

**3rd Generation Partnership Project;
Technical Specification Group Radio Access Network;
NR inter-band Carrier Aggregation/Dual connectivity for 3 bands
DL with 2 bands UL
(Release 16)**



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Foreword

This Technical Specification 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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- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
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1 Scope

The present document is a technical report for NR inter-band CA and DC for 3 bands DL with 2 bands UL under Rel-16 time frame. The purpose is to gather the relevant background information and studies in order to address NR inter-band CA and DC for 3 bands DL with 2 bands UL for the Rel-16 band combinations in Table 1-1 to Table 1-3

Table 1-1: Release 16 Inter-band NR CA for 3 bands DL with 2 band UL

CA combination	REL independent from
n1-n3-n41	Rel-15
n1-n3-n78	Rel-15
n1-n7-n28	Rel-15
n3-n8-n78	Rel-15
n3-n77-n257	Rel-15
n3-n28-n77	Rel-15
n3-n78-n257	Rel-15
n3-n40-n41	Rel-15
n28-n77-n257	Rel-15
n28-n78-n257	Rel-15
n40-n41-n79	Rel-15
n66-n70-n71	Rel-15
n77-n79-n257	Rel-15
n78-n79-n257	Rel-15

Table 1-2: Release 16 Inter-band NR DC for 3 bands DL

DC combination	REL independent from

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

2 References

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

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

- [1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".
- [2] 3GPP TS 38.101-1: "NR; User Equipment (UE) radio transmission and reception; Part 1: Range 1 Standalone".
- [3] 3GPP TS 38.101-2: "NR; User Equipment (UE) radio transmission and reception; Part 2: Range 2 Standalone".

3 Definitions, symbols and abbreviations

3.1 Definitions

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

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

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

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

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

3.2 Symbols

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

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

3.3 Abbreviations

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

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

4 Background

The present document is a technical report for NR inter-band CA and DC for 3 bands DL with 32 bands UL under Rel-16 time frame. The document covers each band combination specific issues (i.e. one sub-clause defined per band combination)

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

4.1 TR Maintenance

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

5 inter-band Carrier Aggregation for 3 bands DL with 2 bands UL: Specific Band Combination Part

5.1 inter-band within FR1

5.1.1 CA_n1-n3-n78

5.1.1.1 Operating bands for CA

Table 5.1.1.1-1: 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-n3-n78	n1	1920MHz	–	1980MHz	2110MHz	–	2170MHz	FDD	
	n3	1710MHz	–	1785MHz	1805MHz	–	1880MHz	FDD	
	n78	3300MHz	–	3800MHz	3300MHz	–	3800MHz	TDD	

5.1.1.2 Channel bandwidths per operating band for CA

Table 5.1.1.2-1: Supported channel bandwidths per CA configuration

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_n1A-n3A-n78A	CA_n1A-n3A	n1	15	Yes	Yes	Yes	Yes									0
			30		Yes	Yes	Yes									
			60		Yes	Yes	Yes									
	CA_n1A-n78A	n3	15	Yes	Yes	Yes	Yes	Yes	Yes							
			30		Yes	Yes	Yes	Yes	Yes							
			60		Yes	Yes	Yes	Yes	Yes							
	CA_n3A-n78A	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	

NOTE 1: This UE channel bandwidth is optional in this release of the specification.

5.1.1.3 Co-existence studies

For UE coexistence study of Band n1 + Band n3, the 2nd, 3rd, 4th and 5th order harmonics and 2nd, 3rd, 4th and 5th order intermodulation products were calculated and presented in Table 5.1.1.3-1

Table 5.1.1.3-1: Harmonic and IMD analysis

UE UL carriers	fx_low	fx_high	fy_high	
UL frequency (MHz)	1710	1785	1920	1980
2 nd harmonics frequency limits (MHz)	2*fx_low	2*fx_high	2* fy_low	2* fy_high
2 nd harmonics frequency limits (MHz)	3420	3570	3840	3960
3 rd harmonics frequency limits (MHz)	3*fx_low	3*fx_high	3* fy_low	3* fy_high
3 rd harmonics frequency limits (MHz)	5130	5355	5760	5940
4th harmonics frequency limits (MHz)	4*fx_low	4*fx_high	4* fy_low	4* fy_high
4th harmonics frequency limits (MHz)	6840	7140	7680	7920
5th harmonics frequency limits (MHz)	5*fx_low	5*fx_high	5* fy_low	5* fy_high
5th harmonics frequency limits (MHz)	8550	8925	9600	9900
Two tone 2 nd order IMD products	fy_low – fx_high	fy_high – fx_low	fx_low + fy_low	fx_high + fy_high
IMD frequency limits (MHz)	135	270	3630	3765
Two-tone 3 rd order IMD products	2*fx_low – fy_high	2*fx_high – fy_low	2*fy_low – fx_high	2*fy_high – fx_low
IMD frequency limits (MHz)	1440	1650	2055	2250
Two-tone 3 rd order IMD products	2*fx_low + fy_low	2*fx_high + fy_high	2*fy_low + fx_low	2*fy_high + fx_high
IMD frequency limits (MHz)	5340	5550	5550	5745
Two-tone 4 th order IMD products	3*fx_low – fy_high	3*fx_high – fy_low	3*fy_low – fx_high	3*fy_high – fx_low
IMD frequency limits (MHz)	3150	3435	3975	4230
Two-tone 4 th order IMD products	3*fx_low + fy_low	3*fx_high + fy_high	3*fy_low + fx_low	3*fy_high + fx_high
IMD frequency limits (MHz)	7050	7335	7470	7725
Two-tone 4 th order IMD products	2*fy_low – 2*fx_high	2*fy_high – 2*fx_low	2*fx_low + 2*fy_low	2*fx_high + 2*fy_high
IMD frequency limits (MHz)	270	540	7260	7530
Two-tone 5 th order IMD products	4*fx_low – fy_high	4*fx_high – fy_low	4*fy_low – fx_high	4*fy_high – fx_low
IMD frequency limits (MHz)	4860	5220	5895	6210
Two-tone 5 th order IMD products	4*fx_low + fy_low	4*fx_high + fy_high	4*fy_low + fx_low	4*fy_high + fx_high
IMD frequency limits (MHz)	8760	9120	9390	9705
Two-tone 5 th order IMD products	3*fx_low – 2*fy_high	3*fx_high – 2*fy_low	3*fy_low – 2*fx_high	3*fy_high – 2*fx_low
IMD frequency limits (MHz)	1170	1515	2190	2520
Two-tone 5 th order IMD products	2*fx_low + 3*fy_low	2*fx_high + 3*fy_high	2*fy_low + 3*fx_low	2*fy_high + 3*fx_high
IMD frequency limits (MHz)	9180	9510	8970	9315

Co-existence study for UL Band n1 + Band n79 as presented in the table 5.1.1.3-1, and co-existence study for the case of UL Band n1 + Band n78 or UL Band n3 + Band n78 are quite similar as study for EN-DC with same band numbers captured in TR 37.863-02-01. The own Rx impact of the 3rd band is shown as the followings.

- 2nd, 4th order IMD generated by dual uplink of Band n1 + Band n3 may fall into own Rx of Band n78
- 2nd, 3rd and 5th order IMD generated by dual uplink of Band n1 + Band n78 may fall into own Rx of Band n3.
- 5th order IMD generated by dual uplink of Band n3 + Band n78 may fall into own Rx of Band n1.

5.1.1.4 $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values

For three DLs and two ULs of Band n1, n3 and n78, the $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values are shown in table 5.1.1.4-1 and table 5.1.1.4-2, respectively. The requirements are reused from that for DC_1A_n3A-n78A in table 6.7.4 in TR 37.716-21-21

Table 5.1.1.4-1: $\Delta T_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n1-n3-n78	n1	0.6
	n3	0.6
	n78	0.8

Table 5.1.1.4-2: $\Delta R_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta R_{IB,c}$ [dB]
CA_n1-n3-n78	n1	0.2
	n3	0.2
	n78	0.5

5.1.1.5 REFSENS requirements

Based on Table 5.3.5 in TR 37.716-21-21, The MSD requirements for CA_n1-n3-n78 are shown in table Table 5.1.1.5-1.

Table 5.1.1.5-1: MSD for the CA configuration

EN-DC Configuration	EUTRA/NR band	UL F_c (MHz)	UL/DL BW (MHz)	UL L_{CRB}	DL F_c (MHz)	MSD (dB)	Duplex mode	IMD order
CA_n1A-n3A-n78A	n1	1950	5	25	2140	N/A	FDD	N/A
	n3	1750	5	25	1845	N/A		N/A
	n78	3700	10	52	3700	28.4	TDD	IMD2
	n1	1950	5	25	2140	N/A	FDD	N/A
	n3	1770	5	25	1865	N/A		N/A
	n78	3360	10	52	3360	11.2	TDD	IMD4
	n1	1950	5	25	2140	N/A	FDD	N/A
	n3	1735	5	25	1830	27.9		IMD2
	n78	3780	10	52	3780	N/A	TDD	N/A
	n1	1940	5	25	2130	3.5	FDD	IMD5
	n3	1770	5	25	1865	N/A		N/A
	n78	3720	10	52	3720	N/A	TDD	N/A

5.1.2 CA_n40-n41-n79

5.1.2.1 Operating bands for CA

Table 5.1.2.1-1: CA band combination of band n40+n41+n79

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_n40-n41-n79 ^{1,2}	n40	2300 MHz		–	2400 MHz		2300 MHz	–	2400 MHz	TDD
	n41	2496 MHz		–	2690 MHz		2496 MHz	–	2690 MHz	TDD
	n79	4400 MHz		–	5000 MHz		4400 MHz	–	5000 MHz	TDD

NOTE 1: The frequency range below 2506 MHz for Band n41 is not used in this band combination.

NOTE 2: Applicable for frequency range above 4800 MHz for Band n79 in this band combination.

5.1.2.2 Channel bandwidths per operating band for CA

Table 5.1.2.2-1: Supported bandwidths per CA band combination of band n40+n41+n79

NR CA Configuration	UL Configuration	NR Band	SCS [kHz]	5 MHz	10 MHz	15 MHz	20 MHz	25 MHz	30 MHz	40 MHz	50 MHz	60 MHz	80 MHz	90 MHz	100 MHz	Bandwidth combination set
CA_n40A-n41A-n79A	CA_n40A-n41A	n40	15	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes					0
			30		Yes											
			60		Yes											
	CA_n40A-n79A	n41	15		Yes	Yes	Yes			Yes	Yes					
			30		Yes	Yes	Yes			Yes	Yes	Yes	Yes		Yes	
			60		Yes	Yes	Yes			Yes	Yes	Yes	Yes		Yes	
	CA_n41A-n79A	n79	15							Yes	Yes					
			30							Yes	Yes	Yes	Yes		Yes	
			60							Yes	Yes	Yes	Yes		Yes	
	CA_n40A-n41A	n40	15	Yes	Yes	Yes	Yes	Yes	Yes	Yes						1
			30		Yes	Yes	Yes	Yes	Yes	Yes						
			60		Yes	Yes	Yes	Yes	Yes	Yes						
	CA_n40A-n79A	n41	15		Yes	Yes	Yes			Yes	Yes					
			30		Yes	Yes	Yes			Yes	Yes	Yes				
			60		Yes	Yes	Yes			Yes	Yes	Yes				
	CA_n41A-n79A	n79	15							Yes	Yes					
			30							Yes	Yes	Yes	Yes		Yes	
			60							Yes	Yes	Yes	Yes		Yes	

5.1.2.3 UE co-existence studies

Based on co-existence studies of Band n40 + Band n41, Band n40 + Band n79 and Band 41 + Band n79 captured in TR 38.716-02-00, own Rx impact of the 3rd band is the followings

- 2nd order IMD (4796 MHz – 5090 MHz) generated by 2UL of bands n40 + n41 fall into part of own band n79.
- 3rd order IMD (4210 MHz – 4704 MHz) generated by dual uplink of Band n40 + Band n41 may fall into part of own band n79. However, since this band combination will only be used in China where the frequency range above 4800 MHz for band n79 is allocated to IMT in China, there are no MSD issue
- As only inter-band carrier aggregation without simultaneous Rx/Tx between n40 and n41 is supported, there are no MSD issue for band n40 and n41 due to dual uplink operation in Band n40 + Band n79 or Band 41 + Band n79.

5.1.2.4 ΔT_{IB} and ΔR_{IB} values

The same $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values specified for 1 band UL for CA_n40-n41-n79 are used as below.

Table 5.1.2.4-1: $\Delta T_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n40-n41-n79	n40	0.5 ¹
	n41	0.5 ¹
	n79	0.8
NOTE 1: Only applicable for UE supporting inter-band carrier aggregation without simultaneous Rx/Tx among band 40 and 41.		

Table 5.1.2.4-2: $\Delta R_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta R_{IB,c}$ [dB]
CA_n40-n41-n79	n40	0 ¹
	n41	0.5 ¹
	n79	0.5
NOTE 1: Only applicable for UE supporting inter-band carrier aggregation without simultaneous Rx/Tx among band 40 and 41.		

5.1.2.5 REFSENS requirements

Based on the analysis in the UE-coexistence studies, compared to its fall back mode, there is additional MSD issue due to dual uplink CA_n40A-n41A operation falling into n79 DL of the third band for this band combination. The required MSD are shown in the following table.

Table 5.1.2.5-1 MSD exception for 3DL/2UL NR CA configuration

Band / Channel bandwidth / N _{RB} / Duplex mode								Source of IMD
NR CA Configuration	NR band	UL F _c (MHz)	UL/DL BW (MHz)	UL C _{LRB}	DL F _c (MHz)	MSD (dB)	Duplex mode	
CA_n40A-n41A-n79A	n40	2340	5	25	2340	N/A	TDD	N/A
	n41	2600	10	50	2600	N/A	TDD	N/A
	n79	4940	40	216	4940	30.5	TDD	IMD2

5.1.3 CA_n3-n8-n78

5.1.3.1 Operating bands for CA

Table 5.1.3.1-1: CA band combination of band n3+n8+n78

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_n3-n8-n78	n3	1710 MHz	—	1785 MHz	1805 MHz	—	1880 MHz	FDD				
	n8	880 MHz	—	915 MHz	925 MHz	—	960 MHz	FDD				
	n78	3300 MHz	—	3800 MHz	3300 MHz	—	3800 MHz	TDD				

5.1.3.2 Channel bandwidths per operating band for CA

Table 5.1.3.2-1: Supported bandwidths per CA band combination of band n3+n8+n78

NR CA Configuration	UL Configuration	NR Band	SCS [kHz]	5 MHz	10 MHz	15 MHz	20 MHz	25 MHz	30 MHz	40 MHz	50 MHz	60 MHz	80 MHz	90 MHz	100 MHz	Bandwidth combination set
CA_n3A-n8A-n78A	CA_n3A-n8A	n3	15	Yes	Yes	Yes	Yes	Yes	Yes							0
			30		Yes	Yes	Yes	Yes	Yes							
			60		Yes	Yes	Yes	Yes	Yes							
	CA_n3A-n78A	n8	15	Yes	Yes	Yes	Yes									
			30		Yes	Yes	Yes									
			60													
	CA_n8A-n78A	n78	15		Yes	Yes	Yes			Yes	Yes					
			30		Yes	Yes	Yes			Yes	Yes	Yes	Yes		Yes	
			60		Yes	Yes	Yes			Yes	Yes	Yes	Yes		Yes	

5.1.3.3 UE co-existence studies

The harmonic issue for Band n3+Band n8 + Band n78 has already addressed in TR38.716-03-01.

