# 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:

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

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

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

# 1 Scope

The present document establishes the minimum RF requirements for NR User Equipment (UE) operating on frequency Range 1.

# 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 38.101-2: "NR; User Equipment (UE) radio transmission and reception; Part 2: Range 2 Standalone".

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

[4] 3GPP TS 38.521-1: "NR; User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: Range 1 Standalone".

[5] Recommendation ITU-R M.1545: "Measurement uncertainty as it applies to test limits for the terrestrial component of International Mobile Telecommunications-2000".

[6] 3GPP TS 38.211: "NR; Physical channels and modulation".

[7] 3GPP TS 38.331: "Radio Resource Control (RRC) protocol specification".

[8] 3GPP TS 38.213: "NR; Physical layer procedures for control".

[9] ITU-R Recommendation SM.329-10, "Unwanted emissions in the spurious domain".

[10] 3GPP TS 38.214: "NR; Physical layer procedures for data".

# 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.

**Carrier aggregation band**: A set of one or more operating bands across which multiple carriers are aggregated with a specific set of technical requirements.

**Carrier aggregation bandwidth class**: A class defined by the aggregated transmission bandwidth configuration and maximum number of component carriers supported by a UE.

**Carrier aggregation configuration**: A combination of CA operating band(s) and CA bandwidth class(es) supported by a UE.

**Contiguous carriers**: A set of two or more carriers configured in a spectrum block where there are no RF requirements based on co-existence for un-coordinated operation within the spectrum block.

**Contiguous resource allocation**: A resource allocation of consecutive resource blocks within one carrier or across contiguously aggregated carriers. The gap between contiguously aggregated carriers due to the nominal channel spacing is allowed.

**Contiguous spectrum**: Spectrum consisting of a contiguous block of spectrum with no sub-block gaps.

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

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

**Intra-band contiguous carrier aggregation**: Contiguous carriers aggregated in the same operating band.

**Intra-band non-contiguous carrier aggregation**: Non-contiguous carriers aggregated in the same operating band.

**Sub-block**: This is one contiguous allocated block of spectrum for transmission and reception by the same UE. There may be multiple instances of sub-blocks within an RF bandwidth.

**Sub-block bandwidth**: The bandwidth of one sub-block.

**Sub-block gap**: A frequency gap between two consecutive sub-blocks within an RF bandwidth, where the RF requirements in the gap are based on co-existence for un-coordinated operation.

**UE transmission bandwidth configuration**: Set of resource blocks located within the UE channel bandwidth which may be used for transmitting or receiving by the UE.

**Vehicular UE:** A UE embedded in a vehicle, permanently connected to an embedded antenna system that radiates externally for NR operating bands.

NOTE: Vehicular UE does not refer to other UE form factors placed inside the vehicle.

## 3.2 Symbols

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

ΔFGlobal Granularity of the global frequency raster

ΔFRaster Band dependent channel raster granularity

ΔfOOB Δ Frequency of Out Of Band emission

ΔFTX-RX Δ Frequency of default TX-RX separation of the FDD *operating band*

ΔPPowerClass Adjustment to maximum output power for a given power class

RB The starting frequency offset between the allocated RB and the measured non-allocated RB

ΔRIB,c Allowed reference sensitivity relaxation due to support for inter-band CA operation, for serving cell *c*

ΔRIB,4R Reference sensitivity adjustment due to support for 4 antenna ports

ΔShift Channel raster offset

TC Allowed operating band edge transmission power relaxation

TC,*c*Allowed operating band edge transmission power relaxation for serving cell *c*

ΔTIB,c Allowed maximum configured output power relaxation due to support for inter-band CA operation and due to support for SUL operations, for serving cell *c*

BWChannel Channel bandwidth

BWChannel,block Sub-block bandwidth, expressed in MHz. BWChannel,block= Fedge,block,high- Fedge,block,low

BWChannel\_CA Aggregated channel bandwidth, expressed in MHz

BWChannel,max Maximum channel bandwidth supported among all bands in a release

BWGB max( BWGB,Channel(*k*) )

BWGB,Channel(k) Minimum guard band defined in clause 5.3A.1 of carrier *k*

BWDL Channel bandwidth for DL

BWUL Channel bandwidth for UL

BWinterferer Bandwidth of the interferer

Ceil(x) Rounding upwards; ceil(x) is the smallest integer such that ceil(x) ≥ x

Floor(x) Rounding downwards; floor(x) is the greatest integer such that floor(x) ≤ x

FC *RF reference frequency* on the channel raster, given in table 5.4.2.2-1

FC,block, high Fc of the highest transmitted/received carrier in a *sub-block*

FC,block, low Fc of the lowest transmitted/received carrier in a *sub-block*

FC,low The Fc of the lowest carrier, expressed in MHz

FC,high The Fc of the highest carrier, expressed in MHz

FDL\_low The lowest frequency of the downlink *operating band*

FDL\_high The highest frequency of the downlink *operating band*

FUL\_low The lowest frequency of the uplink *operating band*

FUL\_high The highest frequency of the uplink *operating band*

Fedge,block,low The lower *sub-block* edge, where Fedge,block,low = FC,block,low - Foffset, low.

Fedge,block,high The upper *sub-block* edge, where Fedge,block,high = FC,block,high + Foffset, high.

Fedge , low The *lower edge* of *aggregated channel bandwidth*, expressed in MHz. Fedge,low = FC,low - Foffset,low.

Fedge, high The *higher edge* of *aggregated channel bandwidth*, expressed in MHz. Fedge,high = FC,high + Foffset,high.

FInterferer (offset) Frequency offset of the interferer (between the center frequency of the interferer and the carrier frequency of the carrier measured)

FInterferer Frequency of the interferer

FIoffset Frequency offset of the interferer (between the center frequency of the interferer and the closest edge of the carrier measured)

Foffset Frequency offset from FC\_high to the *higher edge* or FC\_low to the *lower edge.*

Foffset,high Frequency offset from FC,high to the upper *UE RF Bandwidth edge*, or from FC,block, high to the upper sub-block edge

Foffset,low Frequency offset from FC,low to the lower *UE RF Bandwidth edge*, or from FC,block, low to the lower sub-block edge

FOOB The boundary between the NR out of band emission and spurious emission domains

FREF RF reference frequency

FREF-Offs Offset used for calculating FREF

FREF, shift RF reference frequency for Supplementary Uplink (SUL) bands, the uplink of all FDD bands, and TDD bands

Fuw (offset) The frequency separation of the center frequency of the carrier closest to the interferer and the center frequency of the interferer

GBChannel Minimum guard band defined in clause 5.3.3

LCRB Transmission bandwidth which represents the length of a contiguous resource block allocation expressed in units of resources blocks

Max() The largest of given numbers

Min() The smallest of given numbers

 Physical resource block number

NRACLR NR ACLR

NRB Transmission bandwidth configuration, expressed in units of resource blocks

NRB\_agg The number of the aggregated RBs within the fully allocated aggregated channel bandwidth

NRB\_agg The number of the aggregated RBs within the fully allocated aggregated channel bandwidth

for carrier 1 to j, where μ is defined in TS 38.211 [6]

NRB,c The transmission bandwidth configuration of component carrier c, expressed in units of resource blocks

for carrier j, where *μ* is defined in TS 38.211 [6]

NRB,low The transmission bandwidth configurations according to Table 5.3.2-1 for the lowest assigned component carrier in section 5.3A.1

NRB,high The transmission bandwidth configurations according to Table 5.3.2-1 for the highest assigned component carrier in section 5.3A.1

NREF NR Absolute Radio Frequency Channel Number (NR-ARFCN)

NREF-Offs Offset used for calculating NREF

PCMAX The configured maximum UE output power

PCMAX, *c* The configured maximum UE output power for serving cell *c*

PCMAX, *f*, *c* The configured maximum UE output power for carrier *f* of serving cell *c* in each slot

