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Technical Report

3rd Generation Partnership Project;
Technical Specification Group Radio Access Network;
NR;
New frequency range for NR (39.5 - 43.5 GHz)
(Release 16)

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Contents

Foreword

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

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

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  - 1 presented to TSG for information;
  - 2 presented to TSG for approval;
  - 3 or greater indicates TSG approved document under change control.
- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
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In the present document, modal verbs have the following meanings:

shall indicates a mandatory requirement to do something

shall not indicates an interdiction (prohibition) to do something

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

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

should indicates a recommendation to do something

should not indicates a recommendation not to do something

may indicates permission to do something

need not indicates permission not to do something

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

can indicates that something is possible

cannot indicates that something is impossible

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

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

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

might indicates a likelihood that something will happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

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

In addition:

is (or any other verb in the indicative mood) indicates a statement of fact

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

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

1 Scope

The present document is a technical report for Work Item on New Radio (NR) Access Technology, covering the new frequency range between 39.5- 43.5 GHz for NR.

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 38.141-2: "NR; Base Station (BS) conformance testing; Part 2: Radiated conformance testing".

[3] 3GPP TS 38.133: "NR; Radio Resource Control (RRC); Protocol specification".

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

[5] 3GPP TS 38.104: "NR; Base Station (BS) radio transmission and reception".

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].

Operating band: frequency range in which NR operates (paired or unpaired), that is defined with a specific set of technical requirements.

3.2 Symbols

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

Δf_{OOB} Δ Frequency of Out Of Band emission

$\Delta MB_{P,n}$ Allowed relaxation to each, minimum peak EIRP and reference sensitivity due to support for multi-band operation, per band in a combination of supported bands

$\Delta MB_{S,n}$ Allowed relaxation to each, EIRP spherical coverage and EIS spherical coverage due to support for multi-band operation, per band in a combination of supported bands

$\sum MB_P$ Total allowed relaxation to each, minimum peak EIRP and reference sensitivity due to support for multi-band operation, for all bands in a combination of supported bands

$\sum MB_S$ Total allowed relaxation to each, EIRP spherical coverage and EIS spherical coverage due to support for multi-band operation, for all bands in a combination of supported bands

NR_{ACLR}	NR ACLR
N_{RB}	Transmission bandwidth configuration, expressed in units of resource blocks
P_{CMAX}	The configured maximum UE output power
$P_{TMAX,f,c}$	The measured total radiated power for carrier *f* of serving cell *c*
P_{UMAX}	The measured configured maximum UE output power

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
BS	Base Station
BW	Bandwidth
EIRP	Effective Isotropic Radiated Power
EIS	Equivalent Isotropic Sensitivity
FR	Frequency Range
GSCN	Global Synchronization Channel Number
ICS	In-Channel Selectivity
ITU-R	Radiocommunication Sector of the International Telecommunication Union
NR	New Radio
NR-ARFCN	NR Absolute Radio Frequency Channel Number
OTA	Over The Air
RF	Radio Frequency
RX	Receiver
SCS	Sub-Carrier Spacing
TDD	Time division Duplex

4 Background

WRC-19 agenda item 1.13, Resolution **238** (WRC-15) identifies 37-40.5 GHz, 42.5-43.5 GHz, which have allocations to the mobile service on a primary basis; and 40.5-42.5 GHz which may require additional allocations to the mobile service on a primary basis, among other as IMT candidate bands. Consequently, after WRC-15 there have been extensive discussions and studies on the suitability of these bands for IMT allocation in different regulatory organizations. From the WRC-19 preparations, it is evident that many administrations across all ITU regions are interested in the IMT allocation of the whole or part of the 37-43.5 GHz frequency ranges. The position of regulatory bodies and regional forums regarding these ranges are summarized below:

APT (Asia-Pacific Telecommunity) members support identification of the frequency bands 37-40.5 GHz, 40.5-42.5 GHz and 42.5-43.5 GHz, or portions thereof, for IMT considering that protection of the incumbent services in these and adjacent frequency bands should be ensured. APT Members recognize that different administrations would implement IMT in different portions of the 37-43.5 GHz frequency range for IMT, and a global identification for IMT in the 37-43.5 GHz band, or portions thereof, would allow each country/region to implement IMT in different portions of the band in accordance with their national/regional considerations, while still facilitating the benefits of economies of scale.

ASMG (Arab Spectrum Management Group): supports IMT identification within the frequency bands 40.5-42.5GHz and 42.5-43.5GHz.

CEPT (European Conference of Postal and Telecommunications): proposes an IMT identification for 40.5-43.5 GHz. This is a priority band for CEPT and already specified for future harmonization in Europe. Whilst CEPT will not propose IMT identification at WRC-19 and has no intention of using 37-40.5 GHz for IMT, CEPT will not oppose a global IMT identification for the full 37-43.5 GHz range.

Some countries in CITEL including the US, Canada and Brazil support IMT identification for part of 37-43.5 GHz spectrum range.

Position of the RCC (Regional Commonwealth in the field of Communications) administrations on frequency bands 37.0−40.5 GHz and 40.5−42.5 GHz included in Resolution 238 (WRC-15): to be specified taking into account the need to protect both passive and active services.

ATU (African Telecommunications Union) supports the 40GHz band (37-40.5, 40.5-42.5 and 42.5-43.5 GHz frequency range) for IMT identification under Resolution 238 (WRC15).

4.1 Regulatory situation

Table 4.1-1 is the extract of the Radio Regulation (RR) table of allocations providing the services allocated in the 36-47 GHz frequency range.

Table 4.1.1 Allocation information in the 36-47GHz frequency range [2]

Allocation to services		
Region 1	**Region 2**	**Region 3**
36-37 EARTH EXPLORATION-SATELLITE (passive) FIXED MOBILE SPACE RESEARCH (passive) 5.149 5.550A		
37-37.5	FIXED MOBILE except aeronautical mobile SPACE RESEARCH (space-to-Earth) 5.547	
37.5-38	FIXED FIXED-SATELLITE (space-to-Earth) MOBILE except aeronautical mobile SPACE RESEARCH (space-to-Earth) Earth exploration-satellite (space-to-Earth) 5.547	
38-39.5	FIXED FIXED-SATELLITE (space-to-Earth) MOBILE Earth exploration-satellite (space-to-Earth) 5.547	
39.5-40	FIXED FIXED-SATELLITE (space-to-Earth) MOBILE MOBILE-SATELLITE (space-to-Earth) Earth exploration-satellite (space-to-Earth) 5.547	

40.5-41 FIXED FIXED-SATELLITE (space-to-Earth) MOBILE BROADCASTING BROADCASTING-SATELLITE Mobile 5.547	**40.5-41** FIXED FIXED-SATELLITE (space-to-Earth) 5.516B MOBILE BROADCASTING BROADCASTING-SATELLITE Mobile Mobile-satellite (space-to-Earth) 5.547	**40.5-41** FIXED FIXED-SATELLITE (space-to-Earth) MOBILE BROADCASTING BROADCASTING-SATELLITE Mobile 5.547
41-42.5	FIXED FIXED-SATELLITE (space-to-Earth) MOBILE BROADCASTING BROADCASTING-SATELLITE Mobile **5.547 5.551F 5.551H 5.551I**	
42.5-43.5	FIXED FIXED-SATELLITE (Earth-to-space) 5.552 MOBILE except aeronautical mobile RADIO ASTRONOMY 5.149 5.547	
43.5-47 MOBILE 5.553 MOBILE-SATELLITE RADIONAVIGATION RADIONAVIGATION-SATELLITE 5.554		