Based on co-existence studies of Band n3 + Band n8, Band n3 + Band n78 and Band 8 + Band n78 captured in TR 38.716-02-00 and TR37.866-00-02, own Rx impact of the 3rd band is the follows

- 3rd and 5th order IMD generated by dual uplink of Band n3 + Band n8 may fall into part of own band n78.
- 3rd order IMD generated by dual uplink of Band n8 + Band n78 may fall into part of own band n3.
- no IMD issue due to dual uplink of Band n3 + Band n78 falling into own band n8.

5.1.3.4 ΔT_{IB} and ΔR_{IB} values

The same $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values specified for 1 band UL for CA_n3-n8-n78 are used as below.

Table 5.1.3.4-1: $\Delta T_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n3-n8-n78	n3	0.6
	n8	0.6
	n78	0.8

Table 5.1.x.4-2: $\Delta R_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta R_{IB,c}$ [dB]
CA_n3-n8-n78	n3	0.2
	n8	0.2
	n78	0.5

5.1.3.5 REFSENS requirements

Table 5.1.3.5-1 lists the MSD required for the dual connectivity configuration for the cases that IMD interference fall into the own 3rd Rx frequency band. Since Band n8 and Band n20 have similar frequency range, the IMD3 and IMD5 values due to n3+n8 falling into n78 and IMD3 value due to n8+n78 falling into n3 are derived from the similar band combination DC_20A_n3A-n78A in TR 37.864-41-21.

Table 5.1.3.5-1: MSD for the CA configuration

NR Band / Channel bandwidth / NRB / MSD							
CA Configuration	NR band	UL F_c (MHz)	UL/DL BW (MHz)	UL L _{CRB}	DL F_c (MHz)	MSD (dB)	IMD order
CA_n3A-n8A-n78A	n3	1730	5	25	1825	N/A	N/A
	n8	910	5	25	955	N/A	N/A
	n78	3550	10	50	3550	16.1	IMD3 $ f_{Bn3} + 2*f_{n8} $
CA_n3A-n8A-n78A	n3	1730	5	25	1825	N/A	N/A
	n8	910	5	25	955	N/A	N/A
	n78	3370	10	50	3370	4.5	IMD5 $ 3*f_{Bn3} - 2*f_{n8} $
CA_n3A-n8A-n78A	n8	910	5	25	955	N/A	N/A
	n78	3640	10	50	3640	N/A	N/A
	n3	1725	5	25	1820	15.7	IMD3 $ 2*f_{Bn20} - f_{n78} $

5.1.4 CA_n3A_n40A-n41A

5.1.4.1 Operating bands for CA

Table 5.1.4.1-1: Inter-band CA operating bands

NR CA Band	NR Band	Uplink (UL) band		Downlink (DL) band		Duplex mode		
		BS receive / UE transmit		BS transmit / UE receive				
		$F_{UL_low} - F_{UL_high}$		$F_{DL_low} - F_{DL_high}$				
CA_n3A_n40A-n41A	n3	1710 MHz	–	1785 MHz	1805 MHz	–	1880 MHz	FDD
	n40	2300 MHz	–	2400 MHz	2300 MHz	–	2400 MHz	TDD
	n41	2496 MHz	–	2690 MHz	2496 MHz	–	2690 MHz	TDD

5.1.4.2 Channel bandwidths per operating band for CA

Table 5.1.4.2-1: Supported channel bandwidths per CA configuration

NR CA Configuration	Uplink configuration	NR Band	SCS [kHz]	5 MHz	10 MHz	15 MHz	20 MHz	25 MHz	30 MHz	40 MHz	50 MHz	60 MHz	80 MHz	90 MHz	100 MHz	Maximum aggregated bandwidth [MHz]
CA_n3A_n40A-n41A	CA_n3A_n40A CA_n3A_n41A CA_n40A_n41A	n3	15	Yes	Yes	Yes	Yes	Yes	Yes							210
			30		Yes	Yes	Yes	Yes	Yes							
			60		Yes	Yes	Yes	Yes	Yes							
		n40	15	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes					
			30		Yes											
			60		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	

5.1.4.3 Co-existence studies

The harmonic issue for Band n3+Band n40 + Band n41 has already addressed in TR38.716-03-01, where there are no harmonic interference and harmonic mixing problem for CA_n3A_n40A-n41A.

Based on co-existence studies of Band n3 + Band n40, Band n3 + Band n41 and Band 40 + Band n41 captured in TR 38.716-02-00, own Rx impact of the IMD5 is the followings:

- 5th order IMD (1520MHz - 2208MHz) generated by dual uplink of Band n40 + Band n41 may fall into part of own band n3.

5.1.4.4 $\Delta T_{IB,c}$ and ΔR_{IB} values

For CA_n3A_n40A-n41A, the $\Delta T_{IB,c}$ and ΔR_{IB} values are given in the tables below.

Table 5.1.4.4-1: $\Delta T_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n3A_n40A-n41A	n3	0.5
	n40	0.5
	n41	0.5 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.		
NOTE 3: Only applicable for UE supporting inter-band carrier aggregation without simultaneous Rx/Tx among band n40 and n41.		

Table 5.1.4.4-2: $\Delta R_{IB,c}$

Inter-band CA Configuration	NR Band	ΔR_{IB} [dB]
CA_n3A_n40A-n41A	n3	0
	n40	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.		
NOTE 3: Only applicable for UE supporting inter-band carrier aggregation without simultaneous Rx/Tx among band n40 and n41.		

5.1.4.5 REFSENS requirements

Based on the analysis in the UE-coexistence studies, compared to its fall back mode, there is additional MSD issue due to dual uplink CA_40A_n41A operation falling into n3 DL of the third band for this band combination. The required MSD are shown in the following table.

Table 5.1.4.5-1 MSD exception for 3DL/2UL NR CA configuration

NR CA Configuration	NR band	Band / Channel bandwidth / N _{RB} / Duplex mode						Source of IMD
		UL F _c (MHz)	UL/DL BW (MHz)	UL C _{LRB}	DL F _c (MHz)	MSD (dB)	Duplex mode	
CA_n3-40A-n41A	n3	1747.5	5	25	1842.5	1.0	FDD	IMD5
	n40	2347.5	5	25	2347.5	N/A	TDD	N/A
	n41	2600	10	50	2600	N/A	TDD	N/A

5.1.5 CA_n1A-n3A-n41A

5.1.5.1 Operating bands for CA

Table 5.1.5.1-1: 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}	F _{DL_low} – F _{DL_high}	F _{DL_low} – F _{DL_high}		
CA_n1-n3-n41	n1	1920MHz	–	1980MHz	2110MHz	FDD	
	n3	1710MHz	–	1785MHz	1805MHz	FDD	
	n41	2496MHz	–	2690MHz	2496MHz	TDD	

5.1.5.2 Channel bandwidths per operating band for CA

Table 5.1.5.2-1: Supported channel bandwidths per CA configuration

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-n3A-n41A	CA_n1A-n3A	n1	15	Yes	Yes	Yes	Yes									0
			30		Yes	Yes	Yes									
			60		Yes	Yes	Yes									
	CA_n1A-n41A	n3	15	Yes	Yes	Yes	Yes	Yes								
			30		Yes	Yes	Yes	Yes	Yes							
			60		Yes	Yes	Yes	Yes	Yes							
	CA_n3A-n41A	n41	15		Yes	Yes	Yes		Yes	Yes	Yes					
			30		Yes	Yes	Yes		Yes							
			60		Yes	Yes	Yes		Yes							

5.1.5.3 Co-existence studies

For UE coexistence study of Band n1 + Band n3, the 2nd, 3rd, 4th and 5th order harmonics and 2nd, 3rd, 4th and 5th order intermodulation products were calculated and presented in Table 5.1.5.3-1

Table 5.1.5.3-1: Harmonic and IMD analysis

UE UL carriers	fx_low	fx_high	fy_high	
UL frequency (MHz)	1920	1980	1710	1785
2 nd harmonics frequency limits (MHz)	2*fx_low	2*fx_high	2* fy_low	2* fy_high
2 nd harmonics frequency limits (MHz)	3840	3960	3420	3570
3 rd harmonics frequency limits (MHz)	3*fx_low	3*fx_high	3* fy_low	3* fy_high
3 rd harmonics frequency limits (MHz)	5760	5940	5130	5355
4th harmonics frequency limits	4*fx_low	4*fx_high	4* fy_low	4* fy_high
4th harmonics frequency limits (MHz)	7680	7920	6840	7140
5th harmonics frequency limits	5*fx_low	5*fx_high	5* fy_low	5* fy_high
5th harmonics frequency limits (MHz)	9600	9900	8550	8925
2 nd order IMD products	fy_low - fx_high	fy_high - fx_low	fy_low + fx_low	fy_high + fx_high
IMD frequency limits (MHz)	270	135	3630	3765
Two-tone 3 rd order IMD products	2*fx_low - fy_high	2*fx_high - fy_low	2*fy_low - fx_high	2*fy_high - fx_low
IMD frequency limits (MHz)	2055	2250	1440	1650
Two-tone 3 rd order IMD products	2*fx_low + fy_low	2*fx_high + fy_high	2*fy_low + fx_low	2*fy_high + fx_high
IMD frequency limits (MHz)	5550	5745	5340	5550
Two-tone 4 th order IMD products	3*fx_low - 1*fy_high	3*fx_high - 1*fy_low	3*fy_low - 1*fx_high	3*fy_high - 1*fx_low
IMD frequency limits (MHz)	3975	4230	3150	3435
Two-tone 4 th order IMD products	3*fx_low + 1*fy_low	3*fx_high + 1*fy_high	3*fy_low + 1*fx_low	3*fy_high + 1*fx_high
IMD frequency limits (MHz)	7470	7725	7050	7335
Two-tone 4 th order IMD products	2*fx_low - 2*fy_high	2*fx_high - 2*fy_low	2*fx_low + 2*fy_low	2*fx_high + 2*fy_high
IMD frequency limits (MHz)	270	540	7260	7530
Two-tone 5 th order IMD products	fx_low - 4*fy_high	fx_high - 4*fy_low	fy_low - 4*fx_high	fy_high - 4*fx_low
IMD frequency limits (MHz)	5220	4860	6210	5895

Two-tone 5 th order IMD products	$ 2*fx_low - 3*fy_high $	$ 2*fx_high - 3*fy_low $	$ 2*fy_low - 3*fx_high $	$ 2*fy_high - 3*fx_low $
IMD frequency limits (MHz)	1515	1170	2520	2190
Two-tone 5 th order IMD products	$ fx_low + 4*fy_low $	$ fx_high + 4*fy_high $	$ fy_low + 4*fx_low $	$ fy_high + 4*fx_high $
IMD frequency limits (MHz)	8760	9120	9390	9705
Two-tone 5 th order IMD products	$ 2*fx_low + 3*fy_low $	$ 2*fx_high + 3*fy_high $	$ 2*fy_low + 3*fx_low $	$ 2*fy_high + 3*fx_high $
IMD frequency limits (MHz)	8970	9315	9180	9510

For UE coexistence study of Band n1 + Band n41, the 2nd, 3rd, 4th and 5th order harmonics and 2nd, 3rd, 4th and 5th order intermodulation products were calculated and presented in Table 5.1.5.3-2.

Table 5.1.5.3-2 Harmonic and IMD analysis

UE UL carriers	fx_low	fx_high	fy_low	fy_high
UL frequency (MHz)	1920	1980	2496	2690
2 nd harmonics frequency limits	$2*fx_low$	$2*fx_high$	$2* fy_low$	$2* fy_high$
2 nd harmonics frequency limits (MHz)	3840	3960	4992	5380
3 rd harmonics frequency limits	$3*fx_low$	$3*fx_high$	$3* fy_low$	$3* fy_high$
3 rd harmonics frequency limits (MHz)	5760	5940	7488	8070
4 th harmonics frequency limits	$4*fx_low$	$4*fx_high$	$4* fy_low$	$4* fy_high$
4 th harmonics frequency limits (MHz)	7680	7920	9984	10760
5 th harmonics frequency limits	$5*fx_low$	$5*fx_high$	$5* fy_low$	$5* fy_high$
5 th harmonics frequency limits (MHz)	9600	9900	12480	13450
2 nd order IMD products	$ fy_low - fx_high $	$ fy_high - fx_low $	$ fy_low + fx_low $	$ fy_high + fx_high $
IMD frequency limits (MHz)	516	770	4416	4670
Two-tone 3 rd order IMD products	$ 2*fx_low - fy_high $	$ 2*fx_high - fy_low $	$ 2*fy_low - fx_high $	$ 2*fy_high - fx_low $
IMD frequency limits (MHz)	1150	1464	3012	3460
Two-tone 3 rd order IMD products	$ 2*fx_low + fy_low $	$ 2*fx_high + fy_high $	$ 2*fy_low + fx_low $	$ 2*fy_high + fx_high $
IMD frequency limits (MHz)	6336	6650	6912	7360
Two-tone 4 th order IMD products	$ 3*fx_low - 1*fy_high $	$ 3*fx_high - 1*fy_low $	$ 3*fy_low - 1*fx_high $	$ 3*fy_high - 1*fx_low $
IMD frequency limits (MHz)	3070	3444	5508	6150
Two-tone 4 th order IMD products	$ 3*fx_low + 1*fy_low $	$ 3*fx_high + 1*fy_high $	$ 3*fy_low + 1*fx_low $	$ 3*fy_high + 1*fx_high $

IMD frequency limits (MHz)	8256	8630	9408	10050
Two-tone 4 th order IMD products	$ 2*fx_low - 2*fy_high $	$ 2*fx_high - 2*fy_low $	$ 2*fx_low + 2*fy_low $	$ 2*fx_high + 2*fy_high $
IMD frequency limits (MHz)	1540	1032	8832	9340
Two-tone 5 th order IMD products	$ fx_low - 4*fy_high $	$ fx_high - 4*fy_low $	$ fy_low - 4*fx_high $	$ fy_high - 4*fx_low $
IMD frequency limits (MHz)	8840	8004	5424	4990
Two-tone 5 th order IMD products	$ 2*fx_low - 3*fy_high $	$ 2*fx_high - 3*fy_low $	$ 2*fy_low - 3*fx_high $	$ 2*fy_high - 3*fx_low $
IMD frequency limits (MHz)	4230	3528	948	380
Two-tone 5 th order IMD products	$ fx_low + 4*fy_low $	$ fx_high + 4*fy_high $	$ fy_low + 4*fx_low $	$ fy_high + 4*fx_high $
IMD frequency limits (MHz)	11904	12740	10176	10610
Two-tone 5 th order IMD products	$ 2*fx_low + 3*fy_low $	$ 2*fx_high + 3*fy_high $	$ 2*fy_low + 3*fx_low $	$ 2*fy_high + 3*fx_high $
IMD frequency limits (MHz)	11328	12030	10752	11320

For UE coexistence study of Band n3 + Band n41, the 2nd, 3rd, 4th and 5th order harmonics and 2nd, 3rd, 4th and 5th order intermodulation products were calculated and presented in Table 5.1.5.3-3.

