandwidth Combination Set 0 in Table 5.5A.2-1														
		n78	15	Yes	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_n5A-n25A-n78(2A)	-	n5	15	Yes	Yes	Yes	Yes										0
			30		Yes	Yes	Yes										
			60		Yes	Yes	Yes										
		n25	15	Yes	Yes	Yes	Yes	Yes	Yes	Yes							
			30		Yes	Yes	Yes	Yes	Yes	Yes							
			60		Yes	Yes	Yes	Yes	Yes	Yes							
		n78	See CA_n78(2A) Bandwidth Combination Set 2 in Table 5.5A.2-1														

6.6.3 Co-existence studies

Table 6.6.3-1 summarizes frequency ranges where harmonics occur due to 3DL bands CA with 1 UL. The 4th harmonic of Band n5 may fall into own Rx of Band n78. The 2nd harmonic of Band n25 may fall into own Rx of Band n78.

Table 6.6.3-1: Harmonic Interference for 3DLs/1UL

					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**
n5	824	849	869	894	1648	1698	2472	2547	3296	3396
n25	1850	1915	1930	1995	3700	3830	5550	5745		
n78	3300	3800	3300	3800	6600	7600	9900	11400		

Table 6.6.3-2 gives harmonic mixing issue for CA with Band n5, n25 and n6. The 4th harmonic mixing of Band n5 may fall into own Rx of Band n78.

Table 6.6.3-2 Harmonic mixing for 3DLs/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**
n5	824	849	869	894	1738	1788	2607	2682	3476	3576
n25	1850	1915	1930	1995	3860	3990	5790	5985		
n78	3300	3800	3300	3800	6600	7600	9900	11400		

For single uplink, the UE coexistence is already considered for these bands in TS 38.101-1 [3].

6.6.4 $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values

For three simultaneous DLs and one UL of Band n5, n25 and n78, the $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values are shown in table 6.6.4-1 and table 6.6.4-2, respectively. The requirement is derived from the max operation of all fallback CAs.

Table 6.6.4-1: $\Delta T_{IB,c}$ for 3DL aggregation

Inter-band CA Configuration	NR Band	ΔTIB,c [dB]
CA_n5-n25-n78	n5	0.6
	n25	0.6
	n78	0.8
NOTE 1: The requirement is applied for UE transmitting on the frequency range of 2515-2690 MHz. NOTE 2: The requirement is applied for UE transmitting on the frequency range of 2496-2515 MHz.		

Table 6.6.4-2: $\Delta R_{IB,c}$ for 3DL aggregation

Inter-band CA Configuration	NR Band	ΔRIB,c [dB]
CA_n5-n25-n78	n5	0.2
	n25	0.2
	n78	0.5

6.6.5 REFSENS requirements

Band n78 MSD due to Band n5 and Band n25 uplink is already specified in 2DL/1UL WI. No specific analysis for 3DL/1UL is needed.

6.7 CA_n25-n48-n66

6.7.1 Operating bands for CA

Table 6.7.1-1: 3DL Inter-band CA operating bands

NR CA Band	NR Band	Uplink (UL) operating band BS receive / UE transmit F_{UL_low} – F_{UL_high}			Downlink (DL) operating band BS transmit / UE receive F_{DL_low} – F_{DL_high}			Duplex Mode
CA_n25A-n48A-n66A	n25	1850 MHz	–	1915 MHz	1930 MHz	–	1995 MHz	FDD
	n48	3550 MHz	–	3700 MHz	3550 MHz	–	3700 MHz	TDD
	n66	1710 MHz	–	1780 MHz	2110 MHz	–	2200 MHz	FDD

6.7.2 Channel bandwidths per operating band for CA

Table 6.7.2-1: Supported channel bandwidths per CA configuration for 3DL inter-band CA

NR CA Configuration	UL Config	NR Band	SCS [kHz]	5	10	15	20	25	30	40	50	60	70	80	90	100	BCS
CA_n25A-n48A-n66A	-	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	
		n66	15	Yes	Yes	Yes	Yes			Yes							
			30		Yes	Yes	Yes			Yes							
			60		Yes	Yes	Yes			Yes							
CA_n25A-n48(2A)-n66A	-	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														
		n66	15	Yes	Yes	Yes	Yes			Yes							
			30		Yes	Yes	Yes			Yes							
			60		Yes	Yes	Yes			Yes							
CA_n25A-n48C-n66A	-	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														
		n66	15	Yes	Yes	Yes	Yes			Yes							
			30		Yes	Yes	Yes			Yes							
			60		Yes	Yes	Yes			Yes							

6.7.3 Co-existence studies

Table 6.7.3-1 summarizes frequency ranges where harmonics occur due to 3DL bands CA with 1 UL. It can be seen that there are 2nd harmonic issues from n25 UL into n48 DL but that is addressed in the lower order combination CA_n25-48.

Table 6.7.3-1: Harmonic Interference for 3DLs/1UL

					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**
n25	1850	1915	1930	1995	3700	3830	5550	5745	7400	7660
n48	3550	3700	3550	3700	7100	7400	10650	11100	14200	14800
n66	1710	1780	2110	2200	3420	3560	5130	5340	6840	7120

Table 6.7.3-2 gives harmonic mixing issue for the 3DL bands CA with 1 UL. It can be seen that there are no issues.

Table 6.7.3-2 Harmonic mixing for 3DLs/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
n66	1710	1780	2110	2200	4220	4400	6330	6600	8440	8800

For single uplink, the UE coexistence is already considered for these bands in TS 38.101-1.

6.7.4 $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values

For three simultaneous DLs and one UL of Band n25, n48 and n66, the $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values are shown in table 6.7.4-1 and table 6.7.4-2, respectively. Values are same as for DC_2-48_n66.

Table 6.7.4-1: $\Delta T_{IB,c}$ for 3DL aggregation

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n25-n48-n66	n25	0.6
	n48	0.8
	n66	0.6

Table 6.7.4-2: $\Delta R_{IB,c}$ for 3DL aggregation

Inter-band CA Configuration	NR Band	$\Delta R_{IB,c}$ [dB]
CA_n25-n48-n66	n25	0.3
	n48	0.5
	n66	0.3

6.7.5 REFSENS requirements

Compared to its fallback modes, there are no additional MSD requirements for this band combination.

6.8 CA_n39-n40-n41

6.8.1 Operating bands for CA

Table 6.8.1-1: 3DL Inter-band CA operating bands

NR 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_n39A-n40A-n41A	n39	1880 MHz – 1920 MHz	1880 MHz – 1920 MHz	TDD
	n40	2300 MHz – 2400 MHz	2300 MHz – 2400 MHz	TDD
	n41	2496 MHz – 2690 MHz	2496 MHz – 2690 MHz	TDD

6.8.2 Channel bandwidths per operating band for CA

Table 6.8.2-1: Supported channel bandwidths per CA configuration for 3DL inter-band CA

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_n39A-n40A-n41A	-	n39	15	Yes	Yes	Yes	Yes	Yes	Yes	Yes							0
			30		Yes	Yes	Yes	Yes	Yes	Yes							
			60		Yes	Yes	Yes	Yes	Yes	Yes							
		n40	15	Yes	Yes	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			
		n41	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	

6.8.3 Co-existence studies

For 3DL/1UL NR CA, only single uplink operation needs to be considered. For single uplink operation of this combination, only harmonic issue and harmonic mixing issue need to be considered.

Table 6.8.3-1 summarizes frequency ranges where harmonics occur due to 3DL bands CA with 1 UL. It can be seen that no harmonic issue for band combination CA_n39-n40-n41.

Table 6.8.3-1: Harmonic Interference for 3DLs/1UL

					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
n39	1880	1920	1880	1920	3760	3840	5640	5760		
n40	2300	2400	2300	2400	4600	4800	6900	7200		
n41	2496	2690	2496	2690	4992	5380	7488	8070		

Table 6.8.3-2 gives harmonic mixing issue for CA with Band n39, n40 and n41. It is seen that no harmonic mixing issue for band combination CA_n39-n40-n41.

Table 6.8.3-2 Harmonic mixing for 3DLs/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**
n39	1880	1920	1880	1920	3760	3840	5640	5760		
n40	2300	2400	2300	2400	4600	4800	6900	7200		
n41	2496	2690	2496	2690	4992	5380	7488	8070		

6.8.4 ΔT_{IB} and ΔR_{IB} values

For CA_n39A-n40A-n41A, the $\Delta T_{IB,c}$ and ΔR_{IB} values are the same with DC_39_n40-n41, which are given in the tables below.

Table 6.8.4-1: $\Delta T_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n39A-n40A-n41A	n39	0.3
	n40	0.3
	n41	0.3

Table 6.8.4-2: $\Delta R_{IB,c}$

Inter-band CA Configuration	NR Band	ΔR_{IB} [dB]
CA_n39A-n40A-n41A	n39	0
	n40	0
	n41	0

6.8.5 REFSENS requirements

There are no specific REFSENS requirements for this combination in 3DL/1UL NR CA operation.

6.9 CA_n39-n40-n79

6.9.1 Operating bands for CA

Table 6.9.1-1: 3DL Inter-band CA operating bands

NR 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_n39A-n40A-n79A	n39	1880 MHz – 1920 MHz	1880 MHz – 1920 MHz	TDD
	n40	2300 MHz – 2400 MHz	2300 MHz – 2400 MHz	TDD
	n79	4400 MHz – 5000 MHz	4400 MHz – 5000 MHz	TDD

6.9.2 Channel bandwidths per operating band for CA

Table 6.9.2-1: Supported channel bandwidths per CA configuration for 3DL inter-band CA

NR CA	Uplink CA	NR	SCS	5	10	15	20	25	30	40	50	60	70	80	90	100	Bandwidth

configuration	configuration	Band	(kHz)	MHz	MHz	MHz	MHz	MHz	MHz	MHz	MHz	MHz	MHz	MHz	MHz	MHz	combination set
CA_n39A-n40A-n79A	-	n39	15	Yes	Yes	Yes	Yes	Yes	Yes	Yes							0
			30		Yes	Yes	Yes	Yes	Yes	Yes							
			60		Yes	Yes	Yes	Yes	Yes	Yes							
		n40	15	Yes	Yes	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			
		n79	15							Yes	Yes						
			30							Yes	Yes	Yes		Yes		Yes	
			60							Yes	Yes	Yes		Yes		Yes	

6.9.3 Co-existence studies

For 3DL/1UL NR CA, only single uplink operation needs to be considered. For single uplink operation of this combination, only harmonic issue and harmonic mixing issue need to be considered.