PEMAX Maximum allowed UE output power signalled by higher layers

PEMAX, *c* Maximum allowed UE output power signalled by higher layers for serving cell *c*

PInterferer Modulated mean power of the interferer

Plargest BW Power of the largest transmission bandwidth configuration of the component carriers in the bandwidth combination

PPowerClass The nominal UE power (i.e., no tolerance)

P-MPR*c* Power Management Maximum Power Reduction for serving cell *c*

PRB The transmitted power per allocated RB, measured in dBm

PUMAX The measured configured maximum UE output power

Puw Power of an unwanted DL signal

Pw Power of a wanted DL signal

RBstart The lowest RB index of transmitted resource blocks

SCSc SCS for the component carrier c

SCSlargest BW SCS for the largest transmission bandwidth configuration of the component carriers in the bandwidth combination

SCSlow SCS for the lowest assigned component carrier in section 5.3A.1

SCShigh SCS for the highest assigned component carrier in section 5.3A.1

T(PCMAX, *f*, *c*) Tolerance for applicable values of PCMAX, *f*, *c* for configured maximum UE output power for carrier *f* of serving cell *c*

TL,c Absolute value of the lower tolerance for the applicable *operating band* as specified in section 6.2.1

SSREF SS block reference frequency position

UTRAACLR UTRA ACLR

## 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].

ACLR Adjacent Channel Leakage Ratio

ACS Adjacent Channel Selectivity

A-MPR Additional Maximum Power Reduction

BS Base Station

BW Bandwidth

BWP Bandwidth Part

CA Carrier Aggregation

CA\_nX-nY Inter-band CA of component carrier(s) in one sub-block within Band nX and component carrier(s) in one sub-block within Band nY where nX and nY are the applicable NR *operating bands*

CC Component Carriers

CP-OFDM Cyclic Prefix-OFDM

CW Continuous Wave

DC Dual Connectivity

DFT-s-OFDM Discrete Fourier Transform-spread-OFDM

DM-RS Demodulation Reference Signal

DTX Discontinuous TransmissionE-UTRA Evolved UTRA

EVM Error Vector Magnitude

FR Frequency Range

FRC Fixed Reference Channel

GSCN Global Synchronization Channel Number

IBB In-band Blocking

IDFT Inverse Discrete Fourier Transformation

ITU‑R Radiocommunication Sector of the International Telecommunication Union

MBW Measurement bandwidth defined for the protected band

MOP Maximum Output Power

MPR Allowed maximum power reduction

MSD Maximum Sensitivity Degradation

NR New Radio

NR-ARFCN NR Absolute Radio Frequency Channel Number

NS Network Signalling

OCNG OFDMA Channel Noise Generator

OOB Out-of-band

P-MPR Power Management Maximum Power Reduction

PRB Physical Resource Block

QAM Quadrature Amplitude Modulation

RE Resource Element

REFSENS Reference Sensitivity

RF Radio Frequency

RMS Root Mean Square (value)

RSRP Reference Signal Receiving PowerRx Receiver

Rx Receiver

SC Single Carrier

SCS Subcarrier spacing

SDL Supplementary Downlink

SEM Spectrum Emission Mask

SNR Signal-to-Noise Ratio

SRS Sounding Reference SymbolSUL Supplementary uplink

SS Synchronization Symbol

SUL Supplementary uplink

TAE Time Alignment Error

Tx Transmitter

UL MIMO Uplink Multiple Antenna transmission

# 4 General

## 4.1 Relationship between minimum requirements and test requirements

The present document is a Single-RAT specification for NR UE, covering RF characteristics and minimum performance requirements. Conformance to the present specification is demonstrated by fulfilling the test requirements specified in the conformance specification 3GPP TS 38.521-1 [4].

The Minimum Requirements given in this specification make no allowance for measurement uncertainty. The test specification TS 38.521-1 [4] defines test tolerances. These test tolerances are individually calculated for each test. The test tolerances are used to relax the minimum requirements in this specification to create test requirements. For some requirements, including regulatory requirements, the test tolerance is set to zero.

The measurement results returned by the test system are compared - without any modification - against the test requirements as defined by the shared risk principle.

The shared risk principle is defined in Recommendation ITU‑R M.1545 [5].

## 4.2 Applicability of minimum requirements

a) In this specification the Minimum Requirements are specified as general requirements and additional requirements. Where the Requirement is specified as a general requirement, the requirement is mandated to be met in all scenarios

b) For specific scenarios for which an additional requirement is specified, in addition to meeting the general requirement, the UE is mandated to meet the additional requirements.

c) The spurious emissions power requirements are for the long-term average of the power. For the purpose of reducing measurement uncertainty it is acceptable to average the measured power over a period of time sufficient to reduce the uncertainty due to the statistical nature of the signal

d) All the requirements for intra-band contiguous and non-contiguous CA apply under the assumption of the same slot format indicated by *TDD-UL-DL-ConfigurationCommon* and *TDD-UL-DL-ConfigurationDedicated* in the PCell and SCells for NR SA.

## 4.3 Specification suffix information

Unless stated otherwise the following suffixes are used for indicating at 2nd level clause, shown in Table 4.3-1.

Table 4.3-1: Definition of suffixes

|  |  |
| --- | --- |
| Clause suffix | Variant |
| None | Single Carrier |
| A | Carrier Aggregation (CA) |
| B | Dual-Connectivity (DC) |
| C | Supplement Uplink (SUL) |
| D | UL MIMO |

A terminal which supports the above features needs to meet both the general requirements and the additional requirement applicable to the additional clause (suffix A, B, C and D) in clauses 5, 6 and 7. Where there is a difference in requirement between the general requirements and the additional clause requirements (suffix A, B, C and D) in clauses 5, 6 and 7, the tighter requirements are applicable unless stated otherwise in the additional clause.

A terminal which supports more than one feature in clauses 5, 6 and 7 shall meet all of the separate corresponding requirements.

For a terminal that supports SUL for the band combination specified in Table 5.2C-1, the current version of the specification assumes the terminal is configured with active transmission either on UL carrier or SUL carrier at any time in one serving cell and the UE requirements for single carrier shall apply for the active UL or SUL carrier accordingly. For a terminal that supports SUL, the current version of the specification assumes the terminal is not configured with UL MIMO on SUL carrier.

# 5 Operating bands and channel arrangement

## 5.1 General

The channel arrangements presented in this clause are based on the operating bands and channel bandwidths defined in the present release of specifications.

NOTE: Other operating bands and channel bandwidths may be considered in future releases.

Requirements throughout the RF specifications are in many cases defined separately for different frequency ranges (FR). The frequency ranges in which NR can operate according to this version of the specification are identified as described in Table 5.1-1.

Table 5.1-1: Definition of frequency ranges

|  |  |
| --- | --- |
| Frequency range designation | Corresponding frequency range |
| FR1 | 410 MHz – 7125 MHz |
| FR2 | 24250 MHz – 52600 MHz |

The present specification covers FR1 operating bands.

## 5.2 Operating bands

NR is designed to operate in the FR1 operating bands defined in Table 5.2-1.