Table 5.1.5.3-3 Harmonic and IMD analysis

UE UL carriers	fx_low	fx_high	fy_high	
UL frequency (MHz)	1710	1785	2496	2690
2 nd harmonics frequency limits	$2*fx_low$	$2*fx_high$	$2*fy_low$	$2*fy_high$
2 nd harmonics frequency limits (MHz)	3420	3570	4992	5380
3 rd harmonics frequency limits	$3*fx_low$	$3*fx_high$	$3*fy_low$	$3*fy_high$
3 rd harmonics frequency limits (MHz)	5130	5355	7488	8070
4th harmonics frequency limits	$4*fx_low$	$4*fx_high$	$4*fy_low$	$4*fy_high$
4th harmonics frequency limits (MHz)	6840	7140	9984	10760
5th harmonics frequency limits	$5*fx_low$	$5*fx_high$	$5*fy_low$	$5*fy_high$
5th harmonics frequency limits (MHz)	8550	8925	12480	13450
2 nd order IMD products	$ fy_low - fx_high $	$ fy_high - fx_low $	$ fy_low + fx_low $	$ fy_high + fx_high $
IMD frequency limits (MHz)	711	980	4206	4475
Two-tone 3 rd order IMD products	$ 2*fx_low - fy_high $	$ 2*fx_high - fy_low $	$ 2*fy_low - fx_high $	$ 2*fy_high - fx_low $
IMD frequency limits (MHz)	730	1074	3207	3670
Two-tone 3 rd order IMD products	$ 2*fx_low +$	$ 2*fx_high +$	$ 2*fy_low +$	$ 2*fy_high + fx_high $

	fy_low	fy_high	fx_low	
IMD frequency limits (MHz)	5916	6260	6702	7165
Two-tone 4 th order IMD products	3*fx_low - 1*fy_high	3*fx_high - 1*fy_low	3*fy_low - 1*fx_high	3*fy_high - 1*fx_low
IMD frequency limits (MHz)	2440	2859	5703	6360
Two-tone 4 th order IMD products	3*fx_low + 1*fy_low	3*fx_high + 1*fy_high	3*fy_low + 1*fx_low	3*fy_high + 1*fx_high
IMD frequency limits (MHz)	7626	8045	9198	9855
Two-tone 4 th order IMD products	2*fx_low - 2*fy_high	2*fx_high - 2*fy_low	2*fx_low + 2*fy_low	2*fx_high + 2*fy_high
IMD frequency limits (MHz)	1960	1422	8412	8950
Two-tone 5 th order IMD products	fx_low - 4*fy_high	fx_high - 4*fy_low	fy_low - 4*fx_high	fy_high - 4*fx_low
IMD frequency limits (MHz)	9050	8199	4644	4150
Two-tone 5 th order IMD products	2*fx_low - 3*fy_high	2*fx_high - 3*fy_low	2*fy_low - 3*fx_high	2*fy_high - 3*fx_low
IMD frequency limits (MHz)	4650	3918	363	250
Two-tone 5 th order IMD products	fx_low + 4*fy_low	fx_high + 4*fy_high	fy_low + 4*fx_low	fy_high + 4*fx_high
IMD frequency limits (MHz)	11694	12545	9336	9830
Two-tone 5 th order IMD products	2*fx_low + 3*fy_low	2*fx_high + 3*fy_high	2*fy_low + 3*fx_low	2*fy_high + 3*fx_high
IMD frequency limits (MHz)	10908	11640	10122	10735

5th order IMD generated by dual uplink of Band n1 + Band n3 may fall into own Rx of Band n41.

5.1.5.4 $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values

For three simultaneous DLs and two ULs of Band n1, n3 and n41, the $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values are shown in table 5.1.5.4-1 and table 5.1.5.4-2, respectively.

Table 5.1.5.4-1: $\Delta T_{IB,c}$ for 3DL aggregation

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n1-n3-n41	n1	0.5
	n3	0.5
	n41	0.3 ¹
		0.8 ²
NOTE 1: The requirement is applied for UE transmitting on the frequency range of 2545 - 2690 MHz.		
NOTE 2: The requirement is applied for UE transmitting on the frequency range of 2496 - 2545 MHz.		

Table 5.1.5.4-2: $\Delta R_{IB,c}$ for 3DL aggregation

Inter-band CA Configuration	NR Band	$\Delta R_{IB,c}$ [dB]
CA_n1-n3-n41	n1	0
	n3	0
	n41	0 ¹
		0.5 ²
NOTE 1: The requirement is applied for UE transmitting on the frequency range of 2545 – 2690 MHz.		
NOTE 2: The requirement is applied for UE transmitting on the frequency range of 2496 – 2545 MHz.		

5.1.5.5 REFSENS requirements

MSD requirements for CA_n1-n3-n41 with UL bands n1 and n3 are shown below. The LTE requirements of CA_1A-3A-41A can be reused.

Table 5.1.5.5-1: 3DL/2UL interband Reference sensitivity QPSK $P_{REFSENS}$ and uplink/downlink configurations

Band / Channel bandwidth / N_{RB} / Duplex mode								Source of IMD
NR CA Configuration	NR band	UL F_c (MHz)	UL/DL BW (MHz)	UL C_{LRB}	DL F_c (MHz)	MSD (dB)	Duplex mode	
CA_n1A-n3A-n41A	n1	1977.5	5	25	2167.5	N/A	FDD	N/A
	n3	1712.5	5	25	1807.5	N/A	FDD	N/A
	n41	2507.5	10	25	2507.5	5.0	TDD	IMD5

5.1.6 CA_n66-n70-n71

5.1.6.1 Operating bands for CA

Table 5.1.6.1-1: CA band combination of band n66+n70+n71

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_n66-n70-n71	n66	1710 MHz	–	1780 MHz	2110 MHz	–	2200 MHz	FDD	
	n70	1695 MHz	–	1710 MHz	1995 MHz	–	2020 MHz	FDD	
	n71	663 MHz	–	698 MHz	617 MHz	–	652 MHz	FDD	

5.1.6.2 Channel bandwidths per operating band for CA

Table 5.1.6.2-1: Supported bandwidths per CA band combination of band n66+n70+n71

NR CA Configuration	UL Configuration	NR Band	SCS [kHz]	5 MHz	10 MHz	15 MHz	20 MHz	25 MHz	30 MHz	40 MHz	50 MHz	60 MHz	80 MHz	90 MHz	100 MHz	Bandwidth combination set
CA_66A-n70A-n71A	CA_n66A-n71A	n66	15	Yes	Yes	Yes	Yes			Yes						0
			30		Yes	Yes	Yes			Yes						
			60		Yes	Yes	Yes			Yes						
	CA_n70A-n71A	n70	15	Yes	Yes	Yes	Yes ¹	Yes ¹								
			30		Yes	Yes	Yes ¹	Yes ¹								
			60		Yes	Yes	Yes ¹	Yes ¹								
	CA_n66B-n70A-n71A	n71	15	Yes	Yes	Yes	Yes									
			30		Yes	Yes	Yes									
			60													
CA_66B-n70A-n71A	CA_n66A-n71A	n66	15	Yes	Yes	Yes	Yes			Yes						0
			30		Yes	Yes	Yes			Yes						
			60		Yes	Yes	Yes			Yes						
	CA_n70A-n71A	n70	15	Yes	Yes	Yes	Yes ¹	Yes ¹								
			30		Yes	Yes	Yes ¹	Yes ¹								
			60		Yes	Yes	Yes ¹	Yes ¹								
	CA_66(2A)-n70A-n71A	n71	15	Yes	Yes	Yes	Yes									0
			30		Yes	Yes	Yes			Yes						
			60		Yes	Yes	Yes			Yes						

NOTE 1 This UE channel bandwidth is applicable only to downlink

5.1.2.3 UE co-existence studies

For UE coexistence study of Band n66 + Band n71, the 2nd, 3rd, 4th and 5th order harmonics and 2nd, 3rd, 4th and 5th order intermodulation products were calculated and presented in Table 5.1.6.3-1

Table 5.1.6.3-1: Harmonic and IMD analysis for n66+n71

UE UL carriers	fx_low	fx_high	fy_high	
UL frequency (MHz)	1710	1780	663	698
2 nd harmonics frequency limits	2*fx_low	2*fx_high	2* fy_low	2* fy_high
2 nd harmonics frequency limits (MHz)	3420	3560	1326	1396
3 rd harmonics frequency limits	3*fx_low	3*fx_high	3* fy_low	3* fy_high
3 rd harmonics frequency limits (MHz)	5130	5340	1989	2094
4th harmonics frequency limits	4*fx_low	4*fx_high	4* fy_low	4* fy_high
4th harmonics frequency limits (MHz)	6840	7120	2652	2792
5th harmonics frequency limits	5*fx_low	5*fx_high	5* fy_low	5* fy_high
5th harmonics frequency limits (MHz)	8550	8900	3315	3490
Two tone 2 nd order IMD products	fy_low – fx_high	fy_high – fx_low	fx_low + fy_low	fx_high + fy_high
IMD frequency limits (MHz)	1117	1012	2373	2478
Two-tone 3 rd order IMD products	2*fx_low – fy_high	2*fx_high – fy_low	2*fy_low – fx_high	2*fy_high – fx_low
IMD frequency limits (MHz)	2722	2897	454	314
Two-tone 3 rd order IMD products	2*fx_low + fy_low	2*fx_high + fy_high	2*fy_low + fx_low	2*fy_high + fx_high
IMD frequency limits (MHz)	4083	4258	3036	3176
Two-tone 4 th order IMD products	3*fx_low – fy_high	3*fx_high – fy_low	3*fy_low – fx_high	3*fy_high – fx_low
IMD frequency limits (MHz)	4432	4677	209	384
Two-tone 4 th order IMD products	3*fx_low + fy_low	3*fx_high + fy_high	3*fy_low + fx_low	3*fy_high + fx_high
IMD frequency limits (MHz)	5793	6038	3036	3874
Two-tone 4 th order IMD products	2*fy_low – 2*fx_high	2*fy_high – 2*fx_low	2*fx_low + 2*fy_low	2*fx_high + 2*fy_high
IMD frequency limits (MHz)	2234	2024	4746	4956
Two-tone 5 th order IMD products	4*fx_low – fy_high	4*fx_high – fy_low	4*fy_low – fx_high	4*fy_high – fx_low
IMD frequency limits (MHz)	6142	6457	872	1082
Two-tone 5 th order IMD products	4*fx_low + fy_low	4*fx_high + fy_high	4*fy_low + fx_low	4*fy_high + fx_high
IMD frequency limits (MHz)	7503	7818	4362	4572
Two-tone 5 th order IMD products	3*fx_low – 2*fy_high	3*fx_high – 2*fy_low	3*fy_low – 2*fx_high	3*fy_high – 2*fx_low
IMD frequency limits (MHz)	3734	4014	1571	1326

Two-tone 5 th order IMD products	2*fx_low + 3*fy_low	2*fx_high + 3*fy_high	2*fy_low + 3*fx_low	2*fy_high + 3*fx_high
IMD frequency limits (MHz)	5409	5654	6456	6736

Based on the table above, there are no harmonics or intermodulations falling on top of n70. Note that IMD4 between bands n66 and n71 is treated in TR38.716-02-00. Hence no additional requirements are needed.

For UE coexistence study of Band n70 + Band n71, the 2nd, 3rd, 4th and 5th order harmonics and 2nd, 3rd, 4th and 5th order intermodulation products were calculated and presented in Table 5.1.6.3-2

Table 5.1.6.3-2: Harmonic and IMD analysis for n70+n71

UE UL carriers	fx_low	fx_high	fy_high	
UL frequency (MHz)	1695	1710	663	698
2 nd harmonics frequency limits	2*fx_low	2*fx_high	2* fy_low	2* fy_high
2 nd harmonics frequency limits (MHz)	3390	3420	1326	1396
3 rd harmonics frequency limits	3*fx_low	3*fx_high	3* fy_low	3* fy_high
3 rd harmonics frequency limits (MHz)	5085	5130	1989	2094
4th harmonics frequency limits	4*fx_low	4*fx_high	4* fy_low	4* fy_high
4th harmonics frequency limits (MHz)	6780	6840	2652	2792
5th harmonics frequency limits	5*fx_low	5*fx_high	5* fy_low	5* fy_high
5th harmonics frequency limits (MHz)	8475	8550	3315	3490
Two tone 2 nd order IMD products	fy_low – fx_high	fy_high – fx_low	fx_low + fy_low	fx_high + fy_high
IMD frequency limits (MHz)	1047	997	2358	2408
Two-tone 3 rd order IMD products	2*fx_low – fy_high	2*fx_high – fy_low	2*fy_low – fx_high	2*fy_high – fx_low
IMD frequency limits (MHz)	2692	2757	384	299
Two-tone 3 rd order IMD products	2*fx_low + fy_low	2*fx_high + fy_high	2*fy_low + fx_low	2*fy_high + fx_high
IMD frequency limits (MHz)	4053	4118	3021	3106
Two-tone 4 th order IMD products	3*fx_low – fy_high	3*fx_high – fy_low	3*fy_low – fx_high	3*fy_high – fx_low
IMD frequency limits (MHz)	4387	4467	279	399
Two-tone 4 th order IMD products	3*fx_low + fy_low	3*fx_high + fy_high	3*fy_low + fx_low	3*fy_high + fx_high
IMD frequency limits (MHz)	5748	5828	3021	3804

Two-tone 4 th order IMD products	$2*fy_{low} - 2*fx_{high}$	$2*fy_{high} - 2*fx_{low}$	$2*fx_{low} + 2*fy_{low}$	$2*fx_{high} + 2*fy_{high}$
IMD frequency limits (MHz)	2094	1994	4716	4816
Two-tone 5 th order IMD products	$ 4*fx_{low} - fy_{high} $	$ 4*fx_{high} - fy_{low} $	$4*fy_{low} - fx_{high}$	$4*fy_{high} - fx_{low}$
IMD frequency limits (MHz)	6082	6177	942	1097
Two-tone 5 th order IMD products	$4*fx_{low} + fy_{low}$	$4*fx_{high} + fy_{high}$	$4*fy_{low} + fx_{low}$	$4*fy_{high} + fx_{high}$
IMD frequency limits (MHz)	7443	7538	4347	4502
Two-tone 5 th order IMD products	$ 3*fx_{low} - 2*fy_{high} $	$ 3*fx_{high} - 2*fy_{low} $	$3*fy_{low} - 2*fx_{high}$	$3*fy_{high} - 2*fx_{low}$
IMD frequency limits (MHz)	3689	3804	1431	1296
Two-tone 5 th order IMD products	$2*fx_{low} + 3*fy_{low}$	$2*fx_{high} + 3*fy_{high}$	$2*fy_{low} + 3*fx_{low}$	$2*fy_{high} + 3*fx_{high}$
IMD frequency limits (MHz)	5379	5514	6411	6526

Based on the table above, there are no harmonics or intermodulations falling on top of n66. Note that 3rd harmonic and IMD4 between bands n70 and n71 is treated in TR38.716-02-00. Hence no additional requirements are needed.

5.1.6.4 ΔT_{IB} and ΔR_{IB} values

The $D T_{IB,c}$ and $D R_{IB,c}$ are already defined in DL CA_n66A-n70A-n71A in TR38.716-03-01.

5.1.6.5 REFSENS requirements

Based on the analysis in the UE-coexistence studies, compared to its fall back mode, there are no additional MSD issue due to dual uplink operation falling into DL of the third band for this band combination.