Table 6.9.3-1 summarizes frequency ranges where harmonics occur due to 3DL bands CA with 1 UL. It can be seen that 2nd order harmonic of Band n40 will fall into Band n79.

Table 6.9.3-1: Harmonic Interference for 3DLs/1UL

					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
n39	1880	1920	1880	1920	3760	3840	5640	5760		
n40	2300	2400	2300	2400	4600	4800	6900	7200		
n79	4400	5000	4400	5000	8800	10000	13200	15000		

Table 6.9.3-2 gives harmonic mixing issue for CA with Band n39, n40 and n41. It is seen that 2nd harmonic mixing issue for the band combination of n40 and n79.

Table 6.9.3-2 Harmonic mixing for 3DLs/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
n39	1880	1920	1880	1920	3760	3840	5640	5760		
n40	2300	2400	2300	2400	4600	4800	6900	7200		
n79	4400	5000	4400	5000	8800	10000	13200	15000		

6.9.4 ΔT_{IB} and ΔR_{IB} values

For CA_n39A-n40A-n79A, the $\Delta T_{IB,c}$ and ΔR_{IB} values are the same with DC_39_n40-n79, which are given in the tables below.

Table 6.9.4-1: $\Delta T_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n39-n40-n79	n39	0.3
	n40	0
	n79	0.8

Table 6.9.4-2: $\Delta R_{IB,c}$

Inter-band CA Configuration	NR Band	ΔR_{IB} [dB]
CA_n39-n40-n79	n39	0.3
	n40	0.3
	n79	0.5

6.9.5 REFSENS requirements

The harmonic and harmonic mixing issue for band n40 and band n79 have been already addressed in TR38.716-02-00. No need to specify for REFSENS requirements for this combination in 3DL/1UL NR CA operation.

6.10 CA_n1-n77-n257

6.10.1 Operating bands for CA

Table 6.10.1-1: 3DL Inter-band CA operating bands

NR CA Band	NR Band	Uplink (UL) operating band			Downlink (DL) operating band			Duplex Mode
		BS receive / UE transmit			BS transmit / UE receive			
		FUL_low – FUL_high			FDL_low – FDL_high			
CA_n1-n77-n257	n1	1920 MHz	–	1980 MHz	2110 MHz	–	2170 MHz	FDD
	n77	3300 MHz	–	4200 MHz	3300 MHz	–	4200 MHz	TDD
	n257	26500 MHz	–	29500 MHz	26500 MHz	–	29500 MHz	TDD

6.10.2 Channel bandwidths per operating band for CA

Table 6.10.2-1: Supported channel bandwidths per CA configuration for 3DL inter-band CA

NR CA config	UL config	NR Band	SCS (kHz)	5	10	15	20	25	30	40	50	60	70	80	90	100	200	400	Bandwidth combination set
CA_n1A-n77A-n257A	-	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			
		n257	60								Yes					Yes	Yes		
			120								Yes					Yes	Yes	Yes	
CA_n1A-n77A-n257G	CA_n257G	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			
		n257	See CA_n257G in Table 5.5A.1-1 in TS 38.101-2																
CA_n1A-n77A-n257H	CA_n257G CA_n257H	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			
		n257	See CA_n257H in Table 5.5A.1-1 in TS 38.101-2																
CA_n1A-n77A-n257I	CA_n257G CA_n257H CA_n257I	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			
		n257	See CA_n257I in Table 5.5A.1-1 in TS 38.101-2																

NOTE: For the UE that signals support of any bandwidth combination set for carrier aggregation, the UE shall support all single carrier bandwidths for the constituent bands as defined in Table 5.3.5-1 of TS 38.101-1 and in Table 5.3.5-1 of TS 38.101-2 when operating in single carrier mode.

6.10.3 Co-existence requirements

6.10.4 $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values

For three simultaneous DLs and one UL of Band n1, n77 and n257, the $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values are shown in table 6.10.4-1 and table 6.10.4-2, respectively.

Table 6.10.4-1: $\Delta T_{IB,c}$ for 3DL aggregation

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n1-n77-n257	n1	0.6
	n77	0.8
	n257	0

Table 6.10.4-2: $\Delta R_{IB,c}$ for 3DL aggregation

Inter-band CA Configuration	NR Band	$\Delta R_{IB,c}$ [dB]
CA_n1-n77-n257	n1	0.2
	n77	0.5
	n257	0

6.10.5 REFSENS requirements

MSD studies can be omitted because harmonic interference between FR1 bands have been already studied for CA_n1-n77, and harmonic interference between FR1 bands and FR2 band are negligible.

6.11 CA_n1-n78-n257

6.11.1 Operating bands for CA

Table 6.11.1-1: 3DL Inter-band CA operating bands

NR CA Band	NR Band	Uplink (UL) operating band BS receive / UE transmit FUL_low – FUL_high			Downlink (DL) operating band BS transmit / UE receive FDL_low – FDL_high			Duplex Mode
CA_n1-n78-n257	n1	1920 MHz	–	1980 MHz	2110 MHz	–	2170 MHz	FDD
	n78	3300 MHz	–	3800 MHz	3300 MHz	–	3800 MHz	TDD
	n257	26500 MHz	–	29500 MHz	26500 MHz	–	29500 MHz	TDD

6.11.2 Channel bandwidths per operating band for CA

Table 6.11.2-1: Supported channel bandwidths per CA configuration for 3DL inter-band CA

NR CA config	UL config	NR Band	SCS (kHz)	5	10	15	20	25	30	40	50	60	70	80	90	100	200	400	Bandwidth combination set
CA_n1A-n78A-n257A	-	n1	15	Yes	Yes	Yes	Yes												0
			30		Yes	Yes	Yes												
			60		Yes	Yes	Yes												
		n78	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			
		n257	60								Yes					Yes	Yes		
			120								Yes					Yes	Yes	Yes	
CA_n1A-n78A-n257G	CA_n257G	n1	15	Yes	Yes	Yes	Yes												0
			30		Yes	Yes	Yes												
			60		Yes	Yes	Yes												
		n78	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			
		n257	See CA_n257G in Table 5.5A.1-1 in TS 38.101-2																
CA_n1A-n78A-n257H	CA_n257G CA_n257H	n1	15	Yes	Yes	Yes	Yes												0
			30		Yes	Yes	Yes												
			60		Yes	Yes	Yes												
		n78	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			
		n257	See CA_n257H in Table 5.5A.1-1 in TS 38.101-2																
CA_n1A-n78A-n257I	CA_n257G CA_n257H CA_n257I	n1	15	Yes	Yes	Yes	Yes												0
			30		Yes	Yes	Yes												
			60		Yes	Yes	Yes												
		n78	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			
		n257	See CA_n257I in Table 5.5A.1-1 in TS 38.101-2																

NOTE: For the UE that signals support of any bandwidth combination set for carrier aggregation, the UE shall support all single carrier bandwidths for the constituent bands as defined in Table 5.3.5-1 of TS 38.101-1 and in Table 5.3.5-1 of TS 38.101-2 when operating in single carrier mode.

6.11.3 Co-existence requirements

6.11.4 $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values

For three simultaneous DLs and one UL of Band n1, n78 and n257, the $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values are shown in table 6.11.4-1 and table 6.11.4-2, respectively.

Table 6.11.4-1: $\Delta T_{IB,c}$ for 3DL aggregation

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n1-n78-n257	n1	0.3
	n78	0.8
	n257	0

Table 6.11.4-2: $\Delta R_{IB,c}$ for 3DL aggregation

Inter-band CA Configuration	NR Band	$\Delta R_{IB,c}$ [dB]
CA_n1-n78-n257	n1	0
	n78	0.5
	n257	0

6.11.5 REFSENS requirements

MSD studies can be omitted because harmonic interference between FR1 bands have been already studied for CA_n1-n78, and harmonic interference between FR1 bands and FR2 band are negligible.

6.12 CA_n1-n79-n257

6.12.1 Operating bands for CA

Table 6.12.1-1: 3DL Inter-band CA operating bands

NR CA Band	NR Band	Uplink (UL) operating band BS receive / UE transmit FUL_low – FUL_high			Downlink (DL) operating band BS transmit / UE receive FDL_low – FDL_high			Duplex Mode
CA_n1-n79-n257	n1	1920 MHz	–	1980 MHz	2110 MHz	–	2170 MHz	FDD
	n79	4400 MHz	–	5000 MHz	4400 MHz	–	5000 MHz	TDD
	n257	26500 MHz	–	29500 MHz	26500 MHz	–	29500 MHz	TDD

6.12.2 Channel bandwidths per operating band for CA

Table 6.12.2-1: Supported channel bandwidths per CA configuration for 3DL inter-band CA

NR CA config	UL config	NR Band	SCS (kHz)	5	10	15	20	25	30	40	50	60	70	80	90	100	200	400	Bandwidth combination set
CA_n1A-n79A-n257A	-	n1	15	Yes	Yes	Yes	Yes												0
			30		Yes	Yes	Yes												
			60		Yes	Yes	Yes												
		n79	15							Yes	Yes								
			30							Yes	Yes	Yes		Yes		Yes			
			60							Yes	Yes	Yes		Yes		Yes			
		n257	60								Yes					Yes	Yes		
			120								Yes					Yes	Yes	Yes	
CA_n1A-n79A-n257G	CA_n257G	n1	15	Yes	Yes	Yes	Yes												0
			30		Yes	Yes	Yes												
			60		Yes	Yes	Yes												
		n79	15							Yes	Yes								
			30							Yes	Yes	Yes		Yes		Yes			
			60							Yes	Yes	Yes		Yes		Yes			
		n257	See CA_n257G in Table 5.5A.1-1 in TS 38.101-2																
CA_n1A-n79A-n257H	CA_n257G CA_n257H	n1	15	Yes	Yes	Yes	Yes												0
			30		Yes	Yes	Yes												
			60		Yes	Yes	Yes												
		n79	15							Yes	Yes								
			30							Yes	Yes	Yes		Yes		Yes			
			60							Yes	Yes	Yes		Yes		Yes			
		n257	See CA_n257H in Table 5.5A.1-1 in TS 38.101-2																
CA_n1A-n79A-n257I	CA_n257G CA_n257H CA_n257I	n1	15	Yes	Yes	Yes	Yes												0
			30		Yes	Yes	Yes												
			60		Yes	Yes	Yes												
		n79	15							Yes	Yes								
			30							Yes	Yes	Yes		Yes		Yes			
			60							Yes	Yes	Yes		Yes		Yes			
		n257	See CA_n257I in Table 5.5A.1-1 in TS 38.101-2																

NOTE: For the UE that signals support of any bandwidth combination set for carrier aggregation, the UE shall support all single carrier bandwidths for the constituent bands as defined in Table 5.3.5-1 of TS 38.101-1 and in Table 5.3.5-1 of TS 38.101-2 when operating in single carrier mode.