Table 5.2-1: NR operating bands in FR1

|  |  |  |  |
| --- | --- | --- | --- |
| NR operating band | Uplink (UL) *operating band* BS receive / UE transmit  FUL\_low  – FUL\_high | Downlink (DL) *operating band* BS transmit / UE receive  FDL\_low – FDL\_high | Duplex Mode |
| n1 | 1920 MHz – 1980 MHz | 2110 MHz – 2170 MHz | FDD |
| n2 | 1850 MHz – 1910 MHz | 1930 MHz – 1990 MHz | FDD |
| n3 | 1710 MHz – 1785 MHz | 1805 MHz – 1880 MHz | FDD |
| n5 | 824 MHz – 849 MHz | 869 MHz – 894 MHz | FDD |
| n7 | 2500 MHz – 2570 MHz | 2620 MHz – 2690 MHz | FDD |
| n8 | 880 MHz – 915 MHz | 925 MHz – 960 MHz | FDD |
| n12 | 699 MHz – 716 MHz | 729 MHz – 746 MHz | FDD |
| n20 | 832 MHz – 862 MHz | 791 MHz – 821 MHz | FDD |
| n25 | 1850 MHz – 1915 MHz | 1930 MHz – 1995 MHz | FDD |
| n28 | 703 MHz – 748 MHz | 758 MHz – 803 MHz | FDD |
| n34 | 2010 MHz – 2025 MHz | 2010 MHz – 2025 MHz | TDD |
| n38 | 2570 MHz – 2620 MHz | 2570 MHz – 2620 MHz | TDD |
| n39 | 1880 MHz – 1920 MHz | 1880 MHz – 1920 MHz | TDD |
| n40 | 2300 MHz – 2400 MHz | 2300 MHz – 2400 MHz | TDD |
| n41 | 2496 MHz – 2690 MHz | 2496 MHz – 2690 MHz | TDD |
| n50 | 1432 MHz – 1517 MHz | 1432 MHz – 1517 MHz | TDD1 |
| n51 | 1427 MHz – 1432 MHz | 1427 MHz – 1432 MHz | TDD |
| 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 |
| n74 | 1427 MHz – 1470 MHz | 1475 MHz – 1518 MHz | FDD |
| n75 | N/A | 1432 MHz – 1517 MHz | SDL |
| n76 | N/A | 1427 MHz – 1432 MHz | SDL |
| n77 | 3300 MHz – 4200 MHz | 3300 MHz – 4200 MHz | TDD |
| n78 | 3300 MHz – 3800 MHz | 3300 MHz – 3800 MHz | TDD |
| n79 | 4400 MHz – 5000 MHz | 4400 MHz – 5000 MHz | TDD |
| n80 | 1710 MHz – 1785 MHz | N/A | SUL |
| n81 | 880 MHz – 915 MHz | N/A | SUL |
| n82 | 832 MHz – 862 MHz | N/A | SUL |
| n83 | 703 MHz – 748 MHz | N/A | SUL |
| n84 | 1920 MHz – 1980 MHz | N/A | SUL |
| n86 | 1710 MHz – 1780 MHz | N/A | SUL |
| NOTE 1: UE that complies with the NR Band n50 minimum requirements in this specification shall also comply with the NR Band n51 minimum requirements.  NOTE 2: UE that complies with the NR Band n75 minimum requirements in this specification shall also comply with the NR Band n76 minimum requirements. | | | |

## 5.2A Operating bands for CA

### 5.2A.1 Intra-band CA

NR intra-band contiguous carrier aggregation is designed to operate in the operating bands defined in Table 5.2A.1-1, where all operating bands are within FR1.

Table 5.2A.1-1: Intra-band contiguous CA operating bands in FR1

|  |  |
| --- | --- |
| NR CA Band | NR Band  (Table 5.2-1) |
| CA\_n411 | n41 |
| CA\_n771 | n77 |
| CA\_n781 | n78 |
| CA\_n791 | n79 |
| NOTE 1: The minimum requirements only apply for non‑simultaneous Tx/Rx between all carriers. | |

### 5.2A.2 Inter-band CA

NR inter-band carrier aggregation is designed to operate in the operating bands defined in Table 5.2A.2.1-1, where all operating bands are within FR1.

If the mandatory simultaneous Rx/Tx capability applies for a lower order band combination, when the applicable lower order band combination is a band pair in a higher order band combination, the mandatory simultaneous Rx/Tx capability also applies for the band pair in the higher order band combination.

Table 5.2A.2-1: Void

#### 5.2A.2.1 Inter-band CA (two bands)

Table 5.2A.2.1-1: Inter-band CA operating bands involving FR1 (two bands)

|  |  |
| --- | --- |
| NR CA Band | NR Band  (Table 5.2-1) |
| CA\_n3-n771 | n3, n77 |
| CA\_n3-n781 | n3, n78 |
| CA\_n3-n791 | n3, n79 |
| CA\_n8-n751 | n8, n75 |
| CA n8-n781 | n8, n78 |
| CA\_n8-n791 | n8, n79 |
| CA\_n28-n752 | n28, n75 |
| CA\_n28-n781 | n28, n78 |
| CA\_n41-n78 | n41, n78 |
| CA\_n75-n781 | n75, n78 |
| CA\_n76-n781 | n76, n78 |
| CA\_n77-n79 | n77, n79 |
| CA\_n78-n793 | n78, n79 |
| NOTE 1: Applicable for UE supporting inter-band carrier aggregation with mandatory simultaneous Rx/Tx capability.  NOTE 2: The frequency range in band n28 is restricted for this band combination to 703-733 MHz for the UL and 758-788 MHz for the DL.  NOTE 3: For UEs supporting band n77, the minimum requirements apply only when there is non-simultaneous Rx/Tx operation between n78-n79 NR carriers. This restriction applies also for these carriers when applicable NR CA configuration is part of a higher order configuration.  NOTE 4: The minimum requirements apply only when there is non-simultaneous Rx/Tx operation between n77-n79 NR carriers. This restriction applies also for these carriers when applicable NR CA configuration is part of a higher order configuration. | |

## 5.2B Void

## 5.2C Operating band combination for SUL

NR operation is designed to operate in the operating band combination defined in Table 5.2C-1, where all operating bands are within FR1.

If the mandatory simultaneous Rx/Tx capability applies for a lower order band combination, when the applicable lower order band combination is a band pair in a higher order band combination, the mandatory simultaneous Rx/Tx capability also applies for the band pair in the higher order band combination.

Table 5.2C-1: Operating band combination for SUL in FR1

|  |  |
| --- | --- |
| NR Band combination for SUL | NR Band  (Table 5.2-1) |
| SUL\_n78-n802 | n78, n80 |
| SUL\_n78-n812 | n78, n81 |
| SUL\_n78-n822 | n78, n82 |
| SUL\_n78-n832 | n78, n83 |
| SUL\_n78-n842 | n78, n84 |
| SUL\_n78-n862 | n78, n86 |
| SUL\_n79-n802 | n79, n80 |
| SUL\_n79-n812 | n79, n81 |
| NOTE 1: If a UE is configured with both NR UL and NR SUL carriers in a cell, the switching time between NR UL carrier and NR SUL carrier is 0 us.  NOTE 2: For UE supporting SUL band combination simultaneous Rx/Tx capability is mandatory.  NOTE 3: For UE supporting SUL band combination, UL MIMO is not configured on SUL carrier. | |

## 5.3 UE channel bandwidth

### 5.3.1 General

The UE channel bandwidth supports a single NR RF carrier in the uplink or downlink at the UE. From a BS perspective, different UE channel bandwidths may be supported within the same spectrum for transmitting to and receiving from UEs connected to the BS. Transmission of multiple carriers to the same UE (CA) or multiple carriers to different UEs within the BS channel bandwidth can be supported.

From a UE perspective, the UE is configured with one or more BWP / carriers, each with its own UE channel bandwidth. The UE does not need to be aware of the BS channel bandwidth or how the BS allocates bandwidth to different UEs.

The placement of the UE channel bandwidth for each UE carrier is flexible but can only be completely within the BS channel bandwidth.

The relationship between the channel bandwidth, the guardband and the maximum transmission bandwidth configuration is shown in Figure 5.3.1-1.



Figure 5.3.1-1: Definition of the channel bandwidth and the maximum transmission bandwidth configuration for one NR channel

### 5.3.2 Maximum transmission bandwidth configuration

The maximum transmission bandwidth configuration NRB for each UE channel bandwidth and subcarrier spacing is specified in Table 5.3.2-1.

