**3GPP TSG RAN WG1 #113** **R1-230xxxx**

**Incheon, Korea, May 22nd – 26th, 2023**

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| *CR-Form-v12.2* |
| **DRAFT CHANGE REQUEST** |
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|  | **38.213** | **CR** |  | **rev** |  | **Current version:** | **17.5.0** |  |
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| *For* [***HELP***](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 |  | Radio Access Network |  | Core Network |  |

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| ***Title:***  | Introduction of multiplexing in a PUSCH with repetitions HARQ-ACK associated with DL assignments received after an UL grant for the PUSCH |
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| ***Source to WG:*** | Samsung |
| ***Source to TSG:*** |  |
|  |  |
| ***Work item code:*** | TEI18 |  | ***Date:*** | 2023-06-04 |
|  |  |  |  |  |
| ***Category:*** | B |  | ***Release:*** | Rel-18 |
|  | *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:*** | Introduction of multiplexing in a PUSCH with repetitions HARQ-ACK associated with DL assignments received after UL grant for the PUSCH. |
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| ***Summary of change:*** | Introduce support for multiplexing in a PUSCH with repetitions HARQ-ACK associated with DL assignments received after an UL grant for the PUSCH.  |
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| ***Consequences if not approved:*** | No support for multiplexing in a PUSCH with repetitions HARQ-ACK associated with DL assignments received after UL grant for the PUSCH. |
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| ***Clauses affected:*** | 9, 9.1.2.2 |
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|  | **Y** | **N** |  |  |
| ***Other specs*** |  |  |  Other core specifications  |  |
| ***affected:*** |  |  |  Test specifications | TS/TR ... CR ...  |
| ***(show related CRs)*** |  |  |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

\*\*\* Unchanged parts are omitted \*\*\*

# 9 UE procedure for reporting control information

\*\*\* Unchanged parts are omitted \*\*\*

A UE does not expect to multiplex in a PUSCH transmission in one slot with SCS configuration UCI of same type that the UE would transmit in PUCCHs in different slots with SCS configuration if .

A UE does not expect to multiplex in a PUSCH transmission or in a PUCCH transmission HARQ-ACK information that the UE would transmit in different PUCCHs of a same priority index.

A UE does not expect a PUCCH resource that results from multiplexing overlapped PUCCH resources, if applicable, to overlap with more than one PUSCHs if each of the more than one PUSCHs includes aperiodic CSI reports.

A UE does not expect to detect a first DCI format having associated HARQ-ACK information without scheduling a PDSCH reception, and indicating a resource for a PUCCH transmission with a HARQ-ACK codebook that would include the HARQ-ACK information in a slot if the UE

- detects a second DCI format in a PDCCH reception, that ends before a PDCCH reception for the first DCI format, that schedules a PUSCH transmission in the slot, and

- multiplexes the HARQ-ACK codebook in the PUSCH transmission in the slot.

If a UE

- is not provided *enable-Type1-HARQ-ACK-mux-forDLassignmentafterULgrant*, or *enable-Type2-HARQ-ACK-mux-forDLassignmentafterULgrant*, or *enable-Type3-HARQ-ACK-mux-forDLassignmentafterULgrant*, or

- is provided *uci-MuxWithDiffPrio*, or

- transmits a PUSCH without repetitions or transmits a first repetition of a PUSCH transmission

the UE does not expect to detect a first DCI format scheduling a PDSCH reception and indicating a resource for a PUCCH transmission with corresponding HARQ-ACK information that would be included in a HARQ-ACK codebook in a slot if the UE

- detects a second DCI format, in a PDCCH reception that ends before a PDCCH reception for the first DCI format, scheduling the PUSCH transmission in the slot, and

- multiplexes the HARQ-ACK codebook in the PUSCH transmission in the slot.

If a UE

- is provided *enable-Type1-HARQ-ACK-mux-forDLassignmentafterULgrant*, or *enable-Type2-HARQ-ACK-mux-forDLassignmentafterULgrant*, or *enable-Type3-HARQ-ACK-mux-forDLassignmentafterULgrant*, and

- is not provided *uci-MuxWithDiffPrio*,and

- transmits a repetition of a PUSCH transmission other than a first repetition,

the UE includes, in a HARQ-ACK codebook, HARQ-ACK information associated with a PDSCH reception scheduled by a first DCI format indicating a resource for a PUCCH transmission in a slot, when

- the UE detects a second DCI format, in a PDCCH reception that ends before the PDCCH reception for the first DCI format, scheduling a PUSCH transmission in the slot, and

- the UE multiplexes the HARQ-ACK codebook in the PUSCH transmission in the slot, and

- the timeline conditions of and for multiplexing the HARQ-ACK information in the PUSCH, as described in clause 9.2.5.1, are satisfied, and

- the UE does not determine a different PUCCH resource for the PUCCH transmission with the HARQ-ACK information in the slot if the UE is not provided *enable-different-PUCCHresource*, and

- the UE does not determine a different size for the HARQ-ACK codebook after including the HARQ-ACK information if the UE is not provided *enable-different-CBsize*.

