**3GPP TSG-RAN WG4 Meeting # 104-e *R4-221xxxx***

**Electronic Meeting, 15 August - 26 August, 2022**

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| *CR-Form-v12.2* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **38.101-4** | **CR** | **draftCR** | **rev** | 1 | **Current version:** | **17.5.0** |  |
|  | | | | | | | | |
| *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:*** | draft CR: Applicability of RedCap UE demodulation requirements | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Ericsson | | | | | | | | | |
| ***Source to TSG:*** | R4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_redcap-Perf | | | | |  | ***Date:*** | | | 2022-08-25 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **B** |  | | | | | ***Release:*** | | | Rel-17 |
|  | *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:*** | | Noc level is missing for UE power class 7 defined for RedCap FR2 UE.  Test applicability is missing for RedCap UE. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | Change 1: Addition of Noc level for PC7  TS38.101-2 V17.6.0 Table 7.3.2.7-1 specifie REFSENS for PC7. Noc values are derived according TS38.101-4 4.5.3.3:  Noc(PC\_P, Band\_X) = REFSENSPC\_P, Band\_X, 50MHz – 10log10(12 x 120kHz x PRBREFSENS) – SNRREFSENS + Δthermal   = REFSENSPC\_P, Band\_X, 50MHz - 69.8  \* Noc(PC7, Band\_n257) = -85.3 - 69.8 = -155.1  \* Noc(PC7, Band\_n258) = -85.3 - 69.8 = -155.1  \* Noc(PC7, Band\_n261) = -85.3 - 69.8 = -155.1  Change 2: Define applicability of UE demodulation requirements for RedCap | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | It is not clear what requirements are applicable for RedCap UE. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 3.1, 3.3, 4.5.3.2, 5.1.1.1, 5.1.1.11 (new), 7.1.1.1, 7.1.1.7 (new) | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **x** | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | | **x** |  | Test specifications | | | | TS38.521-4 | | |
| ***(show related CRs)*** | |  | **x** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | | Revision of R4-2212890 | | | | | | | | |

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

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].

**DL BWP**: DL bandwidth part as defined in TS 38.213 [11].

**EN-DC**: E-UTRA-NR Dual Connectivity as defined in clause 4.1.2 of TS 37.340 [13].

**Enhanced Receiver Type 1:** SU-MIMO interference mitigation advanced receiver [14]

- R-ML (reduced complexity ML) receiver with enhanced inter-stream interference suppression for SU-MIMO transmissions with rank 2 with 2 RX antennas

- R-ML (reduced complexity ML) receiver with enhanced inter-stream interference suppression for SU-MIMO transmissions with rank 2, 3, and 4 with 4 RX antennas

**FR1**: Frequency range 1 as defined in clause 5.1 of TS 38.101-3 [8].

**FR2**: Frequency range 2 as defined in clause 5.1 of TS 38.101-3 [8].

**RedCap**: A UE with reduced capabilities as defined in clause 4.2 in TS 38.306 [14].

**SSB:** SS/PBCH block as defined in clause 7.8.3 of TS 38.211 [9].

## 3.2 Symbols

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

Es The averaged received energy per Hz of the wanted signal during the useful part of the symbol, i.e. excluding the cyclic prefix, at the UE antenna connector; average power is computed within a set of REs used for the transmission of physical, divided transmission bandwidth within the set

 Subcarrier spacing configuration as defined in clause 4.2 of TS 38.211 [9]

 The power spectral density of a white noise source with average power per Hz as defined in Clause 4.4.3 for conducted requirements and Clause 4.5.3 for radiated requirements