5.1.7 CA_n3-n28-n77

5.1.7.1 Operating bands for CA

Table 5.1.7.1-1: CA band combination of band n3+n28+n77

NR Band	Uplink (UL) band	Downlink (DL) band	Duplex mode
	BS receive / UE transmit	BS transmit / UE receive	
	$F_{UL_low} - F_{UL_high}$	$F_{DL_low} - F_{DL_high}$	
n3	1710 MHz – 1785 MHz	1805 MHz – 1880MHz	FDD
n28	703 MHz – 748 MHz	758 MHz – 803 MHz	FDD
n77	3300 MHz – 4200 MHz	3300 MHz – 4200 MHz	TDD

5.1.7.2 Channel bandwidths per operating band for CA

Table 5.1.7.2-1: Supported bandwidths per CA band combination of band n3+n28+n77

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	80 MHz	90 MHz	100 MHz	Bandwidth combination set
CA_n3A-n28A-n77A	CA_n3A-n28A CA_n3A-n77A CA_n28A-n77A	n3	15	Yes	Yes	Yes	Yes	Yes	Yes							0
			30		Yes	Yes	Yes	Yes	Yes							
			60		Yes	Yes	Yes	Yes	Yes							
		n28	15	Yes	Yes	Yes	Yes									
			30		Yes	Yes	Yes									
			60													
		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	

5.1.7.3 UE co-existence studies

The coexistence studies of UL Band n3 + Band n28, Band n3 + Band n77 and Band n28 + Band n77 have already been captured in the constituent fallback modes in TR 38.716-02-00. According to the coexistence studies in TR 38.716-02-00, the own Rx impact of the 3rd band is shown as the followings.

- 3rd, 4th and 5th order IMD generated by dual uplink of Band n3 + Band n28 may fall into own Rx of Band n77
- 3rd and 4th order IMD generated by dual uplink of Band n28 + Band n77 may fall into own Rx of Band n3.
- 3rd order IMD generated by dual uplink of Band n3 + Band n77 may fall into own Rx of Band n28.

5.1.7.4 ΔT_{IB} and ΔR_{IB} values

For three DLs and two ULs of Band n3, n28 and n77, the same $DT_{IB,c}$ and $DR_{IB,c}$ values specified for 1 band UL for CA_n3-n28-n77 are used as below.

Table 5.1.7.4-1: $\Delta T_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n3-n28-n77	n3	0.6
	n28	0.5
	n77	0.8

Table 5.1.7.4-2: $\Delta R_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta R_{IB,c}$ [dB]
CA_n3-n28-n77	n3	0.2
	n28	0.2
	n77	0.5

5.1.7.5 REFSENS requirements

Table 5.1.7.5-1 lists the MSD required for the dual connectivity configuration for the cases that IMD interference fall into the own 3rd Rx frequency band. For the exception by dual uplink of Band n28 + Band n77, the same exception value in DC_3A-28A_n77A is used and for the exception by dual uplink of Band n3 + Band n28 and Band n3 + Band n77, the same exception values in DC_3A_n28A-n77A is used.

Table 5.1.7.5-1: MSD for the CA configuration

NR Band / Channel bandwidth / NRB / MSD							
CA Configuration	NR band	UL F _c (MHz)	UL/DL BW (MHz)	UL L _{CRB}	DL F _c (MHz)	MSD (dB)	IMD order
CA_n3A-n28A-n77A	n3	1720	5	25	1815	N/A	N/A
	n28	733	5	25	788	N/A	N/A
	n77	4173	10	50	4173	15.9	IMD3 $ 2*f_{Bn3}+f_{n28} $

CA_n3A-n28A-n77A	n28	735	5	25	790	N/A	N/A
	n77	3320	10	50	3320	N/A	N/A
	n3	1755	5	25	1850	17.0	$ 2^*f_{Bn28} + f_{nn7} $
CA_n3A-n28A-n77A	n3	1712.5	5	25	1807.5	N/A	N/A
	n77	4195	10	50	4195	N/A	N/A
	n28	715	5	25	770	15.3	$ 2^*f_{Bn3} + f_{nn7} $

5.1.8 CA_n1A-n7A-n28A

5.1.8.1 Operating bands for CA

Table 5.1.8.1-1: 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-n7-n28	n1	1920 MHz	—	1980 MHz	2110 MHz	—	2170 MHz	FDD
	n7	2500 MHz	—	2570 MHz	2620 MHz	—	2690 MHz	FDD
	n28	880 MHz	—	915 MHz	925 MHz	—	960 MHz	FDD

5.1.8.2 Channel bandwidths per operating band for CA

Table 5.1.8.2-1: 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	80	90	100	Bandwidth combination set
CA_n1A-n7A-n28A	CA_n1A-n7A	n1	15	Yes	Yes	Yes	Yes									0
			30		Yes	Yes	Yes									
			60		Yes	Yes	Yes									
	CA_n1A-n28A	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_n7A-n28A	n28	15	Yes	Yes	Yes	Yes ²									
			30		Yes	Yes	Yes ²									
			60													

NOTE 1: This UE channel bandwidth is optional in this release of the specification.

NOTE 2: For the 20 MHz bandwidth, the minimum requirements are specified for NR UL carrier frequencies confined to either 713-723 MHz or 728-738 MHz

5.1.8.3 UE co-existence studies

The harmonic issue for Band n1+Band n7 + Band n28 has already been addressed in TR38.716-03-01, where there are no harmonic interference and harmonic mixing problem for CA_n1A_n7A-n28A.

Based on co-existence studies of Band n1 + Band n7, Band n1 + Band n28 and Band n7 + Band n28 captured in TR 38.716-02-00, own Rx impact of the IMD5 is the follows:

- 2nd order IMD generated by dual uplink of Band n1 + Band n28 may fall into part of own band n7.
- 5th order IMD generated by dual uplink of Band n1 + Band n7 may fall into part of own band n28.

5.1.8.4 ΔT_{IB} and ΔR_{IB} values

For three simultaneous DLs and one UL of Band n1, n7 and n28, the DT_{IB,c} and DR_{IB,c} values are shown in table 5.1.8.4-1 and table 5.1.8.4-2, respectively. Values are derived from DC_1-7_n28.

Table 5.1.8.4-1: $\Delta T_{IB,c}$ for 3DL aggregation

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n1-n7-n28	n1	0.5
	n7	0.6
	n28	0.6

Table 5.1.8.4-2: $\Delta R_{IB,c}$ for 3DL aggregation

Inter-band CA Configuration	NR Band	$\Delta R_{IB,c}$ [dB]
CA_n1-n7-n28	n1	0
	n7	0
	n28	0.2

5.1.8.5 REFSENS requirements

CA_n1-n7-n28 need to have the same MSD requirements as DC_1-7_n28. Below are the updates needed in Table 7.3A.5-2 of TS 38.101-1.

Table 5.1.8.5-1: 3DL/2UL interband Reference sensitivity QPSK P_{REFSENS} and uplink/downlink configurations

Band / Channel bandwidth / N _{RB} / Duplex mode								Source of IMD
NR CA Configuration	NR band	UL F _c (MHz)	UL/DL BW (MHz)	UL C _{LRB}	DL F _c (MHz)	MSD (dB)	Duplex mode	
CA_n1A-n7A-n28A	n1	1935	5	25	2125	N/A	FDD	N/A
	n7	2533	10	50	2653	30.0	FDD	IMD2
	n28	718	5	25	773	N/A	FDD	N/A
	n1	1935	5	25	2125	N/A	FDD	N/A
	n7	2510	10	50	2630	N/A	FDD	N/A
	n28	730	10	50	785	4.5	FDD	IMD5

5.1.9 CA_n1A-n7A-n78A

5.1.9.1 Operating bands for CA

Table 5.1.9.1-1: 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}	F _{DL_low} – F _{DL_high}	F _{DL_low} – F _{DL_high}		
CA_n1-n7-n78	n1	1920 MHz	–	1980 MHz	2110 MHz	FDD	
	n7	2500 MHz	–	2570 MHz	2620 MHz	FDD	
	n78	3300 MHz	–	3800 MHz	3300 MHz	TDD	

5.1.9.2 Channel bandwidths per operating band for CA

Table 5.1.9.2-1: 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	80	90	100	Bandwidth combination set
CA_n1A-n7A-n78A	CA_n1A-n7A	n1	15	Yes	Yes	Yes	Yes									0
			30		Yes	Yes	Yes									
			60		Yes	Yes	Yes									
	CA_n1A-n78A	n7	15	Yes												
			30		Yes											
			60		Yes											
	CA_n7A-n78A	n78	15		Yes	Yes	Yes			Yes	Yes					
			30		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes ¹	
			60		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes ¹	

CA_n1A-n7A-n78(2A)	CA_n1A-n7A	n1	15	Yes	Yes	Yes																
			30		Yes	Yes	Yes															
			60		Yes	Yes	Yes															
	CA_n1A-n78A	n7	15	Yes																		
			30		Yes	Yes	Yes	Yes	Yes	Yes												
			60		Yes	Yes	Yes	Yes	Yes	Yes												
	CA_n7A-n78A	n78	See CA_n78(2A) Bandwidth Combination Set 0 in Table 5.5A.2-1 in TS 38.101-1																			
	NOTE 1: This UE channel bandwidth is optional in this release of the specification.																					
	NOTE 2: For the 20 MHz bandwidth, the minimum requirements are specified for NR UL carrier frequencies confined to either 713-723 MHz or 728-738 MHz																					

5.1.9.3 UE co-existence studies

The harmonic issue for Band n1+Band n7 + Band n78 has already been addressed in TR38.716-03-01, where there are no harmonic interference and harmonic mixing problem for CA_n1A-n7A-n78A.

Based on co-existence studies of Band n1 + Band n7, Band n1 + Band n78 and Band n7 + Band n78 captured in TR 38.716-02-00, own Rx impact of the IMD5 is the follows:

- 4^e and 5th order IMD generated by dual uplink of Band n1 + Band n7 may fall into part of own band n78.
- 4th order IMD generated by dual uplink of Band n1 + Band n78 may fall into part of own band n7.
- 4th order IMD generated by dual uplink of Band n7 + Band n78 may fall into part of own band n1.

5.1.9.4 ΔT_{IB} and ΔR_{IB} values

For three simultaneous DLs and one UL of Band n1, n7 and n78, the $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values are shown in table 5.1.9.4-1 and table 5.1.9.4-2, respectively. Values are derived from DC_1-7_n78.

Table 5.1.9.4-1: $\Delta T_{IB,c}$ for 3DL aggregation

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n1-n7-n78	n1	0.6
	n7	0.6
	n78	0.8

Table 5.1.9.4-2: $\Delta R_{IB,c}$ for 3DL aggregation

Inter-band CA Configuration	NR Band	$\Delta R_{IB,c}$ [dB]
CA_n1-n7-n78	n1	0.2
	n7	0.2
	n78	0.5

5.1.9.5 REFSENS requirements

CA_n1-n7-n78 need to have the same MSD requirements as DC_1-7_n78 and DC_1_n7-n78. Below are the updates needed in Table 7.3A.5-2 of TS 38.101-1.

Table 7.3A.5-2: 3DL/2UL interband Reference sensitivity QPSK $P_{REFSENS}$ and uplink/downlink configurations

Band / Channel bandwidth / N _{RB} / Duplex mode								Source of IMD
NR CA Configuration	NR band	UL F _c (MHz)	UL/DL BW (MHz)	UL C _{LRB}	DL F _c (MHz)	MSD (dB)	Duplex mode	
CA_n1A-n7A-n78A	n1	1977.5	5	25	2167.5	N/A	FDD	N/A
	n7	2507.5	5	25	2627.5	9.1	FDD	IMD4 f _{n78} -3*f _{B1}
	n78	3305	10	50	3305	N/A	TDD	N/A

	n1	1950	5	25	2140	8.7	FDD	IMD4 $ 2*f_{n78} - 2*f_{B7} $
	n7	2510	10	50	2630	N/A	FDD	N/A
	n78	3580	10	50	3580	N/A	TDD	N/A
	n1	1970	5	25	2160	N/A	FDD	N/A
	n7	2520	5	25	2640	N/A	FDD	N/A
	n78	3390	10	50	3390	10.1	TDD	IMD4 $ f_{B7} - 3*f_{B1} $

5.1.10 CA_n3-n28-n78

5.1.10.1 Operating bands for CA

Table 5.1.10.1-1: CA band combination of band n3+n28+n78

NR Band	Uplink (UL) band				Downlink (DL) band				Duplex mode							
	BS receive / UE transmit		BS transmit / UE receive													
	$F_{UL_low} - F_{UL_high}$		$F_{DL_low} - F_{DL_high}$													
n3	1710 MHz – 1785 MHz				1805 MHz – 1880MHz				FDD							
n28	703 MHz – 748 MHz				758 MHz – 803 MHz				FDD							
n78	3300 MHz – 3800 MHz				3300 MHz – 3800 MHz				TDD							

5.1.10.2 Channel bandwidths per operating band for CA

Table 5.1.10.2-1: Supported bandwidths per CA band combination of band n3+n28+n78

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	80 MHz	90 MHz	100 MHz	Bandwidth combination set
CA_n3A-n28A-n78A	CA_n3A-n28A CA_n3A-n78A CA_n28A-n78A	n3	15	Yes	Yes	Yes	Yes	Yes	Yes							0
			30		Yes	Yes	Yes	Yes	Yes							
			60		Yes	Yes	Yes	Yes	Yes							
		n28	15	Yes	Yes	Yes	Yes									
			30		Yes	Yes	Yes									
			60													
		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	

5.1.10.3 UE co-existence studies

The coexistence studies of UL Band n3 + Band n28, Band n3 + Band n78 and Band n28 + Band n78 have already been captured in the constituent fallback modes in TR 38.716-02-00. According to the coexistence studies in TR 38.716-02-00, the own Rx impact of the 3rd band is shown as the followings.

- 5th order IMD generated by dual uplink of Band n3 + Band n28 may fall into own Rx of Band n78
- 3rd order IMD generated by dual uplink of Band n28 + Band n78 may fall into own Rx of Band n3.

5.1.10.4 ΔT_{IB} and ΔR_{IB} values

For three DLs and two ULs of Band n3, n28 and n78, the same $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values specified for 1 band UL for CA_n3-n28-n78 are used as below.

Table 5.1.10.4-1: $\Delta T_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n3-n28-n78	n3	0.5
	n28	0.3
	n78	0.8

Table 5.1.10.4-2: $\Delta R_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta R_{IB,c}$ [dB]
CA_n3-n28-n78	n3	0
	n28	0.2
	n78	0.5

5.1.10.5 REFSENS requirements

Table 5.110.5-1 lists the MSD required for the dual connectivity configuration for the cases that IMD interference fall into the own 3rd Rx frequency band, it could reuse the MSD value of DC_3A-28A_n78A.