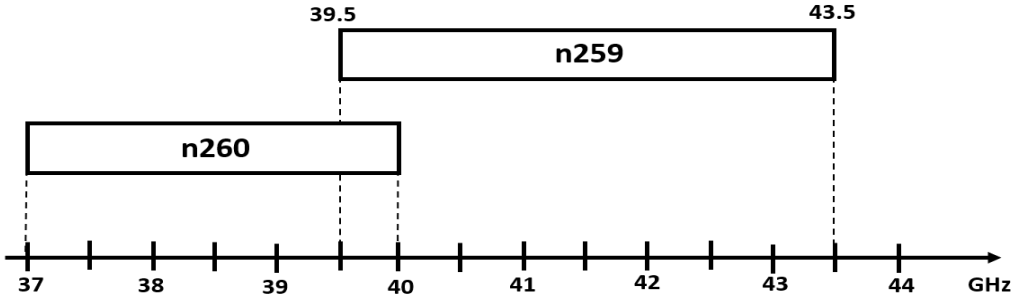
4.2 Outcome of WRC-19 for 37-43.5 GHz spectrum range

WRC-19 was held 28 October-22 November in Sharm El-Sheikh, Egypt and concluded the following decision for spectrum range 37-43.5 GHz:

“For frequency range 37-43.5 GHz he frequency band 37-43.5 GHz, or portions thereof, is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which it is allocated and does not establish priority in the Radio Regulations. Because of the potential deployment of FSS earth stations within the frequency range 37.5-42.5 GHz and high-density applications in the fixed-satellite service in the bands 39.5-40 GHz in Region 1, 40-40.5 GHz in all Regions and 40.5-42 GHz in Region 2 (see No. 5.516B), administrations should further take into account potential constraints to IMT in these bands, as appropriate. Resolution COM4/9 (WRC-19) applies.”

5 NR Frequency band definition

The Band plan for 37-43.5 GHz frequency range is shown in Figure below. Two bands are defined in this range, existing band n260 (37-40 GHz) and the new band n259 (39.5-43.5 GHz).



Band definition in the frequency range 37- 43.5 GHz

Summary of the new NR band is provided in Table 5-1.

Table 5-1: New NR band in FR2

Band number	UL	DL	Duplex mode
n259	39.5 – 43.5 GHz	39.5 - 43.5 GHz	TDD

6 Channel numbering and channel bandwidth

BS channel bandwidth for FR2 has been defined in TS 38.104. They are captured to support at least 50 MHz as a minimum channel bandwidth and up to 400 MHz as the maximum channel bandwidth. In order to apply the same requirement for Band n259, the same bandwidths as other FR2 bands are proposed as shown in table 6-1.

Table 6-1: NR channel bandwidth in the frequency range between 39.5 – 43.5 GHz

NR band		Channel bandwidth			
Band number	data SCS(kHz)	50 MHz	100 MHz	200 MHz	400 MHz
n259	60	Yes	Yes	Yes	
	120	Yes	Yes	Yes	Yes

NR-ARFCN parameters for the global frequency raster are presented in TS 38.104, table 7-2:

Table 6-2: NR-ARFCN parameters for the global frequency raster

Frequency range (MHz)	ΔF_{Global} (kHz)	$F_{REF-Offs}$ (MHz)	$N_{REF-Offs}$	Range of N_{REF}
0 – 3000	5	0	0	0 – 599999
3000 – 24250	15	3000	600000	600000 – 2016666
24250 – 100000	60	24250.08	2016667	2016667 – 3279165

Using information above and the equation $F_{REF} = F_{REF-Offs} + \Delta F_{Global} (N_{REF} – N_{REF-Offs})$, The NR-ARFCN that are applicable in the frequency range 39.5-43.5 GHz can be calculated as in table 6-3:

Table 6-3: Applicable NR-ARFCN in the frequency range between 39.5-43.5 GHz

NR Operating Band	ΔF_{Raster} (kHz)	Uplink and Downlink Range of N_{REF} (First – <Step size> – Last)
n259	60	2270832 – <1> – 2337499
n259	120	2270832 – <2> – 2337499

The synchronization raster in the frequency range between 39.5-43.5 GHz is given in Table 7-4. The distance between applicable GSCN entries is given by the <Step size> indicated in Table 7-4 with the step size interval of 17.28MHz.

Table 6-4: Applicable SS raster entries in the frequency range between 39.5-43.5 GHz

NR Operating Band	SS Block SCS	SS Block pattern[1]	Range of GSCN (First – <Step size> – Last)
n259	120 kHz	Case D	23140 – <1> – 23369
	240 kHz	Case E	23142 – <2> – 23368
NOTE: SS Block pattern is defined in subclause 4.1 in TS 38.213.			

7 Configurations for intra-band contiguous CA

Table 5.5A.1-1(NR CA configurations, bandwidth combination sets, and fallback group defined for intra-band contiguous CA) in 38.101-2 should be updated to include the following configurations for band n259 intra-band contiguous CA.

NR CA configuration	Uplink CA configurations	BWChannel (MHz)	BWChannel (MHz)	BWChannel (MHz)	BWChannel (MHz)	BWChannel (MHz)	BWChannel (MHz)	BWChannel (MHz)	BWChannel (MHz)	Maximum aggregated BW(MHz)	BCS	Fallback group
CA_n259B	CA_n259B	50, 100, 200, 400	400							800	0	3
CA_n259C	CA_n259B	50, 100, 200, 400	400	400						1200	0	
CA_n259G	CA_n259G	50, 100	100	-	-	-	-	-	-	200	0	
CA_n259H	CA_n259G CA_n259H	50, 100	100	100	-	-	-	-	-	300	0	
CA_n259I	CA_n259G CA_n259H CA_n259I	50, 100	100	100	100	-	-	-	-	400	0	
CA_n259J	CA_n259G CA_n259H CA_n259I CA_n259J	50, 100	100	100	100	100	-	-	-	500	0	
CA_n259K	CA_n259G CA_n259H CA_n259I CA_n259J CA_n259K	50, 100	100	100	100	100	100	-	-	600	0	
CA_n259L	CA_n259G CA_n259H CA_n259I CA_n259J CA_n259K CA_n259L	50, 100	100	100	100	100	100	100	-	700	0	
CA_n259M	CA_n259G CA_n259H CA_n259I CA_n259J	50, 100	100	100	100	100	100	100	100	800	0	

	CA_n259K CA_n259L CA_n259M											

8 RF requirements for band n259

8.1 UE specific

For introduction of band n259 only RF requirements for power class 3 has been considered.

8.1.1 Transmitter characteristics

The following requirements define the maximum output power radiated by the UE for any transmission bandwidth within the channel bandwidth for non-CA configuration, unless otherwise stated. The period of measurement shall be at least one sub frame (1ms). The requirement is verified with the test metric of total component of EIRP (Link=Beam peak search grids, Meas=Link angle).

Table 8.1.1-1: UE minimum peak EIRP for power class 3

Operating band	Min peak EIRP (dBm)
n259	18.7
NOTE 1: Minimum peak EIRP is defined as the lower limit without tolerance	

The maximum output power values for TRP and EIRP are found on the Table 8.1.1-2. The max allowed EIRP is derived from regulatory requirements. The requirements are verified with the test metrics of TRP (Link=TX beam peak direction) in beam locked mode and the total component of EIRP (Link=TX beam peak direction, Meas=Link angle).