6.12.3 Co-existence requirements

6.12.4 $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values

For three simultaneous DLs and one UL of Band n1, n79 and n257, the $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values are shown in table 6.12.4-1 and table 6.12.4-2, respectively.

Table 6.12.4-1: $\Delta T_{IB,c}$ for 3DL aggregation

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n1-n79-n257	n1	0
	n79	0
	n257	0

Table 6.12.4-2: $\Delta R_{IB,c}$ for 3DL aggregation

Inter-band CA Configuration	NR Band	$\Delta R_{IB,c}$ [dB]
CA_n1-n79-n257	n1	0
	n79	0
	n257	0

6.12.5 REFSENS requirements

MSD studies can be omitted because harmonic interference between FR1 bands have been already studied for CA_n1-n79, and harmonic interference between FR1 bands and FR2 band are negligible.

6.13 CA_n3-n41-n77

6.13.1 Operating bands for CA

Table 6.13.1-1: 3DL Inter-band CA operating bands

NR CA Band	NR Band	Uplink (UL) operating band BS receive / UE transmit F_{UL_low} – F_{UL_high}			Downlink (DL) operating band BS transmit / UE receive F_{DL_low} – F_{DL_high}			Duplex Mode
CA_n3-n41-n77	n3	1710MHz	–	1780MHz	1805MHz	–	1880MHz	FDD
	n41	2496MHz	–	2690MHz	2496MHz	–	2690MHz	TDD
	n77	3300MHz	–	4200MHz	3300MHz	–	4200MHz	TDD

6.13.2 Channel bandwidths per operating band for CA

Table 6.13.2-1: Supported channel bandwidths

NR CA Configuration	UL Config	NR Band	SCS [kHz]	5	10	15	20	25	30	40	50	60	70	80	90	100	Bandwidth combination set
CA_n3A-n41A-n77A	-	n3	15	Yes	Yes	Yes	Yes	Yes	Yes	Yes							0
			30		Yes	Yes	Yes	Yes	Yes	Yes							
			60		Yes	Yes	Yes	Yes	Yes	Yes							
		n41	15		Yes	Yes	Yes		Yes	Yes	Yes						
			30		Yes	Yes	Yes		Yes	Yes	Yes	Yes		Yes	Yes	Yes	
			60		Yes	Yes	Yes		Yes	Yes	Yes	Yes		Yes	Yes	Yes	
		n77	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_n3A-n41A-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							
		n41	15		Yes	Yes	Yes		Yes	Yes	Yes						
			30		Yes	Yes	Yes		Yes	Yes	Yes	Yes		Yes	Yes	Yes	
			60		Yes	Yes	Yes		Yes	Yes	Yes	Yes		Yes	Yes	Yes	
		n77	See CA_n77(2A) Bandwidth Combination Set 0 in Table 5.5A.2-1 in TS 38.101-1														

NOTE: For the UE that signals support of any bandwidth combination set for carrier aggregation, the UE shall support all single carrier bandwidths for the constituent bands as defined in Table 5.3.5-1 of TS 38.101-1 [3] and in Table 5.3.5-1 of TS 38.101-2 when operating in single carrier mode.

6.13.3 Co-existence studies

Co-existence studies of CA_n3-n41-n77 with 1UL are already covered in the constituent fall-back modes.

6.13.4 $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values

For CA_n3-n41-n77, the $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values can reuse the values for DC_3-41_n77 as shown in table 6.13.4-1 and table 6.13.4-2, respectively.

Table 6.13.4-1: $\Delta T_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n3-n41-n77	n3	0.6
	n41	0.3[1]/0.8[2]
	n77	0.8
NOTE 1: The requirement is applied for UE transmitting on the frequency range of 2515-2690 MHz. NOTE 2: The requirement is applied for UE transmitting on the frequency range of 2496-2515 MHz.		

Table 6.13.4-2: $\Delta R_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta R_{IB,c}$ [dB]
CA_n3-n41-n77	n3	0.2
	n41	0[1]/0.5[2]
	n77	0.5
NOTE 1: The requirement is applied for UE transmitting on the frequency range of 2515-2690 MHz. NOTE 2: The requirement is applied for UE transmitting on the frequency range of 2496-2515 MHz.		

6.13.5 REFSENS requirements

<void>

6.14 CA_n28-n41-n77

6.14.1 Operating bands for CA

Table 6.14.1-1: 3DL Inter-band CA operating bands

NR CA Band	NR Band	Uplink (UL) operating band			Downlink (DL) operating 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-n41-n77	n28	703MHz	–	748MHz	758MHz	–	803MHz	FDD
	n41	2496MHz	–	2690MHz	2496MHz	–	2690MHz	TDD
	n77	3300MHz	–	4200MHz	3300MHz	–	4200MHz	TDD

6.14.2 Channel bandwidths per operating band for CA

Table 6.14.2-1: Supported channel bandwidths

NR CA Configuration	UL Config	NR Band	SCS [kHz]	5	10	15	20	25	30	40	50	60	70	80	90	100	Bandwidth combination set
CA_n28A-n41A-n77A	-	n28	15	Yes	Yes	Yes	Yes		Yes								0
			30		Yes	Yes	Yes		Yes								
			60														
		n41	15		Yes	Yes	Yes		Yes	Yes	Yes						
			30		Yes	Yes	Yes		Yes	Yes	Yes	Yes		Yes	Yes	Yes	
			60		Yes	Yes	Yes		Yes	Yes	Yes	Yes		Yes	Yes	Yes	
		n77	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_n28A-n41A-n77(2A)	-	n28	15	Yes	Yes	Yes	Yes		Yes								0
			30		Yes	Yes	Yes		Yes								
			60														
		n41	15		Yes	Yes	Yes		Yes	Yes	Yes						
			30		Yes	Yes	Yes		Yes	Yes	Yes	Yes		Yes	Yes	Yes	
			60		Yes	Yes	Yes		Yes	Yes	Yes	Yes		Yes	Yes	Yes	
		n77	See CA_n77(2A) Bandwidth Combination Set 0 in Table 5.5A.2-1 in TS 38.101-1														

NOTE: For the UE that signals support of any bandwidth combination set for carrier aggregation, the UE shall support all single carrier bandwidths for the constituent bands as defined in Table 5.3.5-1 of TS 38.101-1 [3] and in Table 5.3.5-1 of TS 38.101-2 when operating in single carrier mode.

6.14.3 Co-existence studies

Co-existence studies of CA_n28-n41-n77 with 1UL are already covered in the constituent fall-back modes.

6.14.4 $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values

For CA_n28-n41-n77, the $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values can reuse the values for DC_28-41_n77 as shown in table 6.14.4-1 and table 6.14.4-2, respectively.

Table 6.14.4-1: $\Delta T_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n28-n41-n77	n28	0.5
	n41	0.3
	n77	0.8

Table 6.14.4-2: $\Delta R_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta R_{IB,c}$ [dB]
CA_n28-n41-n77	n28	0.2
	n41	0
	n77	0.5

6.14.5 REFSENS requirements

There are no additional MSD requirements for this band combination

6.15 CA_n28-n41-n78

6.15.1 Operating bands for CA

Table 6.x.1-1: 3DL Inter-band CA operating bands

NR CA Band	NR Band	Uplink (UL) operating band			Downlink (DL) operating 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-n41-n78	n28	703MHz	–	748MHz	758MHz	–	803MHz	FDD
	n41	2496MHz	–	2690MHz	2496MHz	–	2690MHz	TDD
	n78	3300MHz	–	4200MHz	3300MHz	–	4200MHz	TDD

6.15.2 Channel bandwidths per operating band for CA

Table 6.15.2-1: Supported channel bandwidths

NR CA Configuration	UL Config	NR Band	SCS [kHz]	5	10	15	20	25	30	40	50	60	70	80	90	100	Bandwidth combination set
CA_n28A-n41A-n78(2A)	-	n28	15	Yes	Yes	Yes	Yes		Yes								0
			30		Yes	Yes	Yes		Yes								
			60														
		n41	15		Yes	Yes	Yes		Yes	Yes	Yes						
			30		Yes	Yes	Yes		Yes	Yes	Yes	Yes		Yes	Yes	Yes	
			60		Yes	Yes	Yes		Yes	Yes	Yes	Yes		Yes	Yes	Yes	
		n78	See CA_n78(2A) Bandwidth Combination Set 2 in Table 5.5A.2-1 in TS 38.101-1														

NOTE: For the UE that signals support of any bandwidth combination set for carrier aggregation, the UE shall support all single carrier bandwidths for the constituent bands as defined in Table 5.3.5-1 of TS 38.101-1 [3] and in Table 5.3.5-1 of TS 38.101-2 when operating in single carrier mode.

6.15.3 Co-existence studies

Co-existence studies of CA_n28-n41-n78 with 1UL are already covered in the constituent fall-back modes.

6.15.4 $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values

For CA_n28-n41-n78, the $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values have been defined in TS 38.101-1.

6.15.5 REFSENS requirements

There are no additional MSD requirements for this band combination.