Table 5.3.2-1: Maximum transmission bandwidth configuration NRB

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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 |
| NRB | NRB | NRB | NRB | NRB | NRB | NRB | NRB | NRB | NRB | NRB | NRB |
| 15 | 25 | 52 | 79 | 106 | 133 | 160 | 216 | 270 | N/A | N/A | N/A | N/A |
| 30 | 11 | 24 | 38 | 51 | 65 | 78 | 106 | 133 | 162 | 217 | 245 | 273 |
| 60 | N/A | 11 | 18 | 24 | 31 | 38 | 51 | 65 | 79 | 107 | 121 | 135 |

### 5.3.3 Minimum guardband and transmission bandwidth configuration

The minimum guardband for each UE channel bandwidth and SCS is specified in Table 5.3.3-1,

Table 5.3.3-1: Minimum guardband for each UE channel bandwidth and SCS (kHz)

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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 |
| 15 | 242.5 | 312.5 | 382.5 | 452.5 | 522.5 | 592.5 | 552.5 | 692.5 | N/A | N/A | N/A | N/A |
| 30 | 505 | 665 | 645 | 805 | 785 | 945 | 905 | 1045 | 825 | 925 | 885 | 845 |
| 60 | N/A | 1010 | 990 | 1330 | 1310 | 1290 | 1610 | 1570 | 1530 | 1450 | 1410 | 1370 |

NOTE: The minimum guardbands have been calculated using the following equation: (BWChannel x 1000 (kHz) - NRB x SCS x 12) / 2 - SCS/2, where NRB are from Table 5.3.2-1.

Figure 5.3.3-1: Void

The number of RBs configured in any channel bandwidth shall ensure that the minimum guardband specified in this clause is met.

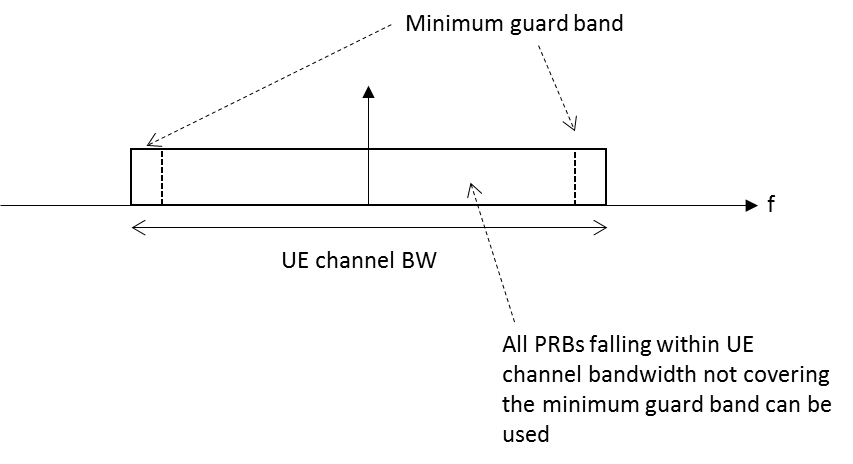


Figure 5.3.3-2: UE PRB utilization

In the case that multiple numerologies are multiplexed in the same symbol due to BS transmission of SSB, the minimum guardband on each side of the carrier is the guardband applied at the configured channel bandwidth for the numerology that is received immediately adjacent to the guard.

If multiple numerologies are multiplexed in the same symbol and the UE channel bandwidth is >50 MHz, the minimum guardband applied adjacent to 15 kHz SCS shall be the same as the minimum guardband defined for 30 kHz SCS for the same UE channel bandwidth.

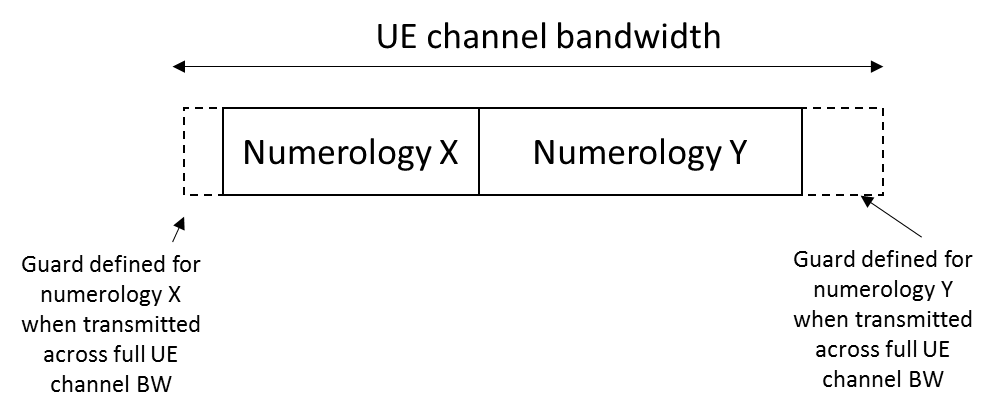


Figure 5.3.3-3 Guard band definition when transmitting multiple numerologies

NOTE: Figure 5.3.3-3 is not intended to imply the size of any guard between the two numerologies. Inter-numerology guard band within the carrier is implementation dependent.

### 5.3.4 RB alignment

For each numerology, its common resource blocks are specified in Clause 4.4.4.3 in TS 38.211 [6], and the starting point of its transmission bandwidth configuration on the common resource block grid for a given channel bandwidth is indicated by an offset to "Reference point A" in the unit of the numerology. The *UE transmission bandwidth configuration* is indicated by the higher layer parameter *carrierBandwidth* [7] and will fulfil the minimum UE guardband requirement specified in Clause 5.3.3.

### 5.3.5 UE channel bandwidth per operating band

The requirements in this specification apply to the combination of channel bandwidths, SCS and operating bands shown in Table 5.3.5-1. The transmission bandwidth configuration in Table 5.3.2-1 shall be supported for each of the specified channel bandwidths. The channel bandwidths are specified for both the TX and RX path.

Table 5.3.5-1 Channel bandwidths for each NR band

|  | NR band / SCS / UE Channel bandwidth | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band | SCS  kHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 30 MHz | 40 MHz | 50 MHz | 60 MHz | 80 MHz | 904 MHz | 100 MHz |
| n1 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n2 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n3 | 15 | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| n5 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| n7 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n8 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| n12 | 15 | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes |  |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| n20 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| n25 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n28 | 15 | Yes | Yes | Yes | Yes5 |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes5 |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| n34 | 15 | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes |  |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes |  |  |  |  |  |  |  |  |  |
| n38 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n39 | 15 | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| n40 | 15 | Yes9 | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| n41 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| n50 | 15 | Yes9 | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes3 |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes3 |  |  |
| n51 | 15 | Yes |  |  |  |  |  |  |  |  |  |  |  |
| 30 |  |  |  |  |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| n66 | 15 | Yes | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  |
| n70 | 15 | Yes | Yes | Yes | Yes3 | Yes3 |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes3 | Yes3 |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes3 | Yes3 |  |  |  |  |  |  |  |
| n71 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| n74 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n75 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n76 | 15 | Yes |  |  |  |  |  |  |  |  |  |  |  |
| 30 |  |  |  |  |  |  |  |  |  |  |  |  |
| 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 |
| n78 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| n79 | 15 |  |  |  |  |  |  | Yes | Yes |  |  |  |  |
| 30 |  |  |  |  |  |  | Yes | Yes | Yes | Yes |  | Yes |
| 60 |  |  |  |  |  |  | Yes | Yes | Yes | Yes |  | Yes |
| n80 | 15 | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| n81 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| n82 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| n83 | 15 | Yes | Yes | Yes | Yes5 |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes5 |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| n84 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n86 | 15 | Yes | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  |
| NOTE 1: void  NOTE 2: void  NOTE 3: This UE channel bandwidth is applicable only to downlink.  NOTE 4: This UE channel bandwidth is optional in this release of the specification.  NOTE 5: 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.  NOTE 6: Void.  NOTE 7: Void.  NOTE 8: Void.  NOTE 9: For this bandwidth, the minimum requirements are restricted to operation when carrier is configured as an SCell part of DC or CA configuration. | | | | | | | | | | | | | |

### 5.3.6 Asymmetric channel bandwidths

The UE channel bandwidth can be asymmetric in downlink and uplink. In asymmetric channel bandwidth operation, the narrower carrier shall be confined within the frequency range of the wider channel bandwidth.

