**3GPP TSG- Meeting #**

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| *CR-Form-v12.2* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
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|  |  | **CR** |  | **rev** | - | **Current version:** |  |  |
|  | | | | | | | | |
| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
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| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network |  | Core Network |  |

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| ***Title:*** |  | | | | | | | | | |
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| ***Source to WG:*** |  | | | | | | | | | |
| ***Source to TSG:*** |  | | | | | | | | | |
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| ***Work item code:*** | NR\_NTN\_solutions-Perf | | | | |  | ***Date:*** | | |  |
|  |  | | | |  | |  | | |  |
| ***Category:*** |  |  | | | | | ***Release:*** | | |  |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) … Rel-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | RAN4 has agreed for introduce performance requirements for NTN UE. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | This big CR merges the following endorsed draft CRs to introduce the performance requirements for NTN UE:  R4-2216396 to Introduce new sections for the definition of throughput and reference channel;  R4-2217345 to introduce propagation channel modes, physical channels and environmental conditions for UE demod requirements;  R4-2217346 to introduce general part of UE NTN performance requirements, update clause 8.1;  R4-2217347 to add clause 8.2.1 with introduction of applicability rules of UE NTN performance requirements. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | The performacne requirements for NTN UE are missing. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | R4-2216396: Annex A;  R4-2217345: Annex B, Annex C, D, E (new);  R4-2217346: 8.1;  R4-2217347: 8.2 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **x** | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | | **x** |  | Test specifications | | | | Unknown currently | | |
| ***(show related CRs)*** | |  | **x** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

<Start of change#1>

General

8.1.1 Relationship between minimum requirements and test requirements

The present document is a Single-RAT and interwork specification for NR UE, covering minimum performance requirements of both conducted and radiated requirements. Conformance to the present specification is demonstrated by fulfilling the test requirements specified in the conformance specification TS TBD [TBD].

The Minimum Requirements given in this specification make no allowance for measurement uncertainty. The test specification TS TBD [TBD] 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.

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 [TBD].

The applicability of each requirement is described under each sub-clause in [8.2.1] and [8.3.1].

8.1.2 Applicability of minimum requirements

The conducted minimum requirements specified in this specification shall be met in all applicable scenarios for FR1.

Unless otherwise stated, all minimum performance requirements defined in Clauses 8 are applicable to UE power class 3 only.

8.1.3 Conducted requirements

8.1.3.1 Introduction

The requirements are defined for the following modes:

- Mode 1: Conditions with external noise source

- Wanted signal with power level Es is transmitted.

- External white noise source with power spectral density Noc is used.

- *Es* and *Noc* levels are selected to achieve target SNR as described in Clause 8.1.3.3.

8.1.3.2 Reference point

The reference point for SNR, Es and Noc of DL signal is the UE antenna connector or connectors.

8.1.3.3 SNR definition

For Mode 1 conditions conducted UE demodulation and CSI requirements the SNR is defined as:

Where

- NRX denotes the number of receiver antenna connectors and the superscript receiver antenna connector *j*.

- The above SNR definition assumes that the REs are not precoded, and does not account for any gain which can be associated to the precoding operation.

- Unless otherwise stated, the SNR refers to the SSS wanted signal.

- The downlink SSS transmit power is defined as the linear average over the power contributions in [W] of all resource elements that carry the SSS within the operating system bandwidth.

- The power ratio of other wanted signals to the SSS is defined in clause [C.3.1].

8.1.3.4 Noc

8.1.3.4.1 Introduction

This clause describes the Noc power level for Mode 1 conditions conducted testing of demodulation and CSI requirements.

8.1.3.4.2 Noc for NR operating bands in FR1

The Noc power spectrum density shall be larger or equal to the minimum Noc power level for each operating band supported by the UE as defined in clause 8.1.3.4.2.1.

Unless otherwise stated, a fixed Noc power level of -145 dBm/Hz shall be used for all operating bands.

