**3GPP TSG-RAN WG2 Meeting #118 Electronic *R2-220xxxx***

**Elbonia, 09 – 20 May 2022**

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| *CR-Form-v12.1* |
| **CHANGE REQUEST** |
|  |
|  | **38.300** | **CR** | **Num** | **rev** | **-** | **Current version:** | **17.0.0** |  |
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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:***  | Corrections for IIoT on simultaneous PUCCH and PUSCH transmission |
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| ***Source to WG:*** | Nokia (rapporteur), CATT |
| ***Source to TSG:*** | R2 |
|  |  |
| ***Work item code:*** | NR\_IIOT\_URLLC\_enh-Core |  | ***Date:*** | 2022-05 |
|  |  |  |  |  |
| ***Category:*** | **F** |  | ***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 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-15 (Release 15)Rel-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)* |
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| ***Reason for change:*** | 1. Current wording “where UCI multiplexing in PUCCH associated with the same priority in combination of UCI multiplexing in a PUSCH associated with a different priority is supported” is misleading and may be misunderstood as UCI can be multiplexed in a PUSCH with different priority. Intended behaviour is UCI can only be multiplexed in a PUSCH with same priority, but simultaneous PUCCH and PUSCH transmission with different priority is supported.
2. The wording “Simultaneous transmission of PUCCH and PUSCH associated with different priorities on cells of different bands is supported,” is unclear if it applies to cells in a same PUCCH group and cells in different PUCCH groups. It should be limited to the same PUCCH group.
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| ***Summary of change:*** | 1. Change “where UCI multiplexing in PUCCH associated with the same priority in combination of UCI multiplexing in a PUSCH associated with a different priority is supported” to “where UCI multiplexing in the PUCCH associated with a priority in combination of UCI multiplexing in a PUSCH associated with a different priority is supported if the UCI multiplexed on PUSCH is of same priority as the PUSCH.”
2. Clarify Simultaneous transmission of PUCCH and PUSCH associated with different priorities on cells of different bands in a PUCCH group is supported.
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| ***Consequences if not approved:*** | The description on simultaneous PUCCH and PUSCH transmission is misleading. |
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| ***Clauses affected:*** | 5.3.3 |
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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:*** |  |

*First Modified Subclause*

5.3.3 Physical uplink control channel

Physical uplink control channel (PUCCH) carries the Uplink Control Information (UCI) from the UE to the gNB. Five formats of PUCCH exist, depending on the duration of PUCCH and the UCI payload size.

- Format #0: Short PUCCH of 1 or 2 symbols with small UCI payloads of up to two bits with UE multiplexing capacity of up to 6 UEs with 1-bit payload in the same PRB;

- Format #1: Long PUCCH of 4-14 symbols with small UCI payloads of up to two bits with UE multiplexing capacity of up to 84 UEs without frequency hopping and 36 UEs with frequency hopping in the same PRB;

- Format #2: Short PUCCH of 1 or 2 symbols with large UCI payloads of more than two bits with no UE multiplexing capability in the same PRBs;

- Format #3: Long PUCCH of 4-14 symbols with large UCI payloads with no UE multiplexing capability in the same PRBs;

- Format #4: Long PUCCH of 4-14 symbols with moderate UCI payloads with multiplexing capacity of up to 4 UEs in the same PRBs.

The short PUCCH format of up to two UCI bits is based on sequence selection, while the short PUCCH format of more than two UCI bits frequency multiplexes UCI and DMRS. The long PUCCH formats time-multiplex the UCI and DMRS. Frequency hopping is supported for long PUCCH formats and for short PUCCH formats of duration of 2 symbols. Short and long PUCCH formats can be repeated over multiple slots or sub-slots, where the repetition factor is either indicated dynamically in the DCI or semi-statically in an RRC configuration.

For operation with shared spectrum channel access in FR1, PUCCH Format #0, #1, #2, #3 are extended to use resource in one PRB interlace (up to two interlaces for Format #2 and Format #3) in one RB Set. PUCCH Format #2 and #3 are enhanced to support multiplexing capacity of up to 4 UEs in the same PRB interlace when one interlace is used.

For operation in FR2-2, PUCCH Format #0, #1, #4 are extended to use resource in configurable number of continuous PRBs, up to 16 PRBs.

Up to two PUCCH configurations can be configured for a UE per PUCCH group (see TS 38.331 [12]), where the first PUCCH configuration is associated with a PUCCH of priority index 0 (low) and the second PUCCH configuration is associated with a PUCCH of priority index 1 (high).

UCI multiplexing in PUCCH is supported when PUCCH transmissions of UCIs coincide in time, and are associated with the same priority (high/low). In addition, multiplexing of HARQ-ACK of priority index 0 (low) and UCI of priority index 1 (high) in PUCCH of priority index 1 (high) is supported when PUCCH transmissions of HARQ-ACK of priority index 0 and UCI of priority index 1 (high) coincide in time.

UCI multiplexing in PUSCH is supported when UCI and PUSCH transmissions coincide in time, either due to transmission of a UL-SCH transport block or due to triggering of A-CSI transmission without UL-SCH transport block, and are associated with the same priority (high/low). In addition, HARQ-ACK multiplexing of a certain priority in PUSCH of a different priority is supported when HARQ-ACK and PUSCH transmissions coincide in time, either due to transmission of a UL-SCH transport block or due to triggering of A-CSI transmission without UL-SCH transport block:

- UCI carrying HARQ-ACK feedback with 1 or 2 bits is multiplexed by puncturing PUSCH;

- In all other cases UCI is multiplexed by rate matching PUSCH.

UCI consists of the following information:

- CSI;

- ACK/NAK;

- Scheduling request.

Simultaneous transmission of PUCCH and PUSCH associated with different priorities on cells of different bands in a PUCCH group is supported, where UCI multiplexing in the PUCCH associated with a priority in combination of UCI multiplexing in a PUSCH associated with a different priority is supported if the UCI multiplexed on PUSCH is of same priority as the PUSCH.

For operation with shared spectrum channel access, multiplexing of CG-UCI and PUCCH carrying HARQ-ACK feedback can be configured by the gNB. If not configured, when PUCCH overlaps with PUSCH scheduled by a configured grant within a PUCCH group and PUCCH carries HARQ ACK feedback, PUSCH scheduled by configured grant is skipped.

QPSK and π/2 BPSK modulation can be used for long PUCCH with more than 2 bits of information, QPSK is used for short PUCCH with more than 2 bits of information and BPSK and QPSK modulation can be used for long PUCCH with up to 2 information bits.

Transform precoding is applied to PUCCH Format #3 and Format #4.

Channel coding used for uplink control information is described in table 5.3.3-1.

**Table 5.3.3-1: Channel coding for uplink control information**

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| **Uplink Control Information size including CRC, if present** | **Channel code** |
| 1 | Repetition code |
| 2 | Simplex code |
| 3-11 | Reed Muller code |
| >11 | Polar code |

*End of Changes*