In FDD, the confinement is defined as a deviation to the default Tx-Rx carrier center frequency separation (defined in table 5.4.4-1) as following:

ΔFTX-RX = | (BWDL – BWUL)/2 |

The operating bands and supported asymmetric channel bandwidth combinations are defined in table 5.3.6-1.

Table 5.3.6-1: FDD asymmetric UL and DL channel bandwidth combinations

|  |  |  |
| --- | --- | --- |
| NR Band | Channel bandwidths for UL (MHz) | Channel bandwidths for DL (MHz) |
| n66 | 5, 10 | 20, 40 |
| 20 | 40 |
| n70 | 5, 10 | 15 |
| 5, 10, 15 | 20, 25 |
| n71 | 5 | 10 |
| 10 | 15 |
| 15 | 20 |

In TDD, the operating bands and supported asymmetric channel bandwidth combinations are defined in table 5.3.6-2.

Table 5.3.6-2: TDD asymmetric UL and DL channel bandwidth combinations

|  |  |  |
| --- | --- | --- |
| NR Band | Channel bandwidths for UL (MHz) | Channel bandwidths for DL (MHz) |
| n50 | 60 | 80 |
| NOTE 1: Both centre frequency and BWP-ID shall match between DL and UL carriers as defined in TS 38.331 [7] cl. 6.3.2 and TS 38.213 [8] section 12.  NOTE 2: In a case a UE is configured with a full width of BWP within both UL/ DL channels, the centre frequency of UL/ DL channels shall be same.  NOTE 3: A position of Point A is common between UL and DL carriers as defined in TS 38.331 [7] cl. 6.3.2. | | |

## 5.3A UE channel bandwidth for CA

### 5.3A.1 General

Figure 5.3A.1-1: Void

Figure 5.3A.1-2: Void

### 5.3A.2 Maximum transmission bandwidth configuration for CA

For carrier aggregation, the maximum transmission bandwidth configuration is defined per component carrier and the requirement is specified in clause 5.3.2.

### 5.3A.3 Minimum guardband and transmission bandwidth configuration for CA

For intra-band contiguous carrier aggregation, *Aggregated Channel Bandwidth* and *Guard Bands* are defined as follows, see Figure 5.3A.3-1.

**FC, low**

**Lower Edge**

**Upper Edge**

**Lowest Carrier Transmission Bandwidth Configuration [RB]**

**FC, high**

**Foffset, low**

**Highest Carrier Transmission Bandwidth Configuration [RB]**

**Resource block**

***Aggregated Channel Bandwidth*, BWchannel\_CA (MHz)**

**Fedge, low**

**Fedge, high**

**Foffset, high**

Figure 5.3A.3-1: Definition of *Aggregated Channel Bandwidth* for intra-band carrier aggregation

The *aggregated channel bandwidth,* BWChannel\_CA, is defined as

BWChannel\_CA = Fedge,high - Fedge,low (MHz).

The lower bandwidth edge Fedge, low and the upper bandwidth edge Fedge,high of the aggregated channel bandwidth are used as frequency reference points for transmitter and receiver requirements and are defined by

Fedge,low = FC,low - Foffset,low

Fedge,high = FC,high + Foffset,high

The lower and upper frequency offsets depend on the transmission bandwidth configurations of the lowest and highest assigned edge component carrier and are defined as

Foffset,low = (NRB,low\*12 + 1)\*SCSlow/2 + BWGB (MHz)

Foffset,high = (NRB,high\*12 - 1)\*SCShigh/2 + BWGB (MHz)

BWGB = max(BWGB,Channel(k))

NRB,low and NRB,high are the transmission bandwidth configurations according to Table 5.3.2-1 for the lowest and highest assigned component carrier, SCSlow and SCShigh are the sub-carrier spacing for the lowest and highest assigned component carrier respectively. SCSlow, SCShigh, NRB,low, NRB,high, and BWGB,Channel(k) use the largest μ value among the subcarrier spacing configurations supported in the operating band for both of the channel bandwidths according to Table 5.3.5-1 and BWGB,Channel(k) is the minimum guard band for carrier k according to Table 5.3.3-1 for the said *μ* value. In case there is no common μ value for both of the channel bandwidths, *μ*=1 is used for SCSlow, SCShigh, NRB,low, NRB,high, and BWGB,Channel(k).

For intra-band non-contiguous carrier aggregation *Sub-block Bandwidth* and *Sub-block edges* are defined as follows, see Figure 5.3A.3-2.

Figure 5.3A.3-2: Definition of sub-block bandwidth for intra-band non-contiguous spectrum

...

Sub block n

**Transmission Bandwidth Configuration of the highest carrier in a sub-block [RB]**

**Transmission Bandwidth Configuration of the lowest carrier in a sub-block [RB]**

**Fedge,block n, low**

**FC,block n,high**

**Fedge,block n,high**

**Foffset,high**

**Foffset,low**

**FC,block n,low**

**Sub-block Bandwidth, BWChannel,block n (MHz)**

**Lower Sub-block Edge**

**Upper Sub-block Edge**

**Resource block**

Sub block n+1

Foffset, low

**Fedge,block n+1, low**

**FC,block n+1,low**

**FC,block n+1,high**

**Fedge,block n+1,high**

**Foffset,high**

**Sub-block Bandwidth, BWChannel,block n+1 (MHz)**

**Lower Sub-block Edge**

**Upper Sub-block Edge**

**Transmission Bandwidth Configuration of the highest carrier in a sub-block [RB]**

**Transmission Bandwidth Configuration of the lowest carrier in a sub-block [RB]**

**Resource block**

The lower sub-block edge of the Sub-block Bandwidth (BWChannel,block) is defined as

Fedge,block, low = FC,block,low - Foffset, low.

The upper sub-block edge of the Sub-block Bandwidth is defined as

Fedge,block,high = FC,block,high + Foffset,high.

The Sub-block Bandwidth, BWChannel,block, is defined as follows:

BWChannel,block = Fedge,block,high - Fedge,block,low (MHz)

The lower and upper frequency offsets Foffset,block,low and Foffset,block,high depend on the transmission bandwidth configurations of the lowest and highest assigned edge component carriers within a sub-block and are defined as

Foffset,block,low = (NRB,low\*12 + 1)\*SCSlow/2 + BWGB (MHz)

Foffset,block,high = (NRB,high\*12 - 1)\*SCShigh/2 + BWGB(MHz)

BWGB = max(BWGB,Channel(k))

where NRB,low and NRB,high are the transmission bandwidth configurations according to Table 5.3.2-1 for the lowest and highest assigned component carrier within a sub-block, respectively. SCSlow and SCShigh are the sub-carrier spacing for the lowest and highest assigned component carrier within a sub-block, respectively. SCSlow, SCShigh, NRB,low, NRB,high, and BWGB,Channel(k) use the largest μ value among the subcarrier spacing configurations supported in the operating band for both of the channel bandwidths according to Table 5.3.5-1 and BWGB,Channel(k) is the minimum guard band for carrier k according to Table 5.3.3-1 for the said *μ* value. In case there is no common μ value for both of the channel bandwidths, *μ*=1 is used for SCSlow, SCShigh, NRB,low, NRB,high, and BWGB,Channel(k).