8.1.3.4.2.1 Derivation of Noc values for NR operating bands in FR1

The minimum Noc power level for an operating band, subcarrier spacing and channel bandwidth is derived based on the following equation:

NocBand\_X, SCS\_Y, CBW\_Z = REFSENSBand\_X, SCS\_Y, CBW\_Z – 10\*log10(12\*SCS\_Y\*nPRB) + D – SNRREFSENS + ∆thermal

where

- REFSENSBand\_X, SCS\_Y, CBW\_Z is the REFSENS value in dBm for Band X, SCS Y and CBW Z specified in Table 7.3.2-1 of TS 38.101-5 [TBD]

- 12 is the number of subcarriers in a PRB

- SCS Y is the subcarrier spacing associated with the REFSENS value

- nPRB is the maximum number of PRB for SCS Y and CBW Z associated with the REFSENS value, and is specified in Table 5.3.2-1 of TS 38.101-5 [TBD]

- D is diversity gain equal to 3 dB

- SNRREFSENS = -1 dB is the SNR used for simulation of REFSENS

- ∆thermal is the amount of dB that the wanted noise is set above UE thermal noise, giving a defined rise in total noise. ∆thermal = 16dB, giving a rise in total noise of 0.1dB, regarded as insignificant**.**

The calculated Noc value for the baseline of Band n256, 15 kHz SCS, 10 MHz CBW is -146.5 dBm/Hz.

An allowance of 1.5dB is made for future bands, giving an Noc power level of -145 dBm/Hz.

<End of change#1>

<Start of change#2>

8.2.1 General

8.2.1.1 Applicability of requirements

8.2.1.1.1 General

The minimum performance requirements are applicable to all FR1 operating bands defined in TS 38.108[TBD].

If same test is listed for different UE features/capabilities in Clauses 8.2.1.1.2, then this test shall apply for UEs which support all corresponding UE features/capabilities.

8.2.1.1.2 Applicability of requirements for optional UE features

The performance requirements in Table 8.2.1.1.2-1 shall apply for UEs which support optional UE features only.

**Table 8.2.1.1.2-1: Requirements applicability for optional UE features**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE feature/capability [TBD]** | **Test type** | | **Test list** | **Applicability notes** |
| NR NTN access (*nonTerrestrialNetwork-r17*) | FR1 FDD | PDSCH | TBD |  |
| NR NTN scenario support (*ntn-ScenarioSupport-r17*) | FR1 FDD | PDSCH | TBD | The requirements apply only when *ntn-ScenarioSupport-r17* is “ngso” or is not inculded. |
| Increasing the number of HARQ processes (*max-HARQ-ProcessNumber-r17*) | FR1 FDD | PDSCH | TBD |  |
| Disabled HARQ feedback for downlink transmission (*harq-FeedbackDisabled-r17*) | FR1 FDD | PDSCH | TBD |  |

<End of change#2>

<Start of change#3>

# Annex A (reserved): Reserved

# A.1 General

## A.1.1 Throughput definition

The throughput values defined in the measurement channels specified in Annex A, are calculated and are valid per codeword. For multi-codeword transmissions, the throughput referenced in the minimum requirements is the sum of throughputs of all codewords.

<End of change#3>

<Start of change#4>

# A.3 DL reference measurement channels

## A.3.1 General

The transport block size (TBS) determination procedure is described in clause 5.1.3.2 of TS 38.214 [12].

Unless otherwise stated, no user data is scheduled on slot #0 within 20 ms in order to avoid SSB and PDSCH transmissions in one slot and simplify test configuration.

## A.3.2 Reference measurement channels for PDSCH performance requirements

For PDSCH reference channels if more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).

### A.3.2.1 FDD

#### A.3.2.1.1 Reference measurement channels for SCS 15 kHz FR1

Table A.3.2.1.1-1: PDSCH Reference Channel for FDD (QPSK)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | **Unit** | **Value** | | | | |
| Reference channel |  | R.PDSCH.1-1.1 FDD |  |  |  |  |
| Channel bandwidth | MHz | 10 |  |  |  |  |
| Subcarrier spacing | kHz | 15 |  |  |  |  |
| Number of allocated resource blocks | PRBs | 52 |  |  |  |  |
| Number of consecutive PDSCH symbols |  | 12 |  |  |  |  |
| Allocated slots per 2 frames | Slots | 19 |  |  |  |  |
| MCS table |  | 64QAM |  |  |  |  |
| MCS index |  | 4 |  |  |  |  |
| Modulation |  | QPSK |  |  |  |  |
| Target Coding Rate |  | 0.30 |  |  |  |  |
| Number of MIMO layers |  | 1 |  |  |  |  |
| Number of DMRS REs |  | 18 |  |  |  |  |
| Overhead for TBS determination |  | 0 |  |  |  |  |
| Information Bit Payload per Slot |  |  |  |  |  |  |
| For Slot i = 0 | Bits | N/A |  |  |  |  |
| For Slots i = 1,…, 19 | Bits | 3904 |  |  |  |  |
| Transport block CRC per Slot |  |  |  |  |  |  |
| For Slot i = 0 | Bits | N/A |  |  |  |  |
| For Slots i = 1,…, 19 | Bits | 24 |  |  |  |  |
| Number of Code Blocks per Slot |  |  |  |  |  |  |
| For Slot i = 0 | CBs | N/A |  |  |  |  |
| For Slots i = 1,…, 19 | CBs | 1 |  |  |  |  |
| Binary Channel Bits Per Slot |  |  |  |  |  |  |
| For Slot i = 0 | Bits | N/A |  |  |  |  |
| For Slots i = 10, 11 | Bits | 12480 |  |  |  |  |
| For Slots i =1,…, 9, 12, …, 19 | Bits | 13104 |  |  |  |  |
| Max. Throughput averaged over 2 frames | Mbps | 3.709 |  |  |  |  |
| Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms  Note 2: Slot i is slot index per 2 frames | | | | | | |