Table 5.1.10.5-1: MSD for the CA configuration

NR Band / Channel bandwidth / NRB / MSD							
CA Configuration	NR band	UL F _c (MHz)	UL/DL BW (MHz)	UL L _{CRB}	DL F _c (MHz)	MSD (dB)	IMD order
CA_n3A-n28A-n78A	n28	735	5	25	790	N/A	N/A
	n78	3320	10	50	3320	N/A	N/A
	n3	1755	5	25	1850	17.3	IMD3 $ 2*f_{Bn28} - f_{nn78} $
CA_n3A-n28A-n78A	n3	1750	5	25	1845	N/A	N/A
	n28	743	5	25	798	N/A	N/A
	n78	3764	10	50	3764	4.5	IMD5 $ 3*f_{n3} - 2*f_{n28} $

5.1.11 CA_n5-n66-n78

5.1.11.1 Operating bands for CA

Table 5.1.11.1-1: CA band combination of band n5+n66+n78

NR Band	Uplink (UL) band				Downlink (DL) band				Duplex mode					
	BS receive / UE transmit			BS transmit / UE receive										
	$F_{UL_low} - F_{UL_high}$			$F_{DL_low} - F_{DL_high}$										
n5	824 MHz –		849 MHz		869 MHz –		894 MHz		FDD					
n66	1710 MHz –		1780 MHz		2110 MHz –		2200 MHz		FDD					
n78	3300 MHz –		3800 MHz		3300 MHz –		3800 MHz		TDD					

5.1.11.2 Channel bandwidths per operating band for CA

Table 5.1.11.2-1: Supported bandwidths per CA band combination of band n5+n66+n78

NR CA Configuration	UL Configuration	NR Band	SCS [kHz]	CA operating / channel bandwidth [MHz]												Bandwidth combination set	
				5	10	15	20	25	30	40	50	60	70	80	90	100	
CA_n5A-n66A-n78A	CA_n5A-n66A, CA_n5A-n78A, CA_n66A-n78A	n5	15	Yes	Yes	Yes	Yes										0
			30		Yes	Yes	Yes										
			60														
	n66	n66	15	Yes	Yes	Yes	Yes	Yes	Yes	Yes							
			30		Yes	Yes	Yes	Yes	Yes	Yes							
			60		Yes	Yes	Yes	Yes	Yes	Yes							
	n78	n78	15		Yes												
			30		Yes												
			60		Yes												

5.1.11.3 UE co-existence studies

The harmonic and intermodulation issues have been studied for the constituent fall-back modes and the reference sensitivity exceptions have been define in TS 38.101-1.

Based on co-existence studies of Band n5 + Band n78, Band n66 + Band n78 and Band 5 + Band n66 captured in TR 38.716-02-00, own Rx impact of the 3rd band is the followings

- 3rd and 5th order IMD generated by dual uplink of Band n5 + Band n66 may fall into part of own band n78.
- 3rd order IMD generated by dual uplink of Band n5 + Band n78 may fall into part of own band n66.
- no IMD issue due to dual uplink of Band n66 + Band n78 falling into own band n5.

5.1.11.4 $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values

The same $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values specified for 1 band UL for CA_n3-n8-n78 are used as below.

Table 5.1.11.4-1: $\Delta T_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n5-n66-n78	n5	0.6
	n66	0.6
	n78	0.8

Table 5.1.11.4-2: $\Delta R_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta R_{IB,c}$ [dB]
CA_n5-n66-n78	n5	0.5
	n66	0.2
	n78	0.5

5.1.11.5 REFSENS requirements

Table 5.11.5-1 lists the MSD required for the dual connectivity configuration for the cases that IMD interference fall into the own 3rd Rx frequency band. The MSD due to IMD3 of n5+n78 falling into n66 is reused from DC_5A-66A_n78A. Since Band n5 and Band n66 have similar UL frequency ranges to those of Band n8 and n3, respectively, the MSD values due to IMD3 and IMD5 of n5+n66 falling into n78 are derived from the CA_n3-n8-n78 in TR 38.716-03-02.

Table 5.1.11.5-1: MSD for the CA configuration

NR Band / Channel bandwidth / NRB / MSD							
CA Configuration	NR band	UL F_c (MHz)	UL/DL BW (MHz)	UL L_{CRB}	DL F_c (MHz)	MSD (dB)	IMD order
CA_n5A-n66A-n78A	n5	830	5	25	875	N/A	N/A
	n66	1720	5	25	2120	N/A	N/A
	n78	3380	10	50	3380	16.1	IMD3 $ f_{n66} + 2*f_{n5} $
CA_n5A-n66A-n78A	n5	830	5	25	875	N/A	N/A
	n66	1720	5	25	2120	N/A	N/A
	n78	3500	10	50	3500	4.5	IMD5 $ 3*f_{n66} - 2*f_{n5} $
CA_n5A-n66A-n78A	n5	830	5	25	875	N/A	N/A
	n66	1720	5	25	2120	13.2	IMD3 $ 2*f_{n5} - f_{n78} $
	n78	3780	10	50	3780	N/A	N/A

5.1.12 CA_n7-n25-n66

5.1.12.1 Operating bands for CA

Table 5.1.12.1-1: CA band combination of band n7+n25+n66

NR Band	Uplink (UL) band		Downlink (DL) band		Duplex mode	
	BS receive / UE transmit		BS transmit / UE receive			
	F_{UL_low} – F_{UL_high}	F_{DL_low} – F_{DL_high}	F_{DL_low} – F_{DL_high}	F_{DL_low} – F_{DL_high}		
n7	2500 MHz – 2570 MHz	2620 MHz – 2690 MHz	2620 MHz – 2690 MHz	2620 MHz – 2690 MHz	FDD	
n25	1850 MHz – 1915 MHz	1930 MHz – 1995 MHz	1930 MHz – 1995 MHz	1930 MHz – 1995 MHz	FDD	
n66	1710 MHz – 1780 MHz	2110 MHz – 2200 MHz	2110 MHz – 2200 MHz	2110 MHz – 2200 MHz	FDD	

5.1.12.2 Channel bandwidths per operating band for CA

Table 5.1.12.2-1: Supported bandwidths per CA band combination of band n7+n25+n66

NR CA Configuration	UL Configuration	NR Band	SCS [kHz]	CA operating / channel bandwidth [MHz]												Bandwidth combination set
				5	10	15	20	25	30	40	50	60	80	90	100	
CA_n7A-n25A-n66A	CA_n7A-n25A, CA_n7A-n66A, CA_n25A-n66A	n7	15	Ye s	Yes				0							
			30		Yes											
			60		Yes											
		n25	15	Ye s	Yes											
			30		Yes											
			60		Yes											
		n66	15	Ye s	Yes											
			30		Yes											
			60		Yes											

5.1.12.3 UE co-existence studies

Based on co-existence studies of Band n7 + Band n25, Band n7 + Band n66 and Band n25 + Band n66 captured in TR 38.716-02-00, there is no own Rx impact on the 3rd band.

5.1.12.4 ΔT_{IB} and ΔR_{IB} values

For CA_n7-n25-n66, the $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values are given in the tables below.

Table 5.1.12.4-1: $\Delta T_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n7-n25-n66	n7	0.5
	n25	0.5
	n66	0.5

Table 5.1.12.4-2: $\Delta R_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta R_{IB,c}$ [dB]
CA_n7-n25-n66	n7	0.5
	n25	0.3
	n66	0.5

5.1.12.5 REFSENS requirements

There is no additional requirement for this band combination.

5.1.13 CA_n7-n66-n78

5.1.13.1 Operating bands for CA

Table 5.1.13.1-1: CA band combination of band n7+n66+n78

NR Band	Uplink (UL) band		Downlink (DL) band		Duplex mode	
	BS receive / UE transmit		BS transmit / UE receive			
	F _{UL_low} – F _{UL_high}	F _{DL_low} – F _{DL_high}	F _{DL_low} – F _{DL_high}	F _{UL_low} – F _{UL_high}		
n7	2500 MHz – 2570 MHz	2620 MHz – 2690 MHz	2620 MHz – 2690 MHz	2500 MHz – 2570 MHz	FDD	
n66	1710 MHz – 1780 MHz	2110 MHz – 2200 MHz	2110 MHz – 2200 MHz	1710 MHz – 1780 MHz	FDD	
n78	3300 MHz – 3800 MHz	TDD				

5.1.13.2 Channel bandwidths per operating band for CA

Table 5.1.13.2-1: Supported bandwidths per CA band combination of band n7+n66+n78

		CA operating / channel bandwidth [MHz]														Bandwidth combination set	
NR CA Configuration	UL Configuration	NR Band	SCS [kHz]	5	10	15	20	25	30	40	50	60	70	80	90	100	
CA_n7A-n66A-n78A	CA_n7A-n66A, CA_n7A-n78A, CA_n66A-n78A	n7	15	Ye s	Yes						0						
			30		Yes												
			60		Yes												
		n66	15	Ye s	Yes												
			30		Yes												
			60		Yes												
		n78	15		Yes												
			30		Yes												
			60		Yes												
CA_n7A-n66A-n78(2A)	CA_n7A-n66A, CA_n7A-n78A, CA_n66A-n78A	n7	15	Ye s	Yes						0						
			30		Yes												
			60		Yes												
		n66	15	Ye s	Yes												
			30		Yes												
			60		Yes												
		n78		See CA_n78(2A) Bandwidth Combination Set 1 in Table 5.5A.2-1													

5.1.13.3 UE co-existence studies

The coexistence study for DC_66_n7-n78 has been presented in TR 37.716-21-21 and the coexistence study for DC_7-66_n78 has been included in TR 37.716-21-11. It can be seen that:

- the IMD3 product of UL CA_n7A-n66A may fall into the Rx frequency of n78,
- the IMD4 product of UL CA_n7A-n78A may fall into the Rx frequency of n66.

5.1.13.4 ΔT_{IB} and ΔR_{IB} values

For CA_n7-n66-n78, the $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values are given in the tables below.

Table 5.1.13.4-1: $\Delta T_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n7-n66-n78	n7	0.5
	n66	0.6
	n78	0.8

Table 5.1.13.4-2: $\Delta R_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta R_{IB,c}$ [dB]
CA_n7-n66-n78	n7	0.5
	n66	0.2
	n78	0.5

5.1.13.5 REFSENS requirements

The n78 DL is affected by the IMD3 of UL CA_n7A-n66A and the MSD value for DC_66_n7-n78 in TR 37.716-21-21 is reused. Moreover, the n66 DL is affected by the IMD4 of UL CA_n7A-n78A and the MSD value for DC_7-66_n78 in TR 37.716-21-11 is reused.

Table 5.1.13.5-1: MSD for the CA configuration

NR Band / Channel bandwidth / NRB / MSD							
CA Configuration	NR band	UL F_c (MHz)	UL/DL BW (MHz)	UL L_{CRB}	DL F_c (MHz)	MSD (dB)	IMD order
CA_n7A-n66A-n78A, CA_n7A-n66A-n78(2A)	n7	2560	5	25	2680	N/A	N/A
	n66	1730	5	25	2130	N/A	N/A
	n78	3390	10	50	3390	16.1	IMD3 $ 2*f_{n7} - f_{n66} $
CA_n7A-n66A-n78A, CA_n7A-n66A-n78(2A)	n7	2550	5	25	2670	N/A	N/A
	n66	1750	5	25	2150	8.7	IMD4 $ 2*f_{n7} - 2*f_{n78} $
	n78	3625	10	50	3625	N/A	N/A

5.1.14 CA_n25-n66-n78

5.1.14.1 Operating bands for CA

Table 5.1.14.1-1: CA band combination of band n25+n66+n78

NR Band	Uplink (UL) band				Downlink (DL) band				Duplex mode	
	BS receive / UE transmit				BS transmit / UE receive					
	$F_{UL_low} - F_{UL_high}$				$F_{DL_low} - F_{DL_high}$					
n25	1850 MHz – 1915 MHz		1930 MHz – 1995 MHz						FDD	
n66	1710 MHz – 1780 MHz		2110 MHz – 2200 MHz						FDD	
n78	3300 MHz – 3800 MHz		3300 MHz – 3800 MHz						TDD	

5.1.14.2 Channel bandwidths per operating band for CA

Table 5.1.14.2-1: Supported bandwidths per CA band combination of band n25+n66+n78

NR CA Configuration	CA operating / channel bandwidth [MHz]															Bandwidth combination set	
	UL Configuration	NR Band	SCS [kHz]	5	10	15	20	25	30	40	50	60	70	80	90	100	
CA_n25A-n66A-n78A	CA_n25A-n66A, CA_n25A-n78A, CA_n66A-n78A	n25	15	Yes							0						
			30		Yes	Yes	Yes	Yes	Yes	Yes							
			60		Yes	Yes	Yes	Yes	Yes	Yes							
	n66	n66	15	Yes													
			30		Yes	Yes	Yes	Yes	Yes	Yes							
			60		Yes	Yes	Yes	Yes	Yes	Yes							
	n78	n78	15		Yes												
			30		Yes												
			60		Yes												

5.1.14.3 UE co-existence studies

Based on co-existence studies of Band n25 + Band n66, Band n25 + Band n78 and Band n66 + Band n78 captured in TR 38.716-02-00, the IM2 and IM4 products of n25 and n66 UL may fall into the RX frequency of n78.

5.1.14.4 ΔT_{IB} and ΔR_{IB} values

For CA_n25-n66-n78 , the $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values are given in the tables below.

Table 5.1.14.4-1: $\Delta T_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n25-n66-n78	n25	0.6
	n66	0.6
	n78	0.8

Table 5.1.14.4-2: $\Delta R_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta R_{IB,c}$ [dB]
CA_n25-n66-n78	n25	0.2
	n66	0.2
	n78	0.5

5.1.14.5 REFSENS requirements

Based on Table 5.1.14.3-1, there are IMD2 & IMD4 products produced by Band n25 and n66 that impact the reference sensitivity of band n78. The required MSD are shown in the following table, which is the same as the MSD for DC_2_n66-n78 in TR 37.716-21-21.