The sub-block gap size between two consecutive sub-blocks Wgap is defined as

Wgap = Fedge,block n+1,low - Fedge,block n,high (MHz)

### 5.3A.4 Void

### 5.3A.5 UE channel bandwidth per operating band for CA

The requirements for carrier aggregation in this specification are defined for carrier aggregation configurations.

For intra-band contiguous carrier aggregation, a carrier aggregation configuration is a single operating band supporting a carrier aggregation bandwidth class with associated bandwidth combination sets specified in clause 5.5A.1. For each carrier aggregation configuration, requirements are specified for all aggregated channel bandwidths contained in a bandwidth combination set, a UE can indicate support of several bandwidth combination sets per carrier aggregation configuration. For intra-band non-contiguous carrier aggregation, a carrier aggregation configuration is a single operating band supporting two or more sub-blocks, each supporting a carrier aggregation bandwidth class.

For inter-band carrier aggregation, a carrier aggregation configuration is a combination of operating bands, each supporting a carrier aggregation bandwidth class.

Table 5.3A.5-1: NR CA bandwidth classes

|  |  |  |  |
| --- | --- | --- | --- |
| NR CA bandwidth class | Aggregated channel bandwidth | Number of contiguous CC | Fallback group |
| A | BWChannel ≤ BWChannel,max | 1 | 1, 2 |
| B | 20 MHz ≤ BWChannel\_CA ≤ 100 MHz | 2 | 2 |
| C | 100 MHz < BWChannel\_CA ≤ 2 x BWChannel,max | 2 | 1 |
| D | 200 MHz < BWChannel\_CA ≤ 3 x BWChannel,max | 3 |
| E | 300 MHz < BWChannel\_CA ≤ 4 x BWChannel,max | 4 |
|  |  |  | 2 |
| G | 100 MHz < BWChannel\_CA ≤ 150 MHz | 3 |
| H | 150 MHz < BWChannel\_CA ≤ 200 MHz | 4 |
| I | 200 MHz < BWChannel\_CA ≤ 250 MHz | 5 |
| J | 250 MHz < BWChannel\_CA ≤ 300 MHz | 6 |
| K | 300 MHz < BWChannel\_CA ≤ 350 MHz | 7 |
| L | 350 MHz < BWChannel\_CA ≤ 400 MHz | 8 |
| NOTE 1: BWChannel, max is maximum channel bandwidth supported among all bands in a release  NOTE 2: It is mandatory for a UE to be able to fallback to lower order NR CA bandwidth class configuration within a fallback group. It is not mandatory for a UE to be able to fallback to lower order NR CA bandwidth class configuration that belong to a different fallback group | | | |

## 5.4 Channel arrangement

### 5.4.1 Channel spacing

#### 5.4.1.1 Channel spacing for adjacent NR carriers

The spacing between carriers will depend on the deployment scenario, the size of the frequency block available and the channel bandwidths. The nominal channel spacing between two adjacent NR carriers is defined as following:

- For NR operating bands with 100 kHz channel raster,

Nominal Channel spacing = (BWChannel(1) + BWChannel(2))/2

- For NR operating bands with 15 kHz channel raster,

Nominal Channel spacing = (BWChannel(1) + BWChannel(2))/2+{-5 kHz, 0 kHz, 5 kHz} for ∆FRaster equals 15 kHz

Nominal Channel spacing = (BWChannel(1) + BWChannel(2))/2+{-10 kHz, 0 kHz, 10 kHz} for ∆FRaster equals 30 kHz

where BWChannel(1) and BWChannel(2) are the channel bandwidths of the two respective NR carriers. The channel spacing can be adjusted depending on the channel raster to optimize performance in a particular deployment scenario.

### 5.4.2 Channel raster

#### 5.4.2.1 NR-ARFCN and channel raster

The global frequency channel raster defines a set of RF reference frequencies FREF. The RF reference frequency is used in signalling to identify the position of RF channels, SS blocks and other elements.

The global frequency raster is defined for all frequencies from 0 to 100 GHz. The granularity of the global frequency raster is ΔFGlobal.

RF reference frequencies are designated by an NR Absolute Radio Frequency Channel Number (NR-ARFCN) in the range (0…2016666) on the global frequency raster. The relation between the NR-ARFCN and the RF reference frequency FREF in MHz is given by the following equation, where FREF-Offs and NRef-Offs are given in table 5.4.2.1-1 and NREF is the NR-ARFCN.

FREF = FREF-Offs + ΔFGlobal (NREF – NREF-Offs)

Table 5.4.2.1-1: NR-ARFCN parameters for the global frequency raster

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Frequency range (MHz) | ΔFGlobal (kHz) | FREF-Offs (MHz) | NREF-Offs | Range of NREF |
| 0 – 3000 | 5 | 0 | 0 | 0 – 599999 |
| 3000 – 24250 | 15 | 3000 | 600000 | 600000 – 2016666 |

The channel raster defines a subset of RF reference frequencies that can be used to identify the RF channel position in the uplink and downlink. The RF reference frequency for an RF channel maps to a resource element on the carrier. For each operating band, a subset of frequencies from the global frequency raster are applicable for that band and forms a channel raster with a granularity ΔFRaster, which may be equal to or larger than ΔFGlobal.

For SUL bands, for the uplink of all FDD bands defined in Table 5.2-1, and for TDD band n34, n38, and n39

FREF, shift = FREF + Δshift, Δshift = 0 kHz or 7.5 kHz.

where Δshift is signalled by the network in higher layer parameter *frequencyShift7p5khz* [7]. For band n34, n38, n39 FREF, shift is only applicable to uplink transmissions using a 15 kHz SCS.

NOTE: A UE operating n34, n38, n39 should support application of FREF, shift for UL transmissions. A UE that does not support it will be unable to communicate with a network that signals Δshift = 7.5 kHz.

The mapping between the channel raster and corresponding resource element is given in Clause 5.4.2.2. The applicable entries for each operating band are defined in Clause 5.4.2.3.

#### 5.4.2.2 Channel raster to resource element mapping

The mapping between the RF reference frequency on the channel raster and the corresponding resource element is given in Table 5.4.2.2-1 and can be used to identify the RF channel position. The mapping depends on the total number of RBs that are allocated in the channel and applies to both UL and DL. The mapping must apply to at least one numerology supported by the UE.

Table 5.4.2.2-1: Channel raster to resource element mapping

|  |  |  |
| --- | --- | --- |
|  | NRBmod2 = 0 | NRBmod2 = 1 |
| Resource element index | 0 | 6 |
| Physical resource block number |  |  |

, *nPRB*, *NRB* are as defined in TS 38.211[6].

#### 5.4.2.3 Channel raster entries for each operating band

The RF channel positions on the channel raster in each NR operating band are given through the applicable NR-ARFCN in Table 5.4.2.3‑1, using the channel raster to resource element mapping in clause 5.4.2.2.

For NR operating bands with 100 kHz channel raster, ΔFRaster = 20 × ΔFGlobal. In this case every 20th NR-ARFCN within the operating band are applicable for the channel raster within the operating band and the step size for the channel raster in Table 5.4.2.3‑1 is given as <20>.

For NR operating bands with 15 kHz channel raster below 3GHz, ΔFRaster = *I* × ΔFGlobal, where *I ϵ {3,6}*. Every *Ith* NR‑ARFCN within the operating band are applicable for the channel raster within the operating band and the step size for the channel raster in Table 5.4.2.3‑1 is given as < *I* >.

For NR operating bands with 15 kHz channel raster above 3GHz, ΔFRaster = *I* × ΔFGlobal, where *I ϵ {1,2}.* Every *Ith* NR‑ARFCN within the operating band are applicable for the channel raster within the operating band and the step size for the channel raster in table 5.4.2.3-1 is given as <*I*>.

In frequency bands with two ΔFRaster, the higher ΔFRaster applies to channels using only the SCS that is equal to or larger than the higher ΔFRaster and SSB SCS is equal to the higher ∆FRaster.

