**3GPP TSG- Meeting #**

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| *CR-Form-v12.2* |
| **DRAFT CHANGE REQUEST** |
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|  |  | **CR** |  | **rev** |  | **Current version:** |  |  |
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| *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 | **X** | Core Network |  |

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| ***Title:***  |  |
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| ***Source to WG:*** |  |
| ***Source to TSG:*** |  |
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| ***Work item code:*** |  |  | ***Date:*** |  |
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| ***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 canbe 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)* |
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| ***Reason for change:*** | Corrections needed on PDSCH scheduling delay for 14-HARQ processes for LTE-MTC, UL power control, downlink power allocation, PUR with 16-QAM features for NB-IoT.1. The definition of PDSCH scheduling delay for LTE-MTC in clause 7.1.11 refers to TS 36.212 which describes the PDSCH scheduling delay in terms of option 0, 1, and 2 respectively. However, the value *j* for PDSCH scheduling delay currently refers to the PDSCH scheduling delay in general rather than a corresponding option as in TS 36.212.
2. The term can also be applied to NPUSCH with QPSK, when 16-QAM is configured for NB-IoT.
3. Replace the description of constant power between symbols by equations for EPRE with 16-QAM for NB-IoT.
4. Support the use of 16QAM for NPDSCH in PUR procedure for NB-IoT.
5. Clarify the TBS index for PUR NPUSCH for NB-IoT.
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| ***Summary of change:*** | 1. The value j for PDSCH scheduling delay for LTE-MTC has been modified to refer to the value of the “PDSCH scheduling delay option”, according to the endorsed text proposal for clause 7.1.11.
2. Power control correction for NB-IoT, include the endorsed text proposal for clause 16.2.1.1.1 to clarify that NPUSCH with QPSK or 16QAM will use the term when 16QAM is configured.
3. Downlink power allocation correction for NB-IoT, include the endorsed text proposal for clause 16.2.2 to replace the description of constant power between symbols by equations.
4. Capture the use of 16QAM for NPDSCH in PUR procedure for NB-IoT, include the endorsed text proposal for clause 16.4.1.5.
5. PUR NPUSCH TBS index clarification for NB-IoT, include the endorsed text proposal for clause 16.5.1.2.
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| ***Consequences if not approved:*** | Incorrect functionality of Rel-17 Additional Enhancements for NB-IoT and LTE-MTC features.1. Unclear value of j for PDSCH scheduling delay for 14-HARQ processes of Rel-17 Additional Enhancements for LTE-MTC.
2. The term cannot be applied to NPUSCH with QPSK, when 16-QAM is configured for NB-IoT.
3. Unclear specification on EPRE with 16-QAM for NPDSCH for NB-IoT.
4. Missing procedure of 16QAM usage for NPDSCH in PUR procedure which can lead to unspecified UE behaviour for NB-IoT.
5. Determination of TBS index for PUR NPUSCH may be incorrectly implemented for NB-IoT.
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| ***Clauses affected:*** | 7.1.11, 16.2.1.1.1, 16.2.2, 16.4.1.5, 16.5.1.2 |
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|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **X** |  Other core specifications  | TS/TR ... CR ... |
| ***affected:*** |  | **X** |  Test specifications | TS/TR ... CR ...  |
| ***(show related CRs)*** |  | **X** |  O&M Specifications | TS/TR ... CR ...  |
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| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

<Unchanged parts are omitted>

### 7.1.11 PDSCH subframe assignment for BL/CE UE

A BL/CE UE shall upon detection of a MPDCCH with DCI format 6-1A/6-1B/6-2 intended for the UE, decode the corresponding PDSCH in subframe(s) *n+ki* with *i = 0, 1, …, NTBN-1* according to the MPDCCH, where

- subframe *n* is the last subframe in which the MPDCCH is transmitted and is determined from the starting subframe of MPDCCH transmission and the DCI subframe repetition number field in the corresponding DCI;

- the value of is the number of scheduled TB determined in the corresponding DCI if present, otherwise;

- the value of  is determined by the repetition number field in the corresponding DCI, where  are given in Table 7.1.11-1, Table 7.1.11-2 and Table 7.1.11-3, respectively

- if the UE is configured with higher layer parameter *multiTB-Gap* and the PDSCH corresponds to an MPDCCH with DCI CRC scrambled by G-RNTI,

- subframe(s) *ni* = *n+ki* with *i=0,1,…, NTBN-1* are *NTBN* BL/CE DL subframe(s), where, subframe *n+x* is the second BL/CE DL subframe after subframe *n*, and for , subframe is the first BL/CE DL subframe after subframe , where is given by higher layer parameter *multiTB-Gap*, and .