Table 5.1.14.5-1: MSD for the CA configuration

NR Band / Channel bandwidth / NRB / MSD							
CA Configuration	NR band	UL F_c (MHz)	UL/DL BW (MHz)	UL L_{CRB}	DL F_c (MHz)	MSD (dB)	IMD order
CA_n25A-n66A-n78A	n25	1880	5	25	1960	N/A	N/A
	n66	1740	5	25	2140	N/A	N/A
	n78	3620	10	50	3620	29.4	IMD2 $ f_{n25} + f_{n66} $
CA_n25A-n66A-n78A	n25	1880	5	25	1960	N/A	N/A
	n66	1740	5	25	2140	N/A	N/A
	n78	3340	10	50	3340	8.9	IMD4 $ f_{n25} - 3*f_{n66} $

5.1.15 CA_n28A-n41A-n78A

5.1.15.1 Operating bands for CA

Table 5.1.15.1-1: 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	–	3800MHz	3300MHz	–	3800MHz	TDD	

5.1.15.2 Channel bandwidths per operating band for CA

Table 5.1.15.2-1: Supported channel bandwidths per CA configuration

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-n78A	CA_n28A-n41A	n28	15	Yes	Yes	Yes	Yes										0
			30		Yes	Yes	Yes										
			60														
	CA_n41A-n78A	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	
	CA_n28A-n78A	n78	15		Yes												
			30		Yes												
			60		Yes												

5.1.15.3 Co-existence studies

For UE coexistence study of Band n28 + Band n41, the 2nd, 3rd, 4th and 5th order harmonics and 2nd, 3rd, 4th and 5th order intermodulation products were calculated and presented in Table 5.1.15.3-1

Table 5.1.15.3-1: Harmonic and IMD analysis

UE UL carriers	fx_low	fx_high	fy_high	
UL frequency (MHz)	703	748	2496	2690
2 nd harmonics frequency limits (MHz)	2*fx_low	2*fx_high	2* fy_low	2* fy_high
3 rd harmonics frequency limits (MHz)	1406	1496	4992	5380
4th harmonics frequency limits	3*fx_low	3*fx_high	3* fy_low	3* fy_high
5th harmonics frequency limits (MHz)	2109	2244	7488	8070
2 nd order IMD products	4*fx_low	4*fx_high	4* fy_low	4* fy_high
IMD frequency limits (MHz)	2812	2992	9984	10760
5th harmonics frequency limits (MHz)	5*fx_low	5*fx_high	5* fy_low	5* fy_high
Two-tone 3 rd order IMD products	fy_low - fx_high	fy_high - fx_low	fy_low + fx_low	fy_high + fx_high
IMD frequency limits (MHz)	1748	1987	3199	3438
IMD frequency limits (MHz)	2*fx_low - fy_high	2*fx_high - fy_low	2*fy_low - fx_high	2*fy_high - fx_low
Two-tone 3 rd order IMD products	1284	1000	4244	4677
IMD frequency limits (MHz)	2*fx_low + fy_low	2*fx_high + fy_high	2*fy_low + fx_low	2*fy_high + fx_high
IMD frequency limits (MHz)	3902	4186	5695	6128
Two-tone 4 th order IMD products	3*fx_low - 1*fy_high	3*fx_high - 1*fy_low	3*fy_low - 1*fx_high	3*fy_high - 1*fx_low
IMD frequency limits (MHz)	581	252	6740	7367
Two-tone 4 th order IMD products	3*fx_low + 1*fy_low	3*fx_high + 1*fy_high	3*fy_low + 1*fx_low	3*fy_high + 1*fx_high
IMD frequency limits (MHz)	4605	4934	8191	8818
Two-tone 4 th order IMD products	2*fx_low - 2*fy_high	2*fx_high - 2*fy_low	2*fx_low + 2*fy_low	2*fx_high + 2*fy_high
IMD frequency limits (MHz)	3974	3496	6398	6876
Two-tone 5 th order IMD products	fx_low - 4*fy_high	fx_high - 4*fy_low	fy_low - 4*fx_high	fy_high - 4*fx_low
IMD frequency limits (MHz)	10057	9236	496	122

Two-tone 5 th order IMD products	$ 2*fx_low - 3*fy_high $	$ 2*fx_high - 3*fy_low $	$ 2*fy_low - 3*fx_high $	$ 2*fy_high - 3*fx_low $
IMD frequency limits (MHz)	6664	5992	2748	3271
Two-tone 5 th order IMD products	$ fx_low + 4*fy_low $	$ fx_high + 4*fy_high $	$ fy_low + 4*fx_low $	$ fy_high + 4*fx_high $
IMD frequency limits (MHz)	10687	11508	5308	5682
Two-tone 5 th order IMD products	$ 2*fx_low + 3*fy_low $	$ 2*fx_high + 3*fy_high $	$ 2*fy_low + 3*fx_low $	$ 2*fy_high + 3*fx_high $
IMD frequency limits (MHz)	8894	9566	7101	7624

For UE coexistence study of Band n28 + Band n78, the 2nd, 3rd, 4th and 5th order harmonics and 2nd, 3rd, 4th and 5th order intermodulation products were calculated and presented in Table 5.1.15.3-2.

Table 5.1.15.3-2 Harmonic and IMD analysis

UE UL carriers	fx_low	fx_high	fy_low	fy_high
UL frequency (MHz)	703	748	3300	3800
2 nd harmonics frequency limits	$2*fx_low$	$2*fx_high$	$2* fy_low$	$2* fy_high$
2 nd harmonics frequency limits (MHz)	1406	1496	6600	7600
3 rd harmonics frequency limits	$3*fx_low$	$3*fx_high$	$3* fy_low$	$3* fy_high$
3 rd harmonics frequency limits (MHz)	2109	2244	9900	11400
4 th harmonics frequency limits	$4*fx_low$	$4*fx_high$	$4* fy_low$	$4* fy_high$
4 th harmonics frequency limits (MHz)	2812	2992	13200	15200
5 th harmonics frequency limits	$5*fx_low$	$5*fx_high$	$5* fy_low$	$5* fy_high$
5 th harmonics frequency limits (MHz)	3515	3740	16500	19000
2 nd order IMD products	$ fy_low - fx_high $	$ fy_high - fx_low $	$ fy_low + fx_low $	$ fy_high + fx_high $
IMD frequency limits (MHz)	2552	3097	4003	4548
Two-tone 3 rd order IMD products	$ 2*fx_low - fy_high $	$ 2*fx_high - fy_low $	$ 2*fy_low - fx_high $	$ 2*fy_high - fx_low $
IMD frequency limits (MHz)	2394	1804	5852	6897
Two-tone 3 rd order IMD products	$ 2*fx_low + fy_low $	$ 2*fx_high + fy_high $	$ 2*fy_low + fx_low $	$ 2*fy_high + fx_high $
IMD frequency limits (MHz)	4706	5296	7303	8348
Two-tone 4 th order IMD products	$ 3*fx_low - 1*fy_high $	$ 3*fx_high - 1*fy_low $	$ 3*fy_low - 1*fx_high $	$ 3*fy_high - 1*fx_low $
IMD frequency limits (MHz)	1691	1056	9152	10697
Two-tone 4 th order IMD products	$ 3*fx_low + 1*fy_low $	$ 3*fx_high + 1*fy_high $	$ 3*fy_low + 1*fx_low $	$ 3*fy_high + 1*fx_high $
IMD frequency limits (MHz)	5409	6044	10603	12148

Two-tone 4 th order IMD products	$ 2*fx_low - 2*fy_high $	$ 2*fx_high - 2*fy_low $	$ 2*fx_low + 2*fy_low $	$ 2*fx_high + 2*fy_high $
IMD frequency limits (MHz)	6194	5104	8006	9096
Two-tone 5 th order IMD products	$ fx_low - 4*fy_high $	$ fx_high - 4*fy_low $	$ fy_low - 4*fx_high $	$ fy_high - 4*fx_low $
IMD frequency limits (MHz)	14497	12452	308	988
Two-tone 5 th order IMD products	$ 2*fx_low - 3*fy_high $	$ 2*fx_high - 3*fy_low $	$ 2*fy_low - 3*fx_high $	$ 2*fy_high - 3*fx_low $
IMD frequency limits (MHz)	9994	8404	4356	5491
Two-tone 5 th order IMD products	$ fx_low + 4*fy_low $	$ fx_high + 4*fy_high $	$ fy_low + 4*fx_low $	$ fy_high + 4*fx_high $
IMD frequency limits (MHz)	13903	15948	6112	6792
Two-tone 5 th order IMD products	$ 2*fx_low + 3*fy_low $	$ 2*fx_high + 3*fy_high $	$ 2*fy_low + 3*fx_low $	$ 2*fy_high + 3*fx_high $
IMD frequency limits (MHz)	11306	12896	8709	9844

For UE coexistence study of Band n41 + Band n78, the 2nd, 3rd, 4th and 5th order harmonics and 2nd, 3rd, 4th and 5th order intermodulation products were calculated and presented in Table 5.1.15.3-3.

Table 5.1.15.3-3 Harmonic and IMD analysis

UE UL carriers	fx_low	fx_high	fy_low	fy_high
UL frequency (MHz)	2496	2690	3300	3800
2 nd harmonics frequency limits	$2*fx_low$	$2*fx_high$	$2*fy_low$	$2*fy_high$
2 nd harmonics frequency limits (MHz)	4992	5380	6600	7600
3 rd harmonics frequency limits	$3*fx_low$	$3*fx_high$	$3*fy_low$	$3*fy_high$
3 rd harmonics frequency limits (MHz)	7488	8070	9900	11400
4 th harmonics frequency limits	$4*fx_low$	$4*fx_high$	$4*fy_low$	$4*fy_high$
4 th harmonics frequency limits (MHz)	9984	10760	13200	15200
5 th harmonics frequency limits	$5*fx_low$	$5*fx_high$	$5*fy_low$	$5*fy_high$
5 th harmonics frequency limits (MHz)	12480	13450	16500	19000
2 nd order IMD products	$ fy_low - fx_high $	$ fy_high - fx_low $	$ fy_low + fx_low $	$ fy_high + fx_high $
IMD frequency limits (MHz)	610	1304	5796	6490
Two-tone 3 rd order IMD products	$ 2*fx_low - fy_high $	$ 2*fx_high - fy_low $	$ 2*fy_low - fx_high $	$ 2*fy_high - fx_low $
IMD frequency limits (MHz)	1192	2080	3910	5104
Two-tone 3 rd order IMD products	$ 2*fx_low + fy_low $	$ 2*fx_high + fy_high $	$ 2*fy_low + fx_low $	$ 2*fy_high + fx_high $
IMD frequency limits (MHz)	8292	9180	9096	10290
Two-tone 4 th order IMD products	$ 3*fx_low - 1*$	$ 3*fx_high -$	$ 3*fy_low -$	$ 3*fy_high -$

	$ fy_{high} $	$ 1*fy_{low} $	$ 1*fx_{high} $	$ 1*fx_{low} $
IMD frequency limits (MHz)	3688	4770	7210	8904
Two-tone 4 th order IMD products	$ 3*fx_{low} + 1*fy_{low} $	$ 3*fx_{high} + 1*fy_{high} $	$ 3*fy_{low} + 1*fx_{low} $	$ 3*fy_{high} + 1*fx_{high} $
IMD frequency limits (MHz)	10788	11870	12396	14090
Two-tone 4 th order IMD products	$ 2*fx_{low} - 2*fy_{high} $	$ 2*fx_{high} - 2*fy_{low} $	$ 2*fx_{low} + 2*fy_{low} $	$ 2*fx_{high} + 2*fy_{high} $
IMD frequency limits (MHz)	2608	1220	11592	12980
Two-tone 5 th order IMD products	$ fx_{low} - 4*fy_{high} $	$ fx_{high} - 4*fy_{low} $	$ fy_{low} - 4*fx_{high} $	$ fy_{high} - 4*fx_{low} $
IMD frequency limits (MHz)	12704	10510	7460	6184
Two-tone 5 th order IMD products	$ 2*fx_{low} - 3*fy_{high} $	$ 2*fx_{high} - 3*fy_{low} $	$ 2*fy_{low} - 3*fx_{high} $	$ 2*fy_{high} - 3*fx_{low} $
IMD frequency limits (MHz)	6408	4520	1470	112
Two-tone 5 th order IMD products	$ fx_{low} + 4*fy_{low} $	$ fx_{high} + 4*fy_{high} $	$ fy_{low} + 4*fx_{low} $	$ fy_{high} + 4*fx_{high} $
IMD frequency limits (MHz)	15696	17890	13284	14560
Two-tone 5 th order IMD products	$ 2*fx_{low} + 3*fy_{low} $	$ 2*fx_{high} + 3*fy_{high} $	$ 2*fy_{low} + 3*fx_{low} $	$ 2*fy_{high} + 3*fx_{high} $
IMD frequency limits (MHz)	14892	16780	14088	15670

2nd, 4th order IMD generated by dual uplink of Band n28 + Band n41 may fall into own Rx of Band n78.

2nd order IMD generated by dual uplink of Band n28 + Band n78 may fall into own Rx of Band n41.

2nd, 5th order IMD generated by dual uplink of Band n41 + Band n78 may fall into own Rx of Band n28.

5.1.15.4 $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values

For three simultaneous DLs and two ULs of Band n28, n41 and n78, the $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values are shown in table 5.1.15.4-1 and table 5.1.15.4-2, respectively.

Table 5.1.15.4-1: $\Delta T_{IB,c}$ for 3DL aggregation

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n28-n41-n78	n28	0.5
	n41	0.3
	n78	0.8

Table 5.1.15.4-2: $\Delta R_{IB,c}$ for 3DL aggregation

Inter-band CA Configuration	NR Band	$\Delta R_{IB,c}$ [dB]
CA_n28-n41-n78	n28	0.2
	n41	0
	n78	0.5

5.1.15.5 REFSENS requirements

MSD requirements for CA_n28-n41-n78 are shown below. The ENDC requirements of DC_28A-41A_n78A and DC_7A_n28A-n78A can be reused.

Table 5.1.15.5-1: 3DL/2UL interband Reference sensitivity QPSK $P_{REFSENS}$ and uplink/downlink configurations

Band / Channel bandwidth / N_{RB} / Duplex mode								Source of IMD
NR CA Configuration	NR band	UL F_c (MHz)	UL/DL BW (MHz)	UL C_{LRB}	DL F_c (MHz)	MSD (dB)	Duplex mode	
CA_n28A-n41A-n78A	n28	738	5	25	793	N/A	FDD	N/A
	n78	3380	10	50	3380	N/A	TDD	N/A
	n41	2642	5	25	2642	29.5	TDD	IMD2
	n41	2642	5	25	2642	N/A	TDD	N/A
	n78	3440	10	50	3440	N/A	TDD	N/A
	n28	743	5	25	798	30.8	FDD	IMD2 ^y
	n41	2565	5	25	2565	N/A	TDD	N/A
	n28	745	5	25	800	N/A	FDD	N/A
	n78	3310	10	50	3310	29.7	TDD	IMD2 ^z
NOTE y: This band is subject to IMD5 also which MSD is not specified.								
NOTE z: This band is subject to IMD4 also which MSD is not specified.								

5.2 inter-band within FR2

5.2.x CA_nX-nY-nZ

5.2.x.1 Operating bands for CA

Table 5.2.x.1-1: CA band combination of band nX+nY+nZ

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

5.2.x.2 Channel bandwidths per operating band for CA

Table 5.2.x.2-1: Supported bandwidths per CA band combination of band nX+nY+nZ

NR CA configuration / Bandwidth combination set									
NR CA configuration	Uplink configuration	NR Band	SCS (kHz z)	50 MHz	100 MHz	200 MHz	400 MHz	Maximum Aggregated bandwidth [MHz]	Bandwidth combination set
CA_nXA-nYA-nZA	CA_nXA-nYA	nX	60	—	—	—	—	0	0
			120	—	—	—	—		
		nY	60	—	—	—	—		
			120	—	—	—	—		
		nZ	60	—	—	—	—		
			120	—	—	—	—		

5.2.x.3 UE co-existence studies

<Editor's note: Text will be added on whether there are IMD issues due to dual uplink operation falling into the DL of the third band. For example: for CA_nXA-nYA-nZA with 2UL CA_nXA-nYA, intermodulation due to Band nX and Band nY falling into Band nZ shall be verified.>

5.2.x.4 ΔT_{IB} and ΔR_{IB} values

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

Table 5.2.x.4-1: $\Delta T_{IB,c}$

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

Table 5.2.x.4-2: $\Delta R_{IB,c}$

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

5.2.x.5 REFSENS requirements

< Editor's note: Text will be added on reference sensitivity exceptions if IMD issue due to dual uplink operation falling into DL of the third band are identified. >

5.3 inter-band between FR1 and FR2

5.3.1 CA_n28-n77-n257

5.3.1.1 Operating bands for CA

Table 5.3.1.1-1: CA band combination of band n28+n77+n257

NR Band	Uplink (UL) band				Downlink (DL) band				Duplex mode	
	BS receive / UE transmit				BS transmit / UE receive					
	$F_{UL_low} - F_{UL_high}$				$F_{DL_low} - F_{DL_high}$					
n28	703MHz – 748MHz				758MHz – 803MHz				FDD	
n77	3300MHz – 4200MHz				3300MHz – 4200MHz				TDD	
n257	26500MHz – 29500MHz				26500MHz – 29500MHz				TDD	

5.3.1.2 Channel bandwidths per operating band for CA

Table 5.3.1.2-1: Supported bandwidths per CA band combination of band n28+n77+n257

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	80 MHz	90 MHz	100 MHz	200 MHz	400 MHz	Bandwidth combination set
CA_n28A-n77A-n257A	CA_n28A-n77A	n28	15	Yes	Yes	Yes	Yes										0	
			30		Yes	Yes	Yes											
			60															
	CA_n28A-n257A	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			

5.3.1.3 UE co-existence studies

The coexistence studies of UL Band n28 + Band n77, Band n28 + Band n257 and Band n77 + Band n257 have been captured in the constituent fallback modes in TR 38.716-02-00. According to the coexistence studies in TR 38.716-02-00, there is no own Rx impact of the 3rd band for this combination.