6.16 CA_n1-n8-n78

6.16.1 Operating bands for CA

Table 6.16.1-1: 3DL Inter-band CA operating bands

NR CA Band	NR Band	Uplink (UL) operating band	Downlink (DL) operating band	Duplex Mode
		BS receive / UE transmit	BS transmit / UE receive	
		F_{UL_low} – F_{UL_high}	F_{DL_low} – F_{DL_high}	

CA_n1-n8-n78	n1	1920MHz	–	1980MHz	2110MHz	–	2170MHz	FDD
	n8	880 MHz	–	915 MHz	925 MHz	–	960 MHz	FDD
	n78	3300MHz	–	3800MHz	3300MHz	–	3800MHz	TDD

6.16.2 Channel bandwidths per operating band for CA

Table 6.16.2-1: Supported channel bandwidths

NR CA Configuration	UL Config	NR Band	SCS [kHz]	5	10	15	20	25	30	40	50	60	80	90	100	Bandwidth combination set
CA_n1A-n8A-n78(2A)	-	n1	15	Yes	Yes	Yes	Yes									0
			30		Yes	Yes	Yes									
			60		Yes	Yes	Yes									
		n8	15	Yes	Yes	Yes	Yes									
			30		Yes	Yes	Yes									
			60													
		n78	See CA_n78(2A) Bandwidth Combination Set 1 in Table 5.5A.2-1													

6.16.3 Co-existence studies

Co-existence analysis is captured into REL16 TR 38.416-03-01 for CA_n1A-n8A-n78A.

6.16.4 $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values

Already in specification.

Table 6.16.4-1: $\Delta T_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n1-n8-n78	n1	0.3
	n8	0.6
	n78	0.8

Table 6.16.4-2: $\Delta R_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta R_{IB,c}$ [dB]
CA_n1-n8-n78	n1	0
	n8	0.2
	n78	0.5

6.16.5 REFSENS requirements

MSD requirements are captured in lower order combinations.

6.17 CA_n8-n40-n41

6.17.1 Operating bands for CA

Table 6.17.1-1: 3DL Inter-band CA operating bands

NR 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_n8-n40-n41	n8	880 MHz – 915 MHz	925 MHz – 960 MHz	FDD
	n40	2300 MHz – 2400 MHz	2300 MHz – 2400 MHz	TDD
	n41	2496 MHz – 2690 MHz	2496 MHz – 2690 MHz	TDD

6.17.2 Channel bandwidths per operating band for CA

Table 6.17.2-1: Supported channel bandwidths

NR CA configuration	Uplink CA configuration	NR Band	SCS (kHz)	5	10	15	20	25	30	40	50	60	70	80	90	100	Bandwidth combination set
CA_n8A-n40A-n41A	-	n8	15	Yes	Yes	Yes	Yes										0
			30		Yes	Yes	Yes										
			60														
		n40	15	Yes	Yes	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			
		n41	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	

6.17.3 Co-existence studies

For 3DL/1UL NR CA, only single uplink operation needs to be considered. For single uplink operation of this combination, only harmonic issue and harmonic mixing issue need to be considered.

Table 6.17.3-1 summarizes frequency ranges where harmonics occur due to 3DL bands CA with 1 UL. It can be seen that the 3rd order harmonic of Band n8 will fall into Band n41.

Table 6.17.3-1: Harmonic Interference

					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
n8	880	915	925	960	1760	1830	2640	2745		
n40	2300	2400	2300	2400	4600	4800	6900	7200		
n41	2496	2690	2496	2690	4992	5380	7488	8070		

Table 6.17.3-2 gives harmonic mixing issue for CA with Band n8, n40 and n41. It is seen that no harmonic mixing issue for band combination CA_n8-n40-n41.

Table 6.17.3-2 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**
n8	880	915	925	960	1850	1920	2775	2880		
n40	2300	2400	2300	2400	4600	4800	6900	7200		
n41	2496	2690	2496	2690	4992	5380	7488	8070		

6.17.4 ΔT_{IB} and ΔR_{IB} values

For CA_n8A-n40A-n41A, the $\Delta T_{IB,c}$ and ΔR_{IB} values are the same with DC_8_n40-n41, which are given in the tables below.

Table 6.17.4-1: $\Delta T_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n8A-n40A-n41A	n8	0.3
	n40	0.3
	n41	0.3

Table 6.17.4-2: $\Delta R_{IB,c}$

Inter-band CA Configuration	NR Band	ΔR_{IB} [dB]
CA_n8A-n40A-n41A	n8	0
	n40	0
	n41	0

6.17.5 REFSENS requirements

The MSD caused by 3rd order harmonic of Band n8 will fall into Band n41 have beed already captured in the TR38.716-02-00. There are no additional REFSENS requirements for this combination in 3DL/1UL NR CA operation.

6.18 CA_n5-n66-n77

6.18.1 Operating bands for CA

Table 6.18.1-1: 3DL Inter-band CA operating bands

NR CA Band	NR Band	Uplink (UL) operating band			Downlink (DL) operating 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-n66-n77	n5	824 MHz	–	849 MHz	869 MHz	–	894 MHz	FDD
	n66	1710 MHz	–	1780 MHz	2110 MHz	–	2200 MHz	FDD
	n77	3300 MHz	–	4200 MHz	3300 MHz	–	4200 MHz	TDD

6.18.2 Channel bandwidths per operating band for CA

Table 6.18.2-1: Supported channel bandwidths

NR CA Configuration	UL Config	NR Band	SCS [kHz]	5	10	15	20	25	30	40	50	60	70	80	90	100	Bandwidth combination set
CA_n5A-n66A-n77A	-	n5	15	Yes	Yes	Yes	Yes										0
			30		Yes	Yes	Yes										
			60														
		n66	15	Yes	Yes	Yes	Yes	Yes	Yes	Yes							
			30		Yes	Yes	Yes	Yes	Yes	Yes							
			60		Yes	Yes	Yes	Yes	Yes	Yes							
		n77	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_n5A-n66-n77(2A)	-	n5	15	Yes	Yes	Yes	Yes										0
			30		Yes	Yes	Yes										
			60														
		n66	15	Yes	Yes	Yes	Yes	Yes	Yes	Yes							
			30		Yes	Yes	Yes	Yes	Yes	Yes							
			60		Yes	Yes	Yes	Yes	Yes	Yes							
		n77	See CA_n77(2A) Bandwidth Combination Set 1 in Table 5.5A.2-1														

6.18.3 Co-existence studies

Table 6.18.3-1 summarizes frequency ranges where harmonics occur due to 3DL bands CA with 1 UL. The 4th harmonic of Band n5 may fall into own Rx of Band n77. The 2nd harmonic of Band n66 may fall into own Rx of Band n77.

Table 6.18.3-1: Harmonic Interference

					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
n5	824	849	869	894	1648	1698	2472	2547	3296	3396
n66	1710	1780	2110	2200	3420	3560	5130	5340		
n77	3300	4200	3300	4200	6600	8400	9900	12600		

Table 6.18.3-2 gives harmonic mixing issue for CA with Band n5, n66 and n77. The 4th harmonic mixing of Band n5 may fall into own Rx of Band n77.

Table 6.18.3-2 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
n5	824	849	869	894	1738	1788	2607	2682	3476	3576
n66	1710	1780	2110	2200	4220	4400	6330	6600		
n77	3300	4200	3300	4200	6600	8400	9900	12600		

For single uplink, the UE coexistence is already considered for these bands in TS 38.101-1 [3].

6.18.4 $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values

For three simultaneous DLs and one UL of Band n5, n66 and n77, the $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values are shown in table 6.18.4-1 and table 6.18.4-2, respectively. The requirement is derived from the max operation of all fallback CAs.

Table 6.18.4-1: $\Delta T_{IB,c}$

Inter-band CA Configuration	NR Band	ΔTIB,c [dB]
CA_n5-n66-n77	n5	0.6
	n66	0.6
	n77	0.8

Table 6.18.4-2: $\Delta R_{IB,c}$

Inter-band CA Configuration	NR Band	ΔRIB,c [dB]
CA_n5-n66-n77	n5	0.2
	n66	0.2
	n77	0.5

6.18.5 REFSENS requirements

Band n77 MSD due to Band n5 and Band n66 uplink is already specified in 2DL/1UL WI. No specific analysis for 3DL/1UL is needed.

6.19 CA_n2-n66-n77

6.19.1 Operating bands for CA

Table 6.19.1-1: 3DL Inter-band CA operating bands

NR CA Band	NR Band	Uplink (UL) operating band			Downlink (DL) operating band			Duplex Mode
		BS receive / UE transmit			BS transmit / UE receive			
		F_{UL_low}	–	F_{UL_high}	F_{DL_low}	–	F_{DL_high}	
CA_n2-n66-n77	n2	1850 MHz	–	1910 MHz	1930 MHz	–	1990 MHz	FDD
	n66	1710 MHz	–	1780 MHz	2110 MHz	–	2200 MHz	FDD
	n77	3300 MHz	–	4200 MHz	3300 MHz	–	4200 MHz	TDD

6.19.2 Channel bandwidths per operating band for CA

Table 6.19.2-1: Supported channel bandwidths

NR CA Configuration	UL Config	NR Band	SCS [kHz]	5	10	15	20	25	30	40	50	60	70	80	90	100	Bandwidth combination set
CA_n2A-n66A-n77A	-	n2	15	Yes	Yes	Yes	Yes										0
			30		Yes	Yes	Yes										
			60		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							
		n77	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	

6.19.3 Co-existence studies

Table 6.19.3-1 summarizes frequency ranges where harmonics occur due to 3DL bands CA with 1 UL. The 2nd harmonic of Band n2 may fall into own Rx of Band n77. The 2nd harmonic of Band n66 may fall into own Rx of Band n77.

Table 6.19.3-1: Harmonic Interference

					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
n2	1850	1910	1930	1990	3700	3820	5550	5730		
n66	1710	1780	2110	2200	3420	3560	5130	5340		
n77	3300	4200	3300	4200	6600	8400	9900	12600		

Table 6.19.3-2 gives harmonic mixing issue for CA with Band n5, n66 and n77. The 2nd harmonic mixing of Band n2 may fall into own Rx of Band n77.

Table 6.19.3-2 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
n2	1850	1910	1930	1990	3860	3980	5790	5970		
n66	1710	1780	2110	2200	4220	4400	6330	6600		
n77	3300	4200	3300	4200	6600	8400	9900	12600		

For single uplink, the UE coexistence is already considered for these bands in TS 38.101-1 [3].