Table 5.4.2.3-1: Applicable NR-ARFCN per operating band

|  |  |  |  |
| --- | --- | --- | --- |
| NR operating band | ΔFRaster  (kHz) | Uplink  Range of NREF  (First – <Step size> – Last) | Downlink  Range of NREF  (First – <Step size> – Last) |
| n1 | 100 | 384000 – <20> – 396000 | 422000 – <20> – 434000 |
| n2 | 100 | 370000 – <20> – 382000 | 386000 – <20> – 398000 |
| n3 | 100 | 342000 – <20> – 357000 | 361000 – <20> – 376000 |
| n5 | 100 | 164800 – <20> – 169800 | 173800 – <20> – 178800 |
| n7 | 100 | 500000 – <20> – 514000 | 524000 – <20> – 538000 |
| n8 | 100 | 176000 – <20> – 183000 | 185000 – <20> – 192000 |
| n12 | 100 | 139800 – <20> – 143200 | 145800 – <20> – 149200 |
| n20 | 100 | 166400 – <20> – 172400 | 158200 – <20> – 164200 |
| n25 | 100 | 370000 – <20> – 383000 | 386000 – <20> – 399000 |
| n28 | 100 | 140600 – <20> – 149600 | 151600 – <20> – 160600 |
| n34 | 100 | 402000 – <20> – 405000 | 402000 – <20> – 405000 |
| n38 | 100 | 514000 – <20> – 524000 | 514000 – <20> – 524000 |
| n39 | 100 | 376000 – <20> – 384000 | 376000 – <20> – 384000 |
| n40 | 100 | 460000 – <20> – 480000 | 460000 – <20> – 480000 |
| n41 | 15 | 499200 – <3> – 537999 | 499200 – <3> – 537999 |
| 30 | 499200 – <6> – 537996 | 499200 – <6> – 537996 |
| n50 | 100 | 286400 – <20> – 303400 | 286400 – <20> – 303400 |
| n51 | 100 | 285400 – <20> – 286400 | 285400 – <20> – 286400 |
| n66 | 100 | 342000 – <20> – 356000 | 422000 – <20> – 440000 |
| n70 | 100 | 339000 – <20> – 342000 | 399000 – <20> – 404000 |
| n71 | 100 | 132600 – <20> – 139600 | 123400 – <20> – 130400 |
| n74 | 100 | 285400 – <20> – 294000 | 295000 – <20> – 303600 |
| n75 | 100 | N/A | 286400 – <20> – 303400 |
| n76 | 100 | N/A | 285400 – <20> – 286400 |
| n77 | 15 | 620000 – <1> – 680000 | 620000 – <1> – 680000 |
| 30 | 620000 – <2> – 680000 | 620000 – <2> – 680000 |
| n78 | 15 | 620000 – <1> – 653333 | 620000 – <1> – 653333 |
| 30 | 620000 – <2> – 653332 | 620000 – <2> – 653332 |
| n79 | 15 | 693334 – <1> – 733333 | 693334 – <1> – 733333 |
| 30 | 693334 – <2> – 733332 | 693334 – <2> – 733332 |
| n80 | 100 | 342000 – <20> – 357000 | N/A |
| n81 | 100 | 176000 – <20> – 183000 | N/A |
| n82 | 100 | 166400 – <20> – 172400 | N/A |
| n83 | 100 | 140600 – <20> –149600 | N/A |
| n84 | 100 | 384000 – <20> – 396000 | N/A |
| n86 | 100 | 342000 – <20> – 356000 | N/A |

### 5.4.3 Synchronization raster

#### 5.4.3.1 Synchronization raster and numbering

The synchronization raster indicates the frequency positions of the synchronization block that can be used by the UE for system acquisition when explicit signalling of the synchronization block position is not present.

A global synchronization raster is defined for all frequencies. The frequency position of the SS block is defined as SSREF with corresponding number GSCN. The parameters defining the SSREF and GSCN for all the frequency ranges are in Table 5.4.3.1-1.

The resource element corresponding to the SS block reference freqeuncy SSREF is given in clause 5.4.3.2. The synchronization raster and the subcarrier spacing of the synchronization block is defined separately for each band.

Table 5.4.3.1-1: GSCN parameters for the global frequency raster

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency range | SS Block frequency position SSREF | GSCN | Range of GSCN |
| 0 – 3000 MHz | N \* 1200kHz + M \* 50 kHz,  N=1:2499, M ϵ {1,3,5} (Note 1) | 3N + (M-3)/2 | 2 – 7498 |
| 3000 – 24250 MHz | 3000 MHz + N \* 1.44 MHz  N = 0:14756 | 7499 + N | 7499 – 22255 |
| NOTE 1: The default value for operating bands with SCS spaced channel raster is M=3. | | | |

#### 5.4.3.2 Synchronization raster to synchronization block resource element mapping

The mapping between the synchronization raster and the corresponding resource element of the SS block is given in Table 5.4.3.2-1.

Table 5.4.3.2-1: Synchronization raster to SS block resource element mapping

|  |  |
| --- | --- |
| Resource element index | 120 |

 is the subcarrier number of SS/PBCH block defined in TS 38.211 clause 7.4.3.1 [6].

#### 5.4.3.3 Synchronization raster entries for each operating band

The synchronization raster for each band is give in Table 5.4.3.3-1. The distance between applicable GSCN entries is given by the <Step size> indicated in Table 5.4.3.3-1.

Table 5.4.3.3-1: Applicable SS raster entries per operating band

|  |  |  |  |
| --- | --- | --- | --- |
| NR operating band | SS Block SCS | SS Block pattern1 | Range of GSCN  (First – <Step size> – Last) |
| n1 | 15 kHz | Case A | 5279 – <1> – 5419 |
| n2 | 15 kHz | Case A | 4829 – <1> – 4969 |
| n3 | 15 kHz | Case A | 4517 – <1> – 4693 |
| n5 | 15 kHz | Case A | 2177 – <1> – 2230 |
| 30 kHz | Case B | 2183 – <1> – 2224 |
| n7 | 15 kHz | Case A | 6554 – <1> – 6718 |
| n8 | 15 kHz | Case A | 2318 – <1> – 2395 |
| n12 | 15 kHz | Case A | 1828 – <1> – 1858 |
| n20 | 15 kHz | Case A | 1982 – <1> – 2047 |
| n25 | 15 kHz | Case A | 4829 – <1> – 4981 |
| n28 | 15 kHz | Case A | 1901 – <1> – 2002 |
| n34 | 15 kHz | Case A | NOTE 3 |
| 30 kHz | Case C | 5036 – <1> – 5050 |
| n38 | 15 kHz | Case A | NOTE 2 |
| 30 kHz | Case C | 6437 – <1> – 6538 |
| n39 | 15 kHz | Case A | NOTE 4 |
| 30 kHz | Case C | 4712 – <1> – 4789 |
| n40 | 30 kHz | Case C | 5762 – <1> – 5989 |
| n41 | 15 kHz | Case A | 6246 – <3> – 6717 |
| 30 kHz | Case C | 6252 – <3> – 6714 |
| n50 | 30 kHz | Case C | 3590 – <1> – 3781 |
| n51 | 15 kHz | Case A | 3572 – <1> – 3574 |
| n66 | 15 kHz | Case A | 5279 – <1> – 5494 |
| 30 kHz | Case B | 5285 – <1> – 5488 |
| n70 | 15 kHz | Case A | 4993 – <1> – 5044 |
| n71 | 15 kHz | Case A | 1547 – <1> – 1624 |
| n74 | 15 kHz | Case A | 3692 – <1> – 3790 |
| n75 | 15 kHz | Case A | 3584 – <1> – 3787 |
| n76 | 15 kHz | Case A | 3572 – <1> – 3574 |
| n77 | 30 kHz | Case C | 7711 – <1> – 8329 |
| n78 | 30 kHz | Case C | 7711 – <1> – 8051 |
| n79 | 30 kHz | Case C | 8480 – <16> – 8880 |
| NOTE 1: SS Block pattern is defined in clause 4.1 in TS 38.213 [8]  NOTE 2: The applicable SS raster entries are GSCN = {6432, 6443, 6457, 6468, 6479, 6493, 6507, 6518, 6532, 6543}  NOTE 3: The applicable SS raster entries are GSCN = {5032, 5043, 5054}  NOTE 4: The applicable SS raster entries are GSCN = {4707, 4715, 4718, 4729, 4732, 4743, 4747, 4754, 4761, 4768, 4772, 4782, 4786, 4793} | | | |

### 5.4.4 TX–RX frequency separation

The default TX channel (carrier centre frequency) to RX channel (carrier centre frequency) separation for operating bands is specified in Table 5.4.4-1.