5.3.1.4 ΔT_{IB} and ΔR_{IB} values

For three DLs and two ULs of Band n28, n77 and n257, the $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values are shown in table 5.3.1.4-1 and table 5.3.1.4-2, respectively.

Table 5.3.1.4-1: $\Delta T_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n28-n77-n257	n28	0.5
	n77	0.8
	n257	0

Table 5.3.1.4-2: $\Delta R_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta R_{IB,c}$ [dB]
CA_n28-n77-n257	n28	0.2
	n77	0.5
	n257	0

5.3.1.5 REFSENS requirements

There is no additional REFSENS requirement for this combination.

5.3.2 CA_n28-n78-n257

5.3.2.1 Operating bands for CA

Table 5.3.2.1-1: CA band combination of band n28+n78+n257

NR Band	Uplink (UL) band	Downlink (DL) band	Duplex mode
	BS receive / UE transmit	BS transmit / UE receive	
	$F_{UL_low} - F_{UL_high}$	$F_{DL_low} - F_{DL_high}$	
n28	703MHz – 748MHz	758MHz – 803MHz	FDD
n78	3300MHz – 3800MHz	3300MHz – 3800MHz	TDD
n257	26500MHz – 29500MHz	26500MHz – 29500MHz	TDD

5.3.2.2 Channel bandwidths per operating band for CA

Table 5.3.2.2-1: Supported bandwidths per CA band combination of band n28+n78+n257

5.3.2.3 UE co-existence studies

The coexistence studies of UL Band n28 + Band n78, Band n28 + Band n257 and Band n78 + Band n257 have been captured in the constituent fallback modes in TR 38.716-02-00. According to the coexistence studies in TR 38.716-02-00, there is no own Rx impact of the 3rd band for this combination.

5.3.2.4 ΔT_{IB} and ΔR_{IB} values

For three DLs and two ULs of Band n28, n78 and n257, the $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values are shown in table 5.3.2.4-1 and table 5.3.2.4-2, respectively.

Table 5.3.2.4-1: $\Delta T_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n28-n78-n257	n28	0.5
	n78	0.8
	n257	0

Table 5.3.2.4-2: $\Delta R_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta R_{IB,c}$ [dB]
CA_n28-n78-n257	n28	0.2
	n78	0.5
	n257	0

5.3.2.5 REFSENS requirements

There is no additional REFSENS requirement for this combination.

5.3.3 CA_n28-n77-n257

5.3.3.1 Operating bands for CA

Table 5.3.3.1-1: CA band combination of band n28+n77+n257

NR Band	Uplink (UL) band	Downlink (DL) band	Duplex mode
	BS receive / UE transmit	BS transmit / UE receive	
	$F_{UL_low} - F_{UL_high}$	$F_{DL_low} - F_{DL_high}$	
n28	703MHz – 748MHz	758MHz – 803MHz	FDD
n77	3300MHz – 4200MHz	3300MHz – 4200MHz	TDD
n257	26500MHz – 29500MHz	26500MHz – 29500MHz	TDD

5.3.3.2 Channel bandwidths per operating band for CA

Table 5.3.3.2-1: Supported bandwidths per CA band combination of band n28+n77+n257

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	80 MHz	90 MHz	100 MHz	200 MHz	400 MHz	Bandwidth combination set	
CA_n28A-n77(2A)-n257A	CA_n28A-n77A CA_n28A-n257A CA_n77A-n257A	n28	15	Yes	Yes	Yes	Yes											0	
			30		Yes	Yes	Yes												
			60																
		n77	See CA_n77(2A) in Table 5.5A.2-1 in TS 38.101-1																
			60								Yes				Yes	Yes			
	CA_n28A-n77(2A)-n257D	n257	120							Yes					Yes	Yes	Yes		
			60																
		n77	See CA_n77(2A) in Table 5.5A.2-1 in TS 38.101-1																
			120																
		n257	See CA_n257D in Table 5.5A.1-1 in TS 38.101-2																
			60																
CA_n28A-n77(2A)-n257G	CA_n28A-n77A CA_n28A-n257A CA_n28A-n257G CA_n77A-n257A CA_n77A-n257G	n28	15	Yes	Yes	Yes	Yes	Yes										0	
			30		Yes	Yes	Yes	Yes											
			60																
		n77	See CA_n77(2A) in Table 5.5A.2-1 in TS 38.101-1																
			120																
		n257	See CA_n257G in Table 5.5A.1-1 in TS 38.101-2																
			60																
CA_n28A-n77(2A)-n257H	CA_n28A-n77A CA_n28A-n257A CA_n28A-n257G CA_n28A-n257H CA_n77A-n257A CA_n77A-n257G CA_n77A-n257H	n28	15	Yes	Yes	Yes	Yes	Yes										0	
			30		Yes	Yes	Yes	Yes											
			60																
		n77	See CA_n77(2A) in Table 5.5A.2-1 in TS 38.101-1																
			120																
		n257	See CA_n257H in Table 5.5A.1-1 in TS 38.101-2																
			60																
CA_n28A-n77(2A)-n257I	CA_n28A-n77A CA_n28A-n257A CA_n28A-n257G CA_n28A-n257H CA_n28A-n257I CA_n77A-n257A CA_n77A-n257G CA_n77A-n257H CA_n77A-n257I	n28	15	Yes	Yes	Yes	Yes	Yes										0	
			30		Yes	Yes	Yes	Yes											
			60																
		n77	See CA_n77(2A) in Table 5.5A.2-1 in TS 38.101-1																
			120																
		n257	See CA_n257I in Table 5.5A.1-1 in TS 38.101-2																
			60																

5.3.3.3 UE co-existence studies

The coexistence studies of UL Band n28 + Band n77, Band n28 + Band n257 and Band n77 + Band n257 have been captured in the constituent fallback modes in TR 38.716-02-00. According to the coexistence studies in TR 38.716-02-00, there is no own Rx impact of the 3rd band for this combination.

5.3.3.4 ΔT_{IB} and ΔR_{IB} values

For three DLs and two ULs of Band n28, n77 and n257, the $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values are shown in table 5.3.3.4-1 and table 5.3.3.4-2, respectively.

Table 5.3.3.4-1: $\Delta T_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n28-n77-n257	n28	0.5
	n77	0.8
	n257	0

Table 5.3.3.4-2: $\Delta R_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta R_{IB,c}$ [dB]
CA_n28-n77-n257	n28	0.2
	n77	0.5
	n257	0

5.3.3.5 REFSENS requirements

There is no additional REFSENS requirement for this combination.

5.3.4 CA_n77-n79-n257

5.3.4.1 Operating bands for CA

Table 5.3.4.1-1: CA band combination of band CA_n77-n79-n257

NR Band	Uplink (UL) band	Downlink (DL) band	Duplex mode
	BS receive / UE transmit	BS transmit / UE receive	
	$F_{UL_low} - F_{UL_high}$	$F_{DL_low} - F_{DL_high}$	
n77	3300MHz – 4200MHz	3300MHz – 4200MHz	TDD
n79	4400MHz – 5000MHz	4400MHz – 5000MHz	TDD
n257	26500MHz – 29500MHz	26500MHz – 29500MHz	TDD

5.3.4.2 Channel bandwidths per operating band for CA

Table 5.3.4.2-1: Supported bandwidths per CA band combination of band CA_n77-n79-n257

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	80 MHz	90 MHz	100 MHz	200 MHz	400 MHz	Bandwidth combination set	
CA_n77-n79A-n257A	CA_n77A-n257A CA_n79A-n257A	n77	15		Yes	Yes	Yes			Yes	Yes							0	
			30		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes				
			60		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes				
		n79	15							Yes	Yes								
			30							Yes	Yes	Yes	Yes		Yes				
			60							Yes	Yes	Yes	Yes		Yes				
		n257	60								Yes				Yes	Yes			
			120								Yes				Yes	Yes	Yes		
CA_n77-n79A-n257G	CA_n77A-n257A CA_n77A-n257G CA_n79A-n257A CA_n79A-n257G	n77	15		Yes	Yes	Yes			Yes	Yes							0	
			30		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes				
			60		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes				
		n79	15							Yes	Yes								
			30							Yes	Yes	Yes	Yes		Yes				
			60							Yes	Yes	Yes	Yes		Yes				
		n257	See CA_n257G in Table 5.5A.1-1 in TS 38.101-2																
			15		Yes	Yes	Yes			Yes	Yes								
			30		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes				
CA_n77-n79A-n257H	CA_n77A-n257A CA_n77A-n257G CA_n77A-n257H CA_n79A-n257A CA_n79A-n257G CA_n79A-n257H	n77	60		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes			0	
			15							Yes	Yes								
			30							Yes	Yes	Yes	Yes		Yes				
		n79	60							Yes	Yes	Yes	Yes	Yes	Yes				
			15							Yes	Yes								
			30							Yes	Yes	Yes	Yes		Yes				
		n257	60							Yes	Yes	Yes	Yes		Yes				
			See CA_n257G and n257H in Table 5.5A.1-1 in TS 38.101-2																
			15		Yes	Yes	Yes			Yes	Yes								
CA_n77-n79A-n257I	CA_n77A-n257A CA_n77A-n257G CA_n77A-n257H CA_n77A-n257I CA_n79A-n257A CA_n79A-n257G CA_n79A-n257H CA_n79A-n257I	n77	30		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes			0	
			60		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes				
			15							Yes	Yes								
		n79	30							Yes	Yes	Yes	Yes		Yes				
			60							Yes	Yes	Yes	Yes		Yes				
			15							Yes	Yes								
		n257	30							Yes	Yes	Yes	Yes		Yes				
			60							Yes	Yes	Yes	Yes		Yes				
			See CA_n257G, n257H, and n257I in Table 5.5A.1-1 in TS 38.101-2																

5.3.4.3 UE co-existence studies

Co-existence studies can be omitted because harmonic interference from n77 to n79 and from n79 to n77 have been already studied for NR CA n77-n79 as described in TR 37.865-01-01, and interference between FR1 bands and FR2 band are negligible.

5.3.4.4 ΔT_{IB} and ΔR_{IB} values

For three simultaneous DLs and one UL of Band n77, n79 and n257, the $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values are shown in table 5.3.4.4-1 and table 5.3.4.4-2, respectively. The $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values are derived from TR 37.865-01-01.

Table 5.3.4.4-1: $\Delta T_{IB,c}$ for 3DL aggregation

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n77-n79-n257	n77	0
	n79	0
	n257	0

Table 5.3.4.4-2: $\Delta R_{IB,c}$ for 3DL aggregation

Inter-band CA Configuration	NR Band	$\Delta R_{IB,c}$ [dB]
CA_n78-n79-n257	n77	0
	n79	0
	n257	0

5.3.4.5 REFSENS requirements

MSD studies can be omitted because harmonic interference from n77 to n79 and from n79 to n77 have been already studied for NR CA n77-n79 as described in TR 37.865-01-01, and interference between FR1 bands and FR2 band are negligible.

5.3.5 CA_n78-n79-n257

5.3.5.1 Operating bands for CA

Table 5.3.5.1-1: CA band combination of band CA_n78-n79-n257

NR Band	Uplink (UL) band	Downlink (DL) band	Duplex mode
	BS receive / UE transmit	BS transmit / UE receive	
	$F_{UL_low} - F_{UL_high}$	$F_{DL_low} - F_{DL_high}$	
n78	3300MHz – 3800MHz	3300MHz – 3800MHz	TDD
n79	4400MHz – 5000MHz	4400MHz – 5000MHz	TDD
n257	26500MHz – 29500MHz	26500MHz – 29500MHz	TDD

5.3.5.2 Channel bandwidths per operating band for CA

Table 5.3.5.2-1: Supported bandwidths per CA band combination of band CA_n78-n79-n257

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	80 MHz	90 MHz	100 MHz	200 MHz	400 MHz	Bandwidth combination set	
CA_n78-n79A-n257A	CA_n78A-n257A CA_n79A-n257A	n78	15		Yes	Yes	Yes			Yes	Yes							0	
			30		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes				
			60		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes				
		n79	15							Yes	Yes								
			30							Yes	Yes	Yes	Yes		Yes				
			60							Yes	Yes	Yes	Yes		Yes				
		n257	60								Yes				Yes	Yes			
			120								Yes				Yes	Yes	Yes		
CA_n78-n79A-n257G	CA_n78A-n257A CA_n78A-n257G CA_n79A-n257A CA_n79A-n257G	n78	15		Yes	Yes	Yes			Yes	Yes							0	
			30		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes				
			60		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes				
		n79	15							Yes	Yes								
			30							Yes	Yes	Yes	Yes		Yes				
			60							Yes	Yes	Yes	Yes		Yes				
		n257	See CA_n257G in Table 5.5A.1-1 in TS 38.101-2																
			15		Yes	Yes	Yes			Yes	Yes								
			30		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes				
CA_n78-n79A-n257H	CA_n78A-n257A CA_n78A-n257G CA_n78A-n257H CA_n79A-n257A CA_n79A-n257G CA_n79A-n257H	n78	60		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes			0	
			15							Yes	Yes								
			30							Yes	Yes	Yes	Yes		Yes				
		n79	60							Yes	Yes	Yes	Yes	Yes	Yes				
			15							Yes	Yes								
			30							Yes	Yes	Yes	Yes		Yes				
		n257	60							Yes	Yes	Yes	Yes		Yes				
			See CA_n257G and n257H in Table 5.5A.1-1 in TS 38.101-2																
			15		Yes	Yes	Yes			Yes	Yes								
CA_n78-n79A-n257I	CA_n78A-n257A CA_n78A-n257G CA_n78A-n257H CA_n78A-n257I CA_n79A-n257A CA_n79A-n257G CA_n79A-n257H CA_n79A-n257I	n78	30		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes			0	
			60		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes				
			15							Yes	Yes								
		n79	30							Yes	Yes	Yes	Yes		Yes				
			60							Yes	Yes	Yes	Yes		Yes				
			15							Yes	Yes								
		n257	30							Yes	Yes	Yes	Yes		Yes				
			60							Yes	Yes	Yes	Yes		Yes				
			See CA_n257G, n257H, and n257I in Table 5.5A.1-1 in TS 38.101-2																

5.3.5.3 UE co-existence studies

Co-existence studies can be omitted because harmonic interference from n78 to n79 and from n79 to n78 have been already studied for NR CA n78-n79 as described in TR 37.865-01-01, and interference between FR1 bands and FR2 band are negligible.

5.3.5.4 ΔT_{IB} and ΔR_{IB} values

For three simultaneous DLs and one UL of Band n78, n79 and n257, the $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values are shown in table 6.x.4-1 and table 6.x.4-2, respectively. The $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values are derived from TR 37.865-01-01.