If a UE multiplexes aperiodic CSI in a PUSCH and the UE would multiplex UCI that includes HARQ-ACK information in a PUCCH that overlaps with the PUSCH and the timing conditions for overlapping PUCCHs and PUSCHs in clause 9.2.5 are fulfilled, the UE multiplexes only the HARQ-ACK information in the PUSCH and does not transmit the PUCCH.

When a UE transmits multiple PUSCHs on respective serving cells in a slot with reference to slots for PUCCH transmissions and the multiple PUSCHs overlap with a PUCCH carrying UCI in the slot, the UE selects all the PUSCHs overlapping with the PUCCH as the candidate PUSCHs for UCI multiplexing within the slot.

If a UE would transmit a single PUSCH scheduled by a DCI format that includes a DAI field on a serving cell in a slot with reference to slots for PUCCH transmissions without any other PUSCH that would be transmitted on any serving cell in the slot and the UE does not determine any PUCCH carrying HARQ-ACK information in the slot, or if the UE indicates the corresponding capability *mux-HARQ-ACK-withoutPUCCH-onPUSCH* and the UE transmits multiple PUSCHs on respective serving cells in a slot with reference to slots for PUCCH transmissions and the UE does not determine any PUCCH carrying HARQ-ACK information in the slot and at least one of the multiple PUSCHs is scheduled by a DCI format that includes a DAI field, the UE selects the single PUSCH or all the multiple PUSCHs in the slot as the candidate PUSCHs for HARQ-ACK multiplexing within the slot except for any PUSCH among the multiple PUSCHs that is scheduled by a DCI format that includes a DAI field that is equal to 4 in case the UE is configured with *pdsch-HARQ-ACK-Codebook = dynamic* or with *pdsch-HARQ-ACK-Codebook-r16*, or is equal to 0 in case the UE is configured with *pdsch-HARQ-ACK-Codebook = semi-static*.

\*\*\* Unchanged parts are omitted \*\*\*

#### 9.1.2.2 Type-1 HARQ-ACK codebook in physical uplink shared channel

If a UE is not provided *pdsch-HARQ-ACK-Codebook = 'semi-static'* for unicast or multicast HARQ-ACK information, the UE does not multiplex the unicast or multicast HARQ-ACK information in the PUSCH transmission, respectively.

If a UE is provided *pdsch-HARQ-ACK-Codebook = 'semi-static'* for unicast and/or multicast HARQ-ACK information, and would multiplex HARQ-ACK information in a PUSCH transmission that is not scheduled by a DCI format or is scheduled by a DCI format that does not include a DAI field, then

- if the UE has not received any PDSCH or SPS PDSCH release or TCI state update that the UE multiplexes corresponding HARQ-ACK information in the PUSCH, based on a value of a respective PDSCH-to-HARQ\_feedback timing indicator field in a DCI format scheduling the PDSCH reception or the SPS PDSCH release or the TCI state update, or on the value of *dl-DataToUL-ACK* or *dl-DataToUL-ACK-r16* or *dl-DataToUL-ACK-r17* if the PDSCH-to-HARQ\_feedback timing indicator field is not present in DCI format 1\_1 or on the value of *dl-DataToUL-ACK-DCI-1-2* or *dl-DataToUL-ACK-DCI-1-2-r17* if the PDSCH-to-HARQ\_feedback timing indicator field is not present in DCI format 1\_2 and the UE is provided *pdsch-HARQ-ACK-Codebook = 'semi-static'* for unicast HARQ-ACK information, or on the value of *dl-DataToUL-ACK* if the PDSCH-to-HARQ\_feedback timing indicator field is not present in DCI format 4\_2 and the UE is provided *pdsch-HARQ-ACK-Codebook = 'semi-static'* for multicast HARQ-ACK information, in any of the occasions for candidate PDSCH receptions by a DCI format or SPS PDSCH on any serving cell , as described in clause 9.1.2.1, the UE does not multiplex HARQ-ACK information in the PUSCH transmission

- else the UE generates the HARQ-ACK codebook as described in clause 9.1.2.1, except that *harq-ACK-SpatialBundlingPUCCH* is replaced by *harq-ACK-SpatialBundlingPUSCH*, unless the UE receives only a SPS PDSCH release, or only SPS PDSCH receptions, or only a PDSCH that is scheduled by DCI format 1\_0 with a counter DAI field value of 1 if the UE is provided *pdsch-HARQ-ACK-Codebook = 'semi-static'* for unicast HARQ-ACK information, or is scheduled by DCI format 4\_1 with a counter DAI field value of 1 if the UE is provided *pdsch-HARQ-ACK-Codebook = 'semi-static'* for multicast HARQ-ACK information, on the PCell in the occasions for candidate PDSCH receptions in which case the UE generates HARQ-ACK information only for the SPS PDSCH release or only for the PDSCH reception as described in clause 9.1.2.