6.19.4 $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values

For three simultaneous DLs and one UL of Band n2, n66 and n77, the $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values are shown in table 6.19.4-1 and table 6.19.4-2, respectively. The requirement is derived from the max operation of all fallback CAs.

Table 6.19.4-1: $\Delta T_{IB,c}$ for

Inter-band CA Configuration	NR Band	ΔTIB,c [dB]
CA_n2-n66-n77	n2	0.6
	n66	0.6
	n77	0.8

Table 6.19.4-2: $\Delta R_{IB,c}$ for

Inter-band CA Configuration	NR Band	ΔRIB,c [dB]
CA_n2-n66-n77	n2	0.2
	n66	0.2
	n77	0.5

6.19.5 REFSENS requirements

Band n77 MSD due to Band n2 and Band n66 uplink is already specified in 2DL/1UL WI. No specific analysis for 3DL/1UL is needed.

6.20 CA_n66-n71-n78

6.20.1 Operating bands for CA

Table 6.20.1-1: 3DL Inter-band CA operating bands

NR CA Band	NR Band	Uplink (UL) operating band BS receive / UE transmit F_{UL_low} – F_{UL_high}			Downlink (DL) operating band BS transmit / UE receive F_{DL_low} – F_{DL_high}			Duplex Mode
CA_n66-n71-n78	n66	1710 MHz	–	1780 MHz	2110 MHz	–	2200 MHz	FDD
	n71	663 MHz	–	698 MHz	617 MHz	–	652 MHz	FDD
	n78	3300 MHz	–	3800 MHz	3300 MHz	–	3800 MHz	TDD

6.20.2 Channel bandwidths per operating band for CA

Table 6.20.2-1: Supported channel bandwidths

NR CA Configuration	UL Config	NR Band	SCS [kHz]	5	10	15	20	25	30	40	50	60	70	80	90	100	BCS
CA_n66A-n71A-n78A	-	n66	15	Yes	Yes	Yes	Yes	Yes	Yes	Yes							0
			30		Yes	Yes	Yes	Yes	Yes	Yes							
			60		Yes	Yes	Yes	Yes	Yes	Yes							
		n71	15	Yes	Yes	Yes	Yes										
			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_n66A-n71A-n78(2A)	-	n66	15	Yes	Yes	Yes	Yes	Yes	Yes	Yes							0
			30		Yes	Yes	Yes	Yes	Yes	Yes							
			60		Yes	Yes	Yes	Yes	Yes	Yes							
		n71	15	Yes	Yes	Yes	Yes										
			30		Yes	Yes	Yes										
			60														
		n78	See CA_n78(2A) Bandwidth Combination Set 2 in Table 5.5A.2-1														
CA_n66(2A)-n71A-n78A	-	n66	See CA_n66(2A) Bandwidth Combination Set 1 in Table 5.5A.2-1														0
		n71	15	Yes	Yes	Yes	Yes										
			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_n66(2A)-n71A-n78(2A)	-	n66	See CA_n66(2A) Bandwidth Combination Set 1 in Table 5.5A.2-1														0
		n71	15	Yes	Yes	Yes	Yes										
			30		Yes	Yes	Yes										
			60														
		n78	See CA_n78(2A) Bandwidth Combination Set 2 in Table 5.5A.2-1														

6.20.3 Co-existence studies

For single uplink, the UE coexistence is already considered in the fallback combinations in TS 38.101-1.

6.20.4 $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values

For three simultaneous DLs and one UL of Band n66, n71 and n78, the $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values are shown in table 6.20.4-1 and table 6.20.4-2, respectively.

Table 6.20.4-1: $\Delta T_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n66-n71-n78	n66	0.6
	n71	0.5
	n78	0.8

Table 6.20.4-2: $\Delta R_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta R_{IB,c}$ [dB]
CA_n66-n71-n78	n66	0.2
	n71	0.2
	n78	0.5

6.20.5 REFSENS requirements

Compared to its fallback modes, there are no additional MSD requirements for this band combination.

6.21 CA_n38-n66-n78

6.21.1 Operating bands for CA

Table 6.21.1-1: 3DL Inter-band CA operating bands

NR CA Band	NR Band	Uplink (UL) operating band BS receive / UE transmit F_{UL_low} – F_{UL_high}			Downlink (DL) operating band BS transmit / UE receive F_{DL_low} – F_{DL_high}			Duplex Mode
CA_n38-n66-n78	n38	2570 MHz	–	2620 MHz	2570 MHz	–	2620 MHz	TDD
	n66	1710 MHz	–	1780 MHz	2110 MHz	–	2200 MHz	FDD
	n78	3300 MHz	–	3800 MHz	3300 MHz	–	3800 MHz	TDD

6.21.2 Channel bandwidths per operating band for CA

Table 6.21.2-1: Supported channel bandwidths

NR CA Configuration	UL Config	NR Band	SCS [kHz]	5	10	15	20	25	30	40	50	60	70	80	90	100	BCS
CA_n38A-n66A-n78A	-	n38	15	Yes	Yes	Yes	Yes	Yes	Yes	Yes							0
			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							

		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_n38A-n66A-n78(2A)	-	n38	15	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes						0
			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							
		n78	See CA_n78(2A) Bandwidth Combination Set 2 in Table 5.5A.2-1														
CA_n38A-n66(2A)-n78A	-	n38	15	Yes	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														
		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_n38A-n66(2A)-n78(2A)	-	n38	15	Yes	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														
		n78	See CA_n78(2A) Bandwidth Combination Set 2 in Table 5.5A.2-1														

6.21.3 Co-existence studies

For single uplink, the UE coexistence is already considered in the fallback combinations in TS 38.101-1.

6.21.4 $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values

For three simultaneous DLs and one UL of Band n38, n66 and n78, the $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values are shown in table 6.21.4-1 and table 6.21.4-2, respectively.

Table 6.21.4-1: $\Delta T_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n38-n66-n78	n38	0.5
	n66	0.5
	n78	0.8

Table 6.21.4-2: $\Delta R_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta R_{IB,c}$ [dB]
CA_n38-n66-n78	n38	0.5
	n66	0.5
	n78	0.5

6.21.5 REFSENS requirements

Compared to its fallback modes, there are no additional MSD requirements for this band combination.

6.22 CA_n25-n38-n78

6.22.1 Operating bands for CA

Table 6.22.1-1: 3DL Inter-band CA operating bands

NR CA Band	NR Band	Uplink (UL) operating band BS receive / UE transmit F_{UL_low} – F_{UL_high}			Downlink (DL) operating band BS transmit / UE receive F_{DL_low} – F_{DL_high}			Duplex Mode
CA_n25-n38-n78	n25	1850 MHz	–	1915 MHz	1930 MHz	–	1995 MHz	FDD
	n38	2570 MHz	–	2620 MHz	2570 MHz	–	2620 MHz	TDD
	n78	3300 MHz	–	3800 MHz	3300 MHz	–	3800 MHz	TDD

6.22.2 Channel bandwidths per operating band for CA

Table 6.22.2-1: Supported channel bandwidths per CA configuration for 3DL inter-band CA

NR CA Configuration	UL Config	NR Band	SCS [kHz]	5	10	15	20	25	30	40	50	60	70	80	90	100	BCS
CA_n25A-n38A-n78A	-	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							
		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_n25A-n38A-n78(2A)	-	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							
		n78	See CA_n78(2A) Bandwidth Combination Set 2 in Table 5.5A.2-1														
CA_n25(2A)-n38A-n78A	-	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							
		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_n25(2A)-n38A-n78(2A)	-	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							
		n78	See CA_n78(2A) Bandwidth Combination Set 2 in Table 5.5A.2-1														

6.22.3 Co-existence studies

For single uplink, the UE coexistence is already considered in the fallback combinations in TS 38.101-1.

6.22.4 $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values

For three simultaneous DLs and one UL of Band n25, n38 and n78, the $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values are shown in table 6.22.4-1 and table 6.22.4-2, respectively.

Table 6.22.4-1: $\Delta T_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n25-n38-n78	n25	0.5
	n38	0.4
	n78	0.8

Table 6.22.4-2: $\Delta R_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta R_{IB,c}$ [dB]
CA_n25-n38-n78	n25	0.2
	n38	0.4
	n78	0.5

6.22.5 REFSENS requirements

Compared to its fallback modes, there are no additional MSD requirements for this band combination.

6.23 CA_n3-n5-n7

6.23.1 Operating bands for CA

Table 6.23.1-1: 3DL Inter-band CA operating bands

NR CA Band	NR Band	Uplink (UL) operating band BS receive / UE transmit F_{UL_low} – F_{UL_high}			Downlink (DL) operating band BS transmit / UE receive F_{DL_low} – F_{DL_high}			Duplex Mode
CA_n3-n5-n7	n3	1710 MHz	–	1785 MHz	1805 MHz	–	1880 MHz	FDD
	n5	824 MHz	–	849 MHz	869 MHz	–	894 MHz	FDD
	n7	2500 MHz	–	2570 MHz	2620 MHz	–	2690 MHz	FDD

6.23.2 Channel bandwidths per operating band for CA

Table 6.23.2-1: Supported channel bandwidths

NR CA Configuration	UL Config	NR Band	SCS [kHz]	5	10	15	20	25	30	40	50	60	70	80	90	100	BCS
CA_n3A-n5A-n7A	-	n3	15	Yes	Yes	Yes	Yes	Yes	Yes	Yes							0
			30		Yes	Yes	Yes	Yes	Yes	Yes							
			60		Yes	Yes	Yes	Yes	Yes	Yes							
		n5	15	Yes	Yes	Yes	Yes										
			30		Yes	Yes	Yes										
			60														
		n7	15	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes						
			30		Yes	Yes	Yes	Yes	Yes	Yes	Yes						
			60		Yes	Yes	Yes	Yes	Yes	Yes	Yes						
CA_n3A-n5A-n7B	-	n3	15	Yes	Yes	Yes	Yes	Yes	Yes	Yes							0
			30		Yes	Yes	Yes	Yes	Yes	Yes							
			60		Yes	Yes	Yes	Yes	Yes	Yes							
		n5	15	Yes	Yes	Yes	Yes										
			30		Yes	Yes	Yes										
			60														
		n7	See CA_n7B Bandwidth Combination Set 0 in Table 5.5A.1-1														

6.23.3 Co-existence studies

Table 6.23.3-1 summarizes frequency ranges where harmonics occur due to 3DL bands CA with 1 UL. It can be seen that there are no issues.