## 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].

AGC Automatic Gain Control

CA Carrier Aggregation

CC Component Carrier

CCE Control Channel Element

CORESET Control Resource Set

CP Cyclic Prefix

CSI Channel-State Information

CSI-IM CSI Interference Measurement

CSI-RS CSI Reference Signal

CW Codeword

CQI Channel Quality Indicator

CRC Cyclic Redundancy Check

CRI CSI-RS Resource Indicator

DC Dual Connectivity

DCI Downlink Control Information

DL Downlink

DMRS Demodulation Reference Signal

DPS Dynamic Point Selection

EPRE Energy Per Resource Element

EN-DC E-UTRA-NR Dual Connectivity

FR Frequency Range

FRC Fixed Reference Channel

GNSS Global Navigation Satellite System

HARQ Hybrid Automatic Repeat Request

HD-FDD Half-duplex Frequency Division Duplex

HST High Speed Train

HST-SFN High Speed Train Single Frequency Network

LI Layer Indicator

MAC Medium Access Control

MCS Modulation and Coding Scheme

MIB Master Information Block

NR New Radio

NSA Non-Standalone Operation Mode

OCC Orthogonal Cover Code

OCNG OFDMA Channel Noise Generator

OFDM Orthogonal Frequency Division Multiplexing

OFDMA Orthogonal Frequency Division Multiple Access

PBCH Physical Broadcast Channel

Pcell Primary Cell

PDCCH Physical Downlink Control Channel

PDSCH Physical Downlink Shared Channel

PMI Precoding Matrix Indicator

PRB Physical Resource Block

PRG Physical resource block group

PSBCH Physical Sidelink Broadcast Channel

PSCCH Physical Sidelink Control Channel

PSFCH Physical Sidelink Feedback Channel

PSS Primary Synchronization Signal

PSSCH Physical Sidelink Shared Channel

PTRS Phase Tracking Reference Signal

PUCCH Physical Uplink Control Channel

PUSCH Physical Uplink Shared Channel

QCL Quasi Co-location

RB Resource Block

RBG Resource Block Group

RE Resource Element

REG Resource Element Group

RI Rank Indicator

RRC Radio Resource Control

SA Standalone operation mode

SCI Sidelink Control Information

SCS Subcarrier Spacing

SINR Signal-to-Interference-and-Noise Ratio

SL Sidelink

SLSS Sidelink Synchronization Signal

SNR Signal-to-Noise Ratio

SS Synchronization Signal

SSB Synchronization Signal Block

SSS Secondary Synchronization Signal

TCI Transmission Configuration Indicator

TDM Time division multiplexing

TRxP Transmission and Reception Point

TTI Transmission Time Interval

UL Uplink

V2X Vehicle to Everything

VRB Virtual Resource Block

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

### 4.5.3 Noc

#### 4.5.3.1 Introduction

For Mode 1 conditions radiated testing of demodulation and CSI requirements it is not feasible in practice to use signal levels high enough to make the noise contribution of the UE negligible. Demodulation requirements are therefore specified with the applied noise higher than the UE peak EIS level in TS 38.101-2 [7] by a defined amount, so that the impact of UE noise floor is limited to no greater than a value **∆BB** at the specified Noc level. As UEs have EIS levels that are dependent on operating band and power class, Noc level is dependent on operating band and power class.

#### 4.5.3.2 Noc for NR operating bands in FR2

Values for Noc according to operating band and power class for single carrier requirements are specified in Table 4.5.3.2-1 for **∆BB** =1dB.

Table 4.5.3.2-1: Noc power level for different UE power classes and frequency bands

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Operating band | UE Power class | | | | | | |
|  | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| n257 | -167.3 | -161.8 | -158.1 | -166.8 | -162.4 | -162.4 | -155.1 |
| n258 | -167.3 | -161.8 | -158.1 | -166.8 | -162.6 | -162.6 | -155.1 |
| n259 |  |  | -154.5 |  | -159.5 |  |  |
| n260 | -164.3 |  | -155.5 | -164.8 |  |  |  |
| n261 | -167.3 | -161.8 | -158.1 | -166.8 |  | -162.4 | -155.1 |
| n262 | -162.3 | -156.6 | -152.6 | -160.8 |  |  |  |
| Note 1: Noc levels are specified in dBm/Hz | | | | | | | |

For PC3 multi-band devices, the Noc power level (NocMB) shall increase by multi-band relaxation defined in Table 6.2.1.3-4 of TS 38.101-2 [7]:

NocMB = NocSB + ∆MBP,n

- NocSB is the Noc defined in Table 4.5.3.2-1

- ∆MBP,n values are specified in TS 38.101-2 [7].

For CA case, the Noc power level (NocCA) shall increase by a relaxation factor defined in TS 38.101-2 [7] Table 7.3A.2.1-1:

NocCA = NocSC + ΔRIB

- NocSC is derived by assuming UE supports single carrier.

- ΔRIB values are specified in TS 38.101-2 [7].

#### 4.5.3.3 Derivation of Noc values for NR operating bands in FR2

The Noc values in Table 4.5.3.2-1 are based on REFSENS for the operating band X and on the UE Power class P, derived based on the following equation:

NocPC\_P, Band\_X = REFSENSPC\_P, Band\_X, 50MHz -10Log10(12 x 120kHz x PRBREFSENS) – SNRREFSENS + ∆thermal

where:

- REFSENSPC\_P, Band\_X, 50MHz is the REFSENS value in dBm specified for the Power Class P of UE in Band X for 50MHz Channel bandwidth in clause 7.3.2 of TS 38.101-2 [7].

- 12 is the number of subcarriers in a PRB

- 120 kHz is chosen as a subcarrier spacing to select PRBREFSENS.

- PRBREFSENS is NRB associated with subcarrier spacing 120 kHz for 50MHz in Table 5.3.2-1 of TS 38.101-2 [7] and is 32.

- 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 rise in total noise of **∆BB**. ∆thermal = -10Log10(10^(∆BB/10)-1) = 5.87dB, giving a rise in total noise ∆BB of 1 dB**.**

For example, the calculated Noc value UE Power class 3 in Band n260 to -155.5 dBm/Hz, rounded to 0.1dB.