Table 6.x.4-1: $\Delta T_{IB,c}$ for 3DL aggregation

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n78-n79-n257	n78	0.5
	n79	0.5
	n257	0

Table 6.x.4-2: $\Delta R_{IB,c}$ for 3DL aggregation

Inter-band CA Configuration	NR Band	$\Delta R_{IB,c}$ [dB]
CA_n78-n79-n257	n78	0
	n79	0
	n257	0

5.3.5.5 REFSENS requirements

MSD studies can be omitted because harmonic interference from n78 to n79 and from n79 to n78 have been already studied for NR CA n78-n79 as described in TR 37.865-01-01, and interference between FR1 bands and FR2 band are negligible.

5.3.6 CA_n3-n78-n257

5.3.6.1 Operating bands for CA

Table 5.3.6.1-1: CA band combination of band n3+n78+n257

NR Band	Uplink (UL) band			Downlink (DL) band			Duplex mode	
	BS receive / UE transmit			BS transmit / UE receive				
	$F_{UL_low} - F_{UL_high}$			$F_{DL_low} - F_{DL_high}$				
n3	1710MHz – 1785MHz			1805MHz – 1880MHz			FDD	
n78	3300MHz – 3800MHz			3300MHz – 3800MHz			TDD	
n257	26500MHz – 29500MHz			26500MHz – 29500MHz			TDD	

5.3.6.2 Channel bandwidths per operating band for CA

Table 5.3.6.2-1: Supported bandwidths per CA band combination of band n3+n78+n257

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	80 MHz	90 MHz	100 MHz	200 MHz	400 MHz	Bandwidth combination set
CA_n3A-n78A-n257A	CA_n3A-n78A	n3	15	Yes	Yes	Yes	Yes	Yes	Yes								0	
	CA_n3A-n257A		30		Yes	Yes	Yes	Yes	Yes									

			60		Yes	Yes	Yes	Yes	Yes														
CA_n3A-n78A-n257D	CA_n3A-n78A CA_n3A-n257A CA_n3A-n257D CA_n78A-n257A CA_n78A-n257D	n78	15		Yes	Yes	Yes			Yes	Yes												
			30		Yes	Yes	Yes			Yes													
			60		Yes	Yes	Yes			Yes													
		n257	60								Yes								Yes	Yes	Yes		
			120								Yes								Yes	Yes	Yes		
		n3	15	Yes	Yes	Yes	Yes	Yes	Yes														
		n78	30		Yes	Yes	Yes	Yes	Yes														
			60		Yes	Yes	Yes	Yes	Yes														
			15		Yes	Yes	Yes	Yes			Yes	Yes											
		n257	30		Yes	Yes	Yes				Yes												
			60		Yes	Yes	Yes				Yes												
			See CA_n257D in Table 5.5A.1-1 in TS 38.101-2																				
CA_n3A-n78A-n257G	CA_n3A-n78A CA_n3A-n257A CA_n3A-n257G CA_n78A-n257A CA_n78A-n257G	n3	15	Yes																			
			30		Yes																		
			60		Yes																		
		n78	15		Yes	Yes	Yes	Yes				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_n3A-n78A-n257H	CA_n3A-n78A CA_n3A-n257A CA_n3A-n257G CA_n3A-n257H CA_n78A-n257A CA_n78A-n257G CA_n78A-n257H	n3	15	Yes																			
			30		Yes																		
			60		Yes																		
		n78	15		Yes	Yes	Yes	Yes				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_n3A-n78A-n257I	CA_n3A-n78A CA_n3A-n257A CA_n3A-n257G CA_n3A-n257H CA_n3A-n257I CA_n78A-n257A CA_n78A-n257G CA_n78A-n257H CA_n78A-n257I	n3	15	Yes																			
			30		Yes																		
			60		Yes																		
		n78	15		Yes	Yes	Yes	Yes				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																				

5.3.6.3 UE co-existence studies

The coexistence studies of UL Band n3 + Band n78, Band n3 + Band n257 and Band n78 + Band n257 have been captured in the constituent fallback modes in TR 38.716-02-00. According to the coexistence studies in TR 38.716-02-00, there is no own Rx impact of the 3rd band for this combination.

5.3.6.4 ΔT_{IB} and ΔR_{IB} values

For three DLs and two ULs of Band n3, n78 and n257, the $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values are shown in table 5.3.6.4-1 and table 5.3.6.4-2, respectively.

Table 5.3.6.4-1: $\Delta T_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n3-n78-n257	n3	0.6
	n78	0.8
	n257	0

Table 5.3.6.4-2: $\Delta R_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta R_{IB,c}$ [dB]
CA_n3-n78-n257	n3	0.2
	n78	0.5
	n257	0

5.3.6.5 REFSENS requirements

There is no additional REFSENS requirement for this combination.

5.3.7 CA_n3-n77-n257

5.3.7.1 Operating bands for CA

Table 5.3.7.1-1: CA band combination of band n3+n77+n257

NR Band	Uplink (UL) band		Duplex mode	
	BS receive / UE transmit			
	$F_{UL_low} - F_{UL_high}$	$F_{DL_low} - F_{DL_high}$		
n3	1710MHz – 1785MHz	1805MHz – 1880MHz	FDD	
n77	3300MHz – 4200MHz	3300MHz – 4200MHz	TDD	
n257	26500MHz – 29500MHz	26500MHz – 29500MHz	TDD	

5.3.7.2 Channel bandwidths per operating band for CA

Table 5.3.7.2-1: Supported bandwidths per CA band combination of band n3+n77+n257

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	80 MHz	90 MHz	100 MHz	200 MHz	400 MHz	Bandwidth combination set	
CA_n3A-n77(2A)-n257A	CA_n3A-n77A CA_n3A-n257A CA_n77A-n257A	n3	15	Yes	Yes	Yes	Yes	Yes	Yes									0	
			30		Yes	Yes	Yes	Yes	Yes	Yes									
			60		Yes	Yes	Yes	Yes	Yes	Yes									
		n77	See CA_n77(2A) Bandwidth Combination Set 0																
			n257	60							Yes				Yes	Yes			
		n257	120								Yes				Yes	Yes	Yes		
			See CA_n257D in Table 5.5A.1-1 in TS 38.101-2																
CA_n3A-n77(2A)-n257D	CA_n3A-n77A CA_n3A-n257A CA_n3A-n257D CA_n77A-n257A CA_n77A-n257D	n3	15	Yes	Yes	Yes	Yes	Yes	Yes	Yes								0	
			30		Yes														
			60		Yes														
		n77	See CA_n77(2A) Bandwidth Combination Set 0																
			n257	See CA_n257D in Table 5.5A.1-1 in TS 38.101-2															
CA_n3A-n77(2A)-n257G	CA_n3A-n77A CA_n3A-n257A CA_n3A-n257D CA_n3A-n257G CA_n77A-n257A CA_n77A-n257G	n3	15	Yes	Yes	Yes	Yes	Yes	Yes	Yes								0	
			30		Yes														
			60		Yes														
		n77	See CA_n77(2A) Bandwidth Combination Set 0																
			n257	See CA_n257G in Table 5.5A.1-1 in TS 38.101-2															
CA_n3A-n77(2A)-n257H	CA_n3A-n77A CA_n3A-n257A CA_n3A-n257G CA_n3A-n257H CA_n77A-n257A CA_n77A-n257G CA_n77A-n257H	n3	15	Yes	Yes	Yes	Yes	Yes	Yes	Yes								0	
			30		Yes														
			60		Yes														
		n77	See CA_n77(2A) Bandwidth Combination Set 0																
			n257	See CA_n257H in Table 5.5A.1-1 in TS 38.101-2															
CA_n3A-n77(2A)-n257I	CA_n3A-n77A CA_n3A-n257A CA_n3A-n257G CA_n3A-n257H CA_n3A-n257I CA_n77A-n257A CA_n77A-n257G CA_n77A-n257H CA_n77A-n257I	n3	15	Yes	Yes	Yes	Yes	Yes	Yes	Yes								0	
			30		Yes														
			60		Yes														
		n77	See CA_n77(2A) Bandwidth Combination Set 0																
			n257	See CA_n257I in Table 5.5A.1-1 in TS 38.101-2															

5.3.7.3 UE co-existence studies

The coexistence studies of UL Band n3 + Band n77, Band n3 + Band n257 and Band n77 + Band n257 have been captured in the constituent fallback modes in TR 38.716-02-00. According to the coexistence studies in TR 38.716-02-00, there is no own Rx impact of the 3rd band for this combination.

5.3.7.4 ΔT_{IB} and ΔR_{IB} values

For three DLs and two ULs of Band n3, n77 and n257, the $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values are shown in table 5.3.7.4-1 and table 5.3.7.4-2, respectively.

Table 5.3.7.4-1: $\Delta T_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n3-n77-n257	n3	0.6
	n77	0.8
	n257	0

Table 5.3.7.4-2: $\Delta R_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta R_{IB,c}$ [dB]
CA_n3-n77-n257	n3	0.2
	n77	0.5
	n257	0

5.3.7.5 REFSENS requirements

There is no additional REFSENS requirement for this combination.

5.3.8 CA_n3-n77-n257

5.3.8.1 Operating bands for CA

Table 5.3.8.1-1: CA band combination of band n3+n77+n257

NR Band	Uplink (UL) band		Duplex mode	
	BS receive / UE transmit			
	$F_{UL_low} - F_{UL_high}$	$F_{DL_low} - F_{DL_high}$		
n3	1710MHz – 1785MHz	1805MHz – 1880MHz	FDD	
n77	3300MHz – 4200MHz	3300MHz – 4200MHz	TDD	
n257	26500MHz – 29500MHz	26500MHz – 29500MHz	TDD	

5.3.8.2 Channel bandwidths per operating band for CA

Table 5.3.8.2-1: Supported bandwidths per CA band combination of band n3+n77+n257

5.3.8.3 UE co-existence studies

The coexistence studies of UL Band n3 + Band n77, Band n3 + Band n257 and Band n77 + Band n257 have been captured in the constituent fallback modes in TR 38.716-02-00. According to the coexistence studies in TR 38.716-02-00, there is no own Rx impact of the 3rd band for this combination.

5.3.8.4 ΔT_{IB} and ΔR_{IB} values

For three DLs and two ULs of Band n3, n77 and n257, the $\Delta T_{IB,c}$ and $\Delta R_{IB,c}$ values are shown in table 5.3.8.4-1 and table 5.3.8.4-2, respectively.

Table 5.3.8.4-1: $\Delta T_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta T_{IB,c}$ [dB]
CA_n3-n77-n257	n3	0.6
	n77	0.8
	n257	0

Table 5.3.8.4-2: $\Delta R_{IB,c}$

Inter-band CA Configuration	NR Band	$\Delta R_{IB,c}$ [dB]
CA_n3-n77-n257	n3	0.2
	n77	0.5
	n257	0

5.3.8.5 REFSENS requirements

There is no additional REFSENS requirement for this combination.

6 2 bands Dual Connectivity with 3 bands DL: Specific Band Combination Part

6.X DC_nX-nY-nZ

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

Annex A:

Change history

Change history							
Date	Meeting	TDoc	CR	Rev	Cat	Subject/Comment	New version
2019-04	RAN4#90 bis	R4-1903829				TR skeleton	0.0.1
2019-08	RAN4#92	R4-1909516				Implemented TP's from RAN4 #91: R4-1906107 TP for TR 38.716-03-02: CA_n1A-n3A-n78A with 2UL, China Telecom, R4-1905624 TP for TR38.716-03-02:2 bands UL for CA_40A-n41A-n79A, ZTE Corporation	V0.1.0
2019-10	RAN4#92 bis	R4-1910834				Implemented TP's from RAN4 #92: R4-1908271 TP for TR 38.716-03-02: CA_n28A-n77A-n257, KDDI R4-1908273 TP for TR 38.716-03-02: CA_n28A-n78A-n257, KDDI R4-1908567 TP for TR38.716-03-02 2 bands UL for CA_n3-n8-n78, ZTE Corporation	V0.2.0
2019-11	RAN4#93	R4-1913238				Implemented TP's from RAN4 #92bis: R4-1911248 TP for TR38.716-03-02_ CA_n3A_n40A-n41A, ZTE Corporation R4-1912577 TP for TR 38.716-03-02 CA_n28A-n77(2A)-n257, KDDI R4-1911710 TP for CA_n77-n79-n257 for TR 38.716-03-02, NTT DOCOMO, INC. R4-1911712 TP for CA_n78-n79-n257 for TR 38.716-03-02, NTT DOCOMO, INC.	V0.3.0
2020-02	RAN4#94 -e	R4-2000804				Implemented TP's from RAN4 #93: R4-1915684, TP for TR 38.716-03-02 CA_n3A-n78A-n257, KDDI R4-1915685, TP for TR 38.716-03-02 CA_n3A-n77(2A)-n257, KDDI R4-1915686, TP for TR 38.716-03-02 CA_n3A-n77A-n257, KDDI R4-1915687, TP for TR 38.716-03-02: CA_n1A-n3A-n41A with two UL bands, Huawei, HiSilicon	V0.4.0
2020-04	RAN4#94 bis-e					Implemented TP's from RAN4 #94-e: 1. R4-2002669, TP for TR38.716-03-02: UL CA Requirements for CA_n66A-n70A-n71A, CA_n66B-n70A-n71A, and CA_n66(2A)-n70A-n71A, Dish Network 2. R4-2000475 , TP for TR38.716-03-02: updated the MSD value for CA_n3-n40A-n41A, ZTE Corporation 3. R4-2000476 , TP for TR38.716-03-02: updated the MSD value for CA_n40A-n41A-n79A, ZTE Corporation 4. R4-2002670, TP for TR 38.716-03-02: CA_n3-n28-n77, SoftBank Corp. 5. R4-2002671, TP for TR 38.716-03-02 to include CA_n1-n7-n28, Ericsson, BT plc 6. R4-2001523, TP for TR 38.716-03-02: CA_n1-n7-n78, Ericsson, BT plc	V0.5.0

2020-05	RAN4#95					Implemented TP's from RAN4 #94-e-Bis: 1, R4-2005080 TP for TR 38.716-03-02: CA_n3A-n28A-n78A, Samsung, KDDI 2, R4-2003460 TP update for TR 38.716-03-02: CA_n3-n28-n77, SoftBank Corp.	V0.6.0
2020-06	RAN4#95	R4-2006873				Implemented TP's from RAN4-95-e: 1, R4-2008372 TP to TR 38.716-03-02 for CA_n7-n25-n66, Huawei, HiSilicon, Bell Mobility, Telus 2, R4-2008373 TP to TR 38.716-03-02 for CA_n7-n66-n78, Huawei, HiSilicon, Bell Mobility, Telus 3, R4-2008374 TP to TR 38.716-03-02 for CA_n25-n66-n78, Huawei, HiSilicon, Bell Mobility, Telus 4, R4-2006610 TP to TR 38.716-03-02 for CA_n5-n66-n78, Huawei, HiSilicon, Bell Mobility, Telus 5, R4-2006929 TP for TR 38.716-03-02 CA_n1A-n3A-n78A with 2UL, China Telecom 6, R4-2008375 TP for TR 38.716-03-02: CA_n28A-n41A-n78A with two UL bands, Huawei, HiSilicon, Etisalat 7, R4-2006068 Correction to n29-n66-n70 CA combination, Dish Network	V0.7.0
2020-06	RAN#88	RP-200675				v1.0.0 submitted for plenary approval	V1.0.0a

Date	Meeting	TDoc	CR	Rev	Cat	Subject/Comment	New version
2020-06	RAN#88					Approved by plenary – Rel-16 spec under change control	16.0.0