Table 6.23.3-1: Harmonic Interference

					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
n3	1710	1785	1805	1880	3420	3570	5130	5355	6840	7140
n5	824	849	869	894	1648	1698	2472	2547	3296	3396
n7	2500	2570	2620	2690	5000	5140	7500	7710	10000	10280

Table 6.23.3-2 gives harmonic mixing issue for the 3DL bands CA with 1 UL. It can be seen that there are no issues.

Table 6.23.3-2 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
n3	1710	1785	1805	1880	3610	3760	5415	5640	7220	7520
n5	824	849	869	894	1738	1788	2607	2682	3476	3576
n7	2500	2570	2620	2690	5240	5380	7860	8070	10480	10760

For single uplink, the UE coexistence is already considered for these bands in TS 38.101-1.

6.23.4 $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values

For three simultaneous DLs and one UL of Band n3, n5 and n7, the $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values are shown in table 6.23.4-1 and table 6.23.4-2, respectively. Values are same as for DC_3-7_n5.

Table 6.23.4-1: $\Delta T_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n3-n5-n7	n3	0.5
	n5	0.3
	n7	0.5

Table 6.23.4-2: $\Delta R_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta R_{IB,c}$ [dB]
CA_n3-n5-n7	n3	0
	n5	0
	n7	0

6.23.5 REFSENS requirements

Compared to its fallback modes, there are no additional MSD requirements for this band combination.

6.24 CA_n5-n7-n78

6.24.1 Operating bands for CA

Table 6.24.1-1: 3DL Inter-band CA operating bands

NR CA Band	NR Band	Uplink (UL) operating band BS receive / UE transmit F_{UL_low} – F_{UL_high}			Downlink (DL) operating band BS transmit / UE receive F_{DL_low} – F_{DL_high}			Duplex Mode
CA_n5-n7-n78	n5	824 MHz	–	849 MHz	869 MHz	–	894 MHz	FDD
	n7	2500 MHz	–	2570 MHz	2620 MHz	–	2690 MHz	FDD
	n78	3300 MHz	–	3800 MHz	3300 MHz	–	3800 MHz	TDD

6.24.2 Channel bandwidths per operating band for CA

Table 6.24.2-1: Supported channel bandwidths

NR CA Configuration	UL Config	NR Band	SCS [kHz]	5	10	15	20	25	30	40	50	60	70	80	90	100	BCS
CA_n5A-n7A-n78A	-	n5	15	Yes	Yes	Yes	Yes										0
			30		Yes	Yes	Yes										
			60														
		n7	15	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes						
			30		Yes	Yes	Yes	Yes	Yes	Yes	Yes						
			60		Yes	Yes	Yes	Yes	Yes	Yes	Yes						
		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_n5A-n7B-n78A	-	n5	15	Yes	Yes	Yes	Yes										0
			30		Yes	Yes	Yes										
			60														
		n7	See CA_n7B Bandwidth Combination Set 0 in Table 5.5A.1-1														
		n78	15		Yes	Yes	Yes	Yes	Yes	Yes	Yes						
			30		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes[4]	Yes	Yes	Yes	
			60		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes[4]	Yes	Yes	Yes	

6.24.3 Co-existence studies

Table 6.24.3-1 summarizes frequency ranges where harmonics occur due to 3DL bands CA with 1 UL. It can be seen that there are 4th harmonic issues from n5 UL into n78 DL but that is is not needed to be addressed at this level.

Table 6.24.3-1: Harmonic Interference

					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
n5	824	849	869	894	1648	1698	2472	2547	3296	3396
n7	2500	2570	2620	2690	5000	5140	7500	7710	10000	10280
n78	3300	3800	3300	3800	6600	7600	9900	11400	13200	15200

Table 6.24.3-2 gives harmonic mixing issue for the 3DL bands CA with 1 UL. It can be seen that there are 4th harmonic mixing issues from n5 UL into n78 DL but that is is not needed to be addressed at this level.

Table 6.24.3-2 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
n5	824	849	869	894	1738	1788	2607	2682	3476	3576
n7	2500	2570	2620	2690	5240	5380	7860	8070	10480	10760
n78	3300	3800	3300	3800	6600	7600	9900	11400	13200	15200

For single uplink, the UE coexistence is already considered for these bands in TS 38.101-1.

6.24.4 $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values

For three simultaneous DLs and one UL of Band n3, n5 and n7, the $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values are shown in table 6.24.4-1 and table 6.24.4-2, respectively. Values are same as for DC_5-7_n78.

Table 6.24.4-1: $\Delta_{TIB,c}$

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n5-n7-n78	n5	0.6
	n7	0.6
	n78	0.8

Table 6.24.4-2: $\Delta_{RIB,c}$

Inter-band CA Configuration	NR Band	$\Delta R_{IB,c}$ [dB]
CA_n5-n7-n78	n5	0.2
	n7	0.2
	n78	0.5

6.24.5 REFSENS requirements

Compared to its fallback modes, there are no additional MSD requirements for this band combination.

6.25 CA_n25-n41-n77

6.25.1 Operating bands for CA

Table 6.25.1-1: 3DL Inter-band CA operating bands

NR CA Band	NR Band	Uplink (UL) operating band BS receive / UE transmit F_{UL_low} – F_{UL_high}			Downlink (DL) operating band BS transmit / UE receive F_{DL_low} – F_{DL_high}			Duplex Mode
CA_n25-n41-n77	n25	1850 MHz	–	1915 MHz	1930 MHz	–	1995 MHz	FDD
	n41	2496 MHz	–	2690 MHz	2496 MHz	–	2690 MHz	TDD
	n77	3300 MHz	–	4200 MHz	3300 MHz	–	4200 MHz	TDD

6.25.2 Channel bandwidths per operating band for CA

Table 6.25.2-1: Supported channel bandwidths

NR CA Configuration	UL Config	NR Band	SCS [kHz]	5	10	15	20	25	30	40	50	60	70	80	90	100	BCS
CA_n25A-n41A-n77A	-	n25	15	Yes	Yes	Yes	Yes	Yes	Yes	Yes							0
			30		Yes	Yes	Yes	Yes	Yes	Yes							
			60		Yes	Yes	Yes	Yes	Yes	Yes							
		n41	15		Yes	Yes	Yes		Yes	Yes	Yes						
			30		Yes	Yes	Yes		Yes	Yes	Yes	Yes		Yes	Yes	Yes	
			60		Yes	Yes	Yes		Yes	Yes	Yes	Yes		Yes	Yes	Yes	
		n77	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_n25A-n41(2A)-n77A	-	n25	15	Yes	Yes	Yes	Yes	Yes	Yes	Yes							0
			30		Yes	Yes	Yes	Yes	Yes	Yes							
			60		Yes	Yes	Yes	Yes	Yes	Yes							
		n41	See CA_n41(2A) Bandwidth Combination Set 1 in Table 5.5A.2-1														
		n77	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_n25A-n41C-n77A	-	n25	15	Yes	Yes	Yes	Yes	Yes	Yes	Yes							0
			30		Yes	Yes	Yes	Yes	Yes	Yes							
			60		Yes	Yes	Yes	Yes	Yes	Yes							
		n41	See CA_n41C Bandwidth Combination Set 0 in Table 5.5A.1-1														
		n77	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	

6.25.3 Co-existence studies

For 3DL/1UL NR CA, only single uplink operation needs to be considered. For single uplink operation of this combination, only harmonic issue and harmonic mixing issue need to be considered.

Table 6.25.3-1 summarizes frequency ranges where harmonics occur due to 3DL bands CA with 1 UL. It can be seen that there are 2nd harmonic issues from n25 UL into n77 DL which need to be addressed in lower order combination.

Table 6.25.3-1: Harmonic Interference

					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
n25	1850	1915	1930	1995	3700	3830	5550	5745	7400	7660
n41	2496	2690	2496	2690	4992	5380	7488	8070	9984	10760
n77	3300	4200	3300	4200	6600	8400	9900	12600	13200	16800

Table 6.25.3-2 gives harmonic mixing issue for the 3DL bands CA with 1 UL. It can be seen that there are 2nd harmonic issues from n25 DL into n77 UL which need to be addressed in lower order combination.

Table 6.25.3-2 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
n25	1850	1915	1930	1995	3860	3990	5790	5985	7720	7980
n41	2496	2690	2496	2690	4992	5380	7488	8070	9984	10760
n77	3300	4200	3300	4200	6600	8400	9900	12600	13200	16800

6.25.4 ΔT_{IB} and ΔR_{IB} values

For three simultaneous DLs and one UL of Band n25, n41 and n77, the $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values are shown in tables below. Values are derived from DC_2-7_n78.

Table 6.x.4-1: $\Delta T_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n25-n41-n77	n25	0.5
	n41	0.5
	n77	0.6

Table 6.x.4-2: $\Delta R_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta R_{IB,c}$ [dB]
CA_n25-n41-n77	n25	0
	n41	0
	n77	0

6.25.5 REFSENS requirements

The 2nd harmonic issues from n25 DL into n77 UL will be addressed in lower order combination.

6.26 CA_n25-n66-n77

6.26.1 Operating bands for CA

Table 6.26.1-1: 3DL Inter-band CA operating bands

NR CA Band	NR Band	Uplink (UL) operating band BS receive / UE transmit F_{UL_low} – F_{UL_high}			Downlink (DL) operating band BS transmit / UE receive F_{DL_low} – F_{DL_high}			Duplex Mode
CA_n25-n66-n77	n25	1850 MHz	–	1915 MHz	1930 MHz	–	1995 MHz	FDD
	n66	1710 MHz	–	1780 MHz	2110 MHz	–	2200 MHz	FDD
	n77	3300 MHz	–	4200 MHz	3300 MHz	–	4200 MHz	TDD

6.26.2 Channel bandwidths per operating band for CA

Table 6.26.2-1: Supported channel bandwidths per CA configuration for 3DL inter-band CA

NR CA Configuration	UL Config	NR Band	SCS [kHz]	5	10	15	20	25	30	40	50	60	70	80	90	100	BCS
CA_n25A-n66A-n77A	-	n25	15	Yes	Yes	Yes	Yes	Yes	Yes	Yes							0
			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							
		n77	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	

6.26.3 Co-existence studies

For 3DL/1UL NR CA, only si§ngle uplink operation needs to be considered. For single uplink operation of this combination, only harmonic issue and harmonic mixing issue need to be considered.