Table A.3.2.1.1-2: PDSCH Reference Channel for FDD (16QAM)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | **Unit** | **Value** | | | | |  |
| Reference channel |  | R.PDSCH.1-2.1 FDD |  |  |  |  |  |
| Channel bandwidth | MHz | 10 |  |  |  |  |  |
| Subcarrier spacing | kHz | 15 |  |  |  |  |  |
| Number of allocated resource blocks | PRBs | 52 |  |  |  |  |  |
| Number of consecutive PDSCH symbols |  | 12 |  |  |  |  |  |
| Allocated slots per 2 frames | Slots | 19 |  |  |  |  |  |
| MCS table |  | 64QAM |  |  |  |  |  |
| MCS index |  | 13 |  |  |  |  |  |
| Modulation |  | 16QAM |  |  |  |  |  |
| Target Coding Rate |  | 0.48 |  |  |  |  |  |
| Number of MIMO layers |  | 1 |  |  |  |  |  |
| Number of DMRS REs |  | 12 |  |  |  |  |  |
| Overhead for TBS determination |  | 0 |  |  |  |  |  |
| Information Bit Payload per Slot |  |  |  |  |  |  |  |
| For Slot i = 0 | Bits | N/A |  |  |  |  |  |
| For Slots i = 1,…, 19 | Bits | 13064 |  |  |  |  |  |
| Transport block CRC per Slot |  |  |  |  |  |  |  |
| For Slot i = 0 | Bits | N/A |  |  |  |  |  |
| For Slots i = 1,…, 19 | Bits | 24 |  |  |  |  |  |
| Number of Code Blocks per Slot |  |  |  |  |  |  |  |
| For Slot i = 0 | CBs | N/A |  |  |  |  |  |
| For Slots i = 1,…, 19 | CBs | 2 |  |  |  |  |  |
| Binary Channel Bits Per Slot |  |  |  |  |  |  |  |
| For Slot i = 0 | Bits | N/A |  |  |  |  |  |
| For Slots i = 10, 11 | Bits | 26208 |  |  |  |  |  |
| For Slots i = 1,…, 9, 12, …, 19 | Bits | 27456 |  |  |  |  |  |
| Max. Throughput averaged over 2 frames | Mbps | 12.411 |  |  |  |  |  |
| Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms  Note 2: Slot i is slot index per 2 frames | | | | | | | |

<End of change#5>

<Start of change#5>

# Annex B (normative): Propagation conditions

B.1 Static propagation condition

B.1.1 UE Receiver with 1Rx

For 2 port transmission the channel matrix is defined in the frequency domain by

.

B.1.2 UE Receiver with 2Rx

For 1 port transmission the channel matrix is defined in the frequency domain by

.

For 2 port transmission the channel matrix is defined in the frequency domain by

.

B.2 Multi-path fading propagation conditions

The multipath propagation conditions consist of several parts:

- A delay profile in the form of a "tapped delay-line", characterized by a number of taps at fixed positions on a sampling grid. The profile can be further characterized by the r.m.s. delay spread and the maximum delay spanned by the taps.

- A combination of channel model parameters that include the Delay profile and the Doppler spectrum that is characterized by a classical spectrum shape and a maximum Doppler frequency.

Initial channel matrix for LOS component of NTN-TDL-C channel model is equal to channel matrix of Static propagation conditions in Clause B.1.

B.2.1 Delay profiles

The delay profiles are derived from the TR 38.811 [x] NTN-TDL models for the desired delay spread and tap resolution. After scaling the normalized delay spread values for each tap by the desired RMS delay spread, the tap delays are quantized to a delay resolution of 5ns by rounding to the nearest multiple of the delay resolution.