Table 8.1.1-2: UE maximum output power limits for power class 3

Operating band	Max TRP (dBm)	Max EIRP (dBm)
n259	23	43

The minimum EIRP at the 50^{th} percentile of the distribution of radiated power measured over the full sphere around the UE is defined as the spherical coverage requirement and is found in Table 8.1.1-3 below. The requirement is verified with the test metric of the total component of EIRP (Link=Beam peak search grids, Meas=Link angle).

Table 8.1.1-3: UE spherical coverage for power class 3

Operating band	Min EIRP at 50 %-tile CDF (dBm)
n259	5.8
NOTE 1: Minimum EIRP at 50 %-tile CDF is defined as the lower limit without tolerance NOTE 2: The requirements in this table are verified only under normal temperature conditions.	

It is also necessary to consider the band specific requirements besides the minimum peak EIRP, maximum output power and spherical coverage. The following part will give the required changes for introducing band n259 into the requirements in TS 38.101-2: P_{UMAX} tolerance, minimum output power, transmit OFF power, adjacent channel leakage ratio, and spurious emission band UE co-existence.

Required changes for TS 38.101-2

Table 6.2.4-1: $P_{UMAX,f,c}$ tolerance

Operating Band	ΔP (dB)	Tolerance T(ΔP) (dB)
n257, n258, n259, n260, n261	ΔP = 0	0
	0 < ΔP ≤ 2	1.5
	2 < ΔP ≤ 3	2.0
	3 < ΔP ≤ 4	3.0
	4 < ΔP ≤ 5	4.0
	5 < ΔP ≤ 10	5.0
	10 < ΔP ≤ 15	7.0
	15 < ΔP ≤ X	8.0
NOTE: X is the value such that $P_{umax,f,c}$ lower bound, $P_{Powerclass}$ - ΔP – T(ΔP) = minimum output power specified in subclause 6.3.1		

Table 6.2A.4-1: P_{UMAX} tolerance

Operating Band	ΔP (dB)	Tolerance T(ΔP) (dB)
n257, n258, n259, n260, n261	ΔP = 0	0
	0 < ΔP ≤ 2	1.5
	2 < ΔP ≤ 3	2.0
	3 < ΔP ≤ 4	3.0
	4 < ΔP ≤ 5	4.0
	5 < ΔP ≤ 10	5.0
	10 < ΔP ≤ 15	7.0
	15 < ΔP ≤ X	8.0
NOTE: X is the value such that P_{umax} lower bound, $P_{Powerclass}$ - ΔP – T(ΔP) = minimum output power specified in subclause 6.3A.1		

Table 6.3.1.2-1: Minimum output power for power class 2, 3, and 4

Operating band	Channel bandwidth (MHz)	Minimum output power (dBm)	Measurement bandwidth (MHz)
n257, n258, n259, n260, n261	50	-13	47.52
	100	-13	95.04
	200	-13	190.08
	400	-13	380.16
NOTE 1: n260 is not applied for power class 2. NOTE 2: n259 is not applied for power class 2 and 4.			

Table 6.3.2-1: Transmit OFF power

Operating band	Channel bandwidth / Transmit OFF power (dBm) / measurement bandwidth			
	50 MHz	100 MHz	200 MHz	400 MHz
n257, n258, n259, n260, n261	-35	-35	-35	-35
	47.52 MHz	95.04 MHz	190.08 MHz	380.16 MHz

Table 6.3A.1.2-1: Minimum output power for CA for power class 2, 3, and 4

Operating band	Channel bandwidth (MHz)	Minimum output power (dBm)	Measurement bandwidth (MHz)
n257, n258, n259, n260, n261	50	-13	47.52
	100	-13	95.04
	200	-13	190.08
	400	-13	380.16
NOTE 1: n260 is not applied for power class 2. NOTE 2: n259 is not applied for power class 2 and 4.			

Table 6.3A.2-1: Transmit OFF power for CA

Operating band	Channel bandwidth / Transmit OFF power (dBm) / measurement bandwidth			
	50 MHz	100 MHz	200 MHz	400 MHz
n257, n258, n259, n260, n261	-35	-35	-35	-35
	47.52 MHz	95.04 MHz	190.08 MHz	380.16 MHz

Table 6.5.2.3-1: General requirements for NR_{ACLR}

	Channel bandwidth / NR_{ACLR} / Measurement bandwidth			
	50 MHz	100 MHz	200 MHz	400 MHz
NR_{ACLR} for band n257, n258, n261	17 dB	17 dB	17 dB	17 dB
NR_{ACLR} for band n259, n260	16 dB	16 dB	16 dB	16 dB
NR channel measurement bandwidth	47.52 MHz	95.04 MHz	190.08 MHz	380.16 MHz
Adjacent channel centre frequency offset (MHz)	+50 / -50	+100.0 / -100.0	+200 / -200	+400 / -400

Table 6.5.3.1-1: Requirements

NR Band	Spurious emission					
	Protected band/frequency range	Frequency range (MHz)			Maximum Level (dBm)	MBW (MHz)
n257	NR Band n259	F_{DL_low}	-	F_{DL_high}	-2	100
	NR Band n260	F_{DL_low}	-	F_{DL_high}	-2	100
	Frequency range	57000	-	66000	2	100
n258	Frequency range	57000	-	66000	2	100
n259	NR Band 257	F_{DL_low}	-	F_{DL_high}	-5	100
	NR Band 261	F_{DL_low}	-	F_{DL_high}	-5	100
	Frequency range	36000	-	37000	7	1000
	Frequency range	57000	-	66000	2	100
n260	NR Band 257	F_{DL_low}	-	F_{DL_high}	-5	100
	NR Band 261	F_{DL_low}	-	F_{DL_high}	-5	100
	Frequency range	57000	-	66000	2	100
n261	NR Band 259	F_{DL_low}	-	F_{DL_high}	-2	100
	NR Band 260	F_{DL_low}	-	F_{DL_high}	-2	100
	Frequency range	57000	-	66000	2	100
NOTE 1: F_{DL_low} and F_{DL_high} refer to each NR frequency band specified in Table 5.2-1 NOTE 2: Void						

Table 6.5A.2.3-1: General requirements for CA NR_{ACLR}

	CA bandwidth class / CA NR_{ACLR} / Measurement bandwidth
	Any CA bandwidth class
CA NR_{ACLR} for band n257, n258, n261	17 dB
CA NR_{ACLR} for band n259, n260	16 dB
NR channel measurement bandwidth[1]	$BW_{Channel\_CA} - GB_{Channel(1)} - GB_{Channel(2)}$
NOTE 1: The $GB_{Channel(i)}$ is the minimum guard band of the component carriers at the lower edge $F_{edge,\ low}$ and the upper edge $F_{edge,high}$ of the sub-block respectively.	