Table 6.26.3-1 summarizes frequency ranges where harmonics occur due to 3DL bands CA with 1 UL. It can be seen that there are 2nd harmonic issues from n25 and n66 UL into n77 DL which need to be addressed in lower order combination.

Table 6.26.3-1: Harmonic Interference

					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
n25	1850	1915	1930	1995	3700	3830	5550	5745	7400	7660
n66	1710	1780	2110	2200	3420	3560	5130	5340	6840	7120
n77	3300	4200	3300	4200	6600	8400	9900	12600	13200	16800

Table 6.26.3-2 gives harmonic mixing issue for the 3DL bands CA with 1 UL. It can be seen that there are 2nd harmonic issues from n25 into n77 UL which need to be addressed in lower order combination

Table 6.26.3-2 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
n25	1850	1915	1930	1995	3860	3990	5790	5985	7720	7980
n66	1710	1780	2110	2200	4220	4400	6330	6600	8440	8800
n77	3300	4200	3300	4200	6600	8400	9900	12600	13200	16800

6.26.4 ΔT_{IB} and ΔR_{IB} values

For three simultaneous DLs and one UL of Band n25, n66 and n77, the $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values are shown in table 6.26.4-1 and table 6.26.4-2, respectively. Values are derived from DC_2-66_n78.

Table 6.26.4-1: $\Delta T_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n25-n66-n77	n25	0.6
	n66	0.6
	n77	0.8

Table 6.26.4-2: $\Delta R_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta R_{IB,c}$ [dB]
CA_n25-n66-n77	n25	0.3
	n66	0.3
	n77	0.5

6.26.5 REFSENS requirements

The 2nd harmonic issues from n25 DL and n66 DL into n77 UL will be addressed in lower order combination.

6.27 CA_n25-n71-n77

6.27.1 Operating bands for CA

Table 6.27.1-1: 3DL Inter-band CA operating bands

NR CA Band	NR Band	Uplink (UL) operating band			Downlink (DL) operating band			Duplex Mode
		BS receive / UE transmit			BS transmit / UE receive			
		F_{UL_low} – F_{UL_high}			F_{DL_low} – F_{DL_high}			
CA_n25-n71-n77	n25	1850 MHz	–	1915 MHz	1930 MHz	–	1995 MHz	FDD
	n71	663 MHz	–	698 MHz	617 MHz	–	652 MHz	FDD
	n77	3300 MHz	–	4200 MHz	3300 MHz	–	4200 MHz	TDD

6.27.2 Channel bandwidths per operating band for CA

Table 6.27.2-1: Supported channel bandwidths

NR CA Configuration	UL Config	NR Band	SCS [kHz]	5	10	15	20	25	30	40	50	60	70	80	90	100	BCS
CA_n25A-n71A-n77A	-	n25	15	Yes	Yes	Yes	Yes	Yes	Yes	Yes							0
			30		Yes	Yes	Yes	Yes	Yes	Yes							
			60		Yes	Yes	Yes	Yes	Yes	Yes							
		n71	15	Yes	Yes	Yes	Yes										
			30		Yes	Yes	Yes										
			60														
		n77	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	

6.27.3 Co-existence studies

For 3DL/1UL NR CA, only si§ngle uplink operation needs to be considered. For single uplink operation of this combination, only harmonic issue and harmonic mixing issue need to be considered.

Table 6.27.3-1 summarizes frequency ranges where harmonics occur due to 3DL bands CA with 1 UL. It can be seen that there are 2nd harmonic issues from n25 UL into n77 DL which need to be addressed in lower order combination.

Table 6.27.3-1: Harmonic Interference

					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
n25	1850	1915	1930	1995	3700	3830	5550	5745	7400	7660
n71	663	698	617	652	1326	1396	1989	2094	2652	2792
n77	3300	4200	3300	4200	6600	8400	9900	12600	13200	16800

Table 6.27.3-2 gives harmonic mixing issue for the 3DL bands CA with 1 UL. It can be seen that there are 2nd harmonic issues from n25 DL into n77 UL which need to be addressed in lower order combination.

Table 6.27.3-2 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
n25	1850	1915	1930	1995	3860	3990	5790	5985	7720	7980
n71	663	698	617	652	1234	1304	1851	1956	2468	2608
n77	3300	4200	3300	4200	6600	8400	9900	12600	13200	16800

6.27.4 ΔT_{IB} and ΔR_{IB} values

For three simultaneous DLs and one UL of Band n25, n71 and n77, the $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values are shown in table 6.27.4-1 and table 6.27.4-2, respectively. Values are derived from DC_2-71_n78.

Table 6.27.4-1: $\Delta T_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n25-n71-n77	n25	0.6
	n71	0.6
	n77	0.8

Table 6.27.4-2: $\Delta R_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta R_{IB,c}$ [dB]
CA_n25-n71-n77	n25	0.2
	n71	0.2
	n77	0.5

6.27.5 REFSENS requirements

The 2nd harmonic issues from n25 DL into n77 UL will be addressed in lower order combination.

6.28 CA_n41-n66-n77

6.28.1 Operating bands for CA

Table 6.28.1-1: 3DL Inter-band CA operating bands

NR CA Band	NR Band	Uplink (UL) operating band BS receive / UE transmit F_{UL_low} – F_{UL_high}			Downlink (DL) operating band BS transmit / UE receive F_{DL_low} – F_{DL_high}			Duplex Mode
CA_n41-n66-n77	n41	2496 MHz	–	2690 MHz	2496 MHz	–	2690 MHz	TDD
	n66	1710 MHz	–	1780 MHz	2110 MHz	–	2200 MHz	FDD
	n77	3300 MHz	–	4200 MHz	3300 MHz	–	4200 MHz	TDD

6.28.2 Channel bandwidths per operating band for CA

Table 6.28.2-1: Supported channel bandwidths per CA configuration for 3DL inter-band CA

NR CA Configuration	UL Config	NR Band	SCS [kHz]	5	10	15	20	25	30	40	50	60	70	80	90	100	BCS
CA_n41A-n66A-n77A	-	n41	15		Yes	Yes	Yes		Yes	Yes	Yes						0
			30		Yes	Yes	Yes		Yes	Yes	Yes	Yes		Yes	Yes	Yes	
			60		Yes	Yes	Yes		Yes	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							
		n77	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_n41(2A)-n66A-n77A	-	n41	See CA_n41(2A) Bandwidth Combination Set 1 in Table 5.5A.2-1														0
		n66	15	Yes	Yes	Yes	Yes										
			30		Yes	Yes	Yes										
			60														
		n77	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_n41C-n66A-n77A	-	n41	See CA_n41C Bandwidth Combination Set 0 in Table 5.5A.1-1														0
		n66	15	Yes	Yes	Yes	Yes										
			30		Yes	Yes	Yes										
			60														
		n77	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	

6.28.3 Co-existence studies

For 3DL/1UL NR CA, only single uplink operation needs to be considered. For single uplink operation of this combination, only harmonic issue and harmonic mixing issue need to be considered.

Table 6.28.3-1 summarizes frequency ranges where harmonics occur due to 3DL bands CA with 1 UL. It can be seen that there are 2nd harmonic issues from n66 UL into n77 DL which need to be addressed in lower order combination.

Table 6.28.3-1: Harmonic Interference for 3DLs/1UL

					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
n41	2496	2690	2496	2690	4992	5380	7488	8070	9984	10760
n66	1710	1780	2110	2200	3420	3560	5130	5340	6840	7120
n77	3300	4200	3300	4200	6600	8400	9900	12600	13200	16800

Table 6.28.3-2 gives harmonic mixing issue for the 3DL bands CA with 1 UL. No issues can be seen.

Table 6.28.3-2 Harmonic mixing for 3DLs/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
n41	2496	2690	2496	2690	4992	5380	7488	8070	9984	10760
n66	1710	1780	2110	2200	4220	4400	6330	6600	8440	8800
n77	3300	4200	3300	4200	6600	8400	9900	12600	13200	16800

6.28.4 ΔT_{IB} and ΔR_{IB} values

For three simultaneous DLs and one UL of Band n41, n66 and n77, the $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values are shown in table 6.28.4-1 and table 6.28.4-2, respectively. Values are derived from DC_66_n7-n78.

Table 6.28.4-1: $\Delta T_{IB,c}$ for 3DL aggregation

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n41-n66-n77	n41	0.5
	n66	0.6
	n77	0.8

Table 6.28.4-2: $\Delta R_{IB,c}$ for 3DL aggregation

Inter-band CA Configuration	NR Band	$\Delta R_{IB,c}$ [dB]
CA_n41-n66-n77	n41	0.2
	n66	0.2
	n77	0.5

6.28.5 REFSENS requirements

The 2nd harmonic issues from n66 DL into n77 UL will be addressed in lower order combination.

6.29 CA_n41-n71-n77

6.29.1 Operating bands for CA

Table 6.29.1-1: 3DL Inter-band CA operating bands

NR CA Band	NR Band	Uplink (UL) operating band	Downlink (DL) operating band	Duplex Mode
		BS receive / UE transmit	BS transmit / UE receive	
		F_{UL_low} – F_{UL_high}	F_{DL_low} – F_{DL_high}	

CA_n41-n71-n77	n41	2496 MHz	–	2690 MHz	2496 MHz	–	2690 MHz	TDD
	n71	663 MHz	–	698 MHz	617 MHz	–	652 MHz	FDD
	n77	3300 MHz	–	4200 MHz	3300 MHz	–	4200 MHz	TDD

6.29.2 Channel bandwidths per operating band for CA

Table 6.29.2-1: Supported channel bandwidths per CA configuration for 3DL inter-band CA

NR CA Configuration	UL Config	NR Band	SCS [kHz]	5	10	15	20	25	30	40	50	60	70	80	90	100	BCS
CA_n41A-n71A-n77A	-	n41	15		Yes	Yes	Yes		Yes	Yes	Yes						0
			30		Yes	Yes	Yes		Yes	Yes	Yes	Yes		Yes	Yes	Yes	
			60		Yes	Yes	Yes		Yes	Yes	Yes	Yes		Yes	Yes	Yes	
		n71	15	Yes	Yes	Yes	Yes										
			30		Yes	Yes	Yes										
			60														
		n77	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_n41(2A)-n71A-n77A	-	n41	See CA_n41(2A) Bandwidth Combination Set 1 in Table 5.5A.2-1														0
		n71	15	Yes	Yes	Yes	Yes										
			30		Yes	Yes	Yes										
			60														
		n77	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_n41C-n71A-n77A	-	n41	See CA_n41C Bandwidth Combination Set 0 in Table 5.5A.1-1														0
		n71	15	Yes	Yes	Yes	Yes										
			30		Yes	Yes	Yes										
			60														
		n77	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	

6.29.3 Co-existence studies

For 3DL/1UL NR CA, only single uplink operation needs to be considered. For single uplink operation of this combination, only harmonic issue and harmonic mixing issue need to be considered.