### 4.5.4 Angle of arrival

Unless otherwise stated, the downlink signal and noise are aligned to the direction with the following criteria:

- Select the known Rx beam peak direction reused from RF testing if available, as far as it satisfies the minimum isolation requirement defined in TS 38.521-4 [16] and rank number in TS 38.521-4 [16] corresponding to the test cases

- Otherwise select one direction which satisfies the REFSENS defined in TS 38.101-2 [7], minimum isolation requirement defined in TS 38.521-4 [16] and rank number in TS 38.521-4 [16] corresponding to the test cases.

4.5.5 Es

For Mode 2 the test system shall transmit the wanted signal with power level Es which is the best achievable power level by the test system.

The test system shall be able to determine achievable Es level and the maximum achievable SNR level

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

### 5.1.1 Applicability of requirements

#### 5.1.1.1 General

The minimum performance requirements are applicable to all FR1 operating bands defined in TS 38.101-1[6].

The minimum performance requirements in Clause 5 are mandatory for UE supporting NR operation, except test cases listed in Clauses 5.1.1.3, 5.1.1.4, 5.1.1.5, 5.1.1.6, 5.1.1.7, 5.1.1.8, 5.1.1.11.

If same test is listed for different UE features/capabilities in Clauses 5.1.1.3 and 5.1.1.4, then this test shall apply for UEs which support all corresponding UE features/capabilities.

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

#### 5.1.1.11 Applicability of requirements for RedCap

The performance requirements in Table 5.1.1.11-1 shall apply for UEs which support optional feature *supportOfRedCap*.

Table 5.1.1.11-1: Requirements applicability for RedCap

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| UE capability | Test type | | Test list | Applicability notes |
| RedCap with 1RX | FR1 FDD and HD-FDD (Note 1) | PDSCH | All tests in Clause 5.2.1.1.1 |  |
|  |  | PDCCH | All tests in Clause 5.3.1.1.1 |  |
|  |  | PBCH | All tests in Clause 5.4.1.1 |  |
|  | FR1 TDD | PDSCH | All tests in Clause 5.2.1.2.1 |  |
|  |  | PDCCH | All tests in Clause 5.3.1.2.1 |  |
|  |  | PBCH | All tests in Clause 5.4.1.2 |  |
|  |  | SDR | Clause 5.5.1 |  |
| RedCap with 2RX | FR1 FDD and HD-FDD (Note 1) | PDSCH | All tests in Clause 5.2.2.1.X |  |
|  |  | PDCCH | All tests in Clause 5.3.2.1.4 |  |
|  |  | PBCH | Clause 5.4.2.1 (Table 5.4.2.1-2 Test 1)  Clause 5.4.2.1 (Table 5.4.2.1-3 Test 1) |  |
|  | FR1 TDD | PDSCH | All tests in Clause 5.2.2.2.X |  |
|  |  | PDCCH | All tests in Clause 5.3.2.2.4 |  |
|  |  | PBCH | Clause 5.4.2.2 (Table 5.4.2.2-4 Test 1)  Clause 5.4.2.2 (Table 5.4.2.2-5 Test 1) |  |
|  |  | SDR | Clause 5.5.1 |  |
| Note 1: If UE support only HD-FDD in a FDD band, this UE is tested with HD-FDD mode otherwise UE is tested with full-duplex FDD mode | | | | |

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

### 7.1.1 Applicability of requirements

#### 7.1.1.1 General

The minimum performance requirements are applicable to the FR2 operating bands defined in TS 38.101-2 [7] with FDL\_high not exceeding 48200 MHz. Additional applicability rules for certain operating bands are specified in Clause 7.1.1.6.

The minimum performance requirements in Clause 7 are mandatary for UE supporting NR operation, except test cases listed in Clause 7.1.1.3, 7.1.1.4, 7.1.1.5, 7.1.1.7.

If same test is listed for different UE features/capabilities in Clauses 7.1.1.3 and 7.1.1.4, then this test shall apply for UEs which support all corresponding UE features/capabilities.

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

7.1.1.7 Applicability of requirements for RedCap

The performance requirements in Table 7.1.1.7-1 shall apply for UEs which support optional feature *supportOfRedCap*.

Table 7.1.1.7-1: Requirements applicability for RedCap

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| UE capability | Test type | | Test list | Applicability notes |
| RedCap with 2RX | FR2 TDD | PDSCH | Clause 7.2.2.2.1 (Tests 1-1, 2-2, and 2-6) |  |
|  |  | PDCCH | Clause 7.3.2.2.1 (Test 1-2)  Clause 7.3.2.2.2 (Test 2-1) |  |
|  |  | PBCH | Clause 7.4.2.2 (Table 7.4.2.2-2 Tests 1 and 2)  Clause 7.4.2.2 (Table 7.4.2.2-3 Tests 1 and 2) |  |
|  |  | SDR | Clause 7.5.1 |  |

------------------------------------------------------------- End of change ------------------------------------------------------------