Table 6.5A.3-1: Requirements for CA

UL CA for any CA bandwidth class	Spurious emission						
	Protected band / frequency range	Frequency range (MHz)			Maximum Level (dBm)	MBW (MHz)	NOTE
CA_n257	NR Band n259	F_{DL_low}	-	F_{DL_high}	-2	100	
	NR Band n260	F_{DL_low}	-	F_{DL_high}	-2	100	
	Frequency range	23600	-	24000	-8	200	2
	Frequency range	57000	-	66000	2	100	
CA_n258	Frequency range	23600	-	24000	-8	200	2
	Frequency range	57000	-	66000	2	100	
CA_n259	NR Band 257	F_{DL_low}	-	F_{DL_high}	-5	100	
	NR Band 261	F_{DL_low}	-	F_{DL_high}	-5	100	
	Frequency range	36000	-	37000	7	1000	
	Frequency range	57000	-	66000	2	100	
CA_n260	NR Band 257	F_{DL_low}	-	F_{DL_high}	-5	100	
	NR Band 261	F_{DL_low}	-	F_{DL_high}	-5	100	
	Frequency range	23600	-	24000	-8	200	2
	Frequency range	57000	-	66000	2	100	
CA_n261	NR Band 259	F_{DL_low}	-	F_{DL_high}	-2	100	
	NR Band 260	F_{DL_low}	-	F_{DL_high}	-2	100	
	Frequency range	23600	-	24000	-8	200	2
	Frequency range	57000	-	66000	2	100	
NOTE 1: F_{DL_low} and F_{DL_high} refer to each NR frequency band specified in Table 5.2-1 NOTE 2: The protection of frequency range 23600 - 2400 MHz is meant for protection of satellite passive services.							

8.1.1.1 Multiband Relaxation

RAN4 agreed on enhancement of multiband relaxation framework for Rel-16 by Replacing cumulative relaxations with equivalent per-band relaxations according to Table 1:

Table1 :UE multi-band relaxation factors for power class 3

Band	$\Delta MB_{P,n}$ (dB)	$\Delta MB_{S,n}$ (dB)
n257	0.7[3]	0.7[3]
n258	0.6	0.7
n259	**0.5**	**0.4**
n260	0.5[1]	0.4[1]
n261	0.5[2,4]	0.7[4]
Note 1: n260 peak and spherical relaxations are 0 dB for UE that exclusively supports n261+n260 Note 2: n261 peak relaxation is 0 dB for UE that exclusively supports n261+n260 Note 3: n257 peak and spherical relaxations are 0 dB for UE that exclusively supports n261+n257 Note 4: n261 peak and spherical relaxations are 0 dB for UE that exclusively supports n261+n257		

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8.1.1.2 Beam Correspondence

Rel-15 beam correspondence mechanism can be reused for n259 with the following value for beam correspondence tolerance for PC3:

Table 2-1: UE beam correspondence tolerance for power class 3

Operating band	Max $\Delta EIRP_{BC}$ at 85th %-tile $\Delta EIRP_{BC}$ CDF (dB)
N257	**3.0**
N258	**3.0**
N259	**3.2**
N260	**3.2**
N261	**3.0**
NOTE: The requirements in this table are verified only under normal temperature conditions as defined in Annex E.2.1	

The BC requirement will be updated to reflect the outcome of the Rel-16 BC discussion in UE RF FR2 WI once the discussion is concluded

8.1.2 Receiver characteristics

The throughput shall be ≥ 95 % of the maximum throughput of the reference measurement channels with peak reference sensitivity specified in Table 8.1.2-1. The requirement is verified with the test metric of EIS (Link=Beam peak search grids, Meas=Link Angle).

Table 8.1.2-1: Reference sensitivity

Operating band	REFSENS (dBm) / Channel bandwidth			
	50 MHz	100 MHz	200 MHz	400 MHz
n259	-84.7	-81.7	-78.7	-75.7

The maximum EIS at the 50th percentile of the CCDF of EIS measured over the full sphere around the UE is defined as the spherical coverage requirement and is found in Table 8.1.2-2 below. The requirement is verified with the test metric of EIS (Link=Beam peak search grids, Meas=Link angle).

Table 8.1.2-2: EIS spherical coverage

Operating band	EIS at 50th %-tile CCDF (dBm) / Channel bandwidth			
	50 MHz	100 MHz	200 MHz	400 MHz
n260	-71.9	-68.9	-66.1-65.9	-63.1-62.9
NOTE 1: The transmitter shall be set to P_{UMAX}. NOTE 2: The EIS spherical coverage requirements are verified only under normal thermal conditions.				

It is also necessary to consider the band specific requirements besides the reference sensitivity and EIS spherical coverage. The following part will give the required changes for introducing band n259 into the requirements in TS 38.101-2: adjacent channel selectivity and in-band blocking.

Required changes for TS 38.101-2

Table 7.5-1: Adjacent channel selectivity

Operating band	Units	Adjacent channel selectivity / Channel bandwidth			
		50 MHz	100 MHz	200 MHz	400 MHz
n257, n258, n261	dB	23	23	23	23
n259, n260	dB	22	22	22	22

Table 7.5A-1: Adjacent channel selectivity for CA

Operating band	Units	Adjacent channel selectivity / CA bandwidth class
		All CA bandwidth class
n257, n258, n261	dB	23
n259, n260	dB	22

Table 7.6.2-1: In band blocking requirements

Rx parameter	Units	Channel bandwidth			
		50 MHz	100 MHz	200 MHz	400 MHz
Power in Transmission Bandwidth Configuration	dBm	REFSENS + 14 dB			
$BW_{Interferer}$	MHz	50	100	200	400
$P_{Interferer}$ for bands n257, n258, n261	dBm	REFSENS + 35.5 dB	REFSENS + 35.5 dB	REFSENS + 35.5 dB	REFSENS + 35.5 dB
$P_{Interferer}$ for band n259, n260	dBm	REFSENS + 34.5 dB	REFSENS + 34.5 dB	REFSENS + 34.5 dB	REFSENS + 34.5 dB
$F_{loffset}$	MHz	≤ -100 & ≥ 100 NOTE 5	≤ -200 & ≥ 200 NOTE 5	≤ -400 & ≥ 400 NOTE 5	≤ -800 & ≥ 800 NOTE 5
$F_{Interferer}$	MHz	F_{DL_low} + 25 to F_{DL_high} - 25	F_{DL_low} + 50 to F_{DL_high} - 50	F_{DL_low} + 100 to F_{DL_high} - 100	F_{DL_low} + 200 to F_{DL_high} - 200

NOTE 1: The interferer consists of the Reference measurement channel specified in Annex A.3.3.2 with one sided dynamic OCNG Pattern OP.1. TDD as described in Annex A.5.2.1 and set-up according to Annex C.
NOTE2: The REFSENS power level is specified in Section 7.3.2, which are applicable according to different UE power classes.
NOTE 3: The wanted signal consists of the reference measurement channel specified in Annex A.3.3.2 with one sided dynamic OCNG pattern OP.1 TDD as described in Annex A.5.2.1 and set-up according to Annex C.
NOTE 4: $F_{loffset}$ is the frequency separation between the center of the channel bandwidth and the center frequency of the Interferer signal.
NOTE 5: The absolute value of the interferer offset $F_{loffset}$ shall be further adjusted (CEIL($|F_{Interferer}|$/SCS) + 0.5)*SCS MHz with SCS the sub-carrier spacing of the wanted signal in MHz. Wanted and interferer signal have same SCS.
NOTE 6: $F_{Interferer}$ range values for unwanted modulated interfering signals are interferer center frequencies.