A UE sets to NACK value in the HARQ-ACK codebook any HARQ-ACK information corresponding to

*-* PDSCH reception scheduled or activated by a DCI format that the UE detects in a PDCCH reception that ends after a PDCCH reception where the UE detects a DCI format scheduling the PUSCH transmission, if the corresponding conditions in Clause 9 for multiplexing associated HARQ-ACK information in a HARQ-ACK codebook in the PUSCH are not valid

*-* SPS PDSCH release or TCI state update that the UE detects in a PDCCH reception that ends after a PDCCH reception where the UE detects a DCI format scheduling the PUSCH transmission.

A UE does not expect to detect a DCI format switching a DL BWP within symbols prior to a first symbol of a PUSCH transmission where the UE multiplexes HARQ-ACK information, where is defined in [6, TS 38.214].

If a UE multiplexes HARQ-ACK information in a PUSCH transmission that is scheduled by DCI format that includes a DAI field, and

- is not provided *fdmed-ReceptionMulticast* and is provided *pdsch-HARQ-ACK-Codebook = 'semi-static'* for both unicast and multicast HARQ-ACK information, or

- is provided *pdsch-HARQ-ACK-Codebook = 'semi-static'* only for one of unicast and multicast HARQ-ACK information

the UE generates the HARQ-ACK codebook as described in clause 9.1.2.1 when a value of the DAI field is except that *harq-ACK-SpatialBundlingPUCCH* is replaced by *harq-ACK-SpatialBundlingPUSCH*. The UE does not generate a HARQ-ACK codebook for multiplexing in the PUSCH transmission when unless the UE receives only a SPS PDSCH release, or only SPS PDSCH(s), or only a TCI state update, or only a PDSCH that is scheduled by a DCI format 1\_0 if the UE is provided *pdsch-HARQ-ACK-Codebook = 'semi-static'* for unicast HARQ-ACK information, or scheduled by a DCI format 4\_1 if the UE is provided *pdsch-HARQ-ACK-Codebook = 'semi-static'* for multicast HARQ-ACK information, with a counter DAI field value of 1 on the PCell in the occasions for candidate PDSCH receptions in which case the UE generates HARQ-ACK information only for the SPS PDSCH release or only for the TCI state update or only for the PDSCH reception as described in clause 9.1.2.

 if the PUSCH is scheduled by a DCI format that includes a DAI field and the DAI field is set to '0'; otherwise, .

If a UE is provided *fdmed-ReceptionMulticast* and is provided *pdsch-HARQ-ACK-Codebook = 'semi-static'* for both unicast and multicast HARQ-ACK information, the UE generates the HARQ-ACK codebook as described in clause 9.1.2.1, except that *harq-ACK-SpatialBundlingPUCCH* is replaced by *harq-ACK-SpatialBundlingPUSCH*

- for the first set of serving cells if a value of the DAI field associated with unicast HARQ-ACK information is [5, TS 38.212]

- for the second set of serving cells if a value of the DAI field associated with multicast HARQ-ACK information is [5, TS 38.212]

The UE does not generate unicast or multicast HARQ-ACK information for multiplexing in the PUSCH transmission when or , respectively, unless the UE receives respectively

- only a unicast or a multicast SPS PDSCH release, or

- only unicast SPS PDSCH(s) or multicast SPS PDSCH(s) having enabled associated HARQ-ACK information reports as described in clause 18, or

- only a TCI state update or a PDSCH that is scheduled by a DCI format 1\_0 with a counter DAI field value of 1 on the PCell, or only a PDSCH that is scheduled by a DCI format 4\_1 having enabled associated HARQ-ACK information report, as described in clause 18, and counter DAI field value of 1 on the PCell

in the occasions for candidate PDSCH receptions in which case the UE generates only the corresponding unicast or multicast HARQ-ACK information.

 if the corresponding value of the DAI field is set to '0'; otherwise, . if the corresponding value of the DAI field is set to '0'; otherwise, [5, TS 38.212].

\*\*\* Unchanged parts are omitted \*\*\*