**Table B.2.1-1: Delay profiles for NR NTN channel models**

|  |  |  |  |
| --- | --- | --- | --- |
| **Type** | **Model** | **Delay spread (r.m.s.)** | **Delay resolution** |
| NLOS | NTN-TDLA100 | 100 ns | 5 ns |
| LOS | NTN-TDLC5 | 5 ns | 5 ns |

**Table B.2.1-2: NTN-TDLA100 (DS = 100 ns)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Tap #** | **Delay [ns]** | **Power [dB]** | **Fading distribution** |
| 1 | 0 | 0 | Rayleigh |
| 2 | 110 | -4.7 | Rayleigh |
| 3 | 285 | -6.5 | Rayleigh |

**Table B.2.1-3 NTN-TDLC5 (DS = 5 ns)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Tap #** | **Delay [ns]** | **Power [dB]** | **Fading distribution** |
| 1 | 0 | -0.6 | LOS path |
| 0 | -8.9 | Rayleigh |
| 2 | 60 | -21.5 | Rayleigh |
| Note 1: Tap #1 follows a Rician distribution. | | | |

B.2.2 Combinations of channel model parameters

The propagation conditions used for the performance measurements in multi-path fading environment are indicated as a combination of a channel model name and a maximum Doppler frequency, i.e., NTN-TDLA<DS>-<Doppler>, or NTN-TDLC<DS>-<Doppler> where '<DS>' indicates the desired delay spread and '<Doppler>' indicates the maximum Doppler frequency (Hz).

Table B.2.2-1 show the propagation conditions that are used for the performance measurements in multi-path fading environment for NLOS and LOS propagation conditions.

**Table B.2.2-1: Channel model parameters for NTN**

|  |  |  |
| --- | --- | --- |
| **Combination name** | **Model** | **Maximum Doppler frequency** |
| NTN-TDLA100-200 | NTN-TDLA100 | 200 Hz |
| NTN-TDLC5-200 | NTN-TDLC5 | 200 Hz |

B.2.3 MIMO Channel Correlation Matrices

The MIMO channel correlation matrices defined in B.2.3 apply for the antenna configuration using uniform linear arrays at both gNB and UE.

B.2.3.1 MIMO Correlation Matrices using Uniform Linear Array (ULA)

The MIMO channel correlation matrices defined in B.2.3.1 apply for the antenna configuration using uniform linear array (ULA) at both gNB and UE.

B.2.3.1.1 Definition of MIMO Correlation Matrices

Table B.2.3.1.1-1 defines the correlation matrix for the gNB.

**Table B.2.3.1.1-1: gNB correlation matrix**

|  |  |  |
| --- | --- | --- |
|  | **One antenna** | **Two antennas** |
| gNB Correlation |  |  |

Table B.2.3.1.1-2 defines the correlation matrix for the UE:

**Table B.2.3.1.1-2: UE correlation matrix**

|  |  |  |
| --- | --- | --- |
|  | **One antenna** | **Two antennas** |
| UE Correlation |  |  |

Table B.2.3.1.1-3 defines the channel spatial correlation matrix. The parameters, *α* and *β* in Table B.2.3.1-3 defines the spatial correlation between the antennas at the gNB and UE.

**Table B.2.3.1.1-3: correlation matrices**

|  |  |
| --- | --- |
| **1x2 case** |  |
| **2x1 case** |  |
| **2x2 case** |  |

B.2.3.1.2 MIMO Correlation Matrices at High, Medium and Low Level

The *α* and *β* for different correlation types are given in Table B.2.3.1.2-1.

**Table B.2.3.1.2-1: The *α* and *β* parameters for ULA MIMO correlation matrices**

|  |  |  |
| --- | --- | --- |
| **Correlation Model** | *α* | *β* |
| **Low correlation** | 0 | 0 |

The correlation matrices low correlation are defined in Table B.2.3.1.2-2 below.

**Table B.2.3.1.2-2: MIMO correlation matrices for low correlation**

|  |  |
| --- | --- |
| **1x2 case** |  |
| **2x1 case** |  |
| **2x2 case** |  |
| Note: **I**d is the *d*×*d* identity matrix. | |

Annex C (normative):  
Downlink physical channels

C.1 General

This annex specifies the downlink physical channels that are needed for setting a connection and channels that are needed during a connection.