Table 7.6A.2-1: In band blocking minimum requirements for intra-band contiguous CA

Rx Parameter	Units	All CA bandwidth classes
Power in Transmission Bandwidth Configuration, per CC		REFSENS + 14 dB
Pinterferer for band n257, n258, n261	dBm	Aggregated power + 21.5
Pinterferer for band n259, n260	dBm	Aggregated power + 20.5
$BW_{Interferer}$	MHz	$BW_{Channel\_CA}$
$F_{loffset}$	MHz	+2*$BW_{Channel\_CA}$ / -2*$BW_{Channel\_CA}$ NOTE 5
$F_{Interferer}$	MHz	F_{DL_low} + 0.5*$BW_{Channel\_CA}$ To F_{DL_high} - 0.5*$BW_{Channel\_CA}$

NOTE 1: The interferer consists of the Reference measurement channel specified in Annex A.3.3.2 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1. and set-up according to Annex C.
NOTE 2: The REFSENS power level is specified in Table 7.3.2-1.
NOTE 3: The wanted signal consists of the reference measurement channel specified in Annex A.3.3.2 QPSK, R=1/3 with one sided dynamic OCNG pattern OP.1 TDD as described in Annex A.5.2.1 and set-up according to Annex C.
NOTE 4: The $F_{Interferer}$ (offset) is the frequency separation between the center of the aggregated CA bandwidth and the center frequency of the Interferer signal.
NOTE 5: The absolute value of the interferer offset $F_{Interferer}$ (offset) shall be further adjusted to (CEIL(|$F_{Interferer}$|/SCS) + 0.5)*SCS MHz with SCS the sub-carrier spacing of the carrier closest to the interferer in MHz. The interfering signal has the same SCS as that of the closest carrier.
NOTE 6: $F_{Interferer}$ range values for unwanted modulated interfering signals are interferer center frequencies.

8.2 BS specific

Based on current BS specification, at least the following requirements needed to be considered for introduction of Band n259.

Table 8.2-1: Required changes in TS 38.104 for n259

Section	Requirement	Required changes in TS 38.104
5.2	Operating bands	Operating band of n259 shall be added in to Table Table 5.2-2.
5.3.5	BS channel bandwidth per operating band	Channel bandwidths and corresponding SCS for n259 shall be added in Table 5.3.5-2.
5.4.2.3	Channel raster entries for each operating band	Applicable NR-ARFCN for n259 shall be added into Table 5.4.2.3-2 once the lower frequency limit for n259 is determined.
5.4.3.3	Synchronization raster entries for each operating band	Applicable SS raster entries for n259 shall be added into Table 5.4.3.3-2 once the lower frequency limit for n259 is determined.

The BS RF requirements summarized in Table 8.2-2 is band agnostic RF requirements for FR2 which are applicable for band n259 as well.

Table 8.2-2: Summary on band agnostic of BS RF requirements for FR2

BS TX side capture in TS 38.104	BS RX side capture in TS 38.104
9.2 Radiated transmit power	10.3 OTA reference sensitivity level
9.3 OTA Base station output power	10.5 OTA In-band selectivity and blocking
9.4 OTA Output power dynamics	10.7 OTA Receiver spurious emissions
9.5 OTA Transmit ON/OFF power	10.9 OTA In-channel selectivity
9.6 OTA Transmitted signal quality	
9.7.2 OTA Occupied bandwidth	
9.7.5 OTA Transmitter spurious emissions	

In the following sections BS specific requirements for band n259 are presented.

8.2.1 Radiated transmitter characteristics

8.2.2.1 Adjacent Channel Leakage Ratio (ACLR)

The BS OTA ACLR limit for spectrum range 37 – 52.6 GHz has been defined in TS 38.104. This is also applicable for Band n259.

8.2.2.2 OTA operating band unwanted emissions

The BS OTA operating band unwanted emission for spectrum range 37 – 52.6 GHz has been specified in TS 38.104, section 9.7. Those limits are applicable for Band n259.

8.2.2.3 Definition of ΔfOBUE and ΔfOOB

In TS 38.104, the definition of Δf_{OBUE} and Δf_{OOB} applies to 3250 MHz operating bandwidth while for band n259 the operating bandwidth is $F_{DL,high} - F_{DL,low} == 4000$ MHz. For Δf_{OBUE} and Δf_{OOB} to be applicable for band n259 the following tables in TS 38.104 should be modified as follows:

Table 9.7.1-1: Maximum offset Δf_{OBUE} outside the downlink operating band

BS type	Operating band characteristics	Δf_{OBUE} (MHz)
BS type 1-O	$F_{DL,high} - F_{DL,low} < 100$ MHz	10
	100 MHz ≤ $F_{DL,high} - F_{DL,low} \leq 900$ MHz	40
BS type 2-O	$F_{DL,high} - F_{DL,low} \leq 4000$ MHz	1500

The same modification should be performed to Table 6.7.1-1: *Maximum offset ΔfOBUE outside the downlink operating band* in TS 38.141-2.

8.2.2.4 Step frequencies for Tx spurious emission

It is also needed to add band n259 to Table 9.7.5.3.2.3-2 in TS 38.104 thus Table 9.7.5.3.2.3-2 should be modified as below to include band n259.

Table 9.7.5.3.2.3-2: Step frequencies for defining the BS radiated Tx spurious emission limits in FR2 (Category B)

Operating band	$F_{step,1}$ [GHz]	$F_{step,2}$ [GHz]	$F_{step,3}$ [GHz] (Note 2)	$F_{step,4}$ [GHz] (Note 2)	$F_{step,5}$ [GHz]	$F_{step,6}$ [GHz]
n258	18	21	22.75	29	30.75	40.5
n259	23,5	35,5	38	45	47,5	59,5
NOTE 1: $F_{step,X}$ are based on ERC Recommendation 74-01 [19], Annex 2. NOTE 2: $F_{step,3}$ and $F_{step,4}$ are aligned with the values for Δf_{OBUE} in Table 9.7.1-1.						

8.2.2.5 Measurement uncertainty and test tolerance

For introduction of band n259 the following updates are needed in TS 38.141-2:

- Update the frequency range in the TT table (Table C.1-2: Derivation of test requirements (FR2 OTA transmitter tests)) as below:
  - Radiated transmit power:
    - 2.0 dB (37 – 43.5 GHz) for normal condition
    - 3.3 dB (37 – 43.5 GHz) for extreme condition.
  - OTA base station output power:
    - 2.4 dB (37 – 43.5 GHz)
  - OTA transmitter OFF power:

  - 3.3 dB (37 – 43.5 GHz)
- OTA ACLR
  - 2.6 dB (37 – 43.5 GHz) for relative ACLR
  - 2.7 dB (37 – 43.5 GHz) for absolute ACLR
- OTA operating band unwanted emissions
  - 2.7 dB (37 – 43.5 GHz)

- Update the frequency range of the test requirements for "radiated transmit power", "OTA base station output power" and "OTA transmitter transient period" from "37 GHz < f ≤ 40 GHz" to "37 GHz < f ≤ 43.5 GHz"

8.2.2 Radiated receiver characteristic

The BS OTA Receiver characteristics have been specified in TS 38.104. The requirements are either band agnostic or are defined for spectrum range 37 – 52.6 GHz. Those limits are applicable for Band n259.

8.2.2.1 Definition of ΔfOBUE and ΔfOOB

In TS 38.104, the definition of Δf_{OBUE} and Δf_{OOB} applies to 3250 MHz operating bandwidth while for band n259 the operating bandwidth is $F_{DL,high} - F_{DL,low} = 4000$ MHz. For Δf_{OBUE} and Δf_{OOB} to be applicable for band n259 the following tables in TS 38.104 should be modified as follows:

Table 10.5.2.3-0: Δf_{OOB} offset for NR operating bands in FR2

BS type	*Operating band characteristics*	*Δf_{OOB} (MHz)*
BS type 2-O	*$F_{UL\_high} - F_{UL\_low} \leqslant 4000$ MHz*	*1500*

The same modification should be performed inTable 7.5.2.5.3-0: *ΔfOOB offset for NR operating bands in FR2* in TS 38.141-2.