- otherwise,

- subframe(s) *ni* = *n+ki* with *i=0,1,…, NTBN-1* are *NTBN* consecutive BL/CE DL subframe(s), where , and subframe *n+x* is the *j*th BL/CE DL subframe after subframe *n*, and *j* is given by the value of the PDSCH scheduling delay option as defined in [4] if the UE is configured with CEModeA and 'PDSCH scheduling delay and HARQ-ACK delay for 14 HARQ' field is present in the corresponding DCI, *j*=2 otherwise.

- for ,

- if the UE is configured with higher layer parameter *interleaving* in *ce-PDSCH-MultiTB-Config*, and PDSCH corresponding to a MPDCCH with DCI CRC scrambled by C-RNTI and where  for BL/CE UE configured with CEModeA,  for BL/CE UE configured with CEModeB,

- BL/CE DL subframes  with  are associated with TB*r+*1 ,

- otherwise,

- BL/CE DL subframes  with  are associated with TB*r+*1 ,.

For BL/CE UEs, and for a PDSCH transmission starting in subframe *n+k0* without a corresponding MPDCCH, the UE shall decode the PDSCH transmission in subframe(s) *n+ki* with *i = 0, 1, …, N-1,* where

- subframe(s) *n+ki* with *i=0,1,…,N-1* are *N* consecutive BL/CE DL subframe(s), where *0≤k0<k1<…,kN-1* and the value of  is determined by the repetition number field in the activation DCI, where  are given in Table 7.1.11-1, Table 7.1.11-2 and Table 7.1.11-3, respectively.

If PDSCH carrying *SystemInformationBlockType1-BR* is transmitted in one narrowband in subframe *n+ki*, a BL/CE UE shall assume any other PDSCH in the same narrowband in the subframe *n+ki* is dropped. If PDSCH carrying SI message is transmitted in one narrowband in subframe *n+ki*, a BL/CE UE shall assume any other PDSCH not carrying *SystemInformationBlockType1-BR* in the same narrowband in the subframe *n+ki* is dropped.

<Unchanged parts are omitted>

#### 16.2.1.1 Narrowband physical uplink shared channel

##### 16.2.1.1.1 UE behaviour

The setting of the UE Transmit power for a Narrowband Physical Uplink Shared Channel (NPUSCH) transmission is defined as follows. For FDD, if the UE is capable of enhanced random access power control [12], and it is configured by higher layers, and for TDD, enhanced random access power control shall be applied for a UE which started the random access procedure in the first or second configured NPRACH repetition level.

The UE transmit power  for NPUSCH transmission in NB-IoT UL slot *i* for the serving cell is given by:

For NPUSCH (re)transmissions corresponding to the random access response grant if enhanced random access power control is not applied, and for all other NPUSCH transmissions except for NPUSCH (re)transmission corresponding to preconfigured uplink resource, when the number of repetitions of the allocated NPUSCH RUs is greater than 2:

[dBm]

otherwise

 [dBm]

where,

- is the configured UE transmit power defined in [6] in NB-IoT UL slot *i* for serving cell .

- is the NPUSCH transmission resource bandwidth normalized by 15 kHz, where {1/4} is used for 3.75 kHz subcarrier spacing and {1, 3, 6, 12} are used for 15kHz subcarrier spacing

- is a parameter composed of the sum of a component  provided from higher layers and a component  provided by higher layers for *j=1*, *3* andfor serving cell where . For NPUSCH (re)transmissions corresponding to a dynamic scheduled grant or a semi-persistent grant then *j=1*, for NPUSCH (re)transmissions corresponding to the random access response grant then *j=2* and for NPUSCH transmission using preconfigured uplink resource then *j=3*. . If enhanced random access power control is not applied, , where the parameter *preambleInitialReceivedTargetPower* [8] () and are signalled from higher layers for serving cell . If enhanced random access power control is applied,

- For *j*=*1*, for NPUSCH format 2, =1; for NPUSCH format 1, is provided by higher layers for serving cell. For *j*=2,  For *j*=*3*,  is the parameter *alpha* in *PUR-Config-NB* provided by higher layers for serving cell.

-  is the downlink path loss estimate calculated in the UE for serving cell  in dB and  = *nrs-Power* + *nrs-PowerOffsetNonAnchor* – NRSRP, where *nrs-Power* is provided by higher layers and Clause 16.2.2, and *nrs-PowerOffsetNonAnchor* is set to zero if it is not provided by higher layers and NRSRP is defined in [5] for serving cell .

- If a NB-IoT UE is configured with *npusch-16QAM-Config* or *pur-UL-16QAM-Config*, then for NPUSCH (re)transmissions with QPSK and 16QAM,

- for and for where  is given by the parameter *deltaMCS-Enabled* provided by higher layers for serving cell , and

- where is the code block size and is the number of resource elements determined as where , , are defined in [3], and is defined in section 16.5.1.1

- otherwise .