C.2 Setup (Conducted)

Table C.2-1 describes the downlink Physical Channels that are required for connection set up.

**Table C.2-1: Downlink Physical Channels required for connection set-up**

|  |
| --- |
| **Physical Channel** |
| PBCH |
| SSS |
| PSS |
| PDCCH |
| PDSCH |
| PBCH DMRS |
| PDCCH DMRS |
| PDSCH DMRS |
| CSI-RS |

C.3 Connection (Conducted)

The following clauses, describes the downlink Physical Channels that are transmitted during a connection i.e., when measurements are done.

C.3.1 Measurement of Performance requirements

Table C.3.1-1 is applicable for measurements in which uniform RS-to-EPRE boosting for all downlink physical channels, unless otherwise stated.

**Table C.3.1-1: Downlink Physical Channels transmitted during a connection (FDD and TDD)**

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Unit** | **Value (Note 2)** |
| SSS transmit power | W | Test specific |
| EPRE ratio of PSS to SSS | dB | 0 |
| EPRE ratio of PBCH to SSS | dB | 0 |
| EPRE ratio of PBCH to PBCH DMRS | dB | 0 |
| EPRE ratio of PDCCH to SSS | dB | 0 |
| EPRE ratio of PDCCH to PDCCH DMRS | dB | 0 |
| EPRE ratio of PDSCH to SSS | dB | 0 |
| EPRE ratio of PDSCH to PDSCH DMRS | dB | Test specific (Note 1) |
| EPRE ratio of CSI-RS to SSS | dB | -10\*log10(L) (Note 3) |
| EPRE ratio of OCNG to SSS | dB | 0 |
| EPRE ratio of PDCCH OCNG to SSS | dB | 0 |
| EPRE ratio of LTE CRS to NR SSS | dB | 0 (Note 4) |
| Note 1: Value is derived from Table 4.1-1 in TS 38.214 [12] based on "Number of DM-RS CDM groups without data" and "DMRS Type" parameters specified for each test.  Note 2: The value is the energy of per RE for a single antenna port before pre-coding.  Note 3:  is the CDM group size of NZP CSI-RS specified for each test.  Note 4: It is only applicable to LTE-NR coexistence tests. | | |

# Annex D (informative): Void

# Annex E (normative): Environmental conditions

E.1 General

This annex specifies the environmental requirements of the UE. Within these limits the requirements of the present documents shall be fulfilled.

E.2 Environmental (Conducted)

The requirements in this clause apply to all types of UE(s).

E.2.1 Temperature

The UE shall fulfil all the requirements in the temperature range defined in Table E.2.1-1.

**Table E.2.1-1: Temperature conditions**

|  |  |
| --- | --- |
| +15°C to +35°C | For normal conditions (with relative humidity of 25 % to 75 %) |

Outside this temperature range the UE, if powered on, shall not make ineffective use of the radio frequency spectrum. In no case shall the UE exceed the transmitted levels as defined in clause 6.2 of TS 38.101-1 [6] for extreme operation.

E.2.2 Voltage

The UE shall fulfil all the requirements in the voltage range defined in Table E.2.2-1.

**Table E.2.2-1: Voltage conditions**

|  |  |
| --- | --- |
| **Power source** | **Normal conditions**  **voltage** |
| AC mains | nominal |
| Regulated lead acid battery | 1,1 \* nominal |
| Non regulated batteries:  Leclanché  Lithium  Mercury/nickel & cadmium | Nominal  1,1 \* Nominal  Nominal |

Outside this voltage range the UE if powered on, shall not make ineffective use of the radio frequency spectrum. In no case shall the UE exceed the transmitted levels as defined in TS 38.101-1[6, Clause 6.2] for extreme operation. In particular, the UE shall inhibit all RF transmissions when the power supply voltage is below the manufacturer declared shutdown voltage.

E.2.3 Vibration

The UE shall fulfil all the requirements when vibrated at the following frequency/amplitudes.

**Table E.2.3-1: Vibration conditions**

|  |  |
| --- | --- |
| **Frequency** | **ASD (Acceleration Spectral Density) random vibration** |
| 5 Hz to 20 Hz | 0,96 m2/s3 |
| 20 Hz to 500 Hz | 0,96 m2/s3 at 20 Hz, thereafter –3 dB/Octave |

Outside the specified frequency range the UE, if powered on, shall not make ineffective use of the radio frequency spectrum. In no case shall the UE exceed the transmitted levels as defined in TS 38.101-1[6] for extreme operation.

<End of change#5>