8.2.2.2 Step frequencies for Rx spurious emission

It is also needed to add band n259 to Table 10.7.3-2in TS 38.104 thus Table 10.7.3-2should be modified as below to include band n259.

Table 10.7.3-2: Step frequencies for defining the radiated Rx spurious emission limits for *BS type 2-O*

Operating band	$F_{step,1}$ (GHz)	$F_{step,2}$ (GHz)	$F_{step,3}$ (GHz)	$F_{step,4}$ (GHz)	$F_{step,5}$ (GHz)	$F_{step,6}$ (GHz)
n257	18	23.5	25	31	32.5	41.5
n258	18	21	22.75	29	30.75	40.5
n259	23,5	35,5	38	45	47,5	59,5
n260	25	34	35.5	41.5	43	52
n261	18	25.5	26.0	29.85	30.35	38.35

9 RRM Requirements

For introduction of band n259 the following sections in TS 38.133 need to be updated to include RRM band specific requirements for band n259:

1) 3.5 Frequency bands grouping
2) Annex B (normative): Conditions for RRM requirements applicability for operating bands

9.1 Frequency bands grouping

The frequency bands grouping for FR2 presented in Table 3.5.3-1 is derived based on UE REFSENS requirements and assuming 0.5 dB step between the neighbour groups. The groups are defined in the order of increasing REFSENS, i.e., the group A has the smallest REFSENS among the groups.

UE REFSENS for band n259 is defined in TR 38.887 [1] as follows:

Table 8.1.2-1: Reference sensitivity

Operating band	REFSENS (dBm) / Channel bandwidth			
	50 MHz	100 MHz	200 MHz	400 MHz
n259	-84.7	-81.7	-78.7	-75.7

In Table 3.5.3-2, Group Y which includes n260 PC3 with REFSENS of -85.7/50 MHz, Table 7.3.2.3-1 in TS 38.101-2 , corresponds to UE REFSENS of -85.5.

Since REFSENS for band n259 is -84.7 dBm/50 MHz, we need to introduce two new groups considering the 0.5 dB steps between two groups. The two new groups are presented in Table 3.5.3-1.

Table 3.5.3-1: NR frequency band groups for FR2

Group	Band group notation	Operating bands
A	NR_TDD_FR2_A	n257[1], n258[1], n261[1]
B	NR_TDD_FR2_B	n257[4], n258[4], n261[4]
C	NR_TDD_FR2_C	
D	NR_TDD_FR2_D	
E	NR_TDD_FR2_E	
F	NR_TDD_FR2_F	n260[4]
G	NR_TDD_FR2_G	n260[1]
H	NR_TDD_FR2_H	
I	NR_TDD_FR2_I	
J	NR_TDD_FR2_J	
K	NR_TDD_FR2_K	
L	NR_TDD_FR2_L	n257[2], n258[2], n261[2]
M	NR_TDD_FR2_M	
N	NR_TDD_FR2_N	
O	NR_TDD_FR2_O	
P	NR_TDD_FR2_P	
Q	NR_TDD_FR2_Q	
R	NR_TDD_FR2_R	
S	NR_TDD_FR2_S	
T	NR_TDD_FR2_T	n257[3], n258[3], n261[3]
U	NR_TDD_FR2_U	
V	NR_TDD_FR2_V	
W	NR_TDD_FR2_W	
X	NR_TDD_FR2_X	
Y	NR_TDD_FR2_Y	n260[3]
Z	NR_TDD_FR2_Z	
AA	NR_TDD_FR2_AA	n259[3]
NOTE 1: UE power class 1. NOTE 2: UE power class 2. NOTE 3: UE power class 3. NOTE 4: UE power class 4.		

9.2 Conditions for RRM requirements applicability for operating bands

Derivation of Minimum SSB_RP values for FR2 is defined in Annex B.2 in TS 38.133 as follows:

9.2.1 Minimum SSB_RP values for Rx Beam Peak angle of arrival

Minimum SSB_RP values are based on Reference sensitivity for the Operating band and for the UE power class, taking a baseline of UE Power class 3 in Band n260 with 50 MHz channel bandwidth.

The calculated Minimum SSB_RP value for the baseline of UE power class 3 in Band n260 is (-109.5+ΣMB_P) dBm/120kHz for intra-frequency measurements and (-107.5+ΣMB_P) dBm/120kHz for inter-frequency measurements.

The following methodology to define the Minimum SSB_RP level for power class X (PC_X) and operating band Y (Band_Y) is used:

For Intra-frequency: Minimum SSB_RP (PC_X, Band_Y) = -109.5 dBm/120kHz + $Refsens_{PC\_X, Band\_Y, 50MHz} - Refsens_{PC3, n260, 50MHz} + Y_{PC\_X} - Y_{PC3} + \Delta MB_P$,

For Inter-frequency: Minimum SSB_RP (PC_X, Band_Y) = -107.5 dBm/120kHz + $Refsens_{PC\_X, Band\_Y, 50MHz} - Refsens_{PC3, n260, 50MHz} + Y_{PC\_X} - Y_{PC3} + \Delta MB_P$.

Using the formulas above will result in following values for band n259:

For Intra-frequency: Minimum SSB_RP (3, n259) = -108 dBm/120kHz

For Inter-frequency: Minimum SSB_RP (3, n259) = -106 dBm/120kHz

9.2.2 Minimum SSB_RP values for angle of arrival within Spherical coverage

Minimum SSB_RP values are based on EIS spherical coverage for the Operating band and for the UE power class, taking a baseline of UE power class 3 in Band n260 with 50 MHz channel bandwidth.

The calculated Minimum SSB_RP value for the baseline of UE power class 3 in Band n260 is (-96.9+ΣMB_S) dBm/120kHz for intra-frequency measurements and is (-94.9+ΣMB_S) dBm/120kHz for inter-frequency measurements.

The following methodology to define the Minimum SSB_RP level for power class X (PC_X) and operating band Y (Band_Y) is used:

For Intra-frequency: Minimum SSB_RP (PC_X, Band_Y) = (-103.9+ΣMB_S +Z) dBm/120 kHz + $Refsens_{PC\_X, Band\_Y, 50MHz} - Refsens_{PC3, n260, 50MHz} + Z_{PC\_X} - Z_{PC3} + \Delta MB_S$,

For Inter-frequency: Minimum SSB_RP (PC_X, Band_Y) = (-101.9+ΣMB_S +Z) dBm/120 kHz + $Refsens_{PC\_X, Band\_Y, 50MHz} - Refsens_{PC3, n260, 50MHz} + Z_{PC\_X} - Z_{PC3} + \Delta MB_S$

Using the formulas above will result in following values for band n259:

For Intra-frequency: Minimum SSB_RP (3, n259) = -95.3 dBm/120kHz

For Inter-frequency: Minimum SSB_RP (3, n259) = -93.3 dBm/120kHz

The following tables in TS 38.133 should be upated based on the calculations above.