<Unchanged parts are omitted>

### 16.2.2 Downlink power allocation

The eNodeB determines the downlink transmit energy per resource element.

For an NB-IoT cell, the UE may assume NRS EPRE is constant across the downlink NB-IoT system bandwidth and constant across all subframes that contain NRS, until different NRS power information is received.

The downlink NRS EPRE can be derived from the downlink narrowband reference-signal transmit power given by *nrs-Power* + *nrs-PowerOffsetNonAnchor,* where the parameter *nrs-Power* is provided by higher layers and *nrs-PowerOffsetNonAnchor* is zero if it is not provided by higher layers. The downlink narrowband reference-signal transmit power is defined as the linear average over the power contributions (in [W]) of all resource elements that carry narrowband reference signals within the operating NB-IoT system bandwidth.

A UE may assume that the ratio of NWUS EPRE to NRS EPRE is 0 dB.

A UE may assume the ratio of NPDSCH EPRE to NRS EPRE among NPDSCH REs (not applicable to NPDSCH REs with zero EPRE) is 0 dB for an NB-IoT cell with one NRS antenna port and -3 dB for an NB-IoT cell with two NRS antenna ports if higher layer parameter *nrs-PowerRatio* is not configured.

If a UE is configured with higher layer parameters *npdsch-16QAM-Config* and *nrs-PowerRatio*,

- the ratio of NPDSCH EPRE to NRS EPRE among NPDSCH REs in symbols with NRS is given by for a cell with one NRS antenna port and for a cell with two NRS antenna ports, where is given by the parameter *nrs-PowerRatio*.

- if higher layer parameter *operationModeInfo* indicates '10' or '11',

- the ratio of NPDSCH EPRE to NRS EPRE among NPDSCH REs (not applicable to NPDSCH REs with zero EPRE) is given by the parameter *nrs-PowerRatio* in symbols without NRS

- otherwise,

- the ratio of NPDSCH EPRE to NRS EPRE among NPDSCH REs (not applicable to NPDSCH REs with zero EPRE) is given by the parameter *nrs-PowerRatio* in symbols without NRS and CRS, and

- the ratio of NPDSCH EPRE to NRS EPRE among NPDSCH REs (not applicable to NPDSCH REs with zero EPRE) is given by the parameter *nrs-PowerRatioWithCRS* in symbols with CRS.

A UE may assume the ratio of NPBCH EPRE to NRS EPRE among NPBCH REs (not applicable to NPBCH REs with zero EPRE) is 0 dB for an NB-IoT cell with one NRS antenna port and -3 dB for an NB-IoT cell with two NRS antenna ports.

A UE may assume the ratio of NPDCCH EPRE to NRS EPRE among NPDCCH REs (not applicable to NPDCCH REs with zero EPRE) is 0 dB for an NB-IoT cell with one NRS antenna port and -3 dB for an NB-IoT cell with two NRS antenna ports.

If higher layer parameter *operationModeInfo* indicates '00' or *samePCI-Indicator* indicates '*samePCI*' for a cell, the ratio of NRS EPRE to CRS EPRE is given by the parameter *nrs-CRS-PowerOffset* if the parameter *nrs-CRS-PowerOffset* is provided by higher layers, and the ratio of NRS EPRE to CRS EPRE may be assumed to be 0 dB if the parameter *nrs-CRS-PowerOffset* is not provided by higher layers. If *nrs-CRS-PowerOffset* is provided by higher layers and is a non-integer value, the value of *nrs-Power* is 0.23 dBm higher than indicated.

<Unchanged parts are omitted>

#### 16.4.1.5 Modulation order and transport block size determination

To determine the modulation order in the NPDSCH, the UE shall

- if the UE is configured with higher layer parameter *npdsch-16QAM-Config* and the DCI is mapped onto the UE specific search space given by C-RNTI, or the UE is configured with higher layer parameter *pur-DL-16QAM-Config* and the DCI is mapped onto the UE specific search space given by PUR-RNTI,

- If the 4-bit "modulation and coding scheme" field () in the DCI is set to ‘1111’,

- use modulation order, **=** 4

- otherwise

- use modulation order, **=** 2- otherwise

- use modulation order, **=** 2.

<Unchanged parts are omitted>

#### 16.5.1.2 Modulation order, redundancy version and transport block size determination

<Unchanged parts are omitted>

The UE shall use (,) and Table 16.5.1.2-2 to determine the TBS to use for the NPUSCH. is given in Table 16.5.1.2-1 if , or if NPUSCH with 16QAM except for NPUSCH transmission using preconfigured uplink resource in which case is given by higher layers in *PUR-Config-NB*,  otherwise. is the value of the "modulation and coding scheme for 16QAM" in the DCI.

<Unchanged parts are omitted>