Table 6.29.3-1 summarizes frequency ranges where harmonics occur due to 3DL bands CA with 1 UL. No issues can be seen.

Table 6.29.3-1: Harmonic Interference

					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
n41	2496	2690	2496	2690	4992	5380	7488	8070	9984	10760
n71	663	698	617	652	1326	1396	1989	2094	2652	2792
n77	3300	4200	3300	4200	6600	8400	9900	12600	13200	16800

Table 6.29.3-2 gives harmonic mixing issue for the 3DL bands CA with 1 UL. No issues can be seen.

Table 6.29.3-2 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**
n41	2496	2690	2496	2690	4992	5380	7488	8070	9984	10760
n71	663	698	617	652	1234	1304	1851	1956	2468	2608
n77	3300	4200	3300	4200	6600	8400	9900	12600	13200	16800

6.29.4 ΔT_{IB} and ΔR_{IB} values

For three simultaneous DLs and one UL of Band n41, n71 and n77, the $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values are shown in table 6.29.4-1 and table 6.29.4-2, respectively. Values are derived from DC_41_n28-n77.

Table 6.29.4-1: ΔTIB,c for 3DL aggregation

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n41-n71-n77	n41	0.3
	n71	0.5
	n77	0.8

Table 6.29.4-2: ΔRIB,c for 3DL aggregation

Inter-band CA Configuration	NR Band	$\Delta R_{IB,c}$ [dB]
CA_n41-n71-n77	n41	0
	n71	0.2
	n77	0.5

6.29.5 REFSENS requirements

No harmonic issues to be addressed.

6.30 CA_n66-n71-n77

6.30.1 Operating bands for CA

Table 6.30.1-1: 3DL Inter-band CA operating bands

NR CA Band	NR Band	Uplink (UL) operating band BS receive / UE transmit F_{UL_low} – F_{UL_high}			Downlink (DL) operating band BS transmit / UE receive F_{DL_low} – F_{DL_high}			Duplex Mode
CA_n66-n71-n77	n66	1710 MHz	–	1780 MHz	2110 MHz	–	2200 MHz	FDD
	n71	663 MHz	–	698 MHz	617 MHz	–	652 MHz	FDD
	n77	3300 MHz	–	4200 MHz	3300 MHz	–	4200 MHz	TDD

6.30.2 Channel bandwidths per operating band for CA

Table 6.30.2-1: Supported channel bandwidths

NR CA Configuration	UL Config	NR Band	SCS [kHz]	5	10	15	20	25	30	40	50	60	70	80	90	100	BCS
CA_n66A-n71A-n77A	-	n66	15	Yes	Yes	Yes	Yes	Yes	Yes	Yes							0
			30		Yes	Yes	Yes	Yes	Yes	Yes							
			60		Yes	Yes	Yes	Yes	Yes	Yes							
		n71	15	Yes	Yes	Yes	Yes										
			30		Yes	Yes	Yes										
			60														
		n77	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	

6.30.3 Co-existence studies

For 3DL/1UL NR CA, only single uplink operation needs to be considered. For single uplink operation of this combination, only harmonic issue and harmonic mixing issue need to be considered.

Table 6.30.3-1 summarizes frequency ranges where harmonics occur due to 3DL bands CA with 1 UL. It can be seen that there are 2nd harmonic issues from n66 UL into n77 DL which need to be addressed in lower order combination.

Table 6.30.3-1: Harmonic Interference

					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
n66	1710	1780	2110	2200	3420	3560	5130	5340	6840	7120
n71	663	698	617	652	1326	1396	1989	2094	2652	2792
n77	3300	4200	3300	4200	6600	8400	9900	12600	13200	16800

Table 6.30.3-2 gives harmonic mixing issue for the 3DL bands CA with 1 UL. No issues can be seen.

Table 6.30.3-2 Harmonic mixing for 3DLs/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
n66	1710	1780	2110	2200	4220	4400	6330	6600	8440	8800
n71	663	698	617	652	1234	1304	1851	1956	2468	2608
n77	3300	4200	3300	4200	6600	8400	9900	12600	13200	16800

6.30.4 ΔT_{IB} and ΔR_{IB} values

For three simultaneous DLs and one UL of Band n66, n71 and n77, the $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values are shown in table 6.30.4-1 and table 6.30.4-2, respectively. Values are derived from DC_66-71_n78.

Table 6.30.4-1: ΔTIB,c for 3DL aggregation

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n66-n71-n77	n66	0.6
	n71	0.6

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

Table 6.30.4-2: ΔRIB,c for 3DL aggregation

Inter-band CA Configuration	NR Band	$\Delta R_{IB,c}$ [dB]
CA_n66-n71-n77	n66	0.2
	n71	0.2
	n77	0.5

6.30.5 REFSENS requirements

The 2nd harmonic issues from n66 DL into n77 UL will be addressed in lower order combination.

Annex A:
Change history

Date	Meeting	TDoc.	CR	Rev	Cat	Subject/Comment	New version
2020-08	3GPP RAN4#96e	R4-2009812				Initial TR skeleton	0.0.1
2020-08	3GPP RAN4#96e	R4-2011886				The following approved TPs have been implemented, R4-2010252, TP for TR 38.717-03-01 CA_n3A-n28A-n41A, Samsung, KDDI R4-2010253, TP for TR 38.717-03-01 CA_n3A-n41A-n78A, KDDI R4-2010528, TP to TR 38.717-03-01: CA_n5-n25-n66, Nokia, Bell Mobility R4-2010530, TP to TR 38.717-03-01: CA_n5-n25-n78, Nokia, Bell Mobility R4-2011674, TP for CA 3DL1UL n1-n77-n79 for TR 38.717-03-01, NTT DOCOMO INC. R4-2011675, TP for CA 3DL1UL n1-n78-n79 for TR 38.717-03-01, NTT DOCOMO INC. R4-2010642, TP for TR38.717-03-01_CA_n39A-n40A-n79A, ZTE R4-2010643, TP for TR38.717-03-01_CA_n39A-n40A-n41A, ZTE R4-2010687, TP to add CA_n25A-n48A-n66A, CA_n25A-n48(2A)-n66A, CA_n25A-n48C-n66A, Ericsson, T-Mobile US R4-2009687, TP for CA_n1-n77-n257 3DL/1UL for TR38.717-03-01, NTT DOCOMO INC. R4-2009688, TP for CA_n1-n78-n257 3DL/1DL for TR38.717-03-01, NTT DOCOMO INC. R4-2009689, TP for CA_n1-n79-n257 3UL/1DL for TR38.717-03-01, NTT DOCOMO INC. R4-2009813, Draft big CR on Introducing NR inter-band CA for 3DL Bands and 1UL band for 38.101-1, CATT R4-2009814, Draft big CR on Introducing NR inter-band CA for 3DL Bands and 1UL band for 38.101-3, CATT	0.1.0
2020-11	3GPP RAN4#97e	R4-2014460				The following approved TPs are implemented, R4-2016752, TP for TR 38.717-03-01 CA_n3-n41-n77, Samsunge, KDDI R4-2016753, TP for TR 38.717-03-01 CA_n3-n41-n78, Samsung, KDDI R4-2014114, TP for TR 38.717-03-01 CA_n28-n41-n77, Samsung, KDDI R4-2014115, TP for TR 38.717-03-01 CA_n28-n41-n78, Samsung, KDDI R4-2014523, draft CR for NR inter-band CA for 3 bands DL, Nokia, T-mobile USA R4-2016754, TP for TR 38.717-03-01: CA_n1A-n8A-n78(2A), Nokia Telefonica R4-2015051, TP for TR38.717-03-01_ CA_n8A-n40A-n41A, ZTE R4-2015078, TP to TR 38.717-03-01: CA_n5-n66-n77, Nokia, Nokia Shanghai Bell R4-2015079, TP to TR 38.717-03-01: CA_n2-n66-n77, Nokia, Nokia Shanghai Bell R4-2015707, TP for TR 38.717-03-01: CA_n66-n71-n78, Huawei, HiSilicon, Bell Mobility, Telus R4-2015708, TP for TR 38.717-03-01: CA_n38-n66-n78, Huawei, HiSilicon, Bell Mobility, Telus R4-2015709, TP for TR 38.717-03-01: CA_n25-n38-n78, Huawei, HiSilicon, Bell Mobility, Telus R4-2016305, TP to add CA_n3A-n5A-n7A, CA_n3A-n5A-n7B, Ericsson, Telstra R4-2016306, TP to add CA_n5A-n7A-n78A, CA_n5A-n7B-n78A, Ericsson, Telstra R4-2016650, TP to add 3DL/1UL CA_n25A-n66A-n77A,	0.2.0

						Ericsson, T-Mobile US R4-2016651, TP to add 3DL/1UL CA_n25A-n71A-n77A, Ericsson, T-Mobile US R4-2016652, TP to add 3DL/1UL CA_n41A-n66A-n77A, CA_n41(2A)-n66A-n77A, CA_n41C-n66A-n77A, Ericsson, T-Mobile US R4-2016653, TP to add 3DL/1UL CA_n41A-n71A-n77A, CA_n41(2A)-n71A-n77A, CA_n41C-n71A-n77A, Ericsson, T-Mobile US R4-2016654, TP to add 3DL/1UL CA_n66A-n71A-n77A, Ericsson, T-Mobile US	