Table B.1.2-2: Conditions for intra-frequency cell re-selection in FR2

Parameter	Angle of arrival	NR operating bands	Minimum SSB_RP Note 2, Note 3					SSB Ês/Iot
			dBm / SCS_{SSB}					
			SCS_{SSB} = 120 kHz				SCS_{SSB} = 240 kHz	dB
			UE Power class				UE Power class	
			1	2	3	4	1, 2, 3, 4	
Conditions	Rx Beam Peak	n257	$-125.3+Y_1$	-110.8	-109.1	$-124.8+Y_4$	(Value for SCS_{SSB} = 120 kHz) +3dB	≥-4
		n258	$-125.3+Y_1$	-110.8	-109.1	$-124.8+Y_4$		
		n259			-105.5			
		n260	$-122.3+Y_1$		-106.5	$-122.8+Y_4$		
		n261	$-125.3+Y_1$	-110.8	-109.1	$-124.8+Y_4$		
	Spherical coverage Note 1	n257	$-117.3+Z_1$	-99.8	-98.2	$-115.8+Z_4$	(Value for SCS_{SSB} = 120 kHz) +3dB	≥-4
		n258	$-117.3+Z_1$	-99.8	-98.2	$-115.8+Z_4$		
		n259			-92.7			
		n260	$-114.3+Z_1$		-93.9	$-110.8+Z_4$		
		n261	$-117.3+Z_1$	-99.8	-98.2	$-115.8+Z_4$		

NOTE 1: Values based on EIS spherical coverage as defined in clause 7.3.4 of TS 38.101-2 [19]. Side condition applies for directions in which EIS spherical coverage requirement is met.
NOTE 2: Values specified at the Reference point to give minimum SSB Ês/Iot, with no applied noise.
NOTE 3: For UEs that support multiple FR2 bands, Rx Beam Peak values are increased by ΔMB_P and Spherical coverage values are increased by ΔMB_S, the UE multi-band relaxation factor in dB specified in clause 6.2.1 of TS 38.101-2 [19].

Table B.2.2-2: Conditions for intra-frequency measurements in FR2

Parameter	Angle of arrival	NR operating bands	Minimum SSB_RP Note 2, Note 3					SSB Ês/Iot
			dBm / SCS_{SSB}					dB
			SCS_{SSB} = 120 kHz				SCS_{SSB} = 240 kHz	
			UE power class				UE power class	
			1	2	3	4	1, 2, 3, 4	
Conditions	Rx Beam Peak	n257	$-128.3+Y_1$	-113.8	-112.1	$-127.8+Y_4$	(Value for SCS_{SSB} = 120 kHz) +3dB	≥-6
		n258	$-128.3+Y_1$	-113.8	-112.1	$-127.8+Y_4$		
		n259			-108.5			
		n260	$-125.3+Y_1$		-109.5	$-125.8+Y_4$		
		n261	$-128.3+Y_1$	-113.8	-112.1	$-127.8+Y_4$		
	Spherical coverage Note 1	n257	$-120.3+Z_1$	-102.8	-101.2	$-118.8+Z_4$	(Value for SCS_{SSB} = 120 kHz) +3dB	≥-6
		n258	$-120.3+Z_1$	-102.8	-101.2	$-118.8+Z_4$		
		n259			-95.7			
		n260	$-117.3+Z_1$		-96.9	$-113.8+Z_4$		
		n261	$-120.3+Z_1$	-102.8	-101.2	$-118.8+Z_4$		

Note 1: Values based on EIS spherical coverage as defined in clause 7.3.4 of TS 38.101-2 [19]. Side condition applies for directions in which EIS spherical coverage requirement is met.

Note 2: Values specified at the Reference point to give minimum SSB Ês/Iot, with no applied noise.

Note 3: For UEs that support multiple FR2 bands, Rx Beam Peak values are increased by ΔMB_P and spherical coverage values are increased by ΔMB_S, the UE multi-band relaxation factor in dB specified in clause 6.2.1 of TS 38.101-2 [19].

Table B.2.3-2**: Conditions for inter-frequency measurements in FR2**

Parameter	Angle of arrival	NR operating bands	Minimum SSB_RP Note 2, Note 3					SSB Ês/Iot
			dBm / SCS_{SSB}					dB
			SCS_{SSB} = 120 kHz				SCS_{SSB} = 240 kHz	
			UE power class				UE power class	
			1	2	3	4	1, 2, 3, 4	
Conditions	Rx Beam Peak	n257	-126.3+Y_1	-111.8	-110.1	-125.8+Y_4	(Value for SCS_{SSB} = 120 kHz) +3dB	≥-4
		n258	-126.3+Y_1	-111.8	-110.1	-125.8+Y_4		
		n259			-106.5			
		n260	-123.3+Y_1		-107.5	-123.8+Y_4		
		n261	-126.3+Y_1	-111.8	-110.1	-125.8+Y_4		
	Spherical coverage Note 1	n257	-118.3+Z_1	-100.8	-99.2	-116.8+Z_4	(Value for SCS_{SSB} = 120 kHz) +3dB	≥-4
		n258	-118.3+Z_1	-100.8	-99.2	-116.8+Z_4		
		n259			-93.7			
		n260	-115.3+Z_1		-94.9	-111.8+Z_4		
		n261	-118.3+Z_1	-100.8	-99.2	-116.8+Z_4		

NOTE 1: Values based on EIS spherical coverage as defined in clause 7.3.4 of TS 38.101-2 [19]. Side condition applies for directions in which EIS spherical coverage requirement is met.
NOTE 2: Values specified at the Reference point to give minimum SSB Ês/Iot, with no applied noise.
NOTE 3: For UEs that support multiple FR2 bands, Rx Beam Peak values are increased by ΔMB_P and Spherical coverage values are increased by ΔMB_S, the UE multi-band relaxation factor in dB specified in clause 6.2.1 of TS 38.101-2 [19].

Table B.2.4.1-2: Conditions for SSB based L1-RSRP measurements in FR2

Parameter	Angle of arrival	NR operating bands	Minimum SSB_RP Note 2, Note 3					SSB Ês/Iot
			dBm / SCS_{SSB}					dB
			SCS_{SSB} = 120 kHz				SCS_{SSB} = 240 kHz	
			UE power class				UE power class	
			1	2	3	4	1, 2, 3, 4	
Conditions	Rx Beam Peak	n257	-125.3+Y_1	-110.8	-109.1	-124.8+Y_4	(Value for SCS_{SSB} = 120 kHz) +3dB	≥-3
		n258	-125.3+Y_1	-110.8	-109.1	-124.8+Y_4		
		n259			-105.5			
		n260	-122.3+Y_1		-106.5	-122.8+Y_4		
		n261	-125.3+Y_1	-110.8	-109.1	-124.8+Y_4		
	Spherical coverage Note 1	n257	-117.3+Z_1	-99.8	-98.2	-115.8+Z_4	(Value for SCS_{SSB} = 120 kHz) +3dB	≥-3
		n258	-117.3+Z_1	-99.8	-98.2	-115.8+Z_4		
		n259			-92.7			
		n260	-114.3+Z_1		-93.9	-110.8+Z_4		
		n261	-	-99.8	-98.2	-		

			117.3+Z_1			115.8+Z_4		

NOTE 1: Values based on EIS spherical coverage as defined in clause 7.3.4 of TS 38.101-2 [19]. Side condition applies for directions in which EIS spherical coverage requirement is met.
NOTE 2: Values specified at the Reference point to give minimum SSB Ês/Iot, with no applied noise.
NOTE 3: For UEs that support multiple FR2 bands, Rx Beam Peak values are increased by ΔMB_P and Spherical coverage values are increased by ΔMB_S, the UE multi-band relaxation factor in dB specified in clause 6.2.1 of TS 38.101-2 [19].

Table B.2.4.2-2: Conditions for CSI-RS based L1-RSRP measurements in FR2

Parameter	Angle of arrival	NR operating bands	Minimum CSI-RS_RP Note 2, Note 3					CSI-RS Ês/Iot
			dBm / SCS_{CSI-RS}					dB
			SCS_{CSI-RS} = 60 kHz				SCS_{CSI-RS} = 120 kHz	
			UE power class				UE power class	
			1	2	3	4	1, 2, 3, 4	
Conditions	Rx Beam Peak	n257	-128.3+Y_1	-113.8	-112.1	-127.8+Y_4	(Value for SCS_{CSI-RS} = 60 kHz) +3dB	≥-3
		n258	-128.3+Y_1	-113.8	-112.1	-127.8+Y_4		
		n259			-108.5			
		n260	-125.3+Y_1		-109.5	-125.8+Y_4		
		n261	-128.3+Y_1	-113.8	-112.1	-127.8+Y_4		
	Spherical coverage Note 1	n257	-120.3+Z_1	-102.8	-101.2	-118.8+Z_4	(Value for SCS_{CSI-RS} = 60 kHz) +3dB	≥-3
		n258	-120.3+Z_1	-102.8	-101.2	-118.8+Z_4		
		n259			-95.7			
		n260	-117.3+Z_1		-96.9	-113.8+Z_4		
		n261	-120.3+Z_1	-102.8	-101.2	-118.8+Z_4		

NOTE 1: Values based on EIS spherical coverage as defined in clause 7.3.4 of TS 38.101-2 [19]. Side condition applies for directions in which EIS spherical coverage requirement is met.
NOTE 2: Values specified at the Reference point to give minimum CSI-RS Ês/Iot, with no applied noise.
NOTE 3: For UEs that support multiple FR2 bands, Rx Beam Peak values are increased by ΔMB_P and Spherical coverage values are increased by ΔMB_S, the UE multi-band relaxation factor in dB specified in clause 6.2.1 of TS 38.101-2 [19].

Table B.2.5-2: Conditions for RRC connection release with redirection to NR in FR2

Parameter	Angle of arrival	NR operating bands	Minimum SSB_RP Note 2, Note 3					SSB Ês/Iot
			dBm / SCS_{SSB}					dB
			SCS_{SSB} = 120 kHz				SCS_{SSB} = 240 kHz	
			UE power class				UE power class	
			1	2	3	4	1, 2, 3, 4	
Conditions	Rx Beam Peak	n257	$-126.3+Y_1$	-111.8	-110.1	$-125.8+Y_4$	(Value for SCS_{SSB} = 120 kHz) +3dB	≥-4
		n258	$-126.3+Y_1$	-111.8	-110.1	$-125.8+Y_4$		
		n259			-106.5			
		n260	$-123.3+Y_1$		-107.5	$-123.8+Y_4$		
		n261	$-126.3+Y_1$	-111.8	-110.1	$-125.8+Y_4$		
	Spherical coverage Note 1	n257	$-118.3+Z_1$	-100.8	-99.2	$-116.8+Z_4$	(Value for SCS_{SSB} = 120 kHz) +3dB	≥-4
		n258	$-118.3+Z_1$	-100.8	-99.2	$-116.8+Z_4$		
		n259			-93.7			
		n260	$-115.3+Z_1$		-94.9	$-111.8+Z_4$		
		n261	-114.3	-100.8	-99.2	$-116.8+Z_4$		

NOTE 1: Values based on EIS spherical coverage as defined in clause 7.3.4 of TS 38.101-2 [19]. Side condition applies for directions in which EIS spherical coverage requirement is met.
NOTE 2: Values specified at the Reference point to give minimum SSB Ês/Iot, with no applied noise.
NOTE 3: For UEs that support multiple FR2 bands, Rx Beam Peak values are increased by ΔMB_P and spherical coverage values are increased by ΔMB_S, the UE multi-band relaxation factor in dB specified in clause 6.2.1 of TS 38.101-2 [19].

Table B.2.6.1-2: Conditions for SSB based UE transmit timing in FR2

Parameter	Angle of arrival	NR operating bands	Minimum SSB_RP Note 2, Note 3					SSB Ês/Iot
			dBm / SCS_{SSB}					dB
			SCS_{SSB} = 120 kHz				SCS_{SSB} = 240 kHz	
			UE power class				UE power class	
			1	2	3	4	1, 2, 3, 4	
Conditions	Rx Beam Peak	n257	$-125.3+Y_1$	-110.8	-109.1	$-124.8+Y_4$	(Value for SCS_{SSB} = 120 kHz) +3dB	≥-3
		n258	$-125.3+Y_1$	-110.8	-109.1	$-124.8+Y_4$		
		n259			-105.5			
		n260	$-122.3+Y_1$		-106.5	$-122.8+Y_4$		
		n261	$-125.3+Y_1$	-110.8	-109.1	$-124.8+Y_4$		
	Spherical coverage Note 1	n257	$-117.3+Z_1$	-99.8	-98.2	$-115.8+Z_4$	(Value for SCS_{SSB} = 120 kHz) +3dB	≥-3
		n258	$-117.3+Z_1$	-99.8	-98.2	$-115.8+Z_4$		
		n259			-92.7			

		n260	$-114.3+Z_1$		-93.9	$-110.8+Z_4$		
		n261	$-117.3+Z_1$	-99.8	-98.2	$-115.8+Z_4$		

NOTE 1: Values based on EIS spherical coverage as defined in clause 7.3.4 of TS 38.101-2 [19]. Side condition applies for directions in which EIS spherical coverage requirement is met.
NOTE 2: Values specified at the Reference point to give minimum SSB Ês/Iot, with no applied noise.
NOET 3: For UEs that support multiple FR2 bands, Rx Beam Peak values are increased by ΔMB_P and Spherical coverage values are increased by ΔMB_S, the UE multi-band relaxation factor in dB specified in clause 6.2.1 of TS 38.101-2 [19].

10 Required changes to NR, E-UTRA, UTRA and MSR specifications

The required changes to the 3GPP specifications for the NR band n259 are summarised in a Table 8-1.

Table 8-1: Overview of 3GPP specifications with required changes

Affected existing specifications			
Spec No.	**Subject of the CR**	**Comments**	**CR/TP (Tdoc)**
38.141-2	Introduction of band n259		R4-2007796
38.104	Introduction of band n259		R4-2008975
38.101-2	Introduction of band n259		R4-2009153
38.133	Introduction of band n259		R4-2008911

Annex A: Change history

Change history							
Date	**TSG #**	**TSG Doc.**	**CR**	**Rev**	**Subject/Comment**	**Old**	**New**
04/2019	RAN4#90bis	R4-17xxxx			TR skeleton	N/A	0.0.0
05/2019	RAN4#91	R4-1907101			TP on General issues		0.1.0
05/2019	RAN4#91	R4-1906861			On frequency range for NR band n259		0.1.0
05/2019	RAN4#91	R4-1907786			Regulatory situation in 37-43.5 GHz frequency range		0.1.0
08/2019	RAN4#92	R4-1909915			BS RF requirements		0.2.0
11/2019	RAN4#92bis	R4-1912187			Band plan for NR band 259		0.3.0
11/2019	RAN4#93	R4-1916055			Channel numbering and channel bandwidth for band n259		0.3.0
11/2019	RAN4#93	R4-1916035			UE RF requirements for n259		0.3.0
03/2020	RAN4#94-e	R4-2001961			TP on General issues		0.4.0
03/2020	RAN4#94-e	R4-2002838			TP on BS RF requirement for band n259		0.4.0
06/2020	RAN4#95-e	R4-2007792			TP on BS RF requirement for band n259		0.5.0
06/2020	RAN4#95-e	R4-2007793			TP on Remaining issues on UE RF for Introduction of band n259		0.5.0
06/2020	RAN4#95-e	R4-2008910			TP on RRM requirements for band n259		0.5.0

Change history							
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