Table 5.4.4-1: Default UE TX-RX frequency separation

| NR Operating Band | TX – RX  carrier centre frequency separation |
| --- | --- |
| n1 | 190 MHz |
| n2 | 80 MHz |
| n3 | 95 MHz |
| n5 | 45 MHz |
| n7 | 120 MHz |
| n8 | 45 MHz |
| n12 | 30 MHz |
| n20 | -41 MHz |
| n25 | 80 MHz |
| n28 | 55 MHz |
| n66 | 400 MHz |
| n70 | 300MHz |
| n71 | -46 MHz |
| n74 | 48 MHz |
| NOTE 1: Void | |

## 5.4A Channel arrangement for CA

### 5.4A.1 Channel spacing for CA

For intra-band contiguous carrier aggregation with two or more component carriers, the nominal channel spacing between two adjacent NR component carriers is defined as the following unless stated otherwise:

For NR operating bands with a 100 kHz channel raster:



while for NR operating bands without a 100 kHz channel raster:



with

*n = µ0*

where BWChannel(1) and BWChannel(2) are the channel bandwidths of the two respective NR component carriers according to Table 5.3.2-1 with values in MHz, *μ0* is the largest *μ* value among the subcarrier spacing configurations supported in the operating band for both of the channel bandwidths according to Table 5.3.5-1 and *GBChannel(i)* is the minimum guard band for channel bandwidth i according to Table 5.3.3-1 for the said *μ* value with *μ* as defined in TS 38.211. In case there is no common μ value for both of the channel bandwidths, *μ0*=1 is selected and *GBChannel(i)* is the minimum guard band for channel bandwidth i according to Table 5.3.3-1 for *μ*=1 with *μ* as defined in TS 38.211.

The channel spacing for intra-band contiguous carrier aggregation can be adjusted to any multiple of least common multiple of channel raster and sub-carrier spacing less than the nominal channel spacing to optimize performance in a particular deployment scenario.

For intra-band non-contiguous carrier aggregation, the channel spacing between two NR component carriers in different sub-blocks shall be larger than the nominal channel spacing defined in this clause.

### 5.4A.2 Channel raster for CA

For inter-band carrier aggregation, the channel raster requirements in clause 5.4.2 apply for each operating band.

### 5.4A.3 Synchronization raster for CA

For inter-band carrier aggregation, the synchronization raster requirements in clause 5.4.3 apply for each operating band.

### 5.4A.4 Tx-Rx frequency separation for CA

For inter-band carrier aggregation, the Tx-Rx frequency separation requirements in clause 5.4.4 apply for each operating band.

## 5.5 Void

## 5.5A Configurations for CA

### 5.5A.1 Configurations for intra-band contiguous CA

Table 5.5A.1-1: NR CA configurations and bandwidth combination sets defined for intra-band contiguous CA

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR CA configuration / Bandwidth combination set | | | | | | | | |
| NR CA configuration | Uplink CA configurations | Channel bandwidths for carrier (MHz) | Channel bandwidths for carrier (MHz) | Channel bandwidths for carrier (MHz) | Channel bandwidths for carrier (MHz) | Channel bandwidths for carrier (MHz) | Maximum aggregated  bandwidth (MHz) | Bandwidth combination set |
| CA\_n41C | - | 40 | 80, 100 |  |  |  | 180 | 0 |
| 50, 60, 80 | 60, 80, 100 |  |  |  |
| CA\_n77C  CA\_n78C  CA\_n79C | - | 50 | 60, 80, 100 |  |  |  | 200 | 0 |
| 60 | 60, 80, 100 |  |  |  |
| 80 | 80, 100 |  |  |  |
| 100 | 100 |  |  |  |
| NOTE: Unless otherwise stated, minimum requirements are applicable irrespective of the order of the component carriers. | | | | | | | | |

Table 5.5A.1-2: Void

### 5.5A.2 Void

### 5.5A.3 Configurations for inter-band CA

Table 5.5A.3-1: Void

#### 5.5A.3.1 Configurations for inter-band CA (two bands)

Table 5.5A.3.1-1: NR CA configurations and bandwith combinations sets defined for inter-band CA (two bands)

| NR CA configuration | Uplink CA configuration | NR Band | SCS  (kHz) | 5  MHz | 10  MHz | 15  MHz | 20  MHz | 25 MHz | 30 MHz | 40  MHz | 50  MHz | 60  MHz | 80  MHz | 90 MHz | 100 MHz | Bandwidth combination set |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| CA\_n3A-n77A | - | n3 | 15 | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| n77 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| CA\_n3A-n78A | CA\_n3A-n78A | n3 | 15 | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| n78 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| CA\_n3A-n79A | - | n3 | 15 | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| n79 | 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\_n8A-n75A | - | n8 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| n75 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| CA\_n8A-n78A | CA\_n8A-n78A | n8 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 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 |
| CA\_n8A-n79A | - | n8 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| n79 | 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\_n28A-n75A | - | n28 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| n75 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| CA\_n28A-n78A | - | n28 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 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 |
| CA\_n41A-n78A | - | n41 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes |  | Yes |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes |  | Yes |
| n78 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| CA\_n75A-n78A | - | n75 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n78 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| CA n76A-n78A | - | n76 | 15 | Yes |  |  |  |  |  |  |  |  |  |  |  | 0 |
| 30 |  |  |  |  |  |  |  |  |  |  |  |  |
| 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 |
| CA\_n77A-n79A | - | n77 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| n79 | 15 |  |  |  |  |  |  | Yes | Yes |  |  |  |  |
| 30 |  |  |  |  |  |  | Yes | Yes | Yes | Yes |  | Yes |
| 60 |  |  |  |  |  |  | Yes | Yes | Yes | Yes |  | Yes |
| CA\_n78A-n79A | - | 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 |

## 5.5B Void

## 5.5C Configurations for SUL

Table 5.5C-1: Supported channel bandwidths per SUL band combination

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| SUL configuration | NR Band | Subcarrier spacing (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 |
| SUL\_n78A-n80A | 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 |
| n80 | 15 | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| SUL\_n78A-n81A | 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 |
| n81 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| SUL\_n78A-n82A | 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 |
| n82 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| SUL\_n78A-n83A | 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 |
| n83 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| SUL\_n78A-n84A | 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 |
| n84 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| SUL\_n78A-n86A | 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 |
| n86 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| SUL\_n79A-n80A | n79 | 15 |  |  |  |  |  |  | Yes | Yes |  |  |  |  | 0 |
| 30 |  |  |  |  |  |  | Yes | Yes | Yes | Yes |  | Yes |
| 60 |  |  |  |  |  |  | Yes | Yes | Yes | Yes |  | Yes |
| n80 | 15 | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| SUL\_n79A-n81A | n79 | 15 |  |  |  |  |  |  | Yes | Yes |  |  |  |  | 0 |
| 30 |  |  |  |  |  |  | Yes | Yes | Yes | Yes |  | Yes |
| 60 |  |  |  |  |  |  | Yes | Yes | Yes | Yes |  | Yes